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COMMISSION STAFF WORKING DOCUMENT

Digital Economy and Society Index (DESI) 2022



Digital Economy and Society Index (DESI) 2022

Country reports

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About the DESI

Since 2014, the European Commission has monitored Member States' progress in digital and published annual Digital Economy and Society Index (DESI) reports. Each year, the reports include country profiles, which help Member States identify areas for priority action, and thematic chapters providing a EU-level analysis in the key digital policy areas. The DESI Index ranks Member States according to their level of digitalisation and analyses their relative progress over the last five years, considering their starting point.

The Commission has adjusted DESI to align it with the four cardinal points set out in the Commission proposal for a decision '[Path to the Digital Decade Policy Programme](#)' which is being negotiated by the European Parliament and the Council. The proposal sets targets at EU level to be reached by 2030 to deliver a comprehensive and sustainable digital transformation across all sectors of the economy. Of the DESI 2022 indicators, 11 measure targets set in the Digital Decade. In the future, the DESI will be aligned even more closely with the Digital Decade to ensure that all targets are discussed in the reports.

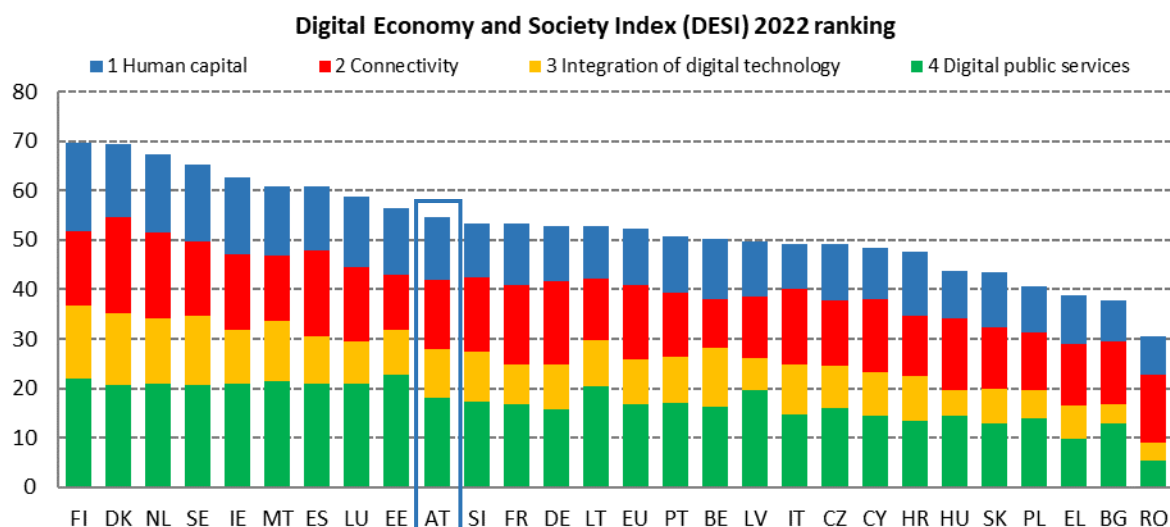
To date, digitalisation in the EU is uneven, although there are signs of convergence. While the frontrunners have remained unchanged, there is a substantial group of Member States that cluster around the EU average. Importantly, the majority of Member States that had a lower level of digitalisation 5 years ago, are progressing at a faster pace than the rest, indicating an overall convergence in digital in the EU.

Reaching the Digital Decade targets depends on a collective effort by all. Each Member State will contribute to this ambitious goal from a different starting point, determined by resources, comparative advantages and other relevant factors such as the population size, the scale of the economy and the areas of specialisation. For example, Member States with large economies or populations will need to perform well to enable Europe as a whole to reach the targets by 2030. Digital frontrunners will need to continue progressing to lead on digitalisation worldwide, while all Member States' digitalisation efforts will be driven by their economic and societal needs.

The DESI scores and rankings of previous years are re-calculated for all Member States to reflect changes in the underlying data. For further information, see the [DESI website](#).

Austria

DESI 2022	Austria		EU
	rank	score	score
DESI 2022	10	54.7	52.3



Austria ranks 10th of the 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI). From 2017 to 2022, the country has progressed at an average yearly relative growth rate of 8 percentage points as regards the DESI indicators¹, well in line with the EU average.

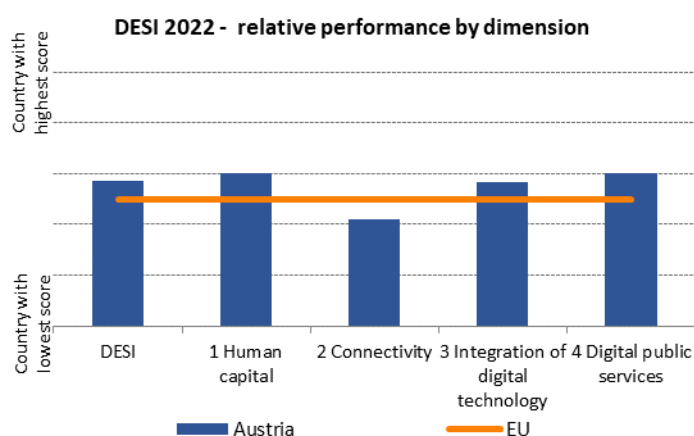
On Human capital, Austria performs better than the EU average in almost all indicators, except for the percentage of enterprises providing ICT training, which is slightly below the EU average. The number of ICT specialists in employment is at the level of the EU average. Austria's performance as regards digital connectivity is mixed: the country is above the EU average in 5G coverage but continues to perform significantly below the EU average for fixed very high-capacity network coverage and take-up. Ensuring access to higher speeds in rural areas remains Austria's biggest hurdle to achieve nationwide Gigabit connectivity by 2030. The country plans to address this challenge through its 2030 Broadband Strategy and public investments in fibre networks in rural areas, also benefitting from EU funds.

On the integration of digital technologies, Austria is above the EU average for several indicators, e. g. for Small and medium-sized enterprises (SMEs) with a basic level of digital intensity, electronic information sharing and social media. Austria needs to continue its ongoing efforts towards the Digital Decade target of 90% of SMEs reaching a basic level of digital intensity. However, the country's performance is mixed as regards its use of more advanced technologies with the use of AI slightly above EU average, but with a

¹ Refer to section 1.3 of the DESI 2022 horizontal chapter.

below EU average level use of big data and cloud. In relation to digital public services, Austria performs overall above EU average, significantly exceeding the EU average on the number of e-Government users. It scores slightly above the EU average in providing digital public services for citizens and slightly below EU average for businesses.

According to the Austrian government, its 'Digital Austria' initiative sets out a vision and the values for a digitally responsible society. 'Digital Austria' provides the framework for the country's digitalisation strategy ([digital action plan Austria](#)), defined by strategic action plans focusing on selected priority topics such as values, data, resilience and security. It is based on the initial plan developed in 2020 and it has been expanded to deal with additional topics since 2021. Currently, these include digital security, digital skills in the public administration, e-health, and the digitalisation of agriculture. The expanded focus of the action plan aims to make Austria more crisis-proof, increase competitiveness and position Austria as a leading region of digital innovation.



In response to Russia's invasion of Ukraine, the organisations involved in the Austrian cybersecurity coordination have increased their collaboration, both at national and EU level.

Digital in Austria's Recovery and Resilience Plan (RRP)

Austria's RRP has a digital share of 52.8% (EUR 1.8 billion²). The plan will contribute to Austria's digital transition in several areas.

- Digital skills are addressed by investments under the components 'Digital recovery' and 'Knowledge-based recovery'. These focus on digitalising education and on reskilling and upskilling. For example, the RRP allocated EUR 172 million on providing all secondary school students with personal IT equipment.

² Each recovery and resilience plan has to dedicate at least 20% of the plan's total allocation to digital objectives. To this end, the plans had to specify and justify to what extent each measure contributes fully (100%), partly (40%) or has no impact (0%) on digital objectives, using Annex VII of the RRF Regulation. Combining the coefficients with the cost estimates of each measure allows assessing to what degree the plan contributes to digital objectives and whether it meets the 20% target.

- Connectivity is addressed by supporting the widespread deployment of gigabit-capable access networks. The plan aims for 50% of Austrian households to have an internet speed capacity of 100Mbits/s. EUR 891 million are planned to be allocated to fulfil this objective.
- To boost innovative research, in particular quantum computing, the plan foresees EUR 107 million to support digital infrastructures and cross-border collaboration on research.
- Furthermore, the Digitalisation Fund is supporting the digitalisation of the public administration with a budget of EUR 160 million. This will help accelerate the digitalisation in the federal administration by financing projects with a cross-departmental impact.

1 Human capital

1 Human capital	Austria		EU
	rank	score	score
DESI 2022	11	51.0	45.7

	Austria			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
1a1 At least basic digital skills % individuals	NA	NA	63% 2021	54% 2021
1a2 Above basic digital skills % individuals	NA	NA	33% 2021	26% 2021
1a3 At least basic digital content creation skills³ % individuals	NA	NA	75% 2021	66% 2021
1b1 ICT specialists % individuals in employment aged 15-74	4.3% 2019	4.5% 2020	4.5% 2021	4.5% 2021
1b2 Female ICT specialists % ICT specialists	20% 2019	20% 2020	19% 2021	19% 2021
1b3 Enterprises providing ICT training % enterprises	18% 2019	18% 2020	18% 2020	20% 2020
1b4 ICT graduates % graduates	4.4% 2018	4.5% 2019	4.4% 2020	3.9% 2020

On Human capital, Austria ranks 11th out of 27 EU countries and is thus above the EU average. Austria is above the EU average for most human capital indicators except for enterprises providing ICT training. The percentage of ICT specialists in employment has reached the EU average; it increased from 4.3% to 4.5%. The percentage of female ICT specialists is EU average (19% for both). For enterprises providing ICT training, Austria is slightly below the average (18% versus 20% for the EU), and for ICT graduates above (4.4% versus 3.9%). Austria is performing above EU average for basic digital skills (63% versus 54% for the EU), basic digital skills (33% versus 26%), and basic content creation skills (75% versus 66%). Austria has two main strategies in the area of digital skills. The Digital Action Plan designs education, training and continuing education to ensure everyone has basic digital skills. The 2030 RTI Strategy (Strategy for Research, Technology and Innovation) has three goals: innovation, excellence and knowledge. Its objective is to increase the proportion of graduates in science, technology, engineering and mathematics (STEM) by 20%, and the proportion of women amongst graduates in technical subjects by 5 %. In order to provide basic skills for all, the Austrian government initiated measures for all age groups. Starting at secondary school, digital basic education ([Digitale Grundbildung](#)) will be compulsory for all students in 2022. This subject will cover, amongst others, media literacy, information processing skills, handling of personal information, and data protection. Furthermore, as the initiative 'Digital

³ Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

School 8 point plan' continues, schools will have access to better broadband, and pupils at the 5th grade will be equipped with a digital device.

Through the initiative '[Digi Scheck](#)', the Federal Ministry for Digital and Economic Affairs funds training courses for apprentices that strengthen their professional and cross-professional competencies (especially in the areas of digitalisation, resource management or climate protection) by means of grants. Up to EUR 500 per course with a maximum of three courses per year will be supported through public funding.

In addition, Austria launched more than 1 790 activities during the [EU Code Week](#) edition 2021. In terms of participation, Austria ranks 9th among EU countries, and it is still in 7th position in relation to the population.

To advance basic digital skills, the programme 'Digital Bonus' will be launched in 2022, developing training offers and to give financial support to individuals. This targets people with difficulties using the internet or little knowledge in how to cope with digital tasks in their professional and private life.

Businesses are also encouraged to provide ICT training, particularly SMEs. A federal support programme with a budget of EUR 2.6 million was launched to develop employee's competencies in IT management, cyber security, cloud services, and e-commerce. This 'Qualifizierungsoffensive' provides Digital Skills vouchers and 'digital pro bootcamps' where participants are trained for 4-weeks.

In order to steer students and women towards ICT, several projects and activities in the STEM field are planned between 2022 and 2024. A total of 3 700 new study places will be created in programmes related to ICT, artificial intelligence (AI), cybersecurity, the internet of things, and e-government. Moreover, a new technical university for digitalisation and digital transformation - TU DuDT ([Technische Universität für Digitalisierung und Digitale Transformation](#) in Linz) - will be established in the academic year 2023/24. The Universities of Applied Sciences develop measures to increase the participation of women's participation in STEM study programmes including communication campaigns, mentoring programmes and special preparation courses.

2 Connectivity

2 Connectivity	Austria		EU
	rank	score	score
DESI 2022	14	56.5	59.9

	Austria		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
2a1 Overall fixed broadband take-up	72%	73%	78%	78%
% households	2019	2020	2021	2021
2a2 At least 100 Mbps fixed broadband take-up	8%	12%	18%	41%
% households	2019	2020	2021	2021
2a3 At least 1 Gbps take-up	<0.01%	<0.01%	<0.01%	7.58%
% households	2019	2020	2021	2021
2b1 Fast broadband (NGA) coverage	79%	87%	93%	90%
% households	2019	2020	2021	2021
2b2 Fixed Very High Capacity Network (VHCN) coverage	14%	39%	45%	70%
% households	2019	2020	2021	2021
2b3 Fibre to the Premises (FTTP) coverage	14%	21%	27%	50%
% households	2019	2020	2021	2021
2c1 5G spectrum	33%	66%	66%	56%
Assigned spectrum as a % of total harmonised 5G spectrum	04/2020	09/2021	04/2022	04/2022
2c2 5G coverage⁴	NA	50%	77%	66%
% populated areas		2020	2021	2021
2c3 Mobile broadband take-up	84%	84%	91%	87%
% individuals	2018	2018	2021	2021
2d1 Broadband price index	75	78	74	73
Score (0-100)	2019	2020	2021	2021

In the Connectivity dimension, Austria ranks 14th out of 27 EU countries. Fast broadband (NGA) coverage improved further over the past year, particularly in rural areas where it surged from 38% in 2020 to 68% in 2021. 93% of Austrian households are now covered with speeds of at least 30 Mbps. However, the country continues to perform significantly below the EU average in fixed very high capacity network (VHCN) coverage. After an almost threefold increase between 2019 and 2020 (from 14% to 39%), total coverage only increased by 6 percentage points (pps) to 45% in 2021. For rural areas, coverage has only increased by 6 pps since 2019. This suggests that the significant improvement in 2020 was a one-time effect, achieved largely by upgrading already existing cable networks in urban areas to DOCSIS 3.1 technology, as opposed to new investments in fibre. Fibre to the premises (FTTP) coverage improved slightly in 2021 but at 27% still lies significantly below the EU average (50%). Ensuring access to higher

⁴ The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

speeds in rural areas remains Austria's biggest challenge to achieving nationwide gigabit connectivity by 2030.

To address this challenge, Austria's 2030 broadband strategy, 'Breitband Austria 2030', plans for public investments in areas where mountainous topography and comparatively low population density discourage the deployment of private networks. In March 2022, the Commission approved, under EU State aid rules, a [EUR 2 bn investment scheme](#) made available through the Recovery and Resilience Facility to deploy passive infrastructure for 'gigabit capable' fibre networks in underserved regions until 2026. These networks must immediately offer at least symmetrical 100 Mbps speeds and be upgradable to symmetrical gigabit speeds without further investments in the deployed passive infrastructure. The six state-owned companies involved in deployment have attracted significant interest from investors and capital market institutions. For example, in November 2021, the Austrian fibre optic infrastructure company ('*Österreichische Glasfaser-Infrastrukturgesellschaft*') announced they will [receive EUR 1 bn in equity](#) from the Allianz Group. In December 2021, Meridiam was selected to [invest more than EUR 100 m](#) in developing the regional fibre network in Liezen, the largest district of Austria. In developing the regional fibre network in Liezen, the largest district of Austria.

Private investments in fibre still remain focused on urban areas. While the incumbent (A1) focuses on [accelerating fibre to the home/building \(FTTH/B\) deployment](#) in brownfield regions and newly built areas, the two other major operators are cooperating with investors or acquiring smaller operators to integrate, upgrade and expand their existing network. To free up resources for investment, all three operators have already divested or are considering divesting towers from their mobile business.

To further facilitate private deployment, the 'Internet Infrastructure Austria 2030 Platform' (PIA 2030), a task force bringing together representatives from all government levels and the private sector, has yet to implement many of the best practices identified in the country's [Connectivity Toolbox](#) roadmap. This includes simplifying the decentralized procedure for granting permits, which has slowed down network deployment to date. Moreover, mobile operators reported that some municipalities remain reluctant to issue permits to deploy 5G base stations, frequently due to widespread concern about electromagnetic field exposure. Addressing such persisting obstacles, for example by expanding initiatives like the '5G Gemeindeservice', an online portal to support local authorities with answers to frequently asked questions, becomes particularly important considering 5G is poised to play a significant role in achieving gigabit connectivity for all households by 2030, in line with the [EU Digital Decade](#) targets.

Austria performs particularly well on mobile connectivity. Early assignment of spectrum in the 3.6 GHz and 700 MHz bands (in 2019 and 2020), coupled with comprehensive 5G coverage obligations, enabled the country to surpass the EU average by 11 percentage points (pps) in 2021. With 77% of populated areas covered with 5G, the country is on track to meet its ambitious national target of nationwide coverage by the end of 2025. Notably, rural 5G coverage increased at the same rate as total coverage, reaching 36% in 2021. All three operators are considering negotiating commercial agreements, in part to meet the [obligations](#) of the 700 MHz auction⁵, as soon as outstanding technical issues to enable active

⁵ In particular, the obligation to cover 80% of underserved areas (cadastral communities) with download speeds of 30 Mbps and 3 Mbps for upload by 2025.

infrastructure sharing for 5G rollout are resolved. During the [consultation on the 2022-2026 Spectrum Release Plan](#) the regulator registered emerging demand for the 26 GHz band and plans to proceed with an award procedure in 2023.

The high take-up of mobile broadband (91%) by individuals shows that Austrian households use it to complement or substitute fixed connections⁶. With only 18% of households subscribing to fixed connections offering at least 100 Mbps, Austria remains far below the EU average (40%). Even where high-speed fixed internet is available, Austrian end-users opt for lower connection speeds or comparable mobile connections. Tellingly, the rapid increase in fixed VHCN coverage between 2019 and 2020 (25 pps) did not result in a corresponding increase in take-up in 2021 (up by 6 pps from 2020), when one third of flat-rate residential broadband connections were being provided via mobile cubes. As of 2021, [prices for fixed and mobile broadband](#) with speeds above 100 Mbps are similar and on average 33% higher than prices for lower speeds. Overall, broadband prices in Austria remain slightly below the EU average.

Main market & regulatory developments

The Austrian market is characterised by competition over infrastructure and prices, which cuts across the fixed and mobile segments. Austria's three largest network operators hold a combined market share of over 80% in voice and broadband (fixed and mobile) and are all offering commercial wholesale access.

In 2021, the Austrian Regulatory Authority for Broadcasting and Communications (RTR) observed increasing difficulties for existing mobile virtual network operators to negotiate competitive wholesale access prices for 5G with their host networks. There is an increased urgency to resolve ongoing disputes in light of an expiring wholesale commitment that Hutchison Drei Austria made when they merged with Orange Austria in 2012. Mediated discussions started by RTR together with the Austrian Competition Authority have yet to yield results.

In 2022, the regulator expects to conclude its ongoing analysis of the fixed wholesale access markets and arrive at a final decision⁷. Developments in recent years show an increased take-up of virtual unbundled lines, accompanied by a proportional decrease in the take-up of physical unbundled lines. Under the current regime, the virtual unbundling remedy applied to the incumbent's (A1) network does not distinguish between different areas (urban/rural) or infrastructures (copper/fibre). In the context of the pending market review, A1 is negotiating on a new virtual unbundling wholesale contract (called VULA 2.0) and on risk sharing schemes for new VHCN deployment (called VHCN access).

On 12 November 2021, Austria notified the Commission of having turned the European

⁶ In a 2020 [consumer survey](#) conducted by the national regulator, RTR, 26% of respondents indicated relying exclusively on mobile cubes or USB sticks to access the internet.

⁷ Corresponding to market 1 of the [Commission Recommendation \(EU\) 2020/2245](#) and market 3b of the [Commission Recommendation \(EU\) 2014/710](#).

Electronic Communications Code into national law in the form of the Telecommunications Act (*Telekommunikationsgesetz*, TKG 2021) and several amendments.

On open internet, recent [court orders](#) highlighted the lack of clear procedures and guidelines for dealing with requests to block websites due to alleged copyright violations. Since the regulator is not allowed to assess incoming requests, operators are themselves forced to assess these requests or go to court.

Handset derived advanced mobile location (AML) remains unavailable for calls to the European emergency number 112. The Austrian authorities are working on an AML endpoint in the public safety answering point system to provide all emergency services with access to caller location information by the end of 2022. While negotiations with Apple have resulted in an agreement to deliver AML data to this endpoint, negotiations with Google are gridlocked over contractual liability issues.

The number and source of consumer complaints remained stable between 2020 and 2021, but the RTR noted an increase in scam calls using caller identification spoofing and fraudulent text messages designed to elicit personal data.

Austria is on track to meet the 5G targets but remains below EU average on fixed VHCN coverage and take-up. The broadband strategy [Breitband Austria 2030](#) contains an ambitious plan to address this challenge with public investments in fibre networks for rural areas. Achieving the 2030 Digital Decade targets will require these numerous local, state-funded networks to be upgradable to gigabit speeds without further investments, and to be easily interoperable and accessible by other operators, for example, through standardised technical and procedural parameters. To further facilitate private fibre deployment, it is important to quickly advance discussions in the context of the PIA 2030. In particular, it is important to decide on concrete measures to simplify the decentralised procedure for granting permits and stimulate demand for high broadband speeds.

3 Integration of digital technology

3 Integration of digital technology	Austria	EU
	rank	score
DESI 2022	10	36.1

	DESI 2020	Austria DESI 2021	DESI 2022	EU DESI 2022
3a1 SMEs with at least a basic level of digital intensity	NA	NA	64%	55%
% SMEs			2021	2021
3b1 Electronic information sharing	43%	43%	45%	38%
% enterprises	2019	2019	2021	2021
3b2 Social media	30%	30%	38%	29%
% enterprises	2019	2019	2021	2021
3b3 Big data	6%	9%	9%	14%
% enterprises	2018	2020	2020	2020
3b4 Cloud	NA	NA	29%	34%
% enterprises			2021	2021
3b5 AI	NA	NA	9%	8%
% enterprises			2021	2021
3b6 ICT for environmental sustainability	NA	70%	70%	66%
% enterprises having medium/high intensity of green action through ICT		2021	2021	2021
3b7 e-Invoices	20%	22%	22%	32%
% enterprises	2018	2020	2020	2020
3c1 SMEs selling online	19%	22%	22%	18%
% SMEs	2019	2020	2021	2021
3c2 e-Commerce turnover	9%	10%	10%	12%
% SME turnover	2019	2020	2021	2021
3c3 Selling online cross-border	15%	15%	16%	9%
% SMEs	2019	2019	2021	2021

On integration of digital technology dimension, Austria ranks 10th of 27 EU countries and is thus above the EU average.

Austria is scoring well on the indicator SMEs with at least basic level of digital intensity with 64% compared to the EU average of 55%. A similar picture can be found for electronic information sharing (45% compared to 38%) and Social media (38% compared to 29%). However, in some advanced technologies, for example cloud and big data, Austria scores below the EU average while in AI it is just above the EU average. For SMEs selling online and online cross-border, Austria ranks above the EU average, but the share of e-commerce in their turnover is slightly below the EU average (10% compared to 12%).

Austria is implementing several measures aimed at improving the development and take up of advanced technologies. The project 'Quantum Austria' is supporting high performance computing and quantum research. The development of hard- and software, research skills and know how including cross-border research collaborations (e.g. with EuroHPC) will lead to commercially available tools at the core of Quantum Austria. The first tender for infrastructure and research cooperation is expected to be

completed in 2022. The project will run until 2026 and has a budget of EUR 107 million financed via the Austrian RRP. In addition, the country is participating in the European Quantum Communication Infrastructure project and currently working on the development of a quantum infrastructure in Austria in collaboration with other participating countries.

Artificial Intelligence is another advanced technology Austria is focussing on. In September 2021, it published the strategy '[2030 Artificial Intelligence Mission Austria \(AIM AT 2030\)](#)', that can help to prepare the ground for Austria's contribution to achieve the Digital Decade target of 75% of European enterprises using artificial intelligence. 'AIM AT 2030' pursues three objectives: (i) develop responsible value-based AI, (ii) position Austria as a research and innovation location for AI and (iii) ensure its competitiveness by the development and use of AI. The implementation takes place within the framework of two fields of action: (i) 'Trustworthy AI' including the creation of AI standards and a legal framework; (ii) 'Create ecosystems' integrating AI in education and training, technology transfer between universities, research institutes and enterprises, as well as financing for enterprises that will cover the entire innovation cycle. In addition, the strategy is strongly focussed on developing 'AI for green'. Furthermore, Austria has already launched a first '[AI for green' call](#) in June 2021, aiming at the development of AI solutions, with a total budget of EUR 7 million, to tackle environmental challenges like climate change mitigation. A second call for proposals is expected to be launched in the first half of 2022. Moreover, the new Future Austria Fund ([Fonds Zukunft Österreich](#)) is expected to invest additional EUR 140 million per year to position Austria as a research location, with EUR 10 to 12 million earmarked for AI.

Regarding cloud services, Austria is continuing its main initiatives. In the framework of the 'Ö-Cloud Initiative', it developed a quality seal for providers of cloud services that comply with the relevant security standards. The verified self-assessment covers 135 criteria relating to data centre operation, transparency and operative procedures. The first quality seals were awarded in July 2022 and are valid for one year. Moreover, Austria is participating in the cloud initiative 'Gaia-X' and established a [Gaia-X Hub Austria](#) in the summer of 2021. The Hub is coordinating the activities of the Austrian stakeholders under Gaia-X and will involve the business and science sectors. An example of a project in the Gaia-X framework is '[EuProGigant](#)'. This research project covers the smart use of data in the European manufacturing industry and is carried out by an Austro-German project consortium.

Austria's participation in the second Important Project of Common European Interest (IPCEI) on Microelectronics and Communication Technologies is also part of its RRP. It aims to strengthen the microelectronics ecosystem while focusing on the development of energy-efficient, secure and performant chips. Currently, 20 Member States are actively involved in the design of the IPCEI. Austria has earmarked a budget of EUR 125 million in its RRP to fund such projects.

Two measures to support the digital transformation of enterprises and SMEs are part of the Austrian RRP. Under the first measure, enterprises can receive an investment premium for their investments in the digitalisation of business models, processes, as well as cybersecurity measures. At least 7 000 enterprises are expected to receive a total funding of EUR 69 million until 2025. The SME-specific measure consists of support programmes (i) KMU.DIGITAL, providing advisory and implementation support for digitalisation projects, and (ii) the e-commerce specific programme KMU.E-Commerce. A total budget of EUR 32 million is available for the two programmes. Additionally, six Digital Innovation

Hubs have been created throughout Austria with different geographical and thematic focus. They will be complemented by European Digital Innovation Hubs as a result of an ongoing call.⁸

Cybersecurity is another area Austria's activities focused on recently. In December 2021, Austria adopted a new [Cybersecurity Strategy](#) (*Österreichische Strategie für Cybersicherheit 2021*) structured around ten objectives. The strategy includes the further development of a research and development community for cybersecurity and the capacity to protect its critical infrastructures and information systems. Concrete measures will be detailed in a catalogue. The publication of the first evaluation report is expected to take place in summer 2022. Austria is conducting several initiatives to support the digital transformation of SMEs and to develop advanced technologies. An even stronger focus on the implementation of concrete measures and activities could further increase the impact of the digitalisation measures in the area of integration of digital technologies.

Highlight: AI marketplace

An AI marketplace was launched in 2021 and provides an overview of the Austrian AI provider landscape and their services. It aims at connecting AI suppliers with potential customers and introduces Austrian enterprises to applications of AI. The marketplace offers a targeted search by application fields, industries, types of cooperation as well as regions. It currently includes almost 150 AI providers from all Austrian provinces and from all kinds of industries (including: automotive, energy, agriculture, security or tourism). In addition, the AI marketplace offers knowledge transfer services that help companies get started in the field of AI. The platform can be accessed via www.ki-marktplatz.at.

⁸ Four Austrian European Digital Innovation Hub proposals have a successful evaluation result, i.e. are invited for grant agreement preparation (which is not a formal commitment for funding). Another three proposals have received a Seal of Excellence.

4 Digital public services

4 Digital public services ⁹	Austria	EU
	rank	score
DESI 2022	12	72.1
		67.3

	DESI 2020	Austria DESI 2021	DESI 2022	EU DESI 2022
4a1 e-Government users	79%	81%	79%	65%
% internet users	2019	2020	2021	2021
4a2 Pre-filled forms	NA	NA	71	64
Score (0 to 100)			2021	2021
4a3 Digital public services for citizens	NA	NA	76	75
Score (0 to 100)			2021	2021
4a4 Digital public services for businesses	NA	NA	81	82
Score (0 to 100)			2021	2021
4a5 Open data	NA	NA	92%	81%
% maximum score			2021	2021

Austria is performing above the EU average in all indicators for digital public services except for digital public services for businesses where it scores slightly below the EU average (81 points versus the EU average of 82 points). The country scores well above the EU average for e-Government users (79% compared to 64%) and above the EU average for pre-filled forms (71 compared to 64) as well as for open data (92% compared to 81%). For both digital public services for citizen and for businesses it represents the EU average with services for citizen being 1 point above, and businesses being 1 point below the EU average.

In the area of digital public services, Austria's strategy '[Digital Action Plan Austria](#)' (*Digitaler Aktionsplan Austria*) is aiming at a one-stop approach for businesses and individuals. The work programme (2020-2024 [Government Programme](#)) describes the stepwise implementation of this strategic vision. The country is mainly continuing and enhancing its ongoing actions and available services. Some of the most relevant examples are the '[Business Service Portal](#)' (*Unternehmensserviceportal*) that supports businesses, the [portal for citizens](#), the electronic identification '[ID Austria](#)' as well as the mobile app '[Digitales Amt](#)' and the electronic health record system ([Elektronische Gesundheitsakte – ELGA](#)).

The Business Service Portal provides 91 public service procedures as well as relevant information to businesses to help them fulfil their information obligations and reduce their administrative burden, e.g. helping people start a business online ([eGründung](#)) and electronic relocation ([elektronische Standortverlegung](#)). Currently, Austria is improving the portal's operation and structure to make it even more user-friendly. Moreover, the basis for cross-border automated exchange, as well as the application

⁹ There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

of the once-only principle in the portal was put into place with a legal amendment in July 2021. Another recent development in the portal that Austria is conducting is a project that uses AI technology to provide targeted and customised information on available funding opportunities for businesses. This project won the 'Best project for the application of innovative technologies and infrastructure' award at the [20th e-Government Competition 2021](#).

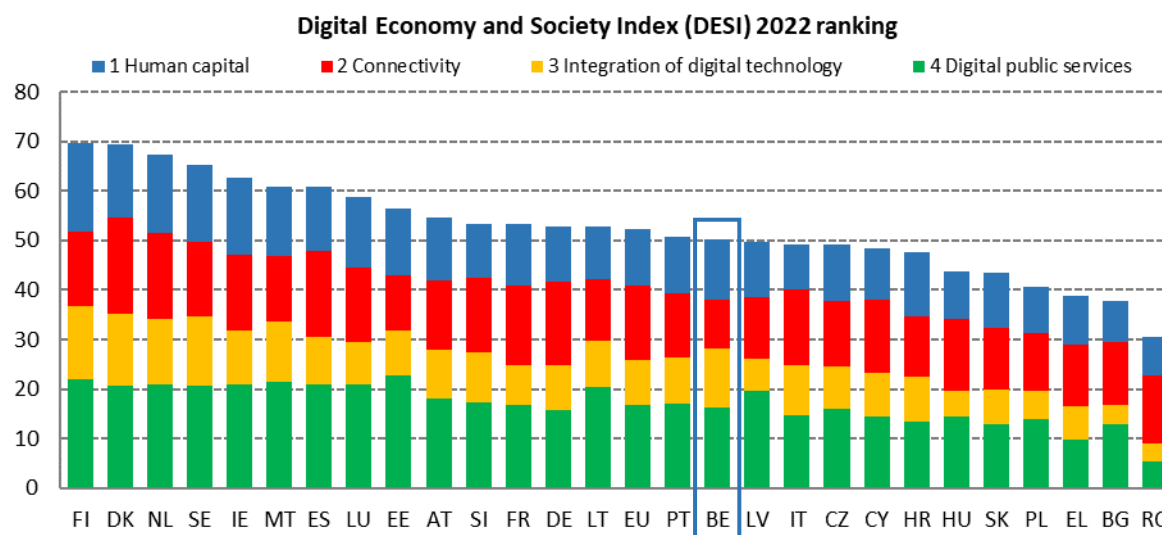
The Austrian electronic identification 'ID Austria' has been available as part of a pilot since January 2021 and is expected to be fully operational end of 2022. The approximately three million users of the currently used and more limited solution 'Mobile Phone Signature' (*Handy-Signatur*) will be migrated to 'ID Austria' as soon as it will be available. Once the 'ID Austria' will be fully operational, every citizen will receive a digital ID automatically with their application for a passport. 'ID Austria' will provide further solutions (e.g. digital driving licence, digital registration certificate) including private sector offers. As a notified scheme under the eIDAS regulation, the full support of EU's system for electronic Identification, authentication and trust services (eIDAS) will allow access to systems supporting the Austrian single-sign-on not only with the Austrian 'ID Austria', but also with all digital IDs from other EU Member States.

'ID Austria' is also the basis for the single sign-on functionality of the 'Digital Office App' ([Digitales Amt App](#)) for mobile phones. Austria is supporting mobile applications, and around one quarter of smartphone users are using the 'Digital Office App' ([eGovernment Monitor 2021](#)). Austria plans to provide everybody the possibility to access their electronic medical records ([Elektronische Gesundheitsakte' - ELGA](#)) with 'ID Austria' in 2022. ELGA makes it easier for patients and authorised ELGA health service providers - i.e. treating physicians, hospitals, care facilities and pharmacies - to access certain health data. Currently already available services – for 'ID Austria' holders – include a vaccination certificate, medical examination results as well as medical prescriptions.

An example of an innovative digital public service is Austria's 'Public Procurement Promoting Innovation Portal' ([Innovationsfördernde öffentliche Beschaffung](#)) which supports innovative solutions in public administrations and establishes contact with providers including start-ups. The system presents both [challenges and innovative solutions](#) that have been evaluated by a jury. This encourages cooperation and building of innovation cluster. Examples of challenges are an online platform to entice (online) participation in the city of Vienna or a system to forecast the water level of the river Danube. Austria was ranked second in the study '[benchmarking innovation procurement investments and policy frameworks across Europe](#)' by the European Commission in 2021.

Belgium

	Belgium		EU
	rank	score	score
DESI 2022	16	50.3	52.3



Belgium ranks 16th of 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI) report. The country's relative growth in digital, considering its starting point, is among the lowest in the EU¹⁰.

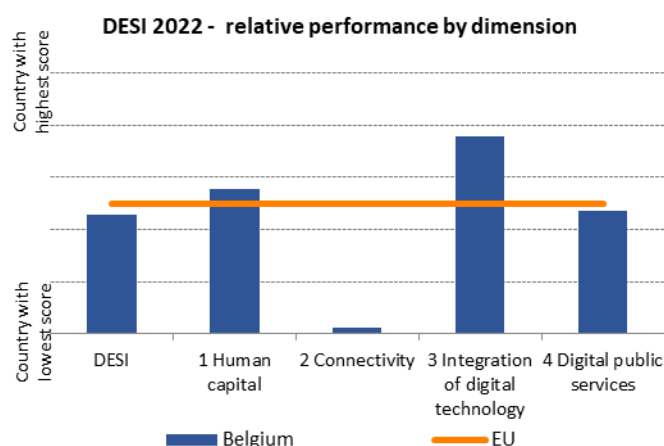
Belgium ranks 6th in the EU in integration of digital technology, with the country's enterprises showing a high uptake of digital technology within their operations. Most notable is the number of enterprises using cloud and SME's selling online which perform well above the EU average (13 and 12 percentage points (p.p.) respectively). Belgium also displays strong performance in terms of e-government users, which has shown a robust increase and now stands at 9 p.p. above the EU average (74% versus 65%). Belgium is below the EU average on connectivity with a 40 percentage points gap from the EU average on Fibre to the Premises rollout.

All levels of government have put in place various digital strategies or plans. [#SmartNation](#), the new federal digital strategy, has been set up in 2021. It revolves around 5 axes mirroring DESI indicators (digital transformation of the economy, digital human capital, digital government, trust/transparency/security, and digital infrastructures and ecosystems). The strategy is supported by the work of a 'Digital Minds' group bringing together 22 people from the academic and business world. This group, that met for the first time on 30 June 2021, will analyse the best ways of implementing the

¹⁰ Refer to section 1.3 of the DESI 2022 horizontal chapter.

country's digital projects, in particular in the context of its recovery and resilience plan, in order to maximise their impact.

Flanders designed a [regional recovery plan](#) (including measures that are part of the country's Recovery and Resilient Facility (RRF)) with seven main strands, one of which digital transformation, for which there is a dedicated strategy for e-government ([Flanders Radically Digital II](#)). The French-speaking community (Wallonia-Brussels Federation) has included in its global [2020-2025 strategy](#) a chapter on digitalisation based on six pillars (governance, data, digital workplace, innovation, digital culture, and users.) The Walloon region also has a digital strategy for 2019-2024, [Digital Wallonia](#), revolving around five themes (the digital sector, digital economy, digital administration, digital territory, digital skills). Wallonia is now also in the process of finalising work on its post-2024 digital strategy. In 2021, the Brussels-Capital region put in place new plans and tools in the areas of IT governance, data, digital inclusiveness, administrative simplification. It is currently developing a regional strategy for economic transition including objectives and actions to stimulate and facilitate companies' digital transition.



As a response to Russia's invasion of Ukraine, Belgium has set up the centralized portal '[info-ukraine](#)' providing information for Belgians in Ukraine/Russia, assistance for people fleeing Ukraine and information for municipalities wishing to accommodate persons. The website is available in six languages: Dutch, French, German, English, Ukrainian and Russian. Additionally, Flanders has set up a dedicated website '[Flanders helps Ukraine](#)', with an overview of everything Flanders does for people fleeing Ukraine, divided into information for citizens and local authorities. Wallonia provides a similar [website](#), covering all the information on the actions in Wallonia to help people fleeing Ukraine.

Digital in Belgium's Recovery and Resilience Plan (RRP)

The Belgian RRP was approved by the Council of the EU on 13 July 2021, with its digital component mainly focused on skills and e-government¹¹. The key deliverables expected in the

¹¹ Each recovery and resilience plan has to dedicate at least 20% of the plan's total allocation to digital objectives. To this end, the plans had to specify and justify to what extent each measure contributes fully (100%), partly (40%) or has no impact (0%) on digital objectives, using Annex VII of the RRF Regulation. Combining the coefficients with

next 12 months concern 5G rollout, the first steps of digitalisation of the justice system and the equipment of schools with IT infrastructure and devices.

On the rollout of 5G, the auction of the 5G spectrum bands is expected to be completed by BIPT, the Belgian regulator of electronic communications, by the second quarter of 2022. On top of this, by the third quarter of 2022, regions are expected to have amended their legislative framework as regards radiation standards, if deemed necessary and recommended by the relevant committees, to allow for an effective 5G rollout.

On the digitalisation of justice, the basic version of a new portal, 'JustOnWeb', is expected to be online by the last quarter of 2022. JustOnWeb will eventually be the 'one stop' web portal, where individuals, businesses, lawyers and public authorities may access justice services and information.

By the last quarter of 2022, it is planned for 3 840 schools and/or educational institutions in Belgium to have received funds to upgrade their ICT infrastructure. The adoption by the Flemish Parliament of the new legislation to improve the current ICT framework in schools is expected by the third quarter of 2022.

the cost estimates of each measure allows assessing to what degree the plan contributes to digital objectives and whether it meets the 20% target.

1 Human capital

1 Human capital	Belgium		EU
	rank	score	score
DESI 2022	13	48.7	45.7

	Belgium			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
1a1 At least basic digital skills % individuals	NA	NA	54% 2021	54% 2021
1a2 Above basic digital skills % individuals	NA	NA	26% 2021	26% 2021
1a3 At least basic digital content creation skills¹² % individuals	NA	NA	67% 2021	66% 2021
1b1 ICT specialists % individuals in employment aged 15-74	5.0% 2019	5.0% 2020	5.6% 2021	4.5% 2021
1b2 Female ICT specialists % ICT specialists	17% 2019	17% 2020	20% 2021	19% 2021
1b3 Enterprises providing ICT training % enterprises	36% 2019	33% 2020	33% 2020	20% 2020
1b4 ICT graduates % graduates	2.1% 2018	2.1% 2019	2.2% 2020	3.9% 2020

Belgium ranks 13th of the 27 EU countries on human capital. Belgium performs equal to the EU average for the number of individuals with basic digital skills and those with above basic digital skills (at 54% and 26% of individuals respectively). It does only slightly better than the EU for individuals with at least basic digital content creation skills indicator (67% versus 66% for the EU). About one-third of Belgian companies provide ICT training to their workers. While this is higher than the EU average, the share has declined compared to 2019. The share of ICT specialists is slightly above the EU average (5.6% in Belgium versus 4.5% in the EU) and the country is also has a higher share of female ICT specialists. With regards to the number of ICT graduates, however, Belgium performs markedly worse than the EU average and has seen only limited growth in this area over the last few years.

The different Belgian federal and regional governments have their own measures in place to improve the basic digital skills of the population and foster digital inclusion. At the federal level, the [Digital Belgium Skills Fund](#) (DBSF) focuses on developing and improving the digital skills of socially vulnerable children, adolescents, and young adults. It funded 27 projects in 2021. One of the associations involved with the DBSF, Eqla, facilitates access to data analysis and data software for blind people. Another project, CoderDojo4All, promotes coding among vulnerable young people (girls, migrants, persons with disabilities). The Brussels-Capital region has started rolling out its [digital appropriation plan](#) for 2021-2024. Finally, the Walloon region continues to implement its Digital Inclusion Plan. A [draft decree](#) on basic digital training for the socio-professional integration of vulnerable groups has been submitted by

¹² Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

the Walloon Minister of Employment in September 2021. It proposes additional training centres and training hours, a standardised teaching method throughout Wallonia, a closer link with employment services, and more stable and increased funding for the entities that provide these courses.

The digitalisation of the education system is also supported at the various levels of the Belgian governments. In Flanders, the rollout of the digital leap programme (Digisprong) has begun and is expected to be supported by RRF funds. Between Q1 2021 and Q1 2022, EUR 180 million were devoted to equipping pupils and students with ICT devices. Another EUR 85 million was used to equip teachers with such devices. A further EUR 10 million was also earmarked for the acquisition of ICT equipment and devices for vocational education and training centres. In Wallonia and the German-speaking community, the yearly digital school programme ([École numérique](#)) that supports schools in their digital transition will be replaced by a more permanent system from 2022 onwards. In the French Community, a reform of the curriculum for the education of teachers is also ongoing. Additional digital and techno-pedagogical skills are to be included in the higher education curricula for future teachers while the development of digital literacy and an introduction to computer sciences for educational, pedagogical and didactic purposes is also planned.

In 2021, in Belgium, nearly 45 000 people took part in Code Week activities ranging from learning basic programming concepts and practicing computational thinking to learning more about artificial intelligence and robotics. 55% of the participants were women and girls¹³.

Belgium continues to have a shortage of ICT professionals. However, actions have been taken to upskill and reskill the labour force, including developing advanced digital skills. The Federal government, together with the National Coalition for digital skills and jobs, has developed a digital skills passport to that end. It has also developed a new platform, [Digiskills Belgium](#). The platform lists all initiatives and training courses to help people improve their digital skills, focusing on digital inclusion and the reskilling and upskilling of the labour force. In Flanders, the job placement agency VDAB continues to offer IT developer training courses for people who are removed from the labour market or other vulnerable citizens (e.g. young people Not in Education, Employment or Training - NEET). It has also extended its online training offering to include a wide range of skills that are currently in demand on the labour market, including those related to Artificial Intelligence (AI) and Internet of Things (IoT). Wallonia is involved in the [‘4.0Ready’](#) Interreg Europe Project (2019 – 2023) which aims to strengthen the capacity of SMEs to engage in Industry 4.0 in addition to improving the digital skills of workers. The Walloon recovery plan also includes a EUR 3.9 million project to develop a basic digital skills training strategy (based on the DigComp EU framework) for workers. The project extends the use of the tools needed for workers to define, maintain, and improve their level of skills. It also offers works suggestions for training courses that correspond to the skills they need to keep up with the digital developments linked to their work environment.

Belgium struggles to increase the number of women ICT specialists needed to fill the vacancies in the sector. The national and intersectoral strategy [‘Women in Digital’](#) was elaborated in collaboration with a multistakeholder group from private, public and academic sectors. The strategy was adopted in March 2021, and officially signed by all government levels in June 2021. A website to support the strategy was launched in April 2022 ([BeDigitalTogether](#)) for which the Federal Public Service Economy, SMEs, Middle Classes, and Energy (FPS Economy) has produced [five testimonial videos](#). These videos promote the

¹³ <https://blog.codeweek.eu/4-million-people-created-code-with-the-help-of-eu-code-week-in-2021/>

creation of new female role models and encourage girls and women to choose studies and careers in the digital sector. A working group Women in Digital, coordinated by FPS Economy, has been created to follow and monitor Belgium's progress in achieving its objectives. Belgium also takes part in the yearly 'Girls in ICT day'. In the Brussels-Capital region, Hub.brussels – (the regional economic development agency – is coordinating an ecosystem of partners to develop actions dedicated to increase the number of women in entrepreneurship, particularly tech companies.

Altogether, these initiatives will contribute to the collective effort needed to reach the EU-level Digital Decade target of having at least 20 million employed ICT specialists by 2030.

The lack of ICT specialists clearly remains a weak point for Belgium, which has the highest share of companies reporting that they find it hard to fill vacancies for ICT jobs in the EU. Further action is necessary to promote ICT studies among students in general and women in particular.

Highlight: Digibanks (Flanders)

With the support of the RRF, Flanders has started to set up local '[Digibanks](#)' to reduce the risk of digital exclusion among vulnerable groups with the following 3 objectives:

- Provide equal access to digital technology by making laptops, tablets and other hardware available on a conditional basis, for example through a lending service.
- Strengthen, through training and knowledge sharing, both personal and technical digital skills.
- Ensure improved digital access to essential services such as the digital government services by providing guidance on the use of such services.

Digibanks target adults in Flanders who are at risk of digital exclusion (e.g. people living in poverty, people with low-literacy skills, single seniors, jobseekers). The structure and composition of each digibank project will be determined using a 'bottom-up' approach, in order to adapt the project to local circumstances.

The total budget for Digibanks is EUR 50 million. Two calls have already been launched in autumn 2021 and [six Digibanks](#) started in Flanders on 1 February 2022.

2 Connectivity

2 Connectivity	Belgium		EU
	rank	score	score
DESI 2022	27	39.8	59.9

	DESI 2020	Belgium DESI 2021	DESI 2022	EU DESI 2022
2a1 Overall fixed broadband take-up % households	79% 2019	85% 2020	84% 2021	78% 2021
2a2 At least 100 Mbps fixed broadband take-up % households	45% 2019	54% 2020	56% 2021	41% 2021
2a3 At least 1 Gbps take-up % households	<0.01% 2019	<0.01% 2020	0.53% 2021	7.58% 2021
2b1 Fast broadband (NGA) coverage % households	99% 2019	99% 2020	99% 2021	90% 2021
2b2 Fixed Very High Capacity Network (VHCN) coverage % households	66% 2019	68% 2020	69% 2021	70% 2021
2b3 Fibre to the Premises (FTTP) coverage % households	4% 2019	7% 2020	10% 2021	50% 2021
2c1 5G spectrum Assigned spectrum as a % of total harmonised 5G spectrum	3% 04/2020	3% 09/2021	3% 04/2022	56% 04/2022
2c2 5G coverage¹⁴ % populated areas	NA	4% 2020	4% 2021	66% 2021
2c3 Mobile broadband take-up % individuals	84% 2018	84% 2018	90% 2021	87% 2021
2d1 Broadband price index Score (0-100)	52 2019	51 2020	56 2021	73 2021

In the Connectivity dimension of DESI, Belgium ranks 27th out of the 27 EU countries.

On fixed connectivity, Belgium has not made a lot of progress towards reaching the Digital Decade targets. While Belgium has largely completed coverage of NGA networks and performs better than the EU average, the rollout of Very High Capacity Networks (VHCN) has progressed slowly. Coverage only reaches 69% of households, less than the EU average. On the take-up of services, Belgium performs strongly in fixed broadband of at least 100Mbps at 56% (15 percentage points higher than the EU average). However, take-up of 1Gbps is still very limited (0.53% versus the EU average of 7.58%).

Belgium traditionally had strong cable TV/COAX infrastructure, but significant efforts have recently been made to roll out fibre to the premises (FTTP) networks. This effort has resulted in some progress on FTTP

¹⁴ The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

coverage (from 4% to 10% in the space of 2 years), however, Belgium is still dead last in the EU in this regard, significantly below the EU average of 50%. Proximus, thanks to a EUR 400 million loan from the European Investment Bank (EIB), has continued with its rollout of FTTH and will accelerate this rollout to reach 70% coverage by 2028.

In Wallonia, the current acquisition process of VOO by Orange, has somewhat stalled the process of upgrading the fixed networks. This may accelerate once the transaction is fully completed. The German-speaking community is expected to benefit from a EUR 19.5 million investment through the RRF to support the deployment of FTTP.

The Belgian market is also characterised by a number of joint ventures for fibre rollout. Proximus entered into agreements with Eurofiber for Wallonia and EQT for Flanders for the rollout of an open fibre network. Telenet and utility provider Fluvius have reached a non-binding agreement about a joint venture to deliver FTTP in Flanders.

As part of the National Broadband Plan, Belgium is allocating EUR 40 million public funding for the deployment of gigabit connectivity in white zones and areas where 100 Mbps cannot be reached. Belgium is also studying the possibility to participate in a CEF2 multi-country project on cross-border connectivity for waterways. Concerning specific targets, all schools, transport hubs and public services will be covered with gigabit connectivity.

Main market & regulatory developments

The Belgian market has seen some significant developments over the course of the year. On the mobile market, Proximus bought out MVNO Mobile Vikings, increasing its mobile market share. Orange, launched a new low-cost mobile brand 'hey!' and continued to increase its overall customer base. Telenet has now fallen under 30% of mobile market share. In 2021, Belgium also saw the entry into the mobile market of Youfone, which signed agreements with Proximus to be able to enter both the mobile and fixed markets.

Orange Belgium has come to an agreement to buy 75%-1 share of VOO. This will significantly change the dynamics of the Belgian market, should this acquisition gain regulatory approval. Orange would be able to deploy its own fixed network in Wallonia rather than using wholesale access.

The market continues to be characterised by the high uptake of bundles, with quadruple play bundles replacing triple play bundles as the most popular bundles on the market. The Belgian market has seen a significant change, with an overall increase in broadband, mobile and App TV bundles, and a significant decrease in triple play bundles without mobile telephony. There has also been an increase in stand-alone broadband. This can be attributed to certain market players' unlimited offerings.

The Belgian market has also seen a continued decrease in fixed telephone network connections, down by 296 000 to 3.6 million. The mobile market channel, on the other hand, has seen a continued increase of 18% in voice and a 19% decrease in text messaging. Mobile data usage has increased by 34%, a significantly lower increase than in previous years (around 60%). Conversely, the increase in fixed broadband traffic was higher than in previous years with an increase of 52%. This difference in growth can probably be attributed to the fact that more people worked from home using the Wi-Fi-network during the COVID-19 pandemic.

The lack of allocation of 5G spectrum by the Belgian authorities, has meant that Proximus, Telenet and Orange have only been able to use provisional licences and existing 3G/4G licenses. This has resulted in a slow rollout of 5G, limited to some Belgian cities.

The main regulatory development was the lack of movement on the issuing of 5G licences. The Royal Decrees for the 5G spectrum bands were signed on the 28th of November 2021 and the multiband auction was completed in June 2022. This delay has been attributed to the political discussions surrounding the conditions to be created for a potential fourth market entrant. Another issue about 5G deployment in Belgium was concerning the electromagnetic fields (EMF) exposure limits in Belgium. With regards to the 5G part of the connectivity toolbox, Belgium was implementing most of the recommendations in its 5G auctions.

Belgium has started the implementation of the net cost reduction part of the connectivity toolbox but is experiencing some implementation delays due to the complex nature of the different implementing authorities in Belgium. The coordination between these entities remains a challenge.

Belgium has also been undertaking a consultation process to verify whether it is necessary to update its social tariffs for broadband.

Finally, on 20 October 2021, the Belgian National Broadband Plan was officially approved by the Council of Ministers. This plan is part of achieving the European connectivity targets and is built around five main areas: 1) mapping network coverage and the white areas in Belgium; 2) facilitating the rollout of very high capacity fixed networks and 5G by setting up a federal Broadband Competence Office; 3) stimulating investments in the white areas (see above); 4) creating support for fibre and 5G, including by setting up a 5G knowledge and learning platform; 5) setting up the Broadband Unit itself within the federal administration.

On mobile connectivity, 5G developments in Belgium have been limited both in terms of 5G spectrum assignment and available coverage. The main constraints for the rollout of 5G services in Belgium were the lack 5G spectrum licences and the difference in rules on Electromagnetic Fields (EMF). Following the royal decrees of November 2021, the 5G spectrum auctions were completed in June 2022 for the 700MHz and 3600MHz bands¹⁵. A re-evaluation of the 26GHz band is only expected after the summer of 2022 due to a lack of demand. Following the auctions and the start of the usage rights for existin operators (30% coverage in 3 years for a new market entrant), coverage for 99.5% of the population is expected in 2 years. Belgium is also offering incentives for the deployment of 5G in rural areas through favourable regulation, 5G demo projects, and subsidies for white zones. On EMF, Belgium is expected to have resolutions about the different EMF limits in the different regions by the middle of of 2022. The approval of such limits, coupled with the assignment of the 5G pioneer bands, should result in an increased uptake of 5G services in the country. Belgium continued to increase the take up of mobile broadband and it is at 90% (an increase of 6 percentage points over last year and 3 percentage points higher than the EU average). For the phase-out of 3G services, there are currently no regulatory interventions envisaged, as market forces and operators are expected to determine the evolution of

¹⁵ On 21 June 2022, Belgium's multi-band auction was held which raised a total of EUR 1.2 billion. There are two new entrants, which will increase the number of operators to five. This development occurred after the cut-off date for this report and therefore such developments are not taken into account in the connectivity score.

these services. Additionally, the expected rollout of 5G coverage will most likely result in a consequential phase-out of 3G networks.

With regard to multi-country projects, Belgium is currently discussing a cross-border project on railways under the CEF2 digital infrastructure funding with Luxembourg and the Netherlands.

Overall, Belgium has made progress towards the 2030 Digital Decade targets, albeit more slowly than previous years. On VHCN, coverage is increasing only slowly, and the country is still lagging in terms of fibre deployment. On mobile networks, the delay in the 5G spectrum auctions has resulted in a 'lost year' in terms of progress on mobile broadband. FTTP rollout is expected to progress although this area also needs more urgency. Belgium is experiencing significant consolidation in the telecoms market and the changing dynamics and new market entrants may result in increased dynamism and help Belgium achieving progress on connectivity.

3 Integration of digital technology

3 Integration of digital technology	Belgium		EU
	rank	score	score
DESI 2022	6	48.0	36.1

	Belgium		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
3a1 SMEs with at least a basic level of digital intensity	NA	NA	65%	55%
% SMEs			2021	2021
3b1 Electronic information sharing	53%	53%	57%	38%
% enterprises	2019	2019	2021	2021
3b2 Social media	34%	34%	45%	29%
% enterprises	2019	2019	2021	2021
3b3 Big data	20%	23%	23%	14%
% enterprises	2018	2020	2020	2020
3b4 Cloud	NA	NA	47%	34%
% enterprises			2021	2021
3b5 AI	NA	NA	10%	8%
% enterprises			2021	2021
3b6 ICT for environmental sustainability	NA	56%	56%	66%
% enterprises having medium/high intensity of green action through ICT		2021	2021	2021
3b7 e-Invoices	21%	25%	25%	32%
% enterprises	2018	2020	2020	2020
3c1 SMEs selling online	29%	24%	30%	18%
% SMEs	2019	2020	2021	2021
3c2 e-Commerce turnover	14%	NA	15%	12%
% SME turnover	2019	2020	2021	2021
3c3 Selling online cross-border	15%	15%	15%	9%
% SMEs	2019	2019	2021	2021

Belgium ranks 6th among EU countries on the integration of digital technology. The use of advanced digital technologies remains one of the country's strengths. Belgian companies, including SMEs, are taking advantage of e-commerce opportunities: 30% of SMEs sell online (well above the EU average of 18%), 15% of them are selling cross-border, and 15% of their turnover comes from the online segment. 45% of Belgian enterprises use social media, up from 34% in 2019, while 57% use electronic information sharing. 47% of them use cloud services and 23% use big data analysis (versus respectively 34% and 14% on average in the EU.) Despite this overall solid performance, Belgian companies still need to catch-up on the use of e-invoices and on the use of ICT for environmental sustainability.

At various levels of government, Belgium has put different measures in place in 2021 to support companies' digital transformation. Wallonia launched an action plan for the digital transformation of the media sector with EUR 30 million over 3 years. The Brussels-capital region opened 3 calls for projects on '[Digital and Economic Transition](#)' (EUR 400 000), '[Tourism recovery - investment in digital solutions](#)' (EUR

500 000) and '[Social economy in support of the inclusive digital transition](#)' (EUR 600 000). It also launched a new [innovation plan](#) for 2021-2027 with digital policy as its transversal pillar.

Various measures have also been taken to support companies' adoption of advanced technologies by enterprises, such as AI, big data or cybersecurity.

On AI, the federal ministry of economy led a [communication campaign](#) in 2021 to raise awareness among SMEs about the accessibility and benefits of AI. A 'Belgian AI Week' was also organized in March 2022, during which a [cartography](#) of the Belgian AI start-ups and scale-ups ecosystem was published by AI4Belgium. This enabled further cooperation amongst those stakeholders and gave them the opportunity to advertise themselves and their products to companies that would like to integrate AI-solutions into their own activities. Flanders continued to roll out its 2019 AI action plan, including its dedicated R&I programme (EUR 32 million per year), over three tracks: research, industry, and society. Wallonia has invested nearly EUR 2 million in the DigitalWallonia4.AI programme since its launch in July 2019 and aims to multiply these resources tenfold by 2024 to get to a EUR 21 million budget as part of the Wallonia Recovery Plan. In February 2021, Wallonia also launched '[Cap IA](#)', a call for projects focusing on Walloon companies that wish to facilitate the marketing of their AI projects which is expected to be renewed for 2022. It accompanies them in their internal development and their entry on the market on a technical level as well as the business level by providing them with aid and personalised support.

On big data, the Brussels Regional Government decided in March 2021 upon a new data strategy with green IT aspects, a data exchange platform, and the standardisation of data.

On cybersecurity, the Belgian National Security Council approved a [Cybersecurity Strategy 2.0](#) for 2021-2025 on 20 May 2021. At federal level, the ministry of economy also put a new cybersecurity self-assessment tool online in March 2022, dedicated to SMEs and self-employed workers, called '[Cyberscan](#)'. In Wallonia, the [CyberExcellence](#) project was launched in November 2021 and a new strategy on cyber is expected in 2022. In Brussels, Software.brussels has organised different [events](#) in 2021 on the cybersecurity topic to raise awareness and find solutions.

Several specific actions continue to support the digital transition of SMEs and start-ups. In Flanders, the SME-growth subsidy has a track supporting the digital transformation of SMEs (EUR 2.5 million) since 2021. VLAIO, the Flemish Innovation and Entrepreneurship Agency, has launched a new support programme for innovative start-ups, whereby a significant share of the funding was granted to tech-driven start-ups. In Brussels, Hub.brussels will also provide digital transformation advice as part of its services to SMEs and start-ups. Wallonia has continued its '[Industrie du Futur](#)' programme to accelerate the digital transformation of manufacturing SMEs and the Wallonia Innovation and Growth ([WING](#)) fund which invests in innovative digital start-ups and, since 2019, in 'deep tech' start-ups with high potential. The selection of Digital Innovation Hubs that will participate in the network of European Digital Innovation Hubs (EDIHs) is ongoing.¹⁶ These hubs will provide access to technical expertise and experimentation for enterprises.

Belgium also has several mechanisms to boost digital investments in R&D&I and advanced technologies. In Flanders, at least EUR 130 million of funding was given to support R&D projects with a significant

¹⁶ Six Belgian European Digital Innovation Hub proposals have a successful evaluation result, i.e. are invited for grant agreement preparation (which is not a formal commitment for funding). Another five proposals have received a Seal of Excellence.

digital component in 2021. Wallonia has adopted a [Smart Specialisation Strategy](#) (S3) for 2021 – 2027 with 5 parts covering R&D and industrial policy. Digital policy features in all parts, but it is particularly pronounced in the ‘Innovations for agile and safe design and production methods’ aspect of the S3. In October 2021, the Research Public Service of Wallonia [reorganised research grants](#) in order to better align these grants with the new S3 strategy. In the field of semi-conductors, Flanders has reached a new agreement with IMEC – a leading international research centre for micro-electronics, nanotechnology, artificial intelligence, design methods and technologies for ICT-systems – that will increase IMEC’s public yearly dotation by EUR 20 million to a total of EUR 127 million. IMEC will also be an important member of the [EU Alliance on Processors and Semiconductor technologies](#) launched by the European Commission in July 2021.

On High-Performance Computing, besides its participation in EuroHPC, Wallonia has announced the [reinforcement](#) of its HPC super computers network in November 2021 and the [setup](#) of a new Tier-1 supercomputer in Charleroi with a EUR 10 million budget.

Despite Belgium’s good performances in this area, there is still room for improvement in terms of integration of advanced digital technologies by enterprises, especially by smaller companies. This is important for Belgium to be able to reach the Digital Decade target of 75% of companies using cloud, AI and big data by 2030.

4 Digital public services

4 Digital public services ¹⁷	Belgium		EU
	rank	score	score
DESI 2022	16	64.8	67.3

	Belgium		EU
	DESI 2020	DESI 2021	DESI 2022
4a1 e-Government users	64%	66%	74%
% internet users	2019	2020	2021
4a2 Pre-filled forms	NA	NA	73
Score (0 to 100)			2021
4a3 Digital public services for citizens	NA	NA	72
Score (0 to 100)			2021
4a4 Digital public services for businesses	NA	NA	81
Score (0 to 100)			2021
4a5 Open data	NA	NA	55%
% maximum score			2021

Belgium's digital public services performances are mixed, reflecting its 16th place in the EU. Belgium's strengths are the share of e-government users (74% against the EU average of 65%) and the use of pre-filled forms (with a score of 73 compared to the EU average of 64). However, Belgium performs slightly below the EU average on the indicator for digital public services for citizens (with a score of 72, against an EU average of 75) and digital public services for businesses (81 versus an EU average of 82). Its performance is also weak when it comes to open data (55% vs the 81% for the EU).

The Belgian government has been able to increase the availability of its online public services. By 2023, the federal government intends to put in place a 'Digital Wallet'. This digital wallet will act as a one-stop-shop for government services, including regional and local ones, allowing every Belgian to request and access all official documents while also enabling the use mobile signatures. The '[Flanders Radically Digital 2](#)' programme has been launched for 2021-2023 and around a quarter of projects in Flanders' [regional recovery plan](#) focus on the digital transformation of the regional and local governments. In Wallonia, a new 'Contract of Administration' was signed in 2021 by the Public Service of Wallonia with 5 objectives, including the digitalisation of services, the reinforced use of data, and the greater use of digital services for internal processes. Wallonia has also put in place a [digital platform](#) to help citizens and municipalities cope with the severe floods of July 2021. In the Brussels-Capital region an administrative simplification plan for 2021-2025, '[Easy Way](#)', was presented in January 2021. The 'Brussels digital Act' will implement the digital by default principle while the once-only principle is expected to be adopted by the end of 2022.

¹⁷ There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

The Secretary of State for Digitalization has also announced the 'Connectoo' project consisting of a training course and a certificate for people offering 'digital emergency assistance' to citizens experiencing difficulties when trying to access digital public services. The [Digital Open-network](#), part of the Directorate-General for Digital Transformation, has been established at the federal level to improve inclusivity and user centricity. Digital Open provides resources and tools to put citizens at the centre of digitalisation projects and helps civil servants improve public services and make them more inclusive, open, reliable, and transparent. In the area of health, where measures are being taken at federal level to enable people to access their medical files, Flanders is also putting in place a health literacy strategy. The focus of this strategy is to level up the digital health literacy skills of the population so that people can access to their medical records while also knowing how to use and benefit from this access.

Belgian regions have put in place initiatives to include the use of new digital technologies in their administration and public services. Flanders takes part in Horizon 2020 projects [DUET](#) (on digital twins) and [URBANAGE](#) (on the use of digital twins, big data and AI for urban planning). In the Flemish administration, the Sandbox Flanders prototyping platform provides an environment where civil servants can experiment safely with new digital products and technologies. Wallonia has also identified the digital twin concept as one of the technologies to be used to reach its 2030 targets in research and innovation policy. The Walloon Digital Agency launched a [dedicated call](#) for projects to the public sector through its existing [Start IA](#) support programme in April 2021. 10 laureate projects, involving 21 Walloon public entities, were selected to benefit from an AI maturity diagnosis carried out by AI expert companies, SMEs, and start-ups. In the Brussels-Capital region, a strategic study was conducted by an external consultancy for the Brussels Informatics Centre (BRIC) on the GovTech topic and opportunities were identified that will be part of a 'govtech.brussels' action plan. The aim is to have this plan in place by the end of 2022. The plan will cultivate a culture of innovation within administrations and promote innovative procurement methods for digital solutions.

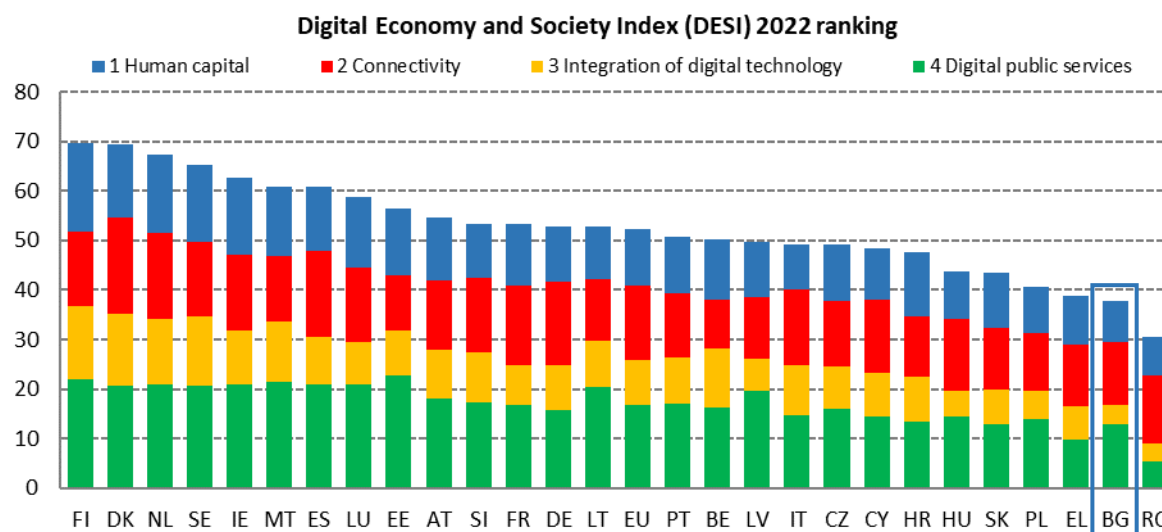
Belgium offers six alternative eID¹⁸ schemes to facilitate people's interactions with public organisations. Five of these schemes offer the possibility to interact with public organisations via a smart device. In total, eight million people (or almost 70% of the population) use at least one of these six schemes, while two of the schemes are also notified to the European Commission under the eIDAS Regulation. One scheme (itsme) that is widely used and notified under the eIDAS Regulation is issued by a private entity in collaboration with the government.

The federal nature of Belgium, with various levels of government (federal, regional, community and local) in charge of different areas of public administration, is a challenge for the coordination and integration of online public services in 'one stop shop' services. People in Belgium have taken up the use of digital administration but more intense coordination between different levels of government is required to improve the online offer. Further progress in open data policies could be helpful to tackle this challenge.

¹⁸ eID schemes in Belgium: FAS / eCards, FAS / Itsme®, FAS / Email OTP, FAS / SMS OTP, FAS / TOTP, FAS / Username / Password.

Bulgaria

	Bulgaria		EU
	rank	score	score
DESI 2022	26	37.7	52.3



Bulgaria ranks 26th of the 27 EU Member States in the European Commission Digital Economy and Society Index (DESI) in 2022. Bulgaria's DESI score grew at an annual average of 9% over the past five years¹⁹. Given the positioning of Bulgaria, this growth rate is not sufficient for the country to catch up with the other EU Member States.

On digital skills, despite recent increased efforts, the country remains significantly below the EU average, having a score of 32.6 versus the EU average of 45.7. The proportion of individuals with at least basic skills and above basic digital skills is well lower than the EU average, the latter significantly so (8% versus the EU average of 26%). Considering the EU's ambitious target of 80% of adults having at least basic digital skills by 2030, the country needs to step up efforts, as more than two thirds of its population lack such skills. Bulgaria also underperforms on the proportion of ICT specialists in the workforce (3.5% versus 4.5% EU average). However, the proportion of female ICT specialists is high.

On Connectivity, Bulgaria score very well on Fibre to the premises coverage (85% of households vs 50% in the EU), it has low prices, but both fixed and mobile broadband take-up is low. In addition, only 25% of 5G spectrum has been assigned (EU average: 56%).

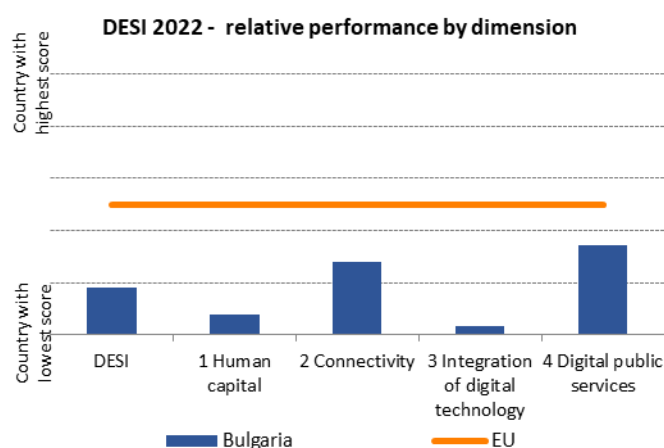
On the business side, the adoption of digital technologies by SMEs remains almost half the EU average. Only 6% of Bulgarian enterprises use big data, 10% cloud and 3% artificial intelligence (AI), as opposed to the EU 2030 targets of 75% for each technology. To support business digitalisation, Bulgaria is making

¹⁹ Refer to section 1.3 of the DESI 2022 horizontal chapter.

use of European Digital Innovation Hubs. Four European Digital Innovation Hubs proposed by the country received a successful evaluation result²⁰ and another eight proposals got a Seal of Excellence.

Bulgaria is facing many challenges regarding the digitalisation of its public services, as it underperforms in most indicators, with the exception of open data, which is on par with the EU average. Only 34% of internet users interact with the government online (65% in the EU). The supply of digital public services for citizens (with a score of 59 versus an EU average of 75) needs to improve significantly to enable Bulgaria to contribute to the 2030 Digital Decade target of all key public services offered fully online. To achieve this goal, Bulgaria has launched the National Registry reform and defined the path to enhance digital transformation.

To overcome the shortcomings in Bulgaria's digital transformation and to put it on a par with the other EU Member States, there needs to be a continued, sustained effort at political and administrative level that builds on the country's strengths to deliver on the reforms and investments in all four dimensions. The recent political instability may have significantly affected attempts in this area.



Concerning Bulgaria's digital-related response to Russia's invasion of Ukraine, major mobile operators offered free international calls from Bulgaria to Ukraine from the first week of the conflict to help the affected people and their relatives. The measures were also extended to offer free roaming, including short messages (SMS) and mobile internet, to mobile service subscribers located in Ukraine. To further ease those in need, prepaid cards and data cards were provided to people fleeing Ukraine who went in Bulgaria. In parallel, Bulgaria's cybersecurity experts working at the Ministry of e-Government and the cybercrime department in the Ministry of Interior took precautionary measures to filter out or completely block traffic potentially leading to attacks to electronic systems or networks originating from over 45 000 internet addresses. In addition, to strengthen the fight against disinformation campaigns during the Russia's invasion of Ukraine, Bulgaria's competent authorities blocked the distribution of the Russia Today channels.

²⁰ Four proposals are invited for grant agreement preparation (which is not a formal commitment for funding).

Digital in Bulgaria's Recovery and Resilience Plan (RRP)

The total budget of the Bulgarian Recovery and Resilience Plan is nearly EUR 6.9 billion, of which EUR 6.3 billion will be financed in the form of non-repayable grants by the Recovery and Resilience Facility. The plan is overall composed of twelve components, in four policy pillars: 1) Innovative Bulgaria, 2) Green Bulgaria, 3) Connected Bulgaria, and 4) Fair Bulgaria.

For the digital transition, the allocated budget is, in total, EUR 1.6 billion²¹ (25.8%²² of the plan's total allocation). Relevant measures, i.e. reforms and investments, are included in multiple components, with a particular focus in digital connectivity (under pillar 3) and the digitalisation of the public sector (pillar 4).

In particular, the Innovative Bulgaria pillar (total investments for digital of approx. EUR 330 million) includes measures for modernising the digital facilities and content of the education system, the digital upskilling of the workforce, enhancing digital connectivity and the innovation capacity of the Bulgarian Academy of Sciences, and fostering the digital transition of small and medium-size companies.

The Green Bulgaria pillar (total investments for digital of approx. EUR 405 million) includes investments in the digital transformation of the electricity transmission grid, that include the extension and upgrade of the telecommunication network together with a comprehensive cybersecurity system. In addition, it includes measures to facilitate the automated data exchange between the administration and farmers with a view to ensuring a more efficient and uniform flow of data, as well as in digital transformation of the agricultural sector.

The Connected Bulgaria pillar (total investments for digital of approx. EUR 632 million) includes measures focusing on building a modern and secure digital infrastructure and maximising the access to online services for citizens, enterprises, public administrations and institutions, especially in rural and remote areas. The investments concern the large-scale deployment of digital infrastructure, development and optimisation of the digital TETRA system and radio relay network, and support the development of the State backbone network by increasing its transmission capacity. The measures also aim at ensuring connectivity to all municipal centres and support the deployment of Very High Capacity Networks in sparsely populated, remote and rural areas. In addition, there are investments in digitalisation of railways and the Bulgarian Post, and digitalisation of integrated management, control and efficient use of water.

Finally, the Fair Bulgaria pillar (total investments for digital of approx. EUR 248 million) includes measures for the digital transformation of the construction sector, and the establishment,

²¹ Each recovery and resilience plan has to dedicate at least 20% of the plan's total allocation to digital objectives. To this end, the plans had to specify and justify to what extent each measure contributes fully (100%), partly (40%) or has no impact (0%) on digital objectives, using Annex VII of the RRF Regulation. Combining the coefficients with the cost estimates of each measure allows assessing to what degree the plan contributes to digital objectives and whether it meets the 20% target.

²² Source: table 8 of [SWD\(2022\) 106 final](#).

maintenance and digitalisation of registration data in public administration. There are also investments dedicated to building up the Unified Information System of Courts, the Single Case Management Information System and the information and communication infrastructure at the Public Prosecutor's Office. Moreover, digitising content of museums, libraries and archives to improve accessibility and foster preservation is part of the RRP. Lastly, measures focus on the development of e-health and of the National Health Information System.

1 Human capital

1 Human capital	Bulgaria		EU
	rank	score	score
DESI 2022	26	32.6	45.7

	Bulgaria		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
1a1 At least basic digital skills	NA	NA	31%	54%
% individuals			2021	2021
1a2 Above basic digital skills	NA	NA	8%	26%
% individuals			2021	2021
1a3 At least basic digital content creation skills²³	NA	NA	44%	66%
% individuals			2021	2021
1b1 ICT specialists	3.1%	3.3%	3.5%	4.5%
% individuals in employment aged 15-74	2019	2020	2021	2021
1b2 Female ICT specialists	28%	28%	28%	19%
% ICT specialists	2019	2020	2021	2021
1b3 Enterprises providing ICT training	10%	7%	7%	20%
% enterprises	2019	2020	2020	2020
1b4 ICT graduates	3.8%	4.0%	4.6%	3.9%
% graduates	2018	2019	2020	2020

In the Human capital dimension, Bulgaria ranks 26th out of the 27 EU countries. Only 8% of individuals have above basic digital skills (versus the 26% EU average), and only 31% have at least basic digital skills (versus the 54% EU average). 7% of enterprises provided ICT training to their staff in 2020, significantly below the EU average of 20%. However, Bulgaria scores well on female ICT specialists (representing 28% of all ICT specialists versus an EU average of 19%), while the proportion of ICT graduates is also high.

Bulgaria's digital skills strategy is embedded in the country's [Digital Transformation by 2030](#) plan. The principal measures of the plan target the education and training system at all levels to improve the digital skills of the workforce. Bulgaria allocated EUR 2 million from the 2021 national budget to launch projects for training academic staff, teachers and practitioners. Bulgaria also invested EUR 2.9 million to set up 21 personal development centres for the digital literacy of students and young people. These youth centres will provide free of charge formal and non-formal training in digital skills, including cybersecurity and best practices for browsing the internet safely.

To support learning activities during the pandemic and to increase children's and students' access to education, over 85 000 devices, such as laptops and tablets were procured partially under the government budget and the national ICT plan. The Ministry of Education and Science has projects

²³ Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

focusing on complementary and alternative approaches to work and study for children with disabilities and special educational needs.

Bulgaria's vocational education and training (VET) scheme explicitly targets students who drop out of formal education including vulnerable groups such as the Roma population. All VET curricula include classes in information technologies, independently of the nature of the studies. Furthermore, in 2021, Bulgaria approved a national programme to integrate IT classes into curricula that are not related to computer science. IT training starts from the third and fourth grade with 1 hour per week, where pupils can develop their computational thinking. As of the 2021 – 2022 academic year, sixth and seventh grade students can learn high-level programming languages such as Python. IT classes are compulsory at high-school level.

The national Human Resources Development Operational Programme aims to increase the workforce's level of digital skills in various sectors through digital skills courses funded by the European Social Fund+ and the Recover and Resilience Facility during the 2021 – 2027 programming period. The overall budget of around EUR 400 million intends to cover the skills deficit of 168 000 people, mainly from vulnerable groups such as the unemployed or elderly people. Since 2019, the Ministry of Education has allocated EUR 1.6 million from the national budget to reform and modernise kindergartens and schools with inclusive educational technologies, such as hearing aids, braille machines and other specialised software for children and students. An adult education platform providing basic digital skills training for 500 000 individuals is up for approval in 2022. Bulgarian SMEs are set to benefit from the reskilling and upskilling of the workforce, which is expected to raise digital competency levels. The latter is a measure included in the National Strategy for SMEs 2021-2027.

Classes for AI programmers and robot programmers are offered under the Learning for IT skills national career programme, alongside professional training provided by non governmental organisations (NGOs). More specifically, NGOs, financially supported under the EFSI Skills & Education Guarantee Pilot in Bulgaria, have launched an IT training programme to help students and professionals pursue a career in software engineering. This initiative is supported by private companies to ensure that these programmes fulfill the requirements of the industry and the market. Currently, Bulgaria has 35 000 employed software engineers and 2 000 ICT specialists graduating annually. In 2021, the National Coalition organised a [hackathon for Girls in AI](#) and completed a project on media literacy and fake news funded by Erasmus+.

There were 460 events that took place in Bulgaria for EU Code Week in 2021, which corresponds to 66.4 activities per 1 million inhabitants. In total, 17 707 people participated, 44% of which were female. Most of the activities (71%) took place in schools.

The percentage of Bulgarians with basic digital skills remains particularly low. This requires extensive and targeted action, also in view of the ambitious Digital Decade 2030 targets. Bulgaria's shortage of ICT specialists in employment is a further obstacle to enterprises having a highly skilled workforce. The country is taking concrete steps to improve the digital skills of its workforce and students, but swift implementation is essential to help Bulgaria tackle its shortcomings in this area.

The Bulgarian Recovery and Resilience Plan includes measures that are entirely or partially linked to digital skills. They have a total digital budget of about EUR 299 million. The measures mainly address challenges linked to education and digital skills training for adults and include:

- The setting up of a national online platform for adult learning, free of charge, which aims to up- and re-skill the workforce and support the acquisition of digital skills (EUR 164 million).
- The promotion of science, technology, engineering and mathematics (STEM) and the setting up of STEM centres and laboratories in schools (EUR 122 million dedicated to digitalisation), to promote interest and skills in subjects related to natural and engineering sciences, artificial intelligence, robotics, and natural sciences.
- Additional investments in youth centres (EUR 32 million) enhance the employability and social inclusion of young people, including from vulnerable groups. These centres will provide a number of activities, also promoting digital equality through access to education and training.

2 Connectivity

2 Connectivity	Bulgaria		EU
	rank	score	score
DESI 2022	19	50.7	59.9

	Bulgaria		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
2a1 Overall fixed broadband take-up	58%	59%	63%	78%
% households	2019	2020	2021	2021
2a2 At least 100 Mbps fixed broadband take-up	11%	15%	22%	41%
% households	2019	2020	2021	2021
2a3 At least 1 Gbps take-up	0.26%	0.27%	0.42%	7.58%
% households	2019	2020	2021	2021
2b1 Fast broadband (NGA) coverage	84%	88%	93%	90%
% households	2019	2020	2021	2021
2b2 Fixed Very High Capacity Network (VHCN) coverage	65%	75%	85%	70%
% households	2019	2020	2021	2021
2b3 Fibre to the Premises (FTTP) coverage	65%	75%	85%	50%
% households	2019	2020	2021	2021
2c1 5G spectrum	0%	25%	25%	56%
Assigned spectrum as a % of total harmonised 5G spectrum	04/2020	09/2021	04/2022	04/2022
2c2 5G coverage²⁴	NA	0%	40%	66%
% populated areas		2020	2021	2021
2c3 Mobile broadband take-up	60%	60%	73%	87%
% individuals	2018	2018	2021	2021
2d1 Broadband price index	72	78	86	73
Score (0-100)	2019	2020	2021	2021

In 2021, Bulgaria surpassed the EU average in both Fast broadband (NGA) coverage (93% versus 90% in the EU) and Fixed Very High Capacity Network (VHCN) coverage (85% versus 70% in the EU). VHCN is provided by Fibre to the Premise (FTTP) technology. FTTP, increased from 75% in 2020 to 85% in 2021 (from 49% to 61% in rural areas). However, Bulgaria still ranks very low in overall fixed broadband take-up (63% of households, EU 78%) and is also lagging behind in the take-up of fixed broadband of at least 100 Mbps (22%, EU 41%). In addition, take-up of 1Gbps broadband is still at an extremely low level (0.42%). The mobile broadband indicators are also below the EU average: 25% of 5G spectrum has been assigned (EU: 56%), while 5G coverage is 40% of populated areas (EU: 66%). 73% of people use mobile

²⁴ The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

broadband (EU: 87%). Low fixed and mobile take-up does not seem to be correlated with high prices, as Bulgaria performs well (ranking 5th) in the Broadband Price index.

Adopted in August 2020, the latest version of Bulgaria's Broadband plan ([Connected Bulgaria](#)) is aligned with the EU's 2025 gigabit society targets, but not yet with the Digital Decade targets (gigabit for everyone and 5G for all populated areas by 2030). Connectivity is identified as a key enabler for competitive enterprises, social inclusion as well as for developing and offering digital public services. The main pillars of the plan, which aims to bring Bulgaria closer to the average DESI connectivity score, are: broadband infrastructure, VHCN deployment, making more efficient use of the spectrum, improving coverage in rural areas, bridging the digital divide and enhancing network security. The plan also identifies 5G as a central technology to provide high-speed connectivity through-out the entire country, particularly in cities.

In terms of volume, mobile broadband traffic²⁵ (49.8%) has grown faster than fixed broadband traffic (36.5%), which indicates that usage patterns are continuing to change as a results of the COVID-19 pandemic. While this could be an opportunity to shift focus towards 5G, Bulgaria is still making slow progresses in both 5G coverage and mobile broadband take-up.

The successful deployment of 5G, and whether, as a consequence, connectivity targets can be met, depend in particular on the availability and assignment of the 5G pioneer bands, which has been significantly delayed. Overall, Bulgaria has only allowed the use of 25% of total harmonised 5G (pioneer) spectrum, against the EU average of 56%.

On 6 April 2021, Bulgaria [completed](#) the auction of the 3.6 GHz band (3.5-3.8 GHz awarded). Although there is commercial interest in all pioneer bands, 5G coverage is at 40%. The three main operators report coverage mainly in cities and resorts as follows: A1 covers 75 cities and resorts, BTC covers over 200 populated places and resorts and Telenor covers 63 cities and resorts.

Operators have expressed an interest in deciding on investments subject to the full release of the 700 MHz band, which is still delayed. Following national consultations, there are plans to release the entire band (2 x 30 MHz), with the exception of 2 x 0.5 MHz, which will be reserved for non-civil use until 2031. The national regulatory authority (CRC) intends to launch a public consultation on the use of spectrum in the 700 MHz band in 2022, with the aim of assigning the band (or portion thereof) in 2023.

In 2021, three undertakings (A1, Telenor and BTC) obtained spectrum in the 2.6 GHz band (2x20 MHz each) with an obligation to cover at least 50% of the population. In the 3.6 GHz band, the same providers were each awarded the rights to use 100 MHz in 2021, with an obligation to cover at least 95% for major cities, such as Sofia, Plovdiv, Varna, Burgas, Ruse and Stara Zagora at an average download speed of 100 Mbps during the first two years, and 90% of populated areas for cities with 30 000 to 90 000 people, with an average download speed of 50 Mbps, and 70% of the entire population with an average download speed of 30 Mbps up to 5 years from the date the authorisation enters into force. The operators are free to use their existing rights in other bands (900 MHz, 1800 MHz, 2 GHz and 2.6 GHz) to reach these objectives.

²⁵ Source: Bulgarian Communications Regulations Commission

As with the 700 MHz band, the 26 GHz band is also partly used for military purposes. The CRC plans to put in place a public consultation for the use of resources and to explore market demand in the 26 GHz band during this year.

Compared to the EU weighted average for 5G pioneer bands, until the beginning of April 2022, Bulgaria has authorised the use of 0% (EU 64%) of the 700 MHz band, 75% (EU 75%) of the 3.4-3.8 GHz band, and 0% (EU 29%) of the 26 GHz band.

Bulgaria plans to use financing under the Recovery and Resilience Facility for a major connectivity project. The current investment gap is estimated at EUR 600 million (up from an estimated EUR 500 million last year), part of which will be covered by the RRF plan, focusing on developing the state-owned connectivity network and deployment of VHCN in rural and sparsely populated areas. In 2021, the European Investment Bank (EIB) and EnduroSat, a fast-growing Bulgarian company providing solutions for the global Space market, announced a venture debt financing agreement of up to EUR 10 million in the area of space data.

Bulgaria has expressed an interest in playing an active role in the CEF-financed 5G corridors flagship project, building on the agreement between Bulgaria, Greece and Serbia for connectivity along the Thessaloniki, Sofia and Belgrade corridor.

In the area of public wi-fi networks, Bulgaria is among the frontrunners in WiFi4EU, with 97% (257 of 265) of the country's municipalities having taken part in the four calls for applications held between 2018 and 2020. The 242 successful municipalities were awarded EUR 3.63 million.

Main market & regulatory developments

No significant developments (entries, consolidations) took place in 2021 in the fixed telephony, fixed internet and mobile markets and market shares remain near identical to those of 2020. In fixed telephony, BTC (the incumbent) has the largest market share (58.9%), followed by A1 (25.3%) and Telenor (13.5%). In fixed internet (offered by 659 companies, figures as of July 2021) BTC had a market share of 27.2% and A1 26.5%. 47.4% of companies have a market share of above 1%. In the mobile market, the market shares were (as of July 2021) A1 at 38%, Telenor at 31.1% and BTC at 30.8%.

No zero-rated services were offered to Bulgarian consumers (private or business) in 2021.

The number of bundled services and their composition have remained stable in recent years. Three new enterprises started offering these services in 2021, bringing the total to 90 (compared to 87 the year before). Consumers continue to show a preference for fixed broadband and TV bundles, which make up 55.9% of bundle subscriptions, followed by voice and mobile bundles at 36.3%.

Bulgaria notified full transposition of the European Electronic Communications Code (EECC) on 29 March 2021. The Commission therefore closed the related infringement case in April 2022.

Bulgaria has, in the context of the Connectivity Toolbox, implemented a number of measures, including (i) streamlining the process for granting permits, (ii) increasing the use of the Single Information Point (SIP), (iii) extending the right of access to existing physical infrastructure, (iv) facilitating the CRC dispute resolution mechanism, (v) monitoring the correct implementation

of EMF and public health (in the competence of the Ministry of Health), (vi) improved incentives for investment (reduced fees for spectrum) and (viii) carrying out closer coordination of the spectrum used for cross-border industry use. Best practices in the Connectivity Toolbox that have not been explicitly addressed are already covered in Bulgaria and their best practices form part of the Bulgarian submission to the Toolbox.

During the first 11 months of 2021, 1 805 end user complaints were received by the Bulgarian NRA, a small increase (6%) compared to the same period in 2020 (1 708 complaints). As in previous years, most complaints regard charges for services, access to and payment of digital content, termination of contract and border roaming issues.

Bulgaria has clearly stated its ambition to converge toward the EU average in the DESI connectivity dimension and reach the 2030 Digital Decade targets. Although many legal instruments have been put in place, in particular the transposition of the EECC, not enough concrete measures have been taken, notably to accelerate 1 Gbps and 5G take-up, building on the country's comparatively good fixed VHCN coverage and competitive broadband prices. The insufficient assignment of 5G spectrum and the long delays in successfully awarding use of spectrum in the 5G pioneer bands has an impact on both the availability and use of high speed connectivity in the entire country, and especially in rural areas. Although there is commercial interest in investing in both 5G and last-mile connectivity in rural and sparsely populated areas, not all the necessary measures have been put in place to make this happen. The speedy implementation of the Recovery and Resilience Plan will play a key role.

Connectivity in Bulgaria's Recovery and Resilience Plan

The Bulgarian Recovery and Resilience Plan includes significant measures linked to digital connectivity. They have a total budget of about EUR 272 million. The measures mainly address challenges linked to efficient use of the spectrum and an effective policy and regulatory framework. Some of these measures are:

- An investment (EUR 269 million) for the upgrade and the extension of coverage of the state backbone network to all municipal centres to offer coverage with very high capacity networks (VHCNs) in areas where relevant infrastructure is not going to develop soon, due to no or little market interest ("white areas").
- The provision of access points for ultra-fast connection to Bulgaria Academy of Science (BAS), the National Supercomputing Centre and the universities and scientific institutes to join European research networks such as GEANT.
- The reduction of the administrative burden and the streamlining of procedures and fees associated with the deployment of 5G networks.

3 Integration of digital technology

3 Integration of digital technology	Bulgaria		EU
	rank	score	score
DESI 2022	26	15.5	36.1

	Bulgaria		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
3a1 SMEs with at least a basic level of digital intensity % SMEs	NA	NA	25% 2021	55% 2021
3b1 Electronic information sharing % enterprises	23% 2019	23% 2019	22% 2021	38% 2021
3b2 Social media % enterprises	10% 2019	10% 2019	13% 2021	29% 2021
3b3 Big data % enterprises	7% 2018	6% 2020	6% 2020	14% 2020
3b4 Cloud % enterprises	NA	NA	10% 2021	34% 2021
3b5 AI % enterprises	NA	NA	3% 2021	8% 2021
3b6 ICT for environmental sustainability % enterprises having medium/high intensity of green action through ICT	NA	68% 2021	68% 2021	66% 2021
3b7 e-Invoices % enterprises	13% 2018	10% 2020	10% 2020	32% 2020
3c1 SMEs selling online % SMEs	7% 2019	8% 2020	10% 2021	18% 2021
3c2 e-Commerce turnover % SME turnover	2% 2019	3% 2020	4% 2021	12% 2021
3c3 Selling online cross-border % SMEs	3% 2019	3% 2019	4% 2021	9% 2021

The Integration of digital technology in business activities remains a weakness for Bulgaria as it ranks 26th among EU countries. The adoption of cloud services (10%), AI (3%) and big data (6%) by enterprises are all among the lowest in the EU. Only 25% of SMEs have a basic digital intensity. They are lagging behind also in online selling as only 10% of SMEs sell online, around half the EU average.

To improve the situation, a voucher-based funding programme started in 2021 to promote and increase the ICT capacity of micro, small and medium-sized enterprises and to encourage them to become more sustainable and competitive. 516 enterprises have benefited from the voucher scheme. This improved their ICT systems, applications, and optimised their business management processes. The scheme also facilitates the digitalisation of SMEs and further encourages the development of knowledge transfers between participating enterprises.

Bulgaria is also taking measures to support the cooperation between R&D institutes and SMEs. For example, Bulgaria allocates funding through the '[Innovation and competitiveness](#)' operational

programme to promote entrepreneurship and help set up and develop new sustainable businesses and high-tech companies. The national fund incorporates BGN 318 million (EUR 163 million) through four equity instruments, including acceleration, seed, venture capital and mezzanine funding. In 2021, these four instruments facilitated investments of BGN 92 million (EUR 47 million) in 150 companies. In 2021, 16% more SMEs participated in joint R&D projects and technology transfers to either public or private R&D institutions, according to the reporting figures for the implementation of the National Programme '[2025 Digital Bulgaria](#)'. Other strategic measures to increase digitalisation in enterprises include the establishment of training innovation centres for the green and digital transitions, as well as the creation of European Digital Innovation Hubs. These Hubs are one of the most highly visible national measures. Four European Digital Innovation Hub proposals received a successful evaluation result²⁶ and another eight proposals got a Seal of Excellence.

Bulgaria is actively represented in the European Blockchain Partnership and a project under the Connecting Europe Facility (CEF) European Blockchain Services Infrastructure is being developed which will run until March 2023.

In the last quarter of 2021, Bulgaria also presented a draft proposal for the implementation of the '[Cybersecurity Bulgaria 2030](#)' National Security Strategy. In 2021, the National Computer Security Incident Response Team updated its roadmap for amending the national Cybersecurity Regulation in accordance with EU directives in order to secure the funding of the projects included in the strategy. As of 2022, the new Bulgarian government is expected to have finalised the adoption of the Cybersecurity Law and to have set out the cybersecurity measures for administrative authorities and institutions.

In summary, Bulgaria plays a prominent role in high-performance computing in Europe with its petascale supercomputer. Nonetheless, the adoption of digital technologies by enterprises remains low and the adoption of advanced technologies like AI and Cloud is even lower. Building on the country's strengths, policies targeting the deployment of these technologies in SMEs should be put in place and implemented so that Bulgaria can reach the EU average.

Highlight: Petascale supercomputer

Bulgaria, as a founding member of the European High Performance Computing Joint Undertaking (EuroHPC JU), has supported the establishment of a [petascale supercomputer located in Sofia Tech Park](#). The supercomputer costed EUR 11.5 million and was inaugurated in October 2021. It will be subsidised by EU and national funding. The supercomputer, together with other high-performance systems and the Distributed Computing Grid Clusters, is openly accessible to the research community and other private and public users. Bulgaria is also a member of the EuroQCI initiative to upgrade its national cybersecurity infrastructure with quantum-level cryptographic keys. A [project called QUASAR](#) for the establishment of a competence centre in quantum communication and intelligent security is ongoing.

²⁶ Four proposals are invited for grant agreement preparation (which is not a formal commitment for funding).

Integration of digital technology in Bulgaria's Recovery and Resilience Plan

The plan includes a number of measures aimed at supporting businesses to adapt their operations to the digital environment, some of which are:

- Improving the quality of research and innovation through investments in digital technologies at research institutions, and supporting the digitalisation of business through a grant scheme for information and communications technology solutions and cybersecurity in SMEs (EUR 15 million).
- Investments in the deployment of advanced technologies such the creation of a quantum platform (EUR 0.5 million).

Lastly, it also includes an investment for the deployment of advanced technologies such as the Euro Quantum Communication Infrastructure (QCI) network at the Bulgarian Academy of Sciences (EUR 0.5 million).

4 Digital public services

4 Digital public services ²⁷	Bulgaria		EU
	rank	score	score
DESI 2022	25	51.9	67.3

	Bulgaria		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
4a1 e-Government users % internet users	36% 2019	36% 2020	34% 2021	65% 2021
4a2 Pre-filled forms Score (0 to 100)	NA	NA	58 2021	64 2021
4a3 Digital public services for citizens Score (0 to 100)	NA	NA	59 2021	75 2021
4a4 Digital public services for businesses Score (0 to 100)	NA	NA	76 2021	82 2021
4a5 Open data % maximum score	NA	NA	78% 2021	81% 2021

Bulgaria performs low on Digital public services, ranking 25th in the EU. 34% of internet users interacted with the government online. The country scores 58 points out of 100 for the amount of data that is pre-filled in public service online forms, below the EU average of 64 points. Bulgaria also ranks below the EU average in terms of digital public services available to citizens (with a score of 59) and businesses (with a score of 76). The use of open data is also somewhat lower than the EU average.

In April 2021, the [National Strategy for e-Government](#) was updated in order to encompass innovative technologies - such as AI, cloud computing, and blockchain - to improve digital public services. Bulgaria plans to embed a user-centric development principle in the strategy. The State e-Government Agency (SEGA) had been implementing the strategy until the end of 2021, while as of 2022, the implementation of the strategy has been handed over to the Ministry of e-Government.

In 2021, SEGA held several events to disseminate information on the available digital services and ICT solutions to the public. Participants could provide feedback, following a user-centric principle. SEGA also certifies compliance with the national Electronic Governance Act and certifies that the information systems used by the administrative authorities are developed and upgraded in compliance with this Act. In addition, SEGA is responsible for the related software copyrights and supports the use of open source solutions. Bulgaria offers a portal for developers and an open-source repository publicly available for e-government applications.

²⁷ There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

Bulgaria has established an eID scheme²⁸ and Bulgarian citizens aged 14 and older can acquire an eID to use for both private and public transactions. The current eID scheme is not notified under the electronic Identification, Authentication and Trust Services (eIDAS) Regulation and it is not mandatorily issued to all citizens. However, Bulgaria has introduced measures to issue an electronic identification scheme in compliance with the eIDAS Regulation. Currently, the procurement procedure for the national electronic identification scheme is still ongoing as an appeal was lodged against the procedure. In August 2021, SEGA was appointed as the competent authority for the verification and notification of the compatible electronic identification schemes. The system will be implemented by the Ministry of e-Government and will be in full compliance with the requirements of the eIDAS Regulation.

Bulgaria has introduced measures to provide key public administrative services online. By the end of 2021, more than 852 electronic administrative services were available online and the national public administration registries can now exchange information electronically. The measures include the upgrade of a single national portal that will include all available e-services. 21 of these services are considered key -such as birth certificates, residence, retirement, the opening and closing of a business - and have been available to EU countries under the Single Digital Gateway (SDG) since December 2021. Furthermore, the introduction of a single digital services portal fulfils the requirements on accessibility for people with disabilities, in compliance with EU Directive 2016/2102 on the accessibility of the websites and mobile applications of public sectors bodies. There are plans for a national data strategy and a regulatory framework for data policy in a data-driven governance.

Bulgaria has set up a [Big Data for Smart Society Institute \(GATE\)](#) in partnership with SEGA. It is working on a pilot project for the creation of a Digital Twins lab for public administration and industrial and business processes and products. The aim of the lab is twofold. First, to support the digital modelling and testing of different use case scenarios, and second, to strengthen interoperability with data exchange between different administrations.

Via the [national electronic portal for public consultations](#), Bulgaria promotes participatory actions for the public, businesses, Institutions and NGOs. The portal aims to enable consultation and to provide recommendations on policy proposals and administrative decisions. SEGA uses software tools to support the decisions by providing public statistics and open data to the population.

Bulgaria provides guarantees for the secure exchange of messages and documents between individuals and the administration pursuant to Regulation 2014/90 by embracing a secure electronic delivery system, which has recently been updated. Moreover, in 2021, information campaigns for the general public were conducted, as well as for public sector employees, on various aspects of cybersecurity, focusing on secure access to public e-services, personal data privacy and trust in services. Although the country has set out the conditions for automated decision-making in its national legislation, AI decision-making has not yet been introduced in the public sector. Since June 2021, the State Hybrid Private Cloud (SHPC) started offering ICT services to 50 administrative e-government systems and there are plan for its connection with EU cloud infrastructures, such as GAIA-X and GEANT. In 2020, a measure was introduced by the municipality of Sofia for the development of digital solutions for the public sector; this

²⁸ National eID scheme name: Evrotrust eID

includes the GovTech ecosystem, which consists of 40 private companies and 120 other organisations based in the capital.

Another positive development is the upgrade in the National Health Information System, which introduced electronic medical records for all people. In 2021, Bulgaria recorded a strong take-up of e-prescriptions, with over 4 800 doctors and 3 550 pharmacists participating and issuing 11 million e-prescriptions. In addition, the use of e-medical records in the national health-care systems facilitates efficient medical checks and interventions.

In summary, Bulgaria launched several initiatives for the digitalisation of the public services, unfortunately without yet tangible effects on its DESI performance, potentially due also to the political instability. The adoption of electronic identification and the digitalization of National registries remain at the top in the list of priorities for the new Ministry of e-Government. Targeted actions have been taken to encourage citizens and businesses to further take up e-Government services while offering training in cybersecurity to raise the trust levels of the users in adopting public e-services.

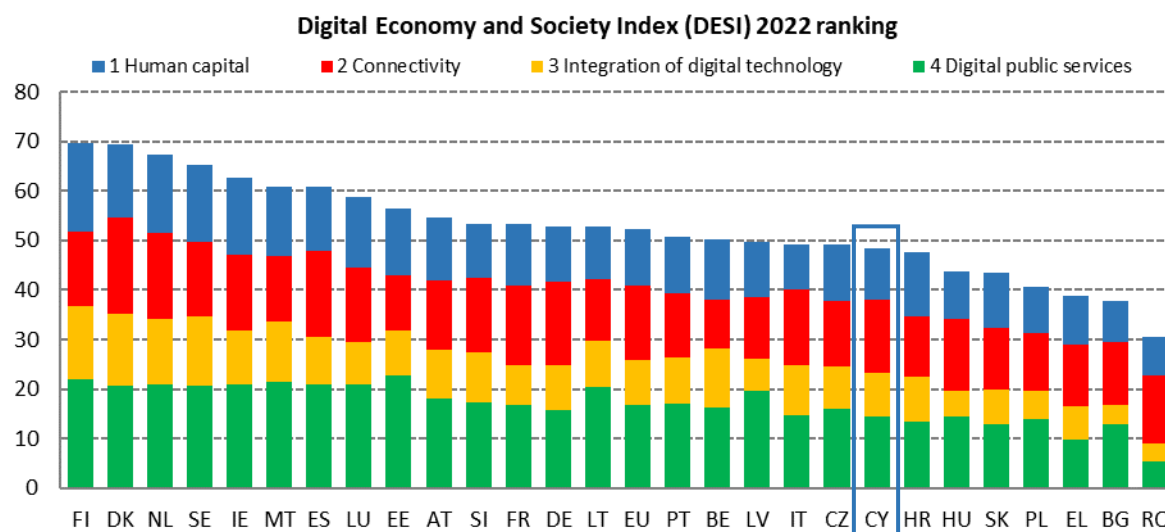
Digital public services in Bulgaria's Recovery and Resilience Plan

The Bulgarian Recovery and Resilience Plan includes measures linked to e-government and digital public services. They have a total budget of about EUR 985 million. The measures aim at the digitalisation of the public administration and digitalisation of justice forms and court decisions. Also, enhancements of e-health and digital innovation in healthcare, is supported. Some of these measures are:

- Digitalisation of paper registries (EUR 49 million).
- Transformation of the information and communication infrastructure at the Public Prosecutor's Office (EUR 15 million).
- The development of the digital TETRA system and radio relay network (EUR 64 million), a unified communication environment for the management, interaction and coordination in crisis prevention accidents, disasters and national security issues.
- Strengthening, further developing and building up the Unified Information System of Courts (EUR 10 million).
- Digitalisation of key litigation processes in administrative justice (EUR 3.6 million).
- National digital platform for medical diagnostics (EUR 12 million).
- Modernisation of the Employment Agency (EUR 11 million).
- Spatial monitoring, control and management through upgrading the Aerospace Monitoring Centre (EUR 57 million).
- Digital transformation of Bulgarian Post and delivery of new digital services (EUR 35 million).

Cyprus

	Cyprus		EU
	rank	score	score
DESI 2022	20	48.4	52.3



Cyprus ranks 20th among 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI). Positively, the country's relative progress, considering its starting point, is above the expected rate, indicating that it is converging to the EU average²⁹.

Cyprus has improved its performance in almost all DESI dimensions, although in most cases it still scores below the EU average. The most marked progress has been made in Connectivity, Integration of Digital technology and Digital public services.

Cyprus ranks above the EU average on mobile broadband take-up and has improved its coverage of Very High Capacity Networks (VHCN). It also scores high in the 5G readiness (67%) and relative coverage (75%) indicators. Nevertheless, coverage by VHCN is still far from both the EU average and the EU's Digital Decade target, which is for all European households to be covered by a Gigabit network and all populated areas to be covered by 5G by 2030. Therefore, Cyprus needs to intensify its efforts in this area.

Although the country improved its score in recent years, Cyprus is still below the EU average on basic digital skills. One out of two Cypriots lacks basic digital skills. A significant change of pace is needed in the country's drive to improve its citizens' digital skills. 66% of Cypriot SMEs use digital technologies and have at least a basic level of digital intensity, which is above the EU average of 55%. Cyprus has already built strong foundations for its contribution to the EU's Digital Decade target to have more than 90% of

²⁹ Refer to section 1.3 of the DESI 2022 horizontal chapter.

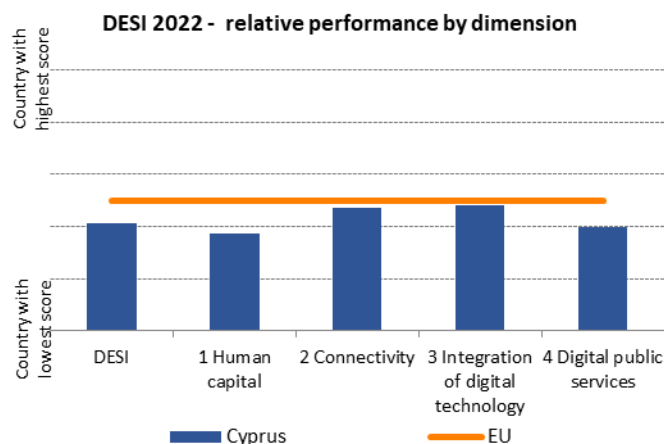
SMEs with at least basic a level of digital intensity. Approximately 63% of Cypriots already interact digitally with public administrations, just below the EU average of 64%. Cyprus' performance on digital public services for citizens and businesses shows that the country must continue its ongoing efforts to enable it to achieve the Digital Decade target of 100% online provision of key public services for EU citizens and businesses by 2030.

The '[Digital Strategy for Cyprus \(2020-2025\)](#)' under the responsibility of the Deputy Ministry of Research, Innovation and Digital Policy (DMRID) should accelerate Cyprus' digital transformation. The strategy, adopted in June 2020, is in line with the objectives proposed in the Commission proposal for a decision of the European Parliament and of the Council establishing the 2030 policy programme '[Path to the Digital Decade](#)'. The Cypriot strategy aims to: (i) promote e-government by redesigning the Ministry's organisation and governance model, by optimising the Ministry's model of service delivery, and by delivering a resilient, robust and secure information and communications technology (ICT) infrastructure; (ii) deliver a stronger digital economy and promote the development of competitive and digital industries; (iii) facilitate high-speed network connectivity and increase take-up; (iv) promote an accessible and inclusive society that has the skills and motivation to both embrace the national digital transformation and actively participate in digital communities; and (v) ensure security in data and infrastructure and increase the public's trust in online transactions. The achievement of these ambitious objectives will be partly reflected in the fulfilment of the relevant Milestones & Targets of the recovery and resilience plan (RRP) and gradually in the DESI data.

As part of its RRP, in December 2021, Cyprus adopted the '[Digital Skills - National Action Plan 2021-2025](#)' to develop and improve the digital skills of its entire population. This action plan aims to accelerate the digital transition by: (i) delivering an inclusive, open, digital society; (ii) boosting the basic digital and basic software skills of Cypriots; and (iii) creating a critical mass of ICT specialists in the country. The action plan will be implemented by the Cypriot '[National Coalition for Digital Skills and Jobs](#)' that will be reactivated in the third quarter of 2022 under the coordination of the DMRID. To this end, a new platform will be available and a related restart event is scheduled within the third quarter of 2022, where the new platform will be unveiled for re-ensuring stakeholders' engagement. The mechanism for implementing actions under the Coalition includes input from the public sector, academia and the private sector.

The new '[Broadband Plan of Cyprus 2021-2025](#)' was announced in November 2021 and aims to strengthen and develop new infrastructure, technologies and connectivity services. The plan sets the following connectivity targets, to be achieved by 2025: (i) Gigabit connectivity for all main socio-economic drivers; (ii) all premises in organised communities (urban or rural) to have access to internet connectivity offering a download speed of at least 100 Mbps, upgradable to 1 Gbps; (iii) 100% of the population living in organised communities (urban or rural) and all major terrestrial transport paths to have uninterrupted 5G coverage with a download speed of at least 100 Mbps; and (iv) 70% of households to have an internet connection with a download speed of at least 100 Mbps.

In May 2019, Cyprus adopted its '[Cyprus Industrial Strategy Policy](#)'. In January 2020, the government approved the [national strategy on Artificial Intelligence](#) (AI), while a [new cybersecurity](#) strategy has been in place since 2021. These strategies are aligned with and support the digital transition actions set out in the RRP.



Digital in Cyprus's Recovery and Resilience Plan (RRP)

Cyprus' RRP has a total value of EUR 1.2 billion of which EUR 282³⁰ million is dedicated to the digital transition. This means that the digital transition accounts for 23% of its RRP, exceeding the EU's target of 20%. The RRP measures will contribute to Cyprus' digital transition and they touch on all DESI dimensions:

- Regarding Human capital, actions focus on education (A new teacher and school evaluation system, including digital skills training for teachers), digital transformation of school units with the aim of enhancing digital skills and skills related to STEM education and digital skills in general (National e-skills Action Plan and measures on Skilling, Reskilling and Upskilling - digital skills).
- Regarding Connectivity the aim is to empower the National Regulatory Authority (OCECPR), to enhance building cabling to be "Gigabit-ready" in order to promote connectivity take-up and enhance very high capacity networks in underserved areas.
- For the Integration of digital technology, there are investments in smart cities, smart and sustainable water management and smart metering infrastructure and the development of FinTech regulatory sandbox.
- Regarding Digital public services, Cyprus plans several reforms and investments on e-government, e-health, Intelligent Transport Systems (ITS) using Digital Twin technologies, cloud-based platforms and e-justice.

³⁰ Each recovery and resilience plan has to dedicate at least 20% of the plan's total allocation to digital objectives. To this end, the plans had to specify and justify to what extent each measure contributes fully (100%), partly (40%) or has no impact (0%) on digital objectives, using Annex VII of the RRF Regulation. Combining the coefficients with the cost estimates of each measure allows assessing to what degree the plan contributes to digital objectives and whether it meets the 20% target.

1 Human capital

1 Human capital	Cyprus		EU
	rank	score	score
DESI 2022	21	41.8	45.7

	Cyprus		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
1a1 At least basic digital skills	NA	NA	50%	54%
% individuals			2021	2021
1a2 Above basic digital skills	NA	NA	21%	26%
% individuals			2021	2021
1a3 At least basic digital content creation skills³¹	NA	NA	60%	66%
% individuals			2021	2021
1b1 ICT specialists	2.7%	3.1%	3.9%	4.5%
% individuals in employment aged 15-74	2019	2020	2021	2021
1b2 Female ICT specialists	19%	18%	19%	19%
% ICT specialists	2019	2020	2021	2021
1b3 Enterprises providing ICT training	31%	25%	25%	20%
% enterprises	2019	2020	2020	2020
1b4 ICT graduates	2.6%	2.9%	2.7%	3.9%
% graduates	2018	2019	2020	2020

Cyprus ranks 21st in the EU on Human capital, below the EU average. In terms of at least basic digital skills, Cyprus is below the EU average of 54%, with 50% of people between 16 and 74 years having at least basic digital skills. 21% of the population have more than basic digital skills and 60% have at least basic content creation skills against EU averages of 26% and 66%, respectively. The share of ICT specialists in the workforce is lower than the EU average (3.9% compared to 4.5%). Cyprus reaches the EU average for female ICT specialists, who represent 19% of ICT specialists in the country. ICT graduates account for 2.7% of Cypriot graduates, compared to the EU average of 3.9%. Cyprus performs well in the share of enterprises providing ICT training which, at 25%, exceeds the EU average of 20%. These figures show that a change of pace is necessary to empower Cypriot citizens as a whole and provide the economy and society with enough ICT specialists to use and deploy advanced technologies.

The '[Digital Skills - National Action Plan 2021-2025](#)' ('the Plan') adopted in 2021 aims at developing and continuously upgrading the digital skills of all Cypriots at every skill level. It takes into consideration the latest developments in the field, including the targets for digital skills set out in Europe's Digital Decade targets and is in line with the EU's '[Path to the Digital Decade](#)' policy programme. The Plan is expected to strengthen the digital skills and capacity of citizens across all ages, education levels and income. Emphasis is placed on actions to respond to the growing needs of the labour market for basic digital skills and ICT specialists. It also aims at redesigning the education system so that it: (i) better uses digital

³¹ Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

tools in teaching and learning processes; (ii) cultivates the skills that will be needed in the future; and (iii) promotes the STEM career path.

The Plan includes an analysis of actions proposed for each target group and the scope of these actions. The target groups are: the general public, general workers (public and private sector), ICT professionals, and the education system. In addition, it sets out plans for measures of general importance, such as: (i) a targeted communications strategy; (ii) an e-learning platform that contains a self-assessment tool; (iii) a list of training opportunities from a variety of stakeholders-members of Cyprus's [National Digital Skills and Jobs Coalition](#); e-learning material; and (iv) provisions for digital infrastructure and equipment in areas and establishments in need of such support. The Plan also contains detailed references to all actions planned in the context of the RRP, in particular actions planned as training programmes for all listed target groups.

To support the measures set out in the Plan, the Cyprus Pedagogical Institute ([CPI](#)) produces digital training content. The CPI works in collaboration with public and private organisations, production companies, scholars, researchers and other professionals in the field. The content produced by the CPI includes educational material (e-books, films and other audio-visual material) that is available online thus contributing to the development of digital skills, especially of students. This material, along with material developed by all Coalition members and the DMRID, will be made available via to the National Digital Skills and Jobs platform that is planned to be launched in the third quarter of 2022. In addition, as part of the digital transformation of schools that is included in the RRP's reform 4 ('Digital transformation of school units with the aim of enhancing digital skills and skills related to STEM education'), Cyprus aims for comprehensive redesign of educational curricula to promote the skills of the future, as well as STEM and ICT careers. To this end, the Plan will include the provision of digital skills and STEM methodology training to at least 3 375 teachers (32% of all teachers in primary and secondary school). It will digitally equip 700 classrooms and produce education material for digital skills and STEM methodology for 120 school subjects.

All secondary schools in Cyprus participated in the 2021 [EU Code week](#), carrying out activities related to coding and computational thinking. EU Code week attracted four million participants in more than 78 000 activities covering more than 50 countries around the world. In 2021, Cyprus organised 34 activities, less than in 2020 due to COVID-19 restrictions, and attracted 1394 participants. These activities saw a balanced share of male and female participants (51% female), with most of the events being held in schools (97%).

In 2021, the DMRID initiated a consultation among all education and training providers on revamping curricula and training offers to better addressing the need for skills identified by employers. These providers included: (i) the Ministry of Education ([MOECYS](#)); (ii) public and private universities; (iii) certified training centres; (iv) the Cyprus Academy of Public Administration ([CAPA](#)); (v) the Cyprus Productivity Centre ([CPC](#)); and (vi) the Human Resource Development Authority ([HRDA](#)). Programmes targeted at helping to upskill private sector workers receive public funding, including from RRF funds. This funding is channelled through the HRDA and the CPC. For training in digital skills provided by the public sector, the DMRID and CAPA have surveyed the market and assessed the needs for advanced digital skills, and are now designing programmes to teach these skills in areas such as cybersecurity. Currently, the DMRID is implementing a project management course across different public sector functions, targeting primarily ICT professionals, including those who are responsible for implementing the RRP reforms and investments.

The share of digital specialists in the Cypriot workforce is below the EU average and the country's future prospects are being undermined by low rates of enrolment in – and graduation from – ICT courses. Cyprus is making significant efforts to improve the digital skills of its citizens through many actions. The swift implementation of the above actions and the monitoring of their results will be very important to ensure a strong contribution from Cyprus to the two skills targets on the EU's Digital Decade targets.³²

Highlight: “Innovative Schools” & “eSafe Schools” programmes

The [Innovative Schools](#) and the [eSafe Schools](#) programmes are designed to help individual schools and teachers use digital technologies and integrate them effectively into learning processes. At the core of these programmes lies the SELFIE Pedagogical Innovation Assistant Toolkit (SELFIE PTK), a comprehensive package that helps schools to develop a digital action plan based on the SELFIE ‘self-reflection’ tool for strengthening schools’ digital capacity. SELFIE PTK provides step-by-step guidelines for: (i) reviewing SELFIE results; (ii) setting priorities and goals; (iii) developing an evidence-based action plan; and (iv) implementing and evaluating that plan.

Both programmes are offered at the beginning of each school year, and schools in Cyprus can apply to participate in these programmes on a voluntary basis. Participating schools receive guidance and support from the CPI. They also receive a small amount of financial support to implement certain training actions. In addition, teachers from each participating school are designated as ‘teacher coaches’. Their role is to act as key supporters of the school’s effort to use and integrate digital technology in the learning process. This effort also aims at forming teacher communities that share and spread good practices. Teacher coaches receive ongoing training through CPI professional development programmes to develop their digital.

Each year, 20-40 schools and corresponding their teacher coaches participate in these programmes with support and training from the CPI. In the long term, is expected that schools will be able to use SELFIE PTK autonomously, contributing to the efforts of MOECYS to roll out school-based implementation of digital education policies to a wider audience. SELFIE PTK was developed under [key action 3 of Erasmus+ \(project SHERPA\)](#) with a total EU grant of EUR 0.5 million.

³² Digital Decade targets: (a) at least 80% of those aged 16-74 to have at least basic digital skills by 2030; (b) at least 20 million ICT specialists to be employed throughout the EU-27, with roughly equal numbers of women and men ICT specialists.

2 Connectivity

2 Connectivity	Cyprus		EU
	rank	score	score
DESI 2022	12	58.8	59.9

	Cyprus		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
2a1 Overall fixed broadband take-up	87%	92%	92%	78%
% households	2019	2020	2021	2021
2a2 At least 100 Mbps fixed broadband take-up	2%	3%	26%	41%
% households	2019	2020	2021	2021
2a3 At least 1 Gbps take-up	<0.01%	<0.01%	0.17%	7.58%
% households	2019	2020	2021	2021
2b1 Fast broadband (NGA) coverage	100%	100%	100%	90%
% households	2019	2020	2021	2021
2b2 Fixed Very High Capacity Network (VHCN) coverage	10%	26%	41%	70%
% households	2019	2020	2021	2021
2b3 Fibre to the Premises (FTTP) coverage	10%	26%	41%	50%
% households	2019	2020	2021	2021
2c1 5G spectrum	0%	67%	67%	56%
Assigned spectrum as a % of total harmonised 5G spectrum	04/2020	09/2021	04/2022	04/2022
2c2 5G coverage³³	NA	0%	75%	66%
% populated areas		2020	2021	2021
2c3 Mobile broadband take-up	84%	84%	91%	87%
% individuals	2018	2018	2021	2021
2d1 Broadband price index	37	42	64	73
Score (0-100)	2019	2020	2021	2021

This year, Cyprus ranks 12th amongst the 27 EU countries for connectivity. During the reporting year, Cyprus began a comprehensive roll-out of fixed and mobile networks mirrored by (i) a significant increase in take-up of both fixed and mobile broadband, including at high speeds; and (ii) a reduction in prices. In policy developments, Cyprus adopted a new national broadband plan (NBP) 2021-2025, and transposed the European Electronic Communications Code into its domestic legislation.

The government indicated that the NBP is aligned with the policies set out in the EU's 'Gigabit Society' and Digital Decade policies. The NBP sets as targets: (i) synchronous gigabit connectivity in Cyprus for all main businesses, industries and population centres; (ii) 5G and high speed connectivity in all urban and rural organised communities; and (iii) take-up of very high capacity networks (VHCN) in at least 70% of

³³ The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

households. In the NBP, the DMRID signalled its intention to continue improving coverage and take-up of VHCNs both fixed and mobile as well as establishing a legislative/regulatory framework to promote private investments while assuring a sound level of competition in the market. The NBP also includes some best practices from the Connectivity Toolbox, which are best practices developed between Member States in cooperation with the Commission with the goal to timely roll out 5G and fast broadband. Amongst the best practices included in the NBP are: (i) reducing the administrative burden of permit granting procedures, and (ii) make available to the public information to determine the availability of fixed and mobile connectivity in different areas. It must also be noted that many of the best practices from the Connectivity Toolbox were already in place before the Connectivity Toolbox was published.

Over the last year, Very High Capacity Network (VHCN) coverage in Cyprus has increased to 41% of population, an impressive 15-percentage-point increase from the 26% coverage in the previous year. Nevertheless, it is still well below the EU average of 70%. This increase is exclusively linked to fibre-to-the-premises (FTTP) deployment exclusively in urban areas. This is because the cable operator has not yet upgraded its DOCSIS 3.0 network, which covers 65.9% of the Cypriot households. Rural FTTP is accessible to 8% of Cypriot households. The National Regulatory Authority (NRA) of Cyprus, OCECPR, expects this coverage to catch up with average EU levels in the coming years. Furthermore, the NRA has been empowered to perform a survey in order to collect geographical data on electronic communication networks, which, among other things, will be used to spot areas that would remain uncovered by VHCN under current plans by commercial operators. To expand VHCN coverage in underserved areas, Cyprus has issued a state aid notification to the Commission (state aid to promote VHCN coverage is permitted under EU rules but must be notified). The investment will be used to fill the private investment gap that exists in rural or semi-urban areas where there is no commercial incentive to invest in a VHCN network.

Private deployment of fibre-to-the-home (FTTH) is underway by three telecoms providers: Cyta, Cablenet and Epic. Cyta has reported that they have so far connected 170 000 premises to fibre, and aim to increase FTTH connectivity to 90% of premises in Cyprus by 2026. Cablenet currently makes use of a hybrid fibre-coaxial network which consists of fibre for the backhaul, and complements this with DOCSIS 3.0 in the local loop. New fibre infrastructure will not substitute the existing DOCSIS 3.0 network, but will be implemented in 'greenfield' roll-out, i.e. where no infrastructure is already present. For its fibre roll-out, Epic has secured financing for EUR 19 million from the European Investment Bank, which will be used to increase the number of homes connected to fibre by Epic from 25 000 to 50 000. Cyta is considering phasing out its services over the existing copper network, but timing for the actual switch-off depends on when the fibre network has reached sufficient coverage. Cyta is allowed to proceed with copper switch-off three years after the public availability of its optical network in a specific area.

Cypriot telecoms providers have been successful in migrating many clients from low speeds to subscriptions offering speeds of at least 100 Mbps. Still, despite the good coverage of gigabit networks, the take-up of gigabit speeds in Cyprus is significantly below the EU average (0.17% against 7.58%). To address this issue, and following its pilot voucher scheme last year, the Cypriot government is currently preparing a new investment plan to continue the voucher scheme for promoting fibre take-up.

Another part of the NBP is the deployment of a new submarine cable, in order to address the need to safeguard capacity in the future, as well as competition on the market. The project would include

funding from both private and public sources and will be carried out in accordance with EU state-aid rules. The plan to invest in a new submarine cable forms part of the government's strategy to become a data gateway for Eastern Europe. Additionally, Cyta plans to start commercial operations for its new submarine cable system 'ARSINOE' in early 2022.

On mobile connectivity, 5G roll-out in Cyprus is underway and mobile broadband take-up has increased significantly to a level well above the EU average. Within 1 year, coverage of 5G networks went from 0% of the population (2020) to 75% of the population (2021). Coverage is expected to further increase thanks to the assignment of two of the three 5G pioneer bands and the launch of investments from mobile network operators. The 700 MHz and the 3.6 GHz 5G pioneer bands were authorised to operators in the beginning of 2021. In the 700 MHz band, Cyta and Epic have received two blocks of 10 MHz, while Cablenet and Primetel have received two blocks of 5 MHz. In the 3.6 GHz band, Cablenet, Cyta, Epic and Primetel have all received 100 MHz spectrum blocks. According to the Cypriot authorities, there is no market demand yet for the 26 GHz band. Cyprus thus scores only 67% in the 5G readiness index. The rights of use include a coverage obligation (a set of requirements that must be met by operators that are allocated spectrum) for 70% of the population, and coverage of all highways and major roads. In addition, the rights of use include obligations on providers to provide speeds of at least 100 Mbps on their 5G networks.

Main market & regulatory developments

Four market players compete on the Cypriot telecoms market: Cyta (incumbent), Cablenet, Epic and Primetel. Bundled services remain popular, with a slight increase this year in fixed broadband subscriptions as part of a bundle to 78% of all bundles, in comparison with 73% of all bundles last year. Of these bundles, 61% consists of fixed telephony and broadband access. Another 25% of bundled connections also include IP/cable TV access.

In 2021, the transposition of the European Electronic Communications Code remained a work in progress in Cyprus. The implementation measures were finally adopted in March 2022. Operators have said that they do not foresee any difficulties in complying with the new regulatory framework. On net neutrality, and following judgements of the Court of Justice of the European Union, the OCECPR has reminded market players that 'zero rating' of any network traffic on commercial grounds is forbidden. Zero rating is the practice of not billing or counting against a consumer's data cap data traffic generated by the use of certain applications or types of applications (e.g. social media, music streaming).

Cyprus has furthermore updated its smartphone application for emergency communications to address shortcomings, namely by including a native non-voice two-way chat function and transmission of the end-user's location to the public safety answering point (i.e. the responding emergency services). However, the latter function requires an end-user to have their device connected to the internet in order to transmit their location.

During 2021, dispute resolutions have taken place in relation to access to the existing physical infrastructure of the incumbent operator. In 2021, OCECPR also began work to revise the current 'co-location decree', which sets rules and conditions for access to network infrastructure. It is expected that the estimated economic life of physical telecoms infrastructure will be altered. Moreover, accredited access seekers may generally install cables

unsupervised, but the incumbent operator retains the right to accompany the access seeker and charge only a specific percentage of the relevant visits. Both measures will have an impact on the access costs to existing physical infrastructure.

New market analyses for markets 1 of the 2020 Recommendation (wholesale local access provided at a fixed location) and 3b of the 2014 Recommendation (wholesale central access provided at a fixed location for mass-market products) are being carried out by the OCECPR. These analyses are planned to be opened for public consultation in 2022. The virtual unbundled local access (VULA) services in the incumbent's reference offer have not been taken up, as the prices for backhaul were considered too high by the alternative operators. Instead, alternative operators opt for grouping of traffic at a higher level.

Finally, the Cypriot Commission for the Protection of Competition, the Cypriot competition authority, has issued an infringement decision against Cyta finding an abuse of its dominant position for pricing below cost its pay-TV service Cytavision in bundled offers in 2013. In addition, the Administrative Court upheld an earlier decision of the Cypriot competition authority that found Cyta to have charged unfair prices for the right to use capacity in the submarine cable from Cyprus to London and Frankfurt.

Cyprus has set ambitious objectives in its NBP. The Cypriot government planned to strongly improve its connectivity – both fixed and wireless. To achieve these targets, the government is partially relying on Cohesion policy funds, and on the EU's CEF2 Digital funding programme. In addition, the private sector has presented plans on VHCN and 5G roll-out in the following years, which are likely to increase coverage in both areas. Finally, the deployment of a new submarine cable is a strategic goal through which Cyprus aims to position itself as an attractive Member State for data centres.

3 Integration of digital technology

3 Integration of digital technology	Cyprus		EU
	rank	score	score
DESI 2022	17	35.3	36.1

	Cyprus		EU
	DESI 2020	DESI 2021	DESI 2022
3a1 SMEs with at least a basic level of digital intensity	NA	NA	66%
% SMEs			2021
3b1 Electronic information sharing	33%	33%	34%
% enterprises	2019	2019	2021
3b2 Social media	38%	38%	42%
% enterprises	2019	2019	2021
3b3 Big data	5%	6%	6%
% enterprises	2018	2020	2020
3b4 Cloud	NA	NA	42%
% enterprises			2021
3b5 AI	NA	NA	3%
% enterprises			2021
3b6 ICT for environmental sustainability	NA	NA	NA
% enterprises having medium/high intensity of green action through ICT		2021	2021
3b7 e-Invoices	11%	13%	13%
% enterprises	2018	2020	2020
3c1 SMEs selling online	12%	15%	17%
% SMEs	2019	2020	2021
3c2 e-Commerce turnover	8%	5%	5%
% SME turnover	2019	2020	2021
3c3 Selling online cross-border	9%	9%	8%
% SMEs	2019	2019	2021

On the integration of digital technology in business activities, Cyprus ranks 17th in the EU. This is helped by the 66% share of Cypriot SMEs with at least a basic level of digital intensity, above the EU average of 55%. Cypriot enterprises also take advantage of technology capabilities by sharing information electronically (34% of Cypriot enterprises share information electronically compared to an EU average of 38%) and by using social media (42% of Cypriot enterprises use social media compared to an EU average of 29%). 17% of Cypriot enterprises sell online, almost reaching the EU average of 18%. The percentage of Cypriot SMEs selling online cross-border is 8%, and almost in line with the EU average of 9%. 42% of enterprises in Cyprus use cloud services, well above the EU average of 34%. However, only 6% of Cypriot enterprises use big-data analytics (below the EU average of 14%) and only 3% use AI (versus an average of 8% in the EU). This shows that there is ample room for improvement to reach the Digital Decade target of having at least 75% of enterprises taking up cloud services, big data and AI by 2030. Cyprus is also underperforming in e-commerce turnover, at 5% of total corporate turnover (EU average is 12%) and in e-invoices, which are used by only 13% of Cypriot enterprises, far below the EU average of 32%.

In May 2019, the Council of Ministers adopted the '[Cyprus Industrial Strategy Policy](#)' for 2019-2030. This strategy recognises the importance of the digital transformation of Cyprus' industry, and the country's transition to a circular economy, the strategy includes a national action plan on the transition to a circular economy). Strengthening the country's digital industry is a key pillar of the strategy, which also aims to increase the adoption and use of various technologies (e.g. Cloud, Big data and AI). In addition, it aims to increase adoption rate of digital production systems and applications, create more smart factories and incorporate more cutting-edge technologies and digital services infrastructures into Cypriot industry.

As part of the implementation of the strategy, the [Ministry of Energy, Commerce and Industry](#) maintains a state-aid subsidy scheme providing financial support for the digital enhancement and upscaling of SMEs. Investments eligible include, but are not limited to cloud computing, big data, data analytics and the use of AI, provided that the overall project will significantly increase enterprise's use of digital technology. [A call for proposals to encourage SMEs to adopt digital technologies](#) was launched in December 2019 with a budget of EUR 6 million. It is now in the payments phase where SME-beneficiaries, following the implementation of their approved projects for digital enhancement, are now claiming payment of their approved subsidy. Out of this EUR 6 million, 50% has already been allocated for the eligible investments. According to the analysis of the Cypriot government, this call for proposals has incentivised private investment in digital technology. More specifically, for every EUR 1 of public aid, the call for proposals yielded an additional EUR 1.3 of private investment on average. In addition, an improved version of this scheme (for the digital enhancement of SMEs) is being prepared with a budget of EUR 30 million. The new scheme is planned to be announced in the third quarter of 2022.

In January 2020, the government approved the [national strategy on AI](#), which will be implemented by the DMRID. The strategy is based on four key pillars: (i) to maximise investment through partnerships; (ii) to create national databases; (iii) to nurture talents and lifelong learning; (iv) and to develop ethical and trustworthy AI. The strategy includes actions such as upgrading public services, creating new models of cooperation through AI, and implementing AI solutions both on internal operations of the public services and in various citizen service centres and channels with the development of automated services such as AI chatbots. The timeframe of implementation is until 2026.

The selection of Digital Innovation Hubs (DIH) that will participate in the network of [European Digital Innovation Hubs \(EDIHs\)](#) is ongoing. One Cypriot DIH proposal has a successful evaluation result, i.e. is invited for grant agreement preparation, which, however, is not a formal commitment for funding, while another proposal has received a "Seal of Excellence". On the national priorities set in both the RRP and the Smart Specialisation Strategy, the DIH is expected to play an important general role by providing digitalisation support to all sectors. It will also help by leading or taking part in processes to encourage stakeholders towards digital innovation. The relevant national co-funding for the DIH in Cyprus is up to EUR 3.18 million for the period 2021-2027.

On Blockchain technology, a [public consultation](#) on a National Blockchain Law was completed in 2021 and feedback was received. Based on this feedback, the drafting of the Law is almost completed. In 2020, Cyprus submitted, through the CEF, a proposal for establishing European Blockchain Service Infrastructure (EBSI) node(s). The proposal was selected for funding, and Cyprus is one of the few early adopters of the EBSI. The implementation of the two-year project started in May 2021, and aims to develop a fully operational national EBSI under the coordination of the DMRID.

Cyprus is committed to developing new advanced technologies and investing in these technologies through EU-coordinated programmes and plans. These technologies include High Performance Computing (HPC), AI and quantum communication infrastructure (QCI). In 2019, [Cyprus signed a declaration](#) agreeing to explore, together with 24 Member States, how to develop and deploy a QCI across the EU over the next 10 years. Cyprus has participated in the EuroHPC Joint Undertaking on HPC, since July 2019 and is co-funding the operation of the HPC National Competence Centre (NCC) with EUR 1 million for the two-year period 2020-2022. Cyprus is currently assessing the continuation of its support to the NCC with an additional budget of 1 million for the next three years under the relevant call. These EU initiatives are expected to provide the means and the opportunities to: (i) enable SMEs to benefit from advanced technologies; (ii) increase the digitalisation of SMEs; and (iii) enable SMEs to be part of the chain for providing of high-quality services and products.

Cyprus is also preparing its national plan on critical infrastructure, which will include the creation of a National QCI Network. The plan will also be connected with the cross-border development of the EuroQCI network. The implementation of a national QCI network is also a major challenge, with potentially great opportunities for industry, government security services and critical infrastructure in Cyprus and academia. A Working Group has been set up to help create a national QCI Network, consisting of the DMRID, the Department of Electronic Communications (DEC), the Digital Security Authority (DSA) and the European University of Cyprus.

The [National Cybersecurity Strategy](#), which was published in June 2020, includes a series of actions in the context of the 'Security for All' approach. The strategy aims at consolidating a secure electronic environment in Cyprus, with special provisions and actions to protect critical information infrastructures. The DSA is the National Cybersecurity Certification Authority and is responsible for the full implementation of the EU Cybersecurity Act at national level. The budget for implementing the strategy is currently around EUR 6.5 million for 2022. The Steering Committee in charge of implementing the strategy follows a dynamic approach and has the ability to ask for additional funds each year depending on the needs it identifies. This means that additional budget could be allocated for 2023 and 2024.

To boost the digital transformation of the Cypriot economy, it is important to raise awareness of the relevance of digitalisation among SMEs. This will enable SMEs and entrepreneurs to reap the full range of benefits from adopting digital technologies. This is also important in the light of the Digital Decade target for more than 90% of SMEs to have at least a basic level of digital intensity by 2030. Change management at all levels of enterprises is also required to address organisational and cultural challenges. For these changes to be successful, the DMRID, as the authority for developing and implementing the national digital policy and strategy, has to decide on and organise: (i) the use of resources; (ii) public-sector processes; (iii) budget allocations; and (iv) other modes. In this context, the full implementation of the Cyprus Industrial Strategy Policy, as well as the reforms and investments included in the RRP are crucial for the success of the digital transformation.

4 Digital public services

4 Digital public services ³⁴	Cyprus		EU
	rank	score	score
DESI 2022	20	57.5	67.3

	Cyprus		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
4a1 e-Government users	58%	59%	63%	65%
% internet users	2019	2020	2021	2021
4a2 Pre-filled forms	NA	NA	31	64
Score (0 to 100)			2021	2021
4a3 Digital public services for citizens	NA	NA	56	75
Score (0 to 100)			2021	2021
4a4 Digital public services for businesses	NA	NA	86	82
Score (0 to 100)			2021	2021
4a5 Open data	NA	NA	91%	81%
% maximum score			2021	2021

Cyprus ranks 20th in Digital public services. It performs above the EU average on open data, with a score of 91% versus the EU's 81%. The level of online interaction between public authorities and the general public has been further improved, with 63% of Cypriot internet users actively engaging in the use of e-government services, close to the EU average of 65%. On pre-filled forms, Cyprus underperforms with a score of 31, well below the EU average score of 64. Furthermore, in digital public services for citizens, Cyprus remains below the EU average of 75 with a score of 56. On the other hand, Cyprus performs well in digital public services for businesses, scoring above the EU average (86 against the EU average of 82).

The government has introduced a national electronic identification (eID) scheme following the [eIDAS Regulation](#), without having notified any eID system yet. The scheme includes a series of legislative acts which were voted by the Parliament in April 2021. According to this legislation, 'Trust Service Provider (TSP)' will be able to provide eID to citizens above 18 years old³⁵. It is expected that the TSP will be operational within 2022 and will start providing eID to Cypriots. The pilot phase is expected to start in the third quarter of 2022. With the establishment of a national scheme on eID following the eIDAS regulation, and of an electronic signature (e-signature), the public will be able to access and interact digitally with the government through the [Government Gateway](#) web platform simply by using their eID. This national eID scheme is expected to be notified to the European Commission in 2022.

³⁴ There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

³⁵ The TSP is obliged according to the legislation to follow a remote server solution using PKI infrastructure (the private keys are kept in an HSM server in the TSP premises)

The government is also developing a ‘Digital Services Factory (DSF)’³⁶, a new delivery model for the development of end-to-end digital services. The DSF includes a set of standards to be followed for the design and development of e-services for both citizens and enterprises in order to achieve uniformity and consistency across all users, including the government. According to the implementation plan, most public services are expected to be online by 2026.

Government IT systems in Cyprus are scattered across several government locations and data centres, with limited security provisions and very high costs of maintenance and operation. To address this fragmentation, Cyprus aims to create a unified cloud environment that will provide cloud computing capabilities for the government by hosting governmental systems and services. The cloud environment will be hosted and operated either in a public cloud or a government private cloud (G-Cloud). Initially, the cloud environment will be used by a limited number of government departments and ministries, but it will be continuously improved and extended to cover most of the existing systems and other upcoming needs. The project is in the initial stage and its procurement phase is under preparation.

The DMRID aims to set up a ‘Digital Market Place (DMP)’ to deliver high-quality services more quickly to the public and improve how citizens and businesses interact with the government. The DMP will be supported by a procurement framework, which is underway, and will allow: (i) the private sector to provide teams to research, test, design, build, and alter digital services; and (ii) public-sector organisations to procure themselves services which are listed in the DMP in the form of ‘mini-competitions’, thus implementing digital services from service providers. It is expected that the DMP will be operational in Q3 2022.

On e-health, the [National e-Health Authority \(NeHA\)](#) has been set up, under Law 59 (I)/2019, as an independent and autonomous entity with the objective of implementing the country’s ‘e-health Roadmap’.

The first implementation phase of Cyprus’s e-health roadmap relates to the deployment of cross-border interoperable e-health services. The services are based on the ‘e-Health Digital Service Infrastructure (eHDSI)’ requirements and EU standards via MyHealth@EU and are provided by NeHA acting as the [Cypriot National Contact Point for e-Health \(NCPeH\)](#)³⁷. Supported by Cyprus’s RRP, the NeHA aims to extend the provided services to enable the exchange of additional data sets, as agreed with eHDSI. The work for this project has been in progress since January 2022. Since February 2022, the NeHA has been carrying out a project aiming to decide on what constitutes the ‘Extensive Set of Health Data’ for all ‘e-Health Records’. The results of this project are fundamental for NeHA’s strategy and are in line with Cyprus’s e-Health Roadmap.

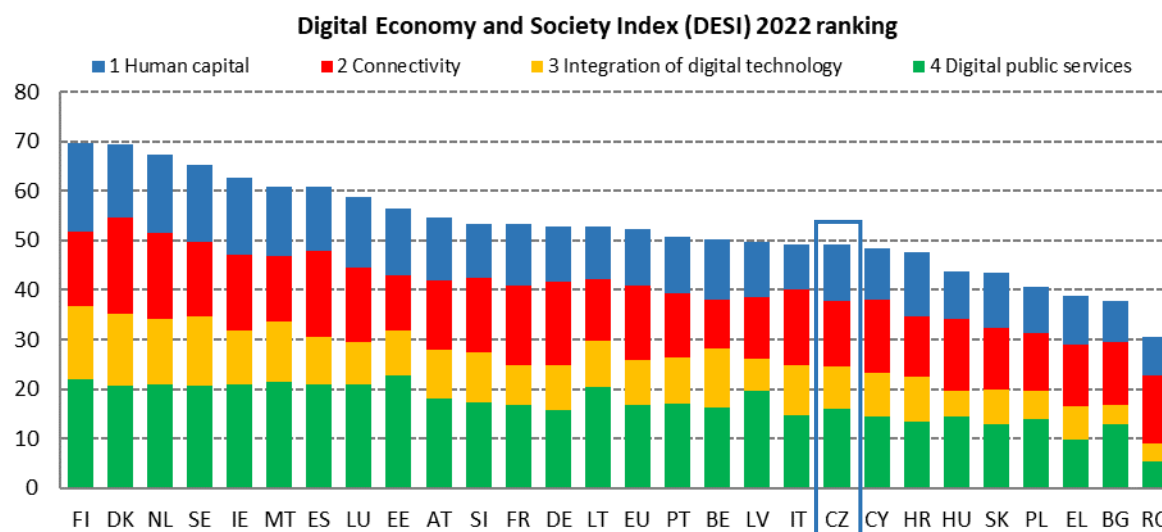
Improving digital public services is particularly important for Cyprus’s digital transition. This will help the digital transformation of the public sector in line with the EU’s Digital Decade target, where all key public services should be made accessible online for citizens and businesses. Therefore, it is very important for Cyprus to implement the policy in line with the national digital strategy together with the reforms and investments included in its RRP.

³⁶ The website will be available in Q3 2022

³⁷ The compliance check team concluded that “the Cyprus NCPeH is legally ready and technically well advanced to be ready for production service operation but it is important to finalise the contractual arrangements...”

Czechia

	Czechia		EU
	rank	score	score
DESI 2022	19	49.1	52.3



Czechia ranks 19th of the 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI), one place below the ranking in 2021. The country's strongest performance is in the Human capital dimension. Czechia has made a relatively solid progress in the overall DESI score since 2017 which grew slightly more than expected by convergence curve, meaning that its score improved at a marginally higher pace than the score of the Union as a whole³⁸. Compared to 2021, Czechia's ranking improved in Digital public services and Connectivity but worsened in Integration of digital technology.

The new government took office in December 2021 and presented digital transformation as an important task of the 4-year work programme. For the first time since 2007, a member of the Cabinet – [Deputy Prime Minister Ivan Bartos](#) – is directly responsible for digitalisation, particularly in the area of public services.

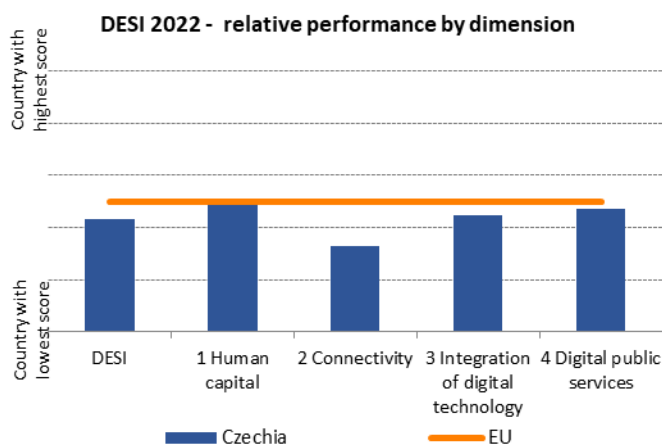
The government continues to implement the [Digital Czechia strategy](#) adopted in 2018 and updated in 2020. The new Cabinet plans another update in 2022. The strategy became a major source of projects for the digital components of the [Czech recovery and resilience plan \(RRP\)](#). The RRP is foreseen to become the most important source of financing for the strategy. The other sources are the European Structural and Investment Funds, Research and innovation strategy for smart specialisation RIS3, the DIGITAL Europe programme and the national budget.

Czechia aligns its actions with the main EU technology strategies, in particular with the [Digital Decade](#) and its targets. Czechia can move closer to reaching these targets through increasing the proportion of

³⁸ For details see the section 1.3 of the DESI 2022 horizontal chapter.

companies that use advanced digital technologies, training more ICT specialists and ensuring cross-border interoperability of digital public services including e-health. In 2022, Czechia will hold the Presidency of the Council of the EU and the programme will include legislative files and initiatives related to digital economy and society, in particular to cybersecurity.

Czechia still faces a lack of ICT specialists in its job market. This significant obstacle hampers the pace of digital transformation across the economy – from enterprises and research institutions to public administration and schools. Czechia is starting to improve in connectivity thanks to previously adopted legislative measures. The proportion of households covered by Fixed Very High Capacity Networks has significantly risen. Digital Innovation Hubs are becoming the backbone for the integration of digital technologies into the economy. The new government will further stimulate digitalisation of public services by improving coordination among public institutions and offering new meaningful and user-friendly services such as virtual ID cards in mobile apps.



Czechia took several targeted actions related to digital technologies as a response to Russia's invasion of Ukraine. Shortly after the start of the invasion, the Czech domain manager (CZ.NIC) in cooperation with public authorities, [blocked several disinformation websites](#) with ties to Russia. [National Cybersecurity Agency](#) (NUKIB) regularly updates the public with potential cyber threats related to the war and it also increased the efforts to stimulate cyber awareness among population. The Ministry of Interior cooperated with other public institutions and rolled-out the website [nasiukrajinci.cz](#) where Ukrainian refugees find information on administrative procedures and help with finding jobs, schools for kids or healthcare issues. The website also offers features for Czech citizens who want to offer help and support to the refugees. Several major NGOs that work with migrants joined forces and promptly developed a virtual marketplace [pomahejukrajine.cz](#) where people can find and offer help. In 6 weeks, this bottom-up initiative gathered 35 000 offers of help ranging from accomodation and transport to psychotherapy or volunteering.

Digital in Czechia's Recovery and Resilience Plan (RRP)

The share of Czechia's RRP dedicated to digital priorities is 22% - EUR 1.56 billion³⁹. The main investments are focused on digitalisation of public services (e-government, e-health), improving connectivity, boosting digital skills and supporting the digital transformation of enterprises.

In 2022, in the area of Human capital, the government will continue the implementation of the reformed school curriculum that increases education in informatics and extends its coverage to other subjects. It also makes digital skills one of the key competences and supplies schools with new digital equipment. The Ministry of Education plans to support universities in their transformation to new forms of learning, focusing in particular on digital technology sectors such as cybersecurity, artificial intelligence (AI) or Industry 4.0. The Council of Economic and Social Agreement is expected to establish a permanent reskilling and upskilling committee.

The RRP has no milestones or targets in Connectivity that are expected to be completed in 2022.

To stimulate integration of digital technologies, the government is expected to launch the Platform for the digitalisation of the economy and the European centre of excellence in AI for Citizens safety and security. The [Central European Digital Media Observatory](#) (CEDMO) is already operational. The Ministry of Industry and Trade is expected to complete 5G reference applications for cities and industrial areas. The RRP also plans that at least one test bed based on digital twin technology and digital transformation equipment in the aviation industry will be fully operational.

In the area of digital public services, the Ministry of Healthcare is expected to set interoperability standards for electronic health systems. Services supported by the RRP as part of the Single Digital Gateway should enter into operation and the government should roll out the National open data catalogue. The [CzechPoint](#) offices are expected to offer new services and plan to further facilitate communication with public administration. The Ministry of the Interior is expected to modernise security information and event management systems of the police and make the systems available for other applications. The government is expected to open centers of competence for supporting e-government, cybersecurity and e-health. The Ministry of Justice plans to increase the number of conference rooms with new audiovisual technologies.

³⁹ Each recovery and resilience plan has to dedicate at least 20% of the plan's total allocation to digital objectives. To this end, the plans had to specify and justify to what extent each measure contributes fully (100%), partly (40%) or has no impact (0%) on digital objectives, using Annex VII of the RRF Regulation. Combining the coefficients with the cost estimates of each measure allows assessing to what degree the plan contributes to digital objectives and whether it meets the 20% target.

1 Human capital

1 Human capital	Czechia		EU
	rank	score	score
DESI 2022	15	45.6	45.7

	Czechia		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
1a1 At least basic digital skills % individuals	NA	NA	60% 2021	54% 2021
1a2 Above basic digital skills % individuals	NA	NA	24% 2021	26% 2021
1a3 At least basic digital content creation skills⁴⁰ % individuals	NA	NA	66% 2021	66% 2021
1b1 ICT specialists % individuals in employment aged 15-74	4.0% 2019	4.2% 2020	4.6% 2021	4.5% 2021
1b2 Female ICT specialists % ICT specialists	10% 2019	10% 2020	10% 2021	19% 2021
1b3 Enterprises providing ICT training % enterprises	25% 2019	25% 2020	25% 2020	20% 2020
1b4 ICT graduates % graduates	4.9% 2018	5.0% 2019	NA 2020	3.9% 2020

In the Human capital dimension, Czechia ranks 15th of the 27 EU countries and its score is just at the EU average. 60% of Czechs have at least basic digital skills, well above the EU average (54%). However, in above basic digital skills, Czechia remains below the EU average (24% vs. 26%). The proportion of ICT specialists in employment grew to 4.6% and is above the EU average (4.5%) but the proportion of women among ICT specialists remains the lowest in the EU (10%).

The central [Digital Czechia strategy](#) and the [Education strategy 2030+](#) are the most important documents for coordinating actions and policies on human capital. Under the Czech RRP, EUR 270 million in investments are planned to be allocated to support the development of digital skills and skills needed for Industry 4.0. The Czech education system is undergoing a major reform that introduced more hours for studying ICT and computational thinking to the curricula, a new concept of computational thinking and new key digital competences with the aim of integrating digital technologies across primary and secondary schools. This reform is expected to help increase the share of Czechs with at least basic digital skills and thus contribute to reaching the Digital Decade target of 80% of Europeans with at least basic digital skills.

The lack of ICT specialists is the biggest obstacle to digitalisation in the country. [According to Eurostat](#), 76% of Czech enterprises that recruited or tried to recruit ICT specialists reported difficulties in filling these positions - the highest share in the EU (EU average: 55%). Despite the relatively high share of

⁴⁰ Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

graduates in ICT (CZ: 5% vs. EU: 3.9%), a [recent survey](#) by Coding Bootcamp Prague and Techloop shows that the economy would have the capacity to absorb an additional 14 000 ICT specialists. In the context of the Digital Decade target of having 20 million employed ICT specialists in the EU, the Czech government plans to address the problem by opening up the job market and simplifying the procedures for enterprises that want to hire digital experts abroad, especially from Eastern Europe. The gender gap in technology remains a major issue. The government does not have a strategy to tackle this and does not offer incentives to encourage girls and women to become ICT specialists.

According to the [Confederation of industry and transport](#), during the pandemic, enterprises increased their support and investments in the training and upskilling of their employees. The RRP will also finance digital reskilling and upskilling of employees and managers in enterprises, particularly in SMEs. The RRP will also help establish 14 regional training centres to provide lifelong learning programmes in the area of digital technologies and Industry 4.0.

Apart from fostering digital skills through standard education or coordinated training, the Ministry of Labour and Social affairs offers an EU-funded free self-assessment tool - [Evaldo.cz](#) - based on the [European Digital Competence Framework](#). It helps people evaluate their level of digital skills and suggests appropriate training opportunities. The tool models real-life situations and evaluates users' digital skills based on their responses and behaviour.

Over [57 000 Czechs](#) participated in the 2021 edition of EU Code Week through 177 registered activities. 53% of these activities took place in schools. One of the biggest activities for the 2021 edition worldwide was [iBobr](#) – a competition in ICT for primary and secondary school pupils. Schools from all Czech cities participated in this competition. It gives young people and their teachers a chance to improve their coding skills and computational thinking and increases their interest in technologies including advanced disciplines such as AI, cybersecurity or data science.

The Czech [National Coalition for digital skills and jobs](#) (DigiKoalice) is an active partnership between public and private organisations. It has 255 members including several ministries, leading ICT companies, start-ups, NGOs and universities. The Coalition participates in the [European Digital Skills and Jobs Platform](#) and focuses in particular on education. It supports teachers, organises webinars, shares free materials and offers a catalogue of relevant training opportunities for everyone. In 2021, together with the organisation [Czechitas](#), the Coalition organised a Czech version of [DigiEduHack](#). During the competition, 12 teams had to develop a solution for a beneficial use of smartphones in the classroom.

Czechia benefits from many active organisations that provide training, and support or run initiatives in digital skills. The education reform will empower teachers and give students new opportunities to learn about digital technologies. The lack of ICT specialists remains a major obstacle. Government support for the existing successful initiatives such as the National Coalition or helping enterprises to upskill their current employees would further improve digital skills among the population.

Highlight 2021 - 2022- Central European Digital Media Observatory (CEDMO)

[CEDMO project](#) is a concrete response to the increasing volume of disinformation and misinformation in the online world. It is an international initiative, started in November 2021 and is coordinated by the Faculty of Social Sciences of the Charles University in Prague.

CEDMO is an independent non-partisan multidisciplinary hub that aims to identify, research and prioritise the most critical sources and causes of information disorders in Central Europe (mainly the Czech Republic, Slovakia and Poland). It builds upon the experience of organisations such as [Demagog.cz](#) that has been fact-checking political debates already for several years. CEDMO's main objectives are:

- Minimise the most dangerous impact of online disinformation for example on security, public health or social coherence
- Increase transparency and understanding through media and digital literacy
- Increase trust through evidence-based research and access to reliable facts and content

CEDMO connects experts from Czechia, Slovakia, Poland, France and Greece and is closely working with the European Digital Media Observatory and other similar regional hubs in the EU. It will also collaborate with the European Centre of Excellence in AI to use the AI tools and methodology to address the spread of online fake news.

[On its website](#), CEDMO offers fact-checked news stories divided into categories such as Russia's invasion of Ukraine, Covid-19, environment or economy. It also offers a toolbox with learning materials on fact-checking tools and recognition of disinformation. For experts, the website groups the most relevant reports and studies from the field.

CEDMO is one of the first initiatives that will receive support from the Czech RRP. Among others, the plan will finance the creation of a panel of minimum 2 000 people who regularly provide input for research in digital and media literacy and resilience of Czech population to disinformation.

2 Connectivity

2 Connectivity	Czechia		EU
	rank	score	score
DESI 2022	17	52.7	59.9

	DESI 2020	Czechia DESI 2021	DESI 2022	EU DESI 2022
2a1 Overall fixed broadband take-up % households	74% 2019	83% 2020	84% 2021	78% 2021
2a2 At least 100 Mbps fixed broadband take-up % households	20% 2019	24% 2020	27% 2021	41% 2021
2a3 At least 1 Gbps take-up % households	<0.01% 2019	0.27% 2020	0.77% 2021	7.58% 2021
2b1 Fast broadband (NGA) coverage % households	92% 2019	92% 2020	93% 2021	90% 2021
2b2 Fixed Very High Capacity Network (VHCN) coverage % households	29% 2019	33% 2020	52% 2021	70% 2021
2b3 Fibre to the Premises (FTTP) coverage % households	29% 2019	33% 2020	36% 2021	50% 2021
2c1 5G spectrum Assigned spectrum as a % of total harmonised 5G spectrum	17% 04/2020	67% 09/2021	67% 04/2022	56% 04/2022
2c2 5G coverage⁴¹ % populated areas	NA	0% 2020	49% 2021	66% 2021
2c3 Mobile broadband take-up % individuals	78% 2018	78% 2018	85% 2021	87% 2021
2d1 Broadband price index Score (0-100)	56 2019	59 2020	67 2021	73 2021

Czechia ranks 17th of 27 EU countries in Connectivity and its score is below the EU average. The country significantly improved its position compared to 2021 when it ranked 22nd.

On fixed networks, in 2021, Czechia experienced a significant increase in the percentage of households covered by Fixed Very High Capacity Networks – 52% compared to 33% in 2020. Although the figure places the country below the EU average for the same indicator (70%), it demonstrates an upward trend. The increase is a result of accelerated Docsis 3.1 deployment (mainly in urban areas), with 33.3% of households now covered by this technology. However, the FTTP coverage observed only a moderate

⁴¹ The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

increase to 35.8% of households in 2021 (from 33.3% in 2020). The Fixed Wireless Access (FWA) coverage also increased in 2021 to 81.4% of total households from 69.5% in 2020⁴².

Czechia is undertaking preparatory work for the implementation of the connectivity reforms in its national RRP. Regarding investments in Very High Capacity Networks, the national regulatory authority, CTU, has already conducted market mapping, while the relevant ministry has launched a public consultation on the result of this mapping. The authorities expect the call for tenders to be organised during 2022. Therefore, it is important for the authorities to accelerate their efforts given that the coverage of the fixed Very High Capacity Networks is still below the EU average.

Beyond the support from the Recovery and Resilience Facility, Czechia intends to further support building of Very High Capacity Networks in market failure areas, notably in white areas and for backhaul networks.

Czechia's strategic connectivity ambitions are outlined in the National plan for the development of Very High Capacity Networks⁴³, approved by the government on 1 March 2021. The plan focuses on the construction of infrastructure for socio-economic drivers as well as in white areas. It aims to facilitate access to download speeds of at least 100 Mbps, with the possibility to upgrade to 1 Gbps for all households, and possibly to minimum gigabit speeds (symmetrical) for businesses, state administration, local self-government and socio-economic entities. At present, the National broadband plan does not take into account the Digital Decade targets.

It is important that Czechia couples its plans for network deployment with appropriate measures that incentivise take-up. According to the data in the table above, the country experienced only a small increase in fixed broadband take-up in 2021: 84% of households subscribed to some kind of broadband connection in 2021, compared to 83% of households in 2020. This places Czechia above the EU average of 77%.

The take-up of at least 100 Mbps fixed broadband remains at 27% below the EU average of 40%. This is presenting only a small increase compared to 2020 where the figure stood at 24%. On mobile networks, 67% of total harmonised 5G spectrum has been assigned in Czechia, placing it above the EU average of 56%. The positive 5G spectrum landscape translates into 49% of populated areas in Czechia covered by 5G in 2021. This is a considerable improvement compared to no areas covered by 5G in 2020.

On 13 November 2020, the national regulatory authority announced that the auction of the 700 MHz and 3.4-3.6 GHz frequency bands was completed (frequency band 3.6-3.8 GHz had already been awarded since 2017). Five operators won spectrum, paying a total of CZK 5.6 billion (EUR 211 million).

⁴² This technology and development therein is newly not reflected in the NGA coverage for Czechia, as NGA is defined to include only VDSL, DOCSIS cable 3.0/3.1 and FTTP technologies for the purposes of the DESI report. It is to be noted that in the previous DESI reports, FWA was erroneously taken into account in the NGA coverage calculation for Czechia. Figures for all years have been restated for this report. As the FWA technology provided at a fixed location represents about 1/3 of the market in Czechia, the correction leads to a noticeable decline in the indicator value.

⁴³ https://www.mpo.cz/assets/cz/e-komunikace-a-posta/elektronicke-komunikace/koncepcie-a-strategie/narodni-plan-rozvoje-siti-nga/2021/3/149908-21_III_mat_VHCN_EN.pdf

The main mobile operators O2, T-Mobile and Vodafone obtained most of the available spectrum. According to the information supplied by the Czech authorities, there is no registered market interest for the use of the 26 GHz band.

On the development of 5G corridors (another investment planned as part of the Czech RRP), a working group of various stakeholders from government, state organisations, railway carriers and mobile operators has been set up, while the regulatory authority has carried out 4G and 5G signal coverage measurements in selected corridors, the results of which are currently being analysed. Overall, Czechia plans to finance 25 studies under the RRP related to the deployment of 5G corridors.

In addition, in cooperation with the Broadband Competence Office, Czechia plans to launch a "5G Ready Municipality" initiative in 2022 to help develop 5G networks at the local level.

Main market & regulatory developments

In two related developments demonstrating strong consolidation tendencies on the Czech market, in January 2021 Telco Pro Services, a.s. (a subsidiary of the semi-state owned energy company ČEZ) acquired three smaller ISP providers - FDLnet.cz, ISP West and TaNET West. Moreover, in July 2021, the companies (smaller ISP providers) KTN Servis s.r.o., TaNET Borsko s.r.o. and ISP West s.r.o. transferred their assets to the successor company ČEZNET, a company 100% owned by Telco Pro Services.

Czechia has notified the European Commission full transposition of the measures transposing the European Electronic Communications Code (EECC). The Commission is currently analysing the completeness and conformity of the notification.

On 18 November 2021, the Commission received a notification from the Czech national regulatory authority (NRA) concerning the wholesale market for access to mobile services⁴⁴ in Czechia. In its notification, CTU assessed that the three criteria have been cumulatively met, and the wholesale market for access to mobile services is therefore a market susceptible to ex ante regulation. Furthermore, CTU found that O2 CZ, T-Mobile CZ and Vodafone CZ hold a position of joint Significant Market Power (SMP) on the wholesale market for access and call origination on public mobile telephone networks in Czechia. CTU therefore intended to designate these three operators as having joint SMP. However, on 20 December 2021, the Commission expressed serious doubts as to whether CTU's draft measures were compatible with EU law with respect to the three criteria test and SMP designation in the wholesale market for access to mobile services in Czechia. On 17 February 2022, following the Phase II investigation, the Commission adopted a veto decision pursuant to Article 32(6) of the EECC. The Commission considered that the ex ante regulation based on the joint SMP finding is unjustified, and noted that parallel regulatory tools (e.g. enforcement of already imposed

⁴⁴ Corresponding to market 15 of Commission Recommendation 2003/311/EC of 11 February 2003 on relevant product and service markets within the electronic communications sector susceptible to ex ante regulation in accordance with the Framework Directive, OJ L 114, 8.05.2003, p. 45.

spectrum related obligations) have the potential to achieve effective competition in the market. Therefore, the Commission requested CTU to withdraw the draft measure.

CTU has identified, through its long-term monitoring efforts, the inconsistency between the often unrealistic quality parameters that are advertised within providers' commercial offers and the actual quality of internet access service. This led CTU to issue in January 2021 a regulation by which the authority established rules on the manner in which the quality parameters should be communicated to the end users.

Czechia's connectivity reforms, carried out with the help of a range of investment tools, started bringing tangible benefits in 2021 and translated into some improvements in the country's performance in connectivity. It is important that Czechia continues to adapt its regulatory landscape to ensure that it is favourable to the projected advances in connectivity. The 2030 Digital Decade targets will be a useful guiding framework for Czechia's connectivity ambitions.

3 Integration of digital technology

3 Integration of digital technology	Czechia		EU
	rank	score	score
DESI 2022	19	33.8	36.1

	Czechia		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
3a1 SMEs with at least a basic level of digital intensity	NA	NA	53%	55%
% SMEs			2021	2021
3b1 Electronic information sharing	38%	38%	38%	38%
% enterprises	2019	2019	2021	2021
3b2 Social media	20%	20%	24%	29%
% enterprises	2019	2019	2021	2021
3b3 Big data	8%	9%	9%	14%
% enterprises	2018	2020	2020	2020
3b4 Cloud	NA	NA	40%	34%
% enterprises			2021	2021
3b5 AI	NA	NA	4%	8%
% enterprises			2021	2021
3b6 ICT for environmental sustainability	NA	56%	56%	66%
% enterprises having medium/high intensity of green action through ICT		2021	2021	2021
3b7 e-Invoices	14%	12%	12%	32%
% enterprises	2018	2020	2020	2020
3c1 SMEs selling online	28%	29%	23%	18%
% SMEs	2019	2020	2021	2021
3c2 e-Commerce turnover	21%	18%	17%	12%
% SME turnover	2019	2020	2021	2021
3c3 Selling online cross-border	15%	15%	11%	9%
% SMEs	2019	2019	2021	2021

Czechia ranks 19th out of 27 EU countries in Integration of digital technology. The country is 4 positions below its ranking in 2021 (15th). The proportion of SMEs with at least a basic level of digital intensity (53%) is just slightly below the EU average (55%). The share of enterprises that use software to share information electronically between different functional areas remains stable and in line with EU average (38%). The use of two or more social media among enterprises is growing (from 20% in 2019 to 24% in 2021) but is yet to reach the EU average (29%). All the e-commerce performance indicators are above the EU average but have decreased compared to 2021. Czechia is still far from the Digital Decade target of at least 75% enterprises using cloud computing, big data or AI.

Czechia follows its main innovation strategy, '[Country for the Future](#)', which offers funding, guidance, support and legislative measures to stimulate innovation, research and integration of digital technologies. The national [RRP](#) is expected to become the key financing tool for the implementation of the Digital Czechia strategy that stimulates digitalisation across the economy and society. Czechia also implements the national [Strategy for AI](#). It is aligned with the EU coordinated plan for AI and it aims to

support excellence and research in the field, stimulate AI take-up in the economy, address AI-related ethical questions and increase the number of AI experts.

Czechia is involved in major European initiatives in the tech sector. The country helped to prepare the [Key Digital Technologies Joint Undertaking](#) and signed the [latest European declarations](#) in connectivity, clean digital technologies and better conditions for start-ups. The Ministry of Industry and Trade endorses relevant organisations participating in European tech networks such as Digital Innovation Hubs (DIHs) or sectoral testing and experimentation facilities (TEFs). Several factories in Czechia produce semiconductors. However, increasing the capacity is necessary for contributing to the Digital Decade target to ensure at least 20% of the chips world production in value are produced in the EU. The Czech Republic is also very active in the area of DLT/blockchain both on the national and EU level where it was of one of the first co-chairs of the European Blockchain Partnership and proposed the SME financing use case.

DIHs are becoming a backbone of the digital transformation of Czech enterprises. These hubs focus primarily on SMEs and start-ups. Five Czech European Digital Innovation Hub proposals have a successful evaluation result⁴⁵ and one other proposal is expected to be selected in the next year. The government plans to complete the national network with similar regional hubs. Czechia is building a European Centre of Excellence in artificial intelligence for a safer society to design model instruments for financing research and development in AI, facilitate knowledge transfers between academia and industry, and establish international cooperation in AI. In June 2021, the top Czech High Performance Computing (HPC) centre and member of the EuroHPC Joint Undertaking [IT4Innovations](#) in Ostrava installed a new peta-scale system [Karolina](#) which ranks (in June 2022) as the [24th most powerful supercomputer in Europe](#) and the [14th most energy-efficient](#) worldwide. The centre cooperates with similar European HPC institutions and will help build a pre-exa-scale supercomputer in Kajaani, Finland.

The public administration supports the digital transformation of SMEs, particularly through the [TREND](#) programme that funds industrial research and experimental development. Its objective is to increase the number of enterprises seeking to innovate and increase the use of ICT. The agency [CzechInvest](#) uses the state budget and the RRP to support start-ups. It connects entrepreneurs with investors, offers mentoring, workshops, investment incentives, helps companies to grow internationally and provides funding at different business stages. In 2021, the grocery delivery start-up Rohlik Group became Czechia's first unicorn (start-up with valuation of over USD 1 billion). The company builds on the popularity of e-commerce among Czech consumers and offers competitive delivery of groceries.

According to the [Confederation of industry and transport](#), the interest in digital transformation and Industry 4.0 among Czech enterprises is growing. 55% of enterprises plan to increase investments in digitalisation and 98% of enterprises boosted their cyber resilience in 2021. The key obstacle remains the lack of qualified ICT specialists on the job market.

The Czech government actively supports the digital transformation of its economy and society. Czechia is a stable partner in most of the key European tech alliances and networks. An active network of Digital Innovation Hubs and support programmes such as TREND are expected to increase the level of digital intensity by SMEs and thus contribute to the related Digital Decade target of having more than 90% of SMEs with at least basic digital intensity. In research and excellence, the priority areas for the country

⁴⁵I.e. are invited for grant agreement preparation (which is not a formal commitment for funding).

are AI and High Performance Computing. The lack of digital experts is preventing companies to progress more dynamically, especially SMEs.

4 Digital public services

4 Digital public services ⁴⁶	Czechia		EU
	rank	score	score
DESI 2022	17	64.5	67.3

	DESI 2020	Czechia DESI 2021	DESI 2022	EU DESI 2022
4a1 e-Government users % internet users	61% 2019	64% 2020	76% 2021	65% 2021
4a2 Pre-filled forms Score (0 to 100)	NA	NA	41 2021	64 2021
4a3 Digital public services for citizens Score (0 to 100)	NA	NA	75 2021	75 2021
4a4 Digital public services for businesses Score (0 to 100)	NA	NA	81 2021	82 2021
4a5 Open data % maximum score	NA	NA	74% 2021	81% 2021

Czechia has improved its ranking in digital public services from 20th position in 2021 to 17th in 2022. In 2021, the share of e-government users grew significantly by 12 percentage points to 76%⁴⁷ and is now well above the EU average (65%). In the pre-filled forms, Czechia's score remains low (41) but in the digital public services for citizens (75) and businesses (81) the scores are in line with the EU average.

Digital transformation of public services is one of the new government's main priorities and for the first time since 2007, a member of the Cabinet - [Ivan Bartos](#) (Pirate party) - is responsible for it.

The first tangible reform that the new Cabinet plans to set out is the creation of a central e-government competence team to coordinate the digital transformation of public administration. As of 2022, this central authority is expected to ensure interinstitutional alignment, interoperability between systems and common standards in architecture, design and functionalities of new or upgraded digital public services. The government aims to reform data management, foster the use of open data and transform central data registers into an interconnected data pool that will strengthen the 'once-only' principle. The government also plans to adjust the job and salary conditions to attract more IT experts to work on the digital transformation of public administration. To ensure the country is fully aligned with the Digital Decade strategy, it is important to improve cross-border interoperability.

For many years, inefficient IT procurement was one of the main issues of Czech public administration. The government plans to target the cases involving vendor lock-in and to conduct rollout measures to

⁴⁶ There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

⁴⁷ Break in series between 2021 and 2022 due to a reformulation of the survey questionnaire in Czechia

make IT procurement more efficient. Public institutions should also get the possibility to re-use IT systems that have been tendered by another institution.

In 2021, the National Cybersecurity Agency (NUKIB) produced an [Action plan](#) for 2021-2025 that complements the [National cybersecurity strategy](#). The plan sets out over 100 actions to make central and critical IT systems more resilient, prevent and track cybercrime, increase cybersecurity skills, foster international collaboration and ensure cyber-secured digital infrastructure. The plan also contains specific measures to strengthen cybersecurity in healthcare and secure systems in telecommunication infrastructure.

More than [5 million people](#) living in Czechia have at least one of 13 eID means to access e-government services. 3 of the means (eOP, MojeID and MEG) are notified to the European Commission under the eIDAS Regulation. Most of these means are provided by banks following the national [bank identity standard](#) introduced in 2021. This solution allows people to use their online banking ID to access public services such as the Citizen's or the Tax portal. Some 330 000 users are registered on the Citizen's Portal (the number more than doubled since 2021) and the authorities report 22 000 accesses per week on average. Further expanding the use of electronic identification solutions among the public will help Czechia reach the corresponding Digital Decade target of at least 80% of citizens using a digital ID.

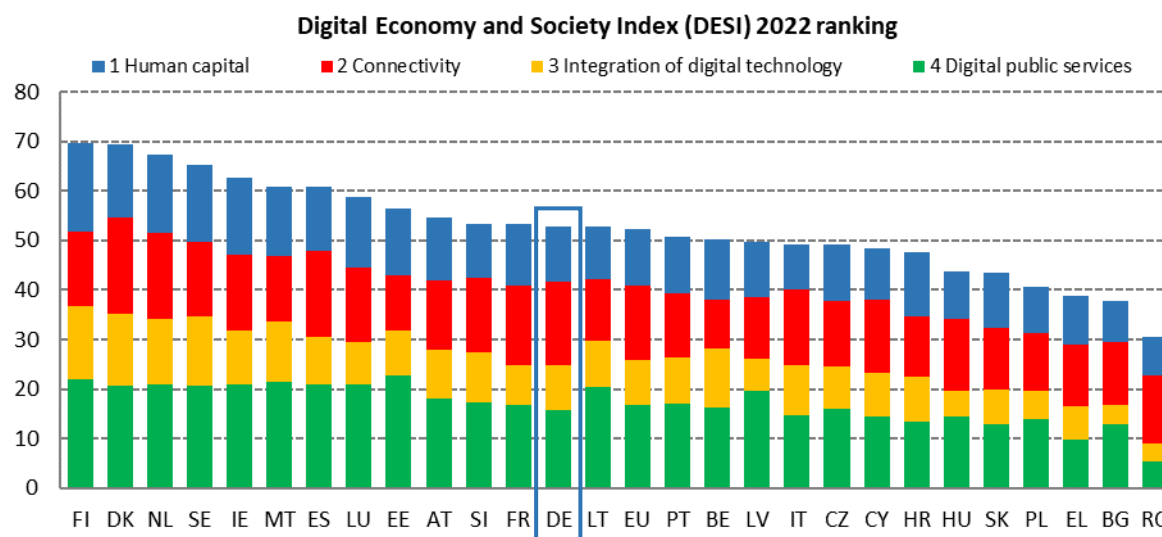
As of 2025, Czechs will have the right to use public services digitally. To reach this objective, the government has almost completed the catalogue of public services that will need to undergo digital transformation. The roadmap towards achieving this milestone in 2025 is explained in the digitalisation plan adopted by the government. Financing will come from the RRP, EU regional funds and the state budget based on the implementation of the [Digital Czechia](#) programme. This law and related measures will make all the key public services accessible digitally and thus help Czechia to fulfill the objectives of the Digital Decade strategy. By 2023, people will be allowed to replace plastic ID cards and driver's licence with a virtual card in a mobile app to stimulate interest in digital public services. This simple solution will allow everybody to directly experience the benefit of using e-government services.

The healthcare system is undergoing digital transformation following the adoption of a [dedicated law](#) in 2021. The number of medical facilities with electronic medical records is gradually increasing and the Ministry of Healthcare is involved in the EU-funded [X-eHealth](#) project that aims to develop a common standard for health data to enable cross-border interoperability.

The digitalisation of public services is an important priority for the new government. The first domain of action targets users and will help to raise interest in using public services through phones or computers. Bank identity or the electronic prescriptions already show the appetite of end users. The second domain aims to transform internal processes, enable data-sharing and make IT procurement more efficient. A major challenge is to ensure complementarity of actions in both of these domains and ensure a coherent delivery of the new solutions.

Germany

	Germany		EU
	rank	score	score
DESI 2022	13	52.9	52.3



Germany ranks 13th of 27 EU Member States in the 2022 Digital Economy and Society Index (DESI). Germany progressed relatively well in the last five years (2017-2022).⁴⁸ As the EU's largest economy, Germany's progress with digital transformation in the coming years will be crucial, to enable the EU as a whole to reach its 2030 Digital Decade targets.

Germany shows a mixed performance on Human capital. The level of basic digital skills and basic digital content creation skills⁴⁹ is slightly below the EU average. However, the share of information and communications technology (ICT) specialists is above the EU average.

On Connectivity, the country performs well. Its fixed very-high-capacity network (VHCN) coverage has improved significantly. At 75%, it is now above the EU average. This counts as a major progress towards the Digital Decade target of all households covered by gigabit networks by 2030. However, Germany is still lagging behind in fibre coverage (at 15.4%, it is ranked among the last Member States in the EU), and the urban-rural digital divide persists (rural fibre coverage is 11.3%, rural VHCN is 22.5%). The country ranks 4th among EU Member States in 5G coverage with 87% of populated areas.

As regards the Integration of digital technology by businesses, most indicators are close to the EU average. There is room for improvement, and Germany has some way to go before it meets the Digital

⁴⁸ Refer to section 1.3 of the DESI 2022 horizontal chapter.

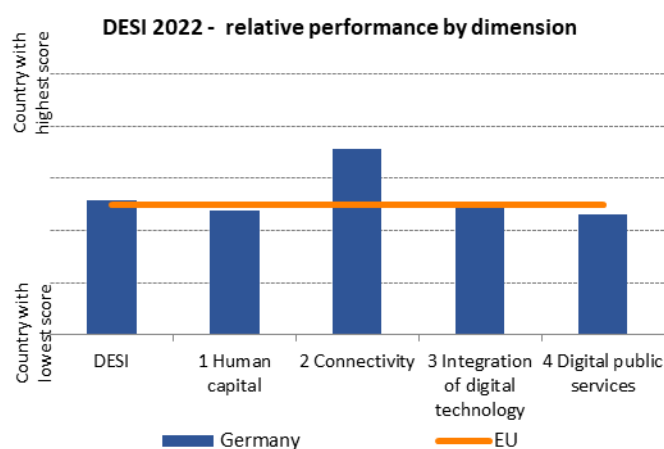
⁴⁹ Germany adapted its reporting in accordance with Eurostat methodology, therefore 2022 DESI take-up figures cannot be compared with figures from previous DESI reports. This change in methodology is unique for Germany.

Decade target of 90% of small and medium-sized enterprises (SMEs) reaching a basic level of digital intensity.

Performance on Digital public services is mixed. Germany scores well on open data, but interaction between the government and the public could be improved. Germany needs to continue with the work it is doing to achieve the Digital Decade target of 100% online provision of key public services for European citizens and businesses.

The new German government took office in December 2021 and set out its digital priorities in the Coalition agreement⁵⁰. Digitalisation is a key priority for the new government, building on the digital dimension of the Recovery and Resilience Plan adopted by the previous government. The implementation strategy 'Shaping Digitalization', adopted on 15 November 2018, is a strategic umbrella covering more than 140 central digital policy projects in five fields of action: digital competence, infrastructure and equipment, innovation and digital transformation, society in the digital transformation and the modern state. By October 2021, over 90% of the implementation steps had been started, of which 44% have been completed. The interactive digital policy dashboard '[digital made in de](#)', tracks progress on each measure covered by the strategy and other German digital strategies (artificial intelligence (AI), blockchain and data strategies), as well as impact indicators for digital policies. The dashboard helps to ensure transparent, verifiable and evidence-based digital policy in Germany.

The new government is working on an overarching digital strategy under which the strategies and measures of the ministries will be classified.



As a response to Russia's invasion of Ukraine in the digital domain, Germany complies with the EU sanctions regarding RT and Sputnik. The German government is communicating actively on the war, e.g. via a theme page of the Federal Agency of Civic Education.⁵¹ To counter disinformation regarding the war, several German ministries provide information on disinformation and links to fact checkers on their homepages. The German government is in continued exchange with operators of platforms and social networks, in order to sensitize them to state-controlled disinformation and to ensure that the government is kept informed when measures are taken.

⁵⁰ [Koalitionsvertrag 2021-2025.pdf \(spd.de\)](#), from page 15.

⁵¹ [Krieg in der Ukraine | bpb.de](#)

The Federal Ministry of the Interior and Community has set up the centralized portal '[Germany4Ukraine](#)' as a secure and reliable digital source of information for people fleeing Ukraine. It bundles information for entering and getting oriented in Germany and provides an overview of the assistance available. The information is provided in Ukrainian, Russian, English and German. Cooperation with further civil and private sector actors is intensified in order to develop the platform towards a 'one-stop-shop' of information for those fleeing Ukraine.

In the context of the war, the potential threat represented by cyber-attacks within Germany has increased. Thus, the Federal Office for Information Security (BSI) conducts an extended cybersecurity monitoring. The BSI and the competent authorities have raised the awareness of relevant German organizations, particularly critical infrastructure operators, of the heightened threat situation and made comprehensive recommendations for action.

Digital in Germany's Recovery and Resilience Plan (RRP)

Digital is the main focus for Germany's RRP. From a total budget of EUR 26.5 billion⁵², more than 50% is allocated to digitalisation⁵³. The plan features two major multi-country 'important project of common European interest' (IPCEI) on digitalisation: Microelectronics and Communication Technologies, and Next Generation Cloud Infrastructure and Services (IPCEI-CIS).

Three out of the four DESI pillars are addressed in the plan, while goals relating to Connectivity, the second DESI pillar, are financed by Germany alone. Developments in 2022 relating to the digital measures in the plan are detailed below.

On Digital skills, the plan includes investments in teacher terminal equipment, an education platform, educational centres of excellence, and modernisation of the Federal Armed Forces' educational institutions. At least EUR 475 000 000 are expected to be disbursed to the teacher terminal equipment projects. Funding guidelines for education platform prototypes are expected to enter into force and the procurement process is expected to be started. The first funding guidelines for educational centres of excellence is expected to enter into force and a call for tenders is expected to be launched for an agency to implement projects for the whole programme. An analysis of the Federal Armed Forces' educational institutions is expected to be carried out and their IT needs identified.

Investments relating to the Digitalisation of businesses and the development and integration of advanced digital technologies are included in several measures. Funding guidelines for the vehicle manufacturer/supplier investment programme were published in 2021. For the measure on building continuing education and training (CET) networks at least 200 additional businesses are expected to be actively involved in CET networks by end 2022. Research projects are supported by the Centre for Digitalisation and Technology Research of the Federal Armed

⁵² This is the net amount excluding value-added tax.

⁵³ Each recovery and resilience plan has to dedicate at least 20% of the plan's total allocation to digital objectives. To this end, the plans had to specify and justify to what extent each measure contributes fully (100%), partly (40%) or has no impact (0%) on digital objectives, using Annex VII of the RRF Regulation. Combining the coefficients with the cost estimates of each measure allows assessing to what degree the plan contributes to digital objectives and whether it meets the 20% target.

Forces. All projects relating to the measure on innovative data policy are expected to have started by the end of 2022. For the cloud IPCEI, potential projects and project participants are expected to have been identified, and research, development and innovation projects should be launched by the end of 2022. For the microelectronics IPCEI, 10 grant decisions should be signed by the end of 2022.

Digitalisation of public services, accounting for more than 50% of digital investment under the plan, is supported by a number of measures in the 'Modern public administration' component. In 2021, the first pilot application was launched for the 'European identity ecosystem' measure. At least four additional application cases, each with at least 10 000 users, are expected to be fully implemented in 2022. For implementation of the Online Access Act, at least 70 public service bundles were due to be online to the general public by end 2021, and widespread digitalisation of federal administrative services as one-for-all services is expected by the end of 2022. As regards the measure on modernisation of registers, pilot projects to test pilot registers are due to be completed by the end of 2023.

The Digital Pension Overview Act (*Gesetz Digitale Rentenübersicht*) came into force in 2021, supporting the digital pension overview measure. For the rail digitalisation measure, seven pilot projects were expected to be completed by the end of 2021.

Two public-health measures are relevant: as part of the measure on digital and technical strengthening of the public health service, public-health offices' progress towards digital maturity will be monitored in 2022 and, under the programme to future-proof hospitals, the Federal Office for Social Security is estimated to have received applications worth at least EUR 2.7 billion for hospital projects by the end of 2021. The 'Reducing barriers to investment' component, also features reform measures, aimed at facilitating and speeding up public investment.

1 Human capital

1 Human capital	Germany		EU
	rank	score	score
DESI 2022	16	45.0	45.7

	DESI 2020	Germany DESI 2021	DESI 2022	EU DESI 2022
1a1 At least basic digital skills % individuals	NA	NA	49% 2021	54% 2021
1a2 Above basic digital skills % individuals	NA	NA	19% 2021	26% 2021
1a3 At least basic digital content creation skills⁵⁴ % individuals	NA	NA	65% 2021	66% 2021
1b1 ICT specialists % individuals in employment aged 15-74	4.0% 2019	4.7% 2020	4.9% 2021	4.5% 2021
1b2 Female ICT specialists % ICT specialists	17% 2019	18% 2020	19% 2021	19% 2021
1b3 Enterprises providing ICT training % enterprises	32% 2019	24% 2020	24% 2020	20% 2020
1b4 ICT graduates % graduates	4.9% 2018	4.5% 2019	4.9% 2020	3.9% 2020

On Human capital, Germany ranks 16th out of 27 EU countries, below the EU average. Basic digital skills and basic digital content creation skills levels⁵⁵ are slightly below the EU average. ICT specialists account for 4.9% of the workforce (compared to the EU average of 4.5%), and 4.9% of all graduates are ICT graduates (compared with the EU average of 3.9%). At 19%, the proportion of female ICT specialists is as high as the EU average. Among German enterprises, 24% offered specialised ICT training to their employees in 2020.

In June 2021, the first implementation report⁵⁶ on the German national skills strategy⁵⁷ was published. The report detailed progress in the 10 action fields identified in the strategy (adopted in 2019). The new German government has given a clear indication to continue with the strategy. More than three quarters of the agreed measures and initiatives were implemented or launched by June 2021 and are documented in the implementation report.

The digitalisation of education is also one of the six priority areas in the German RRP, with three measures of particular relevance here: the investment programme for teacher devices, the education platform and educational centres of excellence.

⁵⁴ Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

⁵⁵ Germany adapted its reporting in accordance with Eurostat methodology, therefore 2022 DESI take-up figures cannot be compared with figures from previous DESI reports. This change in methodology is unique for Germany.

⁵⁶ [Umsetzungsbericht: Nationale Weiterbildungsstrategie \(bmas.de\)](https://www.bmas.de/SharedDocs/DESI/Umsetzungsbericht-Nationale-Weiterbildungsstrategie.pdf?__blob=publicationFile)

⁵⁷ [Nationale Weiterbildungsstrategie - BMBF](https://www.bmbf.de/SharedDocs/DESI/Nationale-Weiterbildungsstrategie.pdf?__blob=publicationFile)

In 2021, projects worth over EUR 2 billion were approved under the Digital Pact for Schools (*DigitalPakt Schule*) for building digital infrastructure and supporting the digital transformation of schools. The federal government and the federal states agreed to allocate EUR 5 billion in federal funding to the pact between 2019 and 2024. The aim is to equip all general and vocational schools with modern digital infrastructure. In the exceptional situation caused by the Corona pandemic, the federal government and the federal states have concluded supplementary agreements to the existing funding guidelines. The federal states will receive additional support in the form of an ‘immediate equipment programme’ for terminal equipment in schools, an agreement to promote the administration of IT in schools, and the programme for loaning equipment to teachers. The federal government is providing EUR 500 million for each of these programmes, while the federal states are contributing at least 10%, thus leading to around EUR 7.5 billion federal funds for the Pact. In addition, the federal states are stepping up their efforts to train teachers in digital teaching and learning.

The German federal Government has set up a programme for CET Networks that provides financial support to pilot projects. The aim is to involve SMEs more in CET measures and to strengthen regional economic and innovation networks. These are networks in which several companies, regional labour market players and actors in the CET landscape cooperate. The focus here is on the identification of CET training needs in the companies as well as advice on and research into suitable training programmes or the conception of new ones in accordance with the identified needs of the companies. The first networks started in December 2020. In 2022 a total of over 50 networks are expected to receive funding.

The Federal Government initiated the innovation competition INVITE. INVITE aims at innovative solutions that – with the help of AI – enable all people to find the right continuing professional training on demand.

The Federal Government has launched the ‘hubs for tomorrow’ to support companies, esp. SMEs, and employees with custom-fit counseling and innovative learning approaches. Furthermore, SMEs are supported in introducing human-centred AI-based systems together with their employees. The first ‘regional hubs for tomorrow’ started their work at the end of 2019 and several more have been established in 2021.

The Federal Ministry of the Interior and Community supports the ‘Germany secure in the network’ initiative (*Deutschland sicher im Netz e.V.*), which launched a programme in March 2022, called *DsiN-Digitalführerschein*⁵⁸, to raise the level of digital skills and competencies among the general public to help them become more involved in the digitalised society. The programme provides free, interactive online courses to develop digital skills for use in professional and private contexts. Certificates are issued so that participants have evidence of their digital skills to show employers.

To promote more women in science, technology, engineering and maths (STEM) professions, and as ICT specialists, in 2008 the Federal Ministry for Education and Research (BMBF) launched the ‘National pact for women in STEM’. It has more than 300 members: STEM education initiatives, universities, R&D, engineering associations, employers’ federations, job centers and industry. Since 2021, the pact is embedded into the activities of the federal STEM agency called ‘STEM connected’ (*MINT vernetzt*), funded by the BMBF, in order to boost its impact. In addition, the BMBF provides ongoing support for

⁵⁸ [DsiN-Digitalführerschein \(DiFü\) - DiFü \(xn--dif-joa.de\)](https://xn--dif-joa.de)

measures to encourage young women to study ICT sciences, which helps to increase the number of female graduates.

Germany does not have a national Digital Skills and Jobs Coalition. The country participated actively in the 2021 EU Code Week⁵⁹, organising 997 events involving 26 777 participants, of whom 42% were girls or women. Some 15% of the activities involved schools⁶⁰.

Digital skills are the focus of several measures in Germany, including the German RRP, covering areas such as teacher training, upskilling and reskilling the workforce, CET, increasing the number of ICT specialists and narrowing the gender gap. These measures are already showing results in some of the indicators.

⁵⁹ [EU Code Week breaks record for number of activities in 2021 with 78,000 events | Shaping Europe's digital future \(europa.eu\)](#)

⁶⁰ [4 million people created code as part of EU Code Week in 2021](#)

2 Connectivity

2 Connectivity	Germany		EU
	rank	score	score
DESI 2022	4	67.3	59.9

	Germany		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
2a1 Overall fixed broadband take-up	88%	92%	82%	78%
% households	2019	2020	2021	2021
2a2 At least 100 Mbps fixed broadband take-up	21%	28%	29%	41%
% households	2019	2020	2021	2021
2a3 At least 1 Gbps take-up	0.15%	1.12%	2.46%	7.58%
% households	2019	2020	2021	2021
2b1 Fast broadband (NGA) coverage	92%	95%	96%	90%
% households	2019	2020	2021	2021
2b2 Fixed Very High Capacity Network (VHCN) coverage	33%	56%	75%	70%
% households	2019	2020	2021	2021
2b3 Fibre to the Premises (FTTP) coverage	11%	14%	15%	50%
% households	2019	2020	2021	2021
2c1 5G spectrum	67%	100%	100%	56%
Assigned spectrum as a % of total harmonised 5G spectrum	04/2020	09/2021	04/2022	04/2022
2c2 5G coverage⁶¹	NA	18%	87%	66%
% populated areas		2020	2021	2021
2c3 Mobile broadband take-up	89%	89%	87%	87%
% individuals	2018	2018	2021	2021
2d1 Broadband price index	75	75	80	73
Score (0-100)	2019	2020	2021	2021

On Connectivity, Germany ranks 4th of the 27 EU countries. For fixed networks, Germany has made progress on most connectivity indicators in 2021. Germany has reached 96% coverage of fast broadband, providing a solid basis for digital participation in society and the economy. Although rural coverage has significantly improved since 2019, from 75% to 85%, well above the EU average of 67.5%, Germany still has a clear digital divide between urban and rural areas. Compared to other EU Member States, Germany performs particularly well on overall fixed broadband take-up and broadband prices. In the broadband pricing index (based on representative baskets of fixed, mobile and converged packages, adjusted for national household income levels), Germany ranks 8th in the EU.

As to preparedness for the Gigabit society, Germany has significantly improved very high-capacity network (VHCN) coverage over the last year from 55.9% in 2020 to 74.9% in 2021 and is currently above

⁶¹ The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

the EU average of 70.2%. However, the country is still lagging in deploying VHCN in rural areas (with a coverage of 22.5% versus 37.1% EU average) and only 15.4% of households have access to a Fibre to the Premises (FTTP) connection (compared to an EU average of 50%), which places Germany among the Member States with the second lowest fibre coverage, while the top five EU performers have a fibre coverage of 85% or more. The lack of fibre connections is accentuated in rural areas where coverage stands at 11.3% versus an EU average of 33.8%. Further roll-out of fibre will have a crucial role to play in meeting the 'Gigabit for everyone' target⁶², as most cable networks have already been upgraded to the DOCSIS 3.1 standard allowing for gigabit capacities. Also, the quality of in-house-cabling will be critical where fibre has been rolled out to the premises or to the property, but not to the network termination points located within individual flats in multiple dwelling units or within the living areas of single dwelling units.

In total, the Federal Government provided [EUR 12 billion](#) to subsidise fibre connections. With the start of the Gigabit programme in April 2021, funding was expanded to cover also the grey NGA areas. Apart from fibre connections for households, the programme aims at the expansion of gigabit connections for socio-economic drivers such as businesses, hospitals, administrative services, transport hubs and fibre connections to schools. A separate programme, the '[Digital Classroom](#)' initiative focusses on connecting schools to broadband networks. Altogether, around 11 700 schools receive funding. In addition to the general national broadband aid schemes, many German regions have separate funding schemes. A [gigabit strategy](#) to implement the objectives of the coalition agreement with regard to digital infrastructure was adopted on 13 July 2022. It includes promising goals on the availability of Fibre to the Premises (FTTP) for all German households by 2030, and of 15 million new FTTP connections by the end 2025. A revised funding programme is currently elaborated to come into effect in 2023. It takes into account, among others, the [expected more comprehensive funding possibilities](#) in the state aid framework. It takes into account, among others, the [expected more comprehensive funding possibilities](#) in the state aid framework.

On mobile connectivity, Germany performs particularly well on 5G spectrum and on 5G coverage, ranking 4th in the EU on the latter. All three incumbent operators are rolling out 5G and the new entrant is preparing to roll out its 5G network. With 87% of populated areas covered, Germany is progressing well towards nationwide 5G coverage. Notably, 49.4% of all populated rural areas have 5G coverage. Overall, [57.5%](#) of Germany's territory was covered by 5G in January 2022. Progress in this area is important for achieving the [EU Digital Decade targets](#). [Standalone 5G](#) network introduction started in 2021, allowing for gigabit speeds and low latency. By January 2022, 5G was available from the three Mobile Network Operators (MNOs) (Deutsche Telekom, Vodafone and Telefónica) in the 3.4-3.7 GHz frequency range. By March 2022, the German regulatory authority, the *Bundesnetzagentur* (BNetzA), had granted about 200 assignments for 5G campus and industrial networks in the 3.7-3.8 GHz band and ten assignments in the 24.25-27.5 GHz band. The Federal mobile funding scheme (budget: EUR 1.1 billion) aims to ensure 5G-capable mobile sites with at least 4G-coverage in white spots that currently have no or only 2G connectivity. In 2021, the Mobile Communications Infrastructure Company (*Mobilfunkinfrastrukturgesellschaft* - MIG) has completed 111 public consultations. The evaluation showed, that more than half of the target areas will be covered on own accounts by the MNOs. The remaining areas are eligible for funding and are being prepared by the MIG (e.g. search for sites and

⁶² This is the EU target for 2030, please see [link](#).

usable land for mobile phone masts, preparation of approval procedures and identification of suitable delivery points for fibre optic connections). Some German regions run separate funding schemes.

Main market & regulatory developments

In November 2021, Deutsche Telekom announced it would be cooperating on network rollout with the financial investor 'IFM investors'. A joint venture, '*GlasfaserPlus GmbH*' is to be set up to provide four million households with fibre-to-the-home connections, targeting rural and subsidised areas. Telefónica group and the insurance company Allianz AG have created the joint venture '*Unsere Grüne Glasfaser*' to invest up to EUR 5 billion to connect about 2.2 million households with fibre, mainly in rural and in underserved areas. In December 2021, the fibre operator Deutsche Glasfaser announced that, with backing from a consortium of creditors, it would be investing EUR 5.75 billion in a fibre roll-out to four million households.

As to market shares, Deutsche Telekom's competitors increased their market share in the broadband market by a small margin, to 61.2% at the end of 2020.

The new Telecommunications Act (*Telekommunikationsgesetz*, [TKG](#)) implements the [European Electronic Communications Code](#) and [entered into force on 1 December 2021](#). It includes notably the phasing-out of the option for landlords to charge for TV and broadband subscriptions as part of a rental contract. The option will be withdrawn by mid-2024. The regulatory authority BNetzA is putting into practice the strengthened end-user's rights for universal service. Moreover, BNetzA will set out the technical specifications for providing universal telecommunications services through an ordinance, for approval by the Federal government as well as by the German legislators (*Bundestag and Bundesrat*). BNetzA had commissioned studies to determine the bandwidth and latency needed to accommodate the minimum services defined by law. Under the TKG, providers must offer universal telecommunication services at affordable prices for consumers. The [public consultation](#) closed at the end of January 2022 and BNetzA intends to publish guidelines for determining affordable prices. Universal service is being financed through a sectoral funding mechanism whereby companies obliged to provide universal services are entitled to compensation if the net cost imposes an unreasonable burden on them.

On market regulation, in February 2021, BNetzA de-regulated the market for call origination in fixed networks⁶³, prompted by increased competition in the market and facilitated by market players' agreement to temporarily continue providing the relevant wholesale products.

For some older types of leased lines⁶⁴, Deutsche Telekom has applied to BNetzA to lift existing wholesale obligations because the technology has reached the end of its lifetime. BNetzA is examining the issue and is analysing which products could be appropriate replacements.

On 2 September 2021, the European Court of Justice (ECJ) found that the 'StreamOn' offer of Deutsche Telekom and 'Vodafone Pass' were not in line with Net Neutrality rules and violated the principle of non-discrimination for all data transmission, regardless of the service for which

⁶³ Market 2 of the 2007 Recommendation on Relevant Markets

⁶⁴ More specifically, Synchronous Digital Hierarchy leased lines

the transmission is used. The ECJ rulings are binding for NRAs. BEREC is currently updating its Open Internet Guidelines in the light of the ECJ decisions. BNetzA has to take utmost account of these guidelines (expected to be published by mid-June 2022) and will accordingly enforce the ECJ rulings.

Germany is preparing to monitor the level of electromagnetic fields (EMF) and is exploring approaches for monitoring the exposure of the public to such fields.

Together with the digital divide between urban and rural fixed VHCN coverage and the take up of high speed services, the main challenge for Germany is the timely rollout of fibre networks to achieve the Digital Decade targets, notably the full coverage of all German households by 2030. Increasing the capacity of the civil works sector is crucial. In particular, the workforce needs more people who are qualified to plan and manage physical works, in order to accelerate non-subsidised private roll-out and to implement the increasing number of new investment projects. Roll-out would also be facilitated by advancing the standardisation of alternative, less time-consuming digging techniques for laying fibre cables, and by faster, simpler permit granting procedures in the public sector, specifically at municipality level.

3 Integration of digital technology

3 Integration of digital technology	Germany		EU
	rank	score	score
DESI 2022	16	35.8	36.1

	DESI 2020	Germany DESI 2021	DESI 2022	EU DESI 2022
3a1 SMEs with at least a basic level of digital intensity % SMEs	NA	NA	59% 2021	55% 2021
3b1 Electronic information sharing % enterprises	29% 2019	29% 2019	38% 2021	38% 2021
3b2 Social media % enterprises	23% 2019	23% 2019	30% 2021	29% 2021
3b3 Big data % enterprises	15% 2018	18% 2020	18% 2020	14% 2020
3b4 Cloud % enterprises	NA	NA	32% 2021	34% 2021
3b5 AI % enterprises	NA	NA	11% 2021	8% 2021
3b6 ICT for environmental sustainability % enterprises having medium/high intensity of green action through ICT	NA	57% 2021	57% 2021	66% 2021
3b7 e-Invoices % enterprises	17% 2018	18% 2020	18% 2020	32% 2020
3c1 SMEs selling online % SMEs	17% 2019	17% 2020	19% 2021	18% 2021
3c2 e-Commerce turnover % SME turnover	10% 2019	11% 2020	10% 2021	12% 2021
3c3 Selling online cross-border % SMEs	10% 2019	10% 2019	10% 2021	9% 2021

Germany ranks 16th in the EU on Integration of digital technology in business activities. Germany's performance for most indicators in this dimension is close to the EU average, including SMEs with at least a basic level of digital intensity and the uptake of advanced technologies by enterprises such as cloud, big data and artificial intelligence. Still, there are areas where German businesses score considerably below the EU average are e-invoices (18% compared to the EU average of 32%) and ICT for environmental sustainability (57% compared to 66%).

Germany has introduced a number of strategies, initiatives and activities to support the digital transformation of companies and the deployment and uptake of advanced technologies. Several measures are specifically tailored to SMEs. The current focus is largely on the continuation or further development of existing measures. In the coalition agreement, the newly-elected government made a pledge to create a friendlier environment for (digital) start-ups.

Recent activities have centred around advanced technologies, in particular IPCEIs on Microelectronics (see highlight box below) and on Next generation cloud infrastructure and services (IPCEI-CIS). The

German RRP allocated a budget of EUR 750 million for IPCEI-CIS. This IPCEI aims to support innovative research and development as well as first industrial deployment projects for cloud infrastructure and services. Among the Member States, 12 are participating in the project.

Another significant work strand related to cloud is the Gaia-X project, aimed at setting up interconnected and trustworthy cloud and edge infrastructure. The first implementation projects are starting: as part of the 'Gaia-X funding competition', 11 consortia were selected to provide safe data infrastructure in several areas including e-health, mobility and construction. Funding of around EUR 117 million will be spent up to the end of 2024. Additional projects are expected to start in 2022.

Germany adopted an artificial intelligence strategy in November 2018 (updated in 2020), with planned investments amounting to EUR 5 billion up to 2025. The focus is on: increasing computing capacity; building AI ecosystems especially for research, skills and research transfer to SMEs in particular; and attracting AI experts and talent to support the development of a competitive European AI network. As of 2022, five AI research competence centres⁶⁵ have been made permanent, to establish an AI research and training network in Germany.

In the field of quantum computing, Germany has launched several business and application-oriented initiatives and projects recently. One example is the call Quantum Computing Demonstrators (*Quantencomputer-Demonstrationsaufbauten*) launched in May 2021⁶⁶. It has a total budget of about EUR 300 million until 2026 and funds eight projects to realize cloud-accessible quantum computers based on different technologies. This measure is accompanied by the call Application Network for Quantum Computing which funds nine projects that develop quantum algorithms and software for use cases exploring the potential of quantum computing in different areas such as energy networks or industrial manufacturing.

Germany is participating in the European Blockchain Partnership (EBP) and the European Blockchain Services Infrastructure (EBSI). The regulatory authority (*Bundesnetzagentur*) has hosted its own EBSI node since 2020.

With the 'SME digital' initiative (*Mittelstand-Digital*) Germany is continuing its activities to support businesses and especially SMEs in their digital transformation. This approach consists of three strands: the SME digital centres of excellence network (*Mittelstand 4.0 Kompetenzzentren and the new Mittelstand-Digital Zentren*)⁶⁷, the investment support scheme Digital Now (*Digital Jetzt*)⁶⁸ and the initiative on cybersecurity for SMEs (*IT-Sicherheit-in-der-Wirtschaft*).⁶⁹

There are currently 26 SME centres of excellence, each with a regional or industry-specific focus. The centres support SMEs free of charge in identifying and implementing suitable digital solutions. One central role of the centres' is to provide SME staff with training on digital technologies. The Centres also identify and develop best practice projects together with SMEs to demonstrate possible digital solutions. As a part of the AI strategy of November 2018 (see above), 19 centers of excellence have extended their support with 'AI Trainers' (KI-Trainer).

⁶⁵ [Karliczek: Mit der Verstetigung der KI-Kompetenzzentren gehen wir den nächsten großen Schritt hin zur KI-Nation - BMBF](#)

⁶⁶ [Bekanntmachung – BMBF – Förderung von Projekten zum Thema 'Quantencomputer-Demonstrationsaufbauten'](#)

⁶⁷ [Mittelstand Digital - Die Zentren im Netzwerk Mittelstand-Digital unterstützen vor Ort](#)

⁶⁸ [BMWK - „Digital Jetzt“ – Neue Förderung für die Digitalisierung des Mittelstands](#)

⁶⁹ [IT Sicherheit - Startseite \(it-sicherheit-in-der-wirtschaft.de\)](#)

The digital now programme (*Digital Jetzt*) has provided 2 800 SMEs with financial support for digital skills and technologies projects. From September 2020 to the end of 2021, it invested around EUR 280 million in total. Financial support was increased in 2021, bringing the total support available up to 2024 to about EUR 460 million⁷⁰.

The Cybersecurity strategy for Germany 2021⁷¹ updated the strategies from 2011 and 2016. It forms the strategic framework for the federal government's action in the field of cybersecurity for the next five years. Furthermore, the strategy is subject to continuous improvement and the goals of the new federal government are incorporated. The federal government has also launched a new research framework programme on IT security 'Digital. Secure. Sovereign.' in 2021, which will continue to systematically drive forward IT security research in Germany. The Cybersecurity for SMEs initiative (*IT-Sicherheit in der Wirtschaft*) assists SMEs in increasing IT Security, including support on individual action plans.

Digital innovation hubs are currently being selected to be part of the network of European Digital Innovation Hubs (EDIHs). 14 German European Digital Innovation Hub proposals have a successful evaluation result⁷², two additional proposals are expected to be selected next year and four additional proposals have received a Seal of Excellence. These hubs will provide access to technical expertise and experimentation for businesses.

The funding guidelines for the 'go digital' consultancy services programme have been updated. Since January 2022, 'go digital' also supports SMEs in developing a digitalisation strategy and data skills. The funding volume for the updated programme amounts to EUR 72 million up to the end of 2024.⁷³

Germany is investing considerably in cutting-edge technologies (AI, quantum, cloud and microelectronics) and is a driver of European cooperation in this field. This is also important for reaching the Digital Decade target of 75% of enterprises using cloud, AI and big data. Further support for the digitalisation of SMEs will help them on the path to digital transformation.

Highlight 2021-2022: Important Project of Common European Interest (IPCEI) on Microelectronics and Communication Technologies led by Germany

Germany participated with France, Italy, the United Kingdom and subsequently Austria in the first IPCEI on microelectronics providing funding of up to EUR 1 billion for 18 companies.⁷⁴

The second IPCEI on microelectronics (included in the DE RRP) is the flagship project for the joint declaration on 'A European initiative on processors and semiconductor technologies' signed by 22 EU Member States in December 2020. It aims to strengthen the microelectronics ecosystem in Germany and Europe while focusing on the development of high-performance, energy-efficient and secure chip production. Financial support for the German semiconductor industry is also included in the coalition agreement of the new German government.

Currently, 20 Member States are actively involved in the design of the IPCEI. Germany is

⁷⁰ BMWK - „Digital Jetzt“ – Neue Förderung für die Digitalisierung des Mittelstands ([bmwi.de](https://www.bmwk.de))

⁷¹ BMWK - IT-Sicherheit ([bmwi.de](https://www.bmwk.de))

⁷² I.e. are invited for grant agreement preparation (which is not a formal commitment for funding).

⁷³ BMWK - „Wir müssen den deutschen Mittelstand besser bei der Digitalisierung unterstützen“ – „go-digital“ wird bis 2024 verlängert ([bmwi.de](https://www.bmwk.de))

⁷⁴ IPCEI on Microelectronics – Important Project of Common European Interest (ipcei-me.eu)

coordinating the process at European level, with 112 direct participants and 32 associated partners involved.

Germany selected 32 projects, with a total investment cost of around EUR 11.8 billion, for submission to the European Commission as part of the IPCEI State aid pre-notification process that started in December 2021. In the RRP, this measure has a budget of EUR 1.5 billion.

4 Digital public services

4 Digital public services ⁷⁵	Germany		EU
	rank	score	score
DESI 2022	18	63.4	67.3

	DESI 2020	Germany DESI 2021	DESI 2022	EU DESI 2022
4a1 e-Government users % internet users	63%	69%	55%	65%
	2019	2020	2021	2021
4a2 Pre-filled forms Score (0 to 100)	NA	NA	42	64
			2021	2021
4a3 Digital public services for citizens Score (0 to 100)	NA	NA	76	75
			2021	2021
4a4 Digital public services for businesses Score (0 to 100)	NA	NA	80	82
			2021	2021
4a5 Open data % maximum score	NA	NA	89%	81%
			2021	2021

Germany ranks 18th in the EU on Digital public services. The country is still underperforming in this area, despite several initiatives from the federal government to accelerate digitalisation in public services. The proportion of internet users using e-government services is 55%, ranking 24th, behind most EU Member States. Regarding pre-filled forms, Germany's score is 42, some way below the EU average of 64, putting it among the five worst performing EU countries. On digital public services for businesses, Germany is close to the EU average with a score of 80, whereas on digital public services for citizens it is just above the EU average with a score of 76. On the open data indicator, Germany performs relatively well, with 89%, compared with the EU average of 81%.

Germany's Online Access Act (*Onlinezugangsgesetz*), adopted in August 2017, requires all German federal and state governments to provide their services for individuals and for companies online, through public-administration websites. Implementation has two main strands, both covered by the German RRP: one for the digitalisation of federal services (*Digitalisierungsprogramm Bund*) and another for the digitalisation of services provided by federal states and municipalities (*Digitalisierungsprogramm Föderal*). In May 2022, 79 of the 575 public services were available online and another 200 were in the process of being put online. Based on the law all public services should be available online by the end of 2022⁷⁶. This is in line with the Digital Decade target of 100% of public services available online by 2030.

Germany offers to its citizens, Union citizens, EEA Nationals but also to foreigners with residence permit three alternative eID schemes⁷⁷ for facilitating their interactions with public organisations but also for

⁷⁵ There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

⁷⁶ [Dashboard Digitale Verwaltung \(ozg-umsetzung.de\)](https://dashboard.digitalisierungsprogramm.de/).

⁷⁷ eID schemes in Germany:

private use. All of these schemes offer the possibility to use them via a smart device. In total, 53 million people in Germany (or almost 64% of the population) use at least one of these schemes, and these schemes are also notified to the European Commission under the eIDAS Regulation. All three types of eID are issued by the government.

In addition, Germany has been working towards the establishment of a 'European identity ecosystem' reflected in its RRP. In close collaboration with approximately 20 major partners from various business sectors, this initiative seeks to enable people to securely and autonomously manage and share a wide range of government and privately issued digital credentials through a wallet application on their smartphone, in line with the self-sovereign identity (SSI) approach. The integration of the Smart eID into the ecosystem is addressed in this process.

The federal German cloud strategy was approved in mid-October 2020. The strategy determines common standards and interfaces needed for the German public administration to achieve multi-cloud-functionality. The target architecture is currently being developed for the administration with the involvement of IT service providers.

In June 2021, the GovTech Campus⁷⁸ was founded as a non-profit association by the federal government, two federal states and several organisations working in cooperation. The aim is to set up a physical and virtual platform to foster connection and collaboration between the public administration and the GovTech community. It should generate international visibility, foster the development of a GovTech ecosystem and facilitate and sustainably increase collaboration and co-creation between civil society, administration, science, and technology.

The steering project 'Register Modernisation' was initiated by Germany's IT Planning Council (*IT-Planungsrat*) in June 2021 and is also part of the German RRP. The project is concerned with modernising the German register landscape and implementing the 'once-only' principle at national and cross-border level. The federal government and the federal states have adopted a roadmap⁷⁹, which serves as the steering project's working programme. In March 2021, the German Register Modernisation Act (*Registermodernisierungsgesetz*, *RegMoG*⁸⁰) was adopted, which represents an important step forward for the implementation of the once-only principle.

The IT Planning Council initiated the Qualifica Digitalis research project to identify the skills needed by staff in public administration. So far, a study identified nine competence clusters with a total of 53 skills relevant for the public service and determined the existing skill level according to these 53 skills in different areas of employment in the public sector. On this basis the projects will provide practical recommendations and orientation for training and learning conditions in the public sector by September 2022.

German eID based on Extended Access Controll (Online-Ausweis) with National Identity Card,
German eID based on Extended Access Controll (Online-Ausweis) with Electronic Residence Permit,
German eID based on Extended Access Controll (Online-Ausweis) with eID Card for Union Citizens and EEA Nationals

⁷⁸ [GovTech Campus Deutschland](#)

⁷⁹ [GovTech Campus Deutschland \(it-planungsrat.de\)](#)

⁸⁰ Register Modernisation Act (28 March 2021), see [DIP - Gesetz zur Einführung und Verwendung einer Identifikationsnummer in der öffentlichen Verwaltung und zur Änderung weiterer Gesetze \(Registermodernisierungsgesetz - RegMoG\) \(bundestag.de\)](#)

In May 2021, the German Federal Academy for Public Administration (*Bundesakademie für öffentliche Verwaltung -BAkÖV*) launched its new Digital Academy. The Digital Academy provides hybrid learning, with both a physical campus and an online platform. These mixed methods are intended to maximise accessibility and scalability.⁸¹ The basis for the heterogeneous learning offering is the Federal Digital Competence Initiative launched in September 2021.

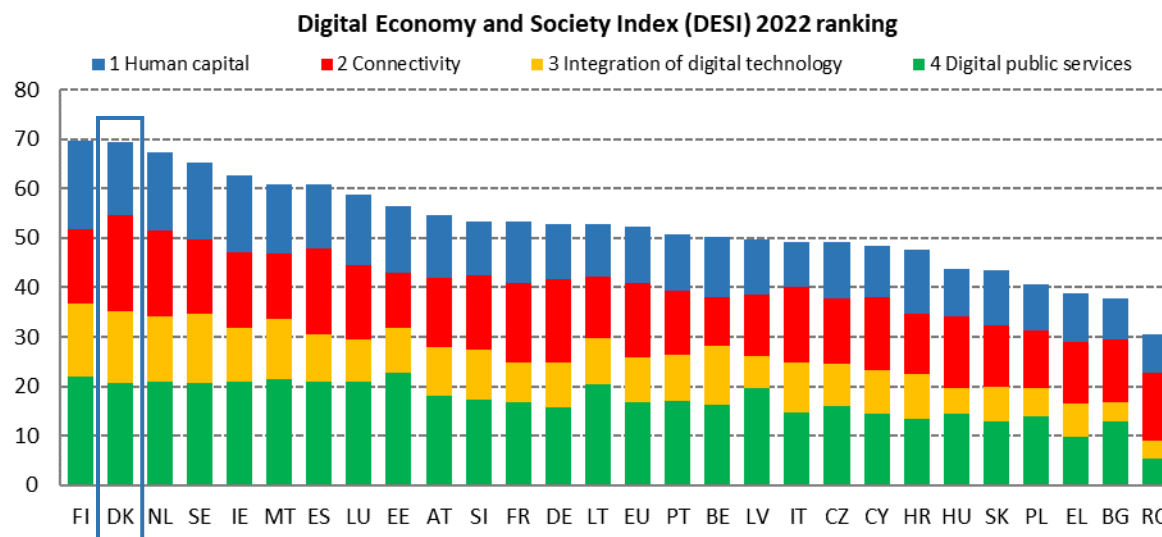
In 2019, the inter-ministerial working group on human resources in digital public administration (AG PersDiV) was launched, with the Federal Ministry of the Interior and Community as lead ministry. The aim is to draw up future-oriented human resource policy for all federal ministries based on digital transformation trends and demographic change.

By including relevant measures in the RRP, Germany is contributing to the deployment of digital public services. If the measures are implemented efficiently and on time, they are expected to lead to improvements in the relevant indicators.

⁸¹ [Future-proofing the public sector through digital and innovation skills training \(apolitical.co\)](https://apolitical.co)

Denmark

DESI 2022	Denmark		EU
	rank	score	score
DESI 2022	2	69.3	52.3



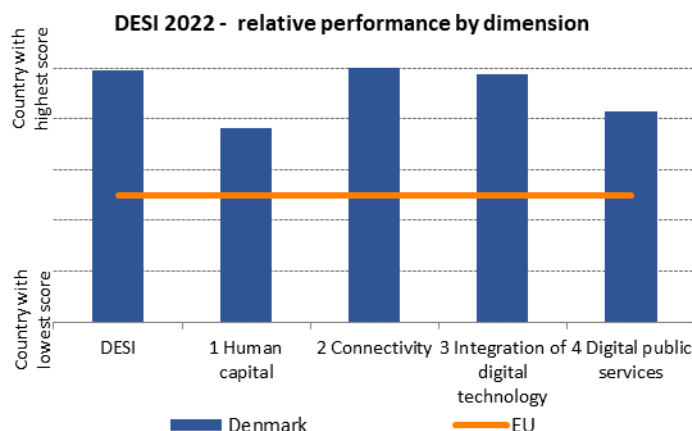
Denmark is a digital front-runner both in the EU and globally and continues to progress relatively well. To remain a global top performer and to reach the Digital Decade targets, it is important that Denmark continues to improve its performance for instance by addressing shortages in digital talent and encouraging SMEs to speed up the uptake of advanced digital technologies. Denmark ranks 5th in the human capital dimension. Danes have strong basic and above digital skills and the country's share of ICT graduates is higher than the EU average. However, more attention must be paid to the lack of ICT specialists (especially women) as this will delay the digital transformation of businesses.

Denmark is ranked 1st in the EU in the connectivity dimension. 95% of households are connected to very-high-capacity networks (VHCNs) and 74% to fibre. 5G coverage is significantly above the EU average with 98% of populated areas, but take-up of at least 1 Gbps is only close to the EU average (7.25% compared to 7.58%). The Danish Recovery and Resilience Plan (RRP) includes investments and reforms to roll out more high-speed internet access (minimum 100 Mbps), including in remote and rural areas of Denmark, where existing coverage is poor due to the lack of sufficient market incentives.

Denmark's enterprise structure is dominated by a high number of small enterprises, which take full advantage of the digital transformation and can support the Danish economy to remain competitive and grow. In 2022, the Danish government adopted, as part of their Recovery and Resilience Plan (RRP), a new digital strategy, which includes substantive policies aimed at the digitalisation of SMEs. New subsidies will, for example, be distributed, as SMEs have been the most affected by the economic crisis following the covid-19 pandemic. Although Denmark is ahead of other European countries in this dimension, ranking 2nd, it is important that Denmark continues to advance to reach the Digital Decade

targets. They include 90% of SMEs having at least basic digital intensity (DK 79%), 75% of enterprises using cloud computing services (DK 62%), big data (DK 27%) and artificial intelligence (DK 24%) by 2030.

Over the years, Denmark has taken a series of policy measures, which have ensured a favourable investment climate and triggered a strong uptake of digital public services, at all levels of government, both by businesses and individuals. Denmark ranks the country has one of the highest rates of e-government use (93% of internet users) and a high score on open data (91%) compared to EU average of (81%) and very well placed to reach the Digital Decade targets of for example 100% online key public services by 2030.



Denmark is preparing for cyber-attacks given Russia's invasion of Ukraine. The Centre for Cyber Security assesses the present threat of destructive cyber-attacks against Denmark. As the situation can change quickly, Local Government Denmark has recommended the municipalities to ensure that basic IT and cyber security in the municipalities are up to date. The municipalities are especially encouraged go through their emergency preparedness and recovery plans. Also, the municipalities should make sure that they have signed up for all relevant notification services. In February 2022, the Centre for Cybersecurity published a [list](#) of cyber and information security information related to security measures, recommended for public and organizations to implement to strengthen their cyber and information security resilience based on best practices.

Digital in Denmark's Recovery and Resilience Plan (RRP)

The Danish RRP budget is EUR 1.6 billion. Denmark plans to invest 25% (EUR 382 million) of the RRP in digital measures⁸².

In May 2022, the Danish government adopted the new digital strategy, which is the main digital reform of the RRP. The digital strategy is the most important deliverable for 2022. The Digital Strategy was launched in continuation of the recommendations from the Danish Government

⁸² Each recovery and resilience plan has to dedicate at least 20% of the plan's total allocation to digital objectives. To this end, the plans had to specify and justify to what extent each measure contributes fully (100%), partly (40%) or has no impact (0%) on digital objectives, using Annex VII of the RRF Regulation. Combining the coefficients with the cost estimates of each measure allows assessing to what degree the plan contributes to digital objectives and whether it meets the 20% target.

Digitisation Partnership and is the first of its kind in Denmark. The strategy calls for broad and binding collaboration on digital development across both the public and the private sector. The strategy foresees 61 initiatives in the period 2022-2026 following 9 core visions for Denmark's digital development:

1. Strengthened cyber- and information security
2. Coherent digital services for citizens and businesses
3. More time for core missions through increased use of welfare technology
4. Increased growth and digital SMEs
5. Future digital health services
6. Accelerating the green transition through digital solutions
7. A strong, ethical and responsible digital foundation
8. Putting Denmark in the centre of international digitalisation
9. Enable Danes for a digital future

Among the significant themes presented, the initiatives aim to maintain Denmark's position as a digital front-runner and to use digital solutions, new technology and data to strengthen Danish welfare, accelerate the green transition, increase growth and digital transformation of Danish SMEs and strengthen cyber and information security. In doing so, the strategy also acknowledges the challenges that may accompany an increasingly digitised society. Therefore, a core element of the strategy is to make sure that citizens can use and benefit from the digital services regardless of digital capabilities. This entails digital skills development as well as ensuring that technology and data are used ethically and with a broad focus on security, responsibility, transparency and trust.

1 Human capital

1 Human capital	Denmark		EU
	rank	score	score
DESI 2022	5	59.2	45.7

	Denmark			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
1a1 At least basic digital skills % individuals	NA	NA	69% 2021	54% 2021
1a2 Above basic digital skills % individuals	NA	NA	37% 2021	26% 2021
1a3 At least basic digital content creation skills⁸³ % individuals	NA	NA	76% 2021	66% 2021
1b1 ICT specialists % individuals in employment aged 15-74	5.1% 2019	5.3% 2020	5.6% 2021	4.5% 2021
1b2 Female ICT specialists % ICT specialists	22% 2019	23% 2020	23% 2021	19% 2021
1b3 Enterprises providing ICT training % enterprises	31% 2019	30% 2020	30% 2020	20% 2020
1b4 ICT graduates % graduates	4.8% 2018	4.9% 2019	5.4% 2020	3.9% 2020

In the Human capital dimension, Denmark ranks 5th of the 27 EU countries. Basic and above basic digital skills levels are higher than the EU average and the share of enterprises providing ICT training is steady around 30% – 10 percentage points over the EU average. The proportion of ICT specialists in the workforce stands at 5.6%. The share of ICT graduates is stable e.g., 1.5 percentage points over the EU average. However, 58% of enterprises that are looking for ICT specialists report hard-to-fill vacancies.

Digital skills are vital to ensure a continued and successful digital transformation of the society and economy. In October 2021, the [Danish Government Digitisation Partnership](#) delivered its [recommendations](#) on how Denmark should harness and use future technological opportunities. It includes nine recommendations on digital skills in the education system, the workforce and digital inclusion. In May 2022, Denmark presented its national digital strategy, which includes four initiatives regarding digital skills and education, based on the Partnership's recommendations. The initiatives introduce more focus on technology in primary schools, improve digital skills and competences among primary school teachers, improve digital skills in higher education as well as creating a digital equipment fund for technical colleges and labour market training (AMU). The initiatives build on some of the former initiatives mentioned below.

In December 2021, the government reached an [agreement](#) with the parliament to strengthen digital education for children and young people by providing EUR 7.1 million from 2022 to 2025. A part of the

⁸³ Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

agreement is to develop and produce inspirational material on digital technologies for teachers and educational institutions that can be used in teaching. This support includes among others access to relevant [assistive digital technology tools](#).

The digital transformation implies that people need to have basic and more advanced digital skills. Therefore, the Danish government has launched several initiatives to improve the digital skills level in education and as well as when you have graduated. Between 2018 and 2021, 46 Danish schools have participated in a [pilot project](#) aimed to test how a discipline called 'digital technology comprehension' could be taught in primary and lower secondary schools.

Danish teachers and pupils are not very active in EU Code Week. Only [1 000 people](#) – of which half were female – participated in the 2021 edition, with 20% of activities taking place in schools.

As part of a follow-up to the 2018 action plan Technology in Education, University College Copenhagen launched an [initiative](#) to pilot the introduction of a technological comprehension module in the teacher training course in 2021.

As a result of the national strategic efforts for the digitalisation continuing of vocational education, the Danish Agency for IT and Learning has launched a [forum for digitalisation](#) across the general and advanced adult education and lifelong learning programmes. The purpose of the forum is to strengthen knowledge sharing and cooperation between providers of adult lifelong learning to support digitisation at all levels.

To increase the number of ICT specialists, the government earmarked additional funding for study places in Science, Technology, Engineering et Mathematics (STEM) fields and 2021. This led to an increase of 1 000 enrolled students in STEM, [up 7% compared with 2017](#) and up 4% compared to 2019. The general number of admissions increased by 3% between 2017 and 2021. In 2021, 66% of the study places enrolments in STEM were males and 34% females, up from 30% in 2017.

In 2021, the Ministry of Higher Education and Science launched a [call for projects](#) on the use of virtual teaching and pedagogy in further tertiary education with a total budget of EUR 700 000. The main aim is to better equip teachers in meetings concerning the digital transformation challenge in education. As a result of the COVID-19 crisis, educational institutions have gained much new knowledge on digital forms of teaching.

As part of the latest cyber security strategy, in 2021 the Ministry of Higher Education and Science allocated EUR 900 000 to [a new initiative](#) for 2022, which aims at to build cyber security skills across higher education to improve digital skills in cyber security. The overall objective is to strengthen society's access to cyber and information security, including experts and generalists.

In addition, on vocational training for public and private employees, the Ministry for Employment allocated in 2021 EUR 6.7 million to 11 [different projects](#) focused on upskilling of the workforce in digital and basic skills. The Ministry of Employment has [five goals for 2021](#), including one for unemployed peoples' digital skills' development. Common to the objectives is that they all aim to bring more people into the workforce to ensure that companies have the manpower they need.

Denmark has taken several specific vocational digital skills initiatives targeted at SMEs. Amongst these is a [graduate program and a trainee program](#), which focuses on mitigating the challenges met by graduates in entering the labour market. An example is a project with project funds from the Danish Agency for Labour Market and Recruitment called [Job in Games](#). The Ministry of Employment also

allocated EUR 2.7 million into an [Entrepreneur Fund](#) in 2021. The funding was granted to several hundreds of small entrepreneurs in need of improving their digital skills. Since the digital transformation affects all levels of government, a new initiative was launched in 2021 for [local government digitisation](#). The main aim is to support municipalities' work to ensure a more successful digital transformation at local level.

During 2021 the Danish government took many new initiatives to improve the digital skills at all educational levels. Vocational digital training programmes have been put in place to improve both private and public employees' digital skills.

2 Connectivity

2 Connectivity	Denmark		EU
	rank	score	score
DESI 2022	1	77.1	59.9

	Denmark			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
2a1 Overall fixed broadband take-up	85%	85%	84%	78%
% households	2019	2020	2021	2021
2a2 At least 100 Mbps fixed broadband take-up	34%	43%	49%	41%
% households	2019	2020	2021	2021
2a3 At least 1 Gbps take-up	1.26%	4.38%	7.25%	7.58%
% households	2019	2020	2021	2021
2b1 Fast broadband (NGA) coverage	96%	96%	98%	90%
% households	2019	2020	2021	2021
2b2 Fixed Very High Capacity Network (VHCN) coverage	93%	94%	95%	70%
% households	2019	2020	2021	2021
2b3 Fibre to the Premises (FTTP) coverage	67%	70%	74%	50%
% households	2019	2020	2021	2021
2c1 5G spectrum	33%	99%	99%	56%
Assigned spectrum as a % of total harmonised 5G spectrum	04/2020	09/2021	04/2022	04/2022
2c2 5G coverage⁸⁴	NA	80%	98%	66%
% populated areas		2020	2021	2021
2c3 Mobile broadband take-up	95%	95%	97%	87%
% individuals	2018	2018	2021	2021
2d1 Broadband price index	61	60	58	73
Score (0-100)	2019	2020	2021	2021

Denmark ranks first amongst the 27 EU Member States in connectivity. Denmark presents an excellent fixed Very High-Capacity Network (VHCN) coverage of 95% of households, the third highest in EU. FTTP coverage continues to increase steadily from 70% to 74%, and quite remarkably FTTP coverage is now higher in rural areas, with a sharp increase from 70.9% to 77.8%. However, this excellent performance is not reflected in the uptake, with only 7.25% (up from 4.38%) of households having taken-up at least 1 Gbps broadband connection, close to the EU's average of 7.58%. Denmark is though above the EU average regarding the uptake of 100 Mbps. Fixed broadband uptake has stagnated at 84% of all households, which is slightly above the EU average of 78%. However, broadband uptake is moving towards services with higher speeds.

⁸⁴ The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

Denmark has a new broadband strategy, which was agreed at a political level at the end of 2021. It replaces the former strategy goal of network coverage of 100 Mbps download / 30 Mbps upload for all households and businesses by 2020. The goal was almost achieved at the end of 2021, when coverage was at 96%. The goals in the new strategy are all households and businesses must be covered by 100/30 Mbps connection by 2025; 98% of households and businesses must be covered by 1 Gbps download speed in 2025; take stock in 2025 to identify the needs and demand for gigabit speeds by 2030. Furthermore, the political agreement confirmed the two overarching principles of the telecommunications policy agreement from 2018, including four benchmarks for: (1) promoting the deployment and exploitation of the technologies of the future, including supporting the green transition; (2) access to the digital society for citizens and businesses across Denmark; (3) good and predictable framework conditions for the telecoms industry and (4) reduction of burdens and well-functioning competition and active consumers.

The goals of the broadband strategy are expected to be reached mainly through a market-based roll-out and technological neutral regulation, supported by limited public grants in rural non-commercially viable areas. In this context EUR 13.5 million has been allocated to the National Broadband pool in 2022. The National Broadband pool was established in 2016 and offers grants to roll-out very high-capacity broadband in underserved areas. The Danish RRP includes a measure to extend the current funding scheme.

During the COVID-19 pandemic, the Danish Energy Agency (DEA) observed increased demand for very high-capacity broadband during the lockdown. For example fixed broadband subscriptions with access to minimum 1 Gbps download rose from 2.2% to 12.3% of the total number of subscriptions, equivalent to approximately 267 000 subscriptions.

Regarding mobile connectivity, the 5G roll-out is progressing very well with 99% of the total harmonised 5G spectrum assigned compared to the EU average of 56%, with a coverage of 98% of the households. This represents the highest coverage in the EU. All major mobile operators offer 5G subscriptions both for retail and commercial markets.

Main market & regulatory developments

The DEA has noticed that fixed telephony subscriptions (VoIP, PSTN and ISDN) continue to drop. From the second half of 2019 to the second half of 2020 fixed telephony subscriptions dropped from 1 003 661 to 706 604 – a sharp fall of approx. 30%. In the same period mobile subscriptions remained stable at around 8.4 million (up 1%), equivalent to approx. 144 subscriptions per 100 citizens in Denmark (including subscriptions to both private and business).

The Danish Business Authority (DBA) evaluated the impact of bundled services as part of the market analysis on the broadband markets. They found that the sales of bundled services in Denmark peaked in 2014 at approx. 1.2 million subscriptions. Since then, sales have fallen steadily and by mid-2021 were down to approx. 540 000 subscriptions.

Compared to all network broadband subscriptions, the share of bundles dropped sharply from

approx. 50% to just 20% of all fixed subscriptions.

In 2019, the incumbent TDC split the company in two independent companies TDC NET and Nuuday, the process was completed on the 31 December 2021 and the TDC Group no longer exists. As part of the functional separation, the infrastructure company TDC NET will focus on rolling out 5G and fibre networks. At the same time, the investment in fibre means that TDC NET will only make further limited upgrades to the copper network and that the coax roll-out will not be a priority either.

In 2021, the DBA completed the reviews of the markets 3a “Wholesale local access provided at a fixed location”/3b “Wholesale central access provided at a fixed location for mass-market products” in Denmark. The wholesale broadband market has been divided into two sub-markets: Market 3HC – Wholesale broadband market for access to high capacity infrastructure (fibre and coax); and market 3LC – Wholesale broadband market for access to low capacity infrastructure (copper). The geographical market definition concludes that there are 21 geographical segmented submarkets on the HC market and 10 operators have been assigned SMP status on one or more submarkets, however only one SMP-operator has been found per market. With respect to the SMP designation for the high capacity infrastructure market, DBA proposed to designate 14 SMP operators in 17 geographic submarkets. In 4 geographic submarkets, DBA identified no SMP operator, either because high capacity networks are not widely deployed, or because none of the operators present is able to act independently. In the 17 remaining markets, DBA has identified 14 different SMP operators. Amongst the 14 SMP operators, 7 are wholesale-only operators and 7 are vertically integrated operators. Pursuant to Article 32(4) of the Code, the Commission informed DBA of its serious doubts⁵² as to the compatibility of the draft measures related to 5 geographic submarkets with Union law. DBA withdrew the notified draft measures in relation to 4 geographic submarkets on which operators would have been designated as having SMP. However, DBA did not withdraw the notified draft measure in relation to a fifth operator that DBA proposed to designate as SMP on the geographic submarket Skanderborg-Odder. As a result of the partial withdrawal of its notified draft measure by DBA, the scope of the phase II investigation was therefore limited to the SMP designation and to the three-criteria test conducted in relation to the geographic submarket Skanderborg-Odder. Following DBA’s withdrawal of the notified draft measures in relation to 4 geographic submarkets and the additional information collected during the Phase II investigation and exchanges with BEREC and DBA, the Commission’s serious doubts have been sufficiently addressed. The Commission withdrew its serious doubts the 1 February 2022 in relation to the designation of Aura as SMP operator in the Skanderborg-Odder market and related three criteria tests.

In 2021, the Complaints Board saw a substantial drop in complaints. This trend was started already in 2020 with a decrease of 15% coinciding with the COVID pandemic and without any other obvious reason.

The 5G spectrum auctions were finalised in the beginning of 2021 and the rollout of 5G is continuing at very good pace with 98% of Denmark covered by 5G and with 99% of the total harmonised 5G spectrum assigned. This is excellent progress towards the goals of the Gigabit Society and the Digital Decade.

The new broadband strategy is a good start for reaching the Gigabit Society targets for 2025 but will need an update in the 2025 review to be aligned to the 2030 Digital Decade targets. In view of the current connectivity infrastructure in Denmark and Demark being ranked number one in connectivity among the EU Member states, the strategy could have been more ambitious, notably to increase the take-up of at least 1 Gbps which is only close to EU average and could seek to achieve the Digital Decade goal of at least 1 Gbps coverage of all households rather than keeping the 100/30 Mbps connection goal for 2025. It is encouraging that the RRF funding is used by Denmark to ensure broadband deployment in areas which would not be reached on commercial terms, thereby increasing the possibility of reaching the targets set for the Gigabit Society and the 2030 Digital Decade.

3 Integration of digital technology

3 Integration of digital technology	Denmark	EU
	rank	score
DESI 2022	2	58.0
		36.1

	DESI 2020	Denmark DESI 2021	DESI 2022	EU DESI 2022
3a1 SMEs with at least a basic level of digital intensity	NA	NA	79%	55%
% SMEs			2021	2021
3b1 Electronic information sharing	50%	50%	50%	38%
% enterprises	2019	2019	2021	2021
3b2 Social media	32%	32%	36%	29%
% enterprises	2019	2019	2021	2021
3b3 Big data	14%	27%	27%	14%
% enterprises	2018	2020	2020	2020
3b4 Cloud	NA	NA	62%	34%
% enterprises			2021	2021
3b5 AI	NA	NA	24%	8%
% enterprises			2021	2021
3b6 ICT for environmental sustainability	NA	54%	54%	66%
% enterprises having medium/high intensity of green action through ICT		2021	2021	2021
3b7 e-Invoices	55%	57%	57%	32%
% enterprises	2018	2020	2020	2020
3c1 SMEs selling online	33%	38%	38%	18%
% SMEs	2019	2020	2021	2021
3c2 e-Commerce turnover	18%	20%	18%	12%
% SME turnover	2019	2020	2021	2021
3c3 Selling online cross-border	10%	10%	14%	9%
% SMEs	2019	2019	2021	2021

Danish enterprises are taking advantage of the digital transformation, ranking 2nd of the 27 EU Member States. SMEs with at least basic intensity stands at 79%, which is 24 percentage points higher than the EU average. The use of artificial intelligence (24%) is three times the EU average and the use of cloud technologies (62%) and big data (27%) are almost twice the EU average. The percentage of SMEs selling online remains stable at 38% – 20 percentage points higher than the EU average. E-Commerce turnover surprisingly dropped slightly from 20% in 2020 to 18% in 2021 but remains 6 percentage point higher than the EU average. The percentage of SMEs selling online cross-border has increased from 10% to 14% in 2021, which is higher than the EU average of 9%.

To better tackle the digitalisation of SMEs, the national programme [SME: Digital](#) has been put in place to advance the digital transition and e-commerce capabilities of Danish SMEs. Under the scheme, SMEs can apply for grants to procure private consulting on how to best digitalise further and to identify the economic and business potential of investing in and applying more advanced digital technologies. In 2021, the grant scheme was extended to include subsidies for SMEs to invest in new hardware and

software. More than 1 200 enterprises benefited from the programme during 2021. SME Digital is driven by Danish Business Authority in collaboration with the Danish Business Hubs, which also provide digital maturity screenings of the SME's and guide them in their further digitalisation, including referring them to other relevant actors who can help them integrate technology.

To increase the number of new enterprises, the Danish government has established the 'Growth Fund' [Vaekstfonden](#) in which banks and private investors work more closely together to discover new start-up companies. The main goal is to support more companies to grow their business. As the digital transformation is also closely connected to sustainable green development, the Danish government has established a [Danish Green Investment Fund](#) that aims at a stronger usage and integration of ICT in enterprises.

Moreover, [Innovation Fund Denmark](#) invested EUR 40 million in an [Innobooster programme](#) which invests in knowledge-based development projects in SMEs and entrepreneurial companies supporting a stronger integration of digital technologies. In 2021, EUR 10 million were earmarked for new technology and IT.

In 2021, the Danish Board for Business Development allocated EUR 0.7 million to European digital innovation hubs supporting new digital based small companies' business development. The selection of Digital Innovation Hubs that will participate in the network of European Digital Innovation Hubs (EDIHs) is ongoing. Three Danish EDIH proposals have a successful evaluation result⁸⁵ and two additional proposals are expected to be selected in the next year. Besides the funding support towards the digital innovation hubs, technological [GTS](#) institutes also provide advanced technological support to Danish enterprises for start-up establishment and development. The support is focused on small business development needs that require advanced technical knowledge. A prominent example is the Alexandra Institute which supports companies and organisations in applying world-class IT research and state of the art digital software development in practice.

Furthermore, the new cluster organisation for digital technologies, [Digital Lead](#), is a gathering point for digital innovation for companies developing digital solutions as well as for other industries and sectors in need of innovative digital solutions. Connecting and empowering technical and commercial talent is essential for unleashing the digital start-up potential, which is why [Copenhagen School of Entrepreneurship](#) has launched the initiative [Digital Start-up Generator](#). The main aim of the Digital Start-up Generator is to strengthen technologies targeted at digital tech start-up business.

Approximately 78% (EUR 300 million) of the digital measures in the Danish RRP are dedicated to the digital transformation of business and digital related R&D in enterprises. Further new measures have been announced by the Danish government in the new national Digital Strategy that reserves EUR 59 million for growth and digitalisation among SMEs. Among other activities, the SMV: Digital program continues and a new program, dubbed SMV: Robot, is introduced, providing SMEs with access to robotics technology.

⁸⁵ I.e. are invited for grant agreement preparation (which is not a formal commitment for funding).

Denmark did not sign up to any Joint Undertaking or multicounty digital flagship projects in 2021. However, as a part of the new digital strategy, the Danish government plans to make co-funding available for Danish stakeholders to participate in European digital initiatives such as common European data spaces and testing and experimentation facilities for AI.

Furthermore, Innovation Fund Denmark has committed EUR 2 million in the first call of the Key Digital Technology Joint Undertaking in 2021 which focuses on topics such as semiconductors. In addition, the Innovation Fund also provided EUR 2.9 million for the PhotoQ project aimed at developing a photonic quantum computing under the [Grand Solutions programme](#). Denmark has also decided to join the industrial alliance on cloud and edge and will in this context work for portability and renewable energy solutions including also access to the cloud and edge market for SMEs. Denmark is also participating in the European Blockchain Partnership as well as the initiative on European Quantum Communication Infrastructure, EuroQCI.

Denmark has also initiated the '[Danish e-Infrastructure Cooperation](#)' (DeiC), in which the Danish Ministry for Higher Education and Science and all eight Danish universities will invest in national research infrastructure for HPC and data spaces. In 2021, Danish Agency for Higher Education and Science published a National strategy for Data Management for the enhancement of research data [Danish e-Infrastructure Cooperation](#).

[Denmark's Artificial Intelligence \(AI\) strategy](#) was adopted in 2019 to ensure economic growth, prosperity and world class public service. It aims to produce the right conditions for companies, researchers and public authorities to optimise a responsible use of AI. Various AI projects are financed through an investment fund with a budget of EUR 26.76 million in 2018 to 2022. These AI-signature projects aim at trying out AI-technology in various areas within the public sector. For example, the development of new business models based on new AI applications and a much wider uptake of AI in the main industrial sectors in Denmark. The strategy has made progress in AI usage widely both in the public and private sectors.

Research and innovation are fundamental to a successful digital transformation. In 2021 [Innovation Fund Denmark](#) allocated approximately EUR 1.3 million to the Grand Solutions programme for digital technology innovation. Grand Solutions projects typically have a high-risk profile and focus on ambitious results with high value creation, whether in the form of new knowledge, improved and/or new processes, systems, products or solutions to politically prioritized societal challenges.

More digitalisation also means more vulnerabilities for cyber-attacks. So, a [new national cyber and information security strategy](#) was launched in December 2021 and like its predecessor it covers a wide range of topics. The strategy defines and establishes critical functions across several sectors that are fundamental for the continued functioning of government and society. The strategy contains 34 initiatives that strengthen the protection of Denmark's digital infrastructure and IT systems, with an overall funding of EUR 36.3 million. The strategy focuses on four strategic objectives: (i) robust protection of key functions of society; (ii) increased level of competencies and management responsibility; (iii) strengthened public-private cooperation; (iv) active international engagement in the fight against cyber threats.

In early February 2022, the Centre for Cybersecurity (CFCS) publicly published a [list of cyber and information security related measures](#), which CFCS recommended that organisations, private companies and government authorities could implement in order to strengthen their cyber and information security and resilience. The measures were based on existing recommendations and best practices.

In 2021, Denmark took several new initiatives to accelerate the digital transformation by improving digital technology integration for private and public companies. Through [SME Digital](#) enterprises applied technologies such as PIM-systems to reduce their need to have large component stocks leading to cost savings. The initiatives show strong determination to make the necessary investments to achieve a rapid and effective digital transformation of the Danish economy and society.

4 Digital public services

4 Digital public services ⁸⁶	Denmark		EU
	rank	score	score
DESI 2022	8	83.1	67.3

	DESI 2020	Denmark DESI 2021	DESI 2022	EU DESI 2022
4a1 e-Government users	94%	92%	93%	65%
% internet users	2019	2020	2021	2021
4a2 Pre-filled forms	NA	NA	86	64
Score (0 to 100)			2021	2021
4a3 Digital public services for citizens	NA	NA	83	75
Score (0 to 100)			2021	2021
4a4 Digital public services for businesses	NA	NA	89	82
Score (0 to 100)			2021	2021
4a5 Open data	NA	NA	91%	81%
% maximum score			2021	2021

Denmark ranks 8th in relation to public services in the EU and scores above the EU average on all indicators. The percentage of e-government users has increased slightly from 92% in 2020 to 93% in 2021 and remains considerably above the EU average of 65%. Denmark scores significantly above the EU average on pre-filled forms (86 compared to 64). Moreover, digital public services for citizens (score of 83) and businesses (89) are above the EU averages of 75 and 82 respectively. Usage of open data is at 91%, which is 10 percentage points higher than the EU average.

Denmark has for years been a frontrunner when it comes to the digitalisation of the public sector. Today, the essential public service solutions that can be digitalised are provided online. The digitalisation of public self-service solutions was made mandatory by law in 2012. Furthermore, to facilitate the access to governmental digital services, a [portal](#) has been put in place to provide citizens with one single point of entry to more than 2 000 digital service solutions across the public sector. Regarding health matters, citizens are offered a single point of entry by the portal [sundhed.dk](#).

Businesses can manage all government-oriented tasks at [virk.dk](#). All citizens and enterprises in Denmark have access to an electronic identity (eID) provided by a one and single national eID scheme. 95% of the population uses eID⁸⁷. It provides access to all digital public services and is used by more than 700 private digital services such as banks, insurances and other businesses for the validation of payment transactions. Denmark's eID infrastructure had its inception in 2001 and has been fully operational since 2018, while the national eIDAS node has been operational since June 2018. There are currently over 70 national e-services connected to the node. Denmark has built on the well-established common digital

⁸⁶ There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

⁸⁷ NemID or MitID

service infrastructure NemID, which is now in the process of migrating to a new eID scheme called '[MitID](#)'. The new solution is a single secure eID solution across sectors, adapted to new technologies and future needs.

Since 2014, it has been mandatory for individuals and businesses to receive mail from public authorities through the digital [Post](#). Today, more than 90 percent (4.5 million) of individuals as well as 800 000 companies and 600 authorities use the next generation of Digital Post, which was launched in March 2022. The new solution is solely owned and operated by the state and modernised to an extent that makes it as future-proof as possible.

In addition, [My Overview](#) aims to provide individuals with an overview of their personal data and interactions with the public sector across sectors and levels of government, e.g., by displaying an overview of ongoing cases, public benefits, payments and appointments and by directing citizens to a relevant self-service solution or to additional information. Likewise, [My Virk](#) aims to provide businesses with an overview of their data and interactions with the public sector.

Denmark has put in place several joint public digital strategies including joint financing to further develop digital services in Denmark. This has facilitated a rapid and more effective digital transformation of public services. For the same reason, Denmark is in the process of implementing a new digital power of attorney allowing individual citizens to help relatives access approximately 40 digital self-services. In practice, this means that people can use their own login credentials and act on behalf of the principal, including keeping track of hospital appointments.

One of the focal points in the 2018-2022 [Digital Health Strategy](#) is to ensure everyone can have access to its medical records online on the official portal for the Danish Healthcare Services.

Finally, Denmark also has a long tradition for close and successful collaborations between the public sector and innovative companies. From January 2022, the government has established [The National Centre for Public-Private Sector Innovation](#) with KL-Local Government Denmark and Danish Regions. The Centre seeks to further strengthen and develop close collaborations between the public sector and private companies, including technology companies. One of three focal points for The Centre is to encourage technologies to support welfare tasks and functions.

Denmark is aspiring to be among the European leaders in digitalisation of public authorities' services by following a user-friendly approach and accomplishing this in record time. Denmark is pursuing a broad roll-out of online public services and a very high usage of open data. The Danish RRF plan also includes measures to further accelerate the digitalisation of the public sector and in the new digital strategy that was presented in May 2022 Denmark has successfully laid the ground for digitalising its public services by digitising databases and administrative processes early. Thus, adopting the legislation needed to increase uptake of digital services in the population and by focusing on fostering trust and developing skills in the population while continuing to provide services for those challenged by the digital transition.

Highlight: The Danish Government Digitisation Partnership

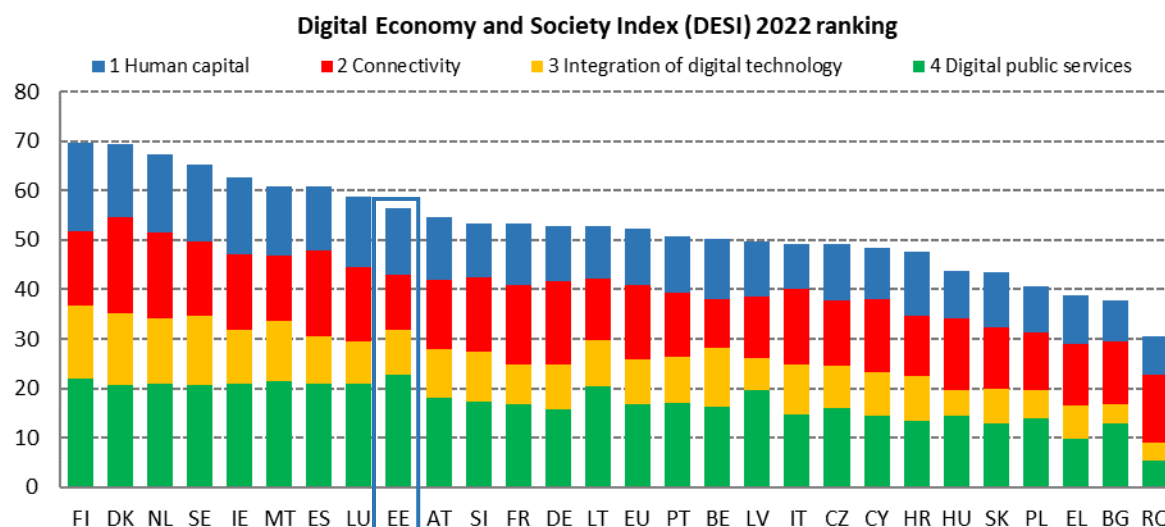
On 16 March 2021, the Danish government established the Danish Government Digitisation Partnership. The Partnership is tasked with preparing recommendations for the Danish government on how Denmark will take advantage of the opportunities provided by

digitalisation in the future, especially with a focus on SMEs. On 19 October, the partnership concluded its work and delivered 46 recommendations to the Danish Government. Based on the overall goals and principles, the Danish government Digitisation Partnership has decided to prioritise 4 focus areas deemed particularly important for future digitalisation:

1. Life-long digital skills development: to benefit from digitalisation, and for Denmark to pursue a digital first strategy, it is essential that all Danes commit to life-long learning in digital skills and understand the implications of digitalisation on their everyday life for democratic society.
2. Increased and responsible use of data: to support growth and innovation and ensure prosperous future, it is important to take advantage of the total value of data while maintaining a high degree of trust in digital solutions. This requires increased and responsible use of data across society.
3. Strong cyber security: To reduce the risk of cyber threats having severe economic consequences and harming security and prosperity in Denmark, a high degree of cyber and information security at all levels is expected to be ensured.
4. Rapid rollout of modern digital infrastructure: to swiftly realise and achieving the value of digitalisation, the development of modern digital infrastructure must be accelerated.

Estonia

DESI 2022	Estonia		EU
	rank	score	score
DESI 2022	9	56.5	52.3



Estonia ranks 9th of 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI). Estonia performs well and scores above the European Union (EU) average in all indicators, except connectivity where it ranks 26th. Estonia's performance growth is slower than that of other countries with similar DESI scores; indicatively, it raised its score by around 6.5% in average every year between 2017 and 2022, compared to an EU average 7.5%.

The country presented the new Estonian [Digital Agenda 2030](#) with three priorities: (i) developing further digital public services; (ii) focusing on cybersecurity and (iii) improving connectivity across the country. Estonia is a front-runner in some DESI indicators, in particular digitalisation of public services, but other areas need attention. Timely implementation of measures, specifically those for 5G deployment and increased business digitalisation should bridge the gap between Estonia's current situation and the Digital Decade ambitions.

On digital skills, Estonia is just above the EU average for basic digital skills. However, the country outperforms in the proportion of Information and Communication Technologies (ICT) specialists in employment and has the highest percentage of ICT graduates in the EU. It is important for Estonia to continue nurturing this pool of specialists to meet the Digital Decade target of 20 million ICT specialists in Europe by 2030.

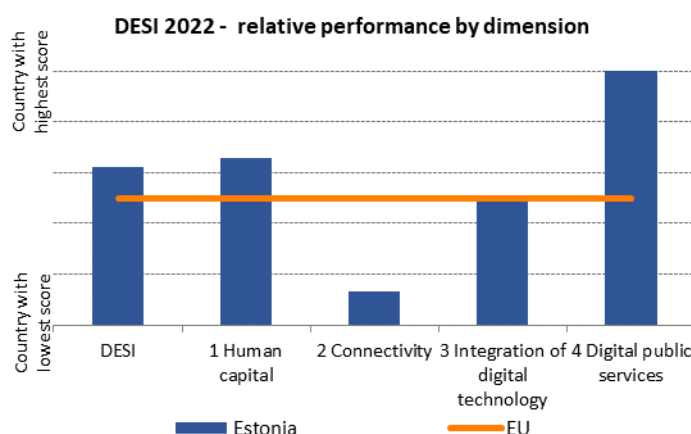
On connectivity, the country's fixed and mobile broadband take-up is high. Furthermore, Estonia scores above the EU average as regards overall fixed Very High Capacity Network (VHCN) coverage, although it is still unavailable to many households in rural areas. However, the country lags behind in providing 5G services commercially due to delays in assigning 5G spectrum bands. Estonia's ability to meet both the

2025 gigabit targets and the 2030 digital decade targets will depend on the outcome of its responses to address those issues.

Businesses are not yet reaping the full benefits of the digital economy. Despite some innovative companies driving the Estonian business ecosystem, more traditional businesses and Small and Medium-sized Enterprises (SMEs) are lagging behind. Most businesses rarely use advanced technologies, with for example only 10% of companies using big data and 3% using Artificial Intelligence (AI) solutions, which is below the 75% objective of the Digital Decade.

Estonia is a global leader in the digitalisation of public services and continues to invest heavily in this area. The country can serve as an example to other Member States for the Digital Decade in that respect. Both the public and businesses are used to carrying out administrative tasks online which are user-centred and very accessible.

Overall, Estonia continues to perform strongly in the uptake of digital technologies. The country is a global leader in the digitalisation of public services. However, to ensure no one is left behind, measures promoting connectivity and further digitalisation of businesses would be essential.



Before the start of Russia's invasion of Ukraine, Estonia was already supporting Ukraine in digital society development since 2014. Most of the support projects were implemented by the Estonian [E-governance Academy](#), a foundation-based international development cooperation implementer. The projects are financed by a broad set of international donors. The current engagements include digital government infrastructure, online services development and cybersecurity related activities, but also physical data protection and cyber security related rapid response related to Russian aggression in 2022.

[Estonia sent computers and other IT hardware to the Ukrainian Ministry of Digital Affairs](#) to support Ukrainian digital capacities and the continuity of digital services. In cooperation with Estonian public sector institutions and the Information Technology and Telecommunication Union (ITL), a total of nearly 1 400 pieces of equipment were planned to be sent to Ukraine. Other actions, including to strengthen cybersecurity, are also ongoing.

Digital in Estonia's Recovery and Resilience Plan (RRP)

In the Estonian RRP, adopted in October 2021, an estimated EUR 208 million is devoted to digital objectives – this represents 21.5% of the plan's total budget⁸⁸. The contribution to the digital transition comes from two of the six components of the plan, with 13 measures (out of 41 in total) addressing digital priorities.

Component 1 (EUR 86.3 million for digital) aims to foster the digital transformation of Estonian companies, mainly targeting industries (overall estimated value: EUR 58 million) and their competitiveness on export markets. Component 3 on digital state (EUR 121.7 million for digital) aims to make the delivery of public services more efficient. It also aims to make the underlying digital infrastructures and systems more resilient and sustainable.

Major milestones and targets should already be reached in 2022, although they have not been yet been assessed by the European Commission. A management team was to be set up in Q4.2021 for the creation and development of a centre of excellence for data governance and open data (Component 3). In 2022, a call for proposals to support the digital transformation of businesses should be published and a ministerial decree will set out support measures for workers to acquire digital skills. Measures supporting business export, including those of ICT companies, will start to be implemented in 2022.

⁸⁸ Each Recovery and Resilience Plan has to dedicate at least 20% of the plan's total allocation to digital objectives. To this end, the plans had to specify and justify to what extent each measure contributes fully (100%), partly (40%) or has no impact (0%) on digital objectives, using Annex VII of the RRF Regulation. Combining the coefficients with the cost estimates of each measure allows assessing to what degree the plan contributes to digital objectives and whether it meets the 20% target

1 Human capital

1 Human capital	Estonia		EU
	rank	score	score
DESI 2022	8	53.9	45.7

	DESI 2020	Estonia DESI 2021	DESI 2022	EU DESI 2022
1a1 At least basic digital skills % individuals	NA	NA	56% 2021	54% 2021
1a2 Above basic digital skills % individuals	NA	NA	28% 2021	26% 2021
1a3 At least basic digital content creation skills⁸⁹ % individuals	NA	NA	66% 2021	66% 2021
1b1 ICT specialists % individuals in employment aged 15-74	5.8% 2019	6.2% 2020	6.2% 2021	4.5% 2021
1b2 Female ICT specialists % ICT specialists	24% 2019	23% 2020	23% 2021	19% 2021
1b3 Enterprises providing ICT training % enterprises	17% 2019	17% 2020	17% 2020	20% 2020
1b4 ICT graduates % graduates	6.7% 2018	8.0% 2019	8.4% 2020	3.9% 2020

Estonia ranks 8th in the Human capital dimension. 56% of the population has at least basic digital skills while 28% has above basic digital skills. In both these indicators, Estonia performs only slightly better than the EU average. The country does rank third in the EU for the number of ICT specialists, as 6.2% of the total workforce is an ICT specialist. However, while this is significantly higher than the EU average of 4.5%, this share has not grown since 2021. The high proportion of ICT specialists is fuelled by a high number of ICT graduates, accounting for 8.4% of all graduates in 2020. This is the highest percentage in the entire European Union. However, the gender gap persists – even if it is smaller than the EU average – as only 23% of ICT specialists are women.

Estonia published its new [Education Strategy 2035](#) in November 2021, addressing digital skills for all target groups and setting objectives to be reached by 2035 for young people and the general population.

[OSKuste Arendamise](#) (OSKA), the Estonian skills forecasting body, plays a key role in skills foresight and policy planning. It analyses the labour and skills needs for the country's economic development for the next 10 years. In 2021, it published key reports on which future policies are based. Those reports include an analysis on the impact of the COVID-19 pandemic on the labour force needs (published in Q1.2021, with [key findings](#) in English), a report on [Digital \(and green\) skills](#) in Estonian (published in Q4.2021, with [key findings in English](#)), and another report on [ICT sector skills](#) (in Estonian and with [key findings in English](#)). OSKA sees the need for 18 000 more ICT workers in the next 7 years and therefore calls for ambitious advanced skills policies.

⁸⁹ Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

Schools in Estonia are generally well-equipped with digital devices. According to the [2020 Education & Training Monitor](#), 99% of students in upper secondary education and around 90% in primary and lower secondary education go to digitally equipped and connected schools. Before the COVID-19 pandemic, Estonia's education system was already well-prepared for distance learning in terms of digital equipment, e-learning platforms, and skills⁹⁰. As a result, almost every child had access to distance learning during the pandemic. The Ministry of Education also helped supply schools with computers to support distance learning for children who needed them. In the 2020/2021 school year, an additional 2 476 computers were supplied to schools, with an additional 300 in summer 2021.

Digital skills are part of the compulsory curricula for students and implementation is regulated by each school. During [EU CodeWeek 2021](#), Estonia was the EU country that organised the most activities in relation to its population size, along with Malta. More than 600 activities were organised, involving 11 440 participants. However, Estonia suffers from shortages of teachers and an ageing population among the current teaching community. Every year, 380 more teachers are needed. This may hamper teaching about digital technologies and developing digital skills in schools.

Estonia is also leading the fight against disinformation⁹¹. There is no specific course on media literacy in Estonian primary and middle schools, but there is a compulsory course on Media Literacy (35 hours in length) for secondary pupils preparing higher education. The course is taught in Estonian in most schools and in Russian in Russian-medium schools.

To sustain the rapid development of ICT companies in Estonia, the country needs a digitally skilled workforce. Estonia needs an estimated 18 000 digital specialists by 2027. As such, the [Estonian Recovery and Resilience Plan \(RRP\)](#), includes a specific measure worth EUR 10 million to support the development of digital skills for workers. By Q2 2026, 2 000 workers should have completed their training courses. A ministerial decree entered into force in Q2 2022 setting out this measure in more detail. The measure was devised follows an extensive consultation with stakeholders, different ministries and public bodies, and is ultimately based on OSKA recommendations.

To tackle the shortage of ICT specialists in the coming years, a legislative proposal to facilitate the immigration of skilled workers is being prepared. It will include a 'growth visa,' that complements the existing [Digital Nomad Visa](#). The new visa will make it easier for IT companies with global growth potential to hire third-country nationals. Estonia is also supporting the creation of specialised new master's programmes. These include a master in data science funded through the European Social Fund (ESF). Other data science and IT training programmes will start in 2022. The [Tallinn University of Technologies](#) also continues to offer a wide range of specialised bachelor's, master's and doctorate degrees in technology to train future generations of Estonian and international digital specialists. In 2021, [Kood/Jõhv](#), a new educational institution opened in the remote and mostly Russian-speaking county of Lääne-Viru. It offers a 2-year programme, free of charge, to people with IT background to become full-stack developers. It relies on a strong network of business partners and is supported by the Finance Ministry.

⁹⁰ More information on Estonian schools in the Education & Training Monitor 2021 edition available here: <https://op.europa.eu/webpub/eac/education-and-training-monitor-2021/en/estonia.html#three>

⁹¹ See for example: "[The country inoculating against disinformation](#)", BBC, 31st January 2022

Overall, Estonia has the ambition to train 7 000 additional ICT specialists in the period 2021-2027. Furthermore, the country is paying particular attention to bridging the gender gap in ICT jobs. To that end, projects to increase the share of women in the ICT sector called ‘Glass Walls and Ceiling in the ICT sector’ were finalised in 2021. The results of these projects will be taken into account when implementing measures under the ESF+ 2021-27 programme to address gender segregation of educational choices and the labour market.

The digitalisation of public services is a priority for Estonia. Civil servants must have the right digital skills so they can contribute to the administration’s digitalisation. Recently, the [DigiGov Academy](#)⁹² e-learning centre was launched for the public sector. This academy aims to raise the digital knowledge and skills levels among civil servants, although courses are open for everybody. There are currently five basic courses available: basics of DigiGov, basics of data, basics of AI, basics of developing e-services and basics of secure digital services. Twenty additional courses are expected in the next two years.

Estonia does well in the human capital dimension of the DESI. The country implements support measures to acquire basic and advance digital skills. However, Estonian companies still report shortages of skilled workers, especially in ICT, and it is important to continue promoting upskilling and reskilling the workforce to fill this gap.

⁹² Only available in Estonian

2 Connectivity

2 Connectivity	Estonia		EU
	rank	score	score
DESI 2022	26	44.4	59.9

	Estonia		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
2a1 Overall fixed broadband take-up	83%	83%	83%	78%
% households	2019	2020	2021	2021
2a2 At least 100 Mbps fixed broadband take-up	14%	19%	20%	41%
% households	2019	2020	2021	2021
2a3 At least 1 Gbps take-up	<0.01%	<0.01%	0.04%	7.58%
% households	2019	2020	2021	2021
2b1 Fast broadband (NGA) coverage	84%	89%	90%	90%
% households	2019	2020	2021	2021
2b2 Fixed Very High Capacity Network (VHCN) coverage	57%	71%	73%	70%
% households	2019	2020	2021	2021
2b3 Fibre to the Premises (FTTP) coverage	57%	71%	73%	50%
% households	2019	2020	2021	2021
2c1 5G spectrum	0%	0%	0%	56%
Assigned spectrum as a % of total harmonised 5G spectrum	04/2020	09/2021	04/2022	04/2022
2c2 5G coverage⁹³	NA	0%	18%	66%
% populated areas		2020	2021	2021
2c3 Mobile broadband take-up	84%	84%	87%	87%
% individuals	2018	2018	2021	2021
2d1 Broadband price index	70	75	70	73
Score (0-100)	2019	2020	2021	2021

Estonia ranks 26th among EU countries on connectivity. This low position is mostly due to the lack of 5G spectrum assignment and coverage.

Estonia's coverage of fixed very high-capacity networks (VHCN) and next generation access (NGA) networks did increase steadily in 2021. VHCN coverage is high, at 73% against the 70% average for the EU, and NGA coverage was 90%, on par with the EU average. There has been a substantial overall increase in VHCN coverage over the last 2 years (by 16 percentage points) due to the successful rollout of high-speed internet by Enefit Connect OÜ (formerly Elektrilevi), an Estonian electricity provider.

The Estonian broadband-infrastructure network project (EstWin⁹⁴) is nearing completion, the backhaul network is almost completely finalised, and now only one small part of southeast Estonia remains to be

⁹³ The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

⁹⁴ The Estwin project has successfully rolled out approximately 7,000 km of fibre backhaul network in rural areas and settlements with less than 10,000 inhabitants where optical networks did not previously exist and where operators had no previous plans to install them. The Estwin project was launched by the Estonian Ministry of

covered. In parallel, Enefit Connect OÜ has continued to provide high-speed internet throughout the country, with 5 650 more addresses connected as of Q3 2021⁹⁵. Completing access to the backhaul network is planned by 2023. In Estonia, EUR 24.29 million from the Recovery and Resilience Facility will be invested in VHCN in rural areas. In addition, a EUR 45 million allocation is planned from the European Regional Development Fund in 2021-2027 for the same purpose. It is estimated that 80 000 more homes⁹⁶ still need to be connected with fibre to cover the remaining white spots located in rural areas of the country.

Estonia has ubiquitous 4G coverage, reaching 99.9 % of the country. Nevertheless, the country lags behind in providing 5G commercial service⁹⁷ due to delays in assigning 5G pioneer bands⁹⁸. The country's 5G spectrum indicator was at 0% in 2021. The Estonian government intends to address this issue by progressively assigning the relevant spectrum bands. First the 3.6 GHz band, followed by the 700 MHz band and then the 26 GHz band. The auction procedure is ongoing for the 3.6 GHz band. Under the terms of the auction, licences have to⁹⁹ subject to the licence holders requesting an extension annually. The Regulatory authority must extend the license by another year if the license fee has been paid and the extension is not at odds with any international law requirements, amendments to the national frequency allocation plan, or any national security issue. In case the current usage would be conflicting with an amendment in the national frequency allocation plan, a period of at least 2 years will be provided during which the user may bring the existing usage into compliance with the amendment and eventually release the frequency, should it be impossible to terminate the relevant breach. The Estonian authorities should assign the 700 MHz band by Q3 2022 and the 26 GHz band is expected to be auctioned in early 2023.

Estonia's new Digital Strategy 2030 was adopted on 7 October 2021. This strategy is in line with the connectivity targets of the Gigabit Society (including the target to make available speeds of 100 Mbps – upgradable to 1 Gbps¹⁰⁰ – to the entire population). The overall objective of the strategy is to achieve

Economic Affairs and Communications in 2009. The aim of this project is to ensure that the EstWin network is not more than 1.5 km away from 98 % of households, businesses and institutions.

⁹⁵ In 2018, Elektrilevi, which is part of the Estonian State-owned energy group Eesti Energia, won a dedicated public competition and committed to connect 40,016 addresses in “white areas” (areas without coverage), thanks to State support worth EUR 20 million. Under the terms of the competition award, Elektrilevi's broadband network should: (i) have a technical capability of 1 Gbps download; (ii) be built over a maximum period of 5 years; and (iii) have a household/business contribution of no more than EUR 200 per connection. As of Q3 2021, Elektrilevi still had 24 352 homes left to pass with fibre.

⁹⁶ Source: Estonian Consumer Protection and Technical Regulatory Authority (ECTRA)

⁹⁷ Only one operator provides 5G commercial service in Tallinn, Harju county, Pärnu, Rakvere and Tartu in the 2.1 GHz band.

⁹⁸ The authorities' design of the 3.6 GHz band auction was challenged in the Administrative Court and in the Circuit Court by a telecommunications operator in 2019. The Decisions of the Administrative Court and the Circuit Court were in favour of the State but were appealed by an operator. The dispute ended in March 2020 when the Supreme Court decided not to take any actions concerning this appeal.

⁹⁹ Conversely, Article 49 of the European Electronic Communications Code provides for a minimal 20 year duration of regulatory predictability for spectrum rights granted by Member States.

¹⁰⁰ Currently, the country features low take-up for 1Gbps, which stood at 0.04% (against an EU average of 7.52%) The latter may be explained by the high prices of that type of subscriptions.

high-speed, reliable, and affordable electronic communications connections in the country by 2030, irrespective of the location.

The strategy notably focuses on developing access networks on the one hand and on the development of 5G and 6G core infrastructure on the other hand. The former supports the development of VHCN in rural areas that have proven to be economically challenging to operators. The latter supports the establishment of core infrastructure in the main transport corridors in Estonia, allowing for uninterrupted 5G coverage and also making the necessary preparations for the adoption of 6G when the relevant technology arrives on the market.

Main market & regulatory developments

On 17 March 2021, the Commission registered a notification from the Estonian Consumer Protection and Technical Regulatory Authority (ECTRA) about the markets for wholesale local access provided at a fixed location ("market 1/2020") and for wholesale central access provided at a fixed location ("market 3b/2014")¹⁰¹.

In the notified draft measure, ECTRA found the operator Telia Eesti AS to hold significant market power on both markets and imposed on this operator the following obligations: (i) access to copper and fibre; (ii) non-discrimination; (iii) transparency; (iv) cost accounting separation; and (v) cost-oriented prices, based on top-down fully distributed historical costs.

The Commission had serious doubts about the compatibility of ECTRA's draft measures with EU Law and considered that they created barriers to the internal market.

In its findings, the Commission pointed to a lack of sufficient evidence supporting the definitions of relevant product markets and national geographic markets. Furthermore, according to the Commission, there was a lack of sufficient evidence that the market for wholesale central access justified the imposition of regulatory obligation. Finally, the Commission considered that there was a lack of sufficient evidence supporting the finding of Significant Market Power in the wholesale local access and wholesale central access markets.

Following the Commission's observations, ECTRA withdrew its draft market analysis in May 2021, and it is now being reviewed.

On consumer protection, the relevant rules of the European Electronic Communications Code became fully applicable in Estonia as of 1 February 2022. Indeed, the Code was transposed into Estonian Law with the adoption of the Electronic Communications Act, Building Code and State Fees Act Amendment Act on 24 November 2021.

There have been about 20 consumer complaints, which is stable year on year, and they were

¹⁰¹Commission Recommendation (EU) 2020/2245 of 18 December 2020 on relevant product and service markets within the electronic communications sector susceptible to ex ante regulation in accordance with Directive (EU) 2018/1972 of the European Parliament and of the Council establishing the European Electronic Communications Code (OJ L 439 of 29.12.2020, p. 23) and Commission Recommendation of 9 October 2014 on relevant product and service markets within the electronic communications sector susceptible to ex ante regulation in accordance with Directive 2002/21/EC of the European Parliament and of the Council on a common regulatory framework for electronic communications networks and services (OJ L 295 of 11.10.2014, p. 79)

about clear contract terms, contractual penalties or other fees for terminating contracts early.

On zero rating offers, there is one by the operator Telia Eesti AS on the market. That offer's compliance with the regulatory framework might need to be assessed in light of the case law adopted by the Court of Justice of the EU on 2 September 2021¹⁰².

Estonia has a high-level of fixed VHCN coverage, including fibre to the premises, except in rural areas where this technology has not yet been made available to many households. The government plans to tackle this through dedicated public funding and implementing its Digital Strategy 2030. The country's ability to meet the 2025 gigabit targets¹⁰³ and the 2030 digital decade targets¹⁰⁴ will depend on the timely execution of the relevant strategy, as well as the assignment of 5G pioneer bands.

¹⁰² Judgment of 2 September 2021 adopted in Cases C-845/19, C-5/20 and C-34/20. ECTRA had previously assessed the operator's practice and concluded that it complied with Regulation (EU) 2015/2120 regardless of any new assessment deemed necessary as a result of the adoption of the Judgments of the Court of Justice.

¹⁰³ Gigabit connectivity for all of the main socio-economic drivers, uninterrupted 5G coverage for all urban areas and major terrestrial transport path; access to connectivity offering at least 100 Mbps for all European households.

¹⁰⁴ All European households are covered by a Gigabit network, all populated areas are covered by 5G.

3 Integration of digital technology

3 Integration of digital technology	Estonia		EU
	rank	score	score
DESI 2022	15	36.5	36.1

	Estonia		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
3a1 SMEs with at least a basic level of digital intensity	NA	NA	54%	55%
% SMEs			2021	2021
3b1 Electronic information sharing	26%	26%	23%	38%
% enterprises	2019	2019	2021	2021
3b2 Social media	16%	16%	22%	29%
% enterprises	2019	2019	2021	2021
3b3 Big data	11%	10%	10%	14%
% enterprises	2018	2020	2020	2020
3b4 Cloud	NA	NA	51%	34%
% enterprises			2021	2021
3b5 AI	NA	NA	3%	8%
% enterprises			2021	2021
3b6 ICT for environmental sustainability	NA	62%	62%	66%
% enterprises having medium/high intensity of green action through ICT		2021	2021	2021
3b7 e-Invoices	23%	62%	62%	32%
% enterprises	2018	2020	2020	2020
3c1 SMEs selling online	17%	16%	18%	18%
% SMEs	2019	2020	2021	2021
3c2 e-Commerce turnover	12%	12%	12%	12%
% SME turnover	2019	2020	2021	2021
3c3 Selling online cross-border	9%	9%	9%	9%
% SMEs	2019	2019	2021	2021

Estonia ranks 15th among EU countries on the integration of digital technology by businesses. There are significant differences between traditional Estonian companies that do not benefit from digital solutions and newer, highly digitalised companies. In Estonia, only 54% of SMEs have at least a basic level of digital intensity, which is just below the EU average and far from the EU target of 90%¹⁰⁵. On the use of digital technology by companies, only: (i) 23% share electronic information (vs 38% in the EU), (ii) 10% use big data technologies (vs 14% in the EU) and (iii) 3% use AI solutions (vs 8% in the EU). This use of advanced technologies is far below the 75% targets set in the Digital Decade. Moreover, only a few SMEs take advantage of the online economy: 18% of them sell online (vs 18% in the EU), but only 9% sell to other countries (vs 9% in the EU).

¹⁰⁵ In the Digital Decade communication ([COM\(2021\) 118 final](#)), the EU sets out its ambitions for 2030: 75% of EU enterprises have taken up cloud computing services, big data and Artificial Intelligence, and more than 90% of EU SMEs reach at least a basic level of digital intensity. The [Digital Intensity Index \(DII\)](#) measures the use of different digital technologies by enterprises and its score (0-12) is determined by how many of the 12 selected digital technologies the enterprises use. the DII distinguishes four levels of digital intensity for each enterprise: count of 0 to 3 points entails a very low level of digital intensity, 4 to 6 – low, 7 to 9 – high and 10 to 12 points – very high DII.

In October 2020, Estonia presented its [2021–2035 Research, Development, Innovation and Entrepreneurship Development Plan](#). This plan is the latest comprehensive strategy for the digitalisation of businesses and includes reforms and investments.

The Estonian RRP includes a specific measure for the digitalisation of businesses (Component 1 – Investment 1.) 230 SMEs are expected to benefit from financial support for digitalisation by 2026 with a total investment of EUR 58 million. The terms and conditions of the grant should be available later in 2022. In addition, the RRP includes specific measures for the digitalisation of the construction sector (EUR 9 million) and the road freight sector (EUR 6 million). Finally, the RRP plans to support Estonian companies, especially ICT companies, with their international and export strategies.

In 2021, the [AI & Robotics Estonia \(AIRE\)](#) Digital Innovation Hub (DIH) was formally launched. This technology hub brings together Estonia's best technological universities, professional associations, and businesses. It helps businesses in their digital transformation and develops demonstration projects for robotics and AI. The centre helps SMEs from the manufacturing sector but also healthcare sector obtain services to develop knowledge-intensive solutions in the field of AI and robotics. AIRE was the Estonian candidate to the network of European DIHs and had a successful evaluation result¹⁰⁶. AIRE's objectives are to increase the digital maturity of manufacturing SMEs, to increase investments into industrial digitalisation, to create a sustainable DIH ecosystem in Estonia and involve relevant stakeholders from the EU, to improve the target groups' competences in AI and robotics, and finally to increase market maturity and market creation potential of Estonian innovations.

Estonia is well known for being the home to innovative companies with global success and impressive growth. The vibrant start-up scene had new successes on the capital market with two more companies listed as unicorns¹⁰⁷ (Glia, founded in 2011, unicorn in 2022 and [Veriff](#), unicorn since 2022). The sector continues to expand with more than 1 200 start-ups as highlighted by the [2021 Estonian Start –up Awards](#). For Estonian start-ups, 2021 was another record-breaking year. They collectively raised almost EUR 1 billion raised on the market (2021: EUR 950 million, 2020: EUR 450 million, 2019: EUR 250 million.) SmartCap, as a subsidiary of Estonian Business and Innovation Agency, addresses market gaps and continues making investments into venture capital funds to boost innovative Estonian companies. [Start-up Estonia](#), the government initiative supporting start-up development, also plays a very active role.

However, as reported by the [OECD in 2020](#), despite this very active and innovative start-up ecosystem, traditional companies continue to lag behind in adopting digital technologies. As a result, there is a high concentration of ICT specialists in a few innovative companies, and more traditional enterprises, particularly SMEs, do not reap the benefits of digital technologies. Room for improvement therefore exists.

On advanced technologies, Estonia is currently finalising its new National Artificial Intelligence Strategy for 2022-2023 which updated the existing one covering 2019 to 2021. To support the take-up of AI by businesses, the strategy will include measures to raise awareness and support the application of such solutions. Estonia also participates in the Nordic-Estonian Quantum Computing e-Infrastructure Quest project ([NeIC NordiQuEst](#)). NordiQuEst will create a Nordic quantum computing ecosystem by setting-up a platform tailored to region's needs, with access to several quantum computers and quantum

¹⁰⁶ i.e. is invited for grant agreement preparation (which is not a formal commitment for funding).

¹⁰⁷ Privately held startup company with a value of over EUR 1 billion

computer simulators. It is a new consortium of seven partners from five countries: Denmark, Finland, Norway, Sweden and Estonia. Furthermore, Estonia is working closely with its neighbouring countries (Finland, Lithuania and Latvia) to develop its National Plan for Quantum Infrastructure.

The Estonian Parliament recently approved the new Electronic Communications Act, which transposes the European legal framework into national law and specifies the requirements and criteria for using hardware and software (including 5G) in national communications networks. In view of the growing concerns in the region and Russia's invasion of Ukraine, cybersecurity has become a top priority for Estonia. The government has sent cybersecurity recommendations to public agencies and companies providing essential services.

Estonia presents a mixed picture concerning the integration of digital technologies. Some companies are driving Estonian digitalisation and the country is investing in advanced digital technologies. However, traditional companies continue to lag behind and overall there is still a lot of room for improvement. It is crucial that all businesses reap the benefits of digital transformation.

4 Digital public services

4 Digital public services ¹⁰⁸	Estonia		EU
	rank	score	score
DESI 2022	1	91.2	67.3

	DESI 2020	Estonia DESI 2021	DESI 2022	EU DESI 2022
4a1 e-Government users % internet users	88% 2019	89% 2020	89% 2021	65% 2021
4a2 Pre-filled forms Score (0 to 100)	NA	NA	87 2021	64 2021
4a3 Digital public services for citizens Score (0 to 100)	NA	NA	92 2021	75 2021
4a4 Digital public services for businesses Score (0 to 100)	NA	NA	98 2021	82 2021
4a5 Open data % maximum score	NA	NA	94% 2021	81% 2021

Estonia is the EU leader in Digital public services. Almost 90% of internet users have access to e-Government services. Scores for digital public services, 92/100 for citizens and 98/100 for businesses, are close to the maximum, and well above the EU average. Pre-filled forms are also widely used and Estonian authorities are making many data sets available as open data.

The country often positions itself as one of the most digitalised nations in the world, branded as [e-Estonia](#). The recent Covid-19 pandemic further increased the need for digital public services. The Estonian priority is now shifting towards the quality and human-centricity of these services. This is reflected in the recently presented [Estonia's Digital Agenda 2030](#), setting the objective of a satisfaction rate of 90% for digital public services.

Estonia is also at the forefront of digital democracy. Electronic voting is possible for local, national and European elections. At the local level, participative decision-making involving online voting is also widely used. This is facilitated by the wide dissemination and take-up of digital identity solutions and digital signatures. Almost 90% of Estonians have an ID card, which is also an eID notified under the eID regulation and issued by the government. It gives citizens access to a wide range of digital public services. In addition, 6 additional eID systems (including 5 of them notified under the eID regulation) exist in the country. E-ID systems of 12 other Member States can be used to access digital Estonian public services.

Estonia continues to invest in its digital public services, including through its RRP. Almost half of the RRP's digital budget is for further digitalising its public services. One of the key projects financed through RRF is the development and implementation of the [Bürokratt](#). This is an interoperable network of AI

¹⁰⁸ There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

applications, giving people to access public services through virtual assistants and voice interaction. A new digital gateway to ease the business administrative tasks will also be completed at a later stage.

Estonia's public sector organisations are working together with private sector companies towards the transition to a real-time business environment, where administrative activities, financial transactions and reporting are created and processed automatically, in real time and in a standardised digital form. The main goals of the [2021-2027 Real-Time Economy](#) are the widespread introduction of B2B e-invoicing, e-receipt and e-waybills as well as the transition to automated data-based reporting. In 2021, preparations were made to continue with analysis and development activities in 2022. This would enable companies to automatically transmit data from their financial software to the state and to automate the sharing of business data between government agencies. The data available for the private sector to make better business decisions. In order to support the transition to the real-time economy, measures aimed at entrepreneurs were mapped (support measures for the transition to e-invoicing and e-waybills) and will be open for entrepreneurs in 2022.

Even before the pandemic, the Estonian health system was already very digitalised. This continued in 2021 as 99% of prescriptions were made digitally. People in Estonia have access to an online environment providing health e-services, their medical records, doctor visits and current prescriptions. Estonia is now working to ensure cross-border access to e-health services and mutual recognition.

In addition to the online services mentioned above, Estonia has developed a [nation 3D digital twin](#) (published on 30 March 2021 and largely financed through EU regional funds)¹⁰⁹ which covers the whole country and is used by all cities and communities, including in rural areas. The use cases are currently focused on planning, designing and constructing buildings, but more real-time applications like energy performance monitoring are planned.

Estonian public institutions are gradually moving from legacy IT systems to a new government cloud solution. This has been developed in line with the national IT Security Standard ([ISKE](#)) to ensure it complies with safety and quality requirements. Since early 2022, the main infrastructure for the government cloud is up and running and the first basic IT services will be provided later in 2022 to customers.

Cybersecurity is another key concern for Estonia and the growing international threats make this an even greater priority. The Digital Strategy for 2030 stresses the objective of making the Estonian cyberspace secure and trustworthy. This may include national security aspects for fighting back the most recent and modern threats, developing capacity to analyse trends and new risks, and increasing capacity to provide cybersecurity protection to public institutions and businesses.

Despite already being a strong leader in the EU, Estonia continues to invest in new digital public services. This investment will make these services more user-centred and user-friendly. The strong focus on cybersecurity is also an example for other countries to follow to ensure these services remain resilient, especially in uncertain times and with growing cyber threats.

¹⁰⁹ Digital twins, or digital replicas of physical objects based on real-time data and other information, have become important tools for improving our understanding of complex systems and helping us make informed decisions. A digital twin can represent a car, a tunnel or an entire factory, for example, and be very useful for testing and predicting how these would perform under different conditions.

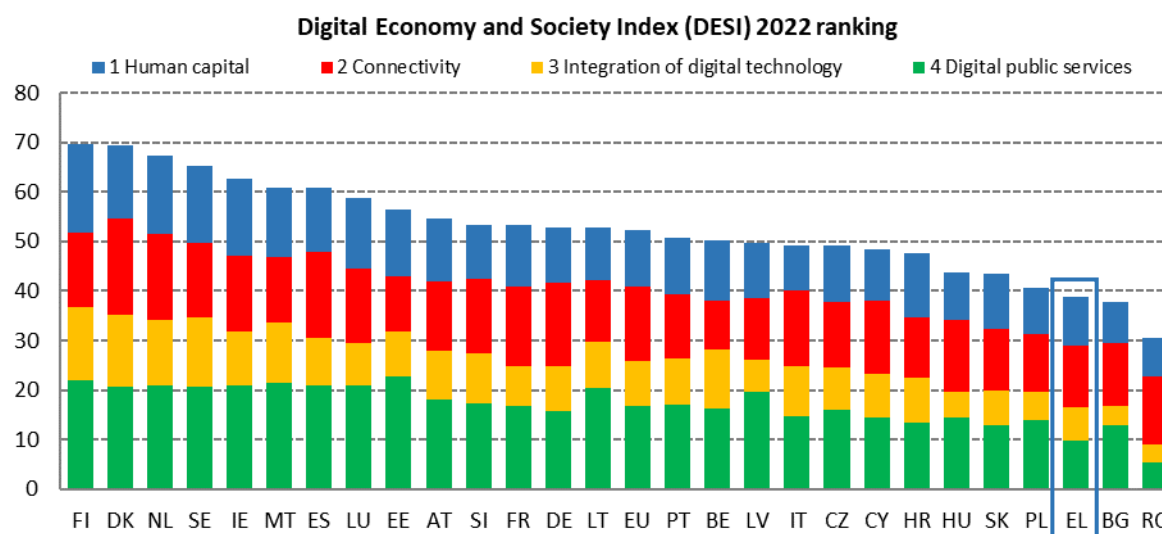
Highlight: Bürokratt – The next generation of digitalisation of public services?

Bürokratt is the vision of how digital public services should work in the age of AI. Bürokratt will be an interoperable network of AI applications, which enable citizens to use public services with virtual assistants through voice-based interaction. Bürokratt aims to provide a layer where AI and other services, public and private, will be able to combine and interact. Government AI agents, bots, and assistants, as well as private sector ones, will serve the user via a united channel, enabling them access to a spectrum of services. The government is already rolling out Bürokratt, first via its Consumer Protection and Technical Regulatory Authority, Police and Border Guard Board and National Public Library. Users will soon be able to carry out such tasks as filing a consumer complaint, applying for permits, renewing their identification cards, reporting a car accident, or borrowing books, all via virtual assistant.

This initiative is expected to receive an estimated EUR 10,48 million support from the RRF as part of the adopted Estonian Recovery Plan (Component 3, measure 4).

Greece

	Greece		EU
	rank	score	score
DESI 2022	25	38.9	52.3



Greece ranks 25th of 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI). However, overall Greece progressed well in recent years comparatively with other EU Member States¹¹⁰, signalling that Greece is catching up.

In connectivity, Greece has made significant progress, notably in Very High-Capacity Networks (VHCN) and 5G coverage. Although, the country still needs to progress particularly in the take-up of at least 100 Mbps fixed broadband which remains very low (9%) compared to the EU average (41%) and further improve 5G coverage (66%) to ensure access to high-speed connectivity in the entire country. In Digital public services the number of active users of e-government services (69%) has increased since last year (67%) and is 5 percentage points above the EU average (64%). The country also made progress with regards to the population having at least basic digital skills - with 52%, Greece is very close to the EU average (54%). On the integration of digital technologies into business activities, Greece performs below the EU average. Only 39% of small and medium-size enterprises (SMEs) have at least a basic level of digital intensity compared to the EU average of 55%. However, 20% of SMEs in Greece sell their goods and services online, above the EU average of 18%.

The '[Digital Transformation Bible](#)' presented by the Ministry of Digital Governance in 2020 became a state law on 5 July 2021. It sets out the strategic roadmap for Greece's digital transformation over the

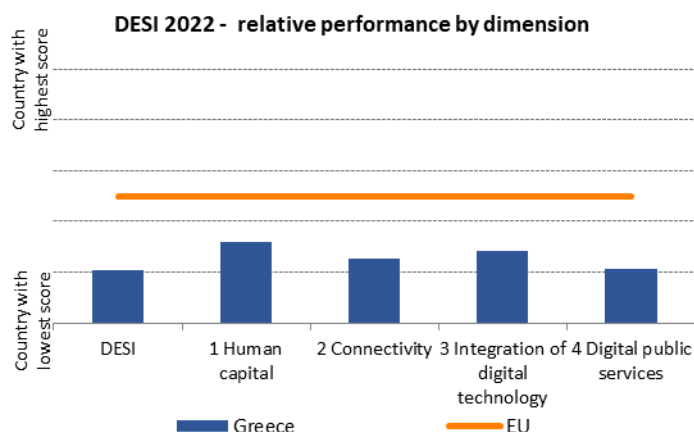
¹¹⁰ Refer to section 1.3 of the DESI 2022 horizontal chapter

next 5 years. The strategy covers six pillars: (i) connectivity; (ii) digital skills; (iii) digital state; (iv) digital business; (v) digital innovation; and (vi) integration of digital technology in every sector of the economy. Greece went on to publish its [Operational Programme for the digital transformation](#) (2021-2027) under the EU cohesion policy in October 2021, which will help it to implement all pillars of the strategy. Greece also participates in a wide spectrum of European initiatives and programs such as the Technical Support Instrument (TSI) and the Research and Innovation funding program Horizon 2020 (e.g. [GLASS](#) project) that contribute to the country's digital transformation.

Furthermore, the COVID-19 pandemic continued to boost the digital transformation of public services. The country's main service is the single 'Gov.gr' portal, which hosts more than 1 370 digital public services. The number of digital transactions recorded in 2021 was 6 times higher (566 million) than in 2020 (94 million). Within the context of the Technical Support Instrument (TSI) 2022, 'Gov.gr' stands at the centre of a new integrated, shared digital public service ecosystem with the next generation of the single digital gateway. Additionally, re-skilling and up-skilling programs for civil servants are also under preparation to ensure utilization of advanced technologies in the public sector. Progress in digitalising enterprises remains slow, but the full implementation of reforms and investments planned under both the recovery and resilience plan (RRP) as well as in the coming EU cohesion funds are expected to help to accelerate progress in the coming years. In 2021, Greece participated to the Digital Europe Programme call for European Digital Innovation Hubs with the objective to improve digital skills, support and enhance digital innovation, in particular by supporting SMEs and High-Tech Start-ups with the establishment of Artificial Intelligence (AI) centres.

In December 2020, Greece published the National Cybersecurity Strategy (2020-2025), an umbrella strategy covering all important and critical sectors that includes a series of actions under the flagship activity program. The Russian invasion of Ukraine has precipitated quick strategic actions and restrictive measures, well ahead of schedule. Examples include (a) the development of a framework to promote excellence in cybersecurity; (b) the increase of the readiness - alerting level of critical infrastructure and take all related measures, such as daily security alerts; (c) the design of a Monitoring Centre for the Critical Infrastructures - Security Operations Center – SOC; (d) the full operation of the protection system regarding governmental web sites. The Hellenic Telecommunications and Post Commission (EETT) also took appropriate measures, in cooperation with the providers, to ensure the suspension of retransmission of two Russian channels abiding by the EU guidelines.

For all DESI dimensions, the measures outlined in the strategy for the digital transformation of Greece are starting to bring about tangible improvements for people across the country, particularly the digitalisation of public services. However, vigilance is required to ensure the swift implementation of the major plans currently in force as it will increase digital opportunities at national level and contribute to the achievement of the Digital Decade targets.



Digital in Greece's recovery and resilience plan (RRP)

Greece's RRP was adopted by the Council on 13 July 2021. It sets out 106 investment measures and 68 reforms to be implemented with a budget of EUR 30.5 billion. 23% of the total budget is reserved for measures related to the digital transformation¹¹¹.

In 2022, several measures to modernise and digitalise the public sector are planned to be launched. These include: (i) projects to digitalise archives and related services (EUR 598 million); (ii) developing interoperability and web services; and (iii) modernising the public administration's one-stop-shops. A reform to deliver on the cybersecurity strategy for the public sector is planned to be launched by Q4/2022. Measures to improve connectivity are also planned to be launched, including the project for the 'Fibre optic infrastructure in buildings' (budget EUR 131 million); and a call for digital transformation of the SMEs (budget EUR 375 million)

¹¹¹ Each recovery and resilience plan has to dedicate at least 20% of the plan's total allocation to digital objectives. To this end, the plans had to specify and justify to what extent each measure contributes fully (100%), partly (40%) or has no impact (0%) on digital objectives, using Annex VII of the RRF Regulation. Combining the coefficients with the cost estimates of each measure allows assessing to what degree the plan contributes to digital objectives and whether it meets the 20% target.

1 Human capital

1 Human capital	Greece		EU
	rank	score	score
DESI 2022	22	40.1	45.7

	DESI 2020	Greece DESI 2021	DESI 2022	EU DESI 2022
1a1 At least basic digital skills % individuals	NA	NA	52% 2021	54% 2021
1a2 Above basic digital skills % individuals	NA	NA	22% 2021	26% 2021
1a3 At least basic digital content creation skills¹¹² % individuals	NA	NA	62% 2021	66% 2021
1b1 ICT specialists % individuals in employment aged 15-74	2.0% 2019	2.1% 2020	2.8% 2021	4.5% 2021
1b2 Female ICT specialists % ICT specialists	22% 2019	29% 2020	21% 2021	19% 2021
1b3 Enterprises providing ICT training % enterprises	15% 2019	12% 2020	12% 2020	20% 2020
1b4 ICT graduates % graduates	3.1% 2018	3.4% 2019	3.5% 2020	3.9% 2020

On Human capital, Greece ranks 22nd of 27 EU countries, scoring below the EU average. With 52% of people (age 16-74) having at least basic digital skills, Greece is very close to the EU average (54%). But zooming into the group age of 16 - 24 years, Greece is among the frontrunners with 88% of young people with at least basic digital skills, much higher than the EU average (71%). The percentage of ICT specialists slightly progressed but remains low (2.8 %) compared to the EU average (4.5%). However, the proportion of women ICT specialists (21%) is above the EU average (19%). Only 12% of enterprises provided ICT training to their employees in 2020, compared to the EU average of 20%.

Equipping people with digital skills is a fundamental goal of Greece's [digital transformation strategy](#). To that end, a strategy for digital skills was jointly developed by the Ministry of Digital Governance, the Ministry of Education and Religious Affairs and the Ministry of Labour and Social Affairs. The strategy sets out three targets: (i) to enhance digital knowledge; (ii) to consolidate the [National Academy of Digital Competences](#); and (iii) to strengthen the [Greek National Coalition for digital skills](#). The strategy sets out to create links between stakeholders, in the fields of education and employment and public sector officials, so that they can work together to improve digital skills. It focuses on vulnerable groups (people with disabilities, older people, etc.) and groups that face particular difficulties to enter the labour market (women, the unemployed, conscripts, etc.). The Greek National Coalition for digital skills

¹¹² Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

will be at the core of this coordination effort. A Digital Skills Strategic Plan is under preparation, to be published by the end of 2022. It aims at enhancing the digital skills of the Greek people to become active members of the digital economy and society with a special focus on actions promoting Digital Citizenship.

Launched in 2021, the National Academy of Digital Competences aims to become the national portal for all digital training providers, both public and private. It currently hosts almost 300 courses and aims to scale up its collection of online courses to enable everyone in the country to acquire basic, intermediate, and advanced digital skills. It also provides a self-assessment tool so that people can determine their individual learning path. To improve digital knowledge, the Ministry of Digital Governance is developing a national digital competence framework and a certification system for digital skills in line with the European digital competence framework.

In 2021, Greece introduced several measures to upskill and reskill the labour force. The Hellenic Manpower Employment Organisation (OAED) was responsible for two of them. Firstly, it launched training courses on cloud technologies for unemployed. This initiative has two phases: unemployed people with IT knowledge will be trained as certified trainers in digital cloud technologies in the first phase, and the online training will be made available to a wider group in the second phase. Secondly, the OAED launched a programme to help provide 5 000 unemployed young people with work experience.

Improving the digital skills (both basic and specialised) of civil servants is also a priority for the Ministry of Digital Governance. As part of the National Coalition for digital skills, this Ministry, along with the Ministry of Interior and the National Centre for Public Administration and Local Governments organise training programmes to upgrade the digital skills of civil servants. In the first phase, a total of 3 000 civil servants should receive training between December 2021 and June 2022. The RRP outlines several other measures to improve digital skills. For example, the 'Digital skills upgrade programmes for conscripts' project planned to be launched in 2022 aims to train 150 000 conscripts by 2025.

Several initiatives planned – including projects presented in the RRP – are expected to contribute to the digital transformation of the education system in Greece, once fully implemented. They are expected to improve (i) the digital equipment and content in schools, (ii) the professional development of teachers, and (iii) the development of digital services in schools and universities. One example is the 'Digital Access' (*Psifiaki Merimna*) project which, in its first phase, allowed to issue by the end of 2021 more than 500 000 vouchers for students from low-income families, including 53 445 for higher education students to buy electronic devices. A second phase of the project for the purchase of digital devices by all public-school teachers started.

The Ministry of Education and Religious Affairs is also continuing the revision of the curricula started last year. The curricula for primary and secondary schools, which are being developed by the Institute for Education Policy (IEP), will promote computational thinking and programming. In 2021, 166 school curricula for primary and secondary education have been upgraded, adopting a learning-outcomes-based approach. The new school textbooks would be available to students in 2023 and accompanied by digital resources and tools. The 'Skills Labs' is another educational novelty implemented at national level in primary and secondary schools in 2021/2022, contributing to further develop pupils' advanced skills. Teachers introduce pupils to coding and programming, and to advanced technologies such as AI,

blockchain the Internet of things and robotics. In 2021, participation in [EU Code Week](#) continued to grow. Greek schools were more active than ever with 95 700 people participating in 2 283 activities organised at 97% in the country's schools - placing Greece among the most active countries.

In 2021 a large-scale intensive program, [T4E](#) (Training for Educators) endowed teachers with the necessary digital competences. More than 82 000 teachers were trained on how to use digital platforms and tools. The IEP has also embarked on numerous professional activities for teachers, providing more than 125 000 training sessions in 2021, launching for this purpose a one stop shop digital platform. The preparedness of the educational system to switch to remote learning was assessed in a [survey by Bertelsmann Stiftung](#) published in December 2021, for OECD and EU countries, placing Greece on the 6th rank (from the 22nd previously).

In higher education, the Ministry of Education and Religious Affairs has initiated specific measures to contribute to the target of 20 million ICT specialists. Conversion courses on reskilling and upskilling in digital studies and advanced technologies are being developed and targeting at university graduates. Furthermore, several initiatives have been launched through the National Strategic Reference Framework (NSRF) as well as the RRF. Some key digital services for higher education students and teachers for 2021 include: [ATLAS](#) a centralized online service to interconnect companies offering internship positions with all academic institutions in Greece; a project to interconnect the information systems of the higher education institutions (HEI) Career Offices and of the Hellenic Authority for Higher Education (HAHE) to facilitate information and good practices exchange. Furthermore, in 2021 25 university projects participated in the action: 'Provide digital equipment to support university students and staff for distance learning due to COVID-19 pandemic'. Greece adopted a law introducing 19 'Centres of Excellence' at the Greek HEIs to reward and support best quality and innovation practices in Higher Education.

Furthermore, during 2021, a new field of interaction between industry and labour market has been strengthened. The establishment of the National System of Vocational Education, Training (VET) and Lifelong Learning contributed to the mapping of labour market needs at local and national level. In addition, Model Vocational Lyceums (EPAL) have been introduced together with new experimental and thematic vocational training institutions. Among the key reform initiatives regarding VET are: the establishment of national and regional councils (The National Central Council of Vocational Education and Training (KSEEEK); the Regional Councils for the Connection of Education with Production and the Labour Market in each region of the country (SSPAE) and investments across all levels of VET (communication campaign for raising awareness on Vocational Education 2020-2027 to Greek society, and upgrade of all laboratory centres which is among the RRP measures).

Stepping up efforts to develop the digital skills of the whole population is indispensable if the country is to create an environment where everyone is empowered and feel digitally safe, and to contribute significantly to the Digital Decade target of 80% of the population having at least basic digital skills in the EU by 2030. Similarly, a strong push to increase the number of digital experts will allow Greece to reap the full benefits of the digital transition in all sectors of the economy and contribute to the Digital Decade target of 20 million ICT specialists in employment in the EU by 2030.

2 Connectivity

2 Connectivity	Greece		EU
	rank	score	score
DESI 2022	22	49.6	59.9

	Greece		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
2a1 Overall fixed broadband take-up	76%	77%	82%	78%
% households	2019	2020	2021	2021
2a2 At least 100 Mbps fixed broadband take-up	1%	3%	9%	41%
% households	2019	2020	2021	2021
2a3 At least 1 Gbps take-up	<0.01%	<0.01%	<0.01%	7.58%
% households	2019	2020	2021	2021
2b1 Fast broadband (NGA) coverage	81%	87%	92%	90%
% households	2019	2020	2021	2021
2b2 Fixed Very High Capacity Network (VHCN) coverage	7%	10%	20%	70%
% households	2019	2020	2021	2021
2b3 Fibre to the Premises (FTTP) coverage	7%	10%	20%	50%
% households	2019	2020	2021	2021
2c1 5G spectrum	0%	99%	99%	56%
Assigned spectrum as a % of total harmonised 5G spectrum	04/2020	09/2021	04/2022	04/2022
2c2 5G coverage¹¹³	NA	0%	66%	66%
% populated areas		2020	2021	2021
2c3 Mobile broadband take-up	67%	67%	76%	87%
% individuals	2018	2018	2021	2021
2d1 Broadband price index	49	53	58	73
Score (0-100)	2019	2020	2021	2021

On Connectivity, with an overall score of 49.6 (compared to EU average of 59.9), Greece ranks 22nd in the EU.

For fixed networks, Greece has made significant progress in Very High Capacity Networks (VHCN) and fast broadband coverage (i.e. next generation access (NGA)). The latter increased by 5 percentage points in 2021, reaching 92% which is above the EU average. VHCN coverage increased to 20%, up from 10% one year earlier, although this is still well below the EU average of 70%. The take-up of at least 100 Mbps fixed broadband remains very low (reaching 9%, up from 3% in 2020) compared to the EU average (41%). Overall fixed broadband take-up is above the EU average (82% compared to 78%). However, Fibre

¹¹³ The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

to the Premise (FTTP) is at 20% in 2021, up from 10% in 2020, and at 0% in rural areas. Greece has progressed in the broadband price index with a score of 58 in 2021 compared to 53 in 2020, still below the EU average. The mobile broadband take-up (76% in 2021) remains below the EU average (87%).

In November 2021, the General Secretariat of Telecommunications and Post of the Ministry of Digital Governance launched a public consultation on the new National Broadband Plan, which aims to achieve the Gigabit objectives for 2025 and the 2030 Digital Decade targets. The plan sets out a series of measures including removing administrative burdens and creating an investment-friendly environment, and aims in particular to ensure high-speed services across the entire country.

Upgrades to the country's network infrastructure will be financed under providers' investment plans and the Recovery and Resilience Facility (RRF), as well as through other public investments such as the [Ultra-fast Broadband initiative](#). The latter aims to provide 100 Mbps / 1 Gbps services to 18% of households in Greece. Particular attention will be given to making sure that EU funds (structural funds, Connecting Europe Facility Digital, RRF) and national funds are mutually reinforcing.

Two big multi-country projects (MCPs) are outlined in the RRF plan - the development of 5G corridors on all major Greek highways (budget: EUR 160 million) and the deployment of submarine cables to connect the mainland with the Greek islands and Cyprus (budget: EUR 30 million). The plan also foresees investments in space technologies and applications, namely the development of a constellation of small satellites (budget: EUR 200 million).

Additionally, the plan includes two demand stimulation projects. The first will support the installation of fibre infrastructure in buildings (budget of EUR 131.3 million), lowering the cost of cabling, which is a considerable cost for end-users to get VHCN network connectivity. The second will extend the Superfast Broadband voucher-scheme, which provides vouchers for 24 months of VHCN service. Over 130 000 vouchers have been issued to date and the number of beneficiaries is expected to grow significantly, as VHCN becomes more widely available. Given the very low take-up and high prices of VHCN services in Greece, this is a very significant measure.

The deployment of NGA networks in the context of the vectoring procedure involving all operators is on schedule. Although most NGA deployment under the vectoring deployment plan concerns implementation of FTTC/VDSL vectoring access networks, operators also deploy Fibre to the Home (FTTH) networks, though to a lesser degree (1 620 FTTH allocated cabinets out of 22 457). Operators also deploy also FTTH networks in different areas, mainly in the vicinity of the local exchanges that they have been allocated, which have been excluded from the vectoring procedure for technical reasons. All operators announced their plan to upgrade the active FTTC/VDSL networks to gigabit connectivity.

On mobile networks, Greece is well advanced on spectrum management. It scores 99% in the 5G spectrum indicator; all three 5G pioneer bands harmonised at EU level have been assigned. The auction included the 700 MHz, the 3 410-3 800 MHz, the 26 GHz bands, as well as the paired terrestrial 2 GHz band, ended on 16 December 2020. In the 700 MHz band, TV migration was finally completed in October 2021. In the 3 600 MHz band, points of presence (PoP) in rural areas were re-allocated to 3 410-3 470 MHz to allow for the 5G networks to use as much contiguous spectrum as possible in the whole band. 3 400-3 410 MHz was reserved for governmental use. In the 26 GHz, the upper 1 GHz was licensed for 5G networks, while existing FWA networks operate in the lower 2 GHz part of the band.

Main market & regulatory developments

The United Group, a leading telecommunications and media operator in Southeast Europe acquired Wind Hellas in January 2022, following European Commission's approval. In 2020, the United Group acquired the Greek telecommunications and pay-TV provider, Forthnet, which was focused mainly on fixed and pay-TV services, while Wind Hellas was focused on both fixed and mobile telecommunications services.

Wind Hellas transferred its fibre business to a newly established company named *Hellenic Open Fibre* (also owned by United Groups), including physical infrastructure like ducts and sites, the fibre cables themselves, and active equipment. Wind Hellas will, however, retain the active equipment that serves its mobile business. Market sources estimate that this move is part of the United Group's general plan to create separate companies to manage the infrastructure department.

Volton Group (via its related company Cell Mobile) is also preparing its entry into the telecommunications market having reached a commercial agreement with Vodafone Greece to operate as a mobile virtual network operator (MVNO).

On 5 October 2021, the Commission registered a notification¹¹⁴ from the Greek national regulatory authority (EETT) on new prices for (i) wholesale high-quality access provided at a fixed location and (ii) wholesale trunk segments of leased lines¹¹⁵. The Commission issued a decision acknowledging the limitations that EETT faced to set temporary prices for products that had not been regulated previously or offered on a commercial basis. However, the Commission urged EETT to finally complete a robust costing model to determine cost-based prices. EETT estimates that the cost model should be ready by January 2023.

After the incumbent's announcement to double the speed of all existing fixed telephony broadband connections at no additional cost, other operators have urged the regulator to evaluate the packages based on the new 'Price Squeeze Model' and to examine the impact that doubling speeds will have on competition. The first EETT's decisions on the approval of some of OTE's packages have been published but the evaluation of most of them is still pending. Regarding the expected notifications for markets 1/2020 and 3b/2014, EETT plans to start the public consultation in June 2022. The same schedule also stands for the finalisation of the price squeeze model.

Reforms and targeted investments are still needed for Greece to achieve the 2025 Gigabit targets, the 2030 Digital Decade targets and to bridge the digital divide, especially in areas where there is market failure. The new National Broadband Plan adopts the Gigabit Society targets and includes a roadmap towards the achievement of these targets.

¹¹⁴ Case EL/2020/2341

¹¹⁵ Corresponding to market 2 of Commission Recommendation (EU) 2020/2245 of 18 December 2020 on relevant product and service markets within the electronic communications sector susceptible to ex ante regulation in accordance with the Code (2020 Recommendation on Relevant Markets).

Notably, three connectivity projects aim at improving Greece's connectivity profile: UFBB (UltraFast Broadband) which is a PPP to deploy connectivity infrastructure covering 18% of the population, WiFi4GR (WiFi for Greece) which aims at creating 2 500 hotspots in the entire country and SFBB (SuperFast Broadband) which will stimulate demand of VHCN services. Financing comes from both national, private and EU funds and amounts to EUR 700 million for UFBB, EUR 15 million for WiFi4GR and EUR 50 million for SFBB.

The adoption of a pro-investment regulatory framework and the current reforms, combined with the funding from the Recovery and Resilience Facility (RRF) as well as the implementation of investments such as the cross-border 5G corridors and the interconnection of the islands with submarine fibre cables will all help Greece improve its connectivity and extend coverage of fibre and 5G. This is especially important for take-up of fast fixed broadband, including fibre and 5G coverage, and will enable people and enterprises across Greece to use next generation infrastructure and lay the ground for high-technology applications and the take-up of emerging technologies.

3 Integration of digital technology

3 Integration of digital technology	Greece		EU
	rank	score	score
DESI 2022	22	26.6	36.1

	DESI 2020	Greece DESI 2021	DESI 2022	EU DESI 2022
3a1 SMEs with at least a basic level of digital intensity % SMEs	NA	NA	39% 2021	55% 2021
3b1 Electronic information sharing % enterprises	38% 2019	38% 2019	35% 2021	38% 2021
3b2 Social media % enterprises	19% 2019	19% 2019	29% 2021	29% 2021
3b3 Big data % enterprises	13% 2018	13% 2020	13% 2020	14% 2020
3b4 Cloud % enterprises	NA	NA	17% 2021	34% 2021
3b5 AI % enterprises	NA	NA	4% 2021	8% 2021
3b6 ICT for environmental sustainability % enterprises having medium/high intensity of green action through ICT	NA	65% 2021	65% 2021	66% 2021
3b7 e-Invoices % enterprises	9% 2018	NA 2020	NA 2020	32% 2020
3c1 SMEs selling online % SMEs	9% 2019	NA 2020	20% 2021	18% 2021
3c2 e-Commerce turnover % SME turnover	4% 2019	NA 2020	11% 2021	12% 2021
3c3 Selling online cross-border % SMEs	4% 2019	4% 2019	7% 2021	9% 2021

Greece ranks 22nd in the EU on the Integration of digital technology into business activities. Only 39% of SMEs have at least a basic level of digital intensity compared to the EU average of 55%. Although 20% of SMEs in Greece are taking advantage of the opportunities presented by online commerce (above the EU average of 18%) only 7% sell online across borders (EU average: 9%). Of SMEs' total turnover, e-commerce accounts for 11%, close to the EU average of 12%. The share of enterprises using social media stands at 29% in line with the EU average. On the adoption of advanced digital technologies, the picture is mixed: 13% of enterprises in Greece use big data, broadly in line with the EU average (14%), but they score well below the EU average on the use of cloud and AI. However, Greece is close to the EU average on ICT for environmental sustainability (65% compared to 66%).

In the Digital Transformation Bible, Greece outlines measures that will help achieve the Digital Decade target of 90% of SMEs having at least a basic level of digital intensity. A notable initiative launched in 2021 is the KEP Plus pilot programme by the Ministry of Digital Governance. This programme will build on the network of Citizen Support Centres, aiming to provide targeted support to start-ups and young

entrepreneurs to boost Greece's digital transformation and create a more efficient business environment.

Although Greece does not have a national strategy on the digital transformation of industry, the Digital Transformation Bible sets out measures to create a favourable regulatory and investment framework to speed up the digitalisation of larger and smaller enterprises. A memorandum of cooperation for setting up a digital Industry 4.0 platform signed between the General Secretariat for Industry and the Ministry of Digital Governance in 2019¹¹⁶ aims to simplify the licensing process for businesses in the industrial sector. General measures to help enterprises speed up their digital transformation (e.g. adaptation of information systems and digital services to cross-border trade, better use of data for new products, markets and business models, and training to improve the digital skills of employees and entrepreneurs) are also planned. In addition, projects for the digitalisation of enterprises in the industrial sector receive support from the EU cohesion policy (2014-2020), the Operational Programme 'Competitiveness, entrepreneurship & innovation' (EPAnEK) and the Hellenic Development Bank.

Greece's RRP includes a major initiative to be launched in 2022 to support the digital transformation of SMEs (budget: EUR 375 million). It will support technologies and services for digitalising SMEs (e.g. e-payment, e-sales and e-invoicing applications, digital advertising tools, teleworking systems, business analytics, digital upskilling, AI, IoT, cybersecurity systems, and cloud infrastructures and services). The RRF Loan Facility, launched in 2022 to incentivise private investment in transformative sectors of the economy is also expected to support the digital transformation of SMEs. Furthermore, the Greek RRP outlines a set of reforms and investments, expected to be launched in 2022 to deliver the [National Cybersecurity Strategy](#) adopted in 2020. It forecasted a budget of EUR 32 million to improve cybersecurity in the public sector and to provide advanced security services for national critical infrastructures. To that end, a National Cybersecurity Operations Centre (SOC) will be set up, and security in the Government Cloud (G-Cloud) critical infrastructure will be strengthened.

In June 2022, four Greek European Digital Innovation Hub (EDIH) proposals have a successful evaluation result¹¹⁷ and three additional proposals have received a Seal of Excellence. The selected EDIHs should start their operations in autumn 2022. The selected EDIHs should play a leading role in: (i) public-private research collaboration, bringing together industry, businesses, and SMEs in needs of new digital solutions; (ii) promoting synergies at region level; (iii) fostering an innovation ecosystem; and (iv) organising networking opportunities, especially in the field of hyper computing systems, AI, machine learning and cyber security.

On advanced technologies, artificial intelligence (AI) is a key strategic area for action in the Digital Transformation Bible. However, Greece's national AI strategy, is still under preparation. In December 2021, 'Athena Research and Innovation Information Technologies Centre' announced the creation of a new independent research unit on artificial intelligence, data science and algorithms (budget: EUR 21 million) called 'Archimedes'. Its main goal is to become an entrance gate to gather the best scientists in AI, create opportunities and facilitate the transfer of research results to the society and the economy. It

¹¹⁶ Law 4635/2019

¹¹⁷ That is, are invited for grant agreement preparation (which is not a formal commitment for funding).

will serve both basic and applied research, in collaboration with Greek and foreign universities, acting as a hub offering opportunities for collaboration and synergies among distinguished Greek academics and young scientists in Greece and abroad. It will also cultivate synergies with the growing start-up ecosystem in Greece to facilitate the transfer of research results to the market. The National Infrastructures for Research and Technology (GRNET) has provided high performance computing (HPC) resources through its Advanced Research Information System ([ARIS](#)) since 2015. In 2021, a process has been launched to expand the system (budget: EUR 23 million), in close collaboration with the EuroHPC Joint Undertaking. The deployment of the upgraded national HPC/AI centre is also supported by concrete in-kind contributions by the national HPC centres of several countries from the Balkan region and Cyprus. The total investment in hardware will only support the installation of a 30PFlop+ machine in a strategic location in the region of Attica. Close cooperation between GRNET and academic institutions will further strengthen the national ecosystem of HPC, AI and data science – already embedded in the Greek EuroHPC Competence Centre. Cooperation with SMEs and industry will help disseminate the scientific developments into the wider economy and strengthen the competitiveness of this sector.

In 2020, the Ministry of Development and Investments launched [Elevate Greece](#), a platform to identify promising start-ups in Greece and support their growth (budget: EUR 60 million). By monitoring and supporting the development and growth of these start-ups, the platform acts as a reference point for the start-up ecosystem in Greece and potential investors. Since its launch, 332 start-ups have been positively evaluated and registered on the platform, and have benefited from its services.

Although the digital transformation of Greece's industry is still at an early stage, swiftly launching RRF projects related to digital transformation and implementing the Operational Programme for digital transformation will help the country achieve its goals. Adopting a full industry 4.0 strategy could also have a positive impact. Closely monitoring the implementation of these initiatives and investments will be key to ensure that they will deliver the projected improvements in terms of overall digitisation of businesses and that Greece can make a significant contribution to the Digital Decade target of more than 90% of EU SMEs reaching at least a basic level of digital intensity.

4 Digital public services

4 Digital public services ¹¹⁸	Greece		EU
	rank	score	score
DESI 2022	26	39.4	67.3

	DESI 2020	Greece DESI 2021	DESI 2022	EU DESI 2022
4a1 e-Government users	68%	67%	69%	65%
% internet users	2019	2020	2021	2021
4a2 Pre-filled forms	NA	NA	45	64
Score (0 to 100)			2021	2021
4a3 Digital public services for citizens	NA	NA	52	75
Score (0 to 100)			2021	2021
4a4 Digital public services for businesses	NA	NA	48	82
Score (0 to 100)			2021	2021
4a5 Open data	NA	NA	82%	81%
% maximum score			2021	2021

Greece ranks 26th in the EU on the Digital public services dimension. The proportion of active users of e-government services (69%) has increased since last year (67%) and is 5 percentage points above the EU average (64%). On open data maturity, with 82%, Greece performs slightly above the EU average of 81%. However, with a score of 45 for pre-filled forms, Greece performs below the EU average (64) although the gap is narrowing (36 versus 63 in DESI 2021¹¹⁹). Greece still scores well below the EU average on both indicators¹²⁰ for digital public services for citizens and for digital public services for businesses with a score of 52 for citizens (EU average: 75) and 48 for businesses (EU average: 82). That said, the provision of services for Greek citizens and businesses¹²¹ improved substantially in 2021 (details in the Box below).

Although the level of progress is not yet entirely reflected in these numbers, Greece has embarked on a comprehensive digitalisation of its public services as outlined in the Digital Transformation Bible. The implementation plan consists of over 450 actions and IT projects. Notable examples include setting-up

¹¹⁸ There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

¹¹⁹ As the [e-government benchmark](#) method was updated, the 2020 data are not included in the table above (i.e. break in the series)

¹²⁰ The current score in DESI 2022 is measured on a biennial basis (2020+2021) by assessing digital services for national users and for cross-border users.

¹²¹ The e-government benchmark covers nine life events (e.g. birth of a child, starting a business). Events covered in 2021 were: regular business operations, health, moving, transport, starting a small claims procedure. Events covered in 2020 were: business start-up, career, studying and family.

critical e-registers, the universal use of a single sign-on mechanism and the continuous upgrade of the single portal for all digital public services ('Gov.gr').

The law underpinning the digital transformation¹²² stipulates that digital communication and services should be the default for public authorities, who should provide their digital services for both individuals and enterprises on 'Gov.gr'. As a result, 'Gov.gr' currently hosts over 1 370 digital public services. Since its launch, more than seven million users have visited the website. Today, 80% of key 'life event' certificates such as for births, marriages, and deaths are issued online. Thanks to the digitalisation of public services and the infrastructure improvements, Greece has recorded an exponential increase in the use of digital public services. In 2021, public digital platforms recorded more than 566 million transactions (six times the 2020-level of 94 million). Between 2018 and 2019 digital transactions had already increased from 8.8 million to 34 million.

In 2021, a new innovative public interface was introduced ('Citizen and Public Organisation Vaults'), to which public organisations could connect their existing information systems, thus providing all their services online in a uniform and centralised manner. New rules have also been adopted on the design of coherent and uniform public services, in line with the 'digital by default' and 'once-only' principles. Furthermore, the Interoperability Centre (KED) ensures the governance of the interoperability framework (i.e. the functional interconnection, identification and synchronisation of information between key registers) and facilitates interoperability. The Ministry of Digital Governance has set up a 'once-only' principle national team, composed of representatives from competent bodies to coordinate the single digital gateway. Its role is to analyse technical solutions at national level, enable the sharing of experiences and support cross-border interoperability.

In the Greek recovery and resilience plan (RRP), e-government and the digitalisation of public services account for a large share of the digital budget (more than EUR 2.7 billion). In 2022, the contracts for one of the key RRP project to modernise the public sector are expected to be awarded (budget: EUR 598 million). It aims to digitalise archives and related services for the justice system, public health, urban planning agencies, cadastre, immigration and asylum, and other sectors). Integrating the archives into the relevant IT systems, together with system interoperability initiatives, will ensure compliance with the 'once only' principle. This will lay the foundation for the digital transformation of public sector bodies and for reducing the administrative burden on people and enterprises.

Another key project to digitally transform the public sector involve the development of cloud services. In 2020-2021, [GRNET](#) started to develop a cloud platform with a layered architecture that enables the rapid development of cloud-based services and the usage of different capabilities. The platform comprises three building blocks: (1) an industry-standard cloud base; (2) a layer of reusable domain capabilities; and (3) a consumer-facing layer of domain services. Once completed, the cloud ecosystem will be able to fulfil the future digitalisation needs of both industry and the public sector. In 2021, the 'G-Cloud Next Generation' project (budget: EUR 24 million) was approved for Cohesion Fund support under the EPAnEK operational programme. The project supports the 'G-cloud central computing infrastructure of the public administration's General Secretariat of Information Systems GSIS).

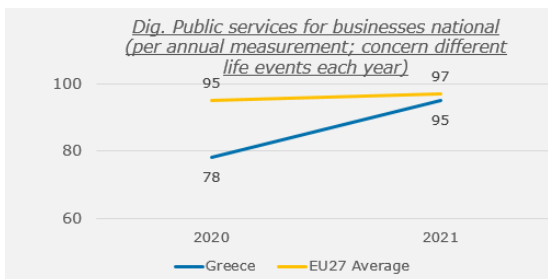
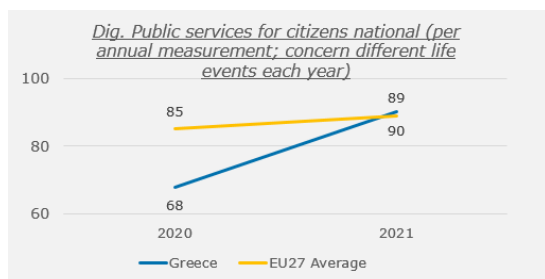
¹²² Law 4727/2020

A key priority of the digital transformation strategy is the implementation of the Electronic Identification and Trust Services Regulation for electronic transactions in the internal market (eIDAS). Greece already offers two different eID schemes¹²³, but they are not yet notified under the eIDAS regulation. Both schemes offer the possibility to interact with public administration via a smart device. 80% of the population use at least one eID scheme in the country.

Greece continues to show a strong commitment to the digital transformation of its public services. Upgrading the infrastructure, simplifying processes, and reducing the administrative burden on people and enterprises remains at the core of the modernisation of public services and state governance. The swift implementation of digital public services for citizens and businesses will make Greece more attractive for domestic and foreign investment, increase its competitiveness and contribute to the Digital Decade target of 100% online accessible provision of key public services for EU citizens and businesses.

Highlight 2021-2022: rapid progress in digital public services available for citizens and businesses at national level

Since the start of the Covid pandemic, Greece has made substantial progress in moving public national services for citizens and businesses online. Greece scores 90 above the EU average of 89 (in 2020, it scored 68 versus 85 EU average). For businesses, it scores 95, slightly below the EU average of 97 (in 2020, it scored 78 versus 95 EU average). For the below measurement, 92 national services were assessed in 2021 and 90 in 2020 for the 9 life events¹⁰ under the e-government benchmark exercise.



The digitalisation of Greece's public services is continuing to expand rapidly. More digital services are constantly offered for example at national level: In January 2021, a [digital service for birth registration](#) was officially launched. Up to 31 March 2022, 171 876 digital registrations regarding a new-born have been recorded. According to the Once Only Principle, births are registered in maternity hospitals. Procedures such as to obtain a Social Security Number, a request for childbirth allowance, official registration to the Population registration office etc. are completed automatically.

As from March 2021, services to [declare a lost or stolen ID card](#) and to [request an extract from](#)

¹²³ eID schemes in Greece: Credentials of the General Secretariat of information Systems for Public Administration (GSISPA) / e-banking credentials

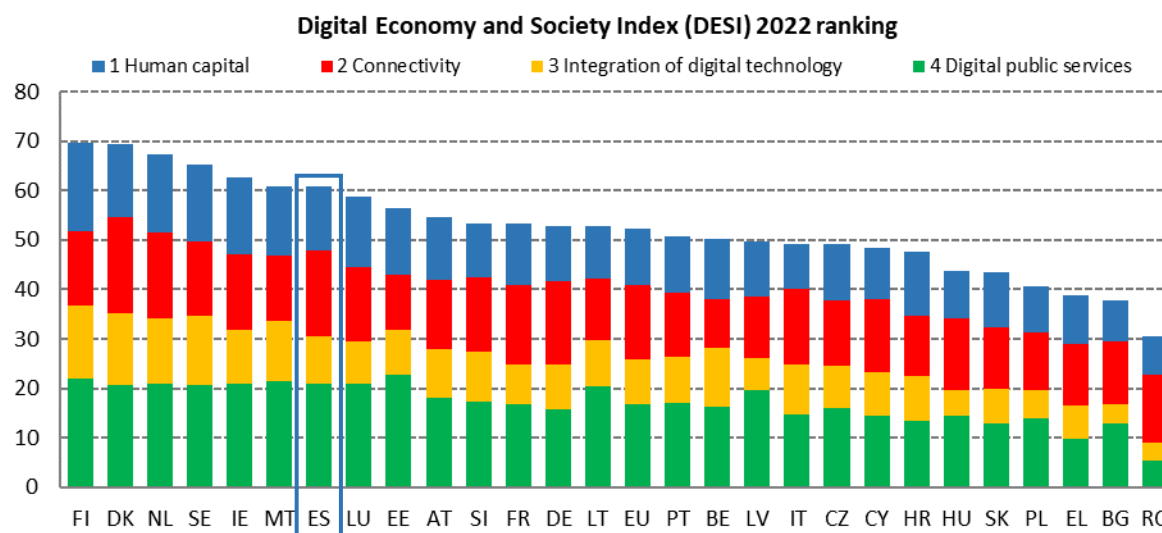
[the Criminal Record](#) were available online; as from April 2021, cadastral information for [legal officers](#), [lawyers](#), [engineers](#) and [notaries](#) is available online, as well as a service for [electronic judicial decisions](#); in May 2021 “[Know Your Customer](#)” citizens information is available; in June 2021 a service to obtain a copy of a [school degree](#) is available online. Services for [unemployed citizens](#) (registration, renewal, and request for unemployment benefit) are also available online. Since November 2021 services for [Digital Document Verification](#) and [Digital Private Contract Certification](#) are available; as well as a service to obtain the [Athens City Traffic Permission](#). A [mobile health app](#) and a service for [maternity allowance](#) are also available; and in December 2021 services to issue, [renew](#) or [replace](#) Driving License as well as to obtain a copy of [vehicle registration certificate](#) in case of lose or thief is available for all 13 Greek Regions. Also since December 2021 the service for [Digital Consensual Divorce](#) is available.

Furthermore, [cross-border services](#) have also been recently added in ‘Gov.gr’, including services for asylum (e.g. [application for submission of documents](#), [request for legal assistance](#)).

In January 2021, the eGovernment portal ‘[Your Guide to Greece](#)’ was also launched, providing the national information for all thematic categories of the Single Digital Gateway Regulation for EU citizens and businesses; in June 2021 an [online VAT one stop shop service](#) is available; in September 2021 a service for [recognition of university degrees and PhD titles](#) and a service for searching for a [certified translator](#) are available; and since November 2021 a service for [renewal of residence permits / residence cards of third country nationals](#) is available.

Spain

DESI 2022	Spain		EU
	rank	score	score
	7	60.8	52.3



Spain ranks 7th of 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI). The country is making relative progress¹²⁴ and overperforming versus previous years, especially on integration of digital technology (ranking 11th, 5 positions above 2021), and also on digital public services (5th compared to the 7th place in 2021) and human capital (10th compared to 12th). Spain is an EU leader in connectivity and ranks 3rd for the second consecutive year.

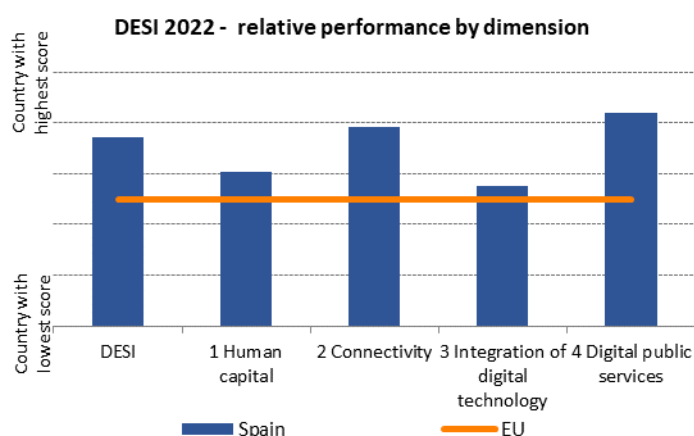
On the human capital dimension, Spain is a relatively good performer on basic digital skills whereas it is below the EU average as regards the proportion of ICT specialists and of ICT graduates. The rate of people in Spain having at least basic digital skills is above the EU average (64% compared to 54%) and has significantly increased during the last years. The number of ICT specialists in employment in Spain is 4.1% compared to the EU average of 4.5%. The shortage of advanced digital experts hampers the country's growth prospects and constrains productivity, especially for small and medium-sized enterprises (SMEs) and micro-enterprises. Several measures outlined in [Spain's Recovery and Resilience Plan](#) (RRP) support the acquisition of digital skills, especially for employees of SMEs. Those measures, together with other technology-specific initiatives such as for cybersecurity or artificial intelligence (AI), are expected to reduce the labour market gap for ICT specialists as well as the ICT gender gap.

¹²⁴ Refer to section 1.3 of the DESI 2022 horizontal chapter.

On digital connectivity, Spain is one of the top EU performers. It continues its steady progress in the roll-out of very high capacity networks (VHCN) and is pursuing strategic reforms and investments under the Recovery and Resilience Facility (RRF) to help achieve the Digital Decade connectivity targets and reduce the digital gap between urban and rural areas.

On integration of digital technologies, the percentage of SMEs with a basic level of digital intensity and using social media is above the EU average. But Spain's enterprises are still lagging behind on new and advanced technologies such as cloud or big data. The lack of a critical mass of digitally-trained workers hinders the integration of digital technologies into Spain's enterprises in general, and SMEs and micro-enterprises in particular, who need digital-skilled professionals to develop further and become more competitive in the digital economy. The [SME Digitalisation Plan 2021-2025](#) will help boost disruptive innovations and entrepreneurship in digital fields, together with other relevant policies and strategies already in place (e.g. Spain Entrepreneurial Nation and the [Digital Rights Charter](#)) or under development (e.g. the [Start-ups Law](#)).

On digital public services, Spain has traditionally been a front-runner and it continues to put in place new services and infrastructures to respond to the rapid development of technology and to people's needs. Spain is committed to modernise its public administration in order to make it more accessible for enterprises and the public. It proactively develops new digital services, particularly in the areas of health, digital identification, cybersecurity, mobile apps and integrating AI into the public sector.



Following Russia's invasion of Ukraine, Spain adopted a [national response plan](#) setting out urgent measures (e.g., updated and strengthened the national cybersecurity strategy, and the adoption of measures aligned with EU recommendations to secure 5G deployment). Several important communication campaigns have been put in place to promote cybersecurity awareness and combat disinformation. One campaign was also launched to help people fleeing Ukraine to Spain. In addition, Spain adopted the measures set out in the [Council Decision \(CFSP\) 2022/351](#) concerning restrictive measures in view of Russia's actions destabilising the situation in Ukraine.

Digital in Spain's Recovery and Resilience Plan (RRP)

Spain's RRP is one of the largest and most ambitious on digital, devoting 28.2%¹²⁵ of the total allocation to digital (EUR 19.6 billion). Particular focus is given to digitalising businesses, including SMEs (25% of the total digital budget), strengthening the digital skills of people across Spain (22%), improving digital connectivity across the country's territory (15%), continuing the digitalisation of the public services (28%), and supporting digital-related R&D and the deployment of digital technologies (10%).

Most of the milestones and targets satisfactory fulfilled by the end of 2021 concerned major reforms and strategies to facilitate the digital transition of Spain's economy and society. Notably, Spain adopted the [Digital Spain 2025 strategy](#); the [National Digital Competences Plan](#); the [strategy for the promotion of 5G technology](#); the SME Digitalisation Plan [2021-2025](#); and the [national AI strategy](#).

In 2022, relevant policy developments will include the new Law on Telecommunications that will transpose into national law the EU Directive establishing the [European Electronic Communications Code](#), as well as the Law on 5G cybersecurity .

¹²⁵ Each Recovery and Resilience Plan has to dedicate at least 20% of the plan's total allocation to digital objectives. To this end, the plans had to specify and justify to what extent each measure contributes fully (100%), partly (40%) or has no impact (0%) on digital objectives, using Annex VII of the RRF Regulation. Combining the coefficients with the cost estimates of each measure allows assessing to what degree the plan contributes to digital objectives and whether it meets the 20% target.

1 Human capital

1 Human capital	Spain		EU
	rank	score	score
DESI 2022	10	51.3	45.7

	Spain		EU
	DESI 2020	DESI 2021	DESI 2022
1a1 At least basic digital skills % individuals	NA	NA	64% 2021
1a2 Above basic digital skills % individuals	NA	NA	38% 2021
1a3 At least basic digital content creation skills¹²⁶ % individuals	NA	NA	74% 2021
1b1 ICT specialists % individuals in employment aged 15-74	3.7% 2019	3.9% 2020	4.1% 2021
1b2 Female ICT specialists % ICT specialists	19% 2019	19% 2020	19% 2021
1b3 Enterprises providing ICT training % enterprises	22% 2019	20% 2020	20% 2020
1b4 ICT graduates % graduates	3.9% 2018	4.2% 2019	4.0% 2020

On human capital, Spain ranks 10th among the 27 EU countries, slightly above the EU average (45,7%). 64% of the people in Spain have at least basic digital skills, above the EU average (54%) but still far from the [Digital Decade target](#) of 80% of the European population with at least basic digital skills by 2030. The country also performs above the EU average on the above basic digital skills and at least basic digital content creation skills indicators (38% and 74%, respectively). Despite a slight increase of ICT specialists in recent years, Spain still performs well below the EU average (4.1% compared to 4.5%). This shortage of ICT specialists hampers productivity, especially for SMEs. The gender divide is still significant, as female ICT specialists account for 19% of the total number of ICT specialists in Spain, in line with the EU average (19%). The percentage of enterprises providing ICT training has not changed over the last 2 years, standing at the same level as the EU average of 20%, and the share of ICT graduates decreased from 4.2% in 2019 to 4% in 2020 (surpassing the EU average of 3.9%).

One of the 10 objectives of the [Digital Spain 2025](#) strategy is to strengthen the digital skills of people across Spain by 2025, with particular focus on workers. Under this strategy Spain adopted the [National Digital Competences Plan](#) in January 2021 to promote digital skills development of people in Spain, but particularly for workers and ICT specialists. This plan is aligned with the Digital Decade targets of 80% of the EU population with basic skills and 20 million ICT specialists employed, half of whom are women, by 2030.

¹²⁶ Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

To contribute to these targets, the National Digital Competences Plan sets out several measures under seven action lines: 1) digital skills training, with special emphasis on population groups at risk of digital exclusion; 2) bridging the digital gender divide; 3) digitalising the education system and developing digital skills for learning; 4) digital skills training throughout working life (focusing on the working population in the private sector and the unemployed); 5) digital skills training for public sector workers; 6) digital skills training for SMEs; and 7) increasing the supply of ICT specialists (via vocational training and university education). The entire Component 19 (EUR 3.59 billion) is dedicated to digital skills, but part of 5 other components also support the acquisition of digital skills. Digital skills training will be also funded under the [Multiannual Financial Framework 2021-2027](#), in particular through the [European Social Fund](#) (ESF) and the [Digital Europe Programme](#) (DIGITAL).

In addition, the [Educa en Digital](#) programme that started in the 2020/2021 academic year aims at closing the existing gaps in schools on access to technologies by increasing the quality of digital tools and providing teachers with training on digital. This programme (budget: EUR 230 million) will provide the 17 autonomous communities and 2 autonomous cities with around 500 000 electronic devices for educational use, including software, security features and internet connection, to be distributed among vulnerable pupils. The programme also includes assistance platforms for teachers, students and educational authorities through an application of AI.

Although coding and digital skills are not mandatory at school, the Ministry of Education updated the school curricula to introduce digital skills training and programming from earliest ages. Moreover, the Ministry of Education and the autonomous communities are working on the [School of Education and Artificial Intelligence](#) project. This project aims to provide teachers in Spain with open educational resources and training that they can incorporate into their teaching practice through programming and robotics activities. In the 2021 edition of [Code Week](#), 953 events took place across Spain, most of them in schools, attracting 86 708 participants, 48% of whom were girls.

The [Spanish Coalition of digital skills and jobs](#) is coordinated by AMETIC, the business association of the digital industry. The coalition gathers 200 stakeholders (companies, public administrations, training centres and universities) actively involved in promoting digital skills and closing the gap between the supply and demand side of ICT specialist in Spain. Many stakeholders are also members of the the Digital Skills Hub, recently created under the National Digital Competences Plan to support the government in designing and monitoring digital skills policies.

In 2021, the National Institute of Cybersecurity (INCIBE) organised the second edition of the [Academia Hacker](#) (with over 2 500 participants) to promote learning and technical skills in cybersecurity. Nearly 10 000 participants have already benefited from this programme so far. In February 2022, INCIBE presented the [Cybersecurity Talent Diagnostic](#) to align actions with market demands on ICT specialists.

Significant skills mismatches in enterprises' workforce, especially in SMEs and micro-enterprises, inhibits the ability of Spanish enterprises to innovate and benefit from advanced technologies. Increasing the number of ICT specialists in Spain, closing the gender gap and reskilling the labour force are extremely important if Spain is to take full advantage of the digital economy and increase its contribution to the Digital Decade targets.

2 Connectivity

2 Connectivity	Spain		EU
	rank	score	score
DESI 2022	3	69.7	59.9

	Spain			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
2a1 Overall fixed broadband take-up	78%	82%	83%	78%
% households	2019	2020	2021	2021
2a2 At least 100 Mbps fixed broadband take-up	53%	65%	72%	41%
% households	2019	2020	2021	2021
2a3 At least 1 Gbps take-up	<0.01%	<0.01%	0.02%	7.58%
% households	2019	2020	2021	2021
2b1 Fast broadband (NGA) coverage	90%	92%	94%	90%
% households	2019	2020	2021	2021
2b2 Fixed Very High Capacity Network (VHCN) coverage	89%	92%	94%	70%
% households	2019	2020	2021	2021
2b3 Fibre to the Premises (FTTP) coverage	80%	85%	89%	50%
% households	2019	2020	2021	2021
2c1 5G spectrum	30%	65%	65%	56%
Assigned spectrum as a % of total harmonised 5G spectrum	04/2020	09/2021	04/2022	04/2022
2c2 5G coverage¹²⁷	NA	13%	59%	66%
% populated areas		2020	2021	2021
2c3 Mobile broadband take-up	85%	85%	94%	87%
% individuals	2018	2018	2021	2021
2d1 Broadband price index	52	73	83	73
Score (0-100)	2019	2020	2021	2021

Spain is one of the EU's top performers on digital connectivity, ranking 3rd among the EU Member States. Spain performs particularly well in fixed very high capacity network (VHCN) coverage (94% compared to an EU average of 70%), while being only a mid-performer on 5G coverage, mainly due to some delay in auctioning all 5G pioneer bands. However, the auction of the 700 MHz band ended in July 2021 and the 26 GHz band is expected to be auctioned by the end of 2022. This, along with a wide range of measures outlined in Component 15 of Spain's RRP, should lead to a rapid increase in 5G coverage.

Spain is making progress towards achieving the 2025 gigabit targets and the [Digital Decade connectivity targets](#) for 2030 (i.e., gigabit for everyone and 5G everywhere). Fixed VHCN coverage is still increasing (by 2 percentage points since the previous year) as persistent gaps between urban and rural areas are starting to close (71.5% of VHCN coverage in rural areas, up from 64.2% the previous year). In this

¹²⁷ The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

context, Spain launched the Universalisation of Digital Infrastructures for Cohesion ([ÚNICO-Banda Ancha](#)) programme in 2021, with the aim of providing fixed broadband networks offering symmetric 300 Mbps speeds, upgradeable to 1 Gbps, to the premises located in rural, remote and less populated areas. The first call in 2021 should allow these networks to reach 1.2 million premises and another call is planned for 2022 (the programme is financed under the Spanish RRP).

5G spectrum and 5G coverage increased dramatically in 2021 and is expected continue to increase rapidly within the next 3 years. The [auction of the 700 MHz band](#) was completed on 21 July 2021, becoming the second of the pioneer bands to be auctioned in Spain after the 3.6 - 3.8 GHz band in 2018 (the *refarming* of this band to allow operators to use larger contiguous amount of spectrum was completed in February 2022). Spain also launched a [public consultation](#) in December 2021 to assess market interest in the third 5G pioneer band, the 26 GHz band. The auction for this pioneer band is expected to take place in the second half of 2022. Its assignment, along with the coverage obligations imposed on operators with rights of use in the 700 MHz band ([Telefónica, Orange and Vodafone](#)) in municipalities, major airports, ports, train stations and roads (to be fulfilled between 2022 and 2025), should contribute to the rapid increase of 5G readiness and coverage.

The national roadmap for the implementation of the [Connectivity Toolbox](#) sets out 30 measures to improve the rollout of fixed and mobile VHCN while helping network operators to reduce the costs of deployment. The roadmap, was launched on 30 April 2021, but some of the measures are still in the development phase. Rapidly implementing these measures would enable a speedy and efficient deployment of 5G and VHC networks.

The take-up of fixed broadband (83%) is steadily increasing, especially the at-least 100 Mbps fixed broadband (72%), with Spain scoring well above the EU average on both indicators (78% and 41%, respectively). A high degree of market competition and relatively low prices facilitated significant broadband take-up in the previous years, especially during the COVID-19 pandemic and due to an increased demand for broadband products (mostly bundled) and pay-TV services (both IPTV and OTT). To stimulate further broadband take-up, Spain's RRP includes a EUR 30 million project, which will provide connectivity vouchers temporarily to vulnerable groups ([Royal-Decree 989/2021](#)). High degree of VHCN coverage was achieved mainly through private investment so far. Public funding, mainly RRF funding, is now earmarked for the deployment of 5G and VHC networks, especially in rural areas, in case market failures on unmet users' needs are proved. The market's consolidation continued in 2021 through mergers (the fourth Spanish operator MásMóvil launched a takeover bid for Euskaltel). In March 2022, Orange and MásMóvil announced the start of [exclusive discussions to create a 50/50 joint venture](#).

Main market & regulatory developments

Telefónica, Orange and Vodafone maintain their significant, albeit steadily decreasing, market share in the fixed broadband market (79% in Q2 2021, almost 4 percentage points less than the previous year). MásMóvil, the fourth largest national operator, acquired Euskaltel in 2021 (the merger was cleared by Spain's national regulatory authority Comisión Nacional de los Mercados y

la Competencia (CNMC) on 16 June and approved by the government on 22 June).

Market competition in Spain is very intense. Low-cost operators, such as MásMóvil and Digi (through its new low-cost brand Virgin Telco) remain very active, and the three main operators pursue a multi-brand retail strategy, offering 4P and 5P bundles¹²⁸ not only to the high-end segment but also to the low-end segment through their secondary brands. Convergent bundles continue to be the most common way of selling fixed broadband services, accounting for up to 13.6 million lines (almost 85% of the total active broadband lines). 4P and 5P remain the most common type of bundles (41% and 37% respectively).

On pay-TV, sports (especially football), premium series, and films, are the key drivers but only Telefónica (owner of La Liga broadcasting rights in Spain) and Orange provide football content. The remedies CNMC introduced to the merger between Telefónica and DTS in 2015 are set to expire in 2023. In December 2021 DAZN acquired 45% of LaLiga rights from season 2022/23 until 2026/27. Telefónica owns the rest of those rights and will also broadcast DAZN's games (agreed in March 2022). OTTs' market share (streaming services) is steadily growing, and more than a half of Spanish households (53%) are subscribed to at least one OTT pay-TV service.

In October 2021, CNMC increased from 66 to 696 the number of municipalities it considered to be "competitive zones" (covering around 70% of Spain's population), meaning that Telefónica is no longer obliged to provide access to its fibre network in this areas. CNMC also reviewed the prices of Telefónica's reference offer for wholesale access to physical infrastructure (a 20% reduction in monthly fees and a 13.7% increase in non-recurring fees due to increased labour costs).

The copper switch-off process is still ongoing. The number of decommissioned copper exchanges increased from 476 to 1 010 (since the first closures in 2015), out of 2 990 exchanges scheduled. In January 2022, it was announced that Telefónica sold part of its copper to Macquarie (the largest shareholder of Spain's wholesale operator Onivia). In February 2022, Telefónica announced that it is acquiring (pending regulatory and competition approval) together with Pontegadea (the real estate arm of Inditex's chairman Amancio Ortega) KKR's 40% stake in the infrastructure group Telxius Telecom (specialised in submarine cables). This [transaction](#) will increase Telefónica and Pontegadea's stake in the group to 70% and 30%, respectively.

In November 2021, the Council of Ministers approved the draft General Law on Telecommunications, which was sent to the Parliament for approval. The government expects the law to be approved by the second quarter of 2022.

In July 2021, Spain launched a [public consultation](#) on the draft Royal Decree regulating emergency communications. The Decree aims to align national rules with the European Electronic Communications Code (EECC) and implement the advance mobile location (AML) system.

In March 2022, Spain approved the [Royal Decree-Law 7/2022](#) setting up requirements to guarantee the security of 5G electronic communications networks and services.

¹²⁸ This category includes 4 Play (fixed and mobile telephony and broadband) and 5 Play (4P plus pay TV)

Spain continues to make steady progress on the roll-out of VHCNs and is pursuing strategic reforms and investments under the RRF that should help it to achieve the Digital Decade connectivity targets and reduce the gap between urban and rural areas. The major stimulus that Spain is introducing in market failure areas, both on the supply and demand side, together with its transposition of the EECC, is expected to foster the necessary pro-investment conditions, facilitating speedy and more efficient deployment of 5G and VHC networks, and meeting the Digital Decade connectivity targets.

Highlight: 5G spectrum assignment and 5G regulatory framework

Following the adoption of Spain's 2020's [strategy for the promotion of 5G technology](#), in October 2021, Spain assigned the 700 MHz band by [Order ETD/1141/2021](#). Now two of the three 5G pioneer bands have been already assigned and the 26 GHz band is expected to be actioned in Q3 2022.

Satisfactory progress on the assignment of the 5G pioneer bands and the implementation of the connectivity toolbox, is helping to create the favourable conditions for an effective development of the fifth-generation ecosystem that will help people in Spain and enterprises to benefit further from the digital economy. The adoption of the new law on Telecommunications (transposing the EECC) and the law on 5G Cybersecurity (incorporating the 5G cybersecurity toolbox), expected by Q2 2022 and Q3 2022 respectively, will help consolidate this process.

3 Integration of digital technology

3 Integration of digital technology	Spain		EU
	rank	score	score
DESI 2022	11	38.5	36.1

	DESI 2020	Spain DESI 2021	DESI 2022	EU DESI 2022
3a1 SMEs with at least a basic level of digital intensity % SMEs	NA	NA	60% 2021	55% 2021
3b1 Electronic information sharing % enterprises	43% 2019	43% 2019	49% 2021	38% 2021
3b2 Social media % enterprises	29% 2019	29% 2019	39% 2021	29% 2021
3b3 Big data % enterprises	11% 2018	9% 2020	9% 2020	14% 2020
3b4 Cloud % enterprises	NA	NA	27% 2021	34% 2021
3b5 AI % enterprises	NA	NA	8% 2021	8% 2021
3b6 ICT for environmental sustainability % enterprises having medium/high intensity of green action through ICT	NA	76% 2021	76% 2021	66% 2021
3b7 e-Invoices % enterprises	33% 2018	33% 2020	33% 2020	32% 2020
3c1 SMEs selling online % SMEs	19% 2019	24% 2020	25% 2021	18% 2021
3c2 e-Commerce turnover % SME turnover	9% 2019	10% 2020	9% 2021	12% 2021
3c3 Selling online cross-border % SMEs	7% 2019	7% 2019	9% 2021	9% 2021

On integration of digital technologies by businesses, Spain ranks 11th, just above the EU average. Spain performs well on some indicators, especially on SMEs with at least a basic level of digital intensity (60% compared to an EU average of 55%), electronic information sharing (49% of enterprises compared to an EU average of 38%), and ICT for environmental sustainability (76% compared to 66%). Uptake is lower for certain advanced technologies, such as big data (9%) and cloud (27%), whereas Spain's performance on AI is in line with the EU average (8%). Spanish enterprises are rapidly increasing their social media presence (39% of enterprises in 2021, up from 29% the previous year), and the share of SMEs selling online is well above the EU average (25% compared to 18%). By contrast, SMEs' e-commerce turnover dropped by 1 percentage point to 9% (EU average: 12%). On e-invoices, Spain's score stagnates at 33% but it is expected to overperform rapidly as e-invoicing will be compulsory for all Spanish enterprises with more than EUR 8 million annual turnover by the end of Q3 2022.

Under [Spain Digital 2025](#) strategy (adopted in July 2020), the [SMEs Digitalisation Plan 2021-2025](#) (adopted in January 2021) sets out a wide range of measures to boost the digital transformation of enterprises, particularly SMEs, micro-enterprises and the self-employed. Most of the measures are being developed or are in the implementation phase.

On digital innovation for SMEs, Spain's RRP includes the provision of digital tools and other measures under Component 13. These includes the Digital Toolkit initiative, renamed as Kit Digital (budget: EUR 3 067 million) and "Agents of Change" programme (budget: EUR 300 million), which are expected to begin in 2022. Both will be entirely financed under the RRF, with at least 30% of their budgets committed in 2022. The Kit Digital approved by [Orden ETD/1498/2021](#) promotes scalable, high-impact, and public-private collaboration mechanisms to accelerate the digitalisation of more than 1 million SMEs, especially micro-enterprises and the self-employed. The Agents of Change programme focuses on providing SMEs with grants to hire digital transformation experts.

The SME Digitalization Plan 2021-2025 sets out some measures expected to be carried out in 2021-2023 that will enhance innovative business clusters and digital innovation hubs. Spain confirmed its participation in the multi-country project for the [EU-wide network of European Digital Innovation Hubs](#) (EDIHs) and under its RRP up to 25 Digital Innovation Hubs (DIH) will receive financial support. The selection of Digital Innovation Hubs that will participate in the network of EDIHs is ongoing. Twelve Spanish European Digital Innovation Hub proposals have a successful evaluation result¹²⁹ and eleven additional proposals have received a Seal of Excellence.

Spain continues to develop its digital regulatory framework. In July 2021, it published its [Digital Rights Charter](#), which seeks to guarantee the same rights online as those that already exist offline. In December 2021, the government also approved the bill for the [Start-ups Law](#) that is currently under parliamentary discussion. Its objective is to boost the number of 'unicorns' in Spain by streamlining requirements and providing considerable tax incentives. This law, together with [Spain Entrepreneurial Nation](#) strategy published in 2021, intends to support start-ups.

Spain participates in the [Important Projects of Common European Interest \(IPCEI\) on Microelectronics](#) that aim to increase the EU's capabilities in electronics design and help deploy the next generation of trusted processors and other electronic components. Such capabilities would enable the EU to meet the target of 20% world production value in semiconductors. It would also ensure broader EU autonomy in critical digital infrastructures and less dependence on non-EU countries.

On edge computing, Spain participates in the [IPCEI Next Generation Cloud Infrastructure and Services](#) initiative, which aims to secure competitive, fair, trustworthy and sustainable access to cloud and edge capabilities from anywhere in the EU. This would help the EU meet its target of deploying at least 10 000 climate-neutral, highly secure edge nodes. Under the initiative, Spain launched the [Gaia-X national hub](#) to create and coordinate the data-sharing ecosystem and to help enterprises solve business problems and create value in the data economy. To date, 5 working groups have been set up in the areas of

¹²⁹ i.e. are invited for grant agreement preparation (which is not a formal commitment for funding).

tourism, health, mobility, agri-food, and industry 4.0, and two more will be set up in 2022 in the areas of environment and energy.

In 2021 Spain launched [Quantum Spain](#), a project aimed to create a quantum computing ecosystem and develop the first high-performance quantum computer in Spain. Planned measures cover space secure communications (aligned with the EuroQCI guidelines) due by Q4 2025. Although Spain has shown interest in the EuroQCI multi-country project, it has not yet confirmed its involvement.

Spain is also very proactive on AI, which supports the country's contribution to the Digital Decade target of 75% of EU enterprises using AI. Under the [National AI Strategy](#) presented by Spain in December 2020, measures to support the development and uptake of AI include the programmes: 1) elements of AI MOOC (i.e., massive open online course); 2) missions in AI; 3) University Chairs in AI; 4) trust environment in AI; 5) use of AI in public administrations; 6) AI and data in management of grants and subsidies; and 7) Spanish Agency for the Supervision of AI.

Spain plays an active role in the [European Blockchain Partnership](#), where it coordinates the working groups on: 1) technical governance; 2) European sovereign digital identity (ESSIF); and 3) diplomas. Under the CEF Telecom Blockchain programme, a Spanish project was awarded to promote [European Blockchain Services Infrastructure](#) use cases on credentials in official and non-official diplomas. As part of the [Early Adopters Programme](#), Spain is working on the use case for sovereign identity and diplomas and will present the results in June 2022. The National Institute of Cybersecurity (INCIBE) is very active in raising awareness on cybersecurity among the public, enterprises, and other stakeholders. In 2021 it launched more than 350 marketing campaigns, targeted to citizens, minors, and SMEs, as well as other institutional campaigns).

Spain will host the MareNostrum 5 supercomputer (located in Barcelona's Supercomputing Centre), which is funded by the EuroHPC Joint Undertaking. Spain is also an active member of the European Cloud Federation initiative, which promote an Iberian space with Portugal and should stimulate the development of advanced data computing technologies, especially in high-performance computing.

There is room for Spanish enterprises to benefit further from digitalisation and new technologies, especially SMEs and micro-enterprises. Integrating advanced technologies could help Spanish enterprises improve productivity, scalability, and reach new markets.

4 Digital public services

4 Digital public services ¹³⁰	Spain		EU
	rank	score	score
DESI 2022	5	83.5	67.3

	Spain			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
4a1 e-Government users	63%	67%	73%	65%
% internet users	2019	2020	2021	2021
4a2 Pre-filled forms	NA	NA	78	64
Score (0 to 100)			2021	2021
4a3 Digital public services for citizens	NA	NA	87	75
Score (0 to 100)			2021	2021
4a4 Digital public services for businesses	NA	NA	94	82
Score (0 to 100)			2021	2021
4a5 Open data	NA	NA	95%	81%
% maximum score			2021	2021

On digital public services, Spain ranks 5th, performing above the EU average for all indicators. The number of internet users that actively engage with e-government services has increased considerably (from 67% in 2020 to 73% in 2021) and is well above the EU average (65%). On pre-filled, Spain shows a relatively high degree of reuse of information across administrations, scoring considerably above the EU average (78 versus 64). Spain also performs well on digital public services for citizens (87), significantly above the EU average (75); businesses (94 points versus 82); and open data (95% versus 81%).

The Digital Spain 2025 strategy embeds the digitalisation of public administration, particularly in the areas of employment, justice (developed through the [Justice 2030](#) plan) and social policies, into its 10-pillar digital agenda. The [Plan for the Digitalisation of Spain's Public Administration 2021-2025](#) develops the digital agenda further, setting out measures on: 1) digital transformation of the State administration; 2) high-impact projects for the public sector digitalisation and trust; 3) the digital transformation and modernisation of the Ministry of Territorial Policy and Public Function as well as the regional and local administrations.

The first pillar aims to improve the usability, quality and accessibility of digital public services. To that end, Spain is setting up an app factory to develop mobile apps and user-friendly services for the public. Expectations are that at least 50% of digital public services will be accessible through a mobile app by the end of 2025 (budget: EUR 8.67 million).

¹³⁰ There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

Strengthening the health system is one of the primary measures in the plan to digitalise public administration. Spain is facilitating interoperable health systems and information exchange between autonomous communities, who are responsible for healthcare provision. This includes a vaccination registry and a monitoring system for electronic prescriptions. Spain is also developing a data space, where regional administrations can stock healthcare information for design purposes, in full respect of data protection rules. The project will be completed by the end of 2022.

In its RRP, Spain confirmed its participation in the multi-country [Genome of Europe](#) project, but has not allocated a budget so far. The project aims to create a federated European genomic reference data resource for public health, healthcare and research purposes. Spain is making progress on digital identification solutions. Updates of [Cl@ve](#) and other certified identification systems will align with the EU guidelines on electronic identification, authentication and trust services (eIDAS). This will enable reuse and interoperability with other EU public administrations. Spain also participates in the [European Self Sovereign identity](#) (ESSIF) project, where it presented in October 2021 the results of its digital identity pilot project, whereby a classic digital certificate can be stored in a person's digital wallet to verify their identity and credentials. There are 3 alternative eID schemes in Spain that can be used both for interactions with public administrations and private use. 34 million people in Spain (over 72% of the total population) have at least one eID scheme, especially the [DNle](#) (issued by the government and mandatory since the age of 14, although available sooner). The 3 schemes are notified under the eIDAS regulation and none of them can be used via smart mobile. Only [TSL Spain](#) is issued by a private company, while [CERES](#) is issued by a private entity in collaboration with the government.

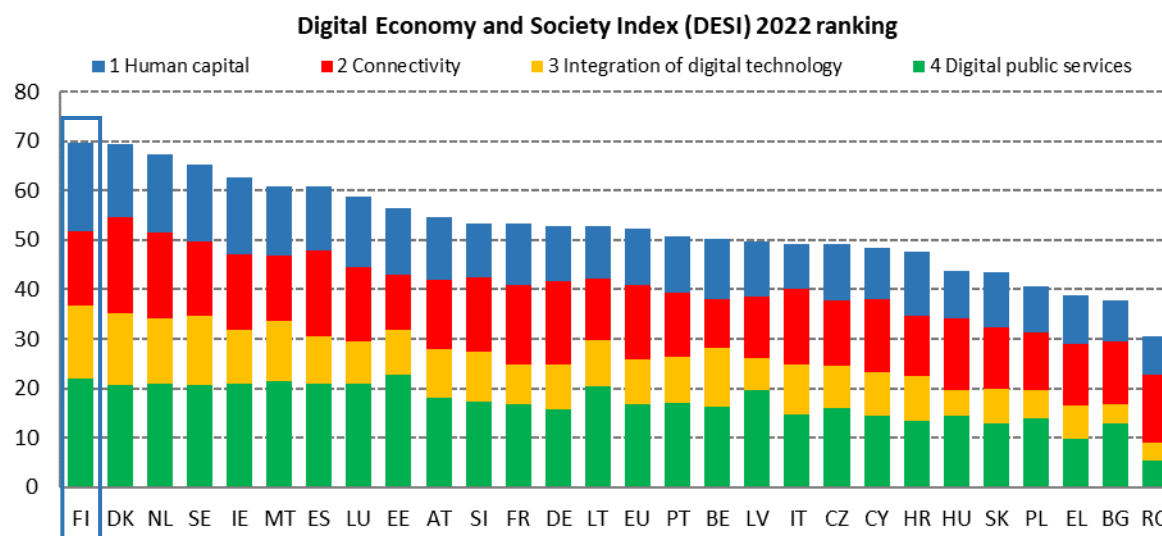
Setting up a cybersecurity operations centre in Spain, as outlined in its Plan for the Digitalisation of Public Administration 2021-2025, will help to ensure safe digital infrastructures, communications and public services provided by public administrations, in line with the National Cybersecurity Strategy. The centre will put in place a national cybersecurity monitoring system to help the State administration and its public bodies to protect themselves against cybersecurity threats.

Spain is in the process of launching the Spanish Artificial Intelligence Supervision Agency in order to minimise the potential risks of the use of AI systems on people's health and safety and fundamental rights. The Agency, approved in the 2022 General State Budget Law (budget: EUR 5 million), will be the first of its kind in Europe.

Spain is at the forefront in e-government and digital public services in the EU. It continues to update its services and infrastructure to bring them in line with rapid technological developments and with the needs of people and businesses. Interoperability at national, regional and local levels will be key to ensure a smooth and efficient digital transition across administration levels, maximising resources and avoiding overlaps.

Finland

	Finland		EU
	rank	score	score
DESI 2022	1	69.6	52.3



Finland ranks 1st of 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI). Finland continues to lead the EU countries on the indicators tracking human capital. The proportion of employed people working as ICT specialists is above EU average by nearly 3 percentage points (7.4% against 4.5%), ICT graduates in Finland account for 7.5% of all graduates, and the share of companies providing ICT training to their employees in Finland is almost twice the EU average. Moreover, the share of SMEs with at least a basic level of digital intensity was considerably above the EU average (82% against 55%), 66% of companies use cloud solutions and 16% integrate AI technology in their operations. Although Finland has already reached the Digital Decade target of 80% of the population with at least basic digital skills, it still needs to increase the percentage of ICT specialists in employment and the share of ICT graduates.

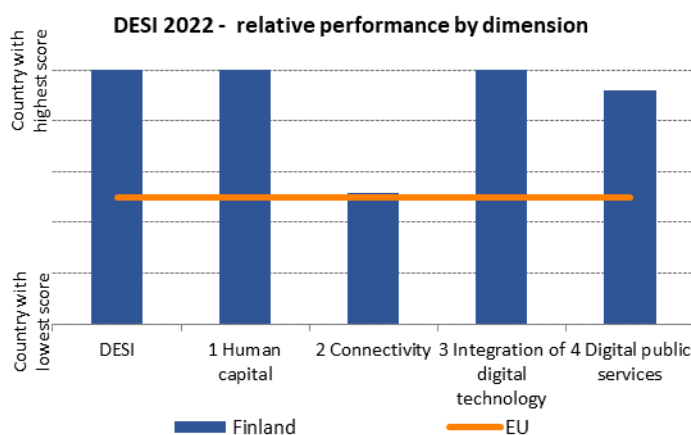
Finland is a leader in 5G commercial services provision. However, it lags behind in the provision of very high capacity network (VHCN) coverage in rural areas. The country intends to tackle that issue by implementing its national broadband plan and dedicated public funding. Its ability to meet the 2025-gigabit targets⁹ and the 2030 Digital Decade targets¹⁰ will depend on the impact of those measures in terms of overall availability of VHCN.

Finnish companies are also intensive users of social media (51% against the EU average of 29%), and of e-invoices (83% against the EU average of 32%). Last, online interaction between government authorities and the public is approaching the maximum with 92% of Finnish internet users using e-government services, almost the same as last year. Finland is well positioned to bring 100% of key public services online and reach the Digital Decade target for 2030 ahead of schedule.

In 2021, Finland continued to implement its digital strategies, including the [digital progress programme](#), [Digivisio 2030](#) and the [updated strategy on artificial intelligence](#). The country created administrative structures or continued improving their operations, financed programmes in this area and developed or launched new systems. The options for future developments were proposed in a report [“Finnish technology policy in 2020s – a global leader through technology and information”](#) published by the Finnish Technology Advisory Board published the report.

To consolidate the legal framework, Finland enacted the [Cyber Security Development Programme](#), and the [Act on improving information security and data protection in critical sectors of society](#). The latter will help to achieve a sufficient level of information security in critical sectors of the economy and society, while the former aims to prepare the country to respond to longer-term threats. Finland welcomed the EU Digital Compass, [announcing the preparation of its own national one](#) in October 2021. Following that decision, a draft national digital compass has been sent to stakeholders for their comments in March 2022. Its adoption is planned for 2022. The purpose is to set national targets and indicators for the thematic areas set out in the EU Digital Decade and to create a coherent vision for long-term digital transformation. To this end, Finland set up the [Digital Transformation Ministerial Working Group](#) to direct the digitalisation of the public administration, the digital transformation, the data economy, information policy and cybersecurity. Part of the group’s task is to draw up guidelines for the preparation of the national digital compass by the ministries. To support the Group’s work and stakeholder engagement, Finland has established a permanent, inter-ministerial coordination group for digitalisation, DigiOffice.

Compared to the EU average, Finland continues to lead on most DESI indicators and keeps improving its excellent scores at a yearly growth above the average of countries with a similar score. Its performance in certain areas may be considered close to optimal or reaching saturation values, hence those may not increase further in the future.



Digital policy in Finland's Recovery and Resilience Plan (RRP)

The contribution to digital objectives in Finland's RRP accounts for EUR 574.3 million, representing 27.5% of the total RRP allocation¹³¹. The plan focuses on reforms and investments in digital public services, digital skills and digital transition of the economy to exploit the full potential of the digital transformation. The plan sets out for example support measures for the digital transition with investments of EUR 50 million in high-speed broadband infrastructure across Finland, EUR 85 million for the Digirail project to roll out the new automatic train protection system on the entire national railway network by 2040, along with the 4G and 5G-based Future Railway Mobile Communication System. The plan allocates EUR 100 million to digital innovation in social welfare and healthcare services; EUR 46 million to invest in continuous learning and EUR 25 million to invest in accelerating key technologies (microelectronics, 6G, artificial intelligence and quantum computing). Another EUR 20 million are allocated to streamline work and education-based immigration in order to facilitate international labour recruitment.

Implementation of the RRP started following its adoption in October 2021. Preparations of the digital projects are underway, with the launch of calls for proposals for the Microelectronics Important Projects of Common European Interest (IPCEI) in 2021.

¹³¹ Each recovery and resilience plan has to dedicate at least 20% of the plan's total allocation to digital objectives. To this end, the plans had to specify and justify to what extent each measure contributes fully (100%), partly (40%) or has no impact (0%) on digital objectives, using Annex VII of the RRF Regulation. Combining the coefficients with the cost estimates of each measure allows assessing to what degree the plan contributes to digital objectives and whether it meets the 20% target.

1 Human capital

	rank	score	score
DESI 2022	1	71.4	45.7

	DESI 2020	Finland DESI 2021	DESI 2022	EU DESI 2022
1a1 At least basic digital skills % individuals	NA	NA	79% 2021	54% 2021
1a2 Above basic digital skills % individuals	NA	NA	48% 2021	26% 2021
1a3 At least basic digital content creation skills¹³² % individuals	NA	NA	83% 2021	66% 2021
1b1 ICT specialists % individuals in employment aged 15-74	6.8% 2019	7.6% 2020	7.4% 2021	4.5% 2021
1b2 Female ICT specialists % ICT specialists	21% 2019	23% 2020	24% 2021	19% 2021
1b3 Enterprises providing ICT training % enterprises	37% 2019	38% 2020	38% 2020	20% 2020
1b4 ICT graduates % graduates	7.0% 2018	7.4% 2019	7.5% 2020	3.9% 2020

Finland ranks 1st out of the 27 EU countries on human capital. Its digital skills level is well above the EU average in all the three indicators concerning digital skills. 79% of individuals have at least basic digital skills, approaching the target of 80% in the EU Digital Decade target, and 48% of individuals have above basic digital skills. The proportion of people employed as ICT specialists is at 7.4%, only slightly less than in the previous year. Finland's proportion of female ICT specialists of 24% is above the EU average of 19%. ICT graduates in Finland account for 7.5% of all the graduates, close to twice the EU average of 3.9%. The share of companies providing ICT training to their employees is also almost twice the EU average.

Building on its world-class educational system, the Ministry of Education and Culture launched the new literacies programme 2020-2022 to stimulate the development of targeted competences in ICT, media literacy and programming skills. To put the programme into practice, the ministry awarded a special grant to 46 development projects to draft competence descriptions in 2021-2022. Other grants were awarded to 22 providers of early childhood education and to 24 providers of pre-primary, primary and lower secondary education. Finland participated in the [2021 edition of EU Code Week](#) although participation was not particularly high.

In higher education, the [Digivisio 2030 programme](#) adopted in 2020 secured the commitment of all 38 of Finland's higher education institutions. They signed an agreement to jointly create new digital services, starting with continuous learning. The programme is developing a platform that in the first phase will pool the continuous learning opportunities from all higher education institutions in one place, making them easy to find.

¹³² Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

The [LUMA centre](#) (an organisation boosting cooperation between schools, universities, and business) continued to motivate children to study STEM subjects by using the most recent pedagogical methods. It also supported lifelong learning for teachers and strengthened research-based teaching.

Digital skills featured in the [continuous learning reform](#) that the Finnish Parliament adopted in December 2020. The reform promotes opportunities for working age people to develop their competences and ensures the availability of skilled labour. In line with the plan, Finland launched a digital service combining education and training, guidance and information on the labour market, and a set of intelligent e-services operating as a platform for a continuous learning system.

The Ministry of Employment and Economy in cooperation with the Ministry of Education and Culture set up an expert group, the [Do Digi Forum](#) to promote digital skills development. The 37 members of the forum represent a wide range of social groups. The forum's work links to the national coalition on digital skills and jobs launched by the European Commission.

Finland announced that it would simplify administrative procedures through an online service platform that consolidates public and private-sector services for foreign workers arriving in Finland. It is expected to include information on job opportunities, matching potential workers and employers, reliable data-sharing between users on the platform, and assistance in managing the administrative process. The project aims to help companies recruit ICT specialists for hard-to-fill vacancies.

Finland's consistent implementation of its programmes and strategies in 2021 yielded many advantages for the economy, resulting in an increase in the quality of life. The [WORK2030 programme for work and well-being at work](#) aims to accelerate the reform of practices and the use of new technology in Finnish workplaces, foster a work culture based on cooperation and trust, and make Finland a leading developer of work-life innovation in the digital age. The goal is to make Finland the world leader in well-being at work by 2030.

2 Connectivity

	rank	score	score
DESI 2022	8	60.5	59.9

	Finland		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
2a1 Overall fixed broadband take-up % households	57%	57%	61%	78%
		2020	2021	2021
2a2 At least 100 Mbps fixed broadband take-up % households	23%	26%	29%	41%
	2019	2020	2021	2021
2a3 At least 1 Gbps take-up % households	0.90%	0.95%	1.45%	7.58%
	2019	2020	2021	2021
2b1 Fast broadband (NGA) coverage % households	75%	75%	75%	90%
	2019	2020	2021	2021
2b2 Fixed Very High Capacity Network (VHCN) coverage % households	62%	67%	68%	70%
	2019	2020	2021	2021
2b3 Fibre to the Premises (FTTP) coverage % households	35%	38%	40%	50%
	2019	2020	2021	2021
2c1 5G spectrum Assigned spectrum as a % of total harmonised 5G spectrum	67%	99%	99%	56%
	04/2020	09/2021	04/2022	04/2022
2c2 5G coverage¹³³ % populated areas	NA	12%	72%	66%
		2020	2021	2021
2c3 Mobile broadband take-up % individuals	92%	92%	96%	87%
	2018	2018	2021	2021
2d1 Broadband price index Score (0-100)	75	74	79	73
	2019	2020	2021	2021

Finland ranks 8th in connectivity among EU countries. There is a noticeable divide regarding fixed network coverage as availability of very high capacity networks (VHCN) is uneven across the country due to the lack of economic incentives to roll out in sparsely populated areas. This issue was partially tackled when the country amended specific State Aid rules in 2018, which resulted in more areas gaining fibre network cover. However, some disparities in its availability still remain. Many sparsely populated areas still do not have any VHCN availability or are served by only one VHCN. Although Finland's rate of fixed VHCN coverage is close to the EU average (68% compared with an EU average of 70%), it scores low (12.4%) in rural areas. The government intends to extend VHCN coverage by implementing its national broadband plan and the digital infrastructure strategy, though it did not succeed in granting funding for

¹³³ The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

broadband projects in 2021¹³⁴. Besides, funds worth EUR 16 million for building fibre networks were reserved in 2021 from the European Agricultural Fund for Rural Development (EAFRD).

Finland also aims to achieve very high capacity connectivity for at least 25 000 dwellings in commercially challenging areas before the second half of 2026 with funding from the RRF. Finland's Recovery and Resilience Plan includes measures to improve very high-capacity connectivity, particularly in rural areas. To support the digital transition, the plan will invest EUR 50 million in the rollout of VHCN, which should benefit those white spot areas.

Fixed broadband take-up is low at all speeds: 61% of households use fixed broadband (compared with an EU average of 78% of households), 29% of households have fixed broadband at 100 Mbps (compared to an EU average of 41%) and only 1.45% of households have fixed broadband at 1 Gbps (compared to an EU average of 7.58%). The low take-up does not appear to be correlated with price. Indeed, Finland's broadband prices are good compared with other EU countries: its broadband price index stood at 79, above the EU average of 73. Take-up might be explained by Finland's low VHCN coverage in rural areas. The low take-up of fixed broadband may also be explained by a considerable number of end users choosing to switch to mobile broadband instead. Finland's mobile market is characterised by high mobile broadband take-up (at 96% against the EU average of 85%). In 2021, there were 9.2 million mobile subscriptions on the market, including 62% of subscriptions for a service of at least 100 Mbps¹³⁵.

The country features ubiquitous 4G coverage and 5G coverage available in 72% of populated areas. The high coverage of 5G is linked to the early availability of the 5G pioneer bands: the 700 MHz band was auctioned in 2016, the 3.6 GHz band in 2018 and the 26 GHz band in 2020. As regards the use of the 3.6 GHz band in neighbouring areas with Russia, licence holders¹³⁶ in that frequency band can now use 130 MHz each in the 3410-3800 MHz band they got from the auction with considerably smaller coordination distances than those stipulated under the applicable radio regulations. This change is expected to positively impact the provision of 5G commercial services in the areas concerned.

Main market & regulatory developments

Three main operators compete on both the fixed and the mobile markets: Telia Company, Elisa and DNA. Several national and regional players invest in fibre networks in addition to those three operators.

The market saw several noticeable business transactions in 2021. On 29 December 2021, Telia Company completed the divestment of 49% of its tower business in Finland and Norway to the asset manager Brookfield and the Swedish pension fund Alecta. The reported aim of the

¹³⁴ The government had reserved EUR 5 million for 2021. However, this amount was not distributed due to the legislative changes needed to the upcoming ones of the General Block Exemption Regulation. Those funds are still available for broadband deployment. The Act on aid for broadband construction 1262/2020 was amended in Parliament so that as of 3 February 2022 it would only allow aid to fibre networks.

¹³⁵ Source: Traficom.

¹³⁶ Telia Company, Elisa and DNA.

transaction was to keep developing Telia's digital infrastructure. In November 2021, the operator Elisa acquired Verkko-osuuskunta Kuitukanava¹³⁷'s fibre network. Also in December 2021, Ålands Telefonandelslag acquired Mariehamns Telefon Ab¹³⁸.

In terms of market patterns, the fixed market is seeing a decommissioning of the copper network. The three main market players Elisa, Telia and DNA have already stopped selling PSTN and ADSL subscriptions. Traficom estimates that most operators will stop selling PSTN and ADSL within five years.

The voice call market is witnessing a switch from fixed-to-mobile as there are only 224 000 fixed telephone lines left (of which 158 000 are business subscriptions), while the number of mobile subscriptions stood at 9.23 million in 2021¹³⁹.

In terms of market regulation, Traficom is carrying out new market analysis for markets 3a (wholesale local access provided at a fixed location), 3b (wholesale central access provided at a fixed location for mass-market products) and 4 (wholesale high-quality access provided at a fixed location) in the 2014 Recommendation on relevant markets. Market 4/2014 is currently entirely deregulated following the Supreme Court's judgment of June 2021, which annulled Traficom's market analysis in that field¹⁴⁰.

As regards universal service, a decree entered into force on 25 October 2021 increasing the minimum data speed of the right to internet connection from 2 to 5 Mbit/s.

An expert group on physical infrastructure expert group led by Traficom is evaluating and implementing the best practices recommended in the connectivity toolbox. Some of those practices identified as the most relevant for the Finnish context include streamlining permit granting procedures for civil works and improving the Single Information Point. The best practice that aims to reduce the environmental footprint of networks is also advancing. It will be monitored using an initial set of indicators that Traficom developed. The practices concerning spectrum were mostly in place before the introduction of the toolbox.

The Act on electronic communications services was amended on 30 December 2020 and entered into force in early 2021. It implemented Directive 2018/1972 establishing the European Electronic Communications Code.

Finland is a front-runner in 5G commercial deployment. However, the coverage of fixed VHCN is uneven and depends on the geographic area. The take-up of 1Gbps is still very low. Finland intends to tackle the VHCN coverage issue by continuing to carry out its national broadband plan and using public funding from the Recovery and Resilience Facility. Its ability to meet the 2025 Gigabit targets¹⁴¹ and the Digital

¹³⁷ A regional fibre cooperative.

¹³⁸ Both companies are regional incumbents on the Åland Islands.

¹³⁹ Source: Traficom.

¹⁴⁰ The Supreme Court considered that Traficom's market analysis should have included more comprehensive cost-related assessments.

¹⁴¹ Gigabit connectivity for all of the main socio-economic drivers, uninterrupted 5G coverage for all urban areas and major terrestrial transport path; access to connectivity offering at least 100 Mbps for all European households.

Decade targets¹⁴² will depend on the impact of those measures in terms of overall availability of VHCN, including fibre to the premises throughout the country.

¹⁴² All European households are covered by a gigabit network, all populated areas are covered by 5G.

3 Integration of digital technology

	rank	score	score
DESI 2022	1	59.1	36.1

	DESI 2020	Finland DESI 2021	DESI 2022	EU DESI 2022
3a1 SMEs with at least a basic level of digital intensity	NA	NA	82%	55%
% SMEs			2021	2021
3b1 Electronic information sharing	43%	43%	48%	38%
% enterprises	2019	2019	2021	2021
3b2 Social media	44%	44%	51%	29%
% enterprises	2019	2019	2021	2021
3b3 Big data	19%	22%	22%	14%
% enterprises	2018	2020	2020	2020
3b4 Cloud	NA	NA	66%	34%
% enterprises			2021	2021
3b5 AI	NA	NA	16%	8%
% enterprises			2021	2021
3b6 ICT for environmental sustainability	NA	77%	77%	66%
% enterprises having medium/high intensity of green action through ICT		2021	2021	2021
3b7 e-Invoices	79%	83%	83%	32%
% enterprises	2018	2020	2020	2020
3c1 SMEs selling online	22%	18%	23%	18%
% SMEs	2019	2020	2021	2021
3c2 e-Commerce turnover	NA	NA	NA	12%
% SME turnover	2019	2020	2021	2021
3c3 Selling online cross-border	9%	9%	8%	9%
% SMEs	2019	2019	2021	2021

Finland ranks 1st among EU countries on the integration of digital technology, scoring well above the EU average on most indicators. Some 82% of Finnish SMEs have at least a basic level of digital intensity, considerably above the EU average of 55%. Advanced technologies continued to be at the heart of Finnish business functions, with 66% using cloud solutions and 16% integrating AI technology in their operations: twice the EU average for both indicators. The proportion of companies that share information electronically is 48% compared to the EU average of 38%. Finnish companies are intensive users of social media - 51% versus the EU average of 29%. E-invoice use by companies is common (83%), while 77% of companies make a medium to high intensity use of ICT for environmental action.

In 2021, Finland continued to implement its [digital progress programme adopted in 2020](#). The main governmental organisation supporting businesses in line with this policy is [Business Finland](#). It funded a range of activities in research and development to support new small companies. For instance, the microelectronics and photonics ecosystem received assistance through national co-innovation projects in the fields of 6G technology, quantum processors, silicon photonics, SoCs (System-on-Chip), SoC design capabilities (including emulation and simulation), MEMS technology, black silicon, and conformal, printable and sustainable electronics. In addition to these areas, Finland also funded innovation projects under the programme *Kasvumoottorit* (growth engines) on the use of data and the development of

digital platforms. In the field of smart mobility, leading companies in digital ecosystems received [funding](#).

Early-stage innovation also received support. Government funding has been an important enabler for many Finnish start-ups, making it possible to lower the risk related to their R&D activities. The programmes that aim to accelerate early-stage growth of innovative start-ups provide EUR 130 million of funding per year. For instance, a recently launched Tempo programme provides EUR 50 000 in grants to accelerate the early-stage growth of innovative start-ups.

Finland participates in the Microelectronics and Communication Technologies IPCEI (ME-CT IPCEI). It has pre-notified three projects that concentrate on developing MEMS sensor platforms, RF wafers and 5/6G and EDGE AI chip design skills. The country is also a member of the EuroHPC Joint Undertaking and will host the Lumi, one of the three pre-exascale [supercomputers](#). Preparations are underway to make Lumi fully operational by mid-2022. The Lumi supercomputer will create completely new opportunities for unprecedented scientific break-throughs especially in interdisciplinary and data-intensive research areas. Also, 20% of the capacity is reserved for business which opens up new opportunities for companies to innovate and develop new data-based business forms such as the platform economy and artificial intelligence. Finland participates in the European Blockchain Partnership. Finland also supports the digital transformation of local businesses and communities via the VTT Technical Research Centre under the multiannual 2018-2022 [digital Finland framework](#) with a budget of EUR 400 million.

European Digital Innovation Hubs (EDIHs) will provide access to technical expertise and experimentation for enterprises. The selection of the DIHs that will participate in the network of EDIHs is ongoing. Four Finnish EDIH proposals have successful evaluation results¹⁴³ and three other proposals have received a Seal of Excellence.

With the November 2020 update of the [AI strategy](#), the government encouraged the development and introduction of AI in companies. It plans to embed AI in a wide array of other technologies such as the internet of things, 3D printing, robotics, quantum computing, and virtual and augmented reality. Funding has been secured for 2019-2022 for the AI business programme (EUR 100 million) and for the Finnish Centre for Artificial Intelligence (FCAI, EUR 8.3 million). An example is the [FCAI – Finnish Centre for Artificial Intelligence](#) funded by the Academy of Finland. It is a community of talents from academia, industry and the public sector working together to solve real-life problems using existing and new AI applications. FCAI is one of Academy of Finland's '[Finnish flagships](#),' hubs for top-level research and impact.

In June 2021, the government adopted the [Cyber Security Development Programme](#) and a resolution on improving information security and data protection in critical sectors of society. This act will ensure a sufficient level of information security in critical sectors of the economy and society, while the cyber security programme aims to build preparedness against cyber threats over the longer term.

Finnish businesses perform well on the integration of digital technologies. One of the main forces driving this integration is cooperation between universities, specialised government agencies and businesses. In the long run, even deeper integration of digital technologies could improve the international reach of the Finnish companies, which will be necessary for Finland to remain competitive globally.

¹⁴³ I.e. are invited for grant agreement preparation (which is not a formal commitment for funding).



4 Digital public services

4 Digital public services ¹⁴⁴	rank	score	score
DESI 2022	2	87.4	67.3

	DESI 2020	Finland DESI 2021	DESI 2022	EU DESI 2022
4a1 e-Government users % internet users	91% 2019	91% 2020	92% 2021	65% 2021
4a2 Pre-filled forms Score (0 to 100)	NA	NA	90 2021	64 2021
4a3 Digital public services for citizens Score (0 to 100)	NA	NA	90 2021	75 2021
4a4 Digital public services for businesses Score (0 to 100)	NA	NA	93 2021	82 2021
4a5 Open data % maximum score	NA	NA	86% 2021	81% 2021

In Digital public services, Finland ranks 2nd among EU countries, scoring well above the EU average. Online interaction between government authorities and the public is approaching the maximum level with 92% of Finnish internet users using e-government services. The country performs very well on pre-filled forms (90%), and on providing online services for both individuals and businesses (scoring 90 and 93, compared to EU averages of 75 and 82 respectively). Finland scores above the EU average on open data, too.

Last year saw the continuation of previously launched programmes. The country refined the architecture of e-government services. A few registration services were integrated after merging into the [Digital and Population Data Services Agency](#) and continued to provide data. The Valtori [ICT centre](#) after being placed under direct supervision of the Ministry of Finance, continued providing ICT services for central government and facilitating intergovernmental tasks. The AuroraAI network that aims to provide services to citizens to help them going through bureaucratic arrangements related to their life events (accidents, certificates etc.) is at pilot stage. At the same time, operating models have been developed to enable human-centric operations of organizations.

In view of future challenges in September 2021 the government appointed a [Ministerial Working Group on Digitalisation, Data Economy and Public Administration](#). Cybersecurity was added to the group's tasks in March 2022. Its purpose is to guide the development of the public administration, digitalisation, the data economy, information policy, and cybersecurity. In parallel, the ministries dealing with digital aspects e.g. the Ministry of Transport and Communications, the Ministry of Finance and the Ministry of Employment and the Economy set up a new group, the DigiOffice to coordinate inter-ministerial cooperation on digitalisation and the data economy.

¹⁴⁴ There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

Following the Commission's publication of the Digital Compass, the government set the goal for Finland to be the first in the EU to create a national digital compass by the end of 2022. It also aimed to create a mechanism to evaluate national developments and the effectiveness of the actions taken.

In e-Health, Finland can achieve the Digital Compass goals with relative ease as the personal health record system is already available for everyone: people can browse their medical records and prescriptions on the national portal [My Kanta](#). MyKanta-pages support several use cases e.g., managing consent, requesting a prescription renewal or saving a living will and organ donation testament. Additionally, through MyKanta, it is possible to store personal welfare data and share it with the authorities.

Finland launched the process to update its digital identity infrastructure. A government-driven large-scale digital identity project is underway in 2020-2023. It aims to develop next-generation electronic identification for Finns and for anyone accessing e-services in Finland. That would translate into equal conditions for all to use the digital identity in social services first, and later in health services, making it possible to expand the personal data that the authorities confirm as transmissible to the other party when using the services.

The [national open data portal](#) continued to provide data in open formats for companies and the public. Following previous observations that Finland is underachieving given its ambitions, the government ran a programme to encourage wider and more efficient use of public data for societal and economic purposes over the period 2020-2022. The focus has been on preparing strategic objectives for opening up and using public sector data, operating framework as well as quality criteria for data and API principles for public government.

The [Digital Twin concept](#) is a recently launched programme to create a national digital register that mirrors the built environment. It is based on widely used standards to ensure compatibility with other countries' projects. The project is overseen by the Ministry of Environment.

The regulation of automatic decision-making in public administration is progressing, and the proposal for legislation allowing automatic administrative decisions is up for public consultation since March 2022. The aim is to adopt the legislation by the end of 2023. Before preparing the national legal instruments further, Finland is waiting for the Artificial intelligence act to clarify the rules around the used AI in public administration.

Finland is an EU leader in most e-government indicators as it has kept pace with fast-changing technology, integrating it in efficient solutions for its population, businesses and the public sector. At central government level, the [Ministerial working group and the Digital office](#) give political impetus for the change, while continuing to refine existing solutions. Increasing threats to cybersecurity and new challenges brought about by AI applications are the issues that this structure will tackle. That may prove to be more difficult at local government level, therefore Finland will need to monitor developments across the country to ensure even results.

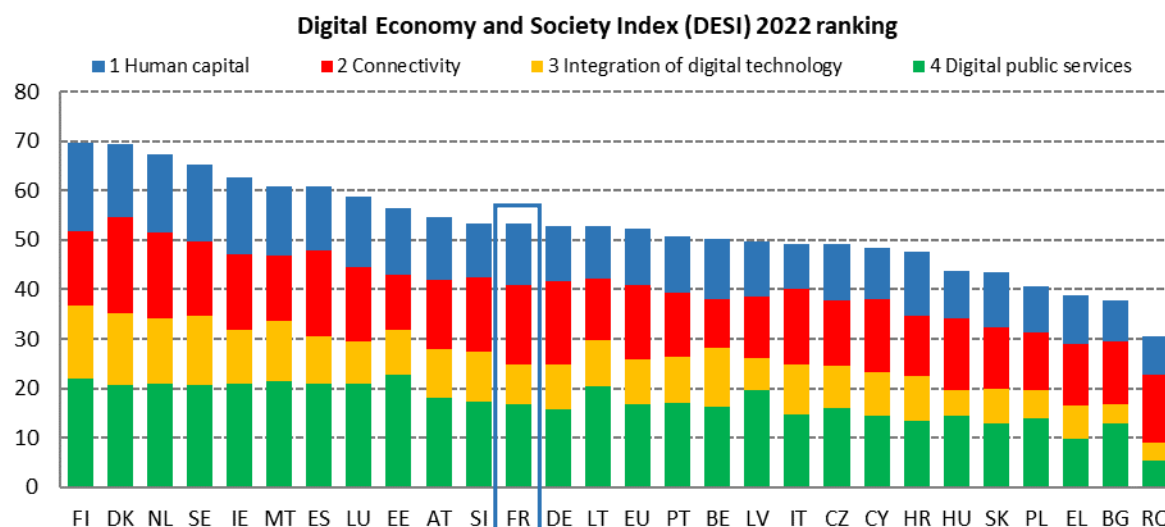
Highlight: Cybersecurity in the public administration

Finland has a long tradition of information and cybersecurity preparedness with clear roles and division of tasks between the authorities based on legislation. Recently, Finland increased its cyber preparedness level allocating public funding to that effect. The ministerial working group on developing the digital transformation, the data economy and public administration is also

responsible for for cybersecurity and the preparedness of public administration. The group has surveyed and prioritised needs for actions and investments on cyber security. The Ministry of Transport and Communications together with the director for cybersecurity provide the government with the situational picture and coordinate actions horizontally in case of severe cybersecurity disruptions. A newly established inter-ministerial group for horizontal coordination secures the flow of information and coordination in severe threats and disruptive situations. Finland is well anchored with the EU's strategic and operational cooperation in preparedness, contingency planning and combating cyber threats.

France

DESI 2022	France		EU
	rank	score	score
DESI 2022	12	53.3	52.3



France ranks 12th of the 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI).

Thanks to a sustained effort in support of digitalisation, France has over-performed in the past years, progressing more than expected, as shown in section 1.3 of the DESI 2022 horizontal chapter. Nevertheless, the country is not yet among the digital frontrunners. Over the coming years, France's progress towards the digital transformation will be crucial for reaching the [Digital Decade targets](#). The digital transformation of the French economy and society is being supported by the [Plan de Relance](#) (Recovery plan), benefitting from a Recovery and Resilience Facility (RRF) contribution of around EUR 40 billion and [France 2030](#), a strategic plan to strengthen technological sovereignty, ensure the greening of the economy and boosting innovation. Initiatives are ongoing in several areas.

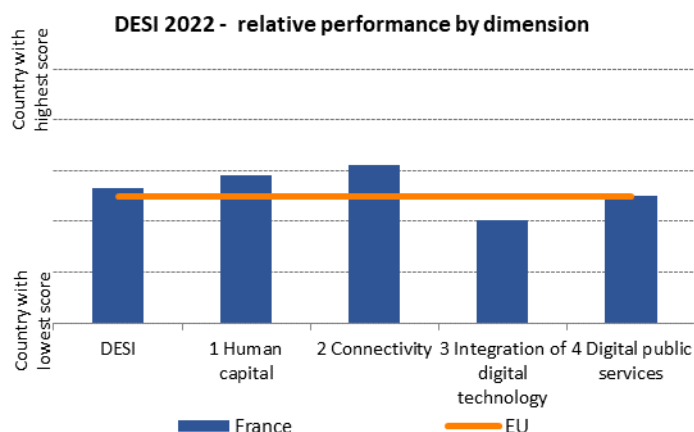
Firstly, education and training systems are being transformed to meet the needs of the economic and social digital transformation. In particular, education and training institutions are being equipped with digital tools and infrastructures, new digital platforms are being developed to facilitate online learning and digital inclusion measures are being implemented for the benefit of the most vulnerable people in France. These measures are key to increase digital skills levels, contributing to France reaching the Digital Decade target of 80% of people with at least basic digital skills by 2030. Measures to boost teachers' digital skills and improve the teaching of digital subjects could still be made more effective, as could measures for the digital upskilling and reskilling of adults.

Digital connectivity has improved in France, with many upgrades on its fixed networks and the continuation of the implementation of the national broadband plan (Plan *France très haut débit*), with a remarkable take-up of 1 Gbps across the country and a very wide availability of mobile broadband (4G coverage of 99% of households). However, the pace of fibre to the home (FTTH) roll-out has slackened in some areas, including very densely populated areas. France set out ambitious targets for providing fast broadband access for all households by 2022 and fibre for all by 2025, in line with the Digital Decade targets¹⁴⁵.

France is paying particular attention to the development of key digital technologies to strengthen its strategic autonomy. In 2021, research acceleration strategies were launched for AI, cloud, cybersecurity, quantum and 5G, to name just some areas. The strategies, now being implemented, are aimed at the development of these technologies, while ensuring widespread deployment of digital solutions across the economy. To achieve this, France has also devoted significant investments to the development of advanced digital skills to ensure there is an adequate supply of the specialists that the economy currently lacks. At the same time, French businesses are starting to use digital tools and solutions more and more: 22% of businesses in 2021 were using big data (6 percentage points higher than the EU average). However, the uptake of other digital solutions could be higher (for example AI, cloud or simply social media). Small and medium-sized enterprises (SMEs) are also finding it more difficult to harness the potential of digital solutions for their business, with 47% having at least basic digital intensity, compared to the EU average of 55%. This puts France at a considerable distance from reaching the Digital Decade target of 90%.

France is making progress in designing and delivering digital services for citizens and businesses and digitalising healthcare. It is increasing the production and use of digital identity cards, making the most frequently used procedures available online through the *démarches-simplifiées* (simplified steps) platform, and making better use of AI and cloud for public services. These efforts need to be sustained for France to be able to reach the Digital Decade target of 100% online provision of key public services for EU citizens and businesses. France is also using electronic health records, available for all citizens since the beginning of 2022.

¹⁴⁵ <https://digital-strategy.ec.europa.eu/en/policies/broadband-france>



Digital policy in France's Recovery and Resilience Plan (RRP)

EUR 8.4 billion, or 21.3% of the French plan, are devoted to the digital transition¹⁴⁶. France will support the development and deployment of key digital technologies, such as cybersecurity, quantum and cloud, with an estimated budget of EUR 1.8 billion. Other key investments concern support for businesses by helping them make the most of digital technologies (planned allocation of EUR 385 million), the digitalisation of primary and secondary schools through digital equipment (planned allocation of EUR 131 million), and the further digitalisation of public services. France aims also at providing access to very high speed networks for all households (100% fibre-to-home) by 2025.

In November 2021, France submitted its first payment request for a total of EUR 8.5 billion. By the end of 2021, all six acceleration strategies for key digital technologies (quantum technologies, cybersecurity, digital education, cultural and creative industries, 5G, cloud) had been validated and published on the website of the Secretariat-General for Investment (*Secrétariat-Général pour l'Investissement – SGPI*). Projects supporting teaching, research, promotion and innovation ecosystems were launched, and an evaluation of the projects was carried out in the first months of 2022.

Other reforms and investments planned to reach their milestones and targets in 2022 include:

- measures for boosting digital identity and the production and circulation of new identity cards;
- measures for upskilling and reskilling the workforce, in particular a top-up of funding for training in digital skills available for individual learning accounts;

¹⁴⁶ Each Recovery and Resilience Plan has to dedicate at least 20% of the plan's total allocation to digital objectives. To this end, the plans had to specify and justify to what extent each measure contributes fully (100%), partly (40%) or has no impact (0%) on digital objectives, using Annex VII of the RRF Regulation. Combining the coefficients with the cost estimates of each measure allows assessing to what degree the plan contributes to digital objectives and whether it meets the 20% target.

- the digital inclusion measure, in particular the training of digital advisers to help the most vulnerable people acquire basic digital skills;
- support for the digitalisation of businesses and the facilitation of digital investments;
- measures for the digitalisation of education, in particular equipping schools with digital tools and infrastructures;
- Connecting 1 700 000 additional buildings to fibre.

1 Human capital

1 Human capital	France		EU
	rank	score	score
DESI 2022	12	49.9	45.7

	France		EU
	DESI 2020	DESI 2021	DESI 2022
1a1 At least basic digital skills % individuals	NA	NA	62% 2021
1a2 Above basic digital skills % individuals	NA	NA	31% 2021
1a3 At least basic digital content creation skills¹⁴⁷ % individuals	NA	NA	76% 2021
1b1 ICT specialists % individuals in employment aged 15-74	4.2% 2019	4.5% 2020	4.5% 2021
1b2 Female ICT specialists % ICT specialists	20% 2019	20% 2020	21% 2021
1b3 Enterprises providing ICT training % enterprises	21% 2019	15% 2020	15% 2020
1b4 ICT graduates % graduates	3.5% 2018	3.6% 2019	3.6% 2020

In the human capital dimension, France ranks 12th of 27 EU countries.

The country performs above the EU average for basic and above basic digital skills, respectively at 62% and 31% of the population. To reach the Digital Decade target of 80% of people with at least basic digital skills, France would need to increase its performance by 18 percentage points by 2030. At 4.5%, the proportion of ICT specialists in employment is in line with the EU average of 4.5%, with a slight increase in the percentage of female specialists, 21% in 2021. France performs well for the digital content creation skills with 76% of people (EU average 66%). The proportion of businesses providing ICT training – 15% of total businesses, compared to 20% EU average – decreased by 6 percentage points between 2019 and 2020. The EU Digital Decade target for ICT specialists is to have 20 million ICT specialists employed in the economy by 2030, accounting for around 10% of employment. To reach this target, France should increase its proportion of ICT specialists.

France is progressively transforming education and training systems to meet the needs of the digital economy and society. For the digitalisation of education, it is investing in digital infrastructures and tools: together with local authorities, it has identified, designed and developed a basic digital kit to provide primary and secondary schools with equipment, connectivity, services and essential resources¹⁴⁸, while teachers benefit from an annual computer bonus to purchase technical equipment. France is also implementing the [Education and digital strategy](#), for the digital transformation of

¹⁴⁷ Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

¹⁴⁸ Funding for connectivity of education institutions is addressed as part of the [Plan France Très Haut Débit](#).

education from kindergarten to university. This will also support the development of education technology and performant digital education ecosystems (EUR 350 million).

Education programmes in primary and secondary schools include the teaching of digital skills, attested by the PIX (paperless information exchange) certification at the end of 6th grade and at middle and high schools (in 2021, 500 000 students were certified and 2 million tested¹⁴⁹). A new system for developing and certifying teachers' digital skills, [Pix+ Édu](#), has also been set up, with funding from France's Recovery and Resilience Plan (RRP).

Since 2021, pilot projects have been in place to encourage the use of digital technologies for education, such as [a dedicated programme](#) for children with special needs or who are sick, providing adapted resources with the support of education technology solutions.

As part of the [Skills Investment Plan](#) and with the support of the RRP, France is expected to invest EUR 465 million in improving public employment services' distance learning offer, equipping training organisations with an interconnected digital platform and supporting the development of hybrid courses. A specific RRP adult learning measure, providing a top-up of the individual learning account for training in digital skills¹⁵⁰, has succeeded in getting 25 000 people trained by the beginning of 2022. Redoubling efforts to support the upskilling and reskilling of the current workforce with digital skills could help to increase the number of people with above basic digital skills.

As part of the RRP, measures to strengthen higher education institutions have been launched. In particular, the project [Excellence in all its forms](#) aims to support the modernisation of institutions, in line with their territorial dynamics and specific needs. The first 15 projects have been selected. Many of them revolve around the digital transformation of the institutions in question.

As part of the France 2030 Plan, announced in 2021, France will support talent development in key digital areas and speed up the adaptation of training programmes for life-long learning to respond to the fast-changing needs of the labour market. A [first call for expressions of interest](#) was launched at the end of 2021 (see highlight).

The new [Artificial Intelligence \(AI\) strategy](#) will also devote EUR 800 million to training and attracting the best international AI talent, by supporting the development of world-class centres of education and training in AI.

To attract the best talent from abroad, France has implemented the [French Tech Visa](#). This is a simplified, fast-track scheme for non-EU start-up employees, founders and investors to obtain a residence permit for France. More than 1 000 visa requests have been made on the dedicated platform since March 2019.

France is getting stakeholders involved in skills development activities. The state and private sectors have signed a number of partnerships¹⁵¹ covering the digital transformation theme and enabling partners to commit to forward-looking and anticipatory actions. For example, a [digital foresight 2025](#) partnership was launched in January 2022 with representatives of the financial services and consulting

¹⁴⁹ Data from the French authorities in the DESI questionnaire.

¹⁵⁰ <https://travail-emploi.gouv.fr/actualites/l-actualite-du-ministere/article/se-former-aux-metiers-du-numerique-en-mobilisant-son-cpf-et-avec-l-aide-de-etat>

¹⁵¹ *Engagements de développement de l'emploi et des compétences* ([EDEC](#))

sectors. The aim is to analyse changes in these sectors, to project digital skills needs and to enable employees to adapt.

These partnerships have led to several types of actions: the [website for the AI maturity assessment of enterprises](#) developed by the national Digital Skills and Jobs Coalition, and the implementation of human resources support for the digital transition.

In 2021, France organised around 500 events to encourage students to code, as part of EU Code Week.

Finally, to gather timely information on the impact of digital technologies on the labour market, the Ministry of Labour, Employment and Inclusion is working with the National Institute for Research in Digital Science and Technology to create [LabourIA](#), a research and experimentation laboratory on the use and impact of AI at work. The aim of this partnership is to carry out, over the next 5 years, projects to analyse and anticipate the consequences of AI on the organisation of work, professions, skills, social dialogue and ethical issues and quality of life at work. The results of the various projects conducted as part of LabourIA will provide useful input for public and private decision makers.

Digital skills are crucial for a successful digital transformation. The measures in place in France address structural weaknesses. If these efforts continue in the direction of equipping the current and future workforce with digital skills at all levels, they have the potential to help France reaching the Digital Decade targets. Some challenges remain concerning digital infrastructures for education institutions and adequate teacher training.

France 2030 – Future skills and professions

The France 2030 Plan, aimed at strengthening innovation and digital capacities to drive the green and digital transition, devotes EUR 2.5 billion of its total allocation to constituting a pipeline of future talent and to reskilling the current workforce, as key enablers for its success. This responds to the need for both more workers and more digitally skilled workers, currently lacking in France and in the EU in general.

To this end, the first calls for [Compétences et Metiers d'Avenir](#) (Future skills and professions) were launched at the end of 2021. The objective is twofold: to support foresight analysis to anticipate skills needs in different priority areas, in line with the key digital acceleration strategies and, on the basis of these analyses, develop an innovative education and training offer targeting students, job-seekers and people already in employment.

Applicants are invited to organise themselves in consortia involving employers (or their representatives), education and training institutions. Projects need to address the key priority areas defined as crucial for a successful economic recovery and for strategic autonomy. Priority areas include cloud, microelectronics, quantum, cybersecurity, 5G, as well as industrial decarbonization, sustainable and healthy food.

The first projects were submitted in February 2022 and a new call was launched in June 2022. These initiatives will complement measures already in place to strengthen adult learning, such as the campus for excellent skills and jobs and vocational training partnerships.



2 Connectivity

2 Connectivity	France		EU
	rank	score	score
DESI 2022	5	64.2	59.9

	France			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
2a1 Overall fixed broadband take-up	71%	NA	80%	78%
% households	2019	2020	2021	2021
2a2 At least 100 Mbps fixed broadband take-up	17%	NA	35%	41%
% households	2019	2020	2021	2021
2a3 At least 1 Gbps take-up	NA	NA	26.75%	7.58%
% households	2019	2020	2021	2021
2b1 Fast broadband (NGA) coverage	62%	69%	74%	90%
% households	2019	2020	2021	2021
2b2 Fixed Very High-Capacity Network (VHCN) coverage	44%	53%	63%	70%
% households	2019	2020	2021	2021
2b3 Fibre to the Premises (FTTP) coverage	44%	53%	63%	50%
% households	2019	2020	2021	2021
2c1 5G spectrum	33%	59%	59%	56%
Assigned spectrum as a % of total harmonised 5G spectrum	04/2020	09/2021	04/2022	04/2022
2c2 5G coverage¹⁵²	NA	0%	74%	66%
% populated areas		2020	2021	2021
2c3 Mobile broadband take-up	82%	82%	88%	87%
% individuals	2018	2018	2021	2021
2d1 Broadband price index	80	78	76	73
Score (0-100)	2019	2020	2021	2021

France ranks 5th in connectivity among EU countries.

The French fixed market features low fast broadband next generation access (NGA) coverage (74% compared to the EU average of 90%) and fixed very high-capacity network (VHCN) coverage. VHCN coverage recorded substantial increase of 10 percentage points bringing it to 63% in 2021 (against 70% for the EU). The fixed network's further expansion is linked to the continuation of its national broadband plan (Plan "France très haut débit"¹⁵³). However, the pace of the fibre to the home (FTTH) roll-out has slackened in some areas, including in very densely populated cities¹⁵⁴.

¹⁵² The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

¹⁵³ The plan aims to speed up the roll-out of fibre networks and connect all households to networks running at a speed of 30 Mbps (and above) by 2022. The French government decided to set a new target for ubiquitous roll-out

Fibre to the premises (FTTP) coverage recorded an overall increase of 10 percentage points year on year, bringing it to 63% reaching about 18 million households. FTTP coverage in rural areas recorded a 12.1 percentage points increase, bringing it to 30.5% reaching 1.447.299 households. It is worth noting an increase in investments on the part of market players: in 2020, they recorded a EUR 12.6 billion increase (namely a 7.7 percentage points increase)¹⁵⁵.

The take-up of 1 Gbps is remarkable in France: 26.75% compared to the EU average of 7.58%. The reason for this may be the availability of commercial offers from several market players in correlation to the increasing number of households being eligible to FTTP technology, as indicated above.

Fixed broadband technology is complemented by mobile broadband availability throughout French territory: the mobile market features ubiquitous 4G coverage (with over 99% households covered). This is due to the successful implementation of 4G deployment commitments made by all four main market players (Orange, SFR, Bouygues Telecom, Free Mobile) since 2018¹⁵⁶. Mobile broadband take-up was equally high, at 88% (87% for the EU). This may be because French broadband prices are relatively good with the index at 76 compared to the EU average at 73.

Furthermore, on mobile connectivity, the French telecommunications market features relatively high 5G coverage, reaching 74% compared to the EU average of 66%. This is partly due to the completion of the auction of the 3.49-3.8 GHz band in Q4 2020, allowing all four mobile network operators¹⁵⁷ as well as some mobile virtual network operators to offer commercial 5G in this band¹⁵⁸. Nevertheless, France's 5G spectrum indicator could be further improved. It stands at 59% due to the lack of assignment of the 26 GHz band. Indeed, in terms of spectrum resources, it can be observed that, as of Q4 2021, France had assigned 100% of the 700 MHz band¹⁵⁹, 77.50% of the 3.6 GHz band, and 0% of the 26 GHz band. In the 26 GHz band, 15 experimental platforms are currently in use until 30 September 2023¹⁶⁰.

of new FTTH networks throughout the country by 2025. This objective is to be carried out through the allocation, by the State, of an additional expected allocation of EUR 240 million as part of the national recovery plan to roll out gigabit networks in market failure areas. These funds will be added to the EUR 3.3 billion already assigned to the plan France Très Haut Débit and the EUR 30 million that were allocated at state level in 2020.

¹⁵⁴ Noticeable disparities in FTTH roll out have been recorded between the following cities where FTTH coverages were as follows: Paris (96%), Marseille (71%), Lyon (95%), Toulouse (86%), Nice (89%), Nantes (82%), Montpellier (82%), Bordeaux (90%), Strasbourg (74%), Lille (58%). Source: Arcep

¹⁵⁵ Source: Arcep

¹⁵⁶ As of Q4 2021, all the 3G sites of those operators had been converted into 4G sites, there was between 96.6% and 99.8% of road corridors covered in 4G, 89% of targeted rural areas had been covered in 4G.

¹⁵⁷ Bouygues Telecom, Free mobile, Orange, SFR.

¹⁵⁸ As of 30 September 2021, 22,636 base stations were equipped with 5G (using 700 MHz, 2100 MHz and 3.4-3.8 GHz bands). Among those, 7537 were using the 3.4-3.8 GHz band. Source: <https://www.arcep.fr/cartes-et-donnees/nos-cartes/deploiement-5g/observatoire-du-deploiement-5g-decembre-2021.html> As to 5G readiness, it can be noted that, on the business to consumer market, as of 15 September 2021, around 30% of mobile subscriptions were 5G compatible. On the business-to-business market, as of Q4 2021, about two thirds of the mobile subscriptions of MNOs and MVNOs that had access to 5G were 5G compatible, source: Arcep.

¹⁵⁹ As per Arcep's decision dated 8 December 2015.

¹⁶⁰ They are currently testing various use cases such as high-speed hotspots for instance.

Main market & regulatory developments

The undertaking “Orange concessions”¹⁶¹ entered the fixed market in November 2021. It designs, builds and runs fibre networks in 24 dedicated areas across the country that are part of public initiative networks¹⁶². It also offers commercial fibre to retail operators.

The mobile market has a large number of Mobile Virtual Network Operators (MVNO). Indeed, around 30 MVNOs are present on the market. However, in 2021, their market shares in mobile lines decreased by 25% after the operator Bouygues Telecom acquired one of the main MVNOs, Euro Information Telecom.

The National Regulatory Authority Arcep acquired new powers in relation to the environment¹⁶³. It now has the power to collect environmental data from various market players (such as telecommunications operators, devices manufacturers, or data centres) to better assess the impact of digital activity on the environment. This data collection is in line with the objectives of the French roadmap on digital and environmental issues¹⁶⁴ aimed at linking economic and environmental aspects more closely together.

As far as consumer trends are concerned, end users signed up for more and more FTTH subscriptions (with an increase of 4.1 million year on year¹⁶⁵). As far as 5G is concerned, 1.6 million reportedly used 5G networks¹⁶⁶.

On consumer complaints, in 2021, Arcep received 38 392 reported issues through “J’alerte l’Arcep”. This is an increase of 10.2 percentage point year on year. The recorded increase may be linked in part to the COVID-19 pandemic which have put operators under pressure. Indeed, a large majority of those reports concern the quality of service (46%) and network development issues (20%), followed by contract and commercial practice related issues (13%). Globally, the

¹⁶¹ Orange concessions is held at 50 % by Orange and at 50 % by a consortium composed of La Banque des Territoires (Caisse des Dépôts), CNP Assurances and EDF Invest.

¹⁶² Réseaux d’initiative publique: areas where private operators have not committed to invest in fibre deployment.

¹⁶³ Further to the entry into force of the “Loi n° 2021-1755 du 23 décembre 2021 visant à renforcer la régulation environnementale du numérique par l’Autorité de régulation des communications électroniques, des postes et de la distribution de la presse ».

¹⁶⁴ The « feuille de route numérique et environnement » was published in February 2021. It includes several dedicated measures such as the commissioning of a study between ARCEP and ADEME with the view to measuring the digital’s environmental footprint in France and identifying best practices to reduce it. The latter is expected to be finalised by mid-2022. In the meantime, a report has already been published. The report states that the terminals account for 79% of the carbon footprint, while data centres account for 16% of it and networks for 5% of it.

¹⁶⁵ FTTH subscriptions represented 43% of overall Internet subscriptions in 2021. Source: Arcep.

¹⁶⁶ As of Q4 2021, source: Arcep.

number of reports on “J’alerte l’Arcep” on issues related to the quality of the FTTH network have increased¹⁶⁷.

France has notified complete transposition of the Directive establishing the European Electronic Communications Code. The Commission services are in the process of scrutinising the notified measures.

Overall, France has achieved ubiquitous 4G coverage on the mobile market and further improved its fixed broadband coverage by rolling out additional fibre network across the country. The fixed market has also seen remarkable take-up of 1Gbps.

Fast broadband (NGA) coverage has reached 74% of the territory. However, rural areas are still not sufficiently covered with fibre to guarantee fixed fast broadband for all. The country's ability to meet the 2025 gigabit targets¹⁶⁸ and 2030 Digital Decade targets¹⁶⁹ will depend on its ability to further expand its fibre network coverage in rural areas. Indeed, ubiquitous fibre coverage could enable France to offer connectivity of at least 100 Mbps possibly upgradable to 1 Gbps for all households.

The country's ability to achieve the 5G related objectives of the 2025 gigabit targets and 2030 Digital decade targets will in turn depend on a prospective improvement of its 5G spectrum indicator, being affected by the lack of assignment of the 26 GHz band¹⁷⁰.

¹⁶⁷To address these issues, Arcep has been chairing a working group since 2019. It brings together telecommunications operators every 6 weeks to find operational solutions. As to statistics, it should however be noted that the increase in the number of reported issues is not necessarily correlated with an increase of existing issues on the ground. Indeed, it may be explained by an increased awareness of the possibility to report an issue via the dedicated platform.

¹⁶⁸ Gigabit connectivity for all of the main socio-economic drivers, uninterrupted 5G coverage for all urban areas and major terrestrial transport paths; access to connectivity of at least 100 Mbps for all European households.

¹⁶⁹ All European households are covered by a Gigabit network, all populated areas are covered by 5G.

¹⁷⁰ Nevertheless, as indicated above, it is worth noting that several experimentation platforms have been opened in the 26 GHz band (in areas such as connected mobility or the Internet of Things for instance), which might materialise in additional use cases for 5G being commercialised in the future.

3 Integration of digital technology

3 Integration of digital technology	France	EU
	rank	score
DESI 2022	20	31.9
		36.1

	DESI 2020	France	DESI 2022	EU
		DESI 2021		DESI 2022
3a1 SMEs with at least a basic level of digital intensity	NA	NA	47%	55%
% SMEs			2021	2021
3b1 Electronic information sharing	48%	48%	45%	38%
% enterprises	2019	2019	2021	2021
3b2 Social media	22%	22%	26%	29%
% enterprises	2019	2019	2021	2021
3b3 Big data	16%	22%	22%	14%
% enterprises	2018	2020	2020	2020
3b4 Cloud	NA	NA	25%	34%
% enterprises			2021	2021
3b5 AI	NA	NA	7%	8%
% enterprises			2021	2021
3b6 ICT for environmental sustainability	NA	55%	55%	66%
% enterprises having medium/high intensity of green action through ICT		2021	2021	2021
3b7 e-Invoices	25%	23%	23%	32%
% enterprises	2018	2020	2020	2020
3c1 SMEs selling online	15%	13%	12%	18%
% SMEs	2019	2020	2021	2021
3c2 e-Commerce turnover	11%	12%	13%	12%
% SME turnover	2019	2020	2021	2021
3c3 Selling online cross-border	6%	6%	6%	9%
% SMEs	2019	2019	2021	2021

As regards the integration of digital technology in businesses' activities, France ranks 20th among EU countries. French businesses are taking advantage of the opportunities offered by big data: 22% of them are using it compared to 14% in the EU. Cloud – used by 25% of French businesses – and AI solutions – used by 7% – are less popular compared to the EU average. French small and medium-sized enterprises (SMEs) are still not quite on a par with the rest of the EU for selling online: only 12% of SMEs sell online – compared to the EU average of 18% – and of these only half do so cross-border. It seems therefore that even during the COVID pandemic SMEs did not switch to online selling. The share of SMEs with at least basic digital is at 47%, against the EU average of 55%. France is still far from achieving the 90% Digital Decade target for 2030.

Both the *France Relance* Plan (partly financed by RRF) and France 2030 devote significant attention to key digital technologies' development and deployment. [Research Acceleration strategies](#), launched in 2021, are now being implemented in AI, cloud, cybersecurity, quantum and 5G, to name just a few areas:

- The second phase of the [AI strategy](#) launched in November 2021 will be supported by an investment of EUR 1.5 billion until 2025. Over half the strategy's resources are allocated to attracting talent (with a dedicated budget of EUR 800 million). It aims to train 3700 students (at bachelor, masters and PhD level) and supports the adoption of AI solutions for 500 SMEs. Its goal is to capture 15 % of the global market for embedded AI by 2025.
- As part of the [cybersecurity strategy](#), initiated in February 2021, a number of projects were launched in 2021 and 2022, such as those supporting innovative research and the setting up of an observatory of cybersecurity skills and professions. The cybermalveillance.gouv.fr portal was also launched in 2021 to provide support for individuals, companies, associations, local authorities and administrations, informing them of digital threats and how to protect themselves. In February 2022, France launched the [Cyber Campus](#), where private companies, public bodies, and government departments will join forces to increase the country's cybersecurity capacity and resilience.
- As part of its [quantum strategy](#), France launched the national platform for quantum computing in 2022. This hybrid computing platform will interconnect conventional ICT systems with quantum computers. These resources will be made available to an international community of laboratories, start-ups and industry representatives. The aim is to facilitate access for these stakeholders to quantum computing capabilities, so that they can identify, develop and test new use cases. In parallel, a number of projects being implemented support research, encourage the development of first-generation quantum accelerators, and support industrial development for quantum-enabling technologies.
- The national [cloud strategy](#) was published at the end of 2021. It has three components: fostering the emergence of a market for trusted cloud services through the SecNumCloud cybersecurity certification, a 'cloud at the centre' policy for government agencies, and an industrial policy. The industrial policy component, to be implemented as part of the *France Relance* Plan will mobilise EUR 667 million over 4 years. It will support the French cloud industry by accelerating the scaling up of French players in critical technologies that are in high demand, by developing disruptive technologies for 2025, such as edge computing, and by supporting research and development projects. These R&D projects will be part of the Important Project of Common European Interest (IPCEI) Cloud, for which France is the co-coordinator with Germany. France is also involved in the cloud-related initiatives of the European Data Strategy, participates in the Cloud Alliance, and supports the Gaia-X initiative.

As part of France 2030, a strategic investment plan of EUR 5 billion has been put in place for semiconductors, in line with the ambitions of the [Chips Act](#). Aimed at strengthening industrial and technological capacities in electronics, the plan will contribute to the implementation of the IPCEI for microelectronics and communication technologies.

France also supports the development of blockchain solutions and their uptake in the economy, as part of the 2019 blockchain strategy. It does so by providing dedicated funding to deep tech companies that in the period 2019-2021 benefited from EUR 30 million support under the deep-tech plan, both directly and through partner funds. In 2022, with the Czech and Swedish Council of the EU presidency co-chairs, France intends to continue working on the transformation of the European blockchain partnership into a new pan-European legal entity (EDIC) and respond to the call on European blockchain services infrastructure and identity as part of the European Digital Agenda.

France supports promising businesses on the path to becoming unicorns with the [French Tech Next40/120](#) programme, designed for French scale-ups capable of becoming world-class technology leaders. Each year, 120 French start-ups and scale-ups are selected to be part of the programme. The selection, based on financial criteria like fundraising or hypergrowth of sales, is open to all models of start-ups (digital, deep-tech, industrial) and all sectors of activity. By joining this programme, companies benefit for 1 year from a system specifically designed to support them in the hyper-growth phase. They profit from enhanced visibility, have access to a specific range of services, and get help to identify their needs in terms of regulations and public policies. At the beginning of 2022, France had 26 unicorns, surpassing its target of 25 by the end of the year.

As regards support measures for the digitalisation of more traditional businesses and SMEs, France has extended the support of [France Num](#) with RRP funding. Its implementation is on track. By the end of 2021, the EUR 500 *France Num* voucher had been offered to more than 112 000 businesses with fewer than 11 employees. There is also a loan guarantee to facilitate access to loans for companies with fewer than 50 employees that have been in business for at least 3 years. The maximum loan amount is EUR 50 000 and the guaranteed rate is 80%. As of 31 December 2021, France Num had provided almost 150 000 coaching sessions and 26 000 individualised diagnoses with action plans and over 2 000 businesses had received targeted support.

The European Digital Innovation Hubs (EDIHs) will provide access to technical expertise and experimentation for enterprises. The selection of the Digital Innovation Hubs that will participate in the network of EDIHs is ongoing. Ten French EDIH proposals have a successful evaluation result¹⁷¹ and additional five proposals are expected to be selected in the next year.

France's measures to strengthen its digital capacities and to support the integration of digital solutions have the potential to contribute significantly to the country's digitalisation. Particular attention will need to be paid to SMEs and micro-enterprises, to ensure that they can fully benefit from the digital transition.

¹⁷¹ I.e., are invited for grant agreement preparation (which is not a formal commitment for funding).

4 Digital public services

4 Digital public services ¹⁷²	France		EU
	rank	score	score
DESI 2022	15	67.4	67.3

	DESI 2020	France DESI 2021	DESI 2022	EU DESI 2022
4a1 e-government users	82%	NA	87%	65%
% internet users	2019	2020	2021	2021
4a2 Pre-filled forms	NA	NA	47	64
Score (0 to 100)			2021	2021
4a3 Digital public services for citizens	NA	NA	69	75
Score (0 to 100)			2021	2021
4a4 Digital public services for businesses	NA	NA	80	82
Score (0 to 100)			2021	2021
4a5 Open data	NA	NA	98%	81%
% maximum score			2021	2021

France ranks 15th in the EU on digital public services. France is among the best performers in terms of e-government users, with 87% of internet users using online public services, against the EU average of 64%. France is also particularly well placed in the area of open data, with a score 17 percentage points higher than the EU average. Its performance is slightly below the EU average in digital public services for citizens and for businesses (respectively 6 percentage points and 2 percentage points below the EU average).

The implementation of the national strategy for the digitalisation of public administration (*tech.gouv* – launched in 2019) is progressing. In 2022, 88% of the most common procedures are digitalised. In addition, to accelerate the dematerialisation and processing of routine administrative procedures, representing 80% of administrative procedures, the French Government has developed and deployed an open-source dematerialisation platform called “[démarches-simplifiées \(simplified steps\)](#)”. The results are significant: the platform has made around 12 000 procedures available online, it is used by 72 000 public employees, and enabled the processing of four million requests in 2021, particularly in the context of the COVID-19 crisis.

In 2016, France launched a digital identity federator called France Connect, relying on pre-existing accounts widely used by French citizens, such as health insurance and tax administration accounts, among others. Now, 6 years later, in 2022, 35 million people use it on a regular basis and around 1 000 public and private online services (mostly banking and insurance services for the private sector) are connected. In 2021, France set up the electronic identification, authentication and trust services node (e-IDAS), to make electronic communication interoperable cross-border by the end of 2022. 40 million

¹⁷² There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

people use at least one e-IDAS platform¹⁷³. All the procedures using the platform make it possible to apply the only-once principle (OOP).

In May 2021, France adopted a new policy for cloud services in public administration, called [*Cloud au centre*](#), making cloud computing the default hosting and production mode for the State's digital services and for all new digital products. French national digital services need to be hosted on one of the two internal inter-ministerial public clouds or on cloud solutions provided by private businesses, in accordance with strict security criteria. The aim of this policy is to ensure the State's sovereignty, the continuity of public services and data protection. A specific team has been set up in the Inter-ministerial department for digital transformation (*Direction interministérielle du numérique*), to support administrations in the use of cloud computing and to organise a community of public actors on this topic. This team works closely with the French Cybersecurity Agency (ANSSI) to ensure a secure environment for the State's use of cloud computing technology.

The use of AI for digital public services has also increased thanks to the AI Lab¹⁷⁴, supporting the development of projects in different areas and for different administrations. Since its launch in 2019, the AI Lab supported the development of 6 projects in 2019 and 15 projects in 2020-2021. It will support 5 new projects in 2022. For example, a pilot project is being developed for the French Court of Cassation by a research team specialized in natural language processing using it to detect divergences in the applications of the law. In parallel, the French customs services are currently implementing an AI solution to fight online tobacco fraud using data made public on the internet. Lastly, the Ministry for the Environmental Transition is developing CarburelA, an AI solution that monitors the sustainability of biofuels blended with fossil fuels in France, by automatically applying business rules to cope with the growing number of energy transactions and the difficulties of controlling information. The above is only a small subset of a growing number of projects.

In the domain of digital healthcare, a personal digital health space (*Mon Espace Santé* – My Health Space) is available for French citizens since January 2022. It provides direct access to a personal secured health data storage space, a secured messaging system to communicate with health professionals, a medical calendar to manage medical appointments and a health app store providing selected health apps. The personalised health space is automatically offered to all citizens, who are at liberty to refuse it. Depending on whether or not the offer of this personalised health space is refused, it may be difficult for France to reach the target of 100% of citizens having access to medical records by 2030.

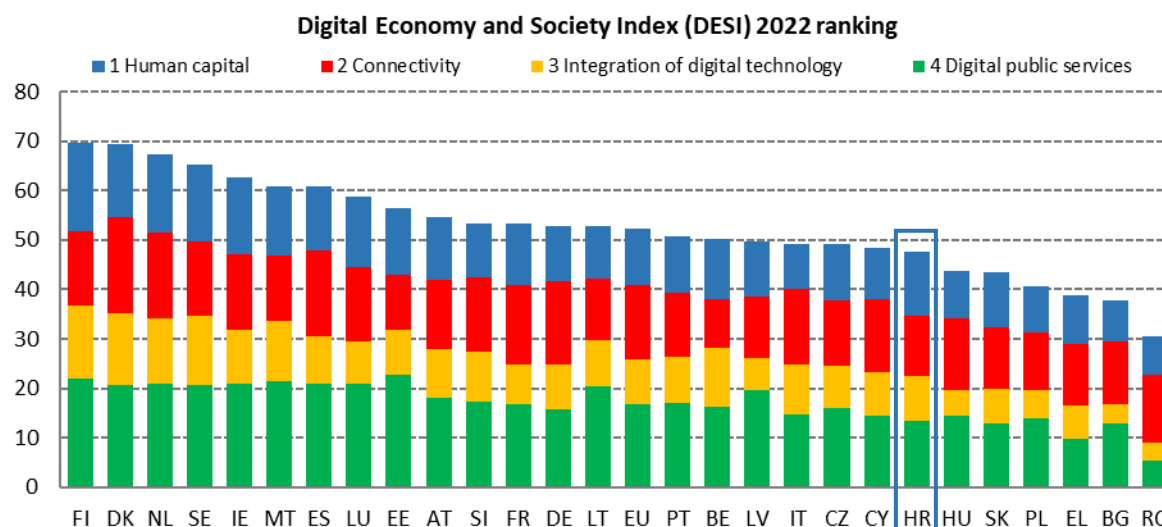
France is already performing well in delivering digital public services. Its efforts need to be sustained to ensure increased efficiency of services for citizens and businesses and ensure their broadest uptake.

¹⁷³ FranceConnect + and Identité numérique La Poste ; impots.gouv.fr (taxes) ; Ameli and MSA (social security)

¹⁷⁴ DESI 2021 – French Country Report

Croatia

	Croatia		EU
	rank	score	score
DESI 2022	21	47.5	52.3



Croatia ranks 21th of 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI). Between 2017 and 2022, Croatia's DESI score grew slightly more than that of the EU¹⁷⁵.

Despite performing well in digital skills, there is still a persistent gap as regards ICT specialists, which in Croatia accounts for a lower percentage of the workforce than the EU average. The shortage of specialists is significantly affecting businesses' integration of digital technology, preventing enterprises, SMEs (Small Medium Enterprises) in particular, from tapping the full potential offered by digital transformation.

Croatia still scores low in the penetration of 100Mbps services, Very High Capacity Networks and 5G coverage and in the broadband price index.

Although the share of ICT specialists in the workforce is below the EU average, Croatia's performance on enterprises' investment in ICT training and on ICT graduates is above the EU benchmark. Despite the actions already initiated to foster digital skills for all, a notable change of pace in the country's digital skills readiness is crucial for the EU to reach the Digital Decade target on ICT specialists.

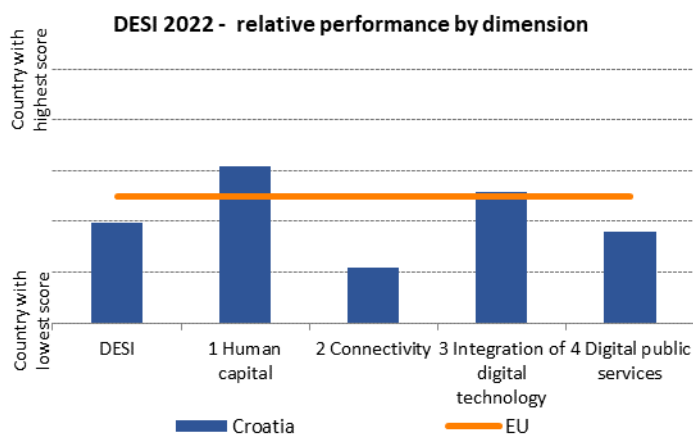
Croatia scores well in terms of open data, but its score is counterbalanced by poor performance in the field of Digital Public Services, with a small number of users, a scarce use of prefilled forms and limited provision of public services both to citizens and enterprises. Ongoing efforts need to be continued to achieve the Digital Decade target of 100% online provision of key public services for citizens and businesses.

¹⁷⁵ Refer to section 1.3 of the DESI 2022 thematic chapters.

Digital technologies have continued to gain popularity among Croatian enterprises, with 35% of them using cloud solutions, 43% using e-invoices and 9% using AI technologies. While these figures lay the foundation for Croatia's contribution to the Digital Decade targets for business digitalisation, the uptake of key technologies such as big data and AI has strong potential to be improved even further..

The new Strategy for Digital Croatia 2030 is being prepared and is expected to be presented by the end of 2022. For the time being, actions to bring about the digital transformation of Croatia economy and society in the next 10 years are governed by the [National Development Strategy 2030](#).

The Central State Office for the Development of the Digital Society (SDURDD) has presented an [Implementation Programme](#) for the development of a digital society for the period 2021-2024. The Programme focuses on the digitalisation of society and promotes balanced and inclusive development for people, economic operators, and public administrations. The Programme encompasses measures ranging from building cybersecurity competences, to increasing digital web accessibility, new e-Citizens services, and interoperability between public services.



In response to Russia's invasion of Ukraine, the Central State Office for the Development of the Digital Society has applied blocking of specific IP addresses from a certain area as a preventive measure of infrastructure protection of the Governments Shared Service Center. To reduce the harmful cyber effects, the Office has intensified its public awareness activities through cybersecurity workshops covering all major areas, including disinformation. The Office is also actively involved in the work of the [Grow2CERT](#) working group, by collecting, analysing, and exchanging data on computer security threats and incidents. The Ministry of Interior has made the upgraded of the firewall system to prevent malicious cyber-attack and intensified the exchange of information on cyber-attacks with EUROPOL.

The [Enter Croatia](#) website added Ukrainian language. Fingerprinting has also been upgraded to facilitate reception and care of displaced persons without the documentation. The new online application [Croatia4Ukraine](#) can be used to apply online for temporary protection while waiting for registration of foreigners for seasonal employment, for up to 90 days.

Digital in Croatia's Resilience and Recovery Plan (RRP)

The plan contributes to the digital transformation of Croatia's society and economy with 20.4% of the plan's total allocation¹⁷⁶. Measures include:

- increasing the efficiency and transparency of public sector bodies;
- establishing management and coordination structures to plan and implement of the digital transformation of society and the public administration and
- providing public administration tools and technologies needed to develop more efficient and high-quality digital services tailored to users needs.

In 2022, a number of measures will be implemented under the RRP:

The 'Upgrading of the Shared Services Center (CDU)' project will start implementing of a Blockchain platform and contribute to the progress of projects in areas such as Digital Identity, Digital Post, Digital Diploma, Digital Notary and Trusted Data Sharing. In 2022, the Croatian Academic and Research Network (CARNET) will further implement e-school projects, addressing the ICT needs of higher education institutions in areas such as artificial intelligence and quantum communication infrastructure.

In Q3 2022, the AI4HEALTH project plans to provide testing before investing, access to finance, skills and training and networking with ecosystems services for users from the public sector and businesses. By the end of Q1 2022, a new set of public services is expected to be published on the e-Citizen portal, spanning the fields of education, censuses, pensions, and the EU Digital COVID certificate.

¹⁷⁶ Each recovery and resilience plan has to dedicate at least 20% of the plan's total allocation to digital objectives. To this end, the plans had to specify and justify to what extent each measure contributes fully (100%), partly (40%) or has no impact (0%) on digital objectives, using Annex VII of the RRF Regulation. Combining the coefficients with the cost estimates of each measure allows assessing to what degree the plan contributes to digital objectives and whether it meets the 20% target.

1 Human capital

1 Human capital	Croatia		EU
	rank	score	score
DESI 2022	9	51.8	45.7

	Croatia		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
1a1 At least basic digital skills % individuals	NA	NA	63% 2021	54% 2021
1a2 Above basic digital skills % individuals	NA	NA	31% 2021	26% 2021
1a3 At least basic digital content creation skills¹⁷⁷ % individuals	NA	NA	81% 2021	66% 2021
1b1 ICT specialists % individuals in employment aged 15-74	3.2% 2019	3.7% 2020	3.6% 2021	4.5% 2021
1b2 Female ICT specialists % ICT specialists	21% 2019	18% 2020	21% 2021	19% 2021
1b3 Enterprises providing ICT training % enterprises	23% 2019	23% 2020	23% 2020	20% 2020
1b4 ICT graduates % graduates	4.0% 2018	4.4% 2019	4.7% 2020	3.9% 2020

In human capital, Croatia ranks 9th of the 27 EU countries. The level of digital skills among the Croatian population is above the EU average in several key indicators. 63% of people between 16 and 74 years in Croatia have at least basic digital skills (versus the EU average of 54%) and 31% of individuals have above-basic digital skills (versus the EU average of 26%). Additionally, 81% of individuals in Croatia have at least basic digital content creation skills, significantly outperforming the EU average (66%). Nevertheless, ICT specialists account for a relatively low percentage (3.6%) of the workforce in Croatia compared to the EU average (4.5%). Female ICT specialists on the other hand represent a slightly higher share of the total number of ICT specialists than the EU average (21% and 19% respectively). ICT graduates currently account for 4.7% of all graduates in Croatia, above the EU average (3.9%) while 23% of Croatian enterprises also offer ICT training to their employees.

The Croatian Academic and Research Network ([CARNET](#)), the main body responsible for the digitalisation of education, has supported the transition to online teaching and learning as a response to COVID-19. [The e-School programme](#) - supported by CARNET – further aims to digitally transform the teaching and educational processes in all schools in Croatia by the end of September 2023. The e-School project will enhance the strategic leadership of schools to increase their digital maturity and strengthen the digital competencies of teachers. Under this project, teachers were already equipped with more than 53 000 laptops. 34 digital educational resources have been produced, as well as more than 500 different educational ICT modules, including 190 interactive items of content and 350 teaching scenarios

¹⁷⁷ Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

for curricular topics. The projects will provide a reliable and secure ICT environment suited to the needs of schools and will ensure that all schools are connected to high-speed internet. Croatia has also developed a [Strategic framework for digital maturity of the schools and school education in the Republic of Croatia \(2030\)](#). This strategic framework was first published in 2020 and is currently funding its activities with resources from the European Social Fund (ESF) and the national budget¹⁷⁸. The Central State Office for the Development of the Digital Society (SDURDD) has presented an [implementation programme](#) for the development of a digital society for the period 2021-2024. This programme is focused on activities to enhance the development of the digital society for people, economic operators, and the public administration.

In the third quarter of 2021, the curriculum for educators teaching basic skills (including digital, reading and mathematics) was successfully completed. Future teachers will receive dedicated training to improve their digital skills, increase the use of digital technologies in the classroom, and to become proficient in using various digital tools in teaching.

Vocational schools and universities in Croatia are strongly cooperating with the private sector to attract and train students in the area of digital skills. [The Croatian National Digital Skills and Jobs Coalition](#) is involved in projects, including establishing regional centres of excellence in vocational education, supporting quality assurance, job market information, employers' involvement in counselling schools, and curriculum enhancement.

In 2021, CARNET received funding to launch the 'enhanced tools for creating equal opportunities in education for pupils with disabilities project' to improve education for children with disabilities and reduce the digital divide by ensuring the availability of assistive technologies. It will focus on equipping education centres for children with disabilities, strengthening teachers' special education competences, and raising awareness of assistive technologies in educating children with learning disabilities.

Croatia is preparing a new strategic document, the national plan for the development of the education system, which is expected to be adopted by the summer of 2022. The programme will be looking at further training and implementation of hybrid forms of teaching, standardisation of digital equipment, online content resources, digital platforms, and providing support to educational institutions in the field of Artificial Intelligence. CARNET will also be exploring new projects in 2022 to better address the ICT needs of higher education, most notably by exploring AI and quantum communication infrastructure in education.

The Ministry of Science and Education and the Croatian Employment Service (CES) is encouraging lifelong learning and training among the working population to facilitate inclusion in the labour market. CES is implementing a measure entitled 'education of unemployed persons and other job seekers', which aims to enable participants to acquire new competencies and find employment. The employment service is targeting people above 50 who need to increase their basic digital skills, and trains them to improve their employability. Between 2019 and 2021, 404 unemployed people completed their education and almost half of them (47%) had found a job 6 months later. In addition, the Croatian Recovery and Resilience Plan will support the re- and upskilling of employed and unemployed people, including digital skills. The plan aims to enable greater participation of unemployed and employed

¹⁷⁸ More than 200 000 tablets have been provided for pupils in recent years, within the curricular reform project.

people in lifelong learning, with an emphasis on acquiring skills related to the green and digital transitions.

Raising the digital skills of the population from an early age is one of Croatia's priorities, for example by promoting coding and digital literacy during [EU Code Week](#). In 2021, the country was among the top 10 countries in the number of activities organised (1 111), reaching more than 68 000 participants, 49% of whom were women. Croatia also continues to award talented students with scholarships in Science, Technology, Engineering and Mathematics (STEM) studies (3 400 scholarships per school year). The SDURDD, in cooperation with the Office for Gender Equality, is coordinating the national implementation of the Declaration on Commitment to Women in the Digital World. The office's key aims are to improve women's digital skills, advance their employability, combat gender stereotypes in the digital world, and encourage girls and young women to consider an ICT career and STEM studies. The office is organising various events including a dedicated roundtable (*Postani i Ti djevojka IT*) and cooperating with the 'Women and Media' portal. Croatia is also in the process of review of the 2022-2027 national gender equality plan, accompanied by a 2022-2024 action plan.

Despite the actions already initiated to foster digital skills for all, supplementary efforts - especially to increase the number of ICT specialists - will be needed to reach the ambitious targets in the [Digital Decade](#). Additionally, despite an increase in the supply of ICT specialists, 68% of Croatian enterprises recruiting or trying to recruit ICT professionals still report problems in finding suitable candidates. A high degree of skills mismatches in companies' workforces limit their capacity to innovate and capitalise from innovation. It is therefore vital to tackle the existing skills mismatches in the labour force by increasing the number of digitally skilled experts.

2 Connectivity

2 Connectivity	Croatia		EU
	rank	score	score
DESI 2022	24	48.1	59.9

	Croatia			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
2a1 Overall fixed broadband take-up	70%	73%	75%	78%
% households	2019	2020	2021	2021
2a2 At least 100 Mbps fixed broadband take-up	6%	9%	16%	41%
% households	2019	2020	2021	2021
2a3 At least 1 Gbps take-up	NA	NA	NA	7.58%
% households	2019	2020	2021	2021
2b1 Fast broadband (NGA) coverage	86%	86%	88%	90%
% households	2019	2020	2021	2021
2b2 Fixed Very High Capacity Network (VHCN) coverage	43%	47%	52%	70%
% households	2019	2020	2021	2021
2b3 Fibre to the Premises (FTTP) coverage	31%	36%	39%	50%
% households	2019	2020	2021	2021
2c1 5G spectrum	0%	100%	100%	56%
Assigned spectrum as a % of total harmonised 5G spectrum	04/2020	09/2021	04/2022	04/2022
2c2 5G coverage¹⁷⁹	NA	0%	34%	66%
% populated areas		2020	2021	2021
2c3 Mobile broadband take-up	70%	70%	81%	87%
% individuals	2018	2018	2021	2021
2d1 Broadband price index	61	60	57	73
Score (0-100)	2019	2020	2021	2021

In the connectivity dimension, Croatia ranks 24th of 27 EU countries. Croatia is performing close to the EU average in fast broadband coverage (up to 30 Mbps) with 88% of households covered. Rural coverage, however, is still low at 47%. Fixed very high capacity network (VHCN) coverage is showing progress but lagging behind the rest of the EU, reaching only 52% in 2021. There is room for improvement, in particular in rural areas, where only 14% of households have access to VHCN and 7% to FTTP. The operator A1 is planning to cover 45 000 households in 2023, primarily in rural areas, while Telemach is deploying fibre in the capital area. This will come in addition to the around 20 000 households already covered, and the 10 000 households expected to be covered by the end of 2022. Several local operators are also increasing deployment of fibre in urban and rural areas. The Croatian

¹⁷⁹ The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

regulatory authority HAKOM reported that [investments in VHCN increased](#) by 115.5% in 2021 compared to 2020. 52% of households now have access to 1 gigabit speed connections.

Even with increased private investments, HAKOM has identified an investment gap of a little under EUR 589 million. This gap needs to be covered by public funding. 20.4% of Croatia's Recovery and Resilience Plan is allocated to digital investments. In the area of connectivity, two investment projects are planned. The first project will increase gigabit connectivity for households and important socio-economic drivers. The other measure will focus on the construction of passive infrastructure, such as stand-alone antenna poles and fibre, to connect mobile network base stations. The second measure targets mainly rural areas with demographic, social and economic conditions below the national average. Croatia also has two EU-funded next-generation network schemes for 2016-2020 that still need to be executed. These funding schemes are being carried over in line with the National Broadband Plan for the period 2021-2027, taking into account the 2025 Gigabit targets and the 2030 Digital Decade objectives. Croatia thus has good foundations for financing VHCN deployment.

Despite the accelerating deployment of fibre, households are not making use of higher broadband speeds. Take-up of at least 100 Mbps fixed broadband speeds is only at 16%, compared to 41% at the EU level. This is despite the fact that about 62% of households are already covered by technologies that enable these speeds. Although take-up in Croatia keeps increasing, additional efforts are therefore necessary to make progress in penetration of services in line with the 2025 Gigabit objectives. One contributing factor preventing progress in the take up of very high-speed services is the presence of high broadband prices in Croatia that consistently remain higher than the EU average. Prices for the higher broadband speeds at 100-200 Mbps and over 200 Mbps are also still above EU average, even though the difference is less marked for connections of speeds up to 100 Mbps. HAKOM conducted a [survey](#) in December 2021 on internet end user habits. The survey confirmed the price sensitivity of end users, who are more likely to switch access technology from copper to fibre if their service provider increases the price of their current connections. The survey also confirms that Croatian end users do not feel the need for higher internet speeds. Households seem to lack incentive and awareness of the potential benefits of higher broadband speeds. Nonetheless, the Ministry of the Sea, Transport and Infrastructure is investing the available funding in the supply side with the development of networks on Croatian islands, rather than supporting take-up stimulation.

Croatia is making progress towards achieving the 2025 Gigabit target of uninterrupted 5G wireless broadband coverage in all urban areas as well as major transport paths by 2025. It also made some progress towards 5G coverage of all populated areas by 2030. Having completed the assignment of 5G spectrum harmonised at EU level already in 2021, Croatia is among the top performers for this indicator. All the major mobile operators acquired spectrum in the 700 MHz, the 3.6 GHz, and the 26 GHz bands. The licences come with coverage obligations (depending on the band) that aim to achieve coverage of 99% of the total length of highways, 95% of the total length of the selected railways and 95% of the population in urban areas by 2025. Moreover, coverage should be ensured for 50% of rural areas by 2027. With near complete 4G coverage and completed 5G spectrum assignment, coupled with the coverage obligations, Croatia is on a good path to reach the 2025 Gigabit target of access to 5G coverage in all urban areas, in all places where people live, work, travel and gather. Some progress has been

noted on 5G coverage (reaching 34% of populated areas) but efforts and investments are still needed to reach the 2030 Digital Decade targets in terms of 5G coverage for all populated areas.

The licences for the 800 MHz, 900 MHz, 1 800 MHz, 2 100 MHz and 2 600 MHz bands expire in 2024 and will be auctioned at the beginning of 2023.

While stringent local planning regimes remain an obstacle to efficient roll-out of both fixed and mobile infrastructure, some funding through the recovery and resilience fund has been targeted towards resolving the issue. A working group to find a solution has been formed, bringing together relevant stakeholders, ministries, and HAKOM. The main issue is that plans often exclude or limit the possibility to set up mobile infrastructure, in some cases due to electromagnetic fields concerns. The ministry noted that public opinion has settled somewhat after all electronic communications operators, in collaboration with Croatian Employers Association and with the support of the ministry and HAKOM started cooperating on technological progress to raise public awareness on the benefits of 5G. In addition, the governmental public awareness campaign called "connected we are safe", which includes the telecommunication operators, has yielded positive results.

Main market & regulatory developments

Market shares remain stable compared to the previous year, with the exception of the incumbent HT Group that no longer has control powers over Optima. On the fixed broadband market, HT Group has a market share of approximately 61%, while A1 has 25% and Optima Telekom 10%. In the mobile market, HT holds 46%, A1 35% and Telemach Croatia 19%.

Since 2014, in the context of an insolvency procedure, the incumbent has held a time-limited right of control over Optima Telekom and had to initiate the sale of its shares in the company and the transfer of its control. In July 2021, Telemach acquired 54.3% of the shares in Optima and the Croatian competition authority cleared the merger. With the merger, Telemach enters the fixed market and has become the third convergent operator. However, the two operators constitute a joint stock company, so Optima is not integrated and remains a competitor on the market. The merger was possible following an amendment of the national Electronic Media Law, removing the impediment to vertical integration.

In 2021 HAKOM adopted a new pricing decision for wholesale broadband access services (naked bitstream) where prices for speeds above 30 Mbps provided over copper network decreased and price for capacity measured in peak hours significantly decreased, regardless of access technologies (copper and FTTx). It is expected that this measure would stimulate higher take up of increased broadband speeds.

In terms of market offers, quadruple play subscriptions (35%) continue to increase, while dual (34%) and triple play (31%) decreased. TV services are included in 72% of all bundle subscriptions and is one of the key drivers for bundling. On the mobile market, post-paid subscriptions continue to be more popular, accounting for 61% of subscriptions, compared to 39% pre-paid. One reason for the increase of post-paid subscriptions is the favourable offers that are often bundled with various devices and the bundling of fixed and mobile services. Households continue to use fixed telephony (83% of households).

Croatia has not yet completed transposition of the European Electronic Communications Code (EECC). A draft law has been prepared and is pending public consultation, which will run under a shortened procedure of 15 days. The transposition is expected by 30 June 2022.

Private infrastructure owners, HT in particular, have been facing high rights-of-way fees in Croatia. The draft electronic communications law transposing the EECC seems to lower these fees considerably. The fees will be lowered to 1/3 of the current level in addition to a maximum cap.

Consumer complaints decreased slightly in 2021 (903) compared to 2020 (993); the most common complaints regarded billing, contractual conditions and service quality. HAKOM offers a certified monitoring tool, the HAKOMetar which measures fixed broadband internet access speeds. The results can be used for lodging consumer complaints.

Croatia's main strength is in 5G spectrum assignment, while its main weakness remains fixed broadband coverage in rural areas and in particular of fibre to the premises. Croatia is making some progress towards the 2025 Gigabit and 2030 Digital Decade targets, but significant improvements are still needed at national level, and in particular for rural areas. Addressing administrative hurdles such as spatial planning and high right-of-way fees is a positive development towards efficient VHCN deployment. Front loading public policy initiatives could help exploit the available VHCN and boost take-up of higher broadband speeds in the transition towards the digital society for both households and the main socio-economic drivers.

3 Integration of digital technology

3 Integration of digital technology	Croatia		EU
	rank	score	score
DESI 2022	14	36.7	36.1

	DESI 2020	Croatia DESI 2021	DESI 2022	EU DESI 2022
3a1 SMEs with at least a basic level of digital intensity	NA	NA	50%	55%
% SMEs			2021	2021
3b1 Electronic information sharing	26%	26%	24%	38%
% enterprises	2019	2019	2021	2021
3b2 Social media	22%	22%	24%	29%
% enterprises	2019	2019	2021	2021
3b3 Big data	10%	14%	14%	14%
% enterprises	2018	2020	2020	2020
3b4 Cloud	NA	NA	35%	34%
% enterprises			2021	2021
3b5 AI	NA	NA	9%	8%
% enterprises			2021	2021
3b6 ICT for environmental sustainability	NA	75%	75%	66%
% enterprises having medium/high intensity of green action through ICT		2021	2021	2021
3b7 e-Invoices	12%	43%	43%	32%
% enterprises	2018	2020	2020	2020
3c1 SMEs selling online	21%	30%	29%	18%
% SMEs	2019	2020	2021	2021
3c2 e-Commerce turnover	9%	14%	13%	12%
% SME turnover	2019	2020	2021	2021
3c3 Selling online cross-border	10%	10%	13%	9%
% SMEs	2019	2019	2021	2021

Croatia ranks 14th among EU countries on the integration of digital technology. 50% of Croatian SMEs have at least a basic level of digital intensity, which is below the EU average of 55%. As for ICT for environmental sustainability, 75% of Croatian enterprises use ICT for environmental sustainability purposes, compared to the EU average of 66%. Croatian enterprises are taking advantage of the opportunities presented by online commerce: 29% of SMEs sell online (above the EU average of 18%) while 13% of all SMEs are selling across borders with 13% of turnover coming from the online segment. Advanced technologies are steadily gaining popularity among Croatian enterprises. 35% of them use cloud solutions, 43% use e-invoices and 9% use AI technologies. For all these three indicators, Croatia performs above the EU average. Electronic information sharing (24%) and social media (24%) are not yet widely used, however.

The national plan for digital transformation of the economy 2021-2027 is a strategic plan supporting the overall implementation of the digital measures under [Croatia's 2021-2030 national development strategy](#). The Ministry of Economy and Sustainable Development is currently in the process of

contracting technical assistance to support the plan's finalisation. Croatia is also working to adopt its smart specialisation strategy in 2022. Both programmes aim to improve the position Croatian enterprises in global value chains via the development of digital business models and digital skills. They will play an essential role in boosting overall digitalisation of businesses and in ensuring that Croatia contributes significantly to meeting the [Digital Decade](#) target of more than 90% of Union SMEs reaching at least a basic level of digital intensity.

The European Centre for Innovation, Advanced Technologies and Skills Development (ECINTV) is currently going through the process of legal adoption of the initiative by the Croatian government. ECINTV will further encourage the digital transformation of the economy, especially for SMEs, as well as lifelong learning for the development of digital and entrepreneurial skills. It will facilitate access to digital solutions and provide networking to strengthen the national innovation ecosystem. Close monitoring of these initiatives and investments' implementation will be vital of Croatia is to reach the Digital Decade target of 75% of enterprises using cloud, AI and big data. The ECINTV support for the digitalisation of SMEs will help them on the path to digital transformation.

The Croatian Recovery and Resilience Plan (RRP) includes the national plan for the development of AI. Croatia is also proposing dedicated measures in the form of vouchers for SMEs to upskill their digital capabilities. Several measures in both the Croatian RRP and other European funds will support digital research and the development of Croatian enterprises. The measures include digital vouchers, grants for digitalisation and financing for the digitalisation of SMEs' business processes. Croatia also provides grants to support the start-up ecosystem in Croatia by stimulating the growth of start-ups in high technology and knowledge sectors.

High Performance Computing (HPC) is among Croatia's digital policy priorities. Croatia is participating in the European High Performance Computing Joint Undertaking (EuroHPC JU) – a public-private partnership providing a common legal, contractual and organisational framework. The Zagreb University [Computing Centre \(SRCE\)](#) is a key e-infrastructure provider for academia. It hosts the ISABELLA computational cluster as a shared HPC resource. Thanks to ISABELLA, computational resources can be used to perform demanding data processing in scientific and research projects to support work on the CERN-led European Data Grid project led. SRCE provides the academic community with a high-throughput computing cloud (HTC Cloud) service. SRCE also participates in two major and strategic projects: the [National Competence Centres in the Framework of EuroHPC](#) (EuroCC), which will help establish of the national competence centres for HPC and contribute to construction of the European HPC ecosystem. Additionally, CERN is leading coordination of the [Croatian Scientific and Educational Cloud](#) – (HR-ZOO) to boost national research and e-infrastructure innovations.

On quantum communication infrastructure (QCI), CARNET is working on deployment of advanced national quantum systems and a network to test quantum communication technologies and integrate them with existing communication networks. Croatia has a small but rapidly growing ecosystem of blockchain start-ups and communities, while in May 2020, the country's financial supervisor approved a bitcoin investment fund. At the end of 2021, the [Ruđer Boskovic Institute](#) (RBI) started an initiative to establish the Croatian node of the European Blockchain Services Infrastructure (EBSI) network. The Croatian RRP will also contribute to upgrading the Shared Service Centre (CDU), with implementation of the blockchain platform to be completed by 2025.

AI is playing an increasingly key role in healthcare, with CARNET launching projects in this area together with the shortlisted European Digital Innovation Hub (EDIH) candidate¹⁸⁰ - AI4HEALTH.Cro. AI4HEALTH.Cro is preparing an offer of services in AI-based innovative solutions for the healthcare and medicine sectors. By the third quarter of 2022, the AI4HEALTH.Cro project plans to provide several benefits in the areas of 'testing before investing', access to finance, skills to training and networking with ecosystems services for the public sector and businesses.

The [national cyber security strategy of the republic of Croatia \(NCSS\)](#) recognises the priority of the digital transformation. The strategy focuses on raising security awareness, delivering high-quality services in line with the Cybersecurity Act, and on strengthening the security and credibility of Croatia's domain space.

Croatia has initiated a range of measures supporting the digitalisation of enterprises and SMEs, with measures ranging from vouchers for skills acquisition and the adoption of new technologies (HPC, quantum computing, AI, Blockchain) to security certificates. There has also been a major effort to digitise the health sector with the adoption of AI in critical round-the-clock services. As a result, a comprehensive, coordinated and integrated approach would be welcome to reinforce Croatia's efforts further. Pairing it with integration of demand and supply measures and establishing strong links with the necessary human capital investments could intensify growth.

Highlight 2021-2022- AI and Health

Croatia is advancing its use of AI in health with the support from the Croatian Science Foundation (HRZZ). Among recent prominent research projects are:

- Biomedical imaging of breast carcinoma (BOBCat) exploring the potential power of the radiomics process in improving breast cancer diagnosis and treatment. The radiomics process can be seen as a novel and valid application of already established techniques from automated medical digital processing, veridical data science principles and trustworthy AI, which creates a bridge between medical imaging and personalised medicine.
- Medical Image Interpretation Methods for Detailed Heart Health Analysis (IMAGINEHEART). This project develops new image processing and machine learning methods for cardiac medical image segmentation and analysis.
- The 'Mystery of subthalamus – anatomical division of subthalamic nucleus' project, which aims at understanding the division of the subthalamus by using AI-assisted computational solutions for automatic neuron recognition and quantification on histological slides.

¹⁸⁰ Four Croatian European Digital Innovation Hub proposals have a successful evaluation result, i.e. are invited for grant agreement preparation (which is not a formal commitment for funding). One additional proposal has received a Seal of Excellence.

4 Digital public services

4 Digital public services ¹⁸¹	Croatia		EU
	rank	score	score
DESI 2022	23	53.6	67.3

	DESI 2020	Croatia DESI 2021	DESI 2022	EU DESI 2022
4a1 e-Government users	41%	52%	55%	65%
% internet users	2019	2020	2021	2021
4a2 Pre-filled forms	NA	NA	38	64
Score (0 to 100)			2021	2021
4a3 Digital public services for citizens	NA	NA	69	75
Score (0 to 100)			2021	2021
4a4 Digital public services for businesses	NA	NA	68	82
Score (0 to 100)			2021	2021
4a5 Open data	NA	NA	84%	81%
% maximum score			2021	2021

Croatia ranks 23rd in the EU on Digital public services. Despite many improvements by the government in digital public services, Croatia still underperforms in this dimension. 55% of internet users relied on e-government services (up from 52% in 2020), slowly inching closer to the EU average of 64%. On pre-filled forms, Croatia scores significantly below the EU average (with a score of 38 compared to the EU average of 64). Croatia is still underperforming on the availability of digital public services, with a score of 69 on digital public services for citizens compared to the EU average of 75) and 68 for businesses against the EU average of 82). Croatia scores relatively well on open data (84% compared to 81% for the EU).

During 2021, efforts have been directed towards implementing various digital solutions for and the upgrading of the central e-health systems. The people of Croatia have access to a variety of online services through the e-Citizen national web portal, which has been used more than 33.5 million times in 2021¹⁸². Among the new applications launched in 2021 were the e-Application of Life Partnership, e-enrolment in educational institutions, the population census and the EU Digital COVID certificate. e-Consultations (e-Savjetovanja) represents an innovative part of the portal, with a unique solution allowing citizens to directly comment on law proposals, regulations, or other strategic documents.

[The Health Portal](#) is among the top seven e-services of the e-Citizen portal. It offers access to the central e-health records data and is fully integrated into the National Central Health Information System (CEZIH). The portal is accessible via authorised access using highly secure national e-citizens

¹⁸¹ There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

¹⁸² Total number of e-citizens on 31 December 2021, was 1 571 947, with an annual increase of approx. 380 000 users in each of the last 2 years.

authentication methods and credentials (NIAS - National Identification and Authentication System). Through the health portal, patients can see all their prescribed and dispensed medications, laboratory results from biochemistry labs within the public primary care network, medical reports from visits to general practitioners, consultation notes and referrals from hospitals and outpatient facilities, and appointments with specialised services in hospital care.

During 2021, additional COVID-19 related features were added to allow access and review patient data on all COVID-19 vaccinations and tests performed to facilitate the scheduling of vaccination appointments (by selecting the desired location and date of vaccination). The system can also authorise the cross-border sharing of information with EU Member States, as part of the Patient Cross Border Rights Directive (2011/24/EU).

During 2021, Croatia fully connected with the eIDAS nodes of Cyprus, Poland, Czechia, Lithuania, Finland, Greece and Denmark. Connections with France, Iceland, Liechtenstein, and Romania are in the pipeline while further connections with Hungary, Ireland and Bulgaria are in the test phase. To date, Croatia has fully connected with 22 EU Member States. Croatia is also actively working to implement Regulation (EU) 2018/1724 on the establishment of a single digital gateway to be able to offer new solutions such as the e-Wallet. These developments are vital to meet the [Digital Decade](#) target on e-ID

In 2022, a project on Upgrading of the Shared Services Centre (CDU), funded by the national RRP, will kick-off with the implementation of the blockchain platform. The CDU's main goal is the central management and consolidation of the state's information infrastructure, data, applications, operations and horizontal processes to enhance transparency, accountability and efficiency of public administration. By the end of 2023, the government cloud is expected to ensure interoperability with over 300 institutions. The RRP measure on the Digitisation of state and public administration services by the business sector (G2B) envisages upgrading the accessibility of the [START platform](#) and digitalising additional services. The START platform enables members of the public to start a business remotely and without intermediaries via a single electronic procedure at a single digital location. Measures in the RRP focus on expanding the range of services, adding new modules and expanding the functionality even further.

The Telemedicine Service of the Croatian Institute of Emergency Medicine (CIEM) maintains the health sector's IT and communications infrastructure and regulates the introduction of telemedicine services in the health system within the network of telemedicine centres. The network currently covers 152 health institutions and includes 166 active telemedicine centres. The number of diagnostic services provided through the telemedicine network in 2021 continued its rapid growth, with 116 631 telemedicine services in the fields of radiology, psychiatry, cardiology and transfusion provided in 2021.

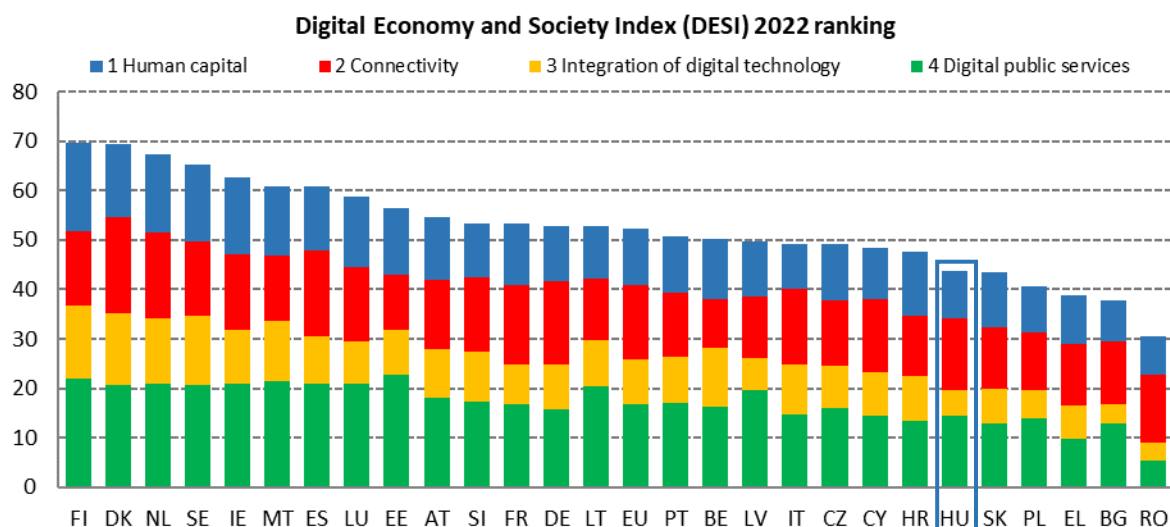
The Croatian Ministry of Health together with the key co-developed stakeholders an eHealth Strategy and an action plan. These set a direction for an eHealth Strategy through a common vision and outline the main action lines, timeline, responsible parties and resources required to implement the recommendations. The eHealth Strategy was integrated into the Croatian national health development plan 2021-2027, which was adopted by the Croatian government on 20 December 2021. The [strategic framework for e-health development 2021-2027](#) has already been finalised and will feed into the National Health Development Plan.

Croatia is proceeding slowly but steadily in its provision of digital public services, including with various e-applications. Progress is evident with the adoption of new applications in the e-Health portal and the

adoption of a new e-Health Strategy. Nevertheless, the ongoing efforts require a boost to achieve the Digital Decade target of 100% online provision of key public services. Complementary actions using citizens and patients' satisfaction surveys may be instrumental in helping Croatian authorities monitor progress and adopt implementation measures to increase their impact on the ground.

Hungary

	Hungary		EU
	rank	score	score
DESI 2022	22	43.8	52.3



Hungary ranks 22nd out of the 27 EU Member States in the Digital Economy and Society Index (DESI) 2022. Over the last few years, it progressed in line with the EU.¹⁸³

On Human capital, the country ranks 23rd, scoring 38 compared to the EU average of 46. 49% of individuals have at least basic digital skills, below the EU average of 54%. 3.1% of graduates studied ICT (EU average: 3.9%), and ICT specialists still represent a relatively low share of the workforce (3.9% versus 4.5% in the EU). A significant improvement in both ICT specialists and digital skills is crucial for the EU to reach the skills targets of the Digital Decade.

Hungary performs well on broadband Connectivity. It remained a leader in the take-up of at least 1Gbps broadband, as 22% of households subscribed to such a service in 2021 compared with 7.6% in the EU. The country scores above the EU average also on Overall fixed broadband take-up, 5G spectrum and Fixed very high capacity network coverage (VHCN). This is also important in light of the Digital Decade target of 100% coverage of all households by gigabit networks by 2030.

Although there was progress in the digitalisation of enterprises in 2021, most Hungarian enterprises do not exploit the opportunities offered by digital technologies. 21% of the companies use an enterprise resource planning software to share information electronically (EU average: 38%), and 13% rely on social media (EU average: 29%¹⁸⁴) or send e-invoices (EU average: 32%). The situation is similar for advanced technologies: on AI, cloud and big data, Hungary scores well below the EU average, too. Uptake of these

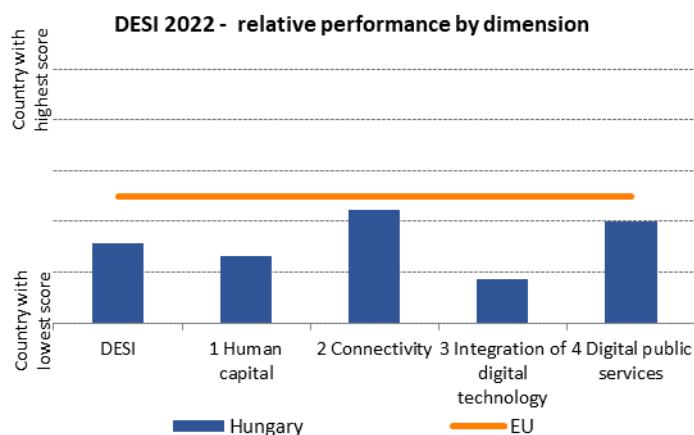
¹⁸³ See section 1.3 of the DESI 2022 thematic chapters.

¹⁸⁴ Using at least two social media channels

services ranged between 3% and 21% as opposed to the Digital Decade target of 75% by 2030. SMEs require a special policy focus, as only 34% of them have at least basic level of digital intensity (EU average: 55%), whereas the Digital Decade targets for at least 90% of SMEs to have at least basic digital intensity.

For Digital public services, the key indicators show a mixed picture. There was substantial progress on the demand side of e-government with 81% of internet users having engaged with the public administration online in 2021, up from 64% in 2019 and above the EU average of 65% in 2021. However, the quality and completeness of the supply of services for both people and businesses remained relatively low, especially for cross-border service provision, which is key to achieving the Digital Decade target for all key public services to be fully online by 2030.

Regarding digital policies, the National Digitalisation Strategy provides the strategic policy framework for 2021-2030. It is an umbrella strategy which groups, clarifies and, in some cases, complements the measures contained in various other strategic documents. The strategy is structured around the four main pillars of the [Digital Decade Compass](#) measured in DESI: digital infrastructure, digital skills, digital economy and digital state. Hungary has the very ambitious and challenging aim of exceeding the EU average in digital development by the middle of the decade and of being among the 10 leading EU economies in terms of digitalisation by 2030.



As a consequence of Russia's invasion of Ukraine, the overall threat level in cyberspace has increased. The National Cybersecurity Centre (NCSC) is, therefore, monitoring the government network infrastructure and the Hungarian cyberspace in an increased preparedness mode on a 24/7 basis. The NCSC has also informed government agencies and critical infrastructure operators of the increased risk-level and has called their attention to the importance of good cyberhygiene and effective cybersecurity measures. The NCSC has issued a detailed warning on the "HermeticWiper" malware, as well.

1 Human capital

1 Human capital	Hungary		EU
	rank	score	score
DESI 2022	23	38.4	45.7

	Hungary			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
1a1 At least basic digital skills % individuals	NA	NA	49% 2021	54% 2021
1a2 Above basic digital skills % individuals	NA	NA	22% 2021	26% 2021
1a3 At least basic digital content creation skills¹⁸⁵ % individuals	NA	NA	59% 2021	66% 2021
1b1 ICT specialists % individuals in employment aged 15-74	3.4% 2019	3.8% 2020	3.9% 2021	4.5% 2021
1b2 Female ICT specialists % ICT specialists	11% 2019	12% 2020	14% 2021	19% 2021
1b3 Enterprises providing ICT training % enterprises	16% 2019	16% 2020	16% 2020	20% 2020
1b4 ICT graduates % graduates	4.6% 2018	4.9% 2019	3.1% 2020	3.9% 2020

Hungary ranks 23rd among EU countries on Human capital. The country scores below the EU average on the three skills indicators. In particular, only 49% of individuals have at least basic digital compared to the EU average of 54% and the Digital Decade target of 80% by 2030. The proportion of ICT specialists in the workforce has increased slightly to 3.9% but remains below the EU average (4.5%). There is a shortage of ICT specialists: 57% of enterprises reported difficulties in filling ICT vacancies in 2020. To reach the Digital Decade Compass target of 20 million ICT specialists in the EU, Member States should have, on average, about 10% of their workforce employed as ICT specialists. The proportion of female ICT specialists is still low (14%). In addition, the percentage of ICT graduates among all graduates stands at 3.1% in 2020, below the EU average of 3.9%. In 2020, 16% of enterprises provided ICT training to their employees, compared with 20% in the EU overall.

The [Hungarian National Social Inclusion Strategy 2030](#)¹⁸⁶ sets several digital objectives. In particular, it aims at improving the digital literacy of students, parents and teachers; further developing the digital infrastructure in disadvantaged regions; reducing online risks (e.g. cyberbullying, addictions, hate speech and data security) and improving the IT infrastructure in schools to effectively address early school leaving. During the first year of the pandemic, the government provided support for the purchase of new digital equipment mainly for institutions dealing with disadvantaged children. It also published free digital smart textbooks for pupils in grades 5-12 on the national public education portal, and developed

¹⁸⁵ Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

¹⁸⁶ Government action plan on the implementation of the strategy: Government Resolution 1619/2021 (IX. 3.).

and published detailed methodological recommendations for teachers and professionals. These measures helped improve the access of tens of thousands of disadvantaged children to digital education.

Digital culture is a compulsory subject in grades 3-11 (ages from 8 to 17), developing computational thinking, coding, programming and digital skills in general. In primary schools (grades 3-8), pupils become familiar with key applications, problem solving with computers and effective, creative and safe use of internet and digital equipment. These skills are further developed in the secondary grades (9-11), including also algorithmic thinking and programming (from robot programming through block programming to coding basic algorithms).

As part of the planned Operational Programme Digital Renewal Plus (DIMOP Plus), in the priority project 'Development of basic digital competence for citizens'¹⁸⁷, Hungary will organise trainings for 110 000 people with no digital skills including 1 100 participants with disabilities and 1 100 participants from minorities. The project will rely on the Digital Success Programme (DSP) Network, consisting of 1 722 DSP points and 1 892 DSP mentors, and will benefit from HUF 10 billion (EUR 25 million) in public funding.

Launched in 2015, the EDIOP¹⁸⁸-6.1.2 programme focuses on developing the digital skills of the working age population through both upskilling and reskilling. This large-scale training scheme has had 250 320 participants so far, very close to the targeted 257 500.

Regarding specialist skills, the 'Programme your Future!' project remained a key initiative in 2021. This project aims to increase the number of people with IT qualifications relevant to the labour market and to improve the skills of ICT specialists. The project seeks to identify which ICT skills are sought after on the labour market, and examines good practices in international, domestic, higher education and corporate training. To increase the recognition and popularity of the IT professions, motivational events are planned for high school students. Several private initiatives are in place (such as Skool, Women in IT Security and Django Girls Budapest) to increase female participation in ICT. In 2021, Hungary participated in EU Code Week with 1 372 activities.

The 2021-2030 National Digitalisation Strategy lists three priority areas for digital skills: (1) developing digital competence (based on the [DigComp](#) framework); (2) increasing the number and qualifications of IT professionals and engineers; and (3) supporting the structural change needed to develop digital skills in education and vocational training. The strategy provides an ambitious framework to upgrade digital skills of citizens, the workforce and IT professionals. EU funding will play a key role to implement the planned measures. All three areas are crucial in light of the Digital Decade targets on skills.

¹⁸⁷ DIMOP Plus 4.2.3. see Government Resolution 1783/2021 (XI.5.) establishing the annual development framework of the Operational Programme Digital Renewal Plus

¹⁸⁸ Economic Development and Innovation Operative Programme

2 Connectivity

2 Connectivity	Hungary		EU
	rank	score	score
DESI 2022	13	57.6	59.9

	Hungary		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
2a1 Overall fixed broadband take-up	82%	81%	83%	78%
% households	2019	2020	2021	2021
2a2 At least 100 Mbps fixed broadband take-up	51%	56%	61%	41%
% households	2019	2020	2021	2021
2a3 At least 1 Gbps take-up	9.26%	13.21%	21.82%	7.58%
% households	2019	2020	2021	2021
2b1 Fast broadband (NGA) coverage	90%	89%	97%	90%
% households	2019	2020	2021	2021
2b2 Fixed Very High Capacity Network (VHCN) coverage	43%	49%	79%	70%
% households	2019	2020	2021	2021
2b3 Fibre to the Premises (FTTP) coverage	43%	49%	64%	50%
% households	2019	2020	2021	2021
2c1 5G spectrum	60%	60%	60%	56%
Assigned spectrum as a % of total harmonised 5G spectrum	04/2020	09/2021	04/2022	04/2022
2c2 5G coverage¹⁸⁹	NA	7%	18%	66%
% populated areas		2020	2021	2021
2c3 Mobile broadband take-up	71%	71%	84%	87%
% individuals	2018	2018	2021	2021
2d1 Broadband price index	64	64	70	73
Score (0-100)	2019	2020	2021	2021

In 2021, Hungary made substantial progress towards the Digital Decade connectivity targets for 2030, as coverage of fixed very high capacity networks (VHCN) grew to 79% (30 percentage points above the previous year). In addition, fast broadband (NGA) coverage went up to 97% (8 percentage points above the previous year). The sharp increase in coverage corresponded to a significant increase of take-up by consumers, which is significantly higher than the EU average (by 20 percentage points for 100 Mbps take-up and 14 percentage points for 1 Gbps take-up).

On the connectivity targets, Hungary has no plans for public investments in very high capacity networks (VHCN). Currently only 1.48% of Hungary's research institutes covered with a symmetrical bandwidth connection of 1Gbps. It, therefore, needs to be much more ambitious if it is to reach the target of 100% 1 Gbps coverage by 2025.

¹⁸⁹ The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

Hungary is planning to use the European Regional Development Fund (ERDF) to support broadband infrastructure deployment in its more rural regions. The funding will be used primarily in white areas to offer gigabit connectivity. More than EUR 253 million from the European Structural and Investment Funds (ESIF) was used in the period between 2014 and 2020 to deploy high speed internet over 30 Mbps.

On 5G, Hungary has also made progress towards the digital connectivity targets for 2030, albeit at a slower pace than for fixed networks. Coverage of 5G in Hungary increased to 18% in 2021 (up by 11 percentage points from the previous year), however it is still significantly lower than the EU average which stands at 66%. The increase is mainly due to the assignment of the 3.6 GHz and the 700 MHz bands in previous years. 60% of the total harmonised 5G spectrum has been assigned in Hungary, mainly through two spectrum auctions organised in 2020 and 2016. Three mobile network operators have launched commercial 5G services in Hungary. The NMHH (national regulatory authority) is in the process of assessing the market needs for the 26 GHz band. The band, which is currently being used for point-to-point microwave links and point-to-multipoint systems, is currently operated by the main mobile operators plus Antenna Hungária (which has been bought out by one of the mobile network operators). To date, mobile operators have not shown any interest in the band due to the limited take up of 5G within the consumer market. A public consultation to identify market needs was organised in March 2022. In terms of 5G, most of the use cases that have been developed were in the business- 2-business market and in collaboration with universities and research centres. The launch of the 26 GHz band is expected to increase the percentage of harmonised spectrum in the country.

Mobile operators have also started the process to switch off their 3G networks. To accelerate the transition away from 3G, the NMHH has introduced a new scheme called *Netrefell*. Launched with a budget of approximately EUR 140 million, customers are eligible to exchange their 3G device for a 4G or 5G enabled phone. It is expected that the scheme will accelerate the uptake of 5G in Hungary.

Main market & regulatory developments

The main development in the Hungarian market was the continuing consolidation trend among telecom operators. The acquisition of UPC by Vodafone was approved. However, the main protagonist of the market was telecoms company 4iG. 4iG, a Hungarian IT and telecoms company has pursued an aggressive approach towards market growth, steadily growing into a major operator in the Hungarian market.

In August of 2021, 4iG and the Hungarian government announced that 4iG and Antenna Hungária had entered into a cooperation agreement to create a new entity that would not only be able to offer competitive market services but would also aim at safeguarding Hungarian national interests in the telecommunications industry. Through this agreement, 4iG acquired a majority interest stake of 80% in Antenna Hungária, which has been a key player in the Hungarian telecommunications sector for decades. The company is also the exclusive provider of national digital terrestrial television and analogue radio broadcasting in Hungary.

In September 2021, 4iG was given the approval to acquire *Invitech*, a fibre network operator. 4iG also bought out DIGI, the second largest operator in Hungary concerning fixed line telephony, fixed line residential broadband and television market. DIGI also started offering

mobile telecommunications services in Hungary in 2019, although its efforts to expand were hampered by its exclusion from the bidding process for 5G spectrum. The sale of DIGI to 4iG was deemed by the Hungarian government to be one of national strategic significance, thus making such transfer exempt from the scrutiny of competition authorities. 4iG has also made important acquisitions in the field of satellite communications with the acquisition of Hungaro DigiTel.

In terms of consumer trends, the Hungarian market has continued to experience an increase with regards to the bundling of products with 67% of households subscribing to bundled products. The most common bundled packages are comprised of a pay television and fixed internet line with only 18% of bundled products including a mobile subscription.

On the regulatory front, Hungary was able to implement the European Electronic Communication Code. Hungary has also participated in the Connectivity Toolbox exercise and has started the process of adopting a number of best practices that emerged from the toolbox to its own market. Notable examples include the developments of its own geospatial information system. The system is expected to be completed by the end of 2022 and will provide information on the location and data of individual networks. The NMHH is also going to publish a guidance document and organise workshops about dispute resolution and is in the process of establishing a simulated model for 5G EMF calculations. The NMHH also intends to use the best practices of the Connectivity Toolbox in the upcoming spectrum auction for the 26 GHz pioneer band for 5G.

2021 was a year of continued progress for Hungary, with a continued increase of both gigabit and 5G coverage. In the fixed network market, there was a significant improvement in the coverage of FTTP and VHCN, which in turn has coincided with a corresponding increase of consumer take-up. This suggests that Hungary seems well positioned to reach the connectivity objectives as set out in the Digital Decade for fixed connectivity. On mobile and 5G, Hungary, however, is still lagging behind in coverage, despite some improvement last year. More needs to be done if Hungary is to reach the related 2030 Digital Decades target of 100% 5G coverage. The achievement of these aims could be better facilitated by the publication and implementation of the National Digitalisation Strategy. Furthermore, the emergence of new players in the Hungarian market, may impact on the current ecosystem, and potentially result in further consolidation of the market.

3 Integration of digital technology

3 Integration of digital technology	Hungary		EU
	rank	score	score
DESI 2022	25	21.6	36.1

	DESI 2020	Hungary DESI 2021	DESI 2022	EU DESI 2022
3a1 SMEs with at least a basic level of digital intensity % SMEs	NA	NA	34% 2021	55% 2021
3b1 Electronic information sharing % enterprises	14% 2019	14% 2019	21% 2021	38% 2021
3b2 Social media % enterprises	12% 2019	12% 2019	13% 2021	29% 2021
3b3 Big data % enterprises	6% 2018	7% 2020	7% 2020	14% 2020
3b4 Cloud % enterprises	NA	NA	21% 2021	34% 2021
3b5 AI % enterprises	NA	NA	3% 2021	8% 2021
3b6 ICT for environmental sustainability % enterprises having medium/high intensity of green action through ICT	NA	65% 2021	65% 2021	66% 2021
3b7 e-Invoices % enterprises	10% 2018	13% 2020	13% 2020	32% 2020
3c1 SMEs selling online % SMEs	12% 2019	13% 2020	18% 2021	18% 2021
3c2 e-Commerce turnover % SME turnover	11% 2019	9% 2020	11% 2021	12% 2021
3c3 Selling online cross-border % SMEs	5% 2019	5% 2019	7% 2021	9% 2021

On the Integration of digital technology in enterprises' activities, Hungary ranks 25th among EU countries. Despite an increase in several indicators in this domain, most Hungarian enterprises still fail to capitalise on digital technology. The country still performs poorly on the technology adoption indicators. Regarding basic technologies, 21% of enterprises have an enterprise resource planning system for electronic information sharing (up from 14% in 2019), and 13% send e-invoices (which are suitable for automatic processing) or use social media (at least two channels). These figures are well below the EU average. The adoption rates for advanced technologies are also low: 3% of enterprises reported using AI, 7% big data and 21% cloud. More and more SMEs engage in e-commerce (reaching the EU average of 18% in 2021 compared to 12% in 2019). However, only one third of SMEs have at least a basic level of digital intensity (EU average: 55%). 65% of enterprises reported that their use of ICT triggered environmentally-friendly measures to a significant extent – that percentage is close to the EU average (66%).

The [Modern Enterprises Programme](#), managed by the Hungarian Chamber of Commerce and Industry, has been Hungary's key instrument for fostering digital developments in the SME sector since 2015.

Under the programme, 14 801 company audits were implemented, 8 373 companies obtained the 'Digitally Qualified Enterprise' classification, 295 events were organised, and 1 093 IT suppliers developed over 3 150 products and services by January 2022. In 2020 and 2021, several specific activities were launched to tackle the crisis caused by the pandemic situation. These included online events, training courses, consultancy services, a digital hotline and targeted crisis communication activities for enterprises. The extension of the programme to 2021-2027 is in preparation. Another measure to support the digital transformation of enterprises are the European Digital Innovation Hubs (EDIH). The EDIH selection is ongoing: three Hungarian EDIH proposals have a successful evaluation result¹⁹⁰ and two proposals are expected to be selected in the next year.

In 2021, a new project (EDIOP 3.2.8) was launched by the government for the development of the data economy. Within the framework of this project, accelerator centres on data management and artificial intelligence will be set up. The accelerator centres of Zalaegerszeg and Debrecen are already operational, and another one will be opened in Balatonfüred soon. The target group of the project is at least 100 SMEs in the services, manufacturing and trade sectors.

There are two dedicated governmental initiatives for the development of the digital start-up ecosystem. The INPUT programme's mission is to build and foster the digital innovation and entrepreneurial ecosystem across the country, focusing in particular on rural areas and on helping innovative ICT start-ups to enter global markets. Until January 2022, the programme involved 1 853 potential ICT start-ups and 528 trainings and events through a network of 12 national coordinators and 76 mentors. Linked to this programme, the EDIOP 8.2.3 specialised seed and pre-seed investment programme financed 62 ICT start-ups by January 2022.

Hungary has been member of the European Blockchain Partnership since 2019. The Governmental Agency for IT Development (KIFÜ), in cooperation with the Digital Success Programme, launched the first Hungarian European Blockchain Services Infrastructure (EBSI) node in 2021. The Hungarian National Bank is a key supporter of blockchain technology and is currently developing a blockchain-based coin register system as a pilot project.

Highlight 2021/2022 – Promoting quantum technology

As part of the National Laboratories initiative, the Quantum Information National Laboratory has been set up to support research, development and experimentation with quantum communications technologies.

The goals of the 5-year project include:

- Developing and testing quantum key distribution systems,
- Connecting different quantum key distribution systems,
- Testing long distance quantum communications networks,
- Investigating different 'beyond QKD' techniques and their practical implementation,
- Identifying use cases and scenarios,
- Educating the next generation of engineers as well as the potential users of quantum,
- Developing quantum network devices, and

¹⁹⁰ i.e. are invited for grant agreement preparation (which is not a formal commitment for funding).

- Developing quantum random number generators for cryptography usage.
Hungary has been member of the EuroQCI initiative since 2018.

The National Digitalisation Strategy identifies four key areas of action for the digitalisation of businesses: (1) increasing SMEs' use of digital technology; (2) developing digital start-ups; (3) targeted development of the ICT industry through support programmes; and (4) using state data assets for economic purposes. Large-scale, targeted, and effective measures are necessary in all the above areas to speed up the digital transformation of businesses, especially SMEs. This is also a focus area in the Digital Decade. More effort may be required to meet the technology adoption targets (AI, cloud and big data) of the Digital Decade.

4 Digital public services

4 Digital public services ¹⁹¹	Hungary	EU
	rank	score
DESI 2022	21	57.4
		67.3

	DESI 2020	Hungary DESI 2021	DESI 2022	EU DESI 2022
4a1 e-Government users	64%	70%	81%	65%
% internet users	2019	2020	2021	2021
4a2 Pre-filled forms	NA	NA	60	64
Score (0 to 100)			2021	2021
4a3 Digital public services for citizens	NA	NA	64	75
Score (0 to 100)			2021	2021
4a4 Digital public services for businesses	NA	NA	74	82
Score (0 to 100)			2021	2021
4a5 Open data	NA	NA	58%	81%
% maximum score			2021	2021

The digitalisation of public services shows a mixed picture in Hungary. The country ranks 21st on this dimension of the DESI. e-Government users increased significantly (from 64% in 2019 to 81% of internet users in 2021), going above the EU average of 64%. Regarding the supply of online services, Hungary scores below average on all three indicators (Pre-filled forms, Digital public services for citizens and Digital public services for businesses), although the gap with the EU average is narrowing¹⁹². The low quality of cross-border services is mainly responsible for these results. On open data maturity (related policies and features of the open data portal), Hungary is also among the weak performers.

As of the end of 2021 there were more than 3 000 public services available online, almost twice as many as a year earlier, of which 439 are provided via the built-in online intelligent forms (iFORM) with automatic pre-filling of personal data (an increase of 70 % in a year). The use of online administration has been mandatory for businesses since 2018.

Hungary started to carry out the bilateral testing of the Hungarian eIDAS node with several Member States in 2021. It is expected that cross-border e-identification will become available in 2022 via the eIDAS scheme, and foreign EU citizens will be able to access Hungarian e-government services more easily. These developments are important for meeting the Digital Decade target on e-ID, requiring at least 80% of the population using such a solution by 2030. In the fourth quarter of 2021 there were approximately 5.7 million national eID cards in circulation in Hungary (covering 58% of the population) that were capable of e-identification. The use of national eID cards remained limited, with about

¹⁹¹ There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

¹⁹² Due to a break in series, no exact comparison over time can be made.

300 000 transactions per month, as most users preferred the client gate trusted profile (5.12 million active profiles and 40 million e-identification transactions monthly in the fourth quarter of 2021).

The National e-Health Infrastructure (EESZT), launched in 2017, provides a unified IT environment to manage communication within the healthcare sector and towards citizens. As of the end of 2021, 6 375 general practitioners (95.7 %), 190 in-patient health care providers (91.3 %), 2 984 pharmacies (96.3 %) and 8 798 private health care service providers (70.2 %) were connected to the system. The use of e-prescriptions increased from 70% to 95% in the last 2 years following the outbreak of COVID-19. Telemedicine services via the platform represented 14% of all general practitioners' care events in December 2021. On the citizens' portal of EESZT, there were 40 000-45 000 daily logins in 2021.

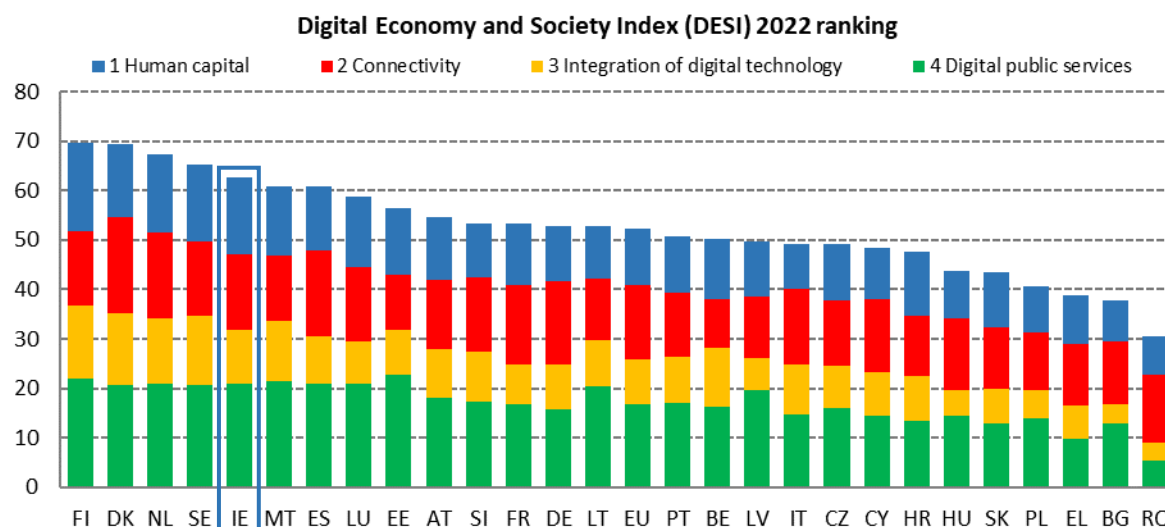
Hungary has renewed the governmental coordination of cybersecurity issues. The coordination framework includes the high-level National Cybersecurity Coordination Council, comprising state secretaries of the ministries and three working groups (National Cyber Space Working Group, International and European Union Cyber Space Working Group and the Working Group for Developing a New National Cyber Strategy) together with the Cybersecurity Forum, a platform for industry, academia, research and other non-governmental stakeholders, supporting the council's work. In 2021, Act L of 2013 on electronic information security of state and municipal bodies was extended with the ground rules on the activities of a national cybersecurity certification authority, implementing Regulation (EU) 2019/881 of the European Parliament and of the Council. Implementing government decrees¹⁹³ have also been adopted and published. Regarding the future security challenges of quantum communication and quantum computing, Hungary introduced the legal requirement to use new crypto-communication standards, i.e. post-quantum cryptography. The act obliges certain organisations providing critical services (e.g. financial institutions and governmental organisations) to use certified post-quantum cryptography applications, in order to make their network communication safer. The legal obligation was enacted into a law at the end of 2021 and will enter into force in July of 2022.

The National Digitalisation Strategy lists five priorities under its digital state pillar: (1) coordinated, user-centric digital development of central and regional administrations and professional systems on all platforms; (2) establishing a data-driven administration by further enhancing interoperable data links between public registries and relevant back-end systems, as well as e-government services; (3) developing smart settlements and smart areas; (4) increasing the information security of government electronic services; and (5) digital development of public services. The proper implementation of the strategy is key to further improving the quality and completeness of the supply of digital public services, both domestically and cross-border, in line with the Digital Decade target on online service provision.

¹⁹³ Governmental Decrees 805/2021. (XII. 28.) and 718/2021. (XII. 20.)

Ireland

	Ireland		EU
	rank	score	score
DESI 2022	5	62.7	52.3



Ireland ranks 5th of the 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI). Ireland's average yearly relative growth of its DESI score between 2017 and 2022 is approximately 8.5%¹⁹⁴, one of the highest in the EU. Ireland performs well regarding the human capital dimension, as the share of people with basic digital skills and digital content creation skills, as well as the share of ICT specialists, including female ICT specialists, is above the EU average. Ireland is a top performer for mobile broadband take-up and scores well for fixed broadband take-up, yet the take-up for at least 100 Mbps fixed broadband and at least 1 Gbps, although increasing steadily, is lower than the EU average. Despite the stagnating 5G spectrum assignments, the 5G coverage has increased significantly and is above the EU average. While enterprises in Ireland take advantage of some digital technologies (for example, social media, big data and cloud), other such technologies are not so widespread (for example, Artificial Intelligence (AI), electronic information sharing and e-invoices). The public services provided to businesses and citizens in Ireland are highly digitalised and a large proportion of internet users engage actively with e-government services.

On 1 February 2022, the government launched a new [National Digital Strategy, 'Harnessing Digital – The Digital Ireland Framework'](#). The strategy supports Ireland's goal of becoming a leader in European and global digital developments, while also placing a strong emphasis on inclusiveness, (cyber)security and safety. The strategy is aligned with EU priorities under the Commission proposal for a Decision ['Path to](#)

¹⁹⁴ Refer to section 1.3 of the DESI 2022 horizontal chapter.

[the Digital Decade](#)'. It includes sections covering four dimensions: digital transformation of business, digital infrastructure, skills, and digitalisation of public services. It is also aligned with national priorities, under Ireland's [2021 Economic Recovery Plan](#) and Ireland's Recovery and Resilience Plan (RRP).

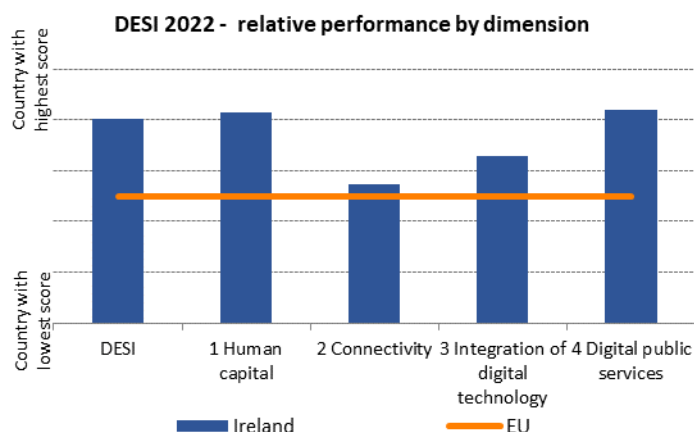
Ireland can be considered a forerunner in the EU on the integration of digital technologies, and as such is expected to make a significant contribution to the collective efforts needed to reach the Digital Decade targets, in particular those for adopting digital technologies and for support to unicorns (a start-up company with a valuation of over USD 1 bn). At the same time, Ireland's own ambition is to keep up with the most digitally advanced nations in the world. Therefore, the country's performance will need to keep improving to reach some of the more ambitious targets.

Ireland is committed to achieving the target of 80% of adults having at least basic digital skills by 2030, as well as increasing the number of graduates with high-level digital skills by 65% to over 12 400 by the end of 2022 aiming to further increase this number over the coming years. To this end, Ireland is taking measures across the entire system, from schools to further education and training, higher education, and lifelong learning in general. Ireland adopted a new [10-year Adult Literacy, Numeracy and Digital Literacy Strategy](#) in 2021 and a new [Digital Strategy for Schools to 2027](#) was published in April 2022. Moreover, as of 2022, indicators used to observe the demand of high-level ICT skills have been monitored in real time to ensure responsiveness in provision of appropriate education and training.

Ireland has set ambitious targets for connectivity in its National Digital Strategy. It is committed to ensuring that all households and businesses are covered by a Gigabit network by 2028 and that all populated areas are covered by 5G by 2030. To achieve these targets, further efforts are necessary to accelerate the implementation of Ireland's [National Broadband Plan \(NBP\)](#). It is also important that the remaining 5G spectrum is awarded without further delay and that Ireland finalises the transposition of the [European Electronic Communications Code \(the EECC\)](#).

Ireland is making sustained efforts to support enterprises in their digitalisation efforts. The aim is to increase the use of cloud computing, big data and AI to ensure that 75% of all enterprises take them up by 2030. For example, Ireland appointed an AI ambassador to promote awareness of the advantages of AI. Ireland also strives to ensure that 90% of small and medium-sized enterprises (SMEs) have a basic level of digital intensity by 2030. For example, Ireland has recently launched a new Digitalisation Voucher to help enterprises make use of digital tools. In addition, through dedicated programmes and funds Ireland is expected to contribute to the Digital Decade target of doubling the number of unicorns in the EU. Furthermore, Ireland continues to invest in cybersecurity, in particular through strengthening the capacities of the [National Cyber Security Centre \(NCSC\)](#).

Not only has Ireland set a target of 100% online provision of key public services, but it also aims to ensure that 90% of these services are actually used online by 2030. In addition, Ireland is taking measures to ensure that, by 2030, at least 80% of eligible citizens are using the digital identification solution [MyGovID](#). Ireland continues implementing the 'once-only' principle, promotes data sharing across the public sector (including through the [Data Governance Board](#) established in December 2021) and regularly involves stakeholders in the co-creation of digital public services. [Connecting Government 2030: A Digital and ICT Strategy for Ireland's Public Service](#) was published in March 2022.



The NCSC is currently operating at a heightened state of preparedness as a result of Russia's invasion of Ukraine and resulting recent cyber incidents. The NCSC has contingency plans in place in case of an increase in tensions and is engaging bilaterally with key infrastructure operators across the government and the private sector. As part of a government-wide process, the NCSC has conducted a risk assessment regarding potential cyber activities. The NCSC has assessed that the potential direct risk to Ireland is low, however there is a moderate to high risk that second or third order effects of cyber action elsewhere could have a knock-on effect in Ireland. The government is engaging with EU partners on their risk assessments also to ensure that its own assessments meets international best practices.

The NCSC has also issued a number of guidance and support documents recently, including a Cyber Vitals checklist and a detailed Advisory Note in February 2022. The Advisory Note detailed a cyber-risk assessment and appropriate advice regarding Russia's invasion of Ukraine. The Cyber Vitals checklist offsets out the priority actions that can be taken during times of heightened cyber threats to assist its constituents in preparation. The NCSC held a series of briefings for government departments, public bodies, regulators and operators of essential services on latest developments in relation to unfolding events in Eastern Europe, including steps to be taken to secure network defences, and what to do if they were the victim of a cyber-attack.

Digital in Ireland's Recovery and Resilience Plan (RRP)

32% of Ireland's RRP is dedicated to accelerating and expanding the country's digital transformation¹⁹⁵.

The plan envisages support to human capital development by providing high-speed broadband connectivity for primary schools and by funding the access to ICT infrastructure for schools. The plan also includes a reform project encompassing four measures designed to support the digital

¹⁹⁵ Each recovery and resilience plan has to dedicate at least 20% of the plan's total allocation to digital objectives. To this end, the plans had to specify and justify to what extent each measure contributes fully (100%), partly (40%) or has no impact (0%) on digital objectives, using Annex VII of the RRF Regulation. Combining the coefficients with the cost estimates of each measure allows assessing to what degree the plan contributes to digital objectives and whether it meets the 20% target.

transformation of education in Ireland at all levels (school, tertiary, lifelong learning): (i) a new Digital Strategy for Schools; (ii) a new 10-year Adult Literacy, Numeracy and Digital Literacy Strategy; (iii) a measure to increase by 65% the number of graduates with high-level ICT skills; and (iv) a measure enabling further and higher education institutions to provide more than 20 000 laptops to disadvantaged students. These projects complement each other, mainstream essential digital skills and are aimed at addressing the digital divide and enhancing digital skills overall.

The plan sets out the building of a low-latency edge platform to maximise the benefit from 5G technologies.

The programme for digital transformation of enterprise in Ireland aims to enhance digitalisation of business and it is expected that by the third quarter of 2022 at least two European Digital Innovation Hubs will have been established.

The national grand challenge programme aims to incentivise and facilitate researchers and innovators to employ research, development and innovation approaches to tackle national and global societal challenges in support of green transition and digital transformation objectives.

The plan also sets out the development of a shared government data centre, an investment in digital capacities, which is also aimed at reducing greenhouse emissions.

Digital public services are also covered in the plan by developing an online response option for the population census and deploying a suite of eHealth projects (ePharmacy and integrated financial management system).

1 Human capital

1 Human capital	Ireland		EU
	rank	score	score
DESI 2022	3	62.6	45.7

	Ireland		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
1a1 At least basic digital skills % individuals	NA	NA	70% 2021	54% 2021
1a2 Above basic digital skills % individuals	NA	NA	40% 2021	26% 2021
1a3 At least basic digital content creation skills¹⁹⁶ % individuals	NA	NA	77% 2021	66% 2021
1b1 ICT specialists % individuals in employment aged 15-74	4.9% 2019	5.7% 2020	6.3% 2021	4.5% 2021
1b2 Female ICT specialists % ICT specialists	21% 2019	21% 2020	20% 2021	19% 2021
1b3 Enterprises providing ICT training % enterprises	31% 2019	27% 2020	27% 2020	20% 2020
1b4 ICT graduates % graduates	7.9% 2018	7.8% 2019	8.6% 2020	3.9% 2020

Ireland ranks 3rd of the EU's 27 countries on human capital and is thus among the top performers in the EU. Ireland scores above the EU average on all three indicators measuring the basic digital and basic digital content creation skills of the population. 70% of people have at least basic digital skills, 40% have above basic digital skills, and 77% have at least basic digital content creation skills, compared to the EU average of 54%, 26% and 66% respectively. Ireland scores above the EU average on the indicators measuring the share of female ICT specialists and ICT specialists. The proportion of ICT graduates (8.6%) is significantly higher than the EU average (3.9%), yet 53% of enterprises reported hard-to-fill vacancies for jobs requiring ICT specialist skills (the EU average is 55.4%)¹⁹⁷. Despite this, only 27% of enterprises offer ICT training to their employees.

To respond to the digitalisation needs, Ireland continues its action to boost digital skills across the entire education system: schools, further education and training (FET), higher education, and lifelong learning in general. This primarily encompasses: (i) a new [Digital Strategy for Schools to 2027](#); (ii) 2017-2026 [STEM Education Policy Statement](#); (iii) [Technology 2022 Ireland's Third ICT Action Plan](#); (iv) [Springboard+](#) and the [Human Capital Initiative](#) (HCI Pillar 1); (v) 2021-2025 [Action Plan for Apprenticeship](#); (vi) FET

¹⁹⁶ Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

¹⁹⁷ [Analyse one indicator and compare countries — Digital Scoreboard - Data & Indicators \(digital-agenda-data.eu\)](#).

Authority's (SOLAS) initiatives; (vii) [Skillnet Ireland](#)¹⁹⁸ Programmes; and (vii) [eCollege](#), the FET online learning platform, which offers free online courses in areas such as computer programming, web and graphic design.

Ireland is rolling out a series of measures to achieve the target of 80% of adults having at least basic digital skills by 2030, set out in the National Digital Strategy, which is in line with the Digital Decade targets. In September 2021, SOLAS launched a [10-year Adult Literacy, Numeracy and Digital Literacy Strategy](#) which includes commitments to (i) reduce the share of adults in Ireland without basic digital skills from 47% to 20%, (ii) roll out a major national literacy awareness campaign and (iii) set up a one-stop shop for all relevant information on literacy.

Ireland continues to implement the [National Further Education and Training \(FET\) Strategy 'Future FET: Transforming Learning' 2020-2024](#), which sets out a series of reforms within the FET sector to improve the existing capacity in the area of digital inclusion and the provision of digital skills. A wide variety of training programmes to boost digital skills in FET are provided by Education and Training Boards and offered through SOLAS's [Skills to Advance](#) (upskilling while in employment) and [Skills to Compete](#) (labour market activation) initiatives. In addition, in 2021, more than 20 000 laptops were provided to disadvantaged students in further and higher education.

To help address challenges stemming from COVID-19 restrictions, in 2020 SOLAS launched [Mitigating Against Educational Disadvantage Fund](#) (MAEDF) to provide funding to help FET learners who were educationally disadvantaged access and participate in community education. In 2021, the MAEDF was made available with over 600 projects funded.

The [Digital Skills for Citizens Grant Scheme](#), which focuses on providing people who are not online with the opportunity to gain basic skills, is due to conclude mid-2022, following the delivery of the training obligations for pre-funded grants.

Skillnet Ireland helps local SMEs to boost digital skills and prepare them for the digital transformation. For example, in February 2022, EUR 5 m investment was announced in new Skillnet Ireland initiative connecting Irish SMEs with global enterprises.

The new Digital Strategy for Schools to 2027 was published in April 2022. It builds on progress achieved under the Digital Strategy for Schools 2015-2020 with an even stronger focus on further embedding the use of digital technologies in all teaching, learning and assessment activities.

Furthermore, to help address the digital divide caused by the lack of access to ICT equipment, in November 2021 EUR 50 m funding was issued in a once off scheme to all primary, special and post-primary schools in the free education scheme, with a circular outlining the applicable criteria.

In addition, EUR 13.5 m was allocated to support a project whereby primary schools, in areas outside of the National Broadband Plan Intervention Area and where commercial provision is insufficient, will be provided with high-speed connectivity of 100 Mbps or greater.

¹⁹⁸Skillnet Ireland is a business support agency of the government of Ireland, responsible for advancing the competitiveness, productivity and innovation of Irish businesses through enterprise-led workforce development.

As labour demand towards advanced digital skills is becoming more pronounced, it is a priority for Ireland to develop more and diverse pathways in the school system, higher education and FET. This is a clear ambition in Ireland's RRP and the National Digital Strategy to increase the number of graduates with high-level digital skills by 65% to over 12 400 by the end of 2022, along with the aim of further increasing digital skills provision in the following years. This measure is aligned with the Digital Decade target of at least 20 million employed ICT specialists in the EU by 2030. In addition, as part of its 2022 work programme, the [Expert Group on Future Skills Needs](#)¹⁹⁹ has approved the undertaking of a regular real-time high-level ICT skills demand indicators study, to help keep pace with rapid technological change, to speed up responsiveness and to inform the provision of education and training.

To boost parity between women and men as ICT specialists, Skillnet Ireland provides dedicated upskilling programmes for women. For example, [Women ReBoot](#) has been helping women with tech sector skills and career experience to (re-)join the tech sector since 2018. In addition, [Women TechStart](#) aims to equip women with tech sector skills and since 2019 has been providing specialist training and career development support. The [Digital Women's Leadership Programme](#), developed by [itag Skillnet](#)²⁰⁰ in 2021, aims to encourage and increase the number of women leaders within the tech sector. These programmes will continue to be delivered in 2022.

To support science, technology, engineering, and maths education and public engagement initiatives, in December 2021, [Science Foundation Ireland](#)²⁰¹ (SFI) approved funding to 48 projects, with a total investment of EUR 3 862 134, which will run in 2022.

The [Irish Digital Skills & Jobs Coalition](#) was among the first European coalitions to receive a grant to develop a generic services platform website, fully interoperable with the core service platform, the [EU Digital Skills and Jobs Platform](#). The two platforms were connected in 2021. Ireland participated in EU Code Week 2021 with 147 activities with over 7 600 participants taking part, 55% of whom were women.

While technological change is advancing rapidly, Ireland is committed to ensuring that the education and training system responds in good time to emerging high-level ICT needs trends. More generally, on basic digital skills development, having a lifelong learning policy is critical to meeting the 80% basic digital skills target for 2030.

¹⁹⁹ Expert Group on Future Skills Needs under Department of Enterprise, Trade and Employment is the chief advisory body on the current and future skills needs of Ireland's economy.

²⁰⁰ itag Skillnet is a business network for companies of all sizes in the technology sector in the West, North West and Mid West Regions.

²⁰¹ SFI is a national foundation for research.

Highlight 2021-2022 - Digital Strategy for Schools to 2027

A new [Digital Strategy for Schools to 2027](#) was published in April 2022. It builds on the 2015-2020 Digital Strategy for Schools and has even a stronger focus on further embedding the use of digital technologies in all teaching, learning and assessment activities including the further development of digital skills and building awareness and knowledge around the safe and ethical use of the internet.

This will be achieved by (i) the ongoing investment to improve the provision of digital infrastructure, connectivity and digital equipment in schools, (ii) the continued provision of high quality digital content for use by teachers in the classroom, (iii) supporting schools and school leaders to further embed effective digital capacity planning and development, and (iv) enhancing key skills development of teachers to ensure a digitally competent and confident teaching workforce which in turn will support the development of digital literacy skills in student population.

The new Digital Strategy for Schools to 2027 will be financed with a further EUR 200 m investment under Ireland's National Development Plan.

2 Connectivity

2 Connectivity	Ireland		EU
	rank	score	score
DESI 2022	6	61.5	59.9

	Ireland		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
2a1 Overall fixed broadband take-up	76%	78%	80%	78%
% households	2019	2020	2021	2021
2a2 At least 100 Mbps fixed broadband take-up	25%	31%	37%	41%
% households	2019	2020	2021	2021
2a3 At least 1 Gbps take-up	0.26%	3.52%	4.27%	7.58%
% households	2019	2020	2021	2021
2b1 Fast broadband (NGA) coverage	96%	96%	96%	90%
% households	2019	2020	2021	2021
2b2 Fixed Very High Capacity Network (VHCN) coverage	35%	83%	89%	70%
% households	2019	2020	2021	2021
2b3 Fibre to the Premises (FTTP) coverage	35%	48%	62%	50%
% households	2019	2020	2021	2021
2c1 5G spectrum	29%	29%	29%	56%
Assigned spectrum as a % of total harmonised 5G spectrum	04/2020	09/2021	04/2022	04/2022
2c2 5G coverage²⁰²	NA	30%	72%	66%
% populated areas		2020	2021	2021
2c3 Mobile broadband take-up	81%	81%	98%	87%
% individuals	2018	2018	2021	2021
2d1 Broadband price index	45	63	59	73
Score (0-100)	2019	2020	2021	2021

With an overall connectivity score of 61.5 Ireland ranks 6th among EU countries.

For fixed networks, there was a steady growth in 2021 of Very High-Capacity Network (VHCN) coverage, increasing from 83% to 89%, while the take-up for at least 1 Gbps services remains low. The Fibre to the Premises (FTTP) coverage has increased little from 48% in 2020 to 62% in 2021 which is above the EU average of 50%. In rural areas the increase more than doubled from 20.6% to 43.1%. Looking at Next Generation Access (NGA), rural areas are covered almost to the same extent as non-rural areas with 93.5% and 96.4%, respectively. The fixed broadband take-up slightly increased, with 80% of all households subscribing to a fixed internet access, slightly above the EU average of 78%. However, only 37% of households availed of at least 100 Mbps fixed broadband take-up, below the EU average of 41%.

²⁰² The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

Most notably, at least 1 Gbps take-up is very slow in Ireland with only 4.27% compared to the EU average of 7.58%.

There have been particularly noteworthy developments regarding VHCN. There were just under 372 000 FTTP broadband subscriptions in Ireland, representing an increase of 49.65% from the fourth quarter of 2020 to the fourth quarter of 2021. This increased take-up follows the rolling out of FTTP by SIRO, National Broadband Ireland (NBI) and Eircom. In November 2021, SIRO announced investments of EUR 620 m, which makes it possible to expand its roll-out from 410 000 premises across 64 towns to eventually pass 770 000 premises across 154 towns.

Ireland's NBP is aligned with the Digital Decade, as well as with the 2025 Gigabit Society's objectives but its implementation is delayed. At this current pace, Ireland will not achieve the 2025 targets as delays have affected the implementation of the NBP. The Department of the Environment, Climate and Communications (the Department) has worked closely with NBI to put in place a remedial plan for 2021 to address the impacts of the COVID-19 pandemic on the project. According to a remedial plan to address COVID-19 related delays which was agreed with the Department in April 2021, NBI was to have almost 60 000 premises passed and available for immediate connection by the end of 2021. NBI is actively working with its network and build partners to address these issues as they arise. As of 1 April 2022, the number of premises passed was over 41 000 while over 62 000 premises could order or pre-order a service across 22 counties. For more than 124 800 premises build is underway demonstrating the project is reaching scale. An Updated Interim Remedial Plan which will recalibrate the targets for 2022 and beyond to take account of the knock-on effects of the COVID-19 pandemic and other delays, with a revised target of 102 000 premises passed by the end of January 2023. The NBP roll-out is currently a 7-year plan under the contract and deployment is due to be completed by the end of 2026. The final goal for the NBI roll-out is still set to reach approximately 544 000 premises.

Ireland ranks 20th among the EU Member States on the indicator 5G spectrum, which has stagnated at 29% (the EU average is 56%). The low ranking on the indicator 5G spectrum is due to the lack of spectrum assignments. The still ongoing spectrum award process was launched by the Commission for Communications Regulation (ComReg) back in April 2021, with the [publication](#) of the Multi Band Spectrum Award – Information Memorandum and Draft Regulations for the 700 MHz, 2.1 GHz, 2.3 GHz and 2.6 GHz bands. ComReg will award in total 470 MHz of spectrum using the combinatorial clock auction format²⁰³. This sets out the timeline but does not currently indicate an end date for the process. Ireland would benefit from finalising the spectrum assignment process without further delay.

Despite the above lack of 5G spectrum assignment, the 5G coverage in the populated areas has increased sharply to 72% compared with the EU average of 66%. The three mobile network operators (MNOs) – Vodafone, Eir and Three – have published the following up-to-date figures for their 5G roll-out: (i) Vodafone is running commercial 5G services in five cities (Dublin, Cork, Limerick, Waterford and Galway); (ii) Eir's 5G network currently covers 322 towns and cities in all 26 counties of the Republic of Ireland, with the enterprise claiming to reach over 70% of the population; and (iii) Three claims to reach

²⁰³ I.e. a clock auction where bidders can make sealed bids for combinations of spectrum lots across different bands.

79% of the population. There were 392 000 5G subscribers (i.e. a subscriber who accessed a 5G network at least once in the quarter) in Ireland at the end of the fourth quarter of 2021, this is equivalent to 4.9% of the mobile subscriptions excluding mobile broadband (dongles) and machine to machine (M2M).

During 2021, Ireland ranked first among the EU Member States for the uptake of mobile broadband with 98%. Due to the extraordinary situation with the COVID-19 pandemic, ComReg assigned temporary spectrum rights in the 700 MHz and 2.1 GHz bands to three MNOs, between 9 April 2020 and 1 April 2022. Provision was made for a further temporary licensing framework beyond 1 April 2022. Under the Wireless Telegraphy (Further Temporary Electronic Communications Services Licences) (No.4) Regulations 2021 ([S.I. No. 138 of 2022](#)), made on 28 March 2022, further licences were granted for a period of three calendar months and ComReg may renew these licences for a further period of up to 1 October 2022.

Main market & regulatory developments

According to the Irish national regulatory authority ComReg, the fixed broadband market has been very stable with very little change in the providers' market share between the third quarter of 2020 and the third quarter of 2021 with the most notable being Eir's share falling from 30.3% to 28.2%.

ComReg notified the Commission ([Case IE/2021/2344](#)) about the pricing of access to civil engineering within the market 3a for 'wholesale local access provided at a fixed location' in Ireland. The Commission has examined the notification and additional information provided by ComReg and believes that the notified draft measure affects trade between Member States and falls within the scope of Article 33(1) of the [EECC](#). The Commission has expressed serious doubts as to whether the notified draft measure complies with EU law and believes that it creates barriers to the internal market.

ComReg notified the Commission (Case IE/2021/2343) about market 3b 'wholesale central access provided at a fixed location for mass-market products' in Ireland. The Commission examined the notification and the additional information provided by ComReg and had no comments.

ComReg has found that the urban Wholesale Central Access (WCA) market is competitive and therefore proposed to lift regulation in this market within a sunset period of 6 months. As regards the regional WCA market, ComReg confirmed the regulatory obligation imposed in the market review of 2018, imposing on Eircom the obligations of: (i) access, (ii) transparency, (iii) non-discrimination, (iv) accounting separation, (v) cost accounting and (vi) price control. In accordance with Article 32(9) of the [EECC](#), ComReg may adopt the draft. The transposition of the [EECC](#) is still ongoing and infringement proceedings have been initiated ([INFR\(2021\)0054](#)) due to non-communication. On 23 September 2021, the Reasoned Opinion was sent to Ireland and on 6 April 2022, the case was referred to the European Court of Justice. The [EECC](#) will be transposed by both primary and secondary legislation. On 14 December 2021, the government approved the General Scheme primary legislation, which will also provide ComReg with enhanced enforcement powers. It is expected to be introduced into the Oireachtas (Irish Parliament) in 2022. The accompanying secondary legislation is at an advanced stage of readiness and will accompany the primary legislation.

Between 1 January 2021 and 31 October 2021, a total of 2 917 complaints were reported by ComReg's Consumer Line from residential and business customers. This is an overall decrease of 61% compared with the total number of complaints reported by ComReg's Consumer Line from the same type of customers in the same period in 2020 (7 547). The complaints being reported to ComReg mainly arise from (a) customer service issues associated with one large service provider and (b) the critical nature of electronic communications services in enabling consumers to continue working effectively in a remote environment.

Regarding caller location information for emergency calls, the Advanced Mobile Location (AML) functionality for emergency SMS on IOS devices has been released by Apple and is now available in Ireland.

It is very encouraging that Ireland's NBP is aligned with the 2025 Gigabit Society, as well as the Digital Decade's objectives. However, it is very important that Ireland addresses the delayed roll-out of the NBP in order to achieve the Gigabit Society's targets, which will not otherwise be reached by 2025.

Overall, Ireland performs very well in mobile broadband take-up (1st place among the EU Member States) and the 5G coverage is above the EU average, but it scores very low on the indicator 5G spectrum; it is therefore important that the remaining 5G spectrum is awarded without further delay. Moreover, it is important for Ireland to accelerate its efforts to reach the targets of the 2025 Gigabit Society and the Digital Decade.

Furthermore, it is important that the EECC's transposition is finalised to: (i) ensure a more consistent internal market approach to radio spectrum policy and management, (ii) deliver conditions for a true internal market by tackling regulatory fragmentation, (iii) protect consumers effectively, (iv) provide a level playing field for all market players, (v) make sure rules are applied consistently, and (vi) provide a more effective regulatory institutional framework.

3 Integration of digital technology

3 Integration of digital technology	Ireland		EU
	rank	score	score
DESI 2022	7	43.3	36.1

	DESI 2020	Ireland DESI 2021	DESI 2022	EU DESI 2022
3a1 SMEs with at least a basic level of digital intensity % SMEs	NA	NA	64% 2021	55% 2021
3b1 Electronic information sharing % enterprises	28% 2019	28% 2019	24% 2021	38% 2021
3b2 Social media % enterprises	44% 2019	44% 2019	32% 2021	29% 2021
3b3 Big data % enterprises	20% 2018	23% 2020	23% 2020	14% 2020
3b4 Cloud % enterprises	NA	NA	47% 2021	34% 2021
3b5 AI % enterprises	NA	NA	8% 2021	8% 2021
3b6 ICT for environmental sustainability % enterprises having medium/high intensity of green action through ICT	NA	67% 2021	67% 2021	66% 2021
3b7 e-Invoices % enterprises	20% 2018	19% 2020	19% 2020	32% 2020
3c1 SMEs selling online % SMEs	35% 2019	32% 2020	33% 2021	18% 2021
3c2 e-Commerce turnover % SME turnover	29% 2019	27% 2020	22% 2021	12% 2021
3c3 Selling online cross-border % SMEs	18% 2019	18% 2019	11% 2021	9% 2021

Ireland ranks 7th of the 27 EU countries and is thus above the EU average. The use of digital technologies is reasonably widespread among the enterprises in Ireland, which take advantage of social media, big data and cloud. Enterprises score just over the EU average of 66% on the ICT for environmental sustainability indicator. While AI use is as high as the EU average, Ireland underperforms in electronic information sharing (24% versus the EU average of 38%) and the use of e-invoices (19% versus the EU average of 32%). SMEs integrate digital technology relatively well. For example, 64% of SMEs have at least a basic level of digital intensity and the proportion of SMEs selling online increased slightly in 2021 (from 32% to 33%). In addition, although in 2021 the performance of SMEs on e-commerce turnover and online cross-border sales decreased sharply from 27% to 22% and from 18% to 11% respectively, Ireland still scores above the EU average for these indicators.

In April 2021, Ireland signed [the Joint Declaration on the European Initiative on Processors and Semiconductor Technologies](#), showing its commitment to industry and innovation. This could contribute to the Digital Decade target of the EU achieving 20% of the world production value in semiconductors.

The Declaration also set out the intention to roll out a second Important Project for Common European Interest (IPCEI) on Microelectronics. Discussions are currently ongoing on including one Irish proposal in this IPCEI.

Through the National Digital Strategy, Ireland's RRP, and the SME and Entrepreneurship Growth Plan that was published in January 2021, Ireland intends to further accelerate digitalisation across enterprises, in particular SMEs, with an emphasis on cloud computing, big data and AI. The target of 75% of enterprises using cloud, big data and AI by 2030 and the target of 90% of SMEs having a basic level of digital intensity by 2030, as set out in the National Digital Strategy are in line with the Digital Decade targets.

The government set up a Digital Transition Fund (DTF) worth EUR 85 m running from 2022 until 2026 to support around 800 enterprises, especially SMEs, in their digital transformation. This concerns, for example, the digitalisation of processes and products or the use of digital technologies to develop new business models, in order to boost enterprises' competitiveness and export potential. Ireland also committed to establishing several European Digital Innovation Hubs (EDIH), to serve as a first stop for enterprises seeking upskilling, innovation, and advisory services in the areas of AI, high performance computing and cybersecurity, act as SME incubators and provide access to infrastructure, technologies and test beds. It is intended that one of the Irish EDIHs will specialise in AI. A competitive process to identify EDIH candidates has concluded and, further to the Commission's evaluation process²⁰⁴, it is anticipated that the Irish EDIH network will be operational in the third quarter of 2022.

Ireland plans to roll out an awareness-raising campaign to encourage all enterprises to digitalise, including a new digital portal open to all enterprises with information on available support. Scoping for that portal will be done during 2022 with input from the Enterprise Digital Advisory Forum with a view to launch in 2023. Enterprise Ireland²⁰⁵ (EI) launched a Digitalisation Voucher support as part of the Temporary aid framework (with applications open until the end of the first half of 2022) to help enterprises prepare a plan for the adoption of digital tools and techniques. By 26 April 2022, EI had supported 227 SMEs. A new Advanced Manufacturing Centre that will provide state-of-the-art facilities for enterprises to develop new technologies is due to open in the third quarter of 2022. A National Clustering Policy and Framework is currently being developed to maximise the potential of clustering as a policy tool to fulfil national enterprise policy objectives including supporting the green and digital transition. In March 2022, the government also agreed to the development of a new White Paper on Enterprise Policy. This is motivated by a number of factors including: the effects of the pandemic; geopolitical developments and changes in the international trading environment which may not be to Ireland's advantage; vulnerabilities in Ireland's enterprise sector and wider economic model; and the need to integrate climate change commitments into enterprise policy over the decade ahead. Given that

²⁰⁴ Two Irish EDIH proposals have a successful evaluation result, i.e. are invited for grant agreement preparation (which is not a formal commitment for funding). Two additional proposals have received a Seal of Excellence.

²⁰⁵ Enterprise Ireland is an agency responsible for the development and growth of Irish enterprises in world markets.

clustering policy will likely be central to any updated enterprise policy, these pieces of work will be aligned and are due for delivery by the end of 2022.

Ireland continues to implement the [National AI Strategy](#), launched in July 2021. An AI ambassador has been appointed to help increase public trust in AI and promote awareness of the advantages of AI. To accelerate the adoption of digital technologies (including cloud, big data, and AI), the government has established an Enterprise Digital Advisory Forum that includes government and industry representatives, as well as the AI ambassador. A [Top Team on Standards for AI](#) continues its involvement in developing the AI standards.

The National Digital Strategy includes a target to ensure that at least 35% of State funding for start-up and early-stage enterprises is invested in innovative digital businesses from 2022, with the ambition of nurturing potential digital unicorns, which could in turn contribute to the Digital Decade target of doubling the number of unicorns in the EU.

In addition to support via the DTF and EDIHs, further support available through the network of [Local Enterprise Offices](#) (LOE) and EI could also help achieve the target of doubling the number of unicorns. The LOE network supports the development of unicorns through [Priming Grants](#) (available to micro enterprises within the first 18 months of starting up; this is the first financial support provided in the development of unicorns) and the [Start Your Own Business Programme](#) (guides in business planning). EI supports the development of unicorns through (i) a EUR 500 m [Disruptive Technologies Innovation Fund](#) (on 8 November 2021, a fourth call for applications was launched), (ii) the [Innovative High Growth Potential Start-ups Fund](#) (helping high growth potential start-up companies with their start-up and development costs), (iii) the [Competitive Start Fund](#) (accelerating the growth of start-up companies that have the capacity and ambition to succeed in global markets) and (iv) the [Commercialisation Fund](#) (helping third-level researchers translate their research into innovative and commercially viable products, services and companies). Furthermore, in February 2022, an [Irish Innovation Seed Fund](#) worth EUR 90 m was announced. This fund will provide capital to innovative Irish start-up companies at their seed stage, in particular in areas such as regional development, climate change and female entrepreneurship.

SFI continues to fund six [SFI Centres for Research Training](#), bringing together research bodies and industry to develop innovation training programmes in data and ICT skills, and 16 [SFI Research Centres](#), dedicated to advanced research in areas which include AI, cloud computing, multimodal interaction, virtual/augmented reality, robotics, and the Internet of Things. To strengthen the research and innovation (R&I) system, a new National Strategy for R&I is currently being developed and publication is expected in the third quarter of 2022.

In 2021, SFI supported the Empower, a new academic and industry research programme, designed to future proof EU data flows and accelerate innovations in data protection internationally. This programme will develop systems to protect citizens and work to their advantage while streamlining data exchange in the European business ecosystem. This programme represents research of almost EUR 10 m focused on data platforms, data governance and ecosystems. It brings together multidisciplinary research in data governance from across the participating SFI Research Centres.

To help achieve the Digital Decade targets in digital infrastructure, it is expected that at least 18 nodes will have been deployed by the end of 2024. These nodes will be interconnected with a high-speed low-latency backbone and will connect with government and commercial datacentres and cloud providers to facilitate data processing at the appropriate location (edge nodes, regional nodes, or the cloud).

Ireland is a partner in the EU's Joint Transnational Co-funding ERA-NET on Quantum Technologies (QuantERA II). In 2021, Ireland allocated EUR 510 000 in funding to EuroHPC activities, in particular to support the EuroHPC Competence Centre (EuroCC) and other EuroHPC R&I projects pursued by [ICHEC](#)²⁰⁶. The same amount has been allocated for this purpose for 2022. Under EuroCC, ICHEC has continued its Academic Flagship and SME Accelerator programmes and as of 2022 has also launched an HPC Innovation Hub, an Enterprise Accelerator Programme, and an Advanced Digital Skills Programme.

Ireland continues to support the development of blockchain technology. The implementation of [FINTECHNEXT \(2019-2023\)](#), a collaborative research programme between University College Cork and Fexco, supported by SFI, is continuing to deliver applied and funded research dedicated to disrupting key fintech verticals. The [FinTech Fusion](#) project (2019-2022), led by the [ADAPT Research Centre](#)²⁰⁷, aims to increase the impact of ICT technologies on RegTech (regulatory compliance), InsureTech (insurance sector) and PayTech (payments) processes. Currently, several leading enterprises in the financial services sector are collaborating to deliver a new platform, the first of its kind in the European financial services industry, to support the verification, tracking, direct access to, and management of, regulatory, professional and education qualifications. [Blockchain Ireland](#)²⁰⁸ has compiled a [proposal for](#) Ireland's Blockchain, crypto and WEB3 strategy and submitted it to the government in May 2022. Ireland is a member of the European Blockchain Partnership and the European Blockchain Services Infrastructure.

The NCSC continues to lead the implementation of the [2019-2024 National Cyber Security Strategy](#) in Ireland. Following a capacity review in 2021, a number of the NCSC capability-building measures have been agreed (for example, additional staff, infrastructure and an associated budget). It is expected that in 2022, the NCSC will begin a graduate training programme, with four computer science graduates recruited each year on 3-year contracts.

Given its standing in the DESI as well as the multitude of measures undertaken, Ireland is well placed to make a significant contribution to the Digital Decade targets for the digital transformation of business.

²⁰⁶ Irish Center for High-End Computing.

²⁰⁷ ADAPT is SFI Research Centre for AI-Driven Digital Content Technology.

²⁰⁸ Blockchain Ireland is an organisation of state agencies, corporates, academics and industry professionals working together to share insights and expertise and to promote the growth of Blockchain technology in Ireland.

4 Digital public services

4 Digital public services ²⁰⁹	Ireland	EU
	rank	score
DESI 2022	6	83.5
		67.3

	DESI 2020	Ireland DESI 2021	DESI 2022	EU DESI 2022
4a1 e-Government users	67%	67%	92%	65%
% internet users	2019	2020	2021	2021
4a2 Pre-filled forms	NA	NA	59	64
Score (0 to 100)			2021	2021
4a3 Digital public services for citizens	NA	NA	80	75
Score (0 to 100)			2021	2021
4a4 Digital public services for businesses	NA	NA	100	82
Score (0 to 100)			2021	2021
4a5 Open data	NA	NA	95%	81%
% maximum score			2021	2021

Ireland ranks 6th of the 27 EU countries in digital public services and is thus well above the EU average. In 2021, the share of e-government users increased significantly from 67% to 92%. Ireland also performs well in digital public services for both businesses (100) and citizens (80), and scores high in open data (95%). However, its performance regarding pre-filled forms is below the EU average.

Ireland intends to go beyond the Digital Decade target of 100% online provision of key public services by ensuring that 90% of applicable services are used online by 2030, as set out in the [Civil Service Renewal 2030 Strategy](#) (CSR2030 Strategy), launched in May 2021, in the [Connecting Government 2030: A Digital and ICT Strategy for Ireland's Public Service](#), published in [March 2022](#), and in the National Digital Strategy. The CSR2030 Strategy will be implemented through a series of 3-year action plans. The first of these, the [Civil Service Renewal 2024 Action Plan](#), published in December 2021, is aligned with the Digital Decade targets and identifies user-centric digital services that are available 24/7 as priority actions.

Connecting Government 2030 Strategy aims to deliver digital government for all, while taking a 'user first' and 'business first' approach in digitalising public services and ensuring interoperability across all levels of government and across public services. It addresses the digitalisation of public services dimension of the National Digital Strategy, is aligned with the targets set out in the CSR2030 Strategy as well as addresses the Digital Decade targets. It replaces the previous Public Service ICT Strategy and 2017-2020 eGovernment Strategy.

²⁰⁹ There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

In 2021, Ireland continued to review and improve the user-friendliness and quality of the services provided by the government services portal [Gov.ie](#). In November 2021, Gov.ie was selected for audit by the National Disability Authority (NDA) as provided for in the Web Accessibility Directive²¹⁰ and a liaison was appointed from the Gov.ie content team. The NDA report found that the Gov.ie website has been designed with accessibility in mind and has a very good level of accessibility. A number of suggestions were actioned and additional enhancements made, which increased the accessibility score from 39% to 96%.

Ireland is committed to applying the ‘once-only’ principle and to ensuring that inclusiveness is inherent to the digital transition, a key ambition of the National Digital Strategy. Therefore, Ireland is taking measures to contribute to the Digital Decade target of at least 80% of Union citizens using a digital identification (ID) solution: the National Digital Strategy includes a goal of 80% of eligible citizens using [MyGovID](#) by 2030. MyGovID is an eID scheme offered to the people in Ireland for facilitating their interactions with public organisations. It is the sole authentication mechanism for public bodies and provides a fundamental element for the ‘once-only’ principle. It also offers the possibility to interact with public organisations via a smart device. Approximately 38% of the adult population of Ireland have and use a verified MyGovID account, which represents very substantial growth over the last three years. According to the 2021 [eGovernment Benchmark](#), Ireland improved its score on cross-border eID services from 0% in 2020 to 6% in 2021 (EU average is 21.7%). However, Ireland has not yet notified MyGovID scheme to the Commission under the eIDAS Regulation²¹¹. New services such as the unique/universal business identifier and base registries, as well as the [Data Governance Board](#) (established in December 2021 under the 2019 [Data Sharing and Governance Act](#) and aligned with the 2019-2023 [Public Service Data Strategy](#)) will help to further progress the implementation of the ‘once-only’ principle, the common delivery of services, as well as a consistent approach to data sharing across public bodies. In addition, work on the environmentally-sustainable shared government data centre is ongoing with detailed design complete and the procurement for construction beginning.

A number of measures are being taken that will help achieve the Digital Decade target of 100% of Union citizens having access to their online medical records. For example, an upcoming Health Bill will set out the legislative basis for an electronic Summary Care Record to be held centrally, which will facilitate better care and treatment by ensuring that health service providers have online access to a centralised patient records system 24/7. As outlined in the National Digital Strategy, through the national contact tracing system and the national vaccination system, the health service in Ireland set up a direct online link with every citizen in the country for the first time. As part of the 2021-2030 [National Development Plan](#), key deliverables include the roll-out of the individual health identifier, electronic patient record systems, corporate systems, modernisation and improvement of technical infrastructure, which are supported by the [Sláintecare](#) report and the [eHealth Strategy](#). It was agreed with the Department of

²¹⁰ Directive (EU) 2016/2102 of the European Parliament and of the Council of 26 October 2016 on the accessibility of the websites and mobile applications of public sector bodies (OJ L 327, 2.12.2016, p. 1).

²¹¹ Regulation (EU) No 910/2014 of the European Parliament and of the Council of 23 July 2014 on electronic identification and trust services for electronic transactions in the internal market and repealing Directive 1999/93/EC (OJ L 257, 28.8.2014, p. 73).

Health / Health Service Executive that, given the impact that the COVID-19 pandemic and the ransomware attack had on the original eHealth plans, a new eHealth plan would be created that would have a 2030 focus so that it would meet the Digital Decade targets. First-cut plans are now being developed and will be published towards the end of 2022 and ultimately be part of the National Digital Roadmap. Further eHealth developments include targeted investments in electronic health records (by hospital site), shared care record, a national ePharmacy programme, national medical imaging system and a patient portal to enable the sharing of data between systems and healthcare organisations. Legislation and a technical solution to support the shared care record (which will be a key component of the 2030 target) are being developed. The technical solution will use the integrated health exchange protocols.

The government's roll-out of digital COVID-19 certificates provided an opportunity to showcase the convenience of digital means and help citizens understand the value of having a 'government' record in their private life. Following the success of this experience, Ireland intends to use similar principles for other credentials, such as the driving licence.

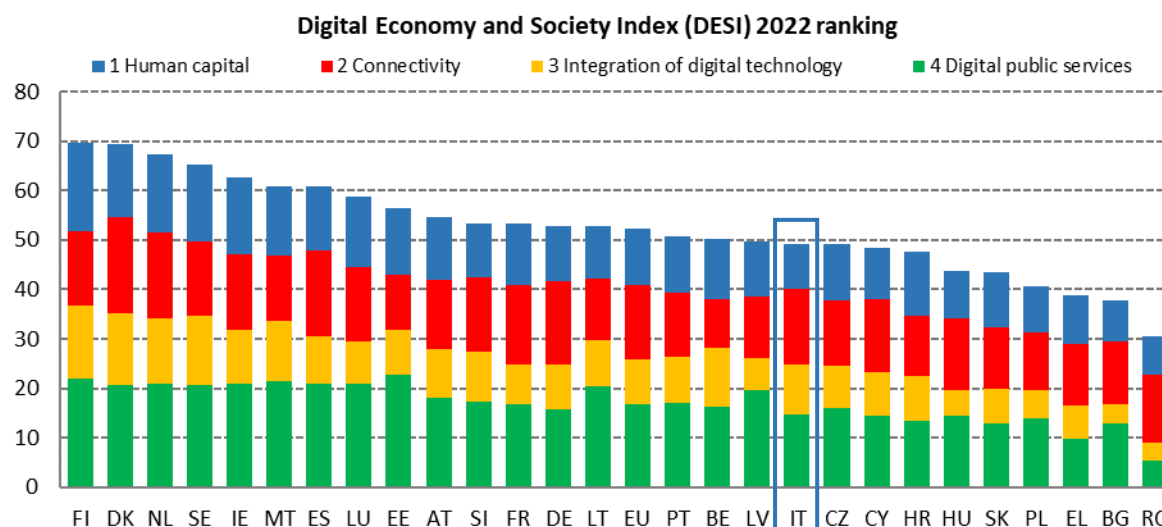
Ireland involves stakeholders in the co-creation of digital public services. For example, each year the Office of the Government CIO at the Department of Public Expenditure and Reform partners with students of Trinity College Dublin to assess online services and document their results and recommendations based on real world experience. In addition to public surveys, Ireland plans to launch a public consultation in 2022 to allow the public to provide its opinion about the prioritisation and redesign of public services. New structures are being developed to create a closer working relationship with industry, academia and the public enabling a more comprehensive approach to the design and delivery of services. For example, a Digital Strategy Implementation Unit within the Office of the Government CIO has been established to oversee the delivery of the digitalisation of public services dimension of the National Digital Strategy and implementation of the Connecting Government 2030 Strategy. The National Digital Strategy and the Connecting Government 2030 Strategy commit to progressing with the implementation of the priority actions from the [2019 Cruinniú GovTech Report](#) making it easier for start-up companies and SMEs to work with the government to improve digital public services. The 2021 [eGovernment Benchmark](#) highlighted Ireland as being fully transparent in designing services with a score of 100%. The 2021 [Future Tech Challenge](#) is a pilot competition to accelerate innovation and technology adoption in the public service through collaboration with the private sector. It will continue in 2022 and is currently at the planning stage.

Cyber security is fundamental in the digitalisation of the public sector. For example, the [Cloud Services Procurement Guidance Note](#), published in February 2021, outlines key elements of the security considerations for the provision of cloud services. The Connecting Government 2030 Strategy commits to designing and building systems that are aligned with best practice in security and cyber defence and to applying the [Public Sector Cyber Security Baseline Standards](#). The standards were published in November 2021 and aim to improve the resilience and security of ICT in public service bodies.

It is important that Ireland continues to maintain its forerunner position in digital public services and showcase measures in the context of the common EU efforts to reach the Digital Decade targets.

Italy

	Italy	EU
	rank	score
DESI 2022	18	49.3
		52.3



Italy ranks 18th out of 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI).

As the third largest EU economy, Italy's progress in the digital transformation over the coming years is crucial to enable the EU as a whole to reach the 2030 Digital Decade targets.

Italy is catching up and, looking at the progress of its DESI score over the past five years, it is advancing at a remarkable pace²¹². In recent years, digital issues have gained political traction notably with the establishment of a ministry responsible for digital affairs, the adoption of several key strategies and the launch of many policy measures.

That said, there are still gaps in the digital transformation to be overcome.

Giving continuity to the initiatives undertaken and leveraging on the many assets which Italy has would allow the country to further improve its performance in the DESI. The Recovery and Resilience Plan, the largest in Europe, endows it with the necessary funds to accelerate the digital transformation. Moreover, the country has a strong industrial base and research communities in key areas such as Artificial Intelligence, High performance computing and quantum. These strengths should be leveraged to deploy digital in all areas of the economy in the full respect of the human centric approach promoted by the [Digital Principles](#).

²¹² Please see Section 1.3 of DESI 2022 Thematic Chapters.

Looking at this year's indicators, Italy is narrowing the gap with the EU when it comes to basic digital skills, however still more than half of Italian people do not have at least basic digital skills. The share of digital specialists on the Italian workforce is below the EU average and future prospects are undermined by low rates of ICT enrolment and graduates. A significant change of pace in Italy's digital skills' readiness is crucial for the EU to reach the Digital Decade target on basic digital and ICT specialists.

For Connectivity, there has been progress in terms of both take-up of broadband services and network deployment. Shortcomings remain in the coverage of Very High Capacity Networks (including fiber-to-the-premises), which is still far from the EU average and the Digital Decade target of universal coverage by 2030.

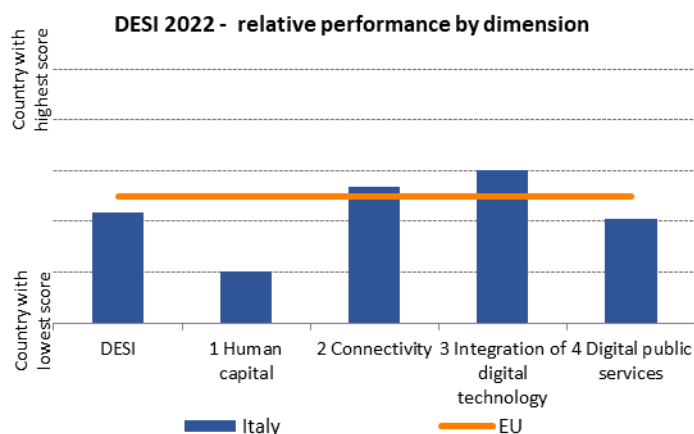
Most Italian small and medium enterprises (60%) have at least a basic level of digital intensity and, in particular, the use of cloud services recorded a significant growth. While Italy is well placed in this dimension and these figures lay the foundation for a strong contribution to the Digital Decade targets for business digitalisation, the uptake of other key technologies such as big data and Artificial Intelligence is still quite limited.

Italy is making progress in the supply of digital public services closing in on the EU average. Ongoing efforts need to be continued to enable Italy to achieve the Digital Decade target of 100% online provision of key public services for EU citizens and businesses and to fully deploy the electronic health record. Although only 40% of Italian internet users use digital public services (against an EU average of 65%), this indicator recorded a remarkable growth in the last two years (increasing by 10 percentage points between 2020 and 2022).

Looking at the policy developments, during the past years, Italy has heightened the focus on digital and put in place numerous measures to foster the digital transformation of the country. The Recovery and Resilience Plan is giving further boost and accelerating progress. Between January 2021 and March 2022, the government launched the public tenders to foster the development of fixed Gigabit connectivity and 5G mobile coverage in market failure areas across Italy. Furthermore, to sustain demand, the government launched a voucher scheme dedicated to SMEs: with a total budget of over EUR 600 million, it facilitates the activation of broadband internet connections from 30 Mbps to more than 1 Gbps with minimum guaranteed bandwidth.

In 2021 and 2022 there were numerous developments in the area of digitalisation of public administrations and public services, starting from the publication of the 'Strategia Cloud Italia' ([Italian Cloud strategy](#)). In 2022 the national population digital register (ANPR) was completed. The uptake of e-ID ('SPID' and 'CIE') and of the app 'IO' (the mobile app to access digital public services) kept increasing. However, the deployment and uptake of the electronic health record remains limited and scattered across regions.

The initiatives to support digital skills development continued to be activated and strengthened under the umbrella of the National Strategy for Digital Skills and its operational plan. In this context, the government established a new special fund ('[Fondo per la Repubblica Digitale](#)') that promotes initiatives to increase digital skills levels. Moreover, the government approved a new programme and national plan to foster personalized labour market plans, the programme 'GOL' (programme for Guaranteed Employability of Workers and National Plan for New Skills). Another important development was the adoption of the [Strategic Program on Artificial Intelligence 2022-2024](#), which includes recommendations to strengthen competences and attract talents.



Following Russia's invasion of Ukraine, the Italian authorities took action to supervise the implementation of the EU sanctions, including the ban of Russian state-controlled media outlets Russia Today and Sputnik. The Italian government and AGCOM are working in close cooperation and keeping an open dialogue and exchange of information with the Internet Service Providers (ISPs) on technical aspects related to the application of [Regulation 2022/350](#)²¹³. Furthermore, AGCOM set up a permanent table to exchange information on all initiatives taken by Italian operators in support of the Ukrainian population.

The National Cybersecurity Agency (ACN) issued a [recommendation](#) inviting public and private entities to urgently perform an analysis of the risks stemming from the use of cybersecurity solutions provided by companies with ties to the Russian Federation (that, given the situation, they might not be able to provide proper support and updates) and to consider diversification strategies. The [Law Decree n. 21/2022 of March 21st](#) – concerning urgent measures to counter the economic and humanitarian effects of the Ukrainian crisis – established, among others, that Public Administrations have to promptly adopt diversification strategies for the relevant categories of products and services.

Digital in Italy's Recovery and Resilience Plan (RRP)

The Italian Recovery and Resilience Plan, the EU's largest, amounts to EUR 191.5 billion. 25.1% of it (i.e. EUR 48 billion) is devoted to the digital transition²¹⁴.

In the context of the first payment request, Italy has achieved 51 milestones and targets. A number of them were related to measures in the area of digital, such as: the reform 'Cloud First and Interoperability', including the new Cloud Strategy and legislative amendments introducing incentives and obligations for cloud adoption by public administrations; the reform of ICT procurement, streamlining and accelerating the procurement process for ICT services and

²¹³ Council Regulation (EU) 2022/350 of 1 March 2022 amending Regulation (EU) No 833/2014 concerning restrictive measures in view of Russia's actions destabilising the situation in Ukraine.

²¹⁴ Each Recovery and Resilience Plan has to dedicate at least 20% of the plan's total allocation to digital objectives. To this end, the plans had to specify and justify to what extent each measure contributes fully (100%), partly (40%) or has no impact (0%) on digital objectives, using Annex VII of the RRF Regulation. Combining the coefficients with the cost estimates of each measure allows assessing to what degree the plan contributes to digital objectives and whether it meets the 20% target.

assets; the publication of the calls for expression of interest to select projects under the 'Important Projects of Common European Interest' (IPCEIs), including 'Microelectronics II' and 'Next Generation Cloud Infrastructure and Service'; and the establishment of the National Programme for the Guaranteed Employability of Workers and a National Plan for New Skills.

In the context of the second payment request, Italy is expected to award all contracts for the five connectivity measures under the plan amounting to a total of EUR 6.7 billion: 'Italia a 1Giga' (Italy at 1Giga), 'Italia 5G' (Italy 5G), 'Scuole connesse' (Connected Schools), 'Sanità connessa' (Connected Healthcare facilities), 'Collegamento isole minori' (Connected smaller islands). The country is also expected to allocate the funding to the IPCEIs in June 2022 and to select the list of participants in the projects by mid-2023.

Based on the Council Implementing Decision on the Italian Recovery and Resilience Plan, other reforms and investments that are associated to milestones and targets meant to be fulfilled in 2022 include measures to:

- Boost the digitalisation of schools (i.e. 'School 4.0') and improve vocational education (i.e. the reform of the tertiary vocational training system 'ITS').
- Strengthen the system of research and technology transfer centres, which might cover fields such as advanced simulation and big data, quantum, Industry 4.0, or artificial intelligence.
- Step up the modernisation of the public administration, with the completion of the national cloud infrastructure (National Strategic Hub) and of the national digital data platform, and the deployment of the measures to strengthen cybersecurity already begun with the appointment of the National Cybersecurity Agency in 2021.

1 Human capital

1 Human capital	Italy	EU
	rank	score
DESI 2022	25	36.6
		45.7

	Italy			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
1a1 At least basic digital skills	NA	NA	46%	54%
% individuals			2021	2021
1a2 Above basic digital skills	NA	NA	23%	26%
% individuals			2021	2021
1a3 At least basic digital content creation skills²¹⁵	NA	NA	58%	66%
% individuals			2021	2021
1b1 ICT specialists	3.5%	3.6%	3.8%	4.5%
% individuals in employment aged 15-74	2019	2020	2021	2021
1b2 Female ICT specialists	15%	16%	16%	19%
% ICT specialists	2019	2020	2021	2021
1b3 Enterprises providing ICT training	19%	15%	15%	20%
% enterprises	2019	2020	2020	2020
1b4 ICT graduates	1.3%	1.3%	1.4%	3.9%
% graduates	2018	2019	2020	2020

In Human capital, Italy ranks 25th of 27 EU countries. Only 46% of people have at least basic digital skills, below EU average of 54%. The gap with the EU average is smaller when it comes to individuals with above basic digital skills (23% in Italy versus 26% in the EU).

The country has a very low share of ICT graduates: only 1.4% of Italian graduates study ICT programmes, which is the lowest in the EU. In the labour market, the percentage of ICT specialists is 3.8% of total employment, remaining below the EU average (4.5%). In parallel, only 15% of Italian enterprises provide ICT training to their employees, five percentage points below the EU average. Italy's performance is closer to the EU average as regards the presence of women in the digital sector: female ICT specialists represent 16% of ICT specialists, against an EU average of 19%.

Italy has a comprehensive [National Strategy for Digital Skills](#) which is being implemented through an [operational plan](#) adopted in December 2020²¹⁶. It identifies 111 initiatives and sets out milestones and targets to be reached by 2025, including equipping 70% of the population with basic digital skills, in line with the Digital Decade target of 80% fixed for 2030. In 2021, the government carried out a [first assessment of the implementation of the operational plan](#), which shows an overall progress, with 34 initiatives (out of the 49 monitored) ongoing or concluded. These initiatives covered education and training, reskilling and upskilling of the workforce, ICT specialised skills and digital skills for the general population.

²¹⁵ Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

²¹⁶ An update of the operational Plan is currently ongoing. Some of the initiatives promoted by the operational plan are funded by the Recovery and Resilience Plan.

Moreover, the ‘Repubblica Digitale’ initiative, led by the Italian Coalition for Digital Skills and Jobs, continued playing a key role, with over 260 initiatives that, in 2021, reached over 2 million students and 90 000 teachers, 240 000 workers and 1.6 million other people. At the end of January 2022, the government also announced the establishment of a fund ([‘Fondo per la Repubblica Digitale’](#)) providing for EUR 350 million to support initiatives on digital skills and train 2 million citizens for 2022-2026. This fund aims to finance, monitor and rigorously evaluate experimental projects and scale-up only those proving to be effective in increasing digital skills.

As a key initiative to promote digital literacy, in 2021, the government published the pilot call for the Digital Civil Service to select 1 000 young volunteers who will provide digital facilitation services. In 2022, a new call will select additional 2 000 young volunteers, with the objective of reaching a total of 9 700 volunteers in the three-year period.

At the end of 2021, Italy adopted the Program ‘GOL’ (National programme for the Guaranteed Employability of Workers) and a National Plan for New Skills, which reform public employment services and promote personalised labour market activation plans. Training paths activated under the programme will encompass digital skills as a cross-cutting priority. More specialised and advanced digital skills are targeted by ‘Training 4.0’, although results on the uptake of this measure are not available yet. In the meantime, the network of technology transfer centres continued providing self-assessment tools, training and information services to enterprises and workers (see section 3).

Italy started the implementation of a number of reforms targeting the education and vocational training system.

Coding and digital teaching were included in teachers’ training programmes as priority areas starting from school year 2022/2023; as from 2025/2026, the development of digital skills should be included in the curricula of schools of all levels²¹⁷.

Two reforms adopted in 2021 are expected to increase flexibility and innovate tertiary education curricula: the reform of University degree groups, encouraging the creation of cross-disciplinary paths and the development of innovative professional profiles²¹⁸; and the reform of PhD programs, promoting the involvement of enterprises in University research programmes and applied research (through industrial PhDs)²¹⁹.

Regarding post-secondary technical education and vocational training, the network of ITS (‘Istituti Tecnici Superiori’) has been reinforced with an increasing focus on 4.0 technologies. In 2022, there were 104 ITS in Italy, and 50% of them used Industry 4.0 technologies (e.g. advanced manufacturing solutions, augmented reality, big data analytics) as part of the learning path²²⁰.

It is also worth mentioning that the new strategy on Artificial Intelligence (AI)²²¹ places a strong focus on skills and attraction of talents and, among others, calls for further strengthening the [National AI PhD Programme](#) (PhD-AI.it). Launched in 2021, this programme offers more than 200 AI curricula spread over roughly 50 universities. To date, the programme has issued 200 PhD scholarships with a budget of EUR 16 million.

²¹⁷ Law 29 December 2021, No 233.

²¹⁸ Law 29 December 2021, No 233.

²¹⁹ Ministerial Decree 1315 of 14.12.2021.

²²⁰ The target established in the operation plan of the digital skills strategy is to reach 60%.

²²¹ [Strategic Programme on Artificial Intelligence 2022-2024](#) (see also section 3 of this report).

Finally, between 2021 and 2022, more than 19 000 EU Code Week events were organised across Italy, targeting primary and secondary-school pupils in particular.

The reinforcement of digital skills and development of human capital should remain a key priority for Italy, as those are conditions for an inclusive and truly impactful digital transformation. It is crucial ensuring continuity of the initiatives launched in the last years and acting on all fronts, by placing equal emphasis on digital literacy, reskilling and upskilling of workers and education of excellence at all levels. Initiatives and policies for digital skills need to be strictly integrated with industrial and labour market policies, also with a view of creating opportunities for young people, attracting and retaining talent.

2 Connectivity

2 Connectivity	Italy	EU
	rank	score
DESI 2022	7	61.2
		59.9

	DESI 2020	Italy	DESI 2022	EU
		DESI 2021		DESI 2022
2a1 Overall fixed broadband take-up	61%	61%	66%	78%
% households	2019	2020	2021	2021
2a2 At least 100 Mbps fixed broadband take-up	22%	28%	38%	41%
% households	2019	2020	2021	2021
2a3 At least 1 Gbps take-up	<0.01%	4.22%	7.06%	7.58%
% households	2019	2020	2021	2021
2b1 Fast broadband (NGA) coverage	89%	93%	97%	90%
% households	2019	2020	2021	2021
2b2 Fixed Very High Capacity Network (VHCN) coverage	30%	34%	44%	70%
% households	2019	2020	2021	2021
2b3 Fibre to the Premises (FTTP) coverage	30%	34%	44%	50%
% households	2019	2020	2021	2021
2c1 5G spectrum	60%	60%	60%	56%
Assigned spectrum as a % of total harmonised 5G spectrum	04/2020	09/2021	04/2022	04/2022
2c2 5G coverage²²²	NA	8%	99.7%	66%
% populated areas		2020	2021	2021
2c3 Mobile broadband take-up	70%	70%	80%	87%
% individuals	2018	2018	2021	2021
2d1 Broadband price index	74	74	76	73
Score (0-100)	2019	2020	2021	2021

With an overall connectivity score of 61.2 Italy ranks 7th among EU countries in Connectivity. In the last reporting period, the most significant progress concerned 5G coverage which went from 8% of populated areas to 99.7%, figure that includes the percentage of 5G coverage provided by spectrum sharing technology. The increase can also be attributed to the coverage and spectrum usage obligations attached to the rights of use of the 5G pioneer bands awarded in 2018, according to the regulation set by AGCOM (Decision No 231/18/CONS), the Italian National Regulatory Authority in the field of Electronic Communications. In this context, all Italian provinces are now starting to benefit from commercial 5G services. Further progress is expected towards the achievement of the target for uninterrupted 5G wireless broadband coverage in all urban areas, major roads and railways by 2025

²²² The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

because of the coverage obligations attached to the rights of use of the 700 MHz band, which will be available for use to the operators (already holding the rights of use) from 1 July 2022.

On fixed broadband infrastructure, while the coverage of fast broadband Next Generation Access (NGA) network increased by 4 percentage points (from 93% of households in 2020 to 97% in 2021) and is above the EU average of 90%, the share of households having access to Very High-Capacity Network (VHCN) technology is still very low (44%) and well below the EU average of 70%, despite the positive trend observed in the last years. In terms of technology, VDSL (Very high bit rate digital subscriber line) is the most widely available NGA broadband technology in Italy, while FTTP (Fiber To The Premises) is also gaining ground slowly, with all major providers investing in the infrastructure and resulting in a coverage of 44% of the households overall and of 17% of households in rural areas.

To support the deployment of digital infrastructure, in 2021, Italy continued the implementation of the structural reforms and simplification measures started in 2020, in the aftermath of the Covid-19 breakout. In line with the best practices identified in the EU Connectivity Toolbox and in the Roadmap submitted by Italy to implement those best practices, in 2021 two legislative decrees were approved with a view to simplifying the procedures and facilitating the installation of infrastructures:

- 1) Legislative Decree 31 May 2021 No 77 ('Decreto Legge Semplificazioni-bis') which further simplifies the authorisation procedure for the installation of electronic communications infrastructure and for digital infrastructure of buildings and real estate units;
- 2) Legislative Decree 8 November 2021 No 207 that transposes Directive (EU) 2018/1972 and simplifies procedures for certain types of installations of electronic communications infrastructures.

Moreover, in order to financially support and foster investments in the medium- and long- term, Italy has developed an ambitious National Recovery and Resilience Plan, in particular in the field of connectivity, with a planned investment of EUR 6.7 billion overall to contribute to reach by 2026 the European Digital Decade targets for 2030. Specifically as regards connectivity, the measures that aim at creating ultra-fast broadband networks, both fixed and mobile, are:

- 1) The 'Italia a 1 Giga' (Italy at 1 Giga) Plan with the objective of providing about 7 million of street addresses that, based on the results of the mapping exercise (carried out in compliance with State aid rules) will not be covered within 2026 by networks able to ensure at least 300Mbps download speed, with fixed connectivity of at least 1 Gbps (gigabit per second) download and 200 Mbps (megabit per second) upload speeds.
- 2) The 'Scuole Connesse' (Connected School) Plan, which has the objective of providing approximately 10 000 schools with free internet connectivity services, with symmetric speeds of at least 1 Gbps, for 6 years including managements, technical assistance and maintenance services. This plan, completing the intervention launched in 2020, will permit to have all the schools with an ultra-broadband connection to internet within 2026.
- 3) The 'Sanità Connessa' (Connected Healthcare facilities) Plan, which aims to provide approximately 12 300 healthcare facilities across the country with symmetric connectivity of at

least 1 Gbps and up to 10 Gbps (depending on the type of facility), for at least 5 years, including management, technical assistance and maintenance services.

- 4) The 'Italia 5G' (Italy 5G) Plan, which aims to encourage the development of 5G mobile networks in market failure areas, in order to fully satisfy the needs for mobile connectivity that can enable the multiple use cases envisaged by the International Telecommunication Union.
- 5) The 'Collegamento isole minori' (Connected smaller Islands) Plan has the objective of providing 19 smaller islands with submarine fibre optic backhauling, in order to ensure adequate ultra-broadband connectivity with the mainland.

These five measures presented in 2021 are part of the broader Ultra Broadband Plan for Italy, together with the plan for the coverage of white areas and the voucher plans, in place since 2015. As of December 2021, 32% of the households included in the National Ultra Broadband Plan in white areas were reached predominantly by fibre. The Plan is scheduled to be completed by 2023. Considerable progress was made in 2021: 943 164 new households were connected (+144% compared with 2020), and 1 168 municipalities were reached (+176% compared with 2020).

Regarding the take-up of broadband services, Italy made noticeable progress during this reporting period. Despite that, all indicators are below the EU average, especially when it comes to overall fixed broadband take-up (66% in Italy, versus 78% in the EU).

Concerning demand stimulation measures, Phase I of the 'Voucher Plan' ended in November 2021. Phase I addressed families with a gross income per year of less than EUR 20 000 and provided for a contribution of up to EUR 500 to upgrade fixed lines or to activate a new line with a speed of at least 30 Mbps. The degree of adoption - i.e. percentage of vouchers requested compared to the vouchers available - at the end of Phase I was around 52% (for a total of over EUR 103 million committed). The geographical distribution of the voucher requests was uneven across the country, with a higher demand in the more economically developed regions, such as the Lombardy region where requests exceeded the number of vouchers available. In other areas of the country the requests were less than the number of available vouchers.

Moreover, in December 2021, the European Commission approved, under EU State aid rules, a voucher scheme for EUR 610 million to help SMEs access high-speed broadband services with download speeds of at least 30 Mbps. The vouchers will cover part of the set-up costs of high-speed broadband services and the monthly fee for a maximum of 24 months and can be used to subscribe to new connections or upgrade existing ones.

Main market & regulatory developments

As regards market developments, in the fixed retail broadband market, all the main operators have consolidated their position with little market share variations over the last reporting period. Sky Italia, which started its FTTH Offer ('Sky Wifi') in September 2020, is now the 8th broadband operator. In the mobile market, Iliad consolidated its position, representing, in September 2021, 10.5% of the 'human' mobile lines (with an increase of 1.7% over the last

year). Among the main Mobile Network Operators, Wind Tre's market share decreased by 1.3%.

On regulatory developments, Italy completed the transposition of Directive (EU) 2018/1972 into national law. Legislative Decree No 207 of 8 November 2021 was published in the Italian Official Journal on 9 December 2021 and entered into force on 24 December 2021.

Following the European Commission decision's C(2021) 9855 of 17 December 2021 (Case IT/2021/2352), AGCOM, the Italian National Regulatory Authority for Telecommunication, approved the final decision (decision No 13/22/CONS) concerning the fourth round of market analysis for wholesale call termination on individual public telephone networks provided at a fixed location (Market No 1 of Recommendation 2014/710/UE) and wholesale call origination at a fixed location (Market No 2 of Recommendation 2007/879/CE). AGCOM removed the *ex-ante* regulation previously imposed on the wholesale call origination market and confirmed continued regulation on the wholesale call termination market on the single fixed network.

In January 2021, TIM notified AGCOM of an offer of commitments pursuant to article 76 EECC (European Electronic Communication Code, Directive (EU) 2018/1972) concerning a co-investment offer in a new VHCN secondary network through the vehicle of a joint venture company, FiberCop. The co-investment offer concerns the deployment of a Fiber To The Home/B secondary network in more than 2000 municipalities of Italy. Following a preliminary assessment, AGCOM requested TIM to amend the offer. In April 2021, an amended offer taking AGCOM's comments into account was published on TIM's website and submitted by AGCOM to a market test (decision No 110/21/CONS). Taking into account the market test results, at the end of August 2021, AGCOM communicated to TIM its preliminary conclusions on the compliance of the commitments with article 76 EECC and the conditions under which it would consider making the commitments binding. TIM amended its commitments and notified a consolidated version of the of the co-investment offer on 22 December 2021. AGCOM assessed this offer and submitted to public consultation (decision n. 1/22/CONS) a draft decision in which it concluded that the offer appeared in principle compliant with article 76 EECC and proposed therefore to lift regulation, subject to certain safeguards, in respect of the new fiber network to be deployed through the co-investment. On 7 June 2022 AGCOM, nevertheless, withdrew its notification to the Commission following a request by TIM to make amendments to the offer in view of inflation.

In 2021, Italy continued on the path of reforms to simplify procedures and boost investments, both private and public, for the roll-out of fixed broadband infrastructures and the development of mobile connectivity. While progress was observed for 5G coverage, Italy has still to make progress, including to foster the development of fibre to the premises, to reach the Digital Decade targets for 2030 for fixed networks. The investments in connectivity will largely benefit from the Recovery and Resilience Plan and from an alignment of the country's strategies with the EU's Digital Decade targets for 2030. Measures to stimulate demand have also been significant; in the upcoming months a balanced distribution of the

incentives as well as continued strong competition at wholesale level to roll out fiber will be crucial to avoid deepening the digital divide within the country.

3 Integration of digital technology

3 Integration of digital technology	Italy	EU
	rank	score
DESI 2022	8	40.7
		36.1

	DESI 2020	Italy DESI 2021	DESI 2022	EU DESI 2022
3a1 SMEs with at least a basic level of digital intensity	NA	NA	60%	55%
% SMEs			2021	2021
3b1 Electronic information sharing	35%	35%	32%	38%
% enterprises	2019	2019	2021	2021
3b2 Social media	22%	22%	27%	29%
% enterprises	2019	2019	2021	2021
3b3 Big data	7%	9%	9%	14%
% enterprises	2018	2020	2020	2020
3b4 Cloud	NA	NA	52%	34%
% enterprises			2021	2021
3b5 AI	NA	NA	6%	8%
% enterprises			2021	2021
3b6 ICT for environmental sustainability	NA	60%	60%	66%
% enterprises having medium/high intensity of green action through ICT		2021	2021	2021
3b7 e-Invoices	42%	95%	95%	32%
% enterprises	2018	2020	2020	2020
3c1 SMEs selling online	10%	11%	13%	18%
% SMEs	2019	2020	2021	2021
3c2 e-Commerce turnover	8%	9%	9%	12%
% SME turnover	2019	2020	2021	2021
3c3 Selling online cross-border	6%	6%	7%	9%
% SMEs	2019	2019	2021	2021

Italy ranks 8th in the EU in Integration of digital technology. Most Italian SMEs have at least basic level of digital intensity (60%, well above the EU average of 55%). However, looking at the uptake of specific technologies, the overall performance is mixed. As result of legislative interventions, almost all Italian enterprises (95%) use e-invoices. The country also performs well in the uptake of cloud services, with 52% of enterprises using this technology (well above the EU average of 34%). The use of ICT for environmental sustainability is also relatively widespread across Italian enterprises, although below the EU average. The use of big data is low (used by 9% of Italian enterprises compared with an EU average of 14%), as is the use of technologies based on Artificial Intelligence (6% of Italian enterprises; the EU average is 8%). The uptake of e-commerce increased between 2020 and 2021, reaching 13% but remaining still below the EU average. The share of e-commerce on SMEs turnover and the share of SMEs selling cross-border recorded no significant increase.

The National Plan 'Transition 4.0' is the main tool to support the uptake of digital technologies by enterprises. Tax benefits under 'Transition 4.0' are funded by the Recovery and Resilience Plan (EUR 13.4 billion) and the complementary national fund (EUR 5.8 billion). A Scientific Committee will monitor the economic impact of the tax credits during their implementation.

The Recovery and Resilience Plan envisages the strengthening of the national network of technology transfer centres (including Competence Centres and European Digital Innovation Hubs), expected to provide services on advanced digital technologies (such as test-before-invest, training, brokerage) to 4 500 SMEs. The selection of national centres that will participate in the network of European Digital Innovation Hubs (EDIHs) is ongoing and 13 EDIH proposals had a successful evaluation result²²³ and additional 17 proposals received a Seal of Excellence.

In November 2021, Italy adopted the [Strategic Program on Artificial Intelligence 2022-2024](#), outlining 24 policy initiatives structured along 3 areas: (i) strengthening competences and attracting talent; (ii) expanding funding of advanced research in AI; and (iii) favouring the adoption of AI and its applications. The strategy builds on existing research communities and infrastructures and addresses weaknesses such as the difficulty to attract foreign talent and the poor performance when it comes to business spending on R&D, patenting and AI applications.

Moreover, the national fund for AI, Internet of Things (IoT) and blockchain was activated in December 2021 with an initial allocation of EUR 45 million²²⁴.

In advanced digital technologies, Italy also aims to strengthen its positioning in the sector of semiconductors technologies, with a planned investment to reinforce production capacity under the Recovery and Resilience Plan, and the participation in the IPCEI 'Microelectronics II'.

The country participates also in the IPCEI on 'Next Generation Cloud Infrastructure and Services', supporting innovative projects for the development of cloud infrastructure and services, with potential applications in areas such as data protection, cybersecurity, industrial automation or healthcare. The project currently is in the phase of pre-notification to the European Commission.

Italy hosts one of the supercomputers in the global top 10²²⁵ (ranked 9) as well as supercomputing centres, such as CINECA, which support research and technology transfer in the area of High Performance Computing (HPC) and quantum computing. In 2021, EUR 17.7 million from the Fund for Sustainable Growth were allocated to support the participation of enterprises in EuroHPC, to contribute to the development of a European supercomputing and data processing ecosystem²²⁶.

In 2021, a group of public entities²²⁷ created the Italian Blockchain Service Infrastructure (IBSI) along the lines of the European initiative ([EBSI](#)). The IBSI infrastructure will test national use cases enabled by distributed registers-based technologies (such as use of digital certificates, fighting against counterfeiting and climate change).

Overall, it is important that Italy supports integrated efforts to guide Italian enterprises towards digitalisation, with a policy mix supporting investments, capacity building and the enhancement of human capital. It is also crucial that Italy continues its efforts in the area of advanced digital technologies, building on its strengths and leveraging on the resources of the Recovery and Resilience Plan to reinforce its position and play a central role in the EU.

²²³ I.e. are invited for grant agreement preparation (which is not a formal commitment for funding).

²²⁴ Decree of the Minister of Economic Development of 6 December 2021.

²²⁵ [November 2021 | TOP500](#).

²²⁶ Decree of the Minister of Economic Development of 6 May 2021.

²²⁷ AgID, Infratel (MISE), Poste Italiane, Sogei and 20 other public bodies (including universities).

4 Digital public services

4 Digital public services ²²⁸	Italy	EU
	rank	score
DESI 2022	19	58.5
		67.3

	Italy	EU
	DESI 2020	DESI 2022
4a1 e-Government users	30%	40%
% internet users	2019	2021
4a2 Pre-filled forms	NA	48
Score (0 to 100)		2021
4a3 Digital public services for citizens	NA	67
Score (0 to 100)		2021
4a4 Digital public services for businesses	NA	79
Score (0 to 100)		2021
4a5 Open data	NA	92%
% maximum score		2021

Italy ranks 19th in the EU in Digital public services. Despite the continued progress, only 40% of Italian internet users resort to digital public services, well below the EU average of 65%. Italy outperforms the EU on open data policies, reaching a score of 92%, but it is still below the EU average for the availability of pre-filled forms, which presents to the users data that is already known to the public administrations. Looking at the scores measuring the supply of digital public services, Italy is very close to the EU average in services for businesses (with a score of 79, against an EU average of 82). The gap with the EU average is slightly higher in relation to the offer of digital public services to citizens (67 in Italy versus 75 in the EU).

These results do not reflect yet the boost that the Recovery and Resilience Plan is expected to have on initiatives for the digitalisation of the public administration and its services.

'[Italia Digitale 2026](#)' set important targets for the modernisation of public administration and services to be achieved with the support of the Recovery and Resilience Plan. The platform '[PA Digitale 2026](#)' helps coordinate the implementation of the Plan's measures and enables public administrations to access funding and receive assistance.

Among the measures taken, in 2021, the government published the national strategy '[Cloud Italia](#)', an important step to improve the security and efficiency of the public administration's digital infrastructure (see 'Highlight'). In the implementation of the cloud strategy, an important role will be played by the new [National Cybersecurity Agency](#) (ACN), which acts as national authority in charge of protecting the national cyberspace.

In 2021, the government published a new [National Interoperability Framework](#). This framework includes different guidelines and facilitates the creation of user-centric, mobile-first and secure digital public

²²⁸ There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

services based on Application Programming Interfaces (APIs). The guidelines streamline the technical and organisational procedures required to exchange public sector information between agencies, thus supporting the implementation of the Once-Only Principle.

Major e-government projects continued to progress, with significant achievements in 2021-2022. As of January 2022, all Italian municipalities had been migrated into the national register of resident population (ANPR), which integrates information spread across administrations into a single register. Currently, Italian citizens can verify their personal data, obtain certificates free of charge or update their residence status online.

The uptake of the e-ID system 'SPID' continued to increase. The target set by 'Italia Digitale 2026' is reaching 70% of people with an e-ID. In March 2022, the number of SPID issued was over 29.4 million (up from 18.9 million in March 2021). 12 297 public administrations and 100 private enterprises provide access to their services via 'SPID'²²⁹.

Moreover, over 27 million people had a national ID card 'CIE' (Carta di Identità Elettronica), which is equipped with a contactless microchip that enables access to online services. Following the 'Simplifications Decree' of 2020²³⁰ and the growing use of e-IDs, many public administrations allow access to their online public services through CIE ('Entra con CIE').

In parallel, the app 'IO' (a 'one-stop-shop' for digital public services) was downloaded more than 26 million times. It allows people to access services provided by about 7 000 national and local authorities, to receive notifications and store documents (e.g. certificates, receipts) in a dedicated section. For example, the application delivered automatically more than 268 million digital COVID-19 certificates to users.

In 2022, there were more than 57 million active electronic health records (EHR), although indicators on uptake by citizens, general practitioners and healthcare facilities vary considerably across regions and remain very low in some of them²³¹. Through the Recovery and Resilience Plan, the government invests a total of EUR 1.3 billion²³², both at central and local levels, to transform the EHR into a unique point of access for health data and services. This investment aims to ensure full interoperability and portability across the Italian Regions.

Finally, 8 000 public employees were reached by the project 'Digital skills for the public administration', and over 16 000 by the national coalition of digital skills²³³. Moreover, in 2022, the government adopted a new strategic plan for the reskilling and upskilling of public employees²³⁴, which acknowledges the central role of digital skills and promotes cooperation with large public and private players to enrich the training offer.

In summary, Italy has taken significant steps to simplify and incentivise the use of digital public services, although results are not yet fully visible in DESI indicators. With the support of the Recovery and Resilience Plan, the country is stepping up efforts for the efficiency and security of digital infrastructure,

²²⁹ AgID website: [Avanzamento trasformazione digitale](#).

²³⁰ [Law Decree of 16 July 2020, n.76](#).

²³¹ AgID website: [Fascicolo Sanitario Elettronico – Monitoraggio](#).

²³² As part of the measure 'Strengthening of the technological infrastructure and of the tools for data collection, data processing, data analysis and simulation' (M6C2, I 1.3), which has a total allocation of about EUR 1.7 billion.

²³³ [Strategia Nazionale per le competenze digitali – Primo rapporto di monitoraggio del Piano Operativo](#).

²³⁴ [Re-skilling the public administration. Qualified people to qualify the country](#)'.

the interoperability of data and information across public administrations, the implementation of the once-only principle and the completion of the EHR. To overcome the delays accumulated over the years, sustained implementation of the planned measures remains crucial, as well as continued attention for simplification and for the digital skills of civil servants and the Italian people.

Italian Cloud Strategy

In September 2021, Italy published the 'Strategia Cloud Italia', which sets out the path for public administrations, including local ones, to move to the cloud. The target is the migration to the cloud of 75% of Italian public administrations by 2026.

Promoting the adoption of secure, efficient, sustainable and reliable data processing infrastructures, the strategy aims to overcome a long-standing weakness of the Italian public administration. An analysis carried in 2018-2019²³⁵ showed that 95% of current Italian data centres did not meet the minimum requirements in terms of security, reliability and computing capacity, leaving a large part of digital public services vulnerable to cyber attacks or to crashes during online traffic surges.

In parallel, the strategy places a strong emphasis on the principles of privacy, data protection and data security as well as on the importance of strategic autonomy in the data processing sector. At the core of the approach, there is the identification of risks linked with different public data and service types and the most suitable cloud delivery modes (public, hybrid or private) to mitigate those risks.

The strategy is structured along three lines of action closely interlinked:

1. *Certification process of cloud services*: the objective is to establish an *ex ante* certification scheme for cloud services that can be purchased by the public administration while ensuring that these services are in line with the necessary requirements of security, reliability and compliance with the relevant regulations and the country's national interest.
2. *The development of a taxonomy to classify data and services managed by public administrations*: data and services can be classified as 'strategic', 'critical', or 'ordinary' depending on the potential threats they would be likely to pose to the country if they were to be compromised. Based on this taxonomy the most appropriate cloud delivery mode will be chosen.
3. *The creation of the National Strategic Hub (NSH)*: a national data processing infrastructure for the hosting of cloud services for 'strategic' and 'critical' public administrations' data, across interconnected data centres geographically distributed throughout the country. The NSH should ensure the highest levels of reliability, resilience and independence for the storage of critical public administrations' data. A call for tenders for its implementation was launched in

²³⁵ AgID, [Censimento del Patrimonio ICT della PA 2018-2019](#).

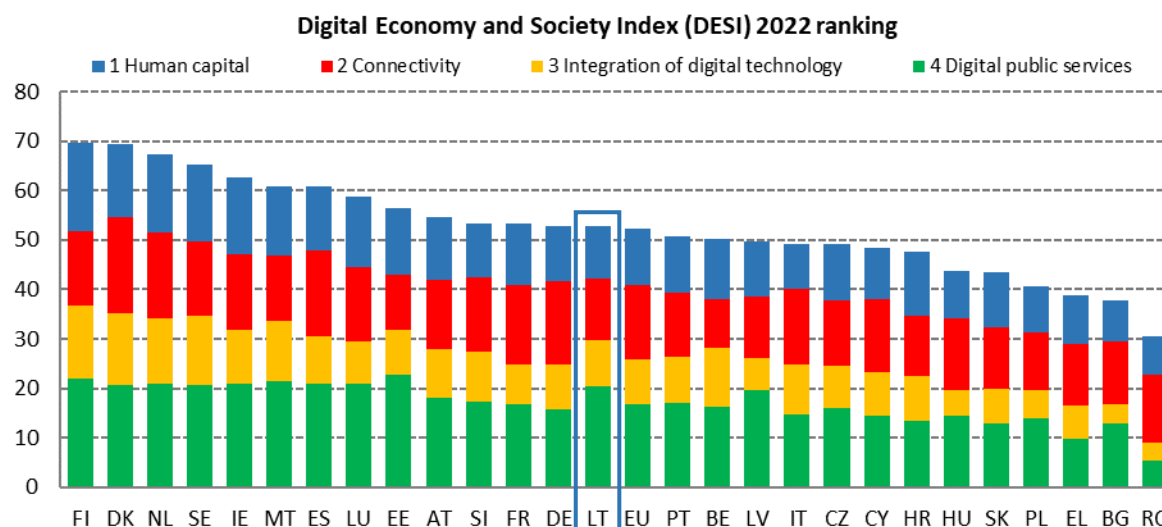
January 2022.

Between December 2021 and January 2022, the government adopted a set of national acts to implement the strategy and laid down the technical standards together with the procedures for certifying cloud services and classifying public administrations' data and services²³⁶.

²³⁶ For more information, see the website of the [Ministry of Technological Innovation and Digital Transformation](#), [AgiD](#) and [ACN](#).

Lithuania

DESI 2022	Lithuania		EU
	rank	score	score
	14	52.7	52.3



Lithuania ranks 14th of 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI). In digital public services the country performs very well, in human capital and integration of digital technology is at par with the EU average, but it still underperforms in connectivity, in particular in 5G. Being close to the average in many indicators, the country's progress has slowed down during the last five years and catch-up with the most digitalised EU countries has not been as speedy as it could have been.

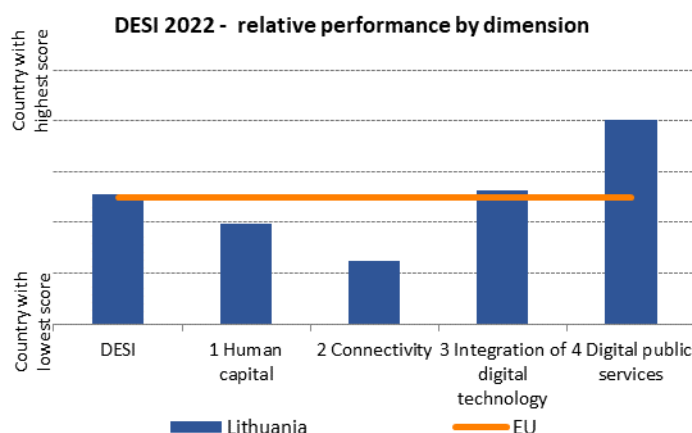
Lithuania has still room to improve the digital skills of its population and to invest in the reskilling and upskilling of its workforce, as it currently ranks 20th in the human capital dimension of the DESI. Noticeably, Lithuania keeps on performing above the EU average in terms of gender balance among ICT professionals.

In connectivity, the picture is mixed. The roll-out of Fibre to the Premises (FTTP) has been steadily increasing and reached a coverage of 78% of households, significantly above the EU average of 50%. On the other hand, Lithuania is among the EU Member States that have assigned the least spectrum for 5G – only 5%, compared to the EU average of 56%. Going forward, addressing the low level of 5G spectrum assignment is critical to foster 5G deployment, thereby increasing the possibility of reaching the targets set for the Gigabit Society and the 2030 Digital Decade.

On the integration of digital technology, Lithuania performs in line with the EU average. It scores around the EU average for SMEs with at least basic digital intensity and below the average for the integration of advanced technologies like artificial intelligence, big data and cloud.

Lithuania has kept on improving its digital public services, performing much better than the EU average. In 2021, the country not only continued to develop its Electronic Information System for Health Services (ESPBI IS), which connects all healthcare providers and pharmacies, but also strived to improve its electronic personal identification solution (ATK). Lithuania has also invested heavily in developing digital government solutions through its GovTech sandbox, which brought forward a number of initiatives in 2021. All those initiatives are expected to support Lithuania's contribution to the Digital Decade targets in those areas.

A good information and digital technology infrastructure is one of the core principles of [Lithuania's 2030 national progress strategy](#). Aside from this main strategy, Lithuania also has many other targeted plans in a variety of areas, including the [2020-2030 Lithuanian industry digitalisation roadmap](#), and the [National Cybersecurity Strategy 2018-23](#). While Lithuania is moving in the right direction, it is important that it matches its investments with strategic reforms, especially in the area of digital skills in the educational system, and increases its support for the digitalisation of SMEs.



In the wake of Russia's invasion of Ukraine, the RCDC initiated a pilot project 'Securing Cyber Space of Ukraine Together' in February of 2022. This project was announced in order to attract more stakeholders and governmental organisations to work together in order to share relevant cyber information about Ukraine. At the same time, the relevant bodies including the National Cyber Security Centre, have given special attention to safeguarding Lithuania's critical information infrastructures and state information resources following the start of the war in Ukraine. The Centre instructed the managers of these resources to strengthen the cyber security of their information systems and took other preventive measures.

Digital in Lithuania's Recovery and Resilience Plan (RRP)

Lithuania is dedicating a considerable proportion of its national Recovery and Resilience Fund (RRF) grants (EUR 700 million or 31.5% of the total allocation) to the digital transformation²³⁷.

²³⁷ Each recovery and resilience plan has to dedicate at least 20% of the plan's total allocation to digital objectives. To this end, the plans had to specify and justify to what extent each measure contributes fully (100%), partly (40%) or has no impact (0%) on digital objectives, using Annex VII of the RRF Regulation. Combining the coefficients with

Its main objectives for the next 12 months will form the basis for innovative technological solutions in business and daily life, the effectiveness of public services, the transformation of public information technology governance and the steps towards 5G.

the cost estimates of each measure allows assessing to what degree the plan contributes to digital objectives and whether it meets the 20% target.

1 Human capital

1 Human capital	Lithuania		EU
	rank	score	score
DESI 2022	20	42.5	45.7

	DESI 2020	Lithuania DESI 2021	DESI 2022	EU DESI 2022
1a1 At least basic digital skills % individuals	NA	NA	49% 2021	54% 2021
1a2 Above basic digital skills % individuals	NA	NA	23% 2021	26% 2021
1a3 At least basic digital content creation skills²³⁸ % individuals	NA	NA	61% 2021	66% 2021
1b1 ICT specialists % individuals in employment aged 15-74	3.1% 2019	3.3% 2020	3.8% 2021	4.5% 2021
1b2 Female ICT specialists % ICT specialists	24% 2019	24% 2020	24% 2021	19% 2021
1b3 Enterprises providing ICT training % enterprises	11% 2019	14% 2020	14% 2020	20% 2020
1b4 ICT graduates % graduates	3.1% 2018	3.7% 2019	4.0% 2020	3.9% 2020

In the human capital dimension, Lithuania ranks 20th of 27 EU countries. Almost half of the population commands basic digital skills, with the EU average above this threshold (49% vs. 54%). A similar difference is shown by the data on above basic digital skills (23% vs. 26%). ICT graduates currently account for 4% of all graduates in Lithuania, it also performs well above the EU average in terms of gender balance in ICT. Lithuanian enterprises are modestly investing in ICT training and 14% of them offered specialised ICT training to their employees, in comparison to the EU average of 20%.

Although Lithuania does not currently have a dedicated digital skills strategy, it runs a number of initiatives to strengthen the digital skills of its population, including the [2020-2030 Industry Digitisation Roadmap](#), and the [2013-2022 State Education Strategy](#). It has developed the [National Skills Strategy](#) in cooperation with the OECD and is reviewing the curricula of primary and secondary schools, with the aim of strengthening also the development of digital competences along with other competences, as well as adult learning. One of the priorities of the [2021-2030 National Digitalisation Development Programme](#) is to improve the digital skills of the socially vulnerable groups, such as disabled or older people, as well as people with lower incomes.

Under the RRF-funded [EdTech project](#), Lithuania supports the transformation of the digital education of the country, which is one of the government's priorities. The project includes funding digital solutions and digital content in the classrooms. Furthermore, to improve the connectivity of schools, a project

²³⁸ Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

'Creating a safe electronic environment for children,' with budget of EUR 3.5 million from the European Social Fund, is financing 2 000 Wi-Fi hotspots there.

Lithuania has also taken measures to upskill and reskill workers. There are specialised IT vocational education and training (VET) schools in Vilnius and Kaunas, offering state-funded education in close cooperation with the industry. Lithuania is currently upgrading its national policies on -qualifications gained outside the formal system.

Lithuania excels in terms of gender equality in the digital sector, which contributes towards the achievement of the Digital Decade gender convergence target. The country is currently in fourth position in the EU with 24% of ICT positions filled by women. Several initiatives, increasing the inclusion of women in Science, Technology, Engineering and Mathematics (STEM), are in implementation, for example a mentorship programme Women Go Tech, supporting women's careers in IT and engineering. Regarding stakeholder engagement, Lithuania works closely with trade associations such as the [INFOBALT](#). In December 2021, the New Generation Lithuania event showcased different possibilities and initiatives for reskilling and upskilling. In April 2021, a two-part community-led event was organised by the Lithuanian National Digital Coalition together with the European Digital Skills and Jobs Coalition, which addressed the role of the country's digital skills initiatives in promoting a post-pandemic recovery. Lithuania organised 444 activities (158.9 per million inhabitants) for the 2021 EU Code Week. Most of those activities (96%) were held in Lithuanian schools. There was a total of 18 709 participants, of whom 47% were women and girls.

Lithuania continues to promote digital skills at all levels as part of its national strategies and initiatives. To tap into the full potential of the digital society and economy, Lithuania should continue following this path and integrate further its' various projects and initiatives in this area. A dedicated digital skills strategy, coordinated by the Ministry of Education, Science and Sport, which centralises digital policies, could strengthen and provide the continuity of all Lithuanian activities in this area.

2 Connectivity

2 Connectivity	Lithuania		EU
	rank	score	score
DESI 2022	23	49.4	59.9

	DESI 2020	Lithuania DESI 2021	DESI 2022	EU DESI 2022
2a1 Overall fixed broadband take-up % households	68% 2019	65% 2020	67% 2021	78% 2021
2a2 At least 100 Mbps fixed broadband take-up % households	32% 2019	31% 2020	36% 2021	41% 2021
2a3 At least 1 Gbps take-up % households	<0.01% 2019	0.23% 2020	0.72% 2021	7.58% 2021
2b1 Fast broadband (NGA) coverage % households	69% 2019	71% 2020	85% 2021	90% 2021
2b2 Fixed Very High Capacity Network (VHCN) coverage % households	61% 2019	67% 2020	78% 2021	70% 2021
2b3 Fibre to the Premises (FTTP) coverage % households	61% 2019	67% 2020	78% 2021	50% 2021
2c1 5G spectrum Assigned spectrum as a % of total harmonised 5G spectrum	0% 04/2020	5% 09/2021	5% 04/2022	56% 04/2022
2c2 5G coverage²³⁹ % populated areas	NA	0% 2020	33% 2021	66% 2021
2c3 Mobile broadband take-up % individuals	74% 2018	74% 2018	85% 2021	87% 2021
2d1 Broadband price index Score (0-100)	79 2019	75 2020	89 2021	73 2021

With an overall connectivity score of 49.4, Lithuania ranks 23rd among EU countries.

The roll-out of Fixed Very High Capacity Network (VHCN) is increasing steadily and covers 78% of households, which is above the EU average of 70%. However, the take-up of 1 Gbps connections is very low, with less than 1% of households. FTTP coverage has increased from 67% in 2020 to 78% in 2021 which is above the EU average of 50%. In rural areas the increase has been significant, rising from 23.3% to 41.1%. The roll-out of fast broadband (NGA) has increased sharply and covers 85% of households. Rural areas are still lagging behind, even though coverage increased sharply from 29.6% of households to 51.8%. The take-up of fixed broadband with speed of at least 100 Mbps is only 36%, slightly below the

²³⁹ The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

EU average of 41%. In terms of fixed broadband take-up, 67% of all households subscribe to a kind of fixed internet access, which is below the EU average of 78%.

There is a growing number of households which rely exclusively on mobile internet, given that its quality is sufficient for their needs and the speed is similar to available fixed broadband. According to 'drive tests' measurements which have been done in the whole territory of Lithuania by the Communications Regulatory Authority (RRT) and consisted of 18 000 tests per mobile operator, the average download speeds in 2021 per mobile operator were 29, 52, 61 and 105 Mbps²⁴⁰. At the end of 2021 there were 764 100 data-only SIM cards, representing 22.1% of all SIM cards with internet.

The National Broadband Plan has been updated in 2021 to cover the next programming period 2021–2027. It provides that internet speeds of at least 100 Mbps should reach not only households in urban areas, but also households in remote rural areas and public institutions. EUR 75 million will be allocated to develop high-speed internet access by building communication towers and laying of fibre lines.

The ongoing Next Generation Access (NGA) internet connection deployment in Lithuania will ensure data transmission speeds of 30 Mbps and higher. In order to achieve the objective of making NGA available in the whole of Lithuania, the NGA internet access infrastructure development project [RAIN3](#) (initiated in 2018) is ongoing. So far, 1 015 km (compared to 778 km in 2020) of fibre cable lines have been deployed (out of 1 200 km planned in total), and 290 telecommunication facilities have been connected. While none of the telecommunication towers (out of 25 planned) have been built, a tender for their construction has been announced. The new towers are planned to be built by the end of 2023. In areas where installation of the communication towers is not possible, the Gigabit Passive Optical Network (GPON) compression infrastructure is planned with around 8 500 connection points.

In 2021, the RRT on the initiative of the Ministry of Transport and Communications ran a project to create the optimal model to promote the use of embedded subscriber identification modules (eSIMs), as well as over-the-air provisioning and provider switching in Lithuania. The [results](#) of the project were presented in December 2021.

The Ministry of Transport and Communication has foreseen the measure 'Step towards 5G. Innovation in mobility' in Lithuania's Recovery and Resilience (RRF) plan 'New Generation Lithuania' under the Digital Transition Component and has allocated EUR 24.5 million for its implementation. The main goal is to create sandbox regime (financial, legal, regulatory environment) for testing and practical application of innovative 5G-based solutions in various sectors to address the most pressing challenges of society, business and public sector, as well as to promote cooperation between industry and academia, internationalization of innovation, creation of value-added jobs, involvement of Lithuanian business and science in international value chains, and development of new business models. 5G based innovations will be developed and tested via open and thematic calls for tender as well a call for start-ups. The expected opening date of the calls is Q3 2022. The measure shall be completed by 31 December 2025.

Lithuania is among the EU Member States that have assigned least spectrum for 5G only 5% compared to the EU average of 56%, and 5G coverage is also at a low level with only 33% coverage in populated

²⁴⁰ <https://www.rrt.lt/wp-content/uploads/2022/03/2021m-JRPK-ataskaita-belaidis-internetas-registruota-1.pdf>

areas, only half of the EU average of 66%. Regarding the 5G pioneer spectrum and in particular the 700 MHz band, the broadcasting service in the Republic of Belarus, has been decommissioned ensuring no interference from those services, but there is no information on the Broadcasting Development Concept from the Russian Federation. Nevertheless, the auction for granting access to the 713-733 MHz and 768-788 MHz frequency ranges (i.e. 2x 20 MHz portion of the 700 MHz band) was announced on 25 October 2021, and interested participants were asked to submit the necessary auction documents by 25 March 2022. There is still no cross-border coordination agreement with the Russian Federation on the 3.6 GHz band (the Russian armed forces use the 3.5 GHz frequency for radars in Kaliningrad), but the auction of the 3.4-3.7 GHz band was announced on 31 March 2022, and the deadline for the submission of the auction documents by interested participants, was 31 May 2022. It was planned that the 26 GHz band will be allocated if there is market demand. By the (end of April 2022), Lithuania had allowed the use of the 700 MHz band (EU weighted average 67.9%), 16.3 % of the 3.4-3.8 GHz band (EU average 75%), and none of the 26 GHz band (EU average 29.1%). Overall, Lithuania has authorised the use of only 5.4% of the total harmonised 5G pioneer spectrum, compared to an EU average of 56%. In relation to the 2025 targets and in particular the 5G coverage, it is important to note that the [Guidelines for the development of Fifth Generation Mobile Communications \(5G\) of Lithuania \(2020-2025\)](#) foresee that commercial 5G services will be launched at the latest by the end of 2022, while commercial 5G services should be available in at least one of Lithuania's five largest cities in terms of population - Vilnius, Kaunas, Klaipėda, Šiauliai or Panevėžys - at the latest by the end of 2023. Lastly, by the end of 2025, 5G should be available in urban areas, on international land transport corridors (Via Baltica, Rail Baltica) and other main motorways and railway lines of national importance, as well as in airports and seaports. Lastly, by the end of 2025, 5G should be available in urban areas, on international land transport corridors (Via Baltica, Rail Baltica) and other main motorways and arterial railway lines of national importance, as well as in airports and seaports. As a result, Lithuania lags substantially behind in 5G deployment, but mobile operators are upgrading their mobile networks by installing equipment to be ready to launch 5G as soon as the auctions are completed.

Main market & regulatory developments

The main market development was the start of the Starlink satellite internet access in Lithuania at the end of 2021 using satellites operated by SpaceX.

From 1 July 2021, UAB Eurocom was merged with UAB Bitė Lietuva, which therefore took over all the rights and obligations as service provider from UAB Eurocom. Retail digital satellite television services provided by another Bitė group company, AS TV Play Baltics, under the Home3 brand, were transferred to UAB Bitė Lietuva.

The incumbent operator Telia Lietuva AB remains the largest operator on the fixed market. On the mobile telephone market UAB Tele2 is the largest operator followed by Telia Lietuva AB and UAB Bitė Lietuva.

Lithuania has amended the law on Electronic Communications so that from 1 May 2022 the Communications Regulatory Authority (RRT) will be managed and decisions be adopted by a collegial management body – the Council of the Communications Regulatory Authority, instead

of the current structure with a single director. The Council will consist of 5 members.

The transposition of the European Electronic Communications Code (EECC) was in 2021 still ongoing. After infringement proceedings²⁴¹ due to lack of notification of transposition measures. A Reasoned Opinion was sent to Lithuania on 23 September 2021. On 11 November 2021, Lithuania adopted the law amending the Law on Electronic Communications in Lithuania, which transposes most of the provisions of the European Electronic Communications Code. Lithuania notified complete transposition of the EECC the 14 April 2022.

As regards market reviews²⁴², price obligations from the current fixed and mobile termination markets have been withdrawn in order to ensure legal certainty for Lithuanian fixed and mobile operators when the Delegated Regulation setting fixed and mobile termination rates entered into application, i.e., as of 1 July 2021.

The number of consumer complaints in 2021 (311) decreased slightly compared with the number of complaints in 2020 (380). Most of them were related to billing (96 complaints), quality of service (48), and the termination of contracts (43).

The goals of the 2021–2027 Lithuanian National Broadband Plan is broadly aligned with the 2025 Gigabit Society objectives, with the exception that the broadband target of at least 100 Mbps is set for 2027 instead of 2025. The National Broadband Plan will have to be updated to align it with the goals set for the 2030 Digital Decade that provides that all European households should be covered by a Gigabit network.

While it is positive and encouraging that Lithuania is using the RRF funding to test 5G technologies, addressing the low level of 5G assignment is critical to foster 5G deployment, thereby increasing the possibility of reaching the targets set for the Gigabit Society and the 2030 Digital Decade.

²⁴¹ (INFR(2021)0060)

²⁴² cases LT/2021/2322-2323 ‘Wholesale call termination on individual public telephone networks provided at a fixed location and wholesale voice call termination on individual mobile networks in Lithuania –withdrawal of price remedies’

3 Integration of digital technology

	rank	score	score
DESI 2022	13	37.2	36.1

		Lithuania		EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
3a1 SMEs with at least a basic level of digital intensity	NA	NA	57%	55%
% SMEs			2021	2021
3b1 Electronic information sharing	48%	48%	45%	38%
% enterprises	2019	2019	2021	2021
3b2 Social media	24%	24%	22%	29%
% enterprises	2019	2019	2021	2021
3b3 Big data	14%	11%	11%	14%
% enterprises	2018	2020	2020	2020
3b4 Cloud	NA	NA	28%	34%
% enterprises			2021	2021
3b5 AI	NA	NA	4%	8%
% enterprises			2021	2021
3b6 ICT for environmental sustainability	NA	74%	74%	66%
% enterprises having medium/high intensity of green action through ICT		2021	2021	2021
3b7 e-Invoices	29%	27%	27%	32%
% enterprises	2018	2020	2020	2020
3c1 SMEs selling online	24%	28%	32%	18%
% SMEs	2019	2020	2021	2021
3c2 e-Commerce turnover	12%	15%	18%	12%
% SME turnover	2019	2020	2021	2021
3c3 Selling online cross-border	13%	13%	12%	9%
% SMEs	2019	2019	2021	2021

In the integration of digital technology dimension, Lithuania ranks 13th of 27 EU countries.

Lithuania has continued to perform slightly above the EU average in most of the indicators for the integration of digital technologies. It has made progress in the areas of SMEs selling online and overall e-commerce turnover, where it performs above the EU average. Some indicators, however, such as electronic information sharing or big data, have declined slightly and will soon need further attention. Only 22% of Lithuanian enterprises actively use social media, 28% uses cloud solutions and 4% is integrating AI technologies into their operations. Big Data are not yet widely used. This shows that more effort needs to be made to reach the 2030 Digital Decade target of at least 75% of enterprises taking up cloud services, Big Data and AI.

Lithuania is conducting in talks about closer cooperation with Taiwan in the area of semiconductors. Taiwan is currently setting up a USD 200 million fund to facilitate development of semiconductors in Lithuania. Lithuania is also considering taking part in the EU's IPCEI on semiconductors.

As part of the RRF plan, EUR 24.5 million has been set aside for the 'Step towards 5G Innovation in Mobility' plan, which will focus on applying 5G connectivity in areas such as autonomous mobility,

drones, the internet of things, virtual reality and robotics. These projects will begin to be developed in the first quarter of 2022 and will take from 6 to 36 months. An additional EUR 15 million has been earmarked for the development of AI products and services.

Lithuania has made efforts to increase the take-up of digital technology by SMEs, to contribute to the [EU target](#) of 90% of Union SMEs having at least a basic level of digital intensity. Lithuania has been implementing the E-komercijos modelis, the [COVID-19](#) measure, which is funded by React EU (EUR 40 million). This policy encourages companies to adopt digital technologies by offering funding to SMEs to support them in re-engineering and digitalising their processes to increase revenue.

Lithuania has also taken important steps to increase the number of successful digital start-ups in the country. The Agency for Science, Innovation and Technology is implementing several projects dedicated to creating new tech start-ups. Among these projects is the TechHub, a programme which provides mentoring and training for the companies, claiming to successfully set up more than 70 companies.

The European Digital Innovation Hubs (EDIHs) will provide access to technical expertise and experimentation for enterprises. The selection process of the Digital Innovation Hubs that will participate in the network of EDIHs is ongoing. Three Lithuanian EDIH proposals have a successful evaluation result.²⁴³ In the development of advanced technology, Lithuania has also taken important steps in areas such as artificial intelligence: the project supported 52 start-ups and companies to promote and integrate the use of AI. The [AI Boost](#) project supported 52 start-ups and companies to promote and integrate the use of AI. In 2021, Lithuania joined the European Grid Infrastructure (EGI), in order to deliver high-performance computing (HPC) resources for academic and public organisations, as well as for SMEs.

Lithuania has made progress in integration and development of digital technologies. It is important that Lithuania matches its investments with strategic reforms, especially in the area of digital skills in the educational system, and balances the investments made in the public and private sectors, with a special focus on SMEs.

Highlight: Cyber Rapid Response Teams and Mutual Assistance in Cyber Security

Lithuania's cybersecurity policy is currently defined in the [2018-2023 National Cyber Security Strategy \(NCSS\)](#). An update of the policy and possibly replacement of this strategy with the National Cyber Security Development Programme is planned by the end of 2022. Cybersecurity has also been identified as a key element of the National Security Strategy presented in December 2021. Lithuania, together with other Member States, implements the EU project 'Cyber Rapid Response Teams and Mutual Assistance in Cyber Security (CRRTs).' The aim of the project is to provide support to cyber threats in time of need to the participation EU countries, EU institutions, CSDP Missions and Operations as well as other partners. Currently, the participating countries are Croatia, Estonia, Lithuania, the Netherlands, Poland and Romania,

²⁴³ I.e., are invited for grant agreement preparation (which is not a formal commitment for funding).

while Belgium, Finland, France, Greece, Italy, Slovenia, Spain have an observer status. Lithuania runs also the Kaunas Regional Cyber Defence Centre (RCDC) monitoring and analysing threats in the region, including partners from Ukraine and Georgia.

4 Digital public services

4 Digital public services ²⁴⁴	Lithuania	EU
	rank	score
DESI 2022	10	81.8
		67.3

	DESI 2020	Lithuania DESI 2021	DESI 2022	EU DESI 2022
4a1 e-Government users	67%	69%	70%	65%
% internet users	2019	2020	2021	2021
4a2 Pre-filled forms	NA	NA	92	64
Score (0 to 100)			2021	2021
4a3 Digital public services for citizens	NA	NA	82	75
Score (0 to 100)			2021	2021
4a4 Digital public services for businesses	NA	NA	93	82
Score (0 to 100)			2021	2021
4a5 Open data	NA	NA	89%	81%
% maximum score			2021	2021

In the Digital public services dimension, Lithuania ranks 10th of 27 EU countries.

Lithuania continues to perform well above the EU average in terms of providing digital public services for both individuals and businesses. The number of e-government users has increased steadily to 70% of internet users, up from 67% in 2019. On pre-filled forms, Lithuania scores significantly above the EU average (92 compared to 64). It also scores well on open data (89% compared to 81% for the EU). The country is progressing slowly but steadily towards the Digital Decade target of all public services being available online.

Lithuania is currently implementing a reform to help it achieve the EU [targets](#) of 100% of key public services being provided online. The current reforms are expected to be completed by 2026. These reforms, which provide for further digitalisation of services and for improving the level of maturity of existing digital services, include integration of digital technologies in the justice system. In December 2021, Lithuania adopted new rules for digitalised document transfer to the State archives. These rules are set to enter into force in 2023.

Regarding the objective of having a public, digital, interoperable identification solution, Lithuania has put in place a Public Key Infrastructure (PKI), as well as a personal ID card both for electronic identification and for electronic signature. Both have been set up according to the requirements of Regulation 910/2014 on electronic identification and trust services for electronic transactions in the internal market and repealing Directive 1999/93/EC (eIDAS). Over 15 Member States currently accept the Lithuanian scheme. This is a step towards the 2030 Digital Decade target of 80% of the population

²⁴⁴ There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

using a digital ID. Lithuania offers also a large available of qualified trust services (5 out of 9 possible types) to its citizens.

Lithuania has made good progress in digital public services. A good example of this is the GovTech sandbox, which focuses on finding digital solutions for better policy making, amongst other activities. Set up by the Ministry of Economy and Innovation and run by the Agency for Science Innovation and Technology, GovTech has funded around 40 e-government solutions via contests and procurement. In total, EUR 2 million has been invested in GovTech solutions, many of which were created at the end of 2021. These include a smart mental health assistant for the prevention of relapses, and a tool for monitoring, analysing and evaluating the activities of Vilnius's educational institutions. Lithuania is currently developing a digital legislative transfer tool to implement GovTech solutions.

The Lithuanian government also uses digital solutions to have the exchanges with the public. The [e-citizen](#) service for instance, involves the public in decision-making, by making it easier to contact government agencies electronically, and to monitor the progress of petitions, applications or public consultations. The [e-seimas](#) service enables the public to participate in the legislative process by registering public legislative initiatives, and registering comments and proposals to legislative acts, among other functions.

Lithuania excels in providing online medical records. The Electronic Information System of Health Services & Cooperation Infrastructure (ESPBI IS) currently hosts 100% of Lithuanian healthcare providers, as well as pharmacies. All national healthcare subjects in Lithuania (LNSS) are required to use the system when providing health-related services. In November 2021 alone, 7 million medical records were uploaded to the ESPBI IS, which is under continuous development.

Another area in which Lithuania records good results is the implementation of artificial intelligence (AI) solutions in decision-making processes. One example is the municipal administration's solution for greening the city of Vilnius, which uses satellite pictures and AI to identify the city's less sustainable areas.

Using RRF funds, Lithuania plans to modernize State Information Resources Interoperability Platform ([Electronic Government Gateway](#)) by implementing an advanced and convenient search for information on public and administrative services provided. It will facilitate the users to order and receive e-services from one place and allow further monitoring of the provision of these services.

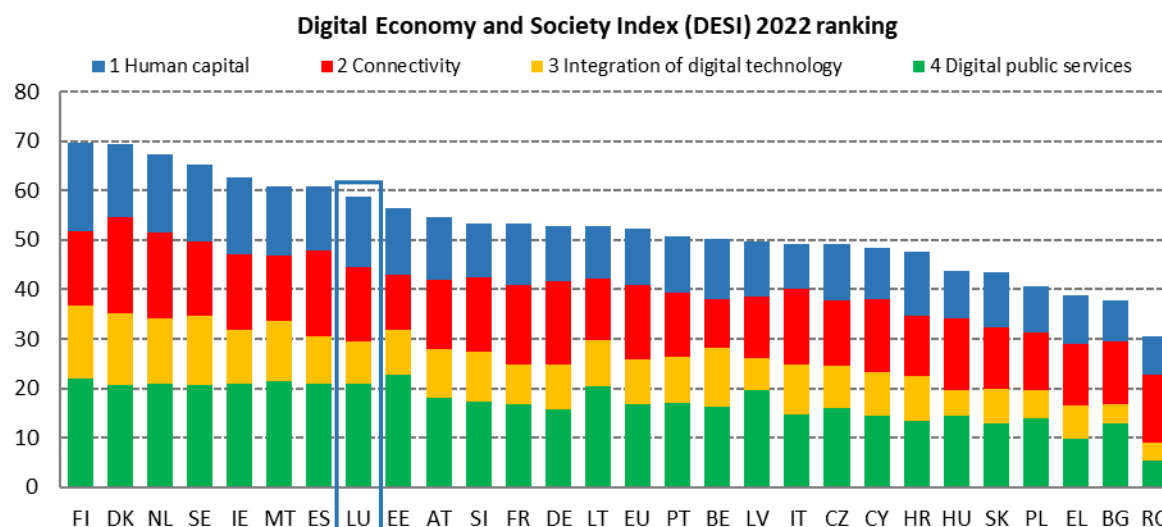
Open Data, one of the strategic goals of the Lithuanian state, has been put forward in the new draft of the Lithuanian Digitization Development Programme for 2021–2030. Lithuania [Open Data Portal](#) became fully [operational](#) in June 2020. It is the single access point to all open data sets in Lithuania. Currently, the portal provides more than 1 700 metadata including 1 400 linked to data sources and described within the DCAT dictionary requirements. More than 500 metadata are available to users in machine readable formats (CSV).

Overall, Lithuania is advancing well in the provision of digital public services, but even greater improvements are necessary to make them even better, more user-friendly, and more easily accessible for the public and businesses. A better-coordinated approach and concerted actions regarding e-services

would help the public and business find the services they need and would allow government bodies to set up the new services and automate the existing ones further.

Luxembourg

DESI 2022	Luxembourg		EU
	rank	score	score
DESI 2022	8	58.9	52.3



Luxembourg ranks 8th of 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI). However, Luxembourg's performance growth is slower than that of other countries' with similar DESI scores. Luxembourg raised its score by 6% on average every year between 2017 and 2022, which is amongst the lowest growth rates in the EU²⁴⁵. The country's share of ICT specialists and graduates is higher than the EU average, but there is still a shortage of ICT specialists which may impede the digitalisation of the Luxembourg economy. Luxembourg continues implementing a range of strategies and initiatives to boost the digital skills of its population. The competent national authorities continued to work on an initiative for children and young people in the school system, and to support advanced digital skills training for industry, education, research and the public sector. A coalition of private and public sector bodies continues to organise a range of thematic digital skills webinars. 64% of 16-74 year-olds in Luxembourg have at least basic digital skills, compared with the EU average of 54%. The country reports an increase in the share of ICT specialists as a percentage of total employment, and in this respect is well above the EU average (6.3% and 4.3% respectively). Almost 20% of ICT specialists are female, slightly above the EU average of 19%, reflecting a sharp increase of four percentage points since 2019.

Luxembourg's new strategy for ultra-high-speed connectivity is intended to accelerate uptake and further development of Very High Capacity Network (VHCN) infrastructure and related services, focusing

²⁴⁵ Please refer to section 1.3 of the DESI 2022 horizontal chapter.

on fixed connectivity. By 2025, every household should have a minimum connection speed of at least 100 Mbps downstream and 20 Mbps upstream. The transition of households and businesses to more efficient and sustainable technologies is intended to be accelerated by stimulating uptake of and demand for connectivity at these speeds. As part of the new strategy, a careful assessment of the possible needs for public funding mechanisms will be based on a detailed mapping of existing fixed infrastructure. The priority is to cover the less than five per cent of the population that does not have access to 100 Mbps today, in order to avoid a digital divide. Under the EU Digital Decade targets, Luxembourg continues to be well on track to meeting the fixed broadband targets. As for mobile connectivity, average LTE coverage stands at 98.4%, well above the EU average. 5G services were commercially launched relatively late, and total 5G coverage still stands at 13%, lagging significantly behind the total EU average of 66%. Investment by the mobile operators in 5G radio access infrastructure is crucial to increasing 5G coverage.

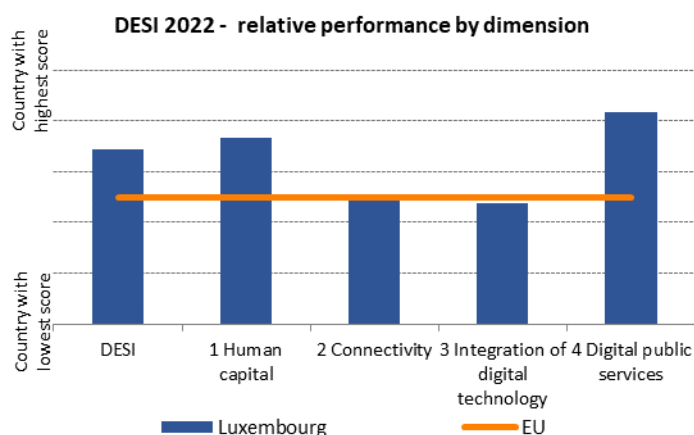
Luxembourg promotes the uptake of strategic digital technologies by businesses. The country invests in a high-performance computer and in 2019 it launched a national public-sector blockchain that is used for exchanging information between the government and banks as part of the student loans authorisation process. Moreover, the country operates nodes of the European Blockchain Service Infrastructure (EBSI), which will provide access to services such as digital diplomas to request a credential for a given digital identity. The country also supports the deployment of digital technologies in the broader business sector, including SMEs. Continued support could improve Luxembourg's contribution to the EU Digital Decade target of 90% of SMEs having at least a basic level of digital intensity. SMEs can benefit from public-private partnerships leveraging knowledge from accredited digitalisation experts. In June 2021 the Ministry of the Economy published a roadmap (*Ons Wirtschaft vu muer*) to accelerate the green transition and digital transformation of the economy and society, including through the creation of a national technological platform to exchange, process and govern data. Luxembourg performs well on the share of businesses that analyse big data (19% versus the EU average of 14%, ranking 9th). However, it consistently lags behind the EU average on the share of businesses that use intermediate or sophisticated cloud services (29% versus an EU average of 34%).

The country also promotes the use of digital technologies in the public administration. The 2020 and 2021 'AI4Gov'²⁴⁶ calls for projects to experiment with artificial intelligence (AI) and data science resulted in the implementation of three experimentation projects that are currently still ongoing. One example is 'Extopia', which is about extraction of topographic objects held by the administration of Cadastre and Topography. In 2021, the Government IT Centre counts 107 public entities using the 'GovCloud'²⁴⁷ for public sector projects. The GovCloud offers more following the acquisition of specialised equipment including graphics processing units, processors adapted to AI calculations in order to enable public sector bodies to achieve their AI projects.

²⁴⁶ The 'AI4Gov' initiative was launched in 2019 and originally six teams received funding for projects on AI in public administration.

²⁴⁷ The Government IT Centre has operated the GovCloud since 2016. GovCloud is a sovereign private cloud for the public sector and managed by the infrastructure-as-a-service principle. Main advantages are reduced costs and increased security.

It is important that Luxembourg's multiple initiatives and programmes which are in many cases first targeted at the public sector, are structured in such a way that they have spill-over effects and support the digitalisation of the private sector. This will subsequently result in attracting private investments, high-tech businesses and a highly skilled workforce.



The existing governmental committee for evaluating cyber risk is actively monitoring cyber threats. Among these is also the evolution of the threat landscape in relation to Russia's invasion of Ukraine.

The government IT centre is developing specific online forms and online procedures to help ease the management of people fleeing from Ukraine as well as their integration. For instance, allowing children to go to school as quickly as possible upon their arrival in Luxembourg.

Digital in Luxembourg's Resilience and Recovery Plan (RRP)

Luxembourg's RRP has a digital share of 31.6%²⁴⁸. In 2021 and 2022, its measures are mainly focused in the areas of digital skills and digital public services. In 2022, Luxembourg's actions in the RRP provide that the single digital register of health professions, which collects relevant administrative and professional information allowing for a better management of health professionals, is operational; the connection of two sites through the establishment of a terrestrial network in the framework of the Luxembourg QCI Laboratory²⁴⁹; working on a solution for virtual appointments between individuals or businesses and the public

²⁴⁸ Each RRP has to dedicate at least 20% of the plan's total allocation to digital objectives. To this end, the plans had to specify and justify to what extent each measure contributes fully (100%), partly (40%) or has no impact (0%) on digital objectives, using Annex VII of the RRF Regulation. Combining the coefficients with the cost estimates of each measure allows assessing to what degree the plan contributes to digital objectives and whether it meets the 20% target.

²⁴⁹ The ultra-secure quantum communication infrastructure (QCI) is intended to enhance security of sensitive data communication within the public and private sectors. The project also consists of developing and deploying a national testbed to be fully integrated into an EU multi-country project. The network is not planned to be accessible to the private sector during the RRP timeframe (until 31 August 2026). The project is oriented to communication between participating Member States.

administration enabling exchanges via videoconference on web browsers.

For 2021, Luxembourg had committed to providing training to employees and jobseekers under the 'future skills' and 'digital skills' initiatives²⁵⁰ and adopted a strategy running until 2025 for the operational and digital transformation of the services of the Luxembourgish employment administration. The country reported it installed a central platform allowing for electronic management of documents and exchanges of documents between public administrations, improving document management by public administrations and reported it deployed a mobile version of MyGuichet²⁵¹, installed on over 220 000 devices.

²⁵⁰ See Section 1 on 'Human Capital'

²⁵¹ See Section 4 on 'Digital Public Services'

1 Human capital

1 Human capital	Luxembourg		EU
	rank	score	score
DESI 2022	6	57.8	45.7

	Luxembourg			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
1a1 At least basic digital skills % individuals	NA	NA	64% 2021	54% 2021
1a2 Above basic digital skills % individuals	NA	NA	32% 2021	26% 2021
1a3 At least basic digital content creation skills²⁵² % individuals	NA	NA	80% 2021	66% 2021
1b1 ICT specialists % individuals in employment aged 15-74	6.1% 2019	6.3% 2020	6.7% 2021	4.5% 2021
1b2 Female ICT specialists % ICT specialists	16% 2019	20% 2020	20% 2021	19% 2021
1b3 Enterprises providing ICT training % enterprises	27% 2019	21% 2020	21% 2020	20% 2020
1b4 ICT graduates % graduates	5.8% 2018	5.0% 2019	6.4% 2020	3.9% 2020

On the human capital dimension, Luxembourg ranks 6th. The country ranks above the EU average on the three digital-literacy indicators. 64% of people in Luxembourg have at least basic digital skills compared to the EU average of 54%. People in Luxembourg score also above the EU average in ‘above basic digital skills’ and in ‘at least basic digital content creation skills’. Luxembourg continues to report an increase in the share of ICT specialists as a percentage of total employment, which is well above the EU average (6.7% and 4.5% respectively). 20% of specialists are female, slightly above the EU average of 19%. The share of businesses providing ICT training to their employees dropped significantly from 27% in 2019 to 21% in 2020, which is still slightly above the EU average of 20%. The share of ICT graduates in the total pool of graduates increased in 2020 compared to the previous year and remains above the EU average (6.4% and 3.9% respectively).

The Digital Skills Programme was launched in May 2021 and financed via the RRF. It offered a EUR 500 voucher to around 30 000 employees covered by a short-time work scheme (‘partial unemployment’) to complete a training course in digital skills from a variety of online classes offered by licensed training institutions until the end of 2021.

In the context of introducing coding and computational thinking in primary schools and in line with the national framework for digital skills (*Medienkompass*, launched in March 2020), a new discipline named ‘digital sciences’ will be launched nationwide in September 2022 in secondary schools following a pilot phase in 18 schools (September 2021 – July 2022). Continuing with the achievements in basic education,

²⁵² Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

the new digital sciences course will gradually be integrated into the curriculum of all classes below secondary education from September 2021. With this new subject and all other *Einfach Digital* initiatives, Luxembourg offers a comprehensive education by combining learning and innovation skills (critical thinking and problem solving, communication and collaboration, creativity and innovation) and digital literacy skills (information literacy, media literacy, information and communication technology literacy, technological literacy).

The Chamber of Commerce has joined forces with the Employment Agency to promote the professional reintegration of those unemployed or threatened by dismissal, by creating various vocational training programmes. Some of them aim to develop the digital skills of jobseekers in different categories: in '[Basic Digital Skills](#)', the participants are jobseekers with very little or no computer skills, in 'Fit4DigitalFuture' the objective is to prepare jobseekers for the digital transformation and to introduce them to the fundamentals of project management and in '[Fit4ProjectManagement](#)' the participants are jobseekers with an interest in and affinity for IT and digital tools, wishing to further develop their project management skills.

The [Luxembourg Digital Skills and Jobs Coalition](#) was very active during the COVID-19 pandemic. In 2021, webinars were organised to promote digital skills in the traditional sectors, digital skills in the space sector, and a visit of the Luxembourg Science Centre. 10 new members joined the coalition. The coalition organised two flagship events: The first was a digital skills matchmaking event which brought together digital skills project owners with contributing public and private institutions. 16 partnerships had been formed for coaching, mentoring, advice, and for financial and logistical support. The event will be reproduced in 2022. Second, 80 students and professors from short cycles of higher education in the fields of communication technologies, informatics, internet of things (IoT) and cloud computing participated in [Luxembourg's Connecting Tomorrow Conference](#) which included a 5G workshop including 10 round tables, each chaired by an expert from industry or research, where participants discussed the future of skills and jobs in domains such as 5G, IoT, environment and cloud.

During Code Week, Luxembourg ranks 4th in terms of the number of activities listed according to the number of inhabitants. The initiative is aimed mainly at primary and secondary school pupils to make coding and digital culture accessible to all, in a fun and engaging way, through activities organised around the world by teachers and coding enthusiasts.

In September 2021, Luxembourg adopted the [National Action Plan for Digital Inclusion](#), designed to ensure the inclusion of all citizens in the digital transformation of the society. The plan addresses specifically people with deficits in digital skills in population groups such as the elderly, people with disabilities or least-skilled workers.

To continue improving the population's digital skills level and to tackle the shortage of ICT specialists, it is critical to continue working on the initiatives outlined above and encourage companies to provide more carefully targeted ICT training to their staff.

2 Connectivity

2 Connectivity	Luxembourg		EU
	rank	score	score
DESI 2022	11	59.3	59.9

	Luxembourg			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
2a1 Overall fixed broadband take-up % households	91% 2019	88% 2020	91% 2021	78% 2021
2a2 At least 100 Mbps fixed broadband take-up % households	45% 2019	53% 2020	63% 2021	41% 2021
2a3 At least 1 Gbps take-up % households	0.46% 2019	1.80% 2020	4.00% 2021	7.58% 2021
2b1 Fast broadband (NGA) coverage % households	98% 2019	99% 2020	99% 2021	90% 2021
2b2 Fixed Very High Capacity Network (VHCN) coverage % households	92% 2019	95% 2020	96% 2021	70% 2021
2b3 Fibre to the Premises (FTTP) coverage % households	68% 2019	72% 2020	75% 2021	50% 2021
2c1 5G spectrum Assigned spectrum as a % of total harmonised 5G spectrum	0% 04/2020	61% 09/2021	61% 04/2022	56% 04/2022
2c2 5G coverage²⁵³ % populated areas	NA	0% 2020	13% 2021	66% 2021
2c3 Mobile broadband take-up % individuals	94% 2018	94% 2018	96% 2021	87% 2021
2d1 Broadband price index Score (0-100)	71 2019	72 2020	67 2021	73 2021

With an overall connectivity score of 59.3, slightly below the EU average of 59.9, Luxembourg ranks 11th among the 27 EU countries. The main reasons are the low uptake of at least 1 Gbps, low 5G coverage and the comparatively low affordability of broadband connectivity.

On fixed networks, Luxembourg is almost fully covered by fast fixed broadband networks, nearly full NGA coverage and has also a very good coverage of very high capacity networks (VHCNs) with 96%, representing 75.2% coverage of fibre to the premises (FTTP) and 90.2% of DOCSIS 3.1. Thanks to the wide availability of VHCNs, Luxembourg performs very well in the uptake of fixed broadband services and 63% of households have opted for speeds of 100 Mbps and above. The uptake of 1 Gbps services is however very low and below the EU average, as offers based on 1Gbps were introduced only in 2019 with rather high tariffs²⁵⁴. Broadband services (based on representative baskets of fixed, mobile and

²⁵³ The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

²⁵⁴ At the same time, according to [ILR figures](#), FTTP technology had a share of 53.3% of all broadband subscriptions in Luxembourg by mid-2021.

converged broadband offers, adjusted for national household income levels) are less affordable compared with the EU average, while they were still found slightly more affordable compared with the EU average [in DESI 2020](#).

Luxembourg published a new [strategy for ultra-high-speed connectivity](#) focusing on accelerating the uptake and further development of VHCN infrastructure and related services. The strategy focuses on fixed connectivity and aims to make connectivity accessible to all. By 2025, every household should have a minimum connection speed of at least 100 Mbps downstream and 20 Mbps upstream. The transition of households and businesses to more efficient and sustainable technologies is intended to be accelerated by stimulating uptake of and demand for connectivity at these speeds. The deployment of future-proof infrastructure is intended to be accelerated, while respecting technological neutrality; transparency is intended to be improved and consumer protection strengthened. Through these actions Luxembourg should become the launchpad of choice for the information and communication technology (ICT) service providers of today and tomorrow.

As part of the new strategy, a careful assessment of the possible needs for public funding mechanisms will be based on a [detailed mapping](#) of existing fixed infrastructure on which the national regulatory authority '*Institut Luxembourgeois de Régulation*' ([ILR](#)) is currently working. Beyond connectivity for households, the connectivity for schools and businesses will be validated. The priority will be to cover the less than five per cent of the population that does not have access to 100 Mbps today, in order to avoid a digital divide.

Under the [EU Digital Decade targets](#), Luxembourg continues to be well on track to meeting the fixed broadband targets. Despite there being no public funding for broadband roll-out, the 100% state-owned incumbent operator POST is the only significant contributor to fibre roll-out. Cable operators have fully upgraded their networks to DOCSIS 3.1 technologies. Given the good FTTP coverage, further roll-out targets households nationwide without fibre connections. Luxembourg had a 20% drop in the total number of FTTP new connections added in 2021 compared with those added in 2020. This slowdown in market-driven fibre roll-out in Luxembourg may reflect higher real rollout costs in areas and premises which are not – or not fully - covered yet and the inflation in overall prices for civil works.

On mobile connectivity, Luxembourg scores 61% on the 5G spectrum indicator, as a result of the authorisation of 60 MHz in the 700 MHz band and 330 MHz in the 3.6 GHz band, which was completed in July 2020. Average LTE coverage stood at 98.4%, above the EU average of 97.5%. 5G services have been commercially launched relatively late, in the second half of 2020. By mid-2021, total 5G coverage still stood at 12.7% (6.7% rural), lagging significantly behind the total EU average of 65.8% (34.7% rural).

Given the good fibre coverage in the country, the crucial element to increasing 5G coverage is investment by the mobile network operators in 5G radio access infrastructure. Electromagnetic field (EMF) strength requirements continue to be a limiting factor for the roll-out and use of such infrastructure. All three mobile network operators in Luxembourg rely mainly on the 700 MHz and 3.6 GHz spectrum bands for roll-out of 5G. ILR prepares a new public consultation on the assignment of the 26 GHz band for 5G for the second half of 2022. The previous public consultation, launched in October 2020, was concluded with the finding that there was no demand which led the ministry to decide in March 2021 not to launch assignments at that point in time. Luxembourg participates in the [5GCroCo project](#) trialling 5G technologies in the cross-border corridor along France, Germany and Luxembourg.

This project aims at defining new business models that can be built on top of these technologies and at impacting standardisation bodies from the telecommunications and automotive industries. The rural municipality of Waldbillig introduced a project to equip the village with high speed Internet connectivity based on 5G fixed wireless access (FWA). The project aims to improve connectivity in an area, where old fixed landlines do not meet the people's connectivity needs. One of the project's aims is to collect best practices for other rural municipalities. 30 communes have used the [Wif4EU vouchers](#) to offer people free public internet access. Rollout of publicly accessible Wi-Fi (public and private) networks is also progressing in transport (trains and stations) and in public spaces such as libraries, city halls and administrative buildings open to the public.

Main market & regulatory developments

According to [ILR figures](#), in 2020, the revenue of the telecommunications market stood at EUR 568.3 million, representing an increase of 0.2% compared to 2019. Investment increased by 14.7% since 2019 and stood at EUR 91.7 million in 2020. It focused on the fixed network (EUR 67.7 million, up by 31.1%) while it decreased in the mobile network (EUR 24.0 million, down by 15.2%). In the first half of 2021, 70.8% of the overall investment was done by POST. POST's market share in the fixed Internet access market fell by 1% in favour of its main competitors Proximus and Luxembourg Online, standing at 61.1%. On the mobile market, market shares in terms of SIM cards of the three main operators show no big changes. Alternative operators are slightly gaining at the expense of POST and Proximus, in terms of pre- and post-paid mobile subscriptions. The number of M2M SIM cards increased by 16% and stands at 77 900 which is however still below the figures for 2019.

Demand for telephony services on fixed networks had peaked in mid-2020 due to the lockdown and is now back on a downward trend (minus 16% in the first half of 2021 for national calls). The volume of mobile calls increased slightly in the same period while the number of mobile subscriptions rose by 8.5%.

On planning and co-ordinating civil works, operators and administrations work together in a transparent way and shared information. The national permit granting procedure is still an issue that has to be tackled in order to swiftly and efficiently deploy broadband.

On the business market, 60.7% of fixed call minutes in Luxembourg are by businesses, and only 39.3% by residential customers. Data for other segments of the business market was not available, but the shares of fixed call minutes illustrate the significance and importance of the business market in Luxembourg.

The [law](#) transposing the [European Electronic Communications Code](#) has been adopted by parliament on 8 December 2021.

ILR monitors closely the switch-off and decommissioning of the copper network. It is therefore increasingly problematic for ILR to rely on the copper anchor for price control of fixed broadband wholesale products provided by POST which has been found to be the only operator with significant market power. Therefore, ILR would benefit from a speedy adoption of the new

Commission recommendations on non-discrimination and costing which would be adapted to network architectures which are increasingly reliant on fibre lines, both in the backhaul and in the local loops. ILR has also commissioned a study to look into this issue.

In 2021, there has been a slight fall in consumer complaints. They focused on pricing and billing of premium rate services, on contract terms and on availability and quality of service. 19% of the complaints concerned bundled services.

Luxembourg continues to improve in rollout and uptake of fibre networks, albeit still below the EU average for the latter on 1Gbps uptake. Funding of rollout of fibre networks in the few areas where market-driven investment cannot be expected in the foreseeable future is under active and detailed consideration by the government. Framing a strategy to streamline permit procedures and to facilitate access to public property to extend fixed and densify mobile networks would further stimulate and accelerate the roll-out of both fixed and mobile network infrastructures, thus ensuring progress towards the 2030 Digital Decade.

3 Integration of digital technology

3 Integration of digital technology	Luxembourg		EU
	rank	score	score
DESI 2022	18	35.0	36.1

	DESI 2020	Luxembourg DESI 2021	DESI 2022	EU DESI 2022
3a1 SMEs with at least a basic level of digital intensity % SMEs	NA	NA	54% 2021	55% 2021
3b1 Electronic information sharing % enterprises	41% 2019	41% 2019	40% 2021	38% 2021
3b2 Social media % enterprises	29% 2019	29% 2019	34% 2021	29% 2021
3b3 Big data % enterprises	16% 2018	19% 2020	19% 2020	14% 2020
3b4 Cloud % enterprises	NA	NA	29% 2021	34% 2021
3b5 AI % enterprises	NA	NA	13% 2021	8% 2021
3b6 ICT for environmental sustainability % enterprises having medium/high intensity of green action through ICT	NA	80% 2021	80% 2021	66% 2021
3b7 e-Invoices % enterprises	16% 2018	14% 2020	14% 2020	32% 2020
3c1 SMEs selling online % SMEs	9% 2019	9% 2020	9% 2021	18% 2021
3c2 e-Commerce turnover % SME turnover	NA 2019	NA 2020	NA 2021	12% 2021
3c3 Selling online cross-border % SMEs	8% 2019	8% 2019	7% 2021	9% 2021

On the integration of digital technology by businesses, Luxembourg ranks 18th and below the EU average. Luxembourg has made major progress in the uptake of digital innovation, in line with the country's ambition for a transition to a data-driven economy. It performs well on the share of businesses that use two or more social media (34% versus the EU average of 29%) and analyse big data (19% versus the EU average of 14%). A high share of businesses (80% versus the EU average of 66%) uses ICT for environmental sustainability. By contrast, Luxembourg continues to perform well below the EU average on the share of SMEs selling online, with only 9% compared to the EU average of 18%. Furthermore, the share of SMEs selling online cross-border has fallen by one percentage point, from 8% to 7%, below the EU average of 9%.

Luxembourg is committed to fully engaging in European partnerships on digital technology. It is a founding member of the Euro High Performance Computing (Euro HPC) Joint Undertaking, supporting the quantum programme in the domains of modular HPC architectures and the use of quantum acceleration. Luxembourg is an active member of the European Important Project of Common European Interest (IPCEI) 'Cloud', of the 'Gaia-X' initiative, and supports via its national Innovation agency digital

transformation projects, especially those supporting the data driven strategy of Luxembourg, the use of new IT technologies, and collaborative creation of added value. This includes cloud, big data, HPC and Artificial Intelligence (AI). Luxembourgish businesses are participating in the IPCEI 'Cloud' through the creation of a large consortium in the area of cybersecurity, fostering collaboration and incident response capabilities in a cloud edge-cloud continuum.

The 'Fit 4 Start Acceleration Programme' has at its core the internet of things (IoT), blockchain, big data, AI, machine learning, robotics, cybersecurity and open source technology. Each year 'Fit 4 Start' offers 35 start-ups a six-month coaching and mentoring programme, free incubation and financial aid of up to EUR 150 000. By connecting the start-ups to local market players, the programme creates promising business opportunities and contributes to the development of a competitive, sustainable and data-driven economy.

In 2021, a new HPC & Data Analytics track of 'Fit 4 Start' was launched in collaboration with LuxProvide S.A, the operator of the national petascale supercomputer Meluxina which is part of 'Euro HPC'. This new track offers support to businesses with specific needs on high performance computing to improve their business models and provides access to cutting edge supercomputing infrastructure in Luxembourg. As of January 2022, 26 user organisations have participated in the pilot edition of this new HPC & Data Analytics track.

The European Digital Innovation Hubs (EDIH) will provide access to technical expertise and experimentation for enterprises. The selection of the Digital Innovation Hubs that will participate in the network of EDIHs is ongoing. One EDIH proposal from Luxembourg is expected to be selected in the next year. Luxembourg is implementing a broad range of initiatives and projects on the integration of digital technologies. It is important that these programmes which are first targeted at the government sector are conceived, openly communicated and implemented in a way to ensure that in the long run they help attract private investment, including international investment, businesses and skills.

4 Digital public services

4 Digital public services ²⁵⁵	Luxembourg		EU
	rank	score	score
DESI 2022	7	83.4	67.3

	Luxembourg			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
4a1 e-Government users	62%	64%	79%	65%
% internet users	2019	2020	2021	2021
4a2 Pre-filled forms	NA	NA	69	64
Score (0 to 100)			2021	2021
4a3 Digital public services for citizens	NA	NA	93	75
Score (0 to 100)			2021	2021
4a4 Digital public services for businesses	NA	NA	97	82
Score (0 to 100)			2021	2021
4a5 Open data	NA	NA	66%	81%
% maximum score			2021	2021

On digital public services, Luxembourg ranks 7th in the EU, well above the EU average. The country performs particularly well in providing digital public services to people, scoring 93 out of 100, versus the EU average of 75. In parallel, this significantly improved offer of services has been well received by a significantly increased number of internet users. While the rise in e-government users as a percentage of all internet users was still a moderate two percentage points in 2020, it has sharply risen by another 15 percentage points in 2021 standing now at 79%, compared with an EU average of 65%. Luxembourg has therefore become one of the EU's frontrunners in accelerating the rollout of digital public services to people – and also to businesses – and for increasing the use of e-government solutions. Luxembourg also performs above the EU average on pre-filled forms. However, it performs below average on open data.

The '[Electronic Governance 2021-2025' strategy](#), drawn up jointly by the Ministry for Digitalisation and the Government IT Centre (CTIE), was adopted by the Government Council in early 2021. The Ministry for Digitalisation aims at strengthening e-government and enabling the transition to digital government. The 'Electronic Governance 2021-2025' strategy is part of this approach. It determines the essential elements of the country's successful digital transition to provide individuals with access to quality digital services and ensure the gradual transition to digital government and a 100% digital public administration. The [Guichet.lu](#) portal is aimed at both individuals and businesses and acts as a single point of contact (SPOC) for interactions with administrative bodies. The portal has seen major updates including (i) carrying out administrative procedures in a simple and transparent manner reusing personal data from authentic sources; (ii) allowing to view the personal data held by official bodies; (iii) receiving electronic documents issued by official bodies (e-delivery); and (iv) booking appointments with

²⁵⁵ There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

administrative bodies. Users can log in to their personal space with electronic authentication certificates that guarantee secure information exchanges and confidentiality of personal data. During 2021, nearly 100 new administrative procedures were made available online, of which more than 80 can directly be completed online by individuals and / or businesses on the central transactional platform. Users can log in to their personal space with electronic authentication certificates that guarantee secure information exchanges and confidentiality of personal data.

This is all facilitated by the Interministerial Committee for Digitalisation, which is the country's platform to develop the digitalisation of public services and public administrations. It defines specific and common needs, supports the sharing of best practices, identifies synergies to establish a coordinated agenda and eases the transversality needed for the proper functioning of an e-administration. The Committee drew up [a roadmap with concrete actions](#) to implement the 'Electronic Governance 2021-2025' strategy.

In 2021, the GovTech Lab²⁵⁶ launched a new call for solutions through an innovation partnership, 'Trust My Data,' mainly looking for ideas for digitising and securing the exchange of state-certified data, based on open standards and allowing for a secure and interoperable exchange of structured data with automatic authenticity verification. The innovation partnership is at the pilot project phase.

People in Luxembourg are offered two alternative eID schemes²⁵⁷ for facilitating their interactions with private and public organisations. Both schemes offer the possibility to interact with private and public organisations via a smart device. In total, approximately 460 000 people²⁵⁸ (or almost 73% of the citizens) use at least one of the schemes, and both schemes are also notified to the European Commission under the eIDAS Regulation. The widely used LuxTrust scheme is issued by a private entity in collaboration with the government.

The Ministry for Digitalisation's central coordination role has led to major improvements in digital public administration, both in terms of the variety and the quality of the services available and in terms of usages and number of users. The public sector is digitally advanced and continues its work to improve digital availability and interactivity for all public services which is essential to completing the process of modernising the public administration and ensuring a substantial contribution to the relevant Digital Decade targets.

Highlight: ['Electronic Governance 2021-2025' strategy](#)

The strategy for 2021-2025 highlights a number of principles to be complied with when public services are digitalised, so that individuals and businesses can be offered public services that meet their needs. It involves promoting cross-cutting digital accessibility, developing user-driven services, offering attractive online public services, and investing in public confidence in online services provided by the State. The strategy goes on to analyse the essential conditions

²⁵⁶ In November 2020, the GovTech Lab was launched, which aims to accelerate the digitalisation of public services through innovation partnerships.

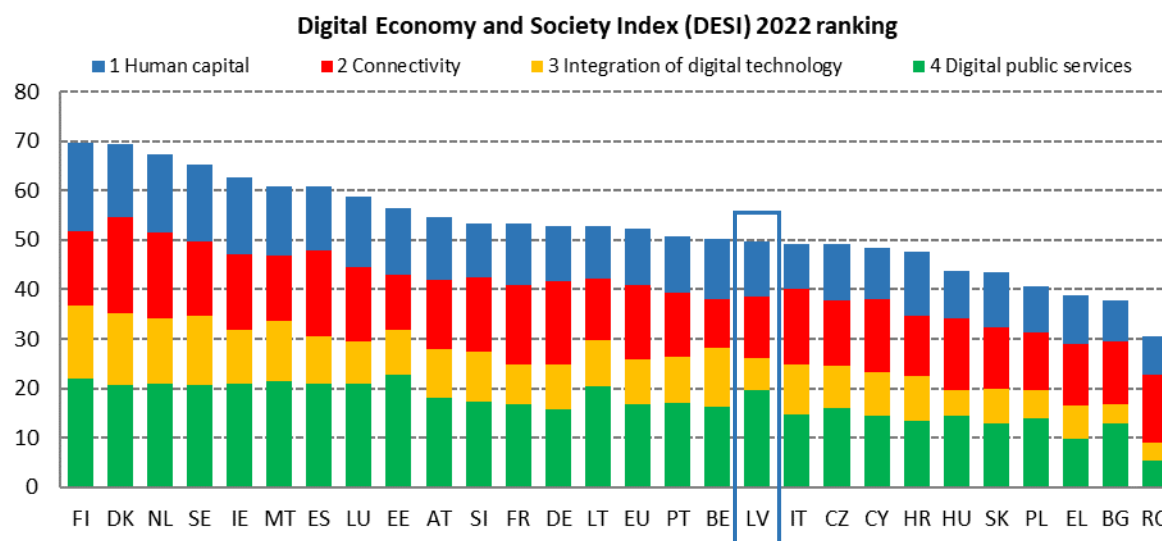
²⁵⁷ eID schemes in Luxembourg: Luxembourg national identity card (eIDcard) and the 'LuxTrust' product working with a variety of devices.

²⁵⁸ This figure includes citizens of Luxembourg and commuters.

required by the central civil service administration enabling it to meet society's needs efficiently. The fundamental aims of digitalisation are to ease the transition to an efficient paperless administration and to provide an IT environment that is conducive to new working methods. The strategy also emphasises the importance of being able to rely on a central IT partner that is competent, agile and dependable. To achieve this, the '*Centre des technologies de l'information de l'Etat*' (CTIE) aims to strengthen its digitalisation services, develop leading-edge infrastructures, and guarantee very high levels of security and reliability.

Latvia

DESI 2022	Latvia		EU
	rank	score	score
	17	49.7	52.3



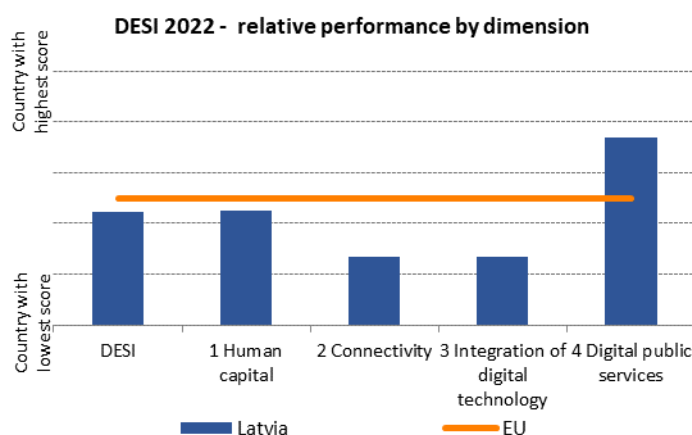
Latvia ranks 17th out of 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI). Latvia's DESI score grew at a slower pace than most of the other EU countries over the last few years. Hence, despite its efforts, Latvia has not been able to catch up with the other Member States yet.

On human capital, the percentage of graduates studying ICT in Latvia remains significantly higher than the EU average. The country also performs relatively well as regards the share of women in its ICT specialists' workforce, even if growth stagnates. The share of ICT specialists, though, has been steadily growing and Latvia is now slowly catching up on the EU average. Among Latvia's population, basic and above basic digital skills, as well as basic digital content creation skills, are still slightly below the EU average. More efforts are thus needed to improve the digital skills of the Latvian population. This will also be crucial for the EU as a whole to reach the Digital Decade targets for basic digital skills and ICT specialists. Latvia continues its solid performance in Connectivity, particularly with regards to its Very High-Capacity Network (VHCN) coverage (91% compared to 70% at EU average). This is relevant to achieve the Digital Decade target of 100% coverage of all households with gigabit networks by 2030. Furthermore, while Latvia has already assigned a significant amount of spectrum for 5G, it has yet to start rolling out 5G. The digital divide, still present despite considerable investments in backhaul connections in rural areas, will be addressed through several new measures. However, the commercial viability of private investments in last-mile connections in rural areas is limited, therefore public funding will be needed to support network rollout in these areas.

The Integration of digital technologies can provide Latvian enterprises with new opportunities to improve their competitiveness. However, a lot of work is still necessary to make use of this potential. Latvian enterprises are well-below the EU average when it comes to the integration of key digital technologies. This is also the case for several important Digital Decade indicators, including the use of Big Data, Artificial Intelligence (AI) and Cloud. The adoption of social media and the use of electronic information sharing did grow significantly – in both cases with 7 percentage points – allowing Latvia to come closer or even catch up with the European average.

Latvia performs well in providing digital public services to its citizens and businesses. Latvia has a high share of e-government users (84% of internet users) and scores above the EU average in the use of pre-filled forms. Latvia is on track towards the Digital Decade target of 100% online provision of key public services for citizens and businesses. Latvia also aims to give all its citizens full access to their electronic health records, also in line with the Digital Decade target. The country is actively improving the level of digital skills of its public administration to further enhance the user-centricity and inclusiveness of its digital public services.

The Latvian 2021-2027 [Digital Transformation guidelines](#) adopted on 6 July 2021 set out an overarching strategy for the country's digital transformation. The guidelines cover internet access, ICT education and skills, modern and efficient public administration, e-services and digital content for society. The 2021-2027 [Education Development guidelines](#), the 2021-2027 [Latvian National Industrial Policy guidelines](#) and the 2021-2027 [Public Health guidelines](#) further complement the Digital Transformation guidelines.



Latvian citizens and ICT companies have donated and dispatched ICT equipment to Ukraine, including routers, IP phones, radios and computers. Latvia has developed specific digital tools for Ukrainian refugees. For example, the Latvian public administration language technology platform, [Hugo.lv](#), provides automated translations into the Ukrainian language. The virtual assistant [HelpUkraineBot.com](#), developed by the company Tilde, provides secure sources of information on the assistance available in Latvia to Ukrainians. The Single State and Municipal service centres provide support to Ukrainian refugees in Latvia for the issuance of visas and residence permits and helps with allowance applications. These support options are described in the Single public services portal [Latvija.lv](#). Latvia has strongly supported EU measures against Russia's major disinformation outlets Russia Today and Sputnik.

Digital in Latvia's Recovery and Resilience Plan (RRP)

The Latvian Recovery and Resilience Plan allocates more than EUR 384 million²⁵⁹, 21% of its budget, to address Latvia's main digital challenges. The Plan's main objectives are to tackle the digital skills gap and boost digital transformation and innovation of enterprises while maintaining the good position as regards the modernisation and digital transformation of public services. Investments in 5G backhaul and last-mile connectivity are also envisaged.

The main objective of the RRP actions in 2021 have been the reforms and strategies aimed at facilitating the digital transition of the Latvian economy and society. One of the milestones was the entry into force of a regulatory framework on the organisation and implementation of remote learning. The adoption of a common model to develop last-mile connectivity and technical requirements for connected and automated driving were also due by the end of 2021.

Several relevant policy developments are envisaged in 2022, such as the entry into force of new legal frameworks for supporting, among others, the digital transformation of public administration processes and services, the development of the national economic data and digital services economy, or the development of central systems and platforms of public administration. Other achievements are also planned, such as the establishment of a fully operational European Digital Innovation Hub (EDIH), or the digital maturity test system for companies to identify their needs in terms of actions and state support.

²⁵⁹ Each recovery and resilience plan has to dedicate at least 20% of the plan's total allocation to digital objectives. To this end, the plans had to specify and justify to what extent each measure contributes fully (100%), partly (40%) or has no impact (0%) on digital objectives, using Annex VII of the RRF Regulation. Combining the coefficients with the cost estimates of each measure allows assessing to what degree the plan contributes to digital objectives and whether it meets the 20% target.

1 Human capital

1 Human capital	Latvia		EU
	rank	score	score
DESI 2022	18	44.1	45.7

	Latvia			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
1a1 At least basic digital skills % individuals	NA	NA	51% 2021	54% 2021
1a2 Above basic digital skills % individuals	NA	NA	24% 2021	26% 2021
1a3 At least basic digital content creation skills²⁶⁰ % individuals	NA	NA	64% 2021	66% 2021
1b1 ICT specialists % individuals in employment aged 15-74	3.0% 2019	3.6% 2020	3.8% 2021	4.5% 2021
1b2 Female ICT specialists % ICT specialists	24% 2019	23% 2020	23% 2021	19% 2021
1b3 Enterprises providing ICT training % enterprises	18% 2019	17% 2020	17% 2020	20% 2020
1b4 ICT graduates % graduates	4.7% 2018	4.4% 2019	4.6% 2020	3.9% 2020

Latvia performs below the EU average in Human capital, ranking 18th among the 27 EU countries. Latvia is only slightly below the EU average as regards both basic and above basic digital skills. 51% of the population aged 16 to 74 has at least basic digital skills and 24% has above basic digital skills, against the respective EU averages of 54% and 26%. Latvia, with 64% of the population with at least basic digital content creation skills, is close to the EU average of 66%. The downward trend in the share of ICT graduates has been reversed and Latvia remains above the EU average, with 4.6% of ICT graduates in the country against 3.9% in the EU. The share of female ICT specialists stands at 23%, against 19% at EU level. Regarding the share of ICT specialists, Latvia is narrowing the gap with the EU average, reaching 3.8% of total employment compared to the EU average of 4.5%.

The 2021-2027 Digital Transformation guidelines issued by the Latvian Ministry of Environmental Protection and Regional Development (MoEPRD) in 2021 establish the development of digital skills as a national priority, aiming to achieve the Digital Decade targets. The Transformation Guidelines include the Latvian mid-term education and skills strategy of the Ministry of Education and Science (MoES): 2021-2027 [Education Development guidelines](#). These guidelines aim to promote and modernise digital skills and science, technology, engineering and maths (STEM) studies, to use ICT in the learning process, and to develop teachers' digital skills.

Latvia's RRP, which includes measures wholly or partly related to digital skills, will address the digital skills gap for most age groups, social and work environments. A total budget allocation of EUR 106

²⁶⁰ Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

million, representing 6% of the whole RRP, is expected to focus on improving digital skills for students and adults, achieving the digital transformation of society and the labour market, including the public administration, and reducing the risks of social exclusion.

In early 2021, MoES together with major telecommunication providers, Riga Technical University and other stakeholders, signed the Memorandum of Cooperation 'Powerful internet for every Latvian school.' On 14 May 2021, MoES also signed a Memorandum of Understanding on 'Computer for Every Child.' The aim of these memoranda is to provide both schools and pupils with ICT tools, including computers, modernised intranets and improved internet connections. The first public procurement launched in August 2021 purchased up to 30 000 computers for basic school pupils. More than 100 schools have improved their internet connections with donated equipment.

The revised general education curriculum - [Skola2030](#) - refers to digital literacy as a transversal skill to be integrated throughout the general education cycle, highlighting coding and algorithmic thinking skills. Under Skola2030, Latvia has, since September 2021, been implementing the integrated modular e-learning management system 'skolo.lv'. The new system provides improved learning content, increased access to digital teaching aids and tools for schools, improved data exchange and support for teachers for learning and teaching. Between 2020 and 2021, 2 040 teachers have started a training to improve their digital skills and 1 921 have already completed it, representing around 28% of teachers with high competence in ICT skills.

A network of Code Week ambassadors, teacher leaders and volunteers has been established in Latvia. The network coordinates the promotion of Code Week in Latvian educational institutions. Since the same educational institutions participate in Code Week activities every year, the main challenge is to attract new educational institutions, new volunteers and teachers of other subjects by showing how to programme. Starting from the second half of 2022, Latvia plans to create 21 international study modules for the acquisition of high-level digital skills in quantum technology, high performance computing (HPC) and language technology, supported by the RRP, to train 3 000 students and specialists (enterprises, academia and the public sector) by 2026.

The implementation plan for an adult education governance model, which applies until 2023, has outlined broader digital skills among its priorities. In May 2021, the [State Education Development Agency](#) launched a call specifically focused on a digital skills education programme for workers over 25. Nearly 27 500 adults participated in IT sector programmes last year, representing 65% of all participants. Workers can get assessments, trainings and certificates in the programmes that cover up to 12 digital skills sets. The programmes are aligned and approved by the Adult Education Management Council established by the MoES.

The Latvian Information and Communication Technology Association (LIKTA) is leading the Latvian [National Coalition](#) for digital skills and jobs. Its Training Commission has developed new ICT programmes under the EU initiative [Digital Skills and Jobs Coalition](#), which aims to tackle the digital skills gap by bringing together EU countries, enterprises and organisations.

Other projects as the 'Digital Competence Development System' project' (DCDS) contribute to improving skills and digital literacy in Latvia. The 'ICTskills4All' project addresses digital skills of the Latvian population and the 'Count me In' project addresses the skills of people with disabilities. 'Women4IT' is a multi-stakeholder partnership involving different countries that aims at improving the gender balance

and gender equality in ICT jobs. A share of 60% of all learners who acquired digital skills in Latvia were women.

The lack of digital skills in the workforce has been slowing down Latvia's digital transformation. The share of ICT specialists in the workforce is increasing, but it is too early to assess the impact of the new policies focussing on reskilling and upskilling.

2 Connectivity

2 Connectivity	Latvia		EU
	rank	score	score
DESI 2022	20	50.1	59.9

	Latvia		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
2a1 Overall fixed broadband take-up	64%	62%	65%	78%
% households	2019	2020	2021	2021
2a2 At least 100 Mbps fixed broadband take-up	38%	38%	43%	41%
% households	2019	2020	2021	2021
2a3 At least 1 Gbps take-up	<0.01%	<0.01%	<0.01%	7.58%
% households	2019	2020	2021	2021
2b1 Fast broadband (NGA) coverage	93%	93%	94%	90%
% households	2019	2020	2021	2021
2b2 Fixed Very High Capacity Network (VHCN) coverage	88%	88%	91%	70%
% households	2019	2020	2021	2021
2b3 Fibre to the Premises (FTTP) coverage	88%	88%	89%	50%
% households	2019	2020	2021	2021
2c1 5G spectrum	33%	29%	63%	56%
Assigned spectrum as a % of total harmonised 5G spectrum	04/2020	09/2021	04/2022	04/2022
2c2 5G coverage²⁶¹	NA	0%	0%	66%
% populated areas		2020	2021	2021
2c3 Mobile broadband take-up	74%	74%	86%	87%
% individuals	2018	2018	2021	2021
2d1 Broadband price index	77	81	76	73
Score (0-100)	2019	2020	2021	2021

Latvia ranks 20th among the 27 EU countries in Connectivity. The country boasts extensive fixed very high-capacity network (VHCN) coverage (91%), exceeding the EU average (70%) by 21 percentage points (pps). Nonetheless, slow progress over the past years suggests that covering the remaining households is challenging. Fibre to the premises (FTTP) coverage has increased by just 1 pps since 2018. Very fast cable networks (DOCSIS 3.1), rolled out to 18% of households in 2021, complement existing fibre connections in cities rather than connecting underserved areas. In rural areas, VHCN coverage has reached 75% in 2021, an increase of only 1 pps compared to the previous year. Latvia's leap towards gigabit connectivity in 2020, when coverage with speeds of over 1 Gbps jumped from 0% to 40%, came about because of upgrades to the incumbents existing network rather than a new rollout. Gigabit connectivity has remained stable in 2021. Insufficient investment in the last mile in rural areas remains Latvia's biggest challenge for covering all households with a gigabit network by 2030.

²⁶¹ The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

The persistent digital divide between urban and rural areas in Latvia suggests that previous efforts to fund the deployment of middle mile infrastructure closer to end-users did not yield intended results. Due to low incomes and low population density, commercial incentives for operators to connect premises in rural areas remain insufficient. Recognising this, Latvia's new [Development Plan for the Electronic Communications Sector](#) concentrates on publicly funding the deployment of last mile infrastructure to achieve nationwide speeds of at least 100 Mbit by 2027. It plans to draw on several EU funding sources, including the Recovery and Resilience Facility (RRF), to support the implementation of a privately managed network model, whereby operators will be selected through competitive tenders organised by regions and municipalities. The Ministry of Transport expects to notify State aid measures and identify relevant areas for deployment in cooperation with local governments in 2022. Despite the gap between coverage and take-up of fixed broadband, Latvia's Development Plan for the Electronic Communications Sector does not include measures to stimulate demand. As of 2021, 65% of households subscribe to fixed connections, compared to 78% in the EU, despite lower average broadband prices. While already connected households are upgrading to higher speeds (at least 100 Mbps fixed broadband take-up increased from 38% in 2020 to 43% in 2021, thus exceeding the EU average of 41%), the overall percentage of households sign up to fixed broadband has barely changed in recent years. By contrast, the uptake of mobile broadband rose from 74% in 2018 to 86% in 2021, trailing the EU average by 1 pps. This suggests that the trend towards fixed-to-mobile substitution for fast broadband connections (4G/NGA) continues.

Latvia lost its leading role in mobile connectivity due to delayed transition to fifth generation wireless networking technology. After achieving near universal 4G/LTE coverage and awarding spectrum in the 3.4-3.8 GHz band as early as 2017²⁶², the country still lacks widespread 5G coverage²⁶³. However, deployment is expected to pick up as a result of the auction of the 700 MHz band in December 2021²⁶⁴. The auction had been delayed over concerns on frequency sharing, which were partially resolved by the regulators [decision](#) from March 2021 to restrict the planned sharing of frequency resources between Bite and Tele2 in order to not distort competition with the incumbent operator (LMT). The two challenger operators consequently decided to end their partnership altogether, including the sharing of passive infrastructure and other active network elements. All three major mobile operators have invested in or announced plans to invest in their respective 5G networks since. For example, LMT [installed more than 100 base stations](#) across the country and Tele2 launched base stations in 15 Latvian settlements, with [plans to accelerate rollout](#) in order to reach 99% of the Latvian population by 2024. Similarly, Bite [announced a EUR 70 million investment](#) project to build several hundred 5G base stations over the next three years. Operators have not yet expressed demand for spectrum in the 26 GHz band.

²⁶² Rights of use of spectrum were awarded to four operators. The 3750-3800 MHz frequency block became available for new authorisation after one of the operators gave up its license. The regulator has not registered any interest in this block since.

²⁶³ There have been developments since the data was collected in mid-2021. As of early 2022, very limited commercial 5G services are available to businesses and individual consumers in selected cities.

²⁶⁴ The regulator assigned three blocks of 2 x 10 MHz in the FDD part of the 700 MHz band and two additional blocks of 1 x 10 MHz in the duplex gap (SDL) to mobile operators. Rights of use will be valid from 1 February 2022 for FDD frequency blocks and from 1 February 2025 for SDL frequency blocks.

The implementation of Latvia's [Connectivity Toolbox](#) roadmap has progressed but more efforts are needed to ease the rapid deployment of 5G to achieve coverage for all urban areas by 2025 and all populated areas by 2030, in line with EU targets. Operators report access difficulties despite legal amendments adopted in February 2021 to simplify deployment of masts, towers, and other communications infrastructure on and in new buildings²⁶⁵. Deployment is even more complicated in border regions due to the lack of an agreement with Russia to prevent possible interference in the 3.6 GHz and 700 MHz bands. In 2021, Latvia took significant preparatory steps to achieve the 2025 target of 5G coverage for major terrestrial transport paths. The Latvian State Radio and Television Centre (LVRTC) identified common technical requirements for electronic communications operators to allow for connected and automated driving along the Via Baltica route, connecting the Baltic States with other essential European transport corridors. LVRTC is tasked with constructing passive infrastructure to enable continuous 5G coverage on the Latvian part of the route by 2025, with funds to be made available under the Recovery and Resilience Facility (RRF) for deploying optical networks along the track. Latvia will draw on private investment for active infrastructure at a later stage in the project.

Main market & regulatory developments

The Latvian market is characterised by strong competition between mobile operators and the fixed incumbent (Tet). Content services have emerged as an important differentiator in this context. In 2021, Tet launched its own content platform and Bite released its own over-the-top media service. Moreover, mobile operators continued to acquire smaller fixed operators as well as IT and IoT companies, suggesting an emerging trend of market consolidation.

Legislative changes prohibiting the construction of visible over-head cabling have increased the demand for regulated access products, specifically for access to the fixed incumbent's civil infrastructure in the historical centre of Riga. Mobile operators note that slow response times and high prices as well as difficulties for municipalities to provide additional underground spaces hinder their rollout plans. The regulator (SPRK) plans to notify new measures to address this issue in 2022.

On 23 September 2021, the Commission addressed a Reasoned Opinion to Latvia for failing to notify measures fully turning the European Electronic Communications Code into national law. Latvia has notified partial measures turning the Code into national law and informed the Commission that the draft law on Electronic Communications and several Cabinet of Ministers Regulations, expected to be adopted by June 2022, will fully turn the Code into national law.

While the number and source of consumer complaints received by the SPRK did not change significantly compared with the previous year, the regulator identified an increase in caller identification (CLI) spoofing cases in 2021, including cases where public telephone numbers used by banking institutions are falsely sent to the receiving parties' screen in an attempt to

²⁶⁵ Amendments to Cabinet Regulation No. 500 of 19 August 2014 "General Construction Regulations" adopted by the Cabinet of Ministers on 28 February 2021.

acquire sensitive personal data. The new numbering usage fees that apply to all numbering ranges in Latvia since 1 January 2022 are expected to help lower the number of such fraud cases.

Latvia paved the way for 5G rollout by assigning the 700 MHz band in 2021. Ensuring rapid coverage to achieve the 2030 Digital Decade targets will require facilitated access to physical and in-building infrastructure. Turning the European Electronic Communications Code into national law in a timely manner is of crucial importance in this regard. 5G could become an important connectivity enabler particularly for rural areas, where deployment of fixed infrastructure for the last mile is proving costly but essential to avoid depopulation and support socio-economic activity. To address this challenge, Latvia's new Development Plan for the Electronic Communications Sector proposes ambitious investments in fibre connections offering speeds of at least 100 Mbit/s in underserved areas. Latvia's digital transformation would benefit from complementary measures to increase the take-up of already widely available fast and very high broadband speeds by Latvian households.

3 Integration of digital technology

3 Integration of digital technology	Latvia		EU
	rank	score	score
DESI 2022	23	25.8	36.1

	Latvia			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
3a1 SMEs with at least a basic level of digital intensity % SMEs	NA	NA	38% 2021	55% 2021
3b1 Electronic information sharing % enterprises	32% 2019	32% 2019	39% 2021	38% 2021
3b2 Social media % enterprises	19% 2019	19% 2019	26% 2021	29% 2021
3b3 Big data % enterprises	8% 2018	9% 2020	9% 2020	14% 2020
3b4 Cloud % enterprises	NA	NA	22% 2021	34% 2021
3b5 AI % enterprises	NA	NA	4% 2021	8% 2021
3b6 ICT for environmental sustainability % enterprises having medium/high intensity of green action through ICT	NA	65% 2021	65% 2021	66% 2021
3b7 e-Invoices % enterprises	7% 2018	15% 2020	15% 2020	32% 2020
3c1 SMEs selling online % SMEs	11% 2019	11% 2020	14% 2021	18% 2021
3c2 e-Commerce turnover % SME turnover	5% 2019	7% 2020	8% 2021	12% 2021
3c3 Selling online cross-border % SMEs	7% 2019	7% 2019	7% 2021	9% 2021

Latvia ranks 23rd among EU countries in Integration of digital technology in enterprises. Although Latvia has improved in some instances, it is still below the EU average in almost all indicators. The share of SMEs with at least a basic level of digital intensity is 38%, which is far below the EU average of 55%. The proportion of Latvian enterprises using social media (two or more) and share information electronically have notably increased and are now around the EU average, both rising by 7 percentage points. However, only 9% of enterprises use big data and only 15% use e-Invoices, both well below the EU average. The share of ICT for environmental sustainability is slightly below the EU average. Latvia's share of enterprises using cloud services (22%) is well below the EU average of 34%. On e-commerce, 14% of SMEs sell online, still below the EU average, and only 7% of SMEs' turnover comes from e-commerce.

Latvia's RRP aims to create a competitive environment to boost digitalisation and innovation. In total, five measures with a total budget allocation of EUR 125 million support the digitalisation of enterprises.

The 2021-2027 [Latvian National Industrial Policy guidelines](#) of the Ministry of Economics (MoE) prioritises the promotion of innovation and digital transformation of businesses. The European Digital

Innovation Hubs (EDIHs) and their regional contact points will serve as one-stop agencies for enterprises. EDIHs will provide information and support for assessing digital maturity, funding programmes for digitalisation, infrastructure investment needs, training for the management of the businesses and its employees, and for creating new innovative products, services and technological solutions. The selection of Digital Innovation Hubs that will participate in the network of European Digital Innovation Hubs (EDIHs) is ongoing. Two Latvian EDIH proposals have a successful evaluation result²⁶⁶.

As stated in the RRP, EDIHs are supposed to provide support to at least 3 500 enterprises and training courses to almost 1 300 enterprises by 2024, and support to at least 7 000 enterprises and courses to 3 000 of them by 2026. EDIHs will also support the digitalisation of processes in commercial activities and the introduction of new digital products and services. Moreover, financial instruments (loans and grants) will be made available from 2022 to ease the digital transformation of economic operators, providing support to purchase and develop Industry 4.0 solutions.

The 'Support to develop new products and technologies under the competence centres' programme aims to increase the competitiveness of enterprises. The MoE envisages between four and six new competence centres. These competence centres will promote cooperation between the research and industrial sectors and will develop and introduce new products and technologies. Until 31 December 2021, the ICT Competence centre project, focused on information and communication technology businesses, has provided support to more than 21 businesses.

MoE public funding programmes directly target start-ups, including enterprises focused on digital solutions, aiming to attract highly skilled employees and start-up founders. The MoE has focused on reducing the bureaucratic burden and investing in R&D and innovation through support initiatives such as the innovation voucher programme, digital skills training, or digitalisation of public services.

Latvia participates in several EU digital technology initiatives. It is a member of the EuroHPC (High-Performance Computing) Joint Undertaking, has signed the Declaration on European Blockchain Partnership and the EU Declaration on Cooperation in Artificial Intelligence. Jointly supported by the RRP, ERDF and its own resources, it is also launching the Latvian National Federated Cloud, focusing on interoperability between the government and academic clouds and integration into the European federated cloud. The idea is to implement cross-border services and access HPC resources via the IPCEI on European Common Data Infrastructure and Services. SIA Tet, VAS Latvia State Radio and Television Centre, University of Latvia Institute of Mathematics and Computer Science plan to participate in the EuroQCI (Quantum Communications Infrastructure) project and set up a quantum communication pilot project in 2022.

Latvia remains below the EU average in most of the indicators in this dimension. The lack of investment in R&D, the lack of qualified employees and the insufficient connectivity in rural areas are also hampering the integration of digital technologies. Planned reforms and investments from the RRP, Cohesion policy programmes and national public funding could help to address these challenges.

²⁶⁶ I.e., are invited for grant agreement preparation (which is not a formal commitment for funding).

4 Digital public services

4 Digital public services	Latvia	EU
	rank	score
DESI 2022	11	78.8
		67.3

	Latvia			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
4a1 e-Government users	80%	85%	84%	65%
% internet users	2019	2020	2021	2021
4a2 Pre-filled forms	NA	NA	77	64
Score (0 to 100)			2021	2021
4a3 Digital public services for citizens	NA	NA	87	75
Score (0 to 100)			2021	2021
4a4 Digital public services for businesses	NA	NA	86	82
Score (0 to 100)			2021	2021
4a5 Open data	NA	NA	77%	81%
% maximum score			2021	2021

Latvia ranks 11th in the EU for Digital public services and scores above the EU average in most categories. With 84% of e-government users, the country by far exceeds the EU average of 65%. Latvia performs well in the availability of digital public services, with a score of 87 on digital public services for citizens (EU average: 75) and a score of 86 for businesses (EU average: 82). Latvia outperforms the European average, scoring 77 compared with the EU average of 64, on pre-filled forms. The only area where Latvia scores below the EU average is open data (77% versus 81%).

The 2021-2027 [Digital Transformation Guidelines](#) adopted in 2021 include targets that aim at improving user-centricity and inclusiveness of digital public services. Latvia's RRP, with several measures for the digital transformation of public administration and municipalities, focuses on modernising governance and the data strategy. The Development Plan of Services Environment 2020-2023 approved by the Cabinet of Ministers in 2020 paved the way for fully online business creation and one of the Digital Transformation guidelines objectives is to continue promoting it. The RRP supports the development of ICT solutions for modernised public administration functions, including the business environment, as well as centralised governance platforms and systems. The RRP also provides for the development of a national data economy and a digital services economy. Digital accessibility of all public services has been strengthened and new services based on the application of digital technologies have been created. People with disabilities can access e-government benefiting from tools provided by the AI based automated translation service of the national platform of digital language tools and technologies, [HUGO.LV](#). The draft 'Law on accessibility of products and services' will turn the European Accessibility Act into national law.

The Latvian Ministry of Environmental protection and regional development supervises the efficiency of the e-governance through the project 'Integrated monitoring of public service provision and end-user

needs'. This research project identifies best practices, ways to improve and measures the progress in implementing e-governance.

The Data State Inspectorate (DSI) monitors compliance in term of processing of personal data with the General Data Protection Regulation. The DSI participates in drafting and harmonising the regulatory framework: the National Information Systems Act. It also provides its assessment, including on whether the processing of specific data categories is justified and proportionate.

Latvia continues to integrate the electronic Identification, Authentication and Trust Services (eIDAS) gateway in e-services and public authority platforms. The Latvian eID scheme, notified to the European Commission under the eIDAS Regulation, provides their eID cards to more than 740 000 Latvians (39% of the citizens). This eID cards facilitate citizens' digital interactions with public and private entities through a smart device. Latvia is amending its 'Natural Person Electronic Identification' Law to stimulate the integration of the eIDAS gateway. The law will mandate public sector providers to integrate the eIDAS gateway in their services and the eID card will be a mandatory personal identification document from 2023. The programme 'My Latvia.lv! Do Digitally!' is encouraging individuals and enterprises to use the e-government services since 2018 (see more info in highlight section below).

The Unified Network of State and Municipal Public Service Centres ([VPVKAC](#)) provides Latvians with local and national services in the same location. Currently operating in 122 premises, the VPVKAC aims to reach 470 locations by 2023.

The 2021-2027 Learning and Development Strategy for Public Administration addresses digital skills training for the public sector establishing trainings courses every six months for VPVKAC employees. The acquisition of e-health skills is integrated into the educational programmes for healthcare professionals.

During 2021, the Latvian e-health system started to provide new services such as remote consultations, remote results of radiological examinations or remote heart monitoring. The system managing immunisation certificates, including COVID certificates, was integrated into the e-health records. Although the Ministry of Health 2021-2027 [Public Health guidelines](#) are in place, the 2022 -2027 Digital Health strategy will establish more detailed guidelines and activities for e-health investments.

Latvia participates in the multi-country project 'Genome for Europe'. The project aims at strengthening Latvia's genetic research and digital capacity to enable secure matching and analysis of these data under the European '1+Million Genomes' initiative.

Latvia continues to perform well in digital public services. It is in the leading group in e-government users, pre-filled forms, and digital public services for citizens. However, it is only slightly above the EU average in digital public services for businesses and below the average in open data, indicating that there is room for improvement in these areas.

Highlight 2021-2022: Unified Network of State and Municipal Public Service Centres

The Unified Customer Service Centres aim to promote a universal integration into the digital environment. With a single systemic customer service policy, the centres ensure a network with a uniform standard of service provision, which allows predetermining those social groups

whose inclusion in the digital environment is in danger and thus adopting a focused approach.

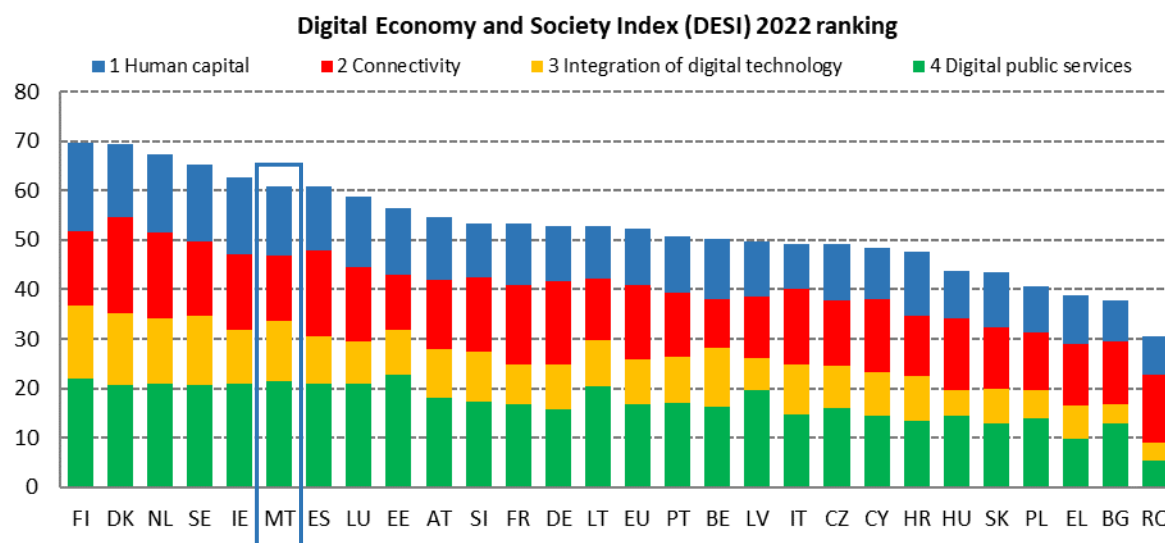
Specialists guide people that have no access to digital technologies lack digital skills in the use of basic electronic services, e.g. the official electronic address or secure electronic signature, which are available on the state portal of electronic services Latvija.lv.

The new 'Remote Official' pilot service launched at the end of 2021 includes customers' support and personalized consultations with specialists from the State Social Security Fund and the State Tax Service and, if necessary, allows remote processing of the service request. Six centres and two state institutions participated in the pilot project.

The 'Remote Officer' service will be implemented in the network in 2022. The new service will allow individuals and entrepreneurs to have fully remote access to more public administration services on-site to reduce administrative burden, accelerate the provision of competent advice from authorities also in regions, thereby contributing to business development.

Malta

DESI 2022	Malta		EU
	rank	score	score
	6	60.9	52.3



Malta ranks 6th out of 27 EU Member States in the 2022 Digital Economy and Society Index (DESI), maintaining its rank from 2021.

In the last 5 years, Malta has focused on the development and deployment of digital technologies, such as Artificial Intelligence (AI) and blockchain. The country launched the first regulatory framework on blockchain in 2018 and its [AI Strategy](#) in 2019. Another example of Malta's focus on digital is [Tech.mt](#), a public-private partnership established in 2019 by the Government of Malta and the Malta Chamber of Commerce, to help position the country as a global hub for emerging technologies. Malta's ambitions are further confirmed by the recently adopted [Smart Specialisation Strategy 2021-2027](#), which identifies digital technologies as one of the priority areas for investment in innovation over the coming years. The publication of Malta's new digital strategy covering the period of 2021-2027 and following up on the [Digital Malta Strategy 2014-2020](#) is delayed.

Malta made good relative progress as regards the overall level of digitalisation of its economy and society, and maintained a comparatively high rank within the EU over the last five years. Between 2017 and 2022, Malta's aggregate DESI score grew slightly more than expected by the convergence curve, meaning it improved at a marginally higher pace than the score of the Union as a whole²⁶⁷.

²⁶⁷ Refer to section 1.3 of the DESI 2022 horizontal chapter.

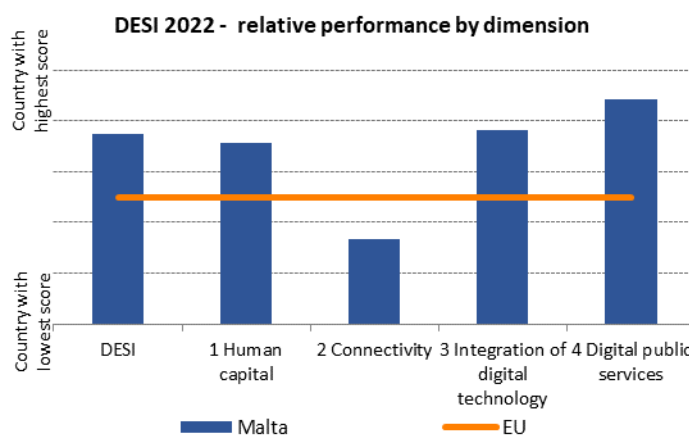
Malta's various efforts are reflected in its good performance across the different dimensions of the 2022 DESI. Nonetheless, over the next years, it will be important for Malta to step up measures to close existing gaps and pioneer advanced digital technologies, building on cooperation with other Member States. For example, there are ample opportunities to strengthen the use of digital technologies for environmental sustainability in order to effectively pursue the twin green and digital transition.

Malta boasts nationwide coverage with fixed very high capacity networks (VHCN) based on the cable DOCSIS 3.1 standard. Fibre coverage lies slightly below EU average (48% compared to 50%). There is quick progress on 5G rollout, even though assignment of 5G spectrum is still low (25% total harmonised 5G spectrum assigned, compared to the EU average of 56%). The country had 20% 5G coverage as of mid-2021 and one operator claimed nationwide coverage by the end of the year.

Sustained action is required to ensure that all people possess the necessary skills to benefit from the digital transformation, and to match the increasing demand for highly skilled ICT specialists. While the share of ICT specialists in the workforce (4.9%) and the share of ICT graduates (6.5%) exceed the EU average, there remains a shortage of professionals with the skills needed to support the increasing adoption of advanced technologies (AI, Internet of Things (IoT), blockchain) by organisations in Malta.

The large majority (73%) of Maltese small and medium-sized enterprises (SMEs) have at least a basic level of digital intensity and Maltese enterprises perform very well in the use of cloud solutions, big data, and, to a lesser extent, AI. Notwithstanding, substantial progress is needed to reach the Digital Decade targets.

There has been a remarkable improvement in the uptake of e-government services, with the share of users reaching 72% in 2021 and surpassing the EU average. Malta continues to be a leader in the offer of digital public services to its people and enterprises, but access to and use of open data remains weak.



Digital in Malta's Recovery and Resilience Plan (RRP)

The Maltese RRP accounts for a total of EUR 316.4 m allocated under the Recovery and Resilience Facility (RRF)²⁶⁸. It devotes 25.5% (EUR 80.8 m) to the digital transition²⁶⁹. The bulk of

²⁶⁸ The total value of the Maltese RRP is EUR 344.9 m, which is above the non-repayable financial support under the RRF of EUR 316.4 m. Malta did not ask for loans.

investments supported under the plan focuses on the digital transformation of the public administration, health and justice systems.

In 2021, Malta has started implementing measures supporting advanced digital skills and the digitalisation of enterprises²⁷⁰.

For example, Malta launched the [Pathfinder MDIA Digital Scholarship](#) in June 2021 to support students in undertaking PhDs or Masters related to AI (see section 1).

As part of the plan, Malta also published a [Smart Specialisation Strategy](#) which identifies digital technologies as an area of focus (see section 3).

Moreover, Malta is preparing a dedicated financial support scheme to stimulate the uptake of digital technologies by Maltese enterprises. The first round of calls, expected to be launched in June 2022, will cover ICT hardware and software for SMEs, followed by a second round addressed at large enterprises.

By the end of 2022, Malta is expected to achieve a first target under the measure 'Further digitalisation and modernisation of the public administration', consisting of two main components:

- Improve digital public services (e.g., by reengineering public and intra-facing services, setting up base and administrative registers for data sharing and reuse, and establishing a national single window for customs);
- Further develop remote working solutions for public officers by providing them with the necessary hardware and software.

²⁶⁹ Each RRP has to dedicate at least 20% of the plan's total allocation to digital objectives. To this end, the plans had to specify and justify to what extent each measure contributes fully (100%), partly (40%) or has no impact (0%) on digital objectives, using Annex VII of the RRF Regulation. Combining the coefficients with the cost estimates of each measure allows assessing to what degree the plan contributes to digital objectives and whether it meets the 20% target.

²⁷⁰ The implementation of those measures is still subject to the assessment of the European Commission.

1 Human capital

1 Human capital	Malta		EU
	rank	score	score
DESI 2022	7	56.6	45.7

	Malta		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
1a1 At least basic digital skills % individuals	NA	NA	61% 2021	54% 2021
1a2 Above basic digital skills % individuals	NA	NA	35% 2021	26% 2021
1a3 At least basic digital content creation skills²⁷¹ % individuals	NA	NA	71% 2021	66% 2021
1b1 ICT specialists % individuals in employment aged 15-74	4.6% 2019	4.4% 2020	4.9% 2021	4.5% 2021
1b2 Female ICT specialists % ICT specialists	11% 2019	11% 2020	26% 2021	19% 2021
1b3 Enterprises providing ICT training % enterprises	26% 2019	28% 2020	28% 2020	20% 2020
1b4 ICT graduates % graduates	6.9% 2018	6.0% 2019	6.5% 2020	3.9% 2020

In the Human capital dimension, Malta ranks 7th out of 27 EU countries. Malta performs above EU average on digital skills: 61% of people have at least basic digital skills, including 35% who boast above basic skill levels across all dimensions²⁷². In digital content creation, 71% of people in Malta possess at least basic skills, compared to 66% in the EU overall. After years of gradual decrease, the share of ICT graduates slightly increased to 6.5% in 2020, which lies above the EU average but has still not returned to the country's 2014 level (9.6%). Outside of higher education, 28% of Maltese enterprises provide ICT training to their employees. The percentage of ICT specialists in the workforce is relatively high (4.9% in Malta versus 4.5% in the EU) and women are comparatively well represented (26% in Malta versus 19% in the EU)²⁷³.

Malta plans to launch a new eSkills Strategy covering the period 2022-2024 in 2022. It will update the current [strategy](#) with actions and recommendations targeting education, society, the workforce and ICT professionals. Emphasis is placed on promoting the inclusive and equitable development and use of basic, advanced and specialized digital skills in line with the 2030 Digital Decade targets (80% of people with at least basic digital skills and 20 million employed ICT specialists in the EU, with convergence between men and women). The new strategy pushes for collaboration between the public and private

²⁷¹ Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

²⁷² Information and data literacy, communication and collaboration, digital content creation, safety, and problem solving.

²⁷³ The jump in the share of female ICT specialists from 11% in 2020 to 26% in 2021 must be interpreted in light of changes in the data collection methodology for this indicator in Malta (refer to DESI 2022 methodological note).

sector, aiming to match education programmes with market demands and ensure consistency in all initiatives related to digital skills in Malta.

The eSkills Malta Foundation, in collaboration with other stakeholders and training providers, implemented several measures in 2021, including an annual digital skills bootcamp and initiatives for upskilling in advanced technologies (e.g., Industry 4.0, blockchain, AI). The foundation also organised training courses and events to promote women in digital. To further advance digital inclusion, Malta participates in the multi-stakeholder partnerships [Women4IT](#) and [ICT 4 the Elderly](#). Moreover, as part of the [EU Code Week](#), between 2021 and the first months of 2022 around 530 events reaching thousands of participants were organised in Malta.

Digital is part of the school curricula. The Ministry for Education, Sport, Youth, Research and Innovation continues to roll out the new ICT curriculum in secondary schools (students aged 11-16). The Ministry is also promoting the integration of coding as part of an updated IT programme taught particularly at middle and secondary schools.

Universities in Malta are actively promoting academic and training offers for specialised ICT skills. In addition to the University of Malta, the Malta College of Arts, Science and Technology (MCAST) offers various courses on a full-time and part-time basis, covering a wide range of advanced digital skills. In particular, MCAST Gateway to Industry (MG2I) offers several courses for re-skilling and upskilling employees. Digital skills also form part of the training offered by Jobsplus, Malta's Public Employment Services.

AI is an area of focus for higher education in Malta. For example, the [Pathfinder MDIA Digital Scholarship](#) supports postgraduate education related to AI with contributions between EUR 3 600 and EUR 10 000. The first round of applications, launched in June 2021, funded a total of 13 scholarships (2 for PhDs and 11 for Masters).

Despite these efforts, the 2021 [ICT Skills Demand and Supply Monitor](#), published by the eSkills Malta Foundation, shows that there is still a shortage of ICT specialists and that the local pipeline of ICT students is likely to be insufficient to meet growing demand. The majority of surveyed organisations indicated that highly specialised professionals able to support the increasing adoption of advanced technologies (AI, IoT, blockchain) are difficult to find and retain in Malta.

As part of the [National Employment Policy 2021-2030](#), the government commits to equipping its workforce with in-demand skills and is launching a new national skills census to identify skills gaps in the Maltese labour market and develop targeted responses.

Overall, it is important for Malta to continue stepping up its efforts to close existing gaps. This includes attracting and training talent to meet the growing demand for a skilled labour force capable of managing the increasing uptake of advanced digital technologies. All of the above initiatives will be key to ensuring, in time, a robust contribution from Malta to attaining the 2030 Digital Decade skills targets as a foundation for inclusive progress in digital.

2 Connectivity

2 Connectivity	Malta		EU
	rank	score	score
DESI 2022	16	53.0	59.9

	Malta		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
2a1 Overall fixed broadband take-up	84%	86%	88%	78%
% households	2019	2020	2021	2021
2a2 At least 100 Mbps fixed broadband take-up	34%	43%	53%	41%
% households	2019	2020	2021	2021
2a3 At least 1 Gbps take-up	NA	1.15%	2.43%	7.58%
% households	2019	2020	2021	2021
2b1 Fast broadband (NGA) coverage	100%	100%	100%	90%
% households	2019	2020	2021	2021
2b2 Fixed Very High Capacity Network (VHCN) coverage	100%	100%	100%	70%
% households	2019	2020	2021	2021
2b3 Fibre to the Premises (FTTP) coverage	39%	41%	48%	50%
% households	2019	2020	2021	2021
2c1 5G spectrum	0%	17%	25%	56%
Assigned spectrum as a % of total harmonised 5G spectrum	04/2020	09/2021	04/2022	04/2022
2c2 5G coverage²⁷⁴	NA	0%	20%	66%
% populated areas		2020	2021	2021
2c3 Mobile broadband take-up	79%	79%	87%	87%
% individuals	2018	2018	2021	2021
2d1 Broadband price index	63	57	65	73
Score (0-100)	2019	2020	2021	2021

In the Connectivity dimension, Malta ranks 16th out of 27 EU countries.

Malta is on track to meet the 2030 Digital Decade connectivity targets. End-users and enterprises have access to fixed broadband speeds of at least 1 Gbps and there was 20% 5G coverage as of mid-2021. While there is still room for improvement towards symmetric gigabit speeds, particularly through fibre to the premises (FTTP) coverage (48% in Malta versus 50% in the EU), Malta's challenge over the coming years will be to ensure that people and enterprises develop relevant use cases to take advantage of very high capacity broadband connections.

Take-up of high speeds still lags far behind coverage, even if there has been significant improvement. As of June 2021, slightly over half of Maltese households (53%) subscribe to fixed internet services of at least 100 Mbps, up 10 percentage points (pps) from 2020 and 12 pps above the EU average. Take-up of

²⁷⁴ The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

gigabit connections doubled, but at 2.4% it still lies significantly below the EU average (7.6%). Low demand for ultrafast bandwidths may stem from a perceived lack of need coupled with relatively high prices, which, although they have decreased over the past year, are still above the EU average. To accelerate take-up, [Tech.mt](#) developed several initiatives to raise awareness of the benefits of using advanced technologies among people and industry in Malta (see also section 3).

The three major Maltese operators are actively investing in VHCN. Notably, Epic (previously Vodafone Malta) launched a EUR 43.2 m project supported by a [EUR 20 m loan from the European Investment Bank](#), with the aim of covering 70% of households with 5G services and 25% of households with fibre by 2024. The historically mobile-focused operator started rolling out its own fibre to the home (FTTH) network and offering fixed services with symmetric 2 Gbps in one city (Mosta) in 2021. To free up additional resources for investment, Epic agreed to sell and lease back its passive mobile infrastructure from Phoenix Towers International. Meanwhile, the two incumbent operators focused on upgrades to their existing network infrastructure: Melita increased the speeds provided by its nationwide hybrid fibre-coax network based on the DOCSIS 3.1 standard, and GO continued rolling-out its FTTH network; however, this was slowed down by difficulties in accessing to private facades.

Access to physical infrastructure remains the biggest obstacle to network deployment as Malta struggles to implement several provisions of the Broadband Cost Reduction Directive²⁷⁵. The single information point operated by Transport Malta features data on road works permits, but does not yet include other relevant data, e.g., on existing physical infrastructure from network operators. GO, Melita and Epic mostly rely on commercial agreements with the national electricity provider Enemalta to pass their cables alongside overhead power lines. Melita also uses GO ducts under a legacy commercial agreement. While the regulator has registered no access disputes to date, staffing the [dispute resolution body](#) will be important to address potential issues in the future.

Following GO's EUR 25 m investment in international connectivity, construction of a [new submarine cable](#) connecting Malta to France, Egypt and beyond was completed in 2021. The cable forms part of the global [PEACE System](#) (Pakistan East Africa Connecting Europe), a Chinese initiative connecting Asia to Europe and Africa through Chinese infrastructure. It provides Malta with additional redundancy beyond the two existing cables terminating in Italy, but also raises potential security risks that will need to be monitored and addressed in line with the [Directive on security of network and information systems](#) (under revision) and the [EU Toolbox for Cybersecurity of 5G networks](#) endorsed by Malta.

All three Maltese mobile operators are rolling out 5G infrastructure and offering 5G services using spectrum in the 3.4-3.8 GHz band. Each operator was assigned the rights of use for a contiguous frequency block of 100 MHz through direct procedure in 2021²⁷⁶. By the end of 2021, Melita claimed nationwide 5G coverage but reported that certain handsets do not support their services and therefore inhibit take-up by customers. The other two operators are expected to achieve nationwide coverage in

²⁷⁵ [Directive 2014/61/EU](#)

²⁷⁶ The band 3.4-3.5 GHz remains unassigned due to a lack of market interest.

2023 in line with the spectrum assignment conditions²⁷⁷. The Malta Communications Authority (MCA) has not registered demand for spectrum in the 700 MHz band or the 26 GHz band so far; however, one operator is licensed to carry out trials in the former until 31 October 2022.

Main market & regulatory developments

At the end of 2021, the fixed broadband market was dominated by two players with a joint market share of over 95%. Compared to the previous year, GO's market share dropped by 0.1 pps to 46.9%, while Melita's market share dropped by 0.1 pps to 48.4%. The two incumbents offer similar internet access products as part of a bundle. Due to the lack of stand-alone options with similar capacity, 94% of all fixed broadband subscribers in Malta receive the service bundled with fixed telephony and/or pay-TV.

Epic is seeking to challenge this status-quo with lower-priced and scaled-down voice and internet service offers. To date, the legacy mobile operator's limited presence in the fixed broadband market (4.6% share) still depends on fixed wireless technology and regulated VULA access to GO's network infrastructure. Epic's investment in its own FTTH infrastructure can be expected to significantly alter the competitive landscape in the coming years.

In light of this development, the MCA withdrew its 2020 finding of joint dominance between GO and Melita in the wholesale access market in order to [reassess infrastructure-based competition](#) in Malta. In December 2021, the regulator announced [plans to consider designating a separate relevant market](#) for physical infrastructure access. In parallel, the MCA is reviewing the market for wholesale high-quality connectivity services. Notification of draft measures for both markets is overdue but envisaged for the third quarter of 2022.

The mobile market is divided between three main operators with stable market shares²⁷⁸. Between 2020 and 2021, they experienced a 1.9% increase in subscriptions mostly to post-paid plans, which now make up almost 44% of all mobile subscriptions in Malta. The upward trend in domestic data usage continued in 2021, albeit at a much more moderate rate than at the onset of the COVID-19 pandemic in 2020.

Malta's only reseller of mobile telephony services, YOM Ltd, ceased operations in 2021. Meanwhile, a potential new market player, mob5g.net Malta Limited, registered interest in the use of vacant radio spectrum in the harmonised 1.8 GHz and 2.6 GHz bands. Assignment will depend on the outcome of the MCA's ongoing due diligence procedure.

On 1 October 2021, Malta notified the Commission of having turned the European Electronic

²⁷⁷ Pursuant to Decision No. MCA/D/21-4177, operators are required to make available any technology and service offering on a nationwide uninterrupted coverage basis within 24 months from the effective date of the grants of rights of use.

²⁷⁸ GO's market share dropped by 0.9 pps from 38.4% in December 2020 to 37.5% in December 2021. Melita's share rose by 1.4 pps from 24.2% to 25.6% during the same timeframe. Epic's share dropped by 0.5 pps, from 37.4% to 36.9%.

Communications Code into national law.

Regarding emergency communications, Maltese authorities report they have entered into an agreement to support all 112 and emergency management platforms with more accurate caller location data leveraging the Global Navigation Satellite System (Galileo). The expected implementation of handset-based Advance Mobile Location for Android and iOS users is delayed to Q4 2022.

In 2021, the MCA observed a rise in fraud cases in which scammers used caller identity manipulation, phishing and smishing techniques to pose as local utilities or postal companies, financial institutions, or law enforcement agencies to elicit personal information.

Malta has already completed important groundwork for a successful digital transformation of enterprises and public services, and FTTP coverage is gradually expanding to complement the nationwide network based on the DOCSIS 3.1 standard. Reaping the benefits of available speeds will require a coherent plan of action, making timely publication of Malta's new digital strategy even more pressing. This includes developing and raising awareness about relevant use cases to incentivise take-up, which would also benefit from lower prices triggered by emergent competitive dynamics, particularly in the fixed market. Facilitated access to and sharing of physical infrastructure could help to lower the cost of underground deployment for all operators and thereby reduce not only prices but also the number of visible aerial cables in Malta. In this context, implementation of the Broadband Cost Reduction Directive as well as a timely review of the wholesale access market are of key importance.

Highlight 2022: Telecost.com

In January 2021, the MCA re-launched [Telecosts.com](https://telecosts.com) as a more user-friendly and easily accessible comparison portal for mobile telephony, fixed telephony, internet, and bundled services. The updated version allows consumers to filter local tariff plans according to their individual needs and preferences, providing them with a list of services comparable along the categories of price, upload and download speed, data limit and contract duration. The portal also helps consumers to consider and evaluate other aspects before subscribing to a service, such as one off charges that could apply (e.g., installation charges) or service promises (e.g., fault repair timeframes). In 2022, the MCA plans to integrate quality of service data in the portal to further improve consumer awareness and promote transparency in the telecom market.

3 Integration of digital technology

3 Integration of digital technology	Malta	EU
	rank	score
DESI 2022	5	48.1
		36.1

	DESI 2020	Malta DESI 2021	DESI 2022	EU DESI 2022
3a1 SMEs with at least a basic level of digital intensity % SMEs	NA	NA	73% 2021	55% 2021
3b1 Electronic information sharing % enterprises	32% 2019	32% 2019	39% 2021	38% 2021
3b2 Social media % enterprises	43% 2019	43% 2019	42% 2021	29% 2021
3b3 Big data % enterprises	24% 2018	30% 2020	30% 2020	14% 2020
3b4 Cloud % enterprises	NA	NA	47% 2021	34% 2021
3b5 AI % enterprises	NA	NA	10% 2021	8% 2021
3b6 ICT for environmental sustainability % enterprises having medium/high intensity of green action through ICT	NA	NA 2021	NA 2021	66% 2021
3b7 e-Invoices % enterprises	18% 2018	22% 2020	22% 2020	32% 2020
3c1 SMEs selling online % SMEs	23% 2019	24% 2020	26% 2021	18% 2021
3c2 e-Commerce turnover % SME turnover	NA 2019	9% 2020	7% 2021	12% 2021
3c3 Selling online cross-border % SMEs	NA 2019	NA 2019	13% 2021	9% 2021

Malta ranks 5th in the EU 27 on the Integration of digital technology. A large share of SMEs in Malta (73% versus 55% in the EU) have at least a basic level of digital intensity. Maltese enterprises are very strong in the use of intermediate or sophisticated cloud computing services (47% versus 34% in the EU) and big data analysis (30%, the highest percentage in the EU). The uptake of AI is just slightly above the EU average (10% versus 8%). Malta also progressed on the uptake of electronic information sharing, which increased from 32% in 2019 to 39% in 2020, now slightly exceeding the EU average (38%). Only the percentage of enterprises that use e-invoices is below the EU average (22% versus 32%). E-Commerce represents 7% of SME's turnover, a figure that slightly decreased compared to the previous year. In 2021, 26% of SMEs sell online and 13% sell across borders.

Despite the good performance in the uptake of digital technologies, research and development expenditure by Maltese enterprises accounts for only 2.2% of the value added in the ICT sector,

compared to 5.3% on average in the EU²⁷⁹. Against this background, Malta's [Smart Specialisation Strategy 2021-2027](#), adopted in 2021, prioritises investment in innovative digital technologies in the areas of AI, IoT, high performance computing, distributed ledger technologies, cybersecurity, chatbots and digital games. These areas will be supported with EU funding under the European Regional Development Fund of the 2021-2027 cohesion policy. In addition, the strategy encourages using digital processes and solutions, such as big data analytics, open data and space applications as means to foster innovation in other fields.

Under the [AI Strategy](#) (launched in 2019), Malta continues its initiatives to position the country as a hub for AI applications. For example, The Malta Digital Innovation Authority (MDIA) launched an [AI Applied Research Grant](#) for local Public Research Institutions²⁸⁰ with a total budget of EUR 125 000 to support AI-related research and innovation in Malta and is planning more projects to facilitate the adoption of AI-based technologies in the public and private sectors.

Distributed ledger technologies are another area of policy focus, with the launch of a dedicated strategy and legal framework in 2018. As participant in the [European Blockchain Partnership](#), Malta seeks to implement a node of the European Blockchain Services Infrastructure (EBSI) by the end of 2022, further strengthening its position in this area.

Several instruments and entities contribute to supporting the digitalisation of Maltese enterprises. For example, [Tech.mt](#) leads various initiatives to assist enterprises in digitalising their operations. [Malta Enterprise](#), the country's economic development agency, supports start-ups through funding and assists enterprises with tools to facilitate digital transformation processes. For example, the [Re-engineering & Transformation Scheme](#) provides SMEs with cash grants to, e.g., seek external advice on measures to optimise the use of technology. Other examples include the Malta Information Technology Agency's (MITA) accelerator 'YouStartIT' or the 'TAKEOFF Seed Fund Award' led by the University of Malta and the Ministry for the Economy, Investment and Small Businesses.

The 'Malta-Digital Innovation Hub', developed as a coalition of public entities active in digital²⁸¹, is expected to focus particularly on high performance computing technology. The selection of the Digital Innovations Hubs that will participate in the network of European Digital Innovation Hubs (EDIHs) is ongoing. One Maltese EDIH proposal has a successful evaluation result²⁸².

In summary, it is important that Malta continues its efforts to boost the digital transformation of enterprises, in particular SMEs, and to strengthen its position in line with the ambitious strategies launched in recent years to make Malta a hub for emerging technologies (e.g., AI, blockchain). More targeted efforts are required to make better use of digital technologies in support of the green transition (e.g., applications for energy efficiency, water management, smart mobility, sustainable

²⁷⁹ Source: Commission calculations and estimates based on PREDICT project, https://joint-research-centre.ec.europa.eu/predict_en

²⁸⁰ Public research institutions may also partner with a private sector entity, but this is not a pre-requisite for application submission.

²⁸¹ It is made up of Malta Communications Authority (MCA), University of Malta, Malta College of Arts, Science & Technology (MCAST), Malta Information Technology Agency (MITA) and the Malta Chamber of Commerce.

²⁸² I.e., it is invited for grant agreement preparation (which is not a formal commitment for funding).

tourism). For example, deployment of mobility-related IT services and interconnections (intelligent transport systems) could be beneficial in improving traffic flows and thereby aid Malta in achieving sustainable mobility.

4 Digital public services

4 Digital public services ²⁸³	Malta		EU
	rank	score	score
DESI 2022	3	85.8	67.3

	DESI 2020	Malta DESI 2021	DESI 2022	EU DESI 2022
4a1 e-Government users % internet users	58% 2019	63% 2020	72% 2021	65% 2021
4a2 Pre-filled forms Score (0 to 100)	NA	NA	87 2021	64 2021
4a3 Digital public services for citizens Score (0 to 100)	NA	NA	100 2021	75 2021
4a4 Digital public services for businesses Score (0 to 100)	NA	NA	97 2021	82 2021
4a5 Open data % maximum score	NA	NA	51% 2021	81% 2021

Malta ranks 3rd in the EU on Digital public services. The share of e-government users increased significantly, from 63% in 2020 to 72% in 2021, thus exceeding the EU average. The country is a leader in providing digital public services to citizens and businesses, quickly approaching the EU Digital Decade target to achieve 100% online provision of key public services by 2030. Malta also scores well in the re-use of information across administrations to make life easier for people (pre-filled forms), but lags behind the EU when it comes to facilitating access to and use of open data.

Currently, all digital public services are accessible through the portal of the [Servizz.gov](https://servizz.gov.mt) Agency, which represents the government's one-stop-shop for people and enterprises.

In 2021, Malta launched [Achieving a Service of Excellence](#), a new 5-year strategy for enhancing the quality, accountability and sustainability of public services. The strategy sets out initiatives to complete the transition from paper-based to fully digitalised processes building on electronic identification (eID) solutions, and to boost data sharing and re-use within public administrations.

As of 2021, the Maltese government offers one eID scheme²⁸⁴ that allows people over the age of 14 to interact with public administration, albeit not yet via a smart device. The scheme is notified to the European Commission under the eIDAS Regulation and used by slightly more than half of the Maltese population (54.2%). There are plans to create a formal framework to boost the use of eID for digital signatures and to implement a 'digital wallet' that can store an electronic version of all official documents.

²⁸³ There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

²⁸⁴ Identity Malta

The national patient portal enabling people in Malta to access their digitised medical records, [myHealth](#), was accessed via eID by over 150 000 people (33.8% of the population aged above 14) by the end of 2021, according to data provided by the Maltese authorities.

Malta also launched an initiative to implement the ‘once only’ principle, enabling the sharing and re-use of data to avoid situations where users are requested to provide information repeatedly. The upcoming data strategy, to be published in 2022, is expected to further facilitate the interoperability within and across the public sector and foster open data policies. The [National Data Portal](#) launched in 2019 is still in beta version and only provided access to a limited set of government data in 2021.

The government has been promoting the use of AI to support the re-design of internal service delivery processes and to improve the quality of services. The six pilot projects launched under the 2019 [AI Strategy](#) to develop AI-based tools in the fields of transport, education, health, customer care, tourism, and water and energy are currently being implemented, with a view to assessing their viability for wider roll-outs. For example, in the field of education, the objective of the pilot is to develop an AI-powered adaptive learning system to create personalised learning programmes based on students’ performance, ambitions and needs, to help achieve better education outcomes.

An important role in the digitalisation of the public administration and its services is expected to be played by the Digital Transformation Hub (Centre of Excellence), which will enrol people and enterprises in Malta in the development of digital public services to ensure they are user-centric by design.

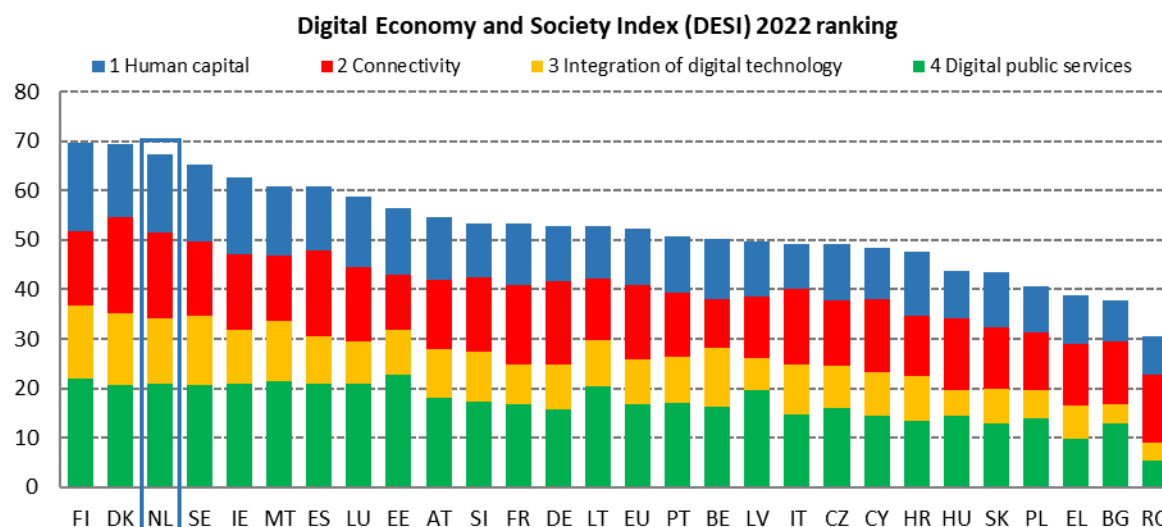
Malta is also in the process of adopting a National Strategy on Cybersecurity. Meanwhile, MITA acts as the National Cybersecurity Coordination Centre²⁸⁵ and is working to establish a national cybersecurity community bringing together entities from different knowledge domains.

It is important that Malta continues its efforts to boost the provision and uptake of digital public services and makes progress in the area of open data. Building on the Maltese RRP, there are opportunities to further use the public sector as a test-bed for the roll-out of advanced digital technologies and to boost the involvement of innovative enterprises to create spill-over effects across the economy.

²⁸⁵ Identified in line with Regulation (EU) 2021/887 of the European Parliament and of the Council of 20 May 2021 establishing the European Cybersecurity Industrial, Technology and Research Competence Centre and the Network of National Coordination Centres.

The Netherlands

	Netherlands		EU
	rank	score	score
DESI 2022	3	67.4	52.3



The Netherlands ranks third out of 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI). The country has been a consistent top performer in the EU and is, despite its already high scores, still able to make progress in some key areas.

The Dutch digital strategy (DDS) for the digital transformation of the economy and society was adopted in 2018. It is updated every year. The most recent version was [published](#) in June 2021. The DDS brings together all policies on digitalisation from the Dutch central government. Among other things, the DDS stresses the importance of an inclusive digital transition in which everyone takes part and it singles out the Netherlands' position as a digital frontrunner in Europe and the world. In January 2022, the new Dutch coalition agreement reaffirmed this ambition. The coalition government further emphasised the importance of seizing the opportunities of the digital transition for the Dutch society and economy.

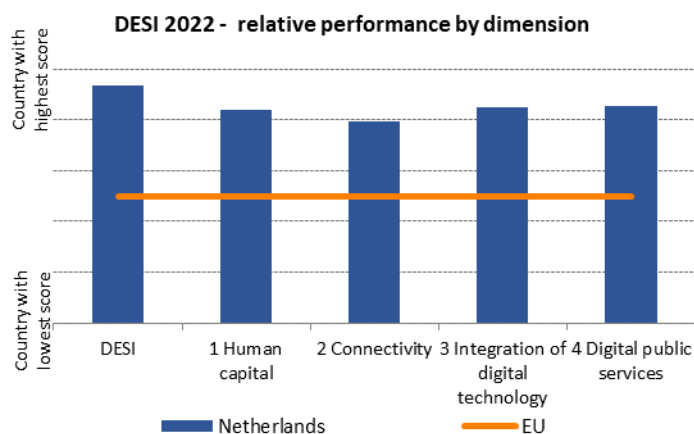
Although the presentation and adoption of the Dutch Recovery and Resilience Plan (RRP) is expected for the second half of 2022, the Netherlands has already begun investing in the digital transition through its National Growth Fund. Through this fund, the Netherlands intends to invest EUR 20 billion over the next few years in priority future growth areas such as innovation, research, and knowledge development. In April 2021, the government [approved](#) the first round of investments by the National Growth Fund with up to EUR 960 million allocated to three digital transition-oriented projects in quantum computing, artificial intelligence (AI), and the use of data in the medical sector. In the April 2022 round, the Growth Fund Committee [recommended](#) additional funding for several more digitally oriented projects to the tune of hundreds of millions of euros. The investments from this National Growth Fund will help cement

the Netherlands' strong position in innovative research, its use of digital technologies, and the level of digital skills in the wider economy. Once approved, the Recovery and Resilience Facility may further complement the effects of this fund.

Furthermore, as the fifth-largest economy in the EU and a top performer in the DESI rankings, the Netherlands' progress in the digital transition over the coming years will be crucial to enable the EU as a whole to reach the Digital Decade targets by 2030.

Nevertheless, more work and reforms are needed to make the Netherlands a worldwide digital frontrunner. Although the Netherlands performs relatively well compared to other EU countries, it needs to continue improving its performance to keep up with the world's most digitally advanced countries in the integration of advanced digital technologies. In particular, the adoption of AI – by only 13% of all Dutch enterprises – remains low and far away from the [EU target](#) for 75% of enterprises to be using AI by 2030. In this regard, the Netherlands could also intensify its participation in major European technology-cooperation projects. The spillover effects of investing in digital technologies could also be further acknowledged, especially the importance of digital technologies in the green transition through the development of the country's smart electricity grid. For this to happen, it will be crucial for the Netherlands to address its severe shortage of digital technology experts and Information and Communications Technologies (ICT) personnel. The difficulty Dutch enterprises face to find qualified ICT specialists – over 70% of Dutch enterprises which recruited or tried to recruit ICT specialists reported such difficulties in 2020 – could slow down progress in other aspects of the digital transition as well as hamper economic growth. If these remaining hurdles are tackled, the Netherlands could accelerate the use of digital technologies in all areas of the economy fully within the human-centric approach championed by the [Digital principles](#).

2021 and 2022 also saw a new focus in the Dutch governance system on the digital transition. As part of this new focus, the coalition government that was formed in January 2022 includes the country's first ever State Secretary for Digital Affairs while a permanent Parliamentary Standing Committee on Digital Affairs was created following the March 2021 parliamentary elections. At the same time, the Ministry of Economic Affairs and Climate Policy remains the main Ministry responsible for the digital economy. In March 2022, the government [submitted](#) its new policy for digitalisation in a letter to the House of Representatives. This letter includes the ambitions and goals for the digital transition of the Netherlands as a starting point for the government-wide digitalisation work agenda in 2022.



Following the Russian invasion of Ukraine, the Netherlands has taken steps to comply with the implementation of EU sanctions. A [newly appointed](#) national coordinator for sanctions implementation and enforcement will streamline processes between the different departments and executive organisations. The National Cyber Security Centre (NCSC) is also closely monitoring the Russian invasion of Ukraine to prepare the Netherlands for the possible consequences of cyber-attacks from Russia. To that end, it has issued several [status reports](#) and it has compiled a list of [basic cybersecurity](#) measures to prepare for a cyberattack. The NCSC also organised several webinars with the Digital Trust Centre to provide updates on the latest developments and to exchange information with the cyber-security community. The NCSC and Cyber Security Incident Response Team – Digital Service Providers (CSIRT-DSP) also take part in the European CSIRT network to further exchange information on Ukraine at the European level.

1 Human capital

1 Human capital	Netherlands		EU
	rank	score	score
DESI 2022	2	63.1	45.7

	Netherlands			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
1a1 At least basic digital skills % individuals	NA	NA	79% 2021	54% 2021
1a2 Above basic digital skills % individuals	NA	NA	52% 2021	26% 2021
1a3 At least basic digital content creation skills²⁸⁶ % individuals	NA	NA	83% 2021	66% 2021
1b1 ICT specialists % individuals in employment aged 15-74	5.6% 2019	5.9% 2020	6.7% 2021	4.5% 2021
1b2 Female ICT specialists % ICT specialists	17% 2019	18% 2020	18% 2021	19% 2021
1b3 Enterprises providing ICT training % enterprises	NA 2019	24% 2020	24% 2020	20% 2020
1b4 ICT graduates % graduates	2.8% 2018	3.1% 2019	3.4% 2020	3.9% 2020

The Netherlands ranks second in Human Capital in the DESI 2022, continuing its streak as one of the best performing EU countries for digital skills and human capital. It continues to score very highly for the share of its population with at least basic digital skills and it is placed at the top of EU countries when it comes to individuals with above basic digital skills. The Netherlands is one of the top five EU countries for the share of ICT specialists as a percentage of its workforce. However, the Netherlands still requires many more ICT specialists to continue to be a frontrunner in the digital transition. In particular, despite steady progress, the 3.4% of graduates who studied ICT out of all graduates in the Netherlands remains behind the EU average of 3.9%. In addition, less than a quarter of enterprises in the Netherlands provide ICT training to their employees. While this is slightly above the EU average, more effort is needed to alleviate the structural difficulties faced by Dutch enterprises in finding qualified ICT personnel. Additionally, growth in the share of female ICT specialists has been very limited, and the Netherlands continues to perform below the EU average on this measure. Only 18% of all ICT specialists in the Netherlands are women compared to an EU average of 19%.

Digital skills feature prominently in the Dutch digitalisation strategy (DDS) and the area of ‘digital skills and inclusion’ has been a main priority of the strategy since 2018.

²⁸⁶ Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

To implement the strategy on digital skills in the DDS, the Netherlands has run an overarching digital-inclusion programme since 2018 to improve people's basic digital skills together with the [Count on Skills 2020-2024](#) programme. The latter is the main initiative to improve basic skills (including language, calculation, and digital skills) with a yearly budget of EUR 60 million. An additional investment of EUR 125 million over 5 years until 2024 has been pledged to the programme.

In the future, the government's work on digital inclusion will shift part of its focus to advanced digital skills, information skills and digital awareness. The Dutch Smart Industry programme [integrates](#) advanced digital skills objectives within its overall goal of promoting and advancing the Dutch digital economy. Every Fieldlab within the Smart Industry Programme – bringing together researchers and entrepreneurs to promote innovation – also functions as a 'Skillslab' for all participants. It further encourages all participants to foster a continuous learning culture.

The [Human Capital Agenda ICT](#) (HCA-ICT) remains the Netherlands' main initiative for increasing the number of ICT professionals in the country. Initiated in 2015, it was renewed in 2019 with a budget of EUR 500 000. Recent efforts to tackle the shortage of ICT professionals in the Netherlands focus around two main pillars: (1) encouraging students to choose ICT-related studies and (2) promoting regional cooperation between education and business. In April 2021, the HCA-ICT [presented](#) a new scaling-up plan with a commitment to educate and re-skill an additional 36 000 ICT students in cooperation with 4 000 companies.

Additional measures to help upskill and re-skill the Dutch labour force are expected in 2022 with the implementation of an individual learning budget for workers called STAP (*Stimuleren Arbeidsmarkt Positie*). From September to December 2021, companies were also able to apply for a EUR 3 750 subsidy to re-skill new or existing employees with digital skills. The results of this scheme are not yet published but there are plans to renew the subsidy scheme in 2022.

The Dutch government also created a specific [taskforce diversity & inclusion](#) for the ICT sector. The taskforce was developed as an initiative of DigitalNL, the Dutch industry organisation for the digital sector, and the Dutch Ministry of Economic Affairs and Climate Policy. The taskforce also supports the Dutch government's ambition to get to full gender parity for ICT specialists by 2030, in keeping with the objective of the [European Digital Decade's](#) targets. To achieve this, the government will rely on the sharing of best practices between companies while a benchmark will also be developed.

In 2021, 518 'Code Week' activities were organised in the Netherlands, of which 86% took place in schools. A total of 14 720 participants took part of which half were female. Overall, the digitalisation and innovation approach for Dutch education is developed per sector, usually in close cooperation with the Ministry of Education and Economic Affairs. This means that the Dutch government sets a general framework and creates financial incentives with conditions for digital education for other organisations (including [Kennisnet](#), [SIVON](#), [SURE](#), and [MBO-Digitaal](#)). The Dutch government accelerated the development of online learning during the COVID-19 pandemic, with additional financial support and the delivery of electronic and digital devices to both schools and households that needed them. A multi-annual curriculum reform in primary and secondary education is ongoing, which should ultimately result in a more focused education in digital literacy as of 2024/2025. The envisaged Dutch education curriculum will not have a particular focus on coding, instead relying on a more holistic overview in

which coding is taught alongside other basic ICT skills such as media literacy, information skills, and computational skills. In October 2021, the Dutch government announced the creation of [National Education Lab for AI](#) to help integrate AI technology in education in a safe and ethical manner.

National Education Lab AI

The Dutch National Growth Fund completed its first round of investment screening in spring 2021 and allocated EUR 80 million to set up a National Education Lab for AI.

This lab will allow stakeholders work on AI-innovations to promote the safe and responsible use of AI technology within Dutch primary and secondary education. The project brings together schools, entrepreneurs, and students. It also enables participating schools to access well-developed public research infrastructure on AI for the first time in the Netherlands.

Interested partners will start developing AI technology to improve the quality of Dutch education and integrate the use of technology in the education curricula, while adhering to principles on ethical and responsible usage where the teacher remains the focal point.

The initial investment of EUR 80 million will be used over the next 10 years.

2 Connectivity

2 Connectivity	Netherlands		EU
	rank	score	score
DESI 2022	2	70.1	59.9

	Netherlands			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
2a1 Overall fixed broadband take-up	98%	90%	97%	78%
% households	2019	2020	2021	2021
2a2 At least 100 Mbps fixed broadband take-up	42%	41%	47%	41%
% households	2019	2020	2021	2021
2a3 At least 1 Gbps take-up	<0.01%	<0.01%	<0.01%	7.58%
% households	2019	2020	2021	2021
2b1 Fast broadband (NGA) coverage	98%	98%	99%	90%
% households	2019	2020	2021	2021
2b2 Fixed Very High Capacity Network (VHCN) coverage	89%	90%	91%	70%
% households	2019	2020	2021	2021
2b3 Fibre to the Premises (FTTP) coverage	34%	36%	52%	50%
% households	2019	2020	2021	2021
2c1 5G spectrum	0%	33%	33%	56%
Assigned spectrum as a % of total harmonised 5G spectrum	04/2020	09/2021	04/2022	04/2022
2c2 5G coverage²⁸⁷	NA	80%	97%	66%
% populated areas		2020	2021	2021
2c3 Mobile broadband take-up	90%	90%	94%	87%
% individuals	2018	2018	2021	2021
2d1 Broadband price index	56	61	68	73
Score (0-100)	2019	2020	2021	2021

The Netherlands remains a top performer in connectivity, ranking second among EU Member States, with broad high-quality infrastructure coverage with several fixed electronic communications networks (copper, cable and fibre) and three mobile network providers.

The Netherlands is already on a good path to reaching the 2025 'Gigabit Society' targets as well as the 2030 'Digital Decade targets' in terms of coverage, with 91% of the country already covered by fixed very high capacity networks (VHCN) and 97% 5G coverage in populated areas. Overall fixed coverage in urban and rural areas in the Netherlands has continued to increase in recent years, in particular due to the modernisation of the fixed networks. Fibre to the premises (FTTP) reached a coverage of 52% in 2021. In 2022, the network provider VodafoneZiggo is expected to complete the upgrade of its national cable network to gigabit speeds (Docsis 3.1). In addition to other market players, the network provider KPN has intensified the roll-out of its fibre network. In addition, the 700 MHz band licences come with

²⁸⁷ The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

coverage obligations to ensure 98% geographical mobile coverage²⁸⁸. These obligations are technology neutral and are likely to contribute to wider 5G deployment. However, in some cases, telecom operators are facing difficulties reaching these coverage obligations. One reason for this is that these obligations require many new mobile sites and telecom operators have encountered problems in setting up these sites in some areas, such as on large areas of private land. There are no targeted obligations to cover major terrestrial transport paths in the Netherlands, but considering that current networks already ensure such coverage, it is likely that 5G will also ensure this coverage.

As a result of the advanced coverage, main socio-economic drivers already have - or can gain - access to gigabit connections due to the wide availability of fixed networks, including fibre backbones, backhauls, and VHCNs. In addition, two national organisations facilitate access to VHCN connections for schools, in particular for academic (secondary and post-secondary) [vocational education](#), and primary and [secondary education](#).

Despite the good pace in VHCN deployment, there is still an investment gap to reach the most remote 19 000 households. The cost of connecting these households can be as much as EUR 100 000 per household, with an overall cost estimated at approximately EUR 250 million, including households' contributions and private investments of approximately 55 million. The Ministry of Economic Affairs and Climate Policy is exploring to what extent these addresses could be connected through public funding. Historically, private investments have driven the deployment of networks on the Dutch market, and there is no national broadband funding scheme.

Despite the wide availability of very high speed networks, the uptake of at least 100 Mbps speeds or gigabit-speed services in the Netherlands is not especially high. The overall take-up of fixed broadband is 97%, but households seem to prefer lower speeds, available over fast broadband (up to 30 Mbps) or mobile connections. Operators are regularly upgrading their entry-level subscriptions with higher broadband speeds, which has contributed to a slight increase in take-up of very-high-speed services. Uptake of 100 Mbps speeds is steadily increasing, and is now at 47% compared to 41% at EU level. However, it could be higher considering the wide coverage of VHCN, including 5G. Nevertheless, broadband prices in the Netherlands remain higher than the EU average, but are starting to fall in price. Mobile broadband take-up continues to increase, and reached 94% of individuals in 2021.

One of the main challenges keeping the Netherlands from its ambition to become a first level leader in connectivity relates to 5G spectrum. With only 33% of its available 5G spectrum already allocated, the Netherlands is falling behind at EU level, where an average of 56% of the 5G spectrum has already been allocated. 5G in the Netherlands is mainly offered through the 700 MHz and 1 800 MHz-bands and has so far been used to offer nationwide coverage and improve mobile quality through stable connections and speeds. While there have been some 5G trials for use cases in areas such as agriculture, smart cities and industry, there is still large potential for improvement. The launch of the auction for the 3.6 GHz

²⁸⁸ By 28 July 2022, licence holders are obliged to cover 98% of the geographical area of all municipalities in the Netherlands. That coverage should ensure that all users can, at any time, access a service that provides them with at least 8 Mbps with a 90% probability. This speed requirement will increase to 10 Mbps by 28 July 2026. To achieve these obligations, licence holders can use any of their available frequencies in other bands.

band will be essential in bringing about this improvement. This auction has been delayed because of legal issues about the current use of this band. The majority of the 3.6 GHz band is currently used by satellite company Inmarsat. In 2021, the District Court of Rotterdam issued an injunction suspending the amendment of the national frequency plan that was required for the auction of the 3.6 GHz band. Following this injunction, the Dutch government formed an independent advisory committee on the use of the spectrum band, which recommends that Inmarsat relocates to Greece when its licence expires. In the meantime, the satellite operator should be allowed to use 80 MHz in the band during the transition period.

is expected to issue its advice by 1 May 2022. The task of the advisory committee is to advise the minister on how and when the 3.6 GHz band can be made available for mobile communication throughout the Netherlands.

On the assignment of the 26 GHz band, a public consultation is expected in the first half of 2022. While the auction could take place as early as the end of 2022, the mobile operators have stressed the importance, from the point of view of their commercial considerations, of first completing the award of the 3.6 GHz band.

Main market & regulatory developments

Market shares in both the fixed and mobile market have remained stable. KPN's market share in the fixed market is over 35% while VodafoneZiggo holds over 40%. On the mobile market, T-Mobile and KPN each hold over 25% of market shares and VodafoneZiggo holds over 20%.

T-Mobile is in the process of being taken over by a private equity. T-Mobile does not expect any major changes in its commercial strategy as a result of this and still expects that roll-out of its fibre network will continue.

On 15 April 2022 ACM [published a draft decision](#) on lower tariffs and improved conditions for access to fiber-optic networks, committing KPN and Glaspoort for 8 years. The draft decision is based on commitments submitted by the two operators to ACM.

Due to the current expansionary phase of the fibre-roll out, operators are targeting the same municipalities and areas. To facilitate the efficient roll-out of fibre, the Dutch authority for consumer and markets (ACM) has issued guidance for municipalities to strategically allocate deployments. ACM has also re-assessed the alleged strategic over-building of fibre networks in urban areas by the incumbent KPN and came to the conclusion that the concerns raised in 2019 about possible delays or strategic over-building have been addressed by market parties. On the ongoing roll-out of fibre networks, T-Mobile, which is a wholesale customer of KPN, sought an injunction to delay KPN's phase-out of the copper network. KPN is planning to phase-out 2.4 million copper connections by 2023. In particular, T-Mobile argued that it did not have sufficient time to migrate its own customers and that the fibre-access prices were higher than for copper. The case was ruled in favour of KPN who were allowed to continue with the project

as planned.

The Ministry of Economic Affairs and Climate Policy has addressed the issues of permit-granting procedures and efficient access to physical infrastructure. To mitigate these problems, the Ministry has successfully created a taskforce of national and local authorities to develop a uniform approach to permit-granting procedures for antennas and access to physical infrastructure for small cells.

A major recent development in the Dutch telecoms landscape has been the transposition into national law of the European Electronic Communications Code, which will contribute to increased legal certainty and direct benefits for both businesses and end-user protection. The Netherlands notified complete transposition in February 2022.

The number of consumer complaints has increased from 1 114 in 2020 to 1 679 in 2022. The main reason for complaints is sales methods, complaints about which increased from 511 in 2020 to 1 250 in 2021. However, ACM does not have information on the reason behind this considerable year-on-year increase. SMS fraud has also increased considerably in the Netherlands. This type of fraud involves sending an SMS to consumers and making the message appear as if an authority or a bank sent it. The message contains a request to pay an invoice and a link to a fraudulent website to make a direct payment. Ministries, ACM and mobile operators are working together with the concerned sectors to find a solution to this type of fraud.

As one of the top performers in connectivity, the Netherlands continues to make improvements, not least in VHCN deployment with steady roll out of fibre to the premises. Following the award of the 700 MHz band, the Netherlands has made further improvements to 5G coverage. However, the delay in assigning the 3.6 GHz band is a real obstacle to making the most of 5G. With already advanced markets, the Netherlands is well positioned to reach the 2025 'Gigabit Society' targets and is on good track to meet the 2030 'Digital Decade' targets. However, reaching these targets will require increasing the low take-up of higher broadband speeds and gigabit connections as well as ensuring VHCN connections in so called white areas, which currently lack such coverage.

3 Integration of digital technology

3 Integration of digital technology	Netherlands		EU
	rank	score	score
DESI 2022	4	52.1	36.1

	Netherlands			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
3a1 SMEs with at least a basic level of digital intensity	NA	NA	75%	55%
% SMEs			2021	2021
3b1 Electronic information sharing	47%	47%	43%	38%
% enterprises	2019	2019	2021	2021
3b2 Social media	37%	37%	49%	29%
% enterprises	2019	2019	2021	2021
3b3 Big data	22%	27%	27%	14%
% enterprises	2018	2020	2020	2020
3b4 Cloud	NA	NA	60%	34%
% enterprises			2021	2021
3b5 AI	NA	NA	13%	8%
% enterprises			2021	2021
3b6 ICT for environmental sustainability	NA	64%	64%	66%
% enterprises having medium/high intensity of green action through ICT		2021	2021	2021
3b7 e-Invoices	22%	25%	25%	32%
% enterprises	2018	2020	2020	2020
3c1 SMEs selling online	21%	19%	23%	18%
% SMEs	2019	2020	2021	2021
3c2 e-Commerce turnover	12%	13%	15%	12%
% SME turnover	2019	2020	2021	2021
3c3 Selling online cross-border	13%	13%	13%	9%
% SMEs	2019	2019	2021	2021

On the integration of digital technologies, the Netherlands ranks fourth in the DESI 2022. Among Dutch small and medium enterprises (SMEs), 3 out of 4 already have a basic level of digital technology integrated in their operations. This is significantly above the EU average of 55%. This pattern of Dutch outperformance of the EU average can be observed for the adoption of several digital technologies. Specifically, Dutch enterprises perform well above the EU average for the share of enterprises using cloud (60% vs an EU average of 34%), big data (27% vs an EU average of 14%), and the use of social media (49% vs an EU average of 29%). However, the Netherlands does not lead by much compared to the EU average in several other key indicators. This is the case for the share of SMEs selling online (23% vs an EU average of 18%), the percentage of SME's e-Commerce turnover (15% vs an EU average of 12%), the use of AI (13% vs an EU average of 8%), the percentage of SMEs selling online cross-border (13% vs an EU average of 9%) and the amount of electronic information sharing (43% vs an EU average of 38%). The Netherlands also performs below the EU average for the use of e-Invoices as a percentage of enterprises (25% vs an EU average of 32%) and the use of ICT for environmental sustainability (64% vs an EU average of 66%). Overall, growth rates for most of these measures on the integration of digital

technologies are limited. And although the Netherlands continues to perform well compared to other EU countries, more ambition and action are needed to increase its performance sustainably into the future.

Existing digital technology and innovation partnerships, including the Dutch Artificial Intelligence Coalition, the Dutch Blockchain Coalition, and the Smart Industry Programme aim to propel the Netherlands to a frontrunner status in digital, innovation, and high-tech expertise. The latter brings together 680 different companies and 50 knowledge- and test centres with EUR 140 million of government funding and welcomed its [49th Fieldlab](#) in February. In April 2021, the State Secretary for Economic Affairs and Climate Policy concluded that, going forward, the new Government coalition would have to develop a new strategy for the Smart Industry programme.

The new Dutch government coalition underscored its ambition to capitalise on the opportunities presented by new digital technologies in its January 2022 [coalition agreement](#). This agreement emphasised the government's ambition to keep investing in and stimulating innovation in digital technologies, including microelectronics, AI, quantum computing and other key technologies.

To that end, the Netherlands participates in several important projects of common European interest (IPCEIs) and technology Joint Undertakings. The country is preparing to submit a project portfolio for the IPCEI Microelectronics II for which it has set aside EUR 230 million. The Netherlands is preparing to participate in the IPCEI on Cloud Infrastructure and Services to help with the roll-out of new cloud-edge technologies. The official submission is expected for the fourth quarter of 2022. The government is also planning to co-invest approximately EUR 70 million in the period 2022-2026 in investment projects in this field, including in the setting-up of new edge nodes.

Furthermore, the Netherlands participates in the Key Digital Technologies Joint Undertaking (KDT JU) under Horizon Europe. Dutch participants in this Joint Undertaking receive EUR 20 million to work on collaborative R&D&I projects. The Eureka Cluster programme, a thematic funding programme that brings together large companies, SMEs, universities, and research institutes also receives an annual EUR 20 million contribution from the Dutch government. Another ad-hoc contribution of EUR 5 million on top of the annual pledge was made in 2021.

Before 2021, the Netherlands was a member of the European High-Performance Computing (HPC) Joint Undertaking and has signed the Declaration on Cooperation Framework in HPC. An evaluation of this declaration is planned in 2022/2023 while an additional EUR 7.5 million will be made available for national co-funding for calls from the EuroHPC partnership under Horizon Europe in 2022. The Netherlands also has an active national hub that is part of Gaia-X financed by the Dutch government. Finally, the Netherlands has signed EU declarations on the European Blockchain Partnership, the European Cloud Alliance, Cooperation on AI, and Quantum Computing Infrastructure.

On the infrastructure for quantum computing, the Netherlands has made key contributions towards creating the first computer with quantum acceleration. The Dutch government financially supports the Quantum Delta NL initiative, a partnership between universities, the Dutch Organisation for Applied Scientific Research (TNO) and other quantum computing hubs. Quantum Delta NL [focuses](#) on three main research projects, one of which (CAT 1 Programme) works specifically on building the first European

quantum computer. A first demonstrator – the Quantum Inspire facility – has already been [launched](#), functioning as the world’s first technology independent quantum computer connected that is to the cloud. This programme also works together in a European context with Digital Europe, the Quantum Flagship initiative, and EuroHPC.

Moreover, in March 2021, board of the National Growth Fund announced that it [would support](#) with EUR 615 million – spread out over 8 years – the implementation of the national quantum agenda. This National Growth Fund also [supports](#) the Dutch Alned programme for AI research with up to EUR 276 million to fund long-term and cross-sectoral Artificial Intelligence research. The total budget for this program is EUR 2.1 billion for the period 2021-2027.

In 2021, the Netherlands also increased its support measures for SMEs. A network of ‘SME workplaces’, bringing together local small businesses and technology students, grew to 20 workplaces, thanks to a specific subsidy scheme. New measures to increase the adoption of digital technologies are planned, and are currently being tested as pilot schemes, while the ambition is for this network to reach more than 97 000 SMEs over the next 3 years. The European Digital Innovation Hubs (EDIHs) will provide access to technical expertise and experimentation for enterprises. The selection of the Digital Innovation Hubs that will participate in the network of EDIHs is ongoing. Six Dutch EDIH proposals have a successful evaluation result.²⁸⁹

²⁸⁹ I.e. are invited for grant agreement preparation (which is not a formal commitment for funding).

4 Digital public services

4 Digital public services ²⁹⁰	Netherlands		EU
	rank	score	score
DESI 2022	4	84.2	67.3

	Netherlands			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
4a1 e-Government users	84%	91%	92%	65%
% internet users	2019	2020	2021	2021
4a2 Pre-filled forms	NA	NA	94	64
Score (0 to 100)			2021	2021
4a3 Digital public services for citizens	NA	NA	85	75
Score (0 to 100)			2021	2021
4a4 Digital public services for businesses	NA	NA	88	82
Score (0 to 100)			2021	2021
4a5 Open data	NA	NA	92%	81%
% maximum score			2021	2021

The Netherlands ranks fourth in Digital Public Services in the DESI 2022. The country performs above the EU average across the board, scoring particularly high for the number of e-Government users as a percentage of internet users (92% vs 65% for the EU) and for the use of pre-filled forms with a score of 94 out of 100 vs the EU average of 64. The differences are smaller for the use of open data (92% in the Netherlands vs 81% in the EU), digital public services for businesses (88% vs 82%) and digital public services for citizens (85% vs 75%).

The 2020 [NL Digibeter Agenda](#) remains the most up-to-date reference document on the Dutch government's digitalisation strategy for digital public services. Beyond the initial premise of creating a 'value-based' agenda for digital public services from the 'perspective of citizens,' the 2020 NL Digibeter Agenda update pays additional attention to (1) making sure everyone can participate in the digital sphere; (2) a more trustworthy digital government service; and (3) taking into account ethical concerns raised by the adoption of new technologies. The five themes of the agenda also remain relevant. These five themes focus on investing in innovation, protecting fundamental rights and public values, accessible and understandable services, personalised services, and future-proof delivery of public services. The efforts to digitalise the government administration have also borne fruit, 100% of government organisations were connected to the most commonly used base registers in January 2021, a significant step towards achieving the 'once only principle,' according to which users should only have to enter their information into a website once, which means that this information can then be used by other websites, saving the user time.

²⁹⁰ There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

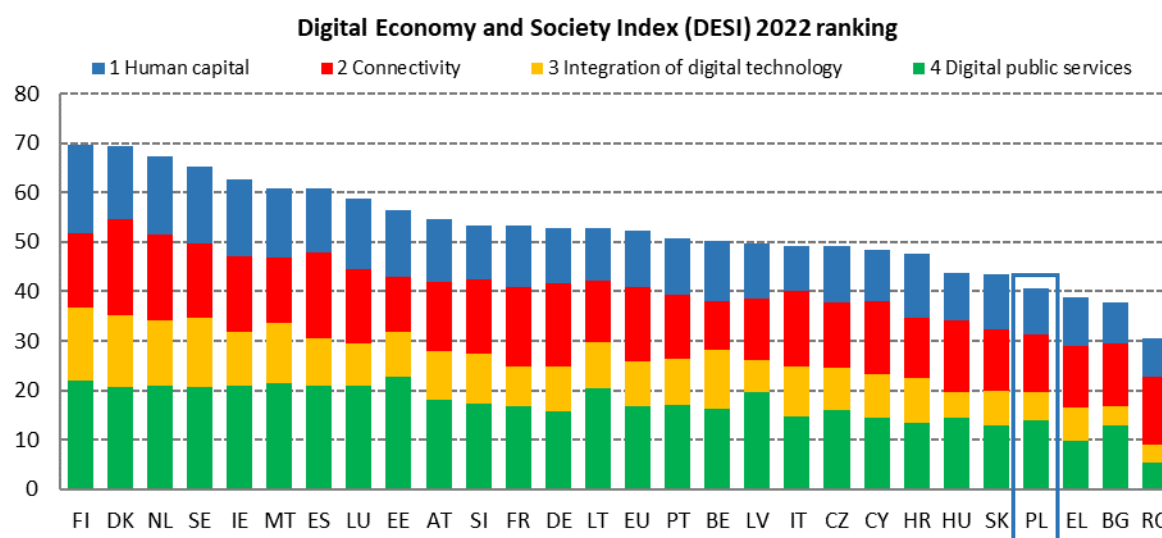
To complement the *Digibeter Agenda* – as well as the overall DDS – the Dutch government presented a new [I-Strategy for 2021-2025](#) in September 2021. This strategy describes the broad direction and choices facing chief information officers (CIO) of the Kingdom of the Netherlands and consists of four ‘red lines.’ The first red line focuses on strengthening execution and improving the quality of the service while putting citizens at the centre of digital policymaking. The second red line concerns taking advantage of the possibilities provided by data, i.e. using data as a starting point for providing other services rather than gathering data as an end in itself. Thirdly, the I-strategy reconfirms humans as the most important part of the digital transition and seeks to attract more ICT talent and professionals. The fourth red line stresses the importance of transparency and openness. In addition to these four red lines, the strategy has 10 major themes including digital resilience, information management, data and algorithms, digital governance, and market and development. On budgets, the 2022 budget of the Ministry of the Interior has set aside EUR 216 million for the information society and digital government. The Dutch digital inclusion programme contains measures to make online government services and websites more accessible, a legal obligation for government websites since September 2020 and for government mobile applications since June 2021. The Dutch parliament [asked](#) the government in November 2021 to present, by the first quarter of 2022, a roadmap on how it plans to fulfil these obligations. In general, the government initiatives on digital accessibility reach between several thousand and the low tens of thousands of Dutch citizens.

Dutch citizens have had the right to get a free electronic copy of their medical records since 1 July 2020. New frameworks on technical, operational, and governance requirements for healthcare data are also continuously being developed in collaboration with the National Patient Federation, the National Health Insurers Organisation, the Ministry of Health, healthcare professional organisations, and healthcare provider organisations.

Efforts to make a digital identity available to citizens and companies also continue apace. Citizens and companies have the ability to use eID solutions - *DigiD* for citizens and *eHerkenning* for companies – notified under the eIDAS scheme. There are plans to anchor these eID solutions in the Digital Government Law, which is currently pending approval in Parliament. The roll-out of these schemes in the Netherlands has been a success, as over 96% of the population has at least one eID.

Poland

	Poland		EU
	rank	score	score
DESI 2022	24	40.5	52.3



Poland ranks 24th of 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI). However, between 2017 and 2022, Poland's aggregate DESI score grew slightly more than the EU average, signalling that Poland is catching up with the rest of the EU²⁹¹.

There are still persistent gaps regarding human capital, where Poland ranks 24th, scoring below average in all the indicators. Only 43% of people between 16 and 74 years have at least basic digital skills (54% in the EU) and 57% have at least basic digital content creation skills (66% in the EU). ICT specialists account for a slightly lower percentage of the workforce in Poland than the EU average.

When looking at the number of ICT graduates, Poland is still scoring below the EU average. The shortage of specialists is significantly affecting businesses' integration of digital technology. Only 18% of enterprises provide a dedicated ICT training; paired with a low level of digital skills and the low propensity of the management to invest in training prevents businesses, in particular SMEs, from tapping into the full potential offered by the digital economy. With the low share of digital specialists in the Polish workforce and the future prospects being undermined by only average rates of ICT enrolment and graduates, a significant change of pace in the country digital skills' readiness is crucial for the EU to reach the Digital Decade targets for basic digital skills and ICT specialists.

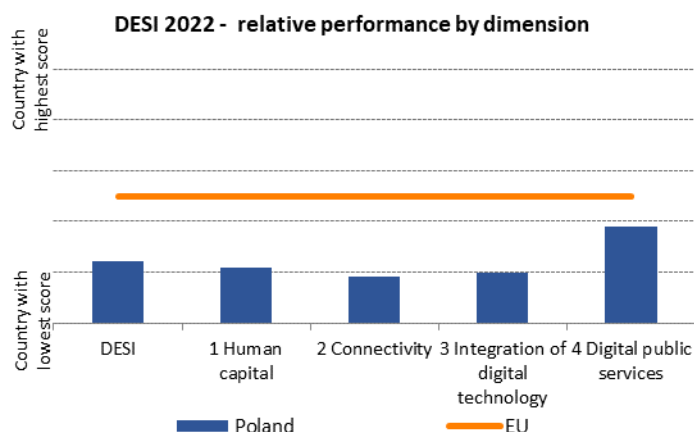
²⁹¹ See section 1.3 of the DESI 2022 thematic chapters.

In 2021, Poland observed an increase in the percentage of households covered by Fixed Very High Capacity Networks – 70% compared to 65% in 2020. Nevertheless, there are still challenges in the deployment of 5G. In particular, only 34% of households were covered by 5G technology in 2021, which is below the EU average of 65%, and the harmonised radio spectrum for 5G deployment has yet to be assigned.

Digital technologies kept on gaining popularity among Polish enterprises, with 19% using cloud solutions and 32% engaging in electronic information sharing (EU: 38%). Nevertheless, there is still a gap to be closed until 2030 to reach the Digital Decade target in cloud, big data and Artificial Intelligence (AI). The current uptake of those technologies ranges between 3% and 19% compared with the EU target of 75% by 2030. It is important to step up the efforts and promote capacity building among Polish enterprises to digitalise further, as only 40% have at least a basic level of digital intensity (EU average: 55%). This is in contrast with the Digital Decade target that at least 90% of SMEs should have ‘at least a basic level’ of digital intensity by 2030. Poland will be able to speed up its digital transformation through further incentives to invest, dedicated support and encouragement (especially for businesses in disadvantaged regions) and improved female digital entrepreneurship.

Poland's performance is also offset by below-average scores in digital public services, where ongoing efforts need to be continued to enable Poland to achieve the Digital Decade target of 100% online provision of key public services for Union citizens and businesses by 2030. When paired up with additional measures promoting the use of e-government services among businesses and individuals, the ongoing efforts could further boost uptake and improve the country's overall score in this dimension. In open data, Poland keeps on faring very well (95% compared to 81% for the EU). In the ‘Open Data Maturity 2021’ it ranked fourth, which is well above the EU average.

Digitalisation remains one of the key priorities of the government, along with simplifying legislation and improving the quality of regulations to support the business environment. Poland currently has no dedicated strategy on the digital transformation of the economy and society. Work is currently under way to identify further actions to be implemented under the new financial perspective under the 2021-2027 European Social Fund Plus (ESF+) and the 2021-2027 European Regional Development Fund (ERDF). In addition, the digitalisation policy for education and the 2030 Digital Competence Development Programme are planned to be adopted in the third quarter of 2022 with a 2030 perspective.



Following Russia's invasion of Ukraine, the [Nationwide Educational Network](#) (Ogólnopolska Sieć Edukacyjna – OSE) has enabled the provision of fast, safe and free internet in places previously connected to the OSE network, which became the admission points for people fleeing from Ukraine. The OSE provides the possibility of free-of-charge increase of the connection capacity in schools with Ukrainian students. Moreover, [NASK Academy](#) (National Research Institute) and the [Polish Safer Internet Center](#), prepared awareness activities and various educational materials to facilitate the work of teachers with Ukrainian students and to help them in combatting stress. There were also several activities launched to fight misinformation online (see highlight).

Digital in Poland's Recovery and Resilience Plan (RRP)

Measures contributing to the digital transition account for 21.3% (over EUR 7.5 bn) of the plan's total allocation, exceeding the required minimum target of 20% outlined in the Regulation²⁹². Out of the plan's six components, component C on Digital Transition clearly stands out as the main contributor to the digital target with interventions in network deployment, e-services in the public administration, education, digital skills and cybersecurity. Digital features well also in other components.

The comprehensive set of measures is expected to have a lasting impact on Poland's digital transformation, especially in developing the broadband and 5G network, improving the delivery of public services to businesses and citizens as well as the digitisation of public administration, while strengthening their resilience and cybersecurity. They will also contribute to the digitalisation of the education system and the development of digital skills. This is also true for the other sectors: the digitalisation of electricity networks should contribute to a better integration of renewables and to reducing energy losses and emissions, the electrification of

²⁹² Each recovery and resilience plan has to dedicate at least 20% of the plan's total allocation to digital objectives. To this end, the plans had to specify and justify to what extent each measure contributes fully (100%), partly (40%) or has no impact (0%) on digital objectives, using Annex VII of the RRF Regulation. Combining the coefficients with the cost estimates of each measure allows assessing to what degree the plan contributes to digital objectives and whether it meets the 20% target.

railways combined with traffic automation will provide incentives to users to switch from individual to collective mode of transportation, and making greater use of e-health digital solutions is also expected to strengthen the efficiency, accessibility and quality of health services.

A crucial issue in implementation of the RRP is to ensure the correct implementation of the plan. The Ministry of Funds and Regional Policy is responsible for this task. It will be supported by a dedicated Monitoring Committee that will be composed of representatives of the bodies implementing the plan, social partners, non-governmental organisations and local governments. The plan stipulates that the Committee will monitor the implementation of reforms and investments, ensure that funds are spent properly, analyse the impact of measures on the economy and its sectors, society and regional development, and ensure that measures implemented under other funding sources are complementary.

1 Human capital

1 Human capital	Poland		EU
	rank	score	score
DESI 2022	24	37.0	45.7

	Poland			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
1a1 At least basic digital skills % individuals	NA	NA	43% 2021	54% 2021
1a2 Above basic digital skills % individuals	NA	NA	21% 2021	26% 2021
1a3 At least basic digital content creation skills²⁹³ % individuals	NA	NA	57% 2021	66% 2021
1b1 ICT specialists % individuals in employment aged 15-74	3.1% 2019	3.4% 2020	3.5% 2021	4.5% 2021
1b2 Female ICT specialists % ICT specialists	14% 2019	15% 2020	16% 2021	19% 2021
1b3 Enterprises providing ICT training % enterprises	13% 2019	18% 2020	18% 2020	20% 2020
1b4 ICT graduates % graduates	3.8% 2018	3.8% 2019	3.7% 2020	3.9% 2020

On the Human capital dimension, Poland ranks 24th of 27 EU countries and is therefore below the EU average. Levels of digital skills remain lower compared to the EU average, with only 43% of people aged between 16 and 74 having at least basic digital skills (EU 54%) and 21% having above basic digital skills. On at least basic digital content creation skills, Poland scores 57%, below the EU average of 66%. ICT specialists and female ICT specialists account for a lower percentage of the workforce in Poland compared with the EU average. ICT graduates currently account for 3.7% of all graduates in Poland. That said, Polish enterprises are slowly investing in ICT training, but still less than one-fifth of them (18%) offered specialised ICT training to their employees.

The measures put in place in 2020, in the wake of the COVID-19 pandemic, continued to be implemented. These included government funding of the Remote School projects (*Zdalna Szkoła, Zdalna Szkoła+*) to buy equipment for students and teachers for remote learning (computers, laptops or tablets). The actions took place under the 2014-2020 [Operational Programme Digital Poland](#), which was funded by the European Regional Development Fund (ERDF). Under the scheme [Zdalna Szkoła](#) almost 2 800 Polish municipalities and districts have received support, by applying for funding in the form of a grant for the purchase of equipment for pupils and teachers. By extending the *Zdalna Szkoła+* programme, a further 2 467 municipalities have received grants.

²⁹³ Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

Another significant project is [Lekcja:Enter](#). It is co-financed by the European Regional Development Fund (ERDF) within the 2014-2020 Operational Programme Digital Poland. The goal is to provide support to teachers in remote education. The training course concentrates not only on new technologies, but also on the less obvious peculiarities of on-line education, e.g. remote education methodology, psychological challenges monitoring and evaluating students' progress in the remote education process, or cooperation between the school and parents. The action provides training to over 75 000 school teachers (open, special and vocational ones).

The multi-annual IT Talent Development programme has been implemented since 2019. It aims at improving young people's advanced digital skills — supporting development in algorithmics, programming, and in designing computer games. Participants in the programme, young people with above-average skills, are developing advanced digital skills that are in high demand in the labour market. Social partners have also continued to implement their programmes. As in previous years, the [National Coalition for Digital Skills and Jobs](#) assisted in coordinating proposals and actions undertaken by the public society to support digital skills, upskilling and reskilling. Indeed, the *Lekcja: Enter*, supported by the [Orange Foundation](#) assist in development of digital skills and prevent digital exclusion through programmes like *Mega Mission* or *#Superkoderzy*. The Orange Foundation also carried out other awareness-raising and educational campaigns that benefited over 0.5 million children.

Non-governmental actors also support the integration of digital technology in the economy and society. EU Code Week continued to be a major event for students, teachers and schools in Poland. Polish Code Week was supported by the partnership between NASK (National Research Institute) and the Chancellery of the Prime Minister, who together runs the 'national Code Week bureau' conducting wide range of activities. Thanks to the strong involvement of schools, non-government organisations (NGOs) and other institutions, the number of events in Poland (15 000) were the [third highest](#) among all participating countries.

There were also country-specific events. The largest non-profit education and technology initiative was [Digital Festival](#) (from 1 to 10 October 2021). More than 150 events were organised, and a number of courses were given. In particular, the [SkillUp Academy](#) recorded more than 10 000 participants.

In the vocational education system, a new occupation of Robotics technician was introduced into the curricula. The qualifications specified in this occupation cover assembly, activation, operation and programming of robotics systems. The core curriculum designed for the occupation define learning outcomes, which include vocational knowledge and skills, professional foreign language, social skills and health and safe rules. The training path for this occupation is carried out in technical secondary schools (for students aged 15-19) or in vocational qualification courses (life-long learning).

Following the launch of the project [Academy of Innovative Applications of Digital Technologies](#) (AI Tech), which targets ICT specialist education in 2020, the first activities were carried out. The digital issues are being mainstreamed into formal tertiary education, led by a consortium of five universities²⁹⁴.

²⁹⁴ The consortium consist of Gdańsk University of Technology, Wrocław University of Science and Technology, Poznań University of Technology, University of Warsaw and Adam Mickiewicz University.

Broader mainstreaming of digital skills was hampered by the fact that a key binding government policy document, the Digital Competence Development Programme (*Program Rozwoju Kompetencji Cyfrowych*), has still not been adopted and it is expected to be established by the end of 2022. Given that Poland needs to keep on enhancing digital skills, adopting this binding would be a positive development. Furthermore, to achieve a high-performing digital education ecosystem and equip all students and teachers with digital skills, Poland plans to develop a comprehensive digitalisation strategy for education that would focus on efficient and meaningful integration of digital technologies in teaching, learning and assessment. Minimum binding standards for equipping all schools with digital infrastructure will be established to ensure equal access to digital education by the end of 2022. At the same time, a participatory approach in the development of any major policies, involving local and regional governments, schools, educators, experts in digital education and civil society, is of particular value.

Despite various actions already initiated to improve digital skills, further efforts especially in increasing the number of ICT specialists and raising society's digital skills are needed in the light of the ambitious targets set out in the Digital Decade.

Human capital in Poland's Recovery and Resilience Plan

The main measures addressing human capital concentrate on the digital skills. They run in two strands: first, to foster the development of a high-performing digital education ecosystem; second, to enhance digital skills and competences for the digital transformation.

To achieve these broad goals, four different initiatives are planned. First, the adoption and implementation of a Digital Competence Development Programme, a multi-annual programme aimed at strengthening the development of digital competences in formal, informal and non-formal education. Second, the adoption of binding minimum legal standards for equipping schools with digital infrastructure that will support the implementation of investments in ICT, enabling the use of digital technologies in learning on an equal level in each school. Third, the policy on digitalisation of education, which is expected to create a comprehensive strategy, constituting the basis for changes in the education system and defining the directions of digitalisation of the education system in the short and long term. Fourth, the large-scale investment in the ICT equipment for primary and secondary schools (including in vocational education and training) and examination centres will support the implementation of the above policy measures, facilitating a more efficient and meaningful integration of ICT in education.

2 Connectivity

2 Connectivity	Poland		EU
	rank	score	score
DESI 2022	25	46.5	59.9

	Poland		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
2a1 Overall fixed broadband take-up	62%	68%	69%	78%
% households	2019	2020	2021	2021
2a2 At least 100 Mbps fixed broadband take-up	28%	37%	43%	41%
% households	2019	2020	2021	2021
2a3 At least 1 Gbps take-up	0.47%	1.10%	2.09%	7.58%
% households	2019	2020	2021	2021
2b1 Fast broadband (NGA) coverage	76%	76%	78%	90%
% households	2019	2020	2021	2021
2b2 Fixed Very High Capacity Network (VHCN) coverage	60%	65%	70%	70%
% households	2019	2020	2021	2021
2b3 Fibre to the Premises (FTTP) coverage	38%	45%	52%	50%
% households	2019	2020	2021	2021
2c1 5G spectrum	0%	0%	0%	56%
Assigned spectrum as a % of total harmonised 5G spectrum	04/2020	09/2021	04/2022	04/2022
2c2 5G coverage²⁹⁵	NA	10%	34%	66%
% populated areas		2020	2021	2021
2c3 Mobile broadband take-up	73%	73%	84%	87%
% individuals	2018	2018	2021	2021
2d1 Broadband price index	81	88	87	73
Score (0-100)	2019	2020	2021	2021

Poland ranks 25th in the EU in the connectivity ranking. In 2021, Poland observed a steady increase in the percentage of households covered by Fixed Very High Capacity Networks – 70% compared to 65% in 2020. As part of this, Poland's total Fibre-to-the-Premises (FTTP) coverage also saw a slight increase – 51.9% in 2021 compared to 44.6% in 2020. The FTTP coverage in rural areas remains at a lower level – only 32.6% of rural households were covered by the technology in 2021 (only slightly below the EU average of 33.3%). However, this shows an upward trend compared with 2020, when 24.1% of rural households had access to the technology. This is comparable to the growth in the EU average over the same period. It should also be noted that the rural population accounts for nearly 40% of the country's population - as of 31 December 2018, 15.3 million people lived in rural areas. The average population density of rural areas in Poland is about 50 people per square kilometre. This contributes to high costs of

²⁹⁵ The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

building telecommunications infrastructure and general low investment attractiveness of rural areas. This also underpins the need to allocate funds to tackle the above mentioned adverse drivers.

In terms of fixed broadband take-up, 69% of households subscribed to any kind of broadband connection in 2021, a small increase compared to 68% of households in 2020. Poland performs well with subscriptions of at least 100Mbps fixed broadband connections - 43% of Polish households used such a connection in 2021, which is above the EU average of 40% for the same indicator. However, at 1.1%, the 1 Gbps take-up remains below the EU average of 2.09% of households. Given that the broadband prices in Poland remain below the EU average, the low take-up of high speeds can be explained by Polish consumers' preference for lower speeds, which they deem sufficient for their connectivity needs.

Poland plans to use a mix of the Recovery and Resilience Facility (RRF) and the European Regional Development Fund (ERDF) to finance its future connectivity ambitions. The authorities estimate that both the RRF and the 2021-2027 ERDF actions will contribute an overall EUR 2 billion to the broadband inclusion of at least 1.5 million households in Next Generation Access-white areas, increasing the rate of households with access to gigabit society's level of services up to more than 80%.

According to the Polish authorities, the RRF reforms are being implemented in line with the scheduled timetable. These include a new regulation on annual telecommunications infrastructure & services inventory, which was in pre-consultations with the telecom operators at the time of drafting this report, and a framework for calls targeting NGA-white areas.

The main goal of the Polish Digital Transformation Strategy for 2025, as outlined in the National Broadband plan, is to ensure that all households have internet access with downstream connection speed of at least 100 Mbps, with the option to upgrade to gigabit speeds. This is in line with the 2025 gigabit society goals. For the goals to be achieved, the plan sets out the required financial and legislative measures, aiming at removing legal barriers hindering the rapid development of broadband networks. While the goals of the Commission proposal for the Digital Decade policy programme are not currently reflected in the National Broadband plan, an update of the strategy is planned for 2022 to take into account those changes.

When it comes to mobile connectivity, 34.2% of households were covered by 5G technology in 2021, which is below the EU average of 65.8% for the same indicator. The low coverage is due to Poland not having yet assigned a common radio spectrum for 5G deployment. However, one of the biggest mobile operators in the country had completed the process of switching off the 3 G network in the 2100 MHz band, allocating the released frequencies to increase the capacity and speed of its 4 G and 5G networks.

There are plans to establish a wholesale operator in the 700 MHz band as well as to create a Strategic Communications Operator, a state-owned entity that would provide telecommunications services to the public administration. The legal proposals were ongoing at the level of the executive branch at the time of drafting this report.

In May 2020, the Polish government cancelled the auction of the 3.6 GHz band, about six weeks after the regulator initiated the procedure, offering four licences that would be valid until 30 June 2035. The Minister of Digital Affairs stated that the cancellation was needed to introduce a law setting out cybersecurity-related requirements forming part of the future reservation decisions. These

requirements will need to be finalised before the new public consultation on the auction of the 3.6 GHz band is launched.

Poland carried out a public consultation on the 26 GHz band between July and September 2020, which showed that Polish operators manifested no demand for the band before 2023.

When it comes to addressing the barriers to 5G deployment, the Polish RRP includes, as one of its planned reforms, a new legal act eliminating barriers to the implementation of the 5G network by vertical industries. Moreover, as part of its RRF plans, Poland plans to establish a framework for financial instruments supporting 5G network deployment.

Main market & regulatory developments

In a development, crucial for mobile infrastructure, Cellnex Poland (an operator of mobile infrastructure in a number of EU countries) finalised two agreements in 2021 to acquire mast infrastructure used to provide services by mobile operators: (i) an acquisition of a 60% share in TowerCo, which owns the telecommunications towers and masts serving mobile network operator P4; (ii) an acquisition of Polkomtel Infrastruktura sp. z o.o., mobile infrastructure operator. Following these two acquisitions, Cellnex now holds approximately 54% of the mobile infrastructure in Poland.

Poland did not transpose the provisions of the European Electronic Communications Code (EECC) by the deadline of 21 December 2020 and had not notified any measures transposing the Directive by the time of drafting this report. The Commission therefore addressed a reasoned opinion to Poland on 23 September 2021.

On 21 October 2021, the Commission registered a notification from the Polish national regulatory authority, Urząd Komunikacji Elektronicznej (UKE) concerning the market for wholesale voice call termination on individual mobile networks. The draft measure sets out obligations for all mobile operators designated as having significant market power (SMP). The proposed remedies mirror those already in place, except for price controls, as UKE proposes to impose the non-price remedies of access, non-discrimination and transparency. Having followed the Commission's approval of the MTR regulation, on 30 December 2021 the UKE's President issued regulatory decisions towards four MNOs operating in Poland.

At the end of 2021, UKE began to receive information about potential abuse by some operators of voice call transit services to compensate in some way for reduced voice call termination revenues. These allegations were being investigated by UKE at the time of drafting this report.

The Polish authorities are currently working on detailed measures implementing the Connectivity Toolbox, in particular in terms of facilitating 5G network deployment. In one of the planned reforms, Poland would like to use State aid as a complement for investments incentivising 5G network roll-out in Poland. In this context, Poland plans to conduct interventions supporting the 5G network development in areas with low population density and along road infrastructure in 2023.

While Poland disposes of a range of ambitious investment instruments which have the potential to advance the deployment of very high capacity networks in the country, it is important that the authorities ensure that the Polish legislation incentivises the development of robust connectivity and that it fully transposes the current EU regulatory framework. At the same time, it is important to ensure that the 2030 Digital Decade targets are central in updating the National Broadband Plan. A swift assignment of the radio spectrum needed for the 5G connectivity in a transparent, open and non-discriminatory way is also of crucial importance.

Connectivity in Poland's Recovery and Resilience Plan

The largest allocation of financial resources in the digital matters of the RRP is dedicated to connectivity, with the purpose of boosting the deployment of very high-capacity networks, including fibre and 5G. This will be done in line with the best practices of the EU Connectivity Toolbox. The total amount allocated to investments in network infrastructure is EUR 1.4 billion for fixed broadband and EUR 1.2 billion for mobile broadband. With these resources Poland aims to provide universal access to high-quality telecommunication infrastructure and modern electronic communication services in market failure areas throughout the country, narrowing the gap between urban and rural areas. The investments will focus on: (i) covering 930 000 households in white NGA areas, to achieve broadband internet access with a capacity of at least 100 Mb/s and possibly increasing it to Gigabit capacity; (ii) supporting the roll-out of 5G network through construction of the 5G bases stations in market failure areas. These measures are expected to contribute to the achievement of the goals set out by the National Broadband Plan, namely speeding up the roll-out of ICT of the country by 2025, as well as achieving the EU's 2025 5G and Gigabit connectivity objectives.

3 Integration of digital technology

3 Integration of digital technology	Poland	EU
	rank	score
DESI 2022	24	22.9
		36.1

	DESI 2020	Poland DESI 2021	DESI 2022	EU DESI 2022
3a1 SMEs with at least a basic level of digital intensity	NA	NA	40%	55%
% SMEs			2021	2021
3b1 Electronic information sharing	29%	29%	32%	38%
% enterprises	2019	2019	2021	2021
3b2 Social media	14%	14%	18%	29%
% enterprises	2019	2019	2021	2021
3b3 Big data	8%	8%	8%	14%
% enterprises	2018	2020	2020	2020
3b4 Cloud	NA	NA	19%	34%
% enterprises			2021	2021
3b5 AI	NA	NA	3%	8%
% enterprises			2021	2021
3b6 ICT for environmental sustainability	NA	60%	60%	66%
% enterprises having medium/high intensity of green action through ICT		2021	2021	2021
3b7 e-Invoices	16%	13%	13%	32%
% enterprises	2018	2020	2020	2020
3c1 SMEs selling online	13%	13%	14%	18%
% SMEs	2019	2020	2021	2021
3c2 e-Commerce turnover	NA	NA	NA	12%
% SME turnover	2019	2020	2021	2021
3c3 Selling online cross-border	5%	5%	5%	9%
% SMEs	2019	2019	2021	2021

On the integration of digital technology in businesses' activities, Poland ranks 24th among EU countries. 40% of Polish SMEs have at least a basic level of digital intensity, which is below the EU average of 55%. As regards ICT for environmental sustainability, 60% of Polish enterprises achieved medium/high intensity of green action through ICT, a value below the EU average of 66%. Polish enterprises are taking advantage of the digital opportunities and are engaging in online commerce, with 14% of SMEs selling online and 5% selling across borders to other EU countries: advanced technologies are slowly but steadily gaining popularity among Polish enterprises, with 19% of them using cloud solutions (EU: 34%) and 32% using electronic information sharing (EU: 38%). Nevertheless, only 18% of Polish enterprises actively use social media and 3% is integrating AI technologies into their operations. e-Invoices and Big Data are not yet widely used. This shows that more effort needs to be made to reach the 2030 Digital Decade target of at least 75% of enterprises taking up cloud services, Big Data and AI.

In the wake of the economic rebound after the first phase of the COVID-19 pandemic, natural developments in the economy were supported by the national authorities with the support of EU funds.

For instance, in 2021, the Polish Agency for Enterprise Development (PARP) used those funds to provide training and advice to managers of micro, small or medium-sized enterprises in adapting their human resources and innovation processes to the challenges of the digital age. Moreover, PARP implemented in 2021 an SME support instrument in the area of digitalisation, dedicated also to enterprises operating in industries particularly affected by the negative effects of the COVID-19 pandemic. The instrument is expected to contribute to creating conditions for the effective functioning of SMEs in the COVID-19 pandemic and should strengthen their competitiveness and resilience to subsequent crises.

After enacting the national AI strategy [Policy for the development of artificial intelligence in Poland from 2020](#) in December 2020, government agencies started to promote the goals set out in this strategy across the board. For instance, the Academy of Innovative Applications of Digital Technologies (AI Tech) aims at creating a model of systemic education of experts in AI, machine learning and cybersecurity. In order to achieve this, it supports close cooperation between universities, central administration and leading businesses operating in digital technologies. The AI4Youth pilot project, launched in September 2021 by the Ministry of Economic Development and Technology in cooperation with Intel, will contribute to the formation of competences in artificial intelligence among young people.

Cooperation between the public and the private sector continues, with some banks providing their customers with authentication services through the 'Trusted Profile' (*Profil Zaufany*), which makes it possible to log in to all online public services and securely sign official documents.

Poland also supports digital technologies through EU-coordinated programmes. It is a member of the EuroHPC Joint Undertaking on high-performance computing, it participates in PRACE (Partnership for Advanced Computing in Europe) and in the PIONIER-LAB National Platform for Integration of Research Infrastructures. It is also an active member of the European Blockchain Partnership Policy Group. The European Digital Innovation Hubs (EDIHs) will provide access to technical expertise and experimentation for enterprises. The selection of the Digital Innovation Hubs that will participate in the network of EDIHs is ongoing. Eleven Polish EDIH proposals have a successful evaluation result²⁹⁶.

Poland supports the idea of implementing trusted, safe and energy efficient cloud solutions for business and administration across the EU. To fulfil this goal, it joined the European Cloud Federation in October 2020 and the IPCEI (Important Projects of Common European Interest) on cloud solutions in March 2021. The preparations for active participation – the Calls for Proposals from the industry – are underway.

The government is consulting the interested parties the possible ways of furthering the evolution of digital economy within the cycle of consultation in preparations of Cohesion Policy under the 2021-2027 EU budget (Multiannual Financial Framework) but also through other channels. For instance, in December 2021, the Future Industry Platform Foundation launched the Digital Platform, a publicly accessible digital tool, which integrates all interested parties in the [Polish 4.0](#) ecosystem.

To continue boosting the Polish economy's digital transformation, it is important to further develop governmental cloud services. Another area for further investment might be the introduction of electronic structured invoices to allow for the issuing, receiving and storing of structured invoices and to

²⁹⁶ I.e. are invited for grant agreement preparation (which is not a formal commitment for funding).

analyse and control data. Poland could also speed up its digital transformation by giving further support to SMEs in their efforts to raise their uptake of advanced technologies and by encouraging start-up ecosystems, businesses in disadvantaged regions, and female digital entrepreneurs. This is of particular importance given the 2030 Digital Decade target, where more than 90% of SMEs should reach at least a basic level of digital intensity.

Integration of digital technology in Poland's Recovery and Resilience Plan

With RRF support, Poland will participate in multi-country project on Cloud and Edge Computing, in order to develop the next generation of joint capabilities in data processing with the participation of Polish businesses and technological actors. The project is expected to develop the next generation of cloud and edge solutions, with high levels of innovation, energy efficiency and a positive environmental impact contributing to the EU Green Deal ambition.

In the support of the digitalisation of businesses, digital competences for SMEs are targeted by the investment on equipping companies to work remotely. The RRP envisages supporting 3 000 micro, small and medium-sized enterprises out of nearly 2 million with advice to firms on digitalisation, remote training for staff and the purchase of licenses and software to enable remote communication.

The plan envisages several investments in the other areas of the economy. Projects related to the development and equipment of competence centres (specialist training centres, implementation support centres, observatories) and infrastructure will support an innovation ecosystem for unmanned vehicles. In the agricultural sector there will be investments in the purchasing of sensors and the implementation of digital ICT systems. In the energy sector, investments in the development of transmission networks, including smart electricity infrastructure, are expected to support the development of modern digital technologies in the electricity market that are necessary to better integrate dispersed renewable sources. In the health sector, the investments cover the launch of three central services: a Patient Health Analysis Tool, an AI-based decision-making support tool for doctors, and a central repository of medical data integrated with other key healthcare systems. Within the five years of RRP implementation, Poland is committed to reach the level of 60% of medical document types digitised and 70% of adult patients covered by the Patient Health Analysis Tool. In the transport sector, there will be investments to digitalise road transport (via Intelligent Transport Systems and equipment for road safety enforcement and controls including 100 automatic road traffic surveillance devices) and railway transport (through trackside and on-board ERTMS deployment, including retrofitting of 180 existing rolling stock, the purchase of 183 new trains, the installation of railways level crossing automation and traffic control systems in 35 railways stations and of dynamic information system in 27 locations).

4 Digital public services

4 Digital public services ²⁹⁷	Poland		EU
	rank	score	score
DESI 2022	22	55.8	67.3

	DESI 2020	Poland DESI 2021	DESI 2022	EU DESI 2022
4a1 e-Government users	49%	49%	55%	65%
% internet users	2019	2020	2021	2021
4a2 Pre-filled forms	NA	NA	74	64
Score (0 to 100)			2021	2021
4a3 Digital public services for citizens	NA	NA	57	75
Score (0 to 100)			2021	2021
4a4 Digital public services for businesses	NA	NA	70	82
Score (0 to 100)			2021	2021
4a5 Open data	NA	NA	95%	81%
% maximum score			2021	2021

Poland ranks 22nd in the EU on Digital public services. 55% of internet users relied on e-government services (up from 49% last year), coming slightly closer to the EU average of 64%. On pre-filled forms, Poland scores significantly above the EU average (74 compared to 64). It also scores very well on open data (95% compared to 81% for the EU). However, Poland is still underperforming in the availability of digital online services, scores 57 on digital public services for citizens (EU average: 75) and 70 for businesses (EU average: 82). In this area, ongoing efforts would need to be stepped up to enable Poland to achieve the Digital Decade target of providing 100% key public services online.

The use of e-government services thrived in the wake of the changes in both demand and supply brought about by the COVID-19 pandemic. To facilitate the move towards the digital sphere, the [Biznes.gov.pl](https://biznes.gov.pl) portal has launched a new English version in January 2022. The portal offers currently access to about 400 online services and over 1 000 descriptions of procedures. There are currently more than 15 million people using at least one of the e-Id profiles. The authentication service 'Trusted Profile' (*Profil Zaufany*) facilitates the interactions with public services and recorded a rise of the number of the profiles set up to EUR 4.6 million in 2021 as compared to EUR 4.1 million in 2020, and slightly over EUR 2 million in 2019. The system's popularity is probably closely related to the possibility to confirm it remotely via e-banking services. In 2021, around 75% of trusted profiles were used in this way. The remaining 25% of trusted profiles not linked to e-banking must use the user ID (login) and secret password established by them to use the trusted profile and will receive the one-off codes sent by SMS to the mobile phone number they have indicated. A trusted profile allows its user to identify and

²⁹⁷ There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

authenticate in public online services, and also to sign documents (i.e. it is a trusted signature). This is an advantage over any e-identification means issued by a bank that can be used for authentication, but not as a trusted signature. This role is used, for instance in the [Internet Patient Account](#). After logging in, a patient can perform most of the essential activities, such as consulting e-prescriptions, indicating the e-mail address for which e-prescriptions are to be sent, indicating the telephone number to which prescription codes are to be sent, registering for their vaccinations or indicating the person authorised to access the account. Of course, an individual can use the profile to perform also other online administrative tasks, including sending a request for a maternity allowance, etc.

In open data, Poland keeps on faring very well. In the 'Open Data Maturity 2021', it ranked fourth, well above the average for EU countries. A key development in open data policy was the Council of Ministers' adoption, in February 2021, of the 2021-2027 [Data Opening Programme](#). The programme is addressed to government administrative bodies and organisational units under them. It can also be used by other actors, e.g. local authorities. It aims at creating an environment in which the economic and social benefits of open data are recognised and translated into the construction of new services and products. The objective is to increase the supply and quality of data available on the [Dane.gov.pl](#) for each user for re-use. The portal has acquired new functionalities (e.g. it follows the DCAT Application Profile (DCAT-AP) specifications, the metadata standard for describing public sector datasets in Europe), and it allows private entities to add additional data. Numerous users' guides and multimedia educational and training materials are available in the portal's knowledge base.

On healthcare, the government's [Patient's Portal](#) continued to provide services building on the successful introduction of e-prescriptions into the patient's online account (*Internetowe Konto Pacjenta*). The *m-Obywatel* application (see box below) enables access to the patient account. In the process of getting rid of paper prescriptions, in January 2020 e-prescriptions have become mandatory (e.g. any prescription is to be issued only in electronic form). This scheme has proven to be an effective and useful tool, benefiting both medical staff and patients who did not have to visit medical facilities to continue treatment. By January 2022, more than 924 million e-prescriptions had been issued. Also, electronic management of the transfers to the doctors (*e-skierowanie*) to selected medical services has been introduced since January 2021. By January 2022, more than 50 million such e-referrals had been issued. Since July 2021, exchanging data contained in the electronic health records and recording data on a medical incident in the Medical Information System is mandatory. This creates an electronic history of the visits, diagnosed diseases and medical procedures that have been carried out. This information is intended to be used by doctors and other medical professionals. Other important activities include extending the functions of the e-health service platform to include the planned central e-registration for selected services, a teleconsultation service (e-visits) and the possibility to order e-prescriptions. The first version of a mobile application, containing e-prescription and e-referral functions, has been available since May 2021.

In response to the COVID-19 pandemic, the Ministry of Health implemented a few pilot projects using telemedicine tools through homecare platform, which aims to monitor patients with COVID-19 at home. Poland plans to further develop existing e-Health solutions, both under national and EU programmes. The development of e-services in the Internet Patient Account, m-Health tools, the development of

telemedicine and remote healthcare, and the increased use of AI in the healthcare system are key priority areas for future.

To sum up, digital services for the public and businesses becoming more user-friendly and easier to access could lead the way to even more improvements in the digital public administration. Promoting the use and understanding of the benefits of these services, including by explaining the data protection and cybersecurity safeguards would increase demand. In this context, the proper implementation of the EU cybersecurity rules is a pressing issue.

Highlight 2021-2022- Countering disinformation

Poland has launched a dedicated team to monitor the publications in social media and identify disinformation campaigns. Disinformation on the web is fought by NASK (National Research Institute), which runs *#WłączWeryfikację* (*#EnableVerification*) profiles. It is run by the institute's experts, who debunk false information circulating on the web. Dangerous posts can be reported to the administration of the portal, either via social media or directly to NASK through a dedicated e-mail address.

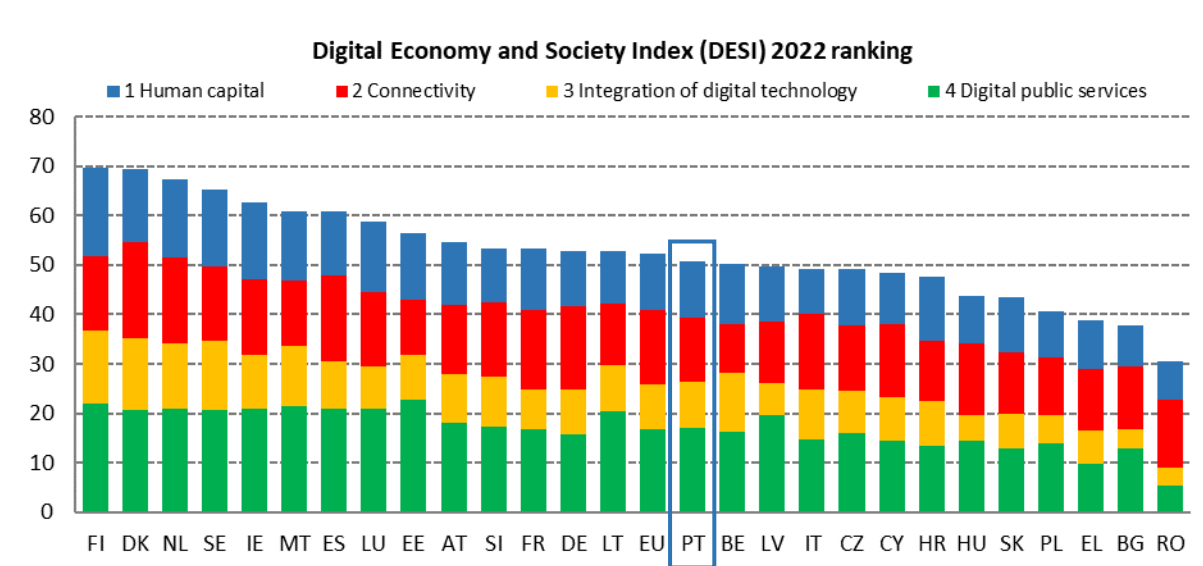
Following Russia's invasion of Ukraine, the overall threat level in cyberspace has increased. The NASK CSIRT (Computer Security Incident Response Team) has recorded several attempts to create phishing messages or websites to gain access to confidential data or financial resources. CSIRT has been operating on a 24/7 basis to immediately remove dangerous content online. This is mainly done through a public warning list. Citizens can report any suspicious online activity via a [dedicated form](#). In addition, it is also important to adhere to the [principles of digital hygiene](#) when using email and social media.

Digital public services in Poland's Recovery and Resilience Plan

Poland's RRP includes relevant structural changes to the public administration and institutions, including the uptake of digital solutions, investment in e-governance infrastructure and the digital skills of public servants. In particular, cybersecurity has a prominent role, with the purpose of ensuring internet security and preventing cybercrime. Further to the growing number of cyber threats and incidents, Poland intends to increase the resilience of IT systems in the public administration, state services responsible for security and businesses as well as raise public awareness of security-related problems, in line with the Polish Cybersecurity Strategy. This includes improving capacity for incident detection and response, notably by setting up regional Security Operation Centres (ISACs), sectoral Computer Security Incident Response Teams (CSIRTs), as well as enhancing public-private information sharing and crisis management systems.

Portugal

	Portugal		EU
	rank	score	score
DESI 2022	15	50.8	52.3



Portugal ranks 15th of the 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI), climbing one step up from last year's ranking. Portugal's relative progress²⁹⁸ is generally slightly below that of its peers, so there is room for the country to accelerate its digitalisation efforts.

Portugal's digital transformation strategy and action plan of 21 April 2020 have set digital inclusion, training of the public, digital transformation of businesses and the public administration as its national priorities. These objectives align with the digital transition component of its recovery and resilience plan (RRP) which focuses on digital skills and the digitalisation of businesses and the public administration. The strategy and action plan's guiding principles capitalise on previous successful programmes and strategies, complementing them with new ones. Structured around three strands - people, companies and public administration – the inter-sectoral plan encompasses the most relevant aspects of the digital transition. A national digital decade strategic roadmap is expected in 2022 to connect the action plan to the goals of the 2030 EU policy programme Path to the Digital Decade.

An official structure was created - [Estrutura de Missão Portugal Digital](#) (EMPD) - to coordinate and monitor implementation of the action plan. This ongoing task is being improved over time as EMPD has developed a [platform](#) to monitor the initiatives' outcomes and DESI indicators, providing transparent information to the public on their progress. In 2021, the government improved INCoDe.2030 - Portugal's

²⁹⁸ Refer to section 1.3 of the DESI 2022 horizontal chapter.

skills strategy - with simpler governance and coordination. It tied each measure to goals and set indicators with targets to be reached in 2025 and 2030. The [Observatory for Digital Competences](#)²⁹⁹ was created in order to have a system for collecting, recording, analysing data and providing information on these and other related indicators, run by the Directorate-General for Education and Science Statistics at the Ministry of Science and Technology.

Portugal has undertaken numerous measures to equip the population with skills, expand connectivity and support technology adoption by small firms. However, disparities in ICT adoption across companies and people remain. More graduates in ICT fields are needed to curb Portugal's digital divide. Portugal's score of 4.7% is approximately at par with the EU average of 4.5% - a positive trend for its future share of digital specialists in the workforce against the backdrop of the Digital Decade EU target on basic digital skills and ICT specialists.

Portugal has stepped up efforts to raise the level of digital skills among the public and the workforce, expanding the scope of its INCoDe.2030 initiative for digital competences with the implementation of the [2020 action plan for the digital transition](#) (APDT). The APDT is an important milestone as timely implementation affects productivity growth in technology adoption especially in small firms.

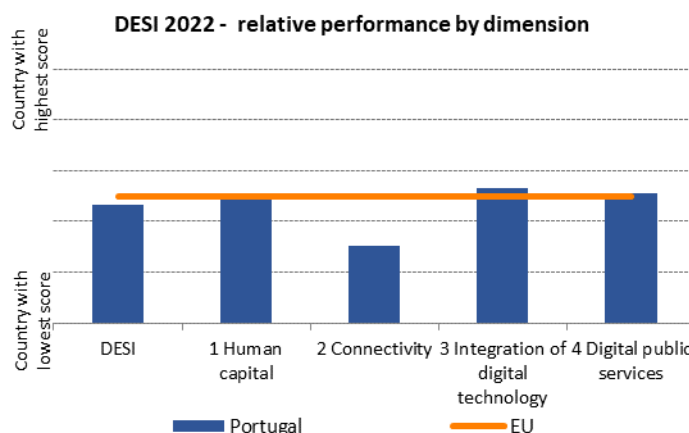
Connectivity infrastructure is of good quality with room for expansion in 5G coverage. The country performs well in terms of fixed broadband access of at least 100 Mbps and fixed high-speed internet coverage, but its performance drops for the number of mobile data subscriptions per 100 people and 5G deployment. Numerous measures are in place to foster the adoption of ICTs and partnerships between firms and research institutes to stimulate innovation. Their scope is expected to expand with the implementation of the recovery and resilience plan.

Portugal has transformed the functioning of its public administration and the design of public services thanks to sustained digitalisation over time, rising to join the EU leaders in that sphere. A comprehensive legal and regulatory framework lays the groundwork for administrative simplification and digitalisation, while ensuring data protection, cybersecurity and participation of the public. The government created a politically empowered governance structure, the Council for Information and Communication Technologies (CTIC), which coordinates implementation of the digital transformation strategy in the public administration. Portugal combined investments in its digital enablers, i.e., digital identity and interoperability platforms, with strategic initiatives that built political support for the reforms. One example is the flagship programme for administrative simplification SIMPLEX, ongoing since 2006. Portugal's digital strategy has also focused on critical services of health and justice and cutting red tape. Except for e-government users and big data applications, Portugal exceeds or is on par with the EU averages in the field of digital public services.

Over-reliance on advanced e-government may, however, risk leaving too many people behind, given Portugal's digital skills gap. In response, a Citizen Spots Network has been set up where public servants show the public how to access and use services from different public institutions and Portugal is currently pursuing an omni-channel approach.

²⁹⁹ With [Decree-Law No.156/2019](#)

Digital transition is one of Portugal's strategic priorities. Digital transition is one of Portugal's strategic priorities. After the new XXIII constitutional government took office on 30 March 2022, the new Secretary of State for digitalisation and administrative modernisation is responsible for digitalisation, directly under the Prime Minister.



Following Russia's invasion of Ukraine, the country made access to services and employment easier for displaced Ukrainians by simplifying the administrative procedures, streamlining requirements and ensuring access to the taxpayer, social security and national health services. The National Cybersecurity Centre raised its alert level, increasing its information-sharing with the public administration, essential services, critical infrastructure operators and the national CSIRTs network. That highlighted the main threats, protection and reaction practices. It was developed considering international cooperation with the EU Agency for Cybersecurity, CERT.EU and the European CSIRTs Network. The best cyber-hygiene practices for the public in this context were also disseminated through social media. Several cyber risk reassessments were made to intensify the monitoring of cyber-attacks, and service provider portfolios were revised, including the replacement of Russian companies. Portugal agreed on free SIM cards for 3 months for displaced Ukrainians with the telecommunications operators.

Portugal for Ukraine is a [platform](#) that brings together all state measures in relation to the conflict in Ukraine including its international aspects, humanitarian aid and the integration of displaced Ukrainians in Portugal (including job offers through the Institute for employment and vocational training). Portugal addressed the information blackout that Russian authorities imposed around certain words and actions, as well as obstructing foreign media in Russia. The [Informal media literacy group](#) held the webinar 'Media freedom: a victim of war?'.

Digital in Portugal's recovery and resilience plan (RRP)

The Portuguese RRP has a digital share of 22.1%³⁰⁰ and its most prominent digital measures are education and training in digital skills; digital transformation of businesses; and digitalisation of

³⁰⁰ Each recovery and resilience plan has to dedicate at least 20% of the plan's total allocation to digital objectives. To this end, the plans had to specify and justify to what extent each measure contributes fully (100%), partly (40%)

the State as a lever for: (i) sustainable public finances; (ii) competitive business environment; and (iii) efficient public administration. The measures target Portugal's digital priorities, touching upon structural aspects of its socio-economic system with a long-term outlook. Portugal has received its first disbursement based on the targets and milestones reached. Some of the digital measures implemented include signed contracts for the purchase of computers for pupils and teachers. That is part of a comprehensive component on digital education to provide public school with better connectivity; digitalisation of educational content; training for teachers in basic or advanced digital skills, including on the integration of digital technologies into the curriculum; digital education laboratories equipped with educational advanced digital technologies like 3D printers and educational robots.

Seventeen digital innovation hubs (DIHs) have been selected to consult 4 000 companies in improving their production processes through automation or incorporation of disruptive technologies.

The legal framework for the digital transformation of the public administration entered into force, namely the strategy and action plan for digital transformation in public administration 2021-2026. It includes provisions on the required information security safeguards, and those specific to cybersecurity to support the digital transition.

The tender for 'Building of digital infrastructure for Accessibility 360°' was published. The measure aims to facilitate the participation of people with disabilities in society by providing digital information tools and services adapted to their needs. Launching the call for tender is a step in implementing the measure for building digital infrastructure like geo-referencing locations and the accessibility of public buildings, as well as including private buildings and parking spaces for reduced mobility.

or has no impact (0%) on digital objectives, using Annex VII of the RRF Regulation. Combining the coefficients with the cost estimates of each measure allows assessing to what degree the plan contributes to digital objectives and whether it meets the 20% target.



1 Human capital

1 Human capital	Portugal		EU
	rank	score	score
DESI 2022	14	45.9	45.7

	DESI 2020	Portugal DESI 2021	DESI 2022	EU DESI 2022
1a1 At least basic digital skills % individuals	NA	NA	55% 2021	54% 2021
1a2 Above basic digital skills % individuals	NA	NA	29% 2021	26% 2021
1a3 At least basic digital content creation skills³⁰¹ % individuals	NA	NA	61% 2021	66% 2021
1b1 ICT specialists % individuals in employment aged 15-74	3.5% 2019	4.0% 2020	4.7% 2021	4.5% 2021
1b2 Female ICT specialists % ICT specialists	18% 2019	21% 2020	21% 2021	19% 2021
1b3 Enterprises providing ICT training % enterprises	28% 2019	23% 2020	23% 2020	20% 2020
1b4 ICT graduates % graduates	2.2% 2018	2.3% 2019	2.6% 2020	3.9% 2020

In the human capital dimension, Portugal ranks 14th of the 27 EU countries, matching the EU average. Scoring slightly above the EU average, over half of Portugal's population has the skills (basic or above basic digital skills) to thrive in a digitalised world, contributing to the take-up of digital technologies and online services in Portugal. Still Portugal has significant room for improvement to catch up with the top performers. The proportion of ICT specialists in employment is at par with the EU average, while the level of ICT graduates scores below it (2.6% versus 3.9%). The share of female ICT specialists is 21%, the same as last year's, surpassing the EU average of 19%. The enterprises providing ICT training remains at 23% like the previous year exceeding the EU average by 3 percentage points.

Raising the level of the population's digital skills has been high on Portugal's political agenda. In May 2021, Portugal aligned its national digital skills initiative INCoDe.2030 with the action plan for the digital transition (APDT) 2025-2030 to cover targeted measures for specific groups and the population at large. Portugal's objectives are to promote digital skills in schools through the programme *Escola Digital* with an estimated budget of EUR 559 million (including connectivity and internet access) and the platform 'Academia Portugal Digital' - a self-assessment tool for digital competence, personalised training and training access targeting 800 000 employed people by 2025. Measures are underway to increase all teachers' and trainees' digital competence through the initiative [Capacitação Digital de Docentes](#) (Digital empowerment of teachers).

³⁰¹ Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

The upskilling and reskilling programmes [Emprego+Digital](#) targets 200 000 employees up to 2025 through partnerships between the Institute for Employment and Vocational Training and the Portugal Digital and Employers Confederations. [Jovem+Digital](#) aims to train 15 000 unemployed youngsters by 2023 and boasts over 8 000 participants since the last quarter of 2020 when it started. The [UPSKILL](#) programme aims to reskill 3 000 unemployed people into IT specialists by 2023. Some 300 people have already been reskilled and are now in employment. The programme's current edition aims to reach 1000 people. *Garantia Digital* targeting 304 700 participants by 2024, reached 69 194 unemployed people in 2021. The 'Adult Impulse programme' under Portugal's RRP launched in June 2021 to update the skills of working-age adults. It will be implemented jointly with the 'STEAM Youth Impulse Programme' through an open tender. The programme *Academias Tecnológicas* brings together technological organisations and academia in order to equip students with advanced skills in emerging technologies. Over 15 000 students have gone through the programme.

Digital inclusion of the population is tackled through the programme '[EU SOU Digital](#)' aiming to reach 1 million digitally excluded people by 2023. Running since 2017, '[MUDA](#)' (movement for active digital use) is an initiative of 40 organisations from different sectors, committed to increasing the number of Portuguese with digital skills, contributing to the target of 80% of those aged 16-74 having basic digital skills. *Roteiro INCoDe.2030 - Capacitação Digital* is a national initiative promoting digital skills to the general public. It provides for studies, measures and platforms to boost inclusion and digital literacy, training, qualification and gender convergence programmes. The INCoDe.2030 programme's [stamp an action](#) initiative acknowledges individuals, organisations and public and private entities that contribute to improving digital skills in Portugal. Initiatives that promote digital inclusion and literacy can apply, as well as education measures for the young and qualification of the working population, including the specialization of people licensed to occupy advanced digital jobs and research projects. So far, 61 stamps have been awarded.

'Engineers for a day' (*Engenheiras por um dia*) is part of the 2018-2030 national Strategy for equality and non-discrimination. It promotes engineering and technology to high-school girls, reaching 10 411 participants since 2017. The project 'Promote' for gender equality opportunities in senior management aims to develop female talent and foster their promotion to management roles in companies. INCoDe.2030 includes initiatives to monitor gender balance, gather disaggregated data and boost women's participation.

The [Agreement on Vocational Training and Qualification](#) of 28 July 2021 aims to ensure that all unemployed people receive digital training under the Digital Guarantee strategy by 2023. The Digital Skills Certificate programme for the acquisition and certification of skills in digital technologies and media improves the skills of the Portuguese people.

Portugal's Digital Skills and Jobs Coalition (CPED) is a public initiative of the government, private and public entities, NGOs and academia committed to strengthening digital skills in Portugal and enhance people's employability. To promote digital skills, INCoDe.2030 and the Foundation for science and technology are developing a national Digital Skills and Jobs Platform that will serve as a repository of digital training and jobs connected to the EU platform. This project is co-financed by the Connecting Europe Facility (CEF2).

The [National network for advanced computing](#) contributes to the goals of INCoDe.2030 by creating the conditions for new knowledge and participation in international R&D networks and programmes. It also promotes the increase of national digital competence in advanced computing and its use by the national research and innovation community.

Portugal participated in EU Code Week 2021 - a grassroots initiative for coding - with 612 mostly school-based activities attended by over 49 000 participants.

A highly skilled workforce is critical for Portugal to rebound from the COVID-19 pandemic and meet the demands of an increasingly digital economy. Portugal has made strides in boosting its educational performance, but its ageing population is one of the main reasons for the widening skills gap between educated youth and older adults. Under the action plan for the digital transition, digital inclusion and training of individuals are national priorities aligned with Portugal's recovery and resilience plan. Portugal has put in place numerous programmes targeting different population groups, vocational education and training options, and created new tertiary education pathways. Their implementation on a large scale is essential to attain appropriate levels of digital literacy and technology uptake.

Portugal has developed a range of strategies and measures backed by political commitment to the digital transformation and its enabling components. Currently, it is imperative that Portugal reinforces their coordination and ensures the implementation of its strategic plans like the APDT. During the time lag necessary for reforms and investments to deliver measurable results, monitoring and data-collection mechanisms to assess progress and orient policy action in the short and medium term would be useful. That would help move Portugal into a quicker implementation mode to progress towards the Digital Decade's vision.

Highlight 2021-2022: Upskill programme

The '[Upskill programme](#)' brings together companies, higher education institutions and the IEF to develop suitable training content for the labour market. These partnerships enable unemployed and underemployed people to reskill in the ICT sector and take up employment in specialised, well-paid jobs helping to raise the national average salary. The programme helps companies overcome shortages of ICT specialists.

2 Connectivity

2 Connectivity	Portugal		EU
	rank	score	score
DESI 2022	18	51.6	59.9

	DESI 2020	Portugal DESI 2021	DESI 2022	EU DESI 2022
2a1 Overall fixed broadband take-up % households	75% 2019	79% 2020	81% 2021	78% 2021
2a2 At least 100 Mbps fixed broadband take-up % households	56% 2019	63% 2020	68% 2021	41% 2021
2a3 At least 1 Gbps take-up % households	1.18% 2019	1.28% 2020	1.89% 2021	7.58% 2021
2b1 Fast broadband (NGA) coverage % households	83% 2019	87% 2020	91% 2021	90% 2021
2b2 Fixed Very High Capacity Network (VHCN) coverage % households	83% 2019	87% 2020	91% 2021	70% 2021
2b3 Fibre to the Premises (FTTP) coverage % households	77% 2019	82% 2020	88% 2021	50% 2021
2c1 5G spectrum Assigned spectrum as a % of total harmonised 5G spectrum	8% 04/2020	8% 09/2021	61% 04/2022	56% 04/2022
2c2 5G coverage³⁰² % populated areas	NA	0% 2020	0% 2021	66% 2021
2c3 Mobile broadband take-up % individuals	72% 2018	72% 2018	82% 2021	87% 2021
2d1 Broadband price index Score (0-100)	51 2019	50 2020	58 2021	73 2021

Portugal ranks 18th in the Connectivity dimension of DESI 2022. It is a top performer in fast broadband (NGA) coverage and fixed Very High-Capacity Network (VHCN) coverage thanks to the successful coexistence of public (2013-2014) and private investment and competition in the country over the last few years. In 2022, around 5.9 million households (91%) had at least one high-speed network (an increase of 5.6% compared to the previous year). The estimated number of households with FTTH networks accounted for around 5.7 million, achieving 88% coverage (increasing by 8.8% or 5.3 percentage points). NOS and Vodafone's agreements to co-invest in FTTH network deployment and reciprocal network sharing is expected to make FTTH accessible to around 2.6 million homes and businesses, both in existing and greenfield areas. Meanwhile, Altice group's Fastfiber, the largest wholesale operator of FTTH network in Portugal, already provides FTTH networks to over 4.8 million

³⁰² The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

homes. Wholesale only broadband network operators continue developing their networks in the less dense areas (10% of national coverage with around 672 thousand households cabled in Portugal by end of Q3 2021).

Portugal is progressing towards achieving the 2025 gigabit targets and the [Digital Decade connectivity targets](#) for 2030 in terms of VHCN (coverage of 91%). Effort is made to close the gap between urban and rural, less populated areas as VHCN is not yet available there. In this context, in 2021 the government created an inter-ministerial working group to: 1) develop a national connectivity action plan; and 2) analyse the needs on population coverage as well as fixed and mobile networks. Following that, the government entrusted the national regulatory authority *Autoridade Nacional de Comunicações* (ANACOM) to update information on the infrastructure and national coverage of VHCN, and prepare the public tender in line with EU State aids rules through [Order 10987/2021](#)³⁰³. Portugal intends to replace its current CAM cable ring (submarine cable connecting the mainland with the Azores and Madeira) that could be co-financed through the Connecting Europe Facility (CEF2).

Take-up of fixed broadband in general (81%) and at least 100Mbps fixed broadband (68%) is steadily growing in Portugal (with a significant increase during the COVID-19 outbreak). Nevertheless, operators' prices are similar in Portugal and competitors focus mostly on upgrading their customers to higher-quality and higher-price offers instead of reducing prices. The broadband price index increased to 58 points in 2021 (8 points above 2020), well below the EU average (73 points).

There is concern about the limited 5G deployment in Portugal. The outcome of the operators' appeals against the Auction Regulation and its possible consequences on 5G developments in Portugal is uncertain. It is worth mentioning that the multi-band [auction](#) of the 700 MHz, 900 MHz, 1800 MHz, 2.1 GHz, 2.6 GHz and 3.6 GHz bands was concluded on 27 October 2021 after 1 727 rounds over 200 days.

The '[5G Auction Regulation](#)' for the assignment of rights of use of the abovementioned frequency bands provided for a [bidding phase for new entrants](#) in the 900 MHz (one lot of 2x5 MHz), the 1800 MHz bands (all the spectrum available in this band) and for a [main bidding phase](#) for the remaining spectrum. The bidding phase for new entrants, which was one of the main points of the operator's appeals against the Auction Regulations lasted from 22 December 2020 till 11 January 2021. The main phase began on 14 January 2021 until 27 October 2021. Due to the long auction delays ANACOM changed the 5G auction regulation to speed up the process through the [amendment](#) of 30 June 2021 and a [draft of a second amendment](#) on 28 August 2021.

MEO, NOS, Vodafone and Dense Air (a wholesale operator) acquired [radio spectrum frequency rights of use](#) during the main phase of the auction, while NOWO and Dixarobil acquired rights of use both in the main and the new entrants' bidding phase. All the frequency lots were assigned, but one lot of 2x5 MHz in the 700 MHz band. In that band, the incumbent operators that acquired rights of use are subject to extended coverage obligations including 95% of the population, 90% of population of low-density areas and of each parish of the autonomous regions, and coverage of certain road and rail infrastructures by

³⁰³ [Order nº 10987/2021](#)

2025. The auction regulation also established network development obligations associated with the 3.6 GHz band.

New entrants acquiring any frequency in the auction are entitled to national roaming access for at least 10 years in the areas where they would not have mobile coverage using the frequencies assigned to it. As of Q1 2022, the three MNOs are negotiating national roaming agreements with new entrants. New entrants are required to cover 25% and 50% of the population within 3 and 6 years of entering into the respective access agreement.

In December 2021, ANACOM launched a public consultation on the [26 GHz band](#) to assess market players' interest, which should help increase future 5G features.

Portugal is entering a new deployment phase which makes progress on the implementation of the [connectivity toolbox](#) even more important. That should help improve the roll out of fast broadband and 5G while encouraging network operators to reduce the costs of deployment. The definition of the electronic communications' legal framework, the related fast-track permit procedure and its correct implementation are essential for the country to achieve its connectivity goals.

Main market & regulatory developments

The Portuguese market is still dominated by the three largest integrated operators (Altice-MEO, NOS and Vodafone), which accounted for 96.6% of the multiple-play offer (40.8%, 36% and 19.8%, respectively) at the end of Q3 2021. Far behind is the fourth largest fixed operator NOWO (3.3%), which also operates as a mobile virtual network operator (MVNO).

The number of fixed services subscriptions continued to grow (2% for fixed voice, 3.2% for pay-TV and 3.9% for fixed broadband versus last year). Fixed broadband services are commercialised mostly through multiple-play bundles (90.3%), whose penetration is still growing but at lower rates (3.6%). 4P and 5P bundles increased by 5.3%, mainly through upgrades of existing clients, and account for 51% of the total multiple play subscribers.

Regarding pay-TV, the market share of the three MNOs in this segment is almost 97%. The three of them have commercial agreements with Eleven Sports to broadcast premium sport content, including the UEFA Champions League. 56% of subscribers use FTTH, which is the most important pay-TV support network since 201. Most of the growth of pay-TV customers is due to the development of FTTH networks.

The market continues the deployment phase amidst concerns about the lack of updated prices on regulated access to civil infrastructures, particularly to MEO's (operator with significant market power) ducts and poles. Regulated prices on access to ducts and poles date back to 2006 and 2010 respectively, to copper local loop to 2010, and to leased lines to 2012. ANACOM published a draft consultation reducing the monthly prices in early 2022.

Portugal has not yet transposed the directive for the European Electronic Communications Code. After the local elections of 26 September 2021 and the legislative elections of 30 January 2022, the new government took office on 30 March. There is no date when Parliament will

adopt the draft law.

In the field of universal service, Portugal approved the [Decree-Law 66/2021](#), introducing a social tariff for the provision of broadband internet access services. All companies providing that service will make it available to low-income consumers or consumers with special social needs at their request and after ANACOM's confirmation of eligibility.

End-users' complaints sharply increased during the COVID-19 pandemic (26% in March 2020-March 2021 compared to the previous year). The main reason was the heavy use of electronic communications services by consumers and companies. Given those circumstances and the economic downturn, the government introduced exceptional, temporary measures on electronic communications services to help some vulnerable groups.

Portugal continues to be among the top performers in the roll-out of fixed VHCNs and take-up of ultra-fast broadband connections (>100 Mbps). Even though the 5G auction took longer than expected the deployment of fifth generation services in Portugal began at the end of 2021 with the first 5G commercial offers. However, there is still uncertainty about the outcome of the proceedings against the 5G auction regulation and its possible consequences for the sector and the country in achieving the [Digital Decade connectivity targets](#) by 2030.

3 Integration of digital technology

3 Integration of digital technology	Portugal		EU
	rank	score	score
DESI 2022	12	37.6	36.1

	DESI 2020	Portugal DESI 2021	DESI 2022	EU DESI 2022
3a1 SMEs with at least a basic level of digital intensity	NA	NA	52%	55%
% SMEs			2021	2021
3b1 Electronic information sharing	42%	42%	52%	38%
% enterprises	2019	2019	2021	2021
3b2 Social media	16%	16%	26%	29%
% enterprises	2019	2019	2021	2021
3b3 Big data	13%	11%	11%	14%
% enterprises	2018	2020	2020	2020
3b4 Cloud	NA	NA	29%	34%
% enterprises			2021	2021
3b5 AI	NA	NA	17%	8%
% enterprises			2021	2021
3b6 ICT for environmental sustainability	NA	86%	86%	66%
% enterprises having medium/high intensity of green action through ICT		2021	2021	2021
3b7 e-Invoices	27%	17%	17%	32%
% enterprises	2018	2020	2020	2020
3c1 SMEs selling online	16%	19%	16%	18%
% SMEs	2019	2020	2021	2021
3c2 e-Commerce turnover	15%	16%	13%	12%
% SME turnover	2019	2020	2021	2021
3c3 Selling online cross-border	8%	8%	8%	9%
% SMEs	2019	2019	2021	2021

Portugal ranks 12th among EU countries regarding the integration of digital technology in business activities, rising 5 steps in the rankings compared to last year. The share of Portuguese enterprises taking advantage of online commerce opportunities marks a downturn, also reflected in the downward trend from 16% to 13% of e-commerce turnover: 16% of SMEs sell online (below the EU average of 18%); 8% of all SMEs sell cross-border, maintaining last year's level. The share of enterprises using cloud services (29%) and those accessing big data (11%) are below the EU average of 34% and 14% respectively. Portugal's enterprises with at least basic digital intensity are 52%, approaching the EU average. Electronic information sharing and social media use by companies sees a sharp rise by 10 percentage points respectively, where the former significantly exceeds the EU average. Portugal holds a leading position in AI adoption, and medium/high intensity of green action through ICT (86%) is significantly above the EU average score (66%).

The action plan for digital transition (APDT) is the main instrument of the government dedicated to the digital transition of businesses. It includes the measure *Indústria 4.0*. programme among others promoting advanced digital competencies and the digitalisation of the economy. That is part of the second phase of *Indústria 4.0 - Advantage 4.0.*, a programme promoted by [COTEC Portugal - Associação Empresarial para a Inovação](#) extended until June 2022.

The APDT includes numerous measures promoting the integration of digital technologies integration into businesses, some funded through the RRP, i.e., test beds, digital commerce, coaching 4.0 and Digital Innovation Hubs, as well the initiative to reinforce the national entrepreneurship ecosystem. Additional support from [Portugal 2030](#) is envisaged to accelerate the digital transition and maturity of the enterprises, with a focus on SMEs. Portugal 2030 encompasses different operational programmes whose foundation is the partnership agreement between Portugal and the Commission. It covers the implementation in 2021-2027 of EUR 24 182 million from the European Regional Development Fund, European Social Security + , Cohesion Fund, Just Transition Fund and the European Maritime, Fisheries and Aquaculture Fund.

Portugal's recovery and resilience plan includes measures to stimulate innovation in small firms: i) strengthening Start-up Portugal's capacity to act as the main public policy implementation agency and ecosystem monitoring, including the development of a new platform that connects start-ups and investors; ii) additional funding for incubators and accelerators and iii) introducing start-up vouchers for the development of new digital and green innovative products and services.

The Digital Maturity Assessment Tools allows enterprises of different sizes and sectors to better understand the relationship between their digital maturity and market performance i.e., turnover, gross added value generated and export capacity. Three tools help assess companies' digital maturity: a general one for SMEs; the THEIA tool adapted to larger companies, and Shift2Future focusing on industry 4.0. A tool for micro-enterprises in the commerce sector is under preparation. Assessing companies' digital situation would allow them to define their digital transition roadmap and investment priorities.

The APDT comprises ongoing and new initiatives for the digitalisation of enterprises. The platform [e-Residency](#) is for assigning digital identity and residency in Portugal, recognising the identity of a non-resident individual or company, giving access to online public services and attributing tax identification and social security numbers, allowing to register a company and open a bank account, the exercise of professional and business activity. The [Free Zones for Technology - Framework for Regulatory Sandboxes](#) are physical environments with a real or quasi-real location, intended to test innovative technologies, products, services and processes with the support of the competent authorities. Their aim is to develop the innovation ecosystem fostering the accumulation of Portuguese knowledge and intellectual property.

The digital capacity-building programme '*+CO3SO Digital*' reskills workers as ICT professionals in SMEs in the inland regions. The RRP's initiatives in *Enterprises 4.0* include: Academia Portugal Digital – a platform and digital skills development programme; Digital Innovation Hubs; a national test beds network with infrastructure for SMEs and start-ups to develop and test new products and services; the national Digital Maturity Certification System with four dimensions/seals (cybersecurity, privacy

accessibility/usability and sustainability); Digital Commerce for the digitalisation of SMEs and micro enterprises in commerce. The initiative 'Digital commerce neighbourhoods' ([Bairros Comerciais Digitais](#)) stimulates the digitalisation of local businesses. The [Aceleradoras do Comércio Digital](#), launched in December 2021 is expected to create 25 accelerators for the digital transition of 30 000 micro companies and SMEs.

[Academia Comércio Digital](#) is an online platform that provides content and training tools for the digital economy, supporting entrepreneurs in commerce and services to digitalise their business, attract new customers and expand into new markets.

The network of Digital Innovation Hubs (DIHs) helps companies especially SMEs, adopt advanced digital technologies in AI, high-performance computing, cloud and cybersecurity. The initiative aims to create a national network of DIHs and integrate it in the European one under the Digital Europe programme. Portugal has 17 recognized DIHs covering its territory, a range of technologies and key sectors of the economy. DIH financing includes a mix of RRP, national component through RRP and the Digital Europe programme for those DIHs that will be selected by the multi-country program. The selection of hubs that will participate in the network of European Digital Innovation Hubs (EDIHs) is ongoing. Three Portuguese EDIH proposals have attained a successful evaluation result³⁰⁴: a seal of excellence.

In 2021, Portugal took significant steps in cybersecurity and eIDAS, regulating³⁰⁵ the Cyberspace Security Legal Framework³⁰⁶ and establishing the National Cybersecurity Centre (CNCS) as the National Cybersecurity Certification Authority. As a result, the CNCS approved a [Regulation Project to establish](#) the technical requirements for communication to the permanent contact points, the security, assets inventory, annual report, and incidents notifications for the public administration, operators of essential services and critical infrastructures, and digital services providers. The [C-Hub: Cybersecurity DIH](#) was integrated in the national DIH Network, aiming to gain access to the European DIH Network.

The National Supervisory Body published³⁰⁷ the requirements and procedures for certification and conformity assessment of the identification system using automatic biometric facial recognition systems.

A working group to establish Portugal's data strategy is foreseen in 2022. The APDT includes a measure to encourage the sharing of information (open government data) and its structured publication. This would make it interconnected and enhance the adoption of big data technologies. The measure aligns with the European data strategy. Portugal's [open data portal](#) has circa 5 000 data sets for reuse.

A new AI strategy is up for adoption by December 2022. Portugal has also launched the 'DIH AI4PA' (Artificial Intelligence & Data Science for the Public Administration), empowering public organisations and SMEs to offer digital solutions tailored to the state's needs.

³⁰⁴ I.e. are invited for grant agreement preparation (which is not a formal commitment for funding).

³⁰⁵ [Decree-law 65/2021](#) and Decree-Law 12/2021

³⁰⁶ It [transposes](#) Directive EU 2016/1148

³⁰⁷ Order 2705/2021

Portugal participates in the European high-performance computing initiative. It has signed a declaration for quantum communication infrastructure and participates in the European Blockchain Partnership. A new blockchain strategy is expected for adoption by December 2022. Barriers to HPC adoption by SMEs exist such as lack of in-house expertise or little to no access to suitable hardware. Nevertheless, potential benefits of improved product quality through enhanced performance and accuracy of the models, cutting time to delivery and innovative services can ultimately help increase their competitiveness. Not only businesses seeking large or fast data processing can benefit and profit from HPC, but also many more, such as those involved with product designing, agricultural production, mapping, engineering and decision making, being many of these micro and SMEs. However, targeted policies and actions are most needed to encourage SMEs to optimise their processes through using HPC. Portugal has been operating its first supercomputer since 2020.

Digitalisation and innovation are high on Portugal's agenda, driven by public policy measures and sector-specific incentives for SMEs. Productivity remains a challenge for these companies' competitiveness, where digitalisation can have a major impact but where companies' abilities to develop digital assets tend to be limited. Knowledge gaps limit the ability of SMEs to integrate digital assets, for example, their awareness of how and where to apply digital solutions to business processes and technical knowledge to integrate digital solutions. More robust communication of the benefits of digital transformation and mobilising cooperation between businesses and academia could add thrust to Portugal's efforts, with special attention to the micro and small enterprises that make up its business fabric.

4 Digital public services

4 Digital public services ³⁰⁸	Portugal		EU
	rank	score	score
DESI 2022	14	67.9	67.3

	DESI 2020	Portugal DESI 2021	DESI 2022	EU DESI 2022
4a1 e-Government users % internet users	54% 2019	57% 2020	59% 2021	65% 2021
4a2 Pre-filled forms Score (0 to 100)	NA	NA	76 2021	64 2021
4a3 Digital public services for citizens Score (0 to 100)	NA	NA	79 2021	75 2021
4a4 Digital public services for businesses Score (0 to 100)	NA	NA	82 2021	82 2021
4a5 Open data % maximum score	NA	NA	66% 2021	81% 2021

Portugal ranks 14th in the EU on digital public services, aligning with the EU average in that dimension. The share of e-government users has increased by 2 percentage points since last year but remains below the 65% of EU average. Portugal performs above the EU average on digital public services for individuals and prefilled forms with 79% and 76% respectively. In digital public services for businesses, its performance is at par with the EU average (82%). Portugal underperforms in the open data indicator scoring 66%³⁰⁹ compared to 81% of EU average.

Portugal's ambition of digital-by-default is materialising with over 95% of key digital public services available online. The national strategy for the digital transformation of public administration ([SDTPA](#)) strengthens Portugal's commitment to provide integrated, seamless digital public services oriented at life events of the public and businesses, anchoring interoperability and reuse of data as fundamental for the public sector's digital transformation. SDTPA's third strategic line of action 'Reference architectures' extends the scope and functionalities of the Interoperability Platform of the public sector (iAP) by developing seamless services and applying the once-only principle, implementing document interoperability across the public sector, and integrating base registries in iAP.

SDTPA is aligned with the national RRP and other sectoral strategies like [Innovation and Modernisation of the State and Public Administration 2020-23](#). One of its four axis is 'Exploring technology for improved

³⁰⁸ There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

³⁰⁹ Figures of 2020 and 2021 are not completely comparable

interoperability and public service integration' by using iAP for the integration of services and data reuse including AI, quality and data analysis services. The iAP is a key instrument for organising services into single points of contact, allowing the public administration to use the information it holds when individuals permit it.

RRP initiatives for the public administration's digital transformation include redesigning public services in an inclusive, omni-channel manner and based on interoperability, and the once-only and share-and-reuse principles in order to deliver simple, inclusive and safe public services.

One of the RRP investments aims to increase the number of services that reuse data available in the iAP through micro-services according to the Public Administration Data Catalogue. Those would be covered by electronic identity and the [Public Administration Personal Data Control System](#) that publish open data. Priority will go to the most commonly used services (5 by 2022, 25 by 2026). These will be developed using the recent 'Common model for the design and development of digital services': principles, standards, reference architectures and common technologies, aimed at all public administrative entities, software and service providers and other partners involved in building these services.

The Action Plan for the Digital Transition (APDT) foresees a cloud-first strategy for the public administration. That will positively affect the entire industry, pushing it to keep up with the sector's cloud adoption requirements. In that regard, the RRP foresees developing guides and support tools for all public administration entities i.e., a decision support tool, a model for cloud contracts, templates for tendering procedures and technical clauses as reference for public entities to contract cloud services, and a qualification plan for civil servants, among others. Portugal will use the RRF, Portugal 2030 and the national budget to fund its initiatives.

Implementation of the single digital gateway ³¹⁰is under way. A national network of focal points from different government areas was created to provide content and services according to both European and national strategies.

SIMPLEX is the national administrative simplification and modernisation programme focused on improving service delivery and efficiency, reducing the administrative burden, dematerialising bureaucratic procedures, and adopting new practices. Its user-driven approach relies on public participation and service co-creation. In 2020-2021, SIMPLEX was organised in two blocks: (i) strengthening the capacity to provide better public services; (ii) ensuring the investment needed to always guarantee that capacity.

Several measures were implemented during the pandemic confinement such as extending the validity of eIDs, allowing people to interact with the government and a video channel for deaf people accessible on the health department website.

³¹⁰ From annexes 1 and 2 to the [Regulation](#)

In the technical-operational domain, Portugal has an electronic health record solution implemented at national level. People can gain access to information in the [Electronic Health Record](#) through SNS24's multichannel options including mobile and secure authentication.

Portugal has several strategies for better policymaking and internal management using innovative digital technologies. Some are completed e.g., cloud, others are being set up like the data strategy, AI (revision), blockchain, smart cities strategy. The cloud strategy for public administration has been published and instruments are being developed to make it operational.

GuIA is a guide for responsible AI in the public sector. Accompanied by a self-assessment, risk-mitigating tool, it revolves around fairness, ethics, explainability, transparency and accountability. It offers recommendations on how to submit AI projects and generate algorithms.

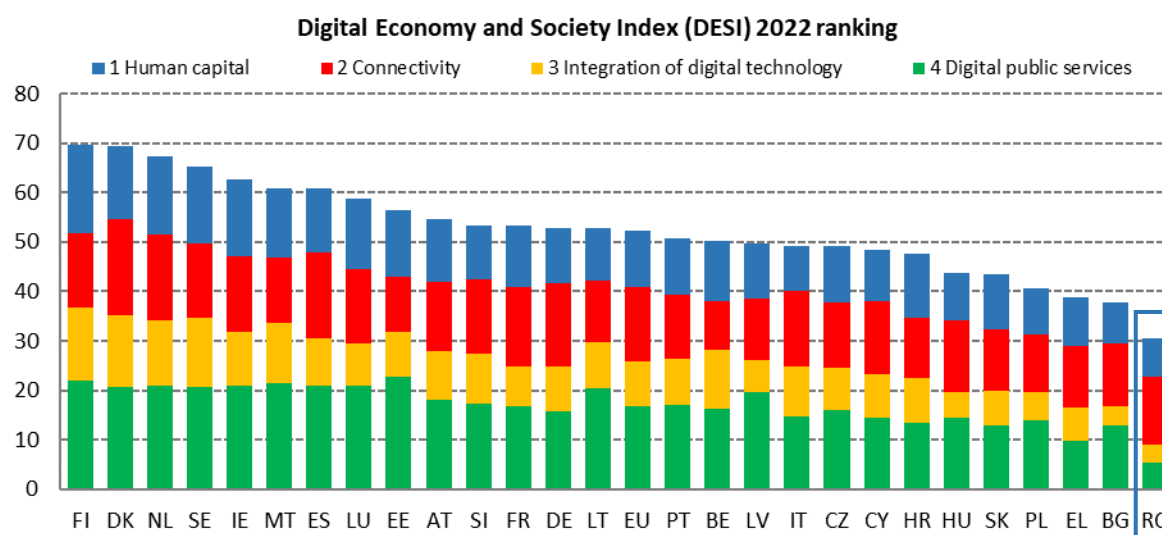
Guides and tools are being developed for all public administration transitioning to the cloud. These will include, a decision support tool, model for cloud contracts, templates for tenders, technical clauses as reference for public entities to contract cloud services, and a [qualification plan for human resources](#).

Courses to increase public servants' digital skills are underway through SDTPA 2021-2026 at the [NAU Platform](#). The [Administrative Modernisation Agency](#) set up the [AMA Academy](#), which develops projects for training, qualification and skills development for the public service. The RRP supported the establishment of the [National Institute of Administration](#) (INA) which has an extensive programme for digital skills: [AP Digital 4.0](#). It aims to train over 60 000 public servants per year in productivity tools, emerging technologies and ICT specialisation. These courses will also be published in NAU platform.

Portugal has institutionalised a robust governance structure. It provides innovative services, designed with users' participation through co-creation, ensuring the relevance of whole-of-government technical solutions. It adopted an omni-channel approach for service delivery, building a common technical basis, a public innovation lab, and digital skills and capabilities in government and society. However, the digital skills divide can hamper user take-up of e-government solutions. Programmes such as EU SOU Digital to empower adults who have never used the internet are important in the thrust to increase the use of digital public services. The ability to make use of ICT tools is strongly correlated with digital skills, and Portugal faces challenges unless it accelerates improvement of the digital skills of the population.

Romania

	Romania		EU
	rank	score	score
DESI 2022	27	30.6	52.3



Romania ranks 27th of the 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI). Importantly, its relative annual growth is behind that of its peers³¹¹, indicating that it is not converging with the rest of the Member States. The country is lagging behind for several indicators in the human capital dimension, with a very low level of basic digital skills compared to the EU average, but maintaining its high rankings in the proportion of female ICT specialists in employment (ranking 2nd) and ICT graduates (ranking 4th). A significant change of pace in Romania's digital skills' readiness is crucial for the EU to reach the Digital Decade target on basic digital skills and ICT specialists. Romania performs comparatively well on connectivity, which is the dimension where it scores best. The take-up of at least 100 Mbps fixed broadband (57%) and fixed very high-capacity networks coverage (87%) surpasses the EU average. This is also important in the light of the Digital Decade target of 100% coverage of all households by gigabit networks until 2030. However, the country's performance in the integration of digital technologies and digital public services is poor compared to the other EU Member States. The share of SMEs with at least a basic level of digital intensity (22%) and the percentage of enterprises sharing information electronically (17%) is the lowest in the EU. The low level of digitalisation and the relatively slow progress is preventing the Romanian economy from taking full advantage of the opportunities offered by digital technologies. This is further aggravated by the very low level of digital public services for both citizens and businesses.

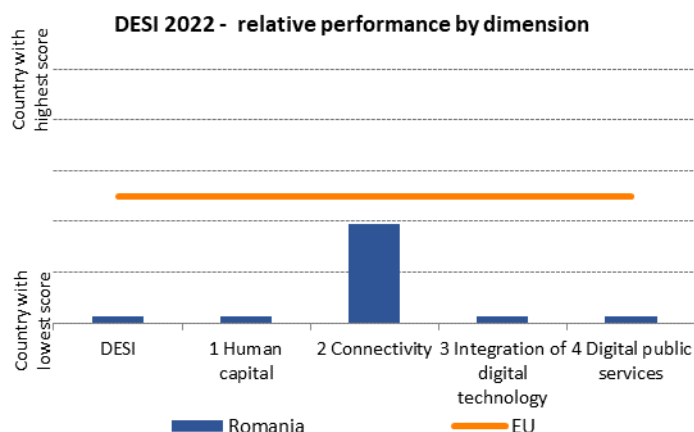
³¹¹ See section 1.3 of the DESI 2022 thematic chapters.

The continuation of the COVID-19 pandemic in 2021 and the frequent changes in government (five governments within the last 4 years) represent a particular challenge for the country. Digitalisation continues to be a key priority of the current government in power since 25 November 2021, along with simplifying legislation and creating a business-supportive regulatory environment. The government is driving the digital transformation of the public sector through the e-government public policy for 2021-2030 (adopted on 3 June 2021) the flagship project for establishing a framework for e-government services and tools. The policy is at the beginning of the implementation process.

With investment support of almost EUR 6 billion (20.5% digital tagging), the Romanian Recovery and Resilience Plan (RRP) includes highly significant measures to fully embrace digitalisation, along all DESI dimensions, i.e. digital skills, connectivity, support of businesses and digital public services. While most of these measures (both reforms and investments) are managed by the Ministry of Research, Innovation and Digitalisation, other Ministries and public entities are in charge of delivering related digital measures, too. An agile governance structure, avoiding fragmentation and ensuring coherent and effective implementation, would greatly benefit the digitalisation efforts carried out under the RRP.

With the refugee crisis started after Russia's invasion of Ukraine, Romanian operators provided free SIM cards to Ukrainians with free calls and data. As of March 2022, some 400 000 SIMs were distributed. Moreover, the operators announced a coordinated approach with the General Inspectorate for Emergencies to direct mobile operators to hotspots of immigration and to install Wi-Fi hotspots in camps. These measures were implemented until the end of March and are now subject to review. According to ANCOM there are agreements at wholesale level to not charge roaming tariffs in place with the Ukrainian telecoms' counterparts.

Taking into account the role of audiovisual media services in shaping public opinion and the right of the public to have access to reliable, current sources of information on Russia's aggression against Ukraine, the National Audiovisual Council (NAC) adopted on 24 February 2022 a Recommendation addressed to audiovisual media service providers requiring them to comply with legal obligations to properly inform the public. The NAC monitors rapidly how issues relating to the aggression of the Russian Federation against Ukraine are reflected in news broadcasts and debates, with the aim of properly informing the public by checking information, avoiding confusing information and observing the rules of ethics. In addition, the NAC made a [recommendation](#) to citizens in Romania, by means of an informative TV spot broadcast by broadcasters under public interest notice, to obtain their information 'exclusively from official sources' in the context of the war in Ukraine. The NAC held a video conference on 11 April 2022 inviting audiovisual regulators from countries bordering Ukraine. On this occasion, the NAC initiated a cooperation mechanism, based on the exchange of best practices, for these authorities to inform each other in advance of the topics of manipulation and disinformation in the context of the conflict in Ukraine and measures to counter disinformation.



Immediately after the beginning of the hostile activities in Ukraine, the National Cybersecurity Directorate (NCSD) has initiated a standard process of monitoring and identifying the resources involved in cyber and malware attacks started in the context of the war in Ukraine. NCSD has issued a list of websites and IP addresses linked to disinformation and attacks and is constantly updating the [list](#). Also, in partnership with the NCSD, Bitdefender is providing technical consulting, threat intelligence and both consumer and enterprise cybersecurity technology to any business, government institution or private citizen of Ukraine for as long as it is necessary. NCSD recommends the quick and precise implementation of adequate measures for the protection of websites and the cyber infrastructures. A [guide](#) of cybersecurity has been published on NCSD website.

Digital in Romania's Recovery and Resilience Plan (RRP)

Romania's Recovery and Resilience Plan has the objective to address most of the country's digital shortcomings, contributing EUR 5.97 billion³¹² (i.e. 20.5% of Romania's total allocation) to digital objectives. The most substantial contribution is under component 7 (Digital transformation), although all components include some measures related to digital.

In component 4 (Sustainable transport), EUR 864 million are allocated to digitalisation of the railway system and the development of sustainable road infrastructure, including digital elements.

Component 7 (Digital transformation), earmarks EUR 1 817 million (the largest contribution for a single component) and focuses on the digital transformation of the public sector, cybersecurity and connectivity. Specifically, this component includes reforms such as the entry into force of the 5G Network Security Law and the adoption of the 2021-2026 National Cybersecurity Strategy. For the former, the call for tenders for the authorisation of

³¹² Each recovery and resilience plan has to dedicate at least 20% of the plan's total allocation to digital objectives. To this end, the plans had to specify and justify to what extent each measure contributes fully (100%), partly (40%) or has no impact (0%) on digital objectives, using Annex VII of the RRF Regulation. Combining the coefficients with the cost estimates of each measure allows assessing to what degree the plan contributes to digital objectives and whether it meets the 20% target.

telecommunications operators to grant 5G licences should be published by June 2022. Other key reforms include the adoption of the government cloud and interoperability law by June 2022 which will trigger significant deployment investments and related services update, the setting up of the task force to implement and monitor digital reforms and investments in the RRP, and the analysis for the options for the government cloud architecture. Additionally, a call for 'grant support for digital skills' to upskill/reskill employees in firms is part of this component.

In Component 8 (Tax and pensions reform), several investments are envisaged for the digitalisation of the tax and pensions authorities.

Component 9 (Business support, research, development and innovation) is also important in the digitalisation context, as it allocates EUR 1 064 million to support businesses' digitalisation and support a multi-country project on 'Low-power processors and semiconductor chips', planned to be implemented as an Important Project of Common European Interest (IPCEI). In addition, the RRP is financing in this context the operationalisation of a public digital platform providing public services for businesses related to setting up/leaving the market for firms, authorization of foreign representations in Romania and obtaining industry-related licenses (Investment 1). A EUR 500 million-worth scheme aims at supporting the uptake of digital technologies/solutions such as artificial intelligence, data, cloud, platforms, block chain, and the digital transformation of the business processes (Investment I3a).

The creation of subnational governments at the meso-level (e.g., functional rural areas) in Component 10 (Local fund) should allow for the full digital integration of public services delivered by administrative units that are part of local consortia. Integration would lead to improved access, especially in less densely urbanised areas where the quality of existing public services is at times below-standard.

Component 14 (Good governance) contributes to foster participation in the digital public space. Under Reform 1, staff of civil society organizations shall receive yearly training to increase their capacity and skills to take part effectively in the public consultation processes through the digital platform e-consultare.gov.ro. In parallel, Investment 3 aims at creating partnership structures between local governments and the civil society also by encouraging the digitalisation of NGOs.

Within Component 15 (Education), a budget of 1 129.5 million is dedicated to reforms and investments for the digitalisation of education. This includes reforms to set out the digital competence profile of the teachers and to assess digital competence in school examinations, as well as to ensure standards for equipping schools with technological equipment and resources for educational purposes online.

1 Human capital

1 Human capital	Romania		EU
	rank	score	score
DESI 2022	27	30.9	45.7

	Romania			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
1a1 At least basic digital skills % individuals	NA	NA	28% 2021	54% 2021
1a2 Above basic digital skills % individuals	NA	NA	9% 2021	26% 2021
1a3 At least basic digital content creation skills³¹³ % individuals	NA	NA	41% 2021	66% 2021
1b1 ICT specialists % individuals in employment aged 15-74	2.3% 2019	2.4% 2020	2.6% 2021	4.5% 2021
1b2 Female ICT specialists % ICT specialists	23.5% 2019	26.2% 2020	26% 2021	19.1% 2021
1b3 Enterprises providing ICT training % enterprises	6% 2019	6% 2020	6% 2020	20% 2020
1b4 ICT graduates % graduates	5.8% 2018	6.3% 2019	6.7% 2020	3.9% 2020

Romania ranks 27th in the human capital dimension of DESI 2022. The country faces a lack of basic digital skills among the population. Romania scores well below the EU average concerning at least basic digital skills (28% vs 54%) and above basic digital skills (9% vs 26%). 41% of the individuals in Romania have at least basic digital content creation skills, below the EU average which stands at 66%. Romania scores below the average also for the proportion of ICT specialists in employment, at 2.6% compared to the 4.5%, but the percentage is increasing steadily. In contrast, the levels of female ICT specialists and ICT graduates remain high and have risen to 26% and 6.7% respectively, scoring in the top tier. The share of enterprises providing ICT training is stagnating at 6%, significantly below the EU average.

Although the country does not yet have a digital skills strategy, there are cross-cutting measures within the RRP, such as the adoption of the legislative framework for the digitalisation of education. The reform aims to ensure the necessary legal framework to develop digital competences for students. This will involve defining the competency profile for teachers and revising the compulsory school curriculum and the framework plan for ICT disciplines at all school levels. The reform will align the educational system with the DigComp European Framework for digital competences for students. Implementation of the reform is to be completed by 30 June 2024.

Additionally, the investments in the RRP under Component 7 - Reform 4 'Increasing digital competence for public service and digital education throughout life for citizens' support the digitalisation of the

³¹³ Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

economy and the transition to industry 4.0 and seek to align the labour market with the latest developments in this sector. These investments will contribute to the implementation of this reform in four fields set out below.

(i) Advanced digital skills training programme for civil servants (EUR 20 million): by mid-2026, 30 000 public officials will be trained to acquire advanced digital skills and 2 500 senior civil servants will follow leadership training and talent management.

(ii) Funding schemes for libraries to become digital skills hubs (EUR 37 million).

(iii) Schemes to upskill/reskill employees in firms (EUR 36 million): this scheme supports the digital transformation of SMEs by increasing their employees' digital skills with a focus on emerging technologies e.g. internet of things, big data, machine learning, artificial intelligence, robotic process automation, blockchain. By the end of 2025, the employees of 2 000 SMEs will have received support.

(iv) Creation of new cybersecurity skills for society and the economy, targeting the development of cybersecurity skills both for students, and for public and private players (EUR 25 million). Cybersecurity training will be organised for 5 000 teachers (at pre-university and university levels), who will then be able to pass on their knowledge to students all around Romania. These training sessions will be completed by mid-2026.

Furthermore, under Component 15 of the RRP, an in-service training programme will develop digital pedagogical competences for teachers in rural areas and other disadvantaged environments. The DigComp European framework for digital competences and internationally recognised standards (ECDL) will be used to design the programme, with some 100 000 teachers expected to participate. A platform collecting multimedia lessons will flank the training to serve as a good practice model for each discipline. Around 50 000 teachers will benefit from exchanges through the platform. A framework to assess the practical application of acquired skills and undertake corrective action will ensure that the programme's effects are long-lasting. The allocated amount is EUR 80 million, and the programme will be completed by Q3 2025.

The modernisation of over 5200 IT laboratories and the development of 1 100 technological hubs as smart labs will ensure infrastructure and digital equipment for more than 3 600 schools not covered by any other funding programmes. The amount allocated in the RRP is EUR 478.50 million, with implementation running from 2021 to 2025.

The National Agency for Employment (ANOFM) delivers vocational training courses for the registered unemployed and jobseekers to help them find a job. The courses are funded from the unemployment insurance budget. In 2021, 673 took ANOFM digital skills training courses.

In 2021, Romania participated in the EU Code Week. The country hosted 53 407 participants in 1 755 events. Female participation reached 44%. The share of activities in schools was 88%³¹⁴.

The very low level of basic digital skills translates into low adoption levels of fixed broadband (66%) despite the high availability of fast broadband (93%) and very high capacity network (VHCN) coverage

³¹⁴ 4 million people created code with the help of EU Code Week in 2021 – Code Week

(87%) (for more see the section on Connectivity). To foster broadband take-up efforts should also focus on improving the general public's skills.

2 Connectivity

2 Connectivity	Romania		EU
	rank	score	score
DESI 2022	15	55.2	59.9

	Romania		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
2a1 Overall fixed broadband take-up	66%	67%	66%	78%
% households	2019	2020	2021	2021
2a2 At least 100 Mbps fixed broadband take-up	49%	51%	57%	41%
% households	2019	2020	2021	2021
2a3 At least 1 Gbps take-up	<0.01%	<0.01%	8.98%	7.58%
% households	2019	2020	2021	2021
2b1 Fast broadband (NGA) coverage	82%	87%	93%	90%
% households	2019	2020	2021	2021
2b2 Fixed Very High Capacity Network (VHCN) coverage	68%	76%	87%	70%
% households	2019	2020	2021	2021
2b3 Fibre to the Premises (FTTP) coverage	68%	76%	87%	50%
% households	2019	2020	2021	2021
2c1 5G spectrum	21%	21%	22%	56%
Assigned spectrum as a % of total harmonised 5G spectrum	04/2020	09/2021	04/2022	04/2022
2c2 5G coverage³¹⁵	NA	12%	25%	66%
% populated areas		2020	2021	2021
2c3 Mobile broadband take-up	65%	65%	82%	87%
% individuals	2018	2018	2021	2021
2d1 Broadband price index	92	97	97	73
Score (0-100)	2019	2020	2021	2021

On Connectivity, Romania ranks 15th of 27 EU countries and is thus below the EU average.

Romania's biggest challenge in terms of connectivity is to improve its overall take-up of fixed broadband, which stagnates at 66% and is significantly below the EU average (78%), in spite of low broadband costs and high coverage of very high capacity networks (VHCN). This stagnation is principally due to the country's skewed demographics and low level of basic digital skills, leading Romania to lag in uptake. However, Romania continues to be a strong player in the field of Next Generation Access (NGA) and VHCN. Fixed broadband coverage rose to 94.1% for total households, just slightly below the EU average of 97.9%. Additionally, fast broadband rose by 6 percentage points to 93%, above the EU average of 90%. Urban areas boast VHCN coverage of 90%, much higher than the EU average of 76%.

³¹⁵ The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

The urban-rural digital gap in VHCN coverage continued to reduce after a 20 percentage point increase to 75.7% coverage in rural areas (double the EU average of 37.1%). Still, operators highlighted difficulties in fibre deployment, specifically in accessing the vicinity of roads and buildings. In response, the Draft-law transposing the European Electronic Communications Code (EECC), apart from transposing this Directive, will reform permit granting, splitting civil works into three categories: the first requires no permit, the second is a simplified procedure, while the third is the normal procedure.

Romania has taken several steps in mapping white and grey areas following a [public inquiry conducted in H1 2021](#). Additionally, ANCOM started populating an infrastructure grade map at national level, with geolocation mapping focused on densely populated areas first. In the view of the national regulator ANCOM, there was a need to calibrate the systems before scaling the operation at national level. The government's [RO-NET](#) project (from 2015), implemented with significant delay, is expected to identify a further 700 localities as recipients of EUR 94 million in investments under the Recovery and Resilience Facility (RRF). This would support rollout of fixed communications infrastructures. This project is expected to be fully completed by the end of 2026. With these measures, Romanian can achieve the gigabit objectives for 2025 and possibly the 2030 Digital Decade targets, specifically because RO-NET developed backhaul infrastructures capable of speeds up to 10 Gb/s. Additionally, the Integrated National Platform Wireless Campus' project for EUR 36.67 million is under implementation. So far, Wi-Fi infrastructure has been built and is operational in approximately 4 200 schools out of the total 4 500 considered.

On the mobile connectivity side, 5G deployment is facing hindrance from multiple sides due to the delayed transposition of the EECC and the burden imposed by the 5G Security Law, adopted following the entry into force of the [Memorandum of Understanding between the USA and Romania](#). Despite high coverage of 4G/LTE (97.1%) and an increase in 5G coverage (25% in 2021, 13 p.p. above the previous year), Romania lags behind the EU average in 5G coverage and faces delays in the assignment of the harmonised 5G spectrum, which remains low (22% compared to the EU average of 56%).

The recently designed spectrum auction was ultimately split into two parts. The first part (completed in November 2021) awarded the available usage rights in the 800 MHz, 2600 MHz and 3400-3600 MHz bands on a short-term basis under the current legislation. Despite availability in the 3400-3600 MHz band (a total of 90 MHz), only a block of 5MHz was awarded to the operator Invite Systems SRL at the conditions offered. While some operators complained about not being able to bid (oral complaint during fact finding mission), according to ANCOM the market did not express demand for the contiguous spectrum available, specifically in the 3.6 GHz band, despite the generous spectrum cap of 120 MHz, which provided favourable conditions for the sale of the rights of use.

The second part of the spectrum auction, detailed in ANCOM's [2022 Action Plan](#), intends to process the award of usage rights for the 700 MHz, 1500 MHz and 3400-3800 MHz bands on a long-term basis for the implementation of broadband electronic communications services (including 5G) following the EECC's entry into force. The conditions for coverage, sharing and reserve obligations are being currently adapted. A public consultation is expected to take place in June 2022. Meanwhile, the implementation of the [5G Security Law](#) (Law No. 163/2021) has raised concern among telecommunications operators over the lack of transparency in the decision-making process. The application of a well-known European

vendor was rejected and as result its equipment may only be used for a further 5years for access and 7years for core (counted from June 2021), if no permit is secured in the meantime. This obligation of compliance lies with the operators.

With the refugee crisis in Ukraine, Romanian operators [undertook](#) voluntary measures providing Ukrainians with free SIM cards with free calls, SMS and data. As of March 2022, some 400 000 SIMs had been distributed. The operators also announced a coordinated approach with the General Inspectorate for Emergencies to install Wi-Fi hotspots in refugee hotspots. These measures were implemented until the end of March and will then be subject to review. According to ANCOM, there are agreements at wholesale level to not charge roaming tariffs in place with the Ukrainian telecoms counterparts.

Main market & regulatory developments

In 2021, the Romanian market registered a 6.5% annual reduction in the total number of providers of public electronic communications networks highlighting consolidation of the market integrated through partnerships or mergers. Notably, Orange Romania acquired a 54% majority stake of the fixed arm of Telekom Romania Communications. On the other side, Telekom Romania Mobile is now acting as a solely mobile operator in Romania and continues to record a growth in its market share.

The Romanian market is characterised by strong competition between 2 international groups (initially mobile operators) and the Romanian (initially cable) operator RCS&RDS. The market is heavily reliant on zero-rating offers that had been the longstanding differentiator. Consequently, mobile operators are burdened with compliance obligations to the recent European Court of Justice rulings³¹⁶. Operators highlight the difficulties attached to migrating away from zero-rating while ANCOM noted there is a formal request for information to assess the impact of this change.

On the transposition of the EECC, on 23 September 2021, the Commission addressed a Reasoned Opinion to Romania for its failure to notify transposition. In response, Romania lodged two extensions while the draft law made its way to the President, awaiting promulgation. However, delays are expected in its final transposition due to three ongoing legal challenges before the Romanian Constitutional Court. The [first](#) is an appeal by 50 deputies over the constitutionality of the obligation on operators to assist authorities in legal surveillance proceedings. The [second](#) is an appeal by the Ombudsman's Office on the ground that provisions for the deployment of electronic communications networks may unduly affect other rights, e.g. property rights and, also, regarding the constitutionality of the obligation on operators to assist authorities in legal surveillance proceedings. The [third](#) appeal was triggered by 41 deputies claiming that simplified deployment creates public health fears due to electromagnetic fields (EMF), and has been rejected by the Constitutional Court. [On 6 April 2022](#), the Constitutional

³¹⁶ ECJ 15 September 2020, Joined Cases C-807/18 and C-39/19, Telenor Magyarország Zrt v Nemzeti Média- és Hírközlési Hatóság Elnöke (ECLI:EU:C:2020:708)

Court rejected the third appeal and postponed the debate regarding the first 2 appeals until 4 May. The authorities signalled that splitting the draft law from the articles subject to legal challenges is possible if the Constitutional Court rules that the articles are indeed unconstitutional, but it remains a decision of the Parliament.

Due to teleworking during the pandemic, complaints regarding quality of service (QoS) increase, especially in rural areas, albeit at lower rates than in 2020. In the context of increased teleworking obligations, many users voiced problems with contract termination, specifically early contract termination, and displayed a greater willingness to change service providers.

Despite good progress in 2021 on increasing fixed broadband coverage, Romania still has to tackle relatively slow take-up and low 5G coverage. Nonetheless, Romania is on the right track to meet the gigabit society and 2030 Digital Decade targets with its comparatively high VHCN coverage, while the expected investments through the RRF will push the country to match the EU averages in the coming years. Nevertheless, this will require ambitious and cross-cutting projects, especially to stimulate take-up of higher capacity networks and bridge the urban-rural gap. To facilitate fibre deployment, timely transposition of the EECC is crucial in order to put in place more efficient permit granting procedures it is crucial to proceed with a timely adoption of the draft Law transposing the EECC and re-launch assignment of the 5G spectrum, which is still low, and its deployment. Moreover, it would be beneficial for this alignment to take the form of an update of the broadband strategy to better reflect the 2025 gigabit and 2030 Digital Decade targets.

3 Integration of digital technology

3 Integration of digital technology	Romania		EU
	rank	score	score
DESI 2022	27	15.2	36.1

	DESI 2020	Romania DESI 2021	DESI 2022	EU DESI 2022
3a1 SMEs with at least a basic level of digital intensity % SMEs	NA	NA	22% 2021	55% 2021
3b1 Electronic information sharing % enterprises	23% 2019	23% 2019	17% 2021	38% 2021
3b2 Social media % enterprises	8% 2019	8% 2019	12% 2021	29% 2021
3b3 Big data % enterprises	11% 2018	5% 2020	5% 2020	14% 2020
3b4 Cloud % enterprises	NA	NA	11% 2021	34% 2021
3b5 AI % enterprises	NA	NA	1% 2021	8% 2021
3b6 ICT for environmental sustainability % enterprises having medium/high intensity of green action through ICT	NA	68% 2021	68% 2021	66% 2021
3b7 e-Invoices % enterprises	20% 2018	17% 2020	17% 2020	32% 2020
3c1 SMEs selling online % SMEs	11% 2019	17% 2020	12% 2021	18% 2021
3c2 e-Commerce turnover % SME turnover	5% 2019	8% 2020	7% 2021	12% 2021
3c3 Selling online cross-border % SMEs	6% 2019	6% 2019	4% 2021	9% 2021

Romania scores poorly in the integration of digital technologies, ranking 27th for that dimension. Almost all indicators remain considerably below the EU average and have either stagnated or even decreased in the past year. The share of SMEs with at least a basic level of digital intensity was 22% (EU average: 55%). Therefore, efforts need to be stepped up to reach the Digital Decade target of 90% of SMEs reaching a basic level of digital intensity by 2030. With 12% of SMEs selling online and 4% selling online cross-border, Romania is lagging behind most EU Member States. The take-up of advanced technologies like cloud reached only 11% compared to the EU average of 34%. As regards artificial intelligence, only 1% of enterprises adopted such technologies (EU average: 8%). Big data remains comparatively low as well, with 5% vs the EU average of 14%. There is a significant gap to be closed by 2030 to reach the Digital Decade target of 75% in cloud, big data and AI. Only the 68% share of enterprises having medium/high intensity of green action through ICT is slightly above the EU average of 66%.

The 2021-2027 government strategy to develop the SME sector and improve the Romanian business environment towards [digital and data economy](#) covers cross-cutting measures such as: (i) development of the Digital Innovation Hubs (DIHs) network³¹⁷; (ii) providing SMEs with opportunities to acquire the skills to benefit from new technologies; (iii) helping SMEs to easily change digital service providers and take advantage of data portability, as provided in the Regulation on free movement of non-personal data; and (iv) raising SMEs' awareness of security threats and stimulating investments in cyber security.

The RRP supports investments for the digitalisation of SMEs to increase their competitiveness, allocating a budget of EUR 500 million for this. Two instruments are available: (i) grants for entrepreneurs in the development of advanced digital technologies i.e. artificial intelligence, data and cloud computing, blockchain, high performance computing, quantum, internet of things, cybersecurity; and (ii) grants of up to EUR 100 000 per enterprise to adopt digital technologies, i.e. purchasing ICT hardware, developing or adapting software applications/licences, procurement of AI systems, presentation website, IT training of staff, etc. The measure is expected to be completed by mid-2024.

On microelectronics, Romania has signed the Joint Declaration on the European Initiative for Processors and Semiconductors. The investment in the multi country project on Low Power Processors and Semiconductor Chips included in the RRP will stimulate the development of microelectronics in Romania, addressing one of the EU's challenges. Romanian industry has shown a strong interest in the IPCEI initiative on this topic, responding to the request of the Ministry of Economy and Entrepreneurship to submit project proposals.

On blockchain, Romania's 2 European Blockchain Services Infrastructure nodes were set up in 2021 by the National Institute for Research and Development in Informatics (ICI Bucharest) and the UEFISCDI higher education and research funding body, together with the Politehnica University of Timișoara. These are at a mature development phase.

The Authority for the Digitalisation of Romania is implementing the 'Strategic framework for the adoption and use of innovative technologies in public administration 2021-2027' project together with the Technical University of Cluj-Napoca. The main objectives are to: (i) draw up a national framework in the field of blockchain technologies for public administration; (ii) develop the national strategy for artificial intelligence; (iii) define the digital innovation hubs concept; (iv) define the framework and funding for Romania's participation in European initiatives and networks and (v) establish a Digital Policy Lab to develop infrastructures, processes, tools and networks.

The main obstacles for the digital transformation of the SME sector in Romania and the bulk of its economy are structural. They require comprehensive and cross-cutting measures geared to raise the level of digital education and managers' understanding of the role of digital tools in business. The low development of digital public services hinders SMEs' uptake of digital management of processes like accounting. Stepping up efforts on the supply side in the form of a convincing mix of services and tools

³¹⁷ The selection of Digital Innovation Hubs that will participate in the network of European Digital Innovation Hubs (EDIHs) is ongoing. Seven Romanian EDIH proposals have a successful evaluation result, i.e. are invited for grant agreement preparation (which is not a formal commitment for funding). One additional proposal is expected to be selected in the next year.

that optimise SMEs' processes and train their staff and management in using them can help stimulate demand from SMEs.

4 Digital public services

4 Digital public services ³¹⁸	rank	Romania score	EU score
DESI 2022	27	21.0	67.3

	DESI 2020	Romania DESI 2021	DESI 2022	EU DESI 2022
4a1 e-Government users	15%	16%	17%	65%
% internet users	2019	2020	2021	2021
4a2 Pre-filled forms	NA	NA	19	64
Score (0 to 100)			2021	2021
4a3 Digital public services for citizens	NA	NA	44	75
Score (0 to 100)			2021	2021
4a4 Digital public services for businesses	NA	NA	42	82
Score (0 to 100)			2021	2021
4a5 Open data	NA	NA	76%	81%
% maximum score			2021	2021

Digital public services continue to be a challenge for Romania. The country performs significantly below the EU average on all indicators, including the availability of digital public services for citizens (a score of 44, compared to the EU average of 75) and businesses (a score of 42 compared to the EU average of 82). The digital interaction between public authorities and the general public is low as well, as only 17% of internet users are using e-government services. The large share of digital investments and reforms dedicated to this dimension in the Romanian Recovery and Resilience Plan presents an opportunity to improve these results. Timely implementation of these measures will contribute to achieving by 2030 the Digital Decade target of 100% online provision of key public services for European citizens and businesses.

Currently, no e-ID scheme is available in Romania. The deployment of e-ID cards and digital signature for Romanians is key in enabling the interactions between public and private bodies and the public. The RRP includes measures to deliver 8.5 million electronic ID cards, with EUR 200 million allocated for this. The e-ID card will store two digital certificates allowing: (i) the authentication to use public online services and (ii) qualified electronic signatures.

RRP-funded investments also target online provision of key public services and the development of a unitary framework for a government cloud system. This includes: (i) deployment of the government cloud infrastructure (EUR 675 m); (ii) cloud development and migration (EUR 187 million); (iii) development of e-health and telemedicine (EUR 400 million); (iv) digitalisation of the judiciary (EUR 162

³¹⁸ There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

million), in the environment (EUR 52 m), and in employment and social protection (EUR 85 million); (v) implementing electronic forms in public procurement (EUR 0.85 million); (vi) electronic ID card and digital signature (EUR 200 million); (vii) digitalisation of the NGOs sector (EUR 10 million) and of the civil service management (EUR 10 million).

These investments aim to modernise the public administration through advanced technologies and a focus on citizens' and businesses' needs. This should go hand in hand with ensuring the prerequisites for data-driven policy development and increase the interoperability of existing digital technologies. Furthermore, the reforms support the development of an integrated architecture of digital public services. The RRP reform of governmental cloud services consists of two strands of action: the Information Systems Interoperability Law and the Government Cloud Act.

On e-health, investments in the RRP include a telemedicine system and the new health insurance IT platform (PIA), aiming at (i) fostering the integration of health institutions through digital infrastructure, (ii) easing access to data for the Ministry of Health and other stakeholders, (iii) reducing fragmentation and (iv) improving the quality of health data. The investment aims to increase the access of rural areas and small urban areas and vulnerable groups to specialised consultations, while reducing waiting times through the use of telemedicine.

Furthermore, the National Health Insurance House in partnership with the Special Telecommunications Service (STS) and the Authority for the Digitalization of Romania is implementing an IT system called eDES. This computer system will connect DES, the electronic health record, the providers of paraclinical, clinical, physical and rehabilitation services, home health care, home palliative care, dentistry, medical devices, assistive devices and technology and emergency consultations at home and unassisted medical transport activities. This will contribute to the target of 100% of Union citizens accessing their medical records.

Additionally, the Ministry of Labour and Social Protection, together with two other institutions, is implementing the [MMPS-SII MMPS Service HUB](#) project, with a budget of RON 133 million (approximately EUR 27 million). The project will concentrate the public's online interactions in a single point of contact - the ministry's portal. This will facilitate submission of applications for social assistance and social service benefits and give the public and enterprises the possibility to consult and create their own electronic files. The project's completion is due for the end of 2023.

Although the user-centricity of digital public services is not measured, the draft action plan for the 2021-2027 national strategy for inclusion and poverty reduction includes a specific action aimed at making public information accessible to all citizens. The information will be published on the websites of mayors' offices and public institutions in an easy-to-read format, together with a set of supporting information for vulnerable people.

Another investment in the RRP, worth around EUR 22 million, supports the public sector's adoption of robotic process automation (RPA) solutions by 18 central administration institutions, which should increase productivity and resilience, reduce error and processing time by automating laborious, repetitive and rules-based tasks.

At the end of 2020, to monitor progress in digital transformation of the public administration in Romania and support strategic decisions by the government, the Authority for the Digitalization of

Romania (ADR) launched the Public Services Catalogue, which will be updated annually. This will be the programming tool for the digitalisation of public services, for planning interventions and for piloting digital public services.

Romania has identified the lack of combined IT and administrative process expertise in the institutions as one of the major structural challenges in its efforts to digitalise its public services sector. It is therefore essential to continuously develop the administrative capacity to implement digitalisation projects, in order to fully benefit from the major initiatives already launched, including the relevant measures in the RRP.

2021-2022 highlight: e-government public policy 2021-2030

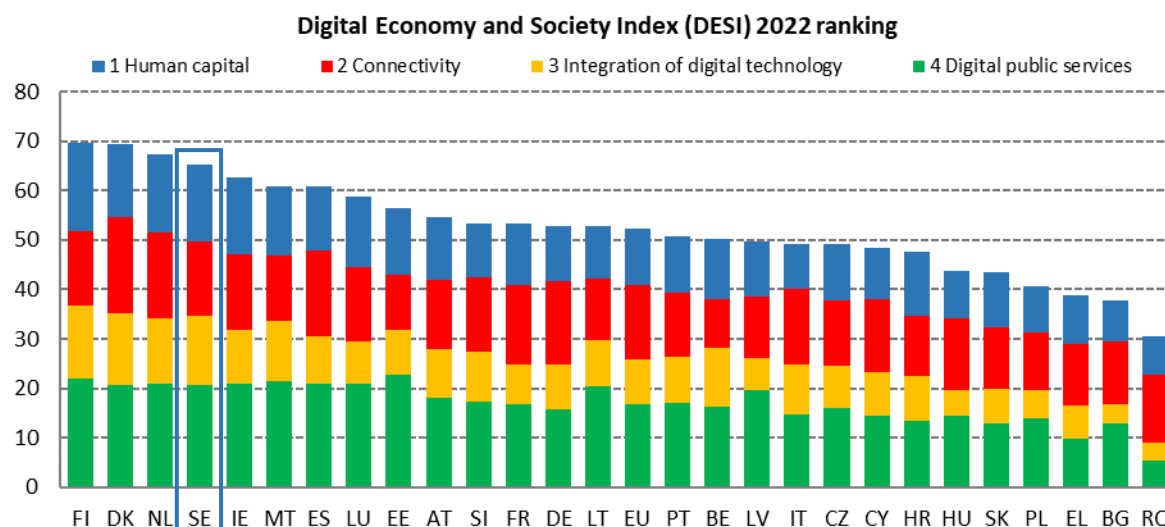
The [e-government public policy](#) was adopted on 3 June 2021.

Digital transformation of the Romanian public sector is driven by the e-government public policy for the period 2021-2030. The policy resulted from the government's flagship project to establish a framework for the development of e-government tools. The policy was drawn up following an extensive consultation with the relevant institutions, with coordination provided by the government's General Secretariat. The public policy will address the insufficient development of electronic public services in Romania. The proposal will aim to provide:

- a vision and a roadmap for the digitalisation of public services in the next 10 years
- a mechanism for regular monitoring, evaluation and adjustment when needed
- a programming and negotiation support tool for the financial period 2021-2027 and a tool for substantiating the digitisation measures covered in the National Recovery and Resilience Plan.

Sweden

DESI 2022	Sweden		EU
	rank	score	score
	4	65.2	52.3



Sweden ranks 4th of 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI). Sweden performs well and has done so over the last couple of years and scores above the overall EU average although the progress is not as fast as previously³¹⁹. On connectivity, Sweden has fallen back to 9th place and is below the EU average on 5G coverage. Concretely, Sweden scores far below the EU average (66%) in 5G coverage of populated areas at 18%. To remain a digital front-runner globally and contribute to the [Digital Decade targets](#), it is important that Sweden continues to improve its performance.

Human capital, where Sweden ranks 4th, continues to be an area of strong performance compared to other countries in the EU. The general population has both a high degree of basic digital skills (67%) and above basic digital skills (36%) and Sweden is heading in the right direction to reach the Digital Decade target of 80% of the population with at least basic digital skills by 2030. Despite having one of the highest percentages of ICT specialists in employment in the EU and an above-average proportion of ICT graduates, Sweden continues to struggle with the supply of ICT professionals in relation to demand, as 55.1% of enterprises report that they find it difficult to fill vacancies. It is important that Sweden does more work to improve this, to avoid delaying the digital transformation of business and to help reach the Digital Decade target of 20 million ICT experts in the EU by 2030.

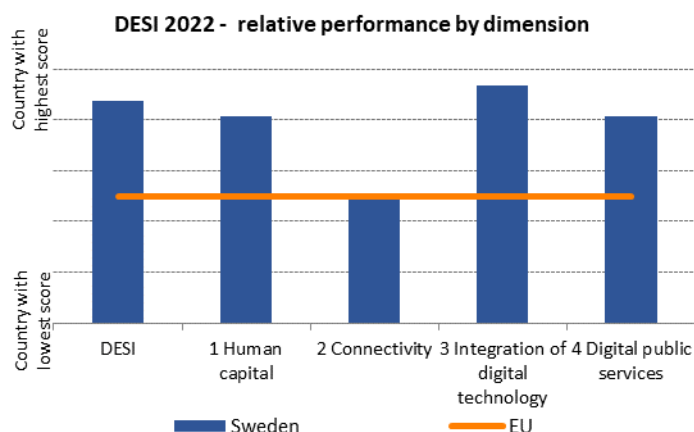
³¹⁹ Refer to section 1.3 of the DESI 2022 horizontal chapter.

Sweden has lately made less progress on connectivity but continues to rank above EU average (9th). Broadband is continually being rolled out, particularly focusing on remote areas. The 5G auction completed in early 2021 was positively received by market actors, who have been awarded a significant share of the available spectrum. This helps Sweden aim for 1Gbps connections throughout the country, although it may have to rely on mobile technologies to reach the target. The auction also paves the way for the country to reach 100% 5G coverage of populated areas by 2030, as set as a target in the Digital Decade. With 83% of households having access to fixed very high-capacity networks, it is also likely that the country will reach the Digital Decade target of all households being covered by a gigabit network by 2030.

Digital technologies, both existing and emerging, are increasingly being used by Swedish enterprises. Sweden ranks 3rd among the EU countries in this field. Sweden adopts new and advanced technologies at a rapid pace, led by significant joint work between academia and the business sector; this can be seen in areas such as Artificial Intelligence (AI), cloud, high performance and quantum computing. Sweden also aims to become a world-class electronics industry country, in electronic components and systems by 2025. Although Sweden is ahead of many European countries in some indicators on the integration of digital technology, it is important that the country encourages more enterprises to use big data and AI to reach the Digital Decade targets of 75% uptake by 2030.

Sweden ranks 9th in the field of digital public services. People in Sweden are highly digitally mature, as are companies and the public sector, and the Digital Decade targets of for example 100% online key public services by 2030 are well within reach. Further work has been done to increase the level of digitalisation and the use of advanced technologies, such as artificial intelligence, and open data by both public and private organisations. This work has shown that there is potential for further improvement, especially in areas such as data exchange and re-use. Use of open data has been identified as a key enabler for innovating in public sector services. Sweden expects to notify the Commission in 2002 that it complies with eIDAS for electronic identification.

The [Swedish Digitisation strategy](#) adopted in 2017 guides the country's work on meeting its digital goals. The original strategy is complemented by other strategies, such the [National Approach to AI](#) (2019) and the [Data Strategy](#) (2021). EU targets for 1Gbps connectivity are being closely monitored in the broadband rollout projects that are planned or in place. Even though the strategy is now more than 4 years old, it aims, together with the complementing strategies, to make Sweden the world leader in unlocking the potential that the digital transformation offers, while creating a digitally advanced public sector that provides legal certainty, availability and which contributes to the development of effective Swedish and EU policies.



Sweden has had a continuous security perspective regarding the digital sphere for a long time. Following Russia's invasion of Ukraine, this has intensified and several actions regarding cyber security have been taken. The Swedish Civil Contingencies Agency has been tasked with, together with the Swedish Police Authority, to carry out an information campaign aimed at the public as well as businesses about cyber and information security and how to protect oneself and/or one's business. Further, The Swedish Civil Contingencies Agency has been given funds to be able to strengthen the national CSIRT, CERT-SE. The funds will enable CERT-SE to provide increased support to users as well as strengthen national resilience against cyberattacks and other it-incidents.

Since 1 January 2022, Sweden has an agency for psychological defence, the Swedish Psychological Defence Agency. The agency is focused on fighting threats of disinformation and foreign interference. Following Russia's invasion of Ukraine, the Swedish Psychological Defence Agency has received additional funding for carrying out an information campaign.

Digital in Sweden's Recovery and Resilience Plan (RRP)

The Swedish RRP includes a set of mutually reinforcing reforms and investments to support economic recovery and growth, and improve social, economic and institutional resilience. The plan has a total allocation of EUR 3.3 billion in grants (representing 0.7% of GDP) and focuses on addressing challenges in relation to the green and digital transitions and human capital. The digital contribution is EUR 673.6 million³²⁰ which is 20.5% of the total contribution. The measures in the digital domain of the RRP are consistent with Sweden's Digital Strategy, launched by the Government in 2017, that sets objectives in the area of digital skills, digital security, digital innovation, digital infrastructure and digital leadership. Measures in the plan correspond to each of these dimensions. The overall goal is for Sweden to be world leader in

³²⁰ Each recovery and resilience plan has to dedicate at least 20% of the plan's total allocation to digital objectives. To this end, the plans had to specify and justify to what extent each measure contributes fully (100%), partly (40%) or has no impact (0%) on digital objectives, using Annex VII of the RRF Regulation. Combining the coefficients with the cost estimates of each measure allows assessing to what degree the plan contributes to digital objectives and whether it meets the 20% target.

the digital transformation.

Progress is being made on the digital transition through significant investments expanding broadband connectivity, especially in less populated areas, which will also help support territorial cohesion. The plan envisages at least 18 400 new buildings being connected to broadband in 2022. The RRP will continue to promote broadband expansion by connecting more households in 2023-2025. Moreover, it also makes provision for the deployment of e-government solutions to be accelerated, by allocating substantial funds for the development of a joint digital infrastructure for public administration. The plan also includes investments in vocational and higher education, with a particular focus on digital skills to meet the labour market needs of the future.

1 Human capital

1 Human capital	Sweden		EU
	rank	score	score
DESI 2022	4	62.0	45.7

	Sweden		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
1a1 At least basic digital skills % individuals	NA	NA	67% 2021	54% 2021
1a2 Above basic digital skills % individuals	NA	NA	36% 2021	26% 2021
1a3 At least basic digital content creation skills³²¹ % individuals	NA	NA	77% 2021	66% 2021
1b1 ICT specialists % individuals in employment aged 15-74	7.0% 2019	7.5% 2020	8.0% 2021	4.5% 2021
1b2 Female ICT specialists % ICT specialists	21% 2019	21% 2020	22% 2021	19% 2021
1b3 Enterprises providing ICT training % enterprises	32% 2019	32% 2020	32% 2020	20% 2020
1b4 ICT graduates % graduates	4.3% 2018	4.3% 2019	4.7% 2020	3.9% 2020

Sweden ranks 4th out of the 27 EU Member States when it comes to human capital. It scores significantly above the EU average on the proportion of the population with at least basic and above basic digital skills. The proportion of ICT specialists is one of the highest in the EU, at 7.5%. 21% of these are female. The proportion of ICT graduates is also above the EU average. Nonetheless, 55.1% of companies seeking to recruit ICT specialists reported hard-to-fill vacancies in 2020 and whilst a third of Swedish enterprises provide ICT training to their staff, 12 percentage points higher than the EU average of 20%.

Sweden considers digital skills a key component of basic and higher education, a tool to close the digital divide and a means to further improve the competitiveness of its businesses and to support its research institutions. Skills are central to all strategies that have been published from 2017 onwards, starting with the [Swedish Digitisation strategy](#) (2017), the [National Approach to AI](#) (2019) and the [Data Strategy](#) (2021). Sweden has also adopted a [National digitalisation strategy for the school system](#) (2017) followed by an [Action plan](#) (2019). Of the [18 initiatives proposed in the Action plan 13 are under way](#).

In June 2021, in an effort to bring digital skills to those who need them and bring them closer to the labour market, the Swedish Government [tasked](#) the Employment Agency, together with a number of

³²¹ Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

other agencies³²², with facilitating the development of platforms for lifelong learning. The agency has also been asked to streamline the way that data and information on education is made available, creating a management structure to ensure lifelong learning and skills supply.

Looking at digital aspects of daily life, the annual national digitally themed day '[Digitalidag](#)' ('Digitaltoday') brings together public and private stakeholders across the societal spectrum to inspire people to be part of digital development. In 2021, 250 stakeholders (up from 210 in 2020) organised 1 315 activities (up from 285 in 2020) in 210 locations across the country (up from 110 in 2020). Participation in EU Code Week fell from 11 000 participants in 2020 to 1 667 participants in 2021. 86% of activities took place in schools, where 46% of participants were girls.

In October 2021, a [report](#) published by the [Swedish Agency for Economic and Regional Growth](#), which focuses on how to increase equality within the digital sector, concludes that there are three main intervention areas that are relevant to equality: increase the inflow of people to the digital sector, strengthen the attractiveness of staying in the sector and facilitate returning to the sector.

During 2021, several measures have been put in place to strengthen the digital maturity of SMEs. There have been specific measures focused on SMEs in rural areas to increase digital maturity, coordinated by the [Swedish Agency for Economic and regional Growth](#). Over [5 000 digital courses](#) are and have been offered focusing on employees in, targeting employees of SMEs.

Sweden emphasises the importance of digital skills for a functioning labour market through a variety of strategies and actions. People in Sweden already have a good level of digital skills. To meet future challenges, Sweden launched several initiatives in 2021 to further raise this level, both for those with basic skills and for those with above basic skills. The proportion of ICT specialists in employment also needs to be increased to avoid delaying the digital transformation of businesses.

Highlight – Digital excellence

The [Sweden's innovation agency](#) and the [Swedish Higher Education Authority](#) was tasked by the government to analyse and propose measures that will develop the supply of digital cutting-edge expertise in 2019. The work is done in collaboration with stakeholders from universities, industry, public administration and social partners.

The initiative – [Digital Skills Sweden](#) – has produced several [reports](#). They, for example, [analyse the estimated shortage](#) of 70 000 skilled ICT workers by 2024; look at how to [define digital excellence](#); [analyse job ads](#), provide [future scenarios](#) on how the availability of digital excellence may look depending on different policy decisions and how trends develop. The initiative has also made a preliminary [proposal of how to promote the supply of digital excellence skills](#). The proposals range from boosting education and research; improved cooperation by creating a specialised Council and to improve the availability of statistics and forecasts. The final report will

³²² The [Swedish National Agency for Education](#), the [Swedish National Agency for Higher Vocational Education](#), the [Swedish Research Council](#), the [Swedish Council for Higher Education](#), [Statistics Sweden](#), the [Swedish Agency for Digital Government](#) and [Sweden's Innovation Agency](#).

be published on 31 October 2022.

Human capital in Sweden's Recovery and Resilience Plan

RRF funding will be used to foster digital skills and address labour shortages in specific professions. Sweden plans to use the RRF to finance more study places in higher vocational training with a special focus on fields of data/IT or other areas that contribute to the digital transition. In addition, Sweden aims to use RRF funds to scale-up the education at universities and other higher education institutions that increase digital skills.

2 Connectivity

2 Connectivity	Sweden		EU
	rank	score	score
DESI 2022	9	60.3	59.9

	Sweden		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
2a1 Overall fixed broadband take-up	86%	84%	82%	78%
% households	2019	2020	2021	2021
2a2 At least 100 Mbps fixed broadband take-up	66%	67%	71%	41%
% households	2019	2020	2021	2021
2a3 At least 1 Gbps take-up	2.84%	3.63%	4.44%	7.58%
% households	2019	2020	2021	2021
2b1 Fast broadband (NGA) coverage	85%	87%	86%	90%
% households	2019	2020	2021	2021
2b2 Fixed Very High Capacity Network (VHCN) coverage	77%	81%	83%	70%
% households	2019	2020	2021	2021
2b3 Fibre to the Premises (FTTP) coverage	77%	80%	82%	50%
% households	2019	2020	2021	2021
2c1 5G spectrum	22%	49%	81%	56%
Assigned spectrum as a % of total harmonised 5G spectrum	04/2020	09/2021	04/2022	04/2022
2c2 5G coverage³²³	NA	14%	18%	66%
% populated areas		2020	2021	2021
2c3 Mobile broadband take-up	90%	90%	95%	87%
% individuals	2018	2018	2021	2021
2d1 Broadband price index	65	69	76	73
Score (0-100)	2019	2020	2021	2021

During 2021, Sweden has fallen behind the EU average on several metrics, ranking 9th overall. On 1Gbps take-up, Sweden is at 4.44% compared to the EU average of 7.58%. In 5G coverage, according to July 2021 data, Sweden (at 18% of populated areas) now scores significantly lower than the EU average (66%). Next generation access coverage in Sweden has seen a small decline compared to 2020 and is at 87% in 2020 (85% in 2019) against the EU average at 87%. In terms of very high-capacity networks

³²³ The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

³²⁴ Judgment of 2 September 2021 adopted in Cases C-845/19, C-5/20 and C-34/20. ECTRA had previously assessed the relevant operator's practice and concluded that it was in compliance with Regulation (EU) 2015/2120 without prejudice to any new assessment that would be deemed necessary as a result of the adoption of the Judgments of the Court of Justice.

83% of households are covered (EU average 70%) continuing the steady increase over the last years (77% in 2020 and 81% in 2021). Fibre to the Premise (FTTP) has increased from 80.5% in 2020 to 82.5% in 2021 (from 48.1% to 54.3% in rural areas). 87% of rural households have access to a broadband connection. The overall take-up by households of fixed broadband has dropped by 2 percentage points and is now at 82%, remaining above the EU average of 77%. Pricing for broadband is slightly lower than the EU average, reflecting a decrease since last year.

The measures put forward in Sweden's [2016 broadband plan](#) regarding the area of broadband connectivity are in line with the national broadband strategy. The plan could, however, be updated to include targets for 5G coverage, especially to fill the gap in levels of connectivity between densely and sparsely populated areas. The plan aimed for all households and companies to have access to 100 Mbps broadband by 2020. The Swedish Government has also set goals for 2025: 98% of the population should have access to 1Gbps, 1.9% to 100 Mbps, and the remaining 0.1% access to at least 30 Mbps. The [Swedish Broadband Forum](#) was set up to solve problems related to the deployment of broadband. It is a key discussion forum, chaired by the Minister for Digital Development, which brings together stakeholders from public authorities and organisations, businesses, and operators.

While progress is being made on achieving 98% population coverage by 2025 for 1Gbps connections, the remaining 2 percentage points are considered costly to be covered by fibre technology (and thus 1Gbps speeds) since those households are in very remote and/or sparsely populated areas and costs are prohibitive, for both public and private sectors. An investment gap of EUR 1.6-2 billion to connect 99.9% of households via fibre infrastructure, and thus 1Gbps connectivity, has been identified. 5G, among others, has been identified as a key technology to achieve 100% broadband access, including in remote areas. However, the broadband strategy does not include detailed 5G connectivity targets, being technology neutral, and there are no immediate plans to revisit and update this. It does aim at achieving the 1 Gbps, 100 Mbps and 30 Mbps targets described above.

For areas where next generation access either does not exist or is not planned for the next 3 years, there is a state aid scheme in place to ensure connectivity with speeds of at least 1 Gbps. This scheme is administered by the Swedish Post and Telecom Authority ([PTS](#)) and, in 2022, it is expected to grant financial aid using national funds amounting to approximately EUR 130 million, in addition to the EUR 160 million for 2021. The Swedish RRP supports broadband expansion in Sweden with a total EUR 464 million, focusing on rolling out high speed broadband in sparsely populated areas. As in the previous year, public and private-sector organisations have neither applied for nor received financing from the European Investment Bank or from the European Fund for Strategic Investments.

The 5G spectrum auction, completed in early 2021 after long delays, has generated substantial commercial interest. In the 3.6 GHz band, 320 MHz of spectrum was awarded nationwide and 40 MHz for local licenses (an additional 40 MHz may be made available considering initial demand), while another 80 MHz was awarded in the 2.3 GHz band. Sweden has not yet assigned rights of use in the 26 GHz band and intends to launch a public consultation to assess the demand for spectrum in this frequency band again during 2022. In 2021, 850 MHz in the lower end of the 26 GHz band was made available for licences with geographical limitations and for indoor use only. Meanwhile, 2G and 3G networks continue to be deactivated, to be replaced by 4G and 5G solutions, and are expected to be completely shut down by 2025 when the current licences in the 900 MHz and paired 2 GHz bands lapse.

As of February 2022, Sweden has allowed the use of 66.7% (EU average 67.9%) of the 700 MHz band, 90% (EU average 75%) of the 3.4-3.8 GHz band, and 85% (EU average 29.1%) of the 26 GHz band (compared to the EU weighted average for 5G pioneer bands). Overall, Sweden has allowed the use of 81% of total harmonised 5G (pioneer) spectrum, against the EU average of 56%.

Continuing the trend observed over the last 10 years, mobile telephony continues to grow compared to fixed telephony. For businesses, overall the proportion of mobile telephony continues to outgrow that of fixed. This is also true for data, where mobile data traffic has increased by 36% compared to last year, compared to 26% the year prior. Private mobile subscriptions are a main driver; each subscriber uses (on average) 9.6 gigabytes of traffic monthly, increased from 7.7 gigabytes a year earlier. In general, it seems that consumers are adapting to using mobile networks for their voice and data needs, while the copper switch-off continues.

In line with consumers switching to 5G devices, there is a significant increase and take up of 5G subscriptions (both private and business), offered by all major operators, up from 220 000 in January 2021 to 469 000 in June 2021, which shows significant (113%) growth. This indicates that 5G services, among which high speed connectivity, will be taken up by consumers as the 5G infrastructure is continuously put in place.

The Swedish National Regulatory Authority noted a significant increase in demand for high speed connectivity in rural areas and secondary homes (country homes). In addition, during the COVID-19 pandemic a much higher than usual demand for high capacity home connections was noted due to teleworking, without the networks having any significant performance issues.

To maintain its frontrunner role and reach the 2030 Digital Decade targets, Sweden needs to address the areas where it has begun to score lower on coverage and take-up, such as 1Gbps take-up and 5G and next generation access coverage. Having almost completed the fibre rollout across the country, Sweden aims to provide 98% 1Gbit coverage by 2025. This is an ambitious goal, seemingly difficult to achieve since the current take-up is very low. There are still questions remaining on how the remaining 2 percentage points in remote and sparsely populated areas will be addressed. As the copper switch-off is underway and fibre rollout has been declining since 2016, Sweden is now focusing on mobile technologies, including 5G, to allow it to reach 100% high speed connectivity in the entire country. The national broadband plan could also be adjusted to take account of the EU 1Gbps targets and investments made accordingly.

Main market & regulatory developments

The only significant market development in 2021 was the buyout of Open Universe and Telenor's fibre assets by Global Connect Sweden. The acquisition impacts approx. 215 000 connected homes and was made at approx. EUR 300 million.

Even though there are around 200 ISPs on the fixed broadband market, the vast majority (80% of end consumers) are served by five companies: Telia, Telenor, Bahnhof, Tele2 (incl. ComHem, merged in 2020) and Bredband 2. The model whereby municipally owned wholesale only operators install the infrastructure and sell or rent capacity to operators is continued. Stokab (in Stockholm) and GothNet (in Gothenburg) are the two main companies. 90% of these

companies are owned by municipalities, the rest are privately owned or have a hybrid ownership model.

Sweden notified full transposition of the European Electronic Communication Code on 27 May 2022 by the new law on Electronic Communication which is in force since June³. The Commission had earlier addressed a Reasoned Opinion to Sweden on 23 September 2021, in accordance with the procedure set out in Article 258 TFEU. The Commission services are assessing the notified measures.

Sweden has not participated actively in work related to the Connectivity toolbox, as the country considers that most of the best practices identified in the toolbox have already been implemented and that most of the issues addressed by the toolbox have already been solved in Sweden. Moreover, and while appreciating that telecom markets are to a high degree harmonised in the EU, Sweden considers that differences in public administration between Member States should be taken into account, in particular the autonomy that Swedish public administration bodies have.

Zero rated services (typically social media and/or access to digital TV services) are offered by all four major operators to both private and business users. Telia with big private and business user bases, offers zero rate services without added constraints. Tele2 and Telenor offer add-on zero rated services to people who subscribe to their TV and streaming services. The compliance of the relevant offer with the regulatory framework might need to be assessed against the Case Law adopted by the Court of Justice of the EU on 2 September 2021.

The number of consumer complaints in particular relating to electromagnetic fields is decreasing. Similar complaints were addressed to the National Regulatory Authority when the rollout of both 3G and 4G networks took place. These complaints are handled by the Radiation Protection Institute. The number of overall complaints is stable, decreasing by 1% compared to 2020. The complaints are in the areas of 5G, copper switch-off, number issues (e.g. portability), service interruption and coverage.

Connectivity in Sweden's Recovery and Resilience Plan

Sweden will use the RRF to support the expansion of broadband connectivity with EUR 464.2 million under the RRF. This represents 14.1 % of Sweden's total allocation. The investments in digital infrastructure aim at addressing remaining connectivity gaps in view of an increasingly digital society. Sweden has already an overall well-developed broadband infrastructure but needs to accelerate broadband roll-out in sparsely populated areas. The purpose of the relevant RRF measure is therefore to invest in fixed high-speed broadband networks in areas where access would not be provided on commercial basis alone.

3 Integration of digital technology

3 Integration of digital technology	Sweden	EU
	rank	score
DESI 2022	3	56.2
		36.1

	DESI 2020	Sweden DESI 2021	DESI 2022	EU DESI 2022
3a1 SMEs with at least a basic level of digital intensity % SMEs	NA	NA	86% 2021	55% 2021
3b1 Electronic information sharing % enterprises	37% 2019	37% 2019	35% 2021	38% 2021
3b2 Social media % enterprises	40% 2019	40% 2019	48% 2021	29% 2021
3b3 Big data % enterprises	10% 2018	19% 2020	19% 2020	14% 2020
3b4 Cloud % enterprises	NA	NA	69% 2021	34% 2021
3b5 AI % enterprises	NA	NA	10% 2021	8% 2021
3b6 ICT for environmental sustainability % enterprises having medium/high intensity of green action through ICT	NA	73% 2021	73% 2021	66% 2021
3b7 e-Invoices % enterprises	36% 2018	45% 2020	45% 2020	32% 2020
3c1 SMEs selling online % SMEs	30% 2019	31% 2020	33% 2021	18% 2021
3c2 e-Commerce turnover % SME turnover	18% 2019	15% 2020	19% 2021	12% 2021
3c3 Selling online cross-border % SMEs	10% 2019	10% 2019	11% 2021	9% 2021

On integrating digital technology in business activities, Sweden ranks 3rd in the EU. Sweden has the highest proportions of SMEs with at least basic level of digital intensity (86%) and enterprises using cloud services (69%) in the EU. 19% of enterprises analyse big data and 10% of enterprises use AI technologies which brings Sweden above the EU average. Sweden is one of the leaders in the EU when it comes to SMEs selling online (33%) and total turnover from e-commerce (19%). However, only 11% sell online cross-border.

To support digitalisation on a regional level, Sweden has selected 15 digital innovation hubs that will be financed with approximately EUR 2.2 million. They will also be supported by the Swedish Agency for Economic and Regional Growth and may become part of the European network of Digital Innovation Hubs. Sweden pre-selected 15 European digital innovation hubs in 2021. Thereof four European digital

innovation hub proposals have a successful evaluation result³²⁵ and additional six European Digital Innovation Hub proposals have received a Seal of Excellence.

Sweden continues to participate in the European Blockchain Partnership and the European Blockchain Services Infrastructure. Sweden is developing an information management service based on blockchain technology for enterprises. Furthermore, in 2021 the Swedish Tax Agency was assigned to follow the Swedish hub of Gaia-X (the European cooperation project focused on data and cloud issues for the future European data economy, supporting Sweden's implementation and participation in the European Data Strategy, including legislation and high-impact projects e.g. common European data spaces). The future Gaia-X cloud marketplace is intended to create a more transparent market for buyers of cloud services, such as SMEs.

Sweden has increased its involvement in relation to high performance computing both at national level, allocating EUR 12 million per year to high performance computing research capacity, and at EU level, being an active partner in EuroHPC, an activity financed with EUR 3 million per year.

The Wallenberg Centre for Quantum Technology runs spans until 2029 and is coordinated by Chalmers Technical University. It includes many other Swedish universities and industry partners. Quantum sensing is coordinated by Lund University and quantum communication by the Royal Institute of Technology (KTH). The centre has a budget of EUR 140 million. It aims to create a high-end quantum computer and to develop and secure Swedish expertise in the main areas of quantum technology: quantum computing and simulation, quantum communications and quantum sensing.

To promote the development of advanced edge/AI, e.g. for climate and security applications of space data. The European Space Agency will open a series of break-through innovation labs in Europe called Φ-lab. The first one, [Φ-lab@Sweden](#), will be focused on edge learning for AI. It will open at AI Sweden, in cooperation with the Swedish Space Agency.

AI is expected to have a clear impact on Swedish society. The national approach to AI (2018), aims to make Sweden a leader in seizing the opportunities that AI can offer to strengthen Sweden's welfare and competitiveness. [AI Sweden](#), the national centre for applied artificial intelligence, is leading several initiatives, such as the development of large-scale language models for the Swedish language and supporting 100 SMEs in making better use of the potential of AI-driven businesses and services. The significance of research in AI is evident from the research bill for 2021-2024 in which AI is one of the focus areas. Positioned to directly finance higher education and research institutions, it has a budget of at EUR 320 million for 2022, EUR 330 million for 2023 and EUR 370 million for 2024. In addition to AI, the budget bill also emphasises the importance of more research into cyber security and how to better apply digital technologies.

Strongly linked to AI and digital innovation, [the 2021 data strategy](#), sees data as an underused resource in Sweden and emphasises the untapped potential in using an ever increasing amount of data in a central, rather than supporting role for both the private and public sectors. It is structured around six goals: 1. increased access to data; 2. open and controlled data sharing; 3. cooperation and culture; 4.

³²⁵ I.e. are invited for grant agreement preparation (which is not a formal commitment for funding).

steering, regulating and monitoring; 5. research, development and competence; and 6. EU and international cooperation.

The 'smarter electronics systems' innovation programme brings together academia, industry and the public sector in an effort to build on the successes of the country's electronics components and systems industry (3 600 companies employing 50 000 people). By 2025, it aims to become a world-class industry, including in semiconductor components. Power electronics, sensors and smart systems are areas where a leap forward could help put Sweden on the path to the Digital Decade.

Sweden is traditionally early in adopting and developing new technologies. The trend from previous years of using private-public partnerships to make the research, development, and transfer of knowledge as fast and efficient as possible is present across all interventions at national level, in all areas of digital technology.

4 Digital public services

4 Digital public services ³²⁶	Sweden	EU
	rank	score
DESI 2022	9	82.4
		67.3

	DESI 2020	Sweden DESI 2021	DESI 2022	EU DESI 2022
4a1 e-Government users	88%	88%	93%	65%
% internet users	2019	2020	2021	2021
4a2 Pre-filled forms	NA	NA	85	64
Score (0 to 100)			2021	2021
4a3 Digital public services for citizens	NA	NA	85	75
Score (0 to 100)			2021	2021
4a4 Digital public services for businesses	NA	NA	88	82
Score (0 to 100)			2021	2021
4a5 Open data	NA	NA	84%	81%
% maximum score			2021	2021

Sweden ranks 9th in the EU on digital public services. It has the highest proportion of e-Government users in the EU. This proportion increased 5 percentage points to 93% in 2021. Digital public services for both individuals and businesses rank higher than the EU average. Sweden scores 85 out of 100 when it comes to the amount of data that is pre-filled in public services online forms. On open data, Sweden performs just above the EU average (84% versus an EU average of 81%).

Digital services are central to the Swedish public administration and, as with education, there is a high degree of decentralisation. Public administration bodies are free to implement and offer services to both individuals and businesses, in line with the overarching goals set out in the [Swedish digitalisation strategy](#) and other strategies that have been published since. However, the decentralised model requires more coordination in some cases, in particular regarding data interoperability issues.

Digitalisation is seen as a key method of simplification, for example in, better regulation for businesses. The Swedish Agency for Public Management is tasked with developing a methodology and indicators for how this is measured and followed up on.

User-centricity is an important aspect of developing and launching services, but as authorities do this in a decentralised way, the Swedish Agency for Digital Government ([DIGG](#)), ensures consistency and provides direction. In June 2021, the Swedish Government tasked DIGG with coordinating a [project](#) to improve the conditions for public authorities and increase their use of artificial intelligence. The project also involved the Swedish Public Employment Service, the Swedish Companies Registration Office and the Swedish Tax Agency. The project has a EUR-0.5-million budget and will run until the end of 2022.

³²⁶ There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

The decentralised nature of the Swedish administration and the ambition to make the 'once only' principle central to the way it operates has led to a realisation that the need to provide a uniform way of accessing services may need stronger central coordination. To support the 'once only' principle and as national coordinators of the Single Digital Gateway Regulation, DIGG wants to implement a [national digital public sector infrastructure](#), for example to facilitate data exchange between public bodies and authorities. In the EU, DIGG works with the Greek 'once only principle' pilot partners.

As regards the digitalisation of justice, eleven government agencies are engaged in an extensive cooperation on data exchange, especially related to the flow of data within criminal proceedings.

Having already reached the target of 80% of the population aged over 16 using a digital means of identification, Sweden is now looking at extending this to those aged 13 or over. DIGG supervises the issuers of Swedish digital identification solutions, such as banks. Sweden participates actively in most of the eIDAS toolbox working groups on EU level. Swedes are offered three alternative eID schemes³²⁷ for facilitating their interactions with public organisations and business. All schemes offer the possibility to interact with public organisations via a smart device. In total, eight million citizens (or 77% of the citizens) use at least one of these three schemes. One scheme (i.e. BankID) is widely used and is issued by a private entity in collaboration with the government.

Another example of the need for centralised coordination is the fact that, while medical records can be accessed through the national healthcare hub [1177.se](#) (*Vårdguiden*), they do not necessarily always interoperate, depending on the healthcare provider. To address this, the Swedish eHealth Agency was [tasked](#) by the Swedish Government in April 2021 with suggesting improvements. The conclusions were published in a [report](#) in February 2022. They argue that critical data must be made available in a standardised format and recommend that this should be an obligation for all health-care providers and related actors in the future. The report also recommends that a new legal framework should be developed.

In summary, Sweden remains a top performer in digital public services. The decentralised model that it uses to implement its strategies has advantages and disadvantages, and the country is actively trying to address the latter. To progress on this, Sweden needs to ensure further coherence and interoperability where necessary and continue to implement and develop open data policies.

Digital public services in Sweden's Recovery and Resilience Plan

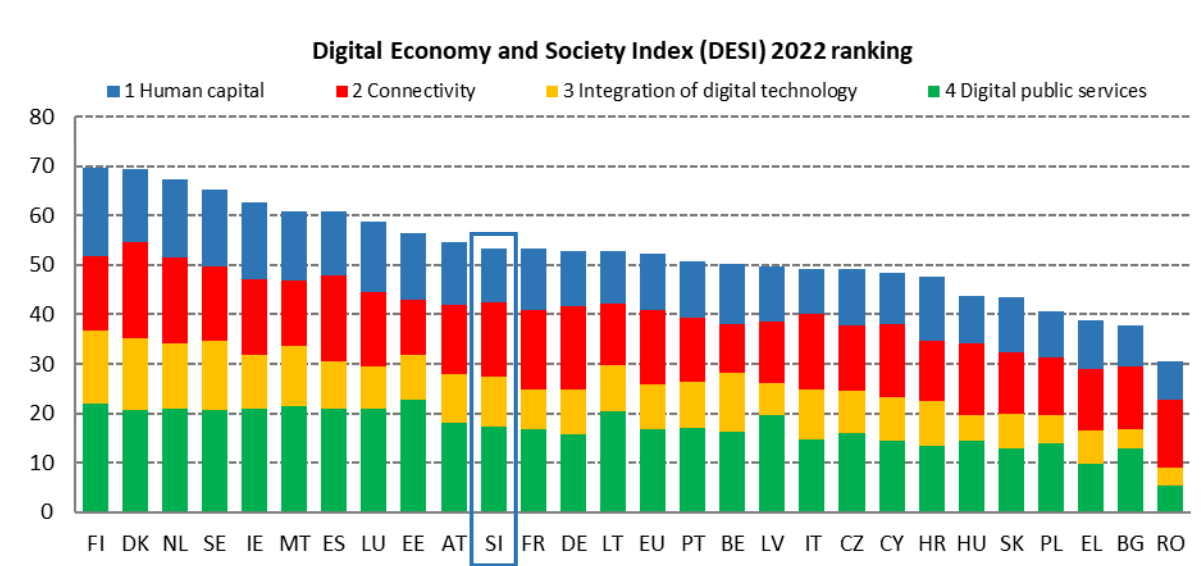
Sweden's RRP aims to support the digitalisation of the Swedish public administration with EUR 20.7 million. The objective is to achieve greater efficiency and security in handling public data, whilst offering citizens and businesses standardised solutions across the public administration. Sweden aims to develop a national framework for basic data, new and improved digital services, as well as elements for the exchange and handling of information and a common trust and security framework. This would lead to standardised solutions for citizens and businesses across the public administration.

³²⁷ BankID, Freja eID Plus and AB Svenska Pass

Sweden also plans to use funds from the RRP to foster synergies between tackling the green and digital transition. The RRP aims to support the use of digital technologies to increase energy efficiency of buildings. A public support scheme should incentivise property-owners to renovate multi-dwelling buildings and apply smart energy systems as part of the renovation effort.

Slovenia

	Slovenia		EU
	rank	score	score
DESI 2022	11	53.4	52.3



Slovenia ranks 11th among the 27 EU Member States in the 2022 edition of the DESI. The country's relative progress³²⁸ generally aligns with the EU average. The country has progressively made digital transformation a priority, investing in public policies that stress the importance of technology and digital literacy for a digitally enabled state and society. Harnessing the possibilities of new information technology requires workers with better digital skills which they can further develop throughout their working lives through reskilling and upskilling. Slovenia approaches the 45.7 EU average in Human capital with a score of 44.3. It falls behind the EU average of 54% and 26% on at least basic digital skills and above basic digital skills (50% and 20% respectively), but levels up with it for the proportion of people with at least basic digital content creation skills. The share of enterprises providing ICT training remains at 26%, exceeding the EU average.

Slovenia's performance in digital connectivity is mixed. Very High-Capacity Network coverage surpasses the EU average, but Slovenia lags behind on 5G deployment. The country scores at the EU average for SMEs with basic digital intensity and scores above it for cloud services and artificial intelligence (AI). It has a solid score on integrating digital technology matching the EU average for small and medium-sized enterprises (SMEs) with basic digital intensity and exceeding it for cloud services and Artificial

³²⁸ Refer to section 1.3 of the DESI 2022 horizontal chapter.

Intelligence (AI). It falls short on its use of big data. In Digital public services, Slovenia shows a good penetration level, scoring below the EU average for digital public services aimed at individuals, and surpassing it for services aimed at businesses.

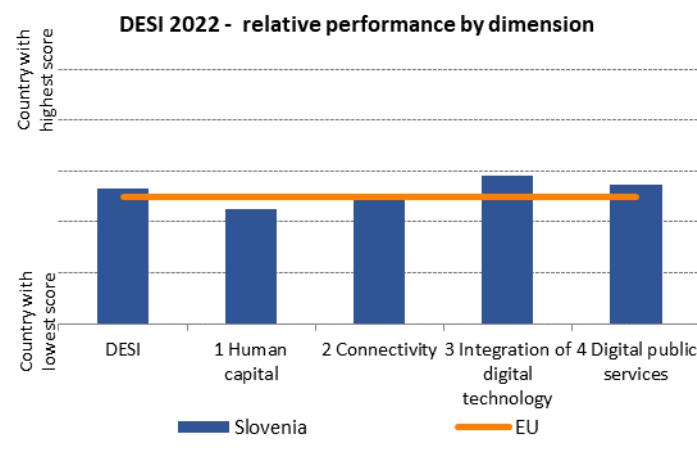
One of the ways to support the digital transformation is to increase the government's own use of digital technologies and expand electronic interaction with the private sector, promoting the adoption of digital technologies in the private sector.

Slovenia has adopted pivotal concepts such as 'digital by default' and the 'once-only' principle as well as key enablers to improve access to and interoperability of government services using digital identity and data rights for individuals. There is also recognition of the need to invest in the country's underlying digital infrastructure, digital skills and the digital capacity of businesses. Although these comprehensive policies show awareness of the country's needs, more is needed to drive the digital transformation across the whole public sector.

Slovenia has progressively prioritised the digital transformation of its economy and public sector as reflected in its legislative and regulatory framework and Recovery and Resilience Plan (RRP). The forthcoming Digital Slovenia 2030 strategy will set the overarching framework for digital transformation, integrating all sectoral strategies. It has four pillars: (i) competences and the digital inclusion ecosystem; (ii) secure and sustainable digital infrastructures, (iii) digital technologies and the digital transformation of businesses; (iv) the digitalisation of public services. The January 2022 strategy on digital transformation of the economy 2021- 2030 is one of the reform measures under Slovenia's RRP, aligned with the EU 2030 digital ambitions.

Slovenia recognises the importance of ensuring inclusive digital skills development to realise lasting economic and social benefits from an inclusive digital society. Identifying essential digital skills and training would help the digital workforce to focus on the evolving needs in job profiles and descriptions. This focus could also promote the Slovenian public sector as an attractive employer, particularly for younger people.

Thanks to its strong data governance, acknowledging the power of data would help Slovenia further unlock public value. This would stimulate data-driven approaches to policymaking and service delivery, strengthening public trust.



The national competent authority for information and cyber security is closely monitoring the situation in Ukraine following Russia's invasion. The Cybersecurity Coordination Group follows the National Cyber Incident Response Plan. The group consists of representatives of the national competent authority, national and government CSIRTs and SOCs of state administration authorities. Additional security information and recommendations to ensure a high level of security of networks and information systems were provided to the state administration and essential services providers bound by the Information Security Act. Recommendations were also sent to managers of critical infrastructure and defence planners. International cooperation has been strengthened with EU, NATO, CISA.

Following the adoption of the restrictive measures³²⁹ in view of Russia's operation in Ukraine, all operators stopped diffusing Russia Today and Sputnik. Slovenian operators voluntarily offered free SIM cards to Ukrainian refugees, free Wi-Fi in refugee centres, free calls to Ukraine and SMS donations in support of refugees from Ukraine. The National Regulatory Authority (AKOS) is working with operators and the government information security office, recommending that they review their response plan for different cyber incident scenarios; check software, backups and updates; ensure that websites are free from vulnerabilities; and monitor threat intelligence about global incidents and vulnerabilities in cyberspace, etc.

Digital in Slovenia's Recovery and Resilience Plan (RRP)

Slovenia's RRP emphasizes four investment and reform clusters: green transition; digital transformation; smart, sustainable and inclusive growth; and health and welfare. The components with the largest budget allocations are the digital transformation of public services and administration (EUR 260 million), healthcare (EUR 83 million), competence development and modernising the education system (EUR 72.4 million)³³⁰.

The [Decree on the determination of means of electronic identification and the use of a central service for online registration and electronic signature regulating e-identification](#) was adopted at the beginning of 2022. A new e-Identity card was launched in March 2022 under that legislation. Slovenia has launched a call for expression of interest in a new generation cloud project, as part of work on creating operational cloud infrastructure. The adoption of a Broadband Plan 2021-2025 is also planned in 2022 in Slovenia's transition to Gigabit Society.

In the context of removing legal and administrative obstacles to the provision of e-services, the government adopted amendments to the General administrative procedure act and the Decree on administrative commerce in 2021. The award of contracts for projects for the digital transformation of enterprises is planned for 2022.

³²⁹ Council Regulation EU 2022/350 of 1 March 2022 amending Regulation 833/2014

³³⁰ Each recovery and resilience plan has to dedicate at least 20% of the plan's total allocation to digital objectives. To this end, the plans had to specify and justify to what extent each measure contributes fully (100%), partly (40%) or has no impact (0%) on digital objectives, using Annex VII of the RRF Regulation. Combining the coefficients with the cost estimates of each measure allows assessing to what degree the plan contributes to digital objectives and whether it meets the 20% target.



1 Human capital

1 Human capital	Slovenia		EU
	rank	score	score
DESI 2022	17	44.3	45.7

	DESI 2020	Slovenia DESI 2021	DESI 2022	EU DESI 2022
1a1 At least basic digital skills % individuals	NA	NA	50% 2021	54% 2021
1a2 Above basic digital skills % individuals	NA	NA	20% 2021	26% 2021
1a3 At least basic digital content creation skills³³¹ % individuals	NA	NA	66% 2021	66% 2021
1b1 ICT specialists % individuals in employment aged 15-74	3.9% 2019	4.4% 2020	4.8% 2021	4.5% 2021
1b2 Female ICT specialists % ICT specialists	20% 2019	17% 2020	17% 2021	19% 2021
1b3 Enterprises providing ICT training % enterprises	28% 2019	26% 2020	26% 2020	20% 2020
1b4 ICT graduates % graduates	3.5% 2018	4.1% 2019	4.1% 2020	3.9% 2020

Slovenia ranks 17th among the 27 EU countries in the Human capital dimension. At least basic and above basic digital skills stand at 50% and 20% respectively, lagging behind the EU average of 54% and 26%. The share of people with at least basic digital content creation skills in Slovenia is at par with the EU average of 66%. The proportion of ICT specialists in employment has increased slightly. The share of female ICT specialists remains the same as last year's at 17%, below the EU average of 19%. Enterprises providing ICT training stand at 26% well above the EU average of 20%. The level of ICT graduates - the same as last year's - slightly surpasses the EU average.

Competences and digital inclusion constitute one of the pillars of the forthcoming Digital Slovenia 2030 strategy. Slovenia has begun a national curriculum reform, covering pre-school children, pupils, high school and university students, teachers and vocational college lecturers, working and inactive adults, retired people and people with disabilities.

The Act for promotion of digital inclusion was adopted in February 2022. Its goals are: (i) promoting the benefits of digital tools; (ii) improving technical knowledge and understanding of digital technologies and their responsible and safe use; (iii) raising the digital competences of the public and bridging the digital gender gap; (iv) increasing the number of employees with digital competences and digital entrepreneurship. The act envisages a bi-annual analysis of the country's digital inclusion levels. The

³³¹ Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

2022-2023 budget is EUR 59.5 million of national funds, including EUR 150 digital vouchers for individuals to purchase computers.

The Slovenian digital education action plan (DEAP) covering formal education up to university level is being adopted.

The Adult and Lifelong Learning Unit at the Ministry of Education, Science and Sport oversees the upskilling of adults including developing digital competences. Measures for building basic digital skills especially for SMEs' employees include vouchers for digital competences at a cost of EUR 3.9 million and an [on-line knowledge database](#) for webinars, conferences and expert articles to upgrade digital competences.

The vocational training ICT programmes are being adjusted to upskill 70% of teachers with digital competences until 2025. The allocated budget is EUR 15 million for teacher upskilling and EUR 15 million for a computational thinking project and ICT at different levels of education.

In higher education, Slovenia's RRP contains an investment that aims to digitalise the pedagogical process and the institutional management at all education levels, provide information and communication infrastructure, and offer e-services for developing digital competences.

The Ministry of Labour, Family, Social Affairs and Equal Opportunities (MoLFSA) is responsible for the implementation of ten competence centres (KOC) that cater for human resources development in various economic sectors. Each is led by a flagship company. Together with other companies from the same industry, they identify the competences for the profiles needed in their field. Digital skills receive special attention, given the growing automation and robotisation of production and business processes. KOC involves 327 companies and over 11 000 enrolments in trainings every year.

Two non-formal education and training projects include among others, digital skills training of long-term unemployed people aged 50+ and unemployed people without education, and people younger than 30 years to improve their employment opportunities.

MoLFSA together with Slovenia's Public Scholarship, Development, Disability and Maintenance Fund has established measures to upskill employees, especially those expected to participate less in learning due to their age. The project for comprehensive support of the active aging workforce helps companies in managing their aging employees. Over 900 companies and some 16 900 employees have been involved during the implementation of the project. Employees mostly engage in training in digital skills (use of digital tools and programmes, digital communication, etc.), foreign languages and soft skills (business communication, negotiation skills, etc.).

In 2022 MoLFSA and the Public Scholarship, Development, Disability and Maintenance Fund will start the project for non-formal education and training of employees. That follows up on the Commission's recommendations to raise adults' digital skills and strengthen employability, resilience, and participation in the labour market by integration into lifelong learning.

Regarding ICT specialists, the target in the strategy for digital transformation of the economy adopted in January 2022 is aligned with the 2030 Digital Compass – 10% of ICT specialists in Slovenia's work force (now 4.8%).

Slovenia has specific measures to upskill people working in SMEs. The Digital Innovation Hub Slovenia offers advice, mentoring and training for SMEs. The Slovene Enterprise Fund offers grants up to EUR 10 000 (digital vouchers) for improving digital skills in SMEs. The Chamber of Commerce and Industry offers trainings and workshops to improve digital skills in enterprises. The [Slovene digital coalition](#) has a dedicated working group for the improvement of digital skills and knowledge.

The new Promotion of Digital Inclusion Act sets out measures to co-finance projects that increase interest in ICT studies. The resolution to make computer science and informatics a compulsory subject in primary and secondary schools is planned for adoption in the first half of 2022. It will be followed by the upskilling of teachers and the preparation of their materials. The implementation of the course is expected to begin in September 2025, following a pilot phase of at least one year and its evaluation.

Slovenia registered 135 activities in Code Week 2021, most of which were school-based, with 3 823 participants.

The curricula reform initiated by the Ministry of Education, Science and Sport emphasises digital-related disciplines, which will deliver digital competences in primary and secondary schools. In parallel, digital learning outcomes for the VET ICT programmes, the large-scale digital upskilling of teachers and expanding the enrolment limits on all major ICT courses should help Slovenia move towards attaining the 2030 Digital Compass target of 20 million ICT specialists.

Slovenia can maximise its human capital potential by proactively raising awareness of the need for digital skills, bolstering lifelong learning incentives and increasing the digital competences of the workforce. Greater policy coherence could be achieved by aligning Slovenians' digital skills with emerging economic and social needs. Society's attitudes towards digital tools and competences could change in case the benefits are made tangible to more people and the barriers to entry are lowered.

2 Connectivity

2 Connectivity	Slovenia		EU
	rank	score	score
DESI 2022	10	59.9	59.9

	Slovenia		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
2a1 Overall fixed broadband take-up	83%	80%	77%	78%
% households	2019	2020	2021	2021
2a2 At least 100 Mbps fixed broadband take-up	21%	29%	36%	41%
% households	2019	2020	2021	2021
2a3 At least 1 Gbps take-up	<0.01%	0.02%	0.02%	7.58%
% households	2019	2020	2021	2021
2b1 Fast broadband (NGA) coverage	87%	88%	89%	90%
% households	2019	2020	2021	2021
2b2 Fixed Very High Capacity Network (VHCN) coverage	64%	66%	72%	70%
% households	2019	2020	2021	2021
2b3 Fibre to the Premises (FTTP) coverage	64%	66%	72%	50%
% households	2019	2020	2021	2021
2c1 5G spectrum	0%	98%	98%	56%
Assigned spectrum as a % of total harmonised 5G spectrum	04/2020	09/2021	04/2022	04/2022
2c2 5G coverage³³²	NA	0%	37%	66%
% populated areas		2020	2021	2021
2c3 Mobile broadband take-up	75%	75%	87%	87%
% individuals	2018	2018	2021	2021
2d1 Broadband price index	63	72	85	73
Score (0-100)	2019	2020	2021	2021

Slovenia ranks 10th in the EU for connectivity and at par with the EU average. The main improvement relates to the increased 5G coverage that went from 0% in 2020 to 37% in 2021. This extended coverage was due to the completion of the 5G multi band auction in April 2021, which also resulted in an increase of Slovenia's 5G spectrum from 0% in 2020 to 98% in 2021. Frequencies in all the pioneer bands have now been assigned. All operators are expected to migrate their 4G core to 5G core by the end of 2025, when requirements for coverage obligations expire. At that time operators will have to provide commercial 5G services in all major cities. Three operators (Telekom Slovenije, A1 and Telemach) have won 100-140 MHz of contiguous spectrum in the public tender. In the auction tender specifications, the Slovenian National Regulatory Agency for telecommunications (AKOS) set up coverage obligations that

³³² The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

require these operators to also provide functionality and support for enhanced mobile broadband access and support for massive internet of things networks.

The overall fixed broadband take-up is in line with the EU average. However, this percentage has decreased from 80% of total households in 2020 to 77% in 2021. This downward trend has characterised the Slovenian market since 2018 and can be partially explained by the simultaneous increase of 13 percentage points in the mobile broadband take-up over the last four reporting periods. Despite recent improvements, fixed broadband take-up of at least 100 Mbps (megabits per second) remains lower than the EU average, while take-up of at least 1 Gbps (gigabit per second) is almost negligible. These low figures cannot find a justification in broadband prices, as the broadband price index has continuously grown in 2021 compared to the previous reporting period and is higher than the EU average for this indicator.

Investments in broadband infrastructure have been delayed due to the COVID-19 crisis which caused a delay in the revision of the Slovenian national broadband strategy (Gigabit infrastructure development plan 2030). Set up in 2016 and updated in 2018, the plan was meant to be revised in 2020 to align the country with the gigabit society targets. The Broadband Plan 2021-2025 is to be adopted in 2022, representing one of the milestones of Slovenia's Recovery and Resilience Plan (RRP). The new plan includes specific targets in line with the gigabit society ones for 2025: 5G coverage for urban areas and main terrestrial transport routes; gigabit connectivity for schools, transport hubs, public services providers and digitally intensive enterprises; and at least 100 Mbps upgradable to 1 Gbps coverage for all people in the country. It also includes the connectivity targets of the Digital Decade programme 2030 which Slovenia plans to meet by 2028 (gigabit connectivity for all households in rural and urban areas, for all enterprises, other socio-economic drivers and 100% 5G coverage of populated areas).

Slovenia's Fixed Very High-Capacity Network (VHCN) coverage has increased in 2021 (72%) and is higher than the EU average (70%). It still faces challenges in rural areas where the percentage of households covered with VHCN is 46%. This is due to the lack of market interest by private investors (take-up of available public funding by market operators was limited even in the 2014-20 European Regional Development Fund cycle). As a result, at the end of 2021 over 100 000 Slovenian households did not have VHCN coverage. Slovenia's RRP contains a measure to rollout VHCN in areas with a market failure ensuring high speed connections for education, academic and research institutions.

The Connecting Europe Broadband Fund (CEBF) supports RUNE Enia d.o.o. investment into an open-access fiber-to-the-home (FTTH) network for residential, business and public administration in rural areas. The project is expected to cover up to 240 000 households. Additional VHCN deployment will be funded through the European Regional Development Fund 2021-27. The authorities estimate that all households will be served by fixed broadband infrastructure in line with the Digital Decade targets mainly through optical fibre technology. Until fixed broadband infrastructure is deployed, other technological solutions such as satellite will be used temporarily to provide broadband connections for the approximately 10% of the households in remote and rural areas. Investors and operators have shown little interest to building broadband infrastructure in those areas, even with publicly co-financed projects.

The implementation of measures in the Slovenian connectivity toolbox roadmap is mainly linked to the adoption of ZEKom-2, the act that will transpose the European Electronic Communication Code into

national law. Measures related to the setting up of the single information point will require specific attention, due to the repartitioning of competency between three different competent authorities. Their coordination will be essential to ensure the coherent provision of information.

Concerning measures to stimulate demand, the Promotion of Digital Inclusion Act adopted in February 2022, includes initiatives that promote digitalisation and upskilling of people's digital competences.

Main market & regulatory developments

As of March 2022, Slovenia had notified only partial measures to transpose the European Electronic Communications Code³³³ into national law. The deadline for the transposition was 21 December 2020.

In 2021, AKOS issued final decisions on:

- Market 1 (2014/710/EU) 'Wholesale call termination on individual public telephone networks provided at a fixed location'. New decisions have been issued due to a new delegated regulation which sets new maximum voice termination rates on fixed networks at EU level in June 2021;
- Market 2 (2014/710/EU) 'Wholesale voice call termination on individual mobile networks'. New decisions have been issued due to a new delegated regulation which sets new maximum voice termination rates on mobile networks at EU level in June 2021.

In 2021 AKOS published its analysis of market 1 (2020/2245/EU) and market 3b (2014/710/EU) and notified the Commission.

Concerning end-users' complaints, most disputes in 2021 were linked to billing (unjustified invoice payment, incorrect invoice) and poor functioning or unavailability of service. The overall number of complaints (553, of which 511 related to electronic communications and 42 to postal services) is higher than in 2020, but still lower in comparison to the average of 720 complaints per year registered before. The decreasing trend should be attributed mainly to the improvements in the AKOS portal, including a service advising end-users on their rights, where to turn for solutions and how to file a formal dispute.

With the completion of the multiband spectrum auction, Slovenia has taken a significant step in implementing its strategy for managing radio spectrum. This implementation is necessary for the timely assignment of the 5G pioneer bands and 5G deployment, which is supported by the remarkable improvements in the mobile broadband coverage. However, Slovenia risks lagging behind in fixed broadband infrastructure particularly in relation to 1 Gigabit networks and in rural areas. This is partially due to the structural characteristics of the Slovenian market and the country's morphology. Therefore, it will be increasingly important to ensure the rapid transposition of the European Electronic Communications Code into national law and the systematic implementation of the recommendation in

³³³ Directive 2018/1972

the EU connectivity toolbox. This will make 5G deployment sustainable for operators and align the country with the 2025 gigabit society targets and the 2030 Digital Decade targets.

3 Integration of digital technology

3 Integration of digital technology	Slovenia	EU
	rank	score
DESI 2022	9	39.8
		36.1

	DESI 2020	Slovenia DESI 2021	DESI 2022	EU DESI 2022
3a1 SMEs with at least a basic level of digital intensity	NA	NA	55%	55%
% SMEs			2021	2021
3b1 Electronic information sharing	33%	33%	36%	38%
% enterprises	2019	2019	2021	2021
3b2 Social media	24%	24%	30%	29%
% enterprises	2019	2019	2021	2021
3b3 Big data	10%	7%	7%	14%
% enterprises	2018	2020	2020	2020
3b4 Cloud	NA	NA	38%	34%
% enterprises			2021	2021
3b5 AI	NA	NA	12%	8%
% enterprises			2021	2021
3b6 ICT for environmental sustainability	NA	74%	74%	66%
% enterprises having medium/high intensity of green action through ICT		2021	2021	2021
3b7 e-Invoices	62%	58%	58%	32%
% enterprises	2018	2020	2020	2020
3c1 SMEs selling online	17%	17%	19%	18%
% SMEs	2019	2020	2021	2021
3c2 e-Commerce turnover	11%	12%	14%	12%
% SME turnover	2019	2020	2021	2021
3c3 Selling online cross-border	12%	12%	13%	9%
% SMEs	2019	2019	2021	2021

Slovenia ranks 9th among EU countries on integrating digital technology in business activities. Slovenian SMEs with at least a basic level of digital intensity level up with the EU average of 55%. Enterprises perform well above the EU average in sending e-invoices and using ICT for environmental sustainability with an advantage of 26 and 8 percentage points respectively. Electronic information sharing has grown from 33% to 36%, but is still falling short of the EU average. The SMEs taking advantage of the opportunities of online commerce have increased by 2 percentage points, surpassing the EU average of 18%. The e-commerce turnover has risen to 14 %, exceeding the EU 12% average. The same trend is present for SMEs selling cross-border. The number of companies using social media is up 6 percentage points from 24%. The proportion of businesses using cloud services (38%) surpasses the EU average, while only 7% access big data services, lagging behind the 14% EU average.

Slovenia is accelerating the digitalisation of its current industries and looking ahead to laying the foundations for cutting-edge sectors, based on the internet of things, big data and artificial intelligence (AI), quantum, cloud and microelectronics. It has channelled investments in those industries through its

Recovery and Resilience Plan (RRP). This is important for reaching the Digital Decade target of 75% of enterprises using the cloud, AI and big data.

The [Strategy on digital transformation of the economy 2021- 2030](#) adopted in January 2022 is one of the reforms in Slovenia's RRP. It is in line with the Digital Decade. Additional resources will come from the European Cohesion policy, Horizon Europe and Invest EU. The strategy prioritises advanced technologies expected to drive economic growth and competitiveness such as artificial intelligence, internet of things, big data processing, blockchain, high-performance computing, quantum computing and 5G. This complements Slovenia's participation in European digital multi-country projects on Next Generation Cloud Infrastructure and Services (IPCEI-CIS), microprocessors and blockchain as cross-border interoperable infrastructure. It also aligns with the country's commitments to improve interoperability, use hybrid cloud to enable digital identity for companies, provide better access to data, cut red tape and raise the level of digital competences.

Slovenia participates in the multi-country project for semiconductors funded with EUR 2.5 million. The public invitation for project proposals was published in 2021. A specialised hub brings together stakeholders to collaborate with R&D organisations, manufacturers and end-users. Slovenia joined the multi-country project for cloud (IPCEI-CIS) in 2021 and participates in the integrated EU project. That is also part of Slovenia's RRP with a planned budget allocation of EUR 5 million.

Slovenia is an active member of the European Blockchain partnership. It took part in developing European blockchain services infrastructure (to the production phase) and the cross-border services use cases, of which SSI (self-sovereign identity use case) and diploma use cases are in the mature phase of development. Slovenia also participates in the early adopters' program. It has signed the EuroQCI Declaration and is engaged in deploying national quantum communication infrastructure for secure quantum key distribution financed from RRF, Digital Europe Programme and Connecting Europe Facility. It participates in Quantum FET flagship's Quantum community network and the ERA-NET QuantERA in the field of quantum technologies. Slovenia is exploring possibilities to enhance the VEGA EuroHPC supercomputer which it hosts.

In the same vein of developing its base for advanced technologies, Slovenia's [National AI programme](#) (NpAI, May 2021) aims to translate AI knowledge and experience into real-world trustworthy, ethical solutions for businesses and the public sector. It sets a framework for dynamic support for SMEs, coupled with support from the European Digital Innovation Hubs (DIH).³³⁴ NpAI supports young researchers doing their graduate studies in companies using AI, organises workshops for technical and development staff and raises awareness for decision-makers.

Slovenia set up the International AI [Research Centre](#) under UNESCO's auspices to support AI solutions making progress towards the UN Sustainable Development Goals. Its new International Institute for Applied AI aims to become a European reference centre for AI, integrate infrastructure into the EU

³³⁴ The selection of the digital innovation hubs (DIHs) that will participate in the network of European DIHs is ongoing. Two Slovenian EDIH proposals have a successful evaluation result, i.e. are invited for grant agreement preparation (which is not a formal commitment for funding). One additional proposal has received a Seal of Excellence.

network of AI centres, develop technological solutions, attract researchers and accelerate knowledge exchange. Calls for the digital transformation of the economy also include AI, e.g. calls for the DEMO pilot projects published in April 2022 worth EUR 30 million, focused on advanced digital technologies (including AI).

Slovenia has put in place several measures to incentivise the take-up of advanced digital solutions by enterprises. The Corporate Income Tax Act introduced tax relief for investments in the digital transition including cloud computing, AI and big data, as of January 2022. The RRP contains an investment for the digital transformation of industries and businesses, catering both to large enterprises and SMEs with a focus on advanced digital technologies. The Chamber of Commerce and Industry is leading on the initiative ai4si, supporting the implementation of big data and AI in enterprises.

Slovenia's RRP contains measures for the setting up of a hybrid cloud in the Ministry of Economic Development and Technology, adopting a strategy for the digital transformation of enterprises; acquisition of e-identity by at least 200 businesses, and interoperability between data management systems and strengthening cyber security.

The Slovene Enterprise Fund implements digital vouchers for up to EUR 10 000 to support over 4300 SMEs in preparing their digital strategy, digital marketing, improve digital skills and cyber security. The Fund provides grants of EUR 100 000 for the digital transformation of up to 480 SMEs (ERDF, ReactEU). The public agency SPIRIT Slovenia offers grants of up to EUR 30 000 to SMEs going international with the use of digital tools (ERDF). DIH Slovenia is building the country's digital ecosystem, promoting digitalisation among SMEs and offering them free services to improve their digital knowledge and skills.

Capturing the potential of the digital economy for Slovenian companies will depend on all its stakeholders including a coherent government strategy across economic sectors that embrace digital technology. This will mean taking advantage of solutions that enable growing sales through digital channels, including boosting export capabilities, improving operating efficiency by integrating automation, and digital streamlining.

4 Digital public services

4 Digital public services ³³⁵	Slovenia		EU
	rank	score	score
DESI 2022	13	69.5	67.3

	DESI 2020	Slovenia DESI 2021	DESI 2022	EU DESI 2022
4a1 e-Government users	63%	77%	77%	65%
% internet users	2019	2020	2021	2021
4a2 Pre-filled forms	NA	NA	68	64
Score (0 to 100)			2021	2021
4a3 Digital public services for citizens	NA	NA	69	75
Score (0 to 100)			2021	2021
4a4 Digital public services for businesses	NA	NA	84	82
Score (0 to 100)			2021	2021
4a5 Open data	NA	NA	92%	81%
% maximum score			2021	2021

Slovenia ranks 13th in the EU on Digital public services. The country performs well on the share of e-government users which is 77% of internet users, significantly exceeding the EU average of 65%. It excels on open data with 92%, considerably outperforming the EU average of 81%. Slovenia's score for digital public services for citizens is 69% compared to 75% at EU average. Interactions between businesses and the dedicated e-government services is 84%, exceeding the EU average by 2 percentage points. On the indicator for pre-filled forms, Slovenia's score of 68 surpasses the EU average of 64.

The digital transformation of the public sector and public administration is a priority in Slovenia's RRP. An accessible and accountable government that shares information and engages people in policy-development and service design, is one of the main components of the digital public services strategy being drawn up. This strategy focuses on strengthening the system against cyber threats.

The Government Information Security Office (GISO), the national competent authority in the field of information and cyber security, has been operational since July 2021. As of 2022 GISO will run activities for capacity building and raising awareness in the field of cyber security financed with national resources, RRF and Cohesion policy.

New legislation for e-identification and trust services was adopted in 2021. The Decree on electronic identification, use of a central service for online registration and electronic signature was adopted at the beginning of 2022. Under this legislation, a new e-Identity card was launched in March 2022. The funds

³³⁵ There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

available under Cohesion policy, CEF, RRF and Digital Europe Programme will finance most of these developments.

Slovenia is applying innovative digital technologies to improve its policymaking and management in the digital public services domain. One of the priority areas in the national AI programme (NpAI) focuses on the public administration.

The country adopted the [Accessibility of Websites and Mobile Applications Act](#) based on Directive 2016/2102. In line with this, the e-government portal [eUprava](#) integrates accessibility requirements at all stages of service development. Over 300 improvements were made to the user experience following last year's independent review, particularly for people with disabilities, which led to a certificate of compliance with Web Content Accessibility Guidelines. Common standards for national administration websites have been adopted for a better user experience and guidelines for e-services development with user-centric approaches are being promoted at design phase. [Partnerstvo za spremembe](#) is a platform for civil servants and the private sector to share good practice and solutions.

Slovenia is rolling out comprehensive measures to increase public sector efficiency regarding service delivery for individuals and businesses, and openings for engagement of the general public in policymaking. Objectives include improving the digital skills of public servants, increasing their accountability, improving the security of the information system, and introducing dynamic administrative processes with pre-filled forms, among others.

The Administration Academy rolls out digital skills courses for civil servants. The Ministry of Public Administration is running the [Inovativen.si](#) project, using innovative methods of policy and service design, co-development, testing of services and user experiences. Several digital tools enable public participation in policymaking and administrative decisions: the portals [E-Demokracija](#), [predlagam.vladi.si](#) and [STOP Bureaucracy portal](#).

The [Decree on information security in the state administration](#) sets minimum requirements, which include standardised information security management frameworks and supervision of information security in the civil service. Public authorities must comply with common technical guidelines, so that their information systems follow minimum common information security requirements and could be hosted on the [private government cloud infrastructure](#).

TRAY is Slovenia's central system for electronic data exchange. It enables reliable and secure data collection for different clients from numerous heterogeneous sources. Its architecture and connectivity make it a once-only principle platform playing an important role in implementing the Single Digital Gateway EU Regulation. A relevant example is the eSociala project that uses TRAY to collect user data from more than 50 public databases or other sources.

JEP is another tool that enables the creation of business process-driven procedures including smart, dynamic application forms with pre-filling capability. JEP is integrated in the principal e-services portals: for the general public ([eUprava](#)) and for legal entities ([SPOT](#)).

Slovenia's De-bureaucratisation Act of December 2021 complements the rules on communication between bodies deciding on rights, legal benefits and obligations in administrative matters. The use of

electronic documents and e-signature by the central administration and public authorities became mandatory as of 4 April 2022.

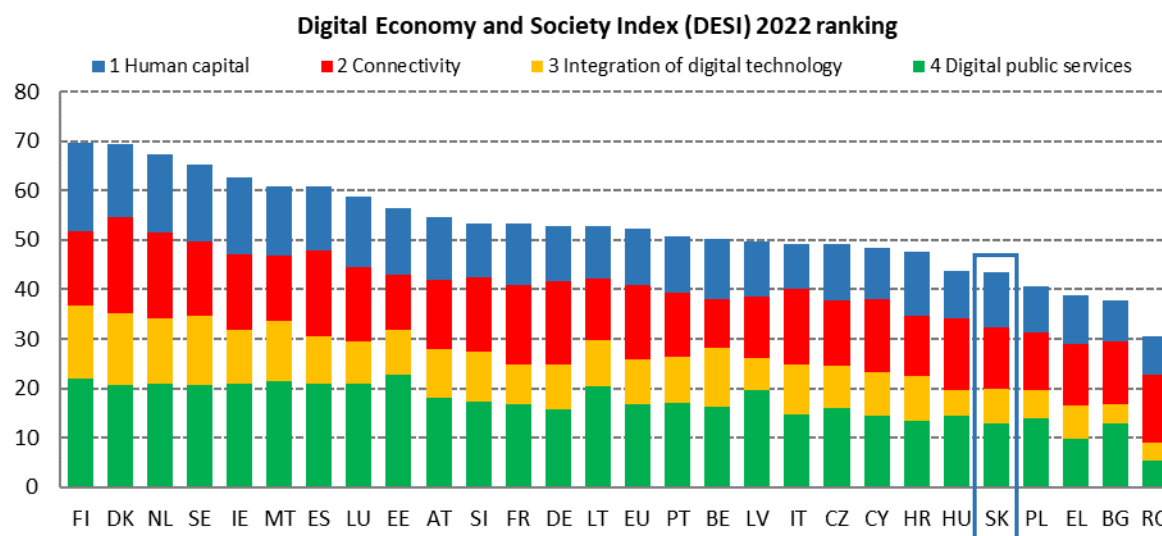
Slovenia has increasingly made digital government a policy priority, investing in technology and digital literacy for a digitally enabled state. It has embraced fundamental principles for the digital transformation - 'digital by default' and 'once only'. Slovenia has adopted key enablers to improve access and interoperability of government services, such as digital identity and individuals' data rights. It is essential to: (i) improve the user experience at all governance levels; (ii) simplify the legal and regulatory basis for accessing data; (iii) increase its transparency, giving individuals and businesses greater practical visibility of data usage, flows and associated consents; and (iv) develop digital skills within the public sector and the users of digital public services.

Highlight 2021-2022: zVEM - e-Health Mobile App

Slovenia has achieved its goal of creating online medical records in the central registry of patient data, accessible via the [zVEM portal](#) with individuals accounting for almost 20% of its registered users (415 000). The zVEM e-health mobile app launched in July 2021, offers users mobile access to the national patient portal. Over 750 000 users (35% of population) have installed the app.

Slovakia

	Slovakia		EU
	rank	score	score
DESI 2022	23	43.4	52.3



Slovakia ranks 23rd of 27 EU Member States in the 2022 edition of the Digital Economy and Society Index (DESI).

Slovakia is just below or around the EU average across the indicators for human capital. 55% of Slovaks have basic digital skills, which is slightly above the EU average of 54%. The proportion of ICT specialists in total employment is 4.2%, slightly below the EU average (4.3%). 16% of ICT specialists are women compared with the EU average of 19%. Slovakia's e-commerce scores have fallen: 13% of SMEs sell online compared with 17% in 2020. 16% of Slovak enterprises used e-invoices in 2020 compared with 32% in the EU. Slovakia is below the EU average across the indicators for digital public services. The proportion of e-government users among internet users has decreased to 62% and is below the EU average of 64%.

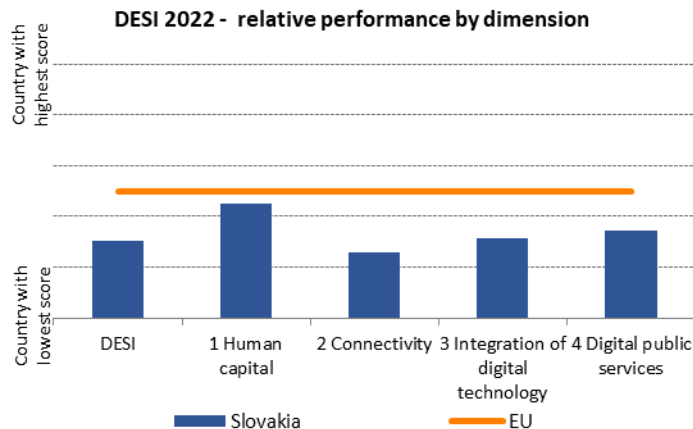
Although Slovakia has made some progress across the dimensions during the last year, most notably on the main coverage and take-up connectivity indicators, improvements have not been sufficient to keep pace with the EU average³³⁶. Digital skills across the population, from primary school students to adults, need to improve in order to successfully meet the challenges of digital transformation. Improving digital skills takes time and measures need to be implemented systematically. Several national strategies underline the need to educate and upskill people in Slovakia so they can work with and use digital technologies. The government is working on a dedicated digital skills strategy.

³³⁶ Refer to section 1.3 of the DESI 2022 horizontal chapter.

Investments that support the integration of digital technology in businesses are being implemented to improve their capacity to keep up with market developments and modernise the economy. However, the use of advanced digital technologies by enterprises remains below the EU average. Slovakia will provide support to businesses, particularly small and medium-sized enterprises (SMEs), for the uptake of cloud, big data and artificial intelligence (AI) technologies by means of building a network of European Digital Innovation Hubs (EDIHs) across the country. These centres will play a key role in increasing the digital intensity of enterprises and therefore they will help in the achievement of the related Digital Decade targets.

Slovakia needs to continue its efforts to improve and expand digital public services. Although progress has been made, the country remains below the EU average in this area. A new strategy document '[The National Concept of Informatization of the Public Administration for years 2021-2026](#)' was approved by the Slovak Government in December 2021. The strategy outlines a vision for more reliable and user friendly digital public services, including e-health, and it explicitly aligns with the 3 Digital Decade targets in this domain.

As set out in Slovakia's Recovery and Resilience Plan (RRP), the Ministry of Investment, Regional Development and Informatization of the Slovak Republic (MIRRI) will adopt a new strategic document, the 'Action Plan for the Digital Transformation of Slovakia for the years 2023-2026'. The action plan will present measures to improve Slovakia's digital performance, building on the 2030 digital transformation strategy for Slovakia as well as on the current [2019-2022 action plan](#). It is currently being prepared and should be finalised by the end of 2022.



Following the increase of threats in the cyberspace as a result of the war in Ukraine, the Slovak Government recently adopted the 'Action Plan for the Coordination of the Fight against Hybrid Threats' by the Ministry of Defence, including measures to fight against disinformation. When it comes to cyber security threat response, the CSIRT.SK team's (established within the MIRRI) participation in several international cyber exercises has been assessed very positively and successfully. The MIRRI is also preparing projects to increase the level of cyber security in the country, in particular those included in the RRP.

The Slovak government has created an online portal to act as a central hub for refugees from Ukraine. The Slovak government has also created an electronic form for temporary asylum registration. To access

the form, WiFi hot spots have been set up in all borders and large-capacity centers. In addition, free SIM cards with internet connection are available for every Ukrainian citizen. Finally, several job portals available in Ukrainian language have been created in cooperation with the private and public sector.

Digital in Slovakia's Recovery and Resilience Plan (RRP)

Digital transformation is one of the main components of the Slovak RRP. Measures in the plan contributing to the digital transition account for 21% (EUR 1.33 billion)³³⁷, exceeding the 20% target. Component 17 - 'Digital Slovakia (state in the mobile, cybersecurity, fast internet for everyone, digital economy)' clearly stands out as the main contributor to achieving the digital target, followed by digital investments in education, research & innovation, and sustainable transport.

The plan will support participation in several multi-country projects to enable the digital transition. This includes participation in a network of digital innovation hubs and EDIHs to support digitalisation of Slovak SMEs. It also includes investment in high performance computing (HPC) with the aim of participating in the EuroHPC joint undertaking. The Recovery and Resilience Facility will also support two other multi-country projects to be determined at a later stage. Other possible projects include participation in the European blockchain and quantum communication infrastructure.

A separate investment in Component 17 will support research and development as well as to apply of digital technologies and instruments in business and research institutions. In this regard, a scheme to provide financial support is being prepared by the MIRRI. The scheme is expected to be launched by the end of Q2 2022.

³³⁷ Each recovery and resilience plan has to dedicate at least 20% of the plan's total allocation to digital objectives. To this end, the plans had to specify and justify to what extent each measure contributes fully (100%), partly (40%) or has no impact (0%) on digital objectives, using Annex VII of the RRF Regulation. Combining the coefficients with the cost estimates of each measure allows assessing to what degree the plan contributes to digital objectives and whether it meets the 20% target.

1 Human capital

1 Human capital	Slovakia		EU
	rank	score	score
DESI 2022	19	44.1	45.7

	Slovakia		EU	
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
1a1 At least basic digital skills % individuals	NA	NA	55% 2021	54% 2021
1a2 Above basic digital skills % individuals	NA	NA	21% 2021	26% 2021
1a3 At least basic digital content creation skills³³⁸ % individuals	NA	NA	72% 2021	66% 2021
1b1 ICT specialists % individuals in employment aged 15-74	3.7% 2019	4.2% 2020	4.3% 2021	4.5% 2021
1b2 Female ICT specialists % ICT specialists	14% 2019	16% 2020	15% 2021	19% 2021
1b3 Enterprises providing ICT training % enterprises	18% 2019	16% 2020	16% 2020	20% 2020
1b4 ICT graduates % graduates	3.9% 2018	3.9% 2019	4.4% 2020	3.9% 2020

On human capital, Slovakia ranks 19th out of the 27 EU countries and is thus below the EU average. 55% of Slovaks have basic digital skills, which is slightly above the EU average of 54%. However, only a 21% of Slovaks have advanced digital skills, which is below the EU average of 26%. The proportion of enterprises that provide ICT training to their employees is 16% compared to the EU average of 20%. The proportion of ICT specialists in total employment is 4.3%, slightly below the EU average of 4.5%. 15% of ICT specialists are women compared with the EU average of 19%.

Several national strategic documents underline the need to increase digital competences of people in Slovakia. The [strategy and action plan to improve Slovakia's position in the DESI index by 2025](#) and the 2019-2022 [action plan for digital transformation of Slovakia](#) outline concrete measures to help the country make progress in the human capital dimension. The [programme of digitalisation of education for 2030](#) highlights the needs to foster digital competences of children, students and educators from pre-primary to tertiary education. However, some important actions such as the measures to attract more digital experts to Slovakia have been delayed. By the end of year 2022, the government is expected to prepare a new standalone digital skills strategy that should cover all population groups (young people, employees, job-seekers, older people, ICT professionals, etc.) and help Slovakia meet the Digital Decade target of 80% of people with at least basic digital skills by 2030.

³³⁸ Break in series for indicators 1a1, 1a2 and 1a3. Figures are not comparable with those in earlier DESI reports.

In 2021, the government adopted a new [lifelong learning strategy](#). It aims to make the Slovak education system more flexible, offering new opportunities for adults and continuous learning, as well as better address the needs of the job market. The strategy includes the introduction of microcredentials that should help the workforce expand or re-focus their qualification, in particular to adapt to the digital transformation. The strategy also outlines the plan to develop a new digital skills strategy focusing on learning opportunities for adults to ensure their continued inclusion in a society transformed by digitalisation. The Slovak education system needs to implement measures to ensure the Digital Decade target in basic digital skills is achieved. The curriculum reform and the measures for improving the performance of universities are still not completed.

Raising a new generation of digital experts already starts at primary and secondary school levels. The [Central School Inspectorate](#) recommended the Slovak government to increase the number of training opportunities being offered to teachers and educators to enable them to use digital technologies more effectively in the classroom. The project [IT Academy – education for 21st century](#), funded by the European Social Fund (ESF) is addressing this recommendation. It involves helping 353 primary and secondary schools undergo digital transformation. The project provides guidance to teachers, enables exchange of experience through the network of [school digital coordinators](#) and will increase the number of courses offered in information and communication technologies (ICT) disciplines. In May 2022, the Ministry of Education published the [programme of digitalisation of education for 2030](#) with [the first action plan for 2021-2024](#). The programme objectives and activities are built around five themes: i) digital infrastructure and equipment for education; ii) digital competences; iii) transformation of education through digital technologies; iv) development of electronic services and information systems in the Ministry of Education and schools; v) cybersecurity and information safety.

In 2021, more than 8 500 Slovaks participated in the EU Code Week, nearly twice as many as in 2020. The number of activities grew from 129 in 2020 to 170 in 2021.

Slovakia faces a major brain drain. According to the Institute for Public Affairs, [half of young, educated Slovaks are seriously considering relocating abroad](#) – in particular to Austria or the Czechia. This trend could significantly slow down digital transformation in Slovakia. Businesses and organisations would not be able to use advanced digital technologies if talented digital experts leave the country. The government plans to use reforms and investments under the RRP to help develop digital skills and expertise among companies through measures such as digital and innovation vouchers and digital innovation hubs initiatives connected with the EU digital innovation hubs network. Slovakia is home of a well-established and active national coalition for digital skills and jobs ([Digitálna Koalícia](#)). It groups relevant ministries, universities, associations, tech companies and the main initiatives that aim to increase people's digital competences. The Slovak National Coalition and Slovak IT Academy coordinate the project [IT Fitness test](#), a large testing scheme that helps people (especially students) evaluate their practical digital skills. In 2021, over 27 000 users participated in it. The participation more than doubled since 2020 but the average score dropped from 62% in 2020 to 40% in 2021 (also because of the massive increase of participants). The results show that students from more active schools that offer wider IT education opportunities score better in testing. Thanks to the Visegrad [Fund](#), in 2022, [the IT](#)

[Fitness test](#) will be extended under the name “IT Fitness test V4” to Poland, the Czechia, Hungary and will be available in English language as well.

Slovakia has in place several strategies that should help increase digital skills among the population, including the development of a new digital skills strategy. To bring about a structural change, the strategy has to be accompanied by a realistic implementation plan that needs to be strictly followed. The IT Academy and the IT Fitness test are good examples of successful initiatives in the area of human capital and they provide valuable information, resources and opportunities for young people and teachers to improve their digital skills. By expanding these and other similar initiatives beyond the education sector, Slovakia would further improve the digital skills of its entire population.

2 Connectivity

2 Connectivity	Slovakia		EU
	rank	score	score
DESI 2022	21	49.8	59.9

	Slovakia			EU
	DESI 2020	DESI 2021	DESI 2022	DESI 2022
2a1 Overall fixed broadband take-up	72%	78%	81%	78%
% households	2019	2020	2021	2021
2a2 At least 100 Mbps fixed broadband take-up	15%	25%	26%	41%
% households	2019	2020	2021	2021
2a3 At least 1 Gbps take-up	<0.01%	0.38%	0.96%	7.58%
% households	2019	2020	2021	2021
2b1 Fast broadband (NGA) coverage	74%	75%	84%	90%
% households	2019	2020	2021	2021
2b2 Fixed Very High Capacity Network (VHCN) coverage	45%	50%	67%	70%
% households	2019	2020	2021	2021
2b3 Fibre to the Premises (FTTP) coverage	44%	49%	62%	50%
% households	2019	2020	2021	2021
2c1 5G spectrum	33%	67%	67%	56%
Assigned spectrum as a % of total harmonised 5G spectrum	04/2020	09/2021	04/2022	04/2022
2c2 5G coverage³³⁹	NA	0%	14%	66%
% populated areas		2020	2021	2021
2c3 Mobile broadband take-up	75%	75%	86%	87%
% individuals	2018	2018	2021	2021
2d1 Broadband price index	60	78	81	73
Score (0-100)	2019	2020	2021	2021

Slovakia ranks 21st in the EU connectivity ranking. On fixed networks, in 2021, Slovakia observed a considerable increase in the percentage of households covered by fixed very high capacity networks, provided on Fibre-to-the-Premises (FTTP) and DOCSIS 3.1 infrastructures – 67% compared to 50% in 2020. The FTTP coverage in rural areas remains at a much lower level – only 21.6% of rural households were covered by this technology in 2021. However, this is still an upward trend compared with 2020, when 18% of rural households had access to this technology.

In terms of fixed broadband take-up, 81% of households subscribed to some kind of broadband connection in 2021, a small increase compared with 78% of households in 2020. This places Slovakia slightly above the EU average and may be the result of low broadband prices, which are less expensive than the EU average. 26% of households in Slovakia had access to at least 100 Mbps fixed broadband

³³⁹ The 5G coverage indicator does not measure users' experience, which may be affected by a variety of factors such as the type of device used, environmental conditions, number of concurrent users and network capacity. 5G coverage refers to the percentage of populated areas covered by at least one operator as reported by operators and national regulatory authorities.

connection in 2021, which is below the EU average of 40% for the same indicator. This means that, despite the relatively low prices, Slovak users prefer to opt for less speedy broadband. This is exemplified in particular by the 1 Gbps take-up, which stands at only 0.96% of households in the country.

The Slovak government adopted the new national broadband plan in March 2021, setting out Slovakia's connectivity vision and targets until 2030. The plan aims for all households, whether urban or rural, to have access to an internet connection of at least 100 Mbps, with the possibility of upgrading to gigabit speeds, as well as for major socio-economic drivers to have access to gigabit connectivity. The tender procedure for the feasibility study of the broadband plan has started – the purpose of the study will be to set out the details of broadband interventions in Slovakia.

The Slovak authorities plan to update their connectivity goals to bring them in line with the 2030 Digital Decade targets, once the latter are in place.

On public funding for infrastructure deployment, the Slovak government intends to finance the development of ultra-fast broadband in the 2021-2027 budget period through the Slovakia Programme.

The Connecting Europe Facility 2 is foreseen to cover 5G corridors. This would mainly involve building corridors between Member States (e.g. between Slovakia and Czechia) and possible 5G projects for smart communities.

The Slovak RRP does not include investments in connectivity.

For mobile networks, although 67% of the total harmonised 5G spectrum has been assigned in Slovakia, only 14% of populated areas are covered by 5G. This highlights the need to further develop public and private investments in 5G deployment in the country.

The Slovak national regulatory authority imposed obligations, as part of the 2020 5G auction, to ensure that at least 95% of the population of each regional capital of Slovakia are covered by a 5G network by the end of 2025 and that at least 90% of the population living outside the regional cities are covered by 5G by the end of 2027. To fulfil of these obligations, the mobile network operators in Slovakia are reporting an increase in coverage, gradually rolling out 5G networks in major cities (especially Bratislava and Banská Bystrica).

Slovakia already assigned frequencies in the 3.6 GHz band in 2016, with rights of use extending until the end of 2024. As frequencies were allocated in line with the principle of technological neutrality, mobile network operators (MNOs) who hold these rights are already entitled to use them to provide 5G services.

To allocate the rights to use of frequencies in the 3.6 GHz band as of 2025, the Slovak regulatory authority launched a selection procedure on 1 March 2022, which was successfully completed on 5 May 2022. The whole 3400 – 3800 MHz band was assigned in this auction, with the validity of the rights of use set to last until the end of 2045. The successful bidders are required to build an electronic communications network with two 5G access points in each district of Slovakia and with at least 300 5G access points throughout the entire Slovak territory by the end of 2028.

The 26 GHz band is currently used for both civil and military purposes – the existing rights in the band are expected to expire in 2025.

Market and regulatory developments

Slovakia has notified the full transposition of the measures transposing the European Electronic Communications Code to the European Commission. The Commission is currently analysing the completeness and conformity of the notification.

In 2021, the Slovak regulatory authority observed an increase in complaints concerning unsolicited communications. This was due to an information campaign run in the Slovak media by one of the mobile operators. Other relevant sources of end-user complaints included pricing and billing, availability and quality of service as well as contractual terms.

On 10 and 11 June 2021, respectively, the Commission registered two notifications from the Slovak regulatory authority concerning wholesale voice call termination on individual mobile networks and wholesale call termination on individual public telephone networks provided at a fixed location in Slovakia. The RÚ carried out a three-criteria test of the two relevant markets for wholesale voice call termination on individual mobile networks and wholesale call termination on individual public telephone networks provided at a fixed location according to Articles 64 and 67 of the European Electronic Communications Code. It concluded that the second criterion of the three-criteria test is not fulfilled, therefore the whole three-criteria test has not been fulfilled in both cases. Based on the results of the mentioned tests, RÚ proposed to remove both relevant markets from the national list of the markets susceptible to ex-ante regulation. Once the RÚ issue a decision amending the list of relevant markets in the Collection of Legislative Acts of Slovakia, the designated operators will no longer be deemed to have significant market power. The Commission had examined the notification and made no comments.

Slovakia observed a steady increase of the indicators for main coverage and take-up of connectivity, often coming close to surpassing the EU average. It is important to ensure that the end-users are aware of the tangible benefits of accessing high and very high internet speeds. In addition, it is important to accelerate the country's deployment of 5G networks, both via public and private means. The 2030 Digital Decade targets will serve as a useful guiding framework for future updates of Slovakia's national broadband plan.

3 Integration of digital technology

3 Integration of digital technology	Slovakia		EU
	rank	score	score
DESI 2022	21	27.8	36.1

	DESI 2020	Slovakia DESI 2021	DESI 2022	EU DESI 2022
3a1 SMEs with at least a basic level of digital intensity % SMEs	NA	NA	43% 2021	55% 2021
3b1 Electronic information sharing % enterprises	31% 2019	31% 2019	31% 2021	38% 2021
3b2 Social media % enterprises	18% 2019	18% 2019	21% 2021	29% 2021
3b3 Big data % enterprises	9% 2018	6% 2020	6% 2020	14% 2020
3b4 Cloud % enterprises	NA	NA	31% 2021	34% 2021
3b5 AI % enterprises	NA	NA	5% 2021	8% 2021
3b6 ICT for environmental sustainability % enterprises having medium/high intensity of green action through ICT	NA	76% 2021	76% 2021	66% 2021
3b7 e-Invoices % enterprises	15% 2018	16% 2020	16% 2020	32% 2020
3c1 SMEs selling online % SMEs	11% 2019	17% 2020	13% 2021	18% 2021
3c2 e-Commerce turnover % SME turnover	11% 2019	11% 2020	8% 2021	12% 2021
3c3 Selling online cross-border % SMEs	7% 2019	7% 2019	7% 2021	9% 2021

Slovakia ranks 21st in the EU on integration of digital technology by enterprises. 43% of Slovak SMEs reach at least a basic level of digital intensity compared with the EU average of 55%. Slovakia is just below the EU average in the use of AI by enterprises (5% versus 8%) and in the use of intermediate or sophisticated cloud services (31% versus 34%). The proportion of enterprises that use big data analysis is 6% compared with the EU average of 14%. The country's e-commerce scores have decreased: 13% of SMEs sell online compared with 17% the year before. The share of SME turnover from e-commerce has also decreased to 8% (EU average: 12%). 16% of Slovak enterprises used e-invoices in 2020 compared with 32% in the EU. In 2021, 76% of Slovak businesses had a medium to high level of use of ICT technologies for more environmentally friendly actions, which is 10 percentage points higher than the EU average of 66%. 7% of SMEs sell online cross-border, compared with 9% for the EU.

Slovakia continues to follow its [2030 strategy for the digital transformation of Slovakia](#) (*Stratégia digitálnej transformácie Slovenska 2030*). This supports the integration of innovative technologies in

enterprises, including cloud and edge computing, HPC, blockchain and AI. Concrete measures are described in [Slovakia's action plan for digital transformation for 2019-2022](#) (*Akčný plán digitálnej transformácie Slovenska na roky 2019 – 2022*), which aims to facilitate the digital transformation of the economy, focusing on data economy, innovation ecosystem, smart mobility and financial innovations (FinTech).

Slovakia will help enterprises, particularly SMEs, to take up cloud, big data and AI technologies by building a network of EDIHs across the country. Five DIHs/EDIHs are expected to be in place by the end of Q3 2022 as defined in the Slovak RRP³⁴⁰. The EDIHs will help monitor the digital maturity of enterprises which will help track progress towards achieving the Digital Decade target of having 90% of SMEs with at least a basic level of digital intensity. EDIHs will also prepare and provide individual digital and/or technical solutions tailored to the support users, including public bodies. The services offered by EDIHs will be provided for free or at a price lower than the market price.

To make innovation and digitalisation of enterprises even more attractive and accessible, Slovakia will implement a voucher support system under the Recovery and Resilience Fund (RRF). Through an open call procedure and evaluation, the successful enterprise will receive a voucher to use for research and innovation services. The measure aims to intensify cooperation between Slovak enterprises and other actors in the digitalisation and innovation ecosystem, and to improve enterprises' knowledge and step up technology transfer in their activities. Three types of vouchers will be offered: an innovation voucher, a digital voucher, and a patent voucher. This measure could also help Slovak start-ups to expand on the EU and global level.

Slovakia is a member of the European High-Performance Computing Joint Undertaking (EuroHPC) and the country plans to build an energy-efficient HPC solution in the new segments of users. The new HPC solution will provide computing power within the EuroHPC and will be available to public bodies, the private sector and academia. The aim will be to step up the creation of a sustainable ecosystem of manufacturers and providers of technological components, software and services. The construction of the supercomputer will be financed through the Recovery and Resilience Facility (RRF) and will be put into operation by Q4 2024.

The Slovak Academy of Sciences (*Slovenská Akadémia Vied*, or SAV) is developing algorithms for quantum computing. Other institutions, including government ministries and universities, are working together in the area of quantum technologies through the consortium [QUTE.SK](#) (National Center for Quantum Technologies). Slovak researchers are aligning their activities with the European Quantum Flagship programme and will help bring the EU to the cutting edge of quantum capabilities by 2030 as foreseen in the Digital Decade strategy. For example, theoretical mathematicians are specialising in the development of algorithms for quantum computing.

Slovakia continues to intensify its efforts to scale up its digital economy. However, the country does not issue implementation reports or any updates to track the delivery of the policies described in the 2030

³⁴⁰ The selection of Digital Innovation Hubs that will participate in the network of European Digital Innovation Hubs (EDIHs) is ongoing. Four Slovakian EDIH proposals have a successful evaluation result, i.e. are invited for grant agreement preparation (which is not a formal commitment for funding). One additional proposal has received a Seal of Excellence.

strategy of the digital transformation of Slovakia and its action plan for digital transformation for 2019-2022. Slovakia continues to rank below the EU average, although in some areas, such as AI and cloud, it is slowly improving. The main barriers to enterprises integrating digital technology are the persisting administrative burden, the low awareness of financing possibilities and financial instruments. These challenges need to be considered when laying down the national strategic roadmaps detailing how Slovakia intends to contribute to the achievement of the Digital Decade targets, once the decision on establishing the policy programme 'Path to the Digital Decade' enters into force.

4 Digital public services

4 Digital public services ³⁴¹	Slovakia		EU
	rank	score	score
DESI 2022	24	52.0	67.3

	DESI 2020	Slovakia DESI 2021	DESI 2022	EU DESI 2022
4a1 e-Government users	69%	68%	62%	65%
% internet users	2019	2020	2021	2021
4a2 Pre-filled forms	NA	NA	45	64
Score (0 to 100)			2021	2021
4a3 Digital public services for citizens	NA	NA	65	75
Score (0 to 100)			2021	2021
4a4 Digital public services for businesses	NA	NA	75	82
Score (0 to 100)			2021	2021
4a5 Open data	NA	NA	50%	81%
% maximum score			2021	2021

With a score of 52.0 in 2022, Slovakia ranks 24th in the EU for digital public services. Slovakia is below the EU average for all monitored indicators. The proportion of e-government users among internet users has fallen to 62%, below the EU average of 65%. In the category ‘amount of data pre-filled in public service online forms’, the country scores 45 in 2020, below the EU average of 64. Digital public services for citizens is also below the EU average, with the country scoring 65 compared with 75 at EU level. There is also a gap for digital public services for businesses, where Slovakia scores 75 compared with the EU average of 82.

Investments in digital technologies in the country’s public administration are a strong focus of Slovakia’s RRP. Measures are planned to minimise the required administrative steps for citizens and businesses, reduce the time and costs, and improve the user-friendliness of digital public services. Furthermore, Slovakia also intends to strengthen and standardise cybersecurity across all sectors of public administration to increase trust in the new e-services.

A new strategy document ‘[The National Concept of Informatization of the Public Administration for years 2021-2026](#)’ was approved by the Slovak Government in December 2021. This document focuses on developing the concept of strategic priorities as a driving force to achieve the EU 2030 Digital Decade targets. The strategy contains concrete initiatives for government cloud, user-oriented digital services, data transformation, public procurement, cyber and information security and human resources support in IT. A timely and effective implementation of the strategy will help improve digital public services in

³⁴¹ There is break in the series for indicators 4a2, 4a3, 4a4 and 4a5. As a result, no comparison of indicator and dimension results is possible over time.

Slovakia. The strategy also outlines priority ‘life situations’ for citizens and businesses, where simplified and more efficient digital solutions will be proposed.

Slovakia’s public administration and public services have traditionally had a comparatively low level of digitalisation, which has been a major barrier to the widespread take-up of digital public services by citizens and businesses. This is why investments in digital technologies in public administration are another strong focus of Slovakia’s RRP, under which a total of EUR 686 million is allocated to this policy area.

According to the [EU eGovernment Benchmark 2021](#), Slovakia is among the countries that are not making full use of ICT opportunities. Relative indicators in the Benchmark show that for all the environmental characteristics (user, government and digital context), Slovakia is below the European average. However, this is similar to the performance of other neighbouring European countries.

Investments are needed to improve the public administration’s efficiency and user-friendliness in order to reduce administrative burden and improve the business environment. The focus should be on making investments more effective. In addition, the public procurement of IT purchases requires reforms and investments to make it more efficient.

In 2021, the MIRRI implemented measures to increase cybersecurity, enable more efficient spending of public resources and build proactive public services. For example, thanks to the ‘Act against bureaucracy’, people will not have to submit paper documents to public authorities from 1 January 2022 onwards, such as marriage and birth certificates, residence certificate, etc. Slovak authorities estimate that this will help save of around EUR 42 million per year for people and businesses.

The need to improve public IT procurement has been highlighted by the Supreme Audit Office of Slovakia. The [Audit Office looked into issues with the portal Slovensko.sk](#) managed by the [National Agency for Network and Electronic Services \(NASES\)](#) and concluded that there were many irregularities. Therefore, the MIRRI should examine public IT procurement that is financed by national and EU funds.

In 2021, the MIRRI also worked to improve the procurement of public IT purchases, saving approximately EUR 72 million. Guidelines have also been developed to prevent vendor lock through a template document ‘Contract for work to deliver IT’. The MIRRI is also working with other public agencies to remove vendor lock from existing contracts.

With every ID issued after 2013, Slovaks are offered with a national eID scheme for facilitating their interactions with public administration and private use, although it cannot be used via a smart device (mobile identification). In total, almost four million people (or almost 72% of the citizens) have an eID scheme assigned, which is also notified to the European Commission under the eIDAS Regulation.

Insufficient digital skills in public administration are a bottleneck for development. Developing digital skills in the public sector is an essential prerequisite for successfully meeting the challenges of digital transformation. Therefore, specific opportunities to develop the digital skills of civil servants should be available. Targeted investments aiming to develop specialised skills of IT and cybersecurity professionals working in the public sector are set out in Slovakia’s RRP. Considering the Digital Decade target of providing online access to all key public services by 2030, a step change will be required to achieve this.

Highlight 2021: Hackathons – Fast grants

The 'Hackathons - Fast grants' initiative is an investment planned under the RRP. Its aim is to provide fast, innovative and primarily digital solutions that public institutions need by means of 20 hackathons. These will be organised between 2022 and 2026, including the development, testing and implementation of solutions. Any public institution can take part in determining and/or suggesting the topics or challenges to be addressed by the hackathons. The development and implementation of winning solutions from hackathons will be supported by up to EUR 100 000 per winning solution. An aim of this investment is to leverage the innovative potential of start-ups and SMEs in Slovakia, while at the same time boost entrepreneurial spirit among young innovators.