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PROPOSAL

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To:	Ms Thérèse BLANCHET, Secretary-General of the Council of the European Union
No. Cion doc.:	SWD(2025) 335 annex
Subject:	COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT REPORT Accompanying the document Proposal for a Regulation of the European Parliament and of the Council on the safety, resilience and sustainability of space activities in the Union

Delegations will find attached document SWD(2025) 335 annex.

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PART 2/2

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

Annexes to the Impact Assessment Report

Accompanying the document

Proposal for a Regulation of the European Parliament and of the Council

on the safety, resilience and sustainability of space activities in the Union

{COM(2025) 335 final} - {SEC(2025) 335 final} - {SWD(2025) 336 final}

List of annexes

GLOSSARY OF TERMINOLOGY

Term	Meaning
Safety and sustainability in space	Safety refers to the practice that aims to ensure the protection and well-being of astronauts, spacecraft and the orbital environment. It involves mitigating risks and preventing accidents or incidents that could have harmful consequences (e.g. space debris generation, loss of space assets), thereby ensuring the long-term viability of space activities. Safety is therefore related to sustainability in space. It requires measures for mitigation and remediation related to, for example, the responsible disposal of space hardware, monitoring spacecraft end-of-life impacts and measuring propellant residuals. It also aims to minimise the negative impacts of space operations on other activities such as astronomy.
Resilience	Resilience refers to the capacity of space infrastructure and assets to maintain their digital and physical integrity and functionality at all times. Space infrastructure cover all space assets and systems across all relevant segments (ground, space, links, communication and user connections). The respective resilience measures and practices should aim to prevent, protect against, resist, respond to, mitigate and recover from events linked to digital/ICT risk and to physical security risk.
Environment	Environment refers to the practice that aims to minimise the negative impacts of space operations on the Earth's environment for the entire life cycle of space activity. It involves creating a sector-specific methodology based on the PEF method (product environmental footprint category rules – PEFCR) to calculate the environmental footprint. The environmental approach includes covering the data gaps, promoting research and developing missing characterisation models as well applying ecodesign principles to space activities.
Life cycle assessment (LCA)	A life cycle assessment (LCA) is defined as the systematic analysis of the potential environmental impacts of products or services during their entire life cycle. An LCA evaluates the potential environmental impacts of a product (production, distribution, use and end-of-life phases) or service throughout its entire life cycle. This includes the upstream (e.g. suppliers) and downstream (e.g. waste management) processes associated with the production (e.g. production of raw, auxiliary and operating materials), use phase and disposal (e.g. waste incineration).
Product environmental footprint (PEF)	A method to measure the environmental performance of products or services, 'Commission recommendation on the use of the Environmental Footprint

	methods to measure and communicate the life cycle environmental performance of products and organisation,[1]' from 2021.
PEFCR	A product environmental footprint category rule (PEFCR) is a technical guide for conducting a comprehensive PEF study for a given product, taking into account its supply chains. It comprises consistent and specific rules for measuring the environmental impact of a product or service through an LCA.
Space activity	Activities conducted as part of a space mission during its life cycle.
Space segment	Part of a space system, placed in space, to fulfil the space mission's objectives.
Ground segment	Part of a space system, located on the ground, which monitors and controls space segment element(s).
Spacecraft	Manned or unmanned vehicle designed to orbit or travel in space. Note: a spacecraft is a space segment element.
Launch segment	Part of a space system that is used to transport space segment elements into space.
EUSST Partnership	Group of Member States established according to the Space Regulation providing the EUSST services (collision avoidance, re-entry services and fragmentation). Today, it comprises 15 Member States.
Collision avoidance services	The risk assessment of collision between spacecraft or between spacecraft and space debris, and the potential generation of collision avoidance alerts during the phases of launch, early orbit, orbit raising, in-orbit operations and disposal phases of spacecraft missions.
Space debris	Any space object including spacecraft or fragments and elements of a spacecraft in Earth's orbit or re-entering Earth's atmosphere, which are non-functional or no longer serve any specific purpose, including parts of rockets or artificial satellites, or inactive artificial satellites.
Re-entry services	The risk assessment of the uncontrolled re-entry of space objects and space debris into the Earth's atmosphere and the generation of related information, including the estimation of the timeframe and likely location of possible impact.
New Space	New Space refers to the emerging private space industry, driven by a series of technological trends and business model innovations, resulting in the costs of space systems being reduced, shorter life cycles in delivery and more risk-taking.

[1] C(2021)9332 final

ANNEX 1: REGULATORY SCRUTINY BOARD COMMENTS – COMPILATION AND RESPONSE

Regulatory Scrutiny Board Comments – Second Opinion

	RSB Comment	Action taken/Response
1	The report should further integrate the analysis of legislative frameworks (e.g. the Network and Information Systems Directive (2022) and the Critical Entities Resilience Directive), clearly identifying the existing policy gaps in an evolving regulatory environment. It should explain whether and how these developments may affect the economic impacts of the policy options, including the baseline scenario.	Legal gaps have been identified in a table included under the Problem driver section (Section 2.2.2). The economic impact of the gaps identified in the problem section have been reflected in the assessment of the policy options.
2	In describing implementation of the preferred option, the report should provide more information on the envisaged mechanism to ensure **compliance with EU requirements by all actors, including non-EU actors**. Whereas additional proportionality analysis is provided, the report should better explain how the lighter regimes described are reflected in the policy design, how they will be applied in practice in the options and how they will affect concerned stakeholders, in particular SMEs and start-ups. The report should clearly explain how the size of companies would be reflected when embedding proportionality in the rules.	The section describing the implementation of the preferred option (6.1.3.) now includes a sub-section on Compliance and governance outlining the envisaged mechanism to ensure compliance with the proposed requirements by all actors, including non-EU actors. The proportionality section has been further developed, including a table with the criteria, rationale and consequences of the application of the application of the light regime to relevant entities (Table 12). It also includes an explanation on how the proportionality regime would be applied, and the relevant considerations to company size for the application of the light regime.
3	The report should further develop the analysis of competitiveness. It should further analyse EU competitiveness in terms of the current and emerging actors and activities, in particular New Space. The report should further expand on how the initiative will ensure that the correct level of requirements to foster competitiveness is identified. It should further expand the analysis of international competitiveness, with available evidence on likely developments in the markets of the main space actors and in international markets, the current and potential participation of the EU space sector, and further information on national and international development of standards.	The competitiveness analysis has been expanded to include deeper insights into New Space, regulatory harmonisation, and international market positioning. It includes references on likely developments in the markets of the main space actors and international markets.

	RSB Comment	Action taken/Response
4	As regards competitiveness of SMEs and startups, the report should expand on their specific challenges, including those due to size and type of activity, as well as the international dimension of SME competitiveness. The report should assess, and quantify to the extent possible, the impact of the envisaged SME mitigation measures.	Section 6.1.8 on Impact on SMEs has been expanded to reflect the specific challenges faced by SMEs, including due to size and type of activity. The report also includes an estimated quantification on the impact of the envisaged SME mitigation measures.
5	Following the expanded analysis of costs and benefits, the report **should ensure that all estimates and calculations are consistent throughout the report and annexes**, and that the same data is reported across all tables, with calculations presented in a clear and structured manner. **Assumptions need to be comprehensively explained.** The **aggregated costs for satellite and launcher manufacturers and operators should be integrated in all relevant tables**, ensuring consistency of data used. All of the cost and benefit estimates should be clearly included in the overall economic impacts, which as a result, should clearly differentiate the benefits and costs of each policy option (reflecting as well the voluntary nature of certain options), providing **explicit overall values for each option**. The report should thoroughly review the presentation of costs and cost savings to identify administrative and adjustment costs in the context of the **One In, One Out approach**.	Consistency in the cost benefit analysis across the report and annexes has been double checked and corrected when relevant. The format of the calculations and tables has also been adjusted to reflect the figures more clearly. Assumptions have been explained. Administrative and adjustment costs have been identified throughout the report in the context of the One In, One Out approach (incl. as part of the sections on SME and international competitiveness).
6	The report should significantly **improve the initiative's monitoring and evaluation framework**, laying down clear, comprehensive and robust indicators allowing to measure progress in performance and ultimately success.	The report includes now a more developed table with clear indicators, baseline and target scenarios, annual progress estimates and review frequencies for each of the specific objectives of the preferred policy option (Section 11). This monitoring and evaluation framework with specific Key Performance Indicators would allow the effective assessment of the implementation of the measures included in the preferred option and its effectiveness.

Regulatory Scrutiny Board Comments – First Opinion

	RSB comment	Action taken/response
1	The report should better define the **scope of the initiative**. It should clarify the types of activities and the actors that will be covered by the legislative act. It should be clear how it will cover space-related products and services in the EU, or provided to EU public authorities, businesses and citizens. It should also be clear if it includes non-EU operators, under what conditions, and how effective enforcement would work.	A more detailed overview of the current licensing requirements for satellite and launch operators has been added to the report, highlighting the operator's role as the regulatory entry point at national level (Section 2.1.1). The report includes, under the description of the different policy options, the scope of application of the envisaged measures. This includes a detailed explanation of how this would affect different types of EU and non-EU operators. The scope has also been expanded to cover those stakeholders affected by the problems identified (Table 1).
2	The report should better explain the **key policy choices**. It should be clearly stated who would design, how, and when, the different components of the policy measures, e.g. requirements, licences, labels, and mitigation measures. The report should provide a clear presentation of the **mitigating measures** and lighter regimes envisaged, in particular for SMEs. It should detail how relevant criteria such as size or criticality will be applied in a proportionate manner in the various options.	The report further elaborates on the key policy options (Section 5.3). It includes an overview of measures and risks to be assessed (Table 5 – Overview of measures). Under subsidiarity (Section 3.3.), the report elaborates further on the proportionality of the proposed initiative (e.g. mitigating measures and lighter regimes envisaged), detailing the criteria under which such a regime would apply for each pillar. The report provides further details into the 'space safety/sustainability/resilience labels', highlighting the differences between the label envisaged in policy option 1 and policy options 2, 2+ and 2++. It also provides the timeline, scope and content for each of the described policy options, and details the scope of application/affected stakeholders. The report also elaborates on the support measures envisaged under policy option 2+ (Section 6.1.3) describing those that could be put in place and their impact on SMEs.

3	The report should further develop and better present the **impact analysis** so that it is clear what the impacts are for each option. The **benefits** to all affected stakeholders should be better explained and wherever possible monetised, in particular savings due to the reduction of the level of administrative burden, the reduced risk of cyberattacks and safer products/deployment. The **cost analysis** should include an explicit identification of the administrative and adjustment costs, feeding into a comprehensive presentation of the 'one in, one out' approach. Together with the unit cost and relative value estimates already provided, the report should provide the estimates at the aggregate level and in absolute values. It should provide a summary table of all available estimates, including the total costs and benefits of the options explaining the preferred option in greater detail in Annex 3. The analysis should correctly take account of the voluntary character of certain options or part of the options by differentiating the estimates of the costs and benefits according to the assumed take-up rates or explain on what basis it was concluded that all options would result in the same level of the increase in manufacturing costs.	The report provides more detail and clarity on the impact assessment (Section 6). In the assessment of policy options 2 and 2+ (Section 6.1.3), it provides further detail on the benefits of the initiative for the industry in the short, medium and long term, including quantification when possible. It also includes an overview of the costs and how these would be offset. The report also elaborates on the support measures envisaged under policy option 2+ (Section 6.1.3) describing the specific measures that could be put in place and their impact on SMEs. Five new sections have been added to the report: • one including a summarised cost-benefit analysis (Section 6.1.5); • one on the costs for private and public actors (6.1.6); • one on the quantification of the operational benefits (6.1.7); • one focusing on the impact of the different policy options on the international competitiveness of the EU space sector (6.1.8.); and • one on the impact on SMEs (6.1.9.). The section on the impact on SMEs includes a table detailing the costs, benefits, proportionality regime, and envisaged measures to offset the costs (Table 19). The section on the public and private costs also includes an overview of the costs of each policy option for affected stakeholders (Table 13). The section monetising the operational benefits includes tables estimating the costs of collision avoidance manoeuvres and the benefits stemming from the reduced number of such manoeuvres (Tables 16 and 17). The section detailing the costs provides a comprehensive overview of the different costs and types of cost for the described policy options, including administrative and

	RSB comment	Action taken/response
		adjustment costs. The report also highlights how these costs could be offset in the short, medium and long term. The report includes a table detailing the aggregated costs of the satellite manufacturing cost increase (Table 14) and the launcher manufacturing cost increase (Table 15). The voluntary character of certain options has been highlighted under the description of policy options.
4	Based on a strengthened cost and benefit analysis, the report should deliver a more detailed assessment of the impacts on SMEs and the emerging new start-ups. It should assess thoroughly impacts of the envisaged exemptions, specific regimes, or other mitigation measures.	Five new sections have been added to the report: • one including a summarised cost-benefit analysis (Section 6.1.5); • one on the costs for private and public actors (6.1.6); • one on the quantification of the operational benefits (6.1.7); • one focusing on the impact of the different policy options on the international competitiveness of the EU space sector (6.1.8.); and • one on the impact on SMEs (6.1.9.). The section on the impact on SMEs includes a table detailing the costs, benefits, proportionality regime, and envisaged measures to offset the costs (Table 19). The analysis of policy options 2 and 2+ includes an overview of the supporting measures that could be envisaged under the law (Section 6.1.3).

	RSB comment	Action taken/response
5	The assessment of the **impacts on the competitiveness of the EU space sector**, in particular SMEs should be presented in a more structured and detailed manner. The report should be more granular on the short-term and long-term impacts on competitiveness. As regards international competitiveness, the report should describe the global market dynamic and the market share of EU companies. It should fully assess the potential risks for EU operators in case competitors established in other jurisdictions offer similar products or services at lower price due to less stringent standards on safety, security or sustainability or lower production cost. It should substantiate its assessment with an analysis of all relevant factors, including relative position of EU actors, expected developments of the sector in the EU and globally, upscaling opportunities within the EU, etc. The analysis should be reflected coherently in the competitiveness check in Annex.	In the assessment of policy options 2 and 2+ (Section 6.1.3), it provides further detail on the benefits of the initiative for the industry in the short, medium and long term, including quantification when possible. It also includes an overview of the costs and how these would be offset. Five new sections have been added to the report: • one including a summarised cost-benefit analysis (Section 6.1.5); • one on the costs for private and public actors (6.1.6); • one on the quantification of the operational benefits (6.1.7); • one focusing on the impact of the different policy options on the international competitiveness of the EU space sector (6.1.8.); and • one on the impact on SMEs (6.1.9.). Under Section 9 (preferred option), the report assesses the potential risk for EU space operators if they establish themselves outside the EU in order to benefit from less stringent requirements. A box including an overview of the global and the European space economy has been added to the introduction, to provide a more detailed outlook of the economic context and highlighted key facts and figures.
6	The report should also bring forward the **evidence regarding the environmental challenges, supply chain pressures, and raw material dependency**.	A more detailed explanation of the current situation and the specific difficulties and challenges for the space sector regarding environmental sustainability has been added to the report. More detailed information about environmental challenges, supply chain pressures and raw material dependency in relation to space has been included under problem 3 (Section 2.1.3.), including examples and references to relevant studies.

	RSB comment	Action taken/response
7	The **stakeholder views** need to be clearly presented and systematically referred to throughout the report. Stakeholder categories should be clearly identified and differentiated, including innovative space start-ups and Member States.	The views of stakeholders have been systematically referred to throughout the report, highlighted in boxes in the relevant sections. These include the views expressed by Member States during bilateral discussions, and by industry (including start-ups and SMEs) in bilateral discussions and workshops, as well as references to their submissions papers and answers to the targeted and public consultations.
8	The report should set out clearly **what success will look like**. It should explain how this will be monitored and when an evaluation will take place.	The report includes a table detailing how the monitoring and evaluation of impacts will take place (Table 26). It also includes a subsection on what a successful implementation of the initiative would look like (Section 11.1).
9	The report should include an upfront presentation of the international legal context as well as thorough the annex with relevant EU legislation in place, which would support the problem definition. It should provide a fuller context for the numbers and tables included.	The international framework has been elaborated upon and further details provided in the Annex 12. The report incorporates more detail on Member States' diverse approaches to space safety, resilience and sustainability, including examples of diverging requirements set out by EU national space legislation on these three key aspects. The report also includes more detail on the international legal context and the NIS2 and CER Directives (Section 2.2.2 and 2.3). The report has included more context and explanation on the figures and tables.
10	The report should clarify between two seemingly contradicting findings: that over the next four decades, a collision is expected to occur on average once every five years (p. 11) and that a targeted population of 10 000 satellites will amount to 300 disabling collisions within 30 years (p. 18).	The reference to 10 000 satellites amounting to 300 disabling collisions within 30 years has been deleted.

	RSB comment	Action taken/response
11	The report should further **develop the third problem linked to environmental challenges** by explaining the current situation and the specific difficulties and challenges for the space sector. The report should substantiate the need for space industry-specific methodologies for assessing and quantifying the environmental impacts of space activities, explaining why existing methodologies on LCA or existing ESG criteria and notification obligations are insufficient, and in what consist their shortcomings.	The third problem has been further developed to clearly present the relevant environmental challenges for the space sector currently and the regulatory gap that needs to be addressed. This provides an overview of existing methodologies and frameworks (EU sustainability legislation, ESG framework, LCA-related activities initiated by ESA).
12	The general objective(s) should cover other aspects of the initiative beyond the creation of internal market, such as safety, security, resilience, competitiveness and contribution to the twin transition. The part on 'aligning in a consistent and cohesive manner national licensing requirements on safety, resilience, and environmental impact of space operations' should not be part of the general objective(s) as it is too specific and rather identifies a solution.	The general objective has been further developed to encompass aspects such as competitiveness, the long-term sustainability of space activities and the contribution to key EU programmes and policy objectives (EU strategic autonomy, twin transitions, space strategy for Europe) – see Section 4.
13	The analysis should not be using USD, but make a conversion to EUR (the ECB rate and date of the quote should be provided in the relevant first footnote).	All values in USD have been converted to EUR (with the relevant ECB rate and date of the quote provided in the footnote).
14	The report should reconsider the numerical conclusion of symbol-based assessment of options (present also in the earlier tables on impacts overviews), which presently translates qualitative analysis into quantified indicator. The scoring is not intuitive for the efficiency analysis, which mostly discusses costs only, no benefits.	The presentation of the assessment of policy options has been adjusted to provide further clarity analysis and its conclusions (now including both the numerical and the symbol-based assessment).

ANNEX 2: PROCEDURAL INFORMATION

1. LEAD DG, DECIDE PLANNING/COMMISSION WORK PROGRAMME REFERENCES

A Commission proposal for an EU legislative initiative for the safety, resilience and sustainability of space activities (‘EU Space Act’) is part of the 2025 Commission work programme under the priority ‘A Europe fit for the digital age’. The lead DG for this initiative is the DG for Defence Industry and Space (DG DEFIS). The Directorate in charge is Directorate B: Secure and Connected Space. Organisation and timing

The Inter-service Steering Group (ISSG) was set up in Q4 2022 together with the Secretariat-General, Legal Service and relevant DGs to assist in preparing the EU Space Act. There have been five meetings. The last ISSG meeting consultation took place on 17 January 2024. The impact assessment was submitted to the RSB on 15 November 2023. The RSB meeting took place on 13 December 2023 and led to a negative opinion. An updated impact assessment was submitted on 31 January 2024.

There were two workshops with EU Space Act experts on 16 February 2023 and 13 November 2023. Since July 2023, DG DEFIS hosted over 20 bilateral meetings with Member States. A workshop with Member States took place on 16 January 2024. Four dedicated workshops with industry stakeholders were organised on safety and resilience pillars, gathering 170 participants in total. The sustainability pillar was consulted both with Member States and environmental experts. The targeted stakeholder consultation for this initiative was launched on 29 September 2023 and lasted for five weeks until 2 November 2023. The public consultation was launched on 4 September 2023 and lasted until 28 November 2023. The timing for adoption of the Commission proposal for an EU Space Act is Q2 2025.

2. CONSULTATION OF THE RSB

An upstream meeting with the RSB took place on 26 October 2023, which focused on preparing the impact assessment report. Board members provided comments on the policy context, intervention logic, problem definition, objectives, policy options, impacts and stakeholder consultation. Emphasis was placed on the clarity, consistency, level of detail, transparency, and structure of the report. DG DEFIS updated the intervention logic, sharpening certain narratives in line with the comments received.

Following the RSB’s negative opinion on 13 December 2023, DG DEFIS updated the impact assessment report in line with the comments received. A detailed overview of the RSB’s comments and the changes to the report can be found in Annex 1.

3. EVIDENCE, SOURCES AND QUALITY

The Commission carried out an extensive consultation while preparing this impact assessment. Furthermore, the Commission has conducted extensive desk research, covering a wide spectrum of policy studies and reports. Several workshops with experts, industry and Member States took place to collect evidence, as detailed in the synopsis report contained in Annex 3 of this impact assessment. In addition, the external contractor collected evidence from a variety of sources. The quality of the analytical methods is detailed in Annex 5.

ANNEX 3: STAKEHOLDER CONSULTATION (SYNOPSIS REPORT)

In line with the Better Regulation Guidelines, for activities related to the stakeholder consultation we carried out two surveys that addressed the whole space sector community (i.e. academia, business associations, companies, environmental/consumer/non-governmental organisations, public authorities, trade unions, etc.) that ran throughout the month of October 2023.

The stakeholder consultation included the following questionnaires.

1. Targeted stakeholder consultation
2. Public stakeholder consultation
3. Survey on EU Space Act – Safety and sustainability in space
4. Survey on EU Space Act – Resilience
5. Survey on EU Space Act – Environment
6. Dialogue with stakeholders and definition of shared ambition for an LCA methodology for space activities

1. TARGETED STAKEHOLDER CONSULTATION ON THE EU SPACE ACT

The targeted stakeholder consultation ran from **29 September to 2 November 2023**. The questionnaire was divided into two parts:

1. questions about the respondent;
2. questions related to the current situation and the problem assessment, including the policy options.

The summary below addresses the questions related to the two sections. In addition, the consultation included a set of closed questions as well as free text answers in which the respondent was able to insert position papers with more detailed feedback. The survey contained 43 questions.

The consultation targeted the **space sector** covering entities such as: i) academic/research institutions; ii) business associations; iii) spacecraft manufacturers; iv) space operators; v) airlines or air navigation service providers; vi) consumer organisations; vii) environmental organisations; viii) non-governmental organisations (NGOs); ix) public authorities; x) trade unions; and xi) citizens. **Contributions arrived from all over the world**, including the 27 EU Member States and several non-EU countries such as Canada, Japan, Norway, Switzerland, the United States, and the United Kingdom.

In total, **333 contributions were received, and 65 accompanying documents were submitted**. Out of these contributions, **170 represented organisations**, **153 represented citizens**, and the rest were anonymous. From the organisations, spacecraft manufacturers represented 22% of the contributions, followed by other organisations (19%), space operators (14%), academic/research institutions (14%), public authorities (11%), non-governmental organisations (9%), business associations (5%), airlines or air navigation service providers

(3%), environmental organisations and trade unions (1% each). In addition**, 62% of the organisations were either a micro, small, or medium-sized business**. Overall, **47% of the replies came from the EU-27 countries** and only 5% from non-EU countries. The rest of the responses (49%) are not specified.

The various position papers make it clear that there is broad support in the industry for introducing an EU Space Law. In particular, there is broad consensus that the EU Space Act should provide **a clear and common framework** that harmonises the various space regimes in the EU. This is seen as particularly valuable as it would enable organisations to easily expand their operations abroad and offer their services in multiple Member States. Moreover, the introduction of this law is seen as an opportunity for the EU to **take the lead in setting (global) standards** for making space safer, more secure, and more sustainable. This is not only beneficial to businesses, but also to society. At the same time, the industry insists that the law should also aim to **keep the European space industry competitive** by including within its scope companies from non-EU countries that place products or services on the European market.

According to the position papers submitted, the stakeholders mentioned some **general recommendations** for the space law.

- The regulatory framework should clearly set out i**nformation requirements, evaluation criteria, deadlines for the administration to respond, renewal and revocation process and an appeals process**. Specifically, it should include and build upon **the economic and corporate requirements of operators** and the **extension of due diligence,** paying careful attention to their effect on SMEs.
- The law should lay the groundwork for the **technical regulation of missions**, particularly emphasising **security and sustainability** aspects. The possible adoption of **internationally defined standards** is recommended.
- Ensure **consistency between the proposed EU Space Act and other relevant EU legal acts** (e.g. those related to cybersecurity and resilience of critical entities) as well as Member States' national laws and approaches, to ensure coherence across space systems and avoid duplication of efforts. This can be achieved by ensuring the **right coordination between Member State authorities and EU institutions** in this field.
- Consider the importance of the **extraterritorial scope of the EU Space Act** and that it is implemented effectively. Therefore, the future act should be applicable to any entity providing services to the EU market, whether or not they are developed in Europe and whether or not the entity is EU-based.
- Empower **interdisciplinary research and strengthen sharing platforms** to support the development of innovations as well as channel fundings efficiently to provide adequate support where needs be.

Safety pillar

Safety refers to the practice that aims to ensure the protection and well-being of astronauts, spacecraft and the orbital environment. It involves mitigating risks and preventing accidents or incidents that could have harmful consequences (e.g. space debris generation, loss of space *assets), thereby ensuring the long-term viability of space activities. Safety is therefore related to sustainability in space. It requires rules for mitigation and remediation, for example relating to the responsible disposal of space hardware, monitoring the impacts of spacecraft when they reach the end of their life and measuring propellant residuals.*

The data collected during the stakeholder consultation confirms the growing threat posed by an increase in the number of space activities and debris. An overwhelming majority of respondents agree (19.3%) or strongly agree (72.7%) that there is a **growing risk for collision stemming from an intensification of space activities.** These observations align with the objectives set out in the proposal for an EU Space Act and reinstate the importance of addressing these issues to allow for a sustainable use of space.

The three main highest risks considered by the stakeholders are: 1) a major accidental collision in space; 2) the Kessler effect; and 3) outage of essential space-based services. On the other hand, the risks of casualty (on-ground) resulting from re-entering space debris and the risk to aircraft in flight from re-entering space debris are deemed low by the stakeholders. This is especially a concern for the aviation industry, where **80% of respondents from this sector deemed the risk to aircraft in flight from re-entering space debris is either medium-high or high**. Furthermore, the risk to astronauts in orbit (from debris hitting the space station) is considered a medium-level risk.

The targeted consultation shows that there exists a **gap in the current coverage by the international space frameworks to ensure safe and long-term use of space.** The **majority of respondents (58%)** do not believe that the existing international frameworks are efficient, while 27% believe that the existing space laws are somewhat fit for purpose. Overall, the data highlight a mismatch between the fast-evolving space activities, and the legal frameworks that aim to ensure safe and long-term use of space. The main issues with existing regulations are their low level of enforcement, the fact that they are outdated, and they are not fit for purpose. On the one hand, national space legislation is not sufficiently up to date to match new technologies and the changes occurring in the space activities. On the other, there is a disparity among countries and the level of national legislation developed in each country.

The majority of stakeholders (84%) believe that **the increased space activity calls for specific requirements and/or guidance for the safety of space.** Indeed, there is a need to develop new standards, particularly considering the development of mega-constellations, the protection of dark and quiet skies, the new projects concerning lunar exploration, and the increased amount of space activity overall. There is also a need to understand how the Earth's upper atmosphere responds drastically to the increased number of space objects. There should be more monitoring of LEO where the approvals of new constellations are increasingly scrutinised at international venues.

Resilience pillar

Here, resilience refers to the capacity of space infrastructure and assets to maintain their digital and physical integrity and functionality at all times. Space infrastructure covers all space assets and systems across all relevant segments (ground, space, links, communication, user connections). The respective resilience measures and practices should aim to prevent, *protect against, resist, respond to, mitigate, and recover from events linked to digital/ICT risk and physical security risk.*

The majority of respondents (73%) support the idea that the digitalisation of space systems, the mixed structure and complexity of space infrastructure **create specific challenges** for ensuring the resilience and the physical and digital security of the space infrastructure. The results suggest that the over-digitalisation of the sector results in an increase of potential security threats for the industry as a whole. By highlighting those challenges, the data supports the need for intervention to ensure the resilience and physical security of space infrastructure, which the EU Space Act aims to address through its measures directed towards boosting the sector's resilience.

The risk deemed to be the most high (voted by 30% of the respondents) has been that related to difficulties in **replacing and repairing systems or hardware used for physical assets in space, once damaged or hacked.** The risk that was most categorised as medium-high (as voted by 36% of the respondents) is the intrinsic complexity of the international supply chain. This is due to the fact that if a satellite relies on various components from different suppliers, and one of these components contains a hidden vulnerability or malicious code, it can compromise the entire satellite's functionality or data security. Furthermore, respondents are also concerned with the low amount of cyber protection for the commercial off-the-shelf products (COTS) used in satellites, as 30% of them deemed this to be a medium-high risk. In addition, without specific and standardised guidelines, it can be challenging to set out robust cybersecurity measures that are specifically suited to the space environment.

As space systems become more interconnected and digital, they are more likely to become prime targets for cyberattacks that could disrupt communication, navigation and data services. The majority of the respondents (66%) agree that there is a **need to increase the overall level of cybersecurity and resilience of different space infrastructure to ensure protection from cyberattacks**. This is because we see an increase in attacks on all segments, especially since the beginning of Russia's war of aggression against Ukraine, whether these attacks involve jamming, spoofing or interception.

32% of the respondents found **better information sharing on cyber threats** affecting space infrastructure to be one of the most useful rules. It is essential for early detection and, collaborative defence, and for developing effective solutions. It provides valuable threat intelligence, helps mitigate risks, and ensures a coordinated global response to step up space infrastructure security. 30% of respondents believe that there should be more consistency between the approaches used to protect EU space assets and those used to protect Member State space assets. It would ensure efficient resource use, maintains consistency and optimises services that benefit both the EU and countries.

Around **half of the stakeholders (45%) mentioned that a risk management approach and a 'security by design' principle should be applied throughout the full life cycle of the spacecraft** and **space operations.** Protection requirements should also be applied to increase the overall level of cybersecurity of the space infrastructure. It is very important that the design of the 'security by design' principle includes measures such as continuous testing, authentication safeguards and compliance with best programming practices. Furthermore, including cybersecurity **on board of all satellites** is key to ensuring proper detection, recovery from, and response to the related intentional (and non-intentional) threats. This is achieved by establishing and applying cybersecurity criteria that relate to the satellite characteristics and the consequences of a cybersecurity attack.

Environmental sustainability pillar

Environmental sustainability refers to the practice that aims to minimise the negative impacts of space operations on the Earth's environment throughout their entire life cycle. It involves creating a sector-specific methodology based on the PEF method (product environmental footprint category rules – PEFCR) to calculate the environmental footprint of space operations, including covering the data gaps, promoting research and development of missing characterisation models, as well applying ecodesign principles to space activities. It also aims to minimise the negative impacts of ground operations on Earth exploring space (including light pollution).

Most stakeholders (83%) either agree or strongly agree that there is a **need for a common methodology for the space sector to measure its environmental footprint on Earth and in space**. The main reason is that since there will be 15 launchers for over 90 missions over the next five years, a new regulatory framework needs to be brainstormed like never before, all relying on a newly founded ecosystem. The EU, Member States and relevant space actors need to agree on a common methodology as a first step towards mitigation and setting reduction targets. An environmental impact assessment should be included in each authorisation request made by a private entity to the relevant Member State.

The majority of the stakeholders (65%) mentioned that they **implement specific measures** to mitigate the environmental footprint on Earth resulting from their space activities. Within the current measures that stakeholders mentioned they are currently implementing are: i) ISO 14000[2]; ii) green propellants; iii)an internal carbon footprint index, allowing the company to keep track of scope 1-2-3 emissions (GGH protocol); iv) use of electric cars, teleconferences, reduction of paper use, and non-toxic materials; and v) energy, water and waste management.

Most of the respondents (78%) agree that the **increased number of satellites in orbit negatively impacts astronomical research.** In this sense, the objective of addressing light pollution for the purposes of astronomy are aligned with the respondents' opinions. The most useful measures to protect dark and quiet skies should contain technical, regulatory and financial aspects. On the one hand, the positive impacts of including measures that limit light and radio pollution in space activities are a better assessment and knowledge of space objects in orbit, particularly their position, and a better observation of the sky, therefore a better assessment of the risks of collisions. Nevertheless, the cost of the satellites would likely increase.

Preferred policy option

[2] ISO 14000 family Environmental management

Policy Option 2+ is the preferred policy option due to its combination of binding and non-binding measures that provide a certain degree of commonality at EU level and incentivise better behaviour among space actors. 15% of the respondents referred to policy option 2 as being the desirable option as it provides a legislative framework by which all EU space actors can abide, ensuring a level playing field. Policy option 2++ was preferred by 12% of the respondents as it provides a global approach to a global issue. While other respondents believe policy option 2++ is the best, they also mentioned that the feasibility of this option is not clear, at least not in the short term. This is why some stakeholders mentioned a combination of policy options 2 or 2+ and 2++ would be the ideal scenario as it brings a balance between a regional and an international approach.

On **the policy options' effectiveness**, while the some of the respondents could provide an answer as to whether they believe one of the options would likely achieve the general objective compared to no action, of those respondents who did answer, policy option 2+, followed by policy option 2 are the most favoured. 41% of the respondents ranked policy option 2 with a '2' or '3' in terms of the likelihood of it achieving the objective. On the other hand, 46% of the respondents ranked policy option 2+ with a '2' or '3' in terms of the likelihood of it achieving the objective. This is followed by policy option 3 (which received a ranking of '2' or '3' by 31% of the respondents). Policy option 1 was ranked as the least likely to achieve the general objective.

2. PUBLIC CONSULTATION ON EU LEGISLATIVE INITIATIVE ON SAFETY, RESILIENCE AND SUSTAINABILITY OF SPACE ACTIVITIES (EU SPACE ACT)

The public stakeholder consultation ran from **4 October to 28 November 2023**. The questionnaire was, similarly to the targeted stakeholder consultation questionnaire, divided into two parts:

1. questions about the respondent;
2. questions related to the current situation and the problem assessment, including the policy options.

The survey contained 11 questions of a general nature on safety and security risks to space activities, as well as on potential measures at EU level.

The consultation targeted a wide audience including: i) academic/research institutions; ii) business associations; ii) companies/businesses; iv) consumer organisations; v) environmental organisations; vi) NGOs; vii) public authorities; viii) trade unions; and ix) EU and non-EU citizens. **Contributions arrived from all over the world**, including the 27 EU Member States and from non-EU countries such as Canada, the United States, and the United Kingdom.

In total, 44 contributions were received, out of which 20 represented citizens, 10 represented an organisation, 8 academic or research institutions, 3 public authorities, 2 business associations, and 1 NGO. As regards companies, 80% of the respondents were large companies while 20% were SMEs.

Most of the respondents (91%) declared that they were aware or very aware of the **impact of a potential disruption of space-based services on their daily lives**. Therefore, responses show **significant awareness within the public opinion** on space matters, which aligns with the **strong rationale** on the **relevance and need** for a legislative framework regulating space activities in the EU to ensure the long-term sustainability and use of space.

Moreover, the public consultation shows that there is **consensus on the inadequacy of current national space laws for ensuring safe, resilient and sustainable space activities, with 75.5% of the respondents deeming them completely unfit or only partially fit for this purpose**. Respondents referred to the shortcomings of the current international legal framework governing space activities and stressed that current national space laws require updating to address challenges posed by commercial players, large satellite constellations and new technological developments.

Furthermore, around half of the respondents believed that the **best level of action to achieve the objectives of ensuring the safety, resilience and sustainability of space activities is at EU level, through a combination of binding measures and voluntary mechanisms.** This aligns with the findings of this study that identify policy option 2+ as the preferred choice. Most stakeholders also deemed this option to have the highest economic, social and environmental impacts. A large proportion of respondents (over 40%) also deem actions at the international level, such as negotiations leading to bilateral or multilateral agreements to be crucial in this area. Only a limited number of stakeholders (6%) supported the development of a framework based only on non-binding measures.

Safety pillar

The collected public opinion **aligns with the problems and risk identified** in the study and confirm the need for action to mitigate potential negative consequences of space activity leading to a **severe socio-economic impact on Earth and in orbit.** In particular, 75% of respondents perceive the risk of a major accidental collision in space and the potential for a chain reaction of collisions as a medium-high to high risk. Following closely, 59% of respondents consider the risk of an outage of essential space-based services to be of medium-high to high concern.

Meanwhile, the respondents identified the risk of casualties on the ground from re-entering space debris and the risk to aircraft in flights from re-entering space debris as low, although the risk to astronauts in orbit was perceived as a medium-level concern. This suggests that, according to public opinion, these specific risks may be viewed as less immediate or severe compared to the ones described above in the previous paragraph.

Regarding the measures that could be put forward by the proposed initiative, the majority of stakeholders ranked them as high with:

i) 56.8% of answers expressing a high level of interest in an end-of-satellite-life disposal plan;
ii) 52.3% in a space debris mitigation plan;

iii) 50% in a limitation on orbital lifetime after the end of satellite life; and iv) 38.6% in registration with a collision avoidance service.

Responses show more nuanced results for satellite passivation solutions, which were primarily ranked as medium by 31.8% of respondents. The answers suggest there exists a **grassroots** need for EU intervention and align with previous results stated above highlighting the magnitude and widespread awareness of public opinion on the matter.

Resilience pillar

Among the various space cyber and resilience risks presented in the survey, respondents identified the following as high risks: i) 'Difficulties in replacing or repairing systems/hardware on physical assets in space, once damaged or hacked'; and ii) the 'Risk of cyberattacks: Lack of standardisation regarding cybersecurity in space-based infrastructure'. The 'Low level of cyber protection or lack of cybersecurity updates in commercial off-the-shelf products used in satellites' ranked second in perceived risk, with 25% considering it a high risk. On the other hand, the the majority (72.7%) of respondents perceived 'Complexity of the international supply chain, relying on components from multiple manufacturers and sources' as a medium-low to medium-high risk .

While respondents labelled most cyber risks as high, the absolute number of respondents per risk magnitude suggests a lower awareness of these risks compared to those in the safety and environmental sustainability pillars. This underscores the need for increased awareness and EU intervention to address the risks affecting to the resilience and long-term sustainability of space activities in the EU.

As regards to the measures that could be envisaged by the legislative act under the resilience chapter, a significant majority of stakeholders ranked the proposed measures highly, with 45.5% expressing strong interest in enabling robust encryption protocols and 40.9% endorsing risk management measures for identifying vulnerabilities and handling incidents. In addition, 36.4% identified critical space assets as a high to medium-high priority. These responses underscore the widespread awareness and significance of public opinion on the matter, emphasising the need for EU action in these areas. Stakeholders also suggested additional measures to strengthen space resilience and cybersecurity, including: i) creating an EU information sharing and analysis centre for the space sector; ii) identifying and mitigating ground segment cybersecurity risks; iii) securing access to raw materials; and iv) adopting an end-to-end security approach integrating various technologies.

Environmental sustainability Pillar

On the environmental sustainability pillar, most stakeholders deem the proposed measures a high priority, showing a strong interest in establishing a common method to ensure the environmental footprint of space activities is addressed and endorsing environmental impact assessments for such activities. Responses show more nuanced results for the promotion of a circular economy in the space sector, with 22.7% ranking it as either a medium-high or medium-low priority. Stakeholders also proposed additional measures to promote the sustainability of space activities on Earth at EU level, including commitments to green IT standards and regulations that aim to ensure dark skies and quiet skies.

3. SURVEY ON EU SPACE ACT – SAFETY AND SUSTAINABILITY IN SPACE

The survey 'EU Space Act - safety and sustainability in space' ran from 29 September to 30 October 2023, and collected a total of **23 answers**. Most responses came from Spain (6). The rest of the responses come from other EU Member States such as Belgium, France, Germany, Ireland, Italy, Luxembourg, the Netherlands and Slovenia.

Of the respondents**, almost all are classified as either an SME or a mid-cap**. Only one micro-enterprise and two large companies responded to the survey. Moreover, not all responses come from the private sector. Four came from universities, one response from an international organisation, and one response from a governmental organisation.

Of the responding organisations, **13 are currently operating satellites, with two more planning to launch their first satellites in the next three years. Most of these companies operate LEO satellites, sometimes in combination with either GEO (geosynchronous orbits) or MEO (medium earth orbits).** Only 3 out of 11 do not operate any LEO satellite. Furthermore, most of these organisations operate less than 10 satellites in total. Only 4 operate more with 10, 12, 28, and 76 satellites, respectively, under management. Besides, six of the organisations possess design and/or production capabilities for satellites.

Most of the organisations **operate in several countries across the EU.** Besides, some of these organisations also have activities in the UK. However, in general, their base of operations is similar to that in the country indicated at the beginning of the survey. Besides, most indicate that the main reason for operating from this country is due to either cultural proximity or customer intimacy.

Virtually all organisations indicated that **regulatory arbitrage has not been an important consideration** for the location of their headquarters (HQ) or their base of operations. Instead, most responses indicated that business concerns such as customer intimacy have been more important. Only two organisations indicated that national regulations were a key factor. In both cases, the main concern was whether national legislatures allowed novel activities.

About half of the respondents indicated that their organisation usually abides by the national legislation of one Member State only. The other half of these organisations typically operate from/in several Member States and therefore must take into account the national legislation of these countries. Moreover, about a quarter also indicated that they have other laws to take into account, particularly those concerning telecoms and cybersecurity.

Most of the organisations **do not believe they have been directly impacted by laws in non-EU countries**. However, many are afraid that in future this could become a problem that impacts the competitiveness of their business. The organisations that have encountered such impacts from laws in non-EU countries cite laws on space debris, space security and space safety, frequency coordination and access to the 2 GHz band as the source of the impact.

Regarding the measures for improving space safety and sustainability, **almost all respondents stated that they are implementing measures like those mentioned in the survey**. In fact, most indicate that their organisation had already implemented many (10+) of these measures. Generally, most responses are positive about this list of measures as they see them as a useful starting point to improve space sustainability. However, there are concerns about technological limitations and the difficulty of implementing some of these measures. Also, some consider the measures incomplete or not precise enough to give a good analysis of their suitability. DG DEFIS has considered this feedback when selecting the proposed rules, and some measures were disregarded.

Most of the respondents indicated that considering the lack of technological solutions and that some of the measures lack precision, it is impossible for them to make an informed estimate on the costs of implementing such measures. Furthermore, it might also depend on the implementation deadline. Some numbers that were given are an estimate of **EUR 30 000-50 000 per year for precise orbit determination** and **EUR 10 000-100 000 for tracking devices per launch**. Another respondent estimated that, in particular, measure 5 ('Satellites in LEO to be operated above 650 km are deployed under that limit to test functionality') and measure 25 ('Re-entry shall either cause the satellite to demise completely or be performed in a controlled manner.') would be very costly. According to this estimate, the conjunction of those two measures would make **Active Debris Removal (ADR) unviable** as it could double or triple the cost of removing large derelict objects at high altitudes (the most dangerous ones). Besides, one respondent provided the estimate that these measures would create costs of approximately **EUR 50 000 for a 3-6U nanosatellite**.

4. SURVEY ON EU SPACE ACT – RESILIENCE

Following the workshop on the Resilience Pillar of the EU Space Act held on 18 October 2023, participants were requested to complete a questionnaire on the following: i) obstacles and barriers they faced; ii) potential measures to be proposed by the legislative initiative; iii) impact of the potential measures; and iv) incentives and support measures that the law could include. Three companies submitted responses to this questionnaire (two large space operators (Luxembourg and Germany) and one SME (Italy)).

All the respondents carry out their activities in more than one Member State and abide by national space legislation in different Member States. None of them reported having chosen to establish themselves or operate in a certain Member State based on the existence of more favourable laws on space resilience.

On the **barriers and obstacles** faced by companies when carrying out space operations outside the EU, one company replied that some countries have put measures in place that constrain their competitiveness. The measures they cited include: i) the existence of landing rights needed to provide access to the space segment; ii) the need to become incorporated in the country; and iii) heavy and costly licensing conditions to use radio spectrum usage or to import/install/use ground equipment.

When carrying out their activities within the EU in more than one Member State, one company reported that the difference between the security requirements included in programmes carried out on behalf of the EU (e.g. Galileo, EGNOS, Copernicus) and national requirements and regulations posed a significant obstacle for their business. They also reported difficulties in complying with differing regulations on key aspects such as security certification requirements and security risk methodologies.

All respondents ranked the likelihood of cybersecurity incidents targeting space systems in the coming years as ‘very high’.

Most respondents reported having in place risk management models in line with existing ISO standards. Nonetheless, this is based on a national approach, with no consolidation at EU level. Most respondents also saw a need for harmonised cybersecurity standards at EU level for the space sector, in line with some actions taken in this regard in the US (NIST).

None of the respondents were able to quantify the cost of the disruptions caused by cyberattacks, nor the cost of compliance with space security-related legislation at national and international level.

5. Survey on EU Space Act – Environment

The environment questionnaire that specifically addressed experts on LCAs conducted in the space sector ran from 2 October to 16 October 2023. The questionnaire was divided into two parts:

- questions about the respondent;
- questions related to the current situation (baseline), covering comparison, challenges and limitations of methods, user experience and resource allocation;
- questions related to the future, covering aspects linked to the policy options.

The questions related to the three sections are summarised below. In addition, the questionnaire included a set of closed questions and free text answers in which the respondent count insert position papers with more detailed feedback. The survey contained 19 questions.

The consultation targeted bodies/experts in the space sector such as academic/research institutions; spacecraft manufacturers; space operators; and citizens. Contributions arrived from EU and non-EU countries.

In total, 7 contributions were received, of which 4 represented an organisation, 3 represented citizens and 1 was an anonymous contribution.

The **questions related to the current situation (baseline)** concern a method comparison and evaluation process as part of addressing the environmental footprint of space activities. The first set of questions (1 to 4) focuses on comparing the effectiveness of three methods (ISO 14000 standards series, ESA LCA, GHG Protocol) individually, using rating scales and providing explanations on strengths and weaknesses. Questions 5 and 6 address challenges, limitations, and the user experience related to each method. Questions 7 and 8 delve into the relevance and accessibility for stakeholders. The last set of questions (10 to 13) explores resource allocation and costs associated with implementing LCAs. These questions covered the following: i) the reasons for conducting an LCA; ii) cost estimates; and iii) how resource constraints may influence method choice.

The replies provided to these questions stress that an LCA is carried out for many reasons, such as meeting customer requirements, certification, and product ecodesign. Among the evaluated methods (ISO 14000 series, GHG Protocol and ESA LCA), the ISO 14000 standards series and

ESA LCA are rated as effective, particularly for quantifying environmental footprints in a scientifically robust manner, with ESA LCA being recognised for its space-specific considerations. On the other hand, the **GHG Protocol is viewed less favourably for not quantifying the complete environmental footprint** and focusing primarily on greenhouse gas emissions. **Resource constraints impact the number and quality of assessments conducted more than the method choice**.

The **annual costs for various LCA-related activities vary significantly**. These costs vary depending on the LCA's complexity and scope, with some missions incurring expenses ranging from several hundred euro for specific technologies or materials to approximately half a million euro for complex or new products. The following all contribute to the total cost of an LCA: i) data collection and analysis; ii) software and tools; iii) consulting services; iv) access to life cycle inventory databases; v) tool customisation; vi) stakeholder engagement; vii) peer review and verification; viii) reporting and communication; ix) software training; and x) updating and maintenance**. Some respondents quantified annual costs, with figures ranging from EUR 5 000 to 60 000, depending on factors like workforce, data supply and database licences.**

User-friendliness varies, with **GHG Protocol considered more user-friendly**. Challenges and limitations in a space-specific LCA have been noted, and the **GHG Protocol is criticised for its data collection challenges and limited coverage** of certain environmental impacts. Respondents noted that **collecting data from stakeholders can be difficult**, and investment is required to raise awareness among stakeholders to ensure their understanding of the methodology. Furthermore, **the lack of a single industry-agreed score for evaluation complicates the user experience.** While the ESA LCA framework is deemed robust and scientifically sound, its user-friendliness can be increased through addressing data collection challenges and potentially introducing a standardised scoring system.

ISO 14000 and ESA LCA methodologies have several shortcomings that need to be addressed for more effective environmental impact assessments, particularly in the context of the space industry. Challenges in **data collection and the lack of a single industry-agreed score make these standards less user-friendly.** While **ESA LCA** is recognised as more space-specific, it still **lacks success stories on its adaptation**, and both standards may **not comprehensively cover all environmental impacts**. The implementation of both standards is also affected by **data accessibility issues, difficulties in setting organisational boundaries, and the need for a clearer and more coherent approach**. Despite these limitations, ISO 14000 and ESA LCA remain valuable for assessing environmental impacts, and addressing these shortcomings could step up their use in the space industry and other sectors.

The **forward looking questions** revolve around the potential benefits of standardising LCA methodologies for stakeholders in the space sector and soliciting opinions and recommendations on how to achieve this. The replies revealed a **strong consensus among respondents on the benefits of standardising** LCA methodologies in the space sector. Experts emphasised that a **standardised approach could simplify assessments, reduce costs, and promote data reuse, leading to a level playing field for evaluating environmental performance. Access to sustainable finance could be facilitated** for companies if they can show that they have taken action to mitigate the environmental impact of their activities.

However, some believe that the choice of methodology should be based on the specific context of the mission and **suggest a combination of hard-law and soft-law approaches to address environmental priorities effectively.** The preferred LCA methodology varies, with some recommending ISO 14000 series-based methods like ESA LCA or product environmental footprint (PEF) for quantifying environmental footprints beyond greenhouse gases**. Data gaps, uncertainties, reusability, and data quality are identified as critical considerations.**

The **adoption of a standard LCA methodology may help normalise sustainability efforts, particularly in the face of greenwashing concerns.** The choice of methodology is influenced by the organisation's maturity, and it is has been suggested that LCAs should be made mandatory in procurement contracts to drive adoption. The **selection of methodological aspects should be transparent and logical, considering the main end users.** There's a **consensus that harmonising LCA practice in the field, with adjustments for space-specific assessments, is essential to avoid biased results.**

There is a question over mandatory versus voluntary adoption, with **some favouring a mandatory adoption for a more significant impact, while others consider a voluntary adoption as a minimum standard**. Ensuring transparency in the selection of methodological aspects and harmonising LCA practices in the space sector are also widely supported objectives.

In summary, while there is **support for a standard LCA methodology**, there is also recognition of the need for flexibility to address specific mission contexts and priorities. **Data quality and harmonisation are key aspects in method selection,** and **integrating LCAs into the supply chain is seen as crucial** for sustainability efforts in the space sector.

6. DIALOGUE WITH STAKEHOLDERS AND DEFINITION OF SHARED AMBITION FOR A LCA METHODOLOGY FOR SPACE ACTIVITIES

DG DEFIS launched a consultation process in 2022 which aimed to help define a shared ambition and deliver a first agreed roadmap regarding further developments of the life cycle environmental footprint of European space activities and product-specific environmental footprint category rules. Entitled 'Coordination, dialogue with stakeholders and definition of shared ambition', it built on the current state-of-play in the sector and aim to:

- identify work already done or ongoing;
- analyse the missing 'building blocks' for a comprehensive and workable life cycle environmental footprint framework (e.g. building on PEFCR) for European space activities/programmes;
- designing a workplan and resource management among the stakeholders

The goal of this process was to support the work of the European Commission by: (i) helping build consensus around a shared vision; (ii) **analysing the feasibility of developing a PEFCR** focusing on key technical aspects; and (iii) delivering an **initial agreed roadmap** for the development of life cycle environmental footprints of **European space activities and sector-specific footprint rules.**

During this project, **three stakeholder workshops were organised** to gather valuable inputs and feedback from experts. The workshops took place on 30 June, 28 September, and 7 October 2022. In addition to the workshops, **there were 39 bilateral expert meetings** with stakeholders from academic/research institutions, spacecraft manufacturers, space operators, public authorities, and citizen groups.

During the workshops, participatory methods were used to **ensure the inclusion of all of the stakeholders' key perspectives.** The collaborative process resulted in a tangible report outlining a **common framework for environmental footprint studies in European space activities**. Simultaneously, it achieved intangible goals, such as creating a **blueprint for future cooperation and establishing a network to foster trust and understanding among stakeholders.**

Over six months, **several principles guided the weekly meetings and workshops**, emphasising the need for: i) new solutions; ii) **participant-driven discussions**; iii) self-organised spaces; iv) strategic visualisations for common understanding; v) knowledge transfer; and vi) visual artifacts to make insights visible.

The primary outcomes of the workshop and the series of bilateral expert meetings point to the **immense potential in creating a PEFCR for space activities**. This initiative presents a standardised framework with the capacity to streamline the assessment of environmental impacts, decrease the expenses and time associated with studies, and elevate the comparability and transparency of findings. The **space industry has shown resolute support for this approach, underscoring the need for a comprehensive, transparent, and scientifically robust methodology for conducting LCAs on space-related endeavours**. This backing extends to considering the application of PEFCRs across various operational aspects, **encompassing the selection of space infrastructure, product certification, environmental target setting, results comparability, and competitiveness increase**. The process of crafting or revising a PEFCR, as delineated in the most recent PEF recommendation, entails several pivotal stages, including: i) the development of representative products; ii) draft PEFCR versions; iii) auxiliary studies; iv) stakeholder consultations; and v) an impartial review.

Nonetheless, this undertaking, while promising, **presents distinctive challenges and intricacies**, particularly within the context of the space industry. Therefore, gaining a thorough understanding of the time needed, resources needed, and critical hurdles is imperative before developing a novel PEFCR for space activities. While all the technical requirements to be fulfilled are outlined in the PEF recommendation, the consultation process helped to list those that might lead to significant discussions among the members involved in the PEFCR for developing space activities. **These content-related discussions do not necessarily block the development of the PEFCR and can be easily overcome if the European Commission decides to take a decisive role**. Therefore, they are considered to be of **low risk as regards blocking the PEFCR development process**. The findings indicate a comprehensive set of actions that need to be carried out in the short-term, medium-term, and long-term for a specific project. In the short-term, key actions involve appointing a neutral facilitator, selecting team members, and clarifying funding and resource needs. Medium-term actions include stepping up collaboration, developing missing impact categories, and improving sector-specific flows. The long-term actions focus on setting up data-collection systems, adding essential impact categories, and continually updating reference packages with missing data. **These findings provide a clear roadmap for the project's successful execution, with a strong emphasis on collaboration, data development and efficient resource management.**

ANNEX 4: WHO IS AFFECTED AND HOW?

1. PRACTICAL IMPLICATIONS OF THE INITIATIVE

The preferred policy option (2+) envisages an EU binding framework being adopted to regulate the safety, resilience and environmental sustainability of space activities, paired with non-binding and support measures. This initiative will **support the development and functioning of an EU internal market for the space sector by aligning in a consistent and cohesive manner** national licensing requirements on safety, resilience, and the environmental impact of space operations. To ensure a level playing field, these rules would also apply to non-EU companies willing to enter the EU single market. Therefore, the initiative would affect the following stakeholders:

Table 1: Scope of application

EU (public and private) actors	EU satellite operators[3]: they will have to comply with certain measures related to safety, resilience, and environment sustainability[4].
	EU operators providing a 'launching' service: they will have to comply with certain measures related to safety, resilience, and environmental sustainability[5].
	EU (established) providers of (different types) of space-based services: they will provide and use only data/services derived from the use of satellites that comply with the EU measures[6]. This rule would apply to all types of space-based services and should affect all providers of such data[7]: - Satellites producing space-based data, such as for Earth observation: e.g. Copernicus; - Companies using space-based data for providing different services (i.e. gathering of space data in hubs, space applications …).
	Manufacturers of space infrastructure: they would be subject to certain risk management rules to ensure that their processes (manufacture, installation, repair) are resilient.
Non-EU actors	Providers of 'launching' services established in a non-EU country – where the EU satellite operator choses to launch its satellite from a non-EU country and the satellite-based services are intended to be provided in the EU.

[3] Not covering satellites used for exclusively military purposes.
[4] Ultimately this means that only operators that have implemented these obligations (and, consequently, only satellites for which the operators have shown observance of such rules) can obtain a licence at national level.
[5] Ultimately this means that only those launchers for which operators have shown observance of rules can be used by EU satellite operators for the launch activity / service.
[6] Ultimately this means that only data/services derived from the use of satellites that comply with the EU Space Law can circulate in the internal market.
[7] While certain exceptions could be envisaged.

	Providers of space-based services will be covered if they intend to provide their services in the EU[8].

The EU Agency for the Space Programme (EUSPA) would also be relevant in options 2 and 2+, where it would have competences regarding the reporting of cybersecurity incidents for EU-owned assets. It could also help ensure that the requirements are complied with at national level in cases where a technical body does not exist, or a Member State decides to delegate this task to EUSPA. The EU Cybersecurity Agency (ENISA) would develop certification schemes tailored to the space sector.

The preferred option is broadly supported by consulted stakeholders, with 46% of the respondents to the targeted consultation giving policy option 2+ a ranking of 2 or 3 in terms of the likelihood of the option achieving the objectives (see Annex 3).

2. Overview of costs and benefits

Table 2: Overview of costs and benefits for the public and private sector (including SMEs)

	Costs	Benefits
Public sector	**Overheads**: 1-4 FTEs per Member State depending on the maturity of its space sector Up to 15 FTEs for the technical body, plus 2 FTEs for label management for EUSPA, 1 FTE for ENISA for certification schemes tailored to space (for ICT products, services, processes) **Label:** EUR 3 m for developing and implementing the label (EUSPA) **Standards**: EUR 10 m/15 m (EUR 1 m per standard) **Enforcement:** EUR 2-3 m per year	**Lowered overall administrative costs** thanks to regulatory simplification Member States preserve the possibility to use space to allow government missions (military and civilian) to continue Shared costs for developing best practices with the industry
Private sector (including SMEs)	**Satellite operator**: Manufacturing costs – up to 10% of the satellite platform, depending on the level of requirements and the features of the space mission	**Regulatory simplification**: greater market access (1 product, 27 Member States), faster time to market, [poss. 1 licence per constellation rather per individual satellites]

[8] Ultimately, this means that non-EU satellite operators/providers of services will not be able to sell data or provide services within the EU until a check has been carried out (by EUSPA or national bodies notified by Member States as responsible for analysing requirements) and confirms these operators (and consequently the satellites for which they are granted a licence to operate) comply with the EU requirements on safety, resilience and environmental sustainability.

	Costs	Benefits
	Launch service provider: up to EUR 1.5 m for heavy launchers (Ariane 64 class) **Launch service provider (SMEs)**: EUR 200 000 **All**: Risk management costs: 10% of a company's IT budget EUR 100 000 for licensing requirements per product line EUR 4 000-8 000 for implementing the PEFCR	More **revenues due to life extension** of satellite (from five to six years in LEO for a typical satellite) leading to an annualised economic effect of EUR 1.3 bn. **Global competitive advantage**: first mover and high level of protection means that companies boost the competitive advantage vs non-EU competitors. Long-term: **preservation of the EU space business**, 20% of EUR 700 billion in 2031 Development of **new business segments** (such as: active debris removal, OSAM, encryption)

Table 3: Detailed overview of benefits – preferred option

I. Overview of benefits (total for all provisions) – preferred option	
Description	***Comments***
Direct benefits	
Reduced space debris generation, ensuring operations continue and mitigating disruption and manoeuvring costs	Industries engaged in space activities, including satellite operators and space agencies, stand to benefit directly from increased operational efficiency and cost savings stemming from the establishment of binding and non-binding safety measures. From an economic point of view, the preferred option will provide an annual economic effect to the European satellite operators that can be estimated at EUR 674 m. Comparing this benefit to the costs described in the previous section leads to a net benefit for the European satellite operators of EUR 494 million annually. In addition, people relying on satellite-based services, such as telecommunications and weather monitoring, would receive more reliable and resilient services, helping to improve overall societal well-being. Therefore, the regulatory framework positively impacts both the space industry and the broader public by fostering a safer and more sustainable space environment.
Reduced cybersecurity risks ensuring business continuity and mitigating disruption costs	The approach proposed by option 2+ would fortify space systems against potential cyber threats, safeguarding critical infrastructure and sensitive data. Industries involved in space-related ventures, including satellite operators and technology providers, would directly benefit from increased resilience, ensuring uninterrupted operations and mitigating the costs associated with cybersecurity breaches and disruptions. The benefits of the cyber protection required under the preferred option would also add to the overall benefits. The cost of cyberattacks is considered to be 5 times the cost of cyber protection allowing for an annual benefit of EUR 320 million for European manufacturers of space machinery. Beyond the industry, people relying on space-based services, such as navigation and communication, would experience improved reliability and security.
Companies implementing incentive measures/safety labels would gain share in the EU market and boost their global competitiveness	Companies proactively adopting non-binding measures on the three key elements covered by the law (safety, sustainability and resilience) and implementing space

	safe labels stand to gain a competitive edge in the EU market. By showcasing a commitment to safe, sustainable and resilient practices, these companies would not only boost their market share within the EU but also bolster their global competitiveness. The appeal of safety-conscious and incentivised space activities could attract international partners and customers, positioning these companies as leaders in responsible and sustainable space practices.
Improved environmental performance and sustainability in the space sector	The development of a PEFCR method for measuring the environmental footprint of space activities could help industry to systematically identify areas where environmental efficiencies can be achieved. This could lead to a potential reduction of resource consumption, energy use, optimisation of manufacturing processes, etc. throughout the life cycle of space activities.
Indirect benefits	
Environmental benefits: reducing CO_2 emissions and achieving EU and global environmental goals	Systematically implementing a methodology to assess the environmental footprint of space activities would allow environmentally friendly technologies and practices to be developed and integrated across the space value chain. As a result, the sector can move towards more sustainable practices that align with EU and global environmental goals.
Creation of new business opportunities in the space cybersecurity, space safety and space sustainability domain (such as: encryption services and technologies; space situational awareness services; collision avoidance systems; green propellants)	Following the establishment of a binding framework regulating the safety, sustainability and resilience of space activities, companies conducting their activities in these sectors could capitalise on the growing demand for compliance with these measures. This legal framework not only ensures responsible space practices but also stimulates economic growth by creating a dynamic market for cutting-edge space services and technologies within the EU.
Stable and clear legal framework encouraging private investment in space start-ups and SMEs	Clarity in regulations would instil confidence among investors, mitigating uncertainties associated with legal compliance and potential risks. This stability would reduce perceived barriers to entry, making the space sector more attractive for private investment (NB: based on the commercial growth of current start-ups, the total investment need for the next seven years is estimated to be EUR 10 billion). As regulations address safety and sustainability, investors are more likely to view space ventures as responsible and forward-thinking, further boosting the

	sector’s appeal. Compliance with such rules would also make companies eligible for green financing.
Increased awareness on the importance of cybersecurity, safety and sustainability of space operations	Establishing an EU Space Act would increase awareness among stakeholders of the importance of space activities and their safety, sustainability and resilience. This increased awareness would extend across governmental bodies, private companies, and the general public, fostering a collective commitment to securing space assets, ensuring operational safety, and promoting sustainable practices. This would also encourage collaboration and innovation in addressing the multifaceted challenges faced by space operators and strengthen the EU’s strategic position as a global space leader.
Triggering of similar regulatory efforts at global level	Implementing a comprehensive legal framework on space activities by the EU could catalyse global regulatory efforts, positioning the EU as a standard-setter, similarly to what was achieved through GDPR in terms of data privacy. The influence of the EU’s regulations, driven by its significant role in the space sector, may encourage other nations to adopt similar measures, encouraging harmonisation and cooperation on an international scale. The EU’s reputation for setting high standards, combined with the inherently global nature of space activities, boosts its potential to shape a unified approach to safety, sustainability, and resilience in the global space industry. By taking the lead on this, the EU could also boost the global competitiveness of its industry, by ensuring that non-EU countries do not impose their regulations and standards on these three key aspects.
Administrative cost savings related to the ‘one in, one out’ approach*	
Compliance costs	Affected stakeholders: - satellite operators, operators of launch services, manufacturers of space machinery, providers of space-based services - responsible authorities
Prevent internal market fragmentation that results in divergent national legal frameworks regulating the safety, resilience and sustainability of space activities	Affected stakeholders: - Businesses – reduced administrative costs related to compliance with different national legislations and the creation of a licensing process per product line instead of per satellite enabling constellation operations to save approximately EUR 68 million over the next decade.

(1) Estimates are gross values relative to the baseline for the preferred option as a whole (i.e. the impact of individual actions/obligations of the preferred option are aggregated together); (2) Please indicate which stakeholder group is the main recipient of the benefit in the comment section;(3) For reductions in regulatory costs, please describe details as to how the saving arises (e.g. reductions in adjustment costs, administrative costs, regulatory charges, enforcement costs, etc.;); (4) Cost savings related to the 'one in, one out' approach are detailed in Tool #58 and #59 of the 'better regulation' toolbox.

** if relevant*

Table 4: Detailed overview of costs – preferred option

II. Overview of costs – preferred option							
		Citizens/consumers		Businesses		Administration	
		One-off	Recurrent	One-off	Recurrent	One-off	Recurrent
Safety, resilience and sustainability measures	Direct adjustment costs	n/a	n/a	For resilience: see specific estimations based on use cases for the costs of measures in the Restricted Annex. In addition, general estimation in resilience: Cost of risk management: as a proxy, building an inventory management system may vary between EUR 80 000 to 240 000 for a solution of average complexity; and between EUR 240 000 to more than 380 000 for a large-scale system integrated with hardware and that provides inventory analytics (most large companies already	For resilience: see Restricted Annex. Costs of implementing the risk management framework for space systems; carrying out risk assessments; detection, protection measures, business continuity measures; risk management for the supply chain. In general, the recurring cost of cyber protection is considered to be 1% of the annual turnover. For space manufacturers and operators, it could cost EUR 80 million Safety: Cost of establishing, maintaining and promoting the label: In total, this adds up to EUR 3.28 million annually for the governance costs.	Environment: Cost of developing the specific PEFCR for the space sector: EUR 2 450 million (for EU Commission)	n/a

				have this system in place) Cost of developing a PEFCR for space activities: estimated in EUR 2.5 million Environment: Cost of carrying out a PEFCR for the space activities: around EUR 8 000, and EUR 4 000 in case the PEFCR already exists.	Increased costs for satellite operators due to the increased technical requirements for preventing debris leading to an increase in the manufacturing cost of the satellite platform from 3 to 10%		
	Direct administrative costs	n/a	n/a	For resilience: see estimations for the costs of measures in the Restricted Annex	n/a	Setting-up national security monitoring centres	Increase need for staff due to the new technical requirements. - 1 to 2 FTEs for Member States that have an established space sector (11 Member States) - 4 FTEs for Member States drawing up a space law (5 Member States) - 15 FTEs for EUSPA for Member States that choose to trust EUSPA as the notifying body - 2 FTEs for EUSPA for developing the label

							- 1 FTE for ENISA for certification scheme: EUR 4.4 m annually Ongoing obligations (For EUSPA receiving reports of significant incidents from space operators operating EU-owned assets); for national monitoring security centres, costs for processing the data received during the reporting + assessment of an incident. Total overhead cost of EUR 4.4 million annually Monitoring the specific features for the light regime
	Direct regulatory fees and charges	n/a	n/a	n/a	n/a	n/a	n/a
	Direct enforcement costs	n/a	n/a	EUR 100 000+ for the licensing requirements	Safety: Recurrent ROM cost estimate, can be reduced through technology developments:	Setting-up relevant national authorities Monitoring compliance with the risk management rules:	EUR 2-3 million for EUSST

					- small, medium to large satellites: ~3 - 10% platform cost - Cubesat/ nanosat: < EUR 300 000 **Safety; cost of applying and using the label**: The annual costs for using the EU Ecolabel are as follows: micro-enterprises pay between EUR 200 and 350; SMEs pay between EUR 200 and EUR 600; all other companies pay between EUR 200 and 2000. The maximum annual fee is capped at EUR 18 750 for micro-enterprises and SMEs; and, EUR 25 000 for all other companies	For the EU Ecolabel and the annual fee for using the Ecolabel. The maximum annual fee is capped at EUR 18 750 for micro-enterprises and SMEs; and EUR 25 000 for all other companies	
	Indirect costs	n/a	n/a	For resilience: see Restricted Annex	For resilience: see Restricted Annex	n/a	n/a
Costs related to the 'one in, one out' approach							

Total	Direct adjustment costs	n/a	n/a	Familiarisation with new requirements: n/a	EUR 290 million (on an annual basis)	n/a	n/a
	Indirect adjustment costs	n/a	n/a	n/a	n/a	n/a	n/a
	Administrative costs (for offsetting)	n/a	n/a	n/a	1.5 FTEs leading to a total overhead cost of EUR 2.4 million annually.	59 FTEs	n/a

(1) Estimates (gross values) to be provided with respect to the baseline; (2) costs are provided for each identifiable action/obligation of the preferred option, otherwise for all retained options when no preferred option is specified; (3) If relevant and available, please present information on costs according to the standard typology of costs (adjustment costs, administrative costs, regulatory charges, enforcement costs and indirect costs). (4) Administrative costs for offsetting as explained in Tool #58 and #59 of the 'better regulation' toolbox. The total adjustment costs should equal the sum of the adjustment costs presented in the upper part of the table (whenever they are quantifiable and/or can be monetised). Measures taken to compensate adjustment costs to the greatest extent possible are presented in the section of the impact assessment report presenting the preferred option.

3. SUMMARY OF COSTS AND BENEFITS

The tables below (Table 5 and Table **6**) provide a summary and overview of the main costs and benefits associated with the preferred policy option.

The main assumption taken to carry the cost-benefit analysis was that the legislative act would reduce the amount of space debris by 50% by 2034 due to increased sustainability of space activities. In addition, regarding the space sector's resilience, the main assumption is a reduction in cyberattacks on space infrastructure operators leading to reduced disruption of space-based services. This reduction of space debris will be enabled by an overall increase in the protection of space assets due to higher standards for satellite shielding and requirements for satellite passivation and end-of-life de-orbitation. The registration of EU and non-EU satellites in the EUSST register would also allow for better prediction of in-space close encounters, leading to better coordination between satellite operators, therefore reducing the need to carry out on-orbit manoeuvres and limiting the risk of collision with space debris.

The data used for the analysis comes from ESA, national space agencies, the targeted and public consultations supporting this report (collecting 333 and 44 replies, respectively) and the dedicated industry workshops (which gathered over 170 participants).

For a detailed assessment of the costs of resilience measures, see the Restricted Annex.

Table 5: Summary of expected costs

	Costs
Compliance	EUR 136 million annually (1% of annual turnover of the upstream and midstream)
Manufacturing costs	EUR 180 million annually
Private overhead	EUR 2.4 million annually
Administrative overhead	EUR 4.4 million annually
Total costs	**EUR 322.8 million annually**

The overall sustainability and resilience requirements would increase costs for satellite operators by EUR 322.8 million. However, this could be partially negated depending on the specific practices of satellite operators.

Table 6: Summary of expected benefits

	Benefits
Operational benefits	EUR 674 million annually
Resilience benefits	EUR 320 million annually
Regulatory simplification benefits	EUR 6.3 million annually
Total benefits	**EUR 1 000.8 million annually**
Total benefits minus costs	**EUR 677.5 million annually**

Assuming that an EU Space Act would help reduce space debris by 50% over the next 10 years, such a law would benefit satellite operators annually to the tune of EUR 677 million, completely offsetting the costs driven by the higher requirements stemming from the law. Those benefits do not take into account the market opportunities that will be created thanks to the emergence of new markets, such as in-orbit servicing, which at this stage are not mature enough to be objectively quantified.

Overall, the costs for business will be largely offset by: i) the preservation of the long-term sustainability of the space environment that would allow the space industry to continue building, launching and operating space assets, and ii) the benefits for EU citizens thanks to the continued availability of space-based downstream services.

4. RELEVANT SUSTAINABLE DEVELOPMENT GOALS

Space-based data and services have the potential to help achieve a broad range of Sustainable Development Goals (SDGs), therefore helping fulfil the objectives and apply the guidelines and recommendations set out in the 'Space2030' Agenda, including regional strategies, such as the EU Green Deal. There are multiple studies that help the space sector achievement of Sustainable Development Goals, including UNOOSA/EUSPA joint report 'Contribution to the 'Space2030' Agenda: EU Space - Supporting A World Of 8 Billion People'[9] and 'European Global Navigation Satellite System and Copernicus: Supporting the Sustainable Development Goals. Building Blocks towards the 2030 Agenda[10].

As key enablers, the protection of space assets therefore also protects the continued contribution of space for most of the Sustainable Development Goals. Therefore, a legal framework regulating the safety, sustainability and resilience of space activities that ensures the long-term use of space would indirectly support the achievement of most SDGs. However, the analysis included in the table below will focus on the direct impact of option 2+ on relevant SDGs.

[9] EU SPACE supporting a world of 8 billion people, unoosa.org/res/oosadoc/data/documents/2023/stspace/stspace85_0_html/st_space_085E.pdf.

[10] European Global Navigation Satellite System and Copernicus: Supporting the Sustainable Development Goals. Building Blocks Towards the 2030 Agenda, https://www.unoosa.org/res/oosadoc/data/documents/2018/stspace/stspace71_0_html/st_space_71E.pdf.

able 7: Overview of relevant SDGs - preferred option

III. Overview of relevant SDGs – preferred option(s)		
Relevant SDG	**Expected progress towards the Goal**	**Comments**
SDG No 13 – Climate Action	Space technologies play a central role in: - climate change monitoring - weather forecasting - disaster management - search and rescue operations. Ensuring the safety and resilience of space activities through a binding framework will prevent disruptions and ensure continuity of these critical services. Moreover, the development of a PEFCR method for the space sector would allow environmentally friendly technologies and practices to be developed and integrated across the space value chain. As a result, the sector can move towards more sustainable practices that enable the achievement of global climate objectives.	The European Commission will leverage its research programme Horizon Europe to help companies (especially start-ups and SMEs) develop the necessary technologies to ensure compliance with the measures included in the legislative proposal (e.g. alternative/green propellants and electric propulsion systems).
SDG No 8 – Decent Work and Economic Growth	Option 2+ would create a stable and clear legal framework in which the following would be fostered. - Industry expansion and innovation: a stable and predictable environment encourages private investment and industry expansion. This leads to increased innovation and economic growth within the sector, particularly for start-ups and SMEs, boosting the global competitiveness of EU space industry. - Job creation: the growth of the space industry, spurred by a robust legal framework, would create employment opportunities. The development of new markets and business opportunities would also create employment opportunities.	

III. Overview of relevant SDGs – preferred option(s)		
Relevant SDG	**Expected progress towards the Goal**	**Comments**
	Technological transfer: emphasis on sustainability, safety and resilience of space activities would also encourage the development and adoption of new technologies. These may find applications beyond the space sector, contributing to advancements in other industries and sectors of the economy.	
SDG No 9 - Industry, Innovation and Infrastructure	A clear legal framework paired with supporting measures for industry would allow safe, sustainable and resilient space-based infrastructure to be developed, increase the inclusivity of the industry by supporting SMEs, and stimulate innovation through research and development incentives. The development of a PEFCR method for the space sector would allow environmentally friendly technologies and practices to be developed and integrated across the space value chain. The creation of new markets and business opportunities would drive sustainable industrialisation and technological solutions across the EU, while prompting the development of new skills.	
SDG No 12 - responsible consumption and production,	The establishment of a binding framework on the sustainability of space activities would help industry to systematically identify areas where environmental efficiencies can be achieved. This could lead to, e.g. potential reduction of resource consumption and energy use, and optimisation of manufacturing processes, throughout the life cycle of space systems.	The European Commission will leverage its research programme Horizon Europe to help companies (especially start-ups and SMEs) develop the necessary technologies to ensure compliance with the measures included in the legislative proposal (e.g. alternative/green propellants and electric propulsion systems).
SDG no. 17 – Partnerships for the Goals	The implementation of a comprehensive legal framework on space activities by the EU could catalyse global regulatory efforts, positioning the EU as a standard-setter, similarly to what was achieved through GDPR in terms of data privacy. The influence of the EU's regulations,	

III. Overview of relevant SDGs – preferred option(s)		
Relevant SDG	**Expected progress towards the Goal**	**Comments**
	driven by its significant role in the space sector, may encourage other nations to adopt similar measures, fostering harmonisation and cooperation on an international scale. The EU's reputation for setting high standards, combined with the inherently global nature of space activities, increases its potential to shape a unified approach to safety, sustainability, and resilience in the global space industry.	

ANNEX 5: ANALYTICAL METHODS

This Annex provides an overview of the analytical methods used for this impact assessment. The paragraphs below will first describe the different data collection tools, and second, detail how the multi-criteria analysis methodology is developed and applied. To collect fit-for-purpose data, a multi-channel data collection process was prioritised. The objectives of this data collection structure were to broaden the reach of information collected and allow for a self-sustained cross checking of data across sources. This process is most relevant in the example of space-related data as this is often sensitive or non-disclosable due to the strategic nature of the industry.

The collection of data included the following activities.

a) Desk research

Extensive desk research was conducted to build up knowledge of the current state of play, problems faced by different types of stakeholders, and trends. Research areas included finding quantitative evidence related to the current situation, the scope and magnitude of impacts, and the upcoming trends in the space sector. The findings informed the data on intended and unintended impacts required for the impact assessment.

b) Semi-structured interviews

From June to August 2023, 16 interviews were conducted as part of the EU Space Act impact assessment support study. Primary data from experts from a wide range of relevant stakeholders was collected, including: i) officials from European and national public entities in the field of space policy; ii) large commercial space operators; iii) SMEs active in the field; and iv) international organisations. These interviews had a dual aim: (i) collect qualitative insights on the current situation as well as potential impact expected from the creation of the Space Law; and (ii) consolidate quantitative data to best tailor estimations provided in the study. When conducting the interviews, the team carried out the following actions: (i) shortlisting relevant stakeholders; (ii) drafting tailored questionnaires per category of stakeholder targeted; (iii) creating a feedback loop process on the questionnaires with the Commission until validation of the document; (iv) reaching out to and scheduling interviews with shortlisted stakeholders; (v) conducting interviews; (vi) reporting on interviews; and (vii) analysing collected data.

c) Stakeholder consultations

Stakeholder consultations included a public consultation, a targeted stakeholder public consultation, surveys and workshops – see Annex 3 for more details. To assimilate the information collected, special emphasis was put on specific approaches to data analysis tools. This section highlights the different data analysis tools applied to achieve the objectives of this impact assessment.

d) Data triangulation

Data triangulation creates a systematic overview of the results of different consultation methods. This provided us with both qualitative and quantitative information that allowed us to achieve two objectives: (i) to compare and analyse all input from different sources, to spot any contradictions or inconsistencies in the information collected, and ensure all inputs on a given subject lead to coherent findings; (ii) to increase the reliability of certain findings by relying on a combined analysis of data coming from different sources and verifying the results against each other. Through the data triangulation, the study team was able to sense-check the study's findings and data.

e) Impact analysis

In line with the three categories of impacts (economic, social and environmental) identified in the Better Regulation Toolbox, the study team classified the different insights gathered during the data collection into specific sub-impact categories. The study team developed a systematic classification methodology to complement the impact narrative and populate the research with data collected. Firstly, the study team proceeded to consolidate the data gathered, as well as its classification under the three overarching impact categories. Secondly, based on the outputs of the data triangulation, the study team identified specific sub-impacts associated with the policy options set forward. The results of this analysis led to a detailed compilation of impacts expected per policy option.

Cost-benefit analysis (CBA)

In line with standard cost-benefit analysis methodology, a cost-benefit analysis was carried out with the support of a consultancy company. The data used for the CBA came from national space agencies (CNES, DLR), ESA, EUSPA and market research as well as stakeholder consultations. The overhead calculation uses data from the EU standard cost model. The CBA methodology is based on a multi-criteria analysis, combining monetised and non-monetised elements to measure the achievement of the objectives in policy options 2 and 2+. The costs implied by the initiative was quantified in direct financial cost and compared to the monetary benefits that would be enabled by the policy options.

f) Multi-criteria analysis model

In line with the Better Regulation Guidelines, a multi-criteria analysis (MCA) was carried out to assess the policy options. An MCA enables the comparison of policy options against several different independent criteria. The most significant impacts were assessed both qualitatively and quantitatively (insofar as possible) and expressed as a comparison with the baseline scenario. For this purpose and in line with the Better Regulation Toolbox, three assessment criteria were applied and answered the following questions for each policy option.

- **Effectiveness:** How successful would the intervention be in achieving its objectives?
- **Efficiency:** What would the estimated categories of costs and benefits be for the different stakeholders?
- **Coherence:** To what extent is this intervention consistent with other EU and national interventions that are similar and with one another?

This assessment was carried out based on the following scoring system:

- -3 represented a downgrade as compared to the baseline;
- +3 represented an improvement as compared to the baseline.

The scores captured the performance of each policy option on the different assessment criteria. These are then aggregated and further compiled into a permutation matrix providing a final ranking of the preferred policy options.

ANNEX 6: DETAILED PRELIMINARY MAPPING OF NATIONAL SPACE LEGISLATION IN THE EU

Preliminary mapping performed by a contractor as part of the study supporting the impact assessment report[11].

1. EU MEMBER STATES' NATIONAL LEGAL FRAMEWORKS FOR SPACE ACTIVITIES

Table 8: Member States' national legal frameworks for space activities

Country	National instrument(s)	Scope of application	General conditions for licensing[12]	Modification, revocation or suspension of licence	Transfer of licence
Belgium	**Law** of 17 September 2005 on Activities of Launching, Flight Operation or Guidance of Space Objects (revised in 2013) Royal **Decree** of 15 March 2022 Implementing Certain Provisions of the Law of 17 September 2005 on Activities of Launching, Flight Operations and Guidance of Space Objects Operator **Handbook**	The Law on the Activities of Launching applies to **activities** involving the launch, flight operations and guidance of space objects carried out **by natural or legal persons in the zones** placed under the jurisdiction or control of Belgium or using installations, personal or real property, owned by Belgium or under its jurisdiction or its control. The law may also apply to these activities when carried out by natural or legal persons of Belgian nationality if provided for under an international agreement, **regardless**	Space activities require **authorisation** by the Minister with responsibility for space research. The activities must be in accordance with **international law**. The King may impose general conditions for the authorisation of space activities in order to ensure the **safety of persons and goods, environmental protection, the optimal utilisation of airspace and outer space** and the protection of strategic, economic and financial interests of the State, and to comply with Belgium's obligations under international law.	Licences can be **modified, revoked or suspended** in cases of non-compliance with the general or specific licensing conditions, a breach of legislation and compelling reasons of public order or the safety of persons or goods.	In principle, licences **are not transferable. However**, a licence can be transferred if prior authorisation is sought and granted by the Minister with responsibility for space research. The transfer of licences is subject to the same conditions as for licensing.

[11] Contract SC L02/14 Impl. FWC 712/PP/2018 Lot 2. Findings in this preliminary mapping should in no way prejudge or affect the outcome of an analysis or assessment that may be carried out by the Commission.
[12] These conditions are further detailed in Tables 2 and 3 of this Annex when they concern matters of safety and sustainability.

Country	National instrument(s)	Scope of application	General conditions for licensing[12]	Modification, revocation or suspension of licence	Transfer of licence
		of the location where such activities are carried out.	The Minister with responsibility for space research can impose specific **conditions** for the authorisation of a space activity in order to achieve the these aims. In particular, the Minister may impose the **technical assistance** of a third party, set conditions for the location of the activities or the location of the main establishment of the operator or impose taking out insurance to cover damage to third parties.		
Denmark	Outer Space **Act** (Act No 409 of 11 May 2016) Executive **Order** on requirements in connection with the approval of activities in outer space, etc. (Executive Order No 552 of 31 May 2016)	The Outer Space Act applies to space activities **carried out**: (i) within Denmark; and (ii) outside Denmark on Danish craft or facilities or by Danish operators. **Space activities are defined** as launching space objects into outer space; the operation, control and return of space objects to Earth; and other related essential activities.	Space activities may only be carried out after prior **approval** from the Minister for Higher Education and Science. To request authorisation, the operator must provide documentation **demonstrating**: 1) the **ownership** of the space object; 2) that the operator has the required **qualifications**, including the technical expertise and financial capacity, to carry out the space activity; 3) that the space activity is carried out in an **appropriately safe manner and**	Licences can be **modified or revoked** due to non-compliance with the licensing conditions. If revoked, the space activity may be **transferred** to a third party or terminated.	Transfer of the licence is possible but requires prior **authorisation**. If an operator wants to transfer space objects or space activities to another owner or operator domiciled in another country, the Minister for Higher Education and Science may impose requirements for an advance **agreement** with that country to take over the liability for damages.

Country	National instrument(s)	Scope of application	General conditions for licensing[12]	Modification, revocation or suspension of licence	Transfer of licence
			meets the relevant standards and guidelines; 4) that the operator has taken appropriate measures for space **debris** management; 5) that the space activity is carried out in an **environmentally safe** manner; 6) that the space activity does not conflict with national **security** interests, Denmark's international obligations or foreign policy interests; 7) that the operator meets requirements for **insurance** or other liability cover; 8) that the operator meets current ITU regulations on the allocation of frequencies and trajectory positions.		
Greece	**Law** 4508/2017 on Authorisation of Space Activities, Registration in the National Register of Space Objects, Establishment of a Greek Space Organisation and Other Provisions (amended by Law 4712/2020)	Law 4508/2017 is applicable to **space activities**: (a) carried out within **Greece;** (b) carried out outside Greece if facilities, personnel or movable or immovable property belonging to or under its **jurisdiction** are used; c) regardless of location, if they are carried out by natural **persons** of	Space activities require prior **authorisation** by the Minister of Digital Policy, Telecommunications and Media. **Conditions** for licensing: (a) the organisation has the necessary reliability, capability and **experience** to carry out the space activities; (b) the space activity does not pose a	Licences may be **revoked or suspended if** one of the general or special conditions for the licence is not complied with or if the licensing provisions are breached. This may also occur for reasons of public order, safety and health. When an authorisation is revoked or suspended after the launch of the space object into outer space, the Minister for	Transfer of the licence is allowed but subject to prior **authorisation** by the Minister for Digital Policy, Telecommunications and Media. Transfer of the licence is subject to the same **conditions** as for licensing.

		Greek nationality or legal persons domiciled in Greece and only if this is provided for by an international agreement or treaty; d) carried out by natural or legal persons, domestic and foreign, within Greece or for which facilities, personnel, or movable or immovable property of Greece are used or belong to the **jurisdiction** and are under the responsibility of Greece as a launch country in accordance with international law.	threat to national **security**, public order, the security of persons and property, and public health; (c) the space activity does not contradict Greece's obligations under **international law** or the strategic objectives of Greek foreign policy; (d) appropriate provision has been made for the mitigation and management of space **debris** in line with technological developments and international practices; (e) the space activity does not cause contamination of space or celestial bodies or adverse changes to the **environment**; (f) the organisation meets **ITU** requirements for orbital positions and associated radio frequencies; (g) the organisation complies with the **insurance** requirements; (h) the operator has taken appropriate measures for the smooth and safe termination of the space activity. **Additional conditions** may be imposed by the Minister of Digital Policy, Telecommunications and Media in order to ensure the safety of people and property, to protect the environment, to ensure the optimal use of the atmosphere and outer space, to safeguard Greece's strategic, geopolitical and financial interests, and to comply with Greece's obligations under international law.	Digital Policy, Telecommunications and Media must take the necessary measures for the temporary **continuation** or safe termination of the space activity in order to guarantee the safety of space activities and to ensure the protection of property and the environment. To this end, the Minister may issue instructions to the operator or third parties, have recourse to the services of third parties or transfer the space activities to another body in order to ensure continuity of flight and guidance activities. If necessary, the Minister may also issue orders to deactivate or destroy the space object.	

France	**Law** No 2008-518 of 3 June 2008 (Space Operations Act), as amended by Law No 2023-703 of 1 August 2023 (Art. 60) **Decree** No 2009-640 of 9 June 2009, implementing the provisions provided for in Title VII of the Space Operations Act, as amended by Decree No 2022-233 of 24 February 2022 **Decree** No 2009-643 of 9 June 2009 relating to the authorisation granted under the Space Operations Act, as amended by Decree No 2022-234 of 24 February 2022 **Decree** of 31 March 2011 on Technical Regulation issued under the Space Operations Act, as amended by Order 2022-232 of 23 February 2022	Space Operations Act: - **Material scope**: any activity consisting of launching, attempting to launch or intending to procure the launch of an object into outer space, or of ensuring the control of a space object during its journey in outer space, including the Moon and other celestial bodies, and, if necessary, during its return to Earth; and the transfer of a space object which has been authorised under the Space Operations Act and the transfer of control of a space object whose launch has not been authorised under the Act. - **(Quasi-) territorial jurisdiction**: activity carried out in the national territory or using means or facilities under French jurisdiction. - **Personal jurisdiction**: a French natural or legal person, a legal person whose headquarters is located in France.	Space activities may only be carried out after prior **authorisation**. Authorisations to launch, control and transfer the control of a launched space object and its return to Earth are issued after the administrative authority checks the applicant's moral, financial and professional **guarantees** and, where applicable, those of its shareholders. The authority also checks that the systems and procedures it intends to implement comply with technical regulations, in particular on ensuring the **safety** of persons and property and the protection of public health and the **environment**. Authorisations may be subject to **specific conditions** to ensure the safety of persons and property, the protection of public health and the environment, in particular to mitigate the risks associated with space debris. Conditions may also be imposed for reasons of national defence or to comply with France's international obligations. Each application for authorisation must include: (1) an administrative file demonstrating the moral, financial and professional **guarantees** of the applicant; (2) a **technical file** describing the space operation to be conducted and the systems and procedures that the applicant intends to implement; and (3) a file specifying the characteristics of the space object that are necessary to check	Licences may be revoked or suspended on the **grounds** of non-compliance with the licensing conditions, national security or international obligations, or if the licence was granted based on false information.	Transfer of the licence is possible but requires prior **authorisation**.

			that the operation is not likely to compromise **national defence** interests.		
Luxembourg	**Law** on the Exploration and Use of Space Resources, 2017 **Law** on Space Activities, 2020	The Law on Space Activities applies to space **activities** carried out: (1) by an **operator** of any nationality from Luxembourg or using facilities, whether movable or immovable, under the control and jurisdiction of Luxembourg; or (2) in the **territory** of another country or an area not subject to the sovereignty of any state by Luxembourgish nationals or by legal persons established under Luxembourgish law. The Law on Space Activities does **not apply** to missions involving the exploration and use of space resources, which are governed by the Law on the Exploration and Use of Space Resources.	Space activities require prior **authorisation** by the Minister responsible for space affairs. **Conditions** for authorisation: The **operator** must have a solid system of procedures and financial, technical and legal frameworks to plan and carry out space activities. The operator must also have: (i) a solid internal governance system, in particular a clear organisational structure with a division of responsibilities that is clear, transparent and consistent; (ii) effective processes to detect, manage, mitigate and declare the risks to which it is or could be exposed; (iii) mechanisms providing adequate internal controls, including sound administrative and accounting procedures; and (iv) monitoring and security mechanisms of its technical systems and applications. Such arrangements, processes, procedures and mechanisms must be exhaustive and appropriate to the nature, scale and complexity of the risks inherent to the business model of the operator and the space activity. The members of the operator's management body must at all times be of good repute and have the knowledge,	Authorisation is **withdrawn if**: 1. the conditions for granting it are no longer met; 2. the authorisation was obtained by means of false declarations or by any other irregular means; 3. the operator does not use it within 36 months of its granting, waives it or has ceased to exercise its activity in the previous six months. If an authorisation is revoked, the Minister must take all necessary measures to prevent the space activities from affecting the safety of persons or property, the environment or increasing the risk of international liability for Luxembourg. To achieve this, the Minister may engage the services of third parties or transfer control of the object to another operator to ensure the **continuity** of flight and guidance operations. If necessary, the Minister may also proceed with re-orbiting or de-orbiting, even if this risks the loss or destruction of the space object.	Licences are transferable but only with the prior **authorisation** of the Minister. The **conditions** for transferring the licence are the same as for authorisation.

			skills and experience necessary to carry out their duties. The application for authorisation must be accompanied by a risk assessment of the space activity, which specifies the coverage of risks by the operator's own financial means, by an insurance policy or by a guarantee from a credit institution. Authorisation is subject to the existence of sufficient financial means to mitigate the risks of the space activity.		
Netherlands	Space Activities **Act,** 2007 **Order** of the Minister of Economic Affairs dated 7 February 2008, No. WJZ 7119929, containing rules governing licence applications for the conduct of space activities and the registration of space objects **Order** of the Minister of Economic Affairs dated 16 April 2010, No. WJZ/10020347, containing amendments to rules governing licence applications for the conduct of space activities and the registration of space objects **Decree** of 19 January 2015 expanding the scope of the Space Activities Act to include the control	The Space Activities Act applies to **space activities that are carried out** in or from within the Netherlands or else on or from a Dutch ship or Dutch aircraft. **Space activities are defined** as the launch, operation or guidance of space objects in outer space.	Space activities are subject to prior **authorisation** by the Minister of Economic Affairs. A licence is **refused if**: a. this is necessary in order to comply with a treaty or a binding decision of an international institution; b. facts or circumstances suggest that the safety of persons and goods, environmental protection in outer space, the maintenance of public order or national security might be jeopardised by issuing the licence; c. its issuance would contravene rules laid down by law. A licence may **also be refused if**:	Licences may be modified or revoked on compulsory or discretional **grounds**. The licence is revoked if: a. this is requested by the licence holder; b. this is necessary to comply with a treaty or a binding decision of an international institution; c. there is good reason to fear that the maintenance of the licence will jeopardise the safety of persons and goods, environmental protection in outer space, the maintenance of public order or national security. A licence may **also be revoked if**:	Licences are **not transferable**.

	of unguided satellites (Unguided Satellites Decree) **Order** by the Minister of Economic Affairs of 26 June 2015, No. WJZ/15055654, amending the Space Activities Licence Application and Registration Order, in connection with changes to the application form		a. a previously issued licence has been revoked owing to a breach of the rules laid down by law or of the regulations attached to the licence; b. the applicant has not discharged their obligations under a previously issued licence; c. the application or the applicant does not comply with the rules laid down by law; d. there is good reason to fear that that the applicant will not act in accordance with the rules laid down by law; e. this is necessary to protect the safety of persons and goods, the environment in outer space, financial security, public order, national security or to fulfil the country's international obligations.	a. the rules laid down by law or the regulations pertaining to the licence have been, or are being, breached; b. the space activities have not started within the stipulated time limit; c. the purpose of the space activities for which the licence was issued has changed substantially; d. this is justified by a change in the technical or financial capabilities of the licence holder; e. the information or documents furnished with the application prove to be so incorrect or incomplete that a different decision would have been made on the application if the true circumstances had been known at the time of its assessment; f. this is necessary to protect the safety of persons and goods, the environment in outer space, financial security, public order, national security or to fulfil the country's international obligations.	

Austria	Federal **Law** on the Authorisation of Space Activities and the Establishment of a National Registry, 2011 (Outer Space Act) Explanatory **Report** to the Outer Space Act, 2016 **Regulation** No 36/2015 of the Federal Minister for Transport, Innovation and Technology in Implementation of the Federal Law on the Authorisation of Space Activities and the Establishment of a National Space Registry, 2015 (Outer Space Regulation)	The Outer Space Act is applicable to **space activities carried out**: 1. on Austrian territory; 2. on board vessels or aeroplanes, registered in Austria; or 3. by a natural person with Austrian citizenship or legal persons seated in Austria.	Space activities require **authorisation** by the Minister for Transport, Innovation and Technology. **Conditions** for authorisation: 1. the operator possesses the necessary reliability, capability and **expertise** to carry out the space activity; 2. the space activity does not pose any immediate **threat to public order, the safety of people and property and public health**; 3. the space activity does not run counter to national **security**, Austria's obligations under international law or Austrian foreign policy interests; 4. the operator has made appropriate provision for the mitigation of space debris in accordance with the state of the art and in due consideration of **the internationally recognised guidelines for the mitigation of space debris;** in particular, the operator has taken measures limiting the debris released during normal operations; 5. the space activity does **not cause harmful contaminatio**n of outer space or celestial bodies or adverse changes to the environment;	The licence can be **revoked or modified** in cases of non-compliance with the general or specific licensing conditions. If the authorisation is revoked, the operator may be required to temporarily **continue** or safely terminate the activity. If the operator does not comply with these instructions, control of the space activity may be conferred to another operator by the Minister for Transport, Innovation and Technology.	Transfer of the licence is possible but requires **prior authorisation** by the Minister for Transport, Innovation and Technology. The transfer of licences is subject to the same conditions as for licensing.

			6. the operator fulfils the requirements of the International Telecommunication Union (ITU) for **orbital positions and frequency assignments**; 7. the operator has taken out i**nsurance** against liability for damages caused to people and property; 8. the operator has made provision for the **orderly termination** of the space activity. The authorisation may contain additional conditions and obligations.		
Portugal	**Decree-Law** No 16/2019, of 22 January, Laying down the regime of access to and exercise of space activities ANACOM (Autoridade Nacional de Comunicações) **Regulation** No 697/2019, of 5 September, on access to and exercise of space activities Ordinance No 279/2023 of 11 September.	The Decree-Law applies to space activities, considered to be **space operations or launch centre operations** carried out: a) on the national territory, including sea space and airspace under Portuguese sovereignty or jurisdiction, on board Portuguese vessels and aircraft or from facilities under Portuguese jurisdiction or sovereignty, regardless of the operator's nationality; or b) outside the national territory by Portuguese operators or operators established on the national territory.	Space activities are subject to prior **authorisation**. **Conditions** for authorisation: a) the applicant has the technical, economic and financial capacity for the space operations intended to be carried out; b) the space operation provides appropriate safeguards against damage to the Earth's surface, airspace and outer space, according to applicable national and international obligations; c) the space operation guarantees the minimisation of space debris, to the	A licence may be revoked in the following **situations**: a) where the licence holder fails to comply with its duties relating to the exercise of the activity in accordance with the law and the respective licence, including where, for any reason, the compulsory civil liability insurance ceases to be in force or does not allow applicable conditions to be ensured; b) where the licence holder fails to comply with requirements imposed by the space authority;	Transfer of licence is subject to prior **authorisation**.

			greatest possible extent, according to international principles and obligations; d) the space operation is compatible with applicable public security standards, including those relating to public health and the physical security of the public; e) the space operation does not jeopardise internal security and the strategic interests of Portugal or breach international obligations; f) all other authorisations and certificates required for the space operation have been issued by the relevant bodies; g) the applicant has taken out the compulsory civil insurance. **Specific conditions** may also be imposed.	c) where the licence holder repeatedly fails to comply with its duty to submit information to the space authority; d) due to constraints related to the security of persons or property, determined by the relevant authorities.	
Slovenia	Space Activities **Act**, 2022	The Space Activities Act applies to **space activities carried out in** Slovenia and to space objects entered in Slovenia's register of objects launched into outer space. The Act also applies to space activities carried out: (i) **outside** Slovenia on a vessel or aircraft registered in Slovenia: and (ii) by citizens of Slovenia and legal persons established in Slovenia.	Space activities are subject to prior **authorisation**. **Conditions** for authorisation: 1. the operator is professionally qualified and has the technical knowledge of space and similar technologies and the financial capacity to conduct space activities; 2. space activities are conducted in accordance with international standards	A licence may be **revoked** if it is shown that: 1. the launch was not carried out within five years of issuing the licence due to circumstances attributable to the operator; 2. the application for issuing the licence contains false or incomplete information that considerably affected the decision on issuing the licence;	The operation of the space object for which the licence was issued can be **transferred** to another operator that is a citizen of Slovenia or a legal person established in Slovenia only with the Ministry's permission. If the operation of the space object is transferred to an operator that is a citizen of another country or a legal person established in another country, the Ministry can grant permission if Slovenia has signed an international

			and guidelines of internationally recognised standardisation organisations on the safety and technology of space activities; 3. space activities do not pose a threat to national defence, public order, the safety of people or their property, national intelligence and security operations, the protection against natural or other disasters and do not negatively affect public health, the environment or aviation; 4. space activities do not contravene treaties or rules of international law that are binding on Slovenia; 5. space activities envisage the use of available frequencies in accordance with the applicable legislation governing radio spectrum management, except for launch vehicles; 6. space activities envisage measures for limiting the generation of space debris in accordance with the applicable UN Space Debris Mitigation Guidelines and for limiting adverse environmental effects on Earth or outer space or adverse changes to the atmosphere. Before the launch of a space object into outer space, the operator must take out **insurance** against damage caused by the space activity to people or property.	3. the operator does not have the compulsory insurance; 4. the operator no longer meets the conditions for obtaining the licence; 5. revoking the licence is necessary in order to meet Slovenia's international obligations. If a space object has already been launched, the Ministry may, in its decision to revoke the licence, ask the operator to **transfer** the space activities in full to another operator in order to continue the activities, or take steps to **discontinue** the space activities, including procedures for limiting the generation of space debris, to the extent this is technically feasible.	**agreement** with that country regulating liability for damage.

Finland	**Act** 63/2018 on Space Activities, 2018 **Decree** 74/2018 of the Ministry of Economic Affairs and Employment on Space Activities, 2018	The Act on Space Activities applies to **space activities carried out in** Finland and to space activities outside Finland if they are carried out: (i) on board a vessel or aircraft registered in Finland; or (ii) by a Finnish citizen or a legal person incorporated in Finland. **Space activities are defined as** launching a space object into outer space, the operation and control of the space object in outer space, as well as measures to return the space object to Earth.	Space activities may only be carried out after prior **approval** by the Ministry of Economic Affairs and Employment. The **conditions** for authorisation are that: 1) the operator is reliable and has the necessary technical **expertise** and financial capacity to carry out space activities; 2) the operator has provided a **risk assessment** on its space activities to the Ministry and, according to the assessment, the activities will not cause any particular risk to persons, property or public safety; 3) the operator seeks to prevent the generation of space **debris** and adverse **environmental** impacts on Earth, the atmosphere and outer space; 4) the operator has made a **plan for discontinuing** the space activities and for the related measures; 5) the space activities are compatible with national **security** interests, Finland's international obligations and Finland's foreign policy interests; 6) the operator takes out **insurance** against damage caused by the space activities to third parties;	The authorisation may be **amended or withdrawn if**: 1) the application for authorisation contained inaccurate or incomplete information; 2) the operator no longer fulfils the essential conditions for authorisation; 3) the operator has neglected or breached an obligation or restriction laid down in law or the authorisation conditions; 4) amending or withdrawing the authorisation is necessary because of Finland's **international commitments or obligations**. In its decision to amend or withdraw an authorisation, the Ministry may **impose conditions** for the safe continuation or discontinuation of the space activities. When withdrawing an authorisation, the Ministry may also order the operator to transfer the space activities to another operator for their continuation.	The effective control of a space object or of space activities may be transferred to another operator or owner only if the Ministry of Economic Affairs and Employment has **approved** the transfer in advance. The **conditions** for the transfer are the same as for the authorisation of space activities, but further conditions may be imposed for the safe conduct and supervision of the space activities. If a transfer is made to an operator or owner incorporated in another country, the Ministry of Economic Affairs and Employment may require that the country in question **agrees** with Finland in advance on liability for damage caused by the space object.

			7) the operator complies with the rules of the **ITU** in force; 8) the operator provides evidence of compliance with the **export control** provisions in force. **Additional conditions** for the **safe** conduct and supervision of the space activities may be attached to the authorisation.		
Sweden	**Act** on Space Activities (1982:963) **Decree** on Space Activities (1982:1069)	The Act applies to activities in outer space (**space activities**). In addition to activities carried out entirely in outer space, the Act applies to launching objects into outer space and all measures to manoeuvre or in any other way affect objects launched into outer space. Launching sounding rockets or merely receiving signals or information in some other form from objects in outer space are **not considered to be space activities** under this Act.	Space activities **may not be carried out from Sweden by any party other than** the Swedish government without a licence from the government. Similarly, a Swedish natural or legal person may not carry out space activities elsewhere without such a **licence**. A licence **may be restricted** in the way deemed appropriate, taking into account specific circumstances. It may also be subject to certain conditions for monitoring the activity or for other reasons.	Licences can be temporarily or permanently revoked **in cases of** non-compliance with general and specific licensing conditions or for exceptional reasons determined by the government.	

2. EU MEMBER STATES' NATIONAL LEGAL FRAMEWORKS FOR SPACE SAFETY AND SUSTAINABILITY

Table 9: EU Member States' national legal frameworks for space safety and sustainability[13,14]

Country	Safety and sustainability considerations in the licensing of space activities[15]	Compliance with international guidelines and standards on safety and sustainability[16]
Belgium	**General conditions for the authorisation** of space activities may be imposed in order to ensure: (i) the safety of persons and goods; (ii) environmental protection; (iii) the optimal use of airspace and outer space; (iv) the protection of Belgium's strategic, economic and financial interests; and (v) compliance with the country's obligations under international law. The Minister with responsibility for space research can impose **specific conditions** for the authorisation of a space activity in order to achieve these aims. In particular, the Minister may: (i) impose the technical assistance of a third party; (ii) set conditions for the location of the activities or the location of the main establishment of the operator; and (iii) impose taking out insurance against damage to third parties. An **environmental impact assessment** must be conducted by expert(s) appointed by the Minister with responsibility for space research. An initial study is carried out before the authorisation is granted in order to assess the potential impact on Earth's environment or outer space of the launch or operation of the space object. An interim study is carried	The Belgian Science Policy Office notes that the 2005 Law 'forms the tool with which international standards or recommendations are implemented. These include the resolutions and guidelines issued by the United Nations, which respond to the need to regulate space activities and their development. From this perspective, Belgium has chosen not to issue its own standards, but to **align itself with the standards and references recognised on a European and international level**'[17]. The Minister with responsibility for space research may oblige operators to comply with **international standards and rules,** such as the COPUOS Space Debris Mitigation Guidelines, the IADC Space Debris Mitigation Guidelines, ITU Recommendation ITU-R S.1003, European Code of Conduct for Space Debris Mitigation, and ISO standards (24113: Space Systems – Space Debris Mitigation Requirements). Such a decision is taken on a case-by-case basis. However, the King may require all operators to comply with those standards. The **environmental impact assessment** must include a risk assessment of the potential impact of the space object on Earth and the activities' compliance with international standards for

[13] Security issues are covered in Table 11 at the end of this Annex.

[14] This table contains information on adopted national space legislation in more than the 11Member States (based on information in Table 1). This shows Member States' official positions on the relevance of and compliance with international standards for safe and sustainable space activities (third column).

[15] Information in this column is further detailed in Table 3, where relevant.

[16] In this column, general statements by Member States noting that they 'fully comply with' or otherwise 'support' certain space safety and sustainability standards reflect their official positions on this point as compiled in the UNOOSA Compendium of Space Debris Mitigation Standards Adopted by States and International Organizations, 15 May 2023 (the 'UNOOSA Compendium'), https://www.unoosa.org/documents/pdf/spacelaw/sd/Space_Debris_Compendium_COPUOS_15_May_2023.pdf (last accessed on 20 September 2023).

[17] See statement on the Belgian space law official website, https://www.belspo.be/belspo/space/belaw_en.stm (last accessed on 20 September 2023).

Country	Safety and sustainability considerations in the licensing of space activities[15]	Compliance with international guidelines and standards on safety and sustainability[16]
	out at the request of the Minister after the launch of the space object or during its operation in order to evaluate the real consequences of the activities for Earth's environment and outer space. A final study may be carried out at the request of the Minister for when the space object re-enters the atmosphere. When the launch or operating activities include the use of **nuclear power sources**, the operator must mention this in its authorisation application. The Minister grants the authorisation only under specific conditions taking into account, in particular, the danger that the use of such power sources may represent, the basic precautions to be taken with regard to health and safety protection, the protection of the environment and the applicable standards of national and international law.	limiting space debris, as deemed applicable by the Minister. Specifically, the report must contain the necessary information for the operator to demonstrate its compatibility with: (1) the recommendations adopted by the UN COPUOS and published on the dedicated website of the Belgian Science Policy Office[18], to the extent that these recommendations are applicable to the activities concerned; and (2) where applicable, any other models or technical standards identified by the Minister before the authorisation application (Art. 8 §1(1)(d) Royal Decree). If a **nuclear power source** is to be used, the environmental impact assessment must include a specific annex that details the measures to be taken to guarantee the safety of persons and the environment. The annex must include the standards laid down by international and intergovernmental technical bodies that regulate the use of nuclear power sources, in particular in outer space, and determine the compliance of the space object's specifications with these standards (Art. 8 §4 Royal Decree).
Czechia		Czechia does not currently have specific legal instruments in place regulating space activities. However, the country officially states that it **complies with** the following rules in carrying out and authorising their space activities: COPUOS Space Debris Mitigation Guidelines, IADC Space Debris Mitigation Guidelines, European Code of Conduct for Space Debris Mitigation, ISO Space Systems – Space Debris Mitigation Requirements (ISO 24113:2011) and ITU Recommendation ITU-R S.1003.

[18] Applications for space activities under the Belgian law of 2005 have to take into account 'reference standards applicable to the design and manufacture of the object (ESA, ISO, [ITU, United Nations,] etc.)': see https://www.belspo.be/belspo/space/belaw_en.stm. In this regard, the Operators Handbook refers to various sets of international rules and guidelines, contained in, among others, the UN space treaties, Recommendations of the UNGA on the peaceful use of outer space (including, for example, UNGA Resolution 62/101), COPUOS Space Debris Mitigation Guidelines and the 2019 Guidelines for the Long-Term Sustainability of Outer Space Activities, the 2009 COPUOS Safety Framework for Nuclear Power Source Applications in Outer Space, the IADC Space Debris Mitigation Guidelines, and ITU rules and procedures.

Country	Safety and sustainability considerations in the licensing of space activities[15]	Compliance with international guidelines and standards on safety and sustainability[16]
Denmark	The licensing conditions laid down in the Outer Space Act aim to ensure that space activities are carried out in **an appropriately safe manner and meet the relevant standards and guidelines**. Moreover, space activities must be conducted in an **environmentally safe manner**, and operators must take appropriate measures to manage space debris. Operators must also take out insurance or some other liability cover.	The Outer Space Act stipulates that operators must meet **current ITU regulations** on the allocation of frequencies and trajectory positions. The Agency for Science and Higher Education may require that space activities meet 'relevant safety standards and guidelines', and that 'space activities which involve the launch of space objects into earth orbit' meet 'relevant standards and guidelines for space debris management'[19]. In this context, the Executive Order explicitly refers to **standards published by the European Cooperation for Space Standardization (ECSS) or ISO**, but other standards and guidelines may also be considered.
Germany		Germany does not currently have specific legal instruments regulating space activities in place. However, the country officially states that the space debris mitigation requirements of the **Product Assurance and Safety Requirements for DLR Space Projects** are consistent with the COPUOS Space Debris Mitigation Guidelines, the IADC Space Debris Mitigation Guidelines and the European Code of Conduct for Space Debris Mitigation. The Product Assurance and Safety Requirements for DLR Space Projects specifically refer to relevant ISO standards, such as ISO 24113:2011, and standards adopted by the ECSS. Furthermore, the mechanisms NASA STD 8719.14 'Process for Limiting Orbital Debris' and NASA-NPR8715.6A 'Procedural Requirements for Limiting Orbital Debris' were informative references for the Product Assurance and Safety Requirements for DLR Space Projects. Under the Telecommunications Act, users of orbit and frequency rights must respect the recommendations of the **ITU Radiocommunication Assembly** on space debris mitigation (ITU-R S.1003-2, Environmental protection of the geostationary-satellite orbit).

[19] Arts. 5(1) and 6(1) of the Executive Order.

Country	Safety and sustainability considerations in the licensing of space activities[15]	Compliance with international guidelines and standards on safety and sustainability[16]
Greece	The **licensing conditions** laid down in Law 4508/2017 aim to ensure that space activities do not put at risk public order, the security of persons and property, and public health. They also aim to ensure that space activities do not cause contamination of space or celestial bodies or adverse changes to the environment, and the risk of space debris is mitigated. Operators must take out insurance. Operators are required to submit **environmental impact assessments**. An initial report must be drawn up before authorisation to assess the potential environmental impact of the launch or operation of the space object on Earth or outer space. After the launch of the space object or during its operation, an interim report must be drawn up describing the actual effects of the space activity on Earth's environment and outer space. A final report must be drawn up on the space object's return into Earth's atmosphere or the termination or cessation of operations. For any decision on authorising space activities, the Minister of Digital Governance may request **technical assistance** from third parties, such as Greek, European and international organisations and agencies, experts, specialists and scientists, to lay down conditions for the location of the space activities, the main establishment of the operator or insurance to be taken out for space and space objects.	Under Law 4508/2017, operators must make appropriate provision for the mitigation and management of space debris in accordance with **technological developments and international practices**. Operators must meet **ITU requirements** for orbital positions and associated radio frequencies. A joint ministerial decision of the Ministers of Digital Policy, Telecommunications and Media and Environment and Energy may set out the content of the reports, the requirements and the technical standards that the operator must comply with. Until this decision is adopted, **relevant national, European and international standards as well as relevant good practices**, apply[20].

[20] UNOOSA Compendium, p. 41. The only ministerial decision adopted so far for the implementation of Greek Law 4508/2017 relates to Art. 36 of the law, concerning the unrelated issue of supporting consumers with low incomes to reconnect to the electricity supply network. See one-off special aid for the reconnection of electricity supplies, pursuant to Article 36 of Law 4508/2017 (B' 474) as amended and in force, No. YPEN/DIE/70697/861/2020, Official Gazette B' 3088/24-07-2020.

Country	Safety and sustainability considerations in the licensing of space activities[15]	Compliance with international guidelines and standards on safety and sustainability[16]
Spain		Spain does not currently have specific legal instruments regulating space activities in place but officially states it **complies with** the COPUOS Space Debris Mitigation Guidelines. It also **supports** the IADC Space Debris Mitigation Guidelines, the European Code of Conduct for Space Debris Mitigation, ITU Recommendation ITU-R S.1003 and the ISO Space Systems – Space Debris Mitigation Requirements (ISO 24113:2011). Spain also supports the adoption of the draft **International Code of Conduct** for Outer Space Activities.
France	The licensing conditions laid down in the Space Operations Act and subsequent legislation aim to ensure that space activities do not put at risk the **safety** of persons and property, the protection of public health and the **environment** and that operators set out space debris mitigation measures.	The obligations imposed on operators by the Technical Regulation are **consistent with** the COPUOS Space Debris Mitigation Guidelines, the IADC Space Debris Mitigation Guidelines, COSPAR standards, ISO standards such as 24113:2010, CCSDS standards and the European Code of Conduct for Space Debris Mitigation.
Italy		Italy does not currently have specific legal instruments regulating space activities in place. Therefore, 'pending the approval of a national space law, implementation of measures relevant to space debris mitigation are currently limited to the Italian Space Agency's (ASI) standard contracts provisions'[21]. These provisions refer to the **European Code of Conduct for Space Debris Mitigation** as a mandatory document applicable to ASI standard contracts. Specifically, 'for space missions developed before 2005 or already in orbit, the ASI has tried to implement the European Code as much as possible, mainly procedures to mitigate end-of-life space debris, in particular, the disposal phase of the satellites. After 2005, the Space Debris Mitigation European Code of Conduct is an applicable document to ASI space programmes and projects, namely in the design, the development and the operational phase of satellites'[22]. Through the application of this Code, the ASI is also consistent with the COPUOS Space Debris Mitigation Guidelines, the IADC Space Debris Mitigation Guidelines, the ITU Recommendation ITU-R S.1003 and the relevant ISO standards (24113 and subsequent

[21] Ibid., p. 47.
[22] Ibid., p. 47.

Country	Safety and sustainability considerations in the licensing of space activities[15]	Compliance with international guidelines and standards on safety and sustainability[16]
		derived standards); in addition, the ASI will update its current contractual provisions in line with these updated space debris mitigation measures[23].
Luxembourg	Luxembourg's legislation does **not** currently include specific safety and sustainability considerations for the licensing of space activities[24]. Art. 7 of the Law of 2020 only notes that '[a]ny application for authorisation must be accompanied by all useful information for the assessment thereof as well as an activity programme. The standard content of an application for authorisation may be established by a Grand-Ducal regulation'.	
Hungary		No national standards on space debris mitigation have been developed by Hungary, but it notes that it 'follows the **EU's space debris mitigation policy**'[25].

[23] Ibid., pp. 47-48.
[24] The draft 2020 law contained more explicit requirements regarding, among other things, space debris, which were, however, not retained in the final version. See M. Hoffman, 'Entered into Force: The 2020 Space Law of Luxembourg', 2021 *Air & Space Law* 46(4/5), p. 592: 'the operator's obligation to adopt measures to avoid the risks of space debris or contamination of the Earth and space was reduced to a minimum. The final version shifted the "environment" to the definition of damage caused by space objects and made operators liable for it; the obligation to adopt measures to prevent the creation of space debris disappeared'. The author adds that 'the only substantial point missing in the authorisation framework is the obligation to adopt measures avoiding space debris' (p. 601).
[25] UNOOSA Compendium, p. 43.

Country	Safety and sustainability considerations in the licensing of space activities[15]	Compliance with international guidelines and standards on safety and sustainability[16]
Netherlands	The licensing conditions laid down in the Space Activities Act aim to ensure that space activities do not put at risk the **safety** of persons and goods, **environmental protection** in outer space, or the maintenance of public order. However, since its space policy is 'primarily focused on international cooperation in European contexts within ESA, [EUMETSAT] and the EU […] the Netherlands has no national space debris mitigation mechanism'[26].	Although not explicitly set out in legislation, the Netherlands officially states that it **fully complies with** the COPUOS Space Debris Mitigation Guidelines, the IADC Space Debris Mitigation Guidelines, ITU Recommendation ITU-R S.1003, the European Code of Conduct for Space Debris Mitigation and the ISO standards. The Netherlands also 'supports ESA and EU initiatives'[27].
Austria	The general licensing conditions set out in the Outer Space Act aim to ensure that space activities respect public order, the **safety** of persons and property and public health. The general licensing conditions also aim to ensure that space activities do not cause harmful contamination of outer space or celestial bodies or adverse changes to the **environment** Appropriate provision must be made by the operator for the mitigation of **space debris. ITU requirements** for orbital positions and frequency assignments must be met. Operators must also make appropriate provision for the orderly termination of the space activity.	Under the Outer Space Act, one of the general conditions for licensing space activities is that the operator has made appropriate provision for the mitigation of space debris in accordance with the state of the art and **the relevant internationally recognised guidelines**. The Explanatory Report to the Outer Space Act explicitly mentions the IADC Space Debris Mitigation Guidelines, the ESA Requirements on Space Debris Mitigation for ESA Projects, and the COPUOS Space Debris Mitigation Guidelines. Operators may also consider international standards and guidelines not explicitly mentioned in the Explanatory Report. Under the Outer Space Act, operators must follow the **ITU recommendations** on the orbital position and frequency allocation.

[26] UNOOSA Compendium, p. 59.
[27] Ibid.59.

Country	Safety and sustainability considerations in the licensing of space activities[15]	Compliance with international guidelines and standards on safety and sustainability[16]
Poland		Poland officially states that it **fully complies with** the COPUOS Space Debris Mitigation Guidelines, the IADC Space Debris Mitigation Guidelines, ITU Recommendation ITU-R S.1003, the European Code of Conduct for Space Debris Mitigation and ISO standards (24113: Space Systems – Space Debris Mitigation Requirements and others).
Portugal	The general licensing conditions laid down in Decree-Law No 16/2019 aim to ensure that space activities do not cause **damage** to Earth's surface, airspace and outer space, and to minimise the risk of space debris. The conditions also aim to ensure that space activities do not put at risk public **security**, public health and the physical security of the public. The conditions also require operators to take out civil insurance.	Under Decree-Law No 16/2019, operators must provide a **space debris mitigation plan**, which can be based on international standards and guidelines. The ANACOM Regulation No 697/2019 explicitly lists the ISO 24113:2011 standard, the IADC Space Debris Mitigation Guidelines and the COPUOS Space Debris Mitigation Guidelines. Under ANACOM Regulation No 697/2019, operators must also submit a detailed and substantiated plan, in line with standards issued by the US Federal Aviation Administration (**FAA**), demonstrating that the space operation is compatible with applicable public security standards, including those relating to public health, the physical security of the public and environmental protection, and that there are appropriate safeguards against damage to Earth's surface, airspace and outer space.
Slovenia	The general licensing conditions laid down in the Space Activities Act aim to ensure that space activities do not put at risk public order, the **safety** of people or property, public health, the **environment** or aviation. Moreover, space activities must envisage measures for limiting the generation of space debris and for limiting **adverse environmental effects on Earth or outer space** or adverse changes to the atmosphere.	Under the Space Activities Act, one of the general licensing conditions for space activities is that they are conducted in accordance with the **international standards and guidelines of internationally recognised standardisation organisations** on the safety and technology of space activities. Moreover, space activities must envisage measures for limiting the generation of space debris in accordance with the applicable **UN Space Debris Mitigation Guidelines**.

Country	Safety and sustainability considerations in the licensing of space activities[15]	Compliance with international guidelines and standards on safety and sustainability[16]
Slovakia		Slovakia does not currently have specific legal instruments regulating space activities in place but officially states it **fully supports** the COPUOS Space Debris Mitigation Guidelines and **supports** the IADC Space Debris Mitigation Guidelines, the European Code of Conduct for Space Debris Mitigation, ITU Recommendation ITU-R S.1003 and the ISO Space Systems – Space Debris Mitigation Requirements (ISO 24113:2011).
Finland	The licensing conditions laid down in the Space Activities Act aim to ensure that space activities do not pose risks to persons, property or public **safety**. Any person participating in the launch, operation or return of a space object must have the know-how and experience required for the control of the operations under their responsibility. The licensing conditions also aim to ensure that space activities do not generate space debris or have an adverse **environmental impact** on Earth, in atmosphere and outer space. Space activities must be carried on in an environmentally sustainable manner and promote the sustainable use of outer space. In its application for authorisation of space activities, the operator must assess the environmental impact of the activities on Earth, the atmosphere and outer space and present a plan with measures to counter and reduce adverse environmental effects. The operator must specify in the application if any nuclear materials or other radioactive materials are used in the space object. Operators must make a plan for discontinuing the space activities and take out **insurance** against damage caused by the space activities to third parties.	Under the Space Activities Act, operators must comply with the **ITU rules** in force. Moreover, operators must seek to ensure that the space activities do not generate space debris, in accordance with **generally accepted international guidelines**. In particular, operators must restrict the generation of space debris during the normal operations of the space object, reduce the risks of in-orbit break-ups and in-orbit collisions and, after the space object has completed its mission, seek to move it into a less-used orbit or into the atmosphere (Section 10 of the 2018 Act on Space Activities). Although the legislation does not explicitly mention specific international guidelines, the government proposal for the Space Activities Act lists the **following**: COPUOS Space Debris Mitigation Guidelines, IADC Space Debris Mitigation Guidelines, European Code of Conduct for Space Debris Mitigation and ISO standards on space debris mitigation. Furthermore, in their application for authorisation, the operator must include information on '**applied standards** and quality management systems' to show that they meet eligibility requirements (Decree Section 2(4)).

Country	Safety and sustainability considerations in the licensing of space activities[15]	Compliance with international guidelines and standards on safety and sustainability[16]
Sweden	Sweden's legislation does **not** currently include specific safety and sustainability considerations for the licensing of space activities[28].	

[28] In 2020, the Swedish government launched an review of the current legislation in order to 'achieve a long-term sustainable regulation of space activities in line with international regulations and national security needs while creating predictability and good conditions for companies, universities and colleges as well as authorities in the space area'. Available at https://www.unoosa.org/oosa/en/oosadoc/data/documents/2023/aac.105c.12023crp/aac.105c.12023crp.20_0.html. The 2019 Swedish Space Strategy noted that '[o]ne strategic objective should be for Swedish space legislation both to provide support for space activities in Sweden and ensure that international commitments are fulfilled, and to enable private investment in Swedish space activities': Sweden Ministry of Education and Research, 'A Strategy for Swedish Space Activities', 2019, at https://www.government.se/information-material/2019/11/a-strategy-for-swedish-space-activities/.

Table 10: National safety and sustainability requirements for space activities

Country	Space debris	Safety	Sustainability

Belgium	Space debris is covered by the environmental impact assessment (see sustainability column).	Under the Law of 17 September 2005, when the launch or operation activities include the use of nuclear energy sources, the operator must mention this in its authorisation application. In this situation, the Minister only grants authorisation under specific conditions taking into account, in particular, the danger that the use of such energy sources may represent, the basic precautions to be taken with regard to health and public safety, environmental protection and the standards of national law and international law applicable. Safety aspects, especially regarding the use of nuclear energy sources, are also covered in the environmental impact assessment (see sustainability column). Under the Law of 17 September 2005, the operator is required to immediately inform the crisis centre designated by the King of any manoeuvre, any malfunction or any anomaly concerning the space object that is likely to be a danger to people on the ground, aircraft in flight or other space objects, or to cause damage.	Under the Law of 17 September 2005, environmental impact assessments must be carried out by one or more experts appointed by the Minister. 1. An initial study is carried out before granting authorisation. This study is intended to assess the potential impact of the launch or operation of the space object on the Earth's environment or outer space. 2. An interim study is carried out at the request of the Minister after the launch of the space object or during its operation. This study assesses the activities' real consequences for the Earth's environment and outer space. 3. A final study can be carried out at the request of the Minister when the space object re-enters the atmosphere. Under the Royal Decree of 17 September 2005, the environmental impact assessment comprises four parts: 1) the **first part** consists of: (a) a description of the activity and its objectives and the use of the data and derivative products generated by the activity; (b) a description of the technologies, components and system design, and a critical design review of the object; (c) a report on the functional tests of the infrastructure and software carried out as part of the flight model and the flight readiness review; (d) a description of the technical and operational characteristics of the activity and the object by which the operator demonstrates

			these characteristics compatibility with the recommendations adopted by the UN COPUOS, to the extent that these recommendations are applicable to the activities concerned, with any other models or any other technical standards identified by the Minister before submitting the authorisation request. 2) the **second part** concerns the potential impact of the activity on the Earth's environment, including the atmosphere, and, in particular, on the natural and human environment of the launch site; it also includes a description of the measures taken or planned to be taken to reduce or limit this impact; 3) the **third part** concerns the potential impact of the activity on the outer space and includes a description of the measures taken or planned to be taken in order to reduce or limit this impact; this part also includes, where applicable, the measures taken or planned to be taken to ensure the sustainable and rational use of natural resources in space; 4) the **fourth part** concerns: (a) a non-technical summary of the activity; (b) a description of the know-how available to the applicant to carry out the activities; (c) a descriptive summary of activities similar to that for which the application was submitted and in which the operator participated in the three years preceding the application for authorisation. For the second and third parts of the impact study, the activity and its environmental impact are considered in the short, medium and long term.

Country	Space debris	Safety	Sustainability
			The activities are evaluated, in particular, according to the risk of the space object falling back to Earth and the activities' compliance with international standards for limiting space debris, as deemed applicable by the Minister. Where applicable, the impact study includes a description of the measures taken to ensure the activity's rational use of limited natural resources, in particular, the geostationary orbit. Moreover, under the Royal Decree of 17 September 2005, if a nuclear energy source is used on board the space object, the impact must study includes a specific annex. This annex describes the measures taken to guarantee the safety of people and the environment given the risk associated with nuclear energy sources. This annex also includes the standards developed by international or intergovernmental technical bodies that govern the use of nuclear energy sources, particularly in outer space. It also sets out how the specifications of the space object comply with these standards.
Denmark	Under the Outer Space Act, for space activities to be licensed, the operator must have taken appropriate measures for space debris management. Under Executive Order No 552, the Danish Agency for Science, Technology and Innovation may require space activities that involve the launch of space objects into Earth's orbit to meet relevant standards and guidelines for space debris management, such as standards published by the ECSS or the	Under the Outer Space Act, to be licensed, the space activity must be carried out in an appropriately safe manner and meet the relevant standards and guidelines. Under Executive Order No 552, applications to carry out space activities must contain a risk assessment, including the risk of damage caused by the space object.	Under the Outer Space Act, to be licensed, the space activity must be carried out in an environmentally safe manner. Under Executive Order No 552, space activities must be carried out with due consideration for the surrounding environment. The Danish Agency for Science, Technology and Innovation may stipulate requirements for and request a description of:

Country	Space debris	Safety	Sustainability
	International Organization for Standardization (ISO). As a general rule, within 25 years of the end date of the functional operating period of the space object, the space object must either safely leave its Earth orbit again or be safely placed into an orbit where it is deemed not to constitute a danger to other space activities.	Moreover, the Danish Agency for Science, Technology and Innovation may: (i) stipulate requirements that space activities meet relevant safety standards and guidelines, such as standards published by the ECSS or ISO; (ii) require operators to implement a quality assurance and risk management system for the space activity; and (iii) place an emphasis on relevant assessments and decisions already made by foreign national authorities, international space organisations, or similar when assessing the safety of the launch itself.	1) the environmental impact of the space activity on Earth and the atmosphere, e.g. specifying the technology, components, manufacturing processes and products applied; 2) the activity's potential environmental impact on outer space; 3) the operator's measures to minimise the environmental impact on Earth, the atmosphere and outer space.
Greece	Under Law 4508/2017, for space activities to be licensed, appropriate provision must have been made for the mitigation and management of space debris in line with technological developments and international practices.	Under Law 4508/2017, to be licensed, the space activity must not pose a threat to the security of persons and property or to public health.	Under Law 4508/2017, to be licensed, the space activity must not cause contamination of space or celestial bodies or adverse changes to the environment. The application must be accompanied by: (i) a presentation of the organisation's guarantees for the sustainability of the space activity; (ii) a solemn declaration by the organisation on compliance with environmental requirements and practices, as well as with applicable Greek and international environmental legislation; and (iii) a detailed report of the rules to be followed and measures to be taken to protect the environment. For each space activity, the operator is required to submit reports on the space object's environmental impact to the Minister of Digital Policy, Telecommunications and Media in successive stages: • the first of these reports must be drawn up before authorisation is granted; • after the launch of the space object or during its operation, an interim report must set out the actual

			effects of the space activities on Earth's environment or extra-atmospheric space; • The final report must be drawn up when the space object returns to Earth's atmosphere or the activity is terminated or reaches the end of its operations.

France	According to the **Space Operations Act**, the authorisations and licences under the act may be accompanied by additional requirements issued in the interest of the safety of persons and property and the protection of public health and the environment, particularly with a view to limiting risks related to space debris. Under the **Technical Regulation**, with regard to the launching phase, during the design and development of the launcher, the operator has to develop scenarios for fragmentation and space debris generation upon re-entry or neutralisation of the launcher's stages. To this end, it has to determine: - the details of the fragmentation dynamics and of the generated fragments of the launch vehicle; - the size and position of fallout zones for elements not put into orbit. Moreover, with regard to the end-of-life phase, the launch operator has to determine the fallout zones and design the launch vehicle in such a way to limit the generation of debris beyond the end of its operational life.	According to the **Space Operations Act**, authorisations for the launch of a space object or for the control and transfer of control of the object can only be issued after the administrative authority checks the applicant's specific guarantees (set out in Decree 643) and of the compliance of the systems and procedures with the Technical Regulation. The operators must pay particular attention to the safety of persons and property and the protection of public health and the environment, except for derogations in the interests of national defence when carrying out services on behalf of the state (Art. 4). When an authorisation is requested for an operation to be carried out in another country, or using means and facilities located in another country, a partial or total exemption may be granted if the other country's legal and technical framework provides sufficient guarantees for the safety of persons and property, the protection of public health and the environment, and liability. The administrative authority or authorised agents (including environmental agencies) may impose additional measures in the interests of the safety of persons and property and the protection of public health and the environment for the launch of a space object or the control of such an object or a group of coordinated space objects. Under the **Technical Regulation**, the space system must be designed, produced, integrated and implemented in such a way to ensure the safety of people during critical activities. To ensure operational safety, a quality management framework must be drawn up by the launch operator. This has to include a system for monitoring and checking the manufacturing process as well as tracing deviations. This framework must also include a safety and risk analysis, including the definition of safety coefficients and margins, reliability assessments and the identification of critical aspects. When setting out the controlled re-entry phase, the launcher and/or system operator must identify any possible failure scenarios that could lead to potentially dangerous situations. If a controlled re-entry is not possible, the operator has to design its launcher or space element in a such a way to limit the number and energy (kinetic and explosive) of the fragments likely to reach the ground and achieve a risk probability lower than a specific value set by the regulation. In conducting the risk analysis, specific criteria are set by the	Under the **Technical Regulation**, as part of the authorisation request, a space object operator or launcher operator has to send to CNES a hazard report and an environmental impact study and has a legal obligation to comply with the Space Operation Act. The launcher element has to be designed, manufactured and operated in such a way that at the end of its operational phase, all energy reserves are completely exhausted or depleted, to avoid generating waste and mitigate associated risks. In the Technical Regulation, specific measures on planetary protection are set out, and the launcher operator has to comply with the COSPAR Planetary Protection Policy and with Article IX of the Outer Space Treaty. Moreover, the launcher operator has to take into account the environment in which the system has to be operated.

		Technical Regulation and also include scenarios for fragmentation and debris generation, dispersal of debris on the ground and de-orbiting strategies. In any case, the launcher and the space element must be designed, manufactured and operated in such a way that its debris does not cause excessive or unacceptable risk to people, property, public health or the environment, in particular due to environmental pollution by dangerous substances. In determining the fallout zones, specific requirements have to be met in the assessment of the probability of interference with the ground. This must take into account maritime traffic and safety and environmental safety. Specific provisions are included on nuclear safety in relation to the launch operator and the satellite operator and refer to the applicable regulations in force. The regulation distinguishes between end-of-life strategies dependent on orbital regions (i.e. controlled or uncontrolled re-entry or transfer to disposal orbit), reflecting provisions included in the IADC Space Debris Mitigation Guidelines (as revised in 2007), the UN COPUOS Space Debris Mitigation Guidelines and the ISO 24113, and ECSS standards. In the design, manufacturing and implementation of the launcher or system element, as well as in the mission design, specific collision avoidance strategies have to be set out. The deliberate fragmentation of launcher elements is prohibited, and intentional destruction of space objects in orbit should be avoided. According to **Decree No 2009-643**, during the authorisation process, a compliance check of the system and procedures with the Technical Regulation is carried out by the Centre national d'études spatiales (CNES) to ensure the safety of people and property and the protection of public health and of the environment. For critical systems, an additional file describing the characteristics and development plan of the system with regard to the safety of people and property	

		and the protection of public health and the environment may be submitted to CNES to enable the agency to certify its compliance with the Technical Regulation. A conformity notice, delivered after the compliance check and upon satisfaction of the Technical Regulations and CNES best practices does not constitute authorisation for the purposes of the Space Operations Act. Services conducted in the interest of national defence: - for services on behalf of the State by an operator, the Ministry of Defence may authorise the operator to deviate from the Technical Regulation and has to inform the Ministry of Space; - for services by the State, CNES also has to carry out a compliance check to ensure the safety of people and property and the protection of public health and the environment; derogations from the Technical Regulation are allowed, but this has to be communicated to the Ministry of Space.	
Luxembourg		Under the Law of 2020, the authorisation request must be accompanied by a risk assessment of the space activity. The Law of 2020 imposes a number of requirements on operators to ensure that they are capable of carrying out space activities with the 'knowledge, skills and experience required to exercise their duties at all times' (Art. 6) and that they have 'adequate professional experience by having already carried out similar activities with a high level of responsibility and independence in the space sector or a related sector' (Ibid.). These conditions can be construed as requiring a certain level of safety, albeit focused on the qualifications of the operator rather than specific requirements for the space activity.	
Netherlands		Under the Space Activities Act, a licence is refused if the Minister of Economic Affairs judges that the safety of persons and goods might be jeopardised if a licence is issued. Under the Order by the Minister of Economic Affairs of 26 June 2015, the application must include: (i) a complete description of the space activities, including a description of the applicant's knowledge and experience in	Under the Space Activities Act, a licence is refused if the Minister of Economic Affairs judges that the outer space environment might be affected if a licence is issued.

		conducting space activities; (ii) technical information about the space activity; and (iii) a risk analysis indicating what management measures have been taken to safeguard the continuity of the space activities.	
Austria	Under the Outer Space Act, for space activities to be licensed, the operator must make appropriate provision for the mitigation of space debris in accordance with the state of the art and in due consideration of the relevant internationally recognised guidelines. In particular, measures limiting debris released during normal operations have to be taken. Under the Outer Space Regulation, the operator must submit the following as evidence that appropriate provisions for the mitigation of space debris have been made: 1. a report on the measures taken according to the state of the art and in consideration of internationally accepted guidelines, in particular: a) for avoiding space debris and mission residue released during normal operations; b) for preventing on-orbit break-ups of the space object; c) for removing the space object from Earth's orbit at the end of the space activity, either by controlled re-entry or by moving the space object to a sufficiently high Earth orbit ('graveyard orbit'); for non-manoeuvrable space objects, the chosen orbit should ensure that they do not remain in Earth's orbit for more than 25 years after the end of the activity. 2. a demonstration of measures adopted to prevent on-orbit collisions with other space objects.	Under the Outer Space Act, to be licensed, the space activity must not pose any immediate threat to public order, the safety of persons and property and public health. Moreover, the operator must make provision for the orderly termination of the space activity. The operator must also submit the evidence described below. 1. Evidence of compliance with the current state of knowledge in the field, based on advanced techniques, facilities, construction and operation methods, whose functional operability has been tested and proven. If compliance is not an option or if evidence of it is not possible, it must be credibly demonstrated that the space activity does not pose an immediate threat to public order, the safety of persons and property and public health. 2. The results of the tests carried out to verify the safety and solidity of the space object according to the state of the art. 3. Emergency plans in the event of the failure of the communications or data connections, the loss of control of the space object, the failure of essential systems for power supply, attitude control or control of the trajectory and similar exceptional incidents. 4. Information on to what extent the space activity involves the observation of Earth and what kind of data is collected. In particular, the degree of resolution of possible images of the surface of the Earth as well as the planned transfer of raw or processed data must be indicated. If the space activity involves the processing of personal data, the necessary licences for the processing and transfer of this data must be provided.	Under the Outer Space Act, to be licensed, the space activity must not cause harmful contamination of outer space or celestial bodies or adverse changes to the environment. The operator must also submit documents as evidence that the space object does not contain dangerous substances or substances harmful to health, which could cause the harmful contamination of outer space or adverse changes to the environment.

Portugal	Under Decree-Law No 16/2019, to be licensed, the space operation must guarantee the minimisation of space debris to the greatest possible extent, in line with international principles and obligations. Under Regulation No 697/2019, the applicant must submit a plan attesting that the space activity guarantees the mitigation of space debris to the greatest possible extent. The space debris mitigation plan may include measures to be implemented in line with international best practices and principles, especially those provided for in ISO 24113:2011 (Space systems - Space debris mitigation requirements), the 2007 IADC Space Debris Mitigation Guidelines, and in Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space, laid down in UN General Assembly Resolution 62/217, of 22 December 2007. See next column for additional information.	Under Decree-Law No 16/2019, to be licensed, the space operation must provide appropriate safeguards against damage to the Earth's surface, airspace and outer space, in line with national and international obligations. The space activity must also be compatible with applicable public security standards, including those relating to public health and physical security of the public. Under Regulation No 697/2019, the applicant must submit a detailed and substantiated plan, in line with US FAA standards. It should demonstrate that the space operation is compatible with applicable public 'security'[29] standards, including those relating to public health, the physical security of the public and environmental protection, and that it provides appropriate safeguards against damage to the Earth's surface, airspace and outer space. At a minimum, the plan must contain the following: a) identification and description of hazards, as well as the assessment of each risk in terms of their likelihood and severity; b) a risk assessment and management process on the basis of a quantitative analysis, or where this is found not to be justified and proven not to be possible, on the basis of a qualitative analysis; c) risk mitigation measures, setting out the priorities between them, as well as the measures required for their implementation; d) operational procedures designed to address accidents involving the operator, including strategies for reducing harm and providing relief to people directly or indirectly affected.	See previous column.

[29] The text in this table is taken from the English version of Regulation 697/2019 submitted to the UNOOSA database of national space laws (https://www.anacom.pt/render.jsp?contentId=1496233). Article 15 of this version uses the term 'security' although it is clear that the content of this provision and the standards it refers to concern the 'safety' of space activities.

		The launch and/or return operator must also submit an accident investigation plan describing incident and accident reporting procedures. For launch and return operations, in addition to these requirements, the plan must include: a) a description of security measures, including those relating to the launch operation, associated with the various flight stages, from lift-off to the separation of the launcher and the object to be placed on space and the respective final impact; b) identification of the geographic area where the public and property could be exposed to a particular risk, as well as security measures to protect them; c) a description of the launch risk in terms of the possible number of victims, compared to the total number of people exposed to the launch hazard; d) identification of the geographic area and risks for the environment resulting from falling elements of the space object on Earth's surface and into the atmosphere as well as debris from products caused by atmospheric and extra-atmospheric combustion; e) identification of: (i) organisational processes; (ii) processes to identify people that are responsible for the various security aspects; and (iii) communication processes between the launch and/or return operator and the launch centre operator, including a description of their respective responsibilities; f) description of security systems and procedures that allow for the completion of the launch flight. At a minimum, the plan must take account of security risks deriving from: a) the failure, explosion or collision of the launcher;	

		b) falling elements that detach from the space object at the launch and/or return stage; c) the controlled or non-controlled return of the launcher or of some of the launcher stages; d) hazardous, radioactive, explosive or toxic substances on board the launcher, where applicable. For command and control operations, the plan must include: a) description of the levels of security of access to the space object command and control system; b) security assessment of the space object's orbit throughout its operational life; c) assessment of possible collisions with space objects, the orbital parameters of which the applicant is aware of in advance. At a minimum, the plan must take account of command and control operational risks deriving from: a) orbital space debris generated by the space object; b) intentional destruction of the space object in orbit, including for its re-entry into the atmosphere; c) de-orbiting manoeuvres and passivation activities. The licence application must include information that proves that systems used by the command and control operator fulfil the following requirements:	

		a) implementation of a quality management system in line with current best practices for carrying out the space activity; b) general description of the software and computer systems used for flight control and orbiting management; c) assessment of systems that enable the operator information about the space object, throughout the entire duration of the operation, with telemetry data on its status and enables the operator to send the object instructions, particularly in response to non-nominal situations that require measures to restore the space object to its expected status. For decentralised systems, these requirements will cover the systems and processes between the command and control centre and subordinate centres. The applicant must submit the launch centre user guide, which must include the following: a) general description of the launch centre, including: i) name; ii) geographic location; iii) blueprints of the centre, with information on the different facilities and areas (in particular, the operations control centre) and their intended purpose, and information on support equipment; iv) conditions for third parties to use the centre to provide services relating to activities carried out at the launch centre; v) neighbouring and surrounding areas of the centre and closest towns;	

		vi) types of launchers that the centre can accommodate; vii) possibility of the centre being used for more than one launcher at the same time, including the conditions for such use; viii) air corridors and launch and return space pathways; ix) ranges of possible launch azimuths for each launch point; x) any other relevant information relating to the description of the centre. b) launch centre security plan, including, the procedures and measures for: i) the chain of command supporting the centre's security management system; ii) space object launch and/or return cancellation; iii) protection of operational staff and visitors to the launch centre; iv) access to launch and operation control centre areas, with information, where appropriate, on whether there are different security areas and the type of people with access to those areas; v) protection of critical systems whose disruption causes serious damage to security; vi) protection of the centre's facilities and operations; vii) cooperation and coordination with private and public bodies involved in the launch centre operations; viii) prevention and mitigation of the centre's environmental impact;	

		ix) safe storage and handling of hazardous substances in the centre; x) archiving and retaining documents and data and the guarantee of their confidentiality and integrity; xi) implementation of the centre's emergency plan and activation of warning systems; xii) rescue and firefighting; xiii) investigation into incidents at the centre and those associated with operations that take place at the centre, including procedures for notification and reporting to the relevant authorities.	
Slovenia	Under the Space Activities Act, to be licensed, space activities must envisage measures to limit the generation of space debris in line with the UN Space Debris Mitigation Guidelines.	Under the Space Activities Act, to be licensed, space activities must be conducted in line with the international standards and guidelines of internationally recognised standardisation organisations on the safety and technology of space activities. Moreover, space activities must not pose a threat to the safety of people or their property, not obstruct protection against natural or other disasters and do not harm public health, the environment or aviation. A risk assessment of these space activity threats must be drawn up on the basis of the latest expert opinions generally accepted by the scientific community.	Under the Space Activities Act, to be licensed, space activities must envisage measures to limit adverse environmental effects on Earth or outer space or adverse changes to the atmosphere.
Finland	Under the Space Activities Act, for a space activity to be authorised, the operator must seek to prevent the generation of space debris and make a plan for discontinuing the space activities and for the related measures, in line with generally accepted international guidelines. In particular, the operator must: (i) limit the generation of space debris during the normal operations of the space object; (ii) mitigate the risks of in-orbit break-ups and in-orbit collisions; and (iii) move it into a less-	Under the Space Activities Act, for a space activity to be authorised, the operator has to provide a risk assessment to the Ministry showing that the activities will not pose any particular risk to persons, property or public safety. Any person participating in the launch, operation or return of a space object must have the know-how and experience required for the tasks under their responsibility. Under Decree 74/2018, in its application for authorisation, the operator must assess the risk of personal injury and material damage that the space activities may cause to Earth, airspace and outer space and the risk of danger to public	Under the Space Activities Act, for a space activity to be authorised, the operator must seek to prevent adverse environmental impacts on Earth, the atmosphere and outer space. In its application for authorisation, the operator must assess these environmental impacts. Space activities must be carried on in a manner that is environmentally sustainable and promotes the sustainable use of outer space. The operator must present a plan for measures to counter and reduce adverse environmental impacts. Any nuclear materials and other radioactive materials

	used orbit or into the atmosphere after the space object has completed its mission. Under Decree 74/2018, the operator must seek to ensure that, within 25 years from the end of the functional operating period of the space object, the space object moves or is moved into the atmosphere or is moved into an orbit where it is considered not to cause any danger or harm to other space objects or other space activities.	safety. The risk assessment must describe the tests and any other measures conducted on the space object to ensure its safety and durability and include a plan to respond to failures. The risk identification and management must cover the entire life cycle of the space object.	used in the space object must be declared in the application for authorisation.

Sweden	Under the Space Activities Act, a licence may be subject to restrictions as deemed appropriate to address specific circumstances. The licence may also be subject to conditions with regard to control of the activity or for other reasons. However, the Space Activities Act and the Decree on Space Activities do not specify specific requirements for space debris, safety, sustainability, frequencies, orbital positions or insurance.	Space objects are registered by the National Board for Space Activities, under the Decree on Space Activities.

3. EU MEMBER STATES' NATIONAL LEGAL FRAMEWORKS FOR SPACE ACTIVITIES

On Member States' legal frameworks for resilience and cybersecurity, it is important to underline that the ECI and NIS Directives did not cover space assets. The study team analysed Member States' legal frameworks and identified some jurisdictions containing security legislation that is applicable to the space sector. An overview of this legislation is provided in Table 11.

As the new CER and NIS2 Directives entered into application in October 2024[30] and the space sector is in scope of these Directives[31], Member States' legal frameworks for cybersecurity and resilience could be reformed in the future, including obligations applicable to the space sector.

[30] Even though Member State transposition is lacking. https://ec.europa.eu/commission/presscorner/detail/en/inf_24_5988

[31] As explained in Section 4.2.4, ground-based infrastructure owned, managed and operated by Member States or private parties that support the provision of space-based services was included in the scope of the directives.

Table 11: Member States' legislative frameworks for security and their applicability to the space sector

Country	Legislative acts on security and the sectors to which they apply	Legislative acts on security applicable to the space sector	Security obligations applicable to the space sector
Belgium	The Law of 3 May 2019 lays down a framework for the security of network and information systems of general interest to public security. It applies to the following sectors: energy, transport, finance, healthcare, drinking water supply, and digital infrastructure, as well as digital service providers. The Law of 1 July 2011 transposed the ECI Directive into national law. It applies to the following sectors: transport, energy, finance and electronic communications.		
Bulgaria	Decree No 257 of 2018 (Cybersecurity Act) applies to the following sectors: energy, transport, banking, financial market infrastructure, health services, drinking water supply, and digital infrastructure, as well as digital service providers and public administration institutions. Decree No 18 of 1 February 2011 on the identification and designation of European critical infrastructures in the Republic of Bulgaria and measures for their protection applies to the energy and transport sectors.		

Country	Legislative acts on security and the sectors to which they apply	Legislative acts on security applicable to the space sector	Security obligations applicable to the space sector
Czechia	Act No 240/2000 on Crisis Management as amended (Crisis Management Act) Act No 181/2014 on Cyber Security as amended (Cybersecurity Act) Governmental order No 432/2010 on the Criteria for the Identification of a Critical Infrastructure Element as amended Decree No 317/2014 on important information systems and their determination criteria as amended Decree No 437/2017 on the criteria for the determination of an operator of essential service Decree No 82/2018 on Security Measures, Cybersecurity Incidents, Reactive Measures, Cybersecurity Reporting Requirements, and Data Disposal (Cybersecurity Decree) These acts apply to the following sectors: energy, transport, banking, financial market infrastructure, health, water resource management, food industry and agriculture, digital infrastructure, communication and information systems, emergency services and chemical industry, as well	• Act No 181/2014 on Cyber Security as amended (Cybersecurity Act) • Governmental order No 432/2010 on the Criteria for the Identification of a Critical Infrastructure Element as amended • Decree No 317/2014 on important information systems and their determination criteria as amended • Decree No 437/2017 on the criteria for the determination of an operator of essential service • Decree No 82/2018 on Security Measures, Cybersecurity Incidents, Reactive Measures, Cybersecurity Reporting Requirements and Data Disposal (Cybersecurity Decree) These acts apply to communication and information systems. Governmental order No 432/2010 specifies the criteria for the identification of critical infrastructure. It lists satellite communication under communication and information systems, in particular: a) the main terrestrial satellite receiver and transmitter	Obligations of bodies identified as operators or administrators of critical infrastructure: • Implement security measures, both organisational and technical. Organisational measures include: i) information security management system, risk management; security policy; organisational security; ii) setting security requirements for suppliers; iii) asset management; iv) human resources security; v) operation and communication management; vi) access control; vii) acquisitions, development and maintenance; viii) cybersecurity events and cybersecurity incident management; ix) business continuity management; x) control and audit. Technical measures include: i) physical security; ii) communication network integrity protection tools; iii) user identity verification tools; iv) access authorisation management tools; v) malicious code protection tools; vi) tools for recording the activities of users and administrators; vii) cybersecurity incident detection tools; viii) acquisition and evaluation of cybersecurity

Country	Legislative acts on security and the sectors to which they apply	Legislative acts on security applicable to the space sector	Security obligations applicable to the space sector
	as digital service providers and public administration institutions. Governmental order No 432/2010 specifies the criteria for the identification of critical infrastructure elements. It lists satellite communication under communication and information systems, in particular: a) the main terrestrial satellite receiver and transmitter stations; b) the European global satellite-based navigation system; c) a terrestrial communication and control centre; d) a terrestrial connection network.	stations; b) the European global satellite-based navigation system; c) a terrestrial communication and control centre; d) a terrestrial connection network. The government is responsible for the identification of critical infrastructure, including infrastructure for satellite communication.	incident tools; ix) application security; x) cryptographic devices; xi) tools for ensuring a certain level of information availability; xii) industrial and management system security. • Detect cybersecurity incidents and report them to the National Cyber and Information Security Agency. • Take preventative, reactive and protective measures when instructed by the National Cyber and Information Security Agency.
Denmark	Denmark does not have a general cybersecurity framework in place; instead, cybersecurity requirements are included in sector-specific legislation. However, Denmark's space legislation does not include cybersecurity requirements.		

Country	Legislative acts on security and the sectors to which they apply	Legislative acts on security applicable to the space sector	Security obligations applicable to the space sector
Germany	- Act of 14 August 2009 on the Federal Office for Information Security (BSI Act – as amended) - Regulation of 22 April 2016 determining critical infrastructures according to the BSI Act (as amended) These acts apply to the following sectors: energy, health, information technology and telecommunications, transport and traffic, media and culture, water, finance and insurance, food, municipal waste disposal, public administration, as well as digital service providers. The Law on the Revision of energy regulations (2011) and the Regulation on the protection of transmissions systems (2012) apply to the energy and transport sectors.		
Estonia	The Cybersecurity Act of 2018 applies to the following sectors: energy, transport, banking, financial market infrastructure, health, drinking water supply and distribution, digital infrastructure, and ICT, as well as digital service providers. The Act also applies to the vital services specified in the		

Country	Legislative acts on security and the sectors to which they apply	Legislative acts on security applicable to the space sector	Security obligations applicable to the space sector
	Emergency Act of 2019 (but space-based services are not included).		
Ireland	S.I. No 360 of 2018 European Union (Measures for a High Common Level of Security of Network and Information Systems) Regulations 2018 applies to the following sectors: energy, transport, banking, financial market infrastructure, healthcare, drinking water supply and distribution, and digital infrastructure, as well as digital services providers.		
Greece	Law 4577/2018 applies to the following sectors: energy, transport, credit institutions, financial market infrastructure, health, water supply and digital infrastructure, as well as digital services providers. Law 345/2008 applies to the energy and transport sectors.		

Country	Legislative acts on security and the sectors to which they apply	Legislative acts on security applicable to the space sector	Security obligations applicable to the space sector
Spain	- Law 8/2011, of 28 April, establishing measures for the protection of critical infrastructure, as modified by Organic Law 9/2022, of 28 July[32] - Royal Decree-Law 12/2018, of September 7, on security of networks and information systems These acts apply to the following sectors: administration, chemical industry, energy, financial and tax systems, the food supply chain, health, information and communication technologies, nuclear industry, research laboratories, space, transport and water, as well as digital services. The Royal Decree also applies to national security, the internet and scientific research. Law 36/2015 of 28 September, on National Security applies to national defence, public security and public administration.	Law 8/2011, which lays down measures for the protection of critical infrastructure, identifies space as a strategic sector, i.e. an area 'within the labour, economic and productive activity, which provides an essential service or which guarantees the exercise of the authority of the state or the security of the country.' The National Commission for the Protection of Critical Infrastructures is responsible for designating critical operators (on the proposal of the Interdepartmental Working Group for the Protection of Critical Infrastructures). Law 9/2022 sets out that 'the necessary technical and organisational measures will be adopted in order to guarantee the security of the systems and data for the purposes of accessing and consulting this information, in order to address possible cybersecurity risks and threats, taking into account, in particular, the standards and recommendations that apply to it, both at the European and national level' (Art. 5.3).	Under Law 8/2011, designated operators must collaborate with the relevant authorities to optimise the protection of critical infrastructure. The relevant bodies must: • provide technical information to the Ministry of the Interior about the critical infrastructures, updating it on an annual basis or at the request of Ministry; • collaborate on preparing the sectoral strategic plans and carrying out risk analyses on the strategic sector; • prepare the operator safety plan and demonstrate implementation of the measures required by the relevant authority through the appropriate certification; • draw up a specific protection plan for each infrastructure considered to be critical and demonstrate implementation of the

[32] Organic Law 9/2022 of 28 July, concerns the use of financial information and transposes Directive 2019/1153 into national law. The Organic Law deals with the following subjects: access to information, international cooperation, cybercrime, personal data, terrorism and national security.

Country	Legislative acts on security and the sectors to which they apply	Legislative acts on security applicable to the space sector	Security obligations applicable to the space sector
		Royal Decree-Law 12/2018 transposes the NIS Directive into national law. The legislation applies to essential services dependent on the networks and information systems included in the strategic sectors set out in Law 8/2011, including space. The identification of essential services and operators that provide them is carried out by the bodies and procedures provided for by Law 8/2011. Law 36/2015 only refers to the space sector to note that it is one area of special interest for national security, but it does not lay down specific rules.	measures required by the relevant authority through the appropriate certification; • appoint a security and liaison officer and a security delegate • facilitate inspections carried out by the relevant authorities to check compliance with regulations and adopt the security measures recommended by these authorities, solving in the shortest possible time the shortcomings they find. • set up an operator safety area. Law 9/2022 lays down that only special and qualified personnel who are specifically appointed and authorised can access 'the Financial Entitlements File' in line with Law 10/2010 (on money laundering prevention). It also lays down that the exchange of financial information related to terrorism between the Executive Service of the Spanish Commission for the Prevention of Money Laundering and Monetary Offenses and the Financial Intelligence Units of other EU Member States must be carried out through secure and specific electronic communication systems that

Country	Legislative acts on security and the sectors to which they apply	Legislative acts on security applicable to the space sector	Security obligations applicable to the space sector
			guarantee a high level of data security. This also applies to the exchange of financial information and financial analysis with the relevant authorities of EU Member States. Under Royal Decree-Law 12/2018, operators of essential services must comply with the following obligations: • adopt technical and organisational measures in order to manage the risks to the security of the networks and information systems used to provide the services (including measures to prevent and minimise the impact of incidents); • appoint and communicate to the relevant authority the person, unit or body responsible for information security; • notify the relevant authorities about incidents that may have significant disruptive effects on services; • if requested by the relevant authority, inform the public or potentially interested

Country	Legislative acts on security and the sectors to which they apply	Legislative acts on security applicable to the space sector	Security obligations applicable to the space sector
			third parties about incidents when necessary to prevent further incidents or manage one that has already occurred, or when the disclosure of an incident is in the public interest; • resolve security incidents that affect them and request specialised help when they cannot resolve the incidents themselves, providing all the necessary information.
France	- Act 2018-133 of 26 February 2018 - Decree 2018-384 of 23 May 2018 - Order of 13 June 2018 - Order of 14 September 2018 These acts transpose the NIS Directive into French law. They apply to the following sectors: energy, transport, logistics, banking, financial market infrastructure, financial services, insurance, social security, healthcare, supply and distribution of drinking water, processing of non-drinking water,	• Act 2018-133 of 26 February 2018 • Decree 2018-384 of 23 May 2018 • Order of 13 June 2018 • Order of 14 September 2018 These acts transpose the NIS Directive into French law. These acts are not applicable to the space sector. Nevertheless, space is considered a sector of vital importance, under Order of 8 September 2017. This sets out the security rules and the procedures for reporting vital information systems and security incidents relating to the 'space' sub-sector of activities of vital importance, under Articles R. 1332-41-1, R. 1332-41-2 and R. 1332-41-10 of the Defence Code.	Obligations of operators of critical infrastructure: • appoint a delegate for defence and security (for contact with the National Agency for the Security of Information Systems); • declare any IT system of critical importance to the National Agency for the Security of Information Systems; • draw up a security plan describing the organisation and security policy; • draw up a specific protection plan for each of the points of vital importance;

Country	Legislative acts on security and the sectors to which they apply	Legislative acts on security applicable to the space sector	Security obligations applicable to the space sector
	digital infrastructure, education, catering, as well as digital service providers. Under Law 2013-1168 of 18 December 2013 (Military Programming Law) that amended the Defence Code, the following sectors are considered to be of vital importance: health, food, water, telecommunications and broadcasting, space and research, industry, electric energy, natural gas provision, petrol, transport, finance, civil administration and military activities.	Operators of critical infrastructure are appointed by the government.	• notify the National Agency for the Security of Information Systems of any security incidents.
Croatia	The Cybersecurity Law of 2020 for operators of essential services and digital service providers applies to the following sectors: energy, transport, financial market infrastructure, healthcare, and digital infrastructure. The Law on Critical infrastructures, No 56/13, 2023 applies to energy, communication and information technology, traffic, healthcare, water management, food, finance, production, storage and transportation of dangerous substances, public services, national monuments and values. The government may		

Country	Legislative acts on security and the sectors to which they apply	Legislative acts on security applicable to the space sector	Security obligations applicable to the space sector
	designate critical infrastructure in other sectors as well.		
Italy	Decree Law No 65 of 18 May 2018, which transposes the NIS Directive, applies to the following sectors: energy, transport, banking, financial market infrastructure, healthcare, drinking water supply and distribution and digital infrastructure, as well as digital service providers. Decree Law No 105 of 21 September 2019 establishes a national cybersecurity scope. Prime Ministerial Decree No 131 of 30 July 2020 sets out the criteria for the identification of the public and private bodies that fall within the scope, including in the following sectors: public administration, defence, space and aerospace, energy, telecommunications, economy and finance, transport, digital services, critical technologies and social security. Decree-Law No 61 of 11 April 2011 transposes the ECI Directive into national law. This Decree lays	Decree Law No 65 of 18 May 2018, which transposes the NIS Directive into Italian law, does not apply to the space sector. Nevertheless, the space sector was included in the scope of Decree Law No 105 of 21 September 2019. This law aims to ensure a high level of security of the networks and information systems on the basis of which essential state functions or essential services are provided, particularly those networks and systems whose malfunction, interruption or improper use could result in compromising national security. To this end, the legislation sets out the criteria for the identification of the public and private bodies that fall within the national cybersecurity perimeter, including in the space sector. The list of bodies included in the national cybersecurity perimeter is set out by an administrative act of the Prime Minister. Since this act is not subject to publication, the National Cybersecurity Agency notifies bodies of their inclusion in the perimeter.	Obligations of bodies included in the national cybersecurity perimeter: • submit a list of ICT assets used for the provision of essential services to the National Cybersecurity Agency on a yearly basis; • adopt security measures and allow the National Cybersecurity Agency to conduct audits and inspections to monitor the implementation of such measures; (Security measures to be adopted include: measures relating to the organisational structure responsible for security management; security policies and risk management; incident mitigation, management and prevention; physical, logical and data protection; network and information system integrity; operational management; monitoring, auditing and control; training and awareness;

Country	Legislative acts on security and the sectors to which they apply	Legislative acts on security applicable to the space sector	Security obligations applicable to the space sector
	down the procedures for the identification and designation of European critical infrastructure (ICE) in the energy and transport sectors. It also sets out the methods for assessing the safety of such infrastructure and the related minimum protection requirements from threats of human origin, accidental and voluntary, technological and natural disasters. It applies to the following sectors: energy, transports and national security and defence.		procurement of hardware, systems and services); • manage security incidents and notify Italy's Computer Security Incident Response Team when they occur.
Cyprus	Law No 89(I)/2020 on the Security of Network and Information Systems, which transposes the NIS Directive into national law, applies to the following sectors: energy, transport, banking, financial market infrastructure, health, drinking water supply and distribution, digital infrastructure, and digital service providers. Presidential Decree 39/2011, which transposes the ECI Directive, applies to energy and transport.		
Latvia	Law of 25 October 2018 on the Security of Information Technology applies to the following sectors: finance, financial market infrastructure, drinking water supply and distribution, internet exchange point services, domain name system services, top-level domain name registries, energy,		

Country	Legislative acts on security and the sectors to which they apply	Legislative acts on security applicable to the space sector	Security obligations applicable to the space sector
	transport and health, as well as information technologies and digital service providers. The Law on National Security and Cabinet Regulation No 496 of 1 June 2010 on the procedure for the identification of critical infrastructure transposed the ECI Directive into national law. Neither of these acts apply to the space sector.		
Lithuania	- Law No XII-1428 amending the Law on Cybersecurity of the Republic of Lithuania No XIII-1299 - Resolution No 818 of the Government of the Republic of Lithuania of 13 August 2018 These acts apply to the following sectors: energy, transport, healthcare, drinking water supply, distribution and management, and public administration, as well as digital services providers. Law No IX-1908, Law No IX-2030, Law No XI-375, Law No XI-635, Resolution No 717 and Resolution No 943 transpose the ECI Directive into national law.		

Country	Legislative acts on security and the sectors to which they apply	Legislative acts on security applicable to the space sector	Security obligations applicable to the space sector
Luxembourg	Act of 28 May 2019 transposing the NIS Directive applies to the following sectors: energy, transport, credit institutions, financial market infrastructure, healthcare, the supply and distribution of drinking water, and digital infrastructure, as well as digital services providers. The Grand-Ducal Regulation of 12 March 2012 on the identification and designation of critical infrastructure transposes the ECI Directive into national law. It does not apply to the space sector.		
Hungary	Act CLXVI/2012 on the Identification, Designation and Protection of Critical Systems and Infrastructure and Government Decree 65/2013 on the Execution of the Critical Infrastructures Act apply to the following sectors: energy, transport, agriculture, healthcare, social security, finance, ICT, water, national defence and public security.		
Malta	L.N. 216 of 2018 applies to the following sectors: energy, transport, banking, financial market infrastructure, healthcare, drinking water supply and distribution, digital infrastructure and public administration, as well as digital service providers.		

Country	Legislative acts on security and the sectors to which they apply	Legislative acts on security applicable to the space sector	Security obligations applicable to the space sector
	L.N. 434 of 2011 transposes the ECI Directive into national law. It does not apply to the space sector.		
Netherlands	- Network and Information Systems Security Act of 17 October 2018 - Decision dated 30 October 2018, concerning the rules related to the execution of the Network and Information Systems Act These acts apply to the following sectors: energy, transport, banking, financial market infrastructure, drinking water, and digital infrastructure, as well as digital service providers.		
Austria	Network and Information Systems Security Act of 2018 Network and Information Systems Security Regulation of 2019 These acts apply to the following sectors: energy, transport, banking, financial market infrastructure, health services, drinking water supply, and digital		

Country	Legislative acts on security and the sectors to which they apply	Legislative acts on security applicable to the space sector	Security obligations applicable to the space sector
	infrastructure, as well as digital service providers and public administration institutions.		
Poland	The National Cybersecurity Act of 5 July 2018 applies to the following sectors: energy, transport, banking, financial market infrastructure, healthcare, drinking water and digital infrastructure, as well as digital service providers. The Cabinet Regulation of 30 April 2010 on the National Programme for Critical Infrastructure Protection, the Cabinet Regulation of 30 April 2010 on critical infrastructure protection plans and the Act of 29 October 2010 amending the Crisis Management Act transpose the ECI Directive into national law. None of these apply to the space sector.		
Portugal	Law No 46/2018 of 13 August 2007, which transposes the NIS Directive into national law, applies to the following sectors: energy, transport, banking, financial market infrastructure, healthcare, drinking water, and digital infrastructure, as well as digital service providers, and public administration. Decree-law No 20/2022 of 28 January, which transposes the ECI Directive into national law, applies to the following sectors: energy, transport,		

Country	Legislative acts on security and the sectors to which they apply	Legislative acts on security applicable to the space sector	Security obligations applicable to the space sector
	communications, digital infrastructure and digital service providers, public supply of water and waste management, food, health, industry, financial services, public administration, security and defence.		
Romania	Law No 362/2018 ensuring a high common level of security of network and information systems applies to the following sectors: energy, transport, banking, financial market infrastructure, healthcare, drinking water, and digital infrastructure, as well as digital service providers. The Emergency Ordinance on the identification, designation and protection of critical infrastructures and the Government Decision on the composition, tasks and organisation of the Interinstitutional Working Group on Critical Infrastructure Protection transpose the ECI Directive into national law. Chapter V of the Emergency Ordinance mentions the Romanian Space Agency as one of the authorities responsible for critical infrastructure.		
Slovenia	The Information Security Act of 2018 applies to the following sectors: energy, digital infrastructure, drinking water supply and distribution, health, traffic, banking, financial market infrastructure,		

Country	Legislative acts on security and the sectors to which they apply	Legislative acts on security applicable to the space sector	Security obligations applicable to the space sector
	food supply, and environmental protection, as well as digital service providers and public administration. The Regulation on European Critical Infrastructures transposes the ECI Directive into national law. It does not apply to space.		
Slovakia	Act No 69/2018 of 30 January 2018 on Cybersecurity applies to the following sectors: transport, electronic communications, energy, postal services, industry (pharmaceutical, metallurgical and chemical industries), ICT, water and atmosphere (meteorological services, hydraulic engineering and provision of drinking water), and healthcare, as well as digital service providers. Act No 45/2011 on critical infrastructure transposes the ECI Directive into national law. The Act authorises the development of state administration bodies to oversee and implement the policy areas covered by the Directive. Annex No 3 of Act No 45/2011 sets out the sectors under the responsibility of the central authorities, including satellite communications.		

Country	Legislative acts on security and the sectors to which they apply	Legislative acts on security applicable to the space sector	Security obligations applicable to the space sector
Finland	Finland does not have a general cybersecurity framework in place; instead, cybersecurity requirements are included in sector-specific legislation. However, Finland's space legislation does not include cybersecurity requirements.		
Sweden	Act 2018:1174 and Ordinance 2018: 1175 apply to the following sectors: energy, transport, banking, financial market infrastructure, health, supply and distribution of drinking water, digital infrastructure, as well as digital services. The following legislation transposes the ECI Directive into national law: • Ordinance (2012: 512) amending the Ordinance (2007: 1153) containing instructions for the Swedish Energy Agency; • Ordinance (2012: 513) amending Ordinance (2007: 1119) containing instructions for Affärsverket svenska kraftnät; • Ordinance (2012: 793) amending the Ordinance (2010: 185) containing		

Country	Legislative acts on security and the sectors to which they apply	Legislative acts on security applicable to the space sector	Security obligations applicable to the space sector
	instructions for the Swedish Transport Administration; • Ordinance (2009: 611) amending Ordinance (2008: 1002) containing instructions for the Swedish Civil Protection Authority and readiness. Each ordinance authorises specific national administrations to oversee and implement the policy areas covered by the ECI Directive. None of these ordinances apply to the space sector.		

ANNEX 7: LEGAL BASIS

According to settled case law[33] of the EU Court of Justice ('Court of Justice'), the choice of legal basis for an EU legislative proposal must rest on objective factors that are amenable to judicial review. These include, in particular, the aim and the content of the measures envisaged by the EU legislative proposal.

The legislative act envisaged in policy options 2 and 2+ (the EU legislative proposal) provides for an EU legislative act to be adopted that harmonises technical requirements related to safety, resilience and environmental sustainability protection, to ensure that data and services provided through the use of satellites can circulate freely in the internal market without barriers. Article 114 TFEU is considered the most suitable legal basis to support the future EU legislative proposal.

The cybersecurity and physical resilience aspects, as regards Member States' ground-based space infrastructure, have already been harmonised for certain market actors in the space sector (minimum harmonisation Directives) using Article 114 TFEU[34] as a legal basis.

There is now an abundant amount of case law of the Court of Justice on the conditions for using Article 114 TFEU. According to such case law, EU legislative acts adopted under Article 114 TFEU must genuinely have as their objective to improve the conditions for the establishment and functioning of the internal market[35]. While recourse to Article 114 TFEU as a legal basis is possible if the aim is to prevent future obstacles to trade from emerging due the divergences in national laws, the emergence of such obstacles must be likely and the measure in question must be designed to prevent them[36]. Furthermore, according to the case law and provided that such conditions for recourse to Article 114 TFEU as a legal basis are fulfilled, the EU legislature is allowed to rely on that legal basis on the grounds that safeguarding certain general interests such as public health or safety, is a decisive factor in the choices to be made[37].

In this case, the future EU legislative proposal aims to ensure that an internal market is established for the freedom to deliver services and data related to space activities. The use of space in the economy is booming. The number of sectors and of users of space data and technologies increase every year. In addition, the costs of space manufacturing and launch have lowered, resulting in the democratisation of space with an increase of civil and

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[33] Judgment of the Court of Justice, 3 December 2019, C-482/17, Czech Republic against European Parliament and Council, ECLI:EU:C:2019:1035, points 30 and 31.

[34] Directive (EU) 2022/2555 of the European Parliament and of the Council of 14 December 2022 on measures for a high common level of cybersecurity across the Union, amending Regulation (EU) No 910/2014 and Directive (EU) 2018/1972, and repealing Directive (EU) 2016/1148 (NIS 2 Directive) OJ L 333, 27.12.2022, p. 80-152. NIS 2 and CER Directives are both based on Article 114 TFEU and lay down harmonised minimum requirements in their respective areas. The CER Directive will strengthen the physical resilience of critical entities providing vital services (on which the proper functioning of the internal market depends) while NIS 2 Directive aims to achieve a high common level of cybersecurity across the EU.

[35] C-58/08, p. 32.

[36] C-482/17 (already quoted), point 35.

[37] C-482/17 (already quoted), point 36; judgment of 4 May 2016, Poland v Parliament and Council, C 358/14, EU:C:2016:323, paragraph 34.

military activities and players in the space domain. This is demonstrated by the surge of number of national space laws currently in development.

The future EU proposal aims to ensure the freedom to provide services delivered through satellites, which are otherwise vulnerable to the risks and threats of safety, resilience and environmental sustainability related to the satellite design and operation. Those risks and threats could make such services unusable in the future. As a result, the direct aim of the future EU legislative proposal is to develop an internal market for services and data related to space activities.

Until recently, the development, at Member State level, of national space legislation was limited, due to the few activities within the field. As a result, there was no incentive for Member States to draft such legislation. However, as mentioned there is now a democratisation of space activities. More Member States are becoming active in the space industry – not only in manufacturing space machinery but also in launching; for example, several Member States are developing micro launchers[38]. With more ambitions to develop national space activities, Member States also need to develop know-how and local space industries, which can be achieved by introducing measures and incentives to attract talent and companies[39]. Consequently, the number of Member States with national space legislation is also increasing.

Currently, 12 Member States have specific legislation regulating space activities. The level of detail in this legislation varies considerably. Some Member States have adopted minimalist legislation entailing limited obligations. France has the most advanced and detailed legislation due to its activities, being the first EU launching country (Guyana spaceport). In addition, several Member States are contemplating adopting legislation in the space domain. Some are already preparing draft legislation. The common denominator in the national legislation across these Member States is the establishment of licences aiming to ensure compliance with international obligations under the Treaty of Outer of Space[40]. The rise of national legislation across the EU sees national requirements being introduced under the licences for carrying out space activities. However, these requirements do not tackle in a uniform manner matters of safety, resilience and environmental sustainability protection. Current and future legislative disparities across Member States will pose the significant problem of fragmentation of the internal market for space (services and data). This can only be resolved by harmonising core technical elements in these areas.

Application to the future EU legislative proposal

Divergent national laws could be detrimental to the development of space activities at EU level. The increase of differing space legislation at national level might lead to the emergence of obstacles to the free movement of data and the freedom to provide services. A satellite that cannot receive a license from another Member States because of these

[38] Sweden, Germany, Portugal and Italy have space launch plans, albeit at different levels of maturity.

[39] For example, [National programmes - Funding - Luxembourg Space Agency (public.lu).]()

[40] According to Article VI of the *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space*, including the Moon and Other Celestial Bodies: '*States Parties to the Treaty shall bear international responsibility for national activities in outer space (...). The activities of non-governmental entities in outer space, (...), shall require authorization and continuing supervision by the appropriate State Party to the Treaty. (...)*'.

disparate rules (compared to the other Member States it need to be licensed from), would not be able to provide the space based services and data for the single market. As a result, goods that do not fulfil certain requirements laid down in national legislation may not move freely in the internal market, for example, some Member State may impose a requirement to have a specific design to protect a satellite, while others may not. Similarly, launch services might be impacted, if, for example, only some Member States impose certain space surveillance and tracking obligations before and after launch. By harmonising certain technical aspects of safety, resilience and environmental sustainability protection, the EU legislative proposal will allow the free movement of services and data within the single market for space activities.

Distortion of competition: depending on the coverage and depth of national requirements, the costs incurred by companies might diverge, possibly generating a distortion of competition among market actors. Differences in cost can induce regulatory arbitrage and forum shopping. Companies may choose to establish themselves in jurisdictions with fewer constrains and requirements so they can operate at the lowest cost. This concern is particularly relevant for the problem of space debris. Obligations intended to avoid the proliferation of space debris entail a cost for companies (e.g. the obligation to keep sufficient propellant for de-orbiting, or certain technical obligations to shield satellites). Therefore, requirements related to space debris might create a race to the bottom among Member States to become the most attractive regime.

Against this background, it appears that Article 114 TFEU is a suitable legal basis for the future EU proposal. By contrast, Article 189 TFEU is not an appropriate legal basis to support this proposal.

This provision allows the EU to adopt measures to set out a policy for the space domain, taking the form, essentially but not exclusively, of EU space programmes. According to Article 4(3) TFEU, 'in the area of research, technological development and space, the Union shall have competence to carry out activities, in particular to define and implement programmes; however, the exercise of the competence shall not result in Members States being theirs.' It follows that the establishment of a space policy – under Article 189 TFEU –– is a parallel shared competence between the EU and the Member States. This competence is to be understood as allowing the EU to develop space programmes without limiting or preventing the right of Member States to develop their own national programmes. This explains why Article 189(2) TFEU excludes harmonising the laws and regulations of the Member States. In this case, the examination of the aim and content envisaged for the future EU legislative proposal shows that such an act does not relate to the 'development of a Union space policy'. Instead it relates to the approximation of laws and regulations of certain requirements needed to remove and avoid the obstacles to the free movement of goods (satellites) and services (supplied through the use of satellites) to ensure the establishment and functioning of the single market. Article 114 TFEU consequently appears to be a suitable legal basis.

Research and technological development are other topics referred to in Article 4(3) TFEU whereby the EU is empowered to develop a parallel shared competence (for instance, the EU develops its own research programmes, and Member States develop theirs). This does not prevent the EU from adopting harmonisation measures covering products and services connected to these activities. There are also examples of EU legislation harmonising the conditions for placing certain goods on the EU market based on Article 114 TFEU while the goods in question are connected to a policy area for which the Treaty provides a specific legal basis. For instance, the choice of Article 114 TFEU as a legal basis for the adopting EU legislation regulating the placing of tobacco on the market has been confirmed by the Court of Justice even though Article 168(5) of the TFEU (public health) only allows the EU to adopt measures whose direct objective is to protect public health regarding tobacco, excluding any harmonisation of the laws and regulations of the Member States[41].

[41] Judgment 5 October 2000, *Federal Republic of Germany* v *European Parliament and Council of the European Union*, Case C-376/98, ECLI:EU:C:2000:544.

ANNEX 8: DETAILED POLICY OPTIONS

This annex contains additional details on the different policy options described in the impact assessment.

1. BASELINE

At international level, space activities are governed by several treaties dating back to the 1960s and 1970s, in particular the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (OST), further developed in the 1968 Rescue and Return Agreement; the 1972 Liability Convention; the 1975 Registration Convention and the 1979 Moon Agreement. These treaties are further supplemented by non-binding rules promoting space safety and sustainability.

These **non-binding rules** include: the UN 21 Long-Term Sustainability of Outer Space Activities[42], different space debris mitigation guidelines (i.e. the Space Debris Mitigation Guidelines from the Inter-Agency Space Debris Coordination Committee (IADC)[43] and the Guidelines developed by the Committee on the Peaceful Uses of Outer Space[44]), and different regulations and guidelines from the International Telecommunication Union (ITU)[45] focused on radio-frequency and physical interference. Asked whether the current international space laws are fit to ensure the safe and long-term use of space, 50% of the respondents answered no, and 29% somewhat. Only 4% said yes.

At a technical level, the International Organization for Standardization (ISO) and the European Committee for Standardization (CEN) have developed space safety standards that build on the treaties and non-binding rules mentioned above.

The international space regime does not cover Earth's environment. However, there have been **developments in ISO**, including drawing up high-level standards to support organisations in their environmental management activities. While ISO life cycle assessment (LCA) standards provide a valuable framework for conducting environmental assessments, they have shortcomings and limitations. For example, ISO standards provide guidelines, but there are differences in how organisations and practitioners interpret and apply these guidelines, which can result in inconsistencies in LCA studies.

On **cybersecurity and resilience,** there are no specific rules at international level. However, jurisdictions have advanced to different degrees in tailoring their **risk management / cybersecurity** practices to space activities and space systems.

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[42] Guidelines for the Long-term Sustainability of Outer Space Activities.

[43] IADC, IADC Space Debris Mitigation Guidelines (Rev. 3), IADC-02-01 (June 2021), see https://www.iadc-home.org/documents_public.

[44] Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space.

[45] ITU-R: Managing the radio-frequency spectrum for the world.
Environmental protection of the geostationary-satellite orbit. https://www.itu.int/rec/R-REC-S.1003/en.

Spacefaring jurisdictions, such as the US, are developing new and tailored approaches both to space traffic management and risk management. For instance, the US will continue working to mitigate 'current and future operational risks' as part of implementing several US space policy directives on space traffic management[46] and cybersecurity principles of space systems[47]. On cybersecurity, the US interagency reports drawn up by the US National Institute of Standards and Technology (NIST) enshrine detailed principles and practices aiming to apply the NIST cybersecurity framework to space systems[48].

At **national level**, 11 EU Member States have adopted legislation to regulate space activities, while other Member States are considering adopting such legislation (see Section 2.2).

2. POLICY OPTION 1: CO-REGULATION

Option 1 aims to set out certain voluntary measures on safety, resilience and sustainability through a co-regulation approach. Co-regulation combines legislative and regulatory measures with actions taken by those most concerned, drawing on their practical expertise. Co-regulation is defined as 'the mechanism whereby a community legislative act entrusts the attainment of the objectives defined by the legislative authority to parties which are recognised in the field (such as economic operators, the social partners, non-governmental organisations, or associations). This mechanism may be used on the basis of criteria defined in the legislative act so as to enable the legislation to be adapted to the problems and sectors concerned, to reduce the legislative burden by concentrating on essential aspects and to draw on the experience of the parties concerned.'[49]

The Commission, building on its experience of the EUSST Partnership and its activities in IRIS²[50], would, through a legislative act[51], draw up specific requirements that it would like to be met in the field of safety, resilience and sustainability. Those recognised as being representative of the space sector for the three topics (safety, resilience and sustainability) would be mandated to develop the technical application of these requirements. This approach requires a broad participation of stakeholders (some targets will be set in the legislative act) to ensure widespread compliance with the non-binding measures produced.

The work carried out by these bodies would lead to the adoption of a series of non-binding measures (e.g. reflected in best practices, guidelines and charters). To ensure that these voluntary measures are effective, specific minimum targets will be incorporated in the legislative act launching the initiative. If these targets are not met, the Commission will be able to end the process. To develop the measures, the industry would draw from existing

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[46]https://trumpwhitehouse.archives.gov/presidential-actions/space-policy-directive-3-national-space-traffic-management-policy/.

[47] Memorandum on Space Policy Directive-5—Cybersecurity Principles for Space Systems – The White House (archives.gov).

[48] For instance, NIST IR 8270 (Introduction to Cybersecurity for Commercial Satellite Operations) and NIST IR 8401 (Satellite Ground Segment: Applying the Cybersecurity Framework to Satellite Command and Control).

[49] https://www.eesc.europa.eu/sites/default/files/resources/docs/auto_coregulation_en--2.pdf.

[50] Article 3(2)(i) of Regulation (EU) 2023/588 of the European Parliament and of the Council of 15 March 2023 establishing the Union Secure Connectivity Programme for the period 2023-2027 (OJ L 79, 17.3.2023, p. 1).

[51] Communication from the Commission of 25 July 2001 'European governance - A white paper', COM(2001) 428 final..

non-binding international texts (e.g. UN Long-term Sustainability guidelines, IADC guidelines, standards) and therefore anticipate potential future needs through the development of new measures. At the end of the process, the Commission would analyse the results achieved by space sector. If they are in line with the objectives and the targets set in the legislative act, they would be incorporated in an implementing act.

The legislative act would set up a specific forum for exchanges between Member States and the Commission. They would discuss the best approach to incorporate the non-binding measures in their national licensing systems. It could be inspired by Member States current practices when referring to non-binding international texts in national licensing requirements. Considering the non-binding nature of such acts, Member States would still have the freedom to refer to them or not.

The legislative act would support the industry in developing a mechanism to recognise companies that effectively implement the non-binding measures through the creation of 'space safety/sustainability/resilience labels'. Based on the specific topic, the various labels implementing the different components would share the same underlying approach. However, as their scope differs, they would be governed by different steering committees (key stakeholders). Enforcing the labels would be determined by designated stakeholder committees and would be done through transparent mechanisms.

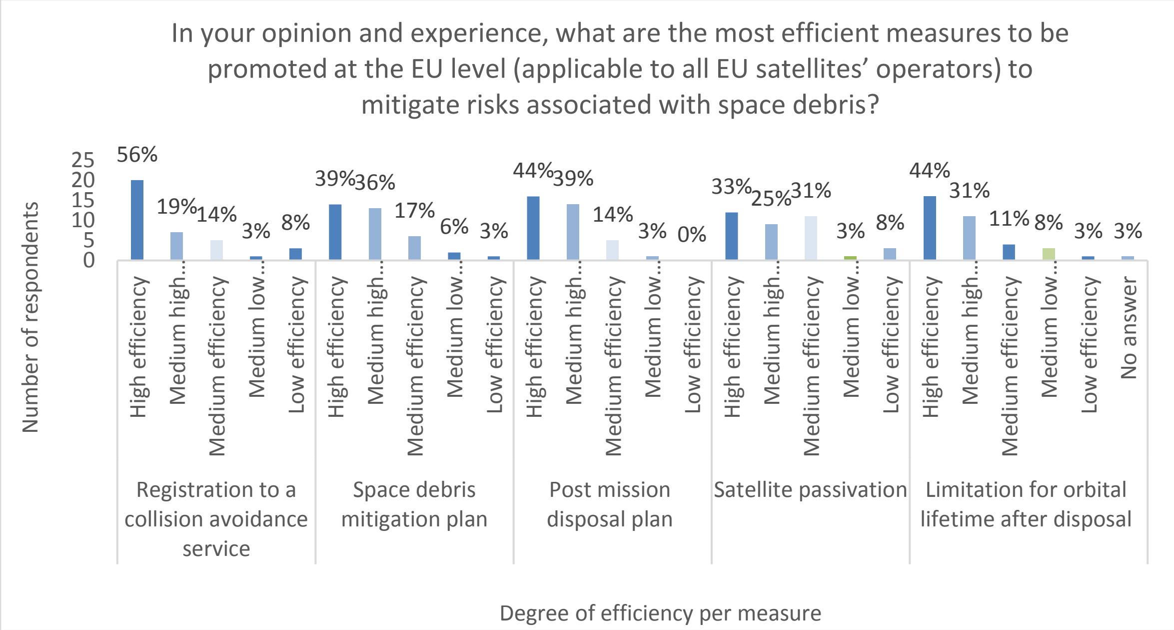
3. POLICY OPTION 2: A BINDING FRAMEWORK AT EU LEVEL

In the area of health, safety and environmental and consumer protection, Article 114(3) TFEU prescribes a high level of protection. The approach to the level and the number of requirements must be based on proportionality between setting a high level to ensure the achievements of the objectives and developing rules that are too stringent, which would become impossible targets the industry to reach. This has been accounted for in the selection of the proposed measures, which builds on an analysis of existing national frameworks, international texts and standards, and industry best practices.

Safety measures are primarily driven by existing standards, but where further guidance is needed, more detailed rules, inspired by national legislation and EU space programmes have been added[52]. The targeted stakeholder consultation included an evaluation of potential measures, and the results show that most respondents agree with the level of efficiency of the proposed measures. In addition, more detailed measures were presented to industry at two different space safety workshops. Participants found that most measures were suitable in addressing the safety challenges. Those that were considered not to be technically feasible have been disregarded.

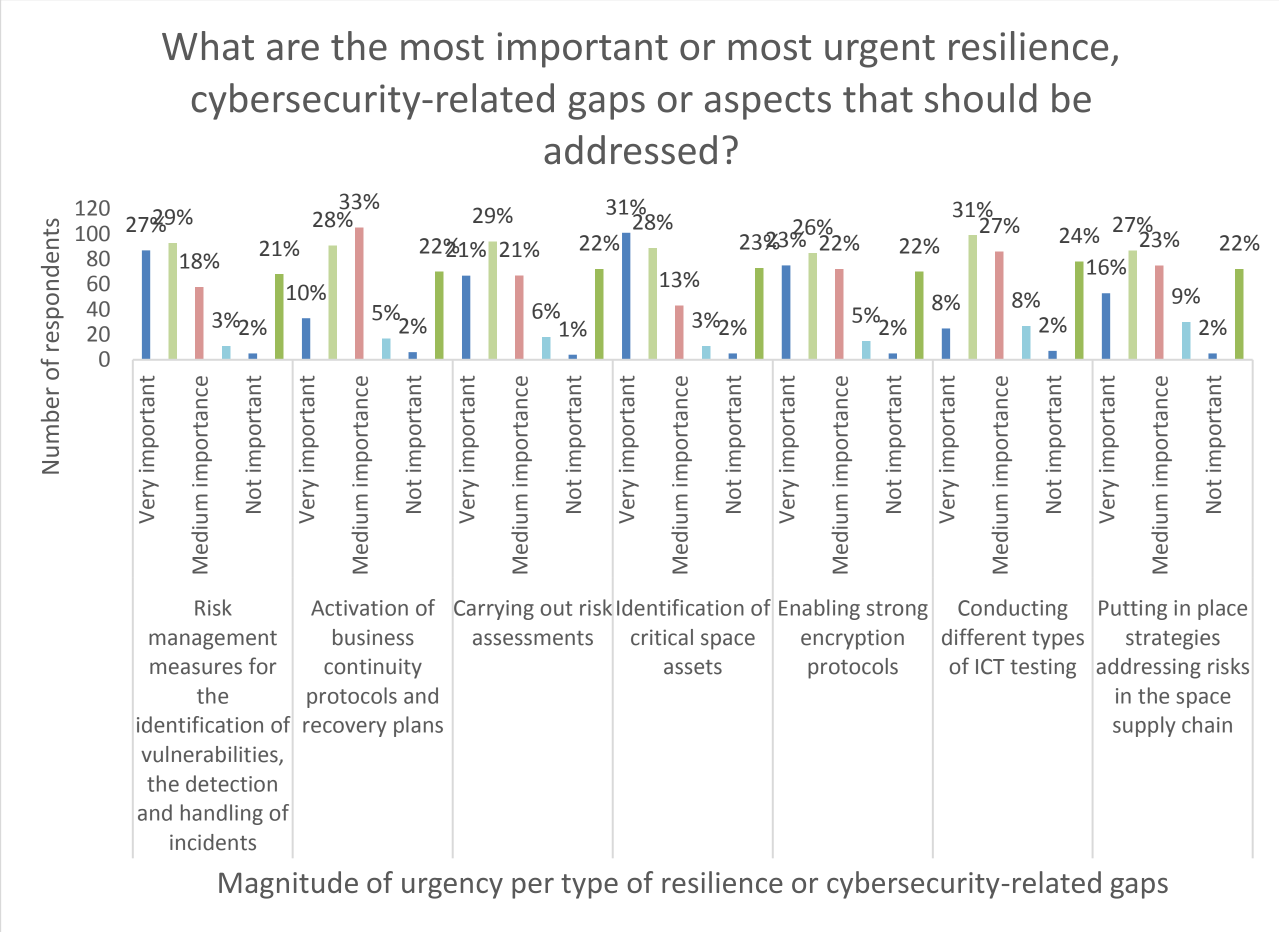
[52] This analysis builds on work being done under Horizon Europe, EUSTM – Space traffic management for the 21st century in Europe and beyond and SPACEWAYS' Home Page (spaceways-h2020.eu).

Figure 1: Overview of stakeholder's views on space debris mitigation



On resilience, the targeted stakeholder consultation and the various rounds of consultations and discussions with the industry show support for adopting a more complete and tailored approach for the space sector through a dedicated system that brings legal clarity and coherence. The resilience requirements in this policy option, including the pillars of the dedicated risk management framework and the approach to the security risk assessment, have received support: these requirements are seen as an effective means to prioritise the efforts and capabilities to boost the resilience of space infrastructure.

Figure 2: Overview of stakeholders views on resilience and cybersecurity-related gaps



The selection of the environmental requirements is crucial to ensure environmental responsibility and sustainability in the rapidly growing space industry. These requirements include: (i) the mandatory implementation of an LCA; (ii) the use of product environmental footprint category rules (PEFCR) for space activities as a standardised calculation method; and (iii) environmental reporting at the moment of licensing.

With an increasing number of satellites, rockets, and space missions being launched, this approach not only provides a systematic assessment of the environmental impact but also has other significant advantages. Requiring environmental reporting at the moment of licensing ensures that space operators are held accountable for their environmental footprint, promoting responsible behaviour from the outset. It enables regulatory authorities to assess the environmental implications of each endeavour, which allows for better-informed decision-making and gives incentives for cleaner and more sustainable space practices.

In addition, it provides a transparent mechanism for stakeholders and the public to scrutinise and understand the environmental consequences of space activities, which fosters public awareness and engagement. This approach, combining LCA practices, PEFCR for space activities, and mandatory environmental reporting, not only reflects the sector's collective expertise but also drives the industry towards greater sustainability, contributes to Earth's environmental preservation, and promotes accountability and public trust in space activities. This approach is also aligned with the views expressed in the many stakeholder consultations that took place.

4. Policy option 2+: A binding framework at EU level, combined with non-binding measures

See the previous section for details on policy option 2.

The creation of the label would take a phased approach.

Through a specific working group consisting of key stakeholders, the Commission would first conduct a stocktaking exercise to identify existing non-binding instruments and gaps in coverage. Based on this exercise, the Commission would develop new non-binding instruments to fill the identified gaps as well as a mechanism to promote the use of existing and new instruments. The aim would be to demonstrate that the EU is proactive in this field, propose new innovative solutions to encourage compliance through incentives and fill gaps while avoiding duplication.

The second phase would be the development of non-binding instruments: space labels would be awarded to companies who correctly implement the instruments on which the labels are based. The labels would share the same underlying components but would differ in scope and therefore be governed by different steering committees (consisting of key stakeholders). The labels would be adopted through a legislative act that would include cross-cutting governance rules and procedures for determining technical progress. How the label is applied would be determined by designated stakeholder committees.

The Commission would develop the procedure for claiming the label. In addition to the recognition that labels inherently bring, Member States would be encouraged to use them: a manual would be developed for authorities awarding public contracts. It would include criteria that Member States must consider when setting targets for purchasing products. Appropriate procedures for monitoring and tackling the misuse of the labels would also be put in place.

Today, many space companies go far in signing pledges to improve space safety, security and sustainability. The labelling mechanism would create a government-approved tool that verifies, validates and certifies those companies that meet the applicable standards. Such transparency would reduce 'greenwashing' and help to incentivise behavioural change. In addition, companies could be more willing to choose a partner carrying a space label that attests that their product is more safe or secure, thereby limiting the risk of future damage.

5. Policy option 2++: A binding framework at EU level

This section contains background information on the different international attempts at regulating space. The experience of the International Code of Conduct for Outer Space

Activities in 2014[53] shows the difficulties in convincing the international community to subscribe to ambitious EU-led initiatives with a comprehensive scope. However, in the past 10 years, there has been more awareness about the importance of having clear rules on space safety, sustainability and security[54]. As a result, multiple initiatives have been launched at international level that demonstrate an **increased willingness** on the part of the international community to discuss ways to improve space safety, security and sustainability, either in the UN[55] or outside an established multilateral framework[56]. It would further develop the commitment made by G7 leaders to promote the safe and sustainable use of outer space by addressing the challenges of space debris and security created by anti-satellite tests[57]. The 2024 UN Summit of the Future was called a 'unique window of opportunity' to discuss global solutions to space safety and security[58]. This policy option would build on the momentum that is expected to be created in the aftermath of this summit.

[53] International Code of Conduct for Outer Space Activities (Draft), Code of conduct Working Document 21 (europa.eu).

[54] See, for example, the debris created by Russia's ASAT test in 2021 and the impact on the safety of the ISS: https://www.armscontrol.org/act/2021-12/news/russian-asat-test-creates-massive-debris.

[55] See the parallel discussions of the Working Group on the Long-Term Sustainability of Outer Space Activities in the UN COPUOS Scientific and Technical Subcommittee, the COPUOS Legal Subcommittee's Working Group on Legal Aspects of Space Resource Activities, the open-ended working group on reducing space threats through norms, rules and principles of responsible behaviours (and the Conference on Disarmament on the prevention of an arms race in outer space).

[56] See the example of the bilateral series of NASA Artemis Accords below and the pledge by 35 countries, including a joint commitment by the Member States of the EU to ban ASAT testing, European Union nations join ASAT testing ban - SpaceNews.

[57] G7 Hiroshima Leaders' Communiqué, 20 May 2023 (g7-2023-hiroshima-leaders-communiqué.pdf (europa.eu)).

[58] U.N. opens "window of opportunity" to improve space governance - SpaceNews.

Table 12: Overview of measures per policy option

		BASELINE	POLICY OPTION 1	POLICY OPTION 2 (PO2)	POLICY OPTION 2+ (PO+)	POLICY OPTION 2++
Congested space: risk of satellite collision	Collision avoidance service	Voluntary	Voluntary, except for label holders	Binding: • subscription to a collision avoidance service and re-entry service for different operations • informing the collision avoidance body about changes to operations	PO2	PO2 and PO+ and additional requirements for non-EU countries (TBC)
Congested space: risk of satellite collision	Limitation of debris during normal operations (design to minimise release of debris or protect against impact, satellite passivation)	International standards exist but are implemented to different degrees	Voluntary, except for label holders. Label could include design mitigation measures from existing standards	Binding: • compliance with existing international standards and potentially more detailed European standards on checks and validation	PO2 and non-binding: • label for space operators who would go further to achieve space safety and sustainability • sharing of best practices	PO2 and PO+ and additional requirements for non-EU countries (TBC)
Congested space: risk of satellite collision	Post-mission disposal (reliable and safe means of disposal, satellite disposal plan, orbital lifetime)	International standards exist but are implemented to different degrees	Voluntary, except for label holders. Label could include design mitigation measures from existing standards	Binding: • compliance with existing international standards and potentially more detailed European standards on orbital lifetime	PO2 and non-binding: • label for space operators who would go further to achieve space safety and sustainability • sharing of best practices	PO2 and PO+ and additional requirements for non-EU countries (TBC)
Increased threat level	Risk management cycle (detection of incidents, protection measures, business continuity and recovery measures)	Non-binding risk assessment models and metrics for space are varied at international level. At national level, there are different approaches and are implemented in Member States to varying degrees. A true baseline is missing across all space systems and the supply chain.	Voluntary: development of best practices and techniques to be shared among market operators on most effective risk management steps and lessons learned	Binding: along the risk management cycle: management of space assets and management and control of access rights • detection and handling of incidents • cyber and physical protection; encryption, patch management, back-up management • business continuity policy response and disaster recovery plans • testing • reporting of significant incidents	PO2	PO2 and PO+ and additional requirements for non-EU countries (TBC)
Increased threat level	Risk assessment per segment	No clear and explicit legal requirement.		Binding: • risk assessment covering the whole life cycle of space activities and operations • specific risk assessment (COTS, non-EU assets)	PO2	PO2 and PO+ and additional requirements for non-EU countries (TBC)

		BASELINE	POLICY OPTION 1	POLICY OPTION 2 (PO2)	POLICY OPTION 2+ (PO+)	POLICY OPTION 2++
				use risk scenarios, threat modelling, use cases		
Increased threat level	Information security requirements, encryption	Divergent approaches to non-binding recommendations, technical profiles (only in one Member State). No common baseline across the internal market and no common general principles.	Voluntary to comply with best practices and information sharing on, for instance, technical aspects such as encryption methods, authentication for satellite communications, how to build effective security to address cyber threats over the potentially long lifetime span of satellites, penetration testing for space infrastructure. Development of practical handbooks – role of ENISA	Binding: Supply chain risk management: review security requirements in contracts with suppliers; software integrity check; control ICT systems connected for maintenance; non-EU assets inventory	PO2 and best practices on cybersecurity going beyond the level set in the EUSL, e.g. on encryption	PO2 and PO+ and additional requirements for non-EU countries (TBC)
Increased threat level	Cyber incidents and cyber threats à suggestion: information sharing	Possibility acknowledged by NIS2 and not yet shaped for space community	Information sharing on cyber threats and remedies applied	Binding reporting requirements • reporting of significant incidents (cyber and non-cyber) • setting up national security monitoring centres with the support of EUSPA	PO2 and participation in the information-sharing hub with the support of EUSPA – EU SPACE ISAC	PO2 and PO+ and additional requirements for non-EU countries (TBC)
Inability to reliably assess and compare the space sector's environmental performance	Environmental impact assessment and development of PEFCR	No specific LCA method for the space sector	Development of LCA for space activities based on the PEF method (PEFCR), voluntary for companies to apply the method	Development of LCA for space activities based on the PEF method (PEFCR), Binding: • submit environmental footprint declaration based on the PEFCR	PO2 and optional: develop and implement a mitigation plan to reduce environmental impact in the life cycle of a space activity	PO2 and PO+ and additional requirements for non-EU countries (TBC)

ANNEX 9: CYBERSECURITY THREATS TO SPACE ASSETS

The complexity of the space infrastructure architecture – space systems have three distinct operational segments: the ground segment, the space segment, and the link segment. Each possesses inherent and specific vulnerabilities, being susceptible to targeted threats that are tailored to its unique characteristics. The supply chain is also a crucial component which can be considered part of all the other segments[59].

Vulnerabilities in the space segment – as a result of the construction[60] and composition of the space system, there are numerous vulnerabilities susceptible to potential exploitation by threat actors. In addition, space systems need to be designed to endure harsh environments, ensuring they are durable and lightweight in design. Any modification which adds extra complexity to mechanics or electronics is deliberately minimised unless deemed necessary[61]. However, any complex design renders the systems susceptible to vulnerabilities, especially if numerous communication links and interconnections or interface points remain unencrypted and unsecured.

Vulnerabilities in small satellites – cyber vulnerabilities recently discovered by a German team of scientists in the ESTCube-1, OPS-SAT and Flying Laptop satellites provide an insight into this type of problem[62]. The analysis exposed six distinct security weaknesses across all three satellites analysed, identifying a total of 13 vulnerabilities. Of particular concern are two cases where the attacker may gain control of the satellite. Such a worst-case scenario would result not only in the loss of the asset, but it could also be exploited as an attack vector against other systems, or even transformed into an ASAT (anti-satellite) weapon. One of the typical problems is the increased use of commercial off-the-shelf (COTS) products in small satellites, which increases the attack surface due to the vulnerabilities arising from different manufacturers' parts and components.

Legacy ICT systems

The tasks of patching and updating satellites pose considerable challenges due to the potential risk of failure and subsequent loss[63]. It is also difficult to repair hardware in space. In addition, a significant proportion of the satellites are of a considerable age, and obsolete due to their long life in orbit (the typical mission for LEO satellites lasts 7 years, 12 years for MEO satellites and 15 years for GEO)[64]. Numerous space systems had been developed before cybersecurity gained significant attention and, therefore, now face vulnerabilities such as hardcoded

[59] V. Varadharajan, *Security Challenges when Space Merges with Cyberspace*', 2022, https://www.researchgate.net/publication/362230522_Security_Challenges_when_Space_Merges_with_Cyberspace.

[60] The space segment consists of satellites and clusters of satellites in orbit/constellations, along with space stations and launch vehicles intended for deploying satellites into space. Each satellite is equipped with a payload and specialised systems dedicated to executing the mission functions. Specialised systems manage tasks such as receiving and processing the uplink and downlink signals, validating and decoding data, transmitting commands to other subsystems, and maintaining the satellite's stabilisation and orientation, among other functions.

[61] S. Katsikas, *Cyber security in New Space*, 2022, https://link.springer.com/article/10.1007/s10207-020-00503-w.

[62] Johannes Willbold, Moritz Schloegel, Manuel Vogele, Maximilian Gerhardt, Thorsten Holz, Ali Abbasi, *Space Odyssey: An Experimental Software Security Analysis of Satellites*, https://publications.cispa.saarland/3934/1/SatSec-Oakland22.pdf.

[63] Patching packages also need prior testing at the ground-based segment.

[64] *Why older satellites present a cyber risk,* https://www.c4isrnet.com/opinion/2018/12/28/why-older-satellites-present-a-cyber-risk/.

credentials[65], making it relatively easy for sophisticated cyberattacks to gain access[66]. Additionally, space systems currently reliant on legacy software may not follow contemporary best practices of secure systems development, such as security by design[67], and adhere instead to outdated security approaches referred to as 'security through obscurity'[68]. As a result, known vulnerabilities can be exploited as shown in a study of 72 cyberattacks on space systems[69].

Vulnerabilities in the ground systems – the easiest way to target space systems is to compromise the ground station infrastructures[70]. Also, as people are generally considered the weakest link in any given system, malicious insiders can share confidential data or participate in attacks from within, while non-malicious insiders can make mistakes, such as misconfiguring systems, but also inadvertently fall into the trap of personal manipulation[71]. Many attacks capitalise on human nature. Tactics like phishing and spear phishing, collectively known as 'social engineering attacks' manipulate employees' willingness to help, often resulting in the disclosure of sensitive credentials or in malware infections. Once components in the ground infrastructure that connect to the user segment are compromised, this type of attack provides a pathway to infiltrate the space segment[72]. The above-mentioned study of 72 cyberattacks found that 15% of the attacks were of the personal manipulation type, mostly phishing[73].

The Turla attack on a satellite internet provider shows how attackers can exploit vulnerabilities in space systems[74]. Attacks can be difficult to detect by intrusion detection systems[75]. In 2014, the network of the National Oceanic and Atmospheric Administration was hacked, presumably by hackers from China. This event disrupted weather information and impacted stakeholders worldwide[76]. Another example of a cyberattack on a space system is the attack on the Atacama Large Millimeter Array (ALMA) Observatory in Chile. The attack forced ALMA to shut down its operations for several weeks. The motives and methods of the attackers are unknown, but

[65] Hard-coding credentials in software development refers to the practice of directly embedding authentication data, such as user IDs and passwords, into the source code of a programme or executable object. In contrast to acquiring credentials from external sources or generating them during runtime, this approach poses security risks.

[66] Wilson Centre, *Cybersecurity Threats in Space: A Roadmap for Future Policy*, 2020. Available at https://www.wilsoncenter.org/blog-post/cybersecurity-threats-space-roadmap-future-policy.

[67] *Security by Design*, available at https://joinup.ec.europa.eu/collection/common-assessment-method-standards-and-specifications-camss/solution/elap/security-design.

[68] Johannes Willbold, Moritz Schloegel, Manuel Vogele, Maximilian Gerhardt, Thorsten Holz, Ali Abbasi, *Space Odyssey: An Experimental Software Security Analysis of Satellites*, https://publications.cispa.saarland/3934/1/SatSec-Oakland22.pdf.

[69] *Characterising Cyber Attacks against Space Systems with Missing Data: Framework and Case Study,* available at https://arxiv.org/pdf/2309.04878.pdf. Ekzhin Ear, Jose L. C. Remy, Antonia Feffer, and Shouhuai Xu

[70] Ground stations have the software and hardware needed to control and track space objects using existing terrestrial networks and systems.

[71] V. Varadharajan, *Security Challenges when Space Merges with Cyberspace*, 2022. URL: https://www.researchgate.net/publication/362230522_Security_Challenges_when_Space_Merges_with_Cyberspace.

[72] For instance, multiple phishing attacks are perpetrated on NASA. Sometimes a network can be successfully infiltrated via infected PDF files or links. See *What is Phishing and Spear Phishing*, available at https://notiondigitalforensics.com.au/cybersecurity-updates-2020-5-26-nasa-phishing-attack/.

[73] *Characterising Cyber Attacks against Space Systems with Missing Data: Framework and Case Study,* available at https://arxiv.org/pdf/2309.04878.pdf.

[74] In this attack, the attacker stole IP addresses and used them to insert false data into systems connected to the compromised IP addresses, such as an autonomous drone, causing it to crash.

[75] *Turla MITRE attack – tactics, techniques and procedures*, available at https://attack.mitre.org/groups/G0010/.

[76] *Cyber security and space security*, available at https://www.thespacereview.com/article/3950/1.

the attack highlights the vulnerability of space systems, especially for those with limited IT budgets[77].

Vulnerabilities in the link segment

The integrity of the link segment is crucial for the ability to send and receive data securely between space-based systems and ground infrastructure for their space-related functions and command and control operations. Even with only basic means[78] attacks can target interconnection devices and overwhelm communication bandwidth with disruptive noise[79]. Jamming has been used extensively[80] during Russia's war of aggression against Ukraine. More sophisticated ‘man-in-the-middle’ attacks involve an attacker intercepting communications between the control centre and the space system. This on-path attack allows the attacker to sniff and eavesdrop on unencrypted or inadequately encrypted traffic. Additionally, attackers can also employ DoS (denial-of-service) attacks on the control centre to seize control of the space system, as previously mentioned in the space segment.

Vulnerabilities in the supply chain

The complexity of the supply chain and vendor ecosystem of (government-funded) space systems pose another significant cybersecurity concern. Typically, the specialised components required for space assets are not all produced by a single manufacturer. Instead, space companies often procure various components from a variety of (approved) vendors worldwide to reduce costs (especially for the production and testing stages). However, the approval process for these vendors may not necessarily require specific evaluation of cybersecurity standards. Consequently, when a space organisation acquires a component from a vendor, it has limited influence on the code created by the software programmer responsible for that component. This lack of visibility and of integrity checks exposes the respective company to significant cybersecurity risks when integrating and assembling such components into space systems. There is potential for hardware to harbour latent backdoors, bugs, or malware that can be activated once in space[81].

Apart from the problem of vendors’ vulnerabilities throughout the system supply chain, space organisations often engage with multiple research institutions that may have security weaknesses. Such collaborations among various partners also may exacerbate potential supply chain security concerns, making it challenging to determine the operational and financial responsibility for the cybersecurity of a system at different stages of the space asset’s lifecycle.

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[77] *World’s Most Expensive Observatory Floored by Cyber-Attack*, available at https://www.infosecurity-magazine.com/news/worlds-most-expensive-observatory/.

[78] For example, GPS satellites emit signals essential for navigation systems (catering to both civilian and military needs). A relatively low-cost jammer can, however, easily disrupt the GPS signal, leading to a local outage, which is classified as a denial-of-service (DoS) attack.

[79] *Security Challenges when Space Merges with Cyberspace*, available at https://www.researchgate.net/publication/362230522_Security_Challenges_when_Space_Merges_with_Cyberspace.

[80] *Satellite Signal Jamming Reaches New Lows*, available at https://spectrum.ieee.org/satellite-jamming.

[81] *Security Challenges when Space Merges with Cyberspace,* available at https://www.researchgate.net/publication/362230522_Security_Challenges_when_Space_Merges_with_Cyberspace.

Consequently, the security challenges in the space supply chain lifecycle arise from the intricate interplay of development, management, utilisation and ownership of space assets[82].

Length of the lifecycle and difficulties in carrying out repair and maintenance: space missions can last for several decades. Space (engineering) systems therefore need to be able to operate for long periods of time. System downtime is not an option. But long lifespans also make systems vulnerable to cyberattacks, especially when they rely on (unpatched) legacy systems. In many cases operators cannot update or upgrade hardware and software because systems are inaccessible, out of reach and can only be maintained if there is a maintenance schedule in place. Challenges therefore arise when security flaws are discovered and it is difficult, if not even impossible, to quickly apply patches or updates, or carry out repairs to space assets due to these operational constraints[83].

Consequently, the type of limitations and challenges that render space systems vulnerable are multifaceted. They result, in fact, from the intersection of many different problems and perspectives. Hence, solutions to address these vulnerabilities also need a comprehensive approach capable of covering multiple different angles.

In particular, even if space assets that the EU itself owns (in the context of the 'EU programme') have a high level of cybersecurity, this is not sufficient to fully protect them. The EU-owned assets operate within an intricate and complex network that increasingly integrates other national and commercial assets (for instance commercial payloads hosted on EU satellites) that lack the same level of cybersecurity. Any component that applies lower security standards compared to the rest may endanger the overall security of the entire constellation.

Counterspace

On a more **general note, looking from an overall perspective**, an additional threat to space infrastructures in the EU also comes from the recent increase in counterspace activities[84]. A report by the Secure World Foundation[85] states that 'an increasing number of countries are looking to use space to enhance their military capabilities and national security' by developing a broad range of defensive and offensive technologies.

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[82] *Hacking the Supply Chain*, https://www.airandspaceforces.com/article/hacking-the-supply-chain/.

[83] *Security Challenges when Space Merges with Cyberspace*, https://www.researchgate.net/publication/362230522_Security_Challenges_when_Space_Merges_with_Cyberspace.

[84] Counterspace capabilities must be able to withstand deliberate and malicious actions that are carried out to demonstrate power, deter competitors, deny use of systems, or gain an information advantage (Joint Communication to the European Parliament and the Council on the European Union Space strategy for Security and Defence, JOIN(2023) 9 final).

[85] The 2022 Global Counterspace Capabilities report Secure World Foundation, Global Counterspace Capabilities Report, 2023, https://swfound.org/counterspace/. Alongside the dominant players (China, Russia, the United States) leading in the areas of research, development, testing, systems and weapons operationalisation (see Figure 10), other emerging players (India, Iran, Japan and North Korea) are investing in counterspace programmes. The multiplication of powers asserting space and counterspace capabilities is a development that calls for increased awareness, notably in the context of current geopolitical transformations.

Figure 10: Weapons systems in outer space

Source: Secure World Foundation's 2022 Global Counterspace Capabilities report

Another important element to bear in mind is that many space technologies are dual-use[86]. In addition, what constitutes a space threat cannot always be identified by merely observing space objects, technologies or space capabilities taken in isolation. It is necessary, instead, to conduct multiple threat analyses and consider the hostile behaviour by adversaries. The effects of counterspace capabilities can be physical damage (caused by a projectile or munition, such as in ASAT attacks or kinetic measures)[87], non-physical damage (caused by electromagnetic pulses, high-powered lasers and high-powered microwaves) or different disruptions and losses such as in the cyber warfare[88]. The latter requires particular attention as cyberattacks provide adversaries with a 'relatively cost-effective means' to achieve strategic or political goals also shielded by 'plausible deniability'[89].

Cyberattacks

As already underlined above, the specific features of space infrastructures - in orbit and on the ground make the space sector particularly vulnerable to cyberattacks[90]. Of course,

[86] Dual-use capabilities include new technologies that overlap civil and military functions. Any system capable of causing physical damage to a space object could also be used to deliberately threaten or disrupt satellites for military purposes. For example, rendezvous and proximity operations satellites have similar technological features to those of anti-satellite weapons (i.e. high levels of manoeuvrability, ability to make significant orbital adjustments to reach a specific target, advanced on-board sensors, software to enable operation at very close distances to other satellites, etc.).

[87] ASATs are kinetic energy weapons that physically crash into satellites and can consist of virtually anything that can reach a high enough altitude, from ballistic missiles to drones and other satellites.

[88] UNIDIR, *Electronic and Cyber Warfare in Outer Space*, 2019, available at https://unidir.org/sites/default/files/publication/pdfs/electronic-and-cyber-warfare-in-outer-space-en-784.pdf.

[89] Lewis, D., Moloney, M., Ussery, N. *SOS Space: Why cybersecurity and supply chain risk management must go hand in hand*, in SPACE NEWS, 2021, available at https://spacenews.com/op-ed-sos-space-why-cybersecurity-and-supply-chain-risk management-must-go-hand-in-hand/.

[90] Joint communication to the European Parliament and the Council on the European Union Space strategy for Security and Defence, JOIN(2023) 9 final.

cybersecurity also increases system complexity[91]. The acceleration of the digitalisation of space systems necessary to offer reliable and fast services (which are crucial to the functioning of society) has led to an increasing number of attack vectors[92] (channels), which inevitably increases the vulnerability of space systems to cyber threats[93]. There are multiple attack categories, notably jamming[94], spoofing[95], computer network exploitation (CNE)[96], hijacking and taking control. These attacks can threaten multiple space segments, some being more impactful on a particular given segment. While it may be tempting to underestimate the dangers posed by tolerating vulnerabilities in space assets just because the assets are located far away, it is crucial to recognise the potential for large-scale effects on Earth in the different sectors[97].

'Spoofing' is the act of disguising communication from an unknown source as being from a known, trusted source. It requires a relatively inexpensive 'spoofer' to manipulate the uplink signal to a satellite, whereby false information can be injected into the target's system. In the case of global navigation systems like GPS or Galileo, such deception can mislead the satellite's receiver into calculating an incorrect position[98]. This can have wide consequences, as the global navigation systems provide precise positioning used for maritime trade, air travel and emergency response units. It is widely believed that in September 2011 the Iranian forces managed to seize control of an American RQ-170 Sentinel drone by altering its GPS coordinates, causing the drone to land in Iran instead of its intended base in Afghanistan[99].

Computer network exploitation (CNE) enables operations and intelligence collection capabilities using computer networks to gather data from target or adversary information systems or networks. This could lead to loss of data, as happened at NASA when around 250 GB of data was transferred to the internet[100].

Hijacking is redirecting or altering broadcast signals from radio, television stations, cable television broadcast feeds, or satellite signals without permission or licence. Hijacking has

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[91] Strong cybersecurity protection such as measures for cryptography create more demand on the CPU as cryptography is based on complex mathematical problems. Cryptography also creates a delay in communication as cipher text must be decrypted to plain text to be interpreted. This creates more system complexity and requires more resources.

[92] In computer security, an attack vector is a specific path, method, or scenario that can be exploited to break into an IT system, thus compromising its security.

[93] RHEA Group, *Why cyberattacks on space systems are a threat to us all*', 2022. Available at https://www.rheagroup.com/why-cyberattacks-on-space-systems-are-a-threat-to-us-all/.

[94] Jamming is a deliberate disruption of communications achieved by interjecting electromagnetic waves on the same frequency. It is meant to degrade the operational performance of the signal.

[95] Spoofing is, in essence, the forgery of a signal. For instance, the spoofing in the case of GNSS includes manipulation of legitimate GNSS signals with the aim to corrupt PNT data or signal measurement integrity (for example, transmission of delayed or false GNSS signals to manipulate an asset's computed position or time and frequency). Spoofing - Glossary | CSRC (nist.gov).

[96] Technique through which computer networks are used to infiltrate the target computers' networks to extract and gather intelligence data, https://csrc.nist.gov/glossary/term/computer_network_exploitation.

[97] Secure World Foundation, Global Counterspace Capabilities Report, 2023. Available at https://swfound.org/media/207567/swf_global_counterspace_capabilities_2023_v2.pdf.

[98] Smith, G. *GPS/GNSS Vulnerabilities are cybersecurity threats*, 2023. Available at: https://nextnav.com/gps-cybersecuritythreat/#:~:text=However%2C%20GPS%20vulnerabilities%20can%20pose,is%20in%20a%20different%20location.

[99] *The Vulnerability of UAVs to Cyber Attacks - An Approach to the Risk Assessment,* https://ccdcoe.org/uploads/2018/10/26_d3r2s2_hartmann.pdf.

[100] *Hackers mirror 250 GB of NASA files on the web*, available at https://www.theregister.com/2016/02/01/250gb_nasa_data_hacked/.

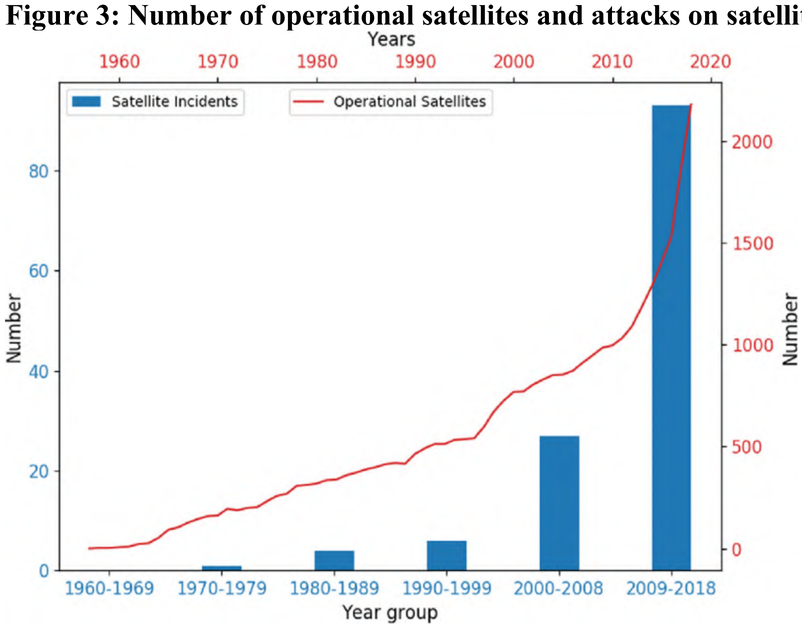
already happened many times. For example, in 2016, Hamas hacked into Israeli TV to issue threats[101].

A hijack attack represents the ability to assume control of a satellite, at least for a short time. This type of attack has already happened at least twice, for example in October 2007 and July 2008 with the Landsat-7 satellite[102] managed by NASA.

Previous events raised the threat level of the EU and Member States[103], prompting the need to adequately protect space infrastructure – recognised as essential services (EU Security Union strategy[104]) – against current and anticipated threats[105].

Finally, awareness is needed of the fact that the number of incidents will rise with the increase in the number of operational satellites. While the number of attacks on satellites gradually increased from 1997, the rise was significant from 2002 and dramatic from 2010 onwards (the number of cyberattacks multiplied by a factor of 13 in the following years[106]).

Figure 3: Number of operational satellites and attacks on satellites



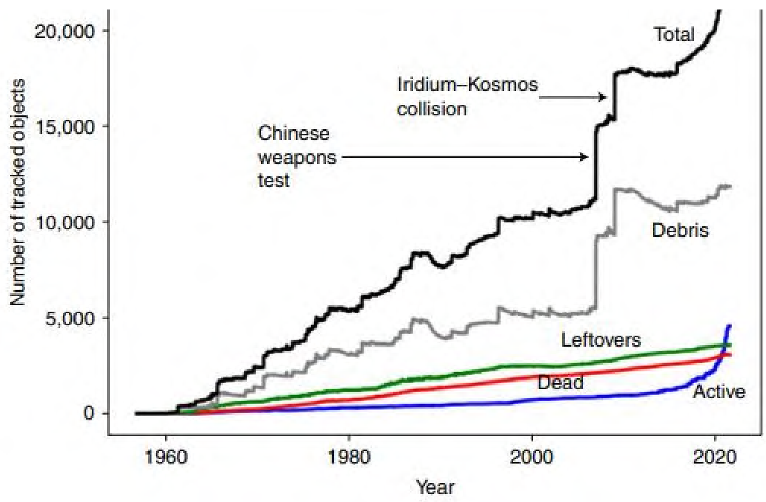
The number of satellite attacks per group of years is plotted on the bottom and left axes, and the number of operational satellites between 1958 and 2018 is plotted on the top and right axes.

[101] *Hamas hacks into Israeli TV and threatens: 'Terror will never end'*, available at https://www.timesofisrael.com/hamas-hacks-israeli-tv-the-terror-will-never-end/.
[102] *Hackers interfered With two US Government satellites*. Information available at https://www.space.com/13423-hackers-government-satellites.html.
[103] Joint Communication to the European Parliament and the Council on the European Union Space strategy for Security and Defence, JOIN(2023) 9 final.
[104] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the EU Security Union strategy, COM(2020) 605 final.
[105] Kruk, S., García-Martín, P., Popescu, M. et al. *The impact of satellite trails on Hubble Space Telescope observations*. Nat Astron 7, 262-268 (2023), https://doi.org/10.1038/s41550-023-01903-3
[106] *Space attacks open database*, available at https://www.spacesecurity.info/en/space-attacks-open-database/.

ANNEX 10: CONGESTED SPACE AND ITS RISKS

The **growing amount of debris** since 2010 (shown in the figure below) has contributed to the congested nature of space[107]. Just one event can cause a spike in the number of pieces of debris. For example, the Chinese ASAT missile fired at a Chinese weather satellite in 2007 created more than 3 000 trackable fragments of space debris, and nearly doubled the risk of collision to satellites in LEO[108].

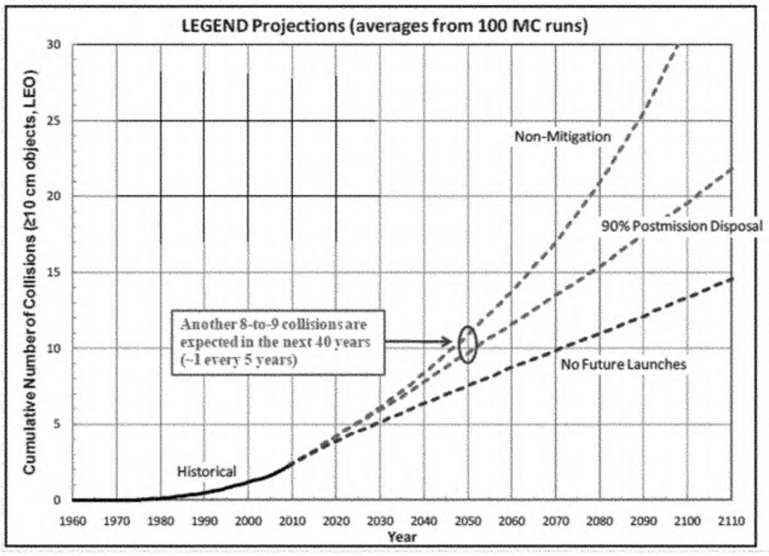
Figure 4: Growth of tracked space debris over time



Depending on the satellite's altitude, a substantial proportion of the debris created by satellite collisions will remain in orbit for several decades[109]. Larger pieces, such as undisposed satellites, which have greater mass, will tend to stay in orbit longer than smaller and lighter fragments. Approximately 25% of the large debris is estimated to remain in orbit after 30 years[110]. As space operations increase, a **potential doubling of the items of space debris may occur within 25 years**[111]. In the longer term, it is expected that the total amount of space debris will be 10 times greater due to the increasing rate of catastrophic collisions[112]. Using computer models derived from observations of debris, collisions are expected to occur every 5 years over the next 40 years (see Figure 5 below).

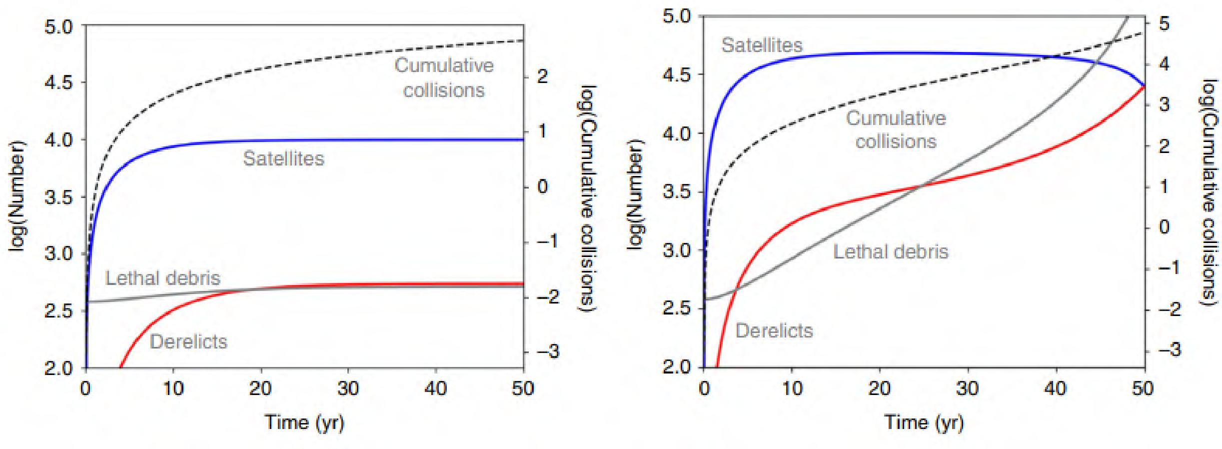
[107] Orbital debris is any human-made object in orbit about the Earth that no longer serves a useful function.
[108] *The Impacts of Large Constellations of Satellites* (nsf.gov)
[109] Wright. D, *Colliding Satellites: Consequences and Implications*, in Union of Concerned Scientists, 2009. Available at: https://www.ucsusa.org/sites/default/files/2019-10/SatelliteCollision-2-12-09.pdf.
[110] Wright. D, *Colliding Satellites: Consequences and Implications*, in Union of Concerned Scientists, 2009. Available at: https://www.ucsusa.org/sites/default/files/2019-10/SatelliteCollision-2-12-09.pdf.
[111] IADC, *Report on the Status of the Space Debris Environment*, 2023.
[112] IADC, *Report on the Status of the Space Debris Environment*, 2023.

Figure 5: Future probability of collisions of space debris[113]



A study which looked at the evolution of the satellite and debris population and the cumulative collisions scenarios in LEO (600 km) found that, **even taking into account frequent satellite de-orbiting after 5 years past the end-of-life, a targeted population of 10 000 satellites will amount to 300 disabling collisions within 30 years**[114]. If there are 40 000 active satellites at 600 km, the evolution of debris will start so quickly, that the effect will be such that 'after 50 years satellites are destroyed faster than they are launched'[115].

Figure 6: Predictions in the evolution of debris, satellites, derelict objects and cumulative collisions at an altitude of 600 km

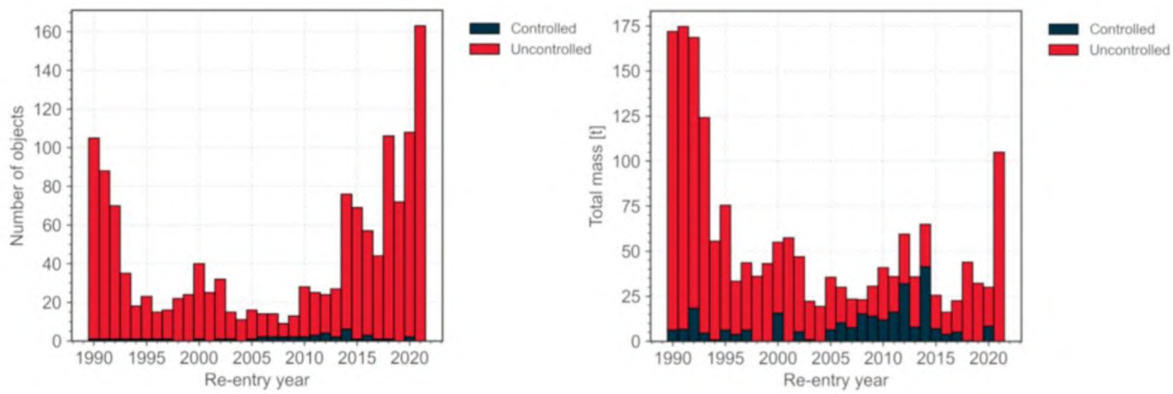


Challenges related to uncontrolled re-entry: Satellite re-entry also contributes to the growing congestion of space. Since 2000 there has been an increasing number of satellites de-orbiting after end-of-life, either through active manoeuvring of the satellite or by placing the

[113] 2023-20531.pdf (govinfo.gov)
[114] nsf.gov/news/special_reports/jasonreportconstellations/JSR-20-2H_The_Impacts_of_Large_Constellations_of_Satellites_508.pdf
[115] Ibid

satellite in an orbit where natural decay occurs[116]. However, as shown in Figure 7, most re-entries happen in an uncontrolled manner, whereby the satellite is left to burn up in the atmosphere without the possibility to manoeuvre it quickly through a protected orbital regime or to land in a specific area in case part of it does not burn up[117]. Hence, as explained in Figure 7 below, the structural uncertainty associated with re-entry further exacerbates debris proliferation and the risk of collision.

Figure 7: Amount of uncontrolled vs controlled de-orbiting

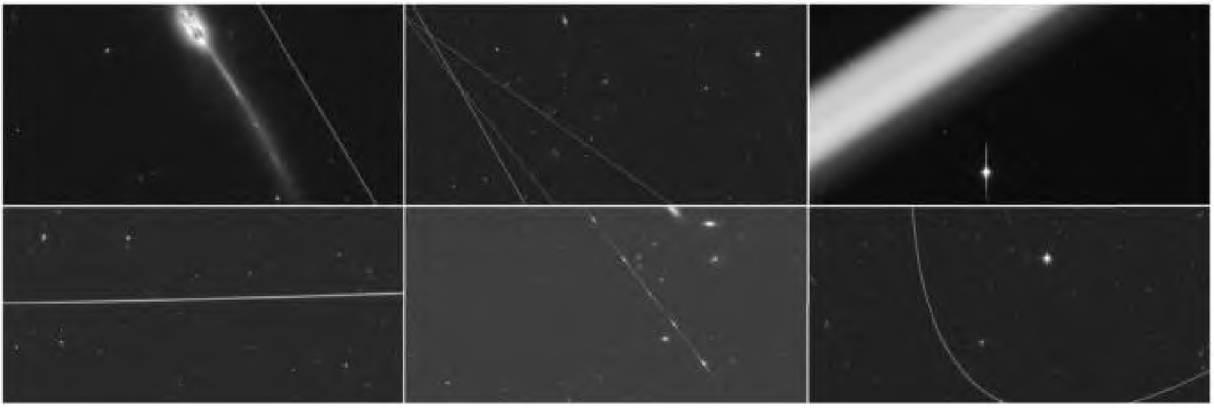


This congestion also creates challenges for astronomy: Satellites reflect a varying degree of sunlight, creating light pollution, whereby the satellites make it more difficult for astronomers to observe faint objects such as stars, galaxies and nebulae. In addition, the movement of satellites affects astronomers' ability to perform observations, as the satellites create streaks on astronomical images. Finally, when satellites re-enter the atmosphere aluminium is released, which creates reflections.

The growing number of satellites means further **disruption to astronomical research**, complicating the scheduling and operation of astronomical observations. For instance, for modern fast wide-field surveys, such as those conducted by the Vera C. Rubin Telescope, the current predictions indicate that approximately 30% to 40% of captured images are expected to suffer significant damage[118]. Post-processing of these images is not a viable solution. Furthermore, light interference can **negatively impact our ability to detect potentially dangerous asteroids heading towards Earth**[119]. The astronomical community has been raising the alarm about this worrying trend[120], but efforts to take action at UN level have been blocked by Iran and Russia[121]. 78% of stakeholders in the consultation agree or strongly agree that the increased number of satellites in orbit negatively impact astronomy.

[116] ESA - Space Environment Report 2023. Orbital decay takes a different amount of time depending on the altitude: from weeks to months from 250 km – 550 km; years from 550 km; decades from 800 km; centuries from 1 000 km; and thousands of years above 36 000 km. The causes of decay are mainly atmospheric drag, gravitational variation, nd solar pressure.
[117] *The case for space environmentalism* Nature Astronomy, available at: https://www.nature.com/articles/s41550-022-01655-6
[118] IAU, 2020, *The impact of mega-constellations of communication satellites on Astronomy*, available at: https://www.unoosa.org/documents/pdf/copuos/stsc/2020/tech-35E.pdf.
[119] https://www.eso.org/public/announcements/ann23001/
[120] Statement by the International Astronomical Union, the Royal Astronomical Society and the American Astronomical Society.
[121] Good heavens: how light pollution is threatening our sky (theparliamentmagazine.eu)

Figure 8: Examples of satellite trails identified by the Hubble Space Telescope



Another impact of the growing number of satellites is the pollution on radio astronomy. Previously, astronomers could mitigate radio interference from commercial radio bands by being placed in remote location. However, LEO satellites operate within a radio-frequency range adjacent to that reserved for radio astronomy, and this proximity can lead to interference issues that adversely affect data collection in the field of radio astronomy.

ANNEX 11: DETAILED IMPACT ASSESSMENT

The analysis in Section 2 of the impact assessment report has shown key problems and drivers leading to severe consequences for the long-term safety, resilience and sustainability of the space sector. Inaction will inevitably make it necessary for large investments and/or market adaptations for companies, to be able to address all the regulatory disparities and legally-based constraints in a fragmented European space sector. All policy options should ensure that the EU space industry remains future-proof, by fostering early compliance with provisions and mitigation of the risks to space safety, resilience and the environment.

To accurately capture the magnitude and extent of the impact of each of the policy options, this report takes the following assumptions:

- **Policy option 1:** Under this policy option the Commission facilitates the codification of non-binding measures between industry and Member States through a co-regulation approach. Co-regulation combines legislative and regulatory measures with actions taken by the actors most concerned, drawing on their practical expertise. In addition, it promotes the development by the industry of labels for safety/ resilience /sustainability. The analysis assumes that 60% of the European satellite industry and 80% of the European launcher industry[122] would comply with the non-binding measures through either the codified codes of conduct or the label.
- **Policy option 2:** This policy option entails the adoption of an EU binding framework. The legally binding nature of the measures would imply a high compliance rate by the European space industry and by non-EU space operators providing services in the EU with the measures put in place under policy option 2.
- **Policy option 2+:** This policy option envisages the adoption of an EU binding framework referred to in option 2, paired with non-binding and support measures. We assume a high compliance rate by the European space industry with the binding components of this policy option and a 20% take-up rate of the voluntary measures that build upon the binding measures.
- **Policy option 2++:** Based on the implementation of policy options 2 and 2+, this option would entail international bilateral agreements to foster a global approach to space safety, resilience and the environmental impact of space activities. Building on the same compliance rate achieved under policy option 2, this option would also reach non-EU operators that do not provide services in the EU and are located in a country that has signed one of the bilateral agreements. It could be reasonably assumed that there would be certain losses of efficiency, costs of coordination and dilution of legal content associated with the international scale of the intervention.

Based on the above-mentioned assumptions, the section below lists the expected impacts stemming from the policy options and identifies how they affect the scenario described in the baseline (Section 5.1).

[122] Source: ESA; Space environment report, 2023. Existing international industry initiatives are already drawing a lot of support, e.g.. The Declaration | Net Zero Space Initiative, which has 62 different companies supporting it, or the Space Safety Coalition, which has 60 supporters for the first version of their best practices for sustainability of space operations.

1. Economic Impacts

This section focuses on the analysis of the economic impacts expected to result from the implementation of policy options 1, 2, 2+ and 2++.

The impact of policy option 2++ presents a complex landscape, coupled with the inherent unpredictability resulting from negotiations with non-EU countries. As the content of these agreements cannot be fully predicted due to the intricacies of diplomatic discussions, it is therefore imperative to make a conservative estimate of the potential impacts. The economic impacts of the different options will be evaluated according to the following categories:

Economic Impacts	Protection of space assets	Competitiveness	Positions of SMEs	Functioning of the internal market	Employment	Financial and costs

1.1. Impact on the protection of space assets

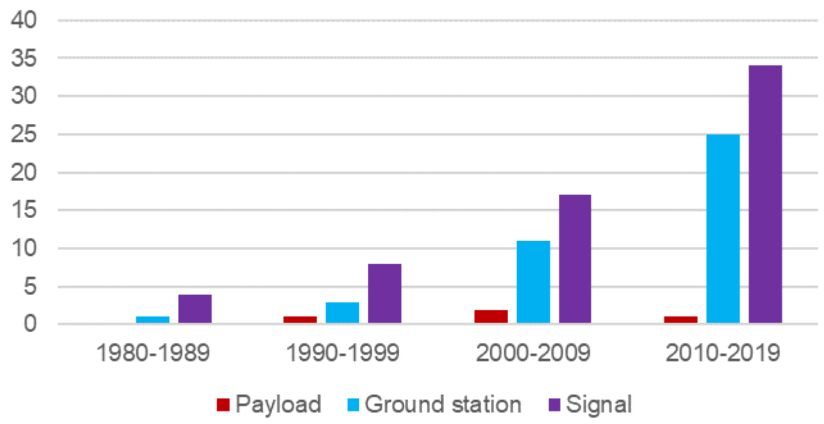
Baseline option: As explained in Section 2, the risk of collision will continue to grow. Regulating the EU space market, therefore, would lead to significant improvements in risk assessment capabilities and ensure a reduction in the creation of space debris, thereby resulting in an increased protection of space assets. A study by the OECD has estimated the risk of collision to be costly, averaging 5 to 10% of mission costs, which often reaches hundreds of millions of dollars[123], with additional costs for carrying out satellite manoeuvres due to service interruption. Moreover, ESA has projected a sixfold increase in the number of close collisions at 500 km[124]. However, the cost (in net present value) of missed opportunities by the satellite industry in 2040 (the cost of inaction under the baseline) escalates from around USD 300 billion, if optimal management begins in 2025, to around USD 700 billion if optimal management begins in 2035[125]. This represents almost the entire value of the global space sector. It is also estimated that the loss of access to space could represent a global loss of 2.56% of global GDP.

Avoiding incidents with a negative impact is essential to protect space infrastructures, as well as activities on Earth that depend on space services. Similarly, as described above, the risk of (cyber)security threats will increase with the potential for hijacking, denial of services of satellites, direct operational loss of the service or equipment destruction, and would have significant consequences on Earth if not addressed jointly. A cyberattack can lead to the loss of potential business to competitors, a lengthy period before activities can resume, potentially significant reputational damage, the loss of market confidence (investors withdrawing) and, in some (albeit limited) cases, can even cause bankruptcy (overdue payments and fines incurred), with various effects based on the magnitude of the attack and the vulnerability of the satellite.

[123] OECD, 'The economics of space sustainability'.2022. URL: *Earth's Orbits at Risk: The Economics of Space Sustainability | en | OECD.*
[124] ESA annual space environment report 2024, https://www.sdo.esoc.esa.int/environment_report/Space_Environment_Report_latest.pdf
[125] Akhil Rao, Matthew G. Burgess, Daniel Kaffine, *Orbital-use fees could more than quadruple the value of the space industry*, Proceedings of the National Academy of Sciences of the United States of America, 2020. URL: https://www.pnas.org/doi/10.1073/pnas.1921260117 .

It is estimated that, on average, a cyberattack would cause USD 29 million in damage, thus making the total systematic cost of all cyberattacks per year around USD 1.3 billion (based on data from 2023). This estimate, therefore, means that space cyberattacks could cost the space industry around USD 1 billion per year, with further significant increases predicted[126]. The worryingly rapid increase in cyberattacks on space systems is shown in Figure 9.

Figure 9: Evolution of cyberattacks on space systems



Policy option 1 supports the development of **non-binding guidelines and voluntary labels** in the EU space industry as a market-driven initiative, intending to stimulate adherence to the most relevant existing standards, best practices and guidelines, and promote new measures where gaps exist. It is assumed that some space operators already take certain protective measures (such as space debris mitigation, satellite tracking and certain good practices of encryption of critical parts of the satellite).

The voluntary aspect of this option means that the level of protection achieved would not be **all-encompassing**. As explained in Section 4, the interconnectedness of all space systems means they are only as strong as their weakest link, and this option would therefore still leave space infrastructure vulnerable to collisions (to a certain extent). In addition, the level of ambition sought by industry may be influenced by unpredictable factors such as the bargaining power of large space actors as compared with the position of small players; the inability of the latter to comply with certain non-binding standards due to smaller budgets; and diverging economic self-interests. Therefore, these measures will result in limited mitigation of space debris and only a slight reduction in threats to the safety and resilience of space assets.

Policy options 2, 2+ and 2++: a high level of protection requires more satellites to comply with any new measures adopted. Hence, options that entail mandatory measures will necessarily imply a higher rate of reduction in space debris and cyber threats, resulting in greatly reduced threats to space assets, applicable to non-EU space operators providing services in the EU (with a greater impact on the rate of the option by also ensuring greater compliance by non-EU actors). Non-EU space operators who do not provide services in the EU may still remain a threat.

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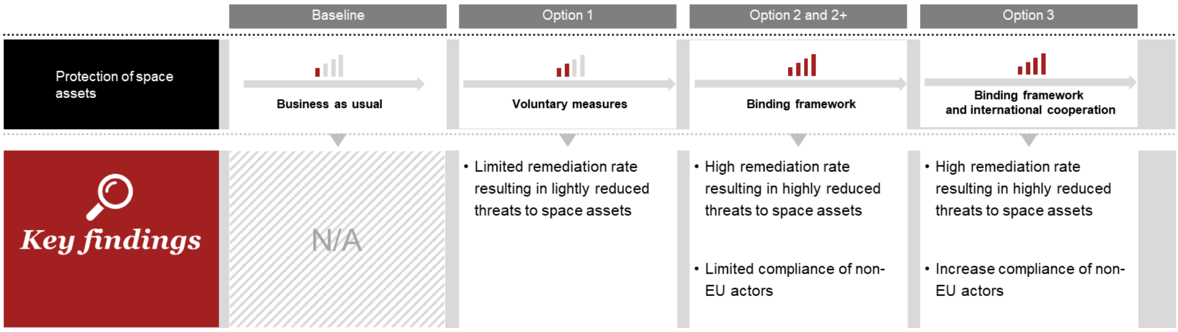
[126] See CyberinFlight 'Public Report Support to Impact Assessment Study' attached to this impact assessment as Annex, p. 9 and 10.

Options 2 and 2+ therefore lead to significant improvements in risk assessment capabilities and savings at the level of the individual company, and for the space industry as a whole. An even greater number of actors – and thus a higher level of protection – would be ensured through option 2++ which would cover non-EU operators who do not provide services in the EU (noting that the requirements may be at a higher level than in option 2). Another benefit of option 2 (and thus, indirectly, 2+ and 2++), would be that the regulatory framework would allow for the development of new business opportunities by creating incentives for the development of New Space solutions to reduce the amount of space debris and increase the resilience and sustainability of space assets.

Finally, the costs of these options would be far lower than the costs entailed by the baseline. The cost of a cyberattack is estimated to be approximatively **five times higher than the estimated cost of the measures needed to prevent or withstand an attack. Thus, a strong regulatory framework could not only reduce the number of successful cyberattacks in the future, but also reduce the average cost of each cyberattack.** Option 2++ would also have delayed benefits due to the time needed to negotiate the various bilateral agreements, which would delay the reduction of space debris in orbit and the imposition of requirements on non-EU space operators not providing any services in the EU. According to stakeholders, however, this could create legal uncertainties for operators due to the multiplication of bilateral agreements.



1.2. The impact on competitiveness and business operations

Baseline: The European space sector, the third largest in the world after the US and Asia, has been growing in size over the past decade, driven by increasing demand for space-based data and services. It had a turnover of EUR 84 billon in 2023 (20% of the global space economy) and more than 250 000 jobs across all segments (up 8% in 2022) and with high demand for space-qualified jobs[127].

However, as described in Section 2, the EU space industry is facing a fragmented regulatory framework, which is likely to adversely impact its capacity to grow and reach the level of maturity needed to compete on a global scale. On a local level, while the planned new spaceports in Europe are expected to create economic opportunities (new possibility to launch satellites) the complexities and disparities of diverse safety, resilience and environmental licensing requirements could hinder business opportunities across EU borders, as these measures would have to be implemented at the design phase. It is estimated that the fragmentation of the internal market will increase the decline of the European space sector in

[127] Source: Eurospace facts and figures (2023).

comparison with foreign competition. This is especially apparent between Europe and the US in the launcher sector, as Europe launched only 6 times in 2022 while the US launched more than 87 times. This decline is mainly due to the fragmentation of European governance, investment and regulation, and results in reduced competitiveness due to the difficulties in launching and using space assets.

Without legal **certainty and clarity** investors may be deterred from investing in the industry. Lack of available funding would have a more significant impact on emerging New Space companies who would face difficulties in scaling up and hence may even choose to leave the EU. On the other hand, established industrial players would see no or little incentive to invest in innovation and become more competitive. The introduction of **voluntary labels and non-binding guidelines** in the EU space industry – as planned for in **policy option 1** – is a market-driven initiative, intended to stimulate adherence to the most relevant existing standards, best practices and guidelines to proactively develop EU-level non-binding instruments. Research has proven[128] that for the industry, voluntary measures such as labelling are powerful tools which, when used effectively and responsibly, create a pro-competitive market environment. Companies implementing these voluntary measures would have a competitive advantage on the market as compared to those that do not, due to the incentives involved. Space companies with the label may also achieve higher valuations from investors and could attract merger and acquisition opportunities or consider initial public offerings. This may nonetheless create additional costs for companies along the value chain depending on their current practices under the different pillars addressed by the non-binding measures. Policy option 1 would, therefore, have a limited impact on the competitiveness of the EU industry.

In the case of **policy option 2,** the binding nature of the measures creates additional administrative obligations and would lead to additional costs of 3-10% for companies. Although the level of compliance costs will depend on the extent of the existing practices and measures implemented by the companies along the value chain, it is assumed that option 2 would lead to a generalised increase in costs for all companies on the market compared to the baseline. This may have different impacts on competitiveness. Given the fragmented nature of the space manufacturing supply chain, it is likely that subcontractors will bear most of these costs. On the other hand, companies in Member States that currently have more stringent requirements will benefit from the equalisation of requirements across the EU, as well as equal treatment of EU and non-EU space operators providing services in the EU. Policy option 2 will create a level playing field in the space sector while spreading additional compliance costs across the market.

Policy option 2+ would have the same impact on competitiveness as policy option 2, in addition to the impacts of option 1, but with a reduced effect. Policy options 2 and 2+ are expected to enhance investor and consumer confidence in space-related products and services, increase competition (including for start-ups and SMEs) and potentially attract more investment by having a common regulatory framework that reduces the administrative burden

[128] DG SANCO (Health and Consumers). Labelling: competitiveness, consumer information and better regulation for the EU, 2006.

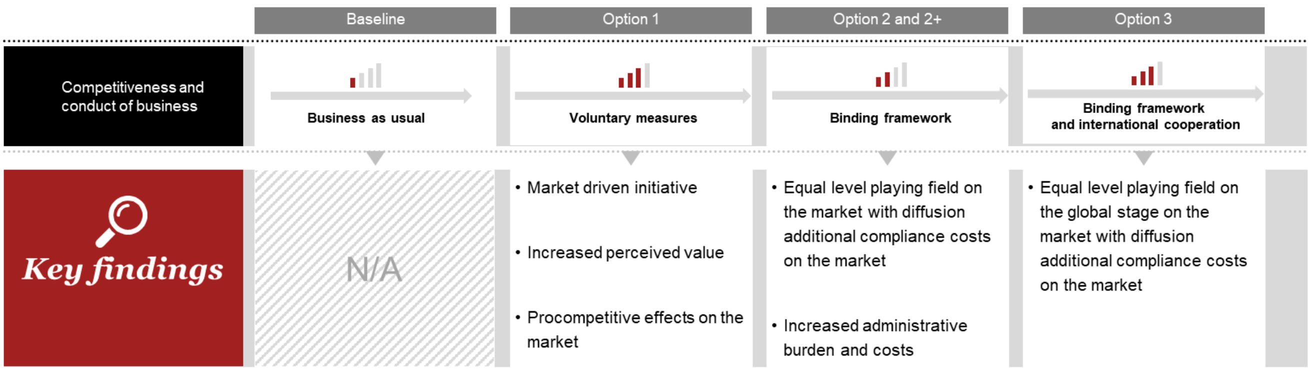
and costs for companies that no longer need to comply with multiple uncoordinated requirements[129].

As **policy option 2++** builds upon the implementation of policy option 2 the primary impact will be the same. This intervention will increase the size of the market as it will not only cover non-EU operators providing services in the EU, but also those beyond the EU's jurisdiction, allowing European companies to be more competitive and reach foreign markets more easily. The entrance of new actors will increase competitiveness on the market and drive prices down at the level of subcontractors.

The adoption of policy options **2, 2+ and 2++** has the potential to stimulate innovation, research and development. By driving these efforts, encouraging resource-efficient practices, and fostering collaboration between academia and industry, all policy options can facilitate the introduction and dissemination of new production methods, technologies and products. Ultimately, this will contribute to the growth and competitiveness of the space sector.

However, navigating and fulfilling regulatory obligations could strain budgets and human resources. In addition, companies need to invest in technology and systems for data collection, monitoring and reporting to meet the regulatory standards, adding to their administrative expenses.

Consequently, the policy options would have an overall positive effect on creating a level playing field for companies and fostering competitiveness. Moreover, action by the EU to regulate core aspects of the space economy will help to bring clarity on benchmarks or requirements for the industry to operate in and compete on the internal market. However, this comes hand in hand with additional costs for companies based on the binding nature of the intervention, as well as on companies' current performance on safety, sustainability, security and environmental matters.



1.3. Positions of SMEs

See also the SME Test in Annex 13.

[129] 68% of SMEs believes option 2(+) would reduce the risk of operators' cherry-picking the Member States with the fewest safety, resilience or environmental requirements. 73% agree it could create an level playing field for all European companies.

The upstream European space sector in 2018 comprised 1 069 SMEs, with a turnover of around EUR 2 billion in 2018[130]. The growth of space activities, coupled with the fragmented nature of the value chain of space assets, has provided economic opportunities for SMEs to act as key subcontractors in the process. Often integrated as upstream subcontractors along the value chain, specific attention should be paid to ensuring a level playing field for SMEs on the internal market to protect the EU industry and enable its sustainable expansion.

The **baseline** is not conducive to improving the **position of small players** in the space sector. SMEs would need to navigate many different and complex national requirements to achieve regulatory compliance under each applicable regime, resulting in increased costs.

104 SMEs answered the targeted consultation. In the experience of 86.5% of the SMEs, the current national space laws are not fit to ensure the safe and long-term use of space. 85% of SMEs answered that increased space activity calls for specific requirements for safety in space, and 69% answered that the risk to space infrastructure calls for specific requirements. 90% of SMEs agreed or strongly agreed that with increased space activity there is a need for a common method to measure the environmental impact of the space sector on Earth and in space.

In the case of **option 1,** similar to all sub-contracting entities along the value chain of space activities, there is a risk that SMEs would be inherently constrained to implement the non-binding measures set by this policy option. This would result in an increase in costs for SMEs while not reducing the administrative burden on the industry, compared to the baseline. Due to their inherently bigger budgets, larger companies would have greater leeway to implement the non-binding measures, giving them a competitive advantage over companies without the financial means to implement the measures. As a result, SMEs may be severely impacted by this transfer of the economic burden to their type of business. The voice of SMEs, therefore, needs to be properly considered in discussions with industry.

In the targeted consultation, 54% of SMEs agreed that non-binding measures give industry the flexibility to develop new technological solutions, but 67% considered that they provide less legal clarity. 56% agreed that safety and resilience measures can limit revenue-producing activities and that non-binding measures therefore are not sufficient.

Option 2 is likely to trigger additional costs for SMEs across the three areas (safety, resilience and environment) due to mitigation measures (a 3 to 10% increase in manufacturing costs). Adhering to the different requirements would require the allocation or reallocation of resources to analyse the requirements and implement, monitor and report on them. This would lead to one-off and recurrent financial and human resources costs, which would impact the competitiveness of SMEs. This impact could, however, be mitigated by embedding proportionality in the rules, to address the specificities of market actors with fewer resources. This proportionality would have to be balanced against the safety and resilience risks of individual satellites.

In addition, SMEs believe that policy option 2 could provide a common, stable and predictable framework to foster the long-term sustainability of the activities of new commercial space actors. It would also create a level playing field for all European companies and reduce the risk

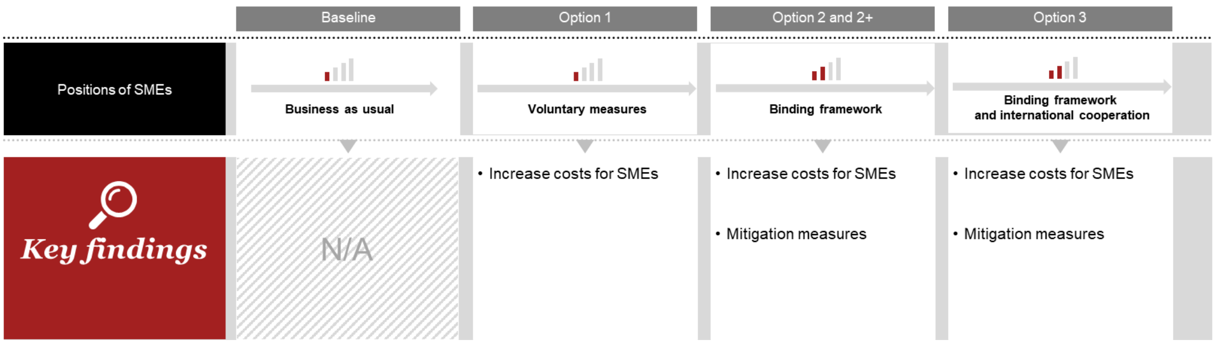
[130] European Parliament, Space Market, 2021. URL: Space Market (europa.eu) referring to a SME4SPACE (2020) study on the economic importance of SMEs in the space industry in European Space Agency Member States.

of operators' cherry-picking Member States with the lowest safety, resilience or environmental standards. At the same time, binding requirements need to include supportive measures for industry. This framework would open the door for SMEs to some new markets, thus expanding the size of the relevant EU market and potentially attracting further private investment which is key for the scaling up and growth of New Space actors (especially those in need of larger investments).

Policy option 2+ is likely to yield similar impacts as policy option 2, coupled with aspects from policy option 1, as SMEs may have a difficult time going beyond the baseline binding requirements. This impact could be mitigated by incentives.

Option 2++ is likely to have approximately the same impact on SMEs as policy option 2. While providing perspectives for market growth for SMEs at the global level as a result of bilateral negotiations, SMEs may also suffer from aggressive competition from foreign companies. Although this policy option aims at creating a level playing field, foreign SMEs may benefit from additional funding or a bigger and more established market share in their home market, which would allow them to capture a bigger share of the internal market than EU SMEs. Therefore, this policy option also represents a risk for SMEs in the European internal market for space. Most SMEs considered that additional action by a **larger number of international actors would strengthen the overall protection** of the environment in orbit and on Earth (59%), but 57% agreed that the multiplication of bilateral agreements **would create legal uncertainties for operators**. 57% believed that an international approach **risked leading to more high-level requirements as a compromise**.

Therefore, while measures can also protect SMEs against safety and resilience risks, they may face a higher burden than established actors in implementing these requirements. Hence, it is necessary to consider mitigating measures to prevent negative impacts on European SMEs on the market.



1.4. Functioning of the internal market

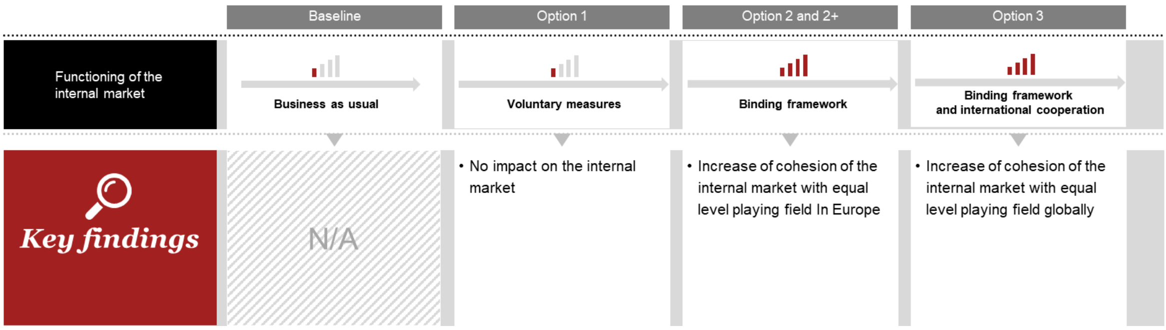
Under the **baseline scenario**, the internal market will remain fragmented due to different requirements by Member States, resulting in the emergence of barriers.

The creation of the co-regulation under **option 1** would not have a direct impact on the functioning of the internal market, although a small impact could be achieved if a certain number of Member States start incorporating the implementing act into their national space laws.

For **option 2,** the regulatory framework and legislative proposal aim at developing a common level playing field at EU level. In addition, implementing stringent safety, resilience and sustainability/environmental measures would not only improve the overall level of safety of space activities but would allow space products and services to circulate without barriers in the internal market. As such, this approach would be expected to enhance investor and consumer confidence in space-related products and services, potentially attracting more investment. Non-space operators providing services in the EU would not benefit from less stringent standards. By imposing equal treatment for EU operators and non-EU satellite operators, policy option 2 encourages fair competition. **Policy option 2+** would provide the same impacts as option 2.

Option 2++, in which bilateral agreements include mutual recognition of standards, would provide the same impacts on the internal market but would do even more to level the playing field with non-EU countries.

Therefore, the different policy options will create a significant impact at the level of the internal market, leading to significant repercussions on competition and associated dynamics.



1.5. Employment

Under the **baseline scenario**, over 250 000 people are currently employed in manufacturing and services[131] in the EU space sector, the second largest space industry in the world. A fast-paced intensification of space activity means there is the potential for the EU space sector to grow if business continues its upward trend. However, due to the disruptions described in Section 2, jobs in the space sector are at stake.

Option 1 is likely to have a limited effect on job creation outside of the personnel required to take part in the development and implementation of the voluntary measures.

Option 2 is likely to: (1) create new jobs in services in relation to regulatory compliance; while at the same time (2) trigger the development of niche expertise and know-how on space safety (notably on space debris mitigation), on cybersecurity and risk assessment methodologies tailored to space and in the environmental domain. On administrative capacity, regulatory agencies and government bodies in charge of enforcing and overseeing compliance with the new measures would, in certain Member States, need to hire and train additional staff, thus leading to more public sector employment. Opportunities to develop new businesses in services and to meet the new requirements could come along, especially in the mid- and long-term perspective (for all three areas of safety, resilience and sustainability). Levelling the playing

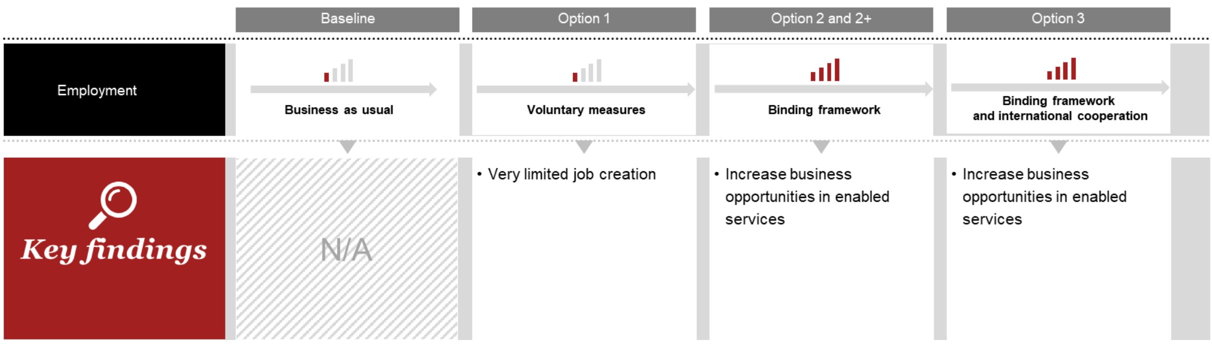
[131] European Parliament, Space Market, 2021, [Space Market (europa.eu)](europa.eu).

field with respect to non-EU space operators, is likely to reduce job losses in the EU (and prevent a brain drain of expertise to outside the EU). This intervention, therefore, would have a positive impact on job creation and the growth of start-ups and SMEs.

Option 2+ would have the same impact as policy option 2. However, the addition of non-binding measures to the intervention is likely to foster more job creation in the sector through the additional efforts to reach a higher threshold than that prescribed under option 2. Depending on the incentives selected, companies could receive special recognition, which may allow them to benefit from additional funding to foster their growth, and hence lead to a need for additional staff. By protecting and providing incentives for compliance, this option fuels positive returns in terms of job creation within and beyond the scope of the EU space industry.

Option 2++ is likely to have similar impacts on employment as policy option 2+. In addition, this option would bring opportunities for job creation regarding expansion into new markets and joint space activities with non-EU countries. By providing pathways for growth, companies are likely to benefit from additional economic opportunities requiring additional labour to absorb new market shares. Therefore, policy option 2++ may pursue the job creation spillovers identified in policy option 2, and would lead to employment benefits for the whole economy.

Overall, the options would boost opportunities for employment in the space sector.



1.6. Financial impact on the private and public sectors

The options may increase companies' manufacturing costs by up to 10%[132]. Those costs would be offset:

- in the long-term, by **preserving space-related business**, which amounts to 0.5% of the EU's GDP;
- in the mid-term, by the **growth** of space activities through regulatory simplification and the enhanced reliability of space-based services, and by extending the **lifetime** of satellites;
- in the short term, through the development **of proportionate measures** to ensure that they do not add unnecessary burdens that could hinder scientific developments (university satellites) and are relevant to specific risks (e.g. very low orbit); and the implementation of **supportive measures** that will offset part of the costs for businesses.

[132] Based on data provided by the ESA and during the stakeholder consultation.

Table 13: Overview of costs for different policy options (public and private)

		Option 1	Option 2	Option 2+	Option 2++
Public costs	Administrative overheads	2 FTEs for label management for EUSPA 1 FTE in ENISA	1-4 FTEs per Member State[1] Up to 15 FTEs in notifying body + 2 FTEs for label management in EUSPA	1-4 FTEs per Member State Up to 15 FTEs in notifying body + 2 FTEs for label management in EUSPA 1 FTE for ENISA	1-4 FTEs per Member State Up to 15 FTEs in notifying body + 2 FTEs for label management in EUSPA 3 FTEs in the European Commission for bilateral agreements
	Label	EUR 3 m for the development and implementation of the label (EUSPA & ENISA)	n/a	EUR 3 m for the development and implementation of the label (EUSPA & ENISA)	EUR 3 m for the development and implementation of the label (EUSPA & ENISA)
	Standards	EUR 10-15 m (EUR 1 m per standard)	EUR 10-15 m (EUR 1 m per standard)	EUR 10-15 m (EUR 1 m per standard)	EUR 10-15 m (EUR 1 m per standards)
	Enforcement	n/a	EUR 2-3 m per year	EUR 2-3 m per year	EUR 2-3 m per year
Private costs	Overheads	0.5 FTE per company	0.5 FTE per company	0.5 FTE per company	0.5 FTE per company
	Compliance costs	EUR 200 to EUR 2000 annual fee for the label	EUR 100k+ for the licensing requirements EUR 4-8k for carrying PEFCR (as part of the licensing request) Up to EUR 240k for risk management (initial expenditure)	EUR 100k+ for the licensing requirements EUR 4-8k for carrying PEFCR (as part of the licensing request) Up to EUR 240k for risk management (initial expenditure) EUR 200 to EUR 2000 annual fee for	EUR 100k+ for the licensing requirements EUR 4-8k for carrying PEFCR (as part of the licensing request) Up to EUR 240k for risk management (initial expenditure) EUR 200 to EUR 2000

				the label (as part of the licensing request)	annual fee for the label
	Manufacturing costs	3-10% increase for satellite platform[133]	3-10% increase for satellite platform	3-10% increase for satellite platform	3-10% increase for satellite platform

For the public sector, the costs of implementation of the various options depend on the maturity of the space economy in each Member State. The public sector costs in Member States with an extensive space economy and a space law would be lower than for other Member States that do not have an existing regulatory framework. Each Member State would need to have between 1 and 4 FTE posts to handle the regulatory needs of the licensing requirements and may want to entrust certain tasks to EUSPA, which would need up to 15 FTE posts.

From the perspective of the private sector, the costs would be similar for options 2, 2+ and 2++. For option 1, the cost of the licensing requirements is not considered, however the satellite operators would still need to obtain a licence from the launching state and from the authorities in their place of operation.

Not to take action would also have a cost. European stakeholders operate several hundred satellites, contributing to a market valued at over EUR 80 billion per year, and the European Union and its Member States increasingly rely on space-based services. Losing access to space due to the uncontrolled proliferation of space debris would therefore have far-reaching negative consequences for the space industry itself and for all economic and societal activities which depend on space services.

In addition, the cost of a cyberattack is estimated to be approximately five times higher than the estimated cost of the cybersecurity measures needed to prevent or withstand an attack. A strong regulatory framework could therefore not only reduce the number of successful cyberattacks in the future but also reduce the average cost of each cyberattack.

[133] Based on data provided by ESA and from consultations with stakeholders (bilateral meetings, replies to targeted stakeholder consultations).

	Baseline	Option 1	Option 2 and 2+	Option 3
costs	Business as usual	Voluntary measures	Binding framework	Binding framework and international cooperation
Key findings	N/A	• Limited costs of compliance • Administrative overhead for enforcement • Development of standards	• Costs of compliance • Administrative overhead for enforcement • Development of standards	• Costs of compliance • Administrative overhead for enforcement and negotiation • Development of standards

2. Social impacts

The benefits that the different options would create would ultimately act as a catalyst for societal progress. Not only by fostering innovation (to varying degrees, depending on the option) but also by contributing to a more sustainable, self-aware, equitable, and socially responsible approach to how business is conducted and how products are developed. To avoid repetition, some of the socio-economic impacts already presented in the section above will not be addressed below. The social impacts of the different options will be evaluated according to the following categories:

2.1. Downstream services for people in the EU

Baseline: With an increasing risk of collisions, space operators would be faced with responding to more collision avoidance alerts, requiring additional human and material resources to implement processes and process data, and further costs impacting the normal use of satellites. Significant impacts may result - as illustrated by collision avoidance manoeuvre performed by the Galileo satellite in 2021, which required the swift reaction and cooperation of the EU SST Partnership, the EUSPA and the Galileo service operator for a total of 22 processing days, including two weeks during which the satellite had to be taken out of service[134]. While not all collision avoidance manoeuvres would necessarily require such a long response time, the **multiplication of this type of disruption** would represent a significant threat to the service provision of navigation systems, satellite-based positioning services and space-based monitoring, and a burden on the capacity of operators which would shift too much of the available resources onto emergency response. This would ultimately translate into severe consequences for all space-based services on Earth. The functionality of activities in critical sectors would be impacted, such as timely services delivered to ambulances or support for accurate navigation (such as emergency services relying on the use of Galileo-enabled improved positioning and timing services). Similarly, the ability of forecasting and alert services that use the Copernicus system to protect potential victims from severe weather events (such as droughts, storms or hurricanes) may be impaired. The **functioning of all space-based services on Earth** (e.g. transport logistics, cross-border trade, financial transactions, air travel, etc.) would, therefore, be at risk[135], thus reducing the efficiency of activities enabled by the

[134] T. Cozzens, *Galileo satellite performs collision avoidance manoeuvre*, 2021. URL: Galileo satellite performs collision avoidance manoeuvre: GPS World.
[135] Yoon, J., Lee, B., Choi, K., *Spacecraft orbit determination using GPS navigation solutions*, in Aerospace Science and Technology, Volume 4, Issue 3, 2000. Available at: https://www.sciencedirect.com/science/article/abs/pii/S1270963800001309,.

respective location-based services, or severely limiting satellite communication or Earth observation data.

Moreover, if a Kessler effect occurs it could have a widespread effect on access to downstream services. But even localised disruptions are a major concern.

From a societal point of view, apart the economic losses, cyberattacks **damage citizens' trust**. As space-based systems collect and transmit vast amounts of sensitive data (including personal information, proprietary data and, in the case of the EU's GOVSATCOM initiative, sensitive government communication[136]) cyberattacks targeting these systems can result in data breaches, unauthorised access to sensitive information, and privacy violations[137]. Society expects and trusts that data and services remain secure. Cyberattacks reduce confidence[138] and studies demonstrate that the level of public trust can be sharply affected[139].

While **option 1** would entail further layers of protection, thus supporting access to downstream essential services to a certain extent, the reach of the measures may remain limited (with consequences for services that rely on data from GNSS, satellite communications and Earth Observation).

Options 2, 2+ and 2++ will protect space infrastructure more consistently, enabling crucial data to be provided to services that rely on data from GNSS, satellite communications and Earth Observation. The creation of an internal market for space-based services will make it possible to provide enhanced services to people in the EU.

2.2. Digitalisation

The global connectivity service will be reduced within the **baseline** framework because communication satellite constellations are under the growing risk of collision (e.g. with space debris), resulting in lost communications and the corruption of data, thereby reducing or disrupting the quality and integrity of downstream services.

Similar to the baseline scenario, **policy option 1** will have a very limited social impact. It will only partially protect the availability and integrity of space-based services. It would not significantly improve or boost the overall quality of today's space-based services, and thus only marginally increase Member States' capability to develop a space-based connectivity layer that would foster digitalisation across the EU.

[136] GeoTech Center, *Cybersecurity of space-based assets and why this is important*, in Atlantic Council, 2021. Available at: https://www.atlanticcouncil.org/insight-impact/in-the-news/cybersecurity-of-space-based-assets-and-why-this-is-important/.
[137] Ibid.
[138] Gomez, M., Shandler, R. 2022, *Cyber conflict and the erosion of trust*. Available at: https://www.cfr.org/blog/cyber-conflict-and-erosion-trust.
[139] Ryan Shandler & Miguel Alberto Gomez, 2023, *The hidden threat of cyber-attacks – undermining public confidence in government*, Journal of Information Technology & Politics, 20:4, 359-374, DOI: 10.1080/19331681.2022.2112796. and Silomon, J. (2020). The Düsseldorf Cyber Incident. Institute for Peace Research and Security Policy. Available at: https://ifsh.de/en/news-detail/the-duesseldorf-cyber-incident After a ransomware incident against a hospital in Düsseldorf, even though the incident was quickly resolved and the hospital resumed its regular services after a few days, most local residents exposed reported reduced trust.

Compared to the baseline, **policy options 2 and 2+** will have significantly greater social impact by ensuring the possibility for space-based services to provide additional benefits for people in the EU, and by creating opportunities to further digitalise the EU through satellite constellations with sophisticated data protection and a high quality of service.

Policy option 2++ will allow the continuous use of satellite connectivity, resulting in the creation of seamless and global space-based connectivity that will help close the digital divide.

2.3. Governance

The continuing fragmentation of the internal market under the **baseline scenario** will have a continuous impact on the industry, and its ability to navigate the Member States' various technical requirements is limited and comprises a continuous administrative burden. Common threats to the space and Earth environment, such as dark and quiet skies are, therefore, insufficiently addressed, and against the principles of good governance.

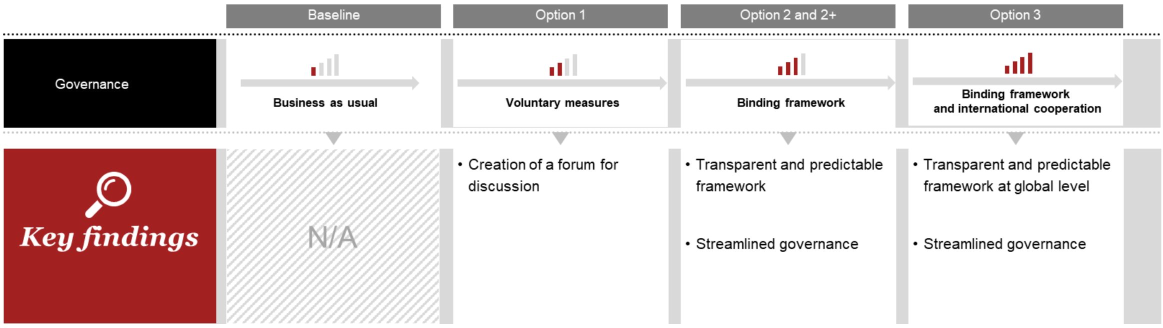
The EU's current space policy is managed by a combination of political and administrative stakeholders. The relevant public ecosystem includes national authorities, the EU Space Programme, Horizon Europe and the European Space Agency, which lacks sufficient administrative resources to address global risks. Without clear, consistent and effective channels for coordination, there is an increasing asymmetry in priorities, fragmentation of policy and regulation, and duplication of efforts. As a result, different pathways are being set out under the different policy options that are being put forward.

Policy option 1 will necessarily enable the creation of an industry-driven forum to discuss the establishment of non-binding measures and appropriate instruments (for instance best practices, guidelines and charters) but will not, as such, entail enforcement responsibilities. However, national licensing conditions on safety, resilience and environmental aspects may continue to differ. 60% of the respondents to the targeted stakeholder consultation agreed or strongly agreed that non-binding rules provide less legal clarity, although the involvement of the EU would make processes more transparent. The protection of dark and quite skies will be limited.

As explained in the impact assessment report, **policy options 2 and 2+ allow for a** process to develop the label and standards, including a range of stakeholder engagements such as Member States, industry actors, academia, NGOs, international organisations, European institutions, bodies and agencies. 65% of the respondents to the targeted stakeholder consultation agreed or strongly agreed that the EU Space Act would provide a common, stable and predictable framework to foster the further expansion and long-term sustainability of the activities of new commercial space actors, and to attract private investment. This all-encompassing approach, aiming to gather stakeholders' insights, is likely to ensure complete and voluntary compliance with the proposed approach. The involvement of stakeholders will encourage uptake of measures, reduce the administrative burden stemming from compliance, and encourage positive governance practices, albeit on a limited scale.

Policy options 2 and 2+ will also **help improve public regulatory governance.** By providing harmonised licensing conditions related to safety, sustainability, resilience and the environment, this approach gives European companies greater predictability and transparency in decision-making processes related to space activities. The reference to technical standards and PEFCR allows stakeholders to conduct mandatory life cycle assessments (LCA), fostering a comprehensive and standardised approach to environmental impact assessments. At the same time, legislative programme committees can create interpretations of requirements if needed. Similarly, as described under policy option 1+, the creation of the Space Label and standards will require consultations with relevant stakeholders. This ensures that diverse perspectives are considered and can lead to more informed and balanced decision-making. Furthermore, policy option 2+ would have even greater impact by creating a forum for the private sector, thereby fostering ownership, and protect indigenous people's access to dark and quiet skies.

Policy option 2++ would have similar impacts to policy option 2, and would provide a transparent and predictable framework. In addition, engaging in bilateral negotiations for the creation of agreements with non-EU countries is likely to strengthen the EU's overall role in terms of global governance by leading by example, for instance through the creation of a binding framework at EU level (policy option 2) and through the promotion of similar measures internationally via bilateral agreements. Under policy option 2++, action at the international level through the negotiation of bilateral agreements is likely to bring more significant benefits to both the EU and non-EU countries, compared to policy option 2. 52% of respondents to the targeted consultation agreed or strongly agreed that a multiplication of bilateral agreements would create legal uncertainties for operators.



2.4. Research and innovation

Baseline: Negative impacts on scientific astronomical observations are likely to have significant consequences for research and innovation. Astronomical research relates to the exploration and use of outer space. It facilitates deep space navigation and exploration, examining the conditions on celestial bodies within our solar system, safeguarding Earth from potentially hazardous asteroids, searching for extra-terrestrial life, and shedding light on the origins of our own planet[140]. The possibilities for research and innovation will be reduced by threats to space assets (used for scientific purposes) and light and radio pollution interfering with the ability to make astronomical observations (reducing observation time by 20 to 40%). 78% of respondents to the targeted consultation agreed or strongly agreed that the increased number of satellites in orbit negatively impacts astronomical research. Furthermore, as pointed out by the International Astronomical Union 'Technological progress is only made possible by parallel advances in scientific knowledge. Satellites would neither operate nor properly communicate without essential contributions from astronomy and physics. It is in everybody's

[140] European Commission. The Net-Zero Industry Act: Accelerating the transition to climate neutrality. Available at: https://single-market-economy.ec.europa.eu/industry/sustainability/net-zero-industry-act_en.

interest to preserve and support the progress of fundamental science such as astronomy, celestial mechanics, orbital dynamics and relativity'[141].

Policy option 1 would stimulate both the space industry and Member States to address the main risks jeopardising safety and sustainability in space, resilience/security and the environment. For instance, stakeholders would work together on the development of non-binding practices and techniques to be shared among market operators on the most effective risk management steps based on best practices, guidelines or charters. For any aspects relating to research and innovation, the new market expected from option 1 will be small and allow only limited business and research opportunities to be created. This option would incentivise the space industry (and their innovations) to comply with voluntary measures, and to adopt cutting-edge technologies with high commercial potential on the internal market and beyond, and would address the protection of dark and quiet skies. However, certain interference with astronomy would remain.

The adoption of **policy options 2 and 2+** has the potential to stimulate innovation, research and development. By driving R&D efforts, encouraging resource-efficient practices, and fostering collaboration between academia and industry, both policy options can facilitate the introduction and dissemination of new production methods, technologies, environmental studies and products, ultimately contributing to the growth and competitiveness of the space sector. This approach would also create new business opportunities to create solutions to the requirements set by the harmonised legal framework and protect research opportunities for astronomy. These policy options would have a significant impact on innovation due to the need to develop new technologies, materials and processes that meet these regulatory requirements. Innovation driven by regulatory requirements can lead to productivity gains. On the research side, options 2 and 2+ will stimulate the development of research on the environmental impact of the space sector, as well as secure astronomy research by protecting the dark skies. Moreover, proportionality is necessary for university space operations performed at low altitude to protect research and development being performed at these orbits.

Under **policy option 2++,** action at the international level through the negotiation of bilateral agreements is likely to bring more significant benefits to both the EU and non-EU countries compared to policy option 2. Examples could include potential research cooperation between the EU and non-EU countries to address issues such as light pollution from satellites or the application of a common methodology to estimate environmental impacts more accurately. Both examples demonstrate how cross-border cooperation is likely to lead to innovation. The adoption of policy options 2, 2+ and 2++ has the potential to stimulate innovation, research and development. It would also protect the ability of astronomers and indigenous communities to observe the dark and quiet skies.

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[141] Understanding the Impact of Satellite Constellations on Astronomy | Press Releases | IAU

	Baseline	Option 1	Option 2 and 2+	Option 3
Research and innovation	Business as usual	Voluntary measures	Binding framework	Binding framework and international cooperation
Key findings	N/A	• Increase opportunities for innovation to comply with the voluntary measures	• New business opportunities to comply with the requirements • Increase research opportunities for astronomy and environmental studies	• New business opportunities to comply with the requirements • Increase research opportunities for astronomy and environmental studies

2.5. Resilience

Baseline scenario: An increased number of threats to space assets due to the growing number of space debris and cyberattacks in the EU **reduces the EU's overall resilience and security** and increases the possibility of disruptions to critical services, secure communication channels, intelligence gathering and surveillance activities, potentially jeopardising national security and defence capabilities[142]. Cyberattacks highlight vulnerabilities, which further 'attract' other cyberattacks to occur. In addition, light pollution interferes with our ability to detect hazardous asteroids.

Due to the increasing **interconnectedness of space-based data and services** between Member States and beyond, a cyberattack can have consequences such as **cross-border spillovers**, and also cause cross-sectoral impacts[143]. Critical infrastructures are also at risk of these cascading effects across sectors and Member States, hence security breaches of critical infrastructures bring wider impacts to other sectors. For instance, the telecommunications sector has a crucial role in other sectors such as aviation, which depends on telecommunication services and global navigation satellite systems for air traffic control and navigation. Financial services also rely on telecommunications infrastructure and on the internet sector, which depend in turn on the reliability of the electricity system[144]. Consequently, an attack (whether in cyberspace or on physical infrastructure) has more significant consequences on the proper functioning of other sectors.

The policy options envisage the development of different sets of measures that will have a positive impact on the EU's resilience against safety and security threats.

The voluntary measures that would be proposed by **policy option 1** are likely to increase awareness of cyber threats posed to space infrastructure and thus increase, to a certain extent, the robustness of industry's capabilities, in light of the various mitigation and protection

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[142] World Economic Forum, *Why we need increased cybersecurity for space-based services*, 2022, available at https://www.weforum.org/agenda/2022/05/increased-cybersecurity-for-space-based-services/.
[143] As seen with the Viasat cyberattack, which resulted in the loss of internet access and possible disruptions to systems in the energy sector in Ukraine, but also impacted other countries and sectors such as the German energy company which lost remote monitoring of 5 800 wind turbines; 9 000 subscribers of a French internet service provider impacted; and 40 000 subscribers of a European internet service provider impacted across Germany, France, Hungary, Greece, Italy and Poland. Available at: https://cyberconflicts.cyberpeaceinstitute.org/law-and-policy/cases/viasat.
[144] European Commission, 2020, impact assessment accompanying the proposal for a Directive on the resilience of critical entities, available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020SC0358&rid=10.

measures voluntarily adhered to thanks to the development of best practices. This will have a certain impact on the overall resilience of the space sector by reducing vulnerabilities along the value chain and improving environmental resilience. This will be done through two channels in particular:

- **Enhancing knowledge on the security challenges in the space sector:** the compilation of best practices, guidelines and information-sharing platforms will increase the industry's knowledge on existing threats and the mitigation measures available. It will foster collaboration between different stakeholders to improve joint resilience and foster the exchange of best practices.
- **Increasing threat prevention and the chances of detection:** the promotion of information-sharing platforms on risk management, as well as security requirements, encryption and cybersecurity, would improve threat prevention. Promoting collaboration channels among stakeholders is likely to provide more accurate information for policymaking aimed at protecting space assets and associated services in orbit and on Earth.

The binding measures in **policy option 2** will:

- **Enhance the EU's data independence and inform policymaking:** the policy option envisages the presence of different information-sharing channels. The binding requirement on data sharing will increase the EU's resilience as regards this issue and foster the centralisation and ownership of information at EU level. Moreover, this will make it possible to map the different vulnerabilities in the space sector and to better anticipate risks. This is likely to strengthen the independence and resilience of the EU on the aspects regulated by the policy intervention.
- **Reducing security vulnerabilities along the value chain:** the different vulnerabilities in space and ground segments, as well as in communication channels and supply chain systems, would be better protected. Guidelines and best practices would provide indicative benchmarks and roadmaps to reach the EU standard security level. Diminishing the risk of threats by, for instance, securing infrastructure software, can reduce the risk of attacks and avoid related costs.
- **Reduce resource dependency and improve environmental resilience:** incorporating LCA practices into environmental management and sustainability efforts can lead to more resilient and strategically autonomous systems that are better equipped to address environmental challenges and disruptions.

Policy option 2+ will have the same impact as policy option 2 and will, additionally, make it possible to incentivise stakeholders who not only fulfil the basic requirements set by the legislation, but who also go the extra mile on these same requirements.

Policy option 2++ is likely to bring similar benefits to policy option 2. In addition, considering the interconnectedness of space assets and infrastructure not only within the EU but also with non-EU countries, the bilateral agreements related to (cyber)security measures are likely to bring major benefits for the EU. The main reason is that if the EU and non-EU countries apply similar measures to secure their assets and infrastructures, a common level of security would be ensured not only within but also beyond the EU.

	Baseline	Option 1	Option 2 and 2+	Option 3
Resilience	Business as usual	Voluntary measures	Binding framework	Binding framework and international cooperation
Key findings	N/A	• Development of best practices for risk assessment	• Reduction of vulnerabilities along the value chain • Improved environmental resilience	• Reduction of vulnerabilities along the value chain • Improved environmental resilience

3. ENVIRONMENTAL IMPACTS

This Section identifies different kinds of **environmental impact** to be anticipated as a result of implementing selected policy options.

However, there are certain commonalities: (i) all policy options envisage assessing (with a view to ultimately minimising) the environmental impacts of the space industry; (ii) we assume in all options the intention to apply circular economy principles to space activities, via the use of a life cycle assessment (LCA) method specific to the space sector; (iii) the specific LCA method for evaluating the environmental impacts of space activities throughout their entire life cycle, from raw material extraction to manufacturing, use and disposal.

LCA considers a range of impact categories, which are environmental aspects such as greenhouse gas emissions, energy consumption, air and water pollution, and resource depletion. These impact categories help quantify and assess the various environmental effects of a given system, allowing for a holistic understanding of its sustainability, which will guide decisions towards more environmentally responsible practices and products. Although the level of impact varies between policy options, the impact categories identified are applicable throughout the different interventions.

Environmental Impacts	Climate	Efficient use of resources	Waste production

3.1. Climate

Under the **baseline**, in the context of space activities, addressing environmental challenges is complicated by different LCA methods, which can lead to misleading conclusions. This complexity makes it difficult to assess and enforce accountability for the environmental impact of space missions.

Policymakers also face challenges in identifying priority areas for intervention and in crafting effective policies because there is limited knowledge about the environmental consequences of space activities. Additionally, the absence of a standardised LCA methodology for space activities hampers compliance with EU legislative initiatives, for example, the Green Claims Directive, which aims to regulate misleading environmental claims and encourage fair competition and progress towards achieving the goals outlined in the Net-Zero Industry Act.

This lack of a standardised LCA methodology impacts how contracts are awarded and stifling innovation within the space industry.

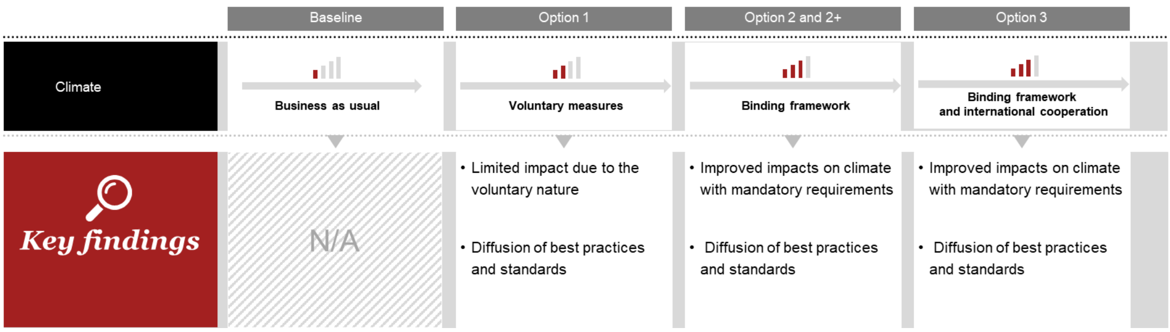
The measures set out by **policy options 1, 2, 2+ and 2++**, whether binding or not, will have tangible climate repercussions. By creating a set of tools and guidelines to assess and reduce the environmental footprint of the space sector, the measures would contribute to two types of climate impacts:

- reduction of greenhouse gas (GHG) emissions and the prevention of ozone depletion caused by various aspects of space activities;
- greater environmental awareness within the space sector, facilitating the sharing of information and public discourse on climate-related actions specific to space missions and their environmental impact.

With the creation of a PEFCR and the diffusion of best practices and guidelines for the space sector under **policy option 1**, the sector will have access to the methodology to create a life cycle assessment of space activties. However, due to its voluntary nature, the impact of policy option 1 is highly dependent on industry adopting the voluntary measures. Based on the assumption that 60% of the satellite industry and 80% of the launcher industry in the EU will adopt the voluntary measures (in line with the base assumption in Section 7), option 1 will have a limited impact on greenhouse gas emissions, the efficient use of resources and on reducing waste.

Policy options 2 and 2+ will have a greater impact on climate change due to the mandatory requirements that they contain, especially regarding the de-orbiting of satellites and LCA. Based on the PEFCR, the licensing requirement will provide an overview of the different environmental impact categories, including higher standards for energy efficiency, and reduce the need for critical materials as well as increase the lifespan of space and ground assets, supported by best practices and standards.

Policy option 2++ will have the same impacts as policy options 2 and 2+, but on a global scale – therefore increasing the impact as more data would be available – but with a delayed action.



3.2. Efficient use of resources (renewables and non-renewables)

The space activity supply chain includes energy-intensive operations such as the sourcing of raw materials, the individual transport of pieces of space assets, launching, and operations on the ground and in space. The combination of these activities, connected worldwide, and on a continual basis, consumes a great deal of energy[145]. Although there is currently little knowledge about the aggregated effects and magnitude of the environmental impacts of these activities, it has been established that they are all individually connected to resource-intensive processes[146]. The interventions proposed by the policy options will make it possible to:

- **reduce the sourcing and use of critical materials:** in line with the recent regulatory changes regarding critical raw materials[147], the best practices put in place by the policy options, as well as the development of the PEF method applied to the space sector (PEFCR) will help to minimise the sourcing and use of critical materials. This will be done, in particular, by identifying critical aspects of the supply chain, by gathering data and providing information on the use of energy and materials for space activities, and by creating rules and measures to reduce the environmental impact of space activities along the value chain. The analysis of the results could potentially help reduce the number of materials used, identify alternatives, and improve their recycling.
- **improve energy efficiency in the sector**: space activities comprise energy-intensive activities along the value chain such as the sourcing of raw materials and testing facilities, etc. Significant amounts of energy and fuel are required for the testing, transport, launching, de-orbiting, and disposal activities of space assets. Additionally, the monitoring of space activities involves energy-intensive data centres to collect, process, analyse and store data[148]. In fact, the operational part of space activities relies entirely on infrastructures in the ground segment which are connected across the world and at all times[149]. Environmentally friendly guidelines, and the use of PEFCR for space activities to assess and compare the energy consumption of the different segments of space activities, could help identify synergies along the value chain and optimise the energy consumption of space activities.
- **reduce the energy consumption of mission rescues:** the different space incident mitigation measures put forward in the different policy options will reduce, to a certain extent, the distribution of debris and the number of collisions in space. In fact, the greater sustainability of in-orbit activities will reduce the necessity for in-orbit safety interventions, which often require large amounts of fuel to operate safety missions. Therefore, the reduction of potential collisions in space reduces the need for fuel and energy-intensive safety missions.

In the **baseline** framework, the use of critical materials will continue to grow.

Policy option 1 will have only a limited impact on the efficient use of resources due to its voluntary nature. It will disseminate best practices and standards.

Policy options 2, 2+ and 2++ will result in a reduction in the use of critical materials, improved energy efficiency and decreased consumption in the sector.

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[145] Interview with Deloitte Sustainability expert.
[146] European Commission, *Analysis of the consequences of the EU's environmental framework on space activities and options towards promoting greener space activities in Europe,* 2014. Note: the Commission will provide EU-owned non-public studies in addition to the impact assessment report.
[147] Critical Raw materials, [Critical raw materials (europa.eu)](https://ec.europa.eu).
[148] International Energy Agency, https://www.iea.org/energy-system/buildings/data-centres-and-data-transmission-networks.
[149] Interview with internal expert.

The different options will make it possible to use of the different dispositions to increase the sustainability of space activities, and will develop baseline knowledge on energy and the use of resources along the value chain of space activities. Moreover, it prevents the risk of additional interventions that would increase the overall energy intensity of the sector. Thus, the policy options can, to a certain extent, help reduce the energy intensity of the space sector, with an increase in efficiency from option 1 to option 2++.

	Baseline	Option 1	Option 2 and 2+	Option 3
Efficient use of resources	Business as usual	Voluntary measures	Binding framework	Binding framework and international cooperation
Key findings	N/A	• Limited impact due to the voluntary nature • Diffusion of best practices and standards	• Reduced use of critical materials • Improve energy efficient of the sector and decrease consumption	• Reduced use of critical materials • Improve energy efficient of the sector and decrease consumption

3.3. Waste generation and recycling

The intensification of space activities raises the question of end-of-life management of space objects and related systems. As the policy foresees the dissemination of sustainability-enhancing best practices and measures, the interventions are expected to have a positive impact on waste production and the recycling of space objects including:

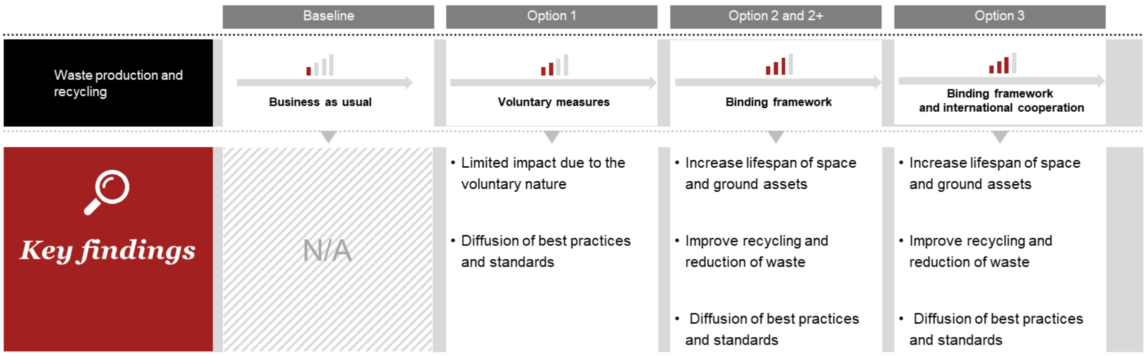
- **improved recycling and reuse of materials:** the creation and use of a PEFCR and the safety measures proposed would have a significant impact on waste management by promoting waste reduction, efficient resource use, responsible disposal and improved waste minimisation technologies.
- **extending the lifespan of in-orbit assets:** by reducing the risk of damage posed by collision and debris and by introducing post-mission mitigation measures, the policy options will reduce the risk of satellite damage or destruction. The extension of a satellite’s lifespan reduces the need for full or total replacement of space assets, reducing the need for resources and energy-intensive manufacturing of space engines.
- **extending the lifespan of ground segment infrastructures and equipment.** As regards the development of sustainable and circular processes to reduce the environmental impact of economic activity, using the PEFCR for space activities could fuel initiatives to extend the lifespan of technical infrastructures, enhance recycling processes, reduce waste, improve the sourcing of materials and apply circular economy principles to ground segment infrastructure and equipment. Thus, the development of the PEFCR could, in targeted and innovative ways, help extend the lifespan of infrastructures and equipment, and increase their recycling rates.

- **Raise awareness and increase industrial transparency:** the implementation of a PEFCR for space activities will contribute to additional transparency[150] on the space industry's environmental behaviours. In line with the recent legal frameworks addressing false green claims, the collection of data and the insights gained from the use of the space activity's LCA practices (based on the PEFCR method) will raise awareness of the environmental impact of space, encouraging behavioural changes in the industry, and fostering transparency. In addition, the greater accuracy of green claims made by companies will likely have a snowball effect on the sector, encouraging environmentally friendly practices and incentivising sustainable industry practices.

Under the **baseline scenario,** water production will increase, and recycling will be very limited.

Policy option 1 will have only a limited impact on the efficient use of resources due to its voluntary nature. It will disseminate best practices and standards. **Policy options 2, 2+ and 2++** will increase the lifespan of space and ground assets, improve recycling and reduce waste based on best practices and standards.

The different options will have a positive environmental impact in terms of improving the management of space waste. Additionally, the reduction of damage to and destruction of space assets increases the potential for the recycling or reuse of critical parts of satellites (e.g. materials, structures, systems etc.). Therefore, the policy options would have a positive impact on the development of broader possibilities for the reuse and recycling of space assets. Thus, the policy options can, to a certain extent, help reduce the energy intensity of the space sector, with an increase in efficiency from option 1 to option 2++.



[150] European Commission, *Analysis of the consequences of the EU's environmental framework on space activities and options towards promoting greener space activities in Europe,* 2014. The Commission will provide EU-owned non-public studies in addition to the impact assessment report.

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ANNEX 12: CONSISTENCY WITH OTHER EU POLICIES

Option 1

We should strive for some synergies with relevant developments in the aviation industry, however it will be difficult to ensure coordination between aviation and space operators through co-regulation during a launch phase.

The overall consistency with the EU's current general cybersecurity and resilience frameworks can be assumed to a certain extent. However, since this option lacks a **comprehensive legislative approach tailored to space resilience**, and considering the current coverage by the NIS2 Directive of the ground segment, it is not clear how the industry-agreed approaches to be developed under co-regulation may relate to and fit into the transposition of the NIS Directive's provisions by Member States. This may create possible duplications or overlaps.

While there is a degree of alignment with the broader EU environmental frameworks, the absence of a mandatory approach dedicated to measuring and reporting the environmental impacts of space activities undermines the overall coherence of this option. Consequently, the proposed option does not introduce significant changes to the baseline scenario, as it retains the methodology on a voluntary basis, thereby upholding the status quo.

Options 2, 2+ and 2++

Space operations transverse through airspace at launch and sometimes at the end of their life if re-entry is chosen as the disposal method. **Synergies with EU aviation legislation are therefore imperative.** That includes, first and foremost, coordination with the relevant air traffic management functions, such as Regulation (EU) 677/2011 on Air Traffic Management Network Functions and the use of airspace. Occurrences related to the interface between aviation and space operations will be reported through the mandatory EU reporting scheme for aviation (Regulation (EU) 376/2014). If future rules on higher airspace operations (HAO) are adopted, synergies should be sought where relevant. However, since policy option 2 does not define the launch vehicle but leaves this to the Member States, no overlap between policy option 2's licensing measures and HAO is expected, as this can be addressed in the future HAO definitions.

The envisaged initiative is consistent with the general EU cybersecurity and resilience frameworks:

(a) as far as the **NIS2 Directive** is concerned, the envisaged initiative would build on the existing horizontal framework prescribed by the NIS 2 Directive. Article 21 of the NIS 2 Directive sets out certain general cybersecurity risk management measures which provide a common basis for all economic sectors covered by the NIS. As these rules are not specific to the cyber protection needs of the space sector, the industry has called for a resilience baseline to be defined for the space sector, with specific rules to protect the ground-to-space command link, the space-to-ground telemetry link and cross-links (uplink and downlink), and to create a robust strategy for cryptography key management as well as rules for the protection of cybersecurity on board satellites.

Options 2/2+/2++ would, therefore, envisage setting out a tailored resilience baseline for the space sector for all applicable space segments, while ensuring full integration with the NIS 2 ecosystem and maintaining the reporting obligations from NIS 2. Moreover, these options would ensure consistency with the Commission proposal for a Regulation on cross-cutting cybersecurity requirements for products with digital elements and amending Regulation (EU) 2019/1020 (the '**Cyber Resilience Act'** or 'CRA'). The purpose of this proposal is to harmonise the essential cybersecurity requirements for products with digital elements and avoid overlapping requirements stemming from different pieces of legislation. These rules would also apply to the products with digital elements used in space infrastructures. Policy options 2/2+/2++ could, moreover, allow for certain synergies with the governance aspects established by the CRA.

(b) The envisaged initiative is also consistent with the objectives of strengthening the resilience of critical entities. The current **Space Regulation** (Article 34) already obliges Member States to take measures which are at least equivalent to those prescribed in the context of Directive 2022/2557 on the resilience of critical entities (CER), repealing Council Directive 2008/114/EC.

(c) The envisaged initiative is consistent with the **Commission proposal for a regulation laying down measures for a high common level of cybersecurity at the institutions, bodies, offices and agencies of the Union (EUIBA**). The proposed EUIBA regulation is aimed at improving the resilience and incident response capacities of EU entities and creating a common framework. It would strengthen the mandate of the Computer Emergency Response Team for the EU institutions, bodies, offices and agencies (CERT-EU). The proposed EUIBA regulation is of relevance to EUSPA (the EU agency within the scope of EUIBA) which would benefit from enhanced cybersecurity and cyber risk management rules, which are essential factors in EUSPA's readiness and capacity to assume a new task of receiving reports of incidents in relation to EU-owned assets (as per the envisaged initiative).

The envisaged initiative is consistent with the general EU environmental frameworks, including the **Commission Recommendation on the use of the Environmental Footprint methods** (C(2021) 9332 final) by implementing the mandatory LCA method for space activities via a PEFCR, ensuring comprehensive environmental reporting, fostering accountability and sustainable practices across the entire lifecycle of space activities, and consistency with other EU initiatives:

- The **Net-Zero Industry Act** aims to propel EU industry toward sustainability by promoting the adoption of zero-emission technologies and practices, fostering a transition to a more environmentally responsible and climate-neutral industrial landscape. The combined effect of mandatory PEFCR and the Zero Industry Act ensures that space activities are not only in compliance with environmental regulations but are actively contributing to more sustainable and environmentally responsible space activities.
- In the EU, **the Corporate Sustainability Reporting Directive (CSRD)** requires large and listed companies to transparently disclose the connection between their strategy,

operating models, and sustainability, starting in 2024. The PEFCR facilitates the effective management of environmental data for CSRD compliance.

- The proposed initiative strategically integrates compliance with the **Taxonomy Regulation** in sustainable finance. By doing so, it actively contributes to the alignment of space activities with the principles of sustainable finance. This inclusion ensures that the environmental impact and sustainability of space activities are systematically assessed and reported in accordance with the established taxonomy framework, promoting transparency and the future inclusion of space activities within the Taxonomy Regulation.
- The **EU Emissions Trading System (ETS)**, a cap-and-trade system for greenhouse gas emissions, requires robust monitoring of direct emissions. PEFCR tools, with emission factors, capture regulated direct emissions and provide a cradle-to-grave view of carbon accounting throughout the value chain.
- For EU space activities, environmental impact assessments are governed by the **Environmental Impact Assessment Directive** and the **Strategic Environmental Assessment Directive**. These directives require Member States to assess the environmental effects of certain projects, plans and programmes before approval.
- The **Ecodesign Directive** steers eco-friendly design, focusing on energy efficiency and waste reduction. Simultaneously, the PEFCR is a vital tool in implementing Ecodesign principles for space activities, providing a comprehensive environmental evaluation throughout the lifecycle of space activities. By combining Ecodesign principles with PEFCR analysis, space activities can harmonise technological innovation with environmental responsibility, aligning with stringent environmental standards and promoting sustainability in space activities.
- The **Green Claims Directive proposal** aims to streamline and standardise sustainability information to improve consumer decision-making and combat greenwashing. The PEFCR aligns with various policies, such as the Packaging and Packaging Waste Regulation, which introduces potential requirements for improved packaging design. The PEFCR helps to contextualising circularity targets, creating audit trails for supply chain implementation, and informing decisions with specialised tools like the packaging tool or Ecodesign.

ANNEX 13: SME TEST

1. IDENTIFICATION OF AFFECTED BUSINESSES

Given the high concentration of SMEs on the European space market, SMEs operate across the entire value chain of space activities, which makes them **relevant stakeholders for this initiative**.

The growth of space activities, coupled with the fragmented nature of the value chain of space assets, has provided economic opportunities for SMEs to act as key subcontractors in the process. Often integrated as upstream subcontractors along the value chain, dedicated attention must be paid to secure and level the playing field for SMEs on the internal market to protect the EU space industry and enable its sustainable expansion.

The section below provides an overview of the different types of SMEs affected:

- **Upstream** (i.e. involved in the development and launch of spacecrafts and other space assets. This includes the design, manufacture and testing of spacecraft, as well as the development of launch vehicles and ground control systems.): the space sector is dominated by a small number of large players, and a large pool of smaller companies at different levels of the value chain. SMEs are emerging as subcontractors in the upstream part of the market, which is mainly dominated by larger companies. The upstream space sector in the EU counts 1 069 SMEs with a turnover of around EUR 2 billion in 2018[151].

- **Downstream** (i.e users of space data for commercial services): as per the European Parliament's report on the Space Market[152], the vast majority of companies in this segment are SMEs.

SMEs are likely to be impacted in different ways according to their position along the value chain. We outline below how different SMEs and their representative organisations were consulted for these assessments and the information on the potentially positive and negative impacts that was gathered through these outreach activities.

2. CONSULTATION WITH SMEs REPRESENTATIVES

Preparation of the legislative initiative included consultations with relevant industry stakeholders, including SMEs:

a. The targeted stakeholder consultation ran from 29 September to 2 November 2023. In total, 322 contributions were received, of which **104 came from SMEs**. A detailed overview of the stakeholder consultation can be found in Annex 3.

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[151] European Parliament, Space Market, 2021. URL: https://www.europarl.europa.eu/RegData/etudes/STUD/2021/695483/IPOL_STU(2021)695483_EN.pdf referring to an SME4SPACE (2020). Study on the economic importance of SMEs in the space industry in ESA Member States.

[152] https://www.europarl.europa.eu/RegData/etudes/STUD/2021/695483/IPOL_STU(2021)695483_EN.pdf, 2021

b. **Workshops with industry on the different pillars of the EU Space Act** (Safety and sustainability in space; resilience; environment) **and corresponding surveys** included representatives from both large and established companies and New Space SMEs and start-ups.
c. **Bilateral meetings and interviews with New Space companies** aimed to gather their views on the challenges they face when navigating the current EU and national legislation on space activities. The companies interviewed included launch service providers; satellite manufacturers and operators, and providers of space equipment.

3. ASSESSMENT OF THE IMPACT ON SMES

Based on the results of the comparison of policy options outlined in the impact assessment, **policy option 2+, Adopt a binding framework at EU level, paired with a non-binding recommendation,** achieved the highest score and is therefore the preferred option. This result is also in line with the preferred option chosen by stakeholders (including by SMEs) in the targeted consultation. This option targets the problems identified in Section 3 of the impact assessment report through binding measures complemented by a non-binding framework.

The costs for industry and particularly SMEs would include meeting technical and operational requirements, coupled with additional costs for administrative checks and enforcement. The development of the necessary standards on safety, sustainability and resilience may also entail supplementary costs. SMEs could encounter costs related to satellite manoeuvres due to potential service interruptions. Overall, these alterations are likely to increase the administrative burden and costs for the entire industry, including SMEs, potentially resulting in a manufacturing cost increase ranging from 3% to 10%. For smaller actors it would be proportionally more expensive to comply with such measures.

This cost impact could be mitigated by support measures, and by embedding proportionality in the rules, which would take different criteria into consideration, such as the size of the company, the criticality of the space mission or the orbit used, as described in the table below.

Overall, the initiative aims to instigate positive outcomes for SMEs. The measures included in policy option 2+ would provide a common, stable, and predictable framework for the conduct of space activities in the EU, attracting private investment and fostering the growth of space start-ups and SMEs. This option will also ensure fairness in the market by ensuring equal treatment for both EU and non-EU space operators providing services within the EU. It is anticipated that the redistribution of compliance costs across the market would encourage equitable competition. Furthermore, the initiative seeks to enhance the coherence of the internal market. It is expected that jobs would be created and that start-ups and SMEs would experience growth. Additionally, there is the prospect of increased business opportunities, particularly in services utilising space data.

The majority of SMEs consulted through the consultation process agreed with this assessment, and stated that this policy option could: (a) provide a common, stable and predictable framework to foster the long-term sustainability of the activities of new commercial space actors, and attract private investment; (b) create a level playing field for all European companies; and (c) reduce the risk of 'cherry picking' between Member States with the lowest level of safety, resilience or environmental requirements.

4. ASSESSMENT OF ALTERNATIVE OPTIONS AND MITIGATING MEASURES

Although the preferred policy option is likely to trigger additional costs for SMEs, this impact could be mitigated by support measures and by embedding proportionality in the rules, to address the specificities of market actors with fewer resources. The proposed legislative initiative would be accompanied by a series of measures to support both technological and operational compliance, as described below:

- **Capacity building** to support companies (satellite operators, launch service providers, manufacturers): the Commission would propose to develop additional documents (guidelines and templates) on how to best comply with the rules and how to use the space labels in national procurement procedures. The Commission would also develop supplementary guidance on the binding rules that would apply to novel areas, such as in-orbit servicing or orbital traffic rules. This support measure would also benefit Member States (competent authorities and notified bodies).
- **Technical assistance** to offset part of the FTE personnel required by SMEs to prepare licensing files: the Commission would create a pool of independent experts that would assist the SMEs to prepare the licensing file, free of charge.
- **Mentoring and coaching**: to offset part of the costs related to cyber resilience for those manufacturers moving from the light to the normal regime, and for SMEs implementing LCA practices based on the PEFCR, the Commission would develop a mentoring and coaching programme, which would include the provision of vouchers.
- **Access to testing**: to offset part of the costs of testing (including threat-led penetration tests) of the platforms brought about by the mandatory requirements, the Commission would: (i) map existing testing facilities and services in the EU; and (ii) develop a framework contract that would ensure fast and affordable access for companies (notably SMEs) to threat-led penetration testing.
- **Development of new technological solutions**: to offset part of the costs related to innovation and the development of new technological solutions that would facilitate industry's compliance with the mandatory requirements (for example, the development of new encryption technologies, on board safety systems, etc.), the Commission could co-fund joint research and development projects as part of Horizon Europe.
- **Exchange of best practices**: to facilitate the exchange of best practices and lessons learned as regards cybersecurity, the Commission would promote and facilitate collaboration and knowledge sharing between stakeholders, through information-sharing hubs and platforms. The legislative initiative would acknowledge that all such information sharing would take place in compliance with EU competition rules and respecting data protection rules. The Commission would incentivise the use of the EU Space Information Sharing Analysis Centre (EU Space ISAC).
- **Standardisation**: to offset part of the costs of manufacturing , the Commission would fund the development of standards that would streamline production processes. The development of standards would closely involve EU industry, including SMEs. This step would also reduce supply chain risks and encourage innovation. For example, launcher neutralisers (a safety component to reduce space debris) are currently bought off the shelf from outside the EU. Relevant European standards would stimulate the development of neutralisers in line with the mandatory requirements.

- **One-stop-shop approach**: to further enhance the benefits of administrative simplification and streamline compliance procedures, in particular for SMEs, the Commission would propose a one-stop-shop approach: (i) the Commission would propose that each Member State should set up a helpdesk for any questions about the licensing system; (ii) at EU level, the Commission, with the support of EUSPA, would set up a helpdesk to answer SMEs' questions, for example if they have difficulty in identifying the Member State in charge of the licence (e.g. an SME in Spain is launching from Portugal and has German shareholders); (iii) the Commission would create an online regulatory portal and self-assessment tool to help companies navigate and identify the applicable legal requirements; (iv) the Commission would provide clear compliance checklists to help companies to comply the relevant requirements.

The legislative initiative could also envisage a regime for smaller companies based on proportionality, imposing a lighter set of rules on market operators who face significant difficulties in complying with the requirements. This proportionality regime is described in Section 3.3 of the impact assessment report.

Table 14 gives an overview of the impact on SMEs of the preferred option, including the costs, benefits, proportionality regime and support measures.

Alternative options: the impact assessment considered three other options:

- the development of non-binding measures (co-regulation and space labels) (policy option 1);
- the adoption of an EU binding framework (policy option 2);
- the signature of international bilateral agreements fostering a global approach to space safety, resilience and the environmental impact of space activities (policy option 2++), building on the framework established in option 2+.

The options were discarded on the basis of their cost, efficiency and effectiveness.

Table 14: Impact on SMEs

Costs	Benefits	Proportionality	Offsetting (support measures)
Satellite operator: Manufacturing costs - up to 10% **Launch service provider**: EUR 200 000 All: risk management costs - 10% of the IT budget of a company	**Regulatory simplification:** greater market access (1 product, 27 Member States), faster time to market. **More revenues** by extending the lifespan of satellites (from 5 to 6 years in LEO). **Greater access to funding**: attractiveness of the EU single market for more funding, able to meet the EUR 10 billion equity	**Light regime for**: - Safety measures for satellites in VLEO (below 400 km) - Derogations from some resilience measures for non-critical missions and	Capacity building, Technical assistance. Mentoring and coaching. Access to testing facilities. Exchange of best practices.

EUR 100 000 for licensing requirements per product line EUR 4 000 - 8 000 for implementing the PEFCR	requirement in the next 7 years. **Global competitive advantage**: first-mover advantage and high level of protection means that companies improve their competitive advantage vs non-EU competitors. **Long-term: preservation of the EU space business**, 20% of EUR 700 billion in 2031. **Development of new business segments** (such as active debris removal, OSAM, encryption).	satellites not using propulsion.	Standardisation activities (closely involving SMEs) One-stop-shop approach.

ANNEX 14: COMPETITIVENESS CHECK

The impacts of policy option 2+ on **costs and price competitiveness** lie in the restructuring of the EU space sector as well as increase compliance costs. Indeed, space companies need to adjust their production lines or substitute existing technologies to comply with new legislative requirements. The costs of restructuring a company depends on its market position, size, current practices, and the extent of the changes required. Larger companies have more resources to invest, whereas smaller companies, including SMEs and micro-businesses, face greater challenges in meeting these costs. As a consequence, the restructuring of the EU space sector could potentially lead to job losses in certain areas, especially if companies need to phase out specific technologies or processes that are no longer compliant. On the other hand, the introduction of new technologies and practices also creates job opportunities in areas related to sustainability, security and compliance.

Since the space sector is highly interconnected with telecommunications and research, changes in the space sector have ripple effects in these industries. In the short term, there may be initial costs associated with compliance, such as in the restructuring of the EU space sector, which affect pricing. In the long run, however, the EU space sector is expected to benefit from improved competitiveness due to compliance with higher standards. This could result in a first-mover advantage, as EU companies may be better positioned to compete in a global market with increasing demands for safe, secure and sustainable standards.

The rising costs of compliance (as described in the economic impact section of the impact assessment) would increase the cost of manufacturing by 3 to 10%, leading to an average annual increase of EUR 180 million in the costs for European operators. This increase will be offset by the increased protection of the space assets, allowing for an extended life in orbit, creating an annual economic benefit for European operators estimated at EUR 675 million. Comparing this to the costs described in the previous section leads to a net benefit for European operators of EUR 495 million per year. In addition, it is considered that cyberattacks cost five times more than cyber protection measures, giving an annual benefit of EUR 320 million for European manufacturers of space machinery. These calculations are furthered explained in Section 6.1.7 of the impact assessment report.

It is likely that option 2+ will have an impact on the EU space industry's **capacity to innovate**. As mentioned above, new jobs will be created due to the spillover effect of the new legislation and standards on EU space activities. The proposed option incentivises the development of new technical skills, leading to more research and innovation. Additionally, the creation of an EU toolbox along with non-binding materials and platforms will set guidelines for satellite operators, manufacturers and Member State authorities on how to operate. It will also reward operators who are able to go the extra mile, fostering a favourable environment for innovation, research and development.

Since the objective of the proposed policy is to create a level playing field in the EU, ensuring that EU space operators do not suffer from distortion of competition from operators outside the EU who benefit from less stringent standards, **international competitiveness** will be impacted in different ways. If non-EU competitors face similar or equivalent requirements in their own markets or when providing services within the EU, the impact on EU manufacturers' relative prices and market shares may be limited. In this case, all competitors would be on a level playing field, and the additional compliance costs may be spread across the industry. However, if non-EU space operators do not face comparable regulatory requirements, EU firms could face a competitive disadvantage. This could affect their market share, especially if non-EU competitors can offer similar products or services at lower prices due to less stringent standards on safety, security or sustainability, or because of lower production costs. Continuous dialogue and knowledge sharing between the EU, industry stakeholders and international partners will be crucial to address any challenges and maintain a level playing field.

The measures envisaged as part of the preferred policy option would not put EU industry at a disadvantage compared to its main competitors in the United States. Currently, US space licences (managed by the Federal Communications Commission (FCC) for spacecraft and the Federal Aviation Administration (FAA) for launchers) require technical specifications for space safety that exceed those of EU Member States. Therefore, the harmonisation of binding rules is not expected to hinder the competitiveness of the EU space industry vis-a-vis the US (the biggest space market). In addition, US regulators impose those requirements for satellite operators wanting to enter the US market, creating barriers for European actors wishing to enter the US market. The preferred policy option would allow EU companies to operate on a level playing field with their direct US competitors, especially with the possibility to have mutual recognition between EU and US requirements.

The proposed legislative initiative will not put the European industry at a disadvantage compared to its main competitors in the US, especially since space is a relatively closed market outside of Europe and the US, with the other major competitors (Russia and China) closed to western companies.

Table 15: Comparison of safety and sustainability requirements in selected EU Member States and the US

	BE	**DK**	**FI**	**FR**	**EL**	**NL**	**AT**	**SI**	**Option 2+**	**USA (FCC)**	**USA (FAA)**
Cybersecurity requirements									Yes	Yes	
In-orbit collision avoidance measures	Yes		Yes	Yes			Yes		Yes	Yes	Yes
Must make appropriate		Yes			Yes			Yes	Yes	Yes	Yes

provision for the mitigation of space debris											
Operators must take specific measures for the mitigation of space debris			Yes	Yes			Yes		Yes	Yes	Yes
Limit on orbital lifetime		Yes		Yes			Yes		Yes	Yes (5 years)	Yes (< 5 years)
Requires environmental impact assessment	Yes	Yes	Yes	Yes	Yes				Yes		Yes
General condition that space activities do not						Yes		Yes	Yes		Yes

cause adverse changes to the environment			

Furthermore, since non-EU competitors would be subject to equivalent requirements when providing services within the EU, the impact on EU manufacturers' relative prices and market shares is expected to be limited. This will create a level playing field for space companies and would benefit SMEs and start-ups, since enhanced EU-wide market access and easier cross-border trade would improve their market share. The other major impact of the preferred policy option on the competitiveness of the European space industry will be that the dedicated authorisation process currently implemented per Member State and per individual space mission will be replaced by an authorisation per product line, making it possible to **transform the administrative burden from a recurrent expense to a one-off expense per product line. This will allow the European space industry, and SMEs especially, to reduce their overall costs and increase their competitiveness**.

The harmonisation of licensing requirements across the EU will remove trade barriers between EU Member States. Furthermore, the mutual recognition of licensing requirements between EU Member States and non-EU countries will lower the trade barriers to the export of satellites and services outside the EU, thus also limiting non-tariff trade barriers.

In terms of **SME competitiveness**, a detailed assessment of the impact on SMEs of the preferred option can be found under Annex 13: SME Test.