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CORRIGENDUM :

This document corrects SWD(2021) 365 final

The document SWD(2021)365 final contained incorrect numbering which is now corrected.
The content of the document remains unchanged.

The text should read as follows:

COMMISSION STAFF WORKING DOCUMENT

Analysis of the national long-term renovation strategies

COMMISSION STAFF WORKING DOCUMENT

Analysis of the national long-term renovation strategies

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Executive summary

Buildings are indispensable for reaching the EU's carbon neutrality, energy efficiency and renewable energy objectives. The building stock is the largest single energy consumer in Europe, accounting for 40% of the EU's energy consumption and 36% of its GHG emissions. To achieve the net 55% emission reduction target by 2030 the EU should reduce buildings' greenhouse gas emissions by 60%, their final energy consumption by 14% and energy consumption for heating and cooling by 18%¹.

In that perspective, the **European Green Deal Communication** underlined that the Commission will rigorously enforce the legislation related to the energy performance of buildings, starting with an assessment of Member States' national long-term renovation strategies². The **Renovation Wave Communication** confirmed the key importance of strict implementation of the Energy Performance of Buildings Directive (EPBD)³ and of **national long-term renovation strategies** as a key planning tool for selecting projects to be funded as a priority.

The present staff working document analyses the long-term renovation strategies submitted by 1st October 2021⁴. It feeds into the implementation of the Renovation Wave strategy; the process of the national resilience and recovery plans, where the "Renovate" component plays a major role and supports the revision of the Energy Performance of Buildings Directive.

Long-term renovation strategies: state of play

Under Article 2a of the EPBD, Member States had to notify the Commission their national strategies by 10 March 2020. Due to the Covid-19 situation, most Member States could not respect this deadline. As of 1st October 2021, 26 Member States had submitted their long-term renovation strategies.

The EPBD precisely defines the content and structure of the long-term renovation strategies that Member States should submit to the Commission, in its Article 2a.

In general, in most long-term renovation strategies submitted by Member States, there is broad support and concrete policy measures for easier access to financing, technical

¹ Compared to 2015 levels, see *SWD (2020) 176 final*. Buildings are responsible for greenhouse gas emissions before, during and after their operational lifetime. The 2050 vision for a decarbonised building stock should progressively take into account the whole life-cycle emissions of the buildings, not only in new construction but also in renovations.

² COM (2019) 640 final: The European Green Deal.

³ 2010/31/EU. For more information, see: https://ec.europa.eu/energy/topics/energy-efficiency/energy-efficient-buildings/energy-performance-buildings-directive_en

⁴ With a view to share best practices among Member States and inspire those that had not yet submitted their strategy, the Commission developed a first Staff Working Document (SWD) analysing the national LTRS submitted by 15 November 2020, namely for 13 Member States (SWD(2021) 69 final). The present Staff Working Document complement and deepen this preliminary analysis, taking into account the 26 LTRS submitted by 1st October 2021, while keeping the same structure.

support, promotion of advisory tools such as one-stop-shops, tackling energy poverty and better information⁵.

However, the long-term renovation strategies submitted vary in terms of:

1. the completeness of the elements required by the EPBD. The level of detail provided varies from one long-term renovation strategy to another. Complementary to this staff working document, JRC will publish an in-depth compliance report.⁶
2. the ambition level of renovation targets and goals in terms of objectives and budget allocation. In particular:
 - Member States have committed to different types of indicative milestones for 2030, 2040 and 2050.
 - Most strategies provide a comprehensive set of different policy measures for regulatory requirements, fiscal and economic incentives and information campaigns.
 - In most cases, measures are matched with budgetary resources but a comprehensive budget allocation is not always clearly displayed. Investments needs are estimated in many strategies but this is not always directly linked to budget allocation (at least until 2030).
 - Most renovation measures have a high ambition energy saving target (medium or nearly zero-energy building level) but the renovation rates vary.
 - Safety issues related to fire and seismic activities is becoming more systematic in the submitted strategies, with almost half of the Member States trying to combine energy renovations with measures that can increase fire and seismic safety.
 - Most strategies provide detailed information for the building stock especially for the residential sector, including additional data for the energy consumption per energy use and fuel type, energy performance based on Energy Performance Certificates (EPCs), construction period, type of ownership, etc.
 - Energy poverty is also addressed in almost all strategies with specific measures targeting vulnerable consumers and worst-performing buildings.
 - Wider benefits are presented in most of the strategies, with some estimations for CO₂ emissions, creation of new jobs or GDP growth, but precise details are lacking in most cases for benefits and co-benefits (e.g. health and well-being, in particular air quality or protection of harmful substances such as radon and asbestos, social innovation or social inclusion).

⁵ See notably: yearly mapping EU R&I for and with Cities : <https://op.europa.eu/en/publication-detail/-/publication/1a11dc10-edba-11eb-a71c-01aa75ed71a1/language-en/format-PDF#:~:text=EU%20research%20%26%20innovation%20for%20and%20with%20cities,accelerate%20their%20transition%20towards%20sustainability%20and%20climate%20neutrality>

⁶ Similar reports, based on an established methodology have been published by the JRC for the previous long-term renovation strategies submitted by Member States in 2014 and 2017
See 'Assessment of second long-term renovation strategies under the Energy Efficiency Directive' (2019) <https://op.europa.eu/en/publication-detail/-/publication/e04473ed-2daf-11e9-8d04-01aa75ed71a1/language-en/format-PDF/source-86607487>.

However, one of the main conclusions of this analysis is that the **data provided by Member States for the different categories requested by Article 2a of the EPBD, vary in nature and make it difficult to precisely compare the effect of the different national measures and assess their cumulative and quantitative impact**. In particular, not all long-term renovation strategies are providing GHG reduction data, which makes it difficult to assess the ambition of the strategies in terms of climate neutrality, mitigation and adaptation **at EU level**.

Structure of the document, good practices and country fiches

The present staff working document contains: (i) a general part that provides an overall assessment of the long-term renovation strategies (including a summary table with the main numeric pledges available, the investments needs and the corresponding budget allocation for each Member State), (ii) a second part that lists existing and planned measures proposed by Member States and highlights good practices and (iii) a third part with an analysis of each Member State's long-term renovation strategy based on a standardised template.

The rich collection of good practices extracted from the long-term renovation strategies have been grouped following the main categories of action proposed in the Renovation Wave Communication. It is impossible to summarise all of them but the following examples from each EU Member State covered by this staff working document, give an impression of the wealth of initiatives included in the following sections of the document:

Strengthening information (including science-based knowledge and solutions), legal certainty and incentives for public and private owners and tenants to undertake renovations

- The **French** strategy includes a gradual set of measures, starting with a ban on rent increase in the case of poorly performing buildings ('passoire énergétique') as from 2021, a ban on renting these as from 2023 and an obligation to renovate all worst performing buildings as from 2028. Moreover, from 1 January 2022, EPCs and tenancy agreements will have to include information on the actual primary and final energy consumption of dwellings and an estimate of the theoretical amount of energy expenditure. These requirements are accompanied by financing schemes (MaPrimeRenov and SARE programme), diagnosis for households with low-income owners in particular, and support for overall renovations.
- The **Dutch** 'Energiesprong' project is generating mass deep renovations with standardised modules in order to achieve major cost and time savings. This initiative is planned to be rolled out in other EU countries too, thanks to a three-year EU Horizon 2020 grant. Moreover, the 'renovation accelerator' supports companies by bringing together part of the demand and providing multiannual predictability to the market, by pooling the demand from housing companies for heat pumps and insulation products. This promotes innovation, increases quality, reduces costs and thus lowers prices, by matching supply and demand.
- In **Latvia**, since 2010 the Law on Management of Residential Houses foresees that every residential building shall have a paper or electronic file including all the building information (e.g. technical documentation, energy passport, audit findings etc.).

Ensuring adequate and well-targeted funding

- **Germany** has adopted key tax support for energy renovation measures in owner-occupied homes, to complement existing support schemes. The tax incentive can be used as an alternative to the existing loan and grant schemes in the buildings' sector. Support will be given for individual measures in owner-occupied houses that are also considered eligible under the existing building support programmes, but may also be provided for comprehensive remediation, if necessary on a step-by-step basis, through several individual measures. It will be provided through a deduction from tax liability spread over 3 years.
- In **Belgium**, in the **Flemish Region**, since October 2017, a premium is available for project leaders who renovate collectively a number of dwellings (at least 10) in order to make them energy efficient and support the citizen in achieving energy saving investments. In the **Walloon region**, new owners who, within 5 years, renovate an apartment which had a low label, to label C or higher, can rely on an interest-free loan as of 2021.
- In **Italy**, the Ecobonus and 110% Superbonus is a tax deduction system intended to cover 110% of the costs of energy efficiency and structural seismic improvements of Italian properties. The "superbonus" can be traded by entitled property owners by selling it to third parties, or setting it against their own suppliers' invoices. It can be combined with works for structural seismic improvements.
- In **Bulgaria**, the development of a National Decarbonisation Fund is proposed to be the main financing scheme in the implementation of the Bulgarian LTRS. The Decarbonisation Fund will operate at a national level and will consist of three sub-funds: (i) for public sector, (ii) for commercial corporation and (iii) for residential buildings. The financial resources will come from European funds, national co-financing, revenues from energy efficiency obligation schemes, green bonds and other debt instruments, international financial institutions, private capitals and others.
- In **Cyprus**, the 'save & upgrade' programme finances renovations in homes and buildings owned or operated by SMEs. A larger subsidy is awarded to buildings that are being refurbished into nearly zero-energy buildings. Moreover, new buildings and buildings to be renovated are allowed to increase the building ratio by 5% if they are energy class A and if at least 25% of their total energy needs are covered by renewable sources.
- In **Finland**, projects realised by energy service companies (ESCOs)⁷ are promoted with an ESCO subsidy. The ESCO subsidy can be granted to any company or corporation for an investment in regular or new technology implemented in building renovations. A higher investment subsidy (25% of investment value) is provided for municipalities that implement energy efficiency measures if the project considered is an ESCO service.

Scaling up technical assistance to bring it closer to regional and local actors

- **Spain** has a wide network of local and regional one-stop shops that provide the public with various services (including financial and technical advice), as well as a number of campaigns to raise the public's awareness on energy-efficient behaviour and opportunities, and provide information on available financial support.
- **Slovakia** developed the Regional Sustainable Energy Centres to support the planning and implementation capacity of municipalities for sustainable energy development in

⁷ For more information on energy service companies, see section 2.7.2

districts/strategic planning regions, in accordance with the proposal for a Vision and Strategy for Development of Slovakia until 2030.

- **Portugal** is simplifying and dematerializing the licensing processes and harmonizing the documents related to the building process, through the reduction of bureaucracy and context costs associated with licensing.

Creating green jobs, upskilling workers, training practitioners and attracting new talent and skills

- In **Czechia**, the EFEKT programme contributes to the system of education that supports the construction sector. It covers the organisation of courses and seminars and other training and information actions, such as those that upgrade the qualifications of energy specialists and those that support the professional activity of installing renewable energy installations, as well as the communication of legislative changes in the field of energy management and energy efficiency.
- **Malta** developed the Skills Building initiative in the construction sector: by 2025, the government will develop a scheme to train and certify professionals and tradesmen of various levels, so that they obtain a mandatory skill card, which they would need to present to work in the respective sectors. Certification will be extended to installers of several technologies and a life-long-learning approach will be adopted through regular training sessions addressed to skill cardholders.

Smart buildings and integration of renewable energy

- In **Ireland**, the Irish Energy Authority hosts a comprehensive database of EPCs, including an interactive map, and providing aggregated data, supporting local policymaking and strategies to alleviate energy poverty or invest in infrastructure.
- In **Sweden**, the ‘smart built environment’ is part of a joint initiative on strategic innovation programmes aiming to create the right conditions for international competitiveness and sustainable solutions to global societal challenges. Sweden also developed a strategic innovation agenda for smart and sustainable cities, ‘viable cities’, which is the biggest project in research and innovation on smart and sustainable cities ever implemented in Sweden.
- **Estonia** is developing simplified digital tools for building where owners notably of single dwellings can input existing building parameters (wall type, window type, heating system, ventilation system) and choose different energy efficiency improvement options (insulation thickness of the exterior wall and roof, new windows with three glass packages, change of heating system, installation of ventilation system, installation of solar panels).
- **Hungary** continued the smart cost-sharing programme for district heating housing launched in September 2019. The use and uptake of smart cost-sharing to enable continuous monitoring of energy consumption is an effective tool to strengthen the awareness of users.

Making the construction ecosystem fit to deliver sustainable renovation, maximising reuse and recycling and circularity

- In **Belgium**, in the **Brussels Capital** region, a study will be launched to define a strategy for reusing building materials. Furthermore, Brussels Environment will develop a methodology to compare the environmental costs of a demolition/reconstruction operation and a renovation. The strategy agreed will be turned into a regulatory obligation. The Brussels authorities also plan to draft and implement a regulation, which will require selective dismantling (via environmental permits), organised in such a way that the reusable elements will be effectively dismantled and recovered for introduction into a re-use chain.

Tackling energy poverty and worst performing buildings

- **Croatia** considers the establishment of a specific fund where costs are reimbursed to energy-poor or at-risk-of-energy-poor households. Additional investments will be needed as approximately 50% of the buildings will also need seismic retrofit.
- In **Lithuania** in 2013, municipalities were asked to identify worst performing buildings and these buildings were prioritised in the programme (which started in 2005) for the renovation (modernisation) of multi-apartment buildings. The Programme will continue and nearly 500 multi-apartment buildings will be renovated each year, with energy savings of 100 GWh. After renovation, the building should qualify for class C and 40% savings should be achieved in the building's energy consumption.
- In **Slovenia**, the ZERO500 programme aims at alleviating growing energy poverty through investments in energy efficiency measures (replacement of facades, windows, roof insulation, installation of ventilation and others). The programme will include 500 low-income households in single-dwelling buildings or apartments in double-dwelling buildings, which will receive 100% of the grants to finance investments.

Public buildings, in particular schools and hospitals, as well as buildings of historic/cultural value and social infrastructure

- In **Greece**, public authorities' building leases or acquisitions require at least a 'C' Energy Performance Certificate class. The obligation should be applied to all existing lease contracts by 2020 and is expected to affect approximately 60% of the public sector's building stock (20 000 buildings).
- **Romania** plans to develop a project pipeline to ensure the refurbishment of public buildings by at least 26 % by 2030, 52% by 2040 and 100 % by 2050. This should include: (i) technical and procedural support (ii) increased support for schools and other public buildings (iii) the aggregation of public building renovations into large procurement packages and (iv) the development of standard tender documentation with performance indicators and specific requirements. Romania is planning to allocate a budget of EUR 300 million from public/EU funds for central government buildings and of EUR 1.3 billion (of which ~ EUR 700 million from the public budget/EU funds and ~ EUR 600 million from the private sector) for municipal public buildings.

Phasing out inefficient technologies and fossil fuels in heating and cooling

- **Austria** developed an 'exit from the oil and remediation cheque for private individuals in 2019 in order to further facilitate the transition to climate-friendly heating systems and support the replacement of heating systems, irrespective of any simultaneous building renovation. It could be combined with additional support for a thermal renovation measure and renewable solutions.
- **Denmark** developed an oil boiler scrapping programme providing aid on the condition that the home owner will have a heat pump on subscription. Denmark also set up a 'heat pump on subscription' programme, where selected companies install, own and operate a heat pump for a building owner. The building owner typically only pays a connecting contribution, a continuous subscription and the cost of heat used.
- In **Luxemburg**, the taxation on heating oil will increase gradually, taking into account the CO2 minimum price described above. The aim is to encourage the shift towards renewable and more climate-friendly heating. To make this measure socially acceptable, an attractive support programme for oil heating exchange will be introduced.

More information is available in the present staff-working document, either in the following thematic sections or in the country specific fiches.

Introduction

The **European Green Deal** aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy, with no net emissions of greenhouse gases in 2050 and to decouple economic growth from resource use. In addition, in its Climate Target Plan 2030⁸, the Commission has proposed to cut net greenhouse gas emissions (GHG) in the EU by at least 55% by 2030 compared to 1990.

Buildings are indispensable for reaching the EU's carbon neutrality, energy efficiency and renewable energy objectives. The building stock is the largest single energy consumer in Europe, accounting for 40% of the EU's energy consumption and 36% of its GHG emissions. To achieve the net 55% emission reduction target by 2030 the EU should reduce buildings' greenhouse gas emissions by 60%, their final energy consumption by 14% and energy consumption for heating and cooling by 18%⁹.

For 75% of the EU's existing building stock, energy performance is poor and the buildings were constructed before current energy requirements were in place. It is estimated that about 85-95% of today's buildings will be in use by 2050. Today, only 11% of the EU's existing building stock undergoes some level of renovation each year, and a focus on reducing energy consumption, modernising technical building systems and installing renewables is lacking in most cases. However, very rarely, renovation works address buildings' energy performance. The weighted annual energy renovation rate is low at some 1%¹⁰. At this pace, cutting carbon emissions from buildings to net-zero would require centuries.

This is why the Commission adopted in October 2020 the 'Renovation Wave for Europe' initiative with the objective **to at least double the annual energy renovation rate of residential and non-residential buildings by 2030¹¹ and to foster deep energy renovations.**

According to the impact assessment for the Climate Target Plan 2030, the residential sector would have to undergo the highest reduction in energy demand in heating and cooling,

⁸ Stepping up Europe's 2030 climate ambition, COM (2 020) 562 final.

⁹ Compared to 2015 levels, see *SWD (2020) 176 final*. Buildings are responsible for greenhouse gas emissions before, during and after their operational lifetime. The 2050 vision for a decarbonised building stock should progressively take into account the whole life-cycle emissions of the buildings, not only in new construction but also in renovations.

¹⁰ Annual energy savings achieved from all renovations (light, medium and deep) compared to the energy consumption of the total building stock. See the 'Comprehensive study of building energy renovation activities and the uptake of nearly zero-energy buildings in the EU (2019)': https://ec.europa.eu/energy/studies/comprehensive-study-building-energy-renovation-activities-and-uptake-nearly-zero-energy_en?redir=1

¹¹ A recent JRC study investigating 20 case study cities around Europe, showed that increasing the building renovation rate to at least 2% may achieve reductions in energy consumptions for heating and cooling between 15 and 23% by 2030, See the 'Innovative seismic and energy retrofitting of the existing building stock (iRESIST+), EUR 30583 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-29687-4, doi:10.2760/768985, JRC 123638': <https://op.europa.eu/en/publication-detail/-/publication/719acded-be94-11eb-a925-01aa75ed71a1/language-en>

ranging between -19% to -23%, compared to 2015. The annual rate of replacement of heating equipment would have to reach around 4% in both the residential and services sector. During the same time period, the share of renewables and waste heat would have to increase to 38-42% to reach the objective.

The Communication on the Renovation Wave¹² stressed that the COVID-19 crisis has brought EU buildings into a sharper focus, going beyond carbon neutrality, energy efficiency and renewable energy objectives. It underlines that as Europe seeks to overcome the COVID-19 crisis, renovation offers a unique opportunity to rethink, redesign and modernise our buildings according to circularity principles and to integrate renewables into their technical heating, cooling and electrical systems to make them fit for a greener and digital society, better prepare them for future climate impacts and sustain the economic recovery¹³.

Furthermore, the strategy is set to contribute to Europe's just transition as it enables the retrofitting of residential buildings, with a clear focus on social and affordable housing, and addresses the urgency of tackling energy poverty and worst performing buildings.

Buildings are also a major source of other air pollution, with 50% of primary fine particulate matter emissions related to heating. The Communication highlighted the importance to ensure high air quality, good water management, disaster prevention and protection against climate-related hazards, removal of and protection against harmful substances such as asbestos and radon, fire and seismic safety. The Communication also highlighted the opportunity when renovating for energy efficiency to ensure accessibility of persons with disabilities and older persons. Paying specific attention to the most vulnerable segments of the population is a priority also as a reaction to the COVID-19 crisis, to foster a stable recovery and resilience¹⁴.

Investing in buildings can inject a much-needed stimulus in the construction ecosystem and the broader economy. Renovation works: (i) are labour-intensive, (ii) create jobs and make investments often rooted in local supply chains, and (iii) generate demand for highly energy-efficient and renewable equipment and professional works and services, which improves the long-term market and quality value of properties. This can be very valuable for a sector where more than 90% of operators are SMEs, hard hit by the economic impact of the COVID-19 crisis. Construction activity fell by 15.7% in 2020 compared with 2019, and energy efficiency investment dropped by 12%. Demand for renewable equipment, technology installation work and professional support services was 30-40% lower in year-on-year comparison¹⁵.

In addition to macroeconomic impacts on GDP and employment, building renovations bring other wider benefits, both at societal and individual/micro level such as health, productivity,

¹² COM(2020) 662 final

¹³ <https://publications.jrc.ec.europa.eu/repository/handle/JRC122143>

¹⁴ https://www.energypoverty.eu/sites/default/files/downloads/observatory-documents/20-06/epov_third_report_final_v2_compressed.pdf

¹⁵ For example, heat pump marketing fell by 40% according to EHPA (European Heat Pump Association).

innovation, energy security, and inclusiveness which are mutually reinforcing in a virtuous process¹⁶.

The Recovery and Resilience Facility, which the European Council agreed to endow **with EUR 672.5 billion**, at least 37% of which is targeted to climate-related expenditure, supports renovation investment and energy efficiency related reforms across Member States. In the Annual Sustainable Growth Strategy for 2021, the Commission proposed the **European Flagships ‘Renovate’ and ‘Power Up’** to support a coordinated intervention by all Member States, based on projects included in their national Recovery and Resilience Plans¹⁷.

To sustain the implementation of these flagship initiatives, the Commission has complemented its guidance¹⁸ to Member States on the preparation of recovery and resiliency plans¹⁹ with tailor-made guidance to each Member State, in the context of the individual assessments of national energy and climate plans and long-term renovation strategies. The Commission also **produced an example of component** called ‘Renovation wave aimed at enhancing energy and resource efficiency’ to give Member States practical guidance on how to prepare reforms and investment projects for renovation under the Recovery and Resilience Facility²⁰.

Moreover, the Commission has developed a flagship technical support project on the Renovation Wave, targeted at Member States wishing to design and implement reforms in support of building renovation. It enables Member States to create the conditions for significantly increasing annual building renovation rates in a cost-effective and socially fair way and to achieve the full potential of the national long-term renovation strategies as key planning tools. The flagship, launched within the scope of the 2022 call of the Technical Support Instrument, focuses on: (i) renovation along thematic areas of the Renovation Wave, including energy poverty alleviation, public buildings and the wider renovation ecosystem; (ii) the implementation of planning tools especially long term renovation strategies and recovery plans; and (iii) the implementation of cohesion policy funding for building renovation.

As of October 2021, 22 Member States have already submitted their **recovery and resilience plans**, and the Commission has been very active in discussing the draft plans with them to make sure that the 'renovate' component is correctly addressed and that it corresponds to the submitted national long-term renovation strategies. The Commission has paid special attention to ensure that information provided in the national long-term renovation strategies, the national energy and climate plans (NECPs²¹) and the plans are consistent, complement each other so that national policies achieve a decarbonised building stock.

¹⁶https://publications.jrc.ec.europa.eu/repository/bitstream/JRC120683/untapping_multiple_benefits_-_hidden_values_in_environmental_and_building_policies.pdf

¹⁷ Support from other EU programmes such as InvestEU, the Connecting Europe Facility, LIFE and Horizon Europe as well as national funds can also be combined with the Recovery and Resilience Facility.

¹⁸ SWD(2020) 205 PART 2/2 and SWD(2021) 12 final

¹⁹ COM(2020) 575 final Annual Sustainable Growth Strategy 2021

²⁰ https://ec.europa.eu/info/sites/info/files/component_renovation.pdf

²¹ https://publications.jrc.ec.europa.eu/repository/bitstream/JRC122862/jrc122862_national_energy_and_climate_plans_under_the_eu_energy_union_governance_final.pdf

The analysis of the 22 RRFs adopted by the Commission by 5 October 2021²² shows that the Member States in question are planning to go beyond the requirement to dedicate at least 37% of their RRF allocation to the climate transition, with a combined **climate-related investment so far** of around **EUR 177 billion**²³, representing around 40% out of a total of EUR 445 billion of RRF funds allocated to these Member States.

43% of this amount is allocated to investments and reforms in energy efficiency and clean energy (Figure 1)²⁴. Nearly all Member States are using the RRF funds for investments in building renovation and clean transport, and many are using it to invest in renewable energy. In this context, Member States have significantly built on the ‘flagship initiatives’ put forward by the Commission²⁵ in relation to the green transition, in particular the ‘Power up’, ‘Renovate’ and ‘Recharge and refuel’ flagship initiatives. More specifically, green investments and reforms supporting the green transition, and counting towards the 37% climate mainstreaming target in the 22 plans assessed to date are allocated as follows:

- 43% (i.e. EUR 76 billion) of the amount allocated to green investments have been allocated to clean energy and building renovation measures. Out of this:
 - 28% have been allocated to building renovation and other energy efficiency measures (EUR 50 billion), with a focus on public infrastructure (EUR 14.3 billion) and private/residential buildings (EUR 26.5 billion), including some social housing projects, thus representing a good way to support energy efficiency and energy poverty, with positive impact on emissions reduction;
 - 15% to clean energy (with a total of EUR 26 billion). This last category includes investments in the production of renewable energy amounting to around EUR 18 billion. Investments dedicated to energy networks and infrastructure amount to EUR 8.3 billion; and
- 35% have been allocated to clean transport (around EUR 62 billion) with significant support given to railway transport, in particular in Eastern Europe.

The RRFs will contribute to scaling up investments in renewable and low-carbon hydrogen by approximately EUR 9.3 billion based on the 22 plans adopted to date.

²² AT, BE, CY, CZ, DE, DK, EE, EL, ES, FI, FR, HR, IE, IT, LT, LU, LV, MT, PT, RO, SI, SK.

²³ The expenditures reported for the RRF are estimates processed by the Commission based on the information on climate tracking published as part of the Commission’s analyses of the recovery and resilience plans. The data reported cover the 22 national recovery and resilience plans assessed and approved by the Commission by 5 October 2021 and the amount will evolve as more plans are assessed. See: https://ec.europa.eu/info/business-economy-euro/recovery-coronavirus/recovery-and-resilience-facility/recovery-and-resilience-plans-assessments_en.

²⁴ Energy efficiency measures cover energy efficiency projects in SMEs or large enterprises, energy renovations in private buildings and public infrastructure and construction of buildings. Clean energy measures cover production of renewables, energy networks and infrastructure as well as hydrogen related investments.

²⁵ Annual Sustainable Growth Strategy 2021, COM(2020) 575 final, 17 September 2020, section IV.

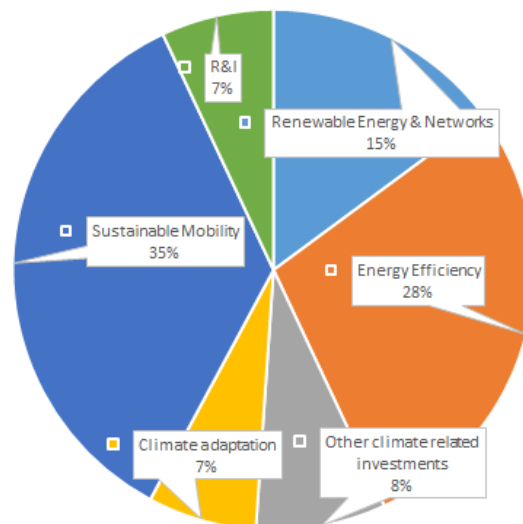


Figure 1: Distribution of climate-related investments in MS' RRP. Source: Own preliminary assessment of 22 RRP adopted by the Commission (by 5 October)

The 2021-27 EU budget will in turn provide significant support to implement the EU Green Deal and the energy transition, including building renovation, across the Union. In particular, the European Regional Development Fund (ERDF) and the Cohesion Fund will allocate at least 30% and 37% respectively of the available funding for the achievement of the Union's climate objectives. This will especially help Member States, regions and local authorities to boost building renovation.

The **European Green Deal Communication** underlined that the Commission will rigorously enforce the legislation related to the energy performance of buildings, starting with an assessment in 2020 of Member States' national long-term renovation strategies²⁶.

The **Renovation Wave Communication** confirmed the importance of strict implementation of the Energy Performance of Buildings Directive and of national long-term renovation strategies as a key planning tool for selecting priority projects to be funded. The Renovation Wave Communication also underlined that **programming documents** should set out **renovation priorities** drawn from the **national energy and climate plans and long-term renovation strategies**. It invited Member States who had not yet presented their long-term renovation strategies to do so. These strategies are also part of the required enabling conditions to access cohesion policy financing through the 2021-2027 programmes that the Commission is analysing in parallel to the recovery and resilience plans. With a view to share best practices among Member States and inspire those that had not yet submitted their strategy, the Commission developed a first Staff Working Document analysing the national **long-term renovation strategies** submitted by 15 November 2020, namely for 13 Member States²⁷.

²⁶ COM (2019) 640 final: The European Green Deal.

²⁷ (SWD(2021) 69 final)

The Communication also underlined heating and cooling as a specific focus area for building renovation. Moreover, the Renovation Wave Communication stated that the Commission will track renovation progress as part of the European Semester as well as through the monitoring and reporting mechanisms set up under the governance system for the energy union and climate action. It will do so in particular through the Technical Working Group on the implementation of the Governance Regulation, with a particular focus on the implementation of **national energy and climate plans** and **long-term renovation strategies**.

Finally, the Renovation Wave was followed up in 2021 with the New European Bauhaus intended as a driving force for the buildings of the future in an attractive, innovative and human-centred way, based on the core values of sustainability (including circularity), aesthetics and inclusiveness. The September Communication ‘New European Bauhaus: Beautiful, Sustainable, Together’ presents the concept of the New European Bauhaus as developed based on the outcomes of the co-design phase. At the same time, the Communication puts on the table the first elements of a support framework for delivery of the initiative in the subsequent phase. With July’s proposal to revise the Energy Efficiency Directive, the Commission proposes to enhance the exemplary role of the public sector by introducing an annual renovation obligation of 3 % for public buildings.

Furthermore, a legislative proposal revising the Energy Performance of Buildings Directive (EPBD) will be adopted in December 2021. One of the most important elements of this revision will be to reinforce the role of national long-term renovation strategies for implementing the objective of the Directive towards a decarbonised building stock by 2050. Based on the present report, the legislative proposal will notably reinforce the comparability of the data submitted by Member States, by introducing a harmonized template.

The present staff working document analyses the long-term renovation strategies submitted by 1st October 2021 to feed into the implementation of the Renovation Wave strategy and of the recovery and resilience plans²⁸. It complements and deepens the preliminary analysis developed in the Staff Working Document (SWD (2021) 69 final), while keeping the same structure. It contains:

1. a general part that provides an overall assessment of the long-term renovation strategies;
2. a second part that lists existing and planned measures proposed by Member States and highlights best practices;
3. a third part with an analysis of each Member State's long-term renovation strategy based on a standardised template.

²⁸ With a view to share best practices among Member States and inspire those that had not yet submitted their strategy, the Commission developed a first Staff Working Document (SWD) analysing the national LTRS submitted by 15 November 2020, namely for 13 Member States (SWD(2021) 69 final).

1 Overall assessment of the long-term renovation strategies

1.1 Submission of Member States' long-term renovation strategies

Under Article 2a of the Energy Performance of Buildings Directive (EPBD), Member States had to notify the Commission of their national long-term renovation strategies by 10 March 2020.

Due to the Covid-19 situation, most Member States could not respect this deadline. As of 1st October 2021, 26 Member States had submitted their long-term renovation strategies.

1.2 Overall assessment of Member States' long-term renovation strategies

The Energy Performance of Buildings Directive precisely defines the content and structure of the long-term renovation strategies that Member States should submit to the Commission, in its Article 2a. To support Member States in the preparation of their strategies, in 2019 the Commission adopted a Recommendation on building renovation, with guidance on the requirements set out in Article 2a²⁹.

In general, there is broad support for easier access to financing, technical support, promotion of advisory tools such as one-stop-shops, tackling energy poverty and better information.

However, the long-term renovation strategies submitted vary in terms of:

1. the completeness of the elements required by the Energy Performance of Buildings Directive,
2. the ambition level of renovation targets and goals in terms of objectives and budget allocation.

As regards the completeness aspect, and from a formal point of view, the submitted long-term renovation strategies have in general respected the requirements of the Energy Performance of Buildings Directive, providing information in the different categories requested by Article 2a. However, the level of detail provided varies from one long-term renovation strategy to another. Complementary to this staff working document JRC will publish an in-depth compliance report. Similar reports, based on an established methodology have been published for the previous long-term renovation strategies submitted by Member States in 2014 and 2017³⁰.

²⁹ The Commission issued the Recommendation on building renovation (EU) 2019/786 on 8 May 2019.

³⁰ See 'Assessment of second long-term renovation strategies under the Energy Efficiency Directive' (2019) <https://op.europa.eu/en/publication-detail/-/publication/e04473ed-2daf-11e9-8d04-01aa75ed71a1/language-en/format-PDF/source-86607487>.

As regards the strategies' **ambition level**:

- Member States have committed to different types of indicative milestones for 2030, 2040 and 2050.
- Most strategies provide a comprehensive set of different policy measures for regulatory requirements, fiscal and economic incentives and information campaigns.
- In most cases measures are matched with budgetary resources but a comprehensive budget allocation is not always clearly displayed. Investments needs are estimated in many strategies but this is not always directly linked to budget allocation (at least until 2030).
- Most renovation measures have a high ambition target (medium or NZEB level) but the renovation rates vary.
- Safety issues related to fire and seismic activities is becoming more systematic in the submitted strategies, with almost half of the Member States trying to combine energy renovations with measures that can increase fire and seismic safety³¹.
- Most strategies provide detailed information for the building stock especially for the residential sector, including additional data for the energy consumption per energy use and fuel type, energy performance based on Energy Performance Certificates, construction period, type of ownership, etc.
- Energy poverty is also addressed in almost all strategies with specific measures targeting vulnerable consumers and worst-performing buildings.

However, one of the main conclusions of this analysis is that the data provided by Member States for the different categories requested by article 2a of the EPBD, vary in nature and make it difficult to precisely compare the effect of the different national measures. In particular, not all long-term renovation strategies are providing GHG reduction data, which makes it difficult to assess the ambition of the strategies in terms of climate mitigation, adaptation and neutrality.

Wider benefits are presented in most of the strategies, with some estimations for CO2 emissions, creation of new jobs or GDP growth but precise details are lacking in most cases for benefits and co-benefits (e.g. health and well-being, in particular air quality or protection of harmful substances such as radon and asbestos, social innovation or social inclusion). Other elements, such as the distributional impacts of renovation strategies on income and purchasing power could also be provided.

To assess each strategy, the Commission services, together with the JRC, has put together the following table with the main numeric pledges available, the investments needs and the

³¹ The Pilot Project 'Integrated techniques for the seismic and energy retrofit of buildings' will provide evidence and guidelines for the integrated renovation of existing buildings for energy efficiency and seismic strengthening, based on the analysis of the current state of the building stock in Europe, scenarios for intervention, technologies for renovation and assessment methodologies. <https://buildings-renovation-makerspace.jrc.ec.europa.eu>

corresponding budget allocation described in the strategies submitted by Member States. This table also includes information from the national energy and climate plans, where appropriate.

Country	Milestones and numeric pledges for renovations towards a decarbonised buildings stock by 2050	Investments needs	Potential areas of further improvement
Austria	• 80% decarbonisation of the building stock by 2050. • Renovation rate (across all building types) to be increased to 3% from current 1.5% p.a. (for the 2020-2050 period).	• In order to maintain the current level of renovation, approximately EUR 5.3 billion is needed per year • If the renovation rate increases to 3%, more than EUR 10 billion is needed by 2050.	• A clearer overview of the measures and budget at regional or federal level could further increase clarity on the strategy and the existing measures. • Wider benefits of building renovation could be analysed in more detail.
Belgium – Brussels	• 100% public buildings energy neutral by 2040 • Renovation rate: more than 2% (for 2020-2050) • Renovation of building stock: 80% residential (2020-2050) • Energy savings by 2050: Residential sector: 53% reduction. 100 kWh/m².y primary energy consumption. Tertiary sector: energy neutral for heating, domestic hot water, cooling and lighting	• Tens of billions of euro will be needed to achieve a stock of sustainable buildings.	• Wider benefits of building renovation could be analysed in more detail, including cost-benefits analysis in terms of jobs, energy cost savings, health and emission reductions
Belgium - Flanders	• Decarbonisation: 74% (Residential), 100% (Non-residential) by 2050. • 70% reduction in energy use (Residential) and 33% reduction in energy use (Non-residential) by 2050. • All buildings (old and new) to have energy performance class A by 2050 (75% energy performance improvement).	• By 2050: EUR 207 billion investment need estimate (modelling).	• Could clarify which of the 3 options has been chosen as the renovation strategy roadmap.
Belgium – Wallonia	• 100% decarbonisation by 2050 • GHG emissions are expected to drop by 51-56% by 2030 for residential buildings, and by 52-62 % for non-residential buildings • By 2050 70.3% reduction in average energy consumption (tertiary and residential). Residential buildings: consumption of less or equal 85 KWh/m² (A label), 41% reduction in primary energy consumption. Tertiary buildings: zero energy/energy neutral building stock (heating, warm water, cooling, lighting).	• By 2030: incentives amount to around EUR50 million a year. • By 2050: EUR 5 billion per year (2020-2050).	• A better overview of the budgetary resources should be provided and the link to the respective measures

Bulgaria	- Decarbonisation: by 2030 1.3 mill tonnes CO₂ emissions saved (period 2021-2030); by 2040: 2.9 mill tonnes CO₂ emissions saved (2031-2040; by 2050: 3.2 mill tonnes CO₂ emissions saved (2041-2050) - Building stock renovation: by 2030 +8% renovated area in 10y (22203509 m²); by 2040 +18% renovated area in 10y (49570668 m²) 26% cumulative; by 2050 +20% renovated area in 10y (55823015 m²) 46% of the total floor area of the existing building stock. - Energy savings: By 2030 2917 GWh 6.9% energy savings; by 2040 6502 GWh energy savings; by 2050: 7329 GWh energy savings.	- By 2030: EUR 2.3 billion investment needs (2021-2030) estimated - By 2040 EUR 5.3 billion (2011-2040) - By 2050 EUR 5.96 billion (2041-2050)	- Could provide more information on the existing building stock: existing number of NZEB, few EPC details; the current renovation rate. - Increase the ambition level for the renovation by 2050. - Increase citizens' awareness on the benefits of energy efficiency. - Promote innovative technologies and materials available on the market.
Croatia	- Renovation rate: 3% by 2030, 3.5% by 2040, 4% by 2050. - Renovation of building stock: 25% by 2030, 60% by 2040, 100% by 2050.	- By 2030: Total investment amount spent (2014-2016): EUR 234 million (HRK 1.8 billion); [49% of which co-financed by the Environmental Protection and Energy Efficiency Fund] - By 2050: EUR 31.6 billion (2020-2050) investment needs (estimate), for the comprehensive renovation of the building stock (HRK 243.23 billion).	Building Renovation Passport could be considered.
Cyprus	Around 33 000 residential buildings and 10 000 non-residential buildings are expected to be renovated by 2030.	- EUR 70 million is needed from the structural funds by until 2027 - A study has identified investment needs of EUR 800 million for the 2020-2030 period	- A more detailed plan for decarbonisation by 2050 in view of increasing the renovation rate. - Wider benefits of building renovation could be analysed in more detail.
Czechia	- Final energy consumption in 2050: 289 PJ. - Renovation rate for: single-family houses: 1.4%, multi-apartment buildings: 0.79% public and commercial buildings: 2% - Decarbonisation: About 40% GHG reduction by 2050. - By 2050: 23.5% reduction in energy use	CZK 325 billion is needed by 2050.	- More detail on the implementation of financial instruments could be helpful. - Trigger points could be more precisely identified. - Wider benefits of building renovation could be analysed in more detail.
Denmark	- Reduction of heating needs by 35% by 2050. - A 100% fossil-free energy supply by 2050. - Energy consumption of existing building stock reduced by 50%.	- Investment needs are estimated at DKK 40.6-76.2 billion until 2050 (=EUR 5.3-9.9 billion) - Saving an additional 1.4 TWh requires almost	Indicative milestones for the efficiency of the building stock should be specified for 2030, 2040

		double the investment (DKK 76.2 billion vs 40.6 DKK) or 0.28 DKK/kWh vs 0.43 DKK/kWh saved	and 2050. • Wider benefits of building renovation could be analysed in more detail.
Estonia	• The target is to renovate 22% of the total building stock by 2030, 64% of the total building stock by 2040 and the entire existing building stock (built prior to 2000) cost-effectively into nearly zero-energy buildings by 2050. • A total of 141 000 existing buildings representing 54 million m² are waiting to be renovated in the next 30 years. • 90% decarbonisation by 2050. • Energy savings: 60% reduction in energy use by 2050.	• The full renovation of all buildings will cost around EUR 22 billion • The annual renovation financing needs are expected to increase almost fivefold: from the current cost of under EUR 200 million up to EUR 900 million	• A more precise overview of the funding allocated to specific measures could further increase clarity on existing and envisaged measures. • Wider benefits of building renovation could be analysed in more detail.
Finland	• The goal is for all buildings (residential and non-residential) to have an energy class of C or above by 2050. • Removing all vacant buildings from the building stock (by 2050, only 70% of the Finnish building stock will remain). • CO₂ emissions reduced by 90% by 2050.	• Implementing the strategy will cost EUR 24 billion over the course of 30 years, or EUR 800 million per year	• The investment needs could be further detailed. • Wider benefits of building renovation could be analysed in more detail.
France	• Carbon neutrality by 2050 for the residential sector. • From 1 January 2023, dwellings whose final energy consumption will exceed a certain threshold may no longer be rented out. • From 1 January 2028, all dwellings with excessive energy consumption will have to be renovated. • 49% decrease in building sector GHG emissions by 2030 compared to 2015 and 94% by 2050. • Residential: 22% reduction in energy consumption in the building sector by 2030, 29% by 2040, and 41% by 2050, compared to base year 2015. • Non-residential energy savings: 40% by 2030, 50% by 2040, 60% by 2050.	• The estimated annual amount of (public/private and public) investment for the 2019-2032 period includes EUR 15-25 billion for buildings. (from the NECP) • The big investment plan: EUR 1.8 billion allocated for government building thermal renovation (2017-2022)	• Wider benefits of building renovation could be analysed in more detail. • Investment needs and budget allocation could be defined in more detail.
Germany	• Reduction of greenhouse gas emissions to 70 MtCO₂eq by 2030, which represents a 67% reduction compared to 1990. • Reduction of non-renewable primary energy consumption to 2000 PJ (556 TWh) by 2030. • From 2030 onwards, the renovation rate is expected to increase from around 1.3% to over 2% for single and two-family houses and from around 1.5% to over 2% for apartment blocks.	• Only 2018 investment figures have been reported: EUR 182.2 million was given out as grants, triggering investments of EUR 734 million	• A more precise quantification of the milestones for 2040 and 2050 could be provided. • Wider benefits of building renovation could be analysed in more detail.

Greece	• Upgrade 12-15% of buildings by 2030. • Renovation rate by 2050: 1.6% (doubling the 2015 one) • 45-49% of building envelopes in residential and 19-20% in non-residential buildings by 2050. • 28-40% Final energy demand reduction (vs 2015) by 2050.	• By 2030: about EUR 10 billion per year • By 2050: up to EUR 20 billion per year (PRIMES modelling)	• Provide supporting evidence on how the indicative targets will be achieved in practice through the proposed policies. • Consider the introduction of building renovation passports, one-stop-shops as well as innovative financial schemes. • Measures to address split incentives are not covered in the strategy. • Provide more concrete steps on how to support vulnerable groups and tackle energy poverty. • Promoting the ESCOs market.
Hungary	• Decarbonisation: By 2030: 20%, by 2040: 60%, by 2050: 90%. • Renovation rate 3% by 2030. • 90% share of NZEB at 2050. • Energy savings: By 2040 40% and by 2050 60% in public buildings (vs 2018-2020 consumption).	• By 2030 EUR 5.1 billion (HUF 1760 billion) 2014-2020 for the renovation of residential and public buildings (HUF 80.2 billion annually) • By 2050 estimated cost of achieving climate neutrality (all the economic sectors) is 145 billion EURO (50 000 billion HUF), 2.5% of GDP per year by 2050	• Better explain how the strategy will be implemented considering that the majority of the new measures will become active only from 2023. • Consider the introduction of Building Renovation Passports.
Ireland	• Retrofit 500 000 homes to an EPC B2 or cost-optimal equivalent or carbon equivalent by 2030 (average of 50 000 homes each year). • Retrofit 1 million houses by 2040 and 1.5 million by 2050. • Install 600 000 heat pumps by 2030. • In the commercial and public sectors, upgrade at least one-third of total commercial premises to EPC B by 2030.	• The Irish government has approved a national development plan that allocates funding of EUR 4.5 billion to support energy efficiency improvements across the residential and public sectors • Increase the price of carbon to EUR 100 per ton by 2030	• Milestones to reach by 2040 and wider benefits could be further detailed. • Budgetary resources to support the strategy's implementation could be further detailed. • Wider benefits of building renovation could be analysed in more detail.
Italy	• Decarbonisation: By 2030: 32.7 Mton CO2 emissions (residential) 10.9 Mton CO2 emissions (non-residential); by 2050: 0.6 Mton CO2 emissions • Renovation rate: by 2030: 2% and 2.8 % (2020-2030) - non-residential; by 2040 and 2050: 2.6%.	• By 2030: EUR 5-8.8 billion (2020-2024) available for Municipalities to make buildings seismic safer/securer and more energy efficient • By 2050: Investment needs (2020-2050) for the residential sector: EUR 9-12 billion/year,	• Consider the introduction of Building Renovation Passports. • Better present the development of a clear roadmap and policy for the 2040-2050 period, when the

	• By 2050 66% of the existing buildings renovated; 80% of the current non-residential buildings renovated. • Energy savings: By 2030: 0.33 Mtoe/year (1.14 Mtoe/y) savings – residential and 0.24 Mtoe/y savings non-residential; By 2050: 13 Mtoe final energy consumption (residential), 11 Mtoe final energy consumption (non-residential)	investment needs (2020-2050) for offices: EUR 0.7 billion/year investment needs (2020-2050) for offices: EUR 0.5 billion/year.	biggest renovation effort lies.
Latvia	• 1 869 kt CO₂eq emissions reduction (80 %) by 2050 • 3% per year of the building floor area of central government buildings by 2040 • 30% multi-apartment buildings renovated (4860 buildings) 500 000 m² public buildings renovated by 2030 • 8100 multi apartment buildings renovated by 2040 • Goal: all new buildings to meet the NZEB requirements and ensure the renovation and conversion of all buildings to meet the requirements of zero or nearly zero energy buildings by 2050.	• By 2050 budget allocated: EUR 50 million from the national budget, EUR 75 million for the action "Promoting energy efficiency in public buildings".	• Provide a clearer overview of the measures as well as the regional or federal budget. • Wider benefits of building renovation should be analysed in more detail.
Lithuania	• Decarbonisation: By 2030 24%, by 2040 60%, by 2050 100%. • Renovation of buildings stock: By 2030 17%, by 2040 43%, by 2050 74% • 100% reduction of annual primary energy consumption from fossil fuels by 2050	• By 2050 Estimated investment needs: EUR 60 billion	• Improve the information on budgetary resources and the timeline of the planned measures. • Consider additional mechanisms based on private sector involvement such as ESCO models. • Consider the introduction of Building Renovation Passports.
Luxembourg	• 58% reduction of final energy demand by 2050 vs 2020. • Renovation rate of the building stock at 3% per year, corresponding to approximately 4 500 housing units per year. • Boiler exchange rate: approx. 5% p.a.	• Not detailed	• Milestones should be extended beyond residential buildings. • Wider benefits of building renovation should be analysed in more detail. • Investments needs and budgetary resources could be defined in more details. • A clear definition of deep renovation could be presented.
Malta	• Decarbonisation: by 2030 Residential: -39%, Non-residential: -38%; by 2040 Residential: -60%, Non-residential: -62%; by 2050:	• By 2030: EUR 308 million (cumulative) for residential, EUR 512 million (cumulative) for non-	• Consider the introduction of Building Renovation Passports and

	Residential: -74%, Non-residential: -77%, 4,5 million CO2 tons • Renovation rate: Residential: up to 5%-6% from 2025 onwards, non-residential 1.1% by 2030 and up to 2.5% by 2050. • Energy savings: 20% by 2030, 20% by 2040 and 25% by 2050 (60000 GWh primary savings).	residential • By 2050: EUR 5,1 billion (over 30 years; undiscounted) expected to be stimulated: EUR 1,3 billion for Households, EUR 2 billion for Businesses, EUR 1,7 billion for Government	One-Stop-Shops. • Promote the Energy Service market. • Improve the fragmentation of competences between ministries and government entities.
Netherlands	• Vision for all buildings to be sustainable by 2050. • CO2 emissions in 2050 = 1.5 million tCO2eq. • Gradually insulate 1.5 million residential and other buildings and make them gas free, or at least ready to switch over to another, sustainable source of heat ('gas-free-ready') by 2030. • Gas-free-ready by 2030 using more renewables and more sustainable sources. • No more fossil fuel used in the building environment by 2030. • 95% CO2 emissions reduction by 2050.	• According to the NECP, the estimated overall amount of private and public investment for the 2019-2030 period is EUR 56-75 billion (roughly 10% of current GDP) for energy. A large share of projected investment amounts is linked to renewable electricity generation and improvement of energy efficiency in key sectors (notably of buildings) • By 2030 Allocated: for the heating fund EUR 900 million (government) + expected 75% private investments (2020-2030); for the renovation accelerator program EUR 130 million (2020-2024); for Sustainable Energy Investment Subsidy (ISDE): EUR 100 million per year (2020-2030)	• The investment needs could be further detailed • Wider benefits of the renovations of buildings could be analysed in more details • Trigger points could be more precisely identified.
Portugal	• Renovation of building stock: By 2030 363 680 501 m ² renovated; by 2040 635 637 685 m ² renovated; by 2050 747 953 071 m ² renovated • Energy savings: By 2030 11%; by 2040 27%; by 2050 34%.	• By 2050 estimated investment needs: EUR 143 492 million (Residential: EUR 113 579 million; Non-residential: EUR 33 414 million)	• Could present the national building stock in a more clear way. • Provide more specific estimates on the wider benefits and energy savings contribution of the measures.
Romania	• GHG emission reduction: By 2030 24%; by 2040 50%; by 2050 80%. • Annual renovation rate: 3.39% (2021-2030); 3.79% (2031-2040); 4.33% (2041-2050) • By 2030 1% increase in NZEB buildings, 19% decrease in worst performing buildings. • By 2040 4% increase in NZEB buildings, 23% decrease in worst performing buildings. • By 2050 77 % of the total floor area of the building stock renovated or rebuilt; 23% increase in NZEB buildings, 26%	• Estimated Needs: EUR 12.8 billion in 2020-2030; Allocated: EUR 5 billion mobilised from the national budget. Part of the amount needed is expected to be covered by EU Structural Funds, depending on the availability of programmes and funds. • Around EUR 3 billion should be dedicated to grants, while some EUR 2 billion should be used to use 4-6 billion euro in financial instruments to reduce the funding gap. In addition, the owners are	• Provide a clearer analysis of the impacts of the proposed measures. • Better reflect measures to combat energy poverty.

	decrease in worst performing buildings. Reduction of final energy consumption: By 2030 9% (0.83 Mtoe); by 2040 3.32 Mtoe energy savings Total consumption: 6.20 Mtoe; by 2050: 65% reduction in final energy consumption (-6.14Mtoe)	expected to contribute around EUR 1.8 billion	
Slovakia	- Decarbonisation: By 2030 5.5 MtCO₂ -61% vs 1990 levels; by 2040: 3.4 MtCO₂ -74% vs 1990 levels; by 2050: Decarbonisation of the building stock 1.8 MtCO₂ (-87% vs 1990 levels; -79% vs 2020 emissions) 40% share of deep renovations on total renovations by 2050 100% multifamily buildings renovated by 2030 and 100% single family buildings renovated by 2040. - Energy savings: by 2030: 39.9 TWh in the building sector [10 518 GWh: cumulative energy savings rate]; by 2040: 33.6 TWh Energy consumption in the building sector; by 2050: 28.3 TWh Energy consumption in the building sector [19 006 cumulative energy savings rate] 40% reduction energy consumption vs 2020 levels [18 368 GWh cumulative energy savings rate]	- By 2030: Total needs estimated: EUR 13.2 billion - By 2040: Total needs estimated EUR 22.2 billion - By 2050: Total needs estimated: EUR 22.8 billion (cumulative), Residential: EUR 17.3 billion, Non-residential: EUR 5.5 billion. - Allocated from multiannual financial framework (2021 to 2027): EUR 750 million (residential); EUR 367.5 million (public buildings) - Allocated from RRP: EUR 300 million (single-family residential); EUR 130 million (historic/protected heritage public buildings); EUR 200 million (public buildings).	- Consider the introduction of Building Renovation Passports and one-stop-shops. - Improve the quality of the Energy Performance Certification scheme.
Slovenia	- By 2030: 70% reduction GHG emissions; 2/3 of energy use in buildings from RES; by 2050 75% reduction CO₂ Emissions - By 2050 74% of single dwellings 91% of multi-apartment buildings renovated 45% reduction in final energy consumption by 2050	- By 2030 Budget estimated and allocated in the private/residential sector: EUR 108.88 million (over the period 2021-2030). - Budget estimated and allocated in the public sector: approximately EUR 890 million (over the period 2021-2030)	- Provide more information on investment needs up to 2050 given the ambitions of the 2050 building stock decarbonisation. - Provide more information on the individual measures.
Spain	1.2 million homes (out of 18.7 million primary residence homes) to be renovated by 2030 - Energy savings of 64 154 GWh (cumulative for 2020-2050) - For residential buildings, a 37% reduction in energy use and 99% reduction in CO₂ emissions by 2050 compared to 2020. - For residential buildings, consumption from heating to be less than 55% by 2050 against 2020 levels. 7.1 million houses are expected to undergo deep renovation by 2050, lowering their individual consumption by 12 kWh/m². - The stock of new buildings between 2020 and 2050 is projected to stand at 3.9 million houses, all of them being nearly zero-energy buildings. - By 2050 reduction in energy use: Non-residential 33%,	- The total volume of investment required for 2020-2030 would be EUR 41 471 million, of which EUR 15 520 million would be private investment for the renovation of ACS/heating equipment - Public investment (EUR 6 946 million) would be used to encourage improvements in the building stock (EUR 4 389 million), covering 1/3 of the total investment required, and a further EUR 2 557 million for the replacement of ACS or heating equipment - Public investment rates for private investment would be 25% for installations and 50% for building stock renovation	Further defining milestones and intermediate targets could help improve monitoring of progress.

	Residential: 70%.	• By 2050: 143 billion (residential sector only)	
Sweden	• 2030: fossil share of building stock end-use energy is 1% • 2040: 0% fossil share of end-energy use amongst the building stock • Every 10 years, the proportion of buildings in the A-C EPC class should be higher than in the previous reference year, and the proportion of buildings in the E-F EPC class should be lower than in the previous reference year. • Buildings built in the 1950s will be renovated in the next 20 years, buildings built from 1961-1975 will be renovated in the next 10 years. Other buildings have a renovation cycle of 40 years, meaning that buildings built after 1981 will start being renovated after 2020. • Expected energy savings by 2050 are around 10-15% (e.g. from 162 kWh/m².y in 2016 to 137 kWh/m².y in 2050).	Not detailed	• Investment needs and budget allocation could be defined in more detail.

From the table above it appears that for some Member States the efforts are not sufficient to decarbonize the building stock by 2050 and further actions and higher ambition will be needed over time, as well as encouraging the deployment of sustainable solutions³² to prepare for the changing climate and contribute to climate neutrality in line with the European Green Deal.

³² Including R&I solutions, in line with Horizon Europe Cities Mission on Climate Neutral and Smart Cities, by 2030

2 Member States' good practice in key categories of existing and planned measures

Article 2a 4) of the Energy Performance of Buildings Directive stipulates that the Commission shall collect and disseminate, best practices on successful public and private financing schemes for energy efficiency renovation as well as information on schemes for the aggregation of small-scale energy efficiency renovation projects.

This section presents a selection of good practices from among existing and planned policies and measures (national, regional and local) described in the submitted long-term renovation strategies. It is therefore not an exhaustive list of the measures proposed in all submitted strategies³³.

The section's structure mirrors the main categories of action specified in the Renovation Wave Communication adopted on 14 October 2020:

- 1) strengthening information, legal certainty and incentives for public and private owners and tenants to undertake renovations;
- 2) ensuring adequate and well-targeted funding;
- 3) increasing the capacity to prepare and implement projects; scaling up technical assistance and making it closer to regional and local actors;
- 4) creating green jobs, upskilling workers and attracting new talent;
- 5) creating a sustainable built environment;
- 6) placing an integrated, participatory and neighbourhood based approach for smart buildings, integrating renewable energy;

In addition, the Renovation Wave Communication singles out **three focus areas** for building renovation:

- 1) tackling energy poverty and worst performing buildings (a Recommendation on energy poverty and an accompanying staff working document to guide Member States in defining and implementing such strategies to reduce energy poverty was adopted as part of the package to reinforce support in this area³⁴);
- 2) public buildings and social infrastructure showing the way;
- 3) decarbonising heating and cooling.

³³ The selection of good practices will be revised and enriched in the updated version of this staff working document once all strategies - or most of them in case of significant delays - are submitted by Member States.

³⁴ Commission Recommendation COM(2020)9600 on energy poverty.

2.1 Strengthening information, legal certainty and incentives for public and private owners and tenants to undertake renovations

The Renovation Wave Communication underlines that the starting point of sustainable renovation is always an individual decision that balances expected benefits and costs. Yet, today, insufficient information on the current energy and resource profile of buildings and the potential benefits of renovation, lack of trust in actual energy savings and split incentives between owners and tenants are among the strongest barriers to such decision being taken. The following good practices can be found in the submitted Long-Term Renovation Strategies.

2.1.1 Introducing mandatory minimum performance levels

Some Member States have decided to introduce minimum performance levels by a specified compliance deadline or at certain moments in the lifetime of a building:

- **Belgium, Brussels:** draft legislation applicable to the residential sector requires work to be carried out at five time intervals staged renovations to achieve a minimum level of performance by 2050 (to be defined by typology, taking into account property constraints, where appropriate). The overall objective is an average of 100 kWh/m².year by 2050. Phased renovation obligation measure to be adopted by 2021, will make it mandatory for homeowners to implement 5 choice measures (identified in the mandatory energy performance certificate) every five years, starting from 2030, with the objective to reduce the building stock energy consumption to the 2050 target.
- **Belgium, Flemish Region:** Mandatory minimum energy performance for non-residential buildings from 2030 onwards. From 2030, these buildings will have to reach a minimum energy performance label to be defined. The public buildings in Flanders provide a good example by meeting the minimum energy performance label by at least 2 years earlier. Compulsory renovation after transfer of ownership for non-residential buildings (from 2021 at the latest five years after a notary transfer in full ownership).
- **Denmark:** all ministries and state institutions must reduce energy consumption by 14% in 2020 compared to 2006. On 17 January 2020, a revised requirement came into force introducing additional requirements for institutions within the state administration.
- **France:** the French strategy includes a gradual set of measures, starting with a ban on rent increase in the case of poorly performing buildings ('passoire énergétique', no performance specified) as from 2021, a ban on renting these as from 2023 and an obligation to renovate all worst performing buildings as from 2028.
- **Greece:** public authorities' building leases or acquisitions require at least a 'C' energy performance certificate class. The obligation should be applied to all existing lease contracts by 2020 and is expected to affect approximately 60% of the public sector's building stock (20 000 buildings).
- **Netherlands:** as of 1 January 2023, all office buildings (including many buildings with rental units) will be required to have an energy label of 'C' or better. This applies to buildings with an electricity consumption of 50 000 kWh/year or more or an annual gas consumption of 25 000 m³. It is estimated that this will impact approximately 38% of all registered office buildings; these must be upgraded by 2023 to meet the new requirement.

2.1.2 Reinforcing the quality and use of Energy Performance Certificates (EPCs)

The Renovation Wave Communication underlines that energy performance certificates (EPCs) and their availability in accessible databases improve transparency of the performance of the building stock. At the building level, EPCs inform about energy performance, the share of renewables and energy costs. At district, regional, national and EU level, they are crucial for identifying the worst performing buildings in urgent need of renovation. They can be used to evaluate improvements relative to the investment before and after the works and to help match available financing with individual renovation projects.

However, the quality and usability of EPCs should be further improved in order to exploit their full potential as an indicator that affects the value of properties and, ultimately, fosters energy upgrades in existing buildings.

The quality of EPCs could be improved by updating the independent control systems and EPC databases and by continuously monitoring and training energy auditors. More elements should be incorporated (cost, benchmarks with reference buildings, wider benefits), while a user satisfaction campaign could help authorities meet market needs. Many Member States also suggest EPC databases should be made more directly interoperable with building register and digitalise the process of developing and collecting EPCs.

The following best practices from submitted long-term renovation strategies can be highlighted:

- In **Austria**, quality reviews of EPCs are organised through the country's independent control systems, in parallel with continuous improvement of EPC databases. Support for renovation and other incentives are usually linked with the submission of an EPC, which ensures that cost-optimal remediation steps can be taken.
- In **Belgium**, in the **Brussels Capital Region**, Energy Performance Certificates will be imposed on any owner, regardless of any transaction. It is not intended to propose three recommendations as the current certification does, but to communicate the mandatory technical measures to be implemented in order to achieve the overall energy performance target to be reached.
- In **Greece and Cyprus**, to raise people's awareness of EPCs, financial incentives have been linked to the issuing of EPCs; examples include the Greek 'saving at home' and the Cypriot 'save & upgrade' programme. In order to further improve the role of EPCs in selling and renting properties, Greece and Cyprus plan to increase inspections of commercial advertising, revise the existing legislative framework for the sale and rental of buildings, and make a further link with financial and fiscal incentives.
- In **Denmark**, an initiative launched in 2018 aimed to improve the precision of the energy label, as well as to better involve and support data and digitalisation, to make it easier to implement cost-effective energy renovations. This initiative also focused other areas, such as indoor climate and comfort, level of thermal comfort, daylight and acoustic conditions. In the context of an action plan for better energy labelling, a user satisfaction survey was carried out, a new training for energy consultants was organised, an information campaign on energy labelling was run and improvements to the database website (SparEnergi.dk), where data on energy labelling in buildings are published, were made.

- In **Estonia**, the development of virtual tools for EPCs and energy audits could be the next step in digitalising the sector. The use of virtual tools would help reduce the time and therefore the cost of producing EPCs and running energy audits. For example, a direct link with the building register, simpler calculations (normal annual heating consumption, energy consumption per square metre, etc.) would make it possible to standardise energy audits in addition to energy labels. The added value would be the possibility of analysing the resulting labels and audit data; the current EPCs are generally documents in pdf format, and therefore not machine readable for analysis. Stakeholders also mentioned that the energy label classes should be stable. A system where the energy label class changes every five years is too unstable for investment decisions to be taken. There is a need for a more stable and easily understandable system for assessing the energy performance of buildings.
- In **France**, from 1 January 2022, energy performance certificates and tenancy agreements will have to include information on the actual energy consumption of dwellings expressed in primary and final energy, and an estimate of the theoretical amount of energy expenditure.
- **Portugal** is introducing of a new version of the energy certificate. Progressive affirmation of the digital version of the energy certificate as an aggregator of information. Interconnection of the energy certificate with supply and demand platforms (of the 'one stop shop' type), such as, for example, the casA + Portal. Moreover, there will be adjustment of the energy certificate in order to reflect, in a more concrete way, the characteristics of the building susceptible to be, among other factors, in a situation of energy poverty.
- **Slovenia** is developing sustainability criteria for buildings: The LIFE IP CARE4CLIMATE project foresees testing the first version of the sustainability indicator system in 2020, including the establishment of a supportive environment and the development of criteria for the evaluation of indicators. Training of experts involved in testing will also be provided. It foresees the creation of a supportive environment for the sustainable valuation of buildings (establishment of the system, certification scheme, training, system maintenance, financing), the preparation of the basis for the promotion and financing of sustainable renovations and the extension of the promotion to sustainable building renovations, the implementation of model sustainable renovation projects for public buildings.

2.1.3 Combining Energy Performance Certificates (EPCs) with Building Renovation Passports (BRP) or roadmaps

Deep renovation is not always achievable in one go. Therefore, the Renovation Wave Communication highlights the importance of creating better conditions for staged renovations and points out instruments such as digital building logbooks, which can integrate all building-related data, including those provided by building renovation passports.

The following best practices from the submitted long-term renovation strategies can be highlighted:

- **Brussels Capital** regional authorities want to put in place a roadmap for residential buildings in order to clarify and explain the steps needed to meet the mandatory minimum

performance threshold required by 2050. The roadmap will consist of an individual renovation plan, complementary to the EPC. The authorities also plan to develop a 'housing passport': a unique digital platform that gathers a building's administrative and technical data (e.g. energy, soil pollution, etc.) in one place; this information can be consulted by the owner (or people with power of attorney, such as, for example, building professionals) and by the competent administration, as detailed in the relevant documents. This 'housing passport' should accompany a building throughout its life. Its purpose is to simplify access to information relating to housing for both the owner and public authorities. The platform will contain information specific to each dwelling, accessible by means of an identifier or the owner's identity card. The passport would be created 'de facto' for each dwelling (as is the land register); it will be particularly useful in real estate transactions (sale/purchase/estate/rent) or during works (renovation, permit requests, etc.) as each main actor (e.g. notaries, building professionals) will be able to access the housing information based on a licence issued by the owner. Building passports will also be created for collective housing, though in a second phase. The possibility of extending them to the tertiary sector will be assessed.

- In **Finland**, considerable resources have been mobilised to support initiatives in this area. The real estate service manual, mandatory since 2000, is a document that describes a building's basic features (ownership, volumes, structures, materials, etc.), specifies maintenance tasks, sets target values and goals for technical service and includes a list of operating costs. It also includes an FAQ section on building life-cycle aspects. In general, the initiative is well-known and appreciated by users. The real estate passport created by the Finnish Green Building Council has a more technical nature, which takes full advantage of building information modelling. This fits into the Finnish administration's plan for mass digitalisation of the construction sector and stimulates real estate productivity.
- **France**: The energy efficiency passport is an online platform offering advice to owners, auditors and professionals. The passport provides a set of solutions combining the best measures for achieving low energy levels, based on a building's specific features.
- **Germany**: the individual renovation passport (iSFP) was initially developed and tested in Baden-Wuerttemberg and has now been adapted so that it can be applied across the entire country. It was officially adopted by the Federal Ministry for Economic Affairs and Energy (BMWi) in 2017. It can already be used voluntarily by energy consultants and for documentation purposes within the Federal Office for Economic Affairs and Export Control (BAFA) 'Energieberatung vor Ort' support programme. iSFP is financially supported through the energy advice for residential buildings (on-site advice, building renovation passport) with up to 80% of the consultancy costs incurred through a grant.
- In **Latvia**, since 2010 the Law on Management of Residential Houses foresees that every residential building shall have a paper or electronic file including all the building information (e.g. technical documentation, energy passport, audit findings etc.).
- **Portugal** will introduce a new version of the energy certificate which will aggregate many information, realise interconnection with supply and demand platforms ('one stop shop' type), such as, for example, the casA+ portal. It will also reflect, the situation of energy poverty.

The iBRoad H2020 project should also be mentioned. It aims to develop an individual building renovation roadmap for single-family houses. With a target focus on residential

buildings, the iBRoad project analyses and builds upon relevant examples from Germany, France and Belgium (Flanders), to identify the essential elements, develop an integrated concept, and produce modular tools suitable for differing national conditions. This tool looks at the building as a whole, and provides a customised renovation plan (iBRoad-Plan) over a long-term horizon (15-20 years). The iBRoad-Plan is combined with a repository of information, i.e. a building logbook or passport (iBRoad-Log), for aspects like energy consumption and production, executed maintenance and building plans.

2.1.4 Supporting nearly zero-energy buildings (NZEBs)

As of 1 January 2021, new buildings must comply with national requirements for nearly zero-energy buildings (NZEBs). Renovation to NZEB level is not always technically feasible or cost-effective and so, in some Member States, financial instruments linked to energy savings or a specific EPC class provide larger subsidies for this.

The following best practice from a submitted long-term renovation strategies can be highlighted:

- In Cyprus, the **'save & upgrade' programme** finances renovations in homes and buildings owned or operated by SMEs. A larger subsidy is awarded to buildings that are being refurbished into NZEBs. Moreover, new buildings and buildings to be renovated are allowed to increase the building ratio by 5% if they are energy class A and if at least 25% of their total energy needs are covered by renewable sources, i.e. if they comply with at least two NZEB requirements.
- The **Dutch** 'Energiesprong' concept is generating mass deep renovations with pre-fabricated, standardised modules in order to achieve major cost and time savings. Energiesprong brokered a deal to bring 110 000 buildings to a NZEB status. Thanks to a three-year EU Horizon 2020 grant, this initiative is planned to be rolled out in other EU countries.

2.2 Ensuring adequate and well-targeted funding

The Renovation Wave Communication underlines that building renovation is one of the sectors facing the largest investment gap in the EU. The Commission estimates that, in order to achieve the proposed 55% climate target by 2030, around EUR 275 billion of additional investment is needed per year.

In the residential building sector, the lack of simple, attractive and easily accessible public incentives for renovation and the lack of mainstream financing products, including one-stop-shops for making it easier to select, finance and install and operate efficient and renewable heating systems, are often mentioned as a barrier.

All submitted long-term renovation strategies have a chapter related to access to finance. These highlight that a large part of building renovation concerns the change or modernisation of heating and cooling systems and the installation of renewables on-site, in-building or nearby, to cover the overall energy needs for electricity, heating and cooling and - increasingly - for transport always in combination with energy efficiency measures, e.g. envelope energy efficiency, building automation and control systems and smart solutions.

In this context, Member States usually recognise that adequate financing and its easy deployment for integrated building renovation is one of the most important elements of reaching the milestones they set.

2.2.1 Stimulating joint procurement

The EPBD (2010/31/EU), as amended by Directive (EU) 2018/844, Article 2a, paragraph 3(a), envisages the possibility to develop projects, including through the implementation of investment platforms, groups and consortia of small and medium-sized enterprises to enable investors to provide package solutions to potential customers. In some cases, joint procurement across borders could also be usefully considered, for instance in twin cities, in line with Article 39 of Directive 2014/24/EU on public procurement. One way to do this is via the set-up of a joint entity by contracting authorities from different Member States, such as a European grouping of territorial cooperation (EGTC) under Regulation (EC) No 1082/2006.

In this area, the following best practices from the submitted long-term renovation strategies can be highlighted:

- **In the Netherlands, the ‘renovation accelerator’** supports companies by bringing together part of the demand and providing multiannual predictability to the market. Through the renovation accelerator, the demand from housing companies for heat pumps and insulation products is pooled. The Ministry of the Interior runs the renovation accelerator in collaboration with various parties to develop more affordable (joint) offers. This promotes innovation, increases quality, reduces costs and thus lowers prices. The purpose is to match supply and demand. The renovation accelerator also takes part in the procurement process and related work. It is, of course, up to the individual company itself to decide on its own assignments. Between now and 2024, EUR 130 million will be available for the renovation accelerator.
- **Finland has developed a ‘pool for energy savings in industries’.** Group construction has been tested and promoted by Finland’s Ministry of the Environment and the local

government. The legal status and financial arrangements of project participants are safeguarded by the Group Construction Act (199/2015). The Act applies to both new and repair construction. In addition to traditional repair projects, there have also been joint purchases of solar panels.

- **In Germany**, as part of the federal/regional dialogue on contracting, around 10-15 forms of contracting for ‘model’ projects in representative sites at local and land-level will be demonstrated to show the potential of contracting and thus help establish a functioning ESCO market. The pilot projects will also be an opportunity to train key actors and to develop standards and guidelines for similar projects.

2.2.2 Reducing the perceived risks of energy efficiency and renewable energy in buildings for investors and the private sector

The EPBD (2010/31/EU), as amended by Directive (EU) 2018/844, Article 2a paragraph 3(b), states that Member States shall facilitate access to appropriate mechanisms to reduce the perceived risk of energy efficiency operations for investors and the private sector more broadly.

In this area, the following good practices from the submitted long-term renovation strategies can be highlighted:

- **In Belgium**, the **Brussels-Capital Region** strategy foresees the establishment of a market facilitator promoting the establishment of ESCO and energy performance contracting (EPC), with a view to creating the conditions for the emergence of ESCO. This facilitating body will also play the role of aggregator of applications in order to limit the expenditure of ESCO in research and project planning. Reduction of funding risks to guide ESCO towards a holistic approach to energy renovation, with the provision of a regional fund over the address of ESCO in order to promote access to capital, provided that the project has a comprehensive approach. The introduction of a partially revolving fund, which could be used for the development of ESCO. In the **Flemish Region**, since October 2017, a premium for project leaders who renovate collectively a number of dwellings (at least 10) in order to make this energy efficient. The project leader shall support the citizen in achieving energy saving investments. The Flemish cities of Antwerp and Mechelen in the context of this project are organising various demonstration projects for collective renovation.
- **In Luxembourg**, with a view to overcoming barriers on the investment market, a financial instrument (a ‘de-risking’ investment platform) is to be designed and implemented to mobilise energy efficiency investments by industry, SMEs and the buildings (renovation) sector, with the primary aim of making progress towards climate emissions, renewable energy and energy efficiency targets, and a secondary aim of reducing energy dependency and increasing energy productivity. The aim of the ‘de-risking’ instrument is to eliminate the obstacles associated with energy improvements and renovations and the associated project funding.
- **In the Netherlands**, the Heating Fund and the National Energy Savings Fund pool public and private money to make attractive financing possible for building owners. The combination of public and private resources makes for a structure in which large amounts of financing can be made available (though the participation of private parties) and risks

shared (through government participation).

- In **Sweden**, the Swedish National Board of Housing, Building and Planning currently offers credit guarantees, which can be used to finance both the construction and conversion of residential properties. Credit guarantees can be provided both during construction and/or for end financing. Irrespective of when a credit guarantee is provided, it cannot amount to more than 90% of the Swedish National Board of Housing, Building and Planning's estimated market value. In the case of housing that is let under a cooperative tenancy right, up to 95% of the market value may be guaranteed. As credit guarantees can also be issued for loans for conversions, this instrument is considered to have some impact on the scope of energy efficiency improvement renovations, particularly as regards private and publicly-owned apartment buildings.
- In **Slovakia**, The use of guaranteed energy services is considered a promising tool to support the renovation of non-residential buildings and is expected to increase more widely in the short term. However, in order to carry out deep renovation of a non-residential building in view of the longer payback period of such an investment, it is necessary to consider blending repayable and non-refundable EU Structural Funds and guaranteed energy services.

2.2.3 Using public funding to leverage additional private-sector investment

The EPBD (2010/31/EU), as amended by Directive (EU) 2018/844, Article 2a paragraph 3(c), draws on public funding to attract additional private sector investment and address specific market failures.

The following good practices from the submitted long-term renovation strategies can be highlighted:

- In **Bulgaria**, the development of a National Decarbonisation Fund is proposed to be the main financing scheme in the implementation of the Bulgarian LTRS. This Decarbonisation Fund will operate at a national level and will consist of three sub-funds: (i) for public sector (ii) for commercial corporation and (iii) for residential buildings. The financial resources will come from: European Funds (Just Transition Fund, InvestEU), national co-financing (budget of state institutions and local authorities), revenues from energy efficiency obligation schemes, Green Bonds and other debt instruments, international financial institutions, private capitals and others. A mechanism involving ESCOs is also foreseen.
- In **Czechia**, the 'PANEL' programme (financed by the state budget), focuses on investment support to reduce the energy demand of multi-family buildings in the form of soft loans. Specifically, it supports the improvement of a building's energy performance (building envelope, technical equipment), the integration of on-site renewables and the renovation of electricity, gas and heat distribution systems.
- **Cyprus**: The Mutual Funds Fund runs a loan scheme for energy efficiency and renewable energy. Its initial capital of EUR 40 million comes from the Cohesion Fund, the European Regional Development Fund and a national contribution. The government has added another EUR 40 million from a loan guaranteed by the European Investment Bank. The Mutual Funds Fund is designed to provide loans to households, SMEs and local authorities to enable them to invest in energy efficiency and renewable energy projects.

These loans will be made available through commercial banks. The Fund is expected to be operational in 2020.

- **In Denmark**, KommuneKredit provides financial services to municipalities and regions, including loans and leases. Moreover, the ‘Pool for energy savings in buildings’ is a subsidy scheme, that, starting from 2021 will substitute the current energy efficiency obligation scheme, will allocate DKK 200 million/y in 2021-2024 with a competitive bidding procedure. The incentive is granted based on the ratio of subsidy per saved kWh in the individual projects. Subsidies are first granted to the project with the lowest costs per saved kWh, then to the one representing the second-lowest costs, and so on. Similar schemes are planned for public buildings (DKK 100 million/y in 2021-2024), and for non-residential buildings (DKK 300 million/y in 2021-2024). Preliminary calculations show that the building pool of DKK 200 million per year in 2021-2024 will have an impact in 2030 of about 1.2 PJ.
- **In Finland**, projects realised by ESCO are promoted with an ESCO subsidy. The ESCO subsidy can be granted to any company or corporation for an investment in regular or new technology implemented in building renovations. A higher investment subsidy (25% of investment value) is provided for municipalities that implement energy efficiency measures if the project in question is an ESCO service.

2.2.4 Using tax incentives, such as tax credits and adapted VAT rates to foster building renovation

The Renovation Wave Communication indicates that Member States should also explore taxation tools to generate economic incentives to finance building renovation.

The submitted long-term renovation strategies include a wide range of examples of such instruments:

Tax credit/ deduction

- **In Brussel Capital**, a reform of property taxation is going to be adopted to promote building renovation investment: modulation of registration and/or inheritance tax in relation to the competition of energy savings works; temporary exemption or reduction of property tax, in case of an ambitious energy renovation (e.g. when several recommendations of the mandatory energy performance certificate are carried out at the same time).
- **In Denmark**, all energy sources for heating buildings, other than biomass, are subject to relatively high taxes. The fees for petroleum and natural gas are indexed and maintained at constant prices. The tax on electricity for heating has been substantially reduced in recent years so that it amounts to approximately DKK 43/GJ and is therefore lower than fossil taxes in 2021. This provides a significant incentive to reduce heating energy consumption and has contributed to a reduction in heat consumption over the last 20-25 years. In addition, Denmark has developed a tax credit of up to DKK 12.200 per person per year (in 2019) for work pay. It is possible to benefit from this deduction for example in the event of installing insulation, replacing windows, improving the heating system, replacing the heating system, etc.
- **Germany** has adopted a key measure in the buildings sector: tax support for energy renovation measures in owner-occupied homes. It was introduced on 1 January 2020 to complement existing support schemes. The tax incentive can be used as an alternative to

the existing loan and grant schemes in the buildings sector. Support will be given for individual measures in owner-occupied housing that are also considered eligible under the existing building support programmes. This includes the replacement of heating in particular, but also the installation of new windows or the insulation of roofs and external walls. Support may also be provided for comprehensive remediation, if necessary on a step-by-step basis, through several individual measures. Eligible costs include 20% of the investment costs and the costs of issuing the certificate (that needs to be submitted to the tax office in order to grant the tax reduction), and 50% of the costs of an energy consultant to carry out the energy planning and supervise the eligible measures. Support will be provided through a deduction from tax liability spread over 3 years, e.g. when replacing old windows with modern thermal windows. By offsetting the support against the fixed tax liability without any progression, as many owners of residential buildings as possible can benefit from the measure.

- In **Finland**, to promote building renovation and investment in new technologies, Finland offers higher tax incentives when the energy efficiency improvement is significantly higher than the level required.
- In **Italy**, the Ecobonus and 110% Superbonus is a tax deduction system intended to cover 110% of the costs of energy efficiency and structural seismic improvements of Italian properties, ensuring tax compliance in the local building industry. This tax credit can be set against tax liabilities of the relevant property owner, over five years, in five equal annual instalments. The “superbonus” can be traded (Cessione del credito) by entitled property owners, effectively by selling it to third parties, or setting it against their own suppliers’ invoices (Sconto in fattura) thus effectively getting the costs of the property improvements paid by the Italian Revenue. It is a substantial improvement on similar, earlier legislation. The Superbonus covers 110% of the costs of energy efficiency and can be combined with works for structural seismic improvements. This measure, covering the expenses incurred between July 2020 and 2023, will be partially financed with the Recovery and Resilience Facility. Moreover, the Sismabonus is the deduction (tax rebate) for measures related to seismic measures for expenditure incurred for seismic works carried out on structural parts of buildings or structurally connected structures, located in areas characterized by medium or high seismicity. Depending on the intervention, the deductions are 50-80% for houses and 50-85% for multi-apartment buildings. For a total maximum expenditure up to EUR 96,000 per building unit for each year. Finally, the "Ecobonus + Sismabonus" (for the renovation of common parts in multi-family buildings) is a unique tax rebate of 80% or 85%, if the building renovation result in a change to 1 or 2 lower seismic risk classes. This deduction will be broken down into 10 annual instalments and shall be applied to an amount of expenditure with an expenditure limit of EUR 136 000, multiplied by the number of building units in each building. In order to benefit from the increased deduction, the measures must, in addition to seismic improvement (reduction of 1 or 2 classes), also comply with the energy requirements laid down in order to obtain the ‘increased’ Ecobonus deduction of 70% or 75%.
- **Lithuania** will develop a **pollution tax** for energy inefficient/polluting buildings, e.g. by introducing an additional tax if the energy consumption of a building exceeds 150 kWh/m² and/or CO₂ emissions. This would take into account not only energy efficiency but also the source of the fuel (in order to move away from fossil fuels). Other alternatives to the implementation of this tax could include a differentiation of the property tax according to energy consumption/CO₂ emissions, an additional levy on non-managed buildings.

- In **Sweden**, tax deduction for renovation, conversion and extension applies to the labour costs for house repairs, maintenance, conversions and extensions. It was introduced in 2008 to increase the supply of labour and reduce undeclared work. Some of the measures covered also help to increase energy efficiency. An obvious effect of the deduction is that it gives property owners an incentive to carry out more renovations. On 1 July 2016 the tax reduction was cut from 50% to 30% of the labour costs. The maximum support will now be SEK 50 000 per person per year. The facility is offered to owners of small buildings, owner-occupied apartments and holiday homes, and to tenants.

Adapted VAT rates

- **The Netherlands** has introduced a specific VAT refund. For insulation of dwellings, labour costs for the application of insulation materials to floors, walls and roofs in dwellings that were built more than 2 years ago it is 9 % instead of 21 %.
- **France** applies a reduced VAT rate (5.5% instead of 20%) to energy renovation (supply and installation) carried out in accommodation spaces that were built more than 2 years ago.
- **In Cyprus**, since 2015, a reduced VAT rate (5 % instead of 19 %) has been applied to the renovation of dwellings for which at least three years have passed since the first date of residence. The reduced rate applies to all saving measures related to buildings and the installation of photovoltaic systems. Combined with sponsorship schemes such as the “save & upgrade” and RES and EXE projects, this measure helps reduce renovation costs.
- **In Luxembourg**, there is a reduced VAT rate of 3% for renovation measures. The conditions for benefiting from the reduced rate of VAT of 3% for renovation measures will be adapted and harmonised with the requirements of the PrimeHouse programme. The aim is to examine whether owners of buildings with a construction age of 10 years can benefit from the reduced VAT rate instead of the current 20 years.

2.2.5 Developing dedicated financial products and business models for building renovation

In this area, the following best practices from the submitted long-term renovation strategies can be highlighted:

Green mortgages, loans, credits, leases

- **In the Netherlands, the credit enhancement for sustainability** helps people who take energy-saving measures in their own home, to borrow a higher amount for that investment. Moreover, the Climate Agreement aims to explore the development of a methodology based on housing neutrality and can guide credit enhancement for sustainability. The extent to which individual energy savings can be taken into account in the consumer credit loan standards will be examined in spring 2020.
- **In BE-Wallonia**, new owners who, within 5 years, renovate an apartment with a bad label to label C or better can rely on an interest-free loan as of 2021. An increased energy premium in the case of renovation to label C or better introduced from 2021 onwards will

also be considered. A discount to the annual housing tax (real estate tax) will be examined.

- In the **Brussels Capital** region of Belgium, the Brussels green loan is available in two ways: a consumer credit issued by Crédal and a mortgage credit from the Housing Fund (extension of the eligible amounts and maintenance of a reduced rate of interest). The authorities are considering to simplify the green loan in the near future, and to open it up to all Brussels citizens with a fixed rate of 1%. They are also considering the possibility of maintaining a revenue ceiling for access to the scheme as well as, under certain conditions, maintaining a 0% rate for vulnerable people.
- In **Sweden**, the 'Kommuninvest' is a credit institution owned by Swedish municipalities and regions which offers financing solutions to municipalities and regions in the form of loans and advice. Kommuninvest finances, for example, municipal housing companies, schools and hospitals. The credit institution is non-profit-making. Kommuninvest has special green loans including for improving energy efficiency in the building stock. Loans may be granted to projects in multi-apartment buildings with a result of at least 15% less energy in terms of energy per square metre than determined by the National Board of Housing.

Energy savings certificates / green bonds

A green bond is a bond where the capital is earmarked for projects and activities that contribute to improving the environment and environmental sustainability. For example, banks and other credit institutions issue green bonds to finance the green loans offered to customers. However, it has also become more common for municipalities and real estate companies, for example, to issue their own green bonds, which may be an alternative to traditional bank loans. The difference between green bonds and conventional bonds is that the capital of green bonds can only be used for green projects that meet the requirements of a specific framework, with criteria set out by the company issuing them.

A number of long-term renovation strategies specify the development of such green bonds:

- **In Belgium, the Flemish region** placed a sustainable bond issue for the first time on 12 November 2018. An amount of EUR 500 million was raised through a public issue from 61 institutional investors from 11 different countries. The bonds mature on 21 November 2033. 'Sustainable bonds' are bonds intended to finance sustainable green or social investments. Flanders uses the amount raised to improve the energy efficiency of its buildings, to build affordable homes and to finance 'passive schools' in the context of 'Schools of Tomorrow'. Moreover, the Flemish energy loan is an interest-free energy loan for the priority target group: EUR 15,000 and duration of 10 years. Since 2015, 21.000 energy loans have been granted for a total of EUR 175 million. It also included the 2 % loans allocated from 2015 to 2018 to the non-priority group. Since 2019, only interest-free loans to people from the priority target group have been granted.
- **France** set up an energy certificate scheme (EEC) in 2005: (1 EEC = 1 kWh cumac³⁵)

³⁵ Cumac : abbreviation of the French '*cumulé*' and '*actualisé*', used after the kWh energy unit

of final energy) is allocated to legal persons such as local authorities, social landlords etc. who have achieved energy saving operations in accordance with certain criteria. These certificates can be freely exchanged.

- In **Finland**, some private parties have issued green bonds to be used especially to improve the energy efficiency of their own properties.
- In **Latvia**, the ALTUM loan from Green bond for energy efficiency improvements is backed by the EIB where the financing is complemented by a guarantee of EUR 3 million from the 'Private Finance for Energy Efficiency (PF4EE) facility' provided by the EU under the LIFE programme. The loan is available both to private companies and to public and municipal companies wishing to provide their services in a significantly more energy-efficient building – office, warehouse, plant, hotel, shop, etc. EUR 20 million, with funding up to EUR 2 850 000 per project, with only 15% of the company's own participation.
- In **Spain**, the PAREER II programme for financing the energy retrofit of existing buildings has proven effective. It was established in December 2017 as a follow-up to PAREER and PAREER-CRECE. It sets out clear and strong requirements (e.g. energy class measured on the EPC scale of CO₂ emissions (kg CO₂/m² year)), extra financing for actions that reach energy class 'A' or 'B' or that increase the initial energy rating of the existing building by more than two letters in the EPC scale). Measures include: (i) improving the energy efficiency of thermal and lighting installations; (ii) conventional solar energy substitution; (iii) replacement of conventional energy by geothermal energy; and (iv) improving the energy efficiency of the thermal envelope. The aid can be in the form of repayable loan or grant.

Funds

- In **Belgium, in the Walloon Region (Wallonia)** an Energy Efficiency Fund involving ESCOs and SMEs provides EUR 20 million to support ESCOs actions to improve energy efficiency in SMEs. For each euro taken from the fund at least one euro must be invested by private entities.
- In **Bulgaria**, a National Decarbonisation Fund is proposed as the main financing scheme in the implementation of the Bulgarian LTRS. The Decarbonisation Fund will operate at a national level and will consist of three sub-funds: (i) for public sector (ii) for commercial corporation and (iii) for residential buildings. The financial resources will come from: European Funds (Just Transition Fund, InvestEU), national co-financing (budget of state institutions and local authorities), revenues from energy efficiency obligation schemes, Green Bonds and other debt instruments, international financial institutions, private capitals and others. A mechanism involving ESCOs is also foreseen.
- In **Cyprus**, the 'Save & Upgrade' scheme finances renovation of homes and buildings owned or used by SMEs, which had requested a building permit before 21 December 2007. It is co-financed by the EU's Cohesion Fund (CF) for households and the European Regional Development Fund (ERDF) for SMEs.
- **Cyprus** developed a 'Mutual Funds Fund': In 2018, the Council of Ministers decided to set up a fund to implement a loan scheme for energy efficiency and RES. The Fund has an initial capital of EUR 40 million, which consists of Cohesion Fund and European Regional Development Fund funding as well as a national contribution. A further EUR 40 million has been added to the Fund by the government from a loan

guaranteed by the European Investment Bank. The ‘Mutual Funds Fund’ is designed to provide loans to households, SMEs and local authorities for energy efficiency and RES projects. These loans will be made available through commercial banks. It is expected to be operational in 2020.

- **In Germany**, the Federal government reconstruction programme will support the long-term renovation strategy for buildings by supporting energy-efficient construction and renovation programmes administered by the KfW. The programme is the same size as the volume support instrument (2016-2017 budget: EUR 2 billion for each year). Energy efficiency measures in the building sector carried out using subsidised loans will be supported in part with repayment grants or, alternatively, investment grants. Moreover, the Incentive Programme for Energy Efficiency (APEE) has been strengthened through the introduction of the Energy Efficiency Incentive Programme (APEE). This includes three investment areas: (1) installation of ventilation systems (ventilation package) combined with a renovation on the building envelope in order to avoid construction damage (among others), (2) the replacement of inefficient heating through efficient heating (heating package), (3) the placing on the market of nuclear fuel cell heating in new buildings and existing buildings. The aid will be granted through a grant for stationary fuel cell heating with an electrical capacity of 0.25 to 5.0 kW through the KfW.
- **Greece** continued the “Saving at home” programme. The Programme was launched in 2010 and was financed by ESIF. The Programme is targeting renovations for single family houses, apartment buildings with participation of all apartments, and single apartments. The renovations need to produce 30% energy savings and at least upgrade of the house/apartment to the next energy class. The grant intensity is dependent on the income of the household and can reach 70%. For high income households (above a threshold) the financing is only an interest free loan.
- **Latvia’s** transformation fund supports the renovation of hazardous and structurally degraded multi-apartment buildings.
- In **Luxemburg** the PrimeHouse support scheme is to be upgraded to allow for deep renovations. The scheme provides investment aid for the energy and sustainable renovation of residential buildings and related qualified energy advice, the construction of sustainable residential buildings and the use of renewable energies (PV, solar thermal installations, wood pumps and heat pumps). It has been extended or revised several times since 2001. The current programme runs until the end of 2020. Its upgrade will include: (i) checking and, if necessary, adjusting the amounts of support; (ii) integrating additional sustainability criteria, in particular to promote the circular economy; (iii) including criteria to mitigate health risks in residential buildings; (iv) developing eligibility criteria for energy efficiency in listed buildings, in coordination with existing Heritage Protection Authority support programmes; and (v) further administrative simplification, for example by increasing the digitalisation of the application procedure or optimising quality assurance (quality improvement – intensity of controls).

2.3 Increasing the capacity to prepare and implement projects and scaling up technical assistance to bring it closer to regional and local actors

2.3.1 Developing energy advisory services for citizens and businesses, including creating one-stop-shops

Article 2a (3) of the EPBD states that Member States shall facilitate access to appropriate mechanisms to provide accessible and transparent advisory tools, such as one-stop-shops for consumers and energy advisory services, related to energy efficiency renovations and financial instruments. Article 20(2) also requires Member States to provide information to owners and tenants through accessible and transparent advisory tools such as one-stop-shops.

“One-stop-shops can be defined as advisory tools that facilitate access to financial mechanisms, assist consumers in relation to technical and financial issues and guide them through a number of key stages in the renovation process (...)”³⁶.

All submitted long-term renovation strategies include the development of advisory services and policies to inform citizens about energy-efficient renovation opportunities and tools.

The following best practices can be highlighted:

- The **Austrian** long-term renovation strategy provides information on many regional assistance services. One example is the energy consultancy in Burgenland, which is a one-stop-shop giving people free and independent advice for construction and renovation projects in private residential areas. Free advice includes comprehensive information on energy issues relating to the construction and renovation of buildings, heating and air conditioning of buildings, and electricity applications. Coordinated information is available in the areas of thermal insulation, windows, heating systems, financial support, energy saving tips, photovoltaics, storage systems, etc. A wide range of brochures and guides is available free-of-charge for all topics. The energy consultations can take place on-site, in the offices of the district authorities, in the office of the Burgenland Provincial Government or in the municipal centre. Questions that need to be answered quickly are often answered by telephone (service hotline) or email. People can sign up for advice online or by phone. A cost-optimal and environmentally-sound renovation and new construction plan is then drawn up together. At the end of the service, customers receive a record of the advice given.
- **In Croatia**, through the Open Partnership Dialogue action stakeholders, local and state representatives, academia, construction and energy professionals were connected and had the opportunity to contribute to the development of the LTRS.
- **In Cyprus**, an online energy-saving tool has been set up to help the public to easily identify the costs and benefits of different energy saving and renewable energy measures in homes. (<http://energysavingstool.cea.org.cy/>).
- **In Czechia**, energy consultation and information centres (‘EKIS’) provide a free public service supporting the introduction of energy saving and renewable energy. This service will be extended to building owners.

³⁶ JRC Science for Policy Report, Accelerating energy renovation investments in buildings - Financial and fiscal instruments across the EU, Economidou, Marina Todeschi, Valeria Bertoldi, Paolo, 2019

- **Denmark** developed the Better Home, a market-driven scheme from the Danish Energy Agency focusing on energy renovation of buildings. It aims to make it easier for building owners (mostly homeowners) to renovate their energy systems by creating a one-stop-shop for energy renovation, where the owner only has to contact one certified building contractor to get advice on energy renovation for the entire building. Denmark also developed the Better Boost Mechanism that meets the EU's description of a building renovation passport and the Default value catalogue: The Danish Energy Agency has set default values for energy savings in order to simplify the calculation of realised energy savings. This is done by a simple multiplication of the value by number of initiatives carried out. The basis for the default values is a professionally qualified tender for the energy savings resulting from an activity.
- **Estonia** developed the State Shared Service Centre provides support for improving the energy performance of central government buildings – both when renovating existing buildings and when building new ones. It also provides local government with support to make their buildings energy efficient.
- **In France**, the FAIRE ('Faciliter, Accompagner et Informer pour la Rénovation Énergétique') network run by ADEME, ANAH and ANIL is a one-stop-shop comprising 1000 experts/450 contact points. The network includes building and real estate professionals, NGOs, local and regional authorities and energy companies who work together to identify relevant solutions for household renovation and to help households put them in practice by increasing their confidence and knowledge, including on how to access funding. In addition, a national renovation observatory has been put in place and will monitor the following indicators: 'renovation equivalents' per year; annual energy consumption of existing building stock; share of building stock per energy performance class (annual monitoring); and share of building stock per heating system. In addition, a standardised technical sheet for energy performance contracting services (CPE services) was created at the end of 2018 to encourage the use of energy performance contracts for new installations.
- In **Italy**, the campaign "Italia in Classe A" (Italy in Class A) is aimed at the Public Administration, businesses, banking institutions, families and students. It aims to stimulate the energy efficiency of processes / systems in the tertiary and industrial sectors and conscious behaviour in the residential sector.
- In **Latvia**, the "Let's live Warmer" campaign aims to inform citizens about energy efficiency, the economic returns of investments and other positive benefits. In addition, the "most energy efficient building in Latvia" campaign aims to promote good practices in the field of energy efficiency of buildings through the construction, renovation and reconstruction of buildings and raising public awareness of the thermal insulation of buildings.
- In **Luxemburg** Myenergy, the national structure for promoting a sustainable energy transition, provides information and support for the efficient use of energy. It is Luxembourg's one-stop-shop for building renovations. The 'myrenovation' application is to be further developed to close information gaps on funding and financing schemes.
- **In the Netherlands**, the 'renovation accelerator' promotes the aggregation of projects into bigger investments that are easier to finance, allowing large-scale renovation of rental homes. As part of this initiative, a regional support programme has been set up and offers a stimulating learning environment which brings together housing associations' demand for (hybrid) heat pumps, insulation and other reduction

measures. Up to 2024, EUR 130 million will be available for the renovation accelerator.

Some more tools that exist in the **Netherlands**:

- The Regular Explorer home allows owners to calculate the costs and benefits of energy saving measures for their home. They can also get advice on the measures they can take to attain a higher energy performance class (e.g. from F to D, or B to A).
 - The Energy Savings Explorer for Offices provides office owners with information on how to qualify for energy label class 'C'. It provides information on the investment costs, the annual savings in energy costs, the payback time and the environmental effect (CO2 reduction per m²).
 - The Knowledge and Innovation Platform for Sustainable Social Real Estate. Eleven sectors are in the process of drawing up roadmaps: Central government (the Central Government Real Estate Agency), municipalities (VNG), provinces (IPO), police, education (primary and secondary, senior secondary vocational, higher professional and university), the healthcare sector and the sports sector. This platform is not intended to support the preparation of the roadmaps, but to help individual institutions make their buildings sustainable.
 - The Gas-free district knowledge and learning programme aims to not only provide technical solutions and information on cost and financing, but to also help with management and organisation, data-based planning, legal aspects and communication and participation.
- **Portugal** is simplifying and dematerializing the licensing processes and harmonizing the documents related to the building process, through the reduction of bureaucracy and context costs associated with licensing.
 - **In Slovakia**, a **television programme called “Energy”** broadcast on a monthly basis on public service television is dedicated to energy efficiency, up-to-date information on improving energy performance and effectively provides the necessary information to owners in all areas related to renovation, maintenance and administration.
 - In **Slovenia** ENSVET - Energy advisory network for citizens strengthens professional support to co-owners in planning energy renovations of multi-apartment buildings as independent expert support for decisions to increase the energy efficiency of the building.
 - **Spain** has a wide network of local and regional one-stop shops ('ventanillas únicas') that provide the public with various services (including financial and technical advice). In addition, a number of campaigns to raise the public's awareness on energy-efficient behaviour and opportunities, and provide information on available financial support (e.g. thematic guides released by the government of Navarra under the SustaNAPlity European project, web portals on building renovation such as. the 'Observatorio Ciudad 3R', and the 'Ni un hogar sin energía' project, developed by ECODES).
 - In **Sweden** the National Renovation Centre (NRC) works with businesses and academic institutions to improve knowledge and provide operators in the building industry with the information necessary to carry out renovations efficiently. The aim is to make existing buildings more environmentally, economically and socially sustainable from a life-cycle point of view, while improving or retaining their function so that they meet the requirements of users and the authorities.

2.4 Creating green jobs, upskilling workers and attracting new talent

The Renovation Wave Communication underlines that the design, installation and operation of circular and low-carbon solutions often require a high level of technical knowledge.

Already before the COVID-19 crisis, there was a shortage of qualified workers to carry out sustainable building renovation and modernisation. The potential for job retention and creation in this sector has been and remains high. Energy efficiency in buildings is the largest generator of jobs per million euro invested.

In the submitted long-term renovation strategies, many Member States indicated a shortage of well qualified technical personnel. The strategies mention a number of programmes that can address this challenge, however these remain largely targeted to specific training areas and are not mainstreamed along the entire construction sector value chain. To bring about system innovations in the construction industry, there must ultimately be more structural arrangements among knowledge institutions, education and training, government, contracting authorities and contractors. Regular training to develop professional skills for energy auditors, designers and architects, installers of heating, cooling and other technical building systems, energy service companies, building firms, project supervisors and other experts, are essential to ensure the market's continuous development. Moreover, the industry should be enabled to absorb specialised professionals with compatible skillsets (including those with experience in relevant declining industries), by offering targeted training. Training will also need to address safety issues related to fire and seismic activities and accessibility for persons with disabilities in order to ensure that it is included when doing deep renovations.

From this perspective, the following best practices from the submitted long-term renovation strategies can be highlighted:

2.4.1 Promote sustainability/climate technology in general education and targeted dissemination activities

- In **Finland**, basic qualifications that are needed in the construction sector are taught at all levels of education. To prepare for a specialisation in building physics, building materials, production techniques, real estate management or house engineering, there is an uninterrupted pathway of mathematical subjects from pre-school to vocational and higher education. Finland also promotes close cooperation between university, polytechnic and initial vocational education.
- In **Romania**, there are many MScs programmes on energy efficiency in universities. Romania also aims to set up a training programme that will: (i) authorise and provide training courses and manuals, (ii) develop training programmes for trainers and qualification criteria for energy auditors, designers, technical leaders and qualified contractors to participate in the renovation programmes, and (iii) establish cooperation with Romanian universities and vocational training institutions. The investment is estimated at EUR 50 million.

2.4.2 Promoting ‘green skills’ for all professions in the construction and building sectors

- In **Austria**, the Energy Academy offers a comprehensive training programme on energy technology, energy management, energy advice, construction, renewable energy and energy efficiency. The target groups include energy managers in companies, municipalities and institutions, building and home technology specialists, planners, energy consultants, energy auditors and interested members of the public. There are currently more than 30 seminars on different topics available. See www.energyacademy.at.
- **Cyprus** participates in the European ‘SME Power Efficiency’ project, which aims to help SMEs improve the skills and competences of their staff, develop specific training programmes for energy managers, undergo energy audits and, above all, to take action and implement the proposed energy saving measures. The actions financed under the project include the development of a free certified education and training programme aimed at training energy managers in SMEs.
- In **Czechia**, the EFEKT programme contributes to the system of education that supports the construction sector. It covers the organisation of courses and seminars and other training and information actions, such those that upgrade the qualifications of energy specialists and those that support the professional activity of installing renewable energy installations, as well as the communication of legislative changes in the field of energy management and energy efficiency.
- In **France**, the PACTE (2015-2019) programme aims to assist construction professionals in building their skills in the area of energy efficiency. The aim is to improve quality in construction and renovation works so that, ultimately, the construction and renovation of buildings is better, faster and cheaper. The actions supported include the development of digital site plans for site staff (tools that have an educational and pictorial presentation on the rules of the art), and the development of tools for measuring the intrinsic energy performance at the reception of a building or specific projects for a particular type of material. The programme supported around 40 projects in mainland France to improve the skills of building professionals, and about 40 projects designed to adapt techniques to local characteristics and to structure the regional sectors. Moreover, since 2007, the FEE Bat programme (training of professionals in energy saving in buildings) has made it possible for construction professionals to grow their skills. Financed by the EDF within the framework of the energy saving certificate scheme, it has allowed more than 175 000 active professionals to get training so far and continues to train around 1 000 interns each month.
- **Malta** developed the **Skills Building initiative** in the construction sector: by 2025, the government will develop a scheme to train and certify professionals and tradesmen of various levels in order to obtain a mandatory skill card which would need to be presented to work in the respective sectors. Certification will be extended to installers of several technologies and a life-long-learning approach will be adopted through regular training sessions addressed to skill card holders.
- **Portugal** is adapting the training of professionals linked to the construction area, empowering them with the necessary qualifications to build NZEB certified buildings, AQUA + water classification, as well as such as Passive House certification, LiderA or other certifications.

- In the **Netherlands**, the Declaration of Intent on the Labour Market and Training aims to prepare future construction professionals to carry out deep renovations. Moreover, with the ‘green deal for the development of decentralised sustainable heating and cooling technologies’, significant steps are being taken to educate specialists who can design, build and maintain the sustainable systems of the future.

2.4.3 Training of energy efficiency professionals and energy consultants

- In **Austria**, the Styrian Energy Advisory Network (netEB) aims to provide clear guidance and improve the quality of energy advice. Although the selection of energy consultants is very wide, they are often specialised in only one field and therefore not sufficiently trained to provide comprehensive advice. All consultants included in the network are appropriately trained and subject to a pre-defined quality control. Through regular training and information sessions, they are up-to-date with the latest energy-related issues.
- In **Czechia**, energy specialists shall be authorised by the Ministry to carry out energy audits, issue energy performance certificates and carry out inspections of heating and air-conditioning systems. In order to ensure that authorised energy specialists have the necessary expertise, Czech legislation requires energy specialists to follow continuous training activities and to obtain a certain number of credits within the legally defined period.
- **Denmark** has set up a training programme for energy consultants. Energy labelling companies must be certified and registered in order to produce EPCs, and it is the companies’ responsibility to ensure that their energy consultants are properly trained. All energy consultants must undergo a training course and pass the corresponding examination in order to be able to carry out EPCs. A new training for energy consultants is being planned in the context of an action plan for better energy labelling and will include requirements for continuous improvement of competences. In addition, the ‘RES approval’ scheme covers companies that install small renewable energy installations in private homes, i.e. heat pumps, solar cells, solar thermal and small biomass boilers and stoves. In order to qualify for a renewable energy installation, an entity must be already authorised to carry out an electrical or heating operation and have employees who have completed a specific renewable education training course.
- **France** has set up the RGE label programme. Professionals must satisfy a number of qualification criteria to provide households with a guarantee of the high quality of their work. Issued for a period of four years with annual monitoring, this certification is based on requirements relating to the training of staff, evidence of technical resources, proof of insurance covering the professional’s liability and checks on work carried out. In 2019, almost 58 000 companies were labelled as RGE, of which 85 % have fewer than 10 employees. Companies with quality labels are identifiable on the www.faire.fr website.
- In **Romania**, the Green Building Professional is a paid programme for the certification and training of specialists in green construction organised by Romanian Council for Green Buildings.
- In **Slovakia** skills and education measures are listed in the strategy: e.g. StavEdu, ingREeS and CraftEdu projects (training programmes for the various types of

professionals involved in energy efficiency in buildings, including training on building smart technologies). The StavEdu project created a national system for the upgrading and further training of craftsmen and workers in the building sector for energy efficiency and renewable energy use in buildings. It mainly concerns craftsmen and workers with medium-level technical training (training certificate). The CraftEdu project builds on the StavEdu to create certified programmes for the further training of craftsmen and workers on energy efficiency and renewable energy use in buildings.

- In **Sweden** Energilyftet is a free web-based training course on low-energy building aimed at customers, architects, engineers, building project managers, administrators and control technicians.

2.4.4 Research programmes, websites & online training, and knowledge centres

EU programmes offer many funding opportunities to support projects that decarbonise the building stock, including training.

BUILD UP Skills³⁷ is a strategic initiative which started under the Intelligent Energy Europe (IEE) programme to boost continuing or further education and training of craftsmen and other on-site construction workers and systems installers in the building sector. Its final aim is to increase the number of qualified workers across Europe to deliver building renovations which offer high-energy performance as well as new, nearly zero-energy buildings. The initiative addresses skills in relation to energy efficiency and renewable energy systems and measures in buildings. Five transnational construction skills projects (BUStoB, ingREeS, MEnS, PROF-TRAC and Train-to-NZEB) have been supported by the construction skills strand of the European Horizon 2020 research and innovation programme aiming to help support and further develop multi-country qualification and training schemes. The BUILD UP Skills Initiative contributes to the objectives of two flagship initiatives of the Commission's 'Europe 2020' strategy — 'Resource efficient Europe' and 'An Agenda for new skills and jobs'.

- In this area, the following best practices from the submitted long-term renovation strategies can be highlighted: In **Czechia**, the THÉTA programme managed by the Technology Agency aims to contribute to the medium- and long-term vision for transforming and modernising the energy sector in line with the approved strategy. The focus is on promoting: (a) projects of public interest; (b) new technologies and system elements with high potential for rapid application in practice, (c) long-term technological potential. This corresponds to the division into individual sub-programmes. Total expenditure for the THETA programme from the state budget for the 2018-2025 period amounts to CZK 4 000 million. In turn, the non-public sources should account for CZK 1 715 million. Total expenditure is therefore CZK 5 715 million.

³⁷ <https://www.buildup.eu/en/skills/about-build-skills>

- In **Ireland**, the SEAI Energy Academy has developed free online training modules for general use and for SMEs to help them identify and pursue energy efficiency opportunities including renovation (see <http://www.seaienergyacademy.ie/>).
- In **France**, the massive open online course (MOOC) platform is being used for training courses that are open to all and are accessible continuously. The available training courses are made up of educational resources (videos, documents) and offer individual or collaborative activities to assess knowledge. The aim of the platform, managed by ADEME under the sustainable building plan, is to provide access to the best e-learning courses in the field of sustainable building. A specific MOOC on sustainable building was launched in November 2016 and operates through a system of shared governance (professional organisations, training organisations, associations). At the beginning of January 2018, almost 20 000 people were registered on the platform (predominantly professionals in the field). See: www.mooc-batiment-durable.fr
- In **the Netherlands**, with the renovation accelerator, landlords, market players and knowledge institutions are working to develop knowledge about and promote the industrial and large-scale sustainability of housing. The renovation accelerator is set up as a national support programme that provides a stimulating learning environment. Large-scale landlords and providers work together to aggregate demand and develop standard packages that make it possible to preserve housing more quickly and cheaply. The support programme has allocated EUR 5 million per year for the period until 2025 (total EUR 30 million). A grant scheme for the most promising innovative projects is also provided in the context of the renovation accelerator.
- In **Romania**, the EU-funded BUILD UP Skills Romania programme has developed a ‘skills roadmap for construction’, to improve skills related to energy efficiency and renewables. The ‘BUS Qualishell’ programme led to the creation of two qualification schemes for high performance building envelopes: (i) ‘train-to-NZEB’ aims to develop and deliver training for construction workers, specialists (architects, designers, experts, energy auditors) and decision makers working towards NZEB goals; (ii) ‘fit-to-NZEB’ aims to develop and deliver various training programmes related to deep energy efficiency renovation (at NZEB level).
- In **Sweden**, the National Renovation Centre (NRC) is attached to Lund Technology Institute and supports stakeholders in the construction sector in ensuring an efficient renovation process. It does so through the creation of knowledge and the dissemination of information. In addition, the web-based Energilyftet initiative, launched in 2016, provides free training relating to low-energy buildings. Furthermore, during the period from May 2016 to December 2017, ongoing seminars were run to inform people and generate interest in energy efficiency improvements, low-energy construction and training.

2.5 Promoting comprehensive and integrated renovation interventions for smart buildings, integration of renewable energy and making it possible to measure actual energy consumption

The Renovation Wave Communication insists on the fact that fully reaping the potential of a renovation in terms of co-benefits requires an integrated approach that has already been successfully piloted. ‘Smart’ homes can promote user comfort and increase the integration of renewable and surplus energy into buildings. This needs an integrated digital renovation that combines energy storage and demand-side flexibility, on-site energy generation from renewable sources, the ‘internet of things’ for the system components, appliances and recharging points for e-mobility. This promotes people’s active participation in the energy system as prosumers. Also citizens at higher risk of exclusion such as persons with disabilities will be involved.

In this area, the following best practices from the submitted long-term renovation strategies can be highlighted:

2.5.1 Collecting, collating and using data for the design and implementation of deep renovation projects and schemes – digital platforms

- In **Denmark**, SparEnergi.dk is a central digital platform for information activities related to energy efficiency solutions. The target audience is both private and public building owners. The site provides good advice on energy savings and knowledge of mainstream energy renovation measures. It includes a tool that allows homeowners to turn their energy label up and see related savings. Overall, the 2018 Energy Agreement allocated DKK 19 million in 2018, DKK 33 million in 2019, DKK 34 million in 2020 and DKK 44 million annually in 2021-2024 for information and data. As a result, a number of analyses and demonstration projects will be carried out, with a focus on promoting the use of data and digitalisation as a driver for energy efficiency and flexible energy use in buildings, including support for a data-based energy management approach.
- **France**, is planning to install a digital logbook for building renovations and to exploit the data on housing. This logbook will be a secure online service to improve knowledge on accommodation. It aims to provide information to and gather information from successive users in order to: encourage work to improve energy performance and provide targeted information to owners on what to do in the event of equipment failures and on the support available and on how to better manage their building to improve energy consumption. It will also be a useful source of information for professionals in need of renovation or energy improvements. It therefore aims to reduce energy poverty.
- In **Germany**, actions relevant to digitalisation are spread in several sections such as energy research programme with an emphasis for buildings on digitalisation, energy system integration, and district/decentralised supply structures. In addition a digital one-stop-shop is planned to be set up to combine the existing information in a transparent manner. The subsidy programmes run by BAFA and KfW are available in an online database. This database is to be the core of a future "digital one-stop-shop".

Moreover, with the ‘Refurbishment configurator’ service launched in 2012 (<https://www.sanierungskonfigurator.de/start.php>), building owners and tenants can learn about possible refurbishment measures for their building, their cost and savings potential and state support programmes on a dedicated website of the Federal Ministry of Economic Affairs and Energy.

- In **Ireland**, the Irish Energy Authority (SEAI) hosts a comprehensive database of EPCs. Under an EU-funded project (EPISCOPE)³⁸, the Irish Energy Action organisation developed a mapping tool for EPCs in 2015, implemented as a pilot project in the northern part of the city of Dublin. This is an interactive map, where layers of building features may overlap (mainly walls, windows, roofs and planters, but also energy poverty indicators, energy supply, metering, etc.) in different Dublin neighbourhoods. Data are aggregated by small areas and administrative units; for each area, the average of indicators (not on individual buildings) was calculated, allowing for targeted intervention, but at a more comprehensive level. The map provides relevant data for local policy making and strategies to alleviate energy poverty or invest in infrastructure³⁹.
- In **Italy**, the State Property Agency database has been established: for reducing the expenditure of the use of buildings by public authorities and to optimise their management (e.g. maintenance planning, rental optimisation, rational use of available spaces, reduce the overall operating cost, including energy supply), IT tools (e.g. a data base, and an IT portal to collect the data) have been introduced to better manage the public buildings and plan their use.
- In **Latvia**, since 2010 the Law on Management of Residential Houses foresees that every residential building shall have a paper or electronic file including all the building information (e.g. technical documentation, energy passport, audit findings etc.).
- In the **Netherlands**, the sustainable housing platform will start developing a data system containing available energy consumption data, building data and building use data. This ensures that building information does not have to be collected separately and therefore the risk of error is reduced. Moreover, the Netherlands is working to promote the digitisation of new and existing buildings through a Building Agenda, with a digitisation deal for the built environment already signed in April 2019. In this document, contracting authorities, market actors and administrations agree on digitally unlocking the available information and sharing it in a more standardised way.
- Based on the past experience of EPISCOPE (Energy Action) and ENERMAP, the **ENERFUND** instrument was developed under the EU’s HORIZON 2020 programme and can also be used as an online tool to facilitate financing decisions for deep energy efficiency renovations.
- In **Sweden** the National Renovation Centre (NRC) works with businesses and academic institutions to improve knowledge and provide operators in the building industry with the information necessary to carry out renovations efficiently. The aim is to make existing buildings more environmentally, economically and socially sustainable from a life-cycle point of view, while improving or retaining their function

³⁸ <https://episcopes.eu/monitoring/case-studies/ie-ireland/>

³⁹ <http://energyaction-static.s3-website-eu-west-1.amazonaws.com/index.html>

so that they meet the requirements of users and the authorities. The Information Centre for Sustainable Construction ICHB's mission is to 'promote energy-efficient renovation and building, using sustainable materials while minimising the impact on the environment from a life-cycle point of view'. This includes collecting information about sustainable building, adapting it to specific target groups and disseminating it. The Centre's website provides information about research, results and experience. The information is targeted at all relevant groups, including professional builders, owners of small buildings, housing association board members, property owners and others involved in the building process in any capacity.

2.5.2 Fostering smart technologies for energy-efficient renovation

The uptake of and investments into digital and innovative technologies by the construction sector remain low.⁴⁰ The Commission will therefore support digitalisation in the construction sector through Horizon Europe, Digital Innovation Hubs and Testing and Experimentation Facilities. Digital tools⁴¹ help record the progression of works, the use of materials and increase productivity. For example, a digital twin of a building, enabled by 3D mapping data, provides information on how the building is performing in real-time and prevents serious accidents by helping predict potential failures in building systems.

- In **France**, the work of the Technical Science Centre for the Building (CSTB), a public industrial and commercial establishment, aims to help those involved in innovation to secure sustainable construction and renovation projects, supporting the energy, environmental and digital transitions. The CSTB continues to make the evaluation of innovative products more accessible by improving their technical procedures, setting up a national support network, and providing regional technical and financial support. The aim is to facilitate the emergence and market access of innovative construction products and processes within the scope of the energy, environmental and digital transition. The CSTB is also an agent of digital stimulation, for example through the CSTB LAB, an accelerator for construction start-ups.
- In **Finland**, a common project organised jointly by the public sector and private enterprises, KIRA-digi, and its follow-up project KIRAHub, have speeded up the process of commissioning smart building technologies. The programme studies and tests the use of the 'internet of things' and artificial intelligence in the management of building energy production and consumption, as well as the classification system for smart building solutions (a smart readiness indicator).
- In **Germany**, the 'EnEff.thof.2050' initiative promotes lighthouse projects that demonstrate innovative technologies and approaches to achieve low-carbon buildings and neighbourhoods. They should help make the entire building stock almost climate-neutral by 2050. Eligible projects may involve developing key technologies (including small parts developed by the sponsor) and procedures for new buildings or the

⁴⁰ Currently, 70% of construction firms dedicate less than 1% of their revenues to digital and innovative projects, and the uptake of Building Information Modelling (BIM) remains particularly low. Technologies, such as IoT, AI, robots, digital twins reduce the time needed for physical works.

⁴¹ Including, Building Information Modelling (BIM), Geographic Information System (GIS) and Augmented Reality

renovation of existing buildings ('innovation projects'). Projects involving ambitious 'model' buildings and neighbourhoods ('transformation projects') can also be supported.

- In **the Netherlands**, the KIRAHub project promotes the digitisation of renovation processes, related expertise and development by increasing open, digital education in the fields of renovation and energy efficiency to support lifelong learning.
- In **Sweden**, the 'smart built environment' is part of a joint initiative on strategic innovation programmes run by Formas (a Swedish research council for sustainable development), Vinnova (Sweden's innovation agency) and the Swedish Energy Agency. The initiative aims to create the right conditions for international competitiveness and sustainable solutions to global societal challenges. In 2018, a number of steps were taken to bring together and establish Smart City Sweden as the national demonstration platform for smart solutions in sustainable cities. A framework agreement was signed with a supplier who will be responsible for operating and developing the platform. The platform will address issues such as planning and construction, digitalisation, social sustainability, mobility and other issues of relevance to sustainable urban development. Moreover, in Sweden, viable Cities is a 12-year strategic innovation programme for smart and sustainable cities with a budget of SEK 1 billion. It brings together 50 stakeholders from a wide range of research fields, industry, public services and civil society. The Smart City Sweden is the national demonstration platform for smart solutions in sustainable cities. In addition to energy and environmental aspects, the platform will address issues such as planning and construction, digitalisation, social sustainability, mobility and other issues of relevance to sustainable urban development.

2.5.3 Promoting faster deployment of smart meters and smart systems

- In **Cyprus**, the distribution system operator plans to install 400 000 smart electricity meters by January 2027. These will provide real-time information on electricity consumption and generation, helping final consumers to optimise their energy use. This information may be particularly useful for building owners and investors looking to implement energy and energy-saving measures.
- **Estonia** is developing simplified digital tools for building owners, for example a technical tool where owners of single dwellings can input existing building parameters (wall type, window type, heating system, ventilation system) and choose different energy efficiency improvement options (insulation thickness of the exterior wall and roof, new windows with three glass packages, change of heating system, installation of ventilation system, installation of solar panels). For commercial real estate owners, a tool that makes it possible to assess energy efficiency based on energy costs will also be developed. Commercial real estate owners are generally not aware of their buildings' energy consumption in kWh or kWh/ (m2a), so this would help them get the unit cost of energy and estimate the energy cost of the building. It would also be possible to propose general recommendations for reducing energy costs in line with a building's overall technical specifications and the main energy consumption component (electricity or heat) determined on the basis of energy bills.
- In **Finland**, in September 2016, the Ministry of Employment and the Economy set up a working group to explore specific actions to enable the smart electricity system to serve customers to participate actively in the electricity market and to contribute to

maintaining security of supply. According to the recommendations of this working group, technical building systems should be designed for consumption elasticity (flexible customer-centred electricity system, smart grids working group, 2018).

- **Hungary** continued the smart cost-sharing programme for district heating housing was launched in September 2019. There are still 200 district-heated dwellings in Hungary where the technical solutions used do not allow the provision of heat to be regulated. The use and uptake of smart cost-sharing to enable continuous monitoring of energy consumption is an effective tool to strengthen the awareness of users.
- The **Swedish** government has developed a broadband strategy for a fully connected Sweden by 2025. Since 2009, the pace of development has been progressing at a very rapid pace, both in broadband roll-out and broadband use. In 2018, 81% of all households and businesses had access to broadband at a speed of at least 100 Mbps. In the same year, some 77% of households had access to fibre, an increase of almost five percentage points compared to the previous year.

2.5.4 Roll-out of infrastructure for e-vehicles in buildings and their car parks

- The **Austrian** long-term renovation strategy reports many regional initiatives in this field, notably, the smart grids model municipality of Köstendorf, Salzburger Flachgau. In this local area, every second household is equipped with a photovoltaic system and electric cars. The smart grid components, such as adjustable recharging points, inverters and a local network transformer, should help to balance supply and demand in such a way as to ensure smooth operation. Residents become prosumers and can consume electricity from their own photovoltaic system or feed it into the electricity grid.
- **Latvia** will promote the construction of electric recharging points in new buildings for multi-apartment and public buildings, as well as in renovated multi-apartment and public buildings and it will ensure that up to 50% of specific parking areas are equipped with charging capability by 2030.
- **Malta's** National **Electromobility** Action Plan (MNEAP) is currently undergoing review and being updated to reflect the National Transport Strategy and National Operational Transport Master Plan, including a new action plan up to 2025 and a strategy leading to 2050.
- In **Romania**, there have been various local initiatives to promote the smart city concept, including e-mobility, and these were merged into the 'smart cities project' (which was launched in 2019). Cities such as Cluj-Napoca, Iasi, Beclean, Zalău, Brăila, Târgoviște and Tulcea are promoting 'smart city' components, especially in the transport/mobility sector. The key success factor for these projects was cooperation between stakeholders, the Ministry of Communications and the Information Society, local administrations, research institutes, universities, companies, associations and the public. Further pilot projects will be based on well-designed local strategies and plans, with the intention to expand based on the results. Key energy and energy efficiency projects notably include smart electricity grids and renewables integration plus storage.
- **Sweden** developed the strategic innovation agenda for smart and sustainable cities, 'viable cities', which is the biggest project in research and innovation on smart and sustainable cities ever implemented in Sweden. The project is led by the University of

Technology (KTH) and brings together around 50 players from a wide range of research fields, industry, public services and civil society. The programme spans 12 years from 2018-2029 and has a total programme budget of SEK 1 billion. In 2017, the Swedish government instructed Formas to develop a 10-year national research programme for sustainable community-building in conjunction with other research funders. The programme covers approximately SEK 100 million per year for the period 2019-2026. In 2018, several steps were taken to bring together and establish Smart City Sweden as the national demonstration platform for smart solutions in sustainable cities. A framework contract was concluded with a supplier to ensure the operation and development of the platform.

2.6 Making the construction ecosystem fit to deliver sustainable renovation

Construction technologies and building materials play a crucial role in achieving energy and resource-efficient renovations. In the submitted long-term renovation strategies, this issue is often linked to broader skills and research policies. Some strategies, however, put a special focus on circularity, adaptability and durability aspects of building materials and technologies to facilitate future renovations, reduce waste, manage waste via high quality treatment, extraction of natural resources, and the associated emissions including GHG by ease of selective dismantling that facilitates the re-use/high-quality recycling of materials.

The policies associated with this approach cover research and innovation on energy-efficient and low embodied energy/carbon construction products. A few strategies, notably the one of the Brussels Capital region, cover the traceability of substances/materials used in buildings from a wider sustainability perspective, also encompassing health and safety elements (e.g. tracking of components, including harmful substances).

The following best practices⁴² can be highlighted:

2.6.1 Maximising the re-use, recycling, and recuperation of materials in deep renovation following waste management and circularity principles

- In the **Brussels Capital** region, the construction sector generates 628 000 tonnes of waste per year, 91% of which is already selectively collected (inert waste, soil & stones, concrete, asphalt, brick, etc.). There are currently few operations for the re-use of materials for these streams. Even though the Brussels Capital region will still be heavily dependent on imports of energy and materials in the future, lower consumption of new construction products and a greater uptake of secondary raw materials will reduce this dependence and the associated environmental impacts. A study will be launched to define a strategy for reusing building materials. Furthermore, Brussels Environment will develop a methodology to compare the environmental costs of a demolition/reconstruction operation and a renovation. The strategy agreed will be turned into a regulatory obligation. The Brussels authorities also plan to draft and implement a regulation which will require selective dismantling (via environmental permits). The dismantling operations will need to be organised in such a way that the reusable elements are effectively dismantled and recovered for introduction into a re-use chain. This vision therefore precludes a classic demolition where the components of the building are often destroyed together, thus preventing the re-use of materials and also limiting the possibilities for recycling. The implementation and monitoring of this measure will be achieved by means of minimum rates of materials caught in the recycling and re-use sectors.

⁴² In addition, the European Commission published in 2020 a guidance document “Circular economy principles in buildings’ design”: <https://ec.europa.eu/docsroom/documents/39984>

2.6.2 Developing life-cycle sustainability of materials used for the construction and renovation of buildings

- **France** developed a system of labelling construction products that provides information in the form of a performance class, ranging from A+ (very low embodied emissions) to C (high embodied emissions). In addition, environmental and health statement sheets, drawn up by certain industrial or trade unions (standard NF P 01-010), present the pollutant emissions of products, i.e. volatile organic compounds and formaldehyde, the risk of fibre emissions, resistance to micro-organisms, thermal comfort, etc.

2.6.3 Enhancing the climate neutrality and resilience of buildings

- In **Cyprus**, a Green tax reform will include carbon pricing in sectors outside Cyprus' emissions trading system. Such a reform is hoped to stimulate investment in energy efficiency and RES in the building sector (to be implemented in 2021) among other sectors.
- In **Flanders**, the climate-induced costs avoided were monetised among the wider benefits of building renovation.
- **Finland, Latvia and Spain** assessed the likely impact of future climate on heating and cooling demand.
- **Hungary** developed a Green Economy Funding Scheme: since 2013, the dominant source (50%) of revenue has been the sale of quotas under the European Union Emissions Trading Scheme (EU ETS) in the form of a quota auction in accordance with a pre-defined auction calendar.
- To better plan the country and its cities in a dynamic economic environment, the government in **Luxembourg** is working on a new Spatial Strategy 2035 ('Programme Directeur'). This strategy sets out proposals for increasing the number of dwellings to be built in Luxembourg in the future (e.g. near existing or new stations), which new transport infrastructure is needed and which taboo zones are key to maintaining biodiversity.
- **Spain** envisage to encourage the deployment of passive architecture, such as heat-shading and heat-dissipation devices, as well as "bioclimatic" vegetation, to combat increasingly hot summers.

2.7 Focus area 1: Tackling energy poverty and worst performing buildings

Energy poverty results from a combination of low income, high expenditure of disposable income on energy, and poor energy efficiency, especially as regards the performance of buildings.

The European Pillar of Social Rights places energy among the essential services everyone shall have access to and calls for support measures for those in need (principle 20). UN Sustainable Development Goal number 7 (SDG7) also calls for ensuring access to affordable, reliable, sustainable and modern energy for all.

The Energy Efficiency Directive 2012/27/EU, as amended by Directive 2018/2002/EU, requires Member States to take account of the need to reduce energy poverty in the context of their energy efficiency obligations. Article 7(11) requires that Member States put in place, to the extent appropriate, energy efficiency measures that address vulnerable households as a priority, including those affected by energy poverty. The Governance Regulation contains similar obligations.

Under the revised Energy Performance of Buildings Directive 2018/844/EU, Member States must outline relevant national measures that help alleviate energy poverty in their long-term renovation strategies to support the renovation of the national stock of residential and non-residential buildings⁴³.

The Renovation Wave Communication stresses that, with nearly 34 million Europeans unable to afford keeping their home adequately warm, tackling energy poverty is an urgent task for the EU and its Member States. Each year, 800 000 social homes need renovation, requiring an estimated EUR 57 billion of additional annual funding. The Renovation Wave is complemented by the Energy Poverty Recommendation and its accompanying Staff Working Document, which provides guidance to Member States on the interpretation of existing energy poverty indicators and on best ways to reach a definition for energy poverty, where Member States deem relevant. The guidance also includes a session identifying best practices under the national energy and climate plans (NECPs).⁴⁴

This year, the Commission has stepped up legislative and policy action to fight energy poverty, especially with the Fit for 55 Package, which addresses the twin-challenge of climate policy and social fairness and which aims to turn them both into opportunities. All initiatives under the 'Fit for 55 Package' have been consistently designed to unfold synergies, to mitigate potentially negative distributional effects, including between Member States,

⁴³ This builds on existing obligations under Article 4 of the Energy Efficiency Directive 2012/27/EU that have been moved to the Energy Performance of Buildings Directive and strengthened as regards the need to address energy poverty. Recital 11 of Directive 2018/844/EU clarifies that the need to alleviate energy poverty should be taken into account, in accordance with criteria defined by the Member States. The Recital further clarifies that while outlining national actions that contribute to the alleviation of energy poverty in their renovation strategies, the Member States have the right to decide what they consider to be relevant actions.

⁴⁴ Available at: https://ec.europa.eu/info/energy-climate-change-environment/overall-targets/national-energy-and-climate-plans-necps_en#final-necps

particularly on the most vulnerable and energy poor, and to make best possible use of the revenues from carbon pricing. In this regard, the 'Fit for 55 Package' has proposed a Social Climate Fund, which could bridge the gap between the Recovery and Resilience Fund and the transition between this current MFF and the post-2027 period, and mobilise EUR 72.2 billion for the period 2025-2032 to support households, notably those living in worst performing buildings. This Fund would cover the upfront costs and ease compliance of low-income households with the minimum energy performance standards proposed in the Energy Performance of Buildings Directive. The investments under the national Social Climate Plans can be an integral part of the financing measures contained in the Building renovation plans under the Energy Performance of Buildings Directive.

Exchange of best practices and increase coordination of policy measures to support vulnerable and energy poor households between Member States, other involved stakeholders and the Commission are crucial to strengthen the efforts and commitments to deliver on a fair and just European Green Deal. The Commission has therefore announced in the recent Communication on Energy Prices⁴⁵ the setting up of a new Energy Poverty and Vulnerable Consumers Coordination Group. The Energy Poverty and Vulnerable Consumers Coordination Group's overall mission shall be to provide the Commission and the Member States with the necessary policy expertise for initiatives aimed at supporting and protecting the most vulnerable consumers, while preserving and enhancing the well-functioning of the internal energy market. Inefficient buildings are often synonymous with energy poverty and social problems. This often means that people with low incomes have little control over their energy expenditure, causing a vicious circle of high energy bills, arrears and problems with wellbeing and health. Section 2.2.2 of the EU Guidance on Energy Poverty (accompanying Commission's Recommendation) looks into these issues and provides a reading of relevant energy performance of building stock indicators across Member States, as well as discussing how they can shed light on the issue of energy poverty⁴⁶.

Poorly performing buildings have high potential for improvement, but their renovation faces persistent barriers ranging from regulatory obstacles to structural factors. Addressing these barriers call for an integrated approach that also accounts for the energy poverty and affordability of housing.

It is important to recall that Commission Recommendation (EU) 2019/786⁴⁷ on building renovation provided a first overview of examples of good practices, notably as regards social housing and delivering advisory services to energy-poor households.

In this area, the following, latest best practices from the submitted long-term renovation strategies can be underlined:

⁴⁵ COM(2021) 660 final

⁴⁶ SWD (2020) 960 final, page 17.

⁴⁷ <https://eur-lex.europa.eu/legal-content/GA/TXT/?uri=CELEX:32019H0786>

2.7.1 Using Energy Performance standards as a key tool to identify the worst performing segments of the building stock

Minimum energy performance standards coupled with financing that limits the monthly net expenditure of inhabitants can significantly accelerate renovation. Accompanying services and technical assistance are essential for the worst performing buildings.

Some Member States are considering setting a specific threshold for gradual phase-out from the market, such as for buildings with an energy performance standard below a certain level:

- In **Belgium**, in the **Flemish region**, vulnerable groups qualify for a free energy scan of their homes; over 20 000 such scans are being carried out every year.
- In **Denmark**, the 2018 Energy Agreement allocates DKK 200 million per year from 2021-2024 to energy savings in buildings. As the savings potential is highest in homes for all-year-round use, efforts are targeting this segment. The pool will support energy actions included in a positive list. In order to ensure the most efficient use of the pool, each action on the positive list will be required. The subordination requirements will ensure that support is provided only for deep renovations where the overall cost-effective potential is achieved to the maximum extent possible. The building's energy label is included as part of the documentation base. The grant will be awarded to building owners who can demonstrate the highest energy saving potential (maximum savings in kWh/m²). This will make sure that the measure targets the least energy-efficient segments of the national building stock.
- In **France**, policies to address the worst performing segment of the building stock are in place, most notably a renovation obligation which will come into force in 2023. The obligation is part of the revised energy and climate law. It includes the following measures:
 - Rent calculations and property estimates will be done upon completion of renovation measures which remove the building from the 'thermal sieve/passeoire thermique' category (term used to designate worst performing buildings, i.e. classes F and G) by 1 January 2021. This will ban worst-segment property owners from increasing the rent between two lettings without undertaking energy renovations.
 - Energy performance diagnostics and rental contracts for housing must include information on the actual primary and final energy consumption of housing, and an estimate of the theoretical amount of energy expenditure by 1 January 2022 at the latest.
 - An obligation to display the theoretical amount of estimated energy expenditure in property advertisements by 1 January 2022 at the latest.
 - Finally, an obligation to renovate these dwellings. From 1 January 2023, energy performance will become a criterion for assessing the decency of housing. From this date, dwellings whose final energy consumption exceeds a certain threshold, defined by decree, may no longer be rented out.
 - From 1 January 2028, all dwellings with excessive energy consumption will have to be renovated.
- In **Malta**, the Energy Incentives Advice Scheme for Vulnerable Households was set up in 2018 aiming at reducing the energy and water consumption through the replacement of

old and inefficient appliances, specifically targeting vulnerable households. This scheme is funded with EUR 200,000 annually.

- **The Netherlands** is addressing the worst performing segments of dwellings by improving the average energy label of the whole stock. In the 2012 Covenant on Energy Saving Industry, the housing corporations, the Woonbond and the public authorities agreed that the total rental housing stock for 2021 must reach an average energy efficiency index of 1.25 (average energy label B).

2.7.2 Energy Service Companies (ESCOs)

In recent years, there has been an increased interest in the provision of energy services to achieve energy and environmental goals. In particular, some new companies providing energy services to final energy users, including the supply and installation of energy-efficient equipment, and/or building refurbishment, have started to operate on the European market. What differentiates these companies, defined as energy service companies (ESCOs), from traditional energy consultants or equipment suppliers is the fact that they can also finance or arrange financing for the operation and their remuneration is directly tied to the energy savings achieved⁴⁸.

The Renovation Wave Communication proposes to expand the use of ESCOs and energy performance contracts, which proved to work well in some Member States to make renovation affordable for all households, including those with a limited ability to cover costs upfront⁴⁹. Some countries have put in place measures to overcome regulatory barriers by creating intermediaries (for example, public ESCOs, public funds, utilities ESCOs) who work with government agencies to organise auctions for local ESCO companies with the aim of carrying out energy efficiency projects. As independent entities, these intermediaries can take over procurement functions, because they are not subject to public procurement regulations and can use alternative procurement methods, for example based on the highest net present value, instead of contracts based on the lowest price and on deliverables, saved energy. They can also use public funding for projects (as a solution to the low value of local ESCOs), can be a ‘neutral intermediary’ between the public agency and the local ESCOs, can resolve potential disputes on energy savings achieved, etc.

The average ESCO market of the European Union has been on a steady rise for the last decades, and the growth and maturity has continued or even increased slightly between 2015 and 2018. Traditionally, energy services markets in Europe included a variety of contract types, many types of contractors (suppliers) and a few types of clients (mainly industry and public sector). There are a number of traditionally well-developed markets in Europe, such as Germany, Italy, France, and some parts of Austria, and Czech Republic for a few decades. However, the ESCO markets have matured in other countries, both in terms of volume and in

⁴⁸ <https://e3p.jrc.ec.europa.eu/node/190>

⁴⁹ For more information : Commission staff working document - SWD(2020) 550 final - Support from the EU budget to unlock investment into building renovation under the Renovation Wave: https://ec.europa.eu/energy/sites/ener/files/eu_renovation_wave_strategy.pdf

complexity, and ESCOs play today an important role in energy efficiency. Barriers still remain, and the ESCO markets still have a great potential.⁵⁰

In this area, the following best practices from the submitted long-term renovation strategies can be highlighted:

- **Austria** will set up an **energy-saving contracting platform** for small- and medium-sized enterprises (SMEs). Its goal will be to record the energy-saving measures that were identified in the context of the supported energy and environmental consultations, but not implemented for various reasons, in a central database, with the consent of the undertakings involved. Contractors and external energy service providers should have access to this database to access information on unimplemented projects and actively contribute to the implementation of upcoming projects. In addition, the platform itself can identify projects from these data according to certain criteria.
- In **Belgium**, the Brussels Capital Region authorities plan to set up a market facilitator that will support the establishment of ESCOs and energy performance contracting (EPC), with a view to creating the conditions for the emergence of ESCOs. This facilitating body will also play the role of aggregator of applications in order to limit the expenditure of ESCOs in research and project planning. This measure will be accompanied by the removal of administrative and legal disincentives and the provision of standard procurements and contracts. Furthermore, a specific public legal vehicle will be created to support the managers of public building applicants in the preparation of the financing solution, and to offer tax and accounting advice for the renovation programme. In the **Flanders Region**, the Flemish Energy Company (VEB) facilitates energy performance contracts between ESCOs and public institutions. This is to remove the burden on public institutions as far as possible: the VEB provides knowledge and experience at technical, legal and project levels so that the ESCO process can be successfully completed.
- In **Cyprus**, a study carried out by the JRC suggests the preparation of standard tender documents for the selection of energy service providers, with a view to concluding energy efficiency contracts by the public and wider public sector. The aim is to create standard documents and a short, step-by-step procedure to guide authorities, both central government and the wider public sector, and help them implement such projects. It is expected that the documents will help increase the use of energy service providers when implementing energy efficiency projects in the public sector.
- In **Finland**, the Finnish Real Estate Federation invested in the implementation of new contract forms in 2017 and 2018. The investments resulted in new document templates that are compliant with the shared contractual practices of the real estate and construction industries. They are available in digital format at www.sopimuslomake.net.
- **The German** LTRS lists a number of mechanisms to promote ESCO and energy performance contracting. The website of the Federal Energy Efficiency Agency provides information on contracting model contracts and guidelines on energy-saving contracting available free of charge. This includes offers specifically aimed at public properties or local authorities.

⁵⁰ JRC report: 'Energy Service Market in the EU', 2019.

As part of the advisory programme ‘Energy advice for non-residential buildings of local authorities/non-profit organisations’, a ‘contracting cheque’ (up to 80% of the net consultancy fee, with a maximum of EUR 2 000) is provided for local authorities and non-profit organisations. A qualified energy consultant examines whether and how the measures proposed in a previous energy audit (also supported) or consultation (refurbishment roadmap) can be implemented using an appropriate contracting model. The aim is to draw the attention of local authorities to the often unfamiliar possibilities of different contracting models, encouraging greater use of energy-saving contracting in particular.

The Federal Government/federal state dialogue on energy-saving contracting will provide a platform for intensive exchanges on energy-saving contracting between representatives of the Federal Government and the federal states. The project aims to remove barriers to the implementation of energy-saving contracting and to build up regional expertise in this area. This will be done through annual plenary meetings and workshops, as well as a mentoring programme, the exchange of examples of best practice and the practical implementation of around 10-15 energy-saving contracting model projects in representative properties in local authorities and at federal state level, with the aim of providing a model for the potential of contracting and thus prompting the establishment of a functioning ESC market in Germany.

2.7.3 Grants

According to the Renovation Wave Communication, financing solutions aiming at cost neutrality for low-income households must address rents, energy and operating costs and local taxes through the use of grants, subsidised renovation measures or the use of energy savings for repayment (limiting upfront investment to available grants).

Grant schemes can be useful in stimulating the market by subsidising energy efficiency investments for households and businesses, which otherwise cannot be fully supported by the market alone due to high upfront costs. They directly fill an immediate financial gap and thus enable a temporary shift in the market.

All submitted long-term renovation strategies list targeted grants to foster energy-efficient renovation in specific aspects of the building stock, for example:

- **Czechia** developed a green savings programme which focuses on investment support to reduce the energy demand of family- and multi-family buildings. Partial and comprehensive renovation of residential buildings is supported. The budget uses proceeds from the trading in emission allowances (state budget). As of 2021, it amounts to CZK 4 000 million.
- **Denmark** developed an oil boiler scrapping programme: an aid scheme of DKK 20 million for the period 2021-2024, for scrapping oil boilers outside the public utilities. Aid is given on the condition that, following the scrapping of the oil boiler, the home owner will have a heat pump on subscription, and is granted to the company which supplies and runs the heat pump. Denmark also set up a ‘heat pump on subscription’ programme. In this scheme, selected companies install, own and operate a heat pump for a building owner. The building owner typically only pays a connecting contribution, a continuous subscription and the cost of heat used. The companies selected to benefit from this scheme will receive a grant per heat pump installation.

- In **Hungary**, the Home Renovation Assistance is a support to families with at least one child. The aid may be granted for both materials and labour costs, as well as for outdoor and indoor works. The maximum amount of aid shall be HUF 3 million in total. Half or half of the cost of materials and labour may be claimed. The implementation of the renovations will be monitored by the capital and county government offices and their district (capital district) offices.
- In **Ireland**, the Better Energy Homes scheme provides grant aid to private homeowners who wish to improve the energy performance of their home.

2.7.4 Focus on multi-apartment housing

The renovation of social and multi-apartment housing faces additional barriers due to the complex decision-making process involved.

The following best practices from the submitted long-term renovation strategies can be highlighted:

- **Croatia** developed an energy renovation programme for multi-residential buildings for 2021-2030, as a follow-up to the programme that ran from 2014 to 2020. The objective is an annual renovation rate of 1 % at the beginning of the period (2021) to be gradually increased to 3 % by 2030. Annual savings are expected to amount to 0.148 PJ. The expected cost of energy renovation is HRK 1.500/m², which corresponds to the 2020 cost. Moreover, the ENU-4 energy renovation programme for multi-residential buildings (approx. 520,000.00 m² renovated annually) has a funds from ESI funds for the next programming period 2021-2027, providing grants amounting to 60% of eligible costs and necessary to achieve a reduction of at least 50% of the heating demand of the building. The renovation up to the NZEB standard should be further encouraged. Implementation of the Program must be accompanied by strong promotional activities, technical assistance to applicants and it is necessary to ensure energy consumption monitoring before and after the energy renovation. In addition, consideration should be given to establishing a specific fund where costs are reimbursed to energy-poor or at-risk-of-energy-poor households. Estimated investment costs in period 2021-30: HRK 14.84 billion as approximately 50% of the buildings will also need seismic retrofit.
- In **Czechia**, the Panel programme provides subsidy for energy efficiency improvements in residential multi-apartment buildings through soft loans.
- **Estonia** developed a renovation programme for multi-apartment housing: since April 2010, around 1100 apartment blocks were reconstructed using pre-constructed elements developed close to multi-dwelling buildings. This renovation process has an impact on the neighbourhood and can also motivate other apartment cooperatives to undertake similar processes.
- In **Germany**, the Federal Government wants to promote the industrial pre-production of façade and roof elements and standardised installation of plant technology, including the supply of self-generated electricity, in conjunction with new investment and contract models. The approaches developed as part of the pilot projects carried out will be put into practice by means of a newly adopted support programme from the end of 2020. The programme's aim is the serial refurbishment of apartment blocks with funding from the BMWi and with the involvement of the Dutch 'Energiesprong' initiative.

- In **Lithuania** in 2013, municipalities were asked to identify worst performing buildings and buildings with thermal energy consumption over 150 kWh/m².year were identified and prioritised in the programme (which started in 2005) for the renovation (modernisation) of multi-apartment buildings. The implementation of the Programme for the renovation of multi-apartment buildings will continue and nearly 500 multi-apartment buildings will be renovated each year, with energy savings of 100 GWh. Priority will be given to multi-dwellings which were constructed in accordance with the technical standards of the Construction Regulation in force before 1993. After renovation, the building should qualify for class C and 40% savings should be achieved in the building's energy consumption. Moreover, a financial instrument will encourage building owners to upgrade old heating systems into newer single-circuit heating systems. Up to 30% of the investment costs will be reimbursed. 40% of the investment need is financed through subsidies while for the other types of buildings, the subsidies represent 30%.
- In the **Netherlands**, the concept of 'Energiesprong' is helping to achieve mass deep renovations with pre-fabricated, standardised modules that lead to major cost and time savings. The Energiesprong brokered a deal to bring 110 000 buildings to a NZEB standard. Thanks to a three-year EU Horizon 2020 grant, the initiative is planned to be rolled out in other EU countries, too.
- In **Slovakia**, since 2010, the '**Best renovated multi-apartment building**' competition has been launched every year, with an emphasis on a comprehensive approach to the renovation of a multi-apartment building, the results of which are announced at the Bratislava construction fair.
- In **Slovenia**, a project office shall be set up for the energy renovation of multi-apartment buildings. The Project Office shall comprise the provision of adequate staff and financial conditions for the implementation of the tasks of supporting the preparation of energy renovation projects for multi-apartment buildings. The operation of the Project Office focuses on the preparation of energy renovation projects for residential buildings and operates on a one-stop-shop basis and as a platform between investors (owners), managers, refurbishment contractors, eco-funds, energy suppliers, ESCO-companies.

2.7.5 Tackling split incentives to establish new 'right to renovate' for citizens living in residential multi-apartment buildings as owners or tenants

Split incentives refer to an information market failure that is based on asymmetric information between the parties and that could lead to energy efficiency investments being foregone, as a result of one party being responsible for investment costs while the other party benefits from energy savings.

Member States, in accordance with Article 19 of the Energy efficiency Directive should take appropriate measures to remove regulatory and non-regulatory barriers to energy efficiency, including the split of incentives between the owner and the tenant of a building or among owners.

A JRC report identifies several practices tackling split incentive issues between landlords and tenants across Europe.⁵¹ While it is clear that a one-size-fits-all solution does not exist due to particularities across various segments of the building sector and different national conditions, a successful approach to overcoming misaligned incentives should consider splitting costs and benefits in a balanced way. Other measures refer to the incorporation of energy performance in the social rent evaluation, prevention/limitation of increases in housing costs for low and middle income households as a consequence of renovations, on-bill finance programme, etc.

The following best practices from the submitted long-term renovation strategies can be highlighted:

- **In Denmark**, the landlord can choose whether energy improvements should be financed through an increase in the rent according to the general rules set out in the Rent Act or in accordance with the specific rules on the overall economic and cost-effective energy improvements. A scheme has been set up for energy renovations in privately rented buildings. It allows for a rent increase by agreement between the parties, calculated based on the total agreed and documented costs of the energy improvement works.
- In **Finland**, the heating costs of rented apartments and rented premises are, as a general rule, included in the rent. It is therefore worthwhile for the owner to keep the building and systems in good condition in order to minimise energy consumption. Hot water consumption is influenced both by the efficiency of water heating, distribution and equipment, and by water usage patterns. Residents' water use patterns vary significantly, so billing based on measured use allows for savings in housing costs. The costs of lighting electricity are very typically borne by tenants themselves. This is accompanied by the possibility of a split incentive as old buildings are equipped with outdated lighting technologies. Modern technologies and controls have the potential to produce more high-quality and cheaper lighting. Examples of models of leases developed by RAKLI include the green lease and light green lease, both of which support the sharing of investment costs and benefits between the landlord and the lessee.
- **Germany** already has a number of rental law instruments targeting 'split incentives'. Since 1 January 2019, annual rent can only be increased by 8% and this increase should be purely due to modernisation costs. The rent increase after modernisation can apply for an unlimited period of time. In other words, the property owner is not bound by the standard rent increase limit that otherwise applies. Current rental law allows the property owner to pass the cost of energy-efficient refurbishment on to the tenant. Ideally, the increase in 'cold rent' and reduced operating costs are in balance, making it possible to achieve 'warm rent' neutrality.
- In **Ireland**, an expert advisory group (comprising representatives from relevant government departments, the SEAI, and the Residential Tenancies Board), established in 2019, compiled a range of possible measures that could help to address the problems. Key measures emerging from the public consultation include the right tax incentives, grants, technical support and appropriate regulation.

⁵¹ JRC report: 'Overcoming the split incentive barrier in the building sector', 2014

- **The Netherlands** are putting in place tenant/owner obligations and rights related to energy renovation. A first step was already taken in the 2018 agreement between housing corporations and the tenants' association. This agreement includes a 'sustainability investment fee table', which is based on the real average savings on energy costs incurred by tenants following the improvement of their home. The scheme does not aim to change legislation, but rather to ensure that tenants agree to sustainability investments when the fee to be paid is based on the agreed table. To promote the transition in the rental sector, the authorities are considering possible **legal changes** requiring that at least 70% of tenants agree to a renovation. Several measures are in place in the Netherlands to help landlords recover some of their investments from the tenants and will be enforced by amending the Law on renting.
 - The Social Rental Agreement contains a 'Table of compensations for investments in sustainability' based on the real average saving in energy costs that tenants make after home improvement.
 - A performance contract joined to a Green Lease can establish agreements on performance guarantees, on how to share the benefits of the sustainability measures and on monitoring methods. This allows both the tenant and landlord to benefit from the sustainability measures.
 - The Energy Performance Compensation (EPV) scheme aims to achieve housing cost neutrality for landlords so that they can recover part of their investment when making social rental homes energy-neutral. Under this scheme, landlords can ask tenants for compensation for energy-neutral or 'Zero on the Meter' homes.
- In the **Wallonia** Region, the regulatory framework should provide owners, including landlords and other investors with a clear signal to plan their investments. Plan to introduce an obligation to increase energy performance of buildings every 5 years, which suits the rental market cycle, where the average lease period is 5 years. Support landlords to improve the overall energy performance of their buildings by various means, including a system of adjusting the rent according to energy performance, communication and promotion, investigating possible incentives, exploring various good practices, facilitating relocation of tenants during major works, etc.

2.7.6 Reinforcing the role of communities

The Renovation Wave Communication underlines the fact that energy communities generate, consume, store and sell energy, and are an important vehicle for increasing the share of renewables used in buildings for electricity, heating and cooling consumption⁵². A community

⁵² Many EU H2020 projects focus on energy communities / collective action initiatives: see, for example, the COMETS Project (<http://www.comets-project.eu/>)

approach may also help lift society's most vulnerable people out of energy poverty and support them in using their untapped potential as active players in the energy system.⁵³

In this area, the following best practices can be highlighted:

- In **Austria** Renovation of the Lehen district in the City of Salzburg: the city owns 26 multi-apartment residential buildings in that district built between 1950 and 1965. The buildings were in need of refurbishment and the city decided to renovate 14 buildings and to demolish 12 buildings and replace them with new buildings. The apartments were insulated in 2013 (façade, cellar ceiling and roof) and received new windows and balconies. The other apartments were demolished in stages and replaced by modern dwellings.
- In **Croatia**, several cities have developed smart city strategies (smart energy management, smart urban administration, sustainable urban mobility and others). Policies and measures on smart technologies and well-connected buildings and communities are defined at a city level through smart city strategies giving examples of such Croatian cities.
- In **Ireland**, the establishment of over 250 sustainable energy communities has been a significant success in encouraging local actors to work together. This is underpinned by mentors and grants. Ireland aims to reach 1 500 sustainable energy communities and to make a concerted effort to ensure that local communities are more conscious of poor carbon technologies and how they can be improved.
- In **Italy**, the introduction of a feed-in tariff to incentive "energy communities" and renewable energy self-consumption and promote of nearly zero energy districts.
- Sustainable neighbourhoods, eco-quartiers made in **Luxembourg** (new buildings): Luxembourg will ensure that future built neighbourhoods will improve urban quality and quality of life and will be free of CO₂. To this end, a definition of sustainable neighbourhoods, with common criteria and a clear methodology, and new funding will be developed. In addition, more harmonised inspections of buildings are to be carried by municipalities out in order to guarantee compliance with construction and energy standards. The Luxembourg government is developing major housing projects with state and municipal partners that aim to be 'zero-CO₂', 'zero-waste', 'car free' and 'socially inclusive' as well as 'climate neutral' even in light of the expected increase in population.
- In the **Netherlands** municipalities have to develop (together with stakeholders and residents) a 'Transition Vision for Heating', an environmental plan and the implementation plan towards eventually ending the supply of gas and being able to offer residents alternative sustainable heating options. The idea is that on an aggregate basis the municipalities' goal under the Transition Vision for Heating should be to make 1.5 million residential and other buildings sustainable by 2030. A programme is already under way to make 100 districts gas-free. In 2018 the first lot of 27 test beds

⁵³ See "Energy communities: an overview of energy and social innovation" at https://publications.jrc.ec.europa.eu/repository/bitstream/JRC119433/energy_communities_report_final.pdf

began, each of which were given about EUR 4 million from the Municipal Fund to cover the project shortfall.

- In **Spain**, a series of developments aims to define and recognise energy communities as key actors in the energy transition. Local energy communities receive particular attention as Spain supports local pilot projects that meet technical and economic solvency requirements at early stage. Spain has also developed new rules on the regulation of self-consumption, with the aim of making it easier for consumers to obtain cleaner energy at a lower cost. Spain also introduced a simplified compensation scheme in order to compensate for their surplus production with consumption or selling surplus energy to the market, and regulates the connections of self-consumption through the public distribution network, which allows consumption and generation to be located in neighbouring buildings.

2.7.7 Fostering Member State measures to promote renewable heating and cooling in buildings, notably for the benefit of low-income and vulnerable consumers

A number of Member States host projects designed to moderate energy demand by focusing on introducing renewable heating and cooling in buildings and/or retrofitting social housing to reduce energy costs for low-income and vulnerable consumers⁵⁴.

- **Croatia** developed an energy poverty programme for 2021-2030 to: (i) address energy poverty through local info-centres, (ii) provide adequate information and advice to energy-poor people and those at risk of energy poverty, and (iii) provide adequate information and advice on energy efficiency measures contributing to the fight against energy poverty, as well as on the possibilities for co-financing activities in this field. Indicators for the monitoring of energy poverty will be identified and a monitoring system will be set up through the already existing system for collecting data on household consumption and habits (Croatian Bureau of Statistics). Energy efficiency measures for energy-poor households will be co-financed, such as the replacement of household appliances with new systems and the improvement or replacement of heating systems (improving the efficiency of heating systems and the replacement of energy products, in particular electricity and fuel oil, with environmentally, economically and energy-efficient ones, in particular for systems using renewable energy sources).
- In **south-east Europe**, the REACH project has been successful in identifying ways to tackle energy poverty and improve energy efficiency in households. The project encompassed several zones in four countries (Bulgaria, Northern Macedonia, Croatia and Slovenia). The objectives were to make it possible for energy-poor households to act to save energy, to change their behaviour and to establish energy poverty as a problem requiring tailored policies and measures at local, national and EU level. As part of the project, the partners collected data and analysed specific aspects of energy

⁵⁴ <https://aster.vlaanderen.nl/english-summary> and <https://energiesprong.org/>. H2020 Transition Zero (<http://transition-zero.eu/>) built on the success of Energiesprong in the Netherlands, advancing its implementation and kick-starting the project in France and the UK (EU Energy Poverty Guidance).

poverty, involved local actors in fighting energy poverty and allowed households experiencing energy poverty to reduce their energy and water consumption. The project trained about 200 energy consultants who contacted households and provided them with advice on energy savings, provided free energy-saving devices and reported good practices from other EU countries. See more at: <http://reach-energy.eu>.

- In **Slovakia**, since 1998, an annual “**Progressive, Affordable Housing**” competition aimed at supporting the development of housing in Slovakia, presenting positive examples of procurement and the construction of affordable housing.
- In **Slovenia**, the ZERO500 programme aims at alleviating growing energy poverty through investments in energy efficiency measures (replacement of facades, windows, roof insulation, installation of ventilation and others). The programme will include 500 low-income households in single-dwelling buildings or apartments in double-dwelling buildings, which will receive 100% of the grants to finance investments.

2.7.8 Energy poverty and related social policy measures

The Renovation Wave Communication also underlines that the EU Building Stock Observatory, the EU Energy Poverty Observatory, the Horizon Europe Mission on Cities and the EU Covenant of Mayors Office can further assist Member States in taking stock and identifying segments in need, and in linking renovation strategies to social indicators and policies to address energy poverty.

The examples below show some of the social policy measures reported by Member States in their long-term renovation strategies:

- In **Belgium, the Brussel Capital region** has developed a wide range of social policies to address energy poverty. The revision of the “Brussels green loan” foresees a 0 % loan rate for a vulnerable target audience. Moreover, free information/coaching support is available to vulnerable households (for example through ‘pro deo’ architects). **The Flanders region**, developed the Rental and insulation premium (previously known as Social Energy Efficiency Projects) for dwellings inhabited by vulnerable private tenants. In addition to a flat-rate contribution of EUR 200, the owner receives EUR 20/m² for roof insulation; EUR 12/m² for wall insulated; EUR 85/m² for high efficiency glazing. In addition, an emergency fund was set up for certain target groups who do not have sufficient financial resources to make their home energy efficient. An interest-free loan of up to EUR 25,000 can be granted to the emergency buyers, poor owners who are required to purchase a poor quality dwelling. Only when the home is disposed of, or at the latest after 20 years, the loan must be reimbursed. A first call (EUR 15.5 million, covering 625 loans) was launched by the Minister of Energy at the beginning of 2020. Finally, the Energy scan for free has been developed. An adviser in the home is looking for energy savings. The residents receive energy-saving tips that can be applied at the outset. Where useful, the energy scanner places free energy saving materials (energy-saving shower head, energy-saving light bulbs, radiator foil, pipe insulation).
- In **Cyprus**, the measures to protect vulnerable electricity consumers include, the right to apply for special household electricity tariff (which is about 20 % lower than the normal tariff), inclusion of a legal provision which foresees continuation or

reconnection of electricity supply in critical periods for vulnerable consumers who face serious health problems, financial incentives for the installation of a residential photovoltaic system using the ‘net-metering’ method and higher grant rates for residential energy upgrades offered by the ‘Save & Upgrade’ financial incentives (75 % instead of 50 % for other consumers) and support for installation of individual energy saving measures.

- **Denmark** has developed a heat supplement for pensioners and early retirees. This is an aid provided by municipalities on an individual basis to pay particularly high heating bills for people who have been affected by changes in their circumstances (e.g. unemployment or sickness).
- **France** has developed a wide range of social policies to address energy poverty, including the creation of a guarantee fund of more than EUR 50 million to help 35 000 households with modest income each year. The energy tax base has also been extended to 20% of households with the lowest incomes in order to make it possible to extend the distribution of the energy voucher to 2.2 million additional households, i.e. 5.8 million households in total.
- **Ireland** has put in place since 2000 the Homes scheme. The scheme provides free energy efficiency upgrades to homes where the householder receives a social welfare payment. The scheme has upgraded more than 142 000 homes since 2000. In addition, the Warmth and Wellbeing pilot scheme provides energy efficiency improvements to the homes of older people and children living with chronic respiratory conditions.
- In **Latvia**, the “**warmer living**” measure is an agreement signed between stakeholders in the public and private sectors to contribute to the reduction of energy poverty by working together and providing information to households.
- **Luxembourg** has a wide range of social measures that contribute to alleviating energy poverty. This includes the Act of 1 August 2007 on the organisation of the electricity market and the organisation of the natural gas market. The amended Acts state that a household customer who is unable to pay their electricity or gas bills may receive social assistance from the competent social security office. In addition, the ‘*allocation de vie chère*’ is a subsidy scheme that helps combat energy poverty. Also, the state rent subsidy can help those in need face a possible increase in the cost of housing. It should also be stressed that Luxembourg’s current legislation prohibits the disconnection from the grid of a household customer who is unable to pay their electricity or gas bills.
- In **Portugal** an energy efficiency criterion in the scope of the lease is included. In addition, alignment of the worst-performing segments targeted for interventions with the minimum energy performance standard in buildings by 2030 is foreseen.
- **Romania** is planning several measures, including ones to: (i) streamline existing heating aid to ensure equity among beneficiaries and a level playing field as regards heating sources, (ii) extend social support to energy poverty other than heating, and (iii) introduce a heating strategy coupled with the phasing out of heat price subsidies.
- In **the Netherlands** landlords are obliged to bring residential properties up to the required ‘standard’ in order to protect tenants from high energy costs. The government agreed that the total rental housing stock would attain an average Energy Index of 1.25 (average energy label B) by 2021. For insulating existing homes subsidy schemes have been in place for a long time.
- In **Spain**, a whole National Strategy to alleviate Energy Poverty is developed and reported in the LTRS; the ‘social bonus’ is a mechanism that the government launched

on 1 July 2009 to protect vulnerable consumers. Royal Decree No 897/2017 introduced new requirements for the application of this social bonus. It differentiates between an electricity and a thermal bonus. In early 2020, as a result of the COVID-19 pandemic, more beneficiaries were added (self-employed people who were forced to cease their activity because of COVID-19 or who have seen their turnover fall by 75% as compared with the previous half-year). Several other social policies to address energy poverty are in place, e.g. agile and low-cost refurbishments available to vulnerable households, increase in the number of social housing renovations through public intervention, specific provisions for vulnerable households in grant allocation for building renovations.

- In **Sweden**, support was introduced to encourage renovation and energy efficiency measures in rented properties in areas facing socioeconomic challenges. The support is divided into two parts: one for renovation and one for energy efficiency. The renovation support, which is 20% of the costs, is given directly to the tenants as a rent rebate over 7 years. The energy efficiency support is calculated on the basis of the energy savings achieved after the renovation. This part of the support is given to the property owner. To be eligible for this part of the support, the renovations must improve energy performance by at least 20%. Support cannot be sought for renovation or energy efficiency alone, as that does not fulfil the purpose of the measure.

2.8 Focus area 2: Public buildings and social infrastructure

The Renovation Wave Communication stresses that public and privately-owned social infrastructure, public administrative buildings, social housing, cultural institutions, schools, hospitals and healthcare facilities can spearhead the Renovation Wave, serving as a role model and reference point for the industrialisation of construction and the co-benefits that become immediately visible to the public.

Moreover, according to Article 2a (1) (e) of the revised EPBD, each long-term renovation strategy must comprise policies and actions for all public buildings. This should include ongoing and planned measures, as provided for in the revised EPBD and the EED, to renovate at least 3 % of central government buildings every year.

All submitted long-term renovation strategies contain a specific chapter on public buildings, underlining that the public sector should play an exemplary role and take the lead by improving energy efficiency in its buildings. Renovation will be used as an opportunity to ensure that public buildings are accessible for persons with disabilities. There are, however, differences between the submitted strategies regarding the scope of the public buildings covered depending on the national administrative structure, as well as concerning the breakdown of these public buildings by sub-sector, e.g. schools or hospitals. Nevertheless, most strategies report dedicated policies for central government buildings and schemes to encourage energy-efficient renovations by local authorities such as municipalities.

The following best practices from the submitted long-term renovation strategies can be highlighted:

2.8.1 Setting targets for public buildings

- In **Belgium, in the Walloon Region**, the public sector is at the forefront of the measures and expected to play exemplary role through exemplary renovations and other. Specifically, exemplary renovation of public housing will be carried out through public housing renovation plan to achieve the average decarbonised EPB A label by 2040 (~ 5 000 dwellings/year), complemented by further activities to support the plan above (e.g. public consultation, studies, etc.). In addition, the exemplary role of public buildings will be strengthened through a number of activities, including coordinated service in the form of one-stop shops, strengthening the role of internal energy managers, and facilitating the financing (by e.g. the Energy Performance Contracting, PPP, citizen funding and other) and by aggregating projects and reducing (perceived) risks.
- In **Bulgaria** measures targeting the public sector include, among others, the implementation of energy management systems in 20 public buildings by 2030, trainings for local authorities, online platform to aggregate projects on public buildings including a list of verified contractors and green bonds for public buildings owned by state or local authorities.
- In **Croatia**, the public sector is obliged to manage energy systematically, as required by the Energy Efficiency Act and through the energy management information system. The aim is to capture and regularly monitor all public sector buildings and street lighting systems by the end of 2030. Savings based on systematic energy management and the introduction of remote sensing during the previous period are set at around 335 TJ per

year. Moreover, Croatia will prolong its energy renovation programme for public sector buildings over the period 2021-2030. From 2016 to 2020, the available ERDF funds amounted to EUR 211 million for the energy renovation of public sector buildings, and up to now approximately HRK 1 494 billion has already been allocated to the energy renovation of 871 buildings. The implementation of projects under this programme is planned to be completed by the end of 2023. Croatia wants to use EU funds for the next programming period 2021-2027, in such a way as to ensure both the mobilisation of private capital and ESCO markets (including hospitals, penitentiaries, etc.).

- In **Malta** appointment of energy officers for public buildings and implementation of energy management systems in public buildings will be mandatory by 2025. Officers responsible for energy management shall be appointed in each public building by 2023.
- In **the Netherlands**, a national real estate company roadmap was developed to ensure that planned investments are made in order to accelerate progress on sustainability goals for national buildings. This concerns buildings with a public function such as education, sport, culture, welfare, social care and/or healthcare. These sectors have committed to agreeing their own roadmap describing their contribution to a net-zero-energy built environment by 2050. The central government should serve as a catalyst for others. All office buildings will have to be energy performance certificate class C by 2023 and energy performance certificate class A by 2030.
- In **Portugal**, the strategy foresees structuring and strengthening the inter-ministerial network of interlocutors to implement the action plan to intervene in the existing public buildings and requalifying the figure of Local Energy Manager, to be called the Energy and Resources Manager.
- **Romania** is planning to develop a project pipeline to ensure the refurbishment of public buildings by at least 26 % by 2030, 52% by 2040 and 100 % by 2050. This should include: (i) technical and procedural support to local authorities for project documentation and access to finance, (ii) increased support for schools and other public buildings with evaluation of technical projects to ensure quality and compliance with best practices, (iii) the aggregation of public building renovations into large procurement packages to get better prices, reduce the number of offers and centralise monitoring, and (iv) the development of standard tender documentation with performance indicators and specific requirements and procedures for technical and economic evaluation, as well as centralised purchasing and procurement frameworks for services and refurbishment works targeting energy efficiency in buildings owned by central government and in municipal buildings. Romania is planning to allocate a budget of EUR 300 million from public/EU funds for central government buildings and of EUR 1.3 billion (of which ~ EUR 700 million from the public budget/EU funds and ~ EUR 600 million from the private sector) for municipal public buildings.

2.8.2 Promoting green public procurement

- **Brussels Capital** authorities have stated that a 100% green electricity supply for public buildings will be imposed in the very short term for the region's administrations (it should be noted that local authorities are already almost all supplied with 100% green electricity). To this end, an obligation will be imposed on the various regional administrative departments (including ministerial offices) and public interest bodies renewing a contract

for the supply of electricity to obtain 100 % green electricity (covered by guarantees of origin).

- **Croatia** adopted a national green public procurement action plan for 2015-2017, which set a target of 50 % of public procurement procedures being green by 2020. A National Commission for Green Public Procurement has been set up and monitors the action plan's implementation through a survey and an electronic public procurement notice. The aim is to have 75 % of public procurement procedures implemented using green public procurement criteria by 2030.
- **Czechia** developed the EFEKT programme: Support to energy management in public buildings, support to good quality energy efficiency projects, support for preparing EPC projects for public and commercial buildings.
- In **Denmark** all ministries are obliged to reduce energy consumption by 14% in 2020 compared to 2006 (the State already reduced its energy consumption by 10.9% in 2006-2018). On 17 January 2020, a revised obligation entered into force introducing additional requirements for the central government institutions. Denmark also developed the Loan pool for municipalities and regions: The 2018 Energy Agreement introduces subsidies for energy efficiency improvements in buildings owned or operated by municipalities carried out between 2021 and 2024. During this period, the scheme will allocate DKK 100 per year in loans to finance energy renovations in buildings owned or operated by municipalities and regions.
- In **France**, a dedicated taskforce for school renovation is to be put in place. Educational premises represent around 50% of the public building stock and account for 30% of total consumption.
- In **Germany**, energy-efficient procurement by public institutions is compulsory under the Public Procurement Regulation (Vergabeverordnung) and all public contributors to pan-European tenders are bound by it. The regulation stipulates that the highest performance level for energy efficiency and - where available - the highest energy efficiency class, will be required when energy-related products are procured or are essential for providing a service. Energy efficiency must also be an evaluation criterion when determining the most economical bid.
- In **Ireland**, the energy efficiency improvement of each public sector body is monitored annually through the monitoring & reporting system operated by SEAI to which each public sector body is legally required to report. Good progress has been made on energy efficiency, with a 27% improvement achieved by the end of 2018 through a combination of behavioural measures, improved energy management and renovation. In the coming years the system will be extended to include a mechanism to monitor compliance with the rule to display energy certificates. Public sector bodies that make savings as a result of their energy efficiency efforts can keep those savings within their organisational budgets.
- In **Luxemburg** another aspect of the state's pioneering role is the replacement by 2025 of light bulbs in public buildings and street lighting by LEDs to improve energy efficiency and help fight against light pollution. The government's administrations will convert all lighting sources from roads, public spaces, buildings, stations and monuments from existing energy-absorbing luminaires to energy-efficient LED lighting.
- In **Slovenia**, the Project Office for Energy Renovation of Public Buildings shall speed up the preparation of integrated energy renovation projects for public buildings by providing expert support for the identification of priority projects, the preparation of such projects, the definition of the delivery model, the monitoring and verification of energy savings and other activities, actively develop and promote new financial models to encourage the

renovation of public buildings and the contractual delivery of energy savings (e.g. exploring an additional energy contract model following a public procurement procedure, examine of an additional model (public-public partnership)

- **Sweden** has developed legislation on the purchase by public authorities of energy-efficient goods, services and buildings and requires public authorities to procure energy-efficient goods, services and buildings above certain thresholds, subject to certain conditions. Reporting on work in this area is being carried out by the Swedish Agency for Natural Resources, which reports to the Government Offices.

2.8.3 Stimulating public-private partnerships to promote public building renovation

- **In Denmark** it is compulsory for local authorities to consider the use of Public Private Partnership (PPP) whenever they decide to carry out new construction or renovation of buildings. PPP projects are supported by standard contracts and manuals, which have been developed by the Government for local authorities.
- **In Finland**, the obligations set out in the Energy Efficiency Directive have been fulfilled through voluntary energy performance contracts. Around 70 % of Finnish municipalities (in terms of number of inhabitants) are covered by such municipal energy performance contracts. Moreover, Finland supports ESCO projects in the public sector with an ESCO subsidy (which will lead to higher incentives). The subsidy is 25% for companies and corporations included in the scope of the energy agreement scheme. If the ESCO project uses new technology, an additional subsidy of up to 40% is available.
- **In Greece**, the "Electra" programme will provide EUR 500 million by 2026 for the implementation of investments of for energy savings in public buildings. The resources of the program come from the Deposits and Loans Fund and from the European Investment Bank, while ESCOs could also participate.

2.8.4 Focusing on key target groups, in particular schools and hospitals

- The **Austrian** strategy contains a number of regional/municipal best practices on the energy-efficient renovation of schools. For instance, in Vienna, the school renovation package provides for the reduction of heat consumption in public compulsory schools through thermal improvements made to the building stock. Between 2008 and 2014, as part of the school renovation package, improvements were made to the building technology used in 189 schools: radiator valves were replaced by thermostatic valves, all radiators, controls and pumps were replaced, pipes were insulated and hot water systems were upgraded. The total savings for the years 2006 to 2014 stood at 32.4 GWh. Another good example is the Upper Austria regional support programme for photovoltaic installations in schools and kindergartens, which enabled the construction of photovoltaic facilities in more than 360 schools. About 40 % of all primary and new secondary schools in Upper Austria were reached through this programme and a total of more than 1 kWp (peak power output) of PV installations were installed in public buildings. Due to its great success, the programme was subsequently continued in kindergartens and installed around 700 kWp photovoltaics in over 180 kindergartens. In total, the measure reached 550 schools and kindergartens. The **PV for schools programme** of the province of Upper Austria enabled the installation of photovoltaic facilities in more than 360 schools and in over 180 kindergartens (700 kWp photovoltaics).

- In **Belgium**, in the **Brussels Capital Region**, a cap of 100% green electricity supply for public buildings will be imposed in the very short term for the regional administrations.
- **Croatia** developed a dedicated programme for the renovation of buildings owned and operated by its Armed Forces. The long-term development plan for the Armed Forces of the Republic of Croatia for 2015-2024 includes the removal of troops from non-adequate sites over two phases — the first phase by the end of 2019 and the second phase over the 2020-2024 period. As a first priority, seven locations were to be targeted, with reconstruction and improvement of energy efficiency. In the second phase, 15 sites will be renovated, which will also include the deployment of renewable energy sources.
- In **Cyprus**, the H2020-funded ‘PEDIA’ project aims to upgrade 25 schools to NZEB level and gain on average 65% in primary energy savings. Overall, it aims to trigger EUR 7.5m in sustainable energy investment, develop an innovative financing solution for schools’ energy efficiency upgrading and introduce an energy management system (ISO50001) into renovated school buildings to monitor and continuously increase energy savings.
- In **France**, schools represent 30% of the consumption of municipal buildings. In 2019, a task force on the energy renovation of schools was launched. A Convention was signed on 30 May 2018 between the state, *Ademe* and the *Caisse des dépôts* to provide comprehensive support for the renovation of buildings owned by local authorities.
- In **Romania**, the Effective Romania programme includes the renovation of several schools, the deep renovation of public buildings, energy efficiency information campaigns, the development of a practical guide for energy efficiency and specialised energy efficiency training for public administration representatives.
- **Slovakia** developed Regional Sustainable Energy Centers to support the planning and implementation capacity of municipalities for sustainable energy development in districts/strategic planning regions in accordance with the proposal for a Vision and Strategy for Development of Slovakia until 2030. The mission of these centers is to optimise energy consumption and consumption in a given territory, to increase its energy self-sufficiency on a RES basis, in strict compliance with the environmental criteria. (EUR 31.83 million, cost for action).

2.9 Focus area 3: Phasing out inefficient technologies and fossil fuels in heating and cooling

According to the impact assessment of the climate target plan for 2030, the residential sector would have to undergo the highest reduction in energy demand in heating and cooling, ranging between -19% to -23% compared with 2015. **The annual rate of replacement of heating equipment would have to reach around 4% in both the residential and services sectors.** During the same time period, the share of renewables used in heating and cooling would have to increase to 40% of final energy consumption to reach the objective.

In this area, the following best practices from the submitted long-term renovation strategies can be highlighted:

2.9.1 Fossil fuel phase-out in private dwellings

- **Austria** developed an ‘exit from the oil and remediation cheque for private individuals 2019’: in order to further facilitate the transition to climate-friendly heating systems, this ‘*Raus-aus-dem-Öl*’ bonus 2019 supported the replacement of heating systems, irrespective of any simultaneous building renovation. To benefit from this, it was necessary to present a valid energy performance certificate of the residential building or an energy advisory protocol of the respective Land. When a thermal renovation measure was submitted, support of up to EUR 6 000 was possible, as well as a supplement for the use of renewable solutions of up to EUR 3 000. Online registration made it much easier for people to apply.
- **Bulgaria** will proceed to mandatory staged decommissioning of solid-fuel heating devices from 2020 to 2024 that do not meet the requirements of the Eco-design under National Ambient Air Quality Improvement Programme.
- **Denmark** has set up grants for scrapping oil boilers: covering the years 2021-2024, these grants (for a total of DKK 20 million/y) will support the replacement of oil-fired boilers with individual heat pumps. There are currently approximately 80 000 oil-fired boilers heating Danish homes.
- **France** is maintaining incentives for individuals to move away from oil heating by 2028 towards renewable heating installations, such as heat pumps, boilers biomass, combined solar systems or a connection to a renewable heating network.
- **In Finland**, the national energy and climate policy aims to be carbon neutral by 2035. Some cities and municipalities are already aiming for carbon neutrality in 2030. In order to achieve this objective, the use of fossil fuels for heat production is restricted. Coal will cease to be used for energy production by 2029. Part of the fossil fuel oil being used must be replaced by bio-oil. Oil heating of state and municipal real estate will be phased out by 2024 (2019 government programme). Finland is encouraging oil-fired buildings to switch to other forms of heating during the 2020s through a separate programme of measures (2019 government programme). In residential buildings, oil heating in individual buildings will be phased out by 2050 (energy and climate strategy).
- **Hungary** has developed a Green Remote Heat Programme: under the programme, the greening of the district heating sector will mainly be achieved by increasing the use of geothermal, waste heat, as well as biomass produced on the basis of sustainability criteria for heating/cooling. A further objective is to increase the use of waste water treatment,

depot gas and the use of biogas of agricultural origin. The incentives for the use of these resources will be developed on the basis of a detailed analysis carried out on a case-by-case basis in larger districts, taking into account local conditions.

- In **Ireland**, further regulation from 2022 will effectively phase out further installation of oil boilers from 2022 and the installation of gas boilers from 2025 in all new dwellings. Ireland also developed the Support Scheme for Renewable Heat supports the replacement of fossil fuel heating systems for commercial, industrial, agricultural, district heating and other non-domestic heat users in the non-ETS sector.
- In **Luxemburg** the taxation of heating oil will gradually be increased, taking into account the CO₂ minimum price described above. The aim is to encourage the shift towards renewable and more climate-friendly heating. To make this measure socially acceptable, an attractive support programme for oil heating exchange will be introduced. The competent ministries will analyse the impact of increasing the cost of heating oil with the public subsidy from the 'Allocation de vie chère' and, if necessary, will respect the effectiveness of this premium, as well as the technical feasibility.
- **The Netherlands'** strategy describes a progressive fossil fuel ban: the country's direct CO₂ emissions from buildings are almost exclusively derived from natural gas heating. There are also indirect emissions from electricity generation. To reach a CO₂-free built environment, the Netherlands is looking to switch to clean electricity and to phase out the use of natural gas, both inside and outside the built environment. Legal adaptations are making dwellings and neighbourhoods progressively no longer connected to natural gas. A Climate Agreement contains specific agreements with landlords on making rented accommodation gas-free. It has been agreed that landlords will make 100 000 rented homes gas-free or 'gas-free-ready' in the next four years. The central government supports landlords by contributing to the costs of making rented dwellings gas-free. This requires EUR 200 million of the money for the energy investment deduction (EIA). It will be called the 'incentive scheme for gas free rented accommodation' (SAH). The scheme will support the connection of rented dwellings to a district heating grid. Additionally, money is available to landlords through the ISDE sustainable energy investment subsidy and, starting in 2022, the 'reduction of landlord levy' (RVV) scheme for sustainability investments, which is comparable with the current STEP ('incentive scheme for energy performance in the rental sector').

2.9.2 Fossil fuel phase-out in public buildings

- **The French** long-term renovation strategy includes an obligation to ban oil heating in public sector buildings by 2030.
- In **Finland**, the 2019 government programme includes a phase-out of fossil fuel oil by the early 2030s. Government buildings are already trying to phase out fossil oil by 2024, by switching from oil heating to district heating, and installing heat pumps (geo-heat pump; air-to-water heat pump and additional source of heat such as biofuel).
- **The Brussels Capital authorities** set out requirements for public buildings which are stricter than those applicable to other buildings, and may also take into account the possibility of producing energy from renewable sources. For existing buildings **undergoing major renovation, 30% of the energy consumed in public buildings must be produced from renewable energy or high-efficiency cogeneration.** In the longer

term (2030), public buildings will be subject to requirements based on an analysis of the environmental impact of materials used on sustainability. The authorities will develop and implement a regulation on building sustainability, complementary to the energy performance regulation. It will first be imposed on public authorities by being included in the technical specifications of public tender specifications, and will then be imposed on the private sector, depending on building type and size.

3 Country

fiches

Austria

Summary of the long-term renovation strategy

Austria's long-term renovation strategy (LTRS) contains milestones, stocktaking and policies. It sets out a clear list of milestones until 2050, expressed in greenhouse gas emission reductions. The strategy is in line with an overall CO2 reduction approach. According to the LTRS modelling, the set of measures is adequate to achieve an 80% decarbonisation of the buildings stock. Austria is applying a comprehensive set of measures to address building renovation which includes regulatory requirements, fiscal and economic incentives and information measures. The strategy focuses on phasing out the use of coal and oil for heating.

Austria's LTRS is highly decentralised. It is structured around federal and regional obligations and measures. This requires strong coordination between the Länder and the Federal government, especially on financing.

Information on the building stock

2011	Single-family buildings	Multi-family buildings	Apartments	Overall
Buildings	1 727 129	175 910	70 940	1 973 979
Residences	2 012 192	961 237	1 326 620	4 300 049
Principal residences	1 730 263	826 558	1 140 747	3 697 567

- Final residential energy consumption per m²: 8.66 Mtoe, Average annual change [%] 2005-2017: -0.38 (Energy Union indicators)
- Despite a population increase of around 14.5% over the last three decades, energy consumption for heating, cooling, hot water, ventilation and lighting in the buildings sector has remained stable.
- House prices have risen strongly in the past decade, but recent data show the opposite trend. Excess demand for housing appears to have peaked in 2016, as building permits and construction picked up. Most indicators suggest that house prices are overvalued by 10% or more.

- New buildings have increased their energy performance (by about 40%) and energy consumption has fallen by approximately 28.6% since 1990.
- The share of renewable energy sources in buildings has significantly increased (due to the technical regulations on construction that require since 2007 to assess alternatives before embarking on any new construction or major renovation) from 38.3% in 1990 to 54.4% in 2017.
- Greenhouse gas emissions in the buildings sector have been reduced by about 35.1% (1990:12 862 ktCO₂eq to 2017:8 347 ktCO₂eq).

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

	Overall CO ₂ emissions modelling average ktCO ₂ eq		CO ₂ milestones in the buildings sector ktCO ₂ eq		
	Households	Buildings	MIN	MEDIUM	MAX
2020	6 214	8 149			
2030	4 687	5 550	6 000	5 600	5 200
2040	3 465	3 949	4 700	3 900	3 500
2050	2 465	2 639	3 700	2 600	1 900
INTENDED	2 146	2 572		2 600 (target)	

The LTRS sets out a list of milestones until 2050, expressed in greenhouse gas emission reductions.

- The strategy focuses on phasing out the use of coal and oil for heating.
- Renovation rate (across all building types) to be increased to 3% from current 1.5% p.a. (for the 2020-2050 period).
- According to the LTRS modelling, the set of measures is adequate to achieve an 80% decarbonisation of the buildings stock.
- By 2050, green gas will reach approximately 20 TWh, with a total volume of 5 TWh already made available by 2030.
- With maximum effort and in the best-case scenario (in particular the presence of a quantity of approximately 2.5 TWh of green gas), the greenhouse gas savings of 3 million tonnes (calculated from the 2017 data basis) envisaged in the NECP can be achieved in 2030.

Investment needs

- To maintain the current level of refurbishment/renovation work, approximately EUR 5.3 billion in economic output must continue to be spent per year (corresponding to approximately EUR 600 per head or slightly over EUR 1 200 per household), especially since the motivation to make thermal energy improvements often goes hand in hand with a multitude of other home improvement options, which of course can also be seen as refurbishment/renovation work.
- Increasing the (effective) refurbishment rate to 3%, which is one of the stated goals of this legislative programme, would require a range of incentives worth over EUR 10 billion. The funds that will need to be earmarked for these incentives are much higher than the EUR 100 million made available via the Federal Refurbishment Check in recent years.

Good practices

Legislative

- Introduction of mandatory energy accounting accompanied by the free use of an internet-based energy accounting tool. This will make buildings comparable and allow for the establishment of benchmarks.
- **Mandatory phase-out of inefficient lighting systems for municipalities.**
- At least 40% of all efficiency measures under the energy efficiency obligation scheme will be effective for households.
- At regional level: i.e. in Carithian Länder: mandatory measures to avoid summer overheating.

Finance

- **Climate and energy model regions programme.** Part of the Climate and Energy Fund, this programme provides regions with support for their energy planning and policy making. This includes the design of tailored investment support (partly financed from the Climate and Energy Fund). It also fosters cooperation between municipalities.
- AT Federal government's renovation plan launched in 2009 grants support in the form of one-off, non-reimbursable grants. It was extended from 2012 onwards to include a category of listed buildings. Results for 2018: 5 782 private and 180 business renovation projects supported, triggering sustainable investments of around EUR 283 million. Annual energy savings of around 111 000 MWh and an annual CO2 savings of over 35 300 tonnes.
- **A 2019 bonus to support the exchange of heating systems** irrespective of a complete building renovation. To be eligible, it was necessary to present a valid energy performance certificate of the residential building or an energy advisory protocol of the respective Land. The funding amounted to up to EUR 5 000 for a single or two-family house and up to EUR 1 000.

Public buildings

- An energy saving potential of 84.7 GWh has been estimated for 2021-2030. This can be achieved through contracting and refurbishment planning measures, a refurbishment offensive (mission 2030) for the public sector and public procurement of energy-efficient building components. The Federal government and the regions have agreed to adhere to a voluntary agreement to reduce CO₂ in the public sector, which will largely be achieved through building renovation.
- **Federal property contracting programme** for renovating Federal buildings.
- The programme for municipalities helps municipalities adhere to energy efficiency requirements, e.g. through training for community staff (energy consultant training) and assessing energy consumption of public buildings against target and limit values (benchmarks for electricity/heat/water).
- The **PV for schools programme** of the province of Upper Austria enabled the installation of photovoltaic facilities in more than 360 schools (more than 1 kWp of PV installed) and in over 180 kindergartens (700 kWp photovoltaics).

Energy poverty – worst performing buildings

- Over a million people are at risk of poverty. According to national statistics, around 2.7% of the population cannot adequately heat their homes in winter. This corresponds to approximately 230 000 people or 120 000 households.
- Energy poverty is addressed by a leverage factor included in the **energy efficiency obligation scheme** under the federal energy efficiency law. Savings achieved in low-income households are leveraged with a factor of 1.5, which makes this segment more interesting for the responsible energy suppliers. Household measures represent 37.3% of the total savings, with annual savings of 25.4 PJ. In low-income households, measures led to annual savings of 0.62 PJ set.

Multi-apartment residential buildings

- Renovation of the Lehen district in the City of Salzburg: the city owns 26 multi-apartment residential buildings in that district built between 1950 and 1965. The buildings were in need of refurbishment and the city decided to renovate 14 buildings and to demolish 12 buildings and replace them with new buildings. The apartments were insulated in 2013 (façade, cellar ceiling and roof) and received new windows and balconies. The other apartments were demolished in stages and replaced by modern dwellings.

Advisory tools

- **Online energy information campaign** (Klimaschutzinitiative klimaaktiv). Information and awareness-raising activities as well as consultations (product-independent, promoted and public) are planned. The energy certificate is to be upgraded qualitatively, and data on the building stock and the technologies for conditioning buildings are to be collected in a structured way (e.g. building and housing

registers). A broad-based communication campaign is planned to enable a targeted transfer of knowledge, e.g. through model buildings that make different building concepts and technologies researchable and tangible.

- **Free advice on energy-related issues** relating to the construction and renovation of buildings, heating and air conditioning of buildings and electricity applications for low-income households. Coordinated information in the areas of thermal insulation, windows and installation, heating systems, support, energy saving tips, photovoltaics, storage systems and cost savings.

Skills

- **Specific training programme for energy consultants:** The Federal Act lays down qualification requirements for energy auditors and energy consultants and requirements for carrying out energy audits, including individuals qualified to carry out energy audits. External energy auditors must also be registered in a publicly accessible register managed by the National Energy Efficiency Monitoring Unit.

Other useful information from the LTRS, the NECP and other sources:

- EPCs are regularly updated with additional information including on regional support programmes.
- Central energy certificate database (ZEUS): regional energy certificates must be submitted by the issuer to the ZEUS energy certificate database of the Land. These are checked automatically for compliance with the energy-related building and subsidy law provisions.

Areas for potential improvement compared to best practices

It could be useful to consider:

- providing a clearer overview of the measures as well as the regional or federal budget to increase clarity on the strategy and the existing measures; and
- analysing in more details the wider benefits of renovating buildings.

Belgium

Summary of the long-term renovation strategy

Belgium submitted three regional strategies.

The **Brussels-Capital** renovation strategy presents a comprehensive and well balanced set of policies to stimulate deep renovation, including “phased renovation obligation”. The strategy also includes a comprehensive set of measures for the mobilisation of investments and activate all funding levers: mobilisation of citizen savings, attractive banking products, tax incentives, third-party investments, equity financing, the activation of EU funds, etc. The strategy doesn’t include milestones and a clear roadmap but an overall target to reach energy neutrality for heating, domestic hot water, cooling and lighting in the tertiary sector and an average 100 kWh/m².y primary energy consumption for residential in 2050. |

The **Wallonian strategy** aims at reducing the energy consumption in the building sector by 70% by 2050 (compared to 2005). The set of policies and measures to reach the target is well described.

The **Flemish long term renovation strategy** provides a well-designed set of measures, including some mandatory renovation provisions (i.e. compulsory renovation after transfer of ownership of non-residential buildings) and several initiatives for the mobilisation of investment in deep renovations with a roadmap towards 2050. The overall 2050 objective (all residential building in class A, 75% energy performance improvement, non-residential sector carbon neutral) is analysed through different scenarios. The Flemish 2050 all sectors objective is to reducing greenhouse gas emissions from the non-ETS sectors by 85% by 2050 (compared to 2005 levels), with the ambition to move towards full climate neutrality. This translate, for the building sector in reducing the emissions of the Flemish building stock by 74% by 2050 (from 8.9 Mt CO₂eq to 2.3 Mt CO₂eq).

Other related indicative targets are the followings:

Information on the building stock

Brussels (number)	Total Residential		573 276
	Non-residential	Social housing	39 607 units
		Commercial	38 543
		Total non-residential	49 850

	Total	623 126
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Flanders (number)	Total Residential		
	Non-residential	Schools Total non-residential	19.7 million m ² 77 524
	Total		

Wallonia (number)	Total Residential		
	Non-residential	Social housing	3013
		Hospitals	861
		Schools	4629
	Total		

- More than half of the buildings in Flanders have an energy performance certificate (1.5 million out of 2.7 million). Only 3.5% of the existing buildings meets the 2050 energy performance target (100KWh/m².y) and 96.5 of the building stock needs to be renovated (3% per year, 90 000 residential unit per year). The current renovation rate is 2.5% (80.000 dwellings renovations per year), but only a limited proportion of this is are deep renovations.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

	Milestones		
	Brussels Capital	Wallonia	Flanders
2030		• Reduce average tertiary and residential energy consumption by 29.1% compared to 2005	• Residential buildings: 30 TWh final energy consumption and 6.9 Mton CO₂ • Public buildings: reduce CO₂ emissions by 40 % and reduce primary energy consumption by 27% compared to 2015

			Healthcare sector: aim to achieve annual energy savings of 2.09% per year (per health institution) and 27% savings by 2030
2040	Public buildings to be energy neutral	- Tertiary buildings: final energy consumption of 80 kWh/m².y - Move towards a zero annual energy balance building stock (produce as much energy as consumed, taking into account that part of the renewable energy production can be decentralised): by 2030 the buildings occupied by central governments; by 2035 schools, other public offices, private offices, shops; other non-residential buildings by 2040	Residential buildings: 21 TWh final energy consumption and 4.6 Mton CO₂
2050	- The entire building stock in Brussels will have to be efficient - Residential: average primary energy consumption 100 kWh/m².y - Tertiary: energy neutral for heating, domestic hot water, cooling and lighting	- Reduce average tertiary and residential energy consumption by 70.3% compared to 2005 - Residential buildings - consumption of less or equal 85 kWh/m².year (A label), i.e. reduction of 41% in the primary energy consumption - Tertiary buildings - strive for zero energy/energy neutral building stock	- Residential buildings: 11 TWh final energy consumption and 2.3 Mton CO₂. - Decarbonisation: 74% (Residential), 100% (Non-residential). 70% reduction in energy use (Residential) and 33% reduction in energy use (Non-residential).

Other estimations	- The planned target corresponds to a 53% reduction of the current average primary consumption in the residential sector. - This means to deep renovate about 80% of the existing residential building stock in the next 30 years (i.e. more than doubling the current 1% yearly renovation rate).	- Overall aim of carbon neutrality by 2050. - Depending on the scenario (3 scenarios with different heat energy mix), the GHG emissions are expected to drop by 51-56% by 2030 for residential buildings, and by 52-62 % for non-residential buildings. - The average household energy bill (kWh) can be reduced by almost 40% by 2030, by half by 2035 and by 60% by 2050. 9-18% of all renovations will have to lead to A label by 2030 to achieve the targets	- For all sectors: reduce its greenhouse gas emissions in the non-ETS sectors by 35% by 2030 and by 85% by 2050 (compared to 2005) with the ambition to move towards full climate neutrality. - All buildings (old and new) to have energy performance class A (EPC index number 100) by 2050 (75% energy performance improvement). - Carbon neutrality for non-residential buildings. - Creating at least 25 000 local stable jobs over the next 4 years and 40 000 and more by 2030. 96.5 of the building stock need to be renovated (3% per year, 90 000 residential unit per year).
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Investment needs

- Some budgetary resources to support the implementation of the **Brussels-Capital** building renovation strategy are listed (e.g. mobilisation of citizen savings, regional and European public funds, banking sector through the promotion of low-interest loans, encouraging the development of third-party investor cooperatives). EU programmes (excluding EIB loans) possible additional funds are: EUR 240.000 per year (2019-2021) of additional EU funding, EUR 800.000 per year (2021-2025), EUR 1.000.000 per year (2025-2030).
- The **Flemish** strategy mentions that investments to renovate the existing buildings until the 2050 target are estimated to be more than EUR 200 billion (EUR 150 billion for residential buildings and EUR 57 billion for non-residential buildings).
- For **Wallonia**, by 2030 incentives will amount to around EUR 50 million a year, while by 2050 EUR 5 billion per year (2020-2050) will be needed.

Good practices

Legislative

Brussels-Capital

- **Phased renovation obligation measure** to be adopted by 2021, will make mandatory for homeowners to implement 5 choice measures (identified in the mandatory energy performance certificate) every five years, starting from 2030, with the objective to reduce the building stock energy consumption to the 2050 target.
- **Energy Performance Certificates** will be imposed on any owner, regardless of any transaction. It is not intended to propose three recommendations as the current certification does, but to communicate the mandatory technical measures to be implemented in order to achieve the overall energy performance target to be reached.
- Reform of property taxation that introduces innovative tax incentives in relation to the building energy performance: modulation of registration and /or inheritance tax in relation to the competition of energy savings works; temporary exemption or reduction of property tax, in case of an ambitious energy renovation (e.g. when several recommendations of the mandatory energy performance certificate are carried out at the same time).
- Tightening of tertiary buildings minimum energy performance requirements for new buildings.
- Ban of coal heating by 2021, oil heating by 2025, and gas by 2030 (under study).
- Obligations on building sustainability (e.g. on materials, acoustics, water)

Wallonia

- The split incentives have been explicitly targeted. The regulatory framework should provide owners, including landlords and other investors with a clear signal to plan their investments. Plan to introduce an obligation to increase energy performance of buildings every 5 years, which suits the rental market cycle, where the average lease period is 5 years. Support landlords to improve the overall energy performance of their buildings by various means, including a system of adjusting the rent according to energy performance, communication and promotion, investigating possible incentives, exploring various good practices, facilitating relocation of tenants during major works, etc.
- Update the Energy Performance Certificate, develop a strategy and action plan to monitor the co-benefits of energy renovation, and gradually make the Energy Performance Certificate mandatory for all existing buildings.
- Recognize and formalize the governance and steering mechanisms of the renovation strategy (clarify the coordinating role of the implementation of the strategy, identify the responsibilities and resources required and involve them). Monitor the proper implementation of the renovation strategy to ensure that the objectives pursued are met and monitor the state of the building stock.
- Improving knowledge of the building stock by centralizing all information on the building stock in a database managed by the Administration. The building passport will be the tool at the heart of the process.

Flanders

- From 2030, non-residential buildings will have to reach a minimum energy performance label to be defined. The public buildings in Flanders provide a good example by meeting the minimum energy performance label by at least 2 years earlier.
- Compulsory renovation after transfer of ownership for non-residential buildings (from 2021 at the latest five years after a notary transfer in full ownership).
- Mandatory roof insulation: by 2020, all roofs of independent dwellings (single-family houses, studios and apartments, i.e. no chambers) should be insulated with an R-value of at least 0.75.
- Mandatory double-glazed units: by 2023, all dwellings must be fitted with double-glazed units.
- VAT tax reduction for demolishing and rebuilding in energy-efficient manner: reduced VAT for demolishing old buildings and rebuilding in energy-efficient manner, in place in 32 cities.
- All new buildings will have to achieve stricter requirements as of 2020 (from E40 to E35) and as of 2021 (from E35 to E30).
- For major renovations the level requirements in 2020 is E70 and E60 in 2025.
- Update of Energy Performance Certificate (EPC): existing scheme will be reviewed to include recommendations for a series of standard measures, including expected energy savings and associated costs.
- Electricity grid operators are obliged to support the planning and implementation of energy measures upon request by local communities.
- Ban for multi-family buildings to use individual gas boiler for heating: as of 2021, houses in new large housing estates and large apartment buildings may only be connected to natural gas for district heating by cogeneration or in combination with a renewable energy system as the main heating system. From that date, E30 will apply to new construction and the limited residual energy demand can therefore easily be met from other sources than fossil fuels.

Finance

Brussels-Capital

- Innovative financing mechanisms are described in three specific datasheets: innovative financing mechanisms, introducing tax incentives for renovation housing stock energy and financing from European funds.
- Introduction of an **energy bonus scheme linked to the renovation obligations of the residential stock**. The premiums will be available if the work is carried out at least one year before the deadlines, with an increase in the amounts granted when several priority measures are carried out at the same time.
- Revision of the **Green loan**: The Brussels green loan has been a financial incentive introduced by the Region since 2008 to support energy-saving investments in housing. This is a loan at a reduced rate (0 to 2%) offered to residents whose annual taxable net income does not exceed certain ceilings in order to pre-finance energy renovation works in the housing sector. Currently, the Brussels Green Loan (PVB) is available in two ways: a consumer credit issued by Crédal and a mortgage credit from the Housing Fund.

Wallonia

- Pilot initiatives such as support to create local cooperatives, repayable advances, credits not attached to the person but to the building, etc. are among the main innovative instruments that are to be put in practice. The strategy also explores issuance of green bonds, promotion of PPPs, establishment of revolving funds, facilitating access to financing to vulnerable households, promotion of ESCOs, assess loans attached "to the building" ("stone" credit solutions), etc.
- Support renovation in rental housing specifically, by e.g. providing support to relocate the tenants during major works, etc. The specific **renovation bonus system** has also been targeting landlord/tenants specifically. They have been able to benefit from bonuses provided that housing is rented in accordance with the indicative rent scale. There is the option to link additional bonus to the actual consumption after renovation (not only based on audit).
- Tax incentives have been in force in Belgium. The strategy aims to specifically link the VAT reductions to deep renovation (or other works, if proven more suitable than deep renovation).

Flanders

- The green bonds and the Flemish energy loans (interest-free energy loan for the priority target group: EUR 15,000 and duration of 10 years.)
- **Linear Green Bonds** (Green OLO): The Federal Government has emitted these bonds for public expenses aiming to a transition to a sustainable economy. Eligible expenses for the period 2021-2030 will be identified in the domain of transport, buildings and energy in general.
- Specific incentives for deep renovations are foreseen in the framework of trigger points (e.g. transactions, purchase, inheritance, rent).
- New owners who, within 5 years, renovate an apartment with a bad label to label C or better can rely on an interest-free loan as of 2021. An increased energy premium in the case of renovation to label C or better introduced from 2021 onwards will also be considered. A discount to the annual housing tax (real estate tax) will be examined.
- For individuals, since 2019 there has been a contribution of EUR 7 500 for the demolition of one or more buildings situated in the Flemish Region and the reconstruction of one or more dwellings or a multi-apartment building.
- Energy Efficiency Fund involving ESCOs and SMEs: EUR 20 million to support ESCOs actions to improve energy efficiency in SMEs. For each euro taken from the fund at least one euro must be invested by private entities.

Public buildings

Brussels-Capital

- According to the Energy Pact commitment, public buildings will be energy neutral by 2040.
- 100% green electricity supply for public buildings will be imposed in the very short term for the Brussels regional administrations.

- Linear Green Bonds (Green OLO): The Federal Government has emitted these bonds for public expenses aiming to a transition to a sustainable economy. Eligible expenses for the period 2021-2030 will be identified in the domain of transport, buildings and energy in general.
- NRClick programme to reduce energy consumption in public buildings, Solarlick programme to produce energy from photovoltaic panels.

Wallonia

- Public sector is at the forefront of the measures and expected to play exemplary role through exemplary renovations and other. Specifically, exemplary renovation of public housing will be carried out through public housing renovation plan to achieve the average decarbonised EPB A label by 2040 (~ 5 000 dwellings/year), complemented by further activities to support the plan above (e.g. public consultation, studies, etc.). In addition, the exemplary role of public buildings will be strengthened through a number of activities, including coordinated service in the form of one-stop shops, strengthening the role of internal energy managers, and facilitating the financing (by e.g. the Energy Performance Contracting, PPP, citizen funding and other) and by aggregating projects and reducing (perceived) risks.
- The creation of cadasters for public housing and public tertiary buildings will make it possible to identify the worst performing buildings to be targeted (renovated) as a matter of priority.
- Public-private partnerships are specifically promoted through structuring and disseminating communication to local authorities on existing PPP solutions, organising standard documents to facilitate the use of innovation partnerships and organising a programme to support the use of innovation partnerships.
- Other measures include: encouraging municipalities to put in place an energy and climate policy on their territory, increase the efficiency of subsidies for the renovation of public tertiary buildings, ensuring revolving funding to allow the financing of longer-term investments, strengthening preferential loans and other credit arrangements for deep renovation, ensure coherence of regional budgets with the long-term objectives of the renovation strategy.

Flanders

- In order to emphasize the exemplary role of public buildings, an Energy Efficiency Action Plan has been in place since 2016, with the aim of reducing CO2 emissions by 2030 by 40% and reduce primary energy consumption by 27% compared to 2015. This was converted, for the entities belonging to the Flemish Government, to an annual savings target of 2.09% of primary energy use.
- For measures with long payback period, the **Climate Fund** funds have developed an instrument to provide financial incentives.
- The Energy Agency Vlaams Energiebedrijf (VEB) has developed a service to encourage public entities to implement energy efficiency actions with energy performance contracts and by making available framework contracts model that these entities can use.

Energy poverty – worst performing buildings

Brussels-Capital

- Approximately 15% of Belgian households spent too much on their income on energy (measured energy poverty) in 2015. 4% of additional households are restricting their consumption (hidden energy poverty).
- Federal Plan to Combat Poverty 2016 – 2019.
- Measures at Federal level (info from NECP): Social tariffs for electricity and gas, support fund for most vulnerable persons (fonds Gaz et électricité), staged payment of bills, online tariff calculator available with regulator to choose cheapest tariff
- Revision of the energy bonus mechanism in order to include vulnerable households. Revision of the Brussels green loan foresees a 0% loan rate for a vulnerable target audience. Free information/coaching support is available to vulnerable households (for example through ‘pro deo’ architects).

Wallonia

- Energy poverty affects around 25% of Walloon households.
- Under the MEBAR operation, Wallonia grants a subsidy to low-income households (owner-occupiers or tenants) to carry out work in their dwellings that will enable them to use energy more efficiently. The planned activities include improving conditions for support of renovation in disadvantaged households, including designing new support mechanisms (credits), social missions, specifying energy poverty conditions, etc.
- Stimulating and facilitating the energy renovation of housing managed by social real estate agencies. The planned actions include the use of rent management by social real estate agencies to encourage renovation without an excessive increase in the overall cost (rent and energy costs), encouraging the social security agencies to improve the energy efficiency of the buildings they manage by consistently integrating energy performance criteria into the renovation of the assets, ensure more resources to promote energy renovations of dwellings that they rent, analyse the possibilities of adapting the rent of dwellings to the proven energy performance of the dwelling and encourage monitoring of energy consumption after renovation in social housing companies.

Flanders

- The Flemish Region accounts for 15.9% of households affected by energy poverty (445 000). In March 2016, the Flemish Government adopted an Energy Poverty Programme with 34 actions to protect energy users from disconnection and achieve energy savings in the homes of vulnerable families, including social tariffs for electricity and gas, support fund for most vulnerable persons (fonds Gaz et électricité), staged payment of bills, online tariff calculator available with regulator to choose cheapest tariff
- Rental and insulation premium (previously known as Social Energy Efficiency Projects) for dwellings inhabited by vulnerable private tenants. In addition to a flat-rate contribution of EUR 200, the owner receives EUR 20/m² for roof insulation; EUR 12/m² for wall insulated; EUR 85/m² for high efficiency glazing.

- Flemish energy interest-free energy loan for the priority target group: EUR 15000 and duration of 10 years. Since 2010, 21000 energy loans have been granted for a total of EUR 175 million.
- **Emergency fund** was set up for certain target groups who do not have sufficient financial resources to make their home energy efficient. An interest-free loan of up to EUR 25,000 can be granted to the emergency buyers, poor owners who are required to purchase a poor quality dwelling. Only when the home is disposed of, or at the latest after 20 years, the loan must be reimbursed. A first call (EUR 15.5 million, covering 625 loans) was launched by the Minister of Energy at the beginning of 2020.
- Increased energy premiums for protected customers (beneficiaries of the social price caps). The Flemish Region provides financial support to all those who invest in energy saving in the form of a premium paid by the distribution system operator. For protected customers, who usually have much less financial resources, the regulation provides for increased amounts for energy contributions.
- **Housing allowance** and accommodation premium at the home of vulnerable tenants of unsuitable or seriously unsuitable housing to an appropriate home (measures taken from housing policy).
- From the **Flemish Climate Fund**, EUR 20 million was foreseen every year in the period 2016-2019 to further invest in the energy renovation of social rented housing. In 2018, a total of EUR 16 million was added to the energy renovation of social rented housing. These funds are used to subsidise energy measures in the renovation and replacement construction of existing dwellings, such as the installation of high-efficiency glass, insulation outer skin and technical provisions including heat pump, condensing boilers or solar water heaters.
- **Energy scan for free.** An adviser in the home is looking for energy savings. The residents receive energy-saving tips that can be applied at the outset. Where useful, the energy scanner places free energy saving materials (energy-saving shower head, energy-saving light bulbs, radiator foil, pipe insulation).
- **Social management law.** The municipality is granted the right to apply for a period of nine years a social home which has been included for at least two years in the empty state register, the register of neglected buildings and dwellings or the register of unsuitable and uninhabitable dwellings.

ESCOs – aggregation of projects

- The **Brussels-Capital** strategy foresees the establishment of a **market facilitator** promoting the establishment of ESCO and energy performance contracting (EPC), with a view to creating the conditions for the emergence of ESCO. This facilitating body will also play the role of aggregator of applications in order to limit the expenditure of ESCO in research and project planning. Reduction of funding risks to guide ESCO towards a holistic approach to energy renovation, with the provision of a regional fund over the address of ESCO in order to promote access to capital, provided that the project has a comprehensive approach. The introduction of a partially revolving fund, which could be used for the development of ESCO.

- The **Wallonian strategy** envisages that aggregation of project will be promoted through investment platforms or groups, and consortia of small and medium-sized enterprises, to allow access to the investor and package solutions for potential clients. The strategy has a diversified strategy to reduce the (perceived) risks of renovation by pooling projects (aggregation), promoting projects by cooperatives, pooling of projects for Energy Performance Contracting, establishing a de-risking platform and training for the banking sector, guarantee of loans for the disadvantaged groups, etc.). Support to Energy Performance Contracting projects and third party financing is explored, including the development and standardization of tools and documents, training in the banking sector, facilitating access to capital for smaller ESCOs, developing pilot projects, monitoring of the market, etc.
- **Flemish Burn Premium.** Since October 2017, a premium for project leaders who **renovate collectively a number of dwellings** (at least 10) in order to make this energy efficient. The project leader shall support the citizen in achieving energy saving investments. The Flemish cities of Antwerp and Mechelen in the context of this project are organising various demonstration projects for collective renovation.
- **Reduction of Risk:** The H2020 Energy Efficient Mortgages Initiative (EEMI) works on mortgages/credits that take into account the positive impact of the improved energy efficiency of a project on the value of assets and credit risk. The EEMI is composed of the Energy Efficient Mortgages Action Plan and the Energy Efficient Data Portal & Protocol Initiative.
- ESCO services for local government buildings by network operator FLUVIUS: Fluvius helps local governments to understand their energy use with an online energy management tool E-lysis (baseline energy use, benchmark with other local administrations, integration of digital meters and telemetry). Fluvius will assist local authorities in the realization of energy total renovation projects, HVAC renovation, and the installation of solar panels and support in the design (burden book, bill, schedule), purchase & award (framework contracts), coordination of the yard, settlement and acceptance.
- The Flemish Energy Business (VEB) facilitates energy performance contracts between ESCO companies and public institutions.
- The **Woningpas** is a free digital passport that was launched at the end of 2018 and will eventually be available to every household in Flanders. Every homeowner has access to relevant information on buildings, land and the environment, certificates and premiums already available to the government.

Advisory tools

Brussels-Capital

- **One-stop-shop**, to be set up by 2024, is a Sustainable Building Facilitation Service that offers specific guidance/coaching to clients and professional building managers and provides the necessary information on their project for the sustainable renovation of buildings.
- A **'building passport'** will be introduced by 2024, with the purpose to simplify access to information relating to housing for both the owner and the public authorities. The platform shall contain information specific to each dwelling, accessible by means of an identifier or

identity card of its owner; it may also contain links to various information on existing buildings and tools. Setting up a building passport simplifies access to administrative documents for owners, administrations and other potential users such as building managers and professionals.

- Support provided to different targets at all levels, by several programmes: e.g. Homegrade, Réseau Habitat, Activities for Energy, Facilitators, coaching, etc.
- **Refurbishment roadmap**: the roadmap consists of an individualised renovation plan, complementary to the PEB certificate. Required for any renovation requiring planning permission, it will be recommended by the support desk in other cases. Depending on the assumptions, the renovation plan will therefore be drawn up by the client's architect or the one provided by the one-stop support center. Whether it is a global renovation or a sequential approach, the plan will be based on a complete diagnosis of the building in terms of energy, urban planning and more broadly, environmental (such as acoustics) and will take into account the owner's wishes and needs.

Wallonia

- **Building renovation passports** are mentioned throughout the whole strategy of Wallonia (with respect to monitoring, roadmaps, etc.). They will play an important role in raising awareness and informing the renovation strategy. The main actions include renovation roadmap tool, developing the energy part of the building passport, and implementation of the other parts (which data to include, identify most suitable IT tools, establish protocols, etc.). While these actions aim at residential buildings, further activities are envisaged for tertiary buildings too.
- Comprehensive support for households in the form of a **one-stop shop** is one of the key elements of the strategy. The main actions include coordination of sustainable housing information advisers, financial support to one-stop shop pilot projects, develop tools and guides to facilitate to promote renovation, integrate social aspects in the advisory service, etc.
- WALLORENO communication campaign: promote all the actions of the renovation strategy towards the general public with a slogan “on the road to the A label”. The campaign includes leaflets, radio and TV spots, etc.

Flanders

- The first version of the Flemish **house passport** was launched on 3 December 2018. The Flemish Energy Agency, the Public Waste Agency, Environment Department and Wonen-Vlaanderen (Flemish Energy Agency), hands together to find a digital passport for Flemish housing. This cooperation was also supported by Information Flanders, Flanders Radal Digital and the Environmental Information Cooperation.
- As part of its mission to promote energy efficiency in public buildings (in the broadest sense), Vlaams Energiebedrijf is developing a data platform called "TERRA". This database allows entities to easily monitor their energy consumption without having to set up a system themselves.

Skills

Wallonia

- Increasing skills in the construction sector include training needs evaluation, development of training modules, on-site training, capacity building in the renovation sector through an Employment and Renovation Alliance, promoting and educating about better materials. Best practices in construction and sustainable renovation included in the competence centers of FOREM and IFAPME (including ConstrForm Hainaut and Liège). Since 2014, the Sustainable Construction Portal has provided professionals (entrepreneurs, architects, consultancy firms, producers and traders) with an internet tool that gathers validated information on innovative and sustainable techniques, materials and products and links with the Energy Portal.

Areas for potential improvement compared to best practices

It could be useful to consider:

- Brussels-Capital: including cost-benefits analysis in terms of jobs, energy cost savings, health and emission reductions
- Wallonia: an overview of available funding and the link to the respective measures.
- Flanders: clarifying which of the 3 options has been chosen as the renovation strategy roadmap.

Bulgaria

Summary of the long-term renovation strategy

The Bulgarian strategy has a vision for the renovation of the Bulgarian building stock by 2050 through three strategic objectives: harmonisation of legislation, sustainable financial mechanism and support for capacity building. A well-structured and comprehensive analysis on the existing barriers for each priority and measures to overcome the barriers are included. Several new funding opportunities and financial mechanisms are analysed including the development of the National Decarbonisation Fund. It is clear that the renovation rate will gradually increase in the next decades with the highest intensification after 2030 and the energy savings and CO₂ emissions reduction will follow the trend. Overall, the Bulgarian LTRS targets are conservative but realistic as the projections made in terms of energy savings are evidence based. The strategy covers policies and measures to overcome obstacles but it is expected that the market inertia will lead to a gradual and smooth implementation rather than a rapid one

Information on the building stock

		No. of buildings	Area (m²)
Total Residential		1 365 898	240 614 647
Non-residential	Offices		14 878 947
	Hospitals/health establishments		9 685 995
	Social housing		18 470 987
	Hotels / Restaurant / leisure		18 898 840
	Sports facilities		1 793 216
	Commercial		10 519 029
	Schools		11 299 037
	Total non-residential		104 923 288
Total			345 537 935

- The strategy deems the Bulgarian building stock energy inefficient.
- Only 6% of the buildings could achieve more than 60% energy saving.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

Under the proposed measures, 45% of the total Bulgarian building stock (60% of the existing residential buildings and 17% of the non-residential buildings) will be renovated by 2050. The targets should lead to 27.89% energy savings in the primary energy consumption and 31.69% energy savings in the final energy consumption by 2030 compared to PRIMES 2007 reference scenario.

	Milestones
2030	• 2,917 GWh energy savings • 1,307 ktCO₂ emissions savings • 2,2203,509 m² (8%) renovated area
2040	• 6,502 GWh energy savings • 2,892 ktCO₂ emissions savings • 49,570,668 m² (18%) renovated area
2050	• 7,329 GWh energy savings • 3,274 ktCO₂ emissions savings • 55,823,015 m² (20%) renovated area • 46% of the total floor area of the existing building stock will be renovated by 2050

- Analysing the energy renovation packages proposed in Annex 3 of the LTRS, it is obvious that a deep renovation is pursued as the majority of the packages lead to over 60% primary energy savings especially in the case of buildings in energy classes below E. Moreover, many packages consist of a high share renewable energy suggesting that also renovation to NZEB is looked-for. However, no prediction for NZEB is offered.
- Over 17 600 new jobs estimated for 2021-2030.
- Annual growth of BGN 557 million by 2030.

Investment needs

By 2030 EUR 2.3 billion investment needs (2021-2030) are estimated, by 2040 EUR 5.3 billion (2031-2040) and by 2050 EUR 5.96 billion (2041-2050).

Good practices

Legislative

- Development of the Energy efficiency obligation scheme until 2030.
- National standards for construction products harmonised with EU technical legislation.
- Mandatory staged decommissioning of solid-fuel heating devices from 2020 to 2024 that do not meet the requirements of the Eco-design under National Ambient Air Quality Improvement Programme.
- Review of the national definition of NZEB.

Finance

- Several financial mechanisms are discussed in the strategy. Some of them are already well known and have been successfully implemented in Bulgaria, such as revolving funds, guarantee funds and special credit line (e.g. Home Energy Efficiency Credit Line) and others have a lower potential or changes in the Bulgarian legislation are needed for full benefits: Green Mortgages, On-bill financing, Performance Contracts.
- The development of a **National Decarbonisation Fund** is proposed to be the main financing scheme in the implementation of the Bulgarian LTRS. The Decarbonisation Fund will operate at a national level and will consist of three sub-funds: (i) for public sector (ii) for commercial corporation and (iii) for residential buildings. The financial resources will come from: European Funds (Just Transition Fund, InvestEU), national co-financing (budget of state institutions and local authorities), revenues from energy efficiency obligation schemes, Green Bonds and other debt instruments, international financial institutions, private capitals and others. A mechanism involving ESCOs is also foreseen.
- Grant assistance for the implementation for energy efficiency and renewable energy measures under operational programmes (the estimated budget of the operational programmes for the period 2021-2030 is BGN 1 398 579 million).
- The National mechanism for financing energy efficiency (NMFEE) envisages financing through different mechanisms and financial instruments, including credit lines, guarantees or combinations of the two, etc. The NMFEE also envisages technical assistance for the implementation of energy efficiency projects. The estimated budget of the measure for the period 2021-2030 is BGN 7 800 million.

Public buildings

- Several measures and policies targeting the Bulgarian public sector are reported throughout the strategy. Special attentions is given to schools, kindergartens, hospital and administrative buildings. ESCOs are seen as the most promising mechanism for the energy renovation of all public buildings.
- Other measures targeting the public sector: implementation of energy management systems in 20 public buildings by 2030; trainings for local authorities; online platform to aggregate projects on public buildings including a list of verified contractors; Green Bonds for public buildings owned by state or local authorities.
- Implementation of energy management systems for public and private buildings and installation of ICT to better connect buildings to external systems and better respond to the needs of their occupants. 20 public buildings with energy management system by 2030.

Energy poverty – worst performing buildings

- Buildings in energy classes E, F and G are identified as the worst energy performing buildings.
- The share of Bulgarian households that cannot face unexpected expenses with their own funds is 32.1% such as the participation in co-financing energy renovation schemes, there is a relative low share of people receiving heating allowances (3.6% in the 2019/2020 cold season) due to eligibility criteria.
- The Bulgarian people at risk of energy poverty are spread in multi-dwellings buildings forming a social mix with high-income citizens rather than being concentrated in individual buildings.
- Bulgaria is currently implementing a support scheme for persons who meet certain income-tested and property-based criteria for poverty, granting heating allowances to eligible recipients via the social assistance system throughout the heating period.
- Before the full liberalization of the energy market, a mechanism to protect vulnerable electricity consumers will be implemented to provide them the minimum amount of electricity needed.
- The renovation of multi-family residential buildings with a view to upgrading them to energy class C will lower the average monthly cost of heating homes and may result in low-income households being able to improve their living conditions sufficiently to be dropped from the category of households at risk of energy poverty.
- Moreover, improving energy efficiency by complementing the national target under Article 7 of Directive 2012/27/EU through a requirement for the implementation of measures, as a matter of priority, to improve energy efficiency for the benefit of vulnerable clients, including households affected by energy poverty and, when appropriate, in buildings used for social housing.

Multi-apartment residential buildings

- Improve the legislation relating to management of condominium property and the maintenance of buildings and professional management of buildings.

Advisory tools

- The Building Renovation Passport is seen as extremely useful for residential buildings to help building inspectors to recognize the green value of energy renovation and to link them to green mortgages.
- National campaigns to promote the benefits of energy efficiency in buildings and local campaigns to inform people about available renovation programmes as well as to increase the credibility in such programmes are planned.
- One-stop shops including provision of tailored advice to building owners and investors are also planned.

Digitalisation / Research and Development

- Development and implementation of a strategy and national plan for digitalisation of the construction sector.
- Development of standards and regulations for the implementation of digitalisation and building information modelling (BIM) in the construction sector, including the necessary accompanying analyses.
- Implementation of the digital reform in the construction industry.
- Digitising technical passport of buildings and connecting databases of municipalities.
- Implementation of the optional Smart Readiness Indicator for Buildings.
- Support for pilot projects for the implementation of new or advanced technologies and renovation techniques to reach energy class A or NZEB levels.

Skills

- Training for local authorities to foster the participation of local authorities in international initiatives such as the Covenant of Mayors, European Energy Awards and others and participation in European projects under Horizon Europe and LIFE and development of pilot and demonstration projects and the promotion of local research.

ESCOs

- ESCOs model is relatively well developed in terms of technical expertise and professional experience but has low investment volumes.
- Measures are planned to develop a more viable market for ESCOs: link financial measures to improve energy efficiency in renovation of buildings with targeted or achieved energy saving; contracts with guaranteed score and provisions of examples energy saving contracts

with guaranteed score for public sector; introduction of requirements for companies to be declared as ESCOs and establishment of a register with ESCOs; update of the Code of conduct and model contract.

Areas for potential improvement compared to best practices

It could be useful to consider:

- Providing more information on the existing building stock: existing number of NZEB, few EPC details; the current renovation rate.
- Increasing the ambition level: 45% of the total building stock renovated by 2050 is realistic but rather conservative.
- Increasing citizens' awareness on the benefits of energy efficiency.
- Promote innovative technologies and materials available on the market.

Croatia

Summary of the long-term renovation strategy

The Croatian LTRS presents a detailed overview on the existing buildings with the expected share of renovated buildings and the expected share of NZEBs. The strategy also provides an overview on the existing policies and measures for renovation identifying the main barriers. Special measures are drawn for buildings with the worst energy performance, buildings with poor seismic behaviour, buildings with cultural value, building owned by the Croatian army and for citizens at risk of energy poverty.

Starting from a renovation rate of 0.7% in 2020, the renovation rate is gradually increasing from 1% to 3% between 2021-2030, from 3% to 3.5% between 2031 and 2040 and up to 4% in 2050. The energy savings in buildings are estimated to be around 65% in 2050 while the corresponding reduction in CO₂ emissions will be around 40%. A detailed assessment of the investments needed to carry out the strategy as well as actions to mobilise such investments are included. To overcome the existing barriers, six categories of measures are proposed: strategic, legislative, technical, financial, communication and research and development.

The Croatian LTRS is ambitious and it goes beyond the targets included in the NECP. The aim is to convert the Croatian building stock into a highly energy efficient building stock by 2050.

Information on the building stock

		Area (m ²)
Total Residential		146 924 679
Non-residential	Offices	9 310 763
	Hospitals/health establishments	3 109 659
	Hotels / Restaurant / leisure	4 083 148
	Sports facilities	438 808
	Commercial	12 167 833
	Schools	5 912 968
	Total non-residential	57 493 554
Total		204 418 233

- Between 2014 and 2019, about 5.7 mill m² have been renovated (0.7% annual renovation rate).
- It is expected that the structural retrofitting of more than 24 000 buildings affected by the March 2020 earthquake will trigger the energy renovation.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

	Milestones
2030	• 25% renovated buildings • 3% renovated annually • 39.2 PJ energy savings and 639.4 ktCO₂ eq reduction in non - residential • 96.8 PJ energy savings and 1527.8 ktCO₂ eq reduction in residential
2040	• 60% renovated buildings • 3.5% renovated annually • 4% of building with cultural value renovated annually • 39.5 PJ energy savings and 639.4 ktCO₂ eq reduction in non - residential • 83.6 PJ energy savings and 1527.8 ktCO₂ eq reduction in residential
2050	• 100% renovated buildings (NZEB or energy efficient buildings) • 4% renovated annually • 36.8 PJ energy savings and 639.4 ktCO₂ eq reduction in non - residential • 68.4 PJ energy savings and 1527.8 ktCO₂ eq reduction in residential

- _____ The current LTRS has the ambitious target to increase the annual renovation rate to 3% by 2030, to 3.5% by 2040 and to 4% by 2050, in order to retrofit all the building stock by 2050.
 - It is expected that by 2050, the contribution of buildings in the all sectors energy savings will be around 65% while the contribution to the CO₂ emission reduction will be around 40%.
 - The energy consumption in residential is expected to decrease by 31% in 2050 compared to 2017. This is due to thermal retrofit of the buildings envelope but also to the implementation of innovative technologies and systems.
 - It is estimated that the natural gas share consumption will decrease by 27% and its share in the total energy consumption will be 21%, while the electricity share will be 38% compared to today's share of 22%.

- The non-residential energy consumption is expected to slightly increase in the coming years until around 2035, due to increased activity and increased floor area. In the non-residential sector, the main energy source in 2050 will be the electricity with a share of 70% while natural gas will account only for 17%.
- The building segment will contribute more than 36% to the reduction in total CO₂ emissions in 2030 and around 40% in 2050.

Investment needs

- Total investment amount spent (2014-2016): EUR 234 million (HRK 1.8 billion); [49% of which co-financed by the Environmental Protection and Energy Efficiency Fund].
- By 2050: EUR 31.6 billion (2020-2050) investment needs (estimate), for the comprehensive renovation of the building stock (HRK 243.23 billion)
- Croatia states in the strategy that does not have financial strength to guarantee the overall investments foreseen in the LTRS. To achieve the ambitious target, Croatia strongly relies on the European structural and investment fund.

Good practices

Legislative

- Energy Efficiency Obligation Scheme for Suppliers: from 2021 onwards the scheme will include all suppliers with more than 50 GWh of energy to the market during the previous year. Suppliers can fulfil their obligation in one of the following three key ways: investing in and stimulating energy efficiency improvements in final consumption; by buying savings from another obligated party or by paying contributions to the Environmental Protection and Energy Efficiency Fund. Cumulative savings over period 2021-30: 621.96 ktoe.
- Introduction of mandatory high-energy efficient buildings as a condition for rental or sale.
- Although large companies are obliged to regularly carry out energy audits, this obligation does not ensure continuous consideration of energy consumption in the company, nor does it include small and medium-sized enterprises. In order to encourage companies to introduce certified energy management systems (ISO 50001), a comprehensive analysis will be performed regarding the possibilities of using the tax system (including taxes and fiscal charges) to stimulate companies to introduce such a system and thus ensure continuous consideration of energy consumption. These tax incentives should be introduced from 2021.
- When the possibility of using grants has been exhausted, consideration should be given to introducing tax incentives for owners who have invested in energy renovation of their building.

Finance

- The Croatian strategy presents a detailed overview on the existing funds for the energy renovation programmes carried out until 2020 and identifies the current financial barriers.
- The involvement of private investors and banks has been minimal and limited to commercial sector. New funding schemes are needed to sustain the investment required by the ambitious measures foreseen in the LTRS.
- To stimulate investment, Open Partnership Dialogue action is seen as one effective tool.
- Three energy renovation programmes, part of the Integrated National and Energy Climate Plan 2021-2030, targeting single-family houses (ENU-3), multi-family houses (ENU-4) and public buildings (ENU -5) are fully described. The programmes are to be continued until 2050 with measures adjusted based on 2021-2030 experience.
- To support the mobilisation of finance several financial and regulatory mechanism are proposed:
 - the creation of a national revolving fund through ESI Funds that will allow energy service providers to access a long-term source of financing under more favourable conditions;
 - the interest subsidy of commercial loans will allow for the placement of financing from commercial banks in the energy renovation of buildings;
 - tax incentives for owners who invest in energy renovation when the possibility of using grants have been exhausted.
- ENU-3 refers to the energy renovation programme for single-family buildings (approx. 350,000.00 m² renovated annually). The primary source of co-financing should be revenues from the sales of greenhouse gas emission allowances at auctions collected by the Environmental Protection and Energy Efficiency Fund, providing grants amounting to 60% of eligible costs and necessary to achieve a reduction of at least 50% of the heating demand of the building. The renovation up to the NZEB standard should be further encouraged. The programme will also cover citizens at risk of energy poverty. Estimated investment costs in period 2021-30: HRK 23.71 billion is needed for energy and seismic retrofit of almost 50% buildings.
- ENU-4 refers to the energy renovation programme for multi-residential buildings (approx. 520 000. m² renovated annually) with funds from ESI funds for the next programming period 2021-2027, providing grants amounting to 60% of eligible costs and necessary to achieve a reduction of at least 50% of the heating demand of the building. The renovation up to the NZEB standard should be further encouraged. Implementation of the Program must be accompanied by strong promotional activities, technical assistance to applicants and it is necessary to ensure energy consumption monitoring before and after the energy renovation. In addition, consideration should be given to establishing a specific fund where costs are reimbursed to energy-poor or at-risk-of-energy-poor households. Estimated investment costs in period 2021-30: HRK 14.84 billion as approx. 50% of the buildings will also need seismic retrofit.

Public buildings

- The Croatian LTRS includes a comprehensive overview on policies and measure for public buildings with a focus on buildings with cultural value and buildings owned by the Croatian army.
 - ENU-5: Energy renovation programme for public sector buildings states that the renovation of public building should be guided by NZEB standard everywhere it is technically feasible (approx. 350 000 m² renovated annually) through ESI funds for the next programming period 2021 -2027. Funding needs to be planned to ensure the activation of private capital and ESCO markets. The renovation of the public sector building must be directed to the NZEB standard wherever technically feasible. Estimated investment costs in period 2021-30: HRK 7.2 billion for energy and seismic retrofit of almost 50% of the existing public buildings.
 - ENU-6: Energy renovation programme for buildings with the status of a cultural asset encourages the use of high efficiency systems. Special attentions is given to the buildings owned and used by the Croatian army.
 - ENU-7 Systematic management of energy in the public sector involves the use of Energy Management Information System (ISGE) to regularly monitor the energy consumption of all public buildings. Energy management system to be applied in all public sector buildings and public lighting until 2030.
- Croatia already has a well-developed national energy management system that gathers data from public building allowing for analyses of energy consumption before and after renovation.
- Promote the development of the energy services market through the implementation of the Public Buildings Renovation Programme – in this segment public sector projects should also be considered in order to make them financially attractive to private investors.
- Energy renovation programme for public lighting: considering the significant potential that exists in the public lighting systems, ESI funds are planned to be used in the next programming period 2021-2027. The financing models to be used should also enable the mobilization of private capital through energy services or public-private partnerships in order to achieve the best multiplier effect. Estimated investment costs in period 2021-30: HRK 2.88 billion.
- 75% of all public procurement processes containing green criteria in 2030.

Energy poverty – worst performing buildings

- Buildings in energy class D or below for continental Croatia and class C or below for coastal Croatia have been identified as the worst energy performing buildings. Such buildings represent between 19% and 82% depending on the building type from the total building stock.
- The Croatian LTRS aims to alleviate the energy poverty. Programmes designed to help citizens at risk of energy poverty are included (e.g. Measure UET-5 and Energy Poverty Programme including the use of renewable energy). Based on these, definition and

identification energy poverty criteria are to be developed. Under the Programme for Energy Poverty Alleviation, approx. HRK 297 to 355 million is needed.

- Additionally, an open dialogue with stakeholders on the energy poverty criteria has already started.
- The alleviation of energy poverty is also addressed in ENU-3 and ENU-4:
 - ENU-3: Energy renovation programme for multi-residential buildings;
 - ENU-4: Energy renovation programme for family houses.

Cities

- Several Croatian cities have developed smart city strategies (smart energy management, smart urban administration, sustainable urban mobility and others). Policies and measures on smart technologies and well-connected buildings and communities are defined at a city level through smart city strategies giving examples of such Croatian cities.
- The strategy addresses the electro-mobility by planning the integration of charging points for electric vehicles.
- Improving sustainability of urban areas: the aim of this measure is to encourage cities and municipalities to build projects for revitalization and development of new urban environments on sustainability principles. The first step is the preparation of urban development plans, which will, based on the evaluation of sustainability indicators, define development projects to improve the defined indicators. For these projects, co-financing will be provided from ESI funds in the period 2021-2027 (EUR 375 million for project financing and HRK 762 000 for planning).

Aggregation of projects / ESCOs

- The Croatian strategy discusses several ways through which the aggregation of project can be done in Croatia. Project aggregation platforms is one possibility.
- Bringing together stakeholders to create investment groups, development of small and medium – sized enterprise consortia grouped around specific themes and packaged renovation solution are also discussed.
- Improvements have been achieved after the implementation of energy renovation project under the ESCO model in line with Eurostat guidance. However, it is stated that deep renovation through such model can be achieved with grant incentives, otherwise deep renovation are not attractive due to long payback periods. Two main measures are proposed to minimise the financial barriers: providing grants for the energy renovation and development of financial instruments to monitor energy service providers.
- Development of standard energy performance contracts and standardised methods for measuring and verifying energy savings that will increase the confidence of users and financial institutions in the ESCO model;

Advisory tools

- Through the **Open Partnership Dialogue action** stakeholders, local and state representatives, academia, construction and energy professionals were connected and had the opportunity to contribute to the development of the LTRS.
- The importance of One-Stop-Shop is discussed by the Croatian strategy. However, it is not clear if and when such service will be available.
- Croatia plans campaigns to increase users' awareness of the existence of affordable source of financing.
- The strategy discusses the connection of the EPC database to the national energy management system to provide access to reliable information on buildings and potential investments in energy efficiency measures.
- Encourage the establishment and establishment of regional energy agencies, and the transformation of existing energy agencies into energy and climate agencies.
- Charter of Cooperation for the Decarbonisation of Buildings by 2050: the aim is to create, through workshops and Open Partner Dialogue, a wide network of related professionals who are ready to engage in dialogue and contribute to the decarbonisation of the building stock by 2050.

Skills

- In Croatia, skills and education in construction and energy efficiency are promoted via several projects aimed at training the Croatian workers (Croskills), increasing the number of experts in energy efficient buildings (Fit-to-NZEB), enhancing the multidisciplinary approach in sustainable construction (Green Building Pro), digitalizing the construction and use of modern IT technologies (BuildUp).
- The NZEB Roadshow project coordinated by the Faculty of Construction in Zagreb targets the dissemination of NZEB know-how among professionals, public administration, producers, investors, workers, students. The creation of a Centre of Excellence on energy efficient buildings is also planned.
- Developing skills and promoting technologies related to nZEB standards in building renovation are also foreseen (ENU-2).

Areas for potential improvement compared to best practices

It could be useful to consider:

- the Building Renovation Passport;
- to elaborate on the energy from renewable sources.

Summary of the long-term renovation strategy

Cyprus' long-term renovation strategy (LTRS) contains milestones for 2030 and sets out a comprehensive set of measures, including regulatory requirements, financial measures, awareness-raising, user behaviour, training and support schemes. According to the LTRS modelling, a mixture of minor, moderate and major renovations in residential and non-residential buildings will lead to a reduction in final energy consumption of 8%, 15% and 20% by 2030, 2040 and 2050 respectively, compared to the baseline projections. However, the plan for decarbonisation in 2050 is not detailed and the renovation rate is still low. The overall ambition could be further increased by adopting more ambitious milestones and measures.

Information on the building stock

Cyprus has 431 059 residential buildings and more than 30 000 non-residential buildings. It has around another 78 000 homes that are used as country or tourist dwellings, meaning that they are typically used seasonally, as well as 54 000 empty homes. 40% of homes in Cyprus were constructed before 1981 and 54% between 1981 and 2006, i.e. the vast majority of homes were constructed when there were no minimum energy performance requirements in force. Based on the available statistics, no energy-saving measures have been taken in 49% of the homes, and only 12% of the homes include some form of thermal insulation.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

Cyprus' energy sector targets for 2021-2030 include:

- final energy consumption of 2 Mtoe in 2030, representing a 13% reduction in final energy consumption compared to the European Commission's 2007 forecast for Cyprus;
- primary energy consumption of 2.5 Mtoe in 2030, representing a 17% reduction in final energy consumption compared to the European Commission's 2007 forecast for Cyprus;
- cumulative energy saving of 243.04 ktoe for 2021-2030;
- 23% RES in final energy consumption;
- 26% RES in final electricity consumption;

- 39% RES in heating and cooling; and
- 14% RES in transportation.

The table below presents the results of a relevant study assessing different scenarios (below the projections for the realistic scenario)

Year	Final energy demand (ktoe)			Total savings (ktoe)	% reduction final energy demand	% reduction GHG emissions	Other
	Residential	Non-residential	Total				
2030	373	266	640	56	8%	24% 40 000 tCOeq	33 000 residential buildings and 10 000 non-residential buildings
2040	373	277	650	112	15%		
2050	361	279	640	163	20%		half the energy intensity in buildings, i.e. energy consumption per unit of gross national product (GDP)

Investment needs

- Based on proposals for the 2021-2027 programming period of the European Structural Funds, support is envisaged for energy upgrades of existing dwellings to nearly zero-energy buildings (NZEB) (EUR 40 million budget), energy efficiency measures in SMEs (EUR 15 million budget) and municipalities (EUR 15 million budget).
- An estimated EUR 800 million (approximately) will be required for 2020-2030.
- The investments in energy upgrades for 2020-2030 are estimated to increase GDP by 0.25%.

Good practices

Legislative

- Setting up of an **energy efficiency obligation scheme**: this is expected to contribute to the 2030 Article 7 requirement by 41.1 % or about 100 ktoe through improvements in energy efficiency in residential, commercial and industrial installations as well as in vehicles. The

scheme includes both awareness-raising and technical measures and should trigger an estimated EUR 150 million in investments in the target sectors (including buildings) for 2020-2030.

- Combination of **structural (seismic)** and energy upgrades during renovation opportunities⁵⁵.
- **Green tax reform** which will include carbon pricing in sectors outside Cyprus' emissions trading system. Such a reform is hoped to stimulate investment in energy efficiency and RES in the building sector (to be implemented in 2021) among other sectors.
- Increase of **building floor area ratio** by 5% if energy class A is met and if at least 25% of total energy needs are covered by renewable sources.
- **Reduced VAT** rate (5% instead of 19%) for housing renovations.

Financial incentives

- The '**Save & Upgrade**' scheme finances renovation of homes and buildings owned or used by SMEs, which had requested a building permit before 21 December 2007. It is co-financed by the EU's Cohesion Fund (CF) for households and the European Regional Development Fund (ERDF) for SMEs.
- The **Fund for RES and EE** was created in 2003 to finance investments in energy performance improvement measures and renewable energy sources' systems. The Fund derives its income from imposing an energy fee per kWh of electricity consumed on all final consumers.
- '**Mutual Funds Fund**': In 2018, the Council of Ministers decided to set up a fund to implement a loan scheme for energy efficiency and RES. The Fund has an initial capital of EUR 40 million, which consists of Cohesion Fund and European Regional Development Fund funding as well as a national contribution. A further EUR 40 million has been added to the Fund by the government from a loan guaranteed by the European Investment Bank. The '**Mutual Funds Fund**' is designed to provide loans to households, SMEs and local authorities for energy efficiency and RES projects. These loans will be made available through commercial banks. It is expected to be operational in 2020.

⁵⁵ A recent JRC study indicates that for high seismicity regions in Cyprus, combined seismic and energy retrofitting provides significant economic benefits over separate interventions, which may be useful for further promoting building renovation. See 'Innovative seismic and energy retrofitting of the existing building stock (iRESIST+)', EUR 30583 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-29687-4, doi:10.2760/768985, JRC 123638': <https://op.europa.eu/en/publication-detail/-/publication/719acded-be94-11eb-a925-01aa75ed71a1/language-en>

Public buildings

- To **renovate central government buildings** EUR 20 million of the EU Structural Funds was secured for 2014-2020 and new funds for 2021-2027 are planned to be used for deep renovations and other measures.
- As part of a long-term strategy to upgrade public schools to NZEB, **photovoltaic systems** with a total capacity of 4 MW and roof insulation will be installed, and EU funds have been secured for technical assistance.
- The H2020-funded **‘PEDIA’ project** aims to upgrade 25 schools to NZEB level and gain on average 65% in primary energy savings. Overall, it aims to trigger EUR 7.5m in sustainable energy investment, develop an innovative financing solution for schools’ energy efficiency upgrading and introduce an energy management system (ISO50001) into renovated school buildings to monitor and continuously increase energy savings.

Energy poverty - worst performing buildings

In 2018, 21.9% of the population reported that they were unable to heat their house in winter, while 12.2% were unable to pay their energy bills on time due to financial difficulties (among the highest in the EU). Measures to address energy poverty include:

- **lower electricity tariffs** for vulnerable consumers (20% lower than the normal tariff);
- continuation or reconnection of electricity supply during critical periods for vulnerable consumers who face serious health problems;
- financial incentives to install a residential photovoltaic system using the ‘net-metering’ method;
- higher financial support for residential energy upgrades under the **‘Save & Upgrade’** scheme (75% instead of 50% for other consumers) and support for installing individual energy saving measures.

Energy communities

- In 2019, the Commissioner of Mountain Areas prepared the ‘national strategy for development of the way of roads’, which includes a mapping of the region’s energy situation and measures to improve it. These measures include an energy upgrade for private and public buildings, visits to households to provide information and raise awareness on energy efficiency, and the collection of sectoral and green waste with a view to their energy recovery. The total estimated cost of the proposed measures for 2019-2030 is estimated at EUR 4 940 000.

Smartness

- Installation of **smart meters** for electricity: the distribution system operator plans to install 400 000 ‘smart’ electricity meters by January 2027.
- Various research and development programmes (VIOLET, SupERB, European Hotels4Climate Project, SMEPower Efficiency).

Advisory tools

- An **online energy-saving tool** has been set up to help the public easily identify the costs and benefits of different energy saving and renewable energy measures in homes. (<http://energysavingstool.cea.org.cy/>).

Skills

- The Energy Office and the Frederick University - who have both been approved by the Energy Agency as evaluating agencies for the Heating Systems Body - organised a total of seven training courses.
- In 2016, the **legal framework for energy managers** was created by Decree of the Minister for Energy, Trade and Industry. In line with the legislation, any organisation/company may be designated as an 'energy manager' provided that it follows a training programme approved by the Energy Service.

Other useful information:

- The new minimum energy performance requirements will be put in place on 1 July 2020. These will require all residential buildings undergoing major renovation to be of energy class A, and all other buildings to be of energy category B+.
- Of the 59 432 energy performance certificates (EPCs) issued so far, only 10.6 % relate to existing buildings, leading to the conclusion that the issuance of EPCs during sale and rental transactions remains low.

Areas for potential improvement compared to best practices

It could be useful to consider:

- further developing the plan for decarbonisation in 2050 so as to increase the renovation rate;
- providing more detail on the wider benefits;
- further developing the ESCOs market;
- exploring district/neighbourhood approaches;
- specifying the development of advisory tools such as one-stop-shops.

Summary of the long-term renovation strategy

Czechia's long-term renovation strategy (LTRS) includes economic measures (investment grants for residential and non-residential buildings financed through structural funds and sales of emission allowances), a communication campaign, technical assistance for energy efficiency projects with a special focus on energy performance certificates (EPC) and education measures. The planned economic measures are mostly a follow-up of the existing programme rather than an update. Most of the LTSR measures are reliant on the final setting of the programmes under the next multiannual financial framework.

The optimal scenario is expected to lead to energy savings of 9% in 2030 and 23.5% in 2050, which is not enough, especially given that Czechia has a higher than average unitary heat consumption in the building sector.

The LTSR lacks details on the implementation of the measures, especially an analysis and quantification of the expected impacts.

Information on the building stock

- Total number of single-family buildings: 1 554 794
- Total number of apartments: 1 896 931
- Total number of non-residential buildings: 613 134
- Public buildings: 117 753
- 25% of single-family houses and 40% of multi-apartment buildings were renovated in 2019. In 2014-2018, 31% of the renovations in multi-family buildings were low renovations, 50% were moderate renovations, and 19% were deep renovations. In 2014-2018, 35% of the renovations in single-family houses were low renovations, 45% were moderate renovations, and 20% were deep renovations. The shares seem to apply to 2020 as well.
- Around 55% of non-residential buildings were renovated in 2019-2020. More specifically, approximately 27% were low renovations, 44% were middle renovations, and 30% were deep renovations (based on estimates from EPC).

Indicative milestones and other information for the vision to decarbonise the building stock by 2050
(based on the optimal scenario of a relevant study)

Milestones of the optimal scenario				
	2020	2030	2040	2050
Specific heat consumption per m ² [MJ/y.m ²]	493	426	368	325
Residential sector	558	488	425	369
Non-residential sector	399	338	287	260
Final energy consumption in the given year [PJ]	373	345	316	289
single-family houses	161	149	136	123
multi-apartment buildings	88	83	78	73
public and commercial buildings	124	113	102	93
Energy savings (compared to baseline 378 PJ) [PJ]	-5	-33	-62	-89
renovation rate	Modelling inputs in the optimal scenario			
single-family houses	1.40%			
multi-apartment buildings	0.79%			
public and commercial buildings	2.00%			
depth of renovation	low	medium	deep	
single-family houses	20%	40%	40%	
multi-apartment buildings	20%	40%	40%	
public and commercial buildings	20%	40%	40%	

- The calculations show that buildings are responsible for 44.35% of Czechia's total emissions. The models show that it is possible to reduce emissions from the current 44.6 Mt to 26 Mt per year by 2050 under the optimal scenario, i.e. by about 40%.

Investment needs

Based on the modelling	2020	2030	2040	2050
Investment costs [CZK billion]	493	426	368	325

- Operational Programme 'technology and applications for competitiveness': CZK 8 000 million.
- Operational Programme 'environment': For the public sector, funding will be provided by the ERDF and the Cohesion Fund (CF). An allocation of CZK 14 000 million is expected.
- New 'green savings' programme and its successor: Revenues from emission trading until now (State budget). From 2021, a budget guaranteed by Act No 383/2012, on the conditions of trading-in greenhouse gas emission allowances, as amended, of CZK 4 000 million per year. For 2020, an allocation of CZK 1,350 million is expected.
- The Modernisation Fund managed by the EIB is expected to support the renovation of State buildings. It is expected that CZK 15 000 million will be used from this fund for the renovation of these buildings for the entire 2021-2030 period.
- PANEL programme: CZK 15 000 million for 2020-2030.

The total funds allocated to this area for 2014-2020 stands at CZK 78.3 billion.

Good practices

Legislative

- Update of the Decree 78/2013 to introduce from 2022 stricter requirements for nearly zero-energy buildings. The amendment also responds to a certain shift in the construction and development of HVAC and updates the parameters of the 'reference buildings'.

Finance - Fiscal

A number of financial instruments are in place (e.g. the 'green savings' programme, the Integrated Regional Operational programme for the residential sector and the 'environment for the public sector' and 'enterprise and innovation for competitiveness for the commercial sector' Operational Programmes). The programmes are mostly in the form of investment grants, and will continue in the next

programming period (2021-2027). However, the LTRS aims to put a much greater focus on financial instruments, which would lead to higher leverage of public finances.

- **New ‘green savings’ programme:** investment subsidy for energy efficiency improvements in residential buildings.
- **Panel programme:** subsidy for energy efficiency improvements in residential multi-apartment buildings through soft loans.
- **ENERG programme:** energy efficiency measures in commercial buildings.

ESCOS

- EPC projects are a rather well-established practice (with the exception of government facilities, which are still bound by budgetary and accounting restrictions).

Public buildings

- Czechia’s strategy for renovating public buildings, especially at municipal and regional level, seems strong. The measures include investment grants, technical assistance, support to EPC, and support to energy management. State-owned buildings still face barriers in developing EPC.
- The LTRS emphasises the role of **energy performance contracting**. It supports technical assistance for developing energy efficiency and specifically EPC projects, and assistance to public tender for EPC projects. Investment grants are the main form of support (the environment Operational Programme and its successor in 2021-2027). The LTRS strives to move from investment grants to a wider range of financial instruments.
- Schools and healthcare facilities are explicitly listed as the recipients of technical assistance to develop EPC projects.
- The environment Operational Programme provides investment grants to public sector buildings, supporting thermal renovation and HVAC, new buildings in passive house standards, monitoring and automation in buildings, and further adaptive measures.
- **EFEKT programme:** Support to energy management in public buildings, support to good quality energy efficiency projects, support for preparing EPC projects for public and commercial buildings.

Multi-apartment residential buildings

- The split-incentives dilemma is perceived as one the main barriers to building renovation, especially for multi-apartment buildings owned by cooperatives. The key initiative to address this issue seems to be the communication campaign on the benefits of energy efficiency measures.

Smartness

- Smart technologies are mainly supported through the ‘enterprise and innovation for competitiveness’ Operational Programme and its successor in 2021-2027. The programme is aimed at companies and supports monitoring, automation and demand management in buildings.
- Additional support stems mainly from research projects (e.g. the national research and innovation strategy for smart specialisation (the ‘RIS3 strategy’) and the Theta programme). The national strategy aims to effectively target European, national, regional and private funding to priority innovative areas of specialisation in order to fully exploit Czechia’s knowledge potential.
- The **Theta programme** aims to use the outputs, results and impacts of supported projects to transform and modernise the energy sector in line with the approved strategic materials in the medium- and long-term. It will support energy research, development and innovation, focusing on: support for projects in the public interest; new technologies and system elements with a high potential for rapid application in practice and support for long-term technological perspectives.
- Other projects include creating a multidisciplinary and interdisciplinary system of cooperation between companies and research organisations to develop energy-efficient and environmentally-friendly technologies, systems, equipment, components, methodologies and strategies for smart buildings in the regions.

Advisory tools

- **Promotion and communication campaign** to raise awareness on energy savings, with a specific target to achieve deeper and good quality renovations
- **EKIS energy consultation** is a free public service to support energy savings and the introduction of renewables.

Skills

- Certified experts (e.g. energy auditors) are obliged to continue their professional education and keep up with the latest information in order to carry out their jobs properly. The Ministry of Industry and Trade runs a programme to support education, which includes workshops, seminars and publications.
- Legal provisions for the following job titles: Energy performance of buildings - energy specialist; installation of renewable energy sources - person authorised to install equipment to produce energy from renewable sources; building design.

Areas for potential improvement compared to best practices

It could be useful to consider:

- providing more specific estimates of impacts (including wider benefits) of the individual measures or groups of measures and information on how the financial instruments (other than investment grants) are going to be implemented and promoted;
- further specifying the trigger points;
- further exploring measures to address energy poverty / vulnerable households;
- exploring district/neighbourhood approaches further;
- specifying the development of advisory tools such as one-stop-shops.

Denmark

Summary of the long-term renovation strategy

Denmark's long-term renovation strategy (LTRS) does not provide indicative milestones for the efficiency of the building stock but it presents a comprehensive and well balanced set of measures (regulation & standards, financial incentives, information, training and advices). Several initiatives for mobilising investment for deep renovations have been put in place.

Information on the building stock

- Total number of buildings: 1 717 580
- Final energy consumption for heating has been reduced by almost 45% compared with 1975 and net heat consumption has been reduced by almost 30%.
- Evolution of net consumption of dwellings

		2017	2020	2025	2030
Heated area	m ²	324.5	321.6	316.7	311.8
Net heat	PJ	139.8	137.4	132.2	127.3
Unit consumption	PJ/million ²	0.431	0.427	0.417	0.408
	kWh/m ²	119.7	118.7	116.0	113.4

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

2030	• 5% reduction in the actual net heat consumption per m2 in homes (vs 2018) • 10% reduction in calculated heat loss per m2 (vs 2018)] • State administration buildings: 42,480 MWh to be saved in 2021-2030. The other state building energy consumption shall be reduced by 10% during the period 2021-2030
2040	• 19% reduction in calculated heat loss per m2 (vs 2018)

2050	• 28% reduction in calculated heat loss per m² (vs 2018) • To have a fossil-free energy supply in 2050 • from NECP: reduction of net energy consumption for heating and hot water with 35% in 2050 compared to 2014; this is in line with the LTRS target
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The Danish government has set an ambitious overall (all sectors) greenhouse gas reduction target for 2030 of 70% compared to 1990 levels.

- From 2020 to 2030 the net heat consumption per m² is expected to be reduced by 4.4% (reduction of 5.9 PJ compared to 2020).
- Energy saving potential: approximately 30% of the building stock to be renovated by 2050 in compliance with the Building Regulations (80-85% of this potential is in buildings built before 1980).

Investment needs

- Investment needs are estimated at 40.6-76.2 DKK billion (note that the most ambitious scenario is less cost efficient). Saving an additional 1.4 TWh requires almost double the investment (76.2 DKK billion vs 40.6 DKK) or 0.28 DKK/kWh saved vs 0.43 DKK/kWh.
- The subsidy scheme for residential buildings allocates DKK 200 million each year for the 2021-2024 period.
- The subsidy scheme for non-residential buildings allocates DKK 300 million each year for the 2021-2024 period.
- The subsidy scheme for public buildings allocates DKK 100 million each year for the 2021-2024 period.

Good practices

Legislative

- New building codes (BR18) with tightened minimum energy requirements for new buildings and the introduction of even more restrictive voluntary requirements ('Building 2020' class).
- The **energy label** has been strengthened since 2019, by raising the quality of the label and promoting dissemination. The label is therefore expected to become an even more important tool to support energy efficiency renovations. More attention is also given to the fact that energy efficiency improves indoor climate and comfort, for example.
- The **energy efficiency obligation scheme**, that played a very important role in the previous LTRS, with 45% of the annual target realised within households, will cease at the end of 2020 and will be substituted with a new energy saving subsidies scheme based on a competitive bidding procedure.

Finance

- Several initiatives to mobilise investment for deep renovations have been put in place and, according to the strategy, the financing of energy efficiency initiatives is not a major barrier for most projects in Denmark.
- The **‘Pool for energy savings in buildings’** is a subsidy scheme, that, starting from 2021 **will substitute the current energy efficiency obligation scheme**, will allocate DKK 200 million/y in 2021-2024 with a competitive bidding procedure. The incentive is granted based on the ratio of subsidy per saved kWh in the individual projects. Subsidies are first granted to the project with the lowest costs per saved kWh, then to the one representing the second-lowest costs, and so on. Similar schemes are planned for public buildings (DKK 100 million/y in 2021-2024), and for non-residential buildings (DKK 300 million/y in 2021-2024). Preliminary calculations show that the building pool of DKK 200 million per year in 2021-2024 will have an impact in 2030 of about 1.2 PJ.
- The Danish pension funds and other parties are able to participate in energy projects by pooling projects in cooperation with other actors as well as through ESCO and EPC schemes.
- The **National Building Fund**, a self-governing institution, whose funds originate from the tenants of the general housing sector. The Fund supports, among other things, the renovation of social housing, and therefore also provides indirect support for energy improvements.
- **National Green Climate Fund**, to support initiatives across all sectors that promote the green transition in an appropriate manner (e.g. establishment grants for electric heat pumps on non- ETS cogeneration plants, promotion of green building, and mapping and advice for decentralised CHP plants).
- **Loans for finance renovations** - mortgage credit system: a much used system of well-established mortgage institutions lending money to building owners with certainty on the value of the building. The financing is obtained through the sale of obligations. The rules for mortgage credit institutions ensure that the obligations are highly secure, which means the interest on loans to buildings owners is low.
- **Municipal mortgage credit** (Kommunekredit): a special credit institution providing financial services, including loans, to municipalities and regions. The funding is provided through the issuance of bonds, including green bonds, to finance, for example, energy-efficient building renovations.
- The **BoligJobordning scheme** grants a **tax credit** of up to DKK 12 200 per person per year (in 2019) for renovation works (e.g. insulation, replacement of windows, improvement or replacement of heating systems).
- **Heat pumps on subscription**: a scheme to help selected companies install, own and operate a heat pump in private buildings. The building owner typically pays only a connection contribution and a bill for the used heat. The selected companies receive a grant per heat pump installed. The scheme will expire in 2020, but will continue under a new scheme focusing on the scrapping of oil boilers.

- **Grants for scrapping oil boilers:** covering the years 2021-2024, these grants (for a total of DKK 20 million/y) will support the replacement of oil-fired boilers with individual heat pumps. There are currently approximately 80 000 oil-fired boilers heating Danish homes.
- **Tax and duties:** In Denmark, all energy sources for heating buildings, other than biomass, are subject to high taxes. Fees for petroleum and natural gas are indexed and maintained at constant prices. Energy efficiency incentives include:
 - Tax credit for work pay, including VAT when paying for labour costs, notably for energy efficiency works.
 - Tax on natural and town gas (carbon tax).
 - A tax (under the Coal Tax Act) on hard coal/lignite (DDK/t). Since 1999 includes also waste heat tax and since 2010, waste incineration tax also covered by that Act.
 - Tax on electricity (DKK/kWh). Increasing reductions on electricity on heat introduced in 2013 to reflect the increasing share of RES in electricity production.

Public buildings

- **All ministries are obliged to reduce energy consumption** by 14% in 2020 compared to 2006 (the State already reduced its energy consumption by 10.9% in 2006-2018). On 17 January 2020, a revised obligation entered into force introducing additional requirements for the central government institutions.
- Construction or renovation and maintenance of public buildings is carried out by private partners, while the public pays an agreed rent for the use of the buildings based on a long-term contract. **ESCO projects can be considered best practice.**
- Local authorities are obliged to consider using the public-private partnership (PPP) model whenever they decide to build or renovate buildings. PPP projects are supported by standard contracts and manuals, which the government has developed for local authorities.
- **Loan pool for municipalities and regions:** The 2018 Energy Agreement introduces subsidies for energy efficiency improvements in buildings owned or operated by municipalities carried out between 2021 and 2024. During this period, the scheme will allocate DKK 100 per year in loans to finance energy renovations in buildings owned or operated by municipalities and regions.
- **Kommune Kredit** is another fund providing financial services to municipalities and regions, including loans and leases.

ESCOs – Energy performance contracts

- Since 2016, energy companies install, finance, run and maintain heat pumps installed in smaller residential and commercial buildings. Customers have no upfront investment cost but pay for the supplied heat much as they would for district heating. This has increased the number of heat pump installations, and heat pumps in the scheme tend to operate more efficiently, because they are run by professionals rather than building owners. The initiative mainly targets areas without a supply of natural gas or district heating.

Split incentives

- This scheme for privately rented buildings allows for rent increases agreed between the parties to be calculated on the basis of the total agreed and documented costs of the energy improvement works. This option only covers leases in properties which at the time of the lease have achieved an energy label rating of A-D, among other energy improvements.
- The ‘**Agreed green urban renewal**’ scheme for energy renovations in private rental buildings allows for rent increases agreed between the parties to be calculated based on the total agreed and documented costs for the energy improvement works.

Energy poverty - worst performing building

- **Heat supplement:** allowances/subsidies are given to the economically weakest group of pensioners.
- Aid by municipalities to help individuals who have been affected by a change in circumstances (e.g. unemployment or sickness) pay for particularly high heating bills.
- The Traffic, Construction and Housing Authority has launched an analysis of the renovation needs of the whole social housing sector, which will serve as a basis for the political negotiations on the size of the renovation framework in a future housing agreement.
- People who fulfil specific conditions and have high housing costs or a high dependency ratio may receive special support if their need for assistance cannot be met through other benefits. The special support is not paid as a lump sum, but is rather calculated as the difference between what the applicant assumes to be able to pay in housing costs (limit value) and the net balance of their network costs, including water, heating, gas, electricity.
- A pilot scheme for public housing enables public housing organisations to carry out tests on ‘dynamic heat accounts’, where the heat cost is billed on the basis of indoor air quality (indoor temperature, humidity and CO2 content) as an alternative to a traditional heat consumption measurement.

Smartness

- Denmark focuses on better using the potential of data and increasing digitisation, so that energy efficiency improvements provide the most value and the transaction costs of energy renovations are reduced.
- The 2018 Energy Agreement allocated DKK 19 million in 2018, DKK 33 million in 2019, DKK 34 million in 2020 and DKK 44 million annually in 2021-2024 for the overall information and data effort.
- Energy development and demonstration: support to R&D activities include energy savings, more efficient energy conversion, renewable energy technologies and advances in system integration and smart energy (updated in the Energy Agreement).

Skills and education

- Setting up of a **knowledge centre** for energy savings in buildings - among other tools and training materials - for the vocational education and training system.
- **Specific training programme** for energy consultants who must pass the corresponding exam to be able to carry out energy label assessments.

Advisory tools

- **Better Home** is a voluntary, market-driven scheme from the Danish Energy Agency focusing on energy renovation of buildings. It aims to make it easier for building owners (mostly homeowners) to renovate their energy systems by creating a **one-stop-shop** for energy renovation, where the owner only has to contact one certified building contractor to get advice on energy renovation for the entire building.
- The **Better Boost Mechanism** meets the EU's description of a building renovation passport.
- The **information campaign** on energy efficiency at end-user level (**SparEnergi.dk**) focuses on home owners, the public sector and businesses (i.e. both private and public building owners). The SparEnergi.dk website provides advice on energy savings and information on mainstream energy renovation measures. It includes a tool for homeowners to boost their energy label and make related savings.

De-risking and aggregation

- From 2019, the **energy label** has been strengthened by raising its quality and promoting dissemination. The label is therefore expected to become an even more important tool to support energy efficiency renovations.
- **Default value catalogue**: The Danish Energy Agency has set default values for energy savings in order to simplify the calculation of realised energy savings. This is done by a simple multiplication of the value by number of initiatives carried out. The basis for the default values is a professionally qualified tender for the energy savings resulting from an activity.
- The **SBI guidelines** give instructions on the method and process for carrying out energy renovation projects in large buildings at all stages of the project - from conception to the operational phase. They therefore help the parties involved realise the energy gains from their major renovation projects.

Other information

- Denmark already significantly reduced energy consumption in its building stock in the last 30 years.

- In 2020, about 20% of the building stock built before 1980 has never been energy renovated; 55-60% has had a light renovation (-30% energy consumption); 20-25% has had an average renovation (-30/-60% energy consumption); and only 5% has had a deep renovation (-60% energy consumption reduction).
- In 2008 it was decided that energy requirements should be established for new buildings built in 2010, 2015 and 2020. The aim is to reduce the energy consumption of new buildings by 25% every 5 years. Two voluntary low energy classes anticipated the requirements that would have entered into force in 2015 and 2020.
- A national EPC database is managed by the Danish Energy Agency (including 600 000 EPC out of a total of 1.7 million buildings).

Areas for further improvements compared to best practices

It could be useful to consider:

- specifying indicative milestones for the efficiency of the building stock in 2040 and a roadmap for achieving the targets;
- analysing in more detail the wider benefits of renovating buildings, including the effect on climate resilience.

Summary of the long-term renovation strategy

Estonia's long-term renovation strategy (LTRS) includes both intermediate milestones and a roadmap to 2050 with a list of existing and planned measures to be implemented in the next decade. The planned cost efficiency measures focus on replacing/improving the heating system to reduce heat loss. The strategy proposes to use state-funded loans, guarantees and other financial support, to introduce new technologies, to develop information and awareness measures, and to increase data availability in order to improve the monitoring process.

Estonia plans to renovate its entire building stock (for all buildings built up to 2000) by turning them into nearly zero-energy buildings by 2050. This target seems very ambitious and the measures to achieve it are unclear. It is also not clear whether the allocated funding is adequate. It will be necessary to increase public funding and private investment to implement the strategy successfully and achieve the goal of decarbonising the building stock.

The Estonian LTRS does not include an energy savings contribution for the policy measures, but it forecasts a potential reduction in final energy consumption and CO₂ emissions.

Information on the building stock

- The total number of buildings in use cover 76 million m². Buildings that are not completely renovated cover 70 million m². The surface to be renovated p/year in 2020 is 500 000 m².
- There are 155 150 single-family houses covering a total floor area of 19 998,000 m².
- There are 22 600 apartment buildings covering a total floor area of 28 378 000 m².
- There are 375 000 non-residential buildings covering a total floor area of 62 million m².
- There are 27 000 non-residential buildings covering a total floor area of 22 m².
- Up to 25% of private houses (around 40 000) and up to 23% apartment buildings (around 5 300) might fall out of use. It is projected that by 2050 up to 10 million square meters of apartment buildings and non-residential buildings will fall out of use.
- In 2018, the central government sector used a total of 2.3 million m², 1.4 million m² of which is owned by the central government and 860 000 m² is rented.
- The State Real Estate Registry has energy performance certificate information on 49% of the floor area of central government owned buildings with climate control. Based on floor area, 25% of government-owned property, i.e. 200 000 m², with an energy performance certificate has been awarded class A, B or C.

- The buildings owned by local authorities cover 5.3 million m².
- If current trends continue, 80% of private houses, 68% of apartment buildings and 60% of non-residential buildings will remain unrenovated in 2050.
- The annual average net area of new private houses with use permits is 200 000 m², which accounts for 1% of the area of private houses taken into use before 2000.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

- The main goal is the full renovation, by 2050, of buildings erected before 2000.
- The target is to renovate 22% of the total building stock by 2030, 64% of the total building stock by 2040 and the entire existing building stock (built prior to 2000) cost-effectively into nearly zero-energy buildings by 2050.
- The potential CO₂ savings from the renovation of existing buildings is 3.9 million tCO₂ in 2050, representing an 89% reduction compared to 4.4 million tCO₂ emission in 2020.
- A total of 141 000 existing buildings covering 54 million m² are waiting to be renovated within the next 30 years. These include around 100 000 single dwellings with a total surface area of 14 million m², around 14 000 apartment dwellings with a total surface area of 18 million m² and around 27 000 non-residential buildings with a total surface area of 22 million m².
- The strategy focuses on non-residential buildings with climate control. Estonia has around 32 000 such buildings covering a total floor area of 28 million m².
- Energy savings, a healthy indoor climate in buildings and a high-quality spatial environment, is estimated to improve the living and working conditions of 80% of the Estonian population.
- The effort so far is inadequate to renovate the existing building stock by 2050, and if the current trend continues only the central government owned buildings (representing 1.5% of the building stock) will be renovated according to plan. Considering the total annual renovation volumes of various building categories, Estonia will need to fully renovate 2.3 million square meters a year, which is almost five times more than the current figure.
- A final energy consumption reduction of around 7 TWh/y would be possible if the buildings were fully renovated. It would be possible to lower the heating consumption by up to 70% (approximately 6.4 TWh/y) and electricity consumption by up to 20% (approximately 0.5 TWh/y).
- Energy savings of 60% by 2050 compared to today could be achieved if the target level of renovation activity were delivered.
- Reconstruction of the building stock by 2050 would reduce greenhouse gas emissions by 90% compared to today (reduction of 4 MtCO₂eq).

- Around 500 to 700 private houses and around 400 apartment buildings are renovated a year. The average annual area that needs to be renovated to achieve the target is approximately twice as big as the current estimate. There is therefore no need to increase the number of apartment buildings that are renovated; instead, the percentage of a full renovation should be increased (at least up to energy class C).
- The average area of non-residential buildings that needs to be renovated each year to achieve the target specified in this strategy is approximately 730 000 m², i.e. around four times bigger than the current estimate.

Residential building renovation volume up to 2050

	Existing		Renovated		Falling into disuse		In need of renovation	
	Quantity	Area, m ²	Quantity	Area, m ²	Quantity	Area, m ²	Quantity	Area, m ²
Private houses	155,000	19,998,000	10,000	1,500,000	40,000	4,800,000	105,000	14,000,000
Apartment buildings	22,600	28,378,000	3,000	5,000,000	5,300	5,000,000	14,000	18,000,000

Renovation need of non-residential buildings until 2050

	Central government	Local government	Private sector	Total
	Area, m ²	Area, m ²	Area, m ²	Area, m ²
OFFICE	271,000	279,000	2,760,000	3,310,000
ACCOMMODATION	74,000	207,000	520,000	801,000
COMMERCE AND SERVICES	69,000	712,000	2,440,000	3,221,000
EDUCATION, RESEARCH	243,000	2,212,000	690,000	3,145,000
HEALTHCARE	12,000	205,000	590,000	807,000
WAREHOUSES	19,000		3,060,000	3,079,000
INDUSTRY	7,000		6,880,000	6,887,000
SPECIAL-PURPOSE BUILDINGS	164,000		150,000	314,000
OTHER		427,000	0	427,000
	860,000	4,000,000	17,100,000	22,000,000

Area to be renovated, m ²							
	2021-2025	2026-2030	2031-2035	2036-2040	2041-2045	2046-2050	TOTAL
Private houses	400,000	950,000	1,900,000	3,100,000	3,900,000	3,800,000	14,000,000
Apartment buildings	2,280,000	3,200,000	4,000,000	3,900,000	3,000,000	1,800,000	18,000,000
Private-sector non-residential buildings	840,000	1,800,000	3,200,000	4,200,000	4,100,000	2,900,000	17,000,000
Local government buildings	680,000	1,400,000	1,300,000	480,000	70,000	0	4,000,000
Central-government buildings	200,000	240,000	230,000	150,000	70,000	20,000	900,000
	4,400,000	7,600,000	10,600,000	11,800,000	11,100,000	8,500,000	53,900,000

CO ₂ emissions	CO ₂ emissions in 2020, t/y			CO ₂ emissions in 2050, t/y			Reduction, %		
	Heating	Electricity	TOTAL	Heating	Electricity	TOTAL	Heating	Electricity	TOTAL
Private house*	429,000	432,000	860,000	25,000	90,000	120,000	94%	79%	86%
Apartment building	467,000	737,000	1,200,000	50,000	88,000	140,000	89%	88%	88%
Office	66,000	270,000	340,000	9,000	19,000	30,000	86%	93%	91%
Commerce	38,000	515,000	550,000	7,000	35,000	40,000	82%	93%	93%
Education	62,000	102,000	160,000	7,000	16,000	20,000	89%	84%	88%
Other buildings	288,000	1,030,000	1,320,000	34,000	94,000	130,000	88%	91%	90%
	1,350,000	3,086,000	4,430,000	132,000	342,000	480,000	90%	89%	89%

*in the case of private houses it is considered that 50% of private houses will install a heat pump and 50% a boiler as a heat source

Investment needs

- The full renovation of all buildings costs around EUR 22 billion.
- The annual renovation financing needs also increase nearly five-fold: from the current cost of under EUR 200 million to EUR 900 million.

- The financial support needed to launch investments in full renovation will grow from the current almost EUR 90 million a year to the maximum of EUR 370 million in 2035. However, almost EUR 300 million will be returned to the state budget as taxes each year.
- According to one possible scenario, the annual financing needs will be around EUR 220 million in the first few years, while the state contribution would presumably be 10%, i.e. the state should cover one-tenth of the amount. The total financing need by 2050 will be EUR 8.4 billion, and the state will get back around 30% of the construction costs as taxes, i.e. the related tax revenue would be EUR 70-170 million a year.
- The annual financing needs of the R&D&I activities are up to EUR 4 million.
- To implement the measures under its LTRS, Estonia will use national tax revenues, EU funds (ERDF, Cohesion Fund and to a lesser extent H2020) and auctioning revenues from the EU greenhouse gas emission allowance trading scheme and the national budgetary strategy.

		Renovation cost, €M						TOTAL
	Cost, €/m ₂	2021-25	2026-30	2031-35	2036-40	2041-45	2046-50	
Private houses	400	161	381	776	1,236	1,541	1,504	5,600
Apartment buildings	300	683	953	1,189	1,160	886	530	5,400
Private-sector non-residential buildings	450	379	811	1,437	1,884	1,828	1,312	7,650
Local government buildings	600	409	869	792	287	41	2	2,400
Central-government buildings	600	119	142	136	90	41	13	540
		1,749	3,156	4,330	4,657	4,337	3,361	21,590

Costs of the renovations proposed by the strategy until 2050

Renovation support, €M			
	Support, %	2020-2025	2026-2030
Private houses	30	48	114
Apartment buildings	40	273	381
Private-sector non-residential buildings	40	152	324
Local government buildings	50	204	435
Central-government buildings	100*	119	142
		796	1,396

* This is not the usual financial support as the central government is the owner of the buildings.

Support needs until 2030

Good practices

Legislative

- The minimum energy performance requirement is mandatory for major renovation for both residential and non-residential and central government buildings. In the Estonian energy performance regulation for buildings, the cost-optimal level of energy efficiency for major renovations corresponds to energy performance certificate class C.

Finance

- A comprehensive renovation of all unreconstructed buildings would require an investment of up to EUR 17 billion per year.
- To promote building renovation, Estonia offers **financial support of 30%, 40% or 50%** depending on the decrease in CO2 emissions, the energy label class to be achieved, and the location and size of the building.
- Financing measures such as **loans, guarantees and grants are available** and are based on an energy audit by the KredEx building SA (the State credit foundation). They include a **mortgage loan guarantee** for buying a new home or for renovating an existing one.
- The strategy sets out a group of measures to improve energy efficiency. They include staged deep renovation for residential and non-residential buildings. If implemented, this will lead to at least an energy class C (triggering financial support for the insulation of external

walls, roof or beech insulation, replacement of old windows with triple glazed windows, renewal of the heating system, installation of thermostatic valves, installation of heat recovery ventilation system, insulation of the wall or a heat pump for exhaust air, building automation system upgrade/correction, changing the lighting into LED lights, upgrade of the heating system, cooling system equilibration or installing a complete new system).

- **Public-private partnerships** to address specific market failures, explore subsidies and gather the revenue needed to finance the measures. Given the limited public funding available, there is a need to increase the use of EU funds, revenue from ETS and other public funds to leverage additional private sector investment.
- **Replacement of a multi-apartment space heater** using biomass or fossil fuel or a heater using direct electric heating by a renewable fuel heater or the connection of a multi-apartment building to a district heating network.
- Construction of local heating to replace the district heating system of an existing building and the demolition of parts of the district heating system falling out of use as a result.
- Mortgage loan guarantee for the purchase of a new home or the renovation of an existing one.
- Aid for the reconstruction of small residential buildings in order to improve their energy efficiency.
- Support for families with many children to acquire, expand or renovate their homes.
- Guarantee for multi-dwelling loans to finance reconstruction works.
- Aid for the comprehensive renovation of multi-apartment buildings.
- Support for the renovation of electrical installations for the transition of the old voltage system buildings in Tallinn to a new voltage system.
- Investment aid for the installation of solar panels for apartment associations, businesses and local authorities.
- Demolition aid to local authorities for the demolition of abandoned residential and non-residential buildings.

Public buildings

- Central government should only purchase or lease buildings that meet at least the minimum energy performance requirements.
- Support measures for improving the energy efficiency of central government buildings, and support for energy-efficient local authority buildings.
- The main types of buildings owned by the central government are schools and offices, and 25% of the real estate area owned by the central government has at least a class C energy label.
- Healthcare buildings and educational (including tertiary) buildings are in the best condition. Information on the energy label for real estate owned by the central government is provided for 49% of the total area of real estate. 25% (or 200 000 m²) of the total surface area

owned by the central government has an A, B or C energy label. Of the central government's rented buildings, 30% (or 230 000 m²) of the indoor air-conditioning has an A, B or C energy label.

- Support for improving the energy efficiency of central government buildings - both when renovating an existing building and when building a new one.
- Demolition aid to local authorities.
- Support for local authorities buildings in implementing energy efficiency measures.

Energy poverty - worst performing buildings

- Energy poverty is not seen as a real issue in Estonia. According to the Energy Poverty Observatory, 2.9% of households struggle with heating costs, while 6.3% are in arrears on energy bills.
- Policy measures on the worst performing segment of the building stock concern buildings built before 2000.
- To address energy poverty, a Taskforce on accessibility has been set up in the State Chancellery to ensure that the renovation of buildings is accessible to all social groups.
- It is estimated that **by 2050 up to 5 000 apartment blocks and up to 10 000 non-residential buildings will fall out of use**. To tackle the worst performing buildings Estonia offers a demolition aid to local authorities for the **demolition** of abandoned residential and non-residential buildings.

Advisory tools

- According to the **National Buildings Register** 3 200 energy performance certificates (based on consumption data) have been issued for residential buildings built before 2000.
- The **State Shared Service Centre** provides support for improving the energy performance of central government buildings – both when renovating existing buildings and when building new ones. It also provides local government with support to make their buildings energy efficient.
- There is currently no central database listing all public buildings. There is a lack of data for monitoring renovation activities. There is no data available to allow building owners and tenants to compare the energy performance of their building with that of other buildings.

Skills

- The building sector currently employs approximately 60 000 workers.

Other useful information

- The number of energy performance certificates issued on the basis of consumption data for residential buildings taken into use before 2000 (included) stands at 3 200. Class A, B or C has been awarded to only 22% of small residential buildings and 9% of apartment buildings with an energy performance certificate.

Areas for potential improvement compared to best practices

It could be useful to consider:

- specifying further funding resources (EU budget, such as ERDF and the Cohesion Fund, further funds for National budgetary strategy) that would need to be allocated to the different measures;
- providing more specific estimates of the wider benefits of individual measures or groups of measures (including the effect on climate resilience) and how the financial instruments (other than investment grants) are going to be implemented and promoted;
- promoting energy services and ESCOs further;
- exploring further district / neighbourhood approaches;
- specifying the setting up of advisory tools such as one-stop-shops;
- developing further the explanation on smart technologies promotion.

Finland

Summary of the long-term renovation strategy

Finland's long-term renovation strategy (LTRS) is detailed and well balanced, with a strong focus on the decarbonisation of the building stock and measures to reduce the carbon footprint. It contains a clear roadmap with intermediate targets for heating energy consumption. Almost all the policies and measures have been adopted and implemented already (new binding legislation and requirements in energy efficiency renovations, voluntary agreements, incentive schemes, information, awareness raising, training and educational measures). The LTRS also includes a list of energy efficiency improvement measures for each building component/system that aim to decarbonise heating for each different type of building. The strategy has a strong focus on reaching carbon neutrality (aiming to reduce by 2050, 90% of CO₂ emissions of the building stock completed by 2020) and cutting the energy consumption of residential and non-residential buildings in half by 2050.

Information on the building stock

- Single-family and semi-detached houses include a total of 1.2 million housing units in a total of 1.1 million buildings, of which 91% are permanently occupied.
- Floor area of single-family and semi-detached houses: 166 million m².
- Floor area of terraced houses: 35 million m².
- Terraced houses include a total of 0.4 million housing units in a total of 82 000 buildings, of which 89% are permanently occupied. Less than 5% of Finns live in housing units that are in poor condition. According to energy performance certificates, 4% of all terraced houses have low energy efficiency.
- Blocks of flats include a total of 1.4 million housing units in a total of 62 000 buildings, of which 88% are permanently occupied.
- Less than 5% of the population live in housing units that are in poor condition. According to energy performance certificates, 10% of all blocks of flats have low energy efficiency. Blocks of flats are responsible for 30% of the heating emissions of the entire housing stock.
- Finland has 144 700 non-residential buildings with a combined floor area of 110 million m². They are divided into commercial buildings and transport and communications buildings (40%), office buildings (20%), buildings for institutional care and educational buildings (30%) and assembly buildings (10%).

- According to energy performance certificates, 12% of the non-residential buildings have low energy efficiency. Non-residential buildings are responsible for almost 40% of the heating emissions of the entire housing stock.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

Finland's LTRS includes specific milestones and indicators for the overall building stock energy consumption, heater, emissions, emission intensity for heating, the share of nearly zero emission building, the share of old and degraded buildings.

Year	Consumption of heating energy (gross) TWh	Consumption of heating energy (delivered) TWh	CO2 emissions (total building stock) 1 000 tCO2	Heating emissions intensity 1 000 tCO2/GWh
2020	70,9	65,1	7.809	110
2030	55,5 (-78% vs 2020)	45,7 (-70% vs 2020)	2.874 (-37% vs 2020)	52
2040	45,1 (-64% vs 2020)	33,3 (-51% vs 2020)	1.476 (-13% vs 2020)	33
2050	36,4 (-51% vs 2020)	24,5 (-38% vs 2020)	654 (-8% vs 2020)	18

- Renovation projects are expected to cut the energy consumption of residential and non-residential buildings by half by 2050 compared to heating energy consumption in 2005.
- By the currently valid binding legislation, CO2 emissions of the building stock will be reduced by 90% by 2050.
- Objective of having all buildings (residential and not residential) with an energy class C or above by 2050.
- Good maintenance to ensure the correct functioning of the building and promote the energy efficiency and indoor conditions of the property.
- Part of the main cost-effective approach highlighted is related to removing all the vacant buildings from the building stock. According to the projections, unused building stock will become more common in Finland and by 2050 only 70% of Finnish building stock will remain.

- The document also indicates that the implementation of the LTRS will lead to 12 000 person-years in the construction products industry and service industries, as well as at construction sites.
- Making the Finnish building stock highly energy efficient and carbon neutral by 2035. Coal use in energy production abandoned as of 2029 and must be replaced with bio-oil. Central government and municipalities will cease using oil heating by 2024. In residential buildings, property-specific oil heating will be abandoned by 2050. Construction companies will prepare a roadmap for the decarbonisation of the industry.

Investment needs

- Implementing the strategy will cost EUR 24 billion over the course of 30 years, or EUR 800 million per year.

Good practices

Legislative

- Municipalities and companies must improve their energy efficiency through **voluntary energy efficiency agreements**. Around 70% of Finnish municipalities (in terms of number of inhabitants) are covered by the municipal energy performance contract.
- Invoicing based on actual measured consumption is an opportunity to make savings in housing costs.

Finance / Fiscal

- In general, funding for renovation projects is available through public and private banks and international financial institutions, e.g. the Nordic Investment Bank (NIB), the European Investment Bank (EIB), and the European Energy Efficiency Fund.
- To promote building renovation and investment in new technologies, Finland offers higher **tax incentives** when the energy efficiency improvement is significantly higher than the level required.
- Banks offer loans for energy efficiency building renovation of up to a maximum of 50% of the building's market value. Leasing-based funding solutions for projects where a renovation to improve energy efficiency is paid monthly are available. Banks also support customers with **green bonds** so that companies and financial institutions can collect funding for projects that support their responsibility agenda and with **green loans**.
- EUR 100 million in energy subsidies for residential renovation projects that will result in an energy efficiency improvement significantly higher than the required level. The amount can cover 50% of the planning costs.

Public buildings

- **Central government and municipalities will stop using oil heating by 2024.**
- ESCO projects in the public sector with an **ESCO subsidy** (which will lead to higher incentives). The subsidy is 25% for companies and corporations included in the scope of the energy agreement scheme. If the ESCO project uses new technology, an additional subsidy of up to 40% is available.
- The Competence Centre for Sustainable and Innovative Public Procurement (KEINO) was established in 2018 to help contracting authorities develop sustainable, innovative public procurement.

Split incentive

- In Finland, the heating costs of rented housing units and other facilities are, as a general rule, included in the rent. The owner should keep the building and its systems in good condition to ensure that as little energy as possible needs to be used to heat the building.
- Invoicing based on actual measured consumption is an opportunity to make savings in housing costs.
- Green Lease and Light Green Lease templates to divide the investment costs and benefits between the landlord and the tenant.
- The Finnish Real Estate Federation has developed for its members ecologically **efficient agreement practices** where the property owner and tenant agree on mutually beneficial means of improving the site's ecological efficiency.

Energy poverty - worst performing buildings

- According to EU studies on energy poverty, 1.7% of Finns have had problems with keeping their homes warm enough and 1% are in danger of being affected by energy poverty.
- Buildings falling under energy classes F and G according to the 2018 legislation are considered as the worst performing building stock in terms of energy efficiency (6% of single-family and semi-detached houses, 4%, of terraced houses and 14% of non-residential buildings).
- **Energy subsidy for renovating buildings in energy classes F and G.** A renovation subsidy can also be applied for if the housing unit/residential building has humidity/microbial damage or indoor air problems.
- **Demolition subsidy** covering 90% of the demolition costs.
- Subsidies in the form of housing allowance and social assistance to cover the housing costs (water, heating bills, rent and maintenance).

7. Share of worst performing building	Indicator	Unit	2020	2030	2040	2050
Single-family and semi-detached houses	Share of F and G energy class buildings total	%	6	0	0	0
Terraced houses	Share of F and G energy class buildings total	%	4	0	0	0
Blocks of flats	Share of F and G energy class buildings total	%	10	1	0	0
Office buildings	Share of F and G energy class buildings total	%	7	2	0	0
Commercial buildings	Share of F and G energy class buildings total	%	9	3	0	0
Educational buildings and day-care centres	Share of F and G energy class buildings total	%	20	9	0	0

Smartness / Databases

- A register for energy performance certificates (EPC) is already available. The Housing Finance and Development Centre of Finland ARA maintains an EPC website which provides relevant information for a variety of stakeholders.
- Determining functional properties of smart electricity meters and **installing second generation electricity meters**.
- **Online permit services for municipalities**.
- Numerous projects to speed up the deployment of smart technologies in buildings, including the joint public-business project Kira-Digi and its successor KIRAHub.
- Centralised data exchange system for retail electricity markets to be introduced in 2022.
- Between 2020 and 2022 Finland will set up a cooperation group coordinated by the Ministry of the Environment to collect information on the built environment and identify legislation and development needs through interaction with stakeholders.

ESCOs

- Projects realised by ESCO are promoted with an **ESCO subsidy**. The ESCO subsidy can be granted to any company or corporation for an investment in regular or new technology implemented in building renovations. A higher investment subsidy (25% of investment value) is provided for municipalities that implement energy efficiency measures if the project considered is an ESCO service.

Advisory tools / Information / Education / Skills

- Finland has well-established consulting services for energy efficiency improvements. There are many initiatives to provide advice and information to owners, tenants, housing associations and public authorities on energy efficiency renovations. For example: a specific platform to communicate information about successful energy efficiency improvements; a public database on cost-effective measures for experts preparing energy performance certificates; a virtual model for implementing a renovation project that requires planning permission; and information on the impact of energy efficiency investments.
- The state-owned company Motiva Oy is responsible for information, consulting, audit templates, calculators, energy efficiency campaigns and supporting projects.
- A programme on humidity and mildew (2009-2016) that provided information and instructions on how to resolve problems in residential buildings will continue as part of a national indoor air and health programme (2018-2028).
- **General education scheme:** Basic qualifications in the construction sector taught at all levels of education, including: building physics, building materials, production techniques, real estate management and house engineering. Preparation includes an uninterrupted pathway of mathematical subjects from pre-school, primary and secondary school through to vocational and higher education. Improved cooperation between universities, polytechnics and initial vocational education.
- In preparation: production of freely accessible educational materials for use in teaching, including from the perspective of renovation and low carbon (cf. BUILD UP Skills Finland). Further development of digital education and continuous learning in order to increase renovation and energy efficiency in the building sector.

De-risking and aggregation

- Banks can offer loans to cover renovation costs up to a maximum of 50% of the building's market value.
- Leasing-based funding solutions for projects where a renovation to improve energy efficiency is paid monthly according to the leasing model.
- Issuing green bonds so that businesses and financial institutions can collect funding for projects that support customers' responsibility agenda.

Areas for potential improvement compared to best practices

It could be useful to consider:

- specifying further the investment needs for specific measures;
- providing more specific estimates of the wider benefits and the energy savings contribution of the measures;
- further developing the data on electro-mobility and the impact of the air quality measures.

Summary of the long-term renovation strategy

France's long-term renovation strategy (LTRS) sets out comprehensive measures to address building renovation (including regulatory requirements, fiscal and economic incentives and information). The measures are in place across all government levels, which guarantees that they are tailored to local needs. The LTRS clearly explains the overall milestones and measures to reach them. The set of measures seems promising in terms of decarbonising France's building stock, especially the legal obligation to refurbish the worst part of the building stock and the tertiary sector.

The LTRS is highly ambitious in terms of planning, objectives (-49% GHG emission of the building sector by 2030 compared with 2015; carbon neutrality by 2050) and policy measures.

Information on the building stock

- In 2013, the French housing stock included around 33.5 million homes, 27.8 million of which were main residences.
- 36% of single-family houses were built before 1948, 18% between 1949 and 1974, 30% between 1975 and 1999 and only 16% after 2000.
- 82% of the stock of single-family houses is occupied by owners, 13% by tenants (private sector) and 3% by tenants in social housing.
- 29% of multi-family houses were constructed before 1948, 32% between 1949 and 1974, 25% between 1975 and 1999 and only 14% after 2000.
- 24% of the stock of multi-family houses is occupied by owners, 42% by tenants (private sector) and 30% by tenants in social housing
- The 1948-1974 construction period saw a large concentration of low-rent social housing units; social housing accounts for almost 40% of the housing units built between 1948 and 1974.
- Single-family buildings represent 59% of the national housing stock and multi-family buildings 41%.
- The table below present the non-residential building stock, where offices, commercial premises and education establishments cover 65% of the total surface area.
- The stock of office buildings covers a total surface area of some 225 million m² in buildings of all sizes.
- The number of commercial buildings amounted to 476 546 in 2011.
- The total surface area of education buildings amounts to 168 250 965 m². This area is mainly occupied by primary schools (écoles) and lower secondary schools (collèges), which cover a total of 110 641 994 m², or 66% of the total floor surface of the stock of education buildings.

- 190 000 dwellings have been renovated to low-energy building standard over 10 years (98% of which are apartments). Such renovations have steadily increased since 2013. In 2018, more than 30 000 dwellings were renovated to low-energy building standards.
- In the tertiary sector, a total surface area of 3.7 million m², have been renovated to low-energy building standard.

Sector	Millions of m ²	% of building stock
Offices	225	23%
Hotels and restaurants	65	7%
Commercial premises	212	22%
Education	188	19%
Communal residences	70	7%
Health care	115	12%
Sport, leisure and culture	72	7%
Transport	25	3%
Total	973	100%

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

Year	Final energy consumption compared to 2010 (ktoe)	
	Residential	Tertiary
2030	-22%	-40%
2040	-29%	-50%
2050	-41%	-60%

- For the residential and tertiary sector, France's national carbon strategy aims for:
 - carbon neutrality by 2050; and

- a 49% decrease in building sector greenhouse gas emissions by 2030 compared to 2015.
- These targets are based on a 22% reduction in energy consumption in the building sector by 2030, 29% by 2040, and 41% by 2050, compared to base year 2015.
- Tertiary sector: a target of reducing energy consumption by 40% in 2030, 50% in 2040 and 60% in 2050.
 - 190 000 dwellings and 3.7 million m² of tertiary buildings have been renovated to the low-energy ‘BBC’ standard over 10 years.

Investment needs

- The estimated annual amount of (public/private and public) investment for the 2019-2032 period includes EUR 15-25 billion for buildings. (from the NECP).
- The big investment plan: EUR 1.8 billion allocated for government building thermal renovation (2017-2022).

Good practices

Legislative

- A **standardised technical sheet for energy performance contracting services** (CPE services) was created at the end of 2018 to encourage the use of energy performance contracts for new installations.
- From 1 January 2022, energy performance certificates and tenancy agreements will have to include information on the **actual energy** consumption of dwellings expressed in primary and final energy, and an estimate of the theoretical amount of energy expenditure.
- **Carbon pricing**, including proposing a minimum price for carbon that is harmonised at European level.
- **New environmental rules for buildings** (including a minimum level of heat from renewable sources; a greenhouse gas emissions criteria that applies to a building’s entire life-cycle; and a higher energy performance requirement, which also considers ‘summer comfort’).
- The factor for the conversion of final energy into primary energy from electricity will be set at 2.3, corresponding to the average calculation over 50 years.
- The emission factor for electricity will be determined by the monthly method by use, which leads to a value of 79 gCO₂/kWh for electric heating.
- A **reduced rate of VAT**: 5.5% applied to energy renovation works (supply and installation) in properties over 2 years-old;

Finance

- Staged renovations are addressed by the ‘bâtiment basse consommation [BBC] compatible’ concept, which certifies that each renovation lot is compatible with an overall renovation roadmap leading to a NZEB.

- Several national and regional programmes and initiatives entail staged renovations that are monitored under the **Effinergie initiative** (see <https://www.effinergie.org/web/bbc-par-etapes>).
- **Energiesprong.fr** which aims to roll-out major renovations works.
- Simplify aid for people in France by making the **tax credit on a flat-rate basis** and adapting the existing zero-rate eco-loan.
- Co-financing through **MaPrimeRenov** and the **SARE** programme (accompanying service for energy renovation), diagnosis (F or G performance diagnostics) for households with low income owners in particular, and support for overall renovations.
- Maintain incentives for individuals to **move away from oil heating by 2028** towards renewable heating installations, such as heat pumps, boilers biomass, combined solar systems or a connection to a renewable heating network.

Public buildings

- Encourage a massive renovation of public buildings by mobilising EUR 4.8 billion.
- A comprehensive set of policies for the public sector, comprising city renovation plans, an open data list of public buildings' energy performance and technical features, regulatory measures (banning of oil boilers) and financial support.
- The 2018 renovation plan has a specific energy consumption reduction objective for the public sector: the State should aim to reduce its stock energy consumption by 15% by 2022 compared with 2010.
- Obligation to **ban oil heating in public sector buildings by 2030**.
- A dedicated **taskforce for school renovation** is to be put in place. Educational premises represent around 50% of the public building stock and account for 30% of total consumption.
- Financing tool for building renovation by regional authorities: as part of the Grand Plan d'investissement 2018-2022, EUR 3 billion is available to local and regional authorities in order to renovate the energy systems in their own buildings.

Energy poverty - worst performing buildings

- 11.6% of people in France are living in energy poverty.
- 15% of the French population stated that they suffered from the cold for at least 24 hours in the winter of 2017; for 4 out of 10 households, this was due to poor insulation.
- 572,440 households were subject to action on the part of an energy supplier (power reduction, disconnection or termination of contract) in 2018 for unpaid energy bills.
- The proportion of households living in energy poverty in metropolitan France as measured by the expenditure indicator fell between 2013 and 2017 from 14.5% to 11.6%, i.e. by 3.3 million households comprising 6.7 million individuals.

- The percentage of households stating that their gas and electricity bills account for a large share of their household expenses rose from 55% to 65% between 2016 and 2018.
- A very comprehensive set of measures to address energy poverty has been put in place, including an energy efficiency obligation scheme, advice and financial support.
- Creation of a **guarantee fund** of more than EUR 50 million to help 35 000 low-income households per year.
- For the stock of private housing and for the lowest income households, the **Habiter mieux ('Better living')** programme of the National Housing Agency (ANAH) has been operating since 1 January 2018. Its ambitious target to renovate 75 000 dwellings by 2022 was actually achieved in 2019.
- Policies to address the worst performing segment of the building stock are in place, most notably a renovation obligation which will come into force in 2023. The obligation is part of the revised energy and climate law. It includes the following measures:
 - Rent calculations and property estimates will be done upon completion of renovation measures which remove the building from the 'thermal sieve/passoire thermique' category (term used to designate worst performing buildings, i.e. classes F and G) by 1 January 2021. This will ban worst-segment property owners from increasing the rent between two lettings without undertaking energy renovations.
 - Energy performance diagnostics and rental contracts for housing must include information on the actual primary and final energy consumption of housing, and an estimate of the theoretical amount of energy expenditure by 1 January 2022 at the latest.
 - An obligation to display the theoretical amount of estimated energy expenditure in property advertisements by 1 January 2022 at the latest.
 - Finally, an **obligation to renovate these dwellings**. From 1 January 2023, energy performance will become a criterion for assessing the decency of housing. From this date, dwellings whose final energy consumption exceeds a certain threshold, defined by decree, may no longer be rented out.
 - **From 1 January 2028, all dwellings with excessive energy consumption will have to be renovated.**
- The **energy tax** base has been extended to 20% of households with the lowest incomes. This will make it possible to extend the distribution of the energy voucher to 2.2 million additional households, i.e. 5.8 million households in total. The tax credit for the energy transition (CITE), and the successor premium, will also be made more effective thanks to the introduction of a new flat rate in 2020.
- Dedicated **energy saving certificates** to benefit low-income households by offering basic measures for EUR 1.
- New **grants** for low/very low income households and subsidised energy audits.
- **Interest-free eco-loans** including for people living in social housing. The aim is to provide individual eco-loans for 35 000 low-income households a year by 2021 and 6 500 loans to building management bodies by 2021 (for multi-family buildings).

- The **National Observatory of Energy Poverty (ONPE)** monitors energy poverty using an annual scorecard and also acts as a think tank on policy solutions.

Advisory tools

- A **national renovation observatory** has been put in place and will monitor the following indicators: ‘renovation equivalents’ per year; annual energy consumption of existing building stock; share of building stock per energy performance class (annual monitoring); and share of building stock per heating system.
- The **FAIRE** (‘Faciliter, Accompagner et Informer pour la Rénovation Énergétique’) network run by ADEME, ANAH and ANIL is a one-stop-shop comprising 1000 experts/450 contact points. The network includes building and real estate professionals, NGOs, local and regional authorities and energy companies who work together to identify relevant solutions for household renovation and to help households put them in practice by increasing their confidence and knowledge, including on how to access funding.
- Regional and local advisory one-stop-shops.

Skills

- The government has put in place a comprehensive set of **skills and education programmes** in the construction sector. For example, ‘Massive open online courses (MOOC)’ for renovation experts which lead to certified qualifications (see <https://www.mooc-batiment-durable.fr>).
- Better training of professionals and better control of the quality of work by reforming the RGE label (recognised as the guarantor of the environment), investing EUR 30 million in the training of professionals and EUR 40 million in innovation.

Digitalisation

- New digital tools designed to collect and process data on housing stock can now be used as a basis for energy renovations.
- The French government is **planning to install a digital logbook** for building renovations and to exploit the data on housing. This logbook will be a secure online service to improve knowledge on accommodation. It aims to provide information to and gather information from successive users in order to: encourage work to improve energy performance and provide targeted information to owners on what to do in the event of equipment failures and on the support available and on how to better manage their building to improve energy consumption. It will also be a useful source of information for professionals in need of renovation or energy improvements. It therefore aims to reduce energy poverty.

Multi-family buildings

- The stock of multi-owner buildings in France comprises 6.9 million primary residences, that is to say 28% of all dwellings in France, located in some 617 000 buildings.
- **3 Energy-saving certificate programmes** have recently been launched to multiply awareness-raising efforts, and provide training and coaching for multi-owner building stakeholders in energy renovation:
 - CEC, at a cost of EUR 3 million, which is developing a coaching scheme for homeowners and management bodies of multi-owner buildings to promote energy renovation;
 - RECIF, at a cost of EUR 2.8 million, which is conducting a major campaign to stimulate demand, managed regionally and implemented locally;
 - ETHEC, at a cost of EUR 1.4 million, which targets multi-owner buildings in town and city centres undergoing revitalisation.
- **2 Energy-saving certificate programmes** focus on awareness-raising and training for professional building management bodies:
 - ACTIMMO, at a cost of EUR 5.75 million, which is developing a standardised awareness-raising tool for professional building management bodies;
 - Expertise rénovation copropriété ('Expertise in the renovation of multi-owner buildings'), at a cost of EUR 5 million, which implements awareness-raising and training measures for professional building management bodies and offers an online training module in energy renovation for co-owners (at www.coprosvertes.fr).
- These programmes will mobilise almost EUR 18 million in energy-saving certificates between now and mid-2021.

Areas for potential improvement compared to best practices

It could be useful to consider:

- Investments needs and budgetary resources could be defined in more details;
- providing more specific estimates on the wider benefits and energy savings contribution of the measures.

Summary of the long-term renovation strategy

Germany's long-term renovation strategy (LTRS) sets out comprehensive measures to address building renovation. It comprises a balanced mix of regulatory requirements, fiscal and economic incentives and information. Fiscal support and energy advice measures have been especially stepped up and refined to address different target groups. The measures are in place across all government levels, which guarantees that measures are tailored to local needs. A quantitative milestone is set for 2030, whereas the milestones set for 2040 and 2050 are qualitative. The LTRS has no concrete budget allocation.

Information on the building stock

- The housing stock in Germany comprises around 19 million buildings with almost 40 million dwellings. This total includes around 14 million single and two-family houses with around 9 million dwellings, and around 5 million apartment blocks with almost 21 million dwellings.
- There are more than 1 million dwellings in non-residential buildings. In 2018, nearly 287 000 new homes were completed in Germany.
- New construction accounts for just over 0.5% of the housing stock.
- 26% of residential buildings were built before 1948, of which almost half (13%) were built before 1919.
- Between 1949 and the first regulation from 1977, which set minimum energy efficiency requirements (First Thermal Protection Regulation) (WSVo)), around 7 million buildings were erected. This means that around 64% of the current housing stock was built before energy efficiency standards became mandatory. A further 3.6 million buildings (20%) were erected before the Third Thermal Protection Regulation in 1995. By 2002, a further almost 2 million residential buildings (10%) were erected. The First Energy Conservation Ordinance (EnEV, 2002) has been in place since 2002. Since then, more than 1 million new residential buildings have been erected (6%).
- Germany has at least 3.5 million non-residential buildings, with an estimated net floor area of 2.35 billion m².
- Germany's cities and municipalities have around 175 000 non-residential buildings.
- The energy performance of buildings improved by more than 25% between 2008 and 2018. Greenhouse gas emissions in the buildings sector were reduced by around 42% between 1990 and 2019. The share of renewable energy in final energy consumption for heating and cooling was over 14% in 2018.
- In 2018, construction permits were granted for the refurbishment or construction of around 340 000 housing units, and around 282 000 housing projects were completed. New construction accounted for around 302 000 of the permits, i.e. around 89% of the 340 000 housing

units. In 2018, new construction projects with around 90 000 housing units were funded under the ‘energy-efficient construction’ programme of the Kreditanstalt für Wiederaufbau (KfW) as part of the CO2 building refurbishment programme.

- In 2018, KfW’s ‘Energy-Efficient Refurbishment’ support programme improved the energy efficiency of around 270 000 housing units. Energy-efficient construction unlocks potential for economic solutions. In the field of renewable energy for heating, the installation of approximately 50 000 renewable heating installations, mainly in residential buildings, was supported in 2018 under the ‘Renewable Energy in the Heating Market Incentive Programme’ (MAP).

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

- Germany aims to reduce the greenhouse gas emissions from its building stock to 70 MtCO₂eq in 2030 (according to its Climate Protection Act), which represents a 67% reduction compared to 1990 (210 MtCO₂eq).
- It also aims to reduce non-renewable primary energy consumption (PEVn.E.) by 2030 to 2 000 PJ (556 TWh). The indicative milestone corresponds to a reduction in PEVn.E. of around 55% as compared with the base year 2008 (4 400 PJ). In 2018, when PEVn.E. was around 3 300 PJ, a reduction in PEVn.E. of around 25% was already achieved as compared with 2008.
- Germany has increased its intended contribution to the European 2030 energy efficiency targets in the heating and cooling sector by 30% as compared with 2008 and by 27% for the share of renewables.
- Germany can at this stage only provide a qualitative description of its indicative milestones for the building sector after 2030. Germany will continue to push for a steady and substantial increase in energy performance beyond 2030. A continued dynamic impact, in particular the measures and instruments adopted last year under the 2030 Climate Change Programme, will increase the potential for significant gains in energy performance. This can be expected to be reinforced by the upcoming investment and renovation cycles in the building stock in the coming years, which will be used to implement energy efficiency, renewable energy, sector coupling and decarbonisation of energy supply and to exploit cross-sectoral synergies such as electro-mobility. Innovation and digitalisation, as well as important achievements from energy research that will be brought into the market, also have the potential to generate further positive effects on energy performance. In addition, the right incentives will further increase the potential for cost reduction in energy performance.
- From 2030 onwards, the refurbishment rate (full refurbishment equivalent) is around 1.3% to over 2% for single and two-family houses and around 1.5% to over 2% for apartment blocks.

Investment needs

- Only 2018 investment figures are reported: EUR182.2 million was given as grants, triggering investment of EUR 734 million.

- The CO2 building renovation programme has generated a total of around EUR 385 billion of private investment since 2006 and the MAP has generated more than EUR 20 billion since 2000. In order to refinance the loans granted to the beneficiaries under the CO2 building renovation programme, KfW issued 'green bonds' for the first time in 2019 for sectors of the programme ('energy-efficient construction').

Good practices

Legislative

- Trigger points are clearly identified (i.e. change of ownership, technical/economic point in time of replacement of a building component, complete refurbishment etc.) together with renovation obligations that come into force once a trigger point is reached.

Finance

- Public funding to leverage additional private investment is largely in use via several dedicated support schemes run by **BAFA and KfW**. The funding schemes will be transformed into an umbrella instrument to have a clearer trademark and simplified access to finance.
- **Tax support for energy renovation measures in owner-occupied homes:** A key measure in the buildings sector is the tax support for energy renovation of buildings, which was introduced on 1 January 2020 to complement existing support schemes. The tax incentive can be used as an alternative to the existing loan and grant schemes in the buildings sector. Support will be given for individual measures in owner-occupied housing that are also considered eligible under the existing building support programmes. This includes the replacement of heating in particular, but also the installation of new windows or the insulation of roofs and external walls. Support may also be provided for comprehensive remediation, if necessary on a step-by-step basis, through several individual measures. Eligible costs include 20% of the investment costs and the costs of issuing the certificate (that needs to be submitted to the tax office in order to grant the tax reduction), and 50% of the costs of an energy consultant to carry out the energy planning and supervise the eligible measures. Support will be provided through a deduction from tax liability spread over 3 years, e.g. when replacing old windows with modern thermal windows. By offsetting the support against the fixed tax liability without any progression, as many owners of residential buildings as possible can benefit from the measure.
- **CO2 - Federal government reconstruction programme:** The programme will support the long-term renovation strategy for buildings by supporting energy-efficient construction and renovation programmes administered by the **KfW**. The programme is the same size as the volume support instrument (2016-2017 budget: EUR 2 billion for each year). Energy efficiency measures in the building sector carried out using subsidised loans will be supported in part with repayment grants or, alternatively, investment grants.
- The **market incentives programme** (MAP) supports installations for the use of renewable energy for the production of heat and cooling, as well as certain heat storage facilities and local heating networks, both in residential and non-residential buildings. This means that

almost exclusively installations in the building stock are eligible for support, and only in exceptional cases of installations in new buildings. The programme consists of two support parts. For smaller plants, the Federal Office of Economics and Export Control (Bundesamt für Wirtschaft und Ausfuhrkontrolle, BAFA) provides investment grants. Solar collectors, biomass plants and efficient heat pumps are eligible for support here. For larger plants, the Federal government grants aid under the KfW renewable energy programme 'Premium' in the form of pro rata loans for soft loans. This part includes large solar thermal, biomass (kraft) works, large efficient heat pumps, biogas lines, deep geothermal plants, local heat networks for renewable heat, and large heat reservoirs for renewable heat. The MAP currently has an annual budget of around EUR 320 million.

- **Incentive Programme for Energy Efficiency (APEE):** The MAP support has been strengthened through the introduction of the Energy Efficiency Incentive Programme (APEE). This includes three investment areas: (1) installation of ventilation systems (ventilation package) combined with a renovation on the building envelope in order to avoid construction damage (among others), (2) the replacement of inefficient heating through efficient heating (heating package), (3) the placing on the market of nuclear fuel cell heating in new buildings and existing buildings. The aid will be granted through a grant for stationary fuel cell heating with an electrical capacity of 0.25 to 5.0 kW through the KfW.
- **Carbon pricing:** The Fuel Emissions Trading Act (BEHG) entered into force in December 2019. From 2021, the Federal government introduced carbon pricing for the transport and heat (non-ETS) sectors. The national emissions trading system (ETS) covers emissions from the combustion of fossil fuels (in particular fuel oil, liquefied petroleum gas, natural gas, coal). In the heating sector, the system covers the emissions of heat produced by the building sector and energy and industrial installations outside the EU ETS. The CO₂ price would be EUR 25 per tonne as of January 2021 and then gradually increase to EUR 55 in 2025. For 2026, a price corridor of a minimum of EUR 55 and a maximum of EUR 65 shall apply.
- The Federal government will promote the **industrial pre-production of façade and roof elements and a standardised installation of plant technology**, including the supply of self-generated electricity, in conjunction with new investment and contract models. The serial approaches developed as part of the pilot projects carried out will be put into practice by means of a newly adopted support programme from the end of 2020. Serial refurbishment of apartment blocks' with funding from the BMWi and with the involvement of the Dutch initiative '**Energiesprong**'. For the next three years, however, the focus will be on the stock of housing companies (mostly apartment blocks).
- **Support programme for heating optimisation (HZO):** The support is up to 30% of the net investment costs for services related both to the replacement of heating and hot water circulation pumps with high-efficiency pumps and to hydraulic balancing, however with a maximum of EUR 25 000. The measure must be carried out in an existing building or on an existing heating system (measures in new buildings are not eligible). Each eligible measure may be applied for once only per heating system. It is appropriate to combine measures, implement them together and apply for them once.

- The ‘**Energy-efficient urban redevelopment**’ support programme invests in comprehensive energy efficiency measures in buildings (indirectly) and supply infrastructure (heat/cooling/water/sewage) in residential areas. It aims to stimulate energy efficiency in the municipal sector. In addition to the planned continuation of the ‘Energy Urban Renovation’ programme, new funding measures will be developed in 2020 or existing ones will be improved. The grant scheme will, in particular, take greater account of environmentally-friendly mobility concepts, inter-municipal concepts, heat network planning measures in remediation management concepts and concepts relating to mixed neighbourhoods (combination of new buildings and existing buildings).

Public buildings

- The Federal government has adopted a comprehensive ‘**Energy efficiency strategy 2050**’ (EffSTRA), which also addresses the buildings sector. This strategy integrates a wide range of energy efficiency measures for 2021-2030 into the new national energy efficiency action plan (NAPE 2.0). It also takes into account the measures in the 2030 climate action programme.
- **New central government buildings need to meet the lowest KfW efficiency standard (EH 40)** from 2022 and renovations need to meet the second-lowest KfW standard (EH 55). A KfW programme grants subsidies to municipalities and a national climate protection initiative promotes municipal climate protection concepts.
- The **Federal government/Länder dialogue contracting** project will provide a platform for intensive energy saving contracts to be set up between the Federal government and the Länder. The project aims to remove barriers to energy-saving contracting and to develop regional competences in this area. Its activities will include annual plenary sessions and workshops, a mentoring scheme and the exchange of best practice. Support will also be given to develop regional centres of excellence.
- Municipalities can form a network to improve their energy and/or resource efficiency. Together they can identify and implement savings by supporting a network of teams. Municipalities and municipal companies can also get a qualification to carry out energy renovation in their own building stock.
- **Energy-efficient procurement by public institutions** is compulsory under the Public Procurement Regulation (Vergabeverordnung) and all public contributors to pan-European tenders are bound by it. The regulation stipulates that the highest performance level for energy efficiency and - where available - the highest energy efficiency class, will be required when energy-related products are procured or are essential for providing a service. Energy efficiency must also be an evaluation criterion when determining the most economical bid.

Energy poverty – worst performing buildings

- The worst performing segment of the national building stock (which includes 30% of the total dwelling space) is clearly identified (i.e. buildings in G energy class, consuming more than 200 kWh/m²). 54% of heated non-residential buildings have a final energy demand of 200 kWh/m² or more and 18% of buildings even have an energy demand of more than 700 kWh/m² of energy.

- Measures to address inefficient buildings and energy poverty include:
 - KfW subsidies for heritage-protected buildings;
 - a requirement under the Energy Conservation Act to ensure a minimum level of energy efficiency if renovation is carried out and to exchange the combustion unit after 30 years;
 - a requirement under the German Federal Emission Control Act for chimney sweeps to monitor heating system emissions;
 - a requirement for heating systems to display a label with their efficiency class;
 - Federal support for energy advice from consumer centres;
 - an energy savings check;
 - a housing allowance (as part of the overall social welfare payments).

Smartness

- An energy research programme that emphasises digitalisation, energy system integration, and district/decentralised supply structures in buildings.
- Federal funding for the **Smart Meters** pilot programme.
- The ‘EnEff.thof.2050’ initiative promotes lighthouse projects that demonstrate innovative technologies and approaches to achieve low-carbon buildings and neighbourhoods. They should help make the entire building stock almost climate-neutral by 2050. Eligible projects may involve developing key technologies (including small parts developed by the sponsor) and procedures for new buildings or the renovation of existing buildings (‘innovation projects’). Projects involving ambitious ‘model’ buildings and neighbourhoods (‘transformation projects’) can also be supported.

Split incentives

- Germany already has a number of **rental law** instruments targeting ‘split incentives’
- Since 1 January 2019, annual rent can only be increased by 8% and this increase should be purely due to modernisation costs. The rent increase after modernisation can apply for an unlimited period of time. In other words, the property owner is not bound by the standard rent increase limit that otherwise applies.
- Current rental law allows the property owner to pass the cost of energy-efficient refurbishment on to the tenant. Ideally, the increase in ‘cold rent’ and reduced operating costs are in balance, making it possible to achieve ‘warm rent’ neutrality.

ESCOs

- The LTRS lists a number of mechanisms (contracting support programme for municipal level ‘EBK’), blueprint ESCO/EPC contracts, federal government-level dialogues on use of ESCO/contracting, model projects for enhanced EPC contracts. The Federal Agency for Energy Efficiency is responsible for promoting the energy service markets and overcoming barriers to ESCO/EPC deployment. The website of the Federal Energy Efficiency Agency provides information on contracting model contracts and guidelines on energy-saving contracting available free of charge. This includes offers specifically aimed at public properties or local authorities.
- As part of the federal/regional dialogue on contracting, around 10-15 forms of contracting for ‘model’ projects in representative sites at local and land-level will be demonstrated to show the potential of contracting and thus help establish a functioning ESCO market in Germany. The pilot projects will also be an opportunity to train key actors and to develop standards and guidelines for similar projects.

Advisory tools

- A comprehensive set of advisory services that are broadly tailored to different needs (energy poverty, residential, SMEs, industry, etc.). They also give advice on access to financing.
- A **digital one-stop-shop is planned** to consolidate the existing information in a transparent manner.
- The individual **building renovation passport (iSFP)** takes into account the added value of energy renovation of residential buildings in the energy advice for residential buildings. iSFP assists the energy consultant in drafting the advisory report. At the end of the consultation, the client will receive an iSFP tailored to them and their building. iSFP is financially supported through the energy advice for residential buildings (on-site advice, building renovation passport) with up to 80% of the consultancy costs incurred through a grant.
- The subsidy programmes run by BAFA and KfW are available in an online database, which will be central to a future ‘digital one-stop-shop’.
- Since 2017, Germany has also introduced an optional, building renovation passport together with an 80% subsidy for issuing it. Subsidised, optional individual building roadmaps for non-residential buildings were introduced in 2016.
- Energy advisory services for residential buildings are available to owners (private property owners, housing associations and communal housing associations). A qualified energy advisor examines the property and prepares a comprehensive energy advisory report which includes the funding per programme and the consultants’ individual possibilities.
- With the ‘**Refurbishment configurator**’ service launched in 2012 (<https://www.sanierungskonfigurator.de/start.php>), building owners and tenants can learn about possible refurbishment measures for their building, their cost and savings potential and state support programmes on a dedicated website of the Federal Ministry of Economic Affairs and Energy.
- Concise initial advice for private households is provided by the Federation of German Consumer Organisations (Bundesverband der Verbraucherzentrale Bundesverband e. V. (vzbv)) and financially supported by the Federal Ministry of Economic Affairs.

- A statistically-verified pool of data will be created in Germany over the next few years using a consolidated data collection concept and will be updated regularly.
- Many information campaigns are also under way, such as the ‘**Germany Does It Efficiently**’ campaign.

Training - Skills

- Current practices are reported for training and providing qualifications for experts, energy consultants, craftsmen, etc.

Areas for potential improvement compared to best practices

It could be useful to consider:

- providing a quantitative description of milestones for 2040 and 2050;
- specifying further the set of indicators to track progress;
- further detailing budgetary resources to support the implementation of proposed measures;
- providing more specific estimates on the wider benefits.

Greece

Summary of the long-term renovation strategy

Greece has presented a comprehensive set of 2030, 2040 and 2050 milestones that are expressed in energy savings, number of renovated buildings, and number of upgrades building envelopes and building technical systems. The evolution of the package of policy measures on energy efficiency from 2014-2020 to 2021-2030 is described, covering a wide range of regulatory requirements, financial incentives and information measures. Despite these positive developments, more supporting evidence is needed on how the proposed milestones will be achieved in practice, together with more concrete steps on how to support vulnerable groups and tackle energy poverty as well as innovative financial schemes.

The LTRS ambition level is deemed moderate. The LTRS states that milestone of upgrading 12-15% of buildings and or building units within the decade 2021-2030 through targeted policy measures. While the planned actions require significant investments (up to EUR 20 billion per year), the suggested renovation rates and share of renovated building stock remain at a modest level.

Information on the building stock

		Number
Total Residential		4 631 528
Non-residential	Offices	53 064
	Hospitals/health establishment	38 664
	Hotels / Restaurant / leisure	24 109
	Commercial	65 957
	Schools	19 167
	Total non-residential	221 643
Total		4 853 172

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

2030	• Upgrade 12-15% of buildings • Final energy demand reduction in buildings of 8% compared to 2015 • Upgrade 23% of building envelopes in residential and 9% in non-residential buildings • Radical reduction in oil use in buildings, 47% gas boilers, use of aerothermal heat pumps, and 11% reduction in traditional biomass combustion
2040	• Final energy demand reduction in buildings 20-28% compared to 2015 • Upgrade 36-42% of building envelopes in residential and 14-16% in non-residential buildings • No oil-fired boilers, 12-21% aerothermal heat pumps, 20% gas boilers, 83-86% solar thermal heaters
2050	• Final energy demand reduction in buildings 28-40% compared to 2015 • Upgrade of 45-49% of building envelopes in residential and 19-20% in non-residential buildings • No electric boilers, 15-50% aerothermal heat pumps, 14-64% gas boilers, 83-92% solar thermal heaters

- The energy upgrade of 15% of Greek homes in 2021-2030 as well as other energy efficiency improvements in the building stock is expected to lead to approximately EUR 8 billion increase in domestic value added and to create and maintain 22 thousand new full-time jobs on an annual basis throughout the period. The increase in the income of the related employees is expected to amount to about EUR 3.4 billion.
- The annual renovation rates targeting the envelope of buildings range from 1.24% to 1.52% in residential buildings depending on the scenario. For non-residential types, it can be range from 0.29% to 1.35% depending also on building type.

Investment needs

- According to the modelling, by 2030 about EUR 10 billion per year will be needed and by 2050 up to EUR 20 billion per year.

Good practices

Legislative

- Mandatory installation of solar thermal systems in new buildings, which are majorly renovated.

Finance

- Continuation of the “Saving at home” programme. The Programme was launched in 2010 and was financed by ESIF. The Programme is targeting renovations for single family houses, apartment buildings with participation of all apartments, and single apartments. The renovations need to produce 30% energy savings and at least upgrade of the house/apartment to the next energy class. The grant intensity is dependent on the income of the household and can reach 70%. For high income households (above a threshold) the financing is only an interest free loan.
- Financial renovation programmes for tertiary buildings sector (excluding public) in the context of the new programming period.
- Introduction of tendering procedures for achieving energy savings with the objective to improve the cost-effectiveness of energy applied technologies, as well as the reduction of risk implementation by third parties through the aggregation of small individual projects.
- Promoting energy audits and energy management systems in SMEs.
- Establishment of the **National Energy Efficiency Fund** to provide support for the implementation of measures improving the energy efficiency in all the energy consumption sectors. In addition, it's expected to facilitate access to funding for the parties involved, to contribute to improving the cost ratio of implemented programmes and to make more effective use of the untapped energy savings potential in specific sectors.
- Planning of financial programmes in the context of the new programming period for the development of CHP and district heating/cooling systems, contributing to the promotion of efficient heating and cooling.
- Energy upgrading of residential buildings and energy vulnerable households and promotion of RES installation for covering their energy needs.
- Introduction of energy efficient systems for heating, cooling, ventilation and lighting in tourist complexes.
- Development of special fiscal incentives for the installation of RES systems for heating and cooling in residential and tertiary sector.

Public buildings

- Improved regulatory framework and strengthening role of energy manager for public buildings.
- Promotion of energy management systems in public buildings.
- As of 31.12.2023, all public authority buildings should be classified as energy class B or above.
- Financial programmes for the renovation of public buildings sector in the context of the new programming period.
- Promotion of energy performance contracting in public sector through targeted financial programmes for the energy efficiency in the public sector.

- "Electra" programme will provide EUR 500 million by 2026 for the implementation of investments of for energy savings in public buildings. The resources of the program come from the Deposits and Loans Fund and from the European Investment Bank, while ESCOs could also participate.

Energy poverty – worst performing buildings

- The LTRS does not give extended details on energy poverty measures but it mentions that targeted energy upgrades in buildings occupied by energy vulnerable households are included in the past plan on energy poverty.
- In the new programming period, the successful financial schemes on residential energy efficiency will be modified to streamline incentives with a view of maximizing energy benefits and to support economically vulnerable and energy vulnerable households.
- Special support for economically vulnerable and energy vulnerable households in the “Save at home” financial incentive scheme.
- Energy upgrading of residential buildings and energy vulnerable households and promotion of RES installation for covering their energy needs.

Smartness – Research and Development

- Strengthening research in buildings regarding new materials, prefabricated active elements for facades and roofs, cost efficient and innovative technological applications in heating and cooling systems, with emphasis on improving reliability and automated operation.
- Research activities in the industrial sector about innovative waste heat recovery technologies, energy efficiency improvement technologies for heating and cooling and the integration of systems.

Areas for potential improvement compared to best practices

It could be useful to consider:

- Providing supporting evidence on how the indicative targets will be achieved in practice through the proposed policies.
- Building renovation passports, one-stop-shops as well as innovative financial schemes.
- Measures to address split incentives are not covered in the strategy.
- Providing more concrete steps on how to support vulnerable groups and tackle energy poverty.
- Promoting the ESCOs market.

Hungary

Summary of the long-term renovation strategy

The Hungarian strategy includes a good description of the building stock, a comprehensive package of existing and planned measures and a list of progress indicators to monitor their implementation. The implementation of the measures will be monitored by the establishment of a building renovation monitoring system. The strategy estimates 90% CO₂ emission reduction by 2050 (compared to 2018-2020 levels), triple the current 1% yearly renovation rate by 2030 and to have 90% of buildings at NZEB level in 2050. Although these objectives are deemed ambitious, the challenge appears to be very high, also considering that the majority of the new measure will become active only from 2023.

Information on the building stock

- Total Residential buildings are 3 854 000 (274 million m²).
- The final energy consumption is on average between 205-225 kWh/m².y
- The current annual renovation rate is approximately 1%.
- An estimate of the evolution of the number of residential dwellings until 2050 reveals approximately 250 000 unit decrease in the period 2020-2050.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

	Milestones
2030	• renovation rate of 3% per year for the total residential stock • annual renovation rate of the public buildings stock of 5% • 18% decrease in final energy consumption in public buildings (vs 2018-2020 consumption) • 20% share of NZEB • 20 % savings in the energy use of the domestic housing stock.
2040	• 60% CO₂ emission reduction (vs 2018-2020 average level) • 60% share of NZEB • 40% decrease in final energy consumption in public buildings (vs 2018-2020 consumption)

2050	• 90% CO2 emission reduction 60% (vs 2018-2020 average level) • 90% share of NZEB • 60% decrease in final energy consumption in public buildings (vs 2018-2020 consumption)
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- The overall objective of the Strategy is to lay the groundwork for achieving a sustainable, energy-efficient and cost-effective domestic building stock by 2050.
- To reach these ambitious targets, the current 1% yearly renovation rate shall be increased to 3% by 2030.
- Energy renovation can improve work performance by 12% in workplaces and educational performance in schools by 3-8%.

Investment needs

- By 2030 EUR 5.1 billion (HUF 1760 billion)
- By 2050 estimated cost of achieving climate neutrality (all the economic sectors) is 145 billion EURO (50 000 billion HUF), 2.5% of GDP per year by 2050.
- The estimated cost of achieving climate neutrality in 2050 (all the economic sectors) is approx. EUR 140 billion (HUF 50 000 billion), 2.5% of GDP per year by 2050.

Good practices

Legislative

- Revision of the current NZEB definition (i.e. primary energy consumption of 100 kWh/m².year for residential buildings, and 90 kWh/m².year for non-residential buildings. Clarification of the legislative environment for the construction of buildings meeting nearly zero energy requirements and of the Regulation on the certification of the energy characteristics of buildings.
- Introduction of an Energy Efficiency Obligation Scheme from (January 2021)
- Promote and facilitate the use of Energy Performance Contracts and ESCO project through a revision of the current legal framework, definition of contract templates.
- The new National Energy Strategy 2030 is expected to be adopted.
- The second National Climate Change Strategy was adopted in 2018 covering the period 2018-2030, with an outlook to 2050. It contains the National Decarbonisation Road Map, the National Adaptation Strategy and the 'Climate Partnership' Awareness Raising Plan. Action Plans to be approved will specify the concrete measures.
- A new tax advantage was introduced in 2017, offered to companies for efficiency-improving investments.

- Reform of the energy certification system for buildings.

Finance

- To address building renovation high capital requirements and the need to aggregate projects, securitization and green bond financial instruments will be used. For reducing the investment risk the concept of a green finance guarantee organisation, the establishment of a green bank and the introduction of public guarantee schemes are under discussion.
- The Hungarian National Bank will provide a risk reduction guarantee to credit institutions, in case of green financial products (e.g. loans for building renovation). This will lead to a reduction of at least 0.3% interest points (green interest rebate).
- **Green Economy Funding Scheme:** since 2013, the dominant source (50%) of revenue has been the sale of quotas under the European Union Emissions Trading Scheme (EU ETS) in the form of a quota auction in accordance with a pre-defined auction calendar.
- **Home Melege Programme:** The scheme is funded by the Green Economy Funding Scheme. It aims to reduce energy costs for households. Projects aim at improving energy efficiency, installing renewable energy systems and modernising heating systems.
- A building renovation dedicated soft loan revolving fund to mobilize private investment is in place since 2017. For the 2021-2027 programming period, a combination of non-reimbursable and repayable assistance is justified in order to ensure the efficient use of EU funds.
- Encourage and support the use of heat pumps. By 2030, approximately 100 000 heat pumps to be installed (capacity: ~410-420 MW).
- **Green Remote Heat Programme:** under the programme, the greening of the district heating sector will mainly be achieved by increasing the use of geothermal, waste heat, as well as biomass produced on the basis of sustainability criteria for heating/cooling. A further objective is to increase the use of waste water treatment, depot gas and the use of biogas of agricultural origin. The incentives for the use of these resources will be developed on the basis of a detailed analysis carried out on a case-by-case basis in larger districts, taking into account local conditions.
- **Home Renovation Assistance** is a support to families with at least one child. The aid may be granted for both materials and labour costs, as well as for outdoor and indoor works. The maximum amount of aid shall be HUF 3 million in total. Half or half of the cost of materials and labour may be claimed. The implementation of the renovations will be monitored by the capital and county government offices and their district (capital district) offices.

Public buildings

- The public sector will play an exemplary role in the decarbonisation of the building stock, with a specific yearly target of renovate 5% of public buildings by 2030, and the introduction of mandatory energy audits.

- Policies for the energy improvement of public buildings are described: energy modernisation of health institutions using ESCO contracts, introduction of mandatory energy audit in public institutions from 2023 (larger than 250m²), use of grants financed by EU funds (e.g. EU funds, ELENA facility). The possible introduction of green bonds is also discussed.
- In line with Eurostat guidelines, Hungary is examining the introduction of Energy Performance Contracts (EPC, to promote energy efficiency improvements in public buildings.
- Energy modernisation of 10 hospitals under ESCO-type energy service contracts: for the first 2 sample projects the allocated budget is: equity capital HUF 1 518 150 000, partly investment loan HUF 3 542 350 000.
- From 2017 every public body is required to keep records on its energy consumption, report it to the offices of the National Network of Energy Engineers and must also draft energy savings plans. Each year a report must be drawn up on the implementation of the Plan. It is also necessary to launch an awareness raising campaign for public body employees.

Energy poverty – worst performing buildings

- Worst performing buildings have been identified: the ones consuming more than 300 kWh/m².y. Worst performing buildings often supported on the basis of their income situation.
- The Energy poverty issue is discussed in the strategy (families spending more than 25% of their total income) and the more concerned households have been identified (e.g. large families and pensioners living alone), together with the regions more effected (northern HU and South Transdanubia regions).
- To address energy poverty the following measures are described: reduction of energy supply cost (from 2013), social fuel scheme (from 2011) and energy efficiency awareness-raising campaigns.
- The energy efficiency obligation scheme is specifically expected to support vulnerable consumers.
- The increased use of decentralised heating solutions and electricity production penetration are expected to help decrease energy poverty

Smartness / Research and development

- The **National Research, Development and Innovation Fund** is a tender fund financed with innovation levies paid by Hungarian companies.
- Continuation of a **smart cost-sharing programme** for district heating housing was launched in September 2019. There are still 200 district-heated dwellings in Hungary where the technical solutions used do not allow the provision of heat to be regulated. The use and uptake of smart cost-sharing to enable continuous monitoring of energy consumption is an effective tool to strengthen the awareness of users.
- Facilitating the installation of 1 million smart meters in the electricity sector.

- **Energy Efficiency Innovation Programme:** the aim of the programme is to reduce the specific energy use of the building stock and industrial production. The programme will build on increased knowledge sharing, advice from a comprehensible and easily accessible network of experts and a focus on investments based on the results of domestic innovation and pilot projects providing the expected payback period. To support public investment, a test center will be set up to develop modern and cost-effective model solutions for the energy modernisation of typical domestic building groups, as identified in the National Building Energy Strategy.

Advisory tools

- The **National Energy Network** has been set up in 2017, to provide free advice and technical assistance to public institutions, promoting the setting up of energy management systems and energy audits. The Network will be strengthened to provide free online and face-to-face consultation service to the public.
- Other awareness raising and information initiatives are described: online information portal on best practices, organization of information campaign, organisation of conferences, information days and campaigns.
- Introduction of One-stop shops from 2023.
- The current energy performance certificate database will be improved so that a significant part of the technical data contained in the certificate are public available in a searchable, filterable way for statistical evaluations.
- Establishment and operation of the Energy Innovation Council.

Skills

- Training and retraining of 20 000 people until 2030.
- Following the assessment of educational needs and the identification of shortages, it is necessary to increase the number of students in the field of energy technology by means of guidance programmes. In-country mobility can be stimulated by reducing the tax burden on aid that facilitates it (e.g. subletting).

ESCOs

- To address current market failures the introduction of Energy Performance Contracts (2023-2027) for renovation and involvement of ESCO in projects (e.g. preparation of model EPC contracts and improving the legal framework to facilitate this kind of contracts) is proposed. The national framework for ESCO market is under revision following the EC recommendation, in order to develop contractual elements related to financial and technical risk sharing and compensation.
- Energy modernisation of health institutions under ESCO-type energy service contracts (2020-2022).

Areas for potential improvement compared to best practices

It could be useful to pay attention to:

- The implementation of the strategy considering that the majority of the new measures will become active only from 2023.
- Building Renovation Passports.

Summary of the long-term renovation strategy

Ireland's long-term renovation strategy (LTRS) sets out a comprehensive set of measures to address building renovation. Its indicative milestones are based on those set out in the Climate Action Plan and National Energy and Climate Plan that focus on reducing CO2 emissions in the built environment by retrofitting existing residential, public and commercial buildings. More specifically, the LTRS aims to reduce CO2 emissions from the built environment by 40-45% relative to 2030 projections by retrofitting 1 500 000 buildings by 2050 with an indicative 2030 target to retrofit 500 000 homes to EPC level B2.

The LTRS clearly describes the building stock and the existing and planned policy measures to retrofit and improve the energy efficiency of the building stock, but it does not provide full details on the budget allocation.

Information on the building stock

- There are approximately 1.7 million occupied residences in Ireland. The vast majority of residential buildings in Ireland are single-family houses. Only one in eight dwellings in Ireland is an apartment or part of a multi-residential unit.
- There are 124 000 buildings in the commercial and public sector with the largest numbers being offices and retail outlets.
- The building stock includes approximately 15 000 public sector buildings.
- There are currently over 45 000 protected structures. 18% of dwellings fall into the traditionally built category.
- Irish homes use 7% more energy than the EU average, and are 70% reliant on fossil fuels, including oil-fired boilers.
- Over 80% of homes and other buildings have an EPC of C or worse.
- The majority of existing housing stock is energy inefficient, with only 0.4 to 1.2% of the stock being renovated each year.
- More than one-third of Irish dwellings are in rural areas and 93% of these dwellings are either detached or semi-detached.
- Ireland has high levels of privately-owned single-family dwellings which makes the retrofitting aggregation more challenging. Approximately two-thirds of residential buildings in Ireland are owner occupied.
- Ireland has the youngest dwelling stock in the EU. Approximately 16% of the residential building stock was built before 1940. A further 15% of the current housing stock was completed before 1970, and has little or no insulation.
- There is a gradual increase in the share of electricity and gas and a gradual, decline in coal, peat and oil use.

- Oil remains the dominant fuel in the residential sector (39% in 2005, 38% in 2018). Electricity is the second largest source of energy (25% in 2018) with natural gas having the next largest share (22% in 2018). The renewables share of final energy used directly in households was 2.5% in 2018 which does not take into account the renewable share of electricity used.
- Over 2007-2014, residential energy use declined by 18%, returning to growth in 2015- 2016, falling again in 2017, and growing again in 2018. The emissions of energy-related carbon per dwelling fell by 39% over 2005-2018.
- Dwellings built in 2015-2019 were considerably more energy efficient than in earlier periods, with 97% of them receiving an EPC A compared with 36% in 2010-2014 and 1% in 2005-2009.
- The installation of oil boilers has fallen from 36% to 4% in new dwellings, and electrical systems (primarily heat pumps) make up 44% of heating systems in new dwellings with this percentage growing steadily each year.
- New buildings require 90% less energy than an equivalent dwelling built in 1978.
- Since its introduction, more than 400 000 households have received government grant support under the better energy programme. The focus since 2017 has been on more in-depth renovation.
- A limited number (around 3% of non-residential and public sector buildings) have been upgraded using support schemes.
- District heating and cooling in Ireland is at a very low level and is estimated to be less than 1% of heat consumption.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

- Ireland's climate action plan sets out a detailed roadmap for 2021-2030 to reduce CO₂eq from the built environment by 40-45%.
- In the residential sector:
 - Retrofitting 500 000 homes to an EPC B2 or cost-optimal equivalent or carbon equivalent by 2030 (average 50 000 homes each year). It is expected that it will be necessary to retrofit 1 million houses by 2040 and 1.5 million by 2050.
 - Local authorities upgrading their housing stock under Phase 2 of the social housing retrofit programme to bring dwellings up to an EPC B2 or cost-optimal equivalent;
 - Installing 600 000 heat pumps (400 000 in existing buildings).
- In the commercial and public sectors at least one-third of total commercial premises upgraded to EPC B.
- It is projected that approximately 355 000 new dwellings will be constructed to an EPC level A by 2030.

Number of Residential Buildings Expected to be Retrofitted to BER B2 per Annum (or carbon equivalent)	
Year	Heat Pumps in Residential Buildings
2021	13,000
2022	33,500
2023	55,000
2024 - 2030	56,215 each year

NECP Projected Energy Efficiency Savings		
Primary Energy Savings (GWh)	2020	2030
Industry	3,564	6,032
Residential	8,436	23,662
Business	8,918	21,166
Transport	1,839	6,859
Cross sectoral	2,347	4,451
Total Savings	25,103	62,171

Investment needs

- The Irish government has approved a national development plan that has allocated funding of EUR 4.5 billion to support energy efficiency improvements across the residential and public sector.
- Increase the price of carbon to EUR 100 per tonne by 2030.

Good practices

Legislative

- **Advanced performance requirements** in the current regulations combined with a mandatory renewables requirement, creating a rapid transition to low-carbon heating systems in new dwellings.
- A **Retrofit taskforce** with cross departmental and agency membership has been established to oversee the design and development of a new retrofit delivery model for the residential sector (supported by stakeholder engagement).
- Further regulation from 2022 will effectively **phase out further installation of oil boilers from 2022 and the installation of gas boilers from 2025 in all new dwellings**.
- An enhanced **EPC advisory report** will be introduced in 2020 and will be provided when a new EPC is obtained.
- Exploring the potential use of **tax incentives** to stimulate the demand for residential energy efficiency improvements.
- A **Code of practice** for the energy-efficient retrofit of dwellings was published in 2014 by the National Standards Authority of Ireland.
- **Retrofit guidance** for traditionally built buildings (in development).
- A guidance document for traditional buildings is being prepared for building professionals, particularly specifiers and installers.

Finance

- A range of government support and grant schemes is in place and is continuously reviewed and redesigned to ensure alignment with government objectives and value for money.
- The **Better Energy Homes** scheme provides grant aid to private homeowners who wish to improve the energy performance of their home.
- The **Deep Retrofit pilot programme** was carried out to establish how best to support deeper levels of renovation in the residential sector, and to gain practical experience on how to develop residential energy efficiency offerings at scale post-2020.
- The **Climate Action Fund** supports initiatives that help Ireland achieve its climate and energy targets in a cost-effective way.
- Accelerated Capital Allowances allow businesses to reduce their taxable profits in line with the amount they spend on energy efficiency.
- The **Support Scheme for Renewable Heat** supports the replacement of fossil fuel heating systems for commercial, industrial, agricultural, district heating and other non-domestic heat users in the non-ETS sector.
- The EXEED programme, launched in 2017, incentivises and facilitates energy efficiency in businesses.

Public buildings

- The building stock includes approximately 15 000 public sector buildings.
- The energy efficiency improvement of each public sector body is monitored annually through the monitoring & reporting system operated by SEAI to which each public sector body is legally required to report. Good progress has been made on energy efficiency, with a 27% improvement achieved by the end of 2018 through a combination of behavioural measures, improved energy management and renovation.

In the coming years the system will be extended to include a mechanism to monitor compliance with the rule to display energy certificates. Public sector bodies that make savings as a result of their energy efficiency efforts can keep those savings within their organisational budgets.

- A new programme was approved that commits to reduce overall greenhouse gas emissions by an average of 7% per year from 2021 to 2030 (a 51% reduction over the decade) and to achieve net-zero emissions by 2050.
- The **Public sector energy efficiency strategy** includes an associated support programme for public bodies.
- A number of **Pathfinder partnership programmes** that focus on energy efficiency retrofit improvements in schools, central government and higher education buildings, have been put in place.
- Ireland benefits from EU support under the structural reform support service (SRSS) to develop a comprehensive public sector building upgrade programme.
- Under Irish legislation, public sector bodies can only enter into new rental or leasing agreements for private sector buildings if they have an EPC of at least A3 (with exemptions allowed in limited circumstances).

Energy poverty - worst performing buildings - social housing

- Alleviating energy poverty is an important policy goal and a key benefit of retrofitting in the residential sector. The **Better Energy Warmer Homes scheme** has been in place since 2000. The scheme provides free energy efficiency upgrades to homes where the householder receives a social welfare payment. The scheme has upgraded more than 142 000 homes since 2000.
- The **Warmth and Wellbeing pilot scheme** provides energy efficiency improvements to the homes of older people and children living with chronic respiratory conditions.
- The Department of Housing, Planning & Local Government is currently funding an ambitious programme by local authorities to insulate and retrofit the least energy-efficient social homes (launched in 2013 and carried out under Phases 1 and 2).
- The same department is working closely with the Department of Communications Climate Action and Environment, Midlands local authorities and SEAI on a pilot retrofitting programme for social housing upgrades, with an allocation of EUR 20 million (from the increased carbon price).

Smartness

- Mechanical electricity meters will be replaced in every house in Ireland by 2024 under the EUR 1.2 billion National Smart Metering programme.

- For public sector bodies, the Office of Public Works has been running the state-wide staff energy conservation campaign ‘Optimising Power at Work’. Every participating building has been fitted with energy monitoring equipment that automatically records electrical and thermal energy usage every 15 minutes.

Split incentives

- An expert advisory group (comprising representatives from relevant government departments, the SEAI, and the Residential Tenancies Board), established in 2019, compiled a range of possible measures that could help to address the problems. Key measures emerging from the public consultation include the right tax incentives, grants, technical support and appropriate regulation.

Energy Communities - Local dimension

- The establishment of over **250 Sustainable Energy Communities** has led to significant success in encouraging local actors.
- The **Better Energy Communities scheme** supports community-based partnerships to improve the energy efficiency of the building stock in homes, schools, community buildings, business premises and energy-poor homes.

ESCOs

- The ESCO market is in its infancy and a number of measures are recommended to promote (e.g. guidelines, template contracts, grants, fuel tax). EPC in the public sector.
- The SEAI supports the wider deployment and use of EPCs by helping build capacity and providing expertise.

Advisory tools

- The SEAI Behavioural Economics Unit, established in 2017, focuses on encouraging homeowners’ and business’ energy behaviour.
- A **network of one-stop-shops will be promoted** by the Retrofit Taskforce.
- Ireland is piloting a **Building Renovation Passport** scheme.

Training - Skills

- The SEAI Energy Academy has developed **free online training modules** for general use and for SMEs to help them identify and pursue energy efficiency opportunities including renovation (see <http://www.seaienergyacademy.ie/>).
- Training programmes that cover energy efficiency and the installation of energy efficiency products are available from the national training body SOLAS, the Education & Training Boards and from various Universities and Institutes of Technology, along with private sector training providers, accredited by a variety of national and international bodies.
- The SEAI also supports relevant professional bodies.

- The Department of Education & Skills continues to engage with higher education institutions to encourage the adaptation of courses, in consultation with stakeholders, to ensure that graduates have the necessary training and skills.
- Establishment of the High Performance Building Alliance that aims to increase Ireland's stock of high performance buildings through training, research and quality standards.
- The SME support programme, operated by SEAI, provides advice and training for SMEs on energy management, particularly in areas such as lighting, heating and cooling.
- A pilot 10-module course, 'Fundamentals of Energy Renovation for Traditional Buildings', was co-developed with expert input from key stakeholders.

Other useful information

- The NZEB requirements will equate to EPC A2 and represents a 70% improvement in energy efficiency and a 70% reduction in CO2 emissions compared to the 2005 Regulations. It also introduces 20% renewables as a percentage of the total building energy use (applied to all new dwellings commencing construction from 1 November 2019).
- The cost-optimal energy performance level for major renovations is equivalent to EPC B2.

Areas for potential improvements compared to best practices

It could be useful to consider:

- providing a quantitative description of milestones for 2040;
- providing more specific estimates of the wider benefits, including the effect on climate resilience;
- providing mechanisms to reduce the perceived risks and the use of public funding to leverage additional private-sector investment;
- developing the description of measures for boosting the ESCOs market;
- further detailing budgetary resources to support the implementation of proposed measures.

Italy

Summary of the long-term renovation strategy

The Italian strategy provides a very good overview of the building stock and a detailed description of existing and planned measures and policies. The overall target is to fully decarbonise the residential sector and "almost" decarbonise the non-residential one at 2050. For that reason, the strategy foresees that in the next 30 years 2/3 of the existing buildings need to be renovated. This means that the current renovation rate needs to be doubled (from 0.85 to 2%) for the period 2020-2030 and to be tripled for the period 2030-2050. While the 2030 targets seem to be achievable with the comprehensive policy framework put in place, in particularly for the residential sector, it is quite challenging for the 2050 objectives.

Information on the building stock

		Number	Area (m2)
	Total Residential	12.42 Million buildings; 32 Million dwellings	3 049 806 184
Non-residential	Offices	74 358 total (17 000 public buildings; 27 Million m ²)	36 000 000
	Hospitals/health establishments	27 033 (209157 beds)	49 600 000
	Social housing	710 594 dwellings	53 670340
	Hotels	27 000	36 500 000
	Commercial/trade	876 300	286 750 000
	Schools	56 000	84 300 000
	Total non-residential	1 576 159	
Total			

- The current “virtual” rate⁵⁶ of deep renovation is 0.85% (with energy saving of 0.332 Mtoe/year).
- Almost 80% of buildings are deemed excellent or good.⁵⁷
- In 2018, it is estimated that 1400 buildings are NZEB, mostly new buildings (90%) and residential (85%), as indicated by the NZEB Observatory. As reported in ENEA’s publication ‘NZEB in Italy 2016-2018’, the renovation at NZEB level of more than 130 public buildings are foreseen by the year 2020. NZEB buildings in 2019 were only 0.03% of total buildings.
- From the cost optimal calculation results, the building envelope is cost effective mainly for the new buildings and the buildings built in 1946-1976; for the single-family house the use of HP and PV is the best solution (full electric buildings). PV can cover 50-70% of the energy consumption of the new residential buildings, 10-20% of the existing ones.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

2030	▪ 2% overall renovation rate for the residential sector: • energy saving of 0.33 Mtoe/y • 32.7 Mton CO2 emissions • 1.9% renovation rate - for the non-residential sector • energy savings of 0.24 Mtoe/y • 10.9 Mton CO2 emissions • 2.8 % renovation rate
2040	• 2.7 % renovation rate for the residential sector • 2.6 % renovation rate for the non-residential sector
2050	• 2.6 % overall renovation rate for the Residential sector: • 2.7 % renovation rate

⁵⁶ This renovation rate expresses how many m² would have been renovated if the measures promoted through “Ecobonus and Bonus Casa” measures had all been deep renovations.

⁵⁷ This data does not seem to be related to the energy performance status.

	• renovation of 66% • full decarbonisation of the residential building stock • all the final energy consumption will be covered by RES (the energy consumption will pass from 32Mtoe in 2020 to 13 Mtoe - all from RES) for the non-Residential sector: • 2.6 % renovation rate • "almost" decarbonised • emission reduced to 0.6 Mton CO2
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- In the strategy is stated that the building stock consumes 45% of the total final energy need in 2018, and it has a very large energy saving potential.
- Wider benefits: additional 79 000 new jobs per year, 13% reduction of energy import, 15% reduction of energy bills etc.

Investment needs

- An overall estimate of the investment need for the period 2020-2030 is provided: EUR 9 to 12 billion annually (3 different scenarios).
- By 2050, in order to promote energy efficiency in public buildings EUR 75 million will be needed.
- By 2050 EUR 50 million from the national budget will be needed.
- By 2030: EUR 5-8.8 billion (2020-2024) available for Municipalities to make buildings seismic safer/securer and more energy efficient
- By 2050: Investment needs (2020-2050) for the residential sector: EUR 9-12 billion/year, investment needs (2020-2050) for offices: EUR 0.7 billion/year investment needs (2020-2050) for offices: EUR 0.5 billion/year.

Good practices

Legislative

- Tax deduction for building renovation: all tax payers, individuals, professionals, companies and businesses may receive deductions for the execution of interventions in existing buildings. EUR 45.4 billion (national budget).
- Introduction of a feed-in tariff to incentive "energy communities" and renewable energy self-consumption and promote of nearly zero energy districts.

Finance

- The strategy describes financial measures to tackle existing barriers, such as the use of energy performance contracts and ESCO financing schemes, Public Private Partnership, target subsidies linked to energy performance, aggregation and de-risking tools, guarantee funds etc.
- **National Energy Efficiency Fund:** The Fund consists of two sections: i) for the granting of guarantees on individual financing operations (30% of the annual resources); ii) for the provision of subsidised loans (70% of the annual resources). EUR 0.8 billion (national budget)
- Fund for the purchase and/or renovation of buildings
- **Ecobonus and 110% Superbonus** is tax deduction system intended to cover 110% of the costs of energy efficiency and structural seismic improvements of Italian properties, ensuring tax compliance in the local building industry. This tax credit can be set against tax liabilities of the relevant property owner, over five years, in five equal annual instalments. The “superbonus” can be traded (Cessione del credito) by entitled property owners, effectively by selling it to third parties, or setting it against their own suppliers’ invoices (Sconto in fattura) thus effectively getting the costs of the property improvements paid by the Italian Revenue. It is a substantial improvement on similar, earlier legislation. The Superbonus cover 110% of the costs of energy efficiency and can be combined with works for structural seismic improvements⁵⁸. This measure, covering the expenses incurred between July 2020 and 2023, will be partially financed with the Recovery and Resilience Facility.
- The **Sismabonus** is the deduction (tax rebate) for measures related to seismic measures for expenditure incurred for seismic works carried out on structural parts of buildings or structurally connected structures, located in areas characterized by medium or high seismicity. Depending on the intervention, the deductions are 50-80% for houses and 50-85% for multi-apartment buildings. For a total maximum expenditure up to EUR 96,000 per building unit for each year.
- The "**Ecobonus + Sismabonus**" (for the renovation of common parts in multi-family buildings) is a unique tax rebate of 80% or 85%, if the building renovation result in a change to 1 or 2 lower seismic risk classes. This deduction will be broken down into 10 annual instalments and shall be applied to an amount of expenditure with an expenditure limit of EUR 136 000, multiplied by the number of building units in each building. In order to benefit from the increased deduction, the measures must, in addition to seismic improvement

⁵⁸ A recent JRC study indicates that for high seismicity regions in Italy, combined seismic and energy retrofitting provides significant economic benefits over separate interventions, which may be useful for further promoting building renovation. See ‘Innovative seismic and energy retrofitting of the existing building stock (iRESIST+), EUR 30583 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-29687-4, doi:10.2760/768985, JRC 123638’: <https://op.europa.eu/en/publication-detail/-/publication/719acded-be94-11eb-a925-01aa75ed71a1/language-en>

(reduction of 1 or 2 classes), also comply with the energy requirements laid down in order to obtain the ‘increased’ Ecobonus deduction of 70% or 75%.

- **White Certificates:** obliged entities shall be required to deliver each year a number of white certificates proportional to the energy distributed by them. EUR 5.6 billion (national budget)

Public buildings

- Measures for the renovation of the public building stock include ad hoc renovation of the central government buildings, white certificates, Conto termico, the National Energy Efficiency Fund, the Kyoto Fund for energy efficiency renovations in public schools and universities, structural funds etc.
- **Conto termico** supports both the production of renewable thermal energy and interventions by the public authorities aimed at improving the energy efficiency of buildings and installations. Contributions can vary according to the intervention type (up to 100% for schools and public health buildings. EU 7.5 billion (national budget).
- Programme for the **Energy Regeneration of Central Administration** (PREPAC): PREPAC is the mechanism for promoting energy efficiency interventions on the buildings of the central public administration, which has the aim of guaranteeing the energy renovation of at least 3% per year of the useful floor area of the buildings (EED Article 5). EUR 0.29 billion (national budget)
- Establishment of the **State Property Agency database:** for reducing the expenditure of the use of buildings by public authorities and to optimise their management (e.g. maintenance planning, rental optimisation, rational use of available spaces, reduce the overall operating cost, including energy supply), IT tools (e.g. a data base, and an IT portal to collect the data) have been introduced to better manage the public buildings and plan their use.
- An IT tool (“Iper”) has been developed to assess the energy performance of all the state owned buildings and compare them to energy performance benchmark, to identify the critical buildings and plan energy efficiency measures.

Energy poverty – worst performing buildings

- Buildings constructed before 1976 have been identified as the worst performing buildings.
- According to the ad hoc indicator adopted in the National Energy Strategy, the number of households in energy poverty in 2017 is more than 8.7 % of the total, equivalent to 2.2 million households, reaching the historic peak of the last 20 years. The incidence of the phenomenon is significantly higher in the Southern regions and is growing. According to a different indicator, which also compares energy expenditure with the heating needs of the dwelling taking into account the type of building, there would be approximately 3 million households affected by energy poverty (11.7 % of the total). In the NECP, the incidence of energy poverty is assumed to remain

broadly unchanged in 2030, ranging from 7% to 8%, due to, among other factors, increase of energy prices, demographic changes, and reduction of household members.

- The Ecobonus is the main measure to tackle energy poverty issues: within the Ecobonus tax rebate incentive, it is possible, for low income families, to transfer the credit to a financial institution, in order to reduce/annul the upfront cost of energy renovation interventions.
- The Ecobonus can also be used to improve the energy performance of the social houses stock.
- Other measures to tackle energy poverty will be financed through EU structural funds 2014-2020 and 2021-2027 periods and funds from the Energy Efficiency Fund.
- In addition, the LTRS propose training and information campaigns to promote behavioural changes and increase the rate of renovation, energy consumption monitoring through targeted energy audits and EPCs in order to identify the worst performing buildings and prioritise the renovation interventions and the development of maps to identify the energy poverty risks.

Advisory tools

- The LTRS reports some existing examples of one-stop shops (e.g. Iren, Fratello Sole, Punti Energia Clima per Comuni-PECC, but the full development of these tools have still to be elaborated.
- Accessible and transparent advice and planning tools will be developed for guiding citizens in the process of improving the performance of their own buildings.
- The campaign "Italia in Classe A" (Italy in Class A) is aimed at the Public Administration, businesses, banking institutions, families and students. It aims to stimulate the energy efficiency of processes / systems in the tertiary and industrial sectors and conscious behaviour in the residential sector.

ESCOs

- The use of Energy Performing Contracting and ESCO is reported in the strategy as important mechanism to promote building renovation, with particular reference to residential private and public buildings.

Smartness – Research and Development

- **National Enterprise Plan 4.0:** this plan consists of a series of measures aimed at encouraging the development of a company through private investments. Thanks to various fiscal incentives, the plan aims to stimulate companies (in particular micro, small and medium-sized enterprises and innovative start-ups) to invest in innovation. EUR 0.5 billion (national budget)

Areas for potential improvement compared to best practices

It could be useful to consider:

- Building Renovation Passports.
- The development of a clear roadmap and policy for the 2040-2050 period, when the biggest renovation effort.

Latvia

Summary of the long-term renovation strategy

The Latvian LTRS seems ambitious aiming to become climate neutral by 2050. There is a strong effort towards the alleviation of energy poverty rate. The strategy reports many economic and fiscal measures supporting the renovations of buildings, including more stringent thermal requirements for building envelope, subsidies, loans and grants to support the renovation of different buildings in the residential, public and municipal sector, together with new and additional funding sources. Strong emphasis is also given to develop the ESCO market.

The main source of funding for the renovation of buildings in Latvia is based on European funds and until now it has mainly focused on improving energy efficiency in multi-apartment buildings. According to the document the 2030 target aims to renovate 30% of multi-apartment buildings, equivalent to 4 860 buildings and to continue to renovate 30% of multi-apartment buildings, equivalent to 8 100 buildings by 2040. For 2050, Latvia ambitious target is to achieve climate neutrality, to have all new buildings meeting the NZEB requirements and to ensure the renovation and conversion of all buildings towards zero or nearly zero-energy buildings. According to the information reported although the building renovation strategy is ambitious, with the current financial resources Latvia will not be able to renovate the entire building stock.

Information on the building stock

		Number	Floor Area (m ²)
Total Residential		363,991	91.08
Non-residential	Offices	7,124	6.53
	Hospitals/medical/health establishments	1,340	2.02
	Hotels / Restaurant / leisure/ other short stay accommodation	5,102	2.77

	Sports facilities	1,048	1.24
	Commercial	8,089	5.08
	Shows	1,123	1.19
	Schools	3,791	6.93
	Religious	1,355	0.44
	Industrial	32,976	18.21
	Non Residential farm buildings	85,003	23.17
	Other types of energy-consuming buildings not previously classified	827,780	33.34
	Other non-residential buildings (garages, reservoirs, bunkers...)	32,116	14.58
	Total non-residential	1,006,847	115.50
	Total	1,402,954	206.58

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

	Milestones
2030	Renovate 30% of multi-apartment buildings - a total of 4860 of multi-apartment buildings.

	Public buildings to renovate 500 000 m² and decrease thermal energy consumption from 140 kWh/m² to around 120 kWh/m²
2040	- Renovate 30% of multi apartment buildings - a total of 8100 multi-apartment buildings. - Public buildings to continue the annual renovation of 3% of the floor area of central government buildings. <i>However it should be noted that such a 3 % renovation rate will not be sufficient from a perspective of 2050 and therefore a parallel solution is needed to promote the renovation of public buildings.</i>
2050	- All new buildings to meet the NZEB requirements and ensure the renovation of all buildings towards NZEB levels. - All households in Latvia to have access to housing and the existing housing stock meets high standards of energy efficiency. - Achieve climate neutrality. - The buildings sector needs to reach 1 869 ktCO₂eq. - Annual savings in the buildings sector should be increased by a further 896 ktCO₂eq to achieve overall savings of at least 80%.

- Latvia's overall energy efficiency objective (primary energy consumption savings) is 0.670 Mtoe (28 PJ). Within this target, the share of energy efficiency improvement in multi-apartment buildings amounts to 0.023 Mtoe (0.945 PJ, 263 GWh).

Investment needs

- The LTRS and the implementation of the measures and programmes will be funded by EU funds and the state budget.
- In order to implement NAP2027 actions, EUR 50 000 000 is foreseen from the state budget.
- To implement the action 'Promoting energy efficiency in public buildings' approx. EUR 75 000 000 is foreseen (85% ERDF funds, 15% national budget).
- Multi apartment buildings: total investment needs EUR 4.52 billion (60% of EUR 7.54 billion).
- Private homes: total investment needs EUR 4.62 billion (60% of EUR 7.7 billion).
- Non-Residential buildings: total indicative financial needs EUR 4.89 billion.
- Rental market is expected to be able to attract investments of around EUR 600 000 000 per year for the construction of new energy efficient housing.

Good practices

Legislative

- Stricter thermal requirements for building envelope and minimum permitted levels of heating for both new and renovated buildings, as well as requirements for the gradual transition of new buildings to NZEB came into effect in 2015.
- The importance of further developing the ESCO market and more stringent building standards to be applied as of 2020 have been highlighted as key to the successful implementation of the building renovation strategy.

Finance

- **State and Local Government Energy Efficiency Fund**: it aims to support initiatives in the field of energy efficiency. The Fund shall consist of contributions from the obligated parties to the energy efficiency obligation scheme, revenues from the energy efficiency levy as well as other financial sources.
- A **Transformation fund** to support the renovation of hazardous and structurally degraded multi-apartment.
- Creation of a long-term low-interest loan for the construction of low-cost housing.
- **ALTUM loan from Green bond** for energy efficiency improvements backed by the EIB where the financing is complemented by a guarantee of EUR 3 million from the 'Private Finance for Energy Efficiency (PF4EE) facility' provided by the EU under the LIFE programme. The loan is available both to private companies and to public and municipal companies wishing to provide their services in a significantly more energy-efficient building – office, warehouse, plant, hotel, shop, etc. EUR 20 million, with funding up to EUR 2 850 000 per project, with only 15% of the company's own participation.

Public buildings

- Promoting energy efficiency in public buildings: the aim of the measure is to promote the improvement of energy efficiency, smart energy management and the use of renewable energy sources in buildings owned or used by a direct public authority or its subordinate bodies or derived public persons performing delegated functions. EUR 75 154 879 (mainly ERDF and National budget).
- Promote energy efficiency and renewable energy use in municipal buildings under integrated local government development programmes: this measure aims to reduce primary energy consumption by promoting energy efficiency and reducing local government expenditure on heating, and by investing in local government buildings. EUR 60 583 995

- According to the document the 2030 target aims to renovate 500 000 m² by 2030 of public buildings and to decrease thermal energy consumption from 140 kWh/m² to around 120 kWh/m². In view of 2040, Latvia aims to continue the annual renovation of 3% of the building floor area of central government buildings.
- Existing municipal AID through TAX incentive: municipalities can benefit from a tax relief under certain parameters and regulations to carry out building renovation. Local governments may set reliefs at 90, 70, 50 or 25 per cent of the amount of real estate tax depending on the type of category.

Energy poverty – worst performing buildings

- The manager of a residential building must plan energy efficiency improvement measures if the heating and DHW exceed certain values
- Alleviation of energy poverty in Latvia is an issue as well as access to affordable housing to all. 15.2% of Latvia population experience severe housing deprivation. The strategy sets a target to reduce energy poverty rate to 7.5% by 2030.
- Among the measures tackling energy poverty are renovating and increasing the number of social housing and create a tool for housing support for disadvantaged people to change residence allowing them to participate in the labour market.
- The support programme “**Balst**” provides aid for the purchase or construction of housing supporting Latvian families with a non-reimbursable state subsidy for the purchase or construction of housing for families with at least three children.
- The “**warmer living**” measure is an agreement signed between stakeholders in the public and private sectors to contribute to the reduction of energy poverty by working together and providing information to households.
- Creation of a long-term low-interest loan for the construction of low-cost housing

Advisory tools

- The strategy acknowledges the need to raise public awareness of the importance of renovation of multi-apartment buildings as well as to develop a favourable public opinion on the modernisation of multi-apartment buildings and to ensure the availability of detailed, clear and high-quality building information and financing instruments.
- **Building renovation passports / Logbook**: since 2010 the Law on Management of Residential Houses foresees that every residential building shall have a paper or electronic file including all the building information (e.g. technical documentation, energy passport, audit findings etc.).
- The “**Let's live Warmer**” campaign aims to inform citizens about energy efficiency, the economic returns of investments and other positive benefits.
- The “**most energy efficient building in Latvia**” campaign aims to promote good practices in the field of energy efficiency of buildings through the construction, renovation and reconstruction of buildings and raising public awareness of the thermal insulation of buildings.

Skills

- **Latvenergo** Energy Efficiency Centre aims to educate customers and increase energy efficiency among the Latvian population.

Smartness

- Latvia will promote the construction of electric recharging points in new buildings for multi-apartment and public buildings, as well as in renovated multi-apartment and public buildings and it will ensure that up to 50% of specific parking areas are equipped with charging capability by 2030.
- All electricity meters should be switched to smart electricity meters until 2022.

ESCOs

- The business model for ESCO is not known among potential clients and financial institutions do not provide credit for ESCO projects as the gains and benefits of energy efficiency measures are still not clear to them. However, ALTUM (a development finance institution) promotes investment in building renovation by offering different financial mechanisms.
- LABEEF (Latvian Baltic Energy Efficiency Facility: a new investment platform, to support Energy Service Companies implementing renovation measures in multi-apartment buildings on the basis of energy performance contracting, financed by private investors and EBRD.

Areas for potential improvement compared to best practices

It could be useful to consider:

- providing a clearer overview of the measures as well as the regional or federal budget to increase clarity on the strategy and the existing measures; and
- analysing in more details the wider benefits of renovating buildings.

Lithuania

Summary of the long-term renovation strategy

The ambition of the Lithuanian LTRS is to fully decarbonise the building stock by 2050 by achieving the following targets: renovate 74% of the building stock, reduce the annual primary energy consumption by 60%, reduce the annual primary energy consumption from fossil fuels by 100% from and reduce the CO2 emissions by 100%. Achieving the targets will require EUR 60 billion up to 2050 but the benefits are estimated at around EUR 75.3 billion over the same period. The Lithuanian strategy presents a list of policies and actions put in place in the Lithuanian NECP to promote deep renovation are presented in the LTRS. A list of 21 actions are developed to support the implementation of the renovation strategy, including integrated planning and monitoring, adequate funding, effective communication and a robust implementation framework.

Information on the building stock

		Number	Area (m²)
Total Residential		570513	129003573
Non-residential	Offices	10377	10096910
	Hospitals/health establishments	1839	2951779
	Hotels / Restaurant / leisure	6900	2496666
	Commercial	8760	7064489
	Shows	2341	2279194
	Schools	4715	8503112
	Religious	1764	633023
	Industrial	48775	35489710
	Other types of energy-consuming buildings	7063	3788289
	Total non-residential	92534	73303172
	Total	663047	202306745

- As of December 2019, 2.6 million buildings with a floor area of 235.3 million m² are registered in Lithuania.
- By 2020, 58 774 units (8% of the building stock) of new and renovated buildings are at least energy class B. They account for 29 481 million m² and represent 15% of the total floor area.
- Only 2% are publicly owned while 45% have mixed ownership fact that could complicate the decision-making process of the renovation.
- Considering that 75% of the existing buildings were built before 1992, by 2050 they will be 60 years old and renovation works are required to keep them in use.
- Residential buildings consume 66% of the total primary energy consumption of the building stock and 77% of the total primary energy consumption is attributed to buildings in energy class D and lower.
- In Lithuania the NZEBs correspond to energy class A++. By January 2020, 46 of such buildings with a floor area of 149 000 m² are registered.
- Between 2013 and 2020 about 2 631 apartment blocks were renovated and about 419 were renovated before 2013.
- In Lithuania, 89.9% of the building's users are also owners therefore owner-tenant dilemmas are of a little importance.
- Only 17% of existing buildings have EPC in Lithuania.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

	Milestones
2030	• Annual PEC: 34 759 GWh (85%) • Annual PEC excluding RES: 19 865 GWh (75%) • CO₂ emissions: 4003 ktCO₂ (76%) • No. of renovated buildings: 99 281 • Share of renovated buildings: 17%
2040	• Annual PEC: 25 888 GWh (39%) • Annual PEC excluding RES: 19 865 GWh (39%) • CO₂ emissions: 2 108 ktCO₂ (40%) • No. of renovated buildings: 225 421 • Share of renovated buildings: 43%

2050	• Annual PEC: 16 162 GWh (40%) reduced by 60% compared to 2020 (40 827 GWh) • Annual PEC excluding RES: 27 GWh (0%) • CO₂ emissions: 0 ktCO₂ (0%) • No. of renovated buildings: 436 008 • Share of renovated buildings: 74%
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- Upgrading to energy class C over 5 000 apartments and about 960 000 m² of public buildings by 2030 is expected to bring energy savings of 1.9 TWh and 0.19 TWh, respectively.
- The main primary energy savings and CO₂ savings will be achieved in individual houses (39% and 30% respectively) followed by multi-family buildings (25% and 24%), other non-residential buildings (20% and 24%) and finally the industrial buildings (16% and 22%).
- Achieving higher energy classes (A+, A++ or NZEB) may face technical constraint as it requires high airtightness and generally it is difficult to meet it in old buildings.
- The investment of each EUR 1 million is expected to create between 19 and 37 job per year.
- The investment of each EUR 1 is estimated to increase the country's GDP by EUR 0.5.
- To estimate the health benefits, for each invested EUR 1 a benefit of EUR 0.325 was considered.

Investment needs

- Achieving the targets will require EUR 60 billion up to 2050 (from EUR 1.1 billion/year by 2030 to EUR 3.1 billion/year by 2050).
- The benefits are estimated at around EUR 75.3 billion over the same period.
- Existing sources will become insufficient by 2030 and new sources need to be launched already now, in particular with a view to making use of European Union funds (e.g. including renovation in the 2021-2027 programmes) and planned initiatives (e.g. the European Green Deal Investment Plan).
- Public funds represent 30% of the total investment need (40% for multi-apartment buildings) while financing solutions (credit type) are anticipated to be developed for the owners' contribution to the renovation costs.

Good practices

Legislative

- Energy saving agreements with energy companies, with annual savings of 100 GWh in the framework of the Energy Efficiency Directive.

- The establishment of competence center is planned, responsible for the development of standardized documents and procedures, development of rules and technical requirements, aid of municipalities and consultation.

Finance

- Loans for the installation of solar power stations/parks managed by **Public Investment Development Agency (VIPA)** of Lithuania.
- Loans for small renovation projects through **Energy Efficiency Financing Platform** (heating system modernisation, changing the windows etc.).
- New actions to support the implementation of the LTRS are planned: financial incentives depending of the energy efficiency level; reduction of energy costs subsidies to decrease the renovation payback and make the renovation more attractive to owners;
- Introduction of a **pollution tax** for energy inefficient/polluting buildings, e.g. by introducing an additional tax if the energy consumption of a building exceeds 150 kWh/m² and/or CO₂ emissions. This would take into account not only energy efficiency but also the source of the fuel (in order to move away from fossil fuels). Other alternatives to the implementation of this tax could include a differentiation of the property tax according to energy consumption/CO₂ emissions, an additional levy on non-managed buildings.
- Replacing boilers with more efficient technologies. This measure will compensate up to 50% of the costs of replacing inefficient individual boilers with more efficient boilers, for households not connected to the district heating system.

Public buildings

- Public buildings represent 2% of the total building stock and they are responsible for 8% from the total primary energy consumption of the building stock.
- A list of measures and actions to promote energy efficiency in public buildings is presented: energy renovation of public buildings, agreements with energy suppliers to educate and advise the consumers and energy saving agreements for energy companies. More than 8.6 TWh energy savings are expected by 2030.
- Around 510 000 m² (central government public buildings) and around 450 000 m² (municipal public buildings) renovated by 2030. Public buildings must reach a minimum class C after renovation.
- Preferential loans for the renovation of public buildings (heating and lighting systems) through **European Regional Development Fund**.

Energy poverty – worst performing buildings

- Worst energy performing buildings are identified as building in energy class D or lower. In Lithuania, they account for 66% from the total building stock. The associated primary energy consumption is 31 591 GWh/year representing 77% from the total primary energy consumption of the building stock. Currently, these buildings represent a priority in the renovation programmes.

- In Lithuania the share of people unable to adequately heat their homes decreased over the past years reaching 26.7%. Although the house heating expenditure is higher in Lithuania compared to the EU average, the decrease in energy poverty is due to rise of wages, decrease of energy prices and increase in using biofuels in the district heating sector. However, it is 3 times higher than the EU average share.
- The share of households spending over 40% of disposable income in household maintenance halved from 2010 to 2018 (from 10.6% to 5.6%) while across EU remained constant (10.8% to 10.3%).
- Currently in Lithuania, the vulnerable people are receiving heating and DHW aid by being reimbursed the heating costs that exceeds 10% of the difference between the family income and the state-supported income. It is expected that by 2050 the need of heating aid will decrease by 80% thus saving an average of EUR 0.58 million per year.
- Vulnerable people entitled to heating aid, receive 100% support in the renovation process.
- The strategy addresses energy poverty. The measure and actions put in place to address energy poverty include general measures to increase revenues and energy efficiency and targeted socio-economic measures such as heating aids, measures targeting a particular housing (multi-apartment buildings) and energy type and measures targeting specific areas/regions.

Multi-apartment residential buildings

- In 2013 municipalities were asked to identify worst performing buildings and buildings with thermal energy consumption over 150 kWh/m².year were identified and prioritised in the programme (which started in 2005) for the renovation (modernisation) of multi-apartment buildings.
- The implementation of the Programme for the renovation of multi-apartment buildings will continue and nearly 500 multi-apartment buildings will be renovated each year, with energy savings of 100 GWh. Priority will be given to multi-dwellings which were constructed in accordance with the technical standards of the Construction Regulation in force before 1993. After renovation, the building should qualify for class C and 40% savings should be achieved in the building's energy consumption.
- To carry out the renovation, an agreement of 50% plus one vote of the owners is sufficient.
- Lending funds for the renovation of multi-apartment buildings through two programmes: one managed by VIPA and Jessica II Fund managed by the European Investment Bank.
- Modernisation of indoor heating and hot water systems in multi-apartment buildings: a financial instrument that will encourage building owners to upgrade old heating systems into newer single-circuit heating systems. Up to 30% of the investment costs will be reimbursed.
- 40% of the investment need is financed through subsidies while for the other types of buildings, the subsidies represent 30%.

Advisory tools

- A more active involvement of the municipalities and closer to the consumer in the renovation process is foreseen by collecting data on the building stock at a municipal level, drawing up municipal LTRS as well as proposing a financial model.
- One-stop shops will be implemented as entities under the coordination of municipalities and will provide methodological and advisory support to citizens.
- Communication to raise awareness on the benefits of renovation for all type of owners.
- Law on Increasing Energy Efficiency concerning agreements with energy suppliers on consumer education and counselling will be extended beyond 2020. According to this Law, energy suppliers are obliged to conclude agreements with the Ministry of Energy to assure consumer education and counselling (including the use of smart meters).

Areas for potential improvement compared to best practices

It could be useful to consider:

- Improving the information on budgetary resources and the timeline of the planned measures to support the implementation of the renovation strategy.
- Additional mechanisms based on private sector involvement such as ESCO models should be considered, providing clear criteria for companies to be classified as ESCOs and a complete legal framework in place.
- Building Renovation Passports.

Summary of the long-term renovation strategy

Luxembourg's long-term renovation strategy (LTRS) sets out a comprehensive set of measures to address building renovation. They include a balanced mix of regulatory requirements, fiscal and economic incentives and information, tailored to specific needs such as barriers against deep renovation, energy poverty, etc. The overall milestones are clearly set only for residential buildings. The measures to tackle energy poverty are very comprehensive.

Overall, Luxembourg's LTSR is highly ambitious with clear measures attributed to each segment (residential and non-residential buildings). However, details on the budget allocation could be further specified.

Information on the building stock

- In 2011, Luxembourg's residential building stock included almost 208 000 residential units, of which around 88 000 were multi-family dwellings and almost 114 000 were single-family dwellings, semi-detached houses and terraced houses.
- The number of apartments in multi-family dwellings as a share of the total number of residential units is 42.4%, while the share of single-family dwellings, semi-detached houses and terraced houses is much higher, at 54.7%.
- The share of owner-occupied residential units is very high (around 70%), and the share of rented units is low.
- The share of social housing is low compared to neighbouring countries (around 3.6%).
- The vast majority of Luxembourg's residential building stock is dependent on fossil fuels in terms of the energy carrier mix for heating; almost 90% of all residential units are heated using fossil fuels.
- Building envelope renovation rates have not been systematically recorded to date. The average area-weighted building envelope renovation rate for the years since 2008 can be roughly estimated at 0.4% to 1% per year of the total stock. Since buildings were also being renovated before 2008, the number of residential units renovated by 2020 can be estimated at around 10–14% of the residential building stock. Lock-in effects resulting from mediocre renovation qualities are therefore only present in a small market segment.
- Non-residential buildings account for around 29% of the total area of all buildings constructed, and residential buildings for 71%.
- Non-residential buildings account for a total area of around 6.75 million m². Adding the 'semi-residential' category (380 000 m²) gives a total area of 7.13 million m². Buildings in the trade and services categories account for around 4.6 million m² of this area.
- The useful floor area in non-residential buildings is more likely to be in the region of at least 14 million m².

- Private office buildings represent the largest individual category in terms of area, while the share of public buildings can be estimated at around 21-30% of the total area covered by non-residential buildings.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

The milestones section presents the following indicators for tracking progress:

Year	Final energy demand (GWh/a) Residential		GHG emissions reduction Residential	Final energy demand (GWh/a) Non-Residential
2020	6438			4 046
2030	4611	-28% vs 2020	- 62%	3 205
2040	3551	- 45% vs 2020	- 96%	2 883
2050	2715	-58% vs 2020		2 557

- The share of renovated buildings in 2020 is estimated to be in the range of 10-14%.
- Renovation rate of the building envelope (according to NECP): 3% per year of the number of housing units built before 1991, corresponding to approximately **4500 housing units per year** (full renovation equivalents) and **420 000 m² per year** for non-residential buildings.
- Renovation rate of the building envelope: approximately 1.6% of the number of all housing units whose building envelope has reached the average technical lifetime, corresponding to **4400 to 7800 housing units per year** (full renovation equivalents, number of housing units to be rehabilitated increases because account is also taken of the construction years after 1990, despite taking the demolition into account).
- Renovation quality: Efficiency class A/A to B/B, with mean renovation depth of approximately 72% in line with NECP.
- Boiler exchange rate (residential and non-residential): approximately 5% p.a. (in relation to the total area of the residential buildings concerned).

Investment needs

Building envelope renovation rate (full renovation equivalent)	Number of residential units to undergo deep renovations	Total living space to be renovated	Renovation investments (minimum performance)	Renovation investments (cost-optimal performance)	Workstations for minimum-performance renovation	Workstations for cost-optimal-performance renovation
%	Residential units/year	m ² living space	EUR/a	EUR/a	EUR/a	EUR/a
0.4	1 000	129 000	47 730 000	69 660 000	430	627
0.6	1 500	193 500	71 595 000	104 490 000	644	940
0.7	1 750	225 750	83 527 500	121 905 000	752	1 097
0.8	2 000	258 000	95 460 000	139 320 000	859	1 254
1.0	2 500	322 500	119 325 000	174 150 000	1 074	1 567
1.2	3 000	387 000	143 190 000	208 980 000	1 289	1 881
1.4	3 500	451 500	167 055 000	243 810 000	1 503	2 194
1.6	4 000	516 000	190 920 000	278 640 000	1 718	2 508
1.8	4 500	580 500	214 785 000	313 470 000	1 933	2 821
2.0	5 000	645 000	238 650 000	348 300 000	2 148	3 135

Good practices

Legislative

- Stricter minimum requirements in terms of thermal insulation for individual components in the form of new energy efficiency regulations (for non-residential buildings from 2021 and for residential buildings from 2023).
- Revision of existing monitoring system to ensure that renovation works comply with the requirements.
- Introduction of ‘**renovation passports**’ (renovation roadmap) to ensure that the overall sum of individual measures gradually results in full renovations with a sufficient depth (‘deep renovation’).
- Obligation to build up financial reserves for the renovation of owner-occupied and rented apartments (based on the example of Austria’s ‘Maintenance and Improvement Contribution’). Introduction of an obligation to build up renovation reserves in ownership communities.
- **Pause in the expansion of gas networks in residential areas.**
- Preparatory measures for the installation of photovoltaic systems on the roofs of other non-residential buildings during redevelopments (with the exception of buildings protected as historical monuments and heavily shaded buildings) from 2023.

- Luxembourg introduced nearly zero-energy building (NZEB) standard for residential buildings as of 1 January 2017. The early introduction of this far-reaching standard has allowed Luxembourg to reduce CO2 emissions in the residential sector despite the growth of the population. This policy will be complemented by a new regulation in summer 2020, which will gradually require climate neutrality for both residential and non-residential new buildings by 2023. This will be extended in the short term (A+ energy class) to ensure 100% renewable energy coverage. Following the introduction of the NZEB standard for new residential buildings in 2017, this standard will also apply to non-residential buildings from 2020/2021. Until 2030, this standard will continue to be raised and the ‘near zero’ standard will be redefined by improving the energy efficiency requirements for new non-residential buildings.
- It is planned to extend the mandatory energy audits for large industrial energy consumers to the SME sector, taking into account the specificity and possible simplifications for SMEs. SMEs will also be required to have their energy consumption reviewed on a regular basis in order to better assess the renovation potential of their buildings among other factors.
- New residential and non-residential buildings will also integrate aspects such as health and wellbeing, alongside a stronger anchoring of sustainability. This will be implemented through the integration of elements in the national energy passport, the ‘LENOZ’ sustainability certification or the creation of a new label. Toxic and harmful building materials will be banned and a positive list of building materials containing natural and ecological building materials will be established.
- The concept of the circular economy will be further promoted in the construction sector in order to improve the quality of future buildings. This should be done through support programmes as part of ‘progressive requirements’.
- **Spatial Strategy 2035:** To better plan the country and its cities in a dynamic economic environment, the government is working under the Ministry of Energy and Spatial Development on a new Spatial Strategy 2035 (‘Programme Directeur’). This strategy sets out proposals for increasing the number of dwellings to be built in Luxembourg in the future (e.g. near existing or new stations), which new transport infrastructure is needed and which taboo zones are key to maintaining biodiversity.
- **Phasing-in of CO2 pricing from 2021** (2021: EUR 20/tonne; 2022: EUR 25/tonne; 2023: EUR 30/tonne).
- 2024: entry into force of a Grand-Ducal Regulation on renovations of non-residential buildings, **potentially including a renovation obligation with a deadline of 2040** (all office buildings subject to the renovation obligation must be renovated by 2040).

Finance

- The **PrimeHouse** support scheme is to be upgraded to allow for deep renovations. The scheme provides investment aid for the energy and sustainable renovation of residential buildings and related qualified energy advice, the construction of sustainable residential buildings and the use of renewable energies (PV, solar thermal installations, wood pumps and heat pumps). It has been extended or revised several times since 2001. The current programme runs until the end of 2020. Its upgrade will include: (i) checking and, if necessary, adjusting the amounts of support; (ii) integrating additional sustainability criteria, in particular to promote the circular economy; (iii) including criteria

to mitigate health risks in residential buildings; (iv) developing eligibility criteria for energy efficiency in listed buildings, in coordination with existing Heritage Protection Authority support programmes; and (v) further administrative simplification, for example by increasing the digitalisation of the application procedure or optimising quality assurance (quality improvement – intensity of controls).

- **Climate loan:** low interest or interest-free loans for low-income households for energy and sustainable renovation of residential buildings. The technical requirements are the same as the PrimeHouse programme. A revision and simplification of conditions and application procedures is planned so that more homeowners can benefit from a climate loan in the future.
- **Reduced VAT rate of 3% for renovation measures:** The conditions for benefiting from the reduced rate of VAT of 3% for renovation measures will be adapted and harmonised with the requirements of the PrimeHouse programme. The aim is to examine whether owners of buildings with a construction age of 10 years can benefit from the reduced VAT rate instead of the current 20 years.
- The 2008 **Housing Compact (Pacte Logement)**, which provides municipalities with additional financial resources to create new housing and public infrastructure, among other support, will expire in December 2020. Given the high demand for affordable housing in Luxembourg, the government has decided to continue and relaunch the scheme under the name ‘Pacte logement 2.0’, providing a wide range of measures to help municipalities achieve key housing objectives and improve the quality of housing for their inhabitants. The focus is on increasing the supply of housing, mobilising building land and improving housing quality and energy performance in both new housing projects and existing ones. The new Pacte Logement will run until around 2030 and its structure will be more diverse. Possible elements include improved advice to municipalities by the Ministry of Housing, a housing adviser function and the promotion of various measures that focus on both the quantity and quality of housing. The catalogue of measures to achieve the objectives was drawn up in cooperation with the municipalities.
- **Taxation of fuel oil and natural gas:** the taxation of heating oil will gradually be increased under the above-mentioned tax reform, taking into account the CO₂ minimum price described above. The aim is to encourage the shift towards renewable and more climate-friendly heating. To make this measure socially acceptable, an attractive support programme for oil heating exchange will be introduced. The competent ministries will analyse the impact of increasing the cost of heating oil with the public subsidy from the ‘Allocation de vie chère’ and, if necessary, will respect the effectiveness of this premium, as well as the technical feasibility.
- Support accompanying the transition to renewable energy sources.

Public buildings

- The stock of central government public buildings amounts to a useful floor area of almost 3 million m² across 710 buildings.
- Requirement to install photovoltaic systems on all public buildings by 2030 (with the exception of buildings protected as historical monuments).

- The government has stepped up its efforts in recent years and implemented an ambitious national renovation programme. Luxembourg drew up an inventory of the public buildings concerned in order to calculate the amount of renovations needed.
- The public social housing institutions, the Société Nationale des Habitations à Bon Marché (SNHBM) and the Fund du Logement are working to gradually renovate and improve the rented housing parks.
- The main city airport is also to be transformed into 'Findel Green Airport'. This notably involves introducing energy saving measures and using renewable energy in order to transform the existing terminal into an 'energy plus' building.
- Another aspect of the state's pioneering role is the **replacement by 2025 of light bulbs in public buildings and street lighting by LEDs** to improve energy efficiency and help fight against light pollution. The government's administrations will convert all lighting sources from roads, public spaces, buildings, stations and monuments from existing energy-absorbing luminaires to energy-efficient LED lighting.
- A State **Top Runner** programme will be introduced to encourage the State and municipalities to purchase energy-efficient equipment.
- **Ultra-efficient public buildings** are part of a government strategy on 'sustainable and energy-efficient public buildings' to improve sustainability, energy efficiency and the use of renewable energy in new and existing public buildings. It integrates circular economy principles and relevant health considerations. It includes introducing an obligation to integrate photovoltaic installations in state-owned buildings, both for new constructions and renovation. It also involves the scaling-up of the Public Buildings Administration's PV programme. The aim is for all suitable public buildings to be equipped with photovoltaic installations by 2025.
- **Climate-friendly schools:** Collection of pupils' ideas for increasing RES and EE in schools in 2019 and integrating RES/EE in school curricula.
- **Land and dwellings and the management of the building stock.** A professional housing adviser (housing adviser) will be made available to the municipalities. In general, synergies with the Climate Pact and the Nature Pact will be identified and made the most of. The capacity of the Ministry of Housing will also be strengthened to help municipalities set up housing estates.

Split incentive

- Luxembourg also plans to introduce the Austrian model (maintenance and improvement contribution). In Austria's non-profit housing construction, the EVB is a third component of the rent, in addition to cold rent and operating costs. Tenants pay a monthly contribution which is used to build up reserves for renovations. The maximum amount of the contribution increases with the age of the building. The payment of the EVB as a special-purpose renovation reserve means that the renovation costs are saved in the long term and are not 'randomly' passed on to the tenants who live in the building at the time of the major renovation.
- Removing obstacles at the level of building managers.

- Adjustment of decision-making sequences (lower quorums) for the implementation of renovation measures (introduction of a simple majority in decisions of ownership communities).

Energy poverty - worst performing buildings

- Luxembourg's worst performing buildings include the following four market segments: (i) conditionally rehabilitable buildings (nominal or ensemble protection); (ii) buildings without monument or ensemble protection with the highest average energy consumption; (iii) underused buildings; and (iv) social housing.
- Energy poverty is clearly defined and a set of indicators have been developed to systematically detect it. The national statistical office is currently developing two indicators to monitor energy poverty.
- The following measures contribute to alleviating energy poverty:
 - Acts of 1 August 2007 on the organisation of the electricity market and the natural gas market. The amended Acts stipulate that a household that is unable to pay its electricity or gas bills may receive social assistance from the competent social security office. The Law of 18. December 2009 on the organisation of social assistance further stipulates that the competent social security office must verify whether the household customer is unable to pay its energy bills and is therefore entitled to social assistance.
 - The ongoing 'allocation de vie chère' scheme aims to combat energy poverty. The state rent subsidy can also help those in need to face a possible increase in the cost of housing. It should also be stressed that the current legislation prohibits the disconnection from the grid of a household customer that is unable to pay its electricity or gas bills.
 - Financial assistance for households for electricity, gas, heating oil, water, food and municipal levies, distributed via 30 social welfare offices.
 - Consultations provided by 'myenergy' to households at risk of energy poverty.
 - Subsidised electrical appliances ('myenergy' scheme 2017-2019).

Smartness

- National initiatives to promote smart technologies are largely integrated into the overall energy market regulation. **Smart meter roll-out** is expected to be completed by the end of 2020.
- Pilot projects for the pre-fabrication of refurbishment elements to counter the labour shortages; cooperation with foreign countries.

ESCOs

- The planned de-risking instrument - the investment bundling platform - seems promising (the platform will help bundle several projects in order to make them attractive for EPCs).

District approaches

- Sustainable neighbourhoods, **eco-quartiers made in Luxembourg** (new buildings): Luxembourg will ensure that future built neighbourhoods will improve urban quality and quality of life and will be free of CO₂. To this end, a definition of sustainable neighbourhoods, with common criteria and a clear methodology, and new funding will be developed under the guidance of the Minister for Spatial Development. In addition, more harmonised inspections of buildings are to be carried by municipalities out in order to guarantee compliance with construction and energy standards. The Luxembourg government is developing major housing projects with state and municipal partners that aim to be ‘zero-CO₂’, ‘zero-waste’, ‘car free’ and ‘socially inclusive’ as well as ‘climate neutral’ even in light of the expected increase in population.

Advisory tools

- The ‘**myrenovation**’ app is to be further developed to close information gaps on funding and financing schemes.
- **Myenergy**, the national structure for promoting a sustainable energy transition, provides information and support for the efficient use of energy. It is Luxembourg’s one-stop-shop for building renovations.
- In autumn 2019, a project to develop tools and methodologies for a future de-risking platform was launched by the Ministry of Energy, in cooperation with the EIB (European Investment Bank) and Myenergy. This project continued in 2020, in close cooperation with the Ministry of Economy and the Ministry of Finance, involving banks and relevant market actors.
- **Building renovation passports are being explored** as a future policy measure. This energy passport would provide owners with a transparent and personalised assessment of the renovation potential and the associated savings. A study found that 56% of tenants do not have information about an energy passport for their building or the energy efficiency class of their building.
- For existing functional buildings, an energy passport ‘plus’ is planned.
- **Heat cadaster and solar cadaster:** Energy investment planning will play a more important role. The Energy and Spatial Planning Departments within the Ministry of Energy and Land Planning are therefore working together to produce two important cadasters; a heat cadaster to identify Luxembourg’s priority housing estates and neighbourhoods that use natural gas or fuel oil with a view to replacing heat grids with renewable energy or waste heat from industrial plants or data centres. A national solar register will also help with the planning of large and smaller solar installations.

Skills

- Improvements in skills and education will be achieved through training and education programmes such as ‘further training on energy and economic optimisation of renovations in non-residential buildings’ and ‘further training to reduce the need for cooling energy in the future climate’ that will complement existing programmes.
- Access to the PrimeHouse support scheme by certified craftsmen in an individual measure. Bonus support for overall renovation only in the case of advice from certified energy consultants. Substantial increase in support for consultancy costs.

Areas for potential improvement compared to best practices

It could be useful to consider:

- enlarging the scope of milestones which currently mostly relate to residential buildings;
- providing more specific estimates of the wider benefits, including the effect on climate resilience;
- further detailing the investment needs for the proposed measures;
- developing a detailed definition of deep renovation.

Summary of the long-term renovation strategy

The Maltese strategy provides an overview on the existing policies and measures for renovation identifying the main barriers. Malta follows a two-fold approach, which is composed of enforcing minimum standards through legal obligations, and providing financial incentives to new buildings going above minimum requirements and to existing buildings to improve their energy performance, complemented by voluntary agreements, Energy Efficiency Obligation (EEO) scheme, education and information campaigns and trainings. The indicative targets foresee an average energy consumption reduction in the residential sector by 26% at 2030, 37% at 2040 and 42% at 2050 (compared to the NECP BAU baseline). Building sector CO₂ emission will be reduced respectively by, 26%, 40% and 52%. The strategy implementation will be monitored calculating, at regular intervals (e.g. 2 years), building sector's energy use and CO₂ emissions reduction and the number of nearly zero-energy buildings. In order to reach the targeted savings, the renovation rate will have to increase by 2.5 percentage points above the baseline up to 2050.

Information on the building stock

- Malta has 180 744 dwellings.
- In general, existing buildings, although not particularly well insulated, have a low energy consumption, due to the mild climate, less than other EU countries (average residential energy consumption in 2018 was 27 kWh/m².y).
- EPC database covers 20-25% of existing buildings.
- Data from 2018 show that the number of dwellings has increased by 23% since 2011.
- Approximately 76% of the occupied residential dwellings are self-owned.
- The renovation rate is quite low: about 0.5% in 2020 (estimated to increase to 0.7% in 2025).
- Maltese households rarely undertake extensive interventions in their dwelling.
- It is more common to demolish and re-build old buildings than to renovate them. This is however not possible for listed buildings, which are buildings of historical value where refurbishment interventions are limited by strict regulations.
- Heat pumps are generally a very efficient way to provide heating and cooling in Malta.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

	Milestones
2030	• Average residential energy consumption: 22 kWh/m².y (-26% from NECP baseline; -18% from 2018) • Total CO2 emissions: ○ Residential 118 ton (-25% from NECP baseline; -39% from 2018) ○ Non-residential 318 ton (-26% from NECP baseline; -38% from 2018) • Renovation rates (annual): ○ Residential buildings: up to 5%-6% from 2025 onwards (of which only 0.6% deep renovations) ○ Non-residential buildings: up to 1.1% (to be increased to 2.5% up to 2050. ○ Public buildings: 5.4%
2040	• Average residential energy consumption: 21 kWh/m².y (-37% from baseline; -20% from 2018) • Total CO2 emissions: ○ Residential: 78 ton (-36% from NECP baseline; -60% from 2018) ○ Non-residential: 196 ton (-40% from NECP baseline; -62% from 2018)
2050	• Average residential energy consumption: 20 kWh/m².y • Energy consumption reduction: ○ Residential: -42% ○ Non-residential: -45% • Total CO2 emissions: ○ Residential 50 ton (-40% from NECP baseline; -74% from 2018) ○ Non-residential 120 ton (-52% from NECP baseline; -77% from 2018) • Cumulative savings of 60 000 GWh of primary energy, leading to emission reduction of 4.5 million tonnes CO2

- Creation of new jobs: between 1 200 and 4 300 jobs per year created in the construction and energy services sectors.

Investment needs

- Investment need for the period 2020-2030: EUR 800 million.
- Investment need for the period 2020-2050: EUR 5.1 billion, 33% funds from government, and the remaining from the private sector.

Good practices

Legislative

- Regulations and **voluntary agreements** target heavy consumers of energy with the aim of encouraging the adoption of energy efficient techniques. The national voluntary agreement scheme, the Energy Efficiency Partnership Initiative (EEPI), has been set up to foster, improve and create a roundtable for improved relations between Government and large enterprises with the aim of resulting in the uptake of energy efficiency practices. Voluntary agreements last for three years.
- **Energy efficiency electricity tariffs** (7.2 mil. EUR/year): post 2020, any electricity tariff will incorporate a mechanism which will incentivize end-users to reduce consumption below an established threshold and deter high consumption by increasing unit cost as consumption increases.

Finance

- The financial incentive schemes include grant schemes to cover 40-50% of the costs for double glazing, roof insulation, PV, solar water heater and heat pumps, tax credits and green/eco loans. They have contributed the largest part to energy savings in Malta (74% of cumulative end use energy savings in the period 2014 to 2020) which confirms their effectiveness.
- Specific grant to finance the sustainable renovation of historical privately owned buildings.
- **Green loans**: Over the last 10 years, commercial banks, like HBSC, Bank of Valletta and APS Bank, offer green loans or ‘eco loans’ with the aim of providing financial assistance in relation to purchases having a positive impact on the environment. Such loans may be used to assist in the capital investment of purchases of renewable energy systems, energy efficient equipment, interventions to the buildings envelope and green mobility, depending on the particular product offered and subject to approval by the bank.
- **Financial support schemes for Solar PV**, focusing on a grant and operating aid will be extended beyond 2020.
- **Solar Water Heaters / Heat Pump Water Heater Scheme** (1.1 mil. EUR/year): Malta will launch new schemes post-2020 to incentivise the installation of solar water heaters and heat pump water heaters in the residential sector. Malta will provide support for the installation of 800 units/year by 2030. The amount of financial assistance which can be claimed will be increased from 50% of eligible costs to 80%.
- **Support Scheme for Services and Industry** (2.5 mil. EUR annually): Malta plans to address savings in industry and services through the establishment of a scheme to promote and address energy efficiency investment. Enterprises will be encouraged to undertake energy efficiency projects through the availability of investment aid, linked to the amount of savings achieved.

Public buildings

- There is no financial scheme or incentive in place for public sector's buildings. However, relevant ministries and public bodies have committed additional funds to implement refurbishment programmes, for example in schools and hospitals.
- Ministries to follow energy efficiency purchases guidelines, carry out audits for the majority of their buildings, carry out a substantial number of energy efficient renovations.
- The Building and Construction Authority will launch a review of the public building stock, aimed at evaluating its energy saving potential and a list of priority actions, including whether projects could be grouped, staged or outsourced (via energy performance contracting) to save on the cost of renovation.
- Appointment of **energy officers for public buildings** and implementation of energy management systems in public buildings (by 2025). Officers responsible for energy management shall be appointed in each public building by 2023.

Energy poverty – worst performing buildings

- Although the Maltese climate is mild and low winter temperatures are rare, energy poverty affects about 6.6% of the population.
- Reducing general poverty is part of Malta's National Strategic Policy for Poverty Reduction and for Social Inclusion 2014-2024, which acknowledges the multidimensional forms of poverty, but some specific measures address energy poverty.
- The **energy benefit scheme** is the main and longest standing instrument to tackle energy poverty in Malta. It aims to decrease the energy cost burden of low-income and vulnerable households. Approximately EUR 4-5 million are budgeted by the Maltese government (Ministry of Social Policy). In 2017, 20,488 consumers received the energy benefit.
- The **Energy Incentives Advice Scheme for Vulnerable Households** was set up in 2018 aiming at reducing the energy and water consumption through the replacement of old and inefficient appliances, specifically targeting vulnerable households. This scheme is funded with EUR 200,000 annually.
- The **Eco-reduction scheme** under which households that consume either: (i) less than 2,000 kWh per year in a single household; or (ii) less than 1 750 kWh per person in a two or more-person household, receive a direct rebate on 15-25% of their electricity bills. This policy incentivises efficiency and lower consumption, while also having a positive effect on the bills of low-income households who fall within the consumption limit.
- **Replacement of Appliances in Households Scheme** is a tailor made financial scheme designed to i) identify vulnerable households, ii) conduct home visits and provide advice on how to consume less energy & water, and iii) if merited, replace old and inefficient appliances with new energy-efficient models.
- The **Energy Efficiency in Low Income Households in the Mediterranean** (ELIH MED) project works towards the identification of cost-effective solutions and innovative public and private financing mechanisms to foster energy efficiency investment in low income

households. Initiated and co-funded by the EU, this project has a total budget of EUR 250 000 to be used for 35 households in Malta for the period 2014-2025.

- The Consumer empowerments in a smart meter world (**SMART-UP**) is a European Horizon 2020 project partnering with local organisations and national ministries to fight energy poverty in 5 EU Member States, i.e. Spain, Italy, France, the UK and Malta. The project focused on increasing the awareness of vulnerable households to their energy consumption and to help them adopt new energy efficient consumption patterns by providing educational and practical means.
- The provision of professional advice, free-of-charge, by the Energy and Water Agency to vulnerable and low-income households on energy efficient appliances and behaviour.

Advisory tools

- Provision of professional advice, free-of-charge, by the Energy and Water Agency to vulnerable and low-income households on energy efficient appliances and behaviour.

Skills

- The Building Industry Consultative Council trainings
- **Skills Building initiative** in the construction sector: by 2025, the government will develop a scheme to train and certify professionals and tradesmen of various levels in order to obtain a mandatory skill card which would need to be presented to work in the respective sectors. Certification will be extended to installers of several technologies and a life-long-learning approach will be adopted through regular training sessions addressed to skill card holders.

Smartness

- The importance of the promotion of smart technologies and electro-mobility is qualitatively discussed in the strategy. An action plan for the deployment of smart technologies, including possible incentives will be elaborated post-2030. The plan will be based on data collected between 2021 and 2030, in relation to renewable energy production, use of energy storage systems, as well as the increase in electro-mobility which is expected to increase the overall energy demand of buildings.
- Malta's National **Electromobility** Action Plan (MNEAP) is currently undergoing review and being updated to reflect the National Transport Strategy and National Operational Transport Master Plan, including a new action plan up to 2025 and a strategy leading to 2050.
- National initiatives to promote **smart meters** installation.

- **SmartCity** Malta project is an example of a highly energy and resource efficient construction area in Malta, which combines a range of innovative and smart technologies and can be used as a benchmark for new developments.

Areas for potential improvement compared to best practices

It could be useful to consider:

- Building Renovation Passports and One-Stop-Shops.
- Promote the Energy Service market.
- Improve the fragmentation of competences between ministries and government entities.

Summary of the long-term renovation strategy

The Dutch long-term renovation strategy (LTRS) sets out an innovative and comprehensive set of policies as well as milestones and stocktaking. The Climate Agreement is the successor to the Energy Agreement and forms the basis of the LTSR. Indicative building renovation milestones towards 2030-2040-2050 are based on the Climate Agreement and calculated using a linear reduction of greenhouse gas emissions and straight conversion of the 2050 CO₂ emission reduction target of 95% indicated in the Climate Act.

A key Climate Agreement objective is to gradually insulate 1.5 million residential and other buildings by 2030 taking a district-oriented approach and to make them gas free, or at least ready to switch over to another, sustainable source of heat ('gas free-ready').

The LTSR comprises a good mix of regulatory requirements, fiscal and economic incentives and information measures.

It focuses strongly on the district-oriented approach to make districts gas-free. This approach integrates environmental policy into urban planning and is based on roadmaps to be implemented by municipalities who should also identify available sources of energy in their district.

Renovation activities are mostly incentivised through tax reduction and tax exemption measures, reduced VAT rates, VAT refund, investments costs deduction, depreciation of investment, favourable loans and interest rates.

Information on the building stock

- The Netherlands has nearly 8 million homes and 470 000 non-residential buildings.
- Owner-occupied homes accounted for approximately 58% of the housing stock in 2019, rented housing association accommodation for 29% and other rented homes for 13%.
- The rental sector in the Netherlands is dominated by social rentals (through 320 housing associations with approximately 2.2 million residential units) which account for around 67% of the rental market for residential properties.
- Homes built before 1975 account for approximately half of the housing stock. Homes built in 1995 or later account for approximately 22%.
- Nearly 6 in every 10 homes built in 1995 or later have energy label A. Only just over 10% have label C or worse. The proportion of homes with a bad label (F or G) has fallen sharply, from 54% in 2006 to 23% in 2018.
- In 2015, the floor area of non-residential buildings stood at approximately 600 million m² (including vacant buildings) spread over 470 000 buildings.

- Industrial halls account for 44%; offices for 15% and shops, healthcare, education and hospitality and catering each account for between 6% and 9% of the total surface area.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

2020	• Gas consumption will fall steadily to 264 PJ • 100 PJ energy saving vs 2012 • New building energy neutral
2030	• Gas consumption will fall steadily to 234 PJ • Gradually insulate 1.5 million residential and other buildings and make them gas-free, or at least ready to switch over to another, sustainable source of heat ('gas free-ready') • 3.4 million metric tonnes less CO₂ • 1 million metric tonnes less emissions from non-residential buildings • 49% reduction in CO₂ emissions
2040	• CO₂ emissions = 8.4 million tCO₂e
2050	• Vision for 2050: all buildings sustainable • CO₂ emissions = 1.5 million tCO₂eq

Milestones are based on CO₂ emission reduction and expressed in CO₂ million metrics tonnes compared to 1990 (based on the Climate Agreement forecasts for the built environment - using a linear reduction of greenhouse gas emissions and a straight conversion of the 2050 CO₂ emission reduction target of 95% indicated in the Climate Act).

- The Climate Agreement stipulates that 1.5 million homes and non-residential buildings are to be made sustainable and natural gas is to be gradually phased out by 2030. To achieve this objective, the Netherlands needs to scale-up its action and renovate 200 000 homes per year. After 2030 a further acceleration will be necessary in order for all homes and non-residential buildings to have sustainable heating by 2050.
- Gas-free programme – districts to be gas-free or gas-free ready by 2030 using more renewables and more sustainable sources; no more fossil fuel used in the building environment by 2030 (Transition Vision for Heating plan).
- Decrease in electricity since 2013, falling further from 78PJ in 2020 to 71 PJ in 2030.
- Increased use of heat pumps and solar panels.
- Gas consumption in the service sector is expected to decrease from 117 PJ in 2020 to 82PJ in 2030.

- Benefits for health and safety and the environment due to the elimination of fossil fuels (replacement of internal combustion engines (petrol, diesel, LPG and CNG) by electric motors). A 10% reduction in NOx gases and particulates by 2030 vs 2016.

Investment needs

- According to the NECP, the estimated overall amount of private and public investment for the 2019-2030 period is EUR 56-75 billion (roughly 10% of current GDP) for energy.
- The heating fund is financed by public and private resources. The government will make a total of EUR 900 million available between now and 2030. To make a flying start with the heating fund in 2020 the government used the structural and financing proceeds of the National Energy Saving Funds (NEF). The volume of financing in the heating fund will grow in the short term to more than EUR 1 billion, with private contributions expected to account for around 75% of the total.
- Housing associations and other landlords obtain from the central government a reduction of the lessor levy of EUR100 million per year.
- The renovation accelerator is an instrument for pooling demand and matching it with supply to enable larger-scale and cheaper renovations. For this, EUR 130 million is available until 2024.

Good practices

Legislative requirements/ standards

- **Mandatory requirement for offices over 100m² to have a minimum ‘C’ energy label by 2023.**
- The Climate Agreement commits to developing standards and target values for the main and characteristic types of residential properties and to provide owner-occupants with guidance on how to make their homes sustainable. The standards and target values will be indicated on the energy label. The standards for existing owner-occupied homes are not mandatory at present, but if owner-occupiers renovate the obligation to comply with the Building Decree already applies.
- **Agreements with landlords:** the starter motor and renovation accelerator aim to make 100 000 rented homes gas-free or ‘gas-free-ready’ in the next 4 years. The central government supports this starter motor by contributing to the costs of making rented dwellings gas-free. For this, it uses EUR 200 million of the Energy Investment Deduction allocation.
- The **Reduction of Landlord Levy (RVV)** scheme aims to help landlords make their properties more sustainable.
- **Lower tax rates.** Labour costs for insulating floors, walls and roofs of homes that are more than 2 years-old are subject to VAT at 9% instead of 21%.

- **Exemption from energy tax for self-generated energy for energy cooperatives** (private individuals). Members of energy cooperatives (groups of private individuals) do not have to pay tax in the first bracket of the energy tax for the portion of the collectively generated renewable electricity allocated to them.
- **Since 1 July 2018, new buildings do not get a gas connection.**

Finance

- **Environmental Investment Deduction (MIA) & Arbitrary Depreciation of Environmental Investments (VAMIL)** (businesses). This allows entrepreneurs to depreciate the investment (up to 75% of the investment cost) with advantages in terms of liquidity and interest. (MIA) offers tax deduction for up to 36% of the investment amount. This deduction is on top of the usual investment deduction for entrepreneurs.
- **Sustainable Energy Investment Subsidy (ISDE)** (businesses and private individuals). This encourages individuals and businesses to invest in (small) appliances for renewable energy generation. It supports sustainable installations such as heat pumps, and will be expanded to cover insulation.
- The **Dutch Municipalities' Stimulus Fund for Housing (SVn)** extends the energy saving loan from the National Energy Savings Fund. Interest and repayments go back into the fund so that new energy saving loans can be granted. A total of EUR 600 million is available.
- The **Heating Fund** offers home owners attractive financing for making their home sustainable, including those that currently have no access to financing. The interest rate will be comparable to that for mortgage loans and will be on the same terms as the national mortgage guarantee. Thanks to the available subsidies for insulation and sustainable heating options, the cost of making homes sustainable will come down. Owners will also increasingly be able to recoup their costs through lower energy bills.
- The combination of public and private resources can mobilise large amounts of financing (though the participation of private parties) and ensure that risks are shared (through government participation).
- The Dutch '**Energiesprong**' concept is generating mass deep renovations with pre-fabricated, standardised modules in order to achieve major cost and time savings. Energiesprong brokered a deal to bring 110 000 buildings to a NZEB status. Thanks to a three-year EU Horizon 2020 grant, this initiative is planned to be rolled out in other EU countries.

Public buildings

- Roadmaps for the public sector aim at a CO2 neutral central government portfolio, but there are no concrete measures in place. Eleven sectors are drawing up roadmaps: Central government (the Central Government Real Estate Agency), municipalities (VNG), provinces (IPO), police, education (primary and secondary, senior secondary vocational, higher professional and university), the healthcare sector and the sports sector.

- The **Central Government Real Estate Agency** (RVB) manages about 12 000 buildings with a total gross floor area of around 12 million m². This includes 11 000 buildings (6 million m² GFA) of the Ministry of Defense, and 1 200 buildings (6 million m²) of other users. The roadmap aims at a CO₂-neutral central government portfolio by 2050, with the vast majority being achieved in 2040 (at least 85% less emissions than in 1990).

Split incentives

- The split incentive dilemma is well addressed in the Netherlands. Several measures are in place to help landlords recover some of their investments from the tenants and will be enforced by amending the Law on renting.
- The **Social Rental Agreement** contains a ‘Table of compensations for investments in sustainability’ based on the real average saving in energy costs that tenants make after home improvement.
- A **performance contract** joined to a Green Lease can establish agreements on performance guarantees, on how to share the benefits of the sustainability measures and on monitoring methods. This allows both the tenant and landlord to benefit from the sustainability measures.
- The **Energy Performance Compensation** (EPV) scheme aims to achieve housing cost neutrality for landlords so that they can recover part of their investment when making social rental homes energy-neutral. Under this scheme, landlords can ask tenants for compensation for energy-neutral or ‘Zero on the Meter’ homes.

Energy poverty - worst performing buildings

- Energy poverty is not a major issue in the Netherlands. However, it is addressed by protecting tenants from high energy costs, and by supporting households with a lower income. In 2014-2015 the Netherlands had a total of 528 000 households at risk of energy poverty.
- The Netherlands assists lower income households through its general social policies. The Netherlands is not in favour of income policies through energy bills. The Netherlands does not have a definition of energy poverty.
- Landlords are obliged to bring residential properties up to the required ‘standard’ in order to protect tenants from high energy costs.
- The government agreed that the total rental housing stock would attain an average Energy Index of 1.25 (average energy label B) by 2021.
- For insulating existing homes subsidy schemes have been in place for a long time.

Smartness

- Promotion of smart technology support measures such as innovation programmes, a Demonstration Energy Innovation scheme, and an obligation for **large non-residential buildings to have an extensive energy and building management system from 2026**.

- The Building and Technology Innovation Centre aims to act as an initiator and broker in order to integrate R&D programmes in the design, construction and technological sectors. This will involve establishing links, as far as possible, with the vocational training sector and addressing labour market and training issues.

Advisory tools, Education

- A digital platform, available to building owners and occupants, serves as a one-stop-shop providing advice on relevant energy efficiency home improvements, financing instruments and possible subsidies.
- The **Regular Explorer home** allows owners to calculate the costs and benefits of energy saving measures for their home. They can also get advice on the measures they can take to attain a higher energy performance class (e.g. from F to D, or B to A). (See <https://energiebesparingsverkenner.rvo.nl/>)
- The **High Ambitions Explorer home** provides owners with advice on how to make their home ‘nearly energy-neutral’. Homeowners can also get information on the costs and benefits of the various measures, and advice on alternatives to gas-fired heating installations. (See <https://energiebesparingsverkenner.rvo.nl/>)
- The **Energy Savings Explorer for Offices** provides office owners with information on how to qualify for energy label class ‘C’. It provides information on the investment costs, the annual savings in energy costs, the payback time and the environmental effect (CO2 reduction per m²). (See <https://energieslag.rvo.nl/news/view/51138486/snel-inzicht-in-besparingsopties-met-de-energiebesparingsverkenner-kantoren>)
- The **Sustainable Housing Platform** has made a start on developing a data template with available data on energy consumption, construction technology and building use.
- The **Knowledge and Innovation Platform for Sustainable Social Real Estate**. Eleven sectors are in the process of drawing up roadmaps: Central government (the Central Government Real Estate Agency), municipalities (VNG), provinces (IPO), police, education (primary and secondary, senior secondary vocational, higher professional and university), the healthcare sector and the sports sector. This platform is not intended to support the preparation of the roadmaps, but to help individual institutions make their buildings sustainable. (See <https://www.rvo.nl/onderwerpen/sustainable-ondernemen/gebouwen/social-vastgoed>)
- The **Gas-free district knowledge and learning programme** aims to not only provide technical solutions and information on cost and financing, but to also help with management and organisation, data-based planning, legal aspects and communication and participation.
- With BUILD UP Skills Netherlands@Work, eight profiles of blue collar professional competences have been created setting out the skills required for building energy-neutral buildings.

De-risking and aggregation

- Specific measure such as the **renovation accelerator** help aggregate projects into bigger investments that are easier to finance, to enable the large-scale renovation of rental homes. The Renovation Accelerator has aggregated housing associations' requests for (hybrid) heat pumps, insulation and other reduction measures, through a regional support programme. Up to 2024, EUR 130 million will be available for the renovation accelerator.
- De-risking is partly addressed by **pooling public and private money** to provide attractive financing for building owners. The Netherlands supports this with the **Heating Fund** and the **National Energy Savings**. By combining public and private resources large amounts of financing can be made available (though the participation of private parties) and risks can be shared (through government participation).

A district-oriented approach to the built environment

- Municipalities have to develop (together with stakeholders and residents) a '**Transition Vision for Heating**', an environmental plan and the implementation plan towards eventually ending the supply of gas and being able to offer residents alternative sustainable heating options.
- The idea is that on an aggregate basis the municipalities' goal under the Transition Vision for Heating should be to make 1.5 million residential and other buildings sustainable by 2030.
- A programme is already under way to make 100 districts gas-free. In 2018 the first lot of 27 test beds began, each of which were given about EUR 4 million from the Municipal Fund to cover the project shortfall.

Areas for potential improvement compared to best practices

It could be useful to consider:

- providing a more precise description of the share of renovated buildings or an absolute value (number or m2 per type of building) in 2020;
- providing more specific estimates of the wider benefits, including the effect on climate resilience;
- further detailing the investment needs and budget allocation for the proposed measures;
- specifying further trigger points.

Portugal

Summary of the long-term renovation strategy

The strategy presents a good overview of the targets proposed and outlines a new set of measures aiming to transform existing buildings into NZEB-like efficiency stock by 2050, reduce emissions, increase thermal comfort, fight energy poverty, improve indoor air quality and address safety issues and efficient management of material resources, water efficiency and improvement of the environmental performance of buildings. The LTRS builds on three main axis: 1) The improvement of quality of life, with a priority to reduce energy poverty, increase thermal comfort and improve internal air quality; 2) Economic growth opportunity via the co-benefits associated with the building stock renovation; 3) Meeting the energy and climate targets coordinated with other policy instruments like the NECP. The level of ambition of the Portuguese LTRS can be considered high.

Information on the building stock

- Total residential buildings in Portugal is around 5 859 540.
- In Portugal, the domestic and service sectors, and the associated building stock, account for more than 30% of the final energy consumed.
- Almost two thirds of the national building stock was built before the introduction in 1990 of energy efficiency requirements for new buildings and therefore the national building stock is ageing, particularly in the residential sector.
- The number of households reaching around 4 million (2011), the mere number of dwellings was estimated at almost 6 million, resulting in a surplus over the number of households by almost 2 million, in turn allocated to vacant or seasonal accommodation.
- Only 9% of certified dwellings qualify as very efficient (efficiency class A and A+).
- Unsatisfactory indoor air quality and exposure to moisture and mould appears in more than 30% of dwellings (EU average is 16%), thus giving Portugal the status of second country in the European Union with the highest winter death rate, with about 19% of the population unable to heat their homes in order to have adequate levels of comfort.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

	Renovated area	Primary Energy Savings	Reduction on housing	CO ₂ eq reduction
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	(m ²)		discomfort	
2030	363 680 501	11%	26%	45-55 %
2040	635 637 685	27%	34%	
2050	747 953 071	34%	56%	

- There is an overall concept that the energy efficiency of the buildings will need to have a NZEB-like energy efficiency by 2050.
- According to the results of the simulations the strategy suggests a cumulative primary energy savings of 40% in residential buildings by 2050 and 28% in non-residential buildings, totalling 34% in terms of the total park of buildings existing at date.
- For the non-residential sector, the estimated share to be renovated in the fields of education, health, sports grounds and other public administration services is expected to be 50% by 2030, 75% by 2040 and 100% by 2050, corresponding to a rather demanding annual renovation rate of 5% in the first decade and 2.5% in the others.
- For private buildings, there is also ambition to renovate 25% of the building stock by 2030, 50% by 2040 and between 75% and 100% by 2050.

Investment needs

By 2050 estimated investment needs: EUR 143 492 M (Residential: EUR 113 579 million; Non-residential: EUR 33 414 million).

Good practices

Legislative

- There is a clear definition of Energy Performance Certificates as a tool to be used into achieving the proposed renovation rates.
- Reorientation of tax revenues to improve environmental and energetic performance of buildings. Examine tax benefits to owners who invest in the energy and water renewal of the properties.
- Study the reinforcement of tax benefits in the purchase of products / services whose energy classification corresponds to the two highest classes or which present a high environmental performance identified by label or certification, and which incorporate recycled materials.
- Simplification and dematerialization of the processes for accessing tax benefits through the use of digital instruments, such as the energy certificate.
- Consider introducing tax incentives for energy efficiency and energy production from renewable sources for self-consumption and a more favorable tax regime for buildings intended for the production of renewable energy"

- Review of the regulatory framework for the energy performance of buildings, considering the instruments for environmental certification of construction products and services. Inclusion of other indicators (e.g. comfort, water-consuming devices and DHW).
- Definition of more ambitious mandatory regulatory minimums with regards to the energy performance of non-residential buildings.
- Alignment between the regulatory requirements related to energy performance and the instruments, existing or to be created, of energy and / or water efficiency labeling of components, devices, equipment or systems in buildings.
- Articulation with the initiatives foreseen under the new framework for self-consumption and energy communities.
- Combating fragmentation of incentives by promoting a balance of incentives and benefits between tenants and owners.
- Use of labeling or environmental certification systems and water classifications as a tool for project evaluation (ex-ante and ex-post) and the identification of measures types of improvement, to support the evaluation of applications for financing the renovation of the building stock.
- Simplification of audits and licensing processes. Alignment of the current energy audit framework in order to harmonize procedures provided for in the EED and EPBD Directives, allowing the various sectors, regardless of size, to benefit from an audit.
- Simplification and dematerialization of the licensing processes and harmonization of documents related to the building process, through the reduction of bureaucracy and context costs associated with licensing.
- Creation of a legal and financial framework that reinforces the role of owners / joint owners associations by regulating and encouraging the renovation of common properties combined with measures to promote energy and water efficiency, including the integration of efficiency of other resources and the principles of circular economy.
- Reinforcement of the regulatory framework for the labelling of products and services related to the construction sector. Promote the adequate dissemination of information and communication of the new generation of energy labels.
- Creation of the Building Book (LogBook) in digital format, to function as an updated archive of all information related to the building and renovations made over time and which may be included in existing systems of general character, namely general record of the characteristics and history of buildings.

Investment needs

- As regards the investment needed until 2050, a total of EUR 143 492 million was estimated, with the largest share relating to the renovation of the residential building stock, amounting to EUR 110 078 million and EUR 33 414 million for non-residential buildings.
- A number of funding programmes/budget sources are identified for the coming years to support energy renovation, such as: Support Programme for Access to Housing, Urban Rehabilitation and Revitalisation Financial Instrument, Rehabilitating for renting - Access Housing, Energy Efficiency Fund, Operational Programme Sustainability and Efficient Use of Resources, Equity Rehabilitation and Conservation Fund, Environmental Fund, Economic and Social Stabilization Programme, European Recovery and Resilience Facility.

Finance

- The actions regarding the mobilisation of finance are presented as a change into regulation, reorienting fiscal revenue for the improvement of energy and environmental behaviour of buildings.
- The new "Portugal 2030" financing mechanism and the European Recovery and Resilience Facility are two of the new financing mechanisms that will be put into place starting from 2021.
- Collaboration with financial entities in the design of specific products to finance the energy renovation of buildings, - Design of a financing framework that allows for the combination / complementarity of different sources of financing.
- Introduction of the concept of energy performance and sustainable buildings in risk assessment indicators, highlighting sustainability criteria such as investment opportunities and as an enhancer of property value.
- Promote the creation of flexible financing platforms.
- Ensure access to renewable energy and alternative water sources in buildings.
- Dissemination and promotion of existing financial support to local entities that carry out programs to support energy renewal in social housing.

Public buildings

- Revamping of an already existing programme "ECO.AP": creation of an action plan until 2030 and 2050, prioritizing the activities to be developed and the investment levels in view of various intervention scenarios and the goals quantified at the level of each ministry, in line with the objectives of LTRS (renovation of 5% of public buildings, per year, until 2030, and 2.5% by 2050).
- Structuring and strengthening the inter-ministerial network of interlocutors to implement the action plan to intervene in the existing public buildings park and requalifying the figure of Local Energy Manager, to be called the Energy and Resources Manager.
- Creation of a fiscal and regulatory framework that favors investment in measures to improve energy and environmental performance of public the buildings, as well as water and other resources.

Energy poverty - worst performing buildings

- Energy Poverty is being given more attention in this strategy with the Portuguese government addressing fully the issue and dedicating to it a set of measures.
- Inclusion of an energy efficiency criterion in the scope of the lease. Alignment of the worst-performing segments targeted for interventions with the minimum energy performance standard in buildings by 2030.
- Dissemination and promotion of existing financial support to local entities that carry out programs to support energy renewal in social housing.

- Study the introduction of tax benefits and energy saving bonuses integrated into the building energy certification scheme.
- Propose the inclusion of a social criterion in the allocation of financial and tax benefits.
- Support most vulnerable populations or low-income families through specific programs to support financing for the renovation of buildings,
- Examine the allocation of support for the replacement / acquisition of space heating systems and domestic hot water by efficient systems (for example, solar thermal, heat pumps, surface geothermal), as well as the replacement / acquisition of water terminal devices
- Promote the integration of the most vulnerable energy populations or low-income families into renewable energy communities, coupled with the promotion of the replacement of equipment based on fossil sources for electricity;

Advisory tools

- In the proposed policies there are several mentions to one stop shops and the introduction of building renovation passports.
- Standardization of measurement criteria and verification of energy savings achieved with renovation projects, namely creation of a database of effective technical and financial performance of investments in energy efficiency at national level.
- Implement an electronic information portal on distributed production, self-consumption and energy communities.
- Introduction of a new version of the energy certificate. Progressive affirmation of the digital version of the energy certificate as an aggregator of information. Interconnection of the energy certificate with supply and demand platforms (of the 'one stop shop' type), such as, for example, the casA + Portal. Adjustment of the energy certificate in order to reflect, in a more concrete way, the characteristics of the building susceptible to the verification, among other factors, of a situation of energy poverty.
- Creation of the building renovation passport, as an optional instrument, which complements the energy certificate.
- Creation of a virtual counter, with decentralized information points across the country, to support the improvement of the energy and water performance of buildings.
- Operationalization of a one-stop shop and creation of an electronic platform that allows streamlining the licensing procedures for energy production projects, reducing the licensing deadlines and providing simple information to promoters and citizens.
- Adapt, and publicize, the current online portals for the energy sector to identify the support and lines of financing available, as well as application deadlines.
- Promote the reinforcement of the performance of local energy and climate agencies in technical support and in the operationalization of access to financial support.
- Creation of a local program for the dissemination of information and support for the implementation of self-consumption renewable energy projects.

- Support measures that promote the reuse of construction components through, for example, agreements between municipalities and companies.
- Reinforcement of advertising campaigns to promote savings and energy efficiency, water efficiency and use of resources and the advantages of renewal.
- Development of awareness campaigns for sustainable production and consumption, through participation and articulation with the various stakeholders in the value chains.
- Support for the development of communication and information campaigns, of an institutional (non-commercial) nature promoted by sector associations and other organizations representing the energy and water efficiency ranks of buildings.
- Promotion of environmental education programs in schools, in partnership with local entities.
- Organization of conventions on the monitoring of the energy efficiency upgrade market.
- Creation of marketing tools, namely, signage that recognizes the buildings where the best practices were implemented and identifies public and private infrastructures that have adopted projects demonstrating the application of circular solutions.
- Promotion of better communication of the benefits of energy efficiency in real estate transactions beyond the energy class of the property.
- Creation of a Resource Observatory, within the Energy Observatory.

Skills

- Operationalization of training programs in energy efficiency and water-energy nexus, including the integration of water efficiency and other resources and the principles of circular economy, which reinforce the technical skills of professionals in the construction sector.
- Adapt the training of professionals linked to the construction area, empowering them with the necessary qualifications to build NZEB certified buildings, AQUA + water classification, as well as such as Passive House certification, LiderA or other certifications.
- Adoption of results and updated recommendations resulting from the Portuguese experience in the BUILD UP Skills initiative.
- Promote the training of professionals related to the construction area and consumers, in conjunction with stakeholders and non-governmental organizations, as well as training other professionals, particularly in the distribution sector, who are in direct contact with the consumer to raise awareness towards more sustainable production and consumption patterns.
- Reinforcement of educational and training content and projects, namely regarding qualification and education and training courses in the area of efficiency.
- Promotion of training in companies, including entrepreneurs and workers and consumers, in conjunction with stakeholders and non-governmental organizations, for the increasing adoption of energy efficiency criteria.
- Promoting the training of business professionals (particularly in the sector of products and construction materials and equipment and systems in the energy area).

- Reinforcement of curricular content and educational and training projects in the areas of energy efficiency, water efficiency and the use of building resources in basic, secondary and post-secondary non-higher qualification courses.
- Creation and / or support of internship programs for higher education students specifically aimed at raising awareness and training future professionals for energy efficiency, water efficiency and the use of resources in buildings.
- Creation of a program of National Awards for the Energy Transition of Buildings

Digitalisation – Research and Innovation

- Survey of the results of research and development (R&D) projects in which Portugal participated related to the theme of energy and water renovation of buildings.
- Promote the creation of research and innovation (I&I) programs that allow the development of technical solutions for the renovation of the park of high-efficiency buildings.
- Deepen knowledge about the interaction between performance improvement environmental and energy efficiency of buildings.
- Classification of buildings according to the 'smart readiness indicator'.
- Strengthening the role of demand-side flexibility in managing the national energy system, ensuring that benefits reach consumers.
- Promotion of the integrated energy renovation of buildings and their surroundings, ensuring good connections between buildings and the constitution of energy communities with energy management solutions.
- Promote the creation of a credit line oriented to support innovation with the aim of introducing new technological concepts in buildings, in the area of energy efficiency and water-energy nexus.
- Strengthen and accelerate the installation of smart meters, including mechanisms to support demand-side management by 2030.
- Promote the installation of temperature, relative humidity, lighting and CO2 sensors in new residential buildings subject to major intervention and in all non-residential buildings, by 2030.
- Promote the installation of systems and equipment that allow the integrated management of consumption and energy production.
- Promote the adaptation of buildings, especially those subject to major renovations, so that they are provided with the necessary infrastructure for the intelligent charging of electric vehicles.
- Digital infrastructure of buildings in order to provide them with greater resilience, namely, in situations of variation in usage patterns (for example, the promotion of teleworking).
- Implement automation and control systems in buildings with a rated thermal power greater than 290 kW by 2025 and encourage their installation in buildings whose power is greater than 100 kW by 2030.
- Create mechanisms to periodically collect information on electricity, gas, water, waste generation using telemetry, surveys, and platform interoperability.

- Integration of building systems, new and old, on a single platform, allowing for transparent monitoring and billing methods.
- Reinforce the current Electronic System for the Registration of Production Units, with a view to establishing an electronic system with the capacity to regulate and control efficiently and safely the records related to the small distributed production units of energy.

Areas for potential improvement compared to best practices

It could be useful to consider:

- Presenting the national building stock in a more clear way.
- Providing more specific estimates on the wider benefits and energy savings contribution of the measures.

Romania

Summary of the long-term renovation strategy

The Romanian renovation strategy presents a range of regulatory requirements, information measures and sets milestones, expressed in energy savings, CO2 reduction and increased share of renewables for 2030, 2040 and 2050. Based on the recommended scenario, the annual renovation rates will increase gradually from the current 0.5% to 3.39% in 2021-2030, 3.79% in 2031-2040 and 4.33% in 2041-2050. This is expected to bring a 9% reduction of final consumption in 2030 (0.83 Mtoe) and cumulative 24% GHG emission reduction (2.34 Mton) in 2021-2030 and 65% reduction of final consumption in 2050 (6.14Mtep) and 80% cumulative GHG emission reduction in 2021-2050.

The Romanian LTRS also reports a list of the main recommended actions to be taken to ensure its timely implementation and to realise the energy savings potential.

Information on the building stock

		Number	Area (Mm2)
Residential	Single-family houses /detached	5 165 000	372.26
	Semi-detached		
	Terraced		
	Apartments /multi-residential dwellings / flats	153 886	210,02
	Total Residential	5318886	582.27
Non-residential	Offices	7500	
	Hospitals/health establishments	547	5.47
	Social housing	50766	3.8
	Hotels / Restaurant / leisure	43642	6.05
	Commercial	122000	20.83
	Schools	18000	17.5
	Total non-residential	242455	62.01
	Total	5561341	644.28

- The majority of Romanians live in small, detached houses and apartments in multifamily buildings.
- More than 63% of these homes have less than 50m² useful surface area, which is much smaller compared to most EU countries.
- In Romania, the vast majority of the population lives in home ownership (94.7 %).
- Homes are far below EU standards on minimum standards of comfort and hygiene; according to Eurostat data 2017, only 50.9 % of the population is connected to urban drainage and 67.5 % of the population has access to drinking water from public networks.
- In Romania, around 90% of the residential apartments are occupied by owners, which makes the problems of split-incentive dilemmas not significant in the medium term.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

	Milestones
2030	• Savings: 0.83 Mtoe (9%) • Total consumption: 8.69 Mtoe • CO2 reduction: 24% • Total CO2 emissions: 7.50 Mton • Increased share of renewable: 0.22 Mtoe (+5%) • Total share of renewable: 4.32 Mtoe • Gradual increase of annual renovation rates from 0.69% to 3.39% • 340 000 building renovated (2.66 million people effected) • 1% increase in NZEB buildings • 19% decrease in worst performing buildings • 30% decrease in citizens affected by energy poverty • 18% of the non-residential buildings equipped with BEM or similar systems • 4 One-Stop-Shop initiatives • 18% increase in the number of owners conducting energy renovation works
2040	• Savings: 3.32 Mtoe • Total consumption: 6.20 Mtoe • CO2 reduction: 50% • Total CO2 emissions: 4.93 Mton • Annual renovation rate: 3.79%

	• 4% increase in NZEB buildings • 23% decrease in worst performing buildings • 70% decrease in citizens affected by energy poverty • 45% of the non-residential buildings equipped with BEM or similar systems • 5 One-Stop-Shop initiatives • 57% increase in the number of owners conducting energy renovation works
2050	• Savings: 6.14 Mtoe (-65%) • Total consumption: 3.38 Mtoe • CO2 reduction: 80% • Total CO2 emissions: 1.99 Mton • Total share of renewable: 6.20 Mtoe • 77% of the total floor area of the building stock will be renovated or rebuilt • Annual renovation rate: 4.33% • 23% increase in NZEB buildings • 26% decrease in worst performing buildings • 100% decrease in citizens affected by energy poverty • 100% of the non-residential buildings equipped with BEM or similar systems • 6 One-Stop-Shop initiatives • 100% increase in the number of owners conducting energy renovation works

- The strategy provides an estimate for the number of construction workers and engineers required in the construction sector to carry out the planned renovation of buildings in each scenario considered (e.g. round 4.000 new engineering staff will be needed to ensure that the scenario 2 renovation targets will be met).
- The Romanian renovation strategy considers that the cost saving potential related to health is estimated to be EUR 1 480 million (direct and indirect).
- According to the recommended scenario the construction sector contributes around 30% to the final energy consumption target.
- NZEBs will be characterized by a primary energy consumption below 50 kWh/m².year, more than 40% share of RES and CO₂ emissions below 7 kgCO₂ /m².

Investment needs

- The estimated investment needs are EUR 12.8 billion in 2020-2030.

- About EUR 700 million should be mobilized to support project preparation, technical assistance, market development and programme management costs (or about EUR 70 million each year up to 2030).
- The central government is expected to provide between EUR 40 million and EUR 200 million per year to support the reimbursement of investments to socially vulnerable persons. For the first implementation period until 2030, it is estimated that only around EUR 5 billion will need to be mobilised from the national budget (representing a total of 2% of GDP over the 10 years or 0.2% of annual GDP per year). Part of this amount could also come from the EU Structural Funds, depending on the availability of programmes and funds. Around EUR 3 billion should be dedicated to grants, while owners are expected to contribute around EUR 1.8 billion.

Good practices

Legislative

- A governance framework for implementing the strategy is proposed. The constitution of an inter-ministerial committee to coordinate the implementation of the LTRS is envisaged. The committee will be responsible for monitoring and reporting the roadmap indicators.
- Appropriate financing arrangements allowing the owner or tenant to use the resulting energy cost savings to pay part of the investment could be developed to overcome split-incentive dilemmas. If apartment owners refuse to accept a renovation proposals, in future there is a risk that they will no longer have access to financial support from public funds.
- Romania still does not have a dedicated regulatory framework for Energy Service Companies (ESCOs). Energy Performance Contracts (EPCs) are rarely used in Romania (typically address energy supply systems and are not used for major energy renovation of buildings). National Energy Regulatory Authority (ANRE) coordinates a Working Group to develop this framework.
- A database for Energy Performance Certificate is foreseen, the data is expected to be available to building owners.
- Revising building standards to stimulate deep renovations of existing buildings, as well as revising and updating the energy efficiency standards based on the cost-optimal methodology.
- Using energy efficiency criteria in public procurement.
- Restrictions on sale or lease of buildings under lowest energy performance categories.

Finance

- Different funding options are considered: Grant (100%), Loan and grant, partly repayable grant (20-60%). Based on the different funding options, four cases are further analysed and a selection of option for each market segment (central government buildings, municipal buildings, multifamily buildings, single-family dwelling, and commercial buildings) is made.

- Creation of the **Energy Efficiency National Fund (EFE)**, financed with private funds, structural funds, possibly also from the State budget.

Public buildings

- Two dedicated programmes are suggested to be developed: a long-term national programme for state-owned public buildings and a long-term national public building programme. Renovation trigger points targeting public buildings are identified and deep and NZEB renovation are pursued.
- The budgetary regulations will be revised to allow for the preservation of the budgetary savings resulting from the energy efficiency improvements until the repayment of the renovation debt, or the central administration should provide budgetary support to the renovation.
- **Effective Romania**, includes the renovation of several schools, the deep renovation of public buildings, energy efficiency information campaigns, the development of a practical guide for energy efficiency and specialised energy efficiency training for public administration representatives.
- For schools it is foreseen an investment of EUR 874.84 million, with a result of energy savings of 0.03 Mtoe, a reduction of CO₂ emission of 0.14 Mton and an increase of RES of 14.81 Mtoe. For the hospitals the recommended investment is of EUR 318.33 million, with an energy saving of 0.01 Mtoe, a reduction of CO₂ of 0.06 Mton and an increase of res of 5.28 Mtoe.
- Ministries with significant building portfolios, such as the Ministry of Education, the Ministry of Health, local authorities and other relevant bodies within the other ministries, should prepare a priority lists for building renovation as part of their infrastructure and energy efficiency planning by 2030 to include buildings with the lowest performance, expected energy savings, investment needs and expected payback periods.

Energy poverty – worst performing buildings

- The energy poverty is only partially integrated into Romanian legislation. While only 5% of the population receives grants for heating based on income thresholds, the percentage could be 19% if additional criteria such as disposable income and access to energy were used. Several measures are proposed to fully address the energy poverty.
- Romanian ordinance addressing energy poverty provides for purely financial support, with no additional measures to incentivise EE for the reduction of the energy bill, which could bring savings both in household funds and in public budgets.
- In many cases, the category of socially vulnerable users overlaps with the worst performing buildings. Worst performing buildings are identified based on age (older than 20 years), total final energy consumption >300 kWh/m².year and final energy consumption for heating >200 kWh/m².year.

- In order to renovate the segment with the lowest energy performance from the building stock, around EUR 3 billion would be needed to finance investments for the 2021-2030 period.
- A list of actions to improve social protection for vulnerable categories of energy poverty are listed. They comprehend the extension of the definition of vulnerable groups, preparation of an action plan for energy poverty, define responsibilities for specific programmes targeting vulnerable users and resource requirement, streamlining of existing heating aid and developing and implementing buildings renovation programmes with measures aiming at ensuring access to finance for socially vulnerable groups.
- Such an intervention would require a budget of around 40 to EUR 200 million per year over the next 10 years. This budgetary estimate has been determined on the basis that 40% of the investments will be reimbursed by the residential owners and about 30% of building owners.

Advisory tools

- It is foreseen to grow 4 **one-stop-shops** by 2030, 5 by 2040 and 6 by 2050.
- It is suggested to include the **Building Renovation Passport** (BRP) in the technical book of the building (mandatory document in Romania encompassing all information on the building concerned). The BRP should be available to owners in digital format and could include other sets of information related to each building, such as funding options available in the area for renovation projects (e.g. green loans, incentives, tax credits), as well as energy bills, equipment maintenance recommendations and ownership obligations.
- At present, there are no widespread awareness-raising campaigns or information programmes about EE in buildings. To overcome this barrier, awareness-raising campaigns to promote the benefits of deep renovations with relevant guidance on appropriate building strategies to conduct them, taking into account best practices and access to public financial instruments, need to be developed.
- Creation, maintenance and updating of a database recording the buildings of the national stock with details of the building type, renovations and upgrades performed over the useful life of the building, safety and structural integrity, energy consumption, etc.

Skills

- **Green Building Professional** is a paid programme for the certification and training of specialists in green construction organised by Romanian Council for Green Buildings.
- **EU-funded programmes BUILD UP Skills Romania** with the **Skills Roadmap for Construction in EE and RES**, **BUS Qualishell** with the development of 2 qualification schemes for high performance building envelopes, **Train-to NZEB** to develop and implement training for construction workers, specialists (architects, designers, experts, energy auditors) and decision makers for NZEB and **Fit-to-NZEB** for the development and implementation of various training programmes for deep energy efficiency renovations (at NZEB level).

Smartness

- The process of developing and collecting Energy Performance Certificates (EPCs) should be digitalised.
- Regarding electro-mobility, complementary measures are suggested to be included during deep renovations for non-residential buildings with more than 10 parking spaces.
- The deployment of smart and efficient technologies for energy efficiency remains weak in Romania, although several major cities are developing local strategies, which were merged in the Smart Cities Project (launched in 2019). A Romanian city (**Alba Iulia**) has initiated various pilot projects, and is currently testing 62 smart solutions (e.g. smart electricity grids and renewables integration plus storage, a 'Internet of Things' (IoT) system for utilities, an energy consumption and cost monitoring software tool for the university, integrated smart metering of utilities in three public buildings, and a pilot project for solar thermal dynamic system).
- Romanian National Integrated Energy and Climate Change Plan contains several priorities for smart technologies: encouraging the development of prosumers together with the development of electricity grids and smart meters; smart distribution of medium and low voltage; general smart meter development goals and smart grids, step-by-step implementation of smart city concept and the IoT deployment in the residential sector; the development of regional clusters for sustainable energy planning, smart energy use in SMEs, etc.

Areas for potential improvement compared to best practices

It could be useful to consider:

- providing a clearer analysis of the impacts of the proposed measures; energy saving impacts and budget are not systematically established for all measures;
- energy efficiency measures to combat energy poverty;
- providing information on the non-residential building stock are missing (e.g. figures on hospitals, schools).

Slovakia

Summary of the long-term renovation strategy

The Slovakian strategy addresses has a direct link to the adopted Integrated National Energy and Climate Plan for 2030 in the energy efficiency dimension and to the adopted Low Carbon Strategy for the Development of the Slovak Republic up to 2030 with an outlook for 2050. Ambitious targets have been set with particular reference to the residential sector: to renovate all multifamily buildings by 2030 and all single family buildings by 2040. The strategy presents a clear roadmap and monitoring of the achievements, in terms of buildings/dwellings renovated, as well as in terms of measures to put in place, with a good use of EU structural funds. The strategy does not clearly differentiate between existing and new measures and it seems that most measures in buildings are a continuation of existing measures, potentially scaled-up.

Information on the building stock

		Number	Area (m2)
Total Residential		1 034 206 buildings (1940400 dwellings)	
Non-residential	Offices	2 556	14 365 517
	Hospitals/health establishments	1 293	15 197 903
	Social housing	13020 buildings (54497 apartments)	
	Schools	6943	58 382 303

- The renovation of multi-apartment buildings has been a tradition in Slovakia for almost 30 years and the share of renovated multi-apartment buildings at the end of 2019 is above 67% and 71% at the end of 2020.
- The share of renovated family houses in Slovakia at the end of 2019 is 48.97% of total dwellings and 52.6% at end 2020.
- Given the high level of private ownership of apartments (in multi-apartment and family buildings) and the very low rental rate of real estate (about 6%),the Slovak Republic does not face the problem of split incentives flowing from the owner-tenant relationship.
- Main renovation barriers include lack of adequate skills, low rate of deep renovations and low quality of EPC.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

	Milestones
2030	• 39.9 TWh energy consumption • 10 518 GWh cumulative energy savings • 5.5 MtCO₂ of CO₂ emissions (-61% compared to 1990 levels) • All multifamily buildings renovated • 29% of residential buildings should be renovated to deep renovation levels • More than half of the renovation of non-residential buildings should be moderate renovation
2040	• 33.6 TWh energy consumption • 18 368 GWh cumulative energy savings • 3.4 MtCO₂ of CO₂ emissions (-74% compared to 1990 levels) • All single family buildings renovated
2050	• 28.3 TWh energy consumption (-40% vs 2020 consumption) • 19 006 GWh cumulative energy savings rate • 1.8 MtCO₂ of CO₂ emissions (-87% compared to 1990 levels; -79% vs 2020 emissions) • Electricity and heat supply decarbonised by 50% • All buildings are expected to be renovated by 2050

- The renovation of the non-residential building sector has so far taken place at a slow pace. They were mostly financed from Structural Funds (ESIF) and private funds.
- The level of carbon emissions in gas will be reduced by 25 % by 2050.
- Renewable energy sources in buildings will grow by 10% every 5 years (or by 2% per year), so by 50% for the period 2025-2050
- The net impact of new buildings on emissions levels by 2050 will be zero.
- 40% of renovations will be deep renovation (>60% primary energy savings); 10% at NZEB levels; 40% medium (30-60% savings) and 10% light (3-30% energy savings).

Investment needs

- The renovation of private non-residential buildings will be carried out mainly with the help of financial institutions and equity. The most appropriate way of using them is a combination of EU Structural Funds operating as guarantees and private resources of providers to enable deep renovation of the building.
- The current total annual investment rate in the renovation of buildings in Slovakia amounts to EUR 900 million while for the future EUR 1.1-1.2 billion will be needed annually, with a peak in 2026-2031 of EUR 1.3 billion per year.
- In line with the assumption that the renovation pace and the renovation period of the building stock are met, the cumulative investment needs are EUR 22.8 billion at 2050 (EUR 17.3 billion for residential buildings, EUR 5.5 billion for non-residential).
- The strategy foresees the use of financial resources from the 2021-2027 Multiannual Financial Framework of EUR 750 million for residential buildings, EUR 367.5 million for public buildings.
- Other additional financial resources should be used from the Recovery and Resilience Facility (NextGenerationEU) within the policies set out in the Modern Vision and successful Slovakia in the Green Economy Energy Efficiency strand, where the proposed resources are EUR 300 million for improving the energy efficiency of family houses, EUR 130 million for the renovation of historical and monumentally protected public buildings and EUR 200 million for improving public buildings.

Good practices

Finance

- The Slovakian strategy presents a detailed overview on the existing measures for the mobilisation of building renovation investments: direct subsidies under the **Housing Development Programme** for insulation of a family house (contribution of EUR 8 000 and a further increase of EUR 800 under the law); loans from the **State Housing Development Fund**; direct subsidies for individual houses.
- Complementary financial instruments: **mortgage lending**, a tax bonus, a construction savings scheme with public support granted in the form of a **State premium to building savings**.
- The **use of guaranteed energy services** is considered a promising tool to support the renovation of non-residential buildings and is expected to increase more widely in the short term. However, in order to carry out deep renovation of a non-residential building in view of the longer payback period of such an investment, it is necessary to consider blending repayable and non-refundable EU Structural Funds and guaranteed energy services.
- **Preferential interest rate loans** will continue to be the cornerstone of financing for building renovation projects over a long period (about 20 years). These loans, combined with a state subsidy and private equity, constitute a well-established and efficient renovation tool in the residential building segment.
- Improving energy efficiency in family houses to reduce greenhouse gas emissions (EUR 700 million).

- **Support for renewable installations in family homes**, including small electricity generation installations up to 10 kW (photovoltaic panels, wind turbines) and heat generators that cover household energy needs (solar collectors, biomass boilers, heat pumps). A household may receive support for only one device of each type.
- Support for the thermal renovation of family houses
- Replacement of obsolete solid fuel heating appliances households: replace obsolete combustion plants in households with low-emission and more energy efficient combustion plants that involve changing the fuel base to low-emission fuels, excluding biomass and other renewable energy sources.
- Improving energy performance in non-residential buildings to reduce greenhouse gas emissions (EUR 2 150 million).

Public buildings

- EU Structural Funds (both repayable and non-reimbursable) will continue to be the main source of funding, combined with state budget and private capital from guaranteed energy services.
- Since February 2019, public authorities can conclude energy efficiency contracts for the public sector for the renovation of public buildings, without increasing government debt, according to “the uniform methodology applicable to the European Union” (in line with Eurostat guidance). This allows the public authority to develop and finance projects through the mobilisation of private capital.
- Carrying out energy audits in public buildings helps to identify renovation measures with the greatest potential for savings and partly fulfils the function of the building passport.
- Promoting energy efficiency improvements in the public sector on the basis of an energy performance contract for the public sector. The beneficiary of a guaranteed energy service is the public sector.
- Improving the energy efficiency of existing public buildings, including insulation.
- Modernisation of public lighting (EUR 600 million).
- Support energy audits, deployment of energy management systems, environmental management and EMAS for public administration, administration and municipality (EUR 46 million).
- **Regional Sustainable Energy Centers** to support the planning and implementation capacity of municipalities for sustainable energy development in districts/strategic planning regions in accordance with the proposal for a Vision and Strategy for Development of Slovakia until 2030. The mission of these centers is to optimise energy consumption and consumption in a given territory, to increase its energy self-sufficiency on a RES basis, in strict compliance with the environmental criteria. (EUR 31.83 million, cost for action).

Energy poverty – worst performing buildings

- Worst performing buildings have been identified: the buildings built before 1983, when a stricter thermal standard entered into force, are the least energy efficient; the non-residential buildings are the most energy-intensive buildings from the whole building stock in Slovakia, with a particular reference to hospitals, schools (mainly primary schools) and school facilities and hotels.
- The Slovak Republic considers energy poverty as part of poverty itself: a number of measures have been adopted so far in this area (e.g. National framework strategy for promoting social inclusion and combating poverty).
- A **housing benefit allowance**, is intended to cover part of the cost of housing, including energy. The housing allowance accounts for a significant part of the eligible income for the most deprived and amounts to EUR 55.80 per month in the case of a household with a single household member, or EUR 89.2 per month for a household with more than one household member, or for the rental of an apartment by more than one tenant.
- Since 1998, an annual “**Progressive, Affordable Housing**” competition aimed at supporting the development of housing in Slovakia, presenting positive examples of procurement and the construction of affordable housing.

Multi-apartment residential buildings

- Support for the introduction and improvement of technical systems in multi-apartment buildings (EUR 525 million).
- Energy efficiency improvements in multi-apartment buildings to reduce greenhouse gas emissions (EUR 3 000 million).
- Support for renewable installations in multi-apartment residential buildings: Acquisition of heat generators that cover the energy needs of households in a multi-apartment building (supply and installation of the system is financed), including solar collectors (EUR 400/kW) and biomass boilers (EUR 80/kW)

Advisory tools

- **Conferences and workshops** to inform managers of multi-apartment and non-residential buildings about legislative changes, new technologies, products, innovative construction practices and trends at established conferences dedicated to renovation and insulation.
- A **television programme called “Energy”** broadcast on a monthly basis on public service television is dedicated to energy efficiency, up-to-date information on improving energy performance and effectively provides the necessary information to owners in all areas related to renovation, maintenance and administration.
- Since 2010, the ‘**Best renovated multi-apartment building**’ competition has been launched every year, with an emphasis on a comprehensive approach to the renovation of a multi-apartment building, the results of which are announced at the Bratislava construction fair.

- **ENERGIU project:** awareness of the possibilities of purchasing and installing RES production facilities, including financial support, is provided by SIEA through free energy advice.
- Development of **Regional Energy Centers** to promote the increase of energy efficiency and the development of RES in regions. (EUR 16.4 million, costs of the action and EUR 12.8 million, costs of technical assistance).

Skills

- Skills and education measures are listed in the strategy: e.g. StavEdu, ingREeS and CraftEdu projects (training programmes for the various types of professionals involved in energy efficiency in buildings, including training on building smart technologies). The StavEdu project created a national system for the upgrading and further training of craftsmen and workers in the building sector for energy efficiency and renewable energy use in buildings. It mainly concerns craftsmen and workers with medium-level technical training (training certificate). The CraftEdu project builds on the StavEdu to create certified programmes for the further training of craftsmen and workers on energy efficiency and renewable energy use in buildings.
- Pilot projects for adult learning have been implemented under Horizon 2020 for new requirements resulting from the industrial revolution, e.g. requirements for nearly zero-energy houses. It is therefore necessary to use the knowledge and outputs of these pilot projects and training and implement them at national level.
- Continuation of the ‘Energy Auditor’ training courses.

Areas for potential improvement compared to best practices

It could be useful to consider:

- providing a clearer overview
- Building Renovation Passports and one-stop-shops.
- Improving the quality of the Energy Performance Certification scheme, together with the development of reliable building passports.

Slovenia

Summary of the long-term renovation strategy

The Slovenian long term building renovation strategy provides a good description of the building stock and a detailed analysis of the barriers to investment, together with the description of a comprehensive package of measures supporting renovations. A reduction of almost 90% of CO2 emission from the building sector is foreseen by 2050 and this translates into reduction by 25% and 45% energy consumption and CO2 emissions already in 2030.

Information on the building stock

		Area (m2)
Total Residential		63 737 000
Non-residential	Offices	573 000
	Hospitals/health establishments	122 000
	Social housing	1 117 000
	Hotels / Restaurant / leisure	2 334 000
	Sports facilities	1 238 000
	Commercial	5 722 000
	Shows	1 367 000
	Schools	3 717 000
	Total non-residential	23 400 000
	Total	87 300 000

- More than 75% of today's buildings are expected to remain in use by 2050.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

	Milestones
2030	• Reducing GHG emissions by at least 70% compared to 2005. • RES account for at least 2/3 of energy uses (excluding electricity and district heat). • Residential Sector: ○ Energy end-use [PJ] 32,62; Reduction 25% (compared to 2020) ○ CO2 emissions [MT] 1,349; Reduction 45% ○ Single-dwelling buildings [1.000 m²]: Partial refurbishment 1.558.0; Medium refurbishment 3.598.8; Comprehensive refurbishment 10.815.8; NZEB Refurbishment 89,6 ○ Multi-dwelling buildings [1.000 m²]: Partial refurbishment 854,5; Medium refurbishment 2.554.5; Comprehensive refurbishment 3.756.0; NZEB Refurbishment 52,6 • Public Sector: ○ Energy end-use savings: 0,52 PJ; reduction 7% (compared to 2020) ○ CO2 savings: 59,7 Kt; reduction 57%
2040	• Residential: ○ Energy end-use [PJ] 27,45; Reduction 37% (compared to 2020) ○ CO2 emissions [MT] 0,875; Reduction 64% ○ Single-dwelling buildings [1.000 m²]: Partial refurbishment 37,5; Medium refurbishment 158,8; Comprehensive refurbishment 11.595.2 NZEB Refurbishment 996,9 ○ Multi-dwelling buildings [1.000 m²]: Partial refurbishment 0,0; Medium refurbishment 20,8; Comprehensive refurbishment 5.001.3; NZEB Refurbishment 539,0 • Public Sector: ○ Energy end-use savings: 0,39 PJ; reduction 6% ○ CO2 savings: 87,2 Kt; reduction 73%

2050	• 74% of single-dwelling buildings and 91% of multi-apartment buildings are energy renovated. • Reduce final energy consumption by 45% • Reduce CO2 emissions by almost 75% compared to 2005. • Residential: ○ Energy end-use [PJ]26,03; Reduction 40% ○ CO2 emissions [MT] 0,745; Reduction 70% ○ Single-dwelling buildings [1.000 m²]: Partial refurbishment 0,0; Medium refurbishment 0,0; Comprehensive refurbishment 534,3; NZEB Refurbishment 3.164.1 ○ Multi-dwelling buildings [1.000 m²]: Partial refurbishment 0,0; Medium refurbishment 0,0; Comprehensive refurbishment 0,5; NZEB Refurbishment 1.145.5 • Public Sector: ○ Energy end-use savings: -0,02 PJ; reduction 0% ○ CO2 savings: 96,9 Kt; reduction 92%"
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- Ban on the use of fuel oil in new buildings by 2021 and a ban on the sale and installation of new boilers on fuel oil by 2023.
- 76% of the floor area of the building stock belongs to buildings built before 1990. Therefore, when planning energy renovations in the period up to 2050, it is also necessary to regulate the systemic treatment of the wider renovation of buildings, including the seismic aspect.

Investment needs

- The Renovation Plan is operationally complex and investment-intensive. The resources of the **Eco-Fund** stemming from the **Climate Fund** do not provide the scale of resources to achieve the dynamics of renovations.
- A total of EUR 108.88 million is foreseen for the period 2021-2030, with a breakdown for different sources of funding.

Good practices

Legislative

- Establish a mechanism to encourage the emergence of ESCOs, with special attention for SMEs.
- Development of sustainability criteria for buildings: The LIFE IP CARE4CLIMATE project foresees testing the first version of the sustainability indicator system in 2020, including the establishment of a supportive environment and the development of criteria for the

evaluation of indicators. Training of experts involved in testing will also be provided. It foresees the creation of a supportive environment for the sustainable valuation of buildings (establishment of the system, certification scheme, training, system maintenance, financing), the preparation of the basis for the promotion and financing of sustainable renovations and the extension of the promotion to sustainable building renovations, the implementation of model sustainable renovation projects for public buildings.

- Increasing the obligations of liable parties to achieve mandatory energy savings for electricity and natural gas suppliers at a level of 1% of the energy sold annually.
- Consideration of the sharing of incentives between owners and tenants shall identify options for establishing an appropriate model for financing energy renovations by energy suppliers.

Finance

- Financial incentives for energy efficiency and RES use in residential buildings: drawing up a financial plan to promote measures in households, including the identification of sources of financing, incentive mechanisms and measures to remove key barriers, and organising the promotion and provision of one-stop-shop assistance. In order to target renovations and achieve the targets in 2030, a separate call for partial and integrated renovations shall be introduced, with at least 70% of the foreseen resources dedicated to financial incentives for energy efficiency and the use of RES in residential buildings to be allocated to integrated energy and renovations in NZEBs, while also increasing leverage.
- The eco-fund shall analyse options for energy efficiency and RES measures, available through incentive mechanisms, and develop new financial instruments for the housing sector including ESCOs.
- Renovation of cultural heritage buildings and other specific groups of buildings.
- Consideration to the possibility of creating a guarantee facility that would provide individual guarantees to borrowers or reserve funds on borrowing from the reserve fund.

Public buildings – public sector

- The energy renovation of 3% of the total floor.
- The public sector buildings consists of 480 buildings and 32 parts of buildings with a total floor area of 890 899m², of which: 25% of buildings or parts of buildings do not yet have an energy performance certificate; 39% of buildings are officially protected as part of a protected environment or because of their special architectural or historical importance; 23% do not meet the required seismic resistance. The list was updated in 2020 and a seismic risk analysis will have to be carried out for another 189 buildings.
- In order to achieve the short-term objective of an integrated energy renovation of 127 116 m² over the period 2014-2023, activities will need to be stepped up.

- A total of approx. EUR 890 million is indicated for the period 2021-2030.
- Local communities have carried out or are carrying out energy renovation of 80 buildings and the investment value amounts to EUR 39.9 million. Most of these projects are a public-private partnership with a two-year preparation cycle and have been co-financed by the EU Cohesion Fund.
- Local authorities have successfully implemented energy renovation projects for buildings mainly thanks to ELENA's technical assistance and financial incentives for energy contract projects for local communities.
- Energy management in the public sector.
- **Project Office for Energy Renovation of Public Buildings** shall speed up the preparation of integrated energy renovation projects for public buildings by providing expert support for the identification of priority projects, the preparation of such projects, the definition of the delivery model, the monitoring and verification of energy savings and other activities, actively develop and promote new financial models to encourage the renovation of public buildings and the contractual delivery of energy savings (e.g. exploring an additional energy contract model following a public procurement procedure, examine of an additional model (public-public partnership))

Energy poverty – worst performing buildings

- More than 40% of one-apartment buildings, or some 100 000 households, are classified in energy classes F and G. These buildings were built mostly before 1980, with high heating energy use and associated costs. Such multi-apartment buildings account for almost 8%, or around 24 000 households.
- Strengthen support activities that will increase the availability of incentives to the poorest households, including through intensive, high-incentive, replacement of old combustion plants with wood biomass and fossil resources.
- Develop criteria for the selection of beneficiaries of financial incentives and extend their selection to recipients of emergency social assistance and social security benefits, where this has not yet been done, and to pensioners.
- Create a comprehensive energy efficiency improvement scheme, which would also be complemented by investment funds based on completed energy audits within the ZERO project.
- Improve monitoring of the implementation of energy poverty reduction instruments and their effects, including by simplifying and upgrading the impact assessment tool within the ZERO project.
- Household energy efficiency aid scheme for vulnerable population groups.
- Non-repayable financial incentives for socially disadvantaged citizens to invest in the renovation of boiler rooms and increase energy efficiency in multi-apartment buildings.
- Non-repayable financial incentives for socially weak citizens to replace old solid fuel combustion plants with new wood biomass combustion plants.

- Project on precise knowledge of the habits and needs of the most vulnerable population.
- Action plan to combat energy poverty.
- **ZERO500 programme** aims at alleviating growing energy poverty through investments in energy efficiency measures (replacement of facades, windows, roof insulation, installation of ventilation and others). The programme will include 500 low-income households in single-dwelling buildings or apartments in double-dwelling buildings, which will receive 100% of the grants to finance investments.

Multi-apartment residential buildings

- An instrument called **building cards** shall be introduced by 2024. It defines the energy, fire and seismic aspects of renovation and provides guidance on recommended and required measures for gradually wider renovation.
- A project office shall be set up for the energy renovation of multi-apartment buildings. The Project Office shall comprise the provision of adequate staff and financial conditions for the implementation of the tasks of supporting the preparation of energy renovation projects for multi-apartment buildings. The operation of the Project Office focuses on the preparation of energy renovation projects for residential buildings and operates on a one-stop-shop basis and as a platform between investors (owners), managers, refurbishment contractors, eco-funds, energy suppliers, ESCO-companies.

Advisory tools

- A building renovation passport is foreseen for co-owners of multi-apartment buildings. The passport is expected to facilitate integrated building renovations and a wider concept of sustainability as it will also include information on seismic and fire risk, indoor air quality etc.
- Establish a building energy performance portal based on all available data, including emission data, which will provide a comprehensive spatial view of the state and emissions of buildings and allow for quality planning of measures. The portal should also enable the monitoring of emissions of particulate matter (PM10 and PM2.5) and ensure air quality.
- ENSVET - Energy advisory network for citizens: Strengthen professional support to co-owners in planning energy renovations of multi-apartment buildings as independent expert support for decisions to increase the energy efficiency of the building. Train independent energy consultants to prepare the relevant content on the building certificate.

Areas for potential improvement compared to best practices

It could be useful to consider:

- Investment needs up to 2050 given the ambitions of the 2050 building stock decarbonisation.

- Providing more information on the individual measures.

Spain

Summary of the long-term renovation strategy

Spain's long-term renovation strategy (LTRS) builds on previous strategies, setting out a comprehensive and well-structured set of policies organised in a coherent and articulated implementation plan. The LTRS target of renovating 1.2 million dwellings over 2021-2030 (improving the EE of the building envelope) would mean an expected substantial increase in the annual renovation rate - from 30 000 dwellings today to 300 000 in 2030.

In the residential sector, the strategy aims for a 99% reduction in greenhouse gas emissions by 2050 compared to today. Resources seems appropriate, comprising a combination of public and private investments. The LTRS sets ambitious but still achievable objectives and targets.

The LTRS interacts with other plans, strategies and frameworks at different levels (e.g. urban renewal plans and the national strategy against energy poverty). It pays specific attention to energy poverty and energy communities.

Information on the building stock

- Of the total of 25.7 million houses in Spain (2020 estimate), 74.6% are main dwellings (18 771 653) and 25.4% are secondary and empty dwellings (6 375 471).
- Multi-family housing accounts for 71.8% and single-family for 28.2% of the housing stock.
- In the secondary housing stock, single-family homes account for 46.9% and multi-family housing for 53.1%.
- The table below presents the situation for the non-residential sector:

	Number	Floor area (1000 m ²)
Total non-residential	12 280 309	2 229 342
Tertiary, services and equipment	2 058 779	998 555
Offices	295 224	117 293
Commercial	1 337 585	239 102
Sports	84 513	225 432
Performances	5 567	112 574

Leisure and hospitality	204 105	106 857
Health and wellbeing	37 640	55 966
Cultural	51 349	112 574
Religious	42 796	28 755

- Among the buildings with an Energy Performance Certificate (EPC), less than 5% are classified as either A or B and slightly more than 15% have a C class.
- Renovation has increased from 25 996 buildings in 2017 to 28 364 in 2019 (9.1%).

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

	Final energy consumption (GWh)	Energy savings and other indicators
2020	• 172 419 (residential) • 131 858 (tertiary)	
2030	• 146 025 (residential) • 131 858 (tertiary)	• Energy savings (GWh): 26 394 (residential) • Renovate 1.2 million homes
2040	• 124 172 (residential) • 91 703 (tertiary)	• Energy savings (GWh): 21 853 (residential)
2050	• 108 264 (residential) • 84 463 (tertiary)	• Energy savings (GWh): 64 154 (Cumulative 2020-2050) • Residential: 37% reduction in energy use and 99% reduction in CO2 emissions compared to 2020 • Residential: consumption from heating would be less than 55% of 2020 levels • Non-residential: 36% reduction in energy use compared to 2020

		• 7.1 million houses are expected to undergo deep renovation, lowering their individual consumption to 12 kWh/m² • The stock of new buildings between 2020 and 2050 is projected to amount to 3.9 million houses, all of them NZEBs.
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- 1.2 million homes (out of 18.7 million primary residence homes) are on the market for renovation in the coming decade.
- Energy renovation of 1.2 million homes would reduce the number of people being diagnosed with cardiovascular problems by 96 000. The total accumulated energy savings would reach 6,949 ktoe.
- Adequate measures for photovoltaic installation and self-consumption (i.e. generating power for one's own use), together with energy efficiency renovations are likely to lead to the expected decarbonisation of the building stock by 2050.
- Emissions are expected to fall from 14 799 503 tCO₂ equivalent (in 2020) to 185 566 t in 2050 with a cumulative reduction of 14 613 937 tCO₂ equivalent over the 2020-2050 period.
- Socioeconomic benefits, including savings on energy bills, increased GDP of 0.47% in 2030, generation of 33-88 000 jobs in 2030 (+0.44%) and improved indoor air quality and health.

Investment needs

- The total amount of investment required for 2020-2030 is EUR 41 471 million, of which EUR 15 520 million should be private investment for the renovation of expired ACS/heating equipment.
- Public investment (EUR 6 946 million) would be used to encourage the rehabilitation of shells (EUR 4,389 million), covering one third of the total investment required, and a further EUR 2.557 million to replace ACS or heating equipment in view of the fuel changes needed to achieve the energy targets set in 2030 (covering 1/5 of the total investment). In this case the ratio of public investment would be 25% for installations and 50% for renovations.
- By 2050 EUR 143 billion will be needed for the residential sector only.

Good practices

Legislative

- **Update of the Technical Construction Code (CTE):** The basic energy saving document as sub-section of the CTE is updated to include NZEB requirements and introduce new indicators and criteria for both new and existing buildings.

- **Update of the Regulation on Thermal Installations in Buildings (RITE):** Update of requirements for the qualification of professionals and companies.
- **New rules on self-consumption:** a simplified compensation scheme to compensate for households' surplus production with consumption or selling surplus energy to the market and to regulate the connections of self-consumption through the public distribution network, which allows consumption and generation to be located in neighbouring buildings. Royal Decree 244/2019 allows collective self-consumption meaning that consumers living in the same building or in nearby buildings can share the energy generated by a single installation under commonly-agreed conditions.
- New rules on the regulation of **energy communities** that define and recognise energy communities as key actors in energy transition.
- **Building energy assessment report** on the state of conservation, and compliance with the basic accessibility and energy efficiency conditions that are mandatory for residential properties over the age of 50. The idea is to make the report a basic tool for boosting energy renovation. In Spain, the conservation of buildings and the fulfilment of basic accessibility conditions are part of the legal obligations inherent to ownership. Owners must carry out the necessary conservation work and provide reasonable accommodation in line with the Building Evaluation Report.
- Creation of a **centralised register of certificates** at the Ministry with statistics on the energy rating status of the building stock.
- Consideration of trigger points, including when to replace boilers and carry out renovations to improve a building's fire/earthquake safety.

Finance

- The **PAREER II programme for financing the energy retrofit** of existing buildings has proven effective. It was established in December 2017 as a follow-up to PAREER and PAREER-CRECE. It sets out clear and strong requirements (e.g. energy class measured on the EPC scale of CO₂ emissions (kg CO₂/m² year)), extra financing for actions that reach energy class 'A' or 'B' or that increase the initial energy rating of the existing building by more than two letters in the EPC scale). Measures include: (i) improving the energy efficiency of thermal and lighting installations; (ii) conventional solar energy substitution; (iii) replacement of conventional energy by geothermal energy; and (iv) improving the energy efficiency of the thermal envelope. The aid can be in the form of repayable loan or grant.
- EUR 240 000 000 for financing renovations in existing buildings. This allows the combining of grants and loans.
- Work should continue on a possible guarantee system or a '**Limited Guarantee Fund**' to cover possible defaults on loans from private financial institutions.
- The **2018-2021 State housing plan** covers nine housing assistance programmes of which two have an impact on improving the energy efficiency of the building stock, promoting better energy efficiency and housing sustainability, and promoting urban and rural

regeneration. The grants (between EUR 8 000 and 12 000 per house) are linked to specific measures and a minimum improvement level. The plan also includes grants to finance the joint rehabilitation of buildings and dwellings, the ‘reurbanisation’ of public areas and, where appropriate, the renovation of buildings under the regeneration and urban/rural renewal actions.

- **ICO line:** all costs for the renovation of dwellings or buildings, or the reform of their common elements, may be eligible for financing, including labour (including VAT or similar taxes). Funding can be provided in the form of a loan, leasing, letting or credit facility.
- ERDF support for energy efficiency in buildings and public infrastructure, and in housing within low-carbon economy axis.
- ERDF support to improve energy efficiency in urban areas under the integrated sustainable urban development (ISUD) axis.
- A fiscal reform incentivises energy efficiency. It includes changes in **real estate tax**, transmission property tax and income tax.

Public buildings

- The **inventory of buildings** produced by the Central Public Administration provides detailed information about the General State Administration’s buildings stock and its energy consumption.
- The government **proposes to extend the 3% per year renovation requirement set out in EED Article 5 to all public bodies**, including autonomous communities and local entities, and to call on each administrative body to develop an energy saving action plan, alongside a range of other initiatives.
- Law 8/2013 introduced different possibilities for the public sector to complement the financing of renovation and urban renewal (reinvestment of town-planning gains by changes of use or increases of construction, rent of roofs for installation of solar panels, etc.), which are implemented at local level.
- The **Spanish Urban Agenda is a national urban policy** that aims to establish the criteria underpinning public policies for Spain’s towns and cities, in order to achieve socially inclusive, environmentally sustainable and economically competitive development. To this end, the Urban Agenda lists a set of strategic objectives and 30 specific objectives and proposes lines of action which, together with a system of monitoring and monitoring indicators and a procedural guide, will enable the other public administrations and actors involved to draw up their respective action plans. It is also an action plan setting out all regulatory measures, planning, financing, governance improvements and exchange of knowledge that the central government administration needs to carry out in order to achieve its objectives.

Energy poverty - worst performing buildings

- The **2019-2024 national energy poverty strategy** adopted by the government on 5 April 2019, integrates all ongoing and planned actions under the various public policies to combat energy poverty and ensure that everyone in Spain can effectively exercise their right to energy. The strategy’s four point approach includes: (i) improving knowledge; (ii) improving the response to the current situation; (iii)

structural changes to reduce energy poverty; and (iv) measures to protect consumers and raise social awareness. The main building-related actions include: (i) agile and low-cost refurbishments for vulnerable households; (ii) an increase in the number of social housing renovations through public intervention; and (iii) specific provisions for vulnerable households in terms of grant allocation for building renovations.

- **‘Bono social’** is a ‘social bonus’ launched by the government on 1 July 2009 to protect vulnerable consumers. Royal Decree No 897/2017 introduced new requirements that need to be met in order to apply the bono social. It differentiates between electricity and the thermal bonus. In early 2020, a number of beneficiaries particularly affected by the COVID-19 pandemic were added (e.g. self-employed people who have ceased their activities because of COVID-19 or have seen their turnover fall by 75% as compared with the previous half-year).

Smartness

- Reference to H2020 research projects (e.g. EuroPACE and AUNA) or other European projects (e.g. Build Upon and FP7 CityFied Project).

Aggregation

- The LTRS sets out appropriate mechanisms for aggregating projects (e.g. the H2020 project ‘AUNA’ has created a platform/forum to help financial actors develop smart finance solutions, including project aggregation, and risk reduction strategies).

ESCOs

- The implementation of the ESCO scheme and the capitalisation of energy savings in large-scale projects such as the district-level action is part of the European FP7 CityFied Project in Valladolid Torrelago, Laguna del Duero. In the latter an entire district has been renovated (building envelopes, district heating, renewables) with a mix of public and private investments directly managed by the building company and the ESCO.

Advisory tools

- Spain has a wide network of local and regional **one-stop shops** (‘ventanillas únicas’) that provide the public with various services (including financial and technical advice).
- The **Building Energy Assessment Report** (already in place) is to be combined with **Building Passport** (not yet implemented). This creates synergies between building projects, making information clearer and more transparent for all stakeholders involved and making it possible to group measures and prepare a roadmap for staged renovations.

- Pilot projects and research for the introduction of a **Building energy passport**: a feasibility study was conducted in 2018 on the objectives and financing tools needed to support staged building renovation. A pilot ‘PAS-E - Building Passport’ has also been developed.
- A number of campaigns to raise the public’s awareness on energy-efficient behaviour and opportunities, and provide information on available financial support (e.g. thematic guides released by the government of Navarra under the SustaNAPlity European project, web portals on building renovation such as. the ‘Observatorio Ciudad 3R’, and the ‘Ni un hogar sin energía’ project, developed by ECODES).
- A number of guides are available for download at: <https://www.idae.es/publicaciones>.
- Updated and new **technical and explanatory guides**, some of which specifically targeted vulnerable households facing energy poverty: e.g. the ‘Express soft rating for vulnerable households - low-cost solutions’ guide.
- Development of user-friendly public tools that enable people to make simulations on the energy performance of buildings, and calculate energy savings and renovations costs (e.g. Galicia’s MOVIGA model of building stock).

Skills

- A number of specific training and information events have been launched, including a series of seminars particularly targeted at technicians, but also at users, housing managers and neighbouring communities. Some of these have been organised by public administrations, others by professional sectors (professional and professional architects’ associations, etc.) and others by the private business community (such as the ANRE rehabilitation forum) or universities.

Areas for potential improvement compared to best practices

It could be useful to consider:

- further developing milestones and intermediate targets in order to better monitor progress.

Summary of the long-term renovation strategy

The measures presented in the Sweden's long-term renovation strategy (LTRS) together with those outlined in the national energy and climate plan (NECP) comprise a comprehensive set of energy efficiency measures in the buildings ecosystem complementing the traditional umbrella energy and carbon tax. The measures set out in the LTRS are often a continuation of previously well-established measures, some of which are being significantly scaled-up or complemented by new policies.

Information on the building stock

- Houses account for 93% of all residential buildings in Sweden. 20% of apartments in houses were built before 1930 and 45% were built between 1961 and 1990.
- In 2016, the heated area in houses amounted to a total of 302 million m² and the energy consumption for heating and hot water stood at 106 kWh/m².
- Approximately 15% of houses fulfil the requirement for near-zero energy buildings, i.e. energy classes A-C. Energy classes D-E account for 53% of energy-declared houses and energy classes F-G account for 32%.
- Apartment buildings account for 5% of all residential buildings in Sweden. According to the apartment register, 61% of apartments in apartment buildings were built between 1941 and 1980.
- Of the apartments in apartment buildings, 27% are owned by the public housing sector, i.e. municipal housing companies, 41% by housing associations and the remaining 32% are under other private ownership.
- Approximately 5% of apartment buildings fulfil the requirement for near-zero energy buildings, i.e. energy classes A-C. The majority (79%) fulfil energy classes E-G. The majority (34%) of apartment buildings in energy classes E-G were built between 1950 and 1979.
- Approximately 3 500 houses and 52 150 apartment buildings contain both residential properties and non-residential premises.
- There are 55 675 non-residential premises. The energy consumption for these buildings is 128 kWh/m².
- Approximately 14% of non-residential buildings currently fulfil the requirement for near-zero energy buildings, i.e. energy classes A-C. The breakdown between energy classes D, E, F and G is relatively evenly split, with 19-24% of non-residential buildings in each class.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

2020	40% reduction compared to 1990 in emissions from sectors outside the EU emission trading system (ETS) by 2020. A maximum of 13% can be generated from additional measures
2030	50% more efficient energy consumption by 2030 - Lower energy consumption per m2 and building type than in 2020 - Higher proportion of buildings in A-C and lower proportion of buildings in E-G than in 2020 - 1% Fossil share of end-energy use in the building stock 75% reduction in emissions compared to 1990 from sectors outside the EU ETS by 2040. A maximum of 2% can be generated from additional measures
2040	100% renewable electricity production - Lower energy consumption per m2 and building type than in 2030 - Higher proportion of buildings in A-C and lower proportion of buildings in E-G than in 2030 - 0% Fossil share of end-energy use in the building stock 63% reduction compared to 1990 in emissions from sectors outside the EU ETS by 2030. A maximum of 8% can be generated from additional measures
2050	Lower energy consumption per m2 and building type than in 2040 Higher proportion of buildings in A-C and lower proportion of buildings in E-G than in 2040 0% of Fossil share of end-energy use in the building stock

- Sweden must cut its net greenhouse gas emissions to zero by 2045 and then achieve negative emissions.
- The EPCs are used as a metric for the definition of milestones. Every 10 years the proportion of buildings with A-C should be higher than the reference year before (2030 to 2020/2040 to 2050/2030) and E-F should also be lower than the previous reference year.
- Sweden's LTRS mentions a current renovation rate of 2.3%. The data concern apartment buildings, but are assumed to also apply to schools and offices. The renovation rates rise from 2.5% to 5% in 2016-2019 and from 2.5% to 10% after 2019.

- Buildings built in the 1950s will be renovated over the next 20 years, buildings built between 1961 and 1975 will be renovated over the next 10 years. Other buildings have a renovation cycle of 40 years, meaning that buildings built after 1981 will start being renovated after 2020.
- According to the strategy's reference scenario, assuming that the existing or equivalent instruments remain in place, the expected energy savings by 2050 will stand at around 10-15% (e.g. from 162 kWh/m².y in 2016 to 137 kWh/m².y in 2050). However, according to a study, the potential for energy savings in the building sector is much higher than the reference scenario (i.e. 25% for the 'energy-efficient renovation' scenario, and 38% for the 'major renovation' scenario).

Year of construction	Proportion of area already renovated, 2019	Expected proportion of renovated area, 2020
Before 1940	14.9%	15.4%
1941-1960	14.9%	15.7%
1961-1970	22.4%	25.2%
1971-1980	14.6%	16.0%
1981-1990	1.9%	2.0%
1991-2000	1.9%	1.9%
2001-2010	1.9%	1.9%
After 2011	1.9%	1.9%

Expected proportion of renovated buildings (apartment buildings, offices and schools) in 2020.

Good practices

Legislative

- The energy performance certificate (EPC) Act requires that for every transaction, an energy declaration should be released. EPCs are widely used throughout the country and are expected to increase in the coming years. With an increase in renovations due to the age of the buildings, EPCs serve as an indicator of the renovation rate of the Swedish building stock.
- A trigger point is a major renovation opportunity that is said to occur every 40-50 years when energy efficiency improvements could be made in addition to structural and safety renovations. Another trigger point is when there is a change in owner or tenant.
- National Board of Housing, Building and Planning Building Regulations: The building regulations include energy management requirements which specify the energy consumption limits in buildings. The primary energy requirement is expressed as kWh per square metre per year, and currently stands at 90 kWh/m² for small buildings (i.e. one- and two-dwelling buildings), 85 kWh/m² for multi-dwelling buildings and 80 kWh/m² for non-residential buildings.
- **Split incentives** are a relatively minor obstacle to energy efficiency improvements compared with profitability issues and knowledge-related obstacles, but are considered to be a bigger problem in non-residential premises because leases do not include heating. Various state-funded initiatives that promote the use of **green leases** may help overcome this barrier.

Finance

- The use of fiscal measures is the stand-out measure that has always been present in Swedish energy efficiency policies. The use of green bonds and green leases are some of the most interesting ones currently in place.
- The **Energy Efficiency Finance Facility** was established in 2011 and offers facilities for loans, equity and guarantees and technical assistance for project development support through EU financial support.
- The **tax deduction for renovation**, conversion and extension applies to the labour costs for house repairs, maintenance, conversions and extensions. It was introduced in 2008 to increase the supply of labour and reduce undeclared work. Some of the measures covered also help to increase energy efficiency. An obvious effect of the deduction is that it gives property owners an incentive to carry out more renovations. On 1 July 2016 the tax reduction was cut from 50% to 30% of the labour costs. The maximum support will now be SEK 50 000 per person per year. The facility is offered to owners of small buildings, owner-occupied apartments and holiday homes, and to tenants.
- **Energy and carbon taxes** increase the cost of using energy and therefore provide consumers with an incentive to take energy-saving measures, reduce their energy consumption and/or consume energy more efficiently.
- **Green bonds** finance certain expenses relating to sustainable investments and projects.

Public buildings

- The **Offentliga fastigheter Collaboration Fund** (Public Properties) is one of the most noteworthy initiatives identified. It is a collaboration between the Swedish Association of Local Authorities and Regions and state property managers. It currently includes a number of energy-related focus areas, such as lighting in public premises, renovation involving energy efficiency measures, energy-efficient schools, and low-energy construction in the state, municipality and county council sectors.
- The **state aid for the refurbishment of school premises** initiative ran from 2015 to 2018, providing grants for the refurbishment of school premises in order to improve the learning and working environment and reduce the impact on the environment.
- **Environmental management systems in central government** and annual monitoring and reporting of the results.
- Purchases of energy-efficient products, services and buildings by authorities: Ordinance (2014:480) requires public authorities to procure energy-efficient goods, services and buildings above threshold values, subject to certain conditions.
- **The Energy Efficiency Council** acts as an arena to raise strategically important issues to strengthen inter-agency cooperation and increase transparency on energy efficiency, including on procurement by central government authorities and measures to improve energy efficiency.
- **Kommuninvest and Sverige AB Credit** institution owned by Swedish municipalities and regions, offers financing solutions to municipalities and regions in the form of loans and advice. Kommuninvest finances municipal housing companies, schools and hospitals, among other bodies. The credit institution is non-profit-making.

Energy poverty - worst performing buildings

- Sweden makes no differentiation between energy poverty and general poverty. The issue is managed within the context of social policy and there are no instruments in place that are specifically aimed at energy poverty.
- On 1 October 2016, support was introduced to encourage renovation and energy efficiency measures in rented properties in areas facing socioeconomic challenges. The support is divided into two parts: one for renovation and one for energy efficiency. The renovation support, which is 20% of the costs, is given directly to the tenants as a rent rebate over 7 years. The energy efficiency support is calculated on the basis of the energy savings achieved after the renovation. This part of the support is given to the property owner. To be eligible for this part of the support, the renovations must improve energy performance by at least 20%. Support cannot be sought for renovation or energy efficiency alone, as that does not fulfil the purpose of the measure.
- For the worst performing buildings, a new requirement to install individual metering and charging for heating and hot water comes into force on 1 July 2021. This is expected to encourage owners of the worst performing buildings, in particular, to improve their performance.

Smartness

- **Viable Cities** is a 12-year strategic innovation programme for smart and sustainable cities with a budget of SEK 1 billion. It brings together 50 stakeholders from a wide range of research fields, industry, public services and civil society.
- **Smart City Sweden** is the national demonstration platform for smart solutions in sustainable cities. In addition to energy and environmental aspects, the platform will address issues such as planning and construction, digitalisation, social sustainability, mobility and other issues of relevance to sustainable urban development.

Advisory tools

- The **National Renovation Centre (NRC)**: The NRC works with businesses and academic institutions to improve knowledge and provide operators in the building industry with the information necessary to carry out renovations efficiently. The aim is to make existing buildings more environmentally, economically and socially sustainable from a life-cycle point of view, while improving or retaining their function so that they meet the requirements of users and the authorities.
- The **Information Centre for Sustainable Construction (ICHB)**: The ICHB's mission is to 'promote energy-efficient renovation and building, using sustainable materials while minimising the impact on the environment from a life-cycle point of view'. This includes collecting information about sustainable building, adapting it to specific target groups and disseminating it. The Centre's website provides information about research, results and experience. The information is targeted at all relevant groups, including professional builders, owners of small buildings, housing association board members, property owners and others involved in the building process in any capacity.
- **Municipal energy and climate advisory services**: Advisory services provide impartial, free, technologically neutral and commercially independent advice to households, companies, housing associations and organisations. This can be done by telephone, email or face-to-face.
- **Renoveringsinfo.se information website**: An initiative of the NRC and Svensk Byggtjänst AB that aims to improve knowledge and distribute information to help operators in the industry carry out renovations efficiently. The website collects opinion pieces, news, examples of renovation projects, research and comprehensive information on specific renovation measures. The news section is a subscriber service, but the other parts of the website are free.
- The Swedish authorities, particularly the Swedish Energy Agency, have developed **web-based tools** to disseminate information about energy consumption and energy efficiency to specific target groups. The information initiatives are targeted at households, companies and authorities.
- **Energikalkylen** is a web-based calculation programme which provides households with information about energy efficiency.

- **Halvera Mera and the Rekorderlig Renovering method:** This is to identify cost-effective measures with a view to halving the energy consumption of buildings, although the improvement in energy efficiency will vary between the buildings concerned. The aim is to increase energy efficiency when property owners renovate their buildings. It provides owners with a systematic overview of the renovation and energy efficiency improvement needs of individual buildings to help inform their decisions in this area, with a focus on indoor environment, energy consumption and knowledge-building.

Skills

- **Training programmes for low-energy buildings:** Capacity-building programmes for low energy consumption in buildings targeted at various building industry operators such as architects, engineers, customers, technicians, installers, site managers and teachers of secondary school building courses.
- **Energilyftet** is a free web-based training course on low-energy building aimed at customers, architects, engineers, building project managers, administrators and control technicians.

Other useful information

- 63% of apartment blocks (104 000) had an EPC and 5% of them fulfil the requirement for NZEB (i.e. energy classes A-C) by 2019. 55 675 non-residential buildings had an EPC and 14% of them fulfil the requirement for NZEB (i.e. energy classes A-C). Only 22% of houses (486k) have had an EPC made by 2019. 15% of houses with ‘NZEB grade’ (A-C) until 2019.

Areas for potential improvement compared to best practices

It could be useful to consider:

- further specifying investment needs and budget allocation related to specific policies.

Annex I - 2014-2020 ERDF and Cohesion Fund investments in energy efficiency

Member State	Declared EU amount (EUR)	Planned EU amount (EUR)	Selected EU amount (EUR)
AT	42.336.805	31.872.819	24.076.680
BE	35.578.233	68.634.895	51.676.946
BG	348.883.739	340.365.032	331.931.635
CY	30.410.423	44.846.067	65.812.867
CZ	1.119.082.316	1.148.474.499	1.683.827.974
DE	677.081.125	1.070.108.935	1.046.672.152
DK	19.241.755	46.346.691	40.432.366
EE	293.609.168	192.150.495	170.847.124
ES	544.036.096	1.246.297.335	1.138.814.674
FI	17.219.149	51.120.487	13.231.515
FR	904.088.252	793.594.430	893.937.330
GR	470.352.443	551.511.243	1.611.885.681
HR	389.549.868	290.059.584	515.881.268
HU	714.093.138	1.101.851.307	1.178.772.067
IE	122.003.620	78.878.975	61.001.810
IT	508.893.568	1.145.838.310	990.332.832
LT	286.999.762	463.312.980	449.579.501
LU	5.258.979	3.610.915	4.198.147
LV	150.450.234	331.103.845	315.094.688
MT	14.968.823	10.748.000	13.997.565
NL	67.606.808	54.380.806	57.511.954
PL	1.645.858.423	2.570.058.385	2.479.436.409
PT	122.038.638	373.361.099	398.543.303
RO	378.303.763	1.102.127.249	1.420.734.768
SE	101.542.918	79.926.257	100.102.501
SI	188.299.632	216.886.210	281.027.977
SK	515.819.937	742.024.462	700.564.646
TC	134.276.814	197.360.142	206.096.693
UK	317.768.957	348.861.503	372.857.979
Grand Total	10.165.653.385	14.695.712.957	16.618.881.053

Categories 013, 014, 068 as of end-2020

- 013: Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures
- 014: Energy efficiency renovation of existing housing stock, demonstration projects and supporting measures
- 068: Energy efficiency and demonstration projects in SMEs and supporting measures