



GOVERNMENT
FROM GRAND-DUCHÉ OF
LUXEMBOURG
Ministry of the Economy
GOVERNMENT



FROM GRAND-DUCHÉ OF
LUXEMBOURG
Ministry of the Environment, Climate and
Biodiversity

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Integrated National Plan on energy and climate change in Luxembourg for the period 2021-2030

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1 outline and procedure for drawing up the plan

1.1 summary

1.1.1 summary table of key objectives

Dimension	Key objectives
Decarbonisation	<ul style="list-style-type: none"> ● Reduction of GHG emissions attributed to Luxembourg under the Regulation (EU) 2018/842 by 55 % by 2030 compared to 2005 <ul style="list-style-type: none"> ○ Sectoral climate targets from 2021 to 2030 for 5 sectors (industry, transport, buildings, agriculture, waste) covering all nationally attributed GHG emissions ● Long-term objective of climate neutrality to achieve the net zero emissions in Luxembourg by 2050 at the latest ● Net absorption increase in LULUCF by -27 kt CO_{2eq} in 2030 compared to the average of net removals for the years 2016, 2017 and 2018 (estimated total net absorption in 2030: -403 kt CO_{2eq})
Renewables	<ul style="list-style-type: none"> ● Increasing the share of renewable energy in the gross final energy consumption compared to the 2020 NECP from 25 % in 2030 to 37 % for 2030 ● Accelerated deployment of different technologies in the sectors of the production of electricity and heat from renewable energy sources as well as electromobility and the use of sustainable biofuels and renewable hydrogen and its derivatives in the transport and industry sector
Energy efficiency	<ul style="list-style-type: none"> ● Energy efficiency improvement target of 42 % by 2030 compared to the European reference EU PRIMES (REF2007) for the year 2030; this energy efficiency improvement target is equivalent to a total final energy consumption for Luxembourg of 36.949 GWh in 2030. ● Energy renovations (improvement of the thermal envelope) efficient and quality of existing buildings with the introduction of (European) obligations for the public sector, incentives (before the mandatory phase) and obligations for non-residential buildings and a voluntary approach with a focus on awareness raising, subsidising and supporting owners and occupants for residential buildings ● All new residential and non-residential buildings equipped ex officio decarbonised heating systems (Fossil-free) ● Decarbonisation of existing residential buildings as a matter of priority through heat pumps with a fossil phase-out based on a voluntary approach with significant financial incentives ● Decarbonisation through an accelerated fossil phase-out for buildings existing functional areas above 1.000 m² with priority over administrative buildings in the tertiary sector, by means of heat pumps and after consultation with the sectors concerned on the timetable for the obligation to take effect ● Energy Efficiency Obligation Scheme (EEOS – Energy) Efficiency Obligation Scheme) with ambitious annual targets

	<ul style="list-style-type: none"> • Evolution of the voluntary agreement with Luxembourg industry with mainstreaming decarbonisation as a complement to energy efficiency and renewable electricity generation and self-consumption • Implementation of the Climate Pact for Business with coaching SMEs to identify and mobilise the implementation of their concrete energy transition and decarbonisation projects • Development of efficient, energy-based district heating networks renewable • Reduction of traffic through the massive expansion of transport audiences and a 49 % share of electromobility by 2030 • Risk sharing mechanism for energy efficiency projects and decarbonisation of businesses • Emergence of an important energy efficiency market in the
Security energy supply	<ul style="list-style-type: none"> • Ensuring a very high level of security of energy supply for all types of energy • Remaining among the countries with the highest level of security in Europe • Maintain a good balance between the level of security expected in relation to the resources invested by the state and consumers, based as far as possible on energy efficiency, flexibility, local and renewable resources • Ensuring network capacity that meets the growing demands of the economic and demographic development of the country • Diversifying countries of origin and supply routes • Anticipating security of supply needs for hydrogen and prepare the corresponding measures, including synergies with other forms of energy (e.g. storage of excess renewable electricity)
Internal energy market	<ul style="list-style-type: none"> • Ensuring a high level of interconnection above levels interconnection of other EU countries • Increasing integration into the interconnected European electricity grid • Deepening the common gas market with Belgium • Developing the hydrogen market as well as a responsive infrastructure future needs • Deepen cooperation at the level of the Pentalateral Energy Forum • Develop the national market with a view to a high level of transparency, competitiveness and efficiency for the benefit of household customers and businesses • Boosting digitalisation and making the energy market more flexible
Research, innovation and competitiveness	<ul style="list-style-type: none"> • Strengthen the governance and coordination of R & D & I activities related to the topics of the NECP • Strengthening interdisciplinary collaborations across the whole chain of maturity (of the basic research into implementation technological or regulatory)

1.1.2 summary table of key policies and measures

Dimension	Key policies and measures
Decarbonisation	<p><u>Cross-cutting policies and measures</u></p> <ul style="list-style-type: none"> <li>• Climate Law establishing the institutional framework and governance of climate policy at national level, including national and sectoral climate targets <li>• Annual increase of the CO₂ tax of EUR 5/t CO₂ to reach one in 2026 level of EUR 45/t CO₂, with revenues generated being used fairly to finance climate and energy transition measures and social compensation measures for low-income households, including fiscal measures or other measures such as the increase of the expensive living allowance <li>• Continuous development of the Climate Pact with municipalities <li>• Decarbonisation strategy pursuing the objective of climate neutrality State administration as early as 2040 <li>• Wide range of financial incentives (Klimabonus Wunnen, Klimabonus Mobilitéit, Klimabonus Bësch, business aid schemes, etc.) and consolidation of financing tools (Climate and Energy Fund, etc.) <li>• Support for citizens and businesses with offers and awareness-raising programmes, information and advice <li>• Initial and continuing vocational training in the field of skills needed for energy transition and climate action <li>• Design of measures to ensure the implementation of a transition just and develop a 'Social Climate Plan' in accordance with Regulation (EU) 2023/955 establishing a Social Climate Fund <p><u>Buildings</u></p> <ul style="list-style-type: none"> <li>• Nearly zero-energy buildings (nZEB) in accordance with the Regulation on the energy performance of decarbonised buildings and heating systems (a heat pump is the reference for any new construction (decarbonisation through electrification)) <li>• Ambitious renovation of the existing building stock with a focus on the support and support for energy renovation measures <li>• Decarbonisation of existing residential buildings as a matter of priority through heat pumps with a fossil phase-out based on a voluntary approach with significant financial incentives <li>• Decarbonisation through an accelerated fossil phase-out for buildings existing functional areas above 1.000 m² with priority over administrative buildings in the tertiary sector, by means of heat pumps and after consultation with the sectors concerned on the timetable for the obligation to take effect <li>• Financial incentives for the decarbonisation of residential buildings by Klimabonus Wunnen scheme, complemented by a social top up <li>• Energy Efficiency Obligation Scheme (EEOS – Energy) Efficiency Obligation Scheme) in place since 2015 with ambitious annual targets, complemented by alternative policy measures to achieve energy savings for final consumers <li>• Pioneering role of the State and municipalities, particularly in their respective areas buildings and lighting

Transport and Mobility

- Implementation of the 2035 National Mobility Plan (PNM2035) and promotion public transport and active mobility
- Accelerated development of electromobility through aid schemes in for the purchase of zero-emission vehicles and the installation of charging stations (Klimabonus Mobilitéit, social leasing of electric cars and business aid schemes), complemented by tax incentives for electric cars
- Extension of charging infrastructure through aid schemes and by facilitating the installation of charging stations, in particular in buildings in co-ownership and areas of activity
- Reduction of fuel sales to non-residents by increase progressive CO₂ tax

Industry

- Climate Pact for Business (SMEs) (Klimapakt fir Betriber)
- Voluntary agreement to decarbonise and improve efficiency energy in industry
- Mandatory energy audits (with revision of criteria and identification decarbonisation potentials)
- Energy Efficiency Obligation Scheme (EEOS – Energy) Efficiency Obligation Scheme) facilitating the identification of the largest energy saving potentials in industry
- Revision of aid schemes for enterprises, with the introduction contracts for difference (Carbon Contracts for Difference) (OPEX aid) in addition to investment aid (CAPEX aid), in line with EU state aid rules
- Risk sharing mechanism for energy efficiency projects and decarbonisation of businesses

Waste

- Implementation and continuous development of legal provisions in waste material and the National Waste and Resource Management Plan
- Promoting the circular economy, including through the implementation of strategies “Kreeslafwirtschaft Lëtzebuerg” and “Null Offall Lëtzebuerg”
- Modernisation and extension of waste water treatment plants and implementation of the sewage sludge recovery strategy

Agriculture

- Legal framework transposing Luxembourg’s National Strategic Plan for the implementation of the Common Agricultural Policy 2023-2027, including farm council and support for sustainable and environmentally-friendly agriculture
- Strengthening the regulatory framework for the use of fertilising products azotised in agriculture

LULUCF

- Consolidation of sustainable management of public and private forests
- Promotion of the Klimabonus Bësch aid scheme for private forests
- Increased use of wood from Luxembourg forests as construction material
- Financial incentives for arable land management favouring increasing organic carbon content, complemented by support for agroforestry

Renewables	<ul style="list-style-type: none"> • Accelerated deployment of PV through tenders and a multitude of regulatory and economic measures • Increase of wind power through Repowering projects and authorisation of new sites and facilitation, respectively acceleration of permit-granting procedures; • Use of heat pumps to increase the share of energy renewables in the heating sector; • Development of infrastructure for transport and storage of hydrogen and the use of renewable hydrogen or its derivatives in sectors of industry that are difficult to electrify; • Incorporation of biofuels and increase in the share of advanced biofuels, accelerated deployment of electromobility and use of hydrogen or synthetic and renewable fuels of non-biological origin, referred to as 'RFNBO' in the transport sector; • Speeding up and simplifying authorisation procedures.
Energy efficiency	<ul style="list-style-type: none"> • Nearly zero-energy buildings (nZEB) in accordance with the legislation on the energy performance of buildings • Ambitious renovation of the existing building stock with a focus on the support and support for energy renovation of housing • Creation of an important energy efficiency investment market for industry, SMEs and large office buildings (through a combination of energy audits, reinforcement of the voluntary agreement with the industrial sector and the establishment of the Climate Pact for Enterprises targeting SMEs in particular, the pursuit and maintenance of the ambitious objectives of the Energy Efficiency Obligation Scheme (EEOS) obliging electricity and natural gas suppliers to incentivise energy savings among final consumers) • Increased energy efficiency in the transport sector by reducing traffic, the massive expansion of public transport and the rapid development of electromobility in cars and vans (state aid, setting up a fast charging network on national territory) • Reduction of the sale of diesel fuel to trucks in transit • Pioneering role of the State and municipalities, particularly in their respective areas buildings and lighting • In-depth training and education programmes for craftsmen and craftsmen planners (engineers/architects)
Security energy supply	<ul style="list-style-type: none"> • Monitoring of the security of supply situation, in close proximity collaboration with relevant stakeholders (network operators, suppliers, HCPN, etc.) • Development and refinement of emergency procedures and measures related to electricity, natural gas, oil and hydrogen • Address energy dependencies through collaboration
Internal energy market	<ul style="list-style-type: none"> • Upgrading electricity transmission and distribution capacities

	<ul style="list-style-type: none"> • Access of Luxembourg network users to the balancing market German and European • Establishment of an Energy Data Platform • New tariff structure for network tariffs • Introduction of dynamic electricity prices • Facilitating the charging of electricity and energy communities
Research, innovation and competitiveness	<ul style="list-style-type: none"> • Creation of a National Centre of Excellence in Research (ncer) for the energy transition and climate action • Establishment of a strategic R & D & I programme for the governance of the energy transition and climate action • Support the establishment of research chairs and public partnerships — private or public-public at the University of Luxembourg and public research centres

1.2 overview of the current state of policy

1.2.1 Background

The **Paris Agreement**, adopted in December 2015, is the basis for global climate action. Achieving the main objective of this agreement requires achieving climate neutrality (net zero GHG emissions) by the middle of the 21st century, which requires a rapid and profound transformation of the economy and society. This is why, in December 2019, the European Commission presented “ **The European Green Deal**”, a strategy for sustainable and inclusive growth to transform the EU into a fair and prosperous society with no net GHG emissions by 2050 and decoupling growth from resource use. The implementation of the Green Deal is ongoing. For example, the **European Climate Law**¹, setting the objective of climate neutrality by 2050 (as well as a net reduction in EU GHG emissions of at least 55 % by 2030), was adopted on 30 June 2021.

Like the European Climate Law, the **amended Climate Law of 15 December 2020** aims to achieve the long-term objective of climate neutrality, which is to achieve net zero emissions in Luxembourg by 2050 at the latest. Overall, the Climate Law sets the legal framework (targets, integrated national energy and climate plan, long-term strategy for GHG emissions reduction) and institutional (Climate Action and Energy Transition Platform, Climate Policy Observatory) to achieve **national climate objectives in the medium and long term**. The intermediate target is to reduce the greenhouse gas emissions attributed to Luxembourg under Regulation (EU) 2018/842 by 55 % by 2030 compared to 2005 (excluding emissions governed by the EU Emissions Trading System). Pursuant to the aforementioned law, **sectoral climate targets** are set by Grand-Ducal Regulation² for the following five sectors until 31 December 2030, so that emissions from these sectors decrease steadily and continuously and reach the national climate target of -55 % in 2030:

1. Energy and manufacturing industries, construction;
2. Transport;
3. Residential and tertiary buildings;
4. Agriculture and forestry;
5. Waste and waste water treatment.

The **National Integrated Energy and Climate Plan (NECP)** for the period 2021-2030, the first version of which was adopted by the Luxembourg Government in 20 May 2020, pursuant to Regulation (EU) 2018/1999³, forms the basis for Luxembourg’s climate and energy policy for 2030. Addressing the following five dimensions, namely decarbonisation, including renewable energy, energy efficiency, security of energy supply, internal energy market and research, innovation and competitiveness, the NECP is the main planning and monitoring instrument in this area. In addition to the above mentioned objective of reducing non-ETS GHG emissions by 55 % by 2030 compared to 2005, the NECP also contains the targets to improve energy efficiency by 4044 % in terms of final energy compared to the 2007 European Reference Scenario and to increase the share of renewable energy to 25 % of gross final energy consumption by 2030. It describes the policies and measures to achieve these objectives and is therefore a roadmap that is implemented through the adoption of laws and regulations, programmes and projects and other measures.

Regulation (EU) 2018/1999 requires Member **States to update their respective NECPs and** submit to the European Commission a draft update of the latest notified version and a final version of the update by 30 June 2024 at the latest.

1.2.1.1 Administrative structure

This update of the NECP is the result of intense **inter-ministerial collaboration within the Inter-Ministerial Committee for Climate Action**, chaired by the Ministry of Environment, Climate and Biodiversity. The

¹Regulation (EU) 2021/1119 establishing the framework for achieving climate neutrality

²Grand-Ducal Regulation of 22 June 2022 determining annual greenhouse gas emission allocations for the period up to 31 December 2030 for the sectors referred to in Article 5 of the amended Climate Law of 15 December 2020

³Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action

compilation and description of the measures have been prepared in sectoral working groups by the experts of the ministries represented in the Committee and their respective administrations. A separate working group accompanied the work entrusted to STATEC as regards modelling and projections of energy consumption and production and GHG emissions in the various sectors, the projections for agriculture being drawn up by the Rural Economy Department of the Ministry of Agriculture, Food and Viticulture and those concerning waste and the LULUCF sector by the Environment Administration.

Building on the experience gained, the Interministerial Committee also serves as a platform for the **coordinated implementation of energy and climate policies and measures**.

1.2.1.2 Specific situation in Luxembourg

When drawing up energy and climate policy, account must be taken of certain specific features of Luxembourg's situation, as well as the structure of energy consumption. Luxembourg is characterised first and foremost by a very dynamic demographic development. In recent years, the population has increased from 493 500 in 2009 to 660 809 in 2022. In addition, Luxembourg's highly open economy is characterised by dynamic development. Other atypical situation: fuel consumption is disproportionately high in Luxembourg, compared to its neighbouring countries, and accounts for around two-thirds of all final energy consumption. The main causes are Luxembourg's central situation in Europe and the favourable fuel price differences compared to neighbouring countries. This structure also generates a relatively low percentage in terms of electricity consumption in Luxembourg, which is just under 15 %. In the electricity sector, the country relies mainly on imports (85 %), as Luxembourg does not have large power plants and its own electricity production, based mainly on renewable energy sources, although growing, cannot cover current needs. Moreover, the structure of industrial energy consumption must be regarded as atypical. Indeed, the share of electricity consumption of the steel industry alone accounts for around 40 % of domestic electricity consumption. The factors mentioned above have therefore influenced the structure of energy consumption in recent years and will probably continue to do so in the future.

Luxembourg is also highly dependent on energy. Luxembourg is one of the few countries in the European Union which do not have fossil resources and therefore has to import virtually all the fuels it needs, whether oil or natural gas. Luxembourg also has no seaport or refining capacity; it is not equipped with gas storage due to inadequate geology and has only limited storage capacity for petroleum products.

Therefore, Luxembourg has few means to influence security of supply through national measures. Coordination of measures and sharing of relevant information at European level is therefore essential. In the framework of the Pentalateral Energy Forum (DE, FR, BE, NE, LU, AU, CH) and in close cooperation with its neighbouring states, Luxembourg has in the past relied on the diversification of sources of origin and supply routes to ensure the country's security of supply.

The current energy crisis has led to the need to introduce extraordinary measures to ensure security of energy supply. At national level, a significant number of activities and measures have been initiated respectively by the relevant stakeholders, including the Ministry of Economy, the High Commissioner for National Protection, and the network operators, in order to monitor, manage and anticipate the crisis.

As a result, and despite the geopolitical situation and the resulting energy crisis, security of supply in Luxembourg therefore remains at a very high level.

Luxembourg has always been in favour of a well-functioning competitive internal energy market and also encourages European approaches to energy infrastructure. These approaches are fully in line with the principles of the European Energy Union.

1.2.2 current policies and measures

In recent years, Luxembourg has made significant progress in terms of energy efficiency, renewable energy and climate action; these are briefly listed below.

1.2.2.1 Climate action

On climate action, Luxembourg has implemented a range of policies and measures in recent years, notably on the basis of the first version of the NECP adopted in 2020. Policies and measures that will be further strengthened and complemented by this update of the NECP. To name just a few **current policies and measures**, the Climate Law, the CO₂ tax, the Climate Pact with municipalities and the **wide range of support schemes that encourage** citizens, municipalities and companies to invest in the energy and climate transition should be made clear.

Since 2021, fossil fuels have been subject to the **CO₂tax**. The annual rates of the CO₂ tax corresponded to EUR 20/t CO₂ in 2021, EUR 25/t CO₂ in 2022 and EUR 30/t CO₂ in 2023. From 1 January 2024, the rate shall be EUR 35/t CO₂. The revenues generated by the CO₂ tax shall be used fairly to finance climate and energy transition measures and social compensation measures in favour of low-income households, including tax measures or other measures such as the increase of the expensive living allowance.

In 2012, the Luxembourg Government launched the **Climate Pact with the municipalities** with a view to guiding, accompanying and supporting local authorities in the fight against climate change. Through their commitment under the Climate Pact, the municipalities align themselves with the objectives set at national level and actively promote climate protection and the energy transition. Through a catalogue of 64 measures, municipalities are effectively oriented towards a sustainable policy in the areas of energy transition, climate change, circular economy, air quality, adaptation to climate change and mobility. The catalogue of measures shall be regularly revised to take account of national objectives and regular evaluations of the programme. In return for their commitment, the municipalities receive assistance from a climate advisor and subsidies from the State depending on the level of certification obtained. The State shall make available the legislative, financial, technical and advisory framework until 31 December 2030. Klima-Agency is mandated for the operational implementation and continuous development of the programme.

1.2.2.2 Energy efficiency

In the area of new building constructions, Luxembourg has continuously raised the level of energy efficiency requirements over the last fifteen years, since the introduction of the first energy performance certificates in Luxembourg in 2008, and is here a pioneer in Europe. The national level of requirement for a near-zero energy building (nZEB) is mandatory for each new construction since early 2017 and is now close to the 'passive house' level, which is a globally recognised benchmark. These nearly zero-energy buildings are generally designated as AA buildings in national energy performance certificates.

In 2020, Luxembourg presented its Long Term Renovation Strategy (LTRS), which was welcomed by the European Commission mainly for its detailed overview of the building stock, but also for national information, awareness-raising and training programmes. Given the significant energy saving potential at the level of the national building stock, the Building Renovation Strategy foresees the implementation of a national initiative for energy renovation. With the involvement of stakeholders from the construction sector, several measures of this building renovation strategy have been further developed and taken into account in the formulation of even more ambitious policies and measures. These policy approaches and measures are being put into practice, including pilot projects.

A number of support instruments have also been developed and introduced to support the energy renovation of buildings. These instruments include investment grants for households (Klimabonus state subsidy scheme, combined with subsidies offered by municipalities and obligated parties under the Energy Efficiency Obligation Scheme) and municipalities (via the Climate and Energy Fund), as well as the introduction of low-interest climate loans for energy renovation. In order to give a new boost to energy efficiency, in 2015 Luxembourg introduced a mechanism that obliges natural gas and electricity suppliers to make concrete energy savings by incentivising energy efficiency measures for final consumers in the sectors they have determined themselves. This mechanism has been extended for the period 2021 to 2030 at an ambitious target level.

In the industry sector, the voluntary agreement between the Government and FEDIL on improving energy efficiency in Luxembourg's industry was reformed for the period 2021 to 2023 in order to improve energy efficiency and by including the inclusion of on-site renewable electricity consumed by businesses. Investment support programmes for enterprises aimed at improving energy efficiency and promoting renewable energy have also been reformed and temporarily adapted in the context of soaring energy prices in order to maintain the competitiveness of businesses.

1.2.2.3 Renewables

In the field of renewable energy, Luxembourg achieved the target of 11 % renewable energy in final energy consumption in 2020, set by Directive 2009/28/EC of 23 April 2009 on the promotion of the use of energy from renewable sources. Directive 2023/2413 of the European Parliament and of the Council of 18 October 2023 amending Directive (EU) 2018/2001 provides for a binding European target of 42.5 % renewable energy in final energy consumption in 2030. The national target increases to 37 % and for the transport sector from 14 to 29 %. The share of renewable energy in final energy consumption reached 14.36 % in 2023.

In the area of new residential and functional buildings, the Regulation on energy efficiency in residential buildings introduced an implicit requirement for the use of renewable energy, including a feasibility study on the use of renewable energy to be annexed to the application for a building permit.

The rules on operational aid (feed-in tariffs and market premiums) have been regularly adapted in recent years, in order to create attractive incentives for investment, in particular in the areas of biomass, wind and photovoltaic, as well as for photovoltaic cooperatives. In 2019, for example, operational aid for photovoltaic was increased and in 2018 a first national tendering procedure for photovoltaic systems on buildings or industrial or landfill sites was put in place. Since then, several calls for tender have taken place. These measures triggered a major wave of investments, which increased solar production from 131 MW in 2018 to around 394 MW at the end of 2023. Recently, new models have been promoted by the Government, such as self-consumption (by individuals and businesses) and innovative concepts such as agri-photovoltaic (the latter through a call for pilot projects). In addition, a number of progress has been made in areas that have been underdeveloped so far, such as geothermal energy and renewable hydrogen, in order to pave the way for their future development.

Finally, it should also be noted that the rate of biofuel to be added to fuel has been increased to 8.4 % for the year 2024. The minimum rate of advanced biofuels increased from 0,2 to 0.4 % in 2024 (after double counting). Since 2020, the Government has restricted the use of first-generation biofuels to a maximum of 5 %, in order to promote the use of second-generation biofuels considered more sustainable, which will allow Luxembourg to reduce the transport target by two points in 2030, thus increasing from 29 to 27 %.

1.2.2.4 Sustainable mobility

Alongside the increased promotion of public transport and active mobility (Luxembourg has the largest investment programme in trains, trams and buses in Europe in relative terms), electro-mobility has also been strongly developed in recent years. As a first step, Luxembourg had opted for the development of a common national infrastructure for public charging stations for electric vehicles. With approximately 2.000 recharging points installed so far in all municipalities in the country, complemented by 220 ultra-fast recharging points SuperChargy, the Chargy network serves as a basic national infrastructure covering much of the current need.

However, the increasing number of electric vehicles requires complementary activities. For example, a programme to subsidise electric charging stations at home, as well as an aid scheme for companies investing in charging infrastructure for electric vehicles, both accessible to the public and serving their own needs, have been introduced and allow the charging infrastructure to develop continuously. Therefore, the private sector is able to take over and complement the national network of charging stations. With more than 3.000 publicly accessible recharging points for a total fleet of more than 30.000 registered electric cars, Luxembourg continues to have one of the dense charging networks in the European Union.

1.2.2.5 *National Recovery and Resilience Plan*

On 30 April 2021, Luxembourg submitted its Recovery and Resilience Plan (RRP) to the European Commission and received a favourable opinion from the European Commission on 18 June 2021. Luxembourg's RRP is based on three pillars, namely 'Cohesion and Social Resilience', 'Green Transition' and 'Digitalisation, Innovation and Governance'. Sustainable recovery is at the heart of the RRP strategy. Indeed, the share of investments contributing to efforts to combat climate change is 69 %, well above the 37 % threshold required by the applicable EU legislation.

All investments under the Green Transition pillar are well reflected in this update of the NECP:

- Decarbonisation of transport
 - Minimum targets for low- and zero-emission vehicles by contracting authorities: see measures 412, 413 and 414 in Chapter 3
 - Implementation of an aid scheme for charging stations for legal persons: see measure 425 in Chapter 3
- Protection of the environment and biodiversity
 - "Naturpakt": see measure 108 in Chapter 3

Thus, the RRP is one of the instruments that enable the objectives as described in this update of the NECP to be achieved.

1.3 Consultations and involvement of national and Union entities and their results

Involving citizens and stakeholders in the preparation of the update of the integrated national energy and climate plan respectively is an important objective of Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action and the amended Climate Law of 15 December 2020.

Preparation of the draft update of the NECP

Thus, in the preparation of the preliminary draft and the draft of this update of the NECP, conventional (legally regulated) and non-conventional forms of participation (not based on the law) were applied.

The Climate Law establishes the framework for conventional participation processes, establishing the Climate Policy Observatory and the Platform for Climate Action and Energy Transition, and setting out the provisions of the public inquiry.

The **Climate Policy Observatory** (JPO) is a scientific council currently composed of seven national and international scientists with expertise in different climate-related areas. Its tasks are to advise on projects, actions or measures likely to have an impact on climate policy, to scientifically evaluate and analyse the effectiveness of measures taken or planned in the field of climate policy, and to propose new measures and to propose research and studies in all climate-related areas. Its tasks also include drafting an annual report to the Government on the implementation of climate policy.

In the context of the 2022 annual report, the CIU made recommendations for the update of the NECP. These recommendations have been analysed and taken into account in the preparation of the preliminary draft update. Subsequently, the CIU made a statement on the preliminary draft, which was taken into account in the finalisation of the draft update.

The **Climate Action and Energy Transition Platform** (Climate Platform) was established to establish a multi-level dialogue between local and national authorities, civil society organisations, professional chambers and employers' and employees' organisations, and other relevant stakeholders, such as youth. In particular, its mission is to participate in the preparation of the preliminary draft of the NECP. In this context, it was asked to deliver an opinion on the preliminary draft update.

This opinion, which was sent to ministers in July 2023, includes both elements on which consensus has been found within the platform, elements whose importance is recognised by all members, but on which there are nuanced views on their application/implementation, and also elements on which views diverge. The individual contributions and positions of the Platform members shall be annexed to the opinion and shall form an integral part thereof.

In addition, the Climate Law provides for the organisation and conduct of a 30-day **public consultation**. It was open from 17 April to 16 May 2023 and accessible via the emwelt.lu and enquetes.public.lu portals. During this period, interested parties could express their views and consult a series of documents, including the preliminary draft update of the NECP, as adopted by the Council of Government on 31 March 2023, a summary of the preliminary draft and a frequently asked questions. They also had the opportunity to submit their comments by e-mail or by post.

A total of 42 responses were received. Of these, 19 came from citizens and 23 from organisations, mostly grouped under the Climate Platform: ABBL, ALFI, Climate Alliance, Chamber of Agriculture, Chamber of Commerce, Chamber of Metiers, Chamber of Employees, Luxembourg Confederation of Commerce, Fédération des Artisans, FEDIL, Groupement Energies Mobilité Luxembourg, House of Automobile, ILR, LCGB, LSF, Ecological Movement, Patrimonial Movement, OAI, OGBL, SYVICOL, UNICEF, City of Differdange, votum Klima.

In addition to the conventional participation bodies and processes, the government has launched a new initiative, the 'Klima-Biergerrot' (KBR) (Citizens' Climate Bureau), to introduce additional unconventional

consultation mechanisms, allowing for representative participation and increased awareness of energy and climate policies. “Can and does Luxembourg want to go further in the fight against global warming? And if so, how?” From the end of January to early July 2022, the KBR gathered a representative sample of 100 people living or working in Luxembourg to discuss this issue. During about 15 meetings, KBR members expressed their views on Luxembourg’s current commitment to combating climate change. In their final report, they brought together 56 proposals to give new impetus to climate policy.

In September 2022, KBR members presented their proposals to the government. Subsequently, the proposals were also presented and discussed in the Chamber of Deputies. In addition to taking the proposed measures into account in the preparation of the preliminary draft update of the NECP, they may also inform other plans and strategies. KBR representatives were also invited by the relevant ministries (Ministry of Energy and Spatial Planning and Ministry of Environment, Climate and Sustainable Development) to participate in bilateral exchanges in order to discuss the various proposals and explain to them the relevant decision-making process.

All **contributions** from the various conventional and non-conventional consultations have been **identified, analysed and duly considered in an inherently collaborative approach between the ministries concerned**, with a view to integrating the draft update of the NECP into the preliminary draft. First, the contributions received led to changes to the measures contained in the preliminary draft update and to some new measures. In addition, some contributions require further analysis and exchange and could be included in the final version of the update. In addition, many comments concerned details on the implementation of the measures contained in the plan, which will be taken into account during the implementation process, where appropriate in consultation with the relevant stakeholders.

Finalisation of the update of the NECP

At its meeting of 21 July 2023, the Council of Government approved the draft update of the NECP, which was subsequently forwarded to the relevant services of the European Commission, for assessment by the European Commission, as provided for in Regulation (EU) 2018/1999. On the basis of this assessment⁴, the European Commission published on 18 December 2023 its recommendations for the draft update of the Luxembourg NECP⁵. The **European Commission’s recommendations** have been analysed in detail by the Ministry of Environment, Climate and Biodiversity and the Ministry of Economy, and the final version of the update duly takes them into account.

On the other hand, the draft update has been revised to reflect the elements contained in the **2023-2028 government programme**, which states, inter alia, that ‘the Government will implement the updated integrated national energy and climate plan (NECP) in a systematic manner so that Luxembourg achieves its climate objectives, as defined in the relevant law’. Finally, the policies and measures of the draft update have, if necessary, been updated to reflect **developments since July 2023**, when the draft was adopted. All this work has been coordinated through the Interministerial Climate Action Committee.

In addition to finalising the update of the NECP, and in accordance with the amended Climate Law of 15 December 2020, the draft update was subject to an **environmental impact assessment as referred to in the amended Law of 22 May 2008** on the assessment of the effects of certain plans and programmes on the environment.

⁴Commission staff working document (SWD (2023) 919 final), Assessment of the draft updated National Energy and Climate Plan of Luxembourg

⁵Commission Recommendation of 18.12.2023 on the draft update of Luxembourg’s integrated national energy and climate plan for the period 2021-2030 and on the consistency of the measures planned by Luxembourg with the Union’s climate-neutrality objective and with ensuring better adaptation (C (2023) 9609 final)

1.4 Regional cooperation in preparing the plan

1.4.1 Pentalateral Energy Forum – The Regional Energy Cooperation Platform The Pentalateral Energy Forum (Penta) is a voluntary regional cooperation between Belgium, France, Germany, Luxembourg, the Netherlands and since 2011 Austria. These countries account for more than 40 % of the EU population and cover more than 50 % of electricity generation in the EU. Switzerland joined the Forum as a permanent observer in 2011 and actively contributes to technical work and decision-making. In close cooperation with the European Commission (upon invitation), the Pentalateral Energy Forum strengthens cooperation between all stakeholders to contribute to a reliable, decarbonised and efficient electricity system based on integrated and well-functioning markets. As the electricity sector plays a crucial role in decarbonising all our societies by 2050 at the latest, Penta countries aim to further increase the share of renewables and fully decarbonise their electricity system as soon as possible and ideally by 2035.

Cooperation is led by the ministers responsible for energy policy, who meet regularly. The activities are monitored by the Penta coordinators under the guidance of the respective Directors-General of the Penta countries. The work programme is implemented by ministries, transmission system operators (TSOs), distribution system operators (DSOs), regulatory authorities and market participants that meet regularly in four thematic support groups. In order for each support group to achieve its objective, exchanges between and within support groups are strongly encouraged and supervised at the level of the Penta coordinators. Support groups also liaise with other international fora, such as North Seas Energy Cooperation.

As the transition to a decarbonised energy system is accelerating, countries are becoming increasingly interdependent and regional cooperation is becoming increasingly important to address the challenges. The Pentalateral Energy Forum is well placed to address many of these challenges, for example by working on security of supply, market integration, energy efficiency and decarbonisation. Over the past two decades, Penta countries have shifted from a purely national political perspective on energy markets to a regional approach. Penta countries are therefore ideally placed to contribute to the next phase of the energy transition.

Supply security

Security of supply has been at the heart of the Pentalateral Energy Forum since its inception. Since the beginning, countries have been cooperating closely to foster security of supply and to prevent, prepare and manage electricity crises in a spirit of solidarity and trust. Important milestones have been achieved through various regional adequacy assessments, common crisis exercises and a common framework under Regulation (EU) 2019/941 on risk-preparedness in the electricity sector.

Today, work on security of supply is organised in a dedicated support group, structured by two main work streams: resource adequacy assessment and risk preparedness. Future work is planned for these two work streams as well as for the interface between them.

Resource Adequacy Assessment

As regards resource adequacy assessments, the Penta countries will work together with the European studies carried out by ENTSO-E (European Resource Adequacy Assessment, seasonal outlook) to improve alignment and usefulness for Penta countries. Based on the expertise and in-depth knowledge in this area, complementary sensitivity analyses could be carried out by Penta TSOs, focusing on the Penta region and taking into account regional specificities and cross-border interdependencies. The following topics deserve to be explored at regional level:

- The link between the planning of the national energy system, the implementation of the TEN-E Regulation and the rapid evolution of the European energy system;
- The role of demand side response and other flexibility resources for system adequacy;
- Improved methods for assessing resource adequacy;

- The need to increase the capacity of the network and optimise the existing network;
- Analysis of critical situations and possible countermeasures.

Risk preparedness

As regards risk preparedness, the objective is to foster regional cooperation in the Penta region with a view to preventing, preparing and managing electricity crises in a spirit of solidarity and transparency and in full compliance with the requirements of a competitive internal electricity market and the operational security procedures of TSOs. The Penta countries will seek effective solutions between all the competent entities involved in crisis management and between European, regional and national levels. As such, work will focus on the implementation of the Memorandum of Understanding on Risk Preparedness in the Electricity Sector, signed on 1 December²⁰²¹, and in particular on:

- Analysis and evaluation of regional measures, including the technical, legal and financial arrangements necessary for their implementation;
- Organisation of regional exercises;
- Revision of the regional electricity crisis scenarios for the Penta region in close cooperation with ENTSO-E and the Commission on applicable methodologies
- In the event of an electricity crisis within Penta, application of the agreed framework.

Interface between resource adequacy assessment and risk preparedness

In addition to the above, Penta countries will also work on the interface between resource adequacy assessments and risk preparedness. A first step was taken with the Penta study on methodological improvements of Resource Adequacy Assessment, which examined differences and overlaps. Penta countries will endeavour to close the gaps between long-term analysis and short-term operational planning, technical and political decision-making, as well as between countries. More specifically, Penta countries intend to support the development of analytical tools and procedures for information exchange and decision-making, closely involving ministries, TSOs, regulatory authorities as well as ACER, ENTSO-E, EU DSO and regional security centres located in the Penta region (i.e. Coreso and TSCNET).

Market integration

The Pentalateral Energy Forum has two decades of experience in market integration. During this period, Penta witnessed and driven major changes in the political landscape, the most important steps being the introduction of flow-based market coupling, first in the Penta region, and now in a larger part of continental Europe.

Promote future-proof market design

In recent years, work on market integration in Penta has expanded in terms of accents and topics. Ministers Penta firmly placed hydrogen on the national and European agenda as a key element for system and market integration. The newly created SG4 actively contributes to the development of an integrated European hydrogen market.

The Pentalateral Energy Forum also aims to contribute to the integration of renewables and the development of a future decarbonised electricity system, in which integrated markets play a crucial role. More recently, two studies have been carried out: “Vision 2050” and “Flexibility”. These studies were carried out in the framework of the Support Group 3 (SG3) on the future electricity system and will serve as a basis for the future work of the Penta Forum.

Vision 2050 compares national decarbonisation scenarios and proposes basic elements for a common political vision of the future electricity system. These building blocks describe the elements necessary for the efficient development of a future electricity system. The Penta countries will continue their work on the Vision 2050 project by drafting a political declaration that will contain a common vision for the future integrated energy

system.

To develop this future electricity system, the Penta countries recognise the need for future-proof market design and will actively exchange on the improvement and implementation of electricity market regulation, while highlighting areas where further work is needed. Based on their past experience, the Penta countries will work together to highlight welfare gains from adopting an integrated and market-based approach to policy issues that may materialise. They will also continue to organise technical exchanges and projects that contribute to the effective implementation of energy policies in the Penta regions.

Flexibility

The Flexibility Report provided additional information on the current and future state of flexibility in the region. It describes the needs and sources of flexibility in 2030/40/50, driven by the integration of renewable energies, and shows that cooperation can lead to significant synergies between countries, thus reducing overall flexibility needs. The report also provides important recommendations on how to promote flexibility in the region and potential measures to improve the flexibility of market participants. Therefore, Penta countries:

- Discuss the harmonisation of non-standardised products such as network services (e.g. redispatching and topological remedial measures).
- Discuss how to facilitate the contribution of flexible market participants' behaviour to the balance of the energy system through wholesale markets and the operation of electricity grids in a secure and stable manner.
- Follow the development of technical requirements for additional electricity demand (e.g. heat pumps and other flexibility sources) to ensure interoperability so that additional electricity demand is truly flexible.
- Work together on the implementation of flexibility provisions in upcoming EU legislation, such as the electricity market reform and the network code on demand response. As far as possible, the Penta countries will endeavour to take into account the flexibility needs of the region when formulating national policy.

Energy efficiency

The Pentalateral Energy Forum (Penta) recognises the importance of continuously improving energy efficiency following the energy efficiency first principle, as a way to reduce dependence on fossil fuels and mitigate the scale of the energy transition challenge. In this respect, Penta considers it important to save energy and make energy demand more flexible. The Penta countries exchanged on the implementation of the electricity demand reduction obligation imposed by EU legislation for winter 2022/2023.

The Penta countries will continue to work together by exchanging on the implementation of the new Energy Efficiency Directive (EU) 2023/1791 and on best practices in energy savings.

Decarbonisation

As described above, and building on previous work on Vision 2050, the Penta countries continue to work towards a common political vision on a decarbonised electricity system, which should be achieved as soon as possible and ideally by 2035. The Penta countries will work together to further develop renewable energy and raise awareness of the importance of flexibility to move towards a fully decarbonised electricity system without losing security of supply. The Penta countries fully recognise the importance of improved regional cooperation and seek to improve it in order to exploit synergies and achieve efficiency gains. The Penta countries will explore the added value of additional regional cooperation on renewable energy integration, grid planning, offshore and onshore connection (in cooperation with North Seas Energy Cooperation) and addressing other issues with a cross-border impact that may arise in the transition to a decarbonised electricity system.

Hydrogen

In 2020, a dedicated support group on hydrogen was set up with the aim of advancing Penta's work and close cooperation on hydrogen. SG4 focuses on regulatory and market developments for the deployment of hydrogen in the Penta countries, in relation to the national, European and international framework. Based on the political declaration on the role of hydrogen in decarbonising the energy system in Europe signed in 2020 and recent developments, including REPowerEU and the IEA report A 10-Point Plan to Reduce the European Union's Reliance on Russian Natural Gas, Penta countries exchange information and define common positions on the future market design for hydrogen deployment developments. In particular, SG4 will continue to work on the development of hydrogen certification, the emerging hydrogen infrastructure in the Penta region and the necessary measures to develop cross-border interconnections. It will also monitor progress in the implementation of Penta countries' hydrogen strategies by looking at regulatory development, support mechanisms, investments, changes in supply and demand, trade, among others.

1.4.2 North Seas Energy Cooperation – Regional cooperation in the field of offshore renewable energy

Luxembourg is part of the North Sea region, which has significant renewable energy potential. The deployment of offshore wind energy will play an increasingly important role in achieving Europe's energy and climate objectives. The EU Offshore Energy Strategy has set the ambitious target of an installed capacity of 300 GW for offshore wind and 40 GW for marine energy by 2050. In addition, the EU Wind Energy Action Plan presented on 24 October 2023 foresees an installed capacity of 500 GW for wind energy in general in 2030. On 19 January 2023, the North Sea Energy Cooperation (NSEC) facilitated the development of a non-binding agreement on offshore renewable energy generation targets in 2050 with intermediate steps in 2040 and 2030 for the priority North Sea grid corridor under the TEN-E Regulation. The objectives for the priority offshore grid corridor NSOG are 60.3 GW in 2030, between 134,9 and 158 GW in 2040, and between 171,6 and 218 GW in 2050. This represents a significant change of scale for the offshore sector, the deployment of renewable energy and the integrated strategic development of offshore. High energy prices, for example in 2022, and geopolitical events threatening the European energy system have highlighted the need to accelerate the deployment of national renewable energy generation capacities and offshore transmission grids at regional level as soon as possible, thereby significantly improving energy security.

Luxembourg is working with the other NSEC countries to identify, analyse and realise concrete cooperation projects. The NSEC is a voluntary, bottom-up, market-oriented regional cooperation initiative, established in 2016, aimed at:

- Creating synergies;
- Avoid incompatibilities between national policies;
- Share knowledge on international best practices;
- Promote common strategies where possible and beneficial.

Ministers responsible for energy meet regularly in the framework of the NSEC. In 2023, the NSEC will be composed of Belgium, Denmark, France, Germany, Ireland, Luxembourg, the Netherlands, Norway and Sweden, with the participation of the European Commission. On 18 December 2022, Nordic Energy Ministers and the European Commissioner for Energy signed a Memorandum of Understanding on cooperation with the United Kingdom in the field of offshore renewable energy. The establishment of this MoU was provided for in the EU-UK Trade and Cooperation Agreement of 30 December 2020, is based on the NSEC and is distinct from but complementary to the NSEC framework.

For the offshore wind sector, it is essential to provide a predictable and stable operating environment in the long term in order to facilitate long-term investment and further reduce costs. To this end, existing barriers need to be removed and attractive investment conditions created. NSEC members are working together to make an important contribution to achieving these objectives through a regular exchange of expertise focused

on several topics within the four NSEC Support Groups (SG):

- SG1 development of hybrid projects and commons;
- SG2 permits, spatial planning maritime and environmental considerations;
- SG3 financing and support frameworks;
- SG4 long-term planning of the network and infrastructure.

In order for each support group to achieve its objective, exchanges between and within support groups are strongly encouraged and supervised at the level of the Penta coordinators. The following examples illustrate this approach: ports (SG1 and SG4), maritime spatial planning and network planning (SG2 and SG4), and how non-tariff criteria can enhance innovation on key challenges for an accelerated, cost-effective and responsible deployment of offshore wind energy (SG1, SG3 and SG4). Finally, the Support Groups work closely with other international fora, such as the Pentilateral Energy Forum and the Clean Industrial Forum, on terrestrial network planning, market agreements and stakeholder engagement.

Development of hybrid and joint projects

The NSEC SG1 serves as a platform to collaborate on concepts of potential offshore wind projects and on coordinated electricity infrastructure, including transmission infrastructure. The activity of the group has intensified as the NSEC countries have launched more joint and hybrid projects in the North Sea, to facilitate technical and ministerial discussions and the sharing of best practices as projects progress.

In addition to joint offshore wind projects, which will be connected and supported by several countries, the Support Group is also working on possible 'hybrid' solutions that use cross-border options to connect offshore wind farms to more than one electricity market and create synergies between countries, as well as on the corresponding EU and national market provisions.

Consequently, SG1 members are developing opportunities for collaboration on hybrid projects as well as on possible legal, regulatory and commercial obstacles. SG1 will continue to work on obstacles and milestones of hybrid and joint projects, which can be addressed at national and regional level. In addition, collaboration will continue to function as a forum for reflection on how to work on issues related to legislative processes at EU and national level.

Permits, maritime spatial planning and environmental considerations

In order to achieve our energy and climate objectives in the EU, it is necessary to speed up planning and permitting procedures at European and national level, and at the same time to better understand the possible ecological boundaries of large-scale wind development in the North Seas and the impacts on other users of the sea. SG2 has compiled an inventory of the spatial tensions of offshore wind farm developments up to 2030 at regional sea level. The next steps will be to better define ecological tensions and potential threats to development and define spatial strategies to avoid or mitigate these threats. In order to improve knowledge and support the deployment of wind energy in the North Sea, North Sea countries will continue to cooperate closely on maritime spatial planning, environmental research and the assessment of the cumulative impact of wind farms between the authorities responsible for energy, maritime spatial planning and the environment.

Financing and support frameworks

Offshore tenders are a central topic for funding and support frameworks. NSEC members coordinate offshore tenders by sharing information on timetables for national tenders in the framework of SG3. In the Working Group, countries also exchange best practices on tender design, grant free support, design elements for system and sector integration, as well as grid connection schemes. The implementation of joint projects is becoming increasingly important to achieve these ambitious goals.

This is why the Group is also looking into the possibilities for financing joint cross-border offshore projects,

including through EU financial instruments such as the Connecting Europe Facility and the EU Renewable Energy Financing Facility. Finally, Power Purchase Agreements (PPAs) play an increasingly important role in financing offshore projects. Countries will address problems, obstacles and solutions for a wider adoption of PPAs. In addition, the group exchanges on decommissioning, lifetime extension and energy replenishment of wind farms.

The aim of these exchanges is also to jointly develop and discuss ideas for the medium-term future of the offshore energy system in terms of installed capacity, for example through coordinated tender schedules.

Delivery 2050: long-term network and infrastructure planning

NSEC SG4 works with ENTSO-E to provide and coordinate contributions to the Offshore Network Development Plan for offshore networks in the North Seas under the EU TEN-E Regulation. In addition, SG4 aims to broaden the discussion on the long-term planning of the network to also include the early development and increase of the production and transport of green hydrogen at sea, as well as its potential role in an increasingly interconnected North Sea energy system. Green hydrogen will play an important role in decarbonising our energy system. Power-to-X, and in particular hydrogen, will play a key role in providing flexibility where and when needed. Hydrogen demand is expected to increase significantly, especially after 2030, due to its potential as a storage energy carrier and as a fuel and feedstock for activities that are difficult to electrify. Several NSEC countries have announced targets for green hydrogen production onshore and offshore. Under SG4, NSEC countries will exchange their first experiences with hydrogen linked to offshore wind, and exchange knowledge on transport infrastructure, renewable energy development and off-shore power-to-X production. They will work together to provide information on offshore hydrogen production, to discuss the deployment of electrolysis and to increase synergies between long-term offshore grid planning and hydrogen network planning. In all aspects of medium- and long-term infrastructure planning, SG4 underlines the importance of a broad engagement in this planning process with Member States and relevant stakeholders, including industry and NGOs, to anticipate and eliminate supply chain bottlenecks (e.g. port development and availability) in the deployment and acceleration of the roll-out of our North Sea energy system. This is closely linked to the importance of safeguarding the security of offshore and underwater critical infrastructure, as well as the supply of critical raw materials, through innovation and better circularity.

2 national objectives and targets

2.1 Decarbonisation dimension

2.1.1 GHG emissions and removals

Following the adoption of the integrated national energy and climate plan for the period 2021-2030 (NECP) in May 2020, the amended Climate Law of 15 December 2020 established the legal basis for Luxembourg's climate policy. In particular, the Climate Law sets out national climate objectives, namely:

- the long-term objective of **climate neutrality** to reach net zero emissions in Luxembourg **by 2050 at the latest**; and
- the intermediate target **of reducing the greenhouse gas emissions attributed to Luxembourg under Regulation (EU) 2018/842 by 55 % by 2030 compared to 2005** (6 excluding emissions governed by the EU Emissions Trading System).

Thus, the national 2030 climate target exceeds the binding contribution requested from Luxembourg under the amended Regulation (EU) 2018/842, which sets a 50 % reduction target for Luxembourg. Luxembourg is therefore not required to adjust its 2030 greenhouse gas emission reduction target in the context of the revision of the NECP.

The aforementioned law also stipulates that **sectoral climate targets** shall be set, by means of a Grand-Ducal Regulation, for five sectors covering all the GHG emissions attributed at national level, the delimitation of which is precisely defined by law:

1. Energy and manufacturing industries, construction;
2. Transport;
3. Residential and tertiary buildings;
4. Agriculture and forestry;
5. Waste and waste water treatment.

The Grand-Ducal Regulation of 22 June 2022⁷ determines the annual emission allocations for the 5 sectors for the period up to 31 December 2030, so that emissions from these sectors decrease steadily and continuously in accordance with the mechanism referred to in Article 4 of Regulation (EU) 2018/842 and achieve the national climate target of -55 % in 2030.

⁶Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030

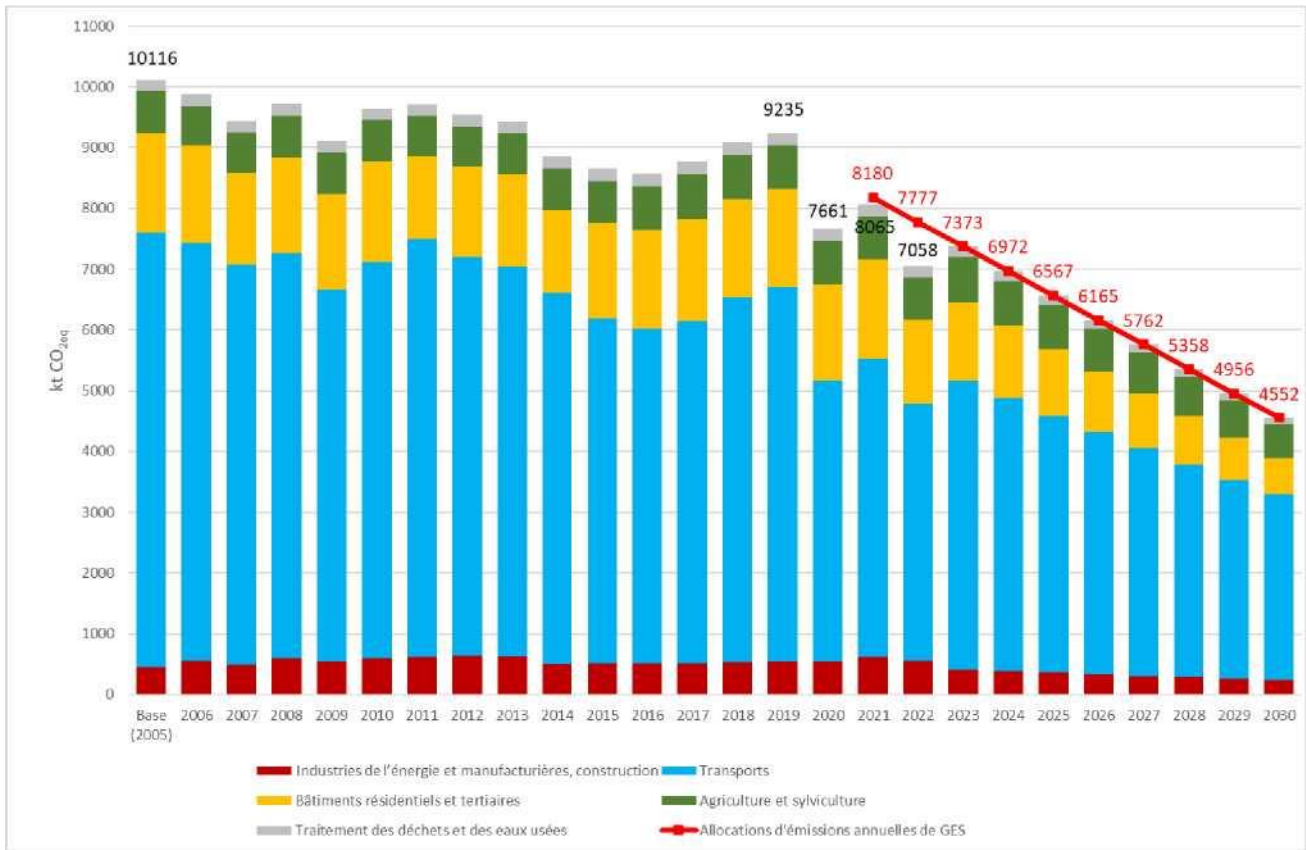
⁷Grand-Ducal Regulation of 22 June 2022 determining annual greenhouse gas emission allocations for the period up to 31 December 2030 for the sectors referred to in Article 5 of the amended Climate Law of 15 December 2020

Table 1: Annual GHG emission allocations for the period up to 31 December 2030

(Thousand tonnes CO _{2eq} (AR5))	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Energy and manufacturing industries, construction	455	431	408	384	360	337	313	289	266	242
Transport	5279	5018	4757	4494	4228	3986	3747	3504	3271	3053
Residential and service sector buildings	1497	1396	1295	1195	1094	993	893	792	691	590
Agriculture and forestry	760	752	742	736	731	704	672	645	609	556
Waste and waste water treatment	189	180	171	163	154	145	137	128	119	111
TOTAL	8180	7777	7374	6971	6568	6164	5761	5358	4955	4552

Annual GHG emission allocations are expressed on the basis of the values for global warming potentials set out in the Fifth Assessment Report (AR5), 2014).

Figure 1: Annual GHG emission allocations for the period up to 31 December 2030 (with historical emissions from 2005 to 2022)



Sources: GHG emissions inventory (submission of March 2024); Grand-Ducal Regulation of 22 June 2022 determining annual greenhouse gas emission allocations for the period up to 31 December 2030

In accordance with Regulation (EU) 2018/841 as amended and in order to consolidate carbon sinks towards climate neutrality by 2050 at the latest, the Grand Duchy of **Luxembourg shall strengthen its targets for net greenhouse gas removals in the land use, land use change and forestry (LULUCF) sector** for the period from 2026 to 2030. The target for 2030 is to increase the net absorption by -27 kt CO_{2eq} compared to the average net removals for the years 2016, 2017 and 2018, which, for information and

⁸Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework

based on the data reported in the inventory submitted in 2020, would lead to a total net absorption of -403 kt CO_{2eq} in 2030. For the period 2026-2029, an absorption volume to be respected will be established in 2025 on the basis of a linear trajectory starting in 2022 at the average of net removals for the years 2021, 2022 and 2023 and leading to the 2030 target.

2.1.2 renewable energy

Objectives

- **Development of renewable energy sources on national territory:**
 - Increase in the share of renewable energy in gross final energy consumption compared to the 2020 NECP from 25 % in 2030 to 37 % as a result of the Green Deal, Fit for 55, REPowerEU and the revision of Directive 2018/2001 on renewable energy by Directive 2023/2413 of 18 October 2023 which brings the overall EU renewable energy target to 42.5 % in order to significantly accelerate the current pace of renewable energy deployment;
 - Ambient deployment of wind, solar, heat pumps and electromobility in Luxembourg.
- **Cooperation measures:**
 - Annual use of the European Union’s renewable energy financing mechanism as a reference instrument;
 - Ad hoc conclusion of cooperation agreements with other Member States with a view to promoting innovative projects such as floating offshore wind projects, the energy infrastructure needed to transport renewable energy sources (electrons and molecules) and the development of the value chain (from production to consumption) of hydrogen and its renewable derivatives (synthetic and renewable fuels of non-biological origin, known as ‘RFNBO’).
- **Scenario with additional measures:**
 - In 2030, renewable electricity produced on the territory will previsibly reach 39 % in final electricity consumption and together with the measures of the EU financing mechanism, this share will reach 75 % (in 2030) and increase to 100 % in 2035 (IEA decarbonisation target).
 - Wind will have to significantly exceed the projected output of the 2020 NECP (674 GWh) to reach 1 043 GWh in 2030.
 - The ambitious target of 1 112 GWh for PV in 2 030 in the NECP 2020 poses a challenge with regard to the interruption of production chains in the field of photovoltaic installations, but is maintained as an objective to be achieved through new and additional measures.
 - In 2030, renewable heating/cooling produced on the territory will reach 40 % of the final consumption of this sector, with an increased role for efficient heat pumps and district heating networks.
 - **The scenario with the additional measures** takes into account the target of 42.5 % of energy from renewable sources in the Union’s gross final consumption of energy in 2030 set out in Directive 2023/2413 and therefore aims to increase the national share from 25 % to 37 % by 2030. It implies the need for additional measures, both at national level through an even greater solar offensive and European cooperation measures with larger quantities.

National specific objectives

- **Renewable electricity**
- **Photovoltaics**
 - Continuation of calls for tenders with increased volumes for large photovoltaic installations:
 - For regular annual calls for tenders with market premiums;
 - Relating to targeted calls for tenders for businesses with investment grants with an emphasis on self-consumption;
 - ‘Agrivoltaic’ call for tenders for the installation of photovoltaic panels in the agricultural environment with a view to ensuring continuous agricultural use and improvement of the ecological quality of the area concerned (pilot project to be evaluated with a view to regular implementation of this instrument);

- Introduction of a solar standard for new buildings combined with targeted support for low-income households.
- Adaptation of aid schemes for small and medium-sized installations with a focus on their attractiveness;
- Establishment of a pre-financing scheme for grants for small installations;
- Increase in own consumption in the residential and business sector;
- Information and awareness raising for citizens and businesses;
- Updating and continuously improving the solar cadastre tool;
- Development of recommendations to standardise and facilitate authorisation procedures, respectively removing the need for planning permission;
- Implementation of a tool to visualise the possibilities of self-consumption.
- **Eolien**
 - Possibility of authorising new sites for the installation of wind turbines using new technologies for the protection and detection of birds and bats;
 - Identification and abolition of barriers to the development of wind energy (e.g. wind turbine installations near areas of economic activity and along transport infrastructure);
 - Promotion of large installations, using in particular the 'repowering' of old installations;
 - Facilitating and speeding up permitting procedures;
 - Follow-up of the actions and instruments of the EU Wind Energy Action Plan;
 - Possibility of holding in the capital of wind energy companies for citizens and municipalities.
- **Solid biomass / Biogaz**
 - Use of sustainable wood from the Greater Region, principle of cascading use;
 - Implementation of the biogas strategy, developed in 2022 and published in 2023, as foreseen by the 2020 NECP, including increased promotion of the use of local manure;
 - Promotion of district heating networks supplied by renewable heat from biogas plants;
 - Promotion of awareness raising and training of operators in the biogas sector;
 - Implementation and adaptation of sustainability and greenhouse gas emissions saving criteria, in particular as a result of the provisions of Directive (EU) 2023/2413.
- **Renewable heat**
- **Heat pump**
 - Acceleration of the deployment of heat pumps in the residential and tertiary sector;
 - Maintenance of financial incentives to support the deployment of heat pumps;
 - Facilitating authorisation procedures for geothermal heat pumps.
- **Geothermal**
 - Acceleration of the deployment of installations to use surface geothermal energy (up to 400 m depth) in combination with heat pumps through regular reassessment and, where appropriate, adaptation of financial incentives;
 - Exploitation of the potential of medium-depth geothermal energy (400-2 000 m) to decarbonise the heat sector. With a view to carrying out first pilot projects, the Geological Service carried out a seismic study in the south of the country to refine the potential in this region. Exploration drilling will be carried out to check local potentials;
 - Provision of tools and sources of information on national geology to facilitate the planning and dimensioning of geothermal installations.
- **District heating**
 - Development of industrial and urban heating networks using renewable and waste heat and putting in place legislation favourable to their development;
 - Adapting financial incentives to take account of low-temperature heating networks (anergy);

- Establishing a legal framework for efficient district heating;
- Promotion of efficient district heating and cooling by providing an IT planning tool.
- **Transport**
 - Increase of the renewable share (provided for in Directive 2023/2413) in the transport sector in view of the 2030 target and sub-targets;
 - Enhanced deployment of electro-mobility (rail, tram and individual mobility);
 - Continuation of the use of advanced biofuels, biofuels and bioliquids and hydrogen and its renewable derivatives for vehicles that are difficult to electrify (e.g. *RFNBO*, i.e. synthetic and renewable fuels of non-biological origin);
 - ReFuelEU Aviation, with a trajectory for sustainable aviation fuels (SAF) with sub-targets for fuels of biological origin and synthetic fuels produced from renewable hydrogen from 2030 onwards.
- **Hydrogen**
 - Implementation of the seven measures of the Hydrogen Strategy, developed and published on 27 September 2021, as foreseen by the 2020 NECP and an update of the Short Term Strategy;
 - Prepare the ground for the deployment of hydrogen transport (and transit) infrastructure, in particular through the introduction of structured legislation and the continuation of regional and European infrastructure studies;
 - Development and launch of instruments to support the production and consumption of renewable hydrogen and in a first phase supporting pilot projects.

2.1.2.1 NECP – current version

The Council of Government adopted the initial version of the National Climate and Energy Plan (NECP) on 20 May 2020. The plan outlines policies and measures to achieve ambitious national greenhouse gas emission reduction targets (-55 %), a minimum share of renewable energy in Luxembourg's gross final energy consumption (25 %) and an improvement in energy efficiency, i.e. a reduction in energy consumption of 4044 % by 2030. It is therefore a roadmap that will be put into practice through the adoption of laws and regulations, programmes and projects in specific areas.

The draft NECP was adopted for the period 2021-2030 by the Government in Council at its meeting of 7 February 2020 and submitted to a public consultation from 12 February to 29 March 2020 inclusive. As part of the public consultation, 328 citizens submitted comments and proposals. In addition, there are 30 institutional actors and groupings from organised civil society, as well as employers' and employees' organisations that have submitted their opinions.

The vast majority of stakeholders welcomed the overall level of ambition of the NECP. In the more detailed comments and proposals, citizens and groupings mainly referred to issues related to the implementation of the NECP. As far as possible, adjustments to the NECP were subsequently made and the Council of Government retained to take into account comments and proposals when drafting regulations, programmes and projects in the specific areas of the NECP between 2020 and 2030.

Since the adoption of the original version, the world has faced multiple crises, including the health crisis and the crisis linked to the war situation in Ukraine. In general, the NECP can be seen as a key element of the economic recovery package in response to the health crisis to address the pressing and urgent threat of climate change. The NECP supports the national economy and will unlock significant potential to strengthen the link between the energy transition and climate policy on the one hand and economic development on the other.

The ambitions of the initial NECP (2020 NECP) by sector are set out in Table 2.

Table 2: Sectoral shares of renewable energy according to the 25 % target scenario as defined in the 2020 NECP

NECP 2020	2017	2020	2025	2030	2035	2040
RES share, electricity sector	8.1 %	11.9 %	23.5 %	33.6 %	38.8 %	45.4 %
RES share, heat sector	8.1 %	13.7 %	19.9 %	30.5 %	35.8 %	47.1 %
RES share, transport sector	6.4 %	11.3 %	18.4 %	25.6 %	40.4 %	54.3 %
Rate of addition of biofuels	5.6 %	7.7 %	8.8 %	10.0 %	14.4 %	18.7 %
Total RES share – domestic production/consumption	6.4 %	9.4 %	13.9 %	19.6 %	24.8 %	31.9 %
Total RES share – including RES	6.4 %	11.8 %	17.6 %	25.0 %	31.0 %	39.3 %

ENR: renewables

2.1.2.2 Renewable energy – Accelerating the transition to 100 % REPowerEU renewables

Directive 2009/28/EC (replaced on 30 June 2021 by Directive (EU) 2018/2001, which has since been amended by Directive (EU) 2023/2413 of the European Parliament and of the Council of 18 October 2023) provided for the establishment by each Member State of a renewable energy action plan, the National Renewable Energy Action Plan (NREAP), which defined the national target for the share of energy from renewable sources consumed in electricity production, in the transport sector, in the heating and cooling sector in 2020, taking into account the effects of other energy efficiency measures on final energy consumption. This target was set at 11 % for Luxembourg and was achieved with a share of 11.7 %, thanks to sustained national development and the conclusion of cooperation agreements with Estonia and Lithuania. From 2019 to 2020, the share of renewable electricity increased from 10.9 % to 13.9 %, transport from 7.7 % to 8 % (12.6 % according to the calculation method of Directive 2009/28/EC) and heating/cooling from 8.7 % to 12.6 %. The efforts and policies undertaken throughout the period 2010 to 2020 have borne fruit and have also contributed to the overall objective of the European Union.

For 2021, the course is maintained and, according to STATEC/EUROSTAT models, Luxembourg achieved a share of 11.7 %.

The 2020 NECP foresaw a rate of 25 % of renewable energy in gross final energy consumption for 2030, but since its publication, the European Union's energy policy has undergone various changes, including the presentation of the Fit for 55 package of July 2021 aimed at further reducing greenhouse gas emissions, the REPowerEU plan of May 2022 drawn up following the energy crisis, and, above all, the recast of Directive 2018/2001 by Directive 2023/2413 published on 31 October 2023, which means that the European Union's, and therefore national, targets had to be revised upwards.

For example, the EU target will increase from 32 to 42.5 % (binding target) with a so-called "Top- up" target of 45 % in 2030. As a result, Luxembourg's specific target increases to 37 %, in line with the recommendations of the European Commission published on 18 December 2023.

In addition to the final target, Luxembourg will have to respect intermediate thresholds which also increase, namely 22 % for 2025 and 28 % for 2027. It should be noted that the share of renewable energy will no longer fall below 11 %, achieved by 2020.

The most recent data published by EUROSTAT apply to the year 2022 with a target of 13.52 %, and Luxembourg's share is 14.36 %. In 2021, this share was 11.7 %. From 2021 to 2022, the share of renewable energy in the electricity sector increased from 14.22 % to 15.94 %, the share in the transport sector increased from 7.96 % to 8.72 %, and the share of renewable energy in the heating/cooling sector increased from 12.90 % to 15.41 %.

Table 3 shows the evolution of the various sectors and the impact of European cooperation.

Table 3: Shares of renewable energy in gross final energy consumption in the different sectors from 2017 to 2022

EUROSTAT-SHARES	2017	2018	2019	2020	2021	2022
RES share, electricity sector%	8.1 %	9.1 %	10.9 %	13.9 %	14.2 %	15.94 %
RES share, heat sector%	7.5 %	8.5 %	8.9 %	12.7 %	12.9 %	15.41 %
RES share, transport sector (without multipliers)	5.4 %	5.4 %	7.0 %	8.0 %	8.0 %	8.72 %
Total RES share – production/consumption	5.9 %	6.2 %	7.0 %	10.1 %	9.9 %	11.23 %
Total RES share – RES cooperation included	5.9 %	8.6 %	7.0 %	11.7 %	11.7 %	14.36 %

Sources: EUROSTAT-SHARES

The period 2021 to 2030 is governed by the amended Directive on the promotion of the use of energy from renewable sources (2018/2001/EU), which entered into force on 30 June 2021.

For Luxembourg, the national contribution towards the overall EU target of 42.5 % increases from 25 % (NECP 2020) to 37 % in 2030.9

This increase will require increased efforts, in particular through a continuous, even accelerated and targeted deployment of solar installations both in the residential sectors, increased obligations and financial incentives for new buildings, industrial and tertiary buildings and the use of heat pumps as a reference heating installation in the new building and as a solution to decarbonise existing buildings alongside efficient heating networks.

Alongside national efforts, European cooperation remains an important pillar for achieving the short-, medium- and long-term objectives, whether through cooperation agreements with other States (Luxembourg signed such an agreement with Denmark on 3 October 2022 for the period 2021-2025) or through the EU Renewable Energy Financing Mechanism (REFM). Luxembourg considers that this instrument will become a reference instrument for the development of European cooperation on renewable energy given the size of the national territory and the limited national potential. Luxembourg will remain at the forefront of these calls for applications organised by the European Commission and has participated in the three calls for applications since the launch of the first REFM in 2021.

9 EU-wide assessment of updated draft National Energy and Climate Plans – Table 2 - <https://eur-lex.europa.eu/legal-content/FR/TXT/HTML/?uri=CELEX:52023DC0796>

Table 4: Projected change in sectoral shares to meet the increased targets of the updated NECP

NECP – update	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
RES share – electricity sector%	14.2 %	18.7 %	21.4 %	26.7 %	30.0 %	32.0 %	33.7 %	34.9 %	36.8 %	39.1 %
RES share – heat sector%	11.2 %	15.4 %	16.5 %	23.7 %	25.8 %	28.9 %	31.1 %	33.8 %	36.6 %	40.1 %
Share ENR – Transport **%	8.2 %	8.5 %	8.6 %	9.2 %	10.2 %	12.2 %	15.1 %	18.6 %	22.3 %	27.1 %
Overall RES share – without cooperation%	9.3 %	11.6 %	12.4 %	16.0 %	17.6 %	19.6 %	21.3 %	23.1 %	25.3 %	28.5 %
Overall RES share – with cooperation%	11.1 %	14.7 %	12.4 %	16.0 %	22.8 %	24.2 %	28.5 %	28.5 %	30.6 %	37.6 %
Indicative trajectory and overall target%	11.0 %	13.5 %	11.0 %	11.0 %	22.0 %	11.0 %	28.0 %	11.0 %	11.0 %	37.0 %

* with multipliers (Article 27 Directive 2018/2001/EC) – 27 % minimum threshold

Member States are also obliged to comply with the binding 2020 national target of 11 % for Luxembourg throughout the period.

2.1.2.3 Renewable electricity sector

Renewable electricity production is based mainly on three technologies: wind, photovoltaic and biomass. Wind and PV will remain the two springs with the greatest potential.

Table 5: Production of energy from renewable sources/technologies in the renewable electricity sector 2017-2022 – GWh:

	2017	2018	2019	2020	2021	2022
Hydroelectric	98	104	104	104	104	99
Eolien	185	207	241	291	315	331
Photovoltaics	108	119	130	161	180	276
Solid biomass	52	95	160	266	285	268
Other (biogas, renewable waste, etc.)	121	124	119	108	105	91
Total RES	565	649	754	930	989	1.065
Consumption – electricity sector	7.077	7.117	6.945	6.697	6.954	6.685
Share of renewable energy	7.98 %	9.11 %	10.86 %	13.89 %	14.22 %	15.94 %

Sources: EUROSTAT

In the period 2017 to 2022, the share of renewable electricity increased from 7.98 % to 15.94 % according to EUROSTAT, notably thanks to 3 large cogeneration plants based on solid biomass or scrap wood and the extension of the wind and photovoltaic park. It increased from 565 GWh produced in 2017 to 1.065 GWh in 2022. In 2019, the revision of operational aid for photovoltaic installations, the extension of the framework for beneficiaries of injection tariffs between 30 and 200 kW to all private individuals and companies (previously reserved for cooperative societies), and the various tenders accelerated the deployment of photovoltaic installations. In 2 021.90 MW¹⁰ and 2 022.40 MW in terms of installed capacity were connected, a record in spite of supply difficulties. The

10 ILR – key figures for the electricity market 2021 - <https://assets.ilr.lu/energie/Documents/ILRLU-1685561960-998.pdf>

total installed photovoltaic power in 2022 was 317 MW¹¹. According to the first figures for 2023, some 3.000 plants could be connected for a capacity of around 78 MW.

2022 was marked by crises in the various energy markets and supply problems. The sectors affected include crafts and construction. In order to prevent the loss of operating aid from having a detrimental and dissuasive effect on delays independent of the implementation of the facilities of the investors' will, the degression was temporarily frozen for new plants whose first injection took place in 2023.

It is clear that wind power and photovoltaic are the main drivers of renewable electricity and it is imperative to accelerate their development. The detailed measures are included in the chapter of policies and measures. In order to further accelerate the deployment of these two technologies and with a view to transposing *Article 15c* and *Article 16a* of Directive 2023/2413, renewables acceleration areas should be designated. Authorisation procedures will be accelerated and simplified. Studies will be carried out to identify potential areas that can be designated and legislative and regulatory changes will be introduced to this end.

¹¹ ILR- CLUDED CHIFFERS OF THE ELECTRICITY MARKET 2022 - <https://assets.ilr.lu/energie/Documents/ILRLU-1685561960-1129.pdf>

Table 6: NECP 2020 – projected development of renewable technologies in the renewable electricity sector – GWh

NECP 2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Hydroelectric	94	95	95	96	97	98	98	99	100	100
Eolienne	228	245	288	333	382	436	492	552	613	674
Photovoltaics	303	418	526	650	786	917	1014	1053	1085	1112
Biogas *	66	68	70	73	70	77	82	88	91	93
Biomass solid **	190	194	193	219	228	241	243	254	257	271
RES generation – electricity sector	881	1020	1172	1370	1563	1769	1930	2046	2146	2251
Consumption – electricity sector	6317	6374	6449	6542	6656	6664	6669	6674	6682	6708
RES share – electricity sector	13.9 %	16.0 %	18.2 %	20.9 %	23.5 %	26.5 %	28.9 %	30.6 %	32.1 %	33.6 %

* including: sewage treatment plant gas and landfill gas

** including: discarded wood

Table 7: Updated NECP – Draft evolution of renewable technologies in the renewable electricity sector – GWh

Renewable electricity	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Hydroelectric	104	104	104	104	104	103	103	103	103	103
Eolien	315	330	430	511	699	800	867	903	962	1043
Photovoltaics	180	316	390	480	580	680	780	890	1000	1112
Renewable waste	43	43	44	45	46	47	48	49	49	50
Biogas *	62	67	71	75	79	84	88	92	96	100
Solid biomass **	285	285	290	540	554	568	582	596	610	624
RES generation – electricity sector	989	1145	1329	1755	2062	2282	2468	2633	2820	3032
Consumption – electricity sector	6954	6120	6209	6564	6866	7129	7322	7538	7673	7756
RES share – electricity sector	14.2 %	18.7 %	21.4 %	26.7 %	30.0 %	32.0 %	33.7 %	34.9 %	36.8 %	39.1 %

* including: sewage treatment plant gas and landfill gas

** including: discarded wood

Table 8: Installed capacity of MW installations:

Renewable electricity	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Hydroelectric	35	35	35	35	35	35	35	35	35	35
Eolien	136	143	187	222	304	348	377	393	418	453
Photovoltaics	277	351	433	533	644	756	867	989	1111	1236
Renewable waste	17	17	17	17	17	17	17	17	17	17
Biogas	11	12	12	13	12	13	14	14	15	16
Solid biomass	35	35	36	70	72	74	75	77	79	81

It can be seen that thanks to the input of wind from many *repowering* projects and a third large scrap wood-based cogeneration plant (around 250 GWh of renewable electricity produced), the total renewable electricity generation of the updated NECP is almost 35 % higher than the 2020 NECP for 2030.

Electricity consumption is also likely to be higher, notably due to the deployment of heat pumps and the principle of general electrification of the energy system to decarbonise notably mobility and industry, hence the importance of energy efficiency also for residential and functional buildings. The final electricity consumption of the NECP 2020 was estimated at 6.708 GWh for 2030, the new modelling of final electricity consumption for 2030 shows a sharp increase in electricity consumption to 7.756 GWh due to the above explanations and the assumptions of economic and demographic growth in Luxembourg up to 2030.

In view of Luxembourg's increased efforts in the field of renewable energy development at national level, and despite the projected increase in electricity consumption, Luxembourg now aims at a target of 39.1 % renewable electricity in its final electricity consumption in 2030, which represents a net increase towards the 2020 NECP target (NEC2020 target: 33.6 %). Total electricity generation from renewable energy sources in 2030 will therefore be significantly higher than projected in the 2020 NECP (3.032 GWh instead of 2.251 GWh), an increase of 35 %.

2.1.2.4 Renewable heat sector

The heat sector has seen significant progress in recent years, in particular due to large solid biomass or discarded wood installations and the latter have contributed significantly to the achievement of the objectives in general. For private individuals, the purchase of heat pumps, wood pellet heating or the connection to an urban network is partly financed by a revalorisation of investment aid, called *Klimabonus*, so that renewable heat will also find buyers in the residential sector.

On the other hand, heat consumption increased in 2021 compared to 2020, from 12.834 GWh in 2020 to 13.371 GWh (Source: Statec-Eurostat), but nevertheless experienced a significant decrease in 2022 (11.424 GWh), a year marked by the energy crisis.

Heat consumption is expected to decrease in the coming years due to measures taken either to reduce gas consumption, to clean up residential buildings through aid to individuals (*Klimabonus Wunnen*), or to the strengthening of the agreement

voluntary with industry. More details can be found in section 2.2. “Energy efficiency dimension”.

Centralised heat production includes heat that is distributed through district heating networks to end users, while in the decentralised production system heat is produced at the place of consumption.

Table 9: Production of energy from renewable sources/technologies in the renewable heat sector 2017-2022 – GWh

	2017	2018	2019	2020	2021	2022
Renewable heat consumption	657	600	382	416	424	502
Renewable heat production	287	449	718	1162	1246	1198
Heat pump	29	37	44	49	54	61
Total renewables	974	1.086	1.143	1.627	1.725	1.761
Total consumption sector	12.928	12.816	12.943	12.834	13.371	11.424
Share of renewable energy	7.53 %	8.48 %	8.83 %	12.67 %	12.90 %	15.41 %

Sources: EUROSTAT

Table 10: NECP 2020 – projected evolution of heat production from renewable sources – GWh

NECP 2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Biogas *	125	129	133	138	133	146	155	168	172	176
Solid biomass (centralised) **	581	593	588	619	621	642	638	657	653	672
Solid biomass (decentralised) **	804	842	878	912	955	978	1005	1028	1059	1091
Solar thermal panels	69	80	90	101	115	127	141	156	173	190
Heat pumps (PAC)	114	132	153	178	207	239	277	319	368	422
RES consumption – heat sector	1.692	1776	1843	1948	2030	2133	2216	2328	2425	2551
Consumption – heat sector	11505	11199	10883	10555	10223	9877	9519	9152	8775	8371
Share ENR – Heat –%	14.7 %	15.9 %	16.9 %	18.5 %	19.9 %	21.6 %	23.3 %	25.4 %	27.6 %	30.5 %

* including: sewage treatment plant gas and landfill gas

** including: discarded wood

Heat pumps play an important role in this sector, not only in the residential sector, where new buildings, built after 1^{January} 2023, where they become the reference technology, but also in the industrial or tertiary sector. In addition to the new building, heat pumps will also be implemented at increasing speed in existing buildings during energy renovations. The renovation rate of existing buildings will need to be accelerated in the coming years to decarbonise the building sector until 2050.

Other options will also be explored, such as medium-depth geothermal energy and efficient district heating networks supplied with renewable or waste heat.

Geothermal energy is proving to be a promising technology to support the decarbonisation of the heat sector. It distinguishes between geothermal energy close to the surface (0-15 m), shallow geothermal energy of

up to 400 m and medium-deep geothermal energy from 400 m deep. Shallow or near-surface geothermal energy is mainly used to provide heat to single-family homes or residences in combination with a heat pump. This technology is currently eligible under the Klimabonus schemes *which* provide for state contributions for geothermal heat pumps through vertical sensors (geothermal probes) or horizontal sensors (geothermal basins). While there are therefore already subsidy instruments in place to promote the exploitation of near-surface and shallow geothermal energy, the government aims to develop economic aid instruments to also support the deployment of medium-deep geothermal energy.

Medium-deep geothermal energy is made up of hydrothermal doublets which can reach higher temperatures than shallow systems. This technology should be encouraged for projects with a higher energy need, such as school/sports sites or for heating residential neighbourhoods respectively, the supply of district heating networks.

To determine the potential of deep geothermal energy in Luxembourg, a study has been carried out which showed high potential especially in the south-east and east of the country, mainly in denser areas with a high thermal energy need. In order to exploit this potential in Luxembourg, several pilot projects are currently being analysed. For example for the Neischmelz project in Dudelange or the Mondorf-les-Bains velodrome where feasibility studies are continued.

The above mentioned study concluded that in Luxembourg the estimated thermal input per geothermal doubling can be between 0.45 MW and 0.95 MW depending on the sites studied. The study also points out that the area in the Esch-sur-Alzette – Contern – Mondorf-les-Bains triangle presents the most favourable conditions for the exploitation of medium-depth geothermal energy.

Given that the municipalities of Esch-sur-Alzette, Schifflange and Dudelange are part of energy-intensive areas and have heat demand in excess of 10 GWh/a per municipality in 2030, centralised supply via district heating networks powered by geothermal doubling seems a viable option. In the near future, as an estimate of the potential to decarbonise the use of this technology, it can be assumed that a number of district heating networks could be installed in the above-mentioned enabling region.

At present, the ministries and administrations concerned are working in consultation to facilitate permitting procedures which may represent a major obstacle to the realisation of medium-depth geothermal energy projects.

In Luxembourg there are a number of district heating networks of different sizes. In recent years, the development of district heating networks has involved both the densification and expansion of existing networks and the implementation of innovative low-temperature projects in new neighbourhoods.

It is planned to develop efficient district heating networks based on renewable energy sources and waste heat recovery. While conventional heat networks operate at high temperatures, the fifth generation of district heating networks allows for the integration of low-temperature energy sources, smart management of energy flows and decentralisation of production. The supply of heat through district heating networks is currently not subject to specific regulatory provisions, respectively to a regulatory authority. A specific regulatory framework is planned to define the rights and obligations of district heating operators. In this context, it is currently not possible to accurately quantify the scope and capacity of district heating networks and their contribution to the heat sector.

The government is putting in place the necessary measures to develop district heating and cooling from solid biomass, biogas, solar, ambient, geothermal and waste heat and cold plants. It is planned to carry out analyses at municipal level to identify existing neighbourhoods that could be equipped with district heating networks in an efficient and cost-effective manner. For these networks, it is recommended to use renewable technologies such as heat pumps (geothermal) or solid biomass. This is particularly the case for high-density districts, where individual heat pumps are difficult to implement, can be decarbonised in the future.

In industry, consumption of natural gas was reduced in 2022. In general, gas consumption decreased and cumulatively, the reduction in natural gas consumption was 26 % between April 2023 and March 2024, well above the 15 % voluntary reduction in natural gas demand decided at European level¹². This reduction is linked to energy sobriety efforts, as described above, and

¹² <https://gouvernement.lu/dam-assets/documents/actualites/2024/04/11-objectif-gaz-naturel/20240411-tat-des-des-effort-de-rduction-de-la-consumation-de-gaz-en-mars-2024.pdf>

will need to be complemented in the coming years by deploying less energy-intensive industrial production processes and/or decarbonised energy carriers. Heat pumps will thus decarbonise the production of 'low temperature' heat (up to 150 °C). Certain processes, especially in the steel industry, and in general those requiring temperatures above 800 °C, will be difficult to electrify and will therefore require the use of alternative fuels such as renewable hydrogen (or its derivatives).

The table below shows the overall contribution of renewable energy to the heat sector, as well as the annual increase, the average over the period 2021-2025 and 2026-2030, as well as the average over the whole period 2021-2030.

Table 11: Updated NECP – projected evolution of renewable sources/technologies in the renewable heat sector – GWh

Renewable heat	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Biogas (centralised) – biomethane	30	119	125	132	138	145	151	158	164	170
Solid biomass (centralised)	1203	1300	1310	2050	2068	2103	2139	2177	2217	2259
Solid biomass (decentralised)	132	150	170	190	210	230	250	270	290	310
Renewable waste (centralised)	12	12	12	12	13	13	13	13	13	14
Solar thermal panels	31	35	40	45	50	55	60	65	70	75
Heat pumps (PAC)	54	216	315	438	522	824	999	1177	1376	1555
RFNBO (Industry)	0	0	0	0	0	0	0	35	63	130
RES consumption – heat sector	1463	1832	1973	2867	3001	3369	3612	3895	4194	4514
Consumption – heat sector	11388	11891	11979	12100	11624	11651	11598	11522	11457	11270
RES share – heat sector	11.2 %	15.4 %	16.5 %	23.7 %	25.8 %	28.9 %	31.1 %	33.8 %	36.6 %	40.1 %
Article 23-2023/2413	0.2 %	4.3 %	1.1 %	7.2 %	2.1 %	3.1 %	2.2 %	2.7 %	2.8 %	3.4 %
Average	3.0 %					2.8 %				
Annex I (a)	2.9 %									

* including: sewage treatment plant gas and landfill gas

** including: discarded wood

Table 12: Installed capacity of electrical installations – MW

Renewable heat	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Biogas (centralised) – biomethane	4	15	16	17	18	19	19	20	21	22
Solid biomass (centralised)	154	167	168	263	265	270	274	279	284	290
Solid biomass (decentralised)	17	19	22	24	27	29	32	35	37	40
Renewable waste (centralised)	5	5	5	6	6	6	6	6	6	6
Solar heating panels	16	18	20	23	25	28	30	33	35	38
Heat pumps (PAC)	27	108	158	219	261	412	500	588	688	778
RFNBO (Industry)	0	0	0	0	0	0	0	4	8	17

With a third large industrial scrap wood-based cogeneration plant and the accelerated deployment of heat pumps, the production of heat from renewable sources will continue to grow significantly. The modelling has further demonstrated that the total heat consumption is higher than that calculated in the 2020 NECP for 2030 (11.270 GWh instead of 8.371 GWh). However, the renewable share increases from 30.5 % to 38.7 %, which represents a net increase compared to the ambitions of the 2020 NECP. Total heat production from renewable energy sources in 2030 will therefore be significantly higher than projected in the 2020 NECP (4.514 GWh instead of 2.551 GWh).

Heat production from solar thermal panels could increase less than expected in the NECP to allow for photovoltaic installations in combination with heat pumps.

2.1.2.5 The transport sector

In the transport sector, Directive 2009/28/EC provided for a minimum share of 10 % of energy from renewable sources in total energy consumption (in the transport sector) for 2020, which was achieved with a share of 12.6 % (including

multipliers), thanks to the increased use of biofuels listed in Annex IX to Directive 2009/28/EC, known as ‘double-counting’. Biofuels are incorporated in accordance with the amended Law of 17 December 2010 fixing excise duties and similar taxes on energy products, electricity, manufactured tobacco products, alcohol and alcoholic beverages. The share of renewable energy is expected to increase in the coming years, whether through biofuels, with a focus on advanced biofuels, renewable electricity or synthetic and renewable fuels of non-biological origin.

Since 2020, Luxembourg has limited the use of high indirect land-use change-risk biofuels to 5 %, and intends to decrease its use in the coming years in accordance with Directive (EU) 2018/2001.

In the coming years, the transport sector will undergo substantial changes in view of the continuous increase in electromobility.

Table 13: NECP 2020 – projected evolution of biofuel rates and consumption – transport sector – GWh

NECP 2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Biofuel rates	8.0 %	8.7 %	8.6 %	8.6 %	8.8 %	9.0 %	9.2 %	9.4 %	9.7 %	10.0 %
RES consumption – transport sector	2729	3 066	3 228	3 436	3 755	3 916	4 101	4 305	4 527	4 769
Consumption – transport sector	22164	21735	21282	20919	20454	20098	19688	19317	18989	18601
Share Enr – Consumption with multipliers	12.3 %	14.1 %	15.2 %	16.4 %	18.4 %	19.5 %	20.8 %	22.3 %	23.8 %	25.6 %

The rate of biofuels blended with petrol remained constant during the crisis years, whether the health crisis or the energy crisis. In order to move towards the target set out in Directive (EU) 2023/2413 amending Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources, namely a share of renewable energy in final energy consumption in transport of at least 29 % or a greenhouse gas intensity reduction of at least 14.5 % by 2030, the share of renewable energy will therefore need to increase. As for the 2020 NECP, the projected evolution below is based on a minimum share of renewable energy.

In view of the decision to reduce the input of biofuels produced from food and feed crops by 2 points, Luxembourg can reduce the minimum share of renewable energy in transport accordingly by 2927 %. In addition, the Directive provides for an increase in the share of biofuels listed in Annex IX (a) from 3,5 to 5.5 %, including a minimum share of RFNBO, renewable fuels of non-biological origin, by 1 % by 2030.

After a period marked by the energy crisis, the rate of biofuels to be incorporated into road fuels in 2023 remained unchanged from 2022 to 8.00 %, but increased for 2024 and is set at 8.4 %. The minimum rate of advanced biofuels increases from 0,2 to 0.4 % (after double counting). From 2024 onwards, high indirect land-use change-risk biofuels cannot now exceed 2 % of the biofuels released for consumption, calculated on the basis of the energy content of the fuels.

A legal framework will be put in place in the future for a credit mechanism allowing fuel suppliers to count or exchange renewable electricity supplied to electric vehicles at public recharging points located on national territory.

Table 14: Updated NECP – projected evolution of biofuel rate and consumption in the transport sector – GWh

Transport Sector	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Biofuel incorporation rate%	7.7 %	8.0 %	8.0 %	8.4 %	8.8 %	9.0 %	9.2 %	9.4 %	9.7 %	10.0 %
Fossil fuels	18831	16599	16507	15974	15221	14093	12983	11942	10798	9687
Share of biofuels – road transport	1581	1466	1452	1489	1501	1435	1365	1300	1233	1162
— <i>Single counting biofuels</i>	1047	830	825	799	761	705	649	597	540	145
— <i>Double counting biofuels</i>	534	618	609	655	655	571	419	288	185	271
— <i>Advanced biofuels</i>	0	18	18	35	85	159	297	415	509	746

<i>Share of advanced biofuels –% * *</i>	0.0 %	0.2 %	0.2 %	0.4 %	1.0 %	2.0 %	4.0 %	6.0 %	8.0 %	12.8 %
RFNBO route	0	0	2	10	15	17	22	47	72	98
<i>Road/Rail – RFNBO share</i>	0.0 %	0.0 %	0.0 %	0.1 %	0.2 %	0.2 %	0.3 %	0.7 %	1.1 %	1.7 %
Electricity Transport	172	198	243	301	371	445	520	597	676	755
Renewable share	19	28	34	56	79	119	156	191	228	264
— ENR transport	4	8	13	26	39	71	98	128	159	211
— ENR rail	15	20	21	26	27	37	41	45	47	53
<i>Share of advanced biofuels and RFNBO * *</i>	0.0 %	0.2 %	0.2 %	0.5 %	1.2 %	2.2 %	4.3 %	6.7 %	9.1 %	14.5 %
Consumption – calculation of overall share	1600	1493	1489	1556	1596	1571	1544	1538	1533	1524
Consumption – calculation of the transport sector	1860	1551	1567	1635	1740	1938	2243	2571	2838	3151
Consumption – transport sector	22768	18324	18154	17732	17060	15943	14841	13831	12713	11622
Share of transport sector	8.2 %	8.5 %	8.6 %	9.2 %	10.2 %	12.2 %	15.1 %	18.6 %	22.3 %	27.1 %

* after application of the double counting rule

** without multipliers, to be taken into account for the overall objective

*** with multipliers (Article 27 Directive 2018/2001/EC), to be taken into account for the objective of the transport sector

The amended Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources provides for multipliers for renewable electricity in order to promote renewable electricity in the transport sector and reduce the comparative disadvantage in energy statistics. However, these multipliers are not involved in the final calculation of the overall share of renewable energy.

From 31 December 2023 until 31 December 2030 at the latest, the limit for high indirect land-use change-risk biofuels must gradually decrease to 0 % in accordance with Directive (EU) 2018/2001 and the latter should be replaced by low indirect land-use change-risk biofuels.

In addition to simple counting biofuels, there are so-called double counting biofuels, which are produced mainly from waste oils and can be counted twice. Finally, the share of advanced biofuels produced from waste from other sources must be incorporated into road transport at least 0.2 % in 2022, at least 1 % in 2025 and at least 5.5 % in 2030, of which 1 % must come from synthetic or renewable fuels of non-biological origin ('RFNBO').

As regards multipliers, it is not clear from Article 27 of Directive (EU) 2018/2001 whether multipliers are to be considered in the numerator or denominator, so the Commission's legal interpretation is that they apply to both. The consequence of this interpretation is that the methodology for applying multipliers is no longer comparable to that taken into account when calculating the shares of renewable energy in the transport sector of the NECP 2020.13

Consumption in the transport sector will be linked to the rise and growth of electromobility. Luxembourg also continues to invest significant amounts in the public transport sector such as the rail network or the bus network, and in the construction of relay car parks. A significant share of renewable energy in the transport sector will therefore be covered by electromobility with a target of 49 % by 2030.

With the entry into operation at the end of 2023 of a first service station for hydrogen, a first stage in Luxembourg's hydrogen strategy is on the way to materialise. Admittedly, it is important to note that a station has only a limited effect on the decarbonisation of transport. Indeed, some redundancy in the supply of this energy carrier will be necessary before logistics and public transport actors invest in the purchase of new hydrogen-powered fuel cell electric vehicles. By 2030, this technology can contribute with a certain decarbonisation potential in the transport sector. The situation along the TEN-T (Trans-European Transport Network) corridors and the limited size of Luxembourg are the reasons why renewable hydrogen can offer significant decarbonisation potential for so-called transit transport.

13 <https://ec.europa.eu/eurostat/documents/38154/4956088/SHARES+tool+manual-2021.pdf/11701ebe-1dae-3b00-4da4-229d86d68744?T=1664793455773> (page 18)

In aviation, it is important to increase the supply of synthetic fuels produced from renewable hydrogen. Aviation accounts for a significant share of total energy demand. As additional energy efficiency gains are limited for this sector, and electricity solutions are unlikely in the medium term, the only option to contribute to the decarbonisation of the aviation sector is the use of biofuels or synthetic fuels of non-biological origin produced from renewable hydrogen. The accelerated application of the Sustainable Aviation Fuel (SAFs) and, above all, synthetic fuels of non-biological origin produced from renewable hydrogen is essential for the decarbonisation of this sector which is essential for the Luxembourg economy. With the publication of the REFuelEU Aviation Regulation, an inter-ministerial group is responsible for setting up the various components of the Regulation.

Table 15: REFuelEU trajectory and targets:

Aviation sector	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
<i>Fossil kerosene</i>	7253	7528	7099	7347	7423	7657	7884	8104	8318	8254	7457
<i>Sustainable aviation fuels and RFNBO</i>	0	0	0	0	152	219	289	363	441	521	3522
Total consumption – air transport	7253	7528	7099	7347	7585	7817	8041	8259	8471	8678	10360
<i>Aviation – SAF share</i>	0.0 %	0.0 %	0.0 %	0.0 %	2.0 %	2.0 %	2.0 %	2.0 %	2.0 %	6.0 %	34.0 %
<i>– of which RFNBO</i>	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	1.2 %	10.0 %

An important regulatory change at European level (ongoing trilogue discussion) is expected in 2023. As a result of this change, resulting from the Fit for 55 measures, renewable energy statistics on renewable hydrogen and its derivatives, which will have to be imported in significant quantities into Luxembourg given the limited potential for domestic production to meet demand in the transport and industry sector, could be taken into account for the balance sheet of the Member State in which these energy carriers are consumed. The supply of these energy carriers will have to be secure in the coming years. The different approaches to European cooperation on renewable energy (bilateral and through the REFM) are already preparing the ground. At the end of such a supply, energy will be accounted for in Luxembourg.

2.1.2.6 Photovoltaic

PV plays a central role in the country's energy production and will play a key role in the coming years, due to the overall limited potential of other renewable energy sources in Luxembourg.

As developments in the photovoltaic sector stagnated in 2018 (+ 3 MW of newly installed capacity), operational aid was increased and a first call for tenders for large power plants was launched to give new impetus. The installed powers have increased gradually: 29 MW in 2019, 27 MW in 2020 (health crisis), 90 MW in 2021, 140 MW in 2022 and previsibly 78 MW in 2023 (unofficial figures) despite the period of multiple crises. The total number of power stations connected at the beginning of 2024 was around 14.000 units.

This is due to the increase in operational aid in 2019, the opening up of power categories from 30 kW to 200 kW to all natural and legal persons (which alone contributed around 30 MW in 2021) and the various calls for tenders organised by the State. In the five tenders published since 2018, 81 MW of power could be awarded, the result being partly affected by multiple crises (pandemic, cost spike, energy crisis, supply chain, lack of skilled labour). For this reason, the models of the evolution of installed capacity had to be adapted and new measures envisaged compared to the 2020 NECP. Delivery difficulties can be alleviated by the production of photovoltaic panels on national territory with a capacity to produce panels of around 50 MW per year.

Table 16: Projected evolution of PV production of PNEC 2020 and updated NECP – GWh

Photov	2026	2027	2028	2029	2030
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	2021	2022	2023	2024	2025					
oltaid										
NECP 2020	303	418	526	650	786	917	1 014	1 053	1 085	1 112
Updated NECP	180	316	390	480	580	680	780	890	1 000	1 112

In order to achieve the ambitious PV targets, measures will need to be stepped up – the 90 MW of the year 2021 showing that the targets can be met. Part of this effort has already been started, respectively accelerated as a result of the multiple crises that caused an increase in the price of electricity. The measures described below, already under way or with a view to completion, may be named.

The results of the first five tenders were mixed. The first four were published before the surge in electricity prices, which highlighted the need for an advantage from renewables, in particular by increasing the possibility of self-consumption. To support this trend, a first special tender for self-consumption was launched, allocating a budget of EUR 30 million with investment support. After its closure, the budget used amounts to EUR 16 million for an allocated power of 46.3 MW – the best result of a tender to date, so a second call for tenders was published in July 2023. The latter reported 33.4 MW. As regards regular tenders offering operational support, the results of the fifth are rather mixed with an allocated capacity of 6 MW. It will be necessary to analyse the results of the two calls for tender, draw conclusions and improve this instrument with a view to the 2030 objective.

In view of the ambitious PV targets, other installations will be needed in the future to achieve the ambitious targets: large scale plants on vague land. However, due to their direct footprint, these solar parks are often seen as competition for agricultural activity. A promising technology to combine agricultural production with renewable energy production by protecting crops against climatic hazards and by promoting a transition to a more environmentally friendly agriculture is agrivoltaic ('agri-PV'). This technology is the combination of agricultural production as primary use and production of electricity from a photovoltaic system as secondary use on the same surface. In October 2022, a pilot call for tenders for pilot projects for the construction and operation of agri- PV plants on agricultural land was launched. The objective of this invitation to tender is to carry out pilot projects adapted to the specific characteristics of Luxembourg agriculture with scientific monitoring to validate the concept of agrivoltaïsm in terms of energy, agriculture and the environment in Luxembourg. 22 tenders were submitted for this first "agri-PV" invitation to tender and 14 were selected for a capacity of 53 MW, a very good impact on stakeholders.

On the basis of the results of the call for tenders for pilot projects, an evaluation is ongoing and will be finalised in the short term with a view to deciding on a future strategy for agri-PV.

In addition to the various invitations to tender, the possibility offered by 'Council Directive (EU) 2022/542 of 5 April 2022 amending Directives 2006/112/EC and (EU) 2020/285 as regards rates of value added tax' was seized by Luxembourg and the VAT rate for photovoltaic plants was reduced by 17 % to the super-reduced rate of 3 %. As regards the obligation to declare electricity generation income in the personal tax return, the power limit below which revenues generated by a PV plant are not to be declared has been raised from 4 kW to 10 kW as of the fiscal year 2021 and is increased to 30 kW following the third tripartite agreement concluded in March 2023.

Installing photovoltaic on surfaces already built, impermeable or impactful by infrastructure remains the government's priority. In order to achieve this, several new measures are envisaged.

It is also planned to introduce pre-financing of state aid for photovoltaic installations – the customer will have to pay only the difference between the total cost and the State subsidy which is directly applied to the final invoice. This will facilitate investments in PV installations and make them more attractive and affordable.

A legal framework will be put in place for the introduction of a standard for photovoltaic plants on new buildings to provide

for installations (e.g. cable ducts) for the future installation of photovoltaic panels (PV-Ready). It is important to create greater market visibility and support for large, small and artisanal businesses in the energy transition from the start of building construction. In the field of buildings in co-ownership, an amendment to the related law tries to facilitate energy works, including the installation of photovoltaic plants. From 1^{January} 2025, each new industrial building must be designed in such a way as to be able to accommodate a photovoltaic installation on its roof. Another avenue to be explored would be to facilitate the installation of PV *plug and play power stations*.

In addition to these measures, it is planned to introduce a support measure for those who do not have the financial means to install a photovoltaic installation at home. Both owners and tenants are targeted. With the possibility of self-consumption of the electricity produced in this way, the State pursues a twofold objective: installation of photovoltaic panels on roofs where it is difficult to promote the development of renewable energies and give the most vulnerable people financial support by reducing part of their electricity bills.

It is still up to the State to take an exemplary role. The State will install photovoltaic panels on all its new buildings with a view in particular to self-consumption and will analyse the extent to which photovoltaic installations can be built along the motorways or on the various sections and railways. This study has been launched and will try more broadly to encompass all nearby land belonging to the State in order to assess the related potential. By 2030, the State therefore aims to cover the majority of the electricity consumption of its real estate by means of photovoltaic installations on national territory. This objective includes the project of equipping all public car parks with photovoltaic shells until 2030 (with the exception of possible cases of technical or regulatory impossibility).

Lastly, it is intended to facilitate permit procedures by identifying potential reductions, and by drawing up standard formulations in the urban planning rules of the municipalities, which may vary (significantly) from one municipality to another with different levels of restrictions. With the entry into force of Council Regulation (EU) 2022/2577, permit procedures for photovoltaic installations are subject to one-month deadlines with tacit agreement for installations with a total capacity of less than or equal to 50 kW, which includes the majority of installations in the residential sector. All other photovoltaic installations must be processed within 3 months. Luxembourg is considering the removal of the requirement of the construction permit for small-scale photovoltaic installations on residential buildings.

In order to achieve the production targets, the additional capacity to be installed per year must exceed 100 MW.

2.1.2.7 Eolien

Alongside photovoltaic, wind energy will play a key role in achieving renewable energy targets and the figures for installed capacity already show that the targets are significantly exceeded in the event of continuous and ambitious efforts.

Table 17: Projected evolution of wind energy production of the NECP 2020 and the updated NECP – GWh

Eolien	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
NECP 2020	228	245	288	333	382	436	492	552	613	674
Updated NECP	315	330	430	511	699	800	867	903	962	1043

The current wind farm currently has 62 wind turbines with a total installed capacity of 166 MW (January 2023). Over the next few years, this capacity is expected to increase, in particular thanks to technological progress and ‘Repowering’ offering more powerful wind turbines, with higher annual production hours. It will now be easier to reconcile species protection with the development of wind energy by using innovative technologies to detect birds and bats, which can deactivate wind turbines when needed. This technology makes it possible to increase annual production hours and thus make built-in sites that were previously unprofitable.

In Luxembourg, there are a limited number of project promoters specialising in wind energy. The implementation of the projects depends largely on the wind conditions on the site and on the possibilities for connection to the electricity grid.

The wind potential is mainly concentrated in the northern part of the country, in the canton of Clervaux, and is limited by the size of the national territory, Natura 2000 protection areas, urbanised areas or areas reserved for radar coverage for aviation.

There are, however, untapped opportunities for the time being, such as installing wind turbines on industrial sites or near roads. Legal changes have been made to allow wind turbines to be installed in these areas. Preliminary feasibility analyses will be carried out in consultation with the competent security administrations.

Another and not least facilitation concerns the granting of permits related to operational projects where different tracks are analysed for the facilitation of permitting procedures in view of the outcome of the REPowerEU plan to further accelerate the deployment of renewable energy. Regulation (EU) 2022/2577 imposes a maximum period of 6 months for Repowering projects and removes the need to carry out an environmental impact assessment under the conditions laid down in that Regulation. These provisions are taken over in Directive 2023/2413 (RED III), with slight changes compared to Regulation 2022/2577.

In order to improve public acceptance and enable the active participation of citizens and municipalities in the energy transition, an obligation is introduced to offer the municipalities and citizens affected by the installation of wind turbines the investment in the capital of companies developing wind energy respectively.

As part of the *European Wind Power Action Plan*, which provides for a wind capacity to be installed for the Union of 500 GW by 2030, Luxembourg is following very closely the developments in the plan and is therefore working to increase wind capacity by facilitating permitting procedures, establishing a catalogue of procedures, involving residents in wind projects and establishing a wind register – measures which are already envisaged at national level as described above.

Even without access to the sea, Luxembourg intends to participate in offshore wind projects via the NSEC group (see NSEC chapter).

2.1.2.8 Biogas

Since 2018, there has been stagnation in the development of the biogas sector, despite the regulatory changes governing the production of electricity from biogas and the injection of biomethane into the natural gas network. In order to relaunch the biogas sector, the 2018 coalition agreement provided for a technical-economic analysis, with the premise of prioritising biogas production from manure. In February 2021, a study setting out the state of play and scenarios for the development of the sector, while highlighting the environmental aspects of biogas, was finalised. The study identified great potential in terms of biomethanisation of livestock manure and environmental measures aimed at reducing emissions during plant operation and optimising digestate management. On the basis of the results of this study, the Government adopted on 26 March 2021 the guidelines for the development of the national biogas strategy.

As part of the national biogas strategy published in June 2023, the government set itself the targets of using 50 % of the manure deposit with a maximum of 1.0 million tonnes per year, mobilising 75 % of the potential of bio-waste and greenery waste as defined by the Law of 21 March 2012 on waste management and, taking into account the objectives of the waste and resource management plan (2018), and limiting the area devoted to energy crop production to 1.500 ha. In order to promote the recovery of livestock manure and to take account of new operating conditions aimed at reducing greenhouse gases, the guidelines provide for a revision of the remuneration for the production of electricity from biogas and for the injection of biomethane into the natural gas network. The promotion of biogas production is also part of the European Commission's REPowerEU plan to accelerate the energy transition and reduce Europe's energy dependence on unreliable suppliers and volatile fossil fuels.

From 2023, biogas plants with a total rated thermal input equal to or greater than 2 MW producing electricity, heat and cooling and biogas injection plants with or without injection characteristics that would potentially enable injection with a production capacity equal to or greater than 19.5 GWh of gross calorific value per year must comply with the sustainability and greenhouse gas emissions saving criteria laid down in Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources. Some of these provisions will be adapted with the implementation of Directive 2023/2413. Concernant for waste water treatment plant gas and

landfill gas, with a moderate increase in electricity and heat production expected by 2030.

Table 18: Projected evolution of energy production from biogas from NECP 2020 and updated NECP – GWh

Biogas * electrified	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
NECP 2020	66	68	70	73	70	77	82	88	91	93
Updated NECP	62	67	71	75	79	84	88	92	96	100
Biogas * heat	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
NECP 2020	125	129	133	138	133	146	155	168	172	176
Updated NECP	30	119	125	132	138	145	151	158	164	170

* including: sewage treatment plant gas and landfill gas

2.1.2.9 Sustainability and greenhouse gas criteria

The sustainability and greenhouse gas emissions saving criteria for biofuels, bioliquids and biomass fuels laid down in Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources have been transposed into national law by the Grand-Ducal Regulation of 3 February 2023 laying down sustainability and greenhouse gas emissions saving criteria for biofuels, bioliquids and biomass fuels. Biofuels, bioliquids and biomass fuels, used to meet the EU renewable energy target and subject to support schemes, must meet the sustainability and greenhouse gas emissions saving criteria. The sustainability and greenhouse gas emissions saving criteria shall apply to:

- solid biomass fuels if used in installations with a total rated thermal input equal to or greater than 20 MW producing electricity, heating and cooling or fuels;
- biogas if used in installations with a total rated thermal input equal to or greater than 2 MW producing electricity, heat and cooling;
- biogas injected into a natural gas network, or biogas without injection into natural gas networks and the characteristics of which would potentially allow for injection if it is produced in an installation with a production capacity equal to or greater than 19.5 GWh of gross calorific value per year.

The economic actors concerned must provide evidence of independent scrutiny using voluntary national or international schemes authorised by the European Commission.

Directive 2023/2413 also provides for adaptations here, in particular that the criteria should apply in the case of solid biomass fuels, in installations producing electricity, heating and cooling with a total rated thermal input equal to or greater than 7.5 MW.

2.1.2.10 Solid biomass

In recent years, energy production from solid biomass and scrap wood is mainly concentrated on large CHP plants. By transposing the provisions of Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources, solid biomass plants with a total rated thermal input of 20 MW or more have to comply with the sustainability and greenhouse gas emissions saving criteria from 2023 onwards. This threshold will fall to 7.5 MW with the transposition of Directive 2023/2413.

The government's bioenergy strategy is aligned with the principle of cascading use of biomass. Future aid schemes shall take into account the availability of biomass for energy and non-energy uses, the protection of forest ecosystems, the principles of the circular economy and the cascading use of solid biomass. In line with the cascading principle, woody

biomass should be used according to its highest economic and environmental added value, in the following order of priority: (1) wood-based products, (2) lifetime extension, (3) reuse, (4) recycling, (5) energy recovery and (6) disposal. Where no use of woody biomass is economically viable or environmentally appropriate, energy recovery shall help reduce the production of energy from non-renewable sources.

The potential for solid biomass focuses on a supply basin formed by countries and border regions (including the Greater Region) to reduce transport-related greenhouse gas emissions.

Given the limited potential for solid biomass, the government is considering making changes to support schemes for new power plants producing electricity from solid biomass. It is expected that the development of solid biomass plants will increase somewhat until 2030 and then stabilise. The increase in production from solid biomass is mainly based on discarded wood (671 GWh). With regard to the limited resources of solid biomass, there are no plans to substantially increase the use of solid biomass. The principle of cascading use of wood will be strengthened. In the medium term, the use of solid biomass for energy production in the heat sector will decrease and be continuously replaced by energy from heat pumps by hydrogen-fired boilers – mainly for boilers supplying heat networks.

Table 19: Projected evolution of energy production from solid biomass (including scrap wood) of the 2020 NECP and the updated NECP – GWh

Solid biomass – electricity	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
NECP 2020	190	194	193	219	228	241	243	254	257	271
Updated NECP	285	285	290	540	554	568	582	596	610	624
Solid biomass – heat *	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
NECP 2020	1385	1435	1466	1532	1576	1621	1643	1685	1712	1763
Updated NECP	1335	1450	1480	2240	2278	2333	2389	2447	2507	2569

* Centralised and decentralised solid biomass

2.1.2.11 Heat pumps

Regulatory requirements for energy efficiency in residential and functional buildings have had a major impact on the development of heat pump systems. This technology is in line with the objective of decarbonisation through the electrification of the building sector. From 2023 onwards, the heat pump shall be used as a reference heating when the energy performance certificate for a new building is drawn up. Heat pumps can be combined with photovoltaic installations favouring self-consumption of the electricity produced. The geothermal heat pump on the other hand allows the use of geothermal energy and offers higher energy efficiency for aerothermal heat pumps, which also makes it attractive for an application in the existing building.

For existing buildings hybrid systems with heat pumps are a transitional solution to decarbonise the staged heating with a view to complete energy remediation. Compared to the 2020 NECP, the projected evolution shows a strong acceleration. This trend is linked, inter alia, to the regulatory requirements mentioned above but also to the continuation of State aid schemes for heat pumps (Klimabonus Wunnen). The deployment of heat pumps will reduce dependence on natural gas imports.

The heat potential of heat pumps in 2030 is estimated at around 1.555 GWh/a compared to 422 GWh modelled for the 2020 NECP.

Table 20: Projected evolution of heat production from heat pumps of PNEC 2020 and updated NECP – GWh

Heat pumps	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
NECP 2020	114	132	153	178	207	239	277	319	368	422

Updated NECP	54	216	315	438	522	824	999	1177	1376	1555
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2.1.2.12 Hydrogen

As announced in the 2020 NECP, Luxembourg’s hydrogen strategy was adopted on 8 July 2021 by the Government and the document was presented to the public on 28 September 2021. This document presents the political aspects and ambitions at different levels (national, regional, international) and the 7 measures planned by the Luxembourg government to develop a renewable hydrogen market.

These include cooperation in infrastructure and certification, implementation of flagship or pilot projects, identification of supply, import and demand potentials, development of financial instruments to stimulate supply and demand, for example through operating aid or investment aid as for other renewable energies, and the deployment of hydrogen service stations, the first installation of which is under construction and will be put into operation in 2023.

The strategy was drawn up under the initiative of the Ministry of Economy and finalised in close consultation with the Ministry of Environment, Climate and Biodiversity, the Ministry of Research and Higher Education, the Ministry of Finance, the Ministry of Mobility and Public Works and the Ministry of Foreign and European Affairs, Defence, Cooperation and External Trade (Directorate for Cooperation and Humanitarian Action). With the adoption of the hydrogen strategy, the two levels of the Task Force H₂ Luxembourg were launched. Under the coordination of the Directorate-General for Energy of the Ministry of Economy, the Steering Committee met for the first time in September 2021 and on a quarterly basis since then, and a first meeting of the Task Force H₂ Luxembourg with stakeholders from the various sectors took place in November 2022 to continue consultations to ensure that the various measures of the strategy are implemented.

With a view to developing an aid instrument to subsidise the production and consumption of renewable hydrogen in Luxembourg, the Department of Energy works with an external consultant using the TaskForce H₂ Luxembourg platform for consultation with stakeholders. It is planned to launch the first call for tenders with a view to carrying out pilot projects in Luxembourg under this instrument in the course of the 2024 financial year.

Alongside efforts at national level, Luxembourg regularly participates in meetings of international groups (Greater Region, Benelux Union, Pentalateral Energy Forum (PLEF), North Seas Energy Cooperation (NSEC), and Hydrogen European Network HyENet) in order to promote Luxembourg positions, including the development and regulation of a future (trans-European) hydrogen infrastructure.

Following the preparation and adoption in May 2020 of a political declaration by the Ministers of the Pentalateral Energy Forum countries (Benelux, in cooperation with Germany, Austria, France and Switzerland), Luxembourg contributed to the development and adoption of a common paper on the regulatory framework for the future hydrogen market and infrastructure in Europe. At the initiative of Luxembourg, and under the Luxembourg Presidency in 2022, the Hydrogen Working Group within the Benelux Secretariat launched a study in the context of the objectives of decarbonising society, on future hydrogen infrastructure needs in the Benelux region and interconnections with neighbouring regions, a study which, following a call for tenders, was entrusted to an external consultant and whose report is currently being finalised.

At national level, two studies were launched in 2022 which have an impact on the hydrogen sector because it appears that, especially in industry, significant demand can emerge faster than foreseen in the national strategy. Indeed, an industry decarbonisation study and a study on the decarbonisation of the road transport sector (logistics) show that demand for hydrogen will be able to materialise already before the end of the decade. It is important to recall that the strategy had identified a total demand potential of between 4.000 and 10.000 GWh (renewable H₂) that would contribute to the decarbonisation of society and thus to the objective of climate neutrality.

The coordinated deployment of a cross-border hydrogen pipeline infrastructure, not only to ensure the transport of hydrogen to Luxembourg to meet the above-mentioned demand, but also useful in terms of transit, is a priority. It is useful to also take into account the potential for demand for hydrogen in neighbouring regions of the Grand Duchy, as identified in the study carried out at Benelux level and neighbouring regions. Close collaboration with the Luxembourg natural gas transmission system operator as well as with the natural gas transmission system operators of neighbouring countries has

been initiated. Luxembourg is working to ensure a connection to a European Hydrogen Infrastructure that will allow the delivery of large quantities of hydrogen in order to meet emerging demand to decarbonise hard-to-electrify sectors and processes. It is estimated that a first hydrogen pipeline could be put into service around 2035.

Table 21: Projected evolution of the production of hydrogen consumption of the NECP 2020 and the updated NECP – GWh

Hydrogen	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
NECP 2020	0	0	0	0	0	0	0	0	0	0
Updated NECP – Total consumption	0	0	2	10	15	20	25	85	138	230
Industrial consumption	0	0	0	0	0	0	0	35	63	130
Consumption in road transport	0	0	2	10	15	17	22	47	72	98

The projected evolution shows hydrogen needs in road transport as well as in industry, replacing fossil energy carriers. Given that hydrogen transport infrastructure through pipelines cannot be achieved before 2030, ideally the production of this renewable hydrogen will be located in the national territory. In the aviation sector the share of hydrogen is expected to reach 104 GWh in 2030, due to the planned RNFB0 target for the aviation sector of 1.2 % of total kerosene consumption.

2.1.2.13 European cooperation

The current framework for cooperation on renewable energy is set out in the amended Directive (EU) 2018/2001.

However, it can already be differentiated between four types of cooperation:

- Statistical transfers from one Member State to another (Article 8 – Directive 2018/2001/EC): at the end of each financial year, a Member State which has achieved a surplus of renewable energy statistics over its target may decide to cooperate and transfer (part of) this surplus to a Member State with a need for statistics to achieve its target. This is an instrument that has already been successfully used in the past by Luxembourg.
- Joint projects within the EU or with third countries in the case of physical interconnection with the Union (Articles 9, 10, 11 and 12 – Directive 2018/2001/EC): in order to exploit the most attractive renewable energy potential, two countries may, in bilateral coordination, develop joint projects with the possibility to contribute financially upstream to a project for which renewable energy statistics are shared fairly according to annual production. In principle, such projects generate significant administrative work during implementation, so that they are more difficult to implement.
- Union renewable energy financing mechanism – REFM (Article 31 – Regulation 2018/1999/EC): It is an instrument in which Luxembourg participated in the first three calls for applications. The second call was successful and a call for tender was launched and 8 photovoltaic projects to be carried out in Finland were selected. This instrument also makes it possible to ensure upstream statistical quantities transferred annually according to the production of the financially supported power stations. This mechanism allows countries with lower renewable energy potential to contribute to the construction and operation of more productive sites or plants in terms of renewable energy outside their territory, e.g. offshore wind in the North Sea, or photovoltaic in the Mediterranean.
- Import of renewable fuels of non-biological origin for the substitution of fossil fuels in industry or transport in Luxembourg (provided for in Article 22a – Recast of Directive 2018/2001/EC): Consumption and not production will be decisive for the statistical calculation of renewable energy molecules such as renewable hydrogen and its renewable derivatives. These molecules can be imported into the EU, or from third countries with interesting potential for renewable hydrogen production. Luxembourg is following this development very closely and will seek to create new synergies on renewable energy, in particular in the field of renewable hydrogen. The Luxembourg industry and the transport difficult to electrify (aviation and transit logistics) will need these molecules and, contrary to the methods of accounting in the electricity market, here the consumer Member State could benefit from the statistics.

2.1.2.13.1 Bilateral cooperation agreements – statistical transfers

During the period 2018 to 2020 and still under the auspices of Directive 2009/28/EC, Luxembourg had concluded two cooperation agreements with Lithuania and Estonia. For the statistical year 2020, Luxembourg acquired 650 GWh equally from Estonia and Lithuania, and thanks to national efforts and cooperation, the 11 % target was exceeded with a share of 11.70 %.

Following this excellent experience of European cooperation, a cooperation agreement was concluded with Denmark for the period 2021-2025, taking into account the objectives and forecasts set out in the 2020 NECP. Following the conclusions of ‘Fit for 55’ and ‘REPowerEU’ and the European Commission’s recommendations of 18 December 2023, the indicative trajectory and the final target will have to be adjusted and additional amounts will have to be procured for at least the years 2025, 2027 and 2030.

Table 22: Quantities to be procured in the framework of European cooperation according to the NECP 2020 – GWh

Quantities of cooperation	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
NECP 2020	1075	1150	1 225	1 299	1 374	1 449	1 524	1 599	1 674	1 748
Updated NECP	800	1200	0	0	1950	1700	2600	1900	1800	2900

Talks have also taken place with Lithuania, Estonia and Portugal, and given the close relationship between the last two countries, not only a Memorandum of Understanding for a cooperation agreement is envisaged, but also cooperation in terms of renewable hydrogen production, either directly, through joint projects, or through the Renewable Energy Financing Mechanism (REFM).

2.1.2.13.2 EU Renewable Energy Financing Mechanism – REFM

In addition to cooperation agreements, Regulation 2018/1999 on the Governance of the Energy Union and Climate Action provides for a financing mechanism for EU renewable energy, where two calls for applications have already been organised by the European Commission and in which Luxembourg has participated each time and intends to continue to do so in future publications, as a contributing Member State.

After a first unsuccessful call for applications, due to a lack of successful projects on the side of host Member States (countries carrying out projects on their territory), Luxembourg again participated in the second call for applications launched on 4 March 2022. Luxembourg committed itself in February 2023 with a budget of EUR 40 million with a host country, Finland, which submitted sufficient capacity to the mechanism. According to the distribution, 80 % of the energy produced is statistically returned to Luxembourg; transfers will thus reach around 150 to 200 GWh per year.

Following the successful conclusion of the first call for tenders on 27 September 2023, 8 photovoltaic projects with a total capacity of 282.77 MW were selected¹⁴.

All applications having passed the eligibility check and meeting the minimum quality requirements were ranked according to the price of their tender, starting with the lowest price. In 2025, the quantities expected will therefore be expected to be included in national statistics.

2.1.2.13.3 European Cooperation 2026 to 2030

For the period 2026 to 2030, the need for cooperation increases by considering the ‘Fit for 55’ and ‘REPowerEU’ packages, which mean that the Union’s and thus national targets are revised upwards. As renewable energy potentials are limited in Luxembourg, it will be increasingly important to turn to these European cooperation mechanisms, be it REFM or

¹⁴ https://energy.ec.europa.eu/news/eu-renewable-energy-financing-mechanism-eu40-million-awarded-8-solar-pv-projects-2023-11-14_en

cooperation agreements.

The quantities to be procured following 'Fit for 55' and 'REPowerEU' are higher than those foreseen in the 2020 NECP.

Table 23: Quantities to be predicted Fit for 55/REPowerEU – without additional measures – GWh

	Objective 2030 NECP 2020	Objective 2030 (37 %) updated NECP
Renewable energy production at national level	6287	9069
Quantity required per European cooperation (REFM and statistical transfers)	1748	2900
Sum – National production and cooperation	8035	11969
Adjusted national final energy consumption *	32141	31812
Share Enr – Production/Consumption – Cooperation included	25 %	37.6 %
Objective 2030	Min. 25 %	Min. 37 %

* see chapter on 2.1.2.14 Interim package and overall objective

With the increase in the targets, Luxembourg's participation in the REFM needs to be revised upwards in order to build a more stable time base for renewable energy in national statistics. As REFM is currently the cheapest and much more concrete way of achieving the objectives than statistical transfers, it should be preferred.

For example, provided that European countries are determined to use this instrument as a reference instrument for European cooperation in the field of renewable energy, to meet around half of the cooperation needs through the REFM. As the lead times for projects financed under the REFM are at least 1-2 years, the following quantities could be reached with the REFM by 2030.

Table 24: Estimated quantities acquired by the REFM – 2023-2030

	Provisional commitment REFM [GWh]	Cumulative REFM output – Annual production [GWh]
2023	200	
2024	300	
2025	300	
2026	400	200
2027	400	500
2028	400	800
2029	400	1200
2030	400	1600

European cooperation in the field of renewable energy could take between 200 and 400 GWh per year. The costs to be associated with these projects range from EUR 40 to 80 million per year. It can be expected that the costs per unit of renewable energy produced from this mechanism will decrease in the future and will be around EUR 10-13/MWh or less. It should also be noted that once the pillar of European cooperation reaches a sufficiently high level thanks to the REFM, annual expenditure on participation in annual calls for projects will decrease again (probably from 2031).

The quantities not reached by the REFM will have to be achieved by statistical transfers (there are binding targets for the years 2025, 2027 and 2030). With the assumptions mentioned above, a need for statistical transfers for 2030 of

1.300 GWh is expected.

In view of the European Commission's recommendations of 18 December 2023 on the draft update of the NECP, the interim targets for 2025 and 2027 have been adjusted to 22 % and 28 % respectively (NECP 2020-17 % in 2025 and 20 % in 2027). The instrument of statistical transfers will enable these intermediate targets to be achieved in order to smooth the path pursued. With an average price of EUR 14/MWh, the annual cost in 2030 will be around EUR 18.2 million.

The evolution of national renewable energy production and gross final energy consumption in the coming years will show whether the needs in terms of the quantities of statistical transfers to be acquired will need to be adjusted.

2.1.2.14 intermediate trajectory and overall target

Table 25: Share of renewable energy by sectors and overall by 2030 – PNEC 2020 – GWh

NECP 2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
RES share – electricity sector	13.9 %	16.0 %	18.2 %	20.9 %	23.5 %	26.5 %	28.9 %	30.6 %	32.1 %	33.6 %
RES share – heat sector	14.7 %	15.9 %	16.9 %	18.5 %	19.9 %	21.6 %	23.3 %	25.4 %	27.6 %	30.5 %
Share ENR – Transport	12.3 %	14.1 %	15.2 %	16.4 %	18.4 %	19.5 %	20.8 %	22.3 %	23.8 %	25.6 %
Overall share – without cooperation	10.2 %	11.2 %	11.9 %	12.8 %	13.9 %	15.0 %	16.1 %	17.2 %	18.3 %	19.6 %
Overall share – with cooperation	12.8 %	14.1 %	15.0 %	16.2 %	17.6 %	19.0 %	20.4 %	21.9 %	23.3 %	25.0 %
National RES production	4247	4547	4691	4920	5156	5449	5677	5890	6071	6287
European cooperation	1075	1.150	1.225	1.299	1374	1.449	1.524	1.599	1.674	1748
RES production + European cooperation	5322	5696	5916	6220	6530	6898	7201	7488	7745	8035
Adjusted gross final energy consumption	41475	40428	39380	38381	37203	36276	35248	34231	33232	32140
Overall RES share –%	12.8 %	14.1 %	15.0 %	16.2 %	17.6 %	19.0 %	20.4 %	21.9 %	23.3 %	25.0 %

Table 26: Share of renewable energy by sector by 2030 – updated NECP – GWh

Indicative trajectory and overall target	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
National RES production	4052	4470	4790	6177	6658	7222	7624	8066	8548	9069
European cooperation	800	1200	0	0	1800	1700	2600	2000	2000	2900
<i>of which statistical transfers</i>	800	1200	0	0	1800	1500	2100	1200	800	1300
<i>of which REFM</i>	0	0	0	0	0	200	500	800	1200	1600
RES production + European cooperation	4852	5670	4790	6177	8458	8922	10224	10066	10548	11969
Final energy consumption	47787	43425	43006	43281	42704	42099	41340	40699	39844	38134
Aviation	7253	7528	7099	7347	7585	7817	8041	8259	8471	8678
– Current share Aviation	15.2 %	17.3 %	16.5 %	17.0 %	17.8 %	18.6 %	19.5 %	20.3 %	21.3 %	22.8 %
– Aviation threshold = 6.18 %	6.18 %	6.18 %	6.18 %	6.18 %	6.18 %	6.18 %	6.18 %	6.18 %	6.18 %	6.18 %
Adjusted gross final energy consumption	43488	38580	38565	38610	37758	36884	35854	34955	33835	31812
Overall RES share	11.2 %	14.7 %	12.4 %	16.0 %	22.4 %	24.2 %	28.5 %	28.8 %	31.2 %	37.6 %
Indicative trajectory and overall target	11.0 %	13.5 %	11.0 %	11.0 %	22.0 %	11.0 %	28.0 %	11.0 %	11.0 %	37.0 %
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
RES share – electricity sector	14.2 %	18.7 %	21.4 %	26.7 %	30.0 %	32.0 %	33.7 %	34.9 %	36.8 %	39.1 %
RES share – heat sector	11.2 %	15.4 %	16.5 %	23.7 %	25.8 %	28.9 %	31.1 %	33.8 %	36.6 %	40.1 %
Share ENR – Transport *	8.2 %	8.5 %	8.6 %	9.2 %	10.2 %	12.2 %	15.1 %	18.6 %	22.3 %	27.1 %
European cooperation	800	1200	0	0	1800	1700	2600	2000	2000	2900
Overall RES share – without cooperation	9.3 %	11.6 %	12.4 %	16.0 %	17.6 %	19.6 %	21.3 %	23.1 %	25.3 %	28.5 %
Overall RES share – with cooperation	11.1 %	14.7 %	12.4 %	16.0 %	22.4 %	24.2 %	28.5 %	28.8 %	31.2 %	37.6 %
Indicative trajectory and overall target	11.0 %	13.5 %	11.0 %	11.0 %	22.0 %	11.0 %	28.0 %	11.0 %	11.0 %	37.0 %

The table comparatively shows the sectoral shares and the overall share achieved by 2030. The comparison shows that the measures and policies will have a positive impact on the different sectors, be it photovoltaic and wind power and heat pumps for the heat sector, as well as the influence of energy efficiency measures.

One parameter plays a significant role, aviation heading, as Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources provides for the calculation of a Member State's gross final consumption of energy that the share of energy consumed in aviation is to be considered as not exceeding 6.18 % of the Member State's gross final consumption of energy, which implies an adjustment of gross final energy consumption.

2.2 energy efficiency dimension

The modelling underpinning the definition of national energy efficiency targets has been drawn up by STATEC, in close cooperation with the experts of the ministries directly concerned for the various sectors, in particular as regards the definition of calculation assumptions and the impact of the various policies and measures (PaMs).

The basis for this modelling is the STATEC NEAM and ThreeME models. The NEAM model takes into account national projections for economic developments and thus changes in GDP, population, employment, number of border residents, residential areas, tertiary, industrial and construction activities, etc., as summarised in the table below.

Table 27: Economic indicators used in NEAM (economic developments)

Indicator	Unit	2020	2025	2030	2035	2040
GDP	billion EUR	59.4	67.4	77.6	85.7	95.7
Population	1000 persons	634.7	698.6	751.4	798.1	843.6
Employment	1000 persons	471.6	537.7	594.5	633	671.9
Frontier workers	1000 persons	205.4	240.3	273.2	294.8	316.6
Residential buildings	million m ²	32.4	36.7	40.7	44.5	48.4
Non-residential building area	million m ²	13.0	14.7	16.2	17.2	18.2

Sources: STATEC (2024) (WAM scenario)

Clarify that certain policies and measures taken into account in the WAM scenario have a positive impact on the development of the Luxembourg economy and consequently on the economic indicators.

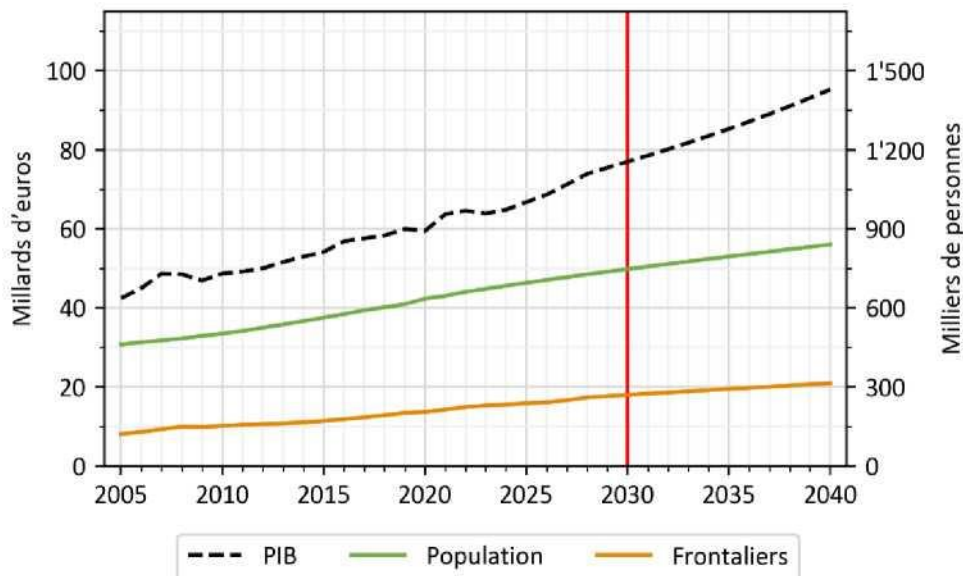
For different indicators (Gross Domestic Product (GDP), population, employment, number of border residents, etc.) the forecasts for 2030 are compared to the respective historical values in 2020. This growth in the different areas is essential for the 2030 objectives of the NECP.

Table 28: Cyclical projections for 2030 compared to 2020

Indicator	Unit	2020	2030	Variation
GDP	billion EUR	59.4	77.6	+ 30.6 %
Population	1000 persons	634.7	751.4	+ 18.4 %
Employment	1000 persons	471.6	594.5	+ 26.1 %
Frontier workers	1000 persons	205.4	273.2	+ 33 %
Residential buildings	million m ²	32.4	40.7	+ 25.6 %
Non-residential building area	million m ²	13.0	16.2	+ 24.6 %

Sources: STATEC 2024 modelling (WAM scenario)

Figure 2: Developments in the national economic situation



Sources: Modelling STATEC 2024, MECO/DG Energy

The exceptionally high cyclical growth in Luxembourg, reflected in the current STATEC projections (and in the modelling for this update of the NECP compared to the 2020 NECP) counterbalances some of the efforts to improve energy efficiency (which are, however, well existing and taken into account in modelling), which explains why the reduction in final energy consumption by 2030 is relatively small or almost non-existent for some sectors (e.g. manufacturing and construction) and is even growing for the aviation sector (kerosene consumption).

With regard to residential buildings (dwellings included in the household sector) and tertiary buildings (included in the trade and services sector), the changes in the economic situation, which means changes in GDP and hence changes in employment, population and number of cross-border commuters, also lead to an increase in building areas, as shown in Figure 10.

This increase in building surfaces is taken into account in the modelling and any net increase (at national level) in the surface area means additional energy consumption, which partly counterbalance energy efficiency measures at building level.

Any future adaptation of national cyclical projections will therefore have a direct impact on modelling and will require, where appropriate, an adaptation of the targets.

Note “EED and EPBD Guidelines”

The objectives for energy efficiency, as well as some of the additional measures included in this update of the NECP, are based on the new versions (recast) of the following two European directives, which take into account ‘Fit For 55’ (FF55) and ‘REPowerEU’:

EED – Energy Efficiency Directive, (EU) 2023/1791;

EPBD – Energy Performance of Buildings Directive, (EU) 2024/1275.

Since the health crisis and the energy crisis, ambitions have evolved and the European institutions have developed two plans called ‘Fit for 55’ (FF55) and ‘REPowerEU’, so that energy efficiency ambitions have been increased at European level.

The European Commission has established a new reference ‘EU Reference Scenario 2020’ (REF2020), which was published in July 2021 and defines a new baseline for the year 2030, compared to the reference scenario ‘EU PRIMES 2007’ (REF2007) which served as a reference (and baseline) for the initial 2020 NECP.

With the introduction of this new reference (REF2020), the percentage targets for improving energy efficiency are no

longer directly comparable between the update of the NECP and the 2020 NECP; table 29 provides a comparison with the two reference scenarios (to be specified that absolute figures in energy consumption (GWh) remain comparable irrespective of the benchmark used).

The new reference (REF2020) was updated by the Commission on the basis of the latest Eurostat data and communicated to the Member States in December 2023. Luxembourg’s national target is also compared to this new benchmark.

Table 29: Determination of the energy efficiency target under the National Energy and Climate Plan and its update

NATIONAL target for improving energy efficiency (energy efficiency improvement = reduction in final energy consumption)	final energy consumption in 2030 (FEC - final energy consumption, without ambient heat, including international aviation)	improvement of energy efficiency compared to initial reference REF2007 (EU PRIMES)	improvement (negative%) of energy efficiency compared to new benchmark REF2020
REF2007 Reference Scenario (EU PRIMES) (FECB2030)	63.453 GWh	—	—
EED target 2018/2002 (EU) (EU overall -32.5 %)	42.831 GWh	— 32.5 %	—
national target “NECP 2020” (initial)	38.000 to 35.568 GWh	— 40 to -44 %	—
<i>new Reference Scenario REF2020 (update December 2023) (FECB2030)</i>	<i>with the introduction of the new reference REF2020, the baseline changes and the targets (in%!) between the initial NECP 2020 and the new NECP 2 023 are no longer directly comparable</i>		
	36.805 GWh		—
target EED 2023/1791 (EU) with Fitfor55 + REPowerEU (new EU global target -11.7 % vs REF2020; EED, Article 4, <u>corrected</u> national contribution FEC based on ambition gap mechanism)	32.564 GWh	— 48.7 %	— 11.5 %
national target “Updated NECP 2024”	36.949 GWh	— 42 %	+ 0.4 %

Sources: MECO /DG Energy 2024 calculations

Luxembourg’s initial 2020 NECP sets an energy efficiency improvement target of -40 to 44 % for the year 2030 compared to the 2007 Reference Scenario (REF2007) used by the EU to define the EU target of -32.5 %. In absolute terms, Luxembourg’s target of -40 % on final energy consumption (FEC) is equivalent to a consumption of 38.000 GWh in 2030 and an improvement of – 44 % is equivalent to a consumption of 35.568 GWh in 2030. The Commission has described this target as ambitious (!) and Luxembourg is one of the few Member States with a positive assessment by the Commission against this dimension of its initial NECP.

Energy efficiency improvement target – indicative national contribution (NEC)

The national indicative energy efficiency contribution (target) is expressed as a percentage improvement in energy efficiency compared to a baseline defined by the European Commission and by an absolute figure corresponding to a target for Luxembourg’s final energy consumption in 2030.

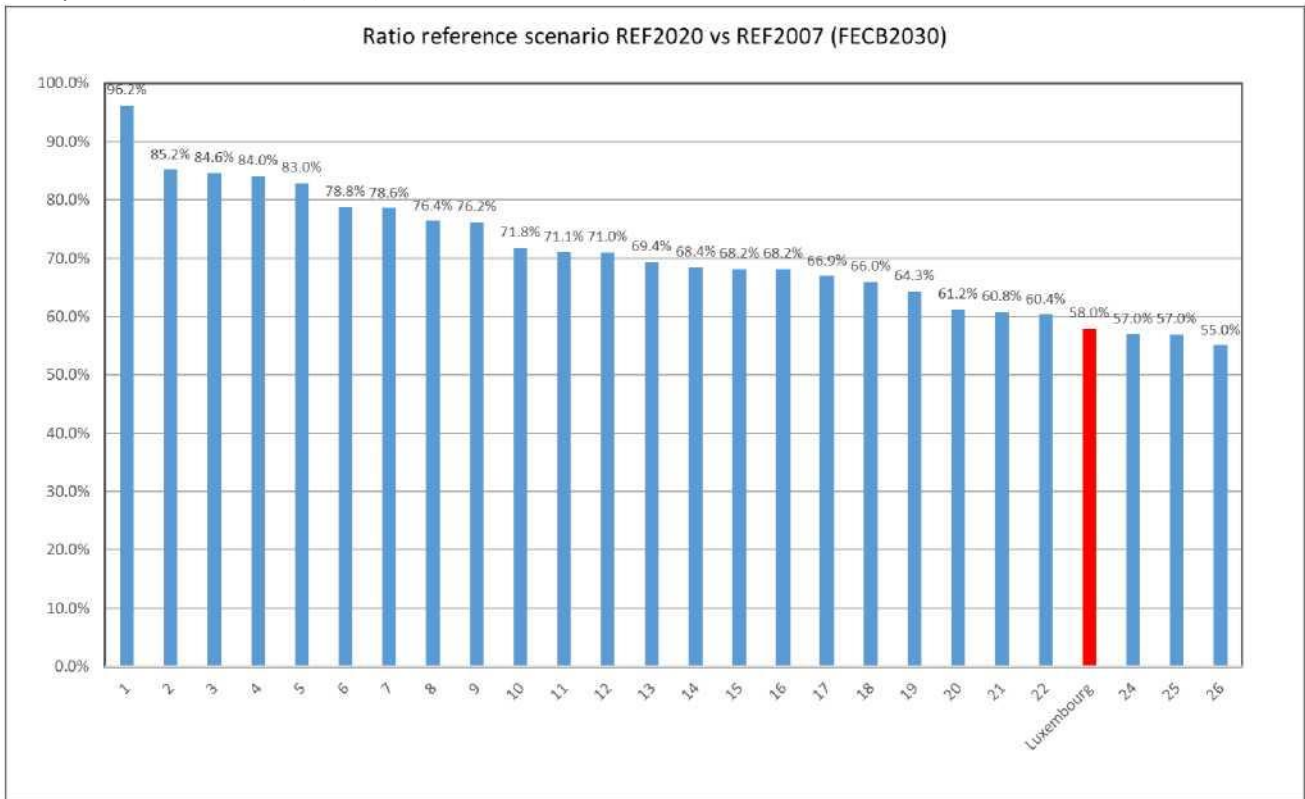
Luxembourg’s target for improving energy efficiency set out in its initial NECP (2019) was based on the Commission’s 2007 baseline (REF2007).

The Commission has established a **new reference (REF2020)** (updated in December 2023) **which considers that all objectives (at the level of the energy efficiency improvement target in 2030) based on the policies and measures included in the NECP (2019) have already been met.**

The reference in FEC, i.e. final energy consumption for 2030 based on the **new** reference scenario (REF2020) is only

36.805 GWh, compared to 63.453 GWh based on the initial reference scenario (REF2007), i.e. there is a 42 % reduction in the benchmark for Luxembourg.

Figure 3: Comparison of REF2007 (initial) with new REF2020



Sources: MECO /DG Energy Graph based on figures published by COM

This methodology applied to redefine a new benchmark, combined with the subsequent re-request, on the basis of the new REF2020 baseline, for the same effort (-11.7 % EU overall) to all Member States, regardless of the level of their initial ambitions (NECP 2020) which were almost ‘reset to zero’ by the new reference, puts at a disadvantage States that were more ambitious in their initial NECP → Luxembourg bears the fact that they revised the benchmark (regardless of the fact that revising the benchmark in progress does not facilitate the reading of the NECP on energy efficiency targets), but **cannot accept the fact that Member States are very ambitious (more ambitious than the overall European target) in their original NECP.**

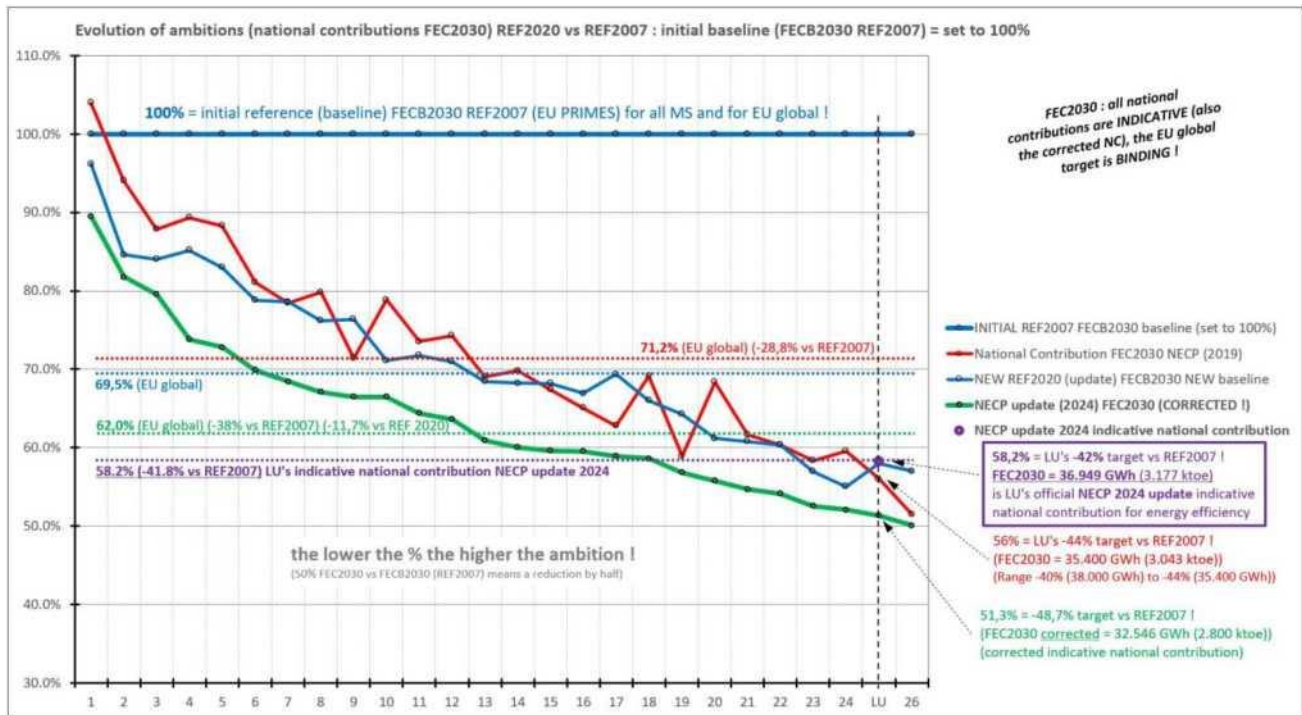
For those Member States that have not taken up the new effort voluntarily in their draft update of the NECP (July 2023), the Commission has applied the ambition gap mechanism and defined a corrected indicative national contribution, which remains indicative; this corrected indicative national contribution was communicated to the Member States by the Commission by a note dated 5 March 2024¹⁵; the corrected indicative contribution for Luxembourg is 2,80 ktoe, equivalent to 32.564 GWh of final energy consumption for the year 2030.

We would like to thank the European Commission for taking into account, as far as possible and within the legal framework of the application of the ambition gap mechanism, the difference in the initial NECP (initial NECP) between Member States, with the aim of not placing at a disadvantage those which were initially very ambitious, but the flexibility allowed by European regulatory texts allowed only partial and largely insufficient consideration in relation to the very large differences in ambition, with the result that the corrected indicative national contribution established for

¹⁵Note on the application of the ‘ambition gap mechanism’ in accordance with Article 4 (5) of the Directive (EU) 2023/1791 on energy efficiency recast (Ref. Ares (2024) 1723454-05/03/2024)

Luxembourg exceeds the ambitions to which Luxembourg can commit.

Figure 4: Evolution of ambitions with the transition from reference REF2007 to REF2020



Sources: MECO /DG Energy Graph based on figures published by COM

The indicative national contribution (initial NECP 2020, -40-44 % compared to REF2007) **was significantly more ambitious than the European target and the level of ambition (absolute target) does not change with the introduction of a new benchmark!**

Achieving the indicative national energy consumption target requires major efforts, in particular taking into account the rather exceptional economic, demographic and cyclical growth of the country, which counterbalances part of the consumption reduction effects and therefore needs to be offset by additional efforts.

An even more ambitious target than the ambitious target in our initial NECP (2020) would be an important brake on future development and more specifically on the country's demographic and cyclical growth, and would also risk losing credibility and stakeholder acceptance.

Summary:

Initial reference EU PRIMES reference scenario 2007 for 2030 (REF2007): FECB2030 = 63.453 GWh Initial indicative national target NECP 2020: **-40 % to -44 % (REF2007)** equivalent to **38.000 to 35.568 GWh** New EU PRIMES 2020 reference for 2030(REF2020) (reference updated in January 2024 (with correction for Malte)): FECB2030 = 36.805 GWh Draft update of the NECP (July 2023): **-44 % (Ref2007)** equivalent to 35.430 GWh

Corrected indicative national contribution (communicated by the European Commission): **-48.7 %** (compared to REF2007) equivalent to 32,564 GWh (corresponding to **-11.5 %** compared to the new REF2020)

Indicative national contribution retained by Luxembourg for this update of the NECP (2024):

Indicative national contribution for improving energy efficiency established on the basis of the taking into account (STATEC modelling) of all the policies and measures adopted by the Government under the WAM scenario for this update of the NECP: -42 % (compared to REF2007) equivalent to 36,949 GWh FEC16 in 2030 (corresponding to + 0.4 %

16FEC = Final Energy Consumption; the final energy taken into account for the energy efficiency balance is final energy excluding ambient heat, including international aviation, as defined in the European Commission/Eurostat Energy Balance Guide (version of 31 January 2019))

compared to the new REF2020).

This energy efficiency improvement target is still within the range (-40 to -44 %) indicated in our initial NECP (2020) and the high level of ambition of its initial NECP is therefore confirmed by Luxembourg.

The modelling developed to assess the impact of policies and measures and define the indicative national contribution to be achieved is not a precise forecast calculation; given the large number of external and internal assumptions and factors having an impact on the model, a monitoring of the actual evolution of the figures and a regular update of modelling with, where appropriate, the adaptation or revision of certain assumptions are necessary.

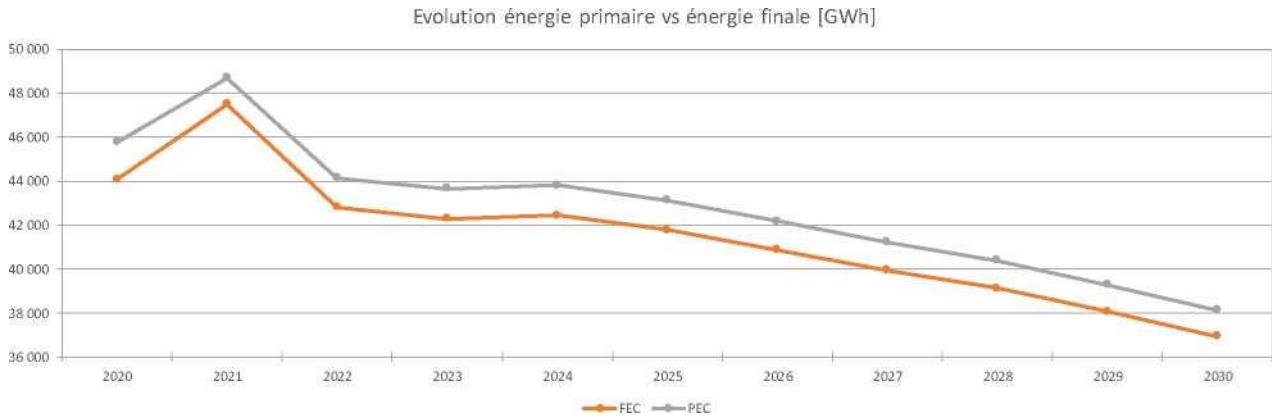
Indicative trajectory for primary energy consumption (PEC)

The final energy consumed in Luxembourg is largely imported, which explains the relatively constant ratio of primary energy (PEC17) to final energy (FEC) and close to 1.

The table below shows a projection of the evolution of primary energy consumption, based on the trajectory for the evolution of final energy consumption leading to the indicative national final energy target in 2030.

Table 30: Primary energy evolution trajectory (PEC)

evolution of primary energy	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	unit
FEC	44 079	47 506	42 818	42 303	42 454	41 793	40 885	39 952	39 134	38 081	36 949	GWh
PEC	45 777	48 689	44 143	43 657	43 813	43 130	42 193	41 231	40 386	39 299	38 131	GWh
PEC/FEC ratio	1.039	1.025	1.031	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032	—



Sources: STATEC 2024 modelling, MECO /DG Energy 2024 calculations

The sectors considered for monitoring Luxembourg’s final energy consumption are:

- **households (including residential buildings)**
 (“Private Haushalte” in NECP 2020)
- **manufacturing and construction**
 (“Industry” in NECP 2020)
- **trade and services (including tertiary buildings)**
 (“Gewerbe, Handel, Dienstleistungen” in NECP 2020)
- **agriculture**
 (agriculture was not indicated separately in the 2020 NECP)
- **transport**

Table 31: Overall energy efficiency target and variations

Final energy consumption in 2030 [GWh] and changes [%]			
	Indicative 2020 NECP targets	PNEC objectives 2020 vs REF2007	Indicative NECP targets mtd 2024
Total all sectors	35 568	— 30 %	36 949
Households	4 611	— 40 %	5 570
Tertiary	3 205	— 24 %	4 434
Industry	6 088	— 17 %	6 587
Transport	21 664	— 15 %	20 300
of which:			
Total road transport	15 728	— 38 %	11 623
Diesel and petrol road transport	14 845	— 41 %	10 770
Aviation	5 936	0 %	8 678
Other specific objectives			
		Objective NECP 2020	PNEC objective mtd 2024
Electromobility: Share of electric cars/plug-in hybrid vehicles in the car fleet by 2030 (residents)		49 %	49 %

Source: Molisation STATEC 2024, MECO table/DG Energy

The WAM scenario takes into account a modulation of the CO₂ tax according to the evolution of the fuel price differential compared to neighbouring countries at the level of the transport sector (road transport fuels) which is necessary in the context of the national GHG emission reduction targets for 2030 and this modulation of the CO₂ tax is also very important in the context of the energy efficiency targets, i.e. the final energy consumption of the transport sector, calculated on the basis of fuels sold in Luxembourg.

The cumulative amount of end-use energy savings to be achieved by Luxembourg in the period 2021-2030 under Article 7(1)(b) on energy savings obligations and in accordance with Directive 2012/27/EU as amended was 21.435 GWh (48.716 GWh x **55 x 0.8 %**) for the 2020 NECP.

This cumulative amount of end-use energy savings is increased as part of the third revision of EED 2012/27/EU, EED (EU) 2023/1791, and now stands at 42,538 **GWh**. This amount corresponds to 87.3 % of the amount of 48.726 GWh or the country's average *final energy consumption (Europe 2020-2030)* in 2016, 2017 and 2018 according to EUROSTAT, as required by the new Directive. The 87.3 % or 42.538 GWh is the sum of new annual energy savings to be achieved over the total period from 2021 to 2030 (10 years). The revised text foresees progressive new annual energy savings rates of 0.8 % from 2021 to 2023, 1.3 % from 2024 to 2025, 1.5 % from 2026 to 2027 and 1.9 % from 2028 to 2030. The total cumulative energy saving rate of 87.3 % is the sum of these annual cumulative rates.

Table 32: Method of calculating the cumulative overall target over the period 2021-2030 according to Article 8 of EED (EU) 2023/1791

2021	0.8 %					0.8 %
2022	0.8 %	0.8 %				1.6 %
2023	0.8 %	0.8 %	0.8 %			2.4 %
2024	1.3 %	1.3 %	1.3 %	1.3 %		5.2 %
2025	1.3 %	1.3 %	1.3 %	1.3 %	1.3 %	6.5 %

2026	1.5 %	1.5 %	1.5 %	1.5 %	1.5 %	1.5 %					9.0 %	
2027	1.5 %	1.5 %	1.5 %	1.5 %	1.5 %	1.5 %	1.5 %					10.5 %
2028	1.9 %	1.9 %	1.9 %	1.9 %	1.9 %	1.9 %	1.9 %	1.9 %			15.2 %	
2029	1.9 %	1.9 %	1.9 %	1.9 %	1.9 %	1.9 %	1.9 %	1.9 %	1.9 %	1.9 %	17.1 %	
2030	1.9 %	1.9 %	1.9 %	1.9 %	1.9 %	1.9 %	1.9 %	1.9 %	1.9 %	1.9 %	19.0 %	
Total cumulative energy savings rate for the period 2021 — 2030											87.3 %	

Sources: Mecco/DG Energy

The Energy Efficiency Obligation Scheme (EEOS), the details of which are set out in Chapter 3.2, will provide up to 2 030 GWh of cumulative energy savings of **13.750 GWh**. The remainder of the overall obligation is filled by alternative policy measures, described in detail in Chapter 3, the respective references of which are set out in Table 33. The contributions of alternative measures to achieving the overall target are indicated as a percentage of the total cumulative economy to be achieved up to 2030. Since the expected amounts of energy savings to be achieved by alternative measures are more difficult to quantify individually by measure than the EEOS obligation scheme (the target to be achieved is precisely quantified in a law and monitored on the basis of the actual savings claimed annually by the obligated parties), the contributions of alternative measures to the overall objective are indicated within a range of values. Energy savings achieved under the EEOS scheme are counted at 100 % at national level, while possible overlapping effects are taken into account at the level of alternative measures, so as not to have a double counting effect.

Table 33: National Energy Efficiency Obligation Scheme (EEOS) and alternative policy measures in accordance with Articles 8, 9 and 10 of EED (EU) 2023/1791

Measures contributing to the achievement of the energy savings obligation target (Directive under revision Articles 7 and 8)	PaMs reference	% in relation to the overall final energy savings target	Cumulative energy saving up to 2030 (compared to EU reference Premiums 2020 (REF2020) in GWh)
Cumulation of all measures		100 %	42 538
Energy efficiency bond scheme (EEOS) *	121	32 %	13 750
Alternative policy measures	—	68 %	28 788
of which:			
CO2 tax on liquid fuels * *	105	66 %	27 970
Aid scheme Klimabonus Wunnen (residential buildings)	307	3-6 % * * *	
Individual housing aid scheme	311	1-4 %	
Tax incentives for energy renovation of housing	313	1 – -3 %	
Aid scheme for municipalities	314	1-2 %	
Promoting public transport	405	6-9 %	
Promotion of innovative mobility services	406	1-2 %	
Promotion of electrification of the Luxembourg registered car fleet	410	7-11 %	
Revised registration tax on road vehicles	420	1-3 %	
Aid scheme for zero CO2 emission vehicles	423	4 – -6 %	
Voluntary agreement on improving energy efficiency in industry (up to and including 2023)	503/504	0 – -1 %	

* overlapping effects with alternative measures are corrected directly on them

* * cumulative total economy over the period 2021-2030 modelled on STATEC figures

* * * the percentages in italics are estimates of potential contributions, the overlap effects corrected

Obligations for the public sector

Obligation to reduce final energy consumption

With the new EED Directive (EU) 2023/1791, Article 5), a new obligation on the final energy consumption of all public sector activities will be introduced: obligation to reduce final energy consumption by 1.9 % per year (and annually) compared to the reference year 2021. For the first 2 years after the transposition of the Directive, this target will still be indicative. This obligation will not include energy consumption of buildings owned by municipal authorities with less than 50.000 inhabitants until 31 December 2026, respectively for municipalities with less than 5.000 inhabitants (phase-in period depending on the size of the municipalities) until 31 December 2029.

Table 34: Final energy consumption, baseline in 2021 and projection of 2030 for public sector buildings (definition in EED (EU) 2023/1791)

Public sector buildings	Final energy consumption for the year 2021 [MWh] (baseline)	1.9 % reduction per year [MWh]	Final energy consumption for the year 2030 [MWh]**	Ë final energy consumption 2030/2021 [%]
State – TOTAL*	470.000 MWh	8.930 MWh	434.280 MWh	– 7.6 %
State – buildings (owned by the State)	<i>Figures under preparation</i>			
State – public transport	<i>Figures under preparation</i>			
State – Armed Forces	<i>Figures under preparation</i>			
State – other	<i>Figures under preparation</i>			
Municipalities – TOTAL***	304.232 MWh	5.780 MWh	281.112 MWh	– 7.6 %
of which:				
Office buildings	18.638 MWh			
Event centres	29.734 MWh			
Schools, colleges and universities	80.402 MWh			
Crèches and relay houses	19.517 MWh			
Fitness	57.212 MWh			
Stay	98.729 MWh			

1 approximate estimate based on LTRS data and ABP information on the total number of buildings

2 * entry into force of the obligation two years after transposition of the Directive (probably in 2027) *** last available consumption of municipal buildings for 2020 on the basis of Enercoach

National renovation strategy

In accordance with Article 2a of Directive (EU) 2018/844 of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency, the Luxembourg Government presented in 2020 the follow-up to the Long Term Renovation Strategy (LTRS). This long-term renovation strategy shall support the renovation of the national stock of residential and non-residential buildings, both public and private, towards a highly energy efficient and decarbonised building stock by 2050, thereby facilitating the cost-effective transformation of existing buildings into nearly zero-energy buildings. The guidelines of the renovation strategy are:

- Priority for full and energy-efficient renovations: significant increase in renovation depth (amount of energy saved compared to before renovation) and renovation rate (number of renovated buildings per year);
- Affordability of energy renovation measures;
- Improved coordination between energy policy and heritage protection;
- Promoting sustainable construction and the circular economy.

These guidelines are constantly taken into account when developing the tools necessary for the progress of the strategy. These tools take various forms:

- Regulatory provisions (regulations and standards);
- Promotion and funding instruments;
- Tax instruments;
- Training;
- Awareness-raising and publicity work;
- Research and pilot projects.

These different tools align with each other to maximise their combined impact.

From a technical point of view, the focus is on energy improvement of the building envelope (thermal insulation) and on improving the energy efficiency of technical installations, with a particular focus on non-fossil energy sources, i.e. replacing old fossil fuel based heating systems with renewable energy systems with a focus on the decarbonisation of buildings through electrification using heat pumps, combined with the production of photovoltaic electricity at building level and optimising the self-consumption of this electricity.

Heat pumps have the particular advantage of decarbonising the energy consumption of a building during its use (electrified heating system based on renewable electricity) and of reducing final energy consumption as reflected in national targets; the ambient energy used (at 2/3 versus 1/3 of electricity) by a heat pump is not accounted for in the final energy consumed in Luxembourg.

Accompanying measures such as continuing vocational training, raising awareness among consumers and craftsmen and research are intended to identify and highlight savings potentials and possible improvements.

In addition to the impact on energy savings and climate, another key indicator to assess the combination of measures is the impact on people living in and using buildings, in particular vulnerable people who are at risk of energy poverty because their income is low while their energy consumption is relatively high. Although Luxembourg is among the EU Member States with the lowest energy poverty rate, many households are unable to heat adequately or need to rely on state aid to pay their energy bills. An analysis of the situation of energy poverty also reveals that the problem is not caused by energy prices alone, but by the fact that in recent years rents have increased at a much faster pace than purchasing power, especially in lower income brackets. An analysis of energy poverty in Luxembourg is therefore a key element of the national energy renovation strategy.

The indicative milestones under the long-term buildings renovation strategy focus on the residential stock. Based on household final energy consumption of 6.438 GWh/a in 2020, the 2040 reduction target was 2.715 GWh/a with an intermediate target of 4.611 GWh/a in 2030. This corresponds to a reduction of 28 % (2030) and 58 % (2040) compared to final energy consumption in 2020.

Based on the analysis of the effects of existing measures of the current policy (Chapter 4, WEM scenario), a need for new measures to accelerate the transition to a decarbonised building stock by 2050 has been identified and included in the WAM scenario of this update.

Table 35: Comparison of LTRS vs WAM modelling indicators (PNEC update 2024)

Final energy consumption of households (including residential buildings)	2020	2030	2040	Unit
LTRS indicators *	6 438	4 611	2 715	GWh
Updated WAM modelling PNEC	5 790	5 570	4 621	GWh

* It should be noted that the indicators in chapter 3.4.1 of the LTRS are not identical to the indicators shown in chapter 4.1.1 of the LTRS. Only the latter indicators, which are identical to the NECP indicators, are to be taken into account.

In order to assess the national energy renovation strategy in an objective manner, the current indicators need to be consolidated and complemented. Attention is currently being paid to assessing the relevance of potential indicators. A register of the energy performance of buildings, which is being developed (in view of the requirements of the new European Directive EPBD (EU) 2024/1275), will monitor the evolution, among other things, of the thermal insulation class of existing buildings, as an indicator of the evolution of energy renovation.

Mandatory energy renovation of public buildings

According to the Energy Sanitation Strategy of the Public Buildings Administration, based on the European Energy Efficiency Directive (EED), 3 % of the surface area of buildings allocated to the central government has been renovated in recent years.

According to data from the Public Buildings Administration (ABP) and in line with Article 5 of the EED Directive, an area

of 61,050^{m²} (out of a total area of 126,253^{m²} of buildings occupied by the central government) would still be affected by the renovation obligation at the end of 2020. As a result, an area of 1.832 m² (or 3 %) would have to be renovated in 2021, 1.777 m² in 2022 and so on, to arrive at a total cumulative area to be renovated from 2021 to 2030 of 16.030 m².

With the new EED Directive (EU) 2023/1791, Article 6), a new obligation to renovate 3 % per year of buildings owned by the public sector (which have a lower energy performance than nZEB level) is introduced. With this European requirement, it will no longer be exclusively the central state that is concerned, but all public bodies, namely the State, municipalities and local unions, among others.

New definition taken from EED (EU) 2023/1791:

- 12) “public bodies” means: national, regional or local authorities and entities directly financed and administered by those authorities but not having an industrial or commercial character:
- 35)) In order to fulfil their obligation, Member States should target the final energy consumption of all public services and all facilities of public bodies. In order to determine the spectrum of recipients concerned, Member States should apply the definition of ‘public bodies’ in this Directive, according to which the expression ‘directly financed by those authorities’ means that those entities are mainly financed by public funds and the expression ‘administered by those authorities’ means that a national, regional or local authority has a majority as regards the choice of management of the entity. The obligation can be fulfilled by the reduction of final energy consumption in any area of the public sector, including transport, public buildings, healthcare, spatial planning, water management and wastewater treatment, sewage and water purification, waste management, district heating and cooling, energy distribution, supply and storage, public lighting, infrastructure planning, education and social services. Member States may also include other types of services when transposing this Directive. To lower the administrative burden for public bodies, Member States should establish digital platforms or tools to collect the aggregated consumption data from public bodies, make them publicly available, and report the data to the Commission. Member States should provide planning and annual reporting on the consumption of public bodies in an aggregated form per sector.

The very ambitious nZEB (nearly Zero Energy Building) level currently defined at national level for new buildings by the amended Grand-Ducal Regulation of 9 June 2021 on the energy performance of buildings will be complemented by a nZEB_{renovation} (nZEB renovation), which will be defined in the context of the transposition of the EPBD (EU) 2024/1275 and the introduction of minimum energy performance standards (MEPS), taking due account of cost-effectiveness (proportionality) and technical feasibility, as provided for by the Directive); this nZEB_{renovation} level will be the minimum requirement for future renovation obligations (in particular for the public sector).

Under renovation obligations, less stringent rules are envisaged for certain categories of buildings, such as protected buildings (protected heritage).

Table 36: Area of public buildings (according to the definition in force in the year in question) covered by the obligation to renovate at least 3 % useful area per year (at a performance level nZEB according to the current text for the revision of the Directive)

Requirements	NECP 2020	Updated NECP	Ê PNEC māj/2020
Total area of buildings with lower energy performance than minimum	Buildings occupied by the central government: 126.253 m² (as at 31.12.2020) (minimum < level required per RGD on the energy performance of buildings)	Buildings owned by the State: 5 400 000 m² (as at 31.12.2022)++++ (nZEB level required by RGD on the energy performance of buildings)	+ 5 273 747 m²

these will have to be established on the basis of the new definition, identifying the buildings covered by the renovation obligation with the respective surfaces and energy consumption.

Energy efficiency targets by sector

The++++ figure given represents only an estimate of the total surface area of the State buildings at the end of 2022, given that it is not possible to determine the total area to be insulated (lower performance level than nZEB level), inter alia, in the absence of a final definition which will be adopted in the context of the revision of Directives EED (EU) 2023/1791 and EPBD ((EU) 2024/1275). A list of all public buildings

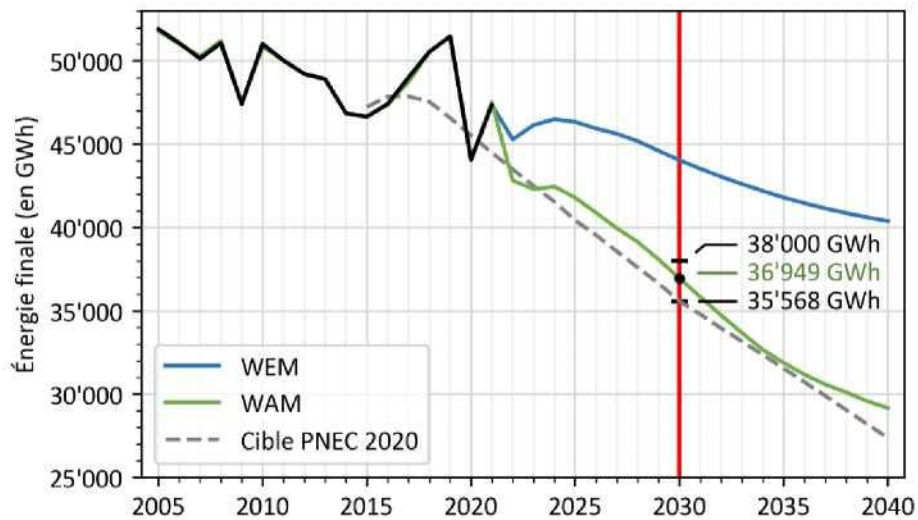
The figures below compare the evolution of final energy consumption for the PNEC 2020 (target) scenarios vs WEM vs WAM (WEM and WAM being based on new STATEC modelling which is the basis for this update of the NECP).

The final energy considered here is final energy excluding ambient heat, including international aviation.

Total all sectors

The overall energy efficiency target for all sectors, modelled in the WAM scenario, is shown in the figure below. The ambitious final energy consumption target of 36.949 GWh in 2030, equivalent to -42 % compared to REF2007, is still within the range of energy efficiency improvements of -40 to -44 % compared to the REF2007 benchmark defined as a national target in the original NECP 2020.

Figure 5: Evolution PNEC 2020 vs WEM vs WAM – TOTAL all sectors



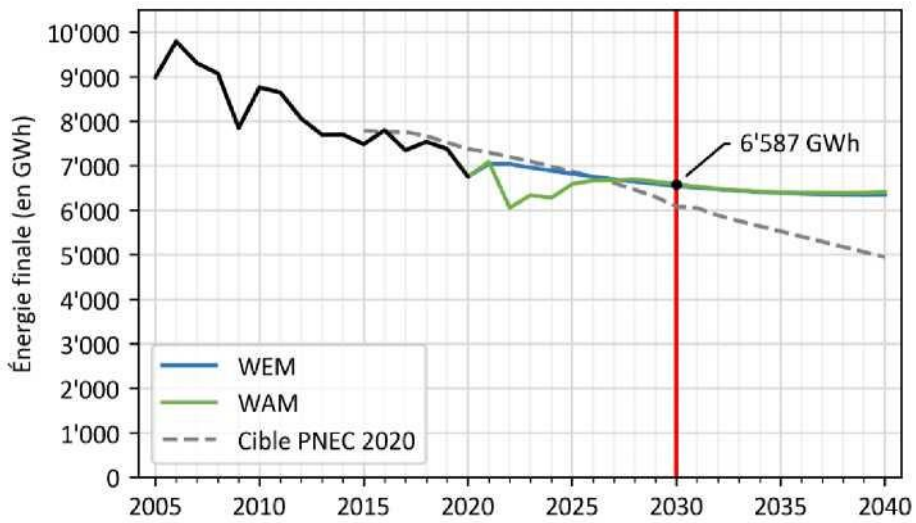
Sources: Modelling STATEC 2024, MECO/DG Energy

Manufacturing and construction

Based on cyclical projections, the continued increase in manufacturing and construction activities outweighs much of the improvement in energy efficiency in this sector, which explains the almost constant final energy consumption between 2020 and 2040, with slight fluctuations.

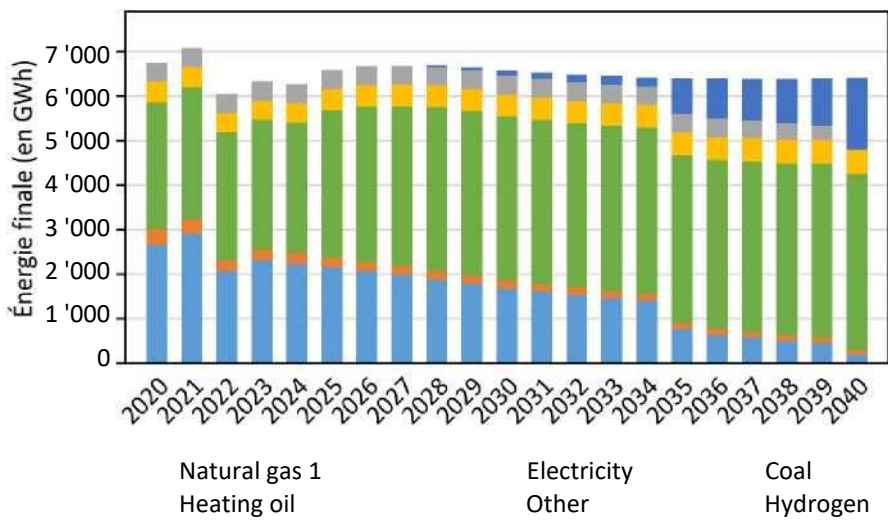
It should be noted that the increase in activities is mainly carried out at the level of non-HTA companies and that there is hardly any change at the level of HTA companies.

Figure 6: Evolution PNEC 2020 vs WEM vs WAM – Manufacturing and construction



Sources: Modelling STATEC 2024, MECO/DG Energy

Figure 7: WAM evolution by energy carrier – Manufacturing and construction



Sources: Modelling STATEC 2024, MECO/DG Energy

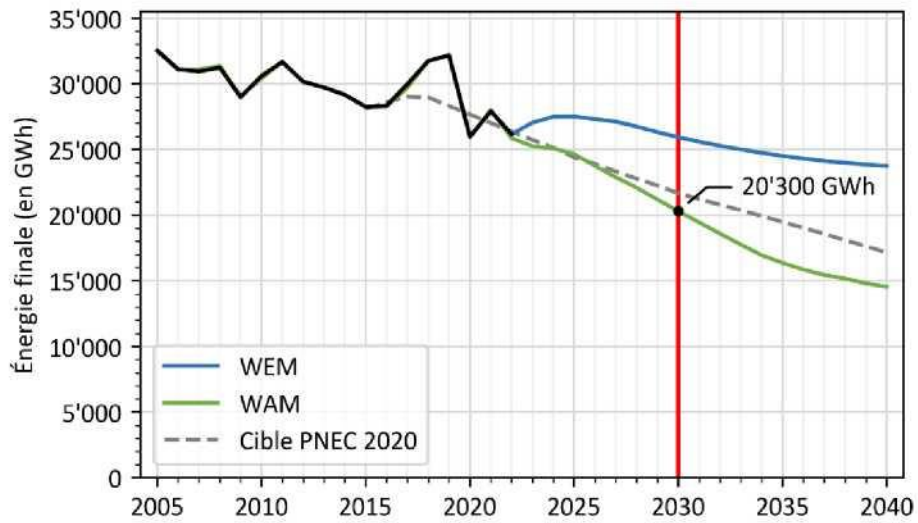
Transport

The sharp decline in final energy consumption in the transport sector is primarily influenced by the modulation of the CO₂ tax according to the evolution of the fuel price differential vis-à-vis neighbouring countries (road transport fuels).

The electrification of the transport sector has a very important influence, both on final energy consumption and on the reduction of GHG emissions in the sector.

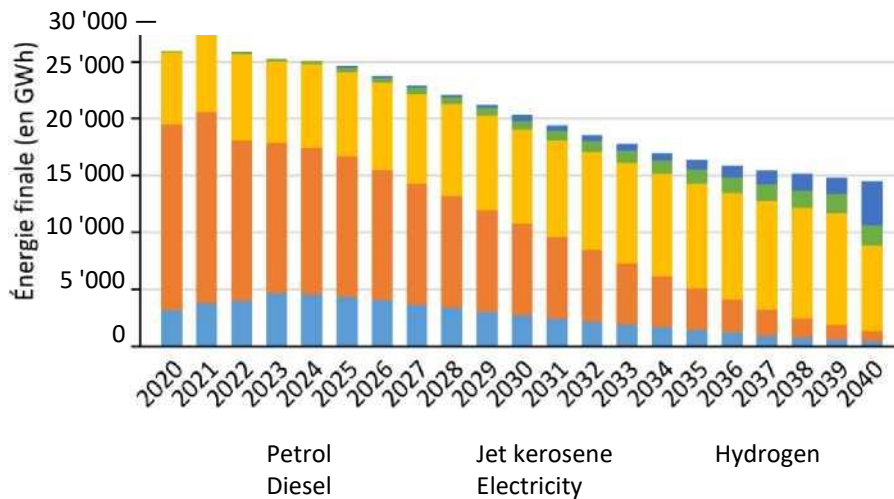
The strong growth of the aviation sector (passenger and freight transport) counterbalances some of the improvements in energy efficiency.

Figure 8 : Évolution PNEC 2020 vs WEM vs WAM – Transports



Sources: Modelling STATEC 2024, MECO/DG Energy

Figure 9: WAM evolution by energy carrier – Transport

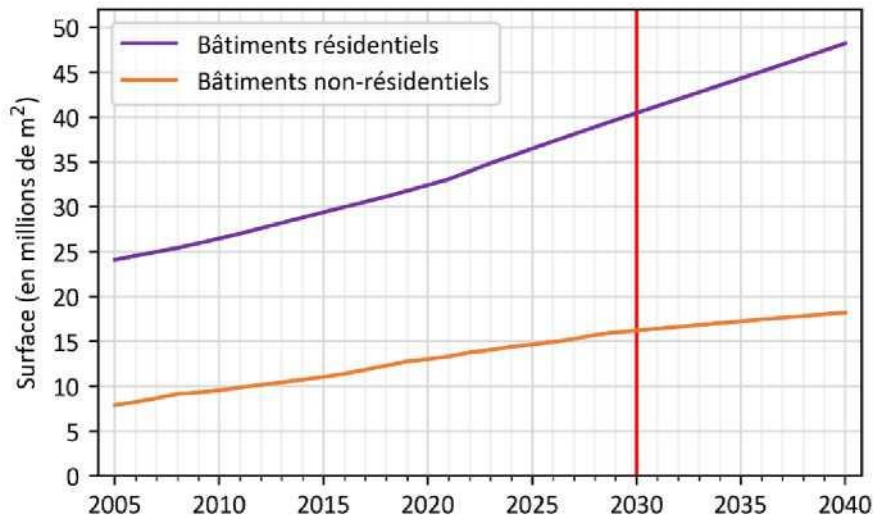


Sources: Modelling STATEC 2024, MECO/DG Energy

Households (including residential buildings)

For the household sector, as well as for the trade and services sector, the strong changes in building surfaces (based on demographic and cyclical developments) (as shown in the following illustration) need to be taken into account when interpreting the evolution of final energy consumption.

Figure 10: Evolution of building surfaces – Households (residential buildings) and Commerces and services (tertiary buildings)

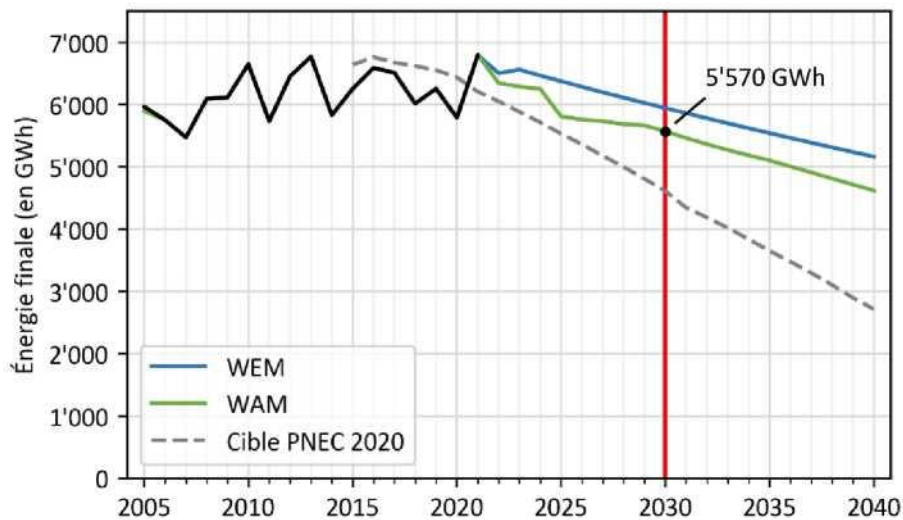


Sources: Modelling STATEC 2024, MECO/DG Energy

The energy consumed by households is largely directly linked to the use (heating) of residential buildings.

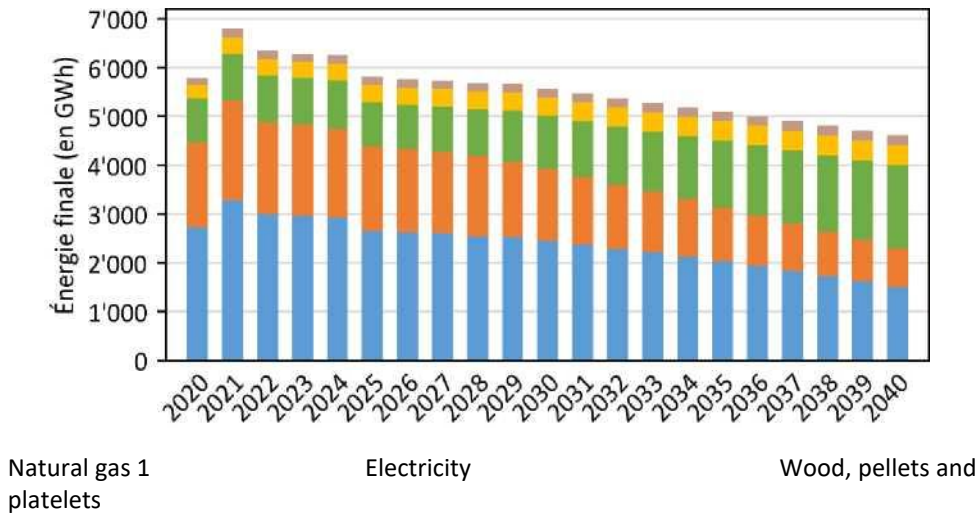
The decarbonisation of buildings through electrification, i.e. the replacement of fossil heating systems with renewable energy systems and in particular by heat pumps has a direct effect on GHG emissions and, specifically for heat pumps, a significant effect on the reduction of final energy consumed.

Figure 11 : Évolution PNEC 2020 vs WEM vs WAM – Ménages



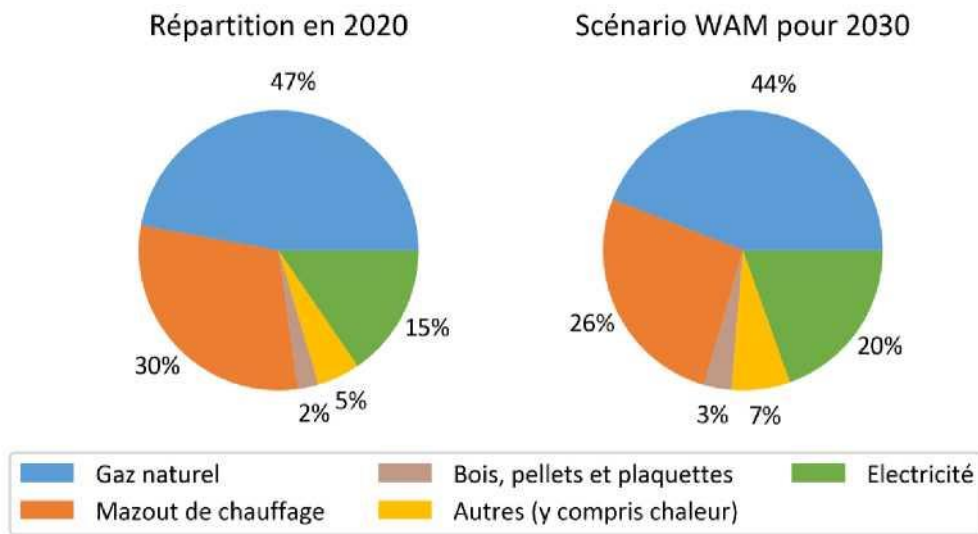
Sources: Modelling STATEC 2024, MECO/DG Energy

Figure 12: WAM evolution by energy carrier – Households



Sources: Modelling STATEC 2024, MECO/DG Energy

Figure 13: Distribution by energy carrier – Households



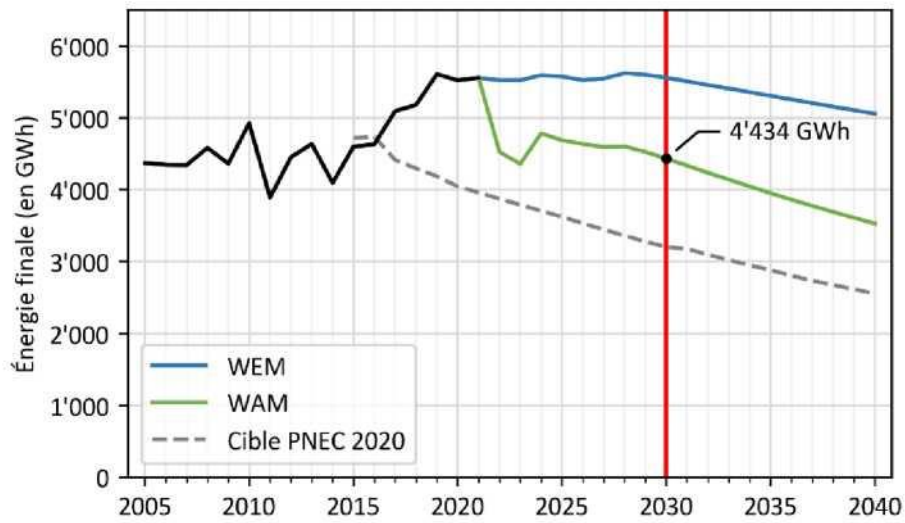
Sources: Modelling STATEC 2024, MECO/DG Energy

Shops and services (including tertiary buildings)

This sector includes tertiary buildings but also all commercial activities and services (which are not specifically attributed to another sector).

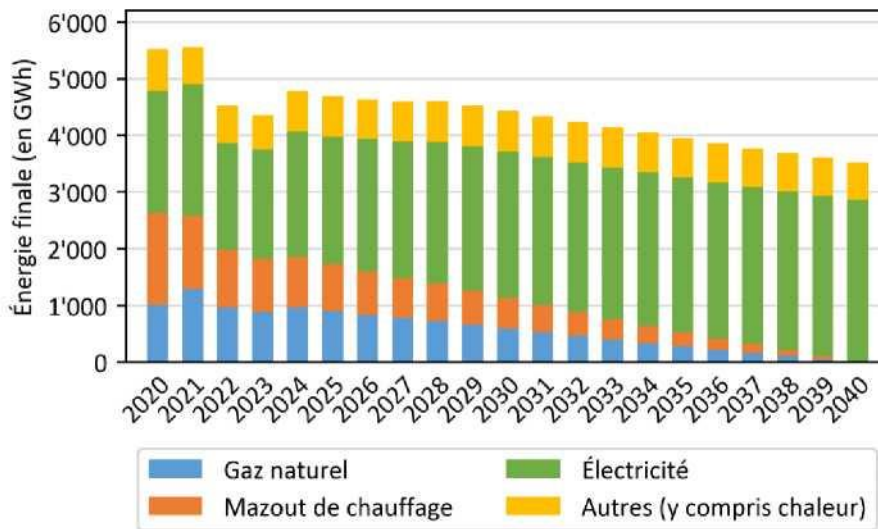
The decarbonisation of buildings through electrification, i.e. the replacement of fossil heating systems with renewable energy systems and in particular heat pumps has a direct effect on GHG emissions and has a significant effect on the reduction of final energy consumed (as ambient heat used by a heat pump is not counted as final energy (FEC without ambient heat)).

Figure 14: Evolution PNEC 2020 vs WEM vs WAM – Commerces and services



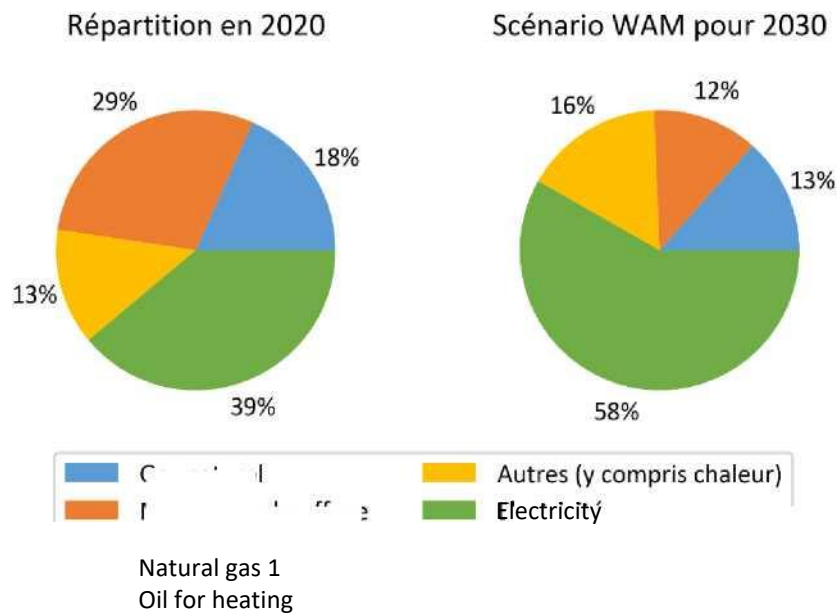
Sources: Modelling STATEC 2024, MECO/DG Energy

Figure 15: WAM evolution by energy carrier – Commerces and services



Sources: Modelling STATEC 2024, MECO/DG Energy

Figure 16: Breakdown by energy carrier – Commerces and services

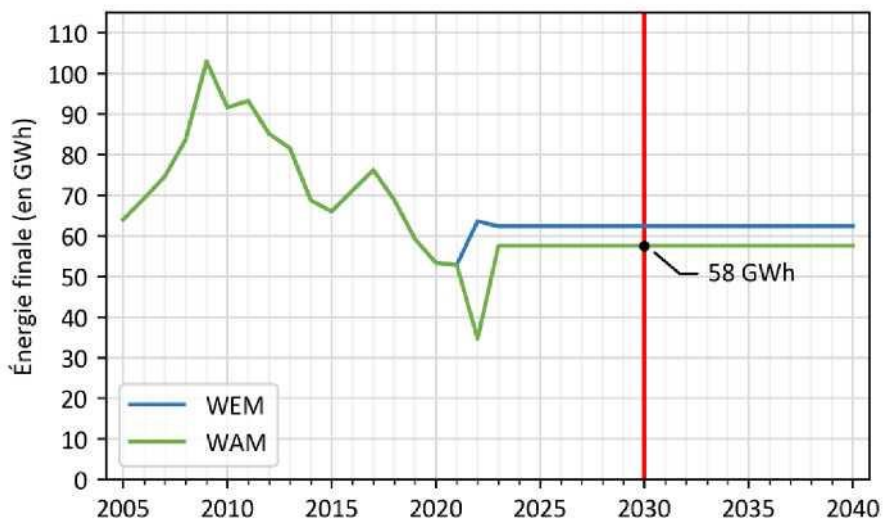


Sources: Modelling STATEC 2024, MECO/DG Energy

Agriculture

The agriculture sector has a relatively low final energy consumption compared to the other sectors

Figure 17: WAM Scenario – Agriculture



considered above. Figure 17 shows the evolution of its final energy consumption up to 2040.

Sources: Modelling STATEC 2024, MECO/DG Energy

2.3 Security of energy supply dimension

In line with statistics from previous years and decades, Luxembourg's main objective and to ensure a very high level of security of energy supply for all types of energy, and to remain among the countries with the highest level in Europe.

At the same time, the aim is also to follow an effective approach, i.e. to maintain a good balance between the level of safety expected and the resources invested by the state and consumers. Moreover, security of supply will have to be ensured through sustainable investments, a need which is clearly reinforced by the new geopolitical context and the energy crisis following the war in Ukraine. The strategy should therefore be based as far as possible on energy efficiency as well as local and renewable resources.

The expansion of the renewables needed to meet the targets will allow Luxembourg to significantly reduce its dependence on electricity imports. However, due to the huge demand for electricity from the industrial sector, national energy sources will not be sufficient to cover Luxembourg's energy supply in the future. In the area of load flexibility, Luxembourg aims to significantly increase the share of consumers actively participating in the electricity market.

The strategy to reduce gas consumption and consequently reduce energy dependency requires a diversified approach. First of all, following the national energy saving campaign 'Zesumme spueren – Zesammenhaale', launched during the energy crisis to encourage the general public to reduce their energy consumption, a new campaign entitled 'Your energy makes a difference' was launched. This campaign follows on from the previous one, but takes a more holistic approach by addressing the energy transition and how everyone can contribute to it. In the industrial sector, key measures to reduce gas consumption include electrification of processes and improving energy efficiency. As regards the real estate sector, the application of strict thermal insulation standards for buildings, as well as the implementation of a renovation strategy, will allow a phase-out of natural gas. In addition, in the electricity sector, a gradual transition of gas-based electricity generation will be achieved through a significant increase in the production of electricity from renewable sources.

However, as Luxembourg depends on energy imports, the European internal market for electricity and gas needs to be fully operational. The country therefore wants to accelerate the completion of the internal market for electricity and gas with intensive cross-border competition between suppliers and with the expansion and diversification of renewable energy offers, for example through renewable PPAs. Among others, investment in offshore wind energy offers an interesting path to support security of energy supply through the high availability of wind energy resources. Therefore, Luxembourg is also in favour of strengthening regional cooperation in the field of security of energy supply, and aims to accelerate the development of demand flexibility and its integration into the internal market in order to address the intermittency of certain renewable energies.

Due to their legal obligations, electricity and gas suppliers attach great importance to their infrastructure in a state of the art. The available capacity of the networks must meet the increasing demands of the country's economic and demographic development. The widespread installation of smart meters for all consumers will enable network providers to manage their networks in an even smarter and more secure way.

In the interest of security of supply in the oil sector, it will be important in the future to be able to continue diversifying countries of origin and supply routes. As the fuel supply to Luxembourg airport is directly provided by an underground pipeline network (CEPS), the diversification of supply routes mainly concerns petroleum products such as diesel, petrol and heating oil. The majority of imports are made by road, while only about one fifth is made by rail. The remaining part of imports is carried out by inland waterway transport on Moselle to the only port of Luxembourg in Mertert.

As a member of the European Union and the International Energy Agency (IEA), Luxembourg is required to have an oil reserve corresponding to an average of 90 days of imports from the previous year. Importers of petroleum products are also subject to the national legal obligation to store eight days domestically, 37 days in the regional territory outside Luxembourg and the remaining quantities in the rest of the EU.

For hydrogen, the objective will initially be to determine the level of security to be considered for hydrogen supply, in order to then be able to define the necessary measures to secure hydrogen supply to the required level. In addition, hydrogen could further enhance Luxembourg's security of electricity supply by opening an additional way to increase flexibility in the electricity grid at national level and by providing seasonal storage opportunities at European level.

As regards the different government plans to respond to the various crises in the energy sectors, several plans have been revised taking into account the new geopolitical context. This includes the risk-preparedness plan in the electricity sector, as well as the Preventive Action Plan and the Gas Emergency Plan. The government's strategy will be to regularly assess these plans taking into account future geopolitical developments. The Government is also preparing for the effects of climate change and its future impact on energy infrastructure. The update of the strategy and action plan for adaptation to the effects of climate change in Luxembourg, currently under preparation, takes account of new scientific knowledge, the new legal context and the experience gained during the last cycle and will thus improve the existing strategy adopted by the Government on 12 October 2018.

2.4 Dimension internal energy market

2.4.1 Electricity interconnectivity

Despite ambitious targets for advancing national renewable energy production, Luxembourg will remain dependent on imports to meet its electricity needs. Therefore, the country requires a high level of interconnection beyond the interconnection levels of other EU countries. Luxembourg's interconnection capacity is already far above the European targets of 15 % for 2030. The level of interconnection (N-0) with Germany currently amounts to approximately 230 %, calculated in relation to the maximum annual load. The planned network expansion projects will increase this level to around 400 % in 2030, providing sufficient reserves to cope with future consumption increases in all areas.

The connection to the electricity grid with Belgium is a support connection which increases Luxembourg's overall security of supply and is particularly useful in the event of major unplanned unavailability on the German side.

2.4.2 Energy transmission infrastructure

In the gas sector, the current infrastructure of the transmission network is considered sufficient, especially as the dismantling of the former gas turbine power plant (TGV) Twinerg has significantly reduced gas consumption in peak periods. No further expansion of cross-border connections is needed. At the same time, the common gas market with Belgium, which has been in place since 2015, will be further developed.

In the electricity sector, Luxembourg plans to further increase its integration into the interconnected European grid in the medium term. The reinforcement of existing interconnections is indeed necessary, given the expected increase in electricity demand and peak load due to projected population growth, diversification of economic activities as well as overall economic growth. Therefore, the transmission system operator Creos plans to build a 380 kV line to replace one of the dual 220 kV lines to Germany by the end of 2028. However, there are no plans to connect the Luxembourg public electricity grid to the French electricity grid.

In the field of hydrogen, Luxembourg's hydrogen strategy has been public since the end of 2021. As a follow-up to this strategy, and under the initiative of Luxembourg, the Hydrogen Working Group within the Benelux Secretariat launched a procedure to launch a study in the context of the objectives of decarbonising society, on future hydrogen infrastructure needs in the Benelux region and on interconnections with neighbouring regions, which will be finalised shortly.

2.4.3 Market integration

From the point of view of Luxembourg, the completion of the internal energy market remains particularly important for the electricity sector. Luxembourg supports the European Commission's efforts to develop a new design of the European market for electricity markets. This design of the electricity market within the Member States must first and foremost be consistent. Specific national approaches weigh on electricity consumers, neglect the impact on other Member States and, in the worst case scenario, undermine security of supply.

The Luxembourg Government, ILR and the Transmission System Operator Creos are actively involved in the development of the internal electricity market in European institutions and bodies.

Cooperation in the framework of the Pentalateral Energy Forum (PLEF), which includes Belgium, the Netherlands, France, Germany, Austria and Switzerland, is particularly important. This region has been technically and economically interlinked for years as a pioneer in the convergence of European electricity markets. Within the PLEF, the strong integration of the German and Luxembourg electricity markets into the cross-border market space is once again distinguished. Luxembourg wishes to maintain this common market area and deepen cooperation further.

It will examine whether the conclusion of bilateral agreements with other Member States on mutual solidarity in the event of energy crises can improve security of supply in Luxembourg.

Compared to the rest of Europe, Luxembourg's electricity and gas prices are well below average. However, the proportion of consumers switching supplier is relatively low. In this context, it is important to maintain comparability and transparency. The active comparison of a supplier's tariffs with those of its competitors and, where appropriate, switching can enable consumers to significantly reduce their energy bills. It is therefore important to be able to compare prices in full transparency, including for new types of offers such as dynamic prices.

Luxembourg has replaced 98 % of electricity meters with smart meters. This new deal allows and will improve the integration of active consumer markets, either through decentralised generation or through active participation in flexible markets to be defined, through individual or collective self-consumption of self-generated electricity or through participation in energy communities.

In order to improve the integration of renewable energy markets, Luxembourg had already converted part of its aid scheme into a rolling market premium. On the other hand, own consumption is promoted by substantial investment aid in return for waiving the injection premiums.

In order to minimise the risk of supply problems in the natural gas sector, as well as to increase security of supply and integrate markets in general, the Belgian gas network operator Fluxys and Creos brought together the two national gas markets in a cross-border market in 2015. As a result of this merger of markets, the non-interruptible capacity available at the Belgium-Luxembourg border has also been significantly increased to its maximum. This makes it possible to significantly increase non-interruptible capacity, even without expansion of lines, and to ensure Luxembourg's security of supply in the long term. This common market also enables undertakings to rely on a more competitive and fluid market for their supply.

As the hydrogen market does not yet exist on the same scale as the other energy markets, the development of such a market will be actively supported and Luxembourg's integration into such a European market will be promoted with a view to the transition of the economy to a decent economy.

2.4.4 Energy poverty

Climate change and the health effects of fossil fuels are particularly affecting low-income sections of the population. Climate action therefore also makes a tangible contribution to more social justice. However, social measures to combat climate change must also be integrated in order to prevent energy poverty.

Luxembourg has a wide-ranging policy to combat general poverty (minimum wage, REVIS, etc.). The country also has a number of measures to provide targeted support to people affected by energy poverty. Under the laws of 1 August 2007 on the organisation of the electricity market and on the organisation of the natural gas market, a household customer who is unable to pay his electricity or gas bills can obtain social assistance from the competent welfare office.

The Law of 18 December 2009 organising social assistance provides that, when applying the procedures laid down in the abovementioned laws on the organisation of the electricity and natural gas market, the competent welfare office must carry out an examination to determine whether or not the household customer is able to pay his energy bills and is entitled to social assistance.

Particular attention must be paid to combating energy poverty in the housing sector: rising housing prices in Luxembourg are today a major social challenge. Low-income population groups often have the right means to rent poorly maintained dwellings with low energy performance in old buildings. Therefore, the government is particularly encouraging the creation of affordable housing. In the housing sector, energy efficiency measures will be designed to improve the national energy balance and living conditions of low-income sections of the population.

Targeted programmes ("Klimabonus") are being put in place to counter rising carbon prices by creating significant financial incentives that will allow owners to switch from fossil fuels to renewables. This shift to

renewable energy will also need to become affordable for people on low incomes. In particular, a 'fuel oil boiler replacement premium' makes it possible to simplify the transition from a technical and financial point of view. Some support programmes are reinforced by housing assistance for people with lower incomes ('Topup social Klimabonus').

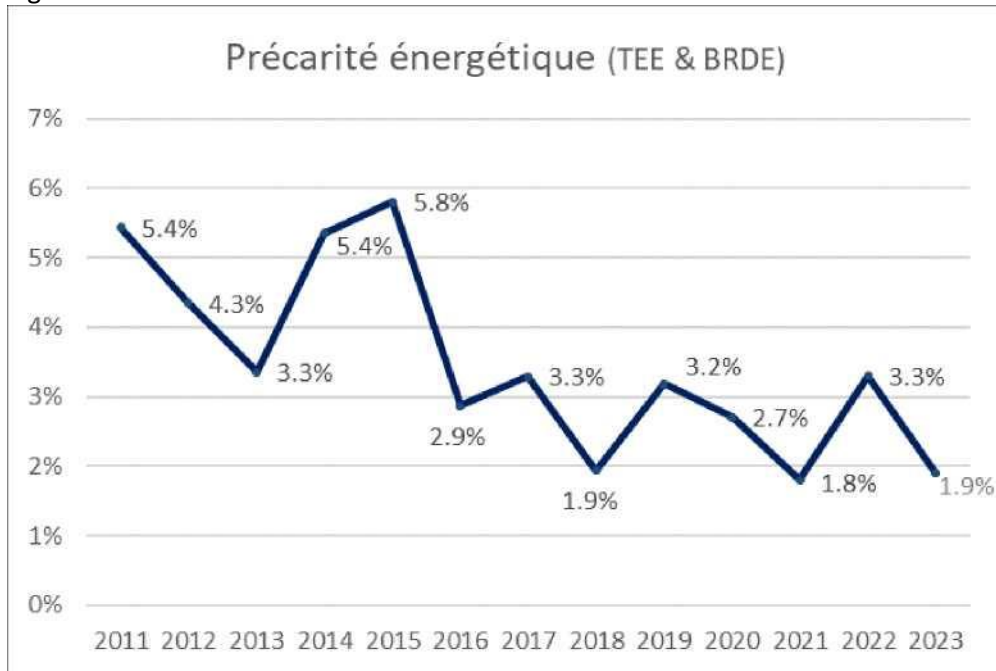
It should also be stressed that the already existing expensive living allowance also helps to combat energy poverty. In addition, low-income households can benefit from State housing support in case of increased rent. It should also be noted that the current legislation on social assistance stipulates that any person who fulfils the conditions for eligibility for social assistance has the right to a minimum supply of domestic energy under specified conditions, if they are unable to cover the cost of their domestic energy.

Investment efforts for infrastructure development and the introduction of free public transport from 2020 onwards are not only a matter of transport policy, but also clearly of the social dimension.

Luxembourg has defined a national indicator for quantifying and monitoring the evolution of energy poverty: the combined TEE & BRDE indicator, which makes it possible to avoid situations of energy waste and situations where the effort rate is acceptable, as well as taking into account the level of poverty in households.

(Note: the Energy Effort Rate (EET) indicator has not been selected on its own because it is not specific to the issue of energy poverty but may include situations of energy waste and the Bas Revenues – High Expenditure (BRDE) indicator has not been selected alone because it includes households with an effort rate deemed acceptable (i.e. above the TEE threshold).)

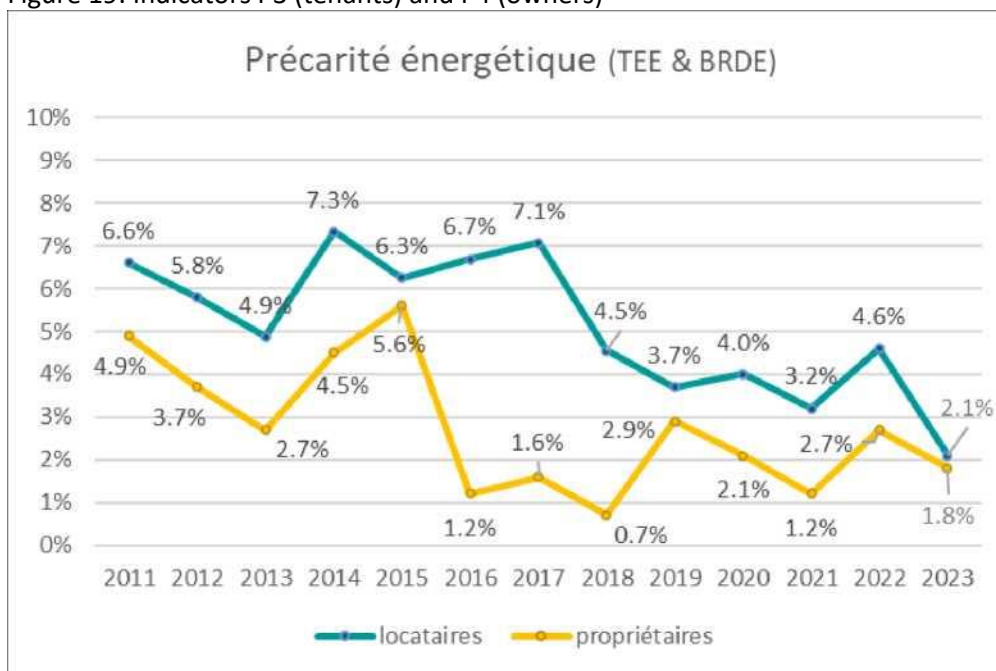
Figure 18: Indicator P1 combined TEE & BRDE



Sources: STATEC 2024

The main indicator P1 is complemented by two additional indicators: indicator P3 identifying tenants' energy poverty and P4 identifying owners' energy poverty.

Figure 19: Indicators P3 (tenants) and P4 (owners)



Sources: STATEC 2024

In 2022, 3.3 % of households in Luxembourg were in energy poverty according to both indicators [TEE and BRDE], almost double compared to 2021. These figures reflect the increase in energy prices since the end of 2021. It is estimated that 1.9 % of households resident in Luxembourg were in energy poverty in 2023, reaching the same level as in 2021.¹⁹ For example, in 2023, the energy price reduction measures decided by the

¹⁹Forecast until August 2023 and including index tranches until September 2023.

Luxembourg government and the multiple wage indexations contribute to reducing energy poverty forecasts for 2023.

2.5 Dimension Research, innovation and competitiveness

2.5.1 Introduction

The transition from current ways of production and life, highly resource and energy (fossil), to a society and economy compatible with the Paris climate objectives requires fundamental systemic transformations in the management of stocks and resource flows, including energy resources. These transformations will have to be applied at multiple levels, starting with people's behaviours and habits, individual and collective investment and consumption choices up to technological innovations, in order to eliminate GHG emissions and even reduce from the atmosphere a certain amount of these anthropogenic GHG emissions accumulated since the beginning of the industrial era, with the ultimate aim of preserving biogeochemical cycles and ecosystem services that ensure human survival and well-being.

The scientific and technological disciplines affected to produce and apply the knowledge needed for these systemic transformations are therefore manifold. The problems to be addressed are partly intrinsically inter- or transdisciplinary requiring close collaboration between public and private R & D & I actors to provide solutions. It follows that public governance of R & D & I must also adopt an interdisciplinary holistic view, set R & D & I priorities and provide the right incentives to adequately contribute to the ambitious objectives of climate neutrality by 2050.

2.5.2 Thematic strategies and objectives

The 'National Research and Innovation Strategy for Luxembourg' of the Ministry of Research and Higher Education (MESR) already²⁰ provides instruments to promote research driven by a societal mission and to support policy development and implementation (policy support), with the following elements identified as crucial:

1. *"coordinated governance, infrastructure and policies;*
2. *a regulatory framework and funding instruments that enable research to be a driver of innovation in industry, services and the public sector; and*
3. *an anchoring of science in society.*

It also identifies 4 priority areas of interdisciplinary research to prepare Luxembourg for future challenges, three of which are essential for the energy transition, in particular (area 1) 'industrial and service transformation', (area 3) 'sustainable and responsible development' and (area 4) 'Education of the²¹ century'²¹. Field 1 includes topics such as digitalisation, modelling and materials science and technology. Field 3 explicitly mentions **climate change, with energy efficiency and smart energy management**, but also economic and social development, such as **green and sustainable finance**, a key lever for the energy transition. Finally, Domain 4 seeks, for example, to promote learning methods to develop the skills needed for systemic transformations, which are also applicable in the context of the energy transition.

These research priorities and support instruments are further detailed in the strategic document of the National Research Fund (NRF) and MESR, entitled '**National Research Priorities for Luxembourg in 2020 and beyond**'²². Set up in 1999, the NRF was first set up to fund public research actors, but in the meantime a range of instruments is in place to support public-private collaboration, and thus also industrial research, as well as research activities with public institutions, to support the development and implementation of policies. The NRF also coordinates national research programmes with regional, European and international programmes,

²⁰National Research and Innovation Strategy for Luxembourg. Ministry of Higher Education and Research, 2020

²¹The link with Domain 2 of the strategy, 'personalised health', is less obvious.

²²National Research Priorities for Luxembourg in 2020 and beyond. National Research Fund (FNR), Ministry of Higher Research Education, 2019

bilaterally and multilaterally²³. A good integration of Luxembourg's research ecosystem in an international context is crucial, given the limited resources and capacities of the country. This allows national actors to benefit from foreign collaborations, exchanges and funding. On the other hand, the small size and sovereignty enable Luxembourg to act as a 'European' testing ground for large-scale projects within national boundaries and across borders, with simultaneous access to the regulatory and socio-economic contexts of Germany, France and Belgium. Luxembourg can also rely on the presence and outreach of key European institutions for the energy transition, such as the European Investment Bank (EIB) with its Climate Bank Roadmap²⁴, or the Court of Justice of the European Union. The regulatory and legal framework is a 1 important^{lever} for the energy transition and climate action.

Private, small, medium and large enterprises are supported in their R & D & I activities by the Ministry of Economy and dedicated budget lines. In addition to funding, companies are advised in their approaches (access to national and European funding, partner search, business creation, etc.) by the National Innovation Agency Luxinnovation. Networking takes place through the innovation clusters, driven by Luxinnovation, which also contribute thematically to the energy transition, in particular the 'Materials & Manufacturing', 'CleanTech', 'Automobility' or 'Wood' clusters²⁵. Energy-related concepts, such as smart grid, smart mobility, smart buildings and the Internet of things are discussed, but also technological developments for the production of renewable energy (PV), storage (hydrogen) or construction materials with a low carbon footprint. Luxinnovation, the University of Luxembourg and LuxProvide jointly manage Luxembourg's National High Performance Computing Competence Centre (HPC). Its mission is to promote the use of HPC related to computing, data analytics or artificial intelligence by industry – in particular SMEs – academia and public administration. A key theme for research actors facilitated by these cutting-edge technologies is Luxembourg's "twin nation", particularly for energy systems.

The 'National long-term climate action strategy', adopted by the Luxembourg Council of Government at COP26 in Glasgow, also²⁶ recognises the crucial importance of R & D & I and Luxembourg's potential pioneer role: *"While capitalising on European and global research and innovation, Luxembourg will consolidate and intensify its efforts in this area to serve the implementation of the transition in the national context. This implies targeted public support, strong entrepreneurial engagement and mobilisation of the whole innovation system, encompassing public research centres LIST and LISER as well as the University of Luxembourg, Luxinnovation and its innovation clusters such as Luxembourg CleanTech Cluster and private research and innovation centres. The small size of Luxembourg allows it to rapidly deploy and demonstrate key technologies and innovations, thus playing a pioneering role in a country."* The R & D & I strategies, measures and activities described in this chapter are crucial for achieving climate neutrality by 2050 and should be significantly strengthened.

Finally, new strategies in relation to energy and climate technologies have recently been formulated at national level, such as the manufacturing decarbonisation roadmap (see measure 510), which describes an indicative pathway for the deployment of clean technologies in the industrial sector, or the hydrogen strategy (see measure 216). With the help of these instruments, Luxembourg intends to become more involved in the efforts made at European Union level, in particular through the Strategic Energy Technology Plan (SET Plan). They will also be able to guide national R & D & I activities to support the decarbonisation of industry and the transition of companies towards a net-zero and circular economy.

23 International Cooperation Opportunities | FNR – Luxembourg National Research Fund

(<https://www.fnr.lu/international-cooperation-opportunities/>)

Climate Bank²⁴ Roadmap (<https://www.eib.org/fr/about/priorities/climate-action/cbr/index.htm>)

25 Luxembourg Cluster Initiative (<https://www.luxinnovation.lu/innovate-in-luxembourg/luxembourg-cluster-initiative/>)

26 Towards climate neutrality in 2050 – adoption of the National Long-term Climate Action Strategy – [gouvernement.lu/Le Government of Luxembourg](https://gouvernement.lu/Le_Government_of_Luxembourg)

(https://gouvernement.lu/fr/actualites/toutes_actualites/communiqués/2021/10-octobre/29-strategie-nationale-action-climat.html)

For carbon capture, utilisation and storage technologies, a policy framework will be created (see measure 523) to support their deployment under specific conditions and for specific industries, such as the cement industry. A preliminary estimate indicates that, given the need for infrastructure development, the amount of CO₂ emissions captured by 2030 will not be significant and limited to small-scale pilot projects. A significant amount may occur after 2030, particularly in the cement industry, waste incineration and large bioenergy plants. For Luxembourg, European cooperation is essential for the deployment of CO₂transport infrastructure to carbon storage and use sites.

Given the small size of Luxembourg's R & D & I ecosystem, research targets for clean technologies and investments needed for the production of net-zero components and equipment are to be formulated instead at EU level. In the same vein, resilient and sustainable supply chains of key net-zero components and equipment are also to be seen for Luxembourg in a mega-region or European context.

2.5.3 R & D & I funding objectives

Effective R & D & I requires substantial funding and Luxembourg has set ambitious targets in terms of R & D & I budgets. Thus, the MESR states in the national research and innovation strategy for Luxembourg: *"In line with the objectives of the Europe 2020 strategy and the government programme 2018-2023, the government will ensure that public investment in research and development is increased to 1 % of GDP. This 1 % target will include public expenditure in the public and private sectors, bearing in mind that expenditure in the public sector is expected to reach 0.8 % of GDP."*

These intentions resulted in particular in an increase of EUR 300 million in the State allocation for the years 2022 to 2025 for public R & D & I actors compared to the period 2018-2021, bringing the overall allocation to EUR 1.67 billion over this new period²⁷. Luxinnovation's performance contract provides for a State contribution of EUR 50 million for the same period²⁸, in particular to inform and guide Luxembourg public and private organisations towards national and European funding for their R & D and innovation activities. These efforts resulted in the allocation of State aid of an order of magnitude of EUR 900 million to companies between 2018 and 2022, in various forms²⁹ (see also Measure No 519).

It is important to note, however, that a precise estimate of funding in relation to the key topics of the NECP is currently not possible, partly due to the very broad thematic range but also partly due to the lack of measurement indicators in place. However, the MESR intends to set up this monitoring framework, in particular through performance contracts for public R & D & I actors. This monitoring should include not only national funding but also European funding such as the Horizon Europe programme, the European territorial cooperation programmes (Interreg) and the European structural funds, whose strategic or priority axes make it easier to identify R & D & I projects linked to the NECP. A measure in the NECP (No 104) makes explicit reference to the Just Transition Fund (JTF) included under the ERDF programme and the NECP intends to reinforce the co-financing and coordination of RDI activities linked to the NECP's themes through the Energy Climate Fund (see measure No 103 and measures in Chapter 3.5). Finally, it is important to mention that energy operators such as Encevo and Sudstrom also support R & D & I projects through dedicated funds, such as the Enovos Foundation³⁰.

A comprehensive and comprehensive scoreboard of public and private investment in R & D & I activities

²⁷ National Reform Programme of the Grand Duchy of Luxembourg in the context of the 2023 European Semester (<https://gouvernement.lu/dam-assets/documents/actualites/2023/04-avril/28-pnr/20230428-pnr-2023-luxembourg-final.pdf>)

²⁸ Convention-Luxinnovation Performance Contract 5/2022-2025 (<https://mesr.gouvernement.lu/dam-assets/documents/multi-annuities-and-contracts-for-establishments/CONVENTION-LUXINNOVATION-CONTRAT-DE-PERFORMANCE-5-2022-2025.pdf>)

²⁹ Almost EUR 1 billion in state aid to companies in five years (<https://www.luxinnovation.eu/fr/news/pres-dun-milliard-deuros-d aides-ets-metes-in-cinq-ans/>)

³⁰ Reception – Enovos Foundation (<https://www.fondation-enovos.lu/fr/>)

contributing to the energy transition and climate action will set national research, innovation and competitiveness targets for 2030 and 2050.

2.5.4 Examples of public and private R & D & I activities related to the energy transition and climate action

The resources and strategic orientations of governance have enabled public and private R & D & I actors to steer their activities towards key energy transition topics and set their own targets. The insert below lists examples of activities, without claiming any completeness in view of the range of possible contributions from different scientific and technological disciplines. However, the examples also illustrate the priority technological objectives, in particular the production and storage of renewable energy with a focus on photovoltaic and green hydrogen and the establishment and management of smart electricity grids. Reducing the carbon impact of building materials is another key theme. There are also cross-cutting issues such as monitoring, territorial planning and green finance.

Depending on the actors, activities are also located at different levels of TRL (technology readiness level) or upstream or downstream of complex value chains, of which Luxembourg covers only a small part. However, their concrete impacts on the energy transition are difficult to quantify or even impossible to model, even though indicators exist to measure research outputs, such as scientific publications or technological patents.

INSERT: List of R & D & I activities in Luxembourg related to the energy transition, to illustrate the wide range of topics and the need to mobilise multidisciplinary expertise:

- Development of innovative materials and technologies for renewable energy production, e.g. at the PV laboratory of the University of Luxembourg³¹ or the production and use of green hydrogen, e.g. at Paul Wurth Chair at the University of Luxembourg³² or the Department of Materials of the Luxembourg Institute of Science and Technology (LIST)³³.
- Research into the development of bioenergy or the recovery of useful substances from waste water or bio-waste streams, in particular for energy production, e.g. by the Environmental and Industrial Biotechnologies Unit of LIST³⁴ or by engineers at the University of Luxembourg in the context of the Interreg WOW project³⁵.
- Development of technical and IT solutions for smart, efficient and secure energy networks, with applications for mobility or real estate, e.g. by the Intelligent Clean Energy Systems (ICES) unit of LIST³⁶ or the “SnT – Interdisciplinary Centre for Security, Reliability and Trust” of the University of Luxembourg³⁷.
- Research on sustainable construction and circular economy at building level, aiming to use sustainable materials, optimise the construction and deconstruction process to promote recycling and reuse of materials and preserve grey energy, e.g. through the ArcelorMittal Chair of the University³⁸ or the SUSTAIN research unit of LIST³⁹. Building Information Modelling (BIM) is an

31 Photovoltaics (<https://www.uni.lu/research/fstm/dphym/research/photovoltaics>)

32 Prof. Ladewig appointed to Paul Wurth Energy Process Engineering Chair (https://www.uni.lu/university/news/slideshow/prof_ladewig_appointed_to_paul_wurth_energy_process_engineering_flesh)

33 Towards new materials for hydrogen production | LIST (<https://www.list.lu/en/news/towards-new-materials-for-hydrogen-production/>)

34 Environmental and Industrial Biotechnologies | LIST (<https://www.list.lu/en/environment/environmental-and-industrial-biotechnologies/>)

35 WOW! — Wider business opportunities for raw materials from Wastewater | Interreg NWE (<https://www.nweurope.eu/projects/project-search/wow-wider-business-opportunities-for-raw-materials-from-wastewater/>)

36 Smart Clean Energy Systems | LIST (<https://www.list.lu/en/environment/intelligent-clean-energy-systems/>)

37 SNT (<https://wwwfr.uni.lu/snt>)

38 ArcelorMittal Chair of Steel Construction (https://wwwfr.uni.lu/recherche/fstm/arcelormittal_chair_of_steel_construction)

39 Environmental Sustainability Assessment and Circularity | LIST (<https://www.list.lu/en/environment/environmental-sustainability-assessment-and-circularity/>)

essential tool for the implementation of these concepts, and ICT sciences therefore also contribute to sustainable construction.

- Development of methods and technologies for continuous monitoring of the effects of climate change and modelling scenarios to best adapt to a changing environment, e.g. by the Environmental Sensing and Modelling Unit of LIST40. Particular attention is paid to agricultural and forestry activities, but also to the prevention of extreme events or the availability of water41.
- Development of alternative approaches to spatial planning and town planning, which are less energy and resource intensive, as they are better structured and organised, for example in the context of the project “Luxembourg in Transition – Territorial directions for the decarbonised and resilient future of the Luxembourg functional region” with the participation of teams from the University of Luxembourg and LIST42.
- Sustainable Finance Research Programme implemented by the Sustainable Finance Chair at the University of Luxembourg, covering various topics such as environmental, social and corporate governance (ESG) disclosure and financial reporting, carbon risk measurement and management of mutual funds, or the risk and return of ESG investors’ activism43.
- Research on sustainable behaviours’: sociological aspects around the emergence of ‘positive climate’ lifestyles and the social consequences of the evolution of the energy transition by LISER teams44, but also by the University of Luxembourg and LIST in collaboration with Encevo on user behaviour45.

R & D & I activities are of course not limited to public research actors. In addition to existing innovative companies, Luxembourg has also seen a wide range of start-ups and clean tech SMEs dealing with energy transition issues such as renewable energy production and storage, mobility and “smart” real estate, and responsible resource management through circular economy principles. Various actors, or even sectors, have also set innovation objectives for the energy transition and have developed RDI structures, such as the Neobuild innovation cluster46 (created for the construction sector by the Council for the Economic Development of Construction – CDEC and transformed into the EIG in 2022 with the assistance of the Ministry of Economy) or Nexxlab, with the participation of CREOS47.

During 2023 Luxinnovation carried out a study of research capacities in the field of energy transition in Luxembourg’s public research centres and carried out a mapping of these public research capacities48. Luxembourg’s research landscape for a sustainable energy transition covers research groups that focus on energy topics such as renewable energy, energy efficiency and smart grids. However, the mapping also includes research groups working on areas indirectly related to energy, such as materials, process engineering, mobility and human behaviour.

This 1^{era} analysis can be extended to private R & D & I actors and provide a solid basis for a comprehensive and

40 Environmental Sensing and Modelling | LIST (<https://www.list.lu/en/environment/environmental-sensing-and-modelling/>)

41 Observatory for Climate, Environment and Biodiversity | LIST (<https://www.list.lu/en/institute/rd-infrastructure/observatory-for-climate-environment-and-biodiversity/>)

42 Luxembourg in Transition (<https://luxembourginttransition.lu/>)

A sustainable finance43 chair for education and research

(https://wwwfr.uni.lu/recherche/highlights/une_chaire_en_finance_durable_pour_l_enseignement_et_la_recherche)

44 Behavioural and experimental economics | LISER (<https://www.liser.lu/?type=module&id=219>) and Urban development and mobility | LISER (<https://www.liser.lu/?type=module&id=149>)

45 Encevo Launches First Joint Research Projects with Uni.lu and LIST

(https://wwwen.uni.lu/university/news/slideshow/encevo_launches_first_joint_research_projects_with_uni_lu_and_list)

46 Welcome – Neobuild (<http://neobuild.lu/>)

47 NEXXTLAB – We simplify energy transition (<https://www.nexxlab.lu/>)

48 [Energy Transition V5 \(luxinnovation.lu\)](https://www.luxinnovation.lu/)

comprehensive scoreboard of public and private investment in R & D & I activities contributing to the energy transition and climate action.

3 policies and measures

Note on budgetary implications:

The measures contained in the update of the integrated national energy and climate plan will be budgeted in line with the fiscal trajectory and the rules of the Stability and Growth Pact. Due to their positive side effects (air quality, job creation), national measures are at the forefront. Climate protection is an urgent task for all humanity. Therefore, our national and international commitments on climate protection are also a budgetary and financial priority. Significant investments will be made for the benefit of future generations.

Measures with a direct impact on public finances will be subject to multi-annual budgeting, as will all capital expenditure. The inter-ministerial committee acting under the Climate Law is responsible for regularly assessing the effectiveness of the measures applied, while respecting the different ministerial competences. These measures will therefore be subject to a qualitative assessment of their impact on the national budget in terms of revenue and expenditure, as well as their effectiveness in relation to national targets for greenhouse gas mitigation, energy efficiency improvements and the development of renewable energy. Positive side effects will also be taken into account. It is therefore perfectly possible that the measures are prioritised according to their effectiveness and that the measures concerned are replaced or supplemented by more effective measures, where appropriate.

The measures contained in the update of the integrated national energy and climate plan, which have already been adopted and incorporated into a Grand-Ducal law or regulation, are taken into account in the budget for 2024 and in multiannual planning.

It goes without saying that the new and reinforced measures contained in the update of the integrated national energy and climate plan must be subject to the usual budgetary procedure.

3.1 Decarbonisation dimension

3.1.1 GHG emissions and removals

3.1.1.1 Cross-cutting policies and measures

Achieving Luxembourg's transition to climate neutrality by 2050 at the latest, while respecting the intermediate targets in 2030, calls for committed, diversified and targeted action. This action requires a strong enabling framework for the coordinated and effective deployment of sectoral policies, strategies and measures, namely:

- ensuring effective **governance** and active **participation** of all transition actors:
 - Climate Law (measure 101)
 - Strengthening climate governance in the government administration (measure 102)
 - Reducing our consumption based carbon footprint (measure 122)
 - Development of monitoring statistics, models and indicators (measure 123)
- providing the necessary incentives through **tax policy**:
 - Tax CO₂ (measure 105)
 - Tax incentives for energy renovation of housing (measure 313)
 - Revised registration tax on road vehicles (measure 420)
 - Revised tax advantage for official cars (measure 421)
 - Modernisation of the tax subsidy for investments made as part of an energy and ecological transition project (measure 520)
- consolidate the **pioneering role of the State and municipalities** by developing **sustainable public procurement**:
 - Decarbonisation strategy pursuing the objective of climate neutrality of State administration already in 2040 (measure 109)
 - Climate Pact 2.0 with municipalities (measure 106), Climate Pact for Trade Unions industrial local authorities (measure 107), Nature Pact with municipalities (measure 108)
 - The forerunner role of the State and the municipalities with regard to buildings (measures 319-321)
 - Decarbonisation of construction sites (measure 323)
 - Electrification of the state car fleet (measure 413), full electrification of the RGTR bus network until 2030 (measure 414)
- fostering societal **engagement and** developing the key role of **education and training**:
 - Vocational training at secondary education level in the context of the energy and climate transition (measure 113), Training of a skilled and sufficient workforce in the buildings sector (measure 318)
 - Public awareness, information and advice promoting behavioural change and enabling framework for citizen engagement (measure 114), awareness raising, information, guides and advisory services on buildings (measure 317), awareness raising, information and advisory services on renewable energy sources (measure 202), Awareness, information and advisory services on mobility (measure 407)
 - Reducing our consumption based carbon footprint (measure 122)
 - National body supporting energy renovation, decarbonisation and implementation of photovoltaic installations for residential buildings (measure 327)
 - scale-up of energy and climate transition projects (measure 119)
- mobilising **research** and fostering **innovation**:
 - National Centre of Excellence in Research (ncer) for energy transition and climate action (measure 115)
 - Strategic R & D & I Programme for Governance of the Energy Transition and Climate Action (Measure 116)
 - Support the establishment of research chairs and public-private or public partnerships at the

University of Luxembourg and public research centres (measure 117)

- exploit the function of inter-sectoral coordination **interritorial and urban planning**:
 - PDAT: gradual reduction of land take and concentration of development in the most appropriate locations (measure 110)
 - Quarter of an hour city (measure 111)

The success of the transition called for depends on two key elements: the implementation of a just transition and the provision of appropriate funding.

Societal acceptance will need to be ensured by implementing a **just and socially fair transition**. Such a transition must not reduce the well-being of citizens, as it is based on the public's responsibility to actively facilitate and support the transition, nor the competitiveness of businesses, which create wealth and function as a driver of the transition. In order to help citizens and businesses succeed in the transition and to support workers in acquiring the skills needed for green jobs, the update of the NECP

- **consolidates the social redistribution** of revenue from the CO₂ tax (measure 105): The revenues generated by the CO₂ tax shall be used fairly to finance climate and energy transition measures and social compensation measures for low-income households by
 - the tax credit CO₂, and
 - an increase in the cost of living allowance;
- **strengthens and expands financial support schemes**:
 - Klimabonus Wunnen aid schemes (measures 307-309)
 - Climate loans scheme (measure 310)
 - Top up social under the Klimabonus Wunnen aid scheme (measure 311)
 - Klimabonus Mobilitéit aid schemes (measures 423-424)
 - Social leasing of electric cars (measure 422)
 - Aid schemes for enterprises (measure 515-520), Fit4Sustainability (measure 513), SME Packages Sustainability (measure 514)
 - Aid scheme for companies investing in charging infrastructure for electric vehicles (measure 425)
 - Aid scheme for the purchase of zero-emission heavy-duty vehicles (measure 426)
 - Just Transition Fund (measure 104)
- **amplifies coaching and training**:
 - National body supporting energy renovation, decarbonisation and implementation of photovoltaic installations for residential buildings (measure 327)
 - Assistance to households in energy poverty (measure 329)
 - Climate Pact for Business (SMEs) (Klimapakt fir Betriber) (measure 511)
 - Voluntary agreement on decarbonisation and improvement of energy efficiency in industry (measure 504)
 - Vocational training at secondary education level in the context of the energy transition (measure 113)
 - Training of a qualified and sufficient workforce in the buildings sector (measure 318)

In accordance with Regulation (EU) 2023/955 establishing a Social Climate Fund, each Member State will have to **draw up a "Social Climate Plan"** containing a coherent set of existing or new national measures and investments aimed at addressing the impact of carbon pricing on vulnerable households, vulnerable micro-enterprises and vulnerable transport users. The development of this plan will allow analyses and measures for a just transition to be further developed, in consultation with the social partners. In particular, the impact of the green transition on the labour market and employment can be further analysed with a view to identifying the jobs created, lost respectively during the green transition, and at developing/complementing the national skills strategy and the necessary training.

On the other hand, the transition to climate neutrality requires significant public and private investment. The financial challenge is **to mobilise investment flows** towards green priorities to ensure coherence with climate objectives. On the one hand, the state budget finances **increasing public investment in key infrastructure and projects related** to mobility or energy or **to the general decarbonisation** of all economic sectors. On the other hand, public finances must help **mobilise the private investment** required for the successful transition (see in particular measure 103 'Climate and Energy Fund' and measure 118 'Using sustainable and climate finance tools to decarbonise').

In order to achieve the climate objectives, it is important to underline the importance of **Regulation (EU) 2020/852 of 18 June 2020 (Taxonomy)**, which establishes a reference framework for defining which economic activities can be considered sustainable. It will require large companies to report the part of their business that is compatible with the taxonomy, with the objective of directing financial flows towards those activities. This is a major step towards decarbonising the financial market, which needs to adapt to new, more transparent and sustainable regulations, and which should lead to GHG emission reductions along the supply chain.

The Government's programme plans to accelerate the transition to net zero by further developing the financial position as an international hub for sustainable finance through innovative initiatives and financial products that respect the environment and the climate and are socially responsible.

In Luxembourg, **sustainable finance** includes all public or private measures that aim to make financial flows compatible with climate-resilient development and environmental degradation. Sustainable finance also takes into account social and governance aspects. In general, a distinction can be drawn between **international climate finance (ICF)**, which meets international commitments on climate finance and international solidarity, the policies and measures deployed by the Government to **mobilise more private funds and make the national financial position more sustainable**, as well as **initiatives from the private sector and civil society**.

As regards the **FCI**, Luxembourg is one of the world's largest donors per capita of public population. For the period 2021-2025, Luxembourg made available EUR 220 million for mitigation, adaptation and other cross-cutting measures for developing countries. The IFI funds are new and additional funds made available by Luxembourg in addition to its official development assistance, which amounts to around 1 % of gross national income in 2022.

At the same time, it is important that **public investment** is a **leverage effect for other sources of financing from the private sector**. This is why support for innovative financing methods is continued.

Since 2016, in addition to its voluntary budgetary contribution, Luxembourg has launched several important initiatives in the field of climate finance, in collaboration with partners in the financial sector, including the LU-EIB Climate Finance Platform, a joint initiative with the European Investment Bank (EIB) to mobilise investments in climate change projects, the International Climate Finance Accelerator, a public-private entity that offers financial and operational support to future fund managers to enable them to launch new innovative climate funds. the Green Earth Impact Fund, a sub-fund of the Luxembourg Earth Impact Fund that benefits from a de-risking mechanism, or the City Climate Finance Gap Fund, which is a trust fund for climate action in cities in developing countries, to name but a few.

With the aim of making its financial position more sustainable, a public-private entity, the **Luxembourg Sustainable Finance Initiative (LSFI)**, was created in 2020 by the relevant ministries, bringing together relevant actors (private, public, and civil society) in the field of sustainable finance. The LSFI is responsible for the implementation of the **Luxembourg Sustainable Finance Strategy**, adopted by the Council of Government in 2021. Given the increased interest of the Luxembourg financial sector, the update of the LSFI strategy in 2024 represents a good opportunity to propose concrete initiatives and products to facilitate the transition to net zero in partnership with financial institutions and other actors active in this field. It is recommended that, in proposing initiatives and products, the revised strategy defines both opportunities and potential, as well as the process of monitoring and monitoring the regular impact.

Title of the measure	No. 101 Climate Law	
Description	<p>The amended Climate Law of 15 December 2020 establishes the institutional framework and governance of climate policy at national level. It sets out the national climate targets, namely the intermediate target of reducing Luxembourg's greenhouse gas emissions (under Regulation (EU) 2018/842) by 55 % by 2030 compared to 2005 and the long-term objective of climate neutrality by 2050 at the latest. It establishes sectoral objectives in the following sectors: energy and manufacturing industries, construction; transport; residential and tertiary buildings; agriculture and forestry; waste and waste water treatment. The Grand-Ducal Regulation of 22 June 2022 determines the annual emission allocations for the 5 sectors for the period up to 31 December 2030. In addition, the Climate Law establishes the Climate Action and Energy Transition Platform and the Climate Policy Observatory.</p> <p>Furthermore, the Climate Law establishes the Climate and Energy Fund and transposes the amended Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the European Union (ETS) into national law.</p>	
Type of policy instrument	Regulatory	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2020	2050	
Responsible entity/entities	MECB	
Reference document (s)	Amended Climate Law of 15 December 2020; Grand-Ducal Regulation of 22 June 2022 determining annual greenhouse gas emission allocations	
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2020/12/15/a994/jo	

Title of the measure	No 102 Strengthening of climate governance in the government administration	
Description	<p>The amended Climate Law of 15 December 2020 establishes the legal basis for climate governance at national level, in particular by setting national and sectoral climate targets as well as establishing the Climate Action and Energy Transition Platform and the Climate Policy Observatory. In addition, the Interministerial Climate Action Committee established by decision of the Government Council of 14 August 2020 is responsible for inter-ministerial coordination of climate policy. In addition to analysing the annual track record of the implementation of the climate objectives and proposing new measures needed to achieve these objectives, one of the tasks assigned to the Committee is the regular assessment of the effectiveness of the measures applied, while respecting the different ministerial competences.</p> <p>This update of the NECP is the result of intense inter-ministerial collaboration within the Committee. The compilation and description of the measures have been prepared in thematic working groups by the experts of the ministries represented in the Committee and their respective administrations. A separate working group supported the work entrusted to STATEC on modelling and projections of emissions in the different sectors.</p> <p>Building on the experience gained, climate governance in general and inter-ministerial cooperation in particular will be analysed and strengthened. In particular, the planned development of statistics and models (measure 123) will be used to improve the regular evaluation of the measures.</p>	
Type of policy instrument	Planning	
State of play	Scheduled	
Start of implementing	End of implementation	Observations
2024	n.e.s.	
Responsible entity/entities	MECB, all relevant ministerial departments	
Reference (s)	Amended Climate Law of 15 December 2020	
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2020/12/15/a994/jo	

Title of the measure	No 103 Climate and Energy Fund	
Description	<p>The amended Climate Law of 15 December 2020 establishes the Climate and Energy Fund. The purpose of the Fund is, inter alia, to contribute to the financing of domestic climate change measures and measures in developing countries.</p> <p>It is financed by allocations from the State budget, part of the autonomous additional excise duty known as the “CO₂ tax”, part of the revenue from the tax on road vehicles, the proceeds from the sale of emission credits under the EU greenhouse gas emission allowance trading scheme, etc.</p> <p>In order to monitor the impact of funding, regular impact assessments will be carried out.</p>	
Type of instrument	Regulatory, Economic	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2020	n.e.s.	
Responsible entity/entities	MECB	
Reference document (s)	Amended Climate Law of 15 December 2020	
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2020/12/15/a994/jo	

Name of measure	No 104 Just Transition Fund	
Description	<p>The Just Transition Fund (JTF), one of the pillars of the Just Transition Mechanism, is a new financial instrument of EU cohesion policy. Its main objective is to co-finance projects of up to 50 % to support the territories most negatively affected by the negative impacts of the transition to a climate-neutral economy of the Union by 2050. In Luxembourg, the JTF will be implemented through the ERDF and ESF + programmes which each have a dedicated JTF priority axis. The Grand Duchy of Luxembourg's national allocation for the JTF amounts to a total amount of approximately EUR 9.2 million, of which approximately 60 % of the resources are allocated to the ERDF programme and approximately 40 % to the ESF + programme. While the JTF operational framework is governed by the ERDF and ESF + programmes, its policy framework is governed by the Territorial Just Transition Plan for Luxembourg (JTTP), which is supposed to designate the JTF's intervention territory and define the transformation sectors, development objectives and eligible types of operations. The plan was drawn up by the Ministry of Economy (DG Energy and ERDF Managing Authority) and the Ministry of Labour, Employment and the Social and Solidarity Economy (as ESF + managing authority), and was approved by the European Commission in December 2022. In order to address the transition challenges in the 11 municipalities in the southern region, the JTTP aims, first, to mitigate the costs of modernising the transforming sectors, tackle energy poverty and facilitate sustainable local mobility, and secondly, to support workers affected by the transition through training.</p>	
Type of instrument	Economic	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2023	2029	
Responsible entity/entities	MECO, MT	
Reference (s)		
Info complementary		

Name of measure	No 105 Tax CO ₂
Description	<p>Since 2021, fossil fuels have been subject to the CO₂ tax. The ceilings for the CO₂ tax are laid down in the amended Law of 17 December 2010 fixing excise duties and similar taxes on energy products, electricity, manufactured tobacco products, alcohol and alcoholic beverages. The annual rates of the CO₂ tax are fixed by Grand-Ducal Regulation and corresponded to EUR 20/t CO₂ in 2021, EUR 25/t CO₂ in 2022 and EUR 30/t CO₂ in 2023. From 1 January 2024, the rate shall be EUR 35/t CO₂. The revenues generated by the CO₂ tax shall be used fairly to finance climate and energy transition measures and social compensation measures in favour of low-income households, including tax measures or other measures such as the increase of the expensive living allowance. Activities covered by the EU greenhouse gas emissions trading scheme are exempt from the tax.</p> <p>In view of the national and sectoral climate targets introduced by the Climate Law, the carbon price will continue to be increased annually by EUR 5/tCO₂ to reach a level of EUR 45/tCO₂ in 2026, corresponding to the price level targeted by the future EU Emissions Trading System for buildings, road transport and fuels in certain industrial sectors, which will be introduced in 2027. As STATEC projections at this stage show that annual increases of EUR 5/t CO₂ will remain necessary to meet Luxembourg's 2021 cumulative emission budgets, it is expected that the provisions on the evolution of the CO₂ tax for the period 2027-2030 will be reassessed in 2026. These developments in the CO₂ tax are to be considered as "on top" of any measures taken by the riparian States, particularly following the introduction of the ETS -2, which could, if necessary, again influence the price differential for road fuels between Luxembourg and neighbouring regions.</p> <p>The Interministerial Climate Action Committee will closely monitor the implementation of the CO₂ tax, including in particular the effectiveness of the tax in relation to sectoral objectives. It will report quarterly to the Council of Government. The Committee will be assisted by a working group composed of STATEC, the Customs and Excise Administration and the Ministries concerned (MFIN, MECB and MECO). It will collect the relevant data and assumptions with a view to preparing for the re-evaluation of the provisions relating to the CO₂ tax referred to above and to anticipate any measures taken by the coastal States. If this work shows that the fuel price differential vis-à-vis our neighbouring regions is affected in such a way that the trajectory for the sale of fuels in line with climate and energy objectives is no longer respected, additional tax adjustments will be implemented. An increase in the CO₂ tax of EUR 5 corresponds to an increase in the price of road fuels from 1,1 to 1,2 cents per litre.</p> <p>Member States will be able to exempt the entities covered by the extension of the emissions trading scheme on condition that they are subject to a national carbon tax equal to or higher than the price in the new EU emissions trading system.</p>

	<p>The government will study in detail which system will be most beneficial in terms of climate action and social impacts. Subsequently, a decision will be taken on whether or not to maintain the national CO₂ tax system beyond 2026. The current system has the clear advantage that half of the revenue from the CO₂ tax is dedicated to social mitigation measures for the most vulnerable households.</p> <p>The Government maintains that: the revenues generated by tax CO₂ half will continue to be spent on climate protection measures and transition energy and for the other half to measures to social compensation for low-income households, including fiscal measures or other measures such as the increase in the expensive living allowance. For 2024, the tax rate is equivalent to EUR 35/t CO₂ with a corresponding 'CO₂ tax credit' of EUR 168. After 2024, the amount of the "tax credit CO₂" will be set annually in a way that is visible to the citizen through the Income Tax Act and will reflect the evolution of the CO₂ tax.</p>	
Type of policy instrument	Tax	
State of progress	Implementation, Planned	
Start of implementing	End of implementation	Observations
2021	n.e.s.	
Responsible entity/entities	MFIN, MECB, MECO	
Reference (s)	Amended Grand-Ducal Regulation of 17 December 2010 fixing the rates applicable to autonomous excise duties on energy products	
Info complementary	https://legilux.public.lu/eli/etat/leg/rgd/2010/12/17/n1/jo	

Title of the measure	No 106 Climate Pact 2.0 with municipalities	
Description	<p>Through their commitment under the Climate Pact, the municipalities align themselves with the objectives set by the Government Plan and actively promote climate protection and the energy transition. On the basis of the experience gathered and taking into account the objectives of the Integrated National Energy and Climate Plan (NECP), three development axes have been identified and identified for the 2.0 Climate Pact: quantification through centralised indicators, improvement of the working environment of municipalities and greater integration of citizens, businesses or other local and regional stakeholders.</p> <p>The governance of the Climate Pact 2.0 has been strengthened internally, in particular by entrusting the monitoring of the EEA programme when implementing the general policy of the municipality directly to a member of the College of Mayor and Aldermen. In the future, municipalities will be encouraged to extend the tasks of “Klimaschäffen” to include elements related to the just transition.</p> <p>Through a catalogue of 64 measures, municipalities are effectively oriented towards a sustainable policy in the areas of energy transition, climate change, circular economy, air quality, adaptation to climate change and mobility. This instrument also includes common specific quantitative key indicators that are closely linked to the objectives of the NECP. The catalogue of measures shall be regularly revised to take account of national objectives and regular evaluations of the programme.</p> <p>In return for their commitment, the municipalities receive assistance from a climate advisor and subsidies from the State depending on the level of certification obtained. The State shall make available the legislative, financial, technical and advisory framework until 31 December 2030. Klima-Agency is mandated for the operational implementation and continuous development of the programme.</p> <p>The Climate Pact 2.0 will be continuously developed and improved. The government will help municipalities to devise a strategy and implement it to achieve climate neutrality in the same way as state administrations.</p> <p>The Climate Pact 2.0 also encourages participation in programmes at European level such as the “Covenant of Mayors” and the “European green capital award”, making international use of local efforts to improve the environment, the economy and the quality of life in cities.</p>	
Type of instrument	Voluntary agreement	
State of play	Implement	
Start of implementing	End of implementation	Observations
2021	2030	Continuous development

Responsible entity/entities	MECB, Klima-Agency
Reference (s)	Law of 25 June 2021 establishing a 2.0 climate pact with municipalities
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2021/06/25/a482/jo

Name of measure	No 107 Climate Pact for Industrial Intercommunal Trade Unions	
Description	<p>The Climate Pact for Industrial Intercommunal Trade Unions aims to support public bodies and services involved in particular in the field of drinking water, wastewater treatment and waste management to reduce greenhouse gas emissions linked to their activities.</p> <p>As regards the wastewater treatment sector, the revision of Directive 91/271/EEC concerning urban waste water treatment includes the achievement of energy neutrality in several stages. For example, the sanitation sector will have to ensure that the total annual energy used comes from renewable sources and reaches:</p> <ul style="list-style-type: none"> - 50 % at the end of 2030 - 75 % at the end of 2035 - 100 % at the end of 2040 <p>In line with the revision of the Urban Waste Water Treatment Directive, this Climate Pact measure will support all other industrial inter-municipal trade unions to gradually achieve climate neutrality. This measure is therefore also in line with the objective of achieving climate neutrality for all public administrations until 2040, as decided by the Chamber of Deputies.</p>	
Type of instrument	Voluntary agreement	
State of progress	Scheduled	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MECB, MECO, Klima-Agency	
Reference (s)		
Info complementary		

Name of measure	No 108 Nature Pact with municipalities	
Description	<p>Like the Climate Pact, the Nature Pact is an instrument to promote communal and regional initiatives to preserve and restore biodiversity.</p> <p>Municipalities are important partners of the state in the field of nature protection and natural resources. Through their decisions, they can make a significant contribution to improving the situation of natural areas and biodiversity.</p> <p>The Nature Pact offers municipalities wishing to actively combat biodiversity loss the opportunity to apply for state support. By joining it, the municipalities undertake to implement the catalogue of measures of the Nature Pact. The catalogue includes nature protection measures in the following areas: “establishment and implementation of a comprehensive strategy”, “urban environment”, “open landscape environment”, “aquatic environment”, “forest environment” and “communication and cooperation”. Some of the Nature Pact measures (such as the development of woody vegetation and plantations in urban areas or the creation of integral forest reserves and ageing islands) show significant carbon sequestration potential.</p> <p>In return for the commitment of the municipalities, the State grants an operating grant to the participating municipalities and covers the costs of the Covenants Nature Advisers. The State shall make available the legislative, financial, technical and advisory framework until 31 December 2030.</p>	
Type of policy instrument	Voluntary agreement	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2021	2030	
Responsible entity/entities	MECB, Klima-Agency	
Reference (s)	Law of 30 July 2021 establishing a nature pact with municipalities	
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2021/07/30/a595/jo	

Name of measure	No 109 Decarbonisation strategy pursuing the objective of climate neutrality of the state administration from 2040	
Description	<p>As part of the exemplary role of the public sector in the fight against climate change, a strategy for decarbonising the state administration will be developed in cooperation with all relevant stakeholders. The strategy will aim at the objective of climate neutrality of the State administration from 2040 and will cover in particular the building stock, the car fleet and the public procurement contracts in general of the State and public institutions. It will address the organisation and resources necessary for its implementation and include an indicative timetable. The Government will, as far as possible, equip all public buildings with photovoltaic installations until 2030 and further accelerate their energy remediation, with a view to their climate neutrality, while taking into account the requirements of the Energy Efficiency Directive and the Energy Performance of Buildings Directive. Regular communication will be organised around the implementation of the strategy and the implementation of flagship projects.</p> <p>The Climate Pact with municipalities will encourage municipal administrations to continue similar efforts.</p> <p>The Government will incorporate environmental and climate-friendly sustainability criteria and promote the circular economy in public invitations to tender and will draw up model specifications for this purpose. In addition to these social, circular and low-carbon criteria, the Government will also use public tenders to promote innovative technologies and solutions while involving ministries and government and local administrations.</p>	
Type of policy instrument	Planning	
State of play	Planned	
Start of implementing	End of implementation	Observations
2024	2040	
Responsible entity/entities	MMTP, ABP, MECO, MECB, MAINT, Belval Fund, Kirchberg Urbanisation and Development Fund	
Reference (s)	Coalition agreement 2023-2028	
Info complementary	https://gouvernement.lu/dam-assets/documents/dossier/formation-gouvernement-2023/accord-coalition.pdf	

Title of the measure	NO 110 PDAT: gradual reduction of land take and concentration of development in the most appropriate locations	
Description	Among the policy objectives of the draft PDAT, the first two have a major impact on the reduction of CO ₂ emissions: gradual reduction of land take and concentration of development at the most appropriate locations. The first objective is to reduce land take to zero in 2050, precisely to preserve agricultural and forest land inter alia for its capacity to absorb CO ₂ . Combined with multifunctional development while preserving and developing the intra-urban green grid, the concentration of development allows a significant reduction in the need for motorised travel and an increase in the quality of life. Moreover, this approach limits diffuse, costly and harmful urban development for landscape quality. Finally, anticipatory infrastructural planning is possible as we know where urban developments will be carried out.	
Type of policy instrument	Planning	
State of play	Implementation	
Start of implementing	End of implementation	Observations
2023	n.e.s.	
Responsible entity/entities	MLOGAT, Other: Municipalities, sectoral policies with territorial impact	
Reference document (s)		
Info complementary	https://amenagement-territoire.public.lu/content/dam/amenagement_territoire/pdat-programme-Director – damnagement-Dual-4072023.pdf	

Name of measure	No 111 City of quarter of an hour	
Description	<p>The concept of the 'Quarter Time City', which aims to provide essential services necessary for living at a distance of a quarter of an hour by walking or by bicycle from the place of residence, is currently being applied in large metropolitan areas such as Paris, Copenhagen, Milan and Dublin.</p> <p>The PDAT provides for this concept to be developed in the three major Luxembourg agglomerations, Nordstad, Agglo-Centre and the South Region. In the context of the Covid pandemic, the importance of proximity to such services has been further accentuated and it is therefore necessary to plan cities taking into account the proximity and accessibility of services. The implementation of this concept requires certain densities (critical mass) but also multi-functional spatial planning.</p>	
Type of instrument	Planning	
State of progress		
Start of implementing	End of implementation	Observations
2024		
Responsible entity/entities	MLOGAT, MAINT, MMTP, Communes	
Reference document (s)		
Info complementary		

Name of measure	No 112 “Green Belt around the Luxembourg City agglomeration” and “Interurban green zone” projects resulting from the international consultation “Luxembourg in Transition”	
Description	<p>Organised between September 2020 and February 2022, the ‘Luxembourg in Transition’ international consultation was a process that brought together several international teams composed of specialists in the field to develop projects to achieve the ecological transition of Luxembourg’s functional territory by 2050. A real ‘out of the box’ think-tank, the consultation allowed a wealth of ideas to inspire sectoral policies but also to raise awareness among citizens to adapt their behaviour. Of the ideas produced, two ideas are already being implemented: “Green belt around the Luxembourg City agglomeration” and the “Green Interurban Zone”. The first aims are to develop a green, natural and agri-food belt around the capital, thus serving a number of objectives, including recreation, the development of green infrastructure and the promotion of local consumption. The second project focuses on the space between the agglomerations of Luxembourg City and the South Region and aims to preserve the landscape qualities of these areas while promoting the development of agri-food. Both projects are also included in the PDAT due to their consistency with the first two policy objectives.</p>	
Type of instrument	Planning	
State of play	Scheduled	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MLOGAT	
Reference document (s)		
Info complementary		

Title of the measure	N° 113 Vocational training in the context of the energy and climate transition
Description	<p>The energy and climate transition relies largely on technological measures. In this context, the availability of a skilled workforce is essential and is currently one of the greatest challenges in providing the means needed to achieve the climate objectives. Guidance to vocational training takes place at the end of the 5th grade (3th year of general secondary education) on the advice of the classroom board, depending on the student's educational performance and interests. There are three training pathways leading to the following qualifications: certificate of professional competence (CCP), diploma of professional competence (DAP) and diploma in technician (DT).</p> <p>In order to ensure that school curricula, course content and challenges related to the skills required in the context of the energy and climate transition are matched, the curricula shall be developed and updated by the curriculum teams, in partnership with representatives of professional chambers, the Chamber of Employees, and sectoral representatives of training companies. Systematic and regular evaluation of the programmes in consultation with the representatives of the professional chambers within the framework of the Vocational Training Steering Group makes it possible to define updating needs and strategic objectives. In this context, the expression of the demand for skills for the energy and climate transition has led to the introduction in the short term of new programmes (DT Smart Technologies including the 'Smart Buildings and Energies' and 'Smart Energy' 'Renewable Energies') and the introduction of additional certifications as part of initial training diplomas, e.g. handling refrigeration units containing fluorinated greenhouse gases ('Kälteschein').</p> <p>In general, the aim is to expand the offer of training in the field of sustainable development, in order to meet, at least in part, the need for skills and skilled workforce in sectors related to the green transition and to expand the offer of up-skilling programmes for anyone wishing to train or deepen their energy and climate skills.</p> <p>It is also imperative to introduce reskilling programmes for skills linked to the green transition, aimed at the target audience of jobseekers and employees at risk of job loss, in order to promote reintegration and retention, together with ADEM. And to continue investing in retraining opportunities to provide unrecognised jobseekers with new opportunities and opportunities.</p> <p>In addition to these public initiatives, it is also appropriate to seek or even strengthen partnerships with private initiatives from civil society in order to promote the development of a broad and diversified training offer.</p>

	In addition, it is appropriate to launch a national initiative to enhance the value of craft jobs for occupations linked to the objectives of the NECP. In this context, professional chambers, craftsmen federations and relevant ministries come together to draw up a programme which, on the one hand, underlines the strategic importance of crafts and, on the other hand, aims to encourage students to actively opt for artisanal training in the fields of energy and climate transition.	
Type of policy instrument	Education	
State of play	Implementation, Under analysis	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MENEJ	
Reference document (s)		
Info complementary		

Name of measure	No 114 Citizens' awareness, information and advice promoting behavioural change and enabling framework for citizen engagement
Description	<p>Klima-Agence supports all societal actors in their commitment to climate protection and energy transition. Thus, Klima- Agency's activities focus on reducing energy consumption, promoting renewable energies, sustainable housing and mobility, as well as managing natural resources and implementing the circular economy.</p> <p>The 'behavioural' component, respectively, that of lifestyles is one of the priority levers for a carbon-neutral society. In this context, Klima-Agency is advancing the mainstreaming of climate change in all its activities and projects with the objective of addressing in concrete terms the themes/concepts of "resilience", "sobriety" and "climate change adaptation" at the level of its various target groups (see measure 122 on consumption based carbon footprint).</p> <p>In this context, Klima-Agence's communication approach is to be evaluated, in particular by producing more short and regular television or radio broadcasts to reach as many viewers as possible. These spots could also be used on social media in the form of small condensed clips or infographics.</p> <p>In addition, Klima-Agence will communicate more clearly on the competences of the various public institutions and administrations in order to facilitate access to information on the various regulations and laws in force and the various subsidies in place.</p> <p>In the context of the Climate Pact 2.0, Klima-Agency and its partners are also mobilising municipalities to raise awareness and encourage their fellow citizens to reflect more on their lifestyle and to make more use of models of citizens' initiatives such as the sharing economy, energy communities, community gardens, etc. Klima-Agence will offer information seminars/workshops to the municipalities to promote and facilitate a sustainable way of life and, together with its partners, provide trainers in this area. One approach could be to set up a "Climate Awareness Workshop" that would specifically adapt to the local and regional context. Following these workshops, participants would receive a certificate ("Klimaführerschein").</p> <p>In developing these measures, Klima-Agence will also rely on research programmes from the University of Luxembourg, LISER and LIST.</p> <p>In general, citizen engagement can be further facilitated by defining a favourable framework and conditions, building on the experience of civil society organisations promoting such engagement.</p> <p>In addition, the government will provide a carbon footprint calculator to raise awareness of the greenhouse gas reduction potential of behavioural changes. Digital tools such as virtual applications or networks will be explored to facilitate the learning process and the exchange of best practices (see measure 122 on consumption based carbon footprint). Information on climate change, decarbonisation and carbon footprint, as well as on</p>

	<p>climate-related strategies and initiatives will also be made available to the general public on the new website klima.lu.</p> <p>It should be noted that awareness raising and education should not only aim to highlight lifestyles that are not in line with climate objectives or the consequences of consumption behaviour. Instead, they should promote a change of values, for example by encouraging solidarity, sharing of practices and sobriety. To this end, support for social sciences and psychology is essential.</p>	
Type of instrument	Information	
State of play	Implementation, Under analysis	
Start of implementing	End of implementation	Observations
		Continuous implementation
Responsible entity/entities	MECB, MECO, Klima-Agency	
Reference document (s)		
Info complementary		

Name of measure	No 115 National Centre of Excellence in Research (ncer) for energy transition and climate action	
Description	<p>At the beginning of 2023, the MESR and the NRF presented a new project for the energy transition. Ncers are expected to provide a structuring framework and funding to pool research excellence around a mission of important societal interest, encouraging high-level transdisciplinary research and cross-sectoral collaboration. The ncer theme will focus on digitalisation and the establishment of a digital twin at national level to accelerate the energy transition and climate action. Ncer projects are funded by the NRF on the basis of an international independent evaluation for a maximum period of eight years and therefore represent long-term investments under national research priorities. The maximum amount of funding of one ncer shall be EUR 15 million over 5-8 years. There are also variable own contributions from research institutions. The ncer promotes transdisciplinary research and close collaboration with public and private actors. In the context of the energy transition and a national digital twin, it will be essential to include social components for change management, territorial organisation and the combination of skills for green finance and for the regulatory and legal framework. While the digital twin technology project is currently being carried out by LIST and SnT, MESR plans to strengthen the above elements by also involving LISER for socio-economic research activities and the establishment of real world labs in relation to a just climate transition, social learning and governance.</p>	
Type of instrument	Research, Economic	
State of progress	Planned	
Start of implementing	End of implementation	Observations
2024	2030	When the ncer comes to an end, it is supposed to be structurally anchored in its home institutions.
Responsible entity/entities	MESR, FNR, MECO	
Reference document (s)		
Info complementary	https://www.fnr.lu/funding-instruments/ncer/	

Title of the measure	No 116 Strategic R & D & I Programme for Governance of the Energy Transition and Climate Action	
Description	<p>Luxembourg already has an important and multidisciplinary ecosystem of public and private R & D & I actors that can contribute to the energy transition and climate action. Thematic development strategies have also been put in place by various actors, in particular the MESR and the NRF, and substantial budgets can be mobilised. However, due to the lack of centralised governance in relation to the topic, R & D & I activities are poorly coordinated. The nest for the energy transition is an important 1st step in this direction, with a focus on digitalisation. To address other priority topics of energy transition and climate action in a structured, grouped and targeted way, integrating social and societal aspects in an interdisciplinary way, a strategic research agenda for societal, industrial and regulatory transfer will be put in place. This programme will be under the governance of the Ministries with Climate Action and Energy in their remit and will support interdisciplinary projects, also integrating spatial planning aspects.</p> <p>The programme will be financed in part from the Climate and Energy Fund. In order to ensure coordination with other activities and high-quality professional management of the research work, close cooperation will be sought with the NRF, in particular through a public-public partnership. Coordination with the industrial community will be carried out with the help of Luxinnovation, in order to identify synergies with support and financing actions for R & D & I in enterprises, in particular SMEs, and to develop experimental projects. The programme will benefit from the specificities of Luxembourg as a field of multi-country experimentation and foster collaboration with international actors and European institutions.</p> <p>This centralised governance and coordination will make it possible to identify past, ongoing and future public-private collaborative R & D & I projects and to better valorise them, in particular for the strategic direction of the programme.</p>	
Type of instrument	Research, Budget	
State of progress	Under analysis	
Start of implementing	End of implementation	Observations
2025	n.e.s.	
Responsible entity/entities	MECB, MECO, MESR, FNR	
Reference (s)	Amended Climate Law of 15 December 2020	
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2020/12/15/a994/jo	

Title of the measure	No 117 Support for the establishment of research chairs and public-private or public-public partnerships at the University of Luxembourg and public research centres	
Description	<p>To succeed in the energy transition, Luxembourg needs advanced skills and sufficient and skilled labour for complex technological tasks. The University of Luxembourg already offers training in this field at various levels, such as the Bachelor in Engineering – Energy and Environment (Uni.lu) and the Master’s degree in Sustainable Development (Uni.lu) – Filière Energie et Environnement (MDD), developed in co-degree by the University of Luxembourg and the University of Liège (Campus Arlon). In addition, the University of Luxembourg will develop its activities and expertise in the field of sustainability with a new Interdisciplinary Research Centre (IC) on sustainable environmental systems with a separate interdisciplinary approach, a holistic vision of disciplines and missions, an international reputation and local impact.</p> <p>Similarly, the Luxembourg Institute of Science and Technology (LIST) is also very active in the field of environmental research and the Luxembourg Institute of Socio-Economic Research (LISER) will be able to contribute to the socio-economic consequences of the energy transition.</p> <p>The aim of this measure is to support the various actors involved in public research in their efforts to create leverage effects in the fields of research described above through research chairs and public-private or public-public partnerships by helping them to identify the industrial or public partners and other sources of funding which may contribute to the creation of the desired leverage effects.</p> <p>The priority R & D & I topics already identified by MECO and MECB to support the energy transition and climate action are coupled energy systems, construction with bio-based materials and landscapes.</p>	
Type of instrument	Research, Education	
State of progress	Planned	
Start of implementing	End of implementation	Observations
2024	n.e.s.	
Responsible entity/entities	MESR, MECO, MECB	
Reference (s)		
Info complementary		

Title of the measure	No 118 Use of sustainable and climate finance tools to decarbonise
Description	<p>Climate and sustainable finance From 2021 to 2025, a total of EUR 220 million is made available for international climate finance, aiming at a balanced distribution between climate change mitigation, adaptation and resilience, and recently loss and damage. In addition, in accordance with the Climate Law of 15 December 2020, the Climate and Energy Fund (see measure 103) allows the financing of national climate projects in the field of sustainable finance through innovative mechanisms and instruments.</p> <p>Blended finance By leveraging public funding to reduce the risk of private investments, blending can help catalyse additional capital for climate solutions. Luxembourg is already acting as a catalyst to boost sustainable investment, including the Klimapakt fir Betriber, the International Climate Finance Accelerator, the Luxembourg Earth Impact Fund and the Luxembourg-EIB Climate Finance Platform. Luxembourg will explore the possibility of expanding its blending offer. There is a significant potential for funding in the area of retail banking and could be considered in the future.</p> <p>Green mortgages Green mortgages can encourage a borrower to buy an energy-efficient building or to renovate an existing building to improve its energy performance. The ‘climate loans’ scheme (measure 310), subsidised by the State, provides, for example, support for energy renovation by reducing the interest rate. The Luxembourg government will explore ways to reduce technical and social barriers to green mortgages, in particular by proposing recommendations to financial institutions based on the energy classes of buildings (in compliance with the General Data Protection Regulation (GDPR)).</p> <p>Green Budgeting Green budgeting consists of integrating sustainability considerations into the national budgetary process and can be a powerful tool to finance the transition to a more sustainable economy. Luxembourg has already taken steps to integrate the principles of green budgeting into its public finance management practices, in particular as regards the expenditure of the NECP. Luxembourg continues to explore how green budgeting practices can be further developed inter alia through the regular budget, special funds and public procurement. For example, the Luxembourg government issued a first sustainable sovereign bond in 2020 for an amount of EUR 1.5 billion to finance and refinance at least 65 sustainable investments. In doing so, Luxembourg was the first European country and the first rated AAA country in the world to issue a sustainable sovereign bond.</p> <p>Raising awareness of climate finance for the financial sector and the general public Raising awareness of the Luxembourg financial sector on climate finance is a key component for achieving climate objectives. As a result, the Luxembourg Sustainable Finance Initiative (LSFI) was created in 2020 with</p>

	<p>one of its aims is to raise awareness, promote and support the development of sustainable finance initiatives in Luxembourg. In the same vein, a strategic partnership with the University of Luxembourg was concluded in 2020 to create a sustainable finance research project, including a Master's programme and a sustainable finance certificate that aims to train talent in the field of climate and sustainable finance. The government will continue to support the awareness raising of the financial sector and the general public.</p>	
Type of policy instrument	Regulatory, Information, Economic	
State of play	Implementation, Under analysis	
Start of implementing	End of implementation	Observations
2020	n.e.s.	
Responsible entity/entities	MECB, MECO, MFIN	
Reference (s)		
Info complementary		

Title of the measure	No 119 Placing of energy and climate transition projects	
Description	<p>Local energy and climate transition projects are important to initiate production and consumption patterns and new solutions compatible with climate protection. However, one of the biggest challenges of the green transition is the scaling up of these initiatives, pilot projects and good practices, while integrating environmental, socio-economic and sound management (“Upscaling”) aspects.</p> <p>To facilitate this, a coalition of public, private and civil society actors is needed. The basic objective is to stimulate and optimise demonstration projects that contribute to an exemplary framework for the development of concepts and guidelines, in order to facilitate a wider deployment of innovative and transformative approaches in Luxembourg and the region.</p>	
Type of policy instrument	Planning	
State of play	Under analysis	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MECB, MECO	
Reference document (s)		
Info complementary		

Name of measure	No 122 Reducing our consumption based carbon footprint
Description	<p>There is consensus among scientists that climate protection is also linked to cultural change: behavioural change, sobriety of lifestyles, promotion of the common good, etc. Therefore, the success of many other measures also depends on people’s willingness to change behaviour.</p> <p>In addition to production-based GHG emissions accounting, as enshrined in international GHG inventory conventions, consumance-based accounting provides important information on how different aspects of our way of life, such as our consumption of mobility, housing, food and goods, contribute to our carbon footprint. Indeed, the consumption based carbon footprint takes into account the GHG emissions that occur worldwide due to what we consume in Luxembourg, while the national production-based inventory only includes GHGs that have been emitted in Luxembourg. The consumption based carbon footprint therefore includes indirect GHG emissions occurring outside Luxembourg.</p> <p>By putting in place the necessary means, the government will establish a consumption-based approach to calculate the carbon footprint to include these indirect emissions. This approach makes it possible to calculate the life cycle GHG emissions of a product or process, such as life cycle GHG emissions associated with different construction materials. In addition, this approach will facilitate the development of measures to reduce the carbon footprint related to consumption, including by encouraging behavioural changes and sobriety.</p> <p>In addition, the government will provide a carbon footprint calculator to raise awareness of the GHG reduction potential of behavioural change (measure 114). Combined with information on how certain actions can reduce a person’s carbon footprint, carbon footprint is an important tool to help citizens reduce their climate impact.</p> <p>The government will explore how applications can be made available to citizens to determine their own carbon footprint and the climate impact of different actions they can undertake, such as promoting public transport or changing diets. These applications can also facilitate the reduction of consumer-related emissions by encouraging repair, the sharing economy and second-hand markets. The information will also be available on the new website klima.lu (measure 114).</p>
Type of instrument	Information, Research
State of progress	Under analysis

Start of implementing	End of implementation	Observations
Responsible entity/entities	MECB, MECO	
Reference document (s)		
Additional info		

Name of measure	No 123 Development of monitoring statistics, models and indicators	
Description	<p>The projections prepared by STATEC for the update of the NECP are a first step to quantify economic and technological trends, as well as measures taken at national and international level. The aim is to monitor energy production, consumption and direct emissions in a short period of time. In order to achieve this, statistics, based on administrative or survey data, need to be improved and multiplied. The collection and availability of new data sources to STATEC will thus enable quantified monitoring of measures and regular monitoring in relation to climate and energy objectives. They will also further develop STATEC projection models, the granularity of which is currently limited by the unavailability of certain data.</p> <p>Beyond the direct emissions approach, data on emissions associated with imported goods and services could be collected (indirect emissions), so that emissions can be estimated throughout the value chain (see also measure 122).</p>	
Type of instrument	Planning, Information	
State of progress	Planned	
Start of implementing	End of implementation	Observations
2024		Continuous implementation
Responsible entity/entities	STATEC, MECB, MECO, MMTP, AEV, SER	
Reference document (s)	Law of 10 July 2011 on the organisation of the National Institute of Statistics and Studies	
Info complementary		

3.1.1.2 Buildings

Measures to decarbonise buildings are closely linked to measures to improve the energy efficiency of buildings, including through energy remediation measures, as any reduction in fossil energy consumption means a reduction in GHG emissions.

At building level, decarbonisation through electrification via a heat pump is the most important alternative to fossil fuels, in particular because part of the (renewable) electricity can be produced at national level and because of the significant energy efficiency gain, as most of the energy provided for heating and domestic hot water by a heat pump comes from the environment (ambient energy).

Any new construction (residential and functional buildings) must comply with the requirements of the amended Grand-Ducal Regulation of 9 June 2021 on the energy performance of buildings, which defines the national 'nZEB' level (nearly Zero Energy Building): thanks to the continuous evolution of ambitions and requirements at regulatory level since the entry into force of the first regulation on the energy performance of residential buildings in 2007 and functional buildings in 2010, and thanks to the parallel development of the competences of the construction sector in Luxembourg to be able to implement these ambitions, Luxembourg's nZEB is now one of the most ambitious in Europe and ensures that any new construction to which this regulation applies is automatically highly efficient in terms of energy efficiency and is decarbonised due to the fact that the heat pump is the reference technology for the installation of heat and domestic hot water production.

The measures planned at building level vary depending on whether they are residential or functional buildings and are also specific to the sector concerned, namely the public sector, the professional sector and individuals.

The public sector has been redefined in the context of the new Energy Efficiency Directive (EED, (EU) 2023/1791), since it will no longer be only the central government buildings that are covered, but all state buildings and municipal buildings. EED includes more ambitious energy renovation obligations for public sector buildings (measure 303). It is important to take into account in this context the need for additional resources at the level of the public sector to be able to implement these European obligations. As regards existing buildings in the professional sector, obligations are announced (measure No 304); the timetable for these obligations will be defined when the Directive is transposed into national law and the sector (CoC, CdM) will be consulted, as well as possible private sector incentives for energy renovation before the mandatory phase will be analysed.

As regards existing housing, the approach to energy efficiency (energy sanitation) and decarbonisation (replacing fossil heating with non-fossil alternatives) is based on voluntary participation, accompanied by support (subsidies) and awareness-raising mechanisms, information and assistance to households; awareness raising focuses on the benefits of energy sanitation (such as reduced energy consumption and costs, comfort gain, upgrading of real estate assets (where appropriate with an extension of the habitable area), etc.) and decarbonisation (measure against global warming, reduction of greenhouse gas emissions, independence of fossil fuels and very volatile prices of fossil fuels, possibility of production and self-consumption of electricity on site, etc.); the various subsidy mechanisms (such as State aid (Klimabonus (No 307), climate loans (No 310), individual housing aid (No 311), aid for stone (No 312), fiscal incentives (No 313), etc.), aid offered by electricity and natural gas suppliers under the energy efficiency obligation mechanism and municipal aid) are reviewed regularly and can mostly be combined and combined, in order to make energy sanitation and decarbonisation measures economically attractive and accessible to all households.

The energy renovation of the worst-performing residential buildings and special assistance to vulnerable households is specifically addressed and will be targeted primarily by the future national body supporting energy renovation, decarbonisation and the implementation of photovoltaic installations for residential buildings (measure No 327), whose future tasks and working methodology are developed, inter alia, in the context of the pilot project for the renovation of 'zesomme renoeren' districts in Differdange (measure No 328).

Name of measure	No 301 Rules governing the energy performance of buildings	
Description	<p>In 2021, the regulatory framework for the energy performance of residential and functional buildings was adapted with the aim of incorporating the various provisions for residential and functional buildings into a single Grand-Ducal Regulation.</p> <p>In particular, this Regulation defines the reference building model that is used to define energy efficiency requirements for individual buildings. The Regulation also defines environmental performance indicators (in CO_{2eq}) and other minimum requirements such as pre-tubing for charging stations or photovoltaic installations, as well as the calculation methodology and content of the energy performance certificate.</p> <p>Revisions and adaptations are foreseen, including the adaptation of energy classes for residential buildings, the definition of an energy performance level nZEB_{renovation} for energy renovation, the installation of photovoltaic panels at the reference building level for dwellings, the obligation (in the form of minimum requirements) to install photovoltaic panels “on the entire surface of the roof” and the reform of the energy performance certificate as an environmental performance certificate, based on the (ongoing) revision of the EU Energy Performance of Buildings Directive. Definition of an energy performance level nZEB_{renovation}, in the context of the revision of the EPBD (EU) 2024/1275) and the introduction of Minimum Energy Performance Standards (MEPS), EN holding duly account of report cost-effectiveness (proportionality) and technical feasibility, as provided for in the Directive); this nZEB_{renovation} level will be the minimum requirement for future renovation obligations (in particular for the public sector).</p> <p>In connection with the European Taxonomy (classification of economic activities with a favourable impact on the environment) and the resulting requirements for financial institutions, Luxembourg will, as part of the revision of the same directive, examine the provision to banks of recommendations based on the energy classes of buildings (in compliance with the General Data Protection Regulation (GDPR)).</p> <p>New tools to assess carbon impacts along the construction and renovation value chain will be put in place based on the future requirements of the EPBD (EU) 2024/1275 and the low-carbon construction roadmap. These efforts will be accompanied by a revision of the guide to sustainable construction and renovation.</p>	
Type of policy instrument	Regulatory	
State of play	Implementation, Planned	
Start of implementing	End of implementation	Observations

2021	n.e.s.	legislation contract since 2007 (residential buildings)/2010 (functional buildings) and regularly adapted, in particular on the basis of the new European EPBD (+ EED, if applicable)
Responsible entity/entities	MECO	
Reference (s)	Amended Grand-Ducal Regulation of 9 June 2021 on the energy performance of buildings	
Info complementary	https://legilux.public.lu/eli/etat/leg/rgd/2021/06/09/a439/jo	

Name of measure	No 302 Decarbonisation of residential buildings: phase out of fossil heaters
Description	<p>Given the objective of decarbonising residential buildings, i.e. reducing greenhouse gas emissions, it is essential to replace all fossil based heating installations with decarbonised heating systems in the medium term.</p> <p>This concerns all heating and domestic hot water systems.</p> <p>A voluntary approach</p> <p>The government promotes a voluntary approach, providing citizens and businesses with a wide range of easy-to-implement and coordinated solutions at national, regional and local level. Collective solutions such as systematic district renovations and decarbonised heat networks will be massively developed, in collaboration with the municipalities and the consultancy and crafts sector. Similarly, skills at the level of the actors involved will continue to be developed and strengthened in the light of current and future decarbonised alternative technologies (heat pumps and district heating networks being targeted as a priority in the context of the decarbonisation of buildings). These measures will complement existing substantial aid schemes, such as the existing State aid scheme ‘Klimabonus’ (including the ‘Masuttersatzprogramm’ bonus increasing the aid granted in the case of the replacement of an existing fossil fuel boiler and, where appropriate, the ‘social top-up’ on Klimabonus aid), as well as, where appropriate, the aid proposed by municipalities and certain private actors, such as the obligated parties (electricity and natural gas suppliers) under the energy efficiency obligation scheme (EEOS).</p> <p>The government will set up national monitoring of the decarbonisation of buildings to monitor the annual evolution of the replacement of fossil heaters with decarbonised alternatives to the decarbonisation pathway (based on annual targets) needed in the context of national greenhouse gas emission reduction targets.</p> <p>In the same context, and in order to facilitate the installation of a heat pump in the event of a failure of an existing fossil boiler, the Government will analyse the usefulness of a stock of emergency heating installations that can be used, if necessary, as an intermediate/transitional solution (a few weeks to a few months) in the event of unforeseen failure on an existing (fossil) boiler. The emergency repair installation will cover the time required for the sizing, choice, control and installation of a heat pump. Emergency heating installations may be fossil-energy installations (natural gas or heating oil, depending on the existing faulty boiler (availability of the fuel in question)), electric heaters, heat pumps or combined systems. The usefulness will be assessed and the establishment of such a stock of troubleshooting will be defined, where appropriate, in close consultation with the sector.</p>

Type of policy instrument	Regulatory	
State of play	Under analysis	
Start of implementing	End of implementation	Observations
		Proactive approach with monitoring from developments from the decarbonisation
Responsible entity/entities	Meco, MECB, MLOGAT, Klima-Agence, OAI, Chamber of Metiers and Federation of Artisans, Communes	
Reference document (s)	Klimabonus Regulation, Energy Efficiency Obligation Scheme (EEOS), Amended Law of 5 August 1993 on the rational use of energy + amended Grand-Ducal Regulation of 9 June 2021 on the energy performance of buildings, etc.	
Info complementary		

Heading from the measurement	No 303 Energy renovation obligation for public buildings
Description	<p>Introduction of an obligation to renovate certain categories of buildings on the basis of the new requirements of the European Directives EED ((EU) 2023/1791) and EPBD ((EU) 2024/1275).</p> <p>Public buildings</p> <ul style="list-style-type: none"> — by public body we mean the State as well as the municipalities and the municipal trade unions, among others; the exact definition below is taken from EED (EU) 2023/1791: <p style="text-align: center;">Extract EED 2023/1791 (EU)/Article 2 Definitions: ORGANISMES PUBLICS </p> <p>(12) 'public bodies' means: <u>national, regional or local authorities and entities directly financed and administered by those authorities but not having an industrial or commercial character;</u></p> <p>i.e. mainly the State, municipalities, municipal unions, etc.</p> <p>Additional clarifications in relation to the definition of "public bodies" (EED extract)</p> <p>(35) in order to fulfil their obligation, Member States should target the final energy consumption of all public services and all facilities of public bodies. In order to determine the spectrum of recipients concerned, Member States should apply the definition of '<u>public bodies</u>' in this Directive, according to which the expression '<u>directly financed by those authorities</u>' means that those entities are mainly financed by public funds and the expression '<u>administered by those authorities</u>' means that a national, regional or local authority has a majority as regards the choice of management of the entity. The obligation can be fulfilled by the reduction of final energy consumption in any area of the public sector, including transport, public buildings, healthcare, spatial planning, water management and wastewater treatment, sewage and water purification, waste management, district heating and cooling, energy distribution, supply and storage, public lighting, infrastructure planning, education and social services. Member States may also include other types of services when transposing this Directive. To reduce the administrative burden on public bodies, Member States should create digital tools or platforms to collect aggregated data on public bodies' consumption, make them public and report it to the Commission. Member States should provide planning and annual reporting on the consumption of public bodies in an aggregated form per sector.</p> <ul style="list-style-type: none"> - all public buildings above 250 m² of useful floor area (heated or cooled) which are owned by a public body and are not nZEB buildings (nearly Zero Energy Building) on 1.1.2024; - for buildings used by a public body but not <ul style="list-style-type: none"> - Proprietary, public bodies are obliged to negotiate with the owner for the building to be renovated; - all types of public buildings, i.e. residential buildings and not — <ul style="list-style-type: none"> - residential, will be subject to a renovation obligation; - at least 3 % of the total surface area (heated or cooled) shall be renovated by <ul style="list-style-type: none"> - the level of energy performance to be achieved after renovation will be the <ul style="list-style-type: none"> - level nZEBRenovation (NZEB level specific for building renovation) defined at national level with due regard to cost-effectiveness (proportionality) and technical feasibility as foreseen by the Directive; - in the context of renovation obligations, less stringent rules are: <ul style="list-style-type: none"> - envisaged for certain categories of buildings, such as protected buildings (protected heritage). <p>Exceptionally, an energy renovation obligation of a building or a ban on replacing a fossil boiler with a new fossil fuel boiler resulting from a measure of the NECP may be waived where the related costs related to the complexity of the works, necessary for its implementation, are disproportionate to the CO₂ reduction potential. These</p>

	<p>exceptions will be specified in the laws relating to obligations and prohibitions. The details are defined by the EED – Energy Efficiency Directive (Article 6) (EU) 2023/1791.</p> <p>When transposing the Directive into national law, the need for additional resources at the level of the public sector will be taken into account by the Government.</p>	
Type of instrument	Regulatory	
State of progress	Under analysis	
Start of implementing	End of implementation	Observations
2026		based on the requirements of EED (EU) 2023/1791 and EPBD ((EU) 2024/1275)
Responsible entity/entities	Meco, MMTP, MAINT, ABP and municipalities	
Reference (s)	Amended Law of 5 August 1993 on the rational use of energy + amended Grand-Ducal Regulation of 9 June 2021 on the energy performance of buildings	
Info complementary		

Title of the measure	No 304 Energy renovation obligation for functional buildings
Description	<p>Introduction of an obligation to renovate certain categories of buildings on the basis of the future requirements of the European Directives EED ((EU) 2023/1791) and EPBD ((EU) 2024/1275).</p> <p>Functional buildings</p> <ul style="list-style-type: none"> - concerns all buildings defined as ‘functional buildings’ in accordance with the rules on the energy performance of buildings; - introduction of minimum energy performance standards (MEPS – Minimum Energy Performance Standards); - every functional building must comply with an energy performance minimum from a certain maturity date; - the level of energy performance to be achieved after renovation will be defined at national level with due regard to cost/effectiveness (proportionality) and technical feasibility, as provided for in the Directive; - in the context of renovation obligations, less stringent rules are envisaged for certain categories of buildings, such as protected buildings (protected heritage); - the timetable for the entry into force of the obligations may vary depending on the sector concerned and the type of building. <p>Exceptionally, an energy renovation obligation of a building or a ban on replacing a fossil boiler with a new fossil fuel boiler resulting from a measure of the NECP may be waived where the related costs related to the complexity of the works, necessary for its implementation, are disproportionate to the CO₂ emission reduction potential. These exceptions will be specified in the laws relating to obligations and prohibitions.</p> <p>The details will be defined in the context of the transposition of the EPBD – Energy Performance of Buildings Directive (EU) 2024/1275, Article 9: minimum energy performance standards for non-residential buildings.</p> <p>The minimum standards will be based on maximum energy performance thresholds (definition of a 16 % threshold and a 26 % threshold) established on the basis of the non-residential building stock on 1^{January} 2020 and the minimum standards will ensure, as a minimum, that all non-residential buildings are below:</p> <ol style="list-style-type: none"> a) the 16 % threshold from 2030 onwards; and b) the 26 % threshold from 2033 onwards. <p>When transposing the Directive into national law, the sectors concerned will be consulted (CoC, CoM), in particular on the timetable for future obligations and possible private sector incentives for energy renovation before the mandatory phase enters into force.</p>
Type of policy instrument	Regulatory

State of play	Under analysis for transposition of the Directive	
Start of implementing	End of implementation	Observations
2026		transposition of EED (EU) 2023/1791 + EPBD ((EU) 2024/1275)
Responsible entity/entities	MECO	
Reference document (s)	Amended Law of 5 August 1993 on the rational use of energy + amended Grand-Ducal Regulation of 9 June 2021 on the energy performance of buildings	
Info complementary		

Title of the measure	No 305 An energy renovation obligation for residential buildings is not envisaged in Luxembourg	
Description	<p>An obligation to renovate residential buildings is not envisaged in Luxembourg. The European EPBD Directive ((EU) 2024/1275, Article 9) provides for the introduction of a trajectory for energy renovation of the residential building stock. In this context, the average primary energy consumption in kWh/(m² p.a.) for the whole residential building stock:</p> <ul style="list-style-type: none"> a) decrease by at least 16 % compared to 2020 by 2030; b) decrease by at least 2022 % compared to 2020 by 2033; c) is gradually decreasing to reach a zero-emission building stock in 2050. <p>Luxembourg will be obliged to achieve the results on the basis of these requirements (i.e. there is a European obligation at Member State level), but this obligation does not automatically mean an obligation for the owners of the dwellings concerned (individuals or businesses). An obligation to renovate residential buildings is not envisaged in Luxembourg; Luxembourg continues to focus on a voluntary approach to energy renovation of housing, supported by policies and incentives such as the “Klimabonus” state aid and the energy efficiency obligation scheme.</p> <p>In this context, Luxembourg will analyse the usefulness and potential impact of setting up a national body to support energy renovation, decarbonisation and the implementation of photovoltaic installations for residential buildings (see measure No 327).</p>	
Type of policy instrument	Regulatory	
State of progress	Under analysis	
Start of implementing	End of implementation	Observations
		depending on the requirements of EED (EU) 2023/1791 + EPBD (EU) 2024/1275)/transposition deadlines; the start of implementation is not yet known, not before 2025
Responsible entity/entities	MECO	
Reference document (s)	Amended Law of 5 August 1993 on the rational use of energy + the amended Grand-Ducal Regulation of 9 June 2021 on the energy performance of buildings	
Info complementary		

Title of the measure	No 306 PRIME House 2017 aid scheme	
Description	Under the PRIME House scheme of 2017, projects initiated between 2017 and 2021 were eligible for financial support for the construction of sustainable housing, the sustainable energy renovation of housing, the establishment of technical facilities for the use of renewable energy sources in housing and energy advice.	
Type of instrument	ØEconomy	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2017	2021	
Responsible entity/entities	MECB, MECO	
Reference (s)	Grand-Ducal Regulation of 23 December 2016 establishing an aid scheme for the promotion of sustainability, rational use of energy and renewable energies in housing	
Info complementary	https://legilux.public.lu/eli/etat/leg/rgd/2016/12/23/n40/consolide/20210401	

Name of measure	No 307 Klimabonus Wunnen scheme
Description	<p>Since 2022, the ‘Klimabonus Wunnen’ scheme has strengthened financial support for the construction of sustainable housing, sustainable energy renovation of housing, the establishment of technical facilities for the use of renewable energy sources in housing and energy advice. The current scheme covers projects initiated between 2022 and 2025.</p> <p>The main changes compared to the previous scheme (PRIME House) are a simplified procedure for access to aid, the enhanced promotion of ecological insulation materials, further encouragement to replace old fossil fuelled boilers, the eligibility of air-to-water and hybrid air-to-water heat pumps in existing buildings and the promotion of self-consumption for photovoltaic installations with a higher subsidy and the inclusion of a battery in the eligible costs. In detail, the amendments concern the following points:</p> <p>Energy renovation:</p> <ul style="list-style-type: none"> - increased subsidies for energy measures and advice - strengthened focus on ecological materials - administrative simplification - introduction of the possibility of implementing measures individuals without the use of full energy advice. <p>Technical installations (renewable energy):</p> <ul style="list-style-type: none"> - increase in subsidies - additional premium for replacing an existing boiler fuelled with fossil fuel - new additional bonus and bonus for the installation of a pump heat-fired in an existing building - increase of the PV premium and eligibility a storage battery in self-power mode - additional premium for the installation of a particulate filter for wood heaters. <p>As part of the package of measures agreed by the government and the social partners in the Tripartite in September 2022, the scheme had been strengthened on an ad hoc basis in three areas: a top-up on financial support for energy remediation, an increase in the bonus for the replacement of a fossil fuel boiler, and an additional increase in aid for photovoltaic installations operating in self-consumption mode.</p> <p>In June 2024, the government proposed to renew the first two top-up supplements for the remaining duration of the support programme, highlighting the priority of energy renovation and fossil energy phase-out for heating purposes.</p> <p>It should be noted that energy suppliers as well as some municipalities also offer additional aid in relation to the “Klimabonus Wunnen” scheme. Klima-Agence’s aid simulator brings together all these aids and provides a tailor-made overview in this context.</p>

Type of policy instrument	Economic	
State of play	Implement	
Start of implementing	End of implementation	Observations
2022	2025	Regular changes during implementation
Responsible entity/entities	MECB, MECO	
Reference (s)	Grand-Ducal Regulation of 7 April 2022 establishing an aid scheme for the promotion of sustainability, rational use of energy and renewable energies in housing	
Info complementary	https://legilux.public.lu/eli/etat/leg/rgd/2022/04/07/a180/jo	

Name of measure	No 308 Digitalisation of the Klimabonus aid scheme	
Description	In order to simplify and speed up access to state aid under the “Klimabonus” scheme, simplification and digitalisation of application forms and procedures in the context of an aid application are a priority. This digitalisation is a necessity to facilitate and speed up access to aid and is part of the State’s efforts to simplify administration and digitalise processes.	
Type of instrument	Economic	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2023		
Responsible entity/entities	MECB, MECO, MinDigital	
Reference (s)	Grand-Ducal Regulation of 7 April 2022 establishing an aid scheme for the promotion of sustainability, rational use of energy and renewable energies in housing	
Info complementary	https://legilux.public.lu/eli/etat/leg/rgd/2022/04/07/a180/io	

Title of the measure	No 309 Pre-financing under the Klimabonus Wunnen scheme	
Description	<p>The Government will gradually introduce arrangements for the pre-financing of climate subsidies. This means that citizens will pay only the part of their funding, for investments that can be subsidised. Companies will receive the grant amounts within a short period of time.</p> <p>Access to finance remains an insurmountable barrier for some people wishing to carry out energy renovation, heating system changes (decarbonisation) or photovoltaic installations.</p> <p>With a view to a just energy transition and in order to make it possible to access projects of this type for persons who are not eligible or who are hard to qualify for climate loans or conventional bank loans, the Government will introduce a pre-financing mechanism.</p> <p>This mechanism will, where appropriate, be taken into account when defining the tasks for the future national body supporting energy renovation, decarbonisation and the implementation of photovoltaic installations for residential buildings (see measure No 327).</p>	
Type of instrument	ØEconomy	
State of play	Under analysis	
Start of implementing	End of implementation	Observations
		implementation planned from 2025 onwards (photovoltaic installations)
Responsible entity/entities	MECB, MECO, Klima-Agency	
Reference document (s)		
Info complementary		

Title of the measure	No 310 Climate Loan Scheme	
Description	<p>In order to facilitate the financing of energy renovation of housing and the establishment of technical installations exploiting renewable energy sources (except photovoltaic), financial support in the form of an 'interest subsidy' to reduce the interest burden is granted to owners (natural persons) of a dwelling. The dwelling must serve as the main and permanent dwelling, be over 10 years old and located in Luxembourg.</p> <p>The owner of the dwelling must have contracted a loan from a financial institution for the financing of the energy remediation works and must have obtained financial aid from Klimabonus for the works financed by the loan.</p> <p>In addition to the interest subsidy, a State guarantee may be requested if the applicant does not have sufficient guarantees.</p>	
Type of policy instrument	Economic	
State of play	Expired	
Start of implementing	End of implementation	Observations
2017	2023	Repealed by entry into force of the Act on Individual Housing Aid see Measure No 311
Responsible entity/entities	MLOGAT	
Reference document (s)	Law of 8 June 2022 on aid for climate loans	
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2022/06/08/a286/jo	

Name of measure	No 311 Individual Housing Aid Scheme	
Description	<p>The Law on Individual Housing Aid of 7 August 2023 provides for individual housing grants linked to income conditions. The objective of this law is to promote the clean-up of housing in order to avoid energy poverty linked to energy costs:</p> <ul style="list-style-type: none"> - improvement premium for energy renovation constituting a supplement to financial assistance under the Klimabonus scheme “Wunnen” (households eligible until income corresponding to the median standard of living (dec. 5); maximum amount of the premium: 100 % of the aid under the Klimabonus Wunnen scheme (‘top up social’); - climate loans – in this case a State guarantee and a climate loan interest grant in addition to the Klimabonus financial aid for works financed by the loan – in connection with the energy renovation of a dwelling (the dwelling must serve as a main and permanent dwelling, be over 10 years old and located in Luxembourg); these provisions fall within the scope of the Climate Loan Scheme. <p>In order to promote the energy consolidation of existing housing and taking account of current interest rates, the Government will analyse a review of the Klimabank system, and in particular the definition of the criteria – particularly social – applicable to climate loans.</p>	
Type of policy instrument	ØEconomy	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2023		
Responsible entity/entities	MLOGAT	
Reference document (s)	Law of 7 August 2023 on individual housing assistance.	
Additional info	https://legilux.public.lu/eli/etat/leg/loi/2023/08/07/a554/jo	

Title of the measure	No 312 Stone aid scheme	
Description	<p>The Law of 7 August 2023 on affordable housing offers financial contributions to social promoters to encourage the creation of affordable housing. This financial contribution covers eligible costs in the following 5 categories:</p> <p>1° the category relating to undeveloped land and special development; 2° the category relating to ordinary development; 3° the category relating to developed land; 4° the category relating to the construction of affordable housing; 5° the category relating to the renovation (and other energy) of affordable rental housing.</p> <p>Ministerial Regulation of 18 October 2023 establishing a specification for the development from accommodation affordable brings together the recommendations on urbanisation, architecture and economicity. The Ministry of Housing and Spatial Planning has set up an advisory committee to advise the Minister, the “Commission d’Accompagnement des Aides à la Pierre” (CAAP).</p>	
Type of instrument	ØEconomy	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2023		
Responsible entity/entities	MLOGAT	
Reference (s)	<p>Law of 7 August 2023 on affordable housing Specifications for the development of affordable housing: Ministerial Regulation of 18 October 2023 establishing specifications for the development of affordable housing</p>	
Additional info	https://legilux.public.lu/eli/etat/leg/loi/2023/08/07/a611/jo	

Name of measure	No 313 Tax incentives for energy renovation of housing	
Description	To promote energy renovation, a depreciation rate of 6 % for 10 years is granted for any investment in the sustainable energy renovation of rented dwellings supported by the “Klimabonus Wunnen” scheme. In addition, housing renovation works (not limited to energy renovation) benefit from the capped application of the super-reduced 3 % VAT rate.	
Type of policy instrument	Tax	
State of play	Implementation	
Start of implementing	End of implementation	Observations
2021	n.e.s.	(3 % VAT rate introduced before 2021)
Responsible entity/entities	MFIN, MECO, MLOGAT	
Reference (s)	Amended Income Tax Act of 4 December 1967 (L.I.R.); Amended Law of 5 August 1969 on Value Added Tax	
Info complementary	https://impotsdirects.public.lu/fr/legislation/LIR.html Amended Grand-Ducal Regulation of 19 November 1999 implementing Article 106 (3) and (4) of the amended Law of 4 December 1967 on income tax (flat-rate depreciation base and depreciation rate for rental buildings)	

Name of measure	No 314 Aid scheme for municipalities	
Description	<p>Municipal administrations, associations of municipalities and public establishments under the supervision of municipalities are eligible for financial aid for energy efficiency projects (e.g. energy renovation of existing municipal buildings, renovation of street lighting, energy optimisation study for municipal and urban development projects) and renewable energy (e.g. solar energy, heat pumps, automatic wood heating, biomass cogeneration plants, district heating networks supplied by renewable energy sources and/or recovered heat). Since 2021, the aid scheme has been financed through the Climate and Energy Fund.</p> <p>The current regime will be reviewed and strengthened to better support municipalities in their decarbonisation efforts.</p>	
Type of policy instrument	Economic	
State of progress	Implementation, Planified	
Start of implementing	End of implementation	Observations
2021	n.e.s.	planned revision and reinforcement of the current regime
Responsible entity/entities	MECB, MECO	
Reference (s)	Circular No 3969 of 5 March 2021 – Climate and Energy Fund	
Info complementary	https://www.klima-agence.lu/fr/FCE	

Name of measure	No 315 Promotion of sustainable construction	
Description	<p>Sustainable construction with the three dimensions and objectives of economic feasibility, societal benefits and respecting the ecosystem boundaries of our planet is a vast area of work that mobilises multiple skills and sectors of activity. This interdisciplinarity also generates complexity and knowledge is often distributed and unconnected.</p> <p>MMTP, MECO and MECB mandated CRTI-B to update and modernise the “Guide to Sustainable Construction and Renovation” in the form of an electronic portal (NOBA.lu) to centralise knowledge and share best practices of sustainable construction in Luxembourg. The guide should make it possible to promote key aspects relating to sustainable construction, existing tools such as reformed LENOZ certification, with implications for initial and continuous training of stakeholders. A specific focus is placed on the environmental impact of construction and on human health.</p> <p>The guide is developed through working groups, involving public and private experts from the entire construction value chain, in addition to the sectoral CRTI-B stakeholders. In 2020, CRTI-B also concluded a collaboration agreement with the National Council for Sustainable Construction (CNCD) to align priorities and pool forces for the benefit of the sector.</p>	
Type of policy instrument	Information	
State of play	Adopted	
Start of implementing	End of implementation	Observations
2021	2024	1st version of the online guide in 2024, continuous development
Responsible entity/entities	MECO, MECB, MLOGAT, MMTP, CRTI-B	
Reference (s)	Coalition agreement 2018-2023	
Info complementary	Sustainable Construction Guide The Luxembourg Construction Portal (crtib.lu)	

Name of measure	No 316 Long-term buildings renovation strategy	
Description	<p>In 2020, the Ministry of Energy and Spatial Planning finalised its Long Term Renovation Strategy (LTRS), proposing measures to frame and facilitate energy renovation in Luxembourg. The aim was to carry out an in-depth analysis of the building stock in Luxembourg and draw conclusions on the development of the typology and energy consumption of buildings in the long term. Based on the data collected, a set of different measures has been identified to accelerate the energy renovation of the building stock.</p> <p>At regulatory level, some measures have been implemented (such as the obligation to set up a dedicated works fund and adaptation of decision-making quorums in co-ownership buildings); a critical analysis of municipal planning instruments to remove barriers to the renovation or installation of solar energy is being finalised and the results and proposals will be shared with the municipalities and ministries concerned.</p> <p>In addition to these regulatory measures, there are other proposals such as the introduction of an individual roadmap for the gradual renovation of the energy performance certificate or the regular adaptation of economic and fiscal instruments to take account of market developments and stakeholders' needs.</p> <p>A regular update (every 5 years) of the long-term buildings renovation strategy is mandatory at European level; the name of this strategy changes with the new EED Directive (EU) 2023/1791, the LTRS becomes the National Building Renovation Plan (NBRP); the final details will be available upon publication of the revised Directive and will be the basis for transposition in Luxembourg.</p>	
Type of instrument	Planning	
State of progress	Adopted	
Start of implementing	End of implementation	Observations
2020	n.e.s.	progressive implementation of the strategy and regular updating of the strategy (according to Article 3 of the EPBD (EU) 2024/1275))
Responsible entity/entities	Meco, Klima-Agency	
Reference (s)	Langfristige Renovierungsstrategie Luxemburg, MEA 2020	
Info complementary	https://mea.gouvernement.lu/dam-assets/energie/energie-effizienz/lu-ltrs-2020.pdf	

Title of the measure	No 317 Awareness raising, information, guides and consultancy services on buildings	
Description	<p>Klima-Agence offers a multitude of services to raise awareness and inform different stakeholders on buildings.</p> <p>For the owners of residential buildings (and tenants), Klima-Agence offers its basic advisory service with the aim of providing an initial overview of the renovation possibilities and financial support available (including its aid simulator and an energy renovation simulator in the near future). During the advice, advisor Klima-Agence may also inform about the details of the energy performance certificate (EPC), the energy assessment of the mandatory Heizungscheck heating system, and measures to optimise and modernise the heating system.</p> <p>Klima-Agence regularly launches awareness-raising campaigns, usually in cooperation with the responsible ministry (s), on various topical issues such as the introduction of a new aid scheme, renewable energy, etc.</p> <p>The measures taken by municipalities are governed by the 2.0 Climate Pact, which promotes measures aimed, inter alia, at the renovation of municipal buildings. A specialist energy renovation adviser assists municipalities at strategic level in this context.</p> <p>For businesses, the 'Klimapakt fir Betriber' proposes measures to improve, inter alia, the energy performance of the companies' buildings.</p> <p>A guide to energy renovation of a building in co-ownership is being developed. This guide will be made available to owners of co-properties, liquidators and design offices to support them from the outset of a renovation project. The aim of this guide is to facilitate the understanding of the different stages of a renovation project, to guide professionals in the development of a comprehensive, pre-defined service offer for the study, monitoring and implementation of (energy) renovation works in co-ownership (for residential and combined (residential/functional) buildings) and to highlight the national regulatory framework reflecting the financial measures and support.</p>	
Type of instrument	Information	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
		continuous implementation
Responsible entity/entities	Meco, MECB, MLOGAT, Klima-Agence	
Reference document (s)		
Info complementary	https://www.klima-agence.lu/fr	

Title of the measure	No 318 Training of a qualified and sufficient workforce in the buildings sector
Description	<p>Offers for initial and continuing vocational training will be regularly reviewed and adapted, in particular in the fields of digitalisation and sustainable development. This continuous adaptation effort will be made in conjunction with professional chambers, companies, teachers and young graduates of vocational training. Continuous evaluation of the methodology for compiling the requirements of the contract and the related curriculum work will have to be continued.</p> <p>Professional profiles will have to be adapted above all to the major transitions that mark the development of the economy and society, such as digitalisation, industry 4.0 and green technologies (renewable, green, green and energy). The diversification of vocational training helps prepare students to cope with these challenges and work in growing sectors, such as renewable energy, cybersecurity and health.</p> <p>Craft companies as well as design offices and architects (designers), notably in the construction sectors (new construction and energy renovation), the industrial sector, the mobility/electro-mobility sectors, and others, are facing significant technological change and are in urgent need of new skills related to the energy transition; companies that are able to address these challenges will have access to new activities and can actively contribute to the NECP objectives in particular in the field of energy efficiency, renewable energy and decarbonisation.</p> <p>As regards continuing vocational training (Up-skilling), the National Continue Vocational Training Centres (CNFPC), the Chamber of Metiers (CdM), the Federation of Crafts with its 'Building Technical Engineering' and 'Completion' Competence Centres (CdC-GTB/PAR), the Building Sectorial Training Institute (IFSB) and other private stakeholders regularly offer theoretical and practical training for craftsmen and energy advisers on various topical issues related to the energy transition, such as regulatory changes, challenges for new skills to be acquired, access to various qualifications ("Nohalteg an d'Zukunft +") and the implementation of innovative solutions.</p> <p>The IAB, in cooperation with training actors, offers training more specifically focused on design and planning, study and promotion of new innovative solutions, architectural integration of energy transition technologies, etc. These courses are aimed primarily at the design and planning offices and architects represented by the IAB.</p> <p>In order to ensure that training programmes for the different skill levels and areas concerned are aligned with the challenges relating to the objectives of the NECP, a systematic and regular evaluation of these programmes in consultation with the actors on the ground and the relevant ministry (s), in the form of a national initiative bringing together all relevant actors, is necessary.</p> <p>To complement this training offer, it is also necessary to continue investing in re-skilling offers to offer to</p>

	<p>jobseekers in other sectors. For example, the installer and heating industry is increasingly trying to move away from fossil heating systems to modern systems such as heat pumps.</p> <p>In order to facilitate access to continuous training at company level, the possibility of financial support and incentives for training related to the energy transition, such as skills bridges for staff in the construction sector, will be analysed.</p>	
Type of policy instrument	Education	
State of play	Implementation, Under analysis	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MENEJ, MECO, Other (s)	
Reference document (s)		
Info complementary	https://www.cnfpc.lu/ ; https://www.lifelong-learning.lu/ ; https://www.cdm.lu/ ; https://www.ifsb.lu/ ; https://www.cdc-gtb.lu/ ; https://www.neobuild.lu/ ; https://www.eacademy.lu/ ; https://www.houseoftraining.lu/ ;	

Name of measure	No 319 The forerunner role of the State with regard to buildings (see also No 303)	
Description	<p>In order to guarantee the state's leading role in buildings, the Public Buildings Administration ensures that all new public buildings are designed and constructed in an exemplary manner. In recent years, new public buildings have already been heated, as far as possible, by heat pumps or wood-energy boilers and are equipped with photovoltaic installations. With the June 2021 rules on the energy performance of buildings, this is becoming the standard in Luxembourg and the State will go further in terms of its pioneering role, namely the construction of positive energy buildings and the maximum use of the roof area available for photovoltaic installations.</p> <p>According to the energy remediation strategy of the Public Buildings Administration, based on the European Energy Efficiency Directive (EED), 3 % of the surface area of buildings belonging to central government has been renovated a year in recent years and this requirement will be maintained in the new directive, i.e. there is an obligation to renovate at least 3 % of the surface area of buildings per year and this requirement will be further strengthened, since the level to be attained by renovation will be the near-zero energy building (nZEB) and its application will be extended to the whole public sector, i.e. all state buildings (more than the central state) (as well as local buildings). The definition of the public sector will be adapted with the revision of the Directive and will henceforth include the State and the municipalities ("public bodies" means national, regional or local authorities and entities directly financed and administered by these authorities but not having industrial or commercial character).</p> <p>Exemplary renovation and construction of buildings will play a key role in the decarbonisation strategy pursuing the objective of climate neutrality of the state administration already in 2040.</p>	
Type of policy instrument	Budget, Information	
State of play	Implementation, Planified	
Start of implementing	End of implementation	Observations
		continuous implementation
Responsible entity/entities	MMTP, ABP, MECO	
Reference document (s)	EU Energy Efficiency Directive Coalition Agreement 2023-2028	
Info complementary		

Name of measure	No 320 The leading role of the public sector in energy efficiency	
Description	<p>In the context of the pioneering role of the public sector in energy efficiency, the European Energy Efficiency Directive (EED (EU) 2023/1791, Article 5) provides for a 1.9 % reduction in final energy consumption per year in the public sector, i.e. an annual improvement in energy efficiency, with a transitional phase of 2 years during which the targets will be indicative.</p> <p>This obligation to improve energy efficiency concerns all public sector activities. The definition of the public sector will be adapted with the revision of the Directive and will henceforth include the State and the municipalities; for municipalities there will be a phasing-in, i.e. municipalities with a population of more than 50.000 will be taken into account from 1.1.2027 and municipalities with a population of more than 5.000 from 1.1.2030.</p> <p>The obligation to renovate certain categories of buildings owned by the public sector complements this obligation to improve energy efficiency in general, in the sense that any energy renovation will also contribute to achieving the objective of improving energy efficiency in general.</p>	
Type of policy instrument	Budget, Information	
State of play	Under analysis	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MMTP, ABP, MECO, MAINT, Communes	
Reference document (s)	EU Energy Efficiency Directive (Revision 2023)	
Info complementary		

Name of measure	No 321 The forerunner role of municipalities in buildings	
Description	<p>The Climate Pact 2.0 provides municipalities with an attractive framework to support them in their pioneering role in the exemplary renovation of the municipal building stock and the construction of new sustainable municipal buildings. To this end, the municipality applies the highest criteria for energy, ecology and resource saving and sustainable adaptation to climate change in the construction, renovation and management/use of its buildings. In this context, municipalities receive financial support from the Climate and Energy Fund. They also benefit from the ‘Klimabonus Wunnen’ scheme when they renovate or build dwellings owned by them. This pioneering and exemplary role of municipalities will be strengthened and made compulsory by the requirements of the new European Directive on energy efficiency (EED, (EU) 2023/1791), in the sense that “public bodies” no longer concern only the State, but also municipalities and local unions, among others.</p> <p>The requirement based on the European Energy Efficiency Directive (EED) to renovate at least 3 % of the surface area of buildings per year will henceforth apply not only to state buildings but also to municipal buildings and this requirement will be reinforced as the level to be attained by renovation will be the near-zero energy building.</p> <p>The definition of the public sector has been adapted with the new EED Directive: (12) ‘public bodies’ means: national, regional or local authorities and entities directly financed and administered by these authorities but not having industrial or commercial character. (35) to fulfil their obligation, Member States should target the final energy consumption of all public services and all facilities of public bodies. In order to determine the spectrum of recipients concerned, Member States should apply the definition of ‘public bodies’ in this Directive, according to which the expression ‘directly financed by those authorities’ means that those entities are mainly financed by public funds and the expression ‘administered by those authorities’ means that a national, regional or local authority has a majority as regards the choice of management of the entity. The obligation can be fulfilled by reducing final energy consumption in any part of the public sector, such as transport, public buildings, healthcare, spatial planning, water management and wastewater treatment, water and waste water treatment, waste management, district heating and cooling, energy distribution and storage and supply, street lighting, infrastructure planning, education and social services. Member States may also include other types of services when transposing this Directive. To lower the administrative burden for public bodies, Member States should establish digital platforms or tools to collect the aggregated consumption data from public bodies, make them publicly available, and report the data to the Commission. Member States should provide planning and annual reporting on the consumption of public bodies in an aggregated form per sector.</p> <p>In addition to obligations concerning their own buildings, municipalities can encourage their citizens to renovate energy by promoting available state aid and offering their own municipal aid programmes.</p>	
Type of policy instrument	Economic, Voluntary Agreement, Information	
State of progress	Implementation, Planned	
Start of implementing	End of implementation	Observations
		continuous implementation

Responsible entity/entities	MECB, MECO, MAINT, Communes, Klima-Agence
Reference (s)	
Info complementary	

Name of measure	No 322 Reduction of the environmental impacts of construction	
Description	<p>The Ministries of Economy and the Environment, Climate and Biodiversity have set up a “Feuille de Route Construction Bas Carbone – Luxembourg”. Through a series of projects and in close collaboration with the construction sector, the programme aims to develop and put in place the tools needed to achieve the sector’s carbon neutrality by 2050. The programme focuses on ‘embedded emissions’ (emissions relating to the production phases of construction materials, construction and subsequent demolition/deconstruction phases) of construction and renovation projects, with the energy performance of buildings themselves being addressed by other measures of the NECP. A close link between a building’s entire life cycle carbon footprint (the calculation of which will become mandatory under the proposal for a recast of the Energy Performance of Buildings Directive – EPBD) and national GHG emission reduction targets is envisaged. Although the roadmap targets GHG emissions in 1, the tools will allow for more comprehensive life cycle assessments, taking into account other environmental impacts as well as human health aspects.</p> <p>In addition to the development of methods and tools, a central point of the roadmap is the identification of concrete solutions to reduce the carbon footprint of buildings, such as more material efficient design or less impactful materials (e.g. bio-based), design for modular use and extended use time, or design for the deconstruction and reuse of products and materials. Keeping existing to the extent possible during conversions and renovations also helps to reduce material intensity. Reducing soil excavations or better managing soil supply and demand makes it possible to address transport needs.</p>	
Type of policy instrument	Regulatory	
State of play	Adopted	
Start of implementing	End of implementation	Observations
2022	2024	1st phase, the regulatory framework will be developed at a later stage
Responsible entity/entities	MECO, MECB, MLOGAT, MMTP	
Reference (s)	Sheet of Route Construction Bas Carbone	
Info complementary	https://gouvernement.lu/fr/actualites/toutes_actualites/communiqués/2023/06-juin/14-turmes-construction-decarbone.html	

Name of measure	No 323 Decarbonisation of construction sites	
Description	<p>In the holistic approach to managing environmental impacts and in particular GHG emissions from the construction sector over the entire useful life cycle of the building (see measure 'Reducing the environmental impacts of construction'), it is important to act at all stages. The construction phase of the building generates direct emissions through trucks and machinery, employed on construction sites and used for demolition, excavation of land, transport of land and materials, and the production and finishing of buildings. Decarbonisation of construction sites takes place in 1 by electrification of trucks and machinery, as demonstrated by initiatives these include: the from the city Oslo (https://www.klimaoslo.no/kategori/english/). In addition to GHG emissions, emissions of noise and exhaust gas pollutants are eliminated at the same time, which are important assets in both urban and rural areas, as these emissions are harmful to both human health and fauna and flora. For the energy supply of machinery that is already electric, such as cranes or tools, and for the recharging of trucks and vans, it is important to provide site operators with a connection to the electricity grid, even before construction starts, in order to minimise the use of fuel-fired electric generators. Operators in the construction sector can be encouraged to invest in these new technologies through (1) public procurement promoting the electrification of state and municipal construction sites, and (2) aid schemes to be put in place for electric construction and transport equipment. These measures will be analysed and implemented gradually.</p>	
Type of policy instrument	Planning, Economic, Other	
State of progress	Under analysis	
Start of implementing	End of implementation	Observations
2023	n.e.s.	Continuous development
Responsible entity/entities	MECO, MMTP, MECB	
Reference (s)	Sheet of Route Construction Bas Carbone	
Info complementary	https://gouvernement.lu/fr/actualites/toutes_actualites/communiqués/2023/06-juin/14-turmes-construction-decarbone.html	

Name of measure	No 324 Minimum energy performance requirements for rented dwellings (proprietary incentives)	
Description	<p>In order to provide an incentive for owners of rented dwellings to carry out energy renovations, it is envisaged to introduce minimum requirements for the energy performance class of any dwelling that is rented out or intended to be rented out. These minimum requirements will be defined taking into account the cost-efficiency ratio (proportionality of renovation measures) and technical feasibility. To clarify that owners are eligible for the various subsidies and incentives (state or other) available for this type of energy renovation work.</p> <p>It is thus intended to create a link between the energy performance class of a dwelling that is rented and the right to rent it and/or the maximum amount of rent allowed.</p> <p>This type of incentive is preferred to involve a landlord directly in the costs of energy (heating + CIE) which are borne by the tenant.</p>	
Type of instrument	Regulatory	
State of progress	Under analysis	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MECO, MLOGAT	
Reference (s)		
Info complementary		

Title of the measure	No 325 Facilitation of energy works in buildings in co-ownership	
Description	By the Law of 30 June 2022 amending the amended Law of 16 May 1975 laying down the status of co-ownership of buildings built up for the purpose of introducing a works fund, facilitating elements were introduced in the field of co-ownership buildings. Previously requiring a three-quarters majority, the following work may henceforth be decided by a majority of the votes of all the co-owners (absolute majority) and, in the absence of a majority decision, by a majority of the votes of the co-owners present or represented (simple majority) in a new general meeting: Energy renovation/Gainting/Completion of plants for the production and storage of energy from renewable energy sources in the common parts. This law also introduces the obligation to set up a works fund in co-ownership.	
Type of instrument	Regulatory	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MECO, MLOGAT	
Reference (s)		
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2022/06/30/a347/jo https://logement.public.lu/fr/proprietaire/copropriete.html#:~:text=La%20loi%20instaurant%20un%20fonds%20de%20travaux,%20le%201er%20ao%C3%BB%202023	

Title of the measure	No 326 Harmonisation of urban planning rules for the energy transition	
Description	<p>Urban planning rules for measures in the context of the energy transition can vary significantly from one municipality to another with different levels of restrictions, making it difficult to implement these different measures.</p> <p>With this in mind and in order to simplify, harmonise and accelerate the deployment of renewable energy sources and the implementation of energy efficiency measures, which form the basis of the energy transition, the Government has proposed standardised and harmonised texts for the PAP (QS and EQS) and revised the Standard Regulation on buildings, public roads and sites (RBVS) concerning certain elements relating to photovoltaic installations, heat pumps and energy remediation works, as summarised in Circular No 2023119 of 15 September 20232 on Harmonisation of municipal legislation on renewable energy sources and energy remediation works in the building.</p> <p>The competent ministers called on the municipalities to align their urban planning regulations (which fall within the scope of municipal autonomy) with the recommendations made by this circular, in order to create a degree of homogeneity between municipalities in the applicable rules.</p> <p>Municipalities are informed and made aware of these recommendations in the context of the Climate Pact 2.0 (Measure 1.3.1 Spatial Planning Instruments) and these subjects are regularly on the agenda of the various exchanges organised with municipalities in this context; the Klima-Agency also provides support and support for municipalities in aligning their regulations.</p>	
Type of policy instrument	Circular	
State of play	Implement	
Start of implementing	End of implementation	Observations
Responsible entity/entities	Meco, MAINT, Communes, Klima-Agence	
Reference document (s)		
Info complementary	<p>Circular No 2023-119: https://maint.gouvernement.lu/fr/circulaires/circulaires2023/circulaire-2023-119.html https://maint.gouvernement.lu/fr/circulaires/circulaires2023/circulaire-2023-119.html</p>	

	Revised RBVS: https://maint.gouvernement.lu/en/publications/brochure-book/reglement-batisses-publics-sites.html
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Title of the measure	No 327 National body supporting energy renovation, decarbonisation and implementation of photovoltaic installations for residential buildings
Description	<p>Energy renovation and the decarbonisation of the stock of buildings are essential in view of the achievement of national targets for reducing greenhouse gas emissions, improving energy efficiency and producing renewable electricity.</p> <p>The proposal for a recast of the Energy Performance of Buildings Directive (EU) 2024/1275 (EPBD) includes targets for the gradual energy renovation of buildings. The objectives are based on minimum energy performance standards (MEPS) to be achieved by type of building and according to a specific timetable. The first buildings initially targeted are the worst-performing buildings.</p> <p>While this proposal targets residential buildings to more than 10 housing units, Luxembourg plans to extend energy renovation support for all residential buildings with low energy performance. Performance levels and deadlines will be defined at national level as part of the transposition of EPBD (EU) 2024/1275. In order to structure and accompany this type of project, Luxembourg is planning to set up a 'national support body for energy renovation, decarbonisation and implementation of photovoltaic installations for residential buildings'.</p> <p>The structure of this entity will be defined taking into account existing national structures (such as the Klima-Agency).</p> <p>Clarify that this entity will not compete with players active on the national market, but will include these actors (e.g. accredited energy advisors or IAB members/consultancy firms) in the context of coaching and other services offered to customers (comparable to the management of active advisors under the Climate Pact for Commons); the future organisation of the entity will be defined in consultation with the sector and relevant stakeholders.</p> <p>This measure is one of the structural measures identified at the level of the long-term renovation strategy.</p> <p>The main objective is to provide structured and comprehensive assistance to owners of residential buildings with low energy performance in identifying improvement potentials, planning, financing (taking into account all existing aid schemes) and implementing measures for energy renovation, decarbonisation and the implementation of photovoltaic installations. The initiative targets all owners of residential buildings (whether rented or not) who undertake to carry out such works. The support will be based on a voluntary commitment from the owners.</p> <p>The roles of this new entity will include inter alia:</p> <ul style="list-style-type: none"> — identification of low-performance residential buildings energy (based on nationally defined performance levels) (based on EPC);

	<ul style="list-style-type: none"> - the establishment of a national/local building typology targeted residential areas, in order to standardise and simplify the identification of potentials and measures to be implemented, with a focus on deep energy renovation; - awareness raising and empowerment of building owners targeted, in cooperation with other stakeholders (municipalities, social offices, INPA, obligated parties, etc.); - management and provision of advisers/accompanying persons in energy renovation (provision based on accredited advisors and/or IAB members/consultancy firms active on the Luxembourg market); - full project management for the implementation of targeted measures (energy renovation, decarbonisation and implementation of photovoltaic installations); - quality assurance at the level of advisers/accompanying persons in energy renovation (certification); - taking account of the various aid available in the context of the targeted work; - specific consideration of EU state aid rules if companies (owners of the targeted buildings) are involved; <p>In this context, the experiences of the pilot project to renovate neighbourhoods launched in the City of Differdange (see measure No 328) will be taken into account when defining the structure and tasks of such an entity.</p>	
Type of policy instrument	Regulatory	
State of play	Definition in progress	
Start of implementing	End of implementation	Observations
Responsible entity/entities	Meco, Klima-Agency	
Reference (s)		
Info complementary		

Title of the measure	No 328 Pilot project “Renovation of neighbourhoods – Differdange”	
Description	<p>As a result of the long-term building renovation strategy, a pilot project for “neighbourhood renovation” is launched in Differdange. Preparatory work and preliminary analysis started in 2022 and the official launch of the project is planned for early 2023.</p> <p>The aim of the pilot project is to increase the renovation rate in the neighbourhoods most suitable for energy renovation, with a focus on deep renovation, by structuring and intensifying advice and support for the owners of the buildings concerned throughout the renovation process.</p> <p>The development of a typology of single-family houses is at the heart of the project. This will make it possible to identify the specific energy saving needs and potentials for each type of building and thus propose specific energy renovation measures for each type of house, taking into account ‘Klimabonus Wunnen’ State aid, possible municipal aid and other private aid (energy efficiency obligation scheme).</p> <p>The project is carried out in cooperation with the National Institute for Architectural Heritage (INPA) to remove barriers to energy renovation of the various types of buildings protected at municipal level. This by harmonising the measures proposed by an energy adviser with the requirements of heritage protection.</p> <p>Another aspect of the project is raising awareness and informing residents through enhanced advisory services and tailored support for Klimabonus aid applications.</p> <p>On the basis of the experience of this project, a standardised approach at national level will be developed with a view to mobilising the potential for renovation in other municipalities and regions in the country in a concerted manner (see measure No 327).</p>	
Type of instrument	Research	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
Responsible entity/entities	Meco, MECB, Klima-Agency	
Reference (s)		
Info complementary	https://www.klima-agence.lu/fr/zesumme-renoveieren	

Title of the measure	No 329 Assistance to households in energy poverty	
Description	<p>The 'Assistance to households in energy poverty' programme aims to better support low-income and energy-poor households, i.e. households that do not have sufficient means to heat their homes properly and/or could not pay their electricity, gas, water or heating bills due to a lack of financial means in the last 12 months.</p> <p>Targeted households are selected, contacted and made aware of this specific assistance offer by the social offices.</p> <p>The households concerned have the possibility to benefit from personalised energy advice from Klima-Agence, as well as a subsidy for the replacement of one or more energy-intensive household appliances and/or the acquisition of one or more new efficient appliances (refrigerator, freezer, dishwasher, washing machine and tumble dryer). This service aims to inform and raise awareness among households and improve their situation and quality of life.</p>	
Type of instrument	ØEconomy	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2017	and others	Implementation: 2017; adapted conditions: 2022
Responsible entity/entities	MFSVA, MECO, MECB, Klima-Agency	
Reference (s)		
Info complementary		

3.1.1.3 Transport – Mobility

Name of measure	No 401 National Mobility Plan 2035	
Description	<p>The 2035 National Mobility Plan (MDP 2035) proposes an overall concept capable of managing 40 % additional travel compared to 2017. It implements the approaches advocated by the Sustainable Mobility Strategy Modu 2.0, i.e. moving from catching-up to anticipating future demand. Two principles are applied. The first is to focus on people’s mobility before looking for solutions for vehicle mobility. The aim is to put in place quality alternatives. The second is to use the infrastructure efficiently. Rather than planning the networks of the different modes of transport separately, it is about finding multimodal synergies, aiming for compact solutions, giving preference to strengthening an existing offer rather than doubling infrastructure. In general terms, the idea is to drain transit traffic to the main network, to relieve city centres as much as possible so that they can be adapted to urban modes of transport – bus or tram, cycling and walking – which are the only ones able to manage the transport flows planned for 2035 in urban areas. The MDP 2035 is first and foremost a consistency of known projects and multimodal optimisation of ongoing planning. However, when developing the concept of global mobility, it became apparent that some parts were missing in the puzzle. Thus, it includes a compendium of all projects at national level necessary to ensure mobility in 2035 and achieve the modal shares targeted, taking into account cross-border mobility. It will be set out in a number of regional studies which will draw up the details of the projects at local level and add additional measures. The MDP is updated at five-year intervals.</p>	
Type of instrument	Planning	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2022	2035	
Responsible entity/entities	MMTP	
Reference (s)	MAP 2035 – National Mobility Plan (MMTP, 2022)	
Info complementary	https://transports.public.lu/fr/contexte/strategie/pnm-2035.html	

Name of measure	No 402 Modu 2.0	
Description	Modu 2.0 is an information tool for planning sustainable mobility. It distinguishes 4 mobility actors (state, municipalities, businesses and citizens) and makes specific recommendations for each actor using a mobility toolkit. In addition, it illustrates the future planning method by which Luxembourg can move from catching-up to anticipation by developing a sustainable mobility concept for 2035 that is consistent with the country's growth scenarios and financial means.	
Type of instrument	Information	
State of play	Implementation	
Start of implementing	End of implementation	Observations
2018	2025	
Responsible entity/entities	MMTP	
Reference (s)	MODU 2.0 – Sustainable Mobility Strategy (MDDI, 2018)	
Info complementary	https://transports.public.lu/fr/contexte/strategie/modu2.html/	

Title of the measure	NO. 403 MMUST	
Description	Funded under the Interreg V A Greater Region programme, MMUST (multimodal model and cross-border mobility scenarios) is a tool to support the decision and evaluation of transport policies for cross-border mobility at the heart of the Greater Region. MMUST can assess the effect of infrastructural and other measures such as teleworking or urban development measures on mobility flows by distinguishing between different modes.	
Type of policy instrument	Planning	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2018	n.e.s.	continuous implementation
Responsible entity/entities	MMTP	
Reference document (s)		
Info complementary	https://www.mmust.eu/	

Title of the measure	No 404 Promotion of active mobility	
Description	The national cycling network is planned and built by the MMTP and will be extended from 650 km to 1.100 km. Extensions of municipal networks can be subsidised at a rate of 30 % if they constitute a connection to the national grid. The MMTP provides municipalities and consultancies with planning aids (veloplängen.lu) and offers technical support to municipalities. The number of secure bicycle parking areas will be gradually increased in the coming years. In order to improve orientation, all national cycle paths will be equipped with signage.	
Type of instrument	Planning, Budget	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2015	2035	continuous implementation
Responsible entity/entities	MMTP	
Reference (s)		
Info complementary	https://veloplängen.lu/	

Title of the measure	No 405 Promotion of public transport	
Description	<p>Between 2018 and 2027, the State will invest EUR 3.9 billion in the development of railway infrastructure. Capacity will be substantially increased (MDP 2035). In addition, the strengthening of direct rail links and the creation of new connections to cities in neighbouring countries are being planned in partnership with the authorities of neighbouring countries. The extension of the tram network in the City of Luxembourg continues. The RGTR bus network is regularly optimised. The bus network in the canton of Esch-sur- Alzette will be reorganised with the arrival of fast tram on a new hub in the south of the country. Buses will be prioritised on three high-level service corridors until 2035 (PNM 2035). The exchange of information between different modes of transport will be improved to provide better quality of service. Since March 2020, public transport has been free of charge in Luxembourg. An extension of free access over a 5 km radius around the borders is under analysis.</p>	
Type of policy instrument	Planning, Budget	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2018	2035	continuous implementation
Responsible entity/entities	MMTP	
Reference document (s)		
Info complementary		

Name of measure	No 406 Promotion of innovative mobility services	
Description	To make carpooling more attractive for carpooling will be introduced on certain motorways in the country (A1, A4, A3 and A6) (PNM 2035). Carsharing will be further promoted as a means of reducing the number of individual cars parked in neighbourhoods.	
Type of instrument	Planning, Information	
State of play	Planned	
Start of implementing	End of implementation	Observations
2022	2035	
Responsible entity/entities	MMTP	
Reference document (s)		
Info complementary		

Name of measure	No 407 Awareness raising, information and advisory services on mobility	
Description	<p>The MMTP offers mobility plans undertaken. It is a tool to help companies to better organise the mobility of their employees. Municipalities may request technical support and co-financing of communal mobility studies. Mobilitylu is continuously improved to provide better access to public transport.</p> <p>MECO is committed to applying the principles of circularity and sustainability through smart management of areas of economic activity coupled with the implementation of quality services and infrastructure. A co-creative process is being developed to involve the various key players in order to ensure wide adoption of these new solutions. In the field of mobility, planning consistent with national objectives and the integration of new concepts into its implementation will improve the quality of the offer, thereby encouraging users to test new services and adopt new habits, for example through the increased use of innovative and smart mobility solutions – while contributing to increasing the attractiveness of sites.</p>	
Type of policy instrument	Information, Planning	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
		continuous implementation
Responsible entity/entities	MMTP, MECO, Other	
Reference (s)		
Info complementary	https://www.mobiliteit.lu/fr/	

Title of the measure	No 408 Establishing a framework for teleworking	
Description	<p>As the gradual digitalisation of work facilitates the decoupling of work from the workplace, teleworking is becoming a good practice to support a society in transition, strengthening the resilience of the economy and having the potential to significantly reduce mobility needs and all associated nuisances. Remote working, including videoconferencing, can reduce commuting and work-related travel both within and outside the country. To facilitate teleworking for all employees in Luxembourg, a legislative framework has been created to define the framework conditions and arrangements for teleworking. In addition, some arrangements have been made to organise teleworking in the civil service. In order to consolidate the legal basis, the Ministry of Civil Service has prepared a draft law accompanied by a Grand-Ducal regulation which are currently in the legislative procedure. In the field of taxation, Luxembourg has concluded with its three neighbouring countries the rules concerning the right to tax of the Contracting States. The three tax treaties provide for tolerance thresholds, i.e. a certain number of days per fiscal year, concerning the right to tax for cross-border workers. These tolerance thresholds are also used by border residents in order to be able to telework without being taxed in their country of residence. The respective tolerance thresholds currently amount to 34 days for tax treaties with Belgium, France and Germany.</p> <p>As regards the social security component, a framework agreement has been reached at European level. It allows less than 50 % of the time spent teleworking (instead of the 25 % normally applicable) for employees in the countries of employment and residence who are signatories to the Framework Agreement, which has been in force since¹ July 2023. Luxembourg signed the agreement of 5 June 2023, together with Germany (17 May 2023) and Belgium (6 June 2023), France (1 July 2023) and the Netherlands (1 July 2023).</p> <p>The signatory countries are listed on the internet page dedicated to the agreement (Belgium being the country depositary from the Agreement)</p> <p>https://socialsecurity.belgium.be/fr/activites-internationales/teletravail-</p> <p>Bosnia and Herzegovina and Switzerland</p> <p>In Luxembourg, the ACSH has set up a dedicated site for requests made. EN application from the Agreement</p> <p>https://ccss.public.lu/fr/actualites/2023/06/20.html</p>	
Type of instrument	Regulatory/bi-/multilateral agreements or conventions	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
		Continuous implementation (n.b. the teleworking agreement in the field of social security has a

		from 5 years renewable automatically (tacit renewal).
Responsible entity/entities	MT, MFIN, M3S, MFP, MECO/DG Energy	
Reference (s)	Law of 1 April 2022 amending Articles L. 414-3 and L. 414-9 of the Labour Code. Framework Agreement on the application of Article 16(1) of Regulation (EC) No 883/2004 in cases of regular cross-border telework	
Info complementary	<p>Work: Law of 1 April 2022 amending Articles L. 414-3 and L. 414-9 of the Labour Code: https://legilux.public.lu/eli/etat/leg/loi/2022/04/01/a172/jo; Convention of 20 October 2020 on the legal arrangements for teleworking: https://itm.public.lu/dam-assets/fr/publications/conventions-collective/codicille/cct-telework.pdf</p> <p>Social security: Official website of the framework agreement on social security teleworking: https://socialsecurity.belgium.be/fr/activites-internationales/teletravail-</p> <p>Bosnia and Herzegovina and Switzerland; ACSH website for cross-border teleworking declarations: https://teletravail.ccss.lu/ Signature of framework agreement on teleworking social security: https://mss.gouvernement.lu/fr/actualites.gouvernement%2Bfr%2Bactualites%2Btoutes_actualites%2B2023%2B06-June%2B2-haagen-accord-border telework.html;</p> <p>Information on the implementation of the Framework Agreement: https://mss.gouvernement.lu/fr/actualites.gouvernement%2Bfr%2Bactualites%2Btoutes_actualites%2B2023%2B06-June%2B20-declaration-telework.html</p>	

Name of measure	No 409 Limitation of the need for mobility – promotion of coworking spaces	
Description	<p>Between 2017 and 2019, the Department of Spatial Planning (date) set up the inter-ministerial working group on limiting the need for mobility in order to deepen one of the strategic recommendations made by the study The Third Industrial Revolution Strategy in the field of mobility. The working group focused its reflections on how to set up co-working spaces close to borders and multimodal hubs in order to significantly reduce the daily travel of border residents. Thus, in addition to the Belval site as a short-term pilot project, the list of potential sites included in October 2019 Rodange (station), Merttert, Bettembourg (station), ZAE Grass, Frisange and Nordstad. In particular, the latter has potential for the devolution of public administrations.</p> <p>In view of the fact that there has been a proliferation of co-working spaces by private actors without State intervention and/or contribution, and while knowing that the State cannot oppose market initiatives, the WG proposed several roles that the State could have in promoting such spaces. These include the launch of a survey among officials of the civil service on daily travel and their preferences between home teleworking and working in a co-working area, and the possibility of creating a co-development area on a border where Luxembourg's tax system applies. Another proposal is to systematically take into account the possibility of creating co-working spaces in the context of the discussions on the devolution of state administrations in agglomerations outside the City of Luxembourg, concerning the need for offices at state level and at the level of planning and redevelopment of stations located near the borders.</p>	
Type of instrument		
State of progress	Planned	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MLOGAT	
Reference (s)		
Info complementary		

Name of measure	No 410 Promotion of electrification of the Luxembourg registered car fleet	
Description	<p>To accelerate the electrification of the car fleet in Luxembourg, a set of measures has been introduced, such as:</p> <ul style="list-style-type: none"> - the establishment and operation of the public charging infrastructure of database Chargy by the system operators; - promotion of the network of private charging stations by means of aid financial and by introducing minimum requirements as part of the regulation of the energy performance of buildings; - the introduction of an aid scheme for companies investing in public or private charging infrastructure, either through a call for projects or by simple application (SME only); - the introduction of financial aid for electric vehicles (cars and vans); - advanced electrification of public vehicle fleets; - the introduction of complementary promotion measures such as: the 'Strom beweegt' initiative; - supporting municipalities with regard to setting up a charging infrastructure; - expansion of the Klima-Agency consultancy service; - adaptation of the Highway Code to allow driving of vehicles N1 non-thermal exceeding 3.500 kg (up to 4.250 kg) with category B licence; - and the Benelux authorisation of mass exceedance maximum allowed for zero-emission commercial vehicles and cars to compensate for the additional weight of batteries. 	
Type of instrument	Regulatory, Economic, Fiscal, Voluntary Agreement, Information, Planning	
State of progress	Implement	
Start of implementing	End of implementation	Observations
		continuous implementation
Responsible entity/entities	MMTP, MECB, MECO, Klima-Agency	
Reference (s)		
Info complementary		

Title of the measure	No 411 Installation of public charging infrastructure	
Description	<p>To anticipate the needs of electromobility, the government organised in 2015 the deployment of a single national infrastructure of 800 public charging stations. This network called Chargy is managed by the network operators who install charging stations on the P + R relay car parks, the public car parks and the public highway (at least one per municipality).</p> <p>As a result of the evolution of electro-mobility deployment, 88 terminals have been converted into SuperChargy ultra-fast terminals with a load power between 150 kW and 350 kW, which are spread over 19 stations.</p> <p>This measure ends with the installation of these 800 terminals and is complemented by the aid scheme for companies investing in charging infrastructure.</p>	
Type of instrument	Regulatory	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2016	2024	
Responsible entity/entities	MMTP, MECO	
Reference document (s)	Amended Grand-Ducal Regulation of 3 December 2015 on public infrastructure related to electric mobility	
Info complementary	https://legilux.public.lu/eli/etat/leg/rgd/2015/12/03/n2/jo	

Title of the measure	No 412 Electrification of the vehicle fleet of contracting authorities and contracting entities (State, municipalities, municipal unions, etc.)	
Description	Contracting authorities and contracting entities shall take into account the life-cycle energy and environmental impacts of certain road vehicles, including energy consumption and CO2 and pollutant emissions, in order to promote and stimulate the market for clean and energy-efficient vehicles when procuring certain road vehicles. For each contracting authority or contracting entity, a minimum percentage of clean vehicles on all vehicles put out to tender must be obtained during reference periods of five years. These minimum targets apply to different modes of public procurement, including purchase, leasing, rental and service contracts.	
Type of policy instrument	Regulatory	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2021	n.e.s.	
Responsible entity/entities	MMTP, MAINT	
Reference (s)	Grand-Ducal Regulation of 2 November 2021 on the promotion of clean road vehicles in support of low-emission mobility	
Info complementary	https://legilux.public.lu/eli/etat/leg/rgd/2021/11/02/a772/io	

Title of the measure	No 413 Electrification of the state car fleet	
Description	Since 2018, the acquisition of rechargeable electric cars (BEV or, where applicable, PHEV) has been prescribed for state services. The purchase of cars with internal combustion engines is only permitted in very exceptional cases or for specific vehicles and a detailed explanation justifying why this is necessary must be submitted. BEV and PHEV cars are purchased centrally under the responsibility of the Ministry of Mobility and Public Works.	
Type of instrument	Voluntary agreement	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2018	n.e.s.	
Responsible entity/entities	MFIN, MMTP, MECB	
Reference document (s)	Budgetary circular on the purchase of vehicles	
Info complementary		

Title of the measure	No 414 Full Electrification of the RGTR bus network until 2030	
Description	The RGTR (General Road Transport Scheme) has set itself the objective of electrifying (BEV, PHEV or FCEV) until 2030 all buses and coaches in its fleet. The public contract launched in 2020 50 % of kilometres will be provided by electric vehicles. It should be noted that Directive (EU) 2019/1161 amending Directive 2009/33/EC on the promotion of clean and energy-efficient road transport vehicles sets for Luxembourg a rate of 45 % of clean buses in invitations to tender between 2021 and 2026 and a rate of 65 % between 2026 and 2030. In view of the initiatives already undertaken by the various operators and the objectives announced by them, the first steps are being taken in order to achieve the objectives set by the Directive.	
Type of instrument	Other	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2021	2030	
Responsible entity/entities	MMTP	
Reference document (s)		
Info complementary		

Title of the measure	No 415 Obligation to incorporate sustainable biofuels into road fuels
Description	<p>The amended Law of 17 December 2010 fixing excise duties and similar taxes on energy products lays down the rate of incorporation of biofuels into road fuels, expressed on the basis of the energy content of the fuels. This rate is adjusted in principle annually by means of the budget law. For 2022 and 2023, due to the energy crisis, it is set at 8.00 %, with the article of the Act stipulating that: ‘Operators releasing petrol and road diesel for consumption must provide proof of the use of biofuels, within the meaning of Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources, which comply with the sustainability criteria laid down therein, at a rate of at least 8.00 %, calculated on the basis of the energy content of the fuels. Renewable electricity released for consumption for electric mobility by operators at their service stations may be counted in accordance with the provisions of Directive (EU) 2018/2001. The share of energy from biofuels produced from cereal and other starch-rich crops, sugars and oil crops, and from crops grown as main crops primarily for energy purposes on agricultural land, shall not exceed 5 % of the biofuels released for consumption, calculated on the basis of the energy content of the fuels.’ From 31 December 2023 until 31 December 2030 at the latest, the limit of high indirect land-use change-risk biofuels, bioliquids and biomass fuels for which the production area is significantly increasing to land with high carbon stock shall gradually decrease to 0 % at the end of 2030. The contribution of advanced biofuels and biogas produced from feedstock listed in Part A of Annex IX to Directive 2018/2001 as a share of final energy consumption in transport shall be at least 0.2 % in 2022 and at least 1 % in 2025 and at least 3.5 % in 2030. The decarbonisation of the transport sector plays a key role in reducing greenhouse gas emissions by 2030 and for full decarbonisation by 2050.</p> <p>Luxembourg aims at a share of renewable energy for the transport sector of at least 25 %, following the scenario of the initial NECP, which takes account of multipliers for electromobility and ‘double-counting’ biofuels, on the one hand, by incorporating the biofuels that remain necessary until the complete replacement of the thermal engine. It should be pointed out that already in the integrated national energy and climate plan, the ambition was well above the 14 % provided for in the recast of the Directive on the promotion of the use of energy from renewable sources. Finally, Luxembourg has also introduced a 5 % limit for the use of first generation biofuels, in order to promote the use of second-generation biofuels considered more sustainable. In addition to biofuels, the contribution of renewable electricity to the transport sector is a major asset and every effort to increase considerably the percentage of electric cars in the car fleet to XX% by 2030. The transport sector remains a major consumer of energy, with the result that reducing fossil fuel consumption is essential to meet the various targets.</p>

	for the share of renewable energy and the reduction of greenhouse gas emissions. Alongside biofuels and electrification, renewable hydrogen will play an important role in transport that is not suitable for electrification. More details can be found in the measure on hydrogen strategy. The measures to decarbonise the transport sector are manifold and it will not be enough to replace one energy carrier with another, but also through measures to reduce the use of individual transport by continuing to promote soft mobility and public transport.	
Type of policy instrument	Regulatory	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2022	2050	adjustment of the year-to-year blending rate
Responsible entity/entities	MECO, MFIN	
Reference (s)	Amended Law of 17 December 2010 fixing excise duties and similar taxes on energy products, electricity, manufactured tobacco products, alcohol and alcoholic beverages	
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2010/12/17/n2/jo	

Title of the measure	No 416 Biomethane in the transport sector	
Description	Analysis and study of the technical-economic aspects of the use of biomethane in the transport sector, including the need for funding for small-scale use, e.g. tractors in agriculture and, on a larger scale, in passenger and freight transport companies that can decarbonise transport vehicles that are currently difficult to decarbonise.	
Type of instrument	Planning	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2022	2024	
Responsible entity/entities	MECO	
Reference (s)		
Info complementary		

Name of measure	No 417 Sustainable aviation fuels at national airport	
Description	The initiative ReFuelEU Aviation from package FF55 proposes that in 2025/30/35/40/45/50, all EU airports with more than one million passengers or 100.000 tonnes of freight will be obliged to integrate in their total fuel consumption at least 2 %/6 %/20 %/34 %/42 %/70 % of SAF (Sustainable Aviation Fuels), of which a share of 0 %/1.2 %/5 %/10 %/15 % is made up of synthetic fuels.	
Type of instrument	Regulatory	
State of play	Adopted	
Start of implementing	End of implementation	Observations
01/01/2024 01/01/2025 (Arts 4, 5, 6, 8 and 10)	2050	LU to designate competent control authorities (DAC/AEV) and establish sanctions
Responsible entity/entities	MMTP, DAC, AEV, Société de l'Aéroport de Luxembourg	
Reference document (s)	Regulation (EU) 2023/2405 of the European Parliament and of the Council of 18 October 2023 on securing a level playing field for sustainable air transport (ReFuelEU Aviation)	
Info complementary	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32023R2405	

Name of measure	No 418 Deployment of alternative fuels infrastructure	
Description	<p>The national policy framework for the development of the market for alternative fuels and the deployment of the corresponding infrastructure (version 2019, published in January 2020), adopted pursuant to Directive 2014/94/EU on the deployment of alternative fuels infrastructure, contains an inventory of the market for alternative fuels in Luxembourg, quantified targets for the deployment of infrastructure open to the public, measures to achieve these objectives. Under FF55, the new Regulation (EU) 2023/1804 of the European Parliament and of the Council of 13 September 2023 on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU has been developed. This Regulation requires each Member State to prepare by 31 December 2024 a new draft national policy framework for the development of the market for alternative fuels in the transport sector and the deployment of the corresponding infrastructure. This draft Nation Framework for Action is to be submitted to the European Commission.</p> <p>The national policy framework should, inter alia, include an assessment of the current situation and market development prospects for alternative fuels in the transport sector, as well as the development of alternative fuels infrastructure, taking into account intermodal access to alternative fuels infrastructure and, where appropriate, cross-border continuity.</p> <p>The Commission shall assess the draft national policy frameworks and may address the draft recommendations to the Member States no later than six months after the transmission of the draft recommendations. By 31 December 2025, each Member State shall prepare its final national policy framework and notify it to the Commission.</p> <p>By 31 December 2027 and every two years thereafter, each Member State shall submit to the Commission a standalone national progress report on the implementation of its national policy framework.</p> <p>At the motorway service station level, concepts will be developed to develop multi-energy hubs in the medium term.</p>	
Type of instrument	Planning	
State of play	Implement	
Start of implementing	End of implementation	Observations
2016	n.e.s.	continuous implementation
Responsible entity/entities	MMTP, MECO	
Reference (s)		
Info complementary		

Title of the measure	No. 419 Road vehicle tax	
Description	Since 1 January 2007, CO ₂ emissions have been taken into account in the calculation of the road vehicle tax. For vehicles registered from 1 January 2001 onwards, the calculation shall be based on the CO ₂ emissions (NEDC value, combined value) as well as the fuel used. For vehicles registered for the first time from 1 January 2021 onwards, the calculation shall be based on the WLTP value of CO ₂ emissions (combined value) as well as the fuel used.	
Type of instrument	Tax	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2007	n.e.s.	amendment of the law in December 2020
Responsible entity/entities	MMTP, MECB	
Reference (s)	Amended Law of 22 December 2006 promoting retention in employment and laying down special measures in the field of social security and environmental policy	
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2020/12/15/a1001/jo	

Title of the measure	No. 420 Revised registration tax on road vehicles	
Description	<p>Currently, in Luxembourg, the registration tax of a vehicle is used only to finance the administrative task of registration by SNCA. Several Member States, including France and Sweden, apply a first registration tax which depends on the vehicle's CO₂ emissions and which may be negative or positive. Experience shows that this system is able to strongly incentivise the registration of new zero-emission cars, while remaining budget-neutral.</p> <p>The advisability of revising the registration system on the basis of existing schemes in other Member States, with a view to possible implementation from 2025, will be examined. By making vehicles with zero running emissions of CO₂ more attractive compared to vehicles powered by combustion engines, such a fiscal instrument could further accelerate the transition to zero-emission CO₂ vehicles^{before} the entry into force in 2035 of the ban on the placing on the market of new fossil fuel powered vehicles in the EU. In order to ensure the long-term fiscal sustainability of the system, consideration should be given to selective taxation of electric vehicles, taking into account environmental and social criteria when electrification of the car fleet is more advanced.</p>	
Type of instrument	Tax	
State of play	Planned	
Start of implementing	End of implementation	Observations
2025	n.e.s.	
Responsible entity/entities	MMTP, MECB	
Reference document (s)		
Info complementary		

Name of measure	No 421 Tax advantage for official cars	
Description	<p>For any new leasing contract concluded since 1 January 2017, the benefit in kind is calculated according to the type of engine (petrol, diesel, electric) and CO₂emissions of the official car. It is staggered in such a way that low CO₂ emission cars (BEV or PHEV) are favoured over petrol and diesel cars. Zero-emission cars (BEV and FECV) benefit from a very favourable rate. Diesel powered cars are put at a disadvantage compared to other engines. For any car registered since 1 January 2021, the benefit in kind is otherwise calculated on the basis of WLTP values (instead of NEDC values). From 2023 onwards, the rate shall be increased by + 0.2 % for the majority of categories of cars with CO₂emissions exceeding 80 g/km. For cars with CO₂emissions of 80 g/km or less, there is no adjustment of the applicable rates. The maximum rate of 1.8 % applies to cars with CO₂emissions above 130 g/km (before 2023: 150 g/km). For official cars newly registered as of 1 January 2025 and for which no contract will be signed before 31 December 2024, the flat-rate scheme will be simplified and particularly favourable to zero-emission CO₂ rollingcars.</p>	
Type of policy instrument	Tax	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2017	n.e.s.	Amendments to the rules in May 2022
Responsible entity/entities	MFIN	
Reference (s)	Amended Grand-Ducal Regulation of 23 December 2016 implementing Article 104 (3) of the amended Law of 4 December 1967 on income tax	
Info complementary	https://legilux.public.lu/eli/etat/leg/rgd/2022/05/12/a256/jo Grand-Ducal Regulation of 12 May 2022 amending the amended Grand-Ducal Regulation of 23 December 2016 implementing Article 104 (3) of the amended Law of 4 December 1967 on income tax.	

Name of measure	No 422 Social motor vehicle leasing	
Description	<p>The 100 % electric car is today an effective and tested instrument to reduce the carbon footprint of individual motorised mobility. The supply of pure electric car models continues to grow, but the difference in the purchase price of such a vehicle compared to a thermal car remains significant. Although existing aid schemes of up to EUR 8.000 are partly closing this gap, a large number of disadvantaged households are unable to buy a 100 % electric car. In order to facilitate the financing of such a vehicle for the most disadvantaged households, a social leasing system for long-term leasing contracts will be explored.</p> <p>Leaving no one behind the transition to cleaner mobility is essential in order to succeed the collective environmental challenge facing society. This social measure is consistent with the measures of the 2035 National Mobility Plan, which provides for a modal shift towards modes of transport other than private cars, such as public transport, active mobility or car-sharing, but nevertheless recognises the role of the car, especially in rural areas for medium and long distance travel.</p> <p>The primary objective of social car leasing would be to give disadvantaged households the possibility to replace their thermal car against a zero CO2 rolling car and thus contribute to the electrification of the car fleet and the reduction of the carbon footprint of the transport sector.</p> <p>It is first proposed to carry out a study involving all stakeholders, including social offices and leasing companies, with the aim of identifying the potential, modalities and opportunities through the introduction of such a social leasing scheme, while taking into account the possibilities offered by car sharing.</p>	
Type of policy instrument	ØEconomy	
State of play	Under analysis	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MMTP, MFSVA, MECB, MFIN	
Reference document (s)		
Info complementary		

Title of the measure	No 423 Aid scheme for zero CO₂ emission vehicles	
Description	<p>To accelerate the transition to zero-emission mobility, a maximum premium of EUR 8.000 is proposed for zero CO₂ vehicles including 100 % electric cars (BEV), hydrogen fuel cell cars (FCEVs) and 100 % electric vans and hydrogen fuel cell vans.</p> <p>This premium may vary depending on the energy consumption, power and size of the vehicle in question. The current regime applies to orders placed up to 30.9.2024. In addition, there are financial support for cycles (conventional and pedelec25) and light vehicles (motorcycle, quadricycle and moped) 100 % electric, applicable for vehicles purchased by 30.9.2024.</p> <p>The coalition programme foresees the continuation of grants, with a periodic review of award criteria and amounts. Thus, the graduation of financial aid according to environmental criteria and social parameters will be adjusted for 100 % electric cars and vans purchased from¹ October 2024. In order to increase the social accessibility of subsidies, new financial support for second-hand cars at least three years old will be introduced. Bike and pedelec25 bonuses will be reserved for persons who are part of a household in receipt of the expensive living allowance or energy bonus.</p>	
Type of instrument	Economic	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2019	2026	prolonged aid scheme with amendments on several occasions
Responsible entity/entities	MECB, MMTP, MECO/DG Energy	
Reference (s)	Amended Grand-Ducal Regulation of 7 March 2019 introducing financial aid for the promotion of road vehicles with zero and low CO ₂ emissions	
Info complementary	https://legilux.public.lu/eli/etat/leg/rgd/2019/03/07/a183/jo	

Name of measure	No 424 Aid scheme for the installation of private charging stations for electric vehicles	
Description	<p>To support the deployment of electro-mobility and promote the burden at home, financial support for the installation of charging stations in single-family homes and residences was introduced in 2020. This measure supports the installation of simple, smart and smart charging systems in multi-family buildings.</p> <p>An extension of the programme entered into force in 2023. This extension also makes adjustments, in particular to facilitate the installation of centralised solutions in co-properties.</p> <p>New financial support for collective intelligent load management systems and the equipment of an existing collective building for the installation of charging stations integrated into this system will be introduced.</p> <p>Other avenues for developing the aid scheme and administrative and legal procedures with a view to facilitating the installation of charging stations in co-properties will be analysed, in particular as regards the reasons for opposing the installation of terminals in a co-ownership.</p>	
Type of instrument	ØEconomy	
State of play	Implementation	
Start of implementing	End of implementation	Observations
2020	2024	
Responsible entity/entities	MECB, MECO/DG Energy, MMTP	
Reference document (s)	Grand-Ducal Regulation of 19 August 2020 introducing financial aid for the installation of private charging stations for electric vehicles	
Info complementary	https://legilux.public.lu/eli/etat/leg/rgd/2020/08/19/a702/jo	

Name of measure	No 425 Aid scheme for undertakings investing in charging infrastructure for electric vehicles	
Description	<p>To complement the public charging network and support the transition of vehicle fleets in companies, an aid scheme proposing three measures to support companies' financial support has been introduced:</p> <ul style="list-style-type: none"> - aid awarded following competitive tendering (call for projects) for companies investing in publicly accessible charging infrastructure or large private charging infrastructure (175 kW); - aid to small and medium-sized enterprises investing in private charging infrastructure reserved for their economic activities. - aid to owners of public service infrastructure (Chargy) and SuperChargy). <p>It should be noted that an important eligibility condition for public terminals is their supply by 100 % renewable sources.</p> <p>Storage facilities form part of the eligible costs in so far as storage reduces the connection capacity needed to connect the charging infrastructure to the grid.</p>	
Type of instrument	ØEconomy	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2022		
Responsible entity/entities	MECO	
Reference (s)	Law of 26 July 2022 on the aid scheme for undertakings investing in charging infrastructure for electric vehicles	
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2022/07/26/a395/jo	

Title of the measure	No 426 Aid scheme for the purchase of zero-emission heavy-duty vehicles	
Description	<p>Following the tripartite agreement reached on 31 March 2022, the government introduced in April 2023 new support for companies investing in zero-emission heavy-duty vehicles (categories N2 and N3).</p> <p>To this end, a comparative study of the various alternative propulsion technologies was launched in autumn 2022. This study enabled the government to make an informed decision on the choice of the most suitable propulsion technology to stimulate the decarbonisation of the logistics sector in Luxembourg.</p> <p>The aid scheme was introduced by introducing a temporary measure in the form of a pilot project, on the basis of the amended Law of 15 December 2017 on an environmental aid scheme.</p> <p>Medium and heavy-duty lorries equipped with zero greenhouse gas emitting engines, such as pure electric vehicles and hydrogen fuel cell vehicles, are eligible for this support. In addition, vehicles equipped with an internal combustion engine with CO₂ emissions below 1 g/kWh are also eligible, as well as the existing solutions for converting existing thermal vehicles into zero rolling emission vehicles.</p> <p>The pilot project is in place for a transitional period for the revision of State aid rules at European level. The aim is to further encourage companies to invest in zero greenhouse gas technologies to reduce the environmental impact of their road freight transport activities. It should be noted that vans (category N1) are already eligible under the existing aid scheme for vehicles with zero CO₂ emissions (amended Grand-Ducal Regulation of 7 March 2019). The amended Law of 15 December 2017 is currently being recast which, in line with the General Block Exemption Regulation (GBER), provides for aid for the purchase of zero-emission vehicles and the conversion of existing vehicles.</p>	
Type of policy instrument	Economic	
State of play	Implementation	
Start of implementing	End of implementation	Observations
2023	n.e.s.	
Responsible entity/entities	MECO, MECB, MMTP, MFIN	

Reference (s)	My Guest: Aid for zero-emission vehicles
Info complementary	https://guichet.public.lu/fr/entreprises/financement-aides/aides-environment/vehicules-zero-emission/aide-vehicules-zero-emission.html

Title of the measure	No 427 Strategy for the decarbonisation of freight transport and logistics	
Description	<p>The Logistics and Energy Transition Working Group will establish a strategy for decarbonising the logistics sector, framed in a European context. It will draw up an inventory of the characteristics of the logistics sector in Luxembourg. It will assess the importance of different sub-sectors (such as the “last mile delivery” in Luxembourg and the Greater Region, the incoming and outgoing flows of dedicated infrastructure and areas of activity and the use of combined rail-road transport) and the distances travelled by the different sub-sectors. It will develop an initial assessment of the different options for a zero-carbon strategy (biofuels, electric or renewable hydrogen, IT/AI optimisation) and infrastructure needs (e.g. electric chargers for hydrogen service areas respectively) and, where appropriate, policy instruments facilitating the shift towards a zero-carbon logistics sector.</p> <p>In view of the Tripartite Agreement of March 2022, it was decided to implement an aid scheme for the acquisition of clean heavy-duty vehicles (see measure 426).</p>	
Type of policy instrument	Planning	
State of play	Planned	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MMTP, MECO, MECB, MFIN	
Reference (s)		
Info complementary		

Title of the measure	No 428 Eurovignette	
Description	<p>The amended Directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructures provides that all transport vehicles will be taxed according to their rate of pollution emitted by driving, but also on the basis of the number of kilometres carried out within the EU and no longer over the duration of the journey. In addition, there are plans to prioritise zero- and low-rolling engines. Transposition of this new Eurovignette Directive in Luxembourg is planned for mid-2024.</p> <p>In order to replace the current Eurovignette user charge regime, a study will be carried out on the implementation of a model for the transport of goods based more on the 'user pays' principle.</p>	
Type of policy instrument	Tax	
State of progress	Scheduled	
Start of implementing	End of implementation	Observations
2024	n.e.s.	
Responsible entity/entities	MMTP, MFIN	
Reference (s)		
Info complementary		

Title of the measure	No 429 Facilitate the installation of charging stations	
Description	A large number of initiatives have already been taken to develop a charging infrastructure that meets the needs of existing and future users, such as the establishment of a public charging infrastructure (Chargy and SuperChargy), different support schemes for the installation of terminals, or the 'Stroom beweegt' initiative. In order to further accelerate the development of the necessary load infrastructure, in particular in areas of activity, buildings in co-ownership, residences or on construction sites, this measure will first and foremost identify and analyse existing obstacles. Secondly, the corresponding measures will be developed to remove these obstacles and facilitate the installation of terminals in these cases.	
Type of policy instrument	Regulatory	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2023	n.e.s.	
Responsible entity/entities	MECO	
Reference (s)		
Info complementary		

Name of measure	No 430 Motorised traffic speed reductions
Description	<p>Speed reductions in motorised traffic have proved their worth, both in terms of road safety, noise and fine and greenhouse emissions. If, at peak times, road congestion has the effect of reducing the actual speed below the maximum permitted speeds, these, combined with roadside developments and police checks, have a definite effect on speeds in uncongested situations.</p> <p>On the motorway network, a limit of 90 km/h is already in place in tunnels. On some sections of the A6 motorway, a limitation of 90 km/h at peak times has had a beneficial effect on road safety and traffic fluidity. This practice, which is widespread on peri-urban motorways, which are characterised not only by high traffic loads, but also by the very low interdistance between the exchangers and a sensitivity of residents to noise pollution, should be tested in other sectors of the motorway network, in particular the bypass of the city of Luxembourg.</p> <p>As a general rule, speed limits must be understandable to drivers and must be capable of being controlled by law enforcement authorities, otherwise they do not have the desired result.</p> <p>These principles, which are preferable to generalised speed limits, apply both outside locality and in urban areas.</p> <p>In urban areas, the vast majority of roads in the Grand Duchy are already limited to 30 km/h, or even occasionally to 20 km/h. These are mainly communal roads in residential neighbourhoods, which are not intended to carry transit traffic. Since 2015, limitations of 30 km/h have also been allowed on local sections of state roads. However, it is essential that these sections, as in any case all the so-called calved areas, are adapted accordingly by the municipality. In these areas, the driver of a motorised vehicle should feel only a visitor in an urban area which is primarily intended for the life of a neighbourhood or locality. Physical adjustments to the carriageway, including shrinkage or elevations, force the driver to reduce speed. The classification of the road network, as recommended by the 2035 National Mobility Plan, distinguishes between roads which are designed to carry significant traffic loads (known as connecting roads), those with very low transit traffic and which are primarily local (known as distribution roads) and those which serve only to serve the local area itself. Of the former, generally in the state, limitations of 30 km/h are still possible on sections of some 200 metres at central or school level. At the request of the municipalities and on condition that they reorganise them accordingly, the State distribution roads can be reduced on much longer sections. Finally, the streets of local services are generally already eased.</p> <p>With this pragmatic approach, which is not limited to reducing the speeds displayed on traffic signs, but which aims to reduce the speeds actually practised by drivers, the government is contributing to road safety and the limitation of greenhouse gases associated with excessive speeds of thermal motor vehicles.</p>

Type of policy instrument	Regulatory	
State of progress	Under analysis	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MMTP	
Reference document (s)		
Info complementary		

Name of measure	No 431 Scheme for greenhouse gas emission allowance trading (ETS) – aviation	
Description	<p>The amended Climate Law of 15 December 2020 transposes into national law the amended Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the European Union (ETS/ETS). The ETS currently applies to electricity generation installations, manufacturing installations and aviation (intra-European flights).</p> <p>With the 2023 reform of the ETS rules applicable to the aviation sector, emission allowances will be fully auctioned from 2026 onwards. The ETS will apply to intra-European flights, while CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation) will apply to extra-European flights to and from third countries participating in CORSIA from 2022 to 2027. When emissions from flights outside Europe reach levels above 85 % of 2019 levels, they will have to be offset by corresponding carbon credits.</p>	
Type of policy instrument	Regulatory	
State of progress	Implementation, Planned	
Start of implementing	End of implementation	Observations
2005	2030	Directive amended several times
Responsible entity/entities	MECB, AEV	
Reference (s)	Amended Climate Law of 15 December 2020	
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2020/12/15/a994/jo	

3.1.1.4 *Industry*

The decarbonisation of Luxembourg's industry goes hand in hand with maintaining the competitiveness of companies in this sector in the long term. It is important in this context to see Luxembourg companies in the face of their competition in Europe and outside Europe at global level.

The topics of decarbonisation, energy efficiency and renewable energy are taken into account in a complementary way and are all important.

Given the exceptional efforts needed in the context of decarbonisation, state aid will be essential and more conventional investment aid (CAPEX) will be supplemented in future by operating aid (OPEX) in line with the European guidelines on State aid (measures Nos 512 to 520).

The voluntary agreement on improving energy efficiency in Luxembourg's industry (measure No 503) is an important tool for the major players in the sector (around fifty companies) and has proved its worth for many years with a focus on energy efficiency; this agreement is currently being revised (measure 504) and will now focus on decarbonisation, energy efficiency and the production and use of renewable energy.

Companies which are not targeted by the voluntary agreement and in particular SMEs are targeted more specifically by the New Climate Pact for Enterprises (No 511), Luxinnovation's FIT4X programmes (No 513) and SME Packages Sustainability (No 514), with the aim of coordinating and coordinating the projects and activities of various stakeholders and managing certain new programmes in support of the common objective of climate protection and energy transition by companies. The Climate Business Pact provides for a voluntary commitment of companies to monitor their decarbonisation and energy transition efforts in the long term.

Title of the measure	No 501 Scheme for greenhouse gas emission allowance trading (ETS/ETS)	
Description	<p>The amended Climate Law of 15 December 2020 transposes into national law the amended Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the European Union (ETS/ETS). The ETS currently applies to electricity generation installations, manufacturing installations and aviation (intra-European flights). The current objective is to reduce the greenhouse gas emissions covered by the scope by 43 % by 2030 compared to 2005 at EU level.</p> <p>The two main aspects of the 2023 reform are the increase in the reduction target from 43 % to 62 % and the inclusion of new sectors, including road transport and buildings, in a dedicated “second ETS” from 2027. The introduction of a carbon border adjustment mechanism will prevent the risk of carbon leakage.</p>	
Type of instrument	Regulatory	
State of play	Implementation, Planned	
Start of implementing	End of implementation	Observations
2005	2030	Directive amended several times
Responsible entity/entities	MECB, AEV	
Reference document (s)	Amended Climate Law of 15 December 2020	
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2020/12/15/a994/jo	

Name of measure	No 502 Aid scheme to compensate for the additional costs of the ETS system for the period 2021-2030	
Description	<p>The support scheme, which forms part of the EU's greenhouse gas allowance trading scheme, makes it possible to cover part of the indirect emission costs incurred in the financial years 2021 to 2030 by companies exposed to a real risk of carbon leakage, thus helping to combat global warming while preserving the competitiveness of European industry. It is thus fully in line with the European Green Deal, which sets a target of a 55 % reduction in greenhouse gas emissions by 2030 and the EU's new industrial strategy to decarbonise all sectors of the economy, in particular energy-intensive ones. In return, companies must carry out an energy audit as provided for in the amended Law of 5 August 1993 on the rational use of energy and implement measures reducing their carbon borrowing if they do not qualify as small and medium-sized enterprises. The aid targets companies that carry out an industrial activity in Luxembourg, in sectors and subsectors deemed to be exposed to a significant risk of carbon leakage due to costs related to the EU greenhouse gas emissions trading scheme, passed on in electricity prices.</p>	
Type of instrument	Economic	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2021	2030	
Responsible entity/entities	MECO	
Reference (s)	Law of 15 July 2022 introducing an aid scheme in the context of the greenhouse gas emission allowance trading scheme for the period 2021-2030	
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2022/07/15/a356/jo	

Title of the measure	No 503 Voluntary agreement on improving energy efficiency in industry (up to and including 2023)	
Description	<p>In 2021, the government concluded an agreement with the Fédération de l'industrie luxembourgeois (Fédération de l'industrie luxembourgeois – FEDIL) committing the member companies to achieve the common objective of improving the overall energy efficiency of all participants by the end of 2023 by 4.5 %. Since 1996, this agreement has been regularly renewed to strengthen the commitment of the various parties involved.</p> <p>Under this agreement, the member companies undertake to implement a number of measures, including the establishment of energy management, the carrying out of an energy audit, continuous training, etc. In return, the Government proposes advantages, particularly in the context of the European Directive on the taxation of energy products and electricity.</p> <p>Around 50 energy-intensive companies from the industrial and tertiary sectors participate in the current period.</p>	
Type of policy instrument	Voluntary agreement	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2021	2023	renewal of the agreement several times since 1996
Responsible entity/entities	Meco, MECB, FEDIL, Klima-Agence	
Reference (s)	Amended GDR of 31 March 2010 on the compensation mechanism in the context of the electricity market design	
Info complementary	https://www.klima-agence.lu/fr/accord-volontaire-fedil	

Title of the measure	No 504 Voluntary agreement on decarbonisation and improvement of energy efficiency in industry (from 2024)	
Description	<p>The Voluntary Agreement (VPA) with industry is revised and renewed for the period 2024-2030. It will take place in two phases. The first phase follows the logic of the previous agreements.</p> <p>For the second phase, the scope will be extended to include the decarbonisation dimension as a complement to energy efficiency. Thus, the energy efficiency improvement index will be complemented by a new decarbonisation index whose objective and calculation methodology will be defined and tested in the first phase, on the basis of concrete cases, while considering the national decarbonisation targets. The second phase will introduce new counterparts whose legal basis will be developed during the first phase, in consultation with FEDIL. The start date of the second phase will be definitively fixed with the official publication of the legal basis setting out the framework for future counterparties.</p> <p>The revision of the FVA will be based on a legal analysis of the possibilities for compensatory measures granted to companies which adhere to the AV (and which comply with their commitments) under the European rules on state aid. In this context, the adaptation of the existing CO₂ tax with a view to introducing a progressive CO₂ tax for non-ETS companies participating in the voluntary agreement will be analysed in order to increase the incentive for these companies to invest in decarbonisation projects.</p>	
Type of policy instrument	Voluntary agreement	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2024	2030	
Responsible entity/entities	Meco, MECB, FEDIL, Klima-Agence	
Reference (s)	Amended GDR of 31 March 2010 on the compensation mechanism in the context of the electricity market design	
Info complementary		

Name of measure	No 505 Compulsory energy audits for enterprises	
Description	<p>On the basis of Article 8 of the EU Energy Efficiency Directive EED UE/2012/27, an obligation to carry out an energy audit every 4 years was introduced for large companies (non-SMEs) already in 2015.</p> <p>The idea of this obligation is to make companies aware of energy-saving potentials, identifying specific potentials for improving energy efficiency in the company. Companies are encouraged to implement the measures thus identified, in so far as they are profitable, in particular by means of the 'energy efficiency' aid proposed by the Ministry of Economy in the context of investment aid for environmental protection and, where appropriate, by financial and non-financial incentives offered by obligated parties under the energy efficiency obligation scheme.</p> <p>The first deadline for carrying out such an audit was 10 December 2016. Energy audits are to be carried out exclusively by persons approved by the Minister responsible for energy and must:</p> <ul style="list-style-type: none"> - be based on up-to-date, measured operational data and <ul style="list-style-type: none"> - energy consumption and, for electricity, load profiles; - include a detailed examination of the energy consumption profile buildings or groups of buildings, as well as industrial operations or installations, including transport; - rely, as far as possible, on a cycle cost analysis life rather than on simple amortisation periods to take into account long-term savings, residual values of long-term investments and discount rates; - be proportionate and sufficiently representative to allow for establish a reliable picture of overall energy performance and identify the most significant opportunities for improvement in a secure manner. 	
Type of instrument	Regulatory	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2016	n.e.s.	revision planned for 2024/2025 (transposition of the new EED (EU) 2023/1791, Article 11)
Responsible entity/entities	Meco, Klima-Agency	
Reference (s)	Law of 5 July 2016 amending the amended Law of 5 August 1993 on the rational use of energy	
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2016/07/05/n2/jo	

Name of measure	No 506 Mandatory energy audits for businesses (new EED (EU) 2023/1791)	
Description	<p>The obligation to carry out an energy audit for companies meeting certain criteria will be revised on the basis of the new Energy Efficiency Directive (EED). (EU) 2023/1791). The eligibility criterion will no longer be the classification of the company on the basis of its size (SME or non-SME), but the level of annual energy consumption. If the level exceeds 10 TJ (2.78 GWh) there is an audit obligation and if it exceeds 85 TJ (23.6 GWh) there is an obligation to set up an energy management system. EPCs (Energy Performance Contracting) will be taken into account.</p> <p>The new EED requires the companies concerned to carry out a concrete action plan on the basis of the measures identified in the energy audit and to draw up a plan for the implementation of the measures to the extent that they are technically and economically feasible. These plans are to be submitted to the management of the company and the plans and the rate of implementation of feasible measures are to be published in the companies' annual report and made public under certain conditions (protection of sensitive and confidential data).</p> <p>An obligation to carry out the measures identified in the energy audit will be introduced, depending in particular on break-even; a calculation methodology and different conditions will be defined as part of this obligation, taking into account, for example, the financial aid and incentives applicable when implementing the measures.</p> <p>The content of the energy audit will be reviewed to include, inter alia, the identification of the company's decarbonisation potentials, complementing energy aspects (energy efficiency and renewable electricity production potential and self-consumption).</p> <p>In addition to this obligation, companies not obliged to carry out regulatory audits and in particular SMEs will be encouraged to carry out energy audits under the New Climate Pact for Business ("Klimapakt fir Betriber").</p>	
Type of instrument	Regulatory	
State of progress	Planned	
Start of implementing	End of implementation	Observations
2024	n.e.s.	transposition of the new EED (EU) 2023/1791
Responsible entity/entities	Meco Klima-Agence, FEDIL	
Reference (s)	Law of 5 July 2016 amending the amended Law of 5 August 1993 on the rational use of energy	
Info complementary		

Title of the measure	No 507 Energy audit and monitoring/optimisation obligation for functional buildings with a surface area greater than 1.000 m²	
Description	<p>As a logical follow-up to the results observed, particularly at the level of functional buildings, in the context of the national energy saving campaign “zesumme spueren – zesammenhalen” implemented from autumn 2022 onwards and in order to ensure the perennity of the measures implemented in this context (as well as future measures with the same objective), a monitoring and optimisation obligation is introduced for functional buildings with a surface area above 1.000 m².</p> <p>Targeted buildings and conditions:</p> <ul style="list-style-type: none"> - the obligation applies to all owners for their buildings functional > 1.000 m² regardless of the status of the owner (public authority or private actor); - if a building is covered by the obligation to carry out an energy audit on the basis of the consumption of the company (owner) (PaMs #506), this obligation also covers the obligation for buildings > 1.000 m²; - identify potential for improvement (energy efficiency; in particular with regard to optimisation of instructions (HVAC) and decarbonisation (building suitable for the implementation of a heat pump (heat output temperature less than or equal to 55 °C, CIE considered separately); - prioritising the implementation of the measures identified on the basis of feasibility and return on investment; - obligation to carry out energy efficiency measures with a return on investment (ROI – return on invest) under the age of 5 (taking into account all applicable state subsidies and private incentives for the implementation of the measures); - the rules governing the implementation of this measure will be: drawn up after consultation with the sectors concerned on the timetable for the entry into force of the obligation, with priority being given to administrative buildings in the tertiary sector. 	
Type of policy instrument	Regulatory	
State of progress	Under analysis	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MECO	
Reference (s)	Law of 5 July 2016 amending the amended Law of 5 August 1993 on the rational use of energy	

Info complementary	
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Name of measure	No 508 Obligation to decarbonise by an accelerated fossil phase-out for functional buildings with a surface area greater than 1.000 m²	
Description	<p>Obligation to decarbonise with an accelerated fossil phase-out for functional buildings with a surface area equal to or greater than 1.000 m² that are suitable for replacing fossil energy based heating with a heat pump (PAC) based on the starting temperature of the heating system below or equal to 55 °C (domestic hot water (DHW) production considered separately).</p> <p>Targeted buildings and conditions:</p> <ul style="list-style-type: none"> - obligation additional to PaMs #506 audit/monitoring obligation and #507; - the obligation applies to all owners for their buildings functional > 1.000 m² regardless of the status of the owner (public authority or private actor); - all functional buildings > 1.000 m²; - obligation to replace fossil-based heating with a heating with one or more heat pump (s) for any functional building that is designed/adapted to be operated with a heating outlet temperature lower than or equal to 55 °C; - the production of domestic hot water (DHW) is considered as separate from the production of domestic hot water (DHW), starting temperature condition less than or equal to 55 °C only applies to the heating circuit (s) of the building; - obligation to replace fossil heating, where appropriate, with a decarbonised heat pump solution within 4 years for any fossil boiler aged 5 years or more (compared to the date of commissioning of the existing boiler); - the rules governing the implementation of this measure will be: drawn up after consultation with the sectors concerned on the timetable for the entry into force of the obligation, with priority being given to administrative buildings in the tertiary sector <p>Exceptionally, an energy renovation obligation of a building or a ban on replacing a fossil boiler with a new fossil fuel boiler resulting from a measure of the NECP may be waived where the related costs related to the complexity of the works, necessary for its implementation, are disproportionate to the CO₂ emission reduction potential. These exceptions will be specified in the laws relating to obligations and prohibitions.</p>	
Type of policy instrument		
State of progress		
Start of implementing	End of implementation	Observations

Responsible entity/entities	MECO
Reference (s)	
Info complementary	

Name of measure	No 509 Monitoring and energy efficiency improvement obligations for data centres	
Description	<p>In view of the sharp evolution of the energy needs of the data centre sector, a (European) obligation to monitor energy consumption and some performance indicators for data centres will be introduced with the transposition of the EED Directive (EU) 2023/1791, Article 12 and taking into account the European Commission Delegated Regulation 2024/1364, for data centres with an energy demand of 500 kW or more; the data will be filled in by the operators of the data centres concerned in a European database (IT platform).</p> <p>Mandatory use of waste heat for data centres with energy demand above 1 MW based on EED (EU) 2023/1791, Article 26 (6), under conditions (technically and economically feasible).</p> <p>Encouraging data centres above 1 MW to take into account the best practices set out in the most recent version of the European Code of Conduct on Data Center Energy Efficiency.</p> <p>In addition to this monitoring obligation at European level on the basis of the EED and in parallel with the European Commission's planned analyses with a view to future energy efficiency improvement obligations and minimum performance levels, Luxembourg will analyse the potential and impact of future European bonds on the sector at national level.</p>	
Type of instrument	Regulatory	
State of progress	Planned	
Start of implementing	End of implementation	Observations
2024	n.e.s.	implemented when transposing EED (EU) 2023/1791
Responsible entity/entities	MECO	
Reference document (s)		
Info complementary		

Title of the measure	No 510 Roadmap for decarbonising industry	
Description	<p>In close cooperation with industry, a first version of a “Decarbonisation of Luxembourg Industry” roadmap is established to support manufacturing companies to decarbonise their activities, contribute to national climate and energy targets and meet the requirements of the EU Emissions Trading System (ETS/ETS). To this end, the roadmap identifies and evaluates decarbonisation levers and potentials in manufacturing (as currently quantifiable). Secondly, it proposes a set of policy measures to facilitate the implementation of potentials and the transformation of the industrial sector. In this respect, the annual needs for renewable electricity and hydrogen are estimated. It should be noted that the roadmap reflects the current state of play regarding the decarbonisation of manufacturing industry, a state which will evolve over time. This roadmap will evolve as new decarbonisation projects are identified and quantified or updated already identified and will be regularly updated and completed over the coming years.</p> <p>The bottom-up approach of this roadmap (based on concrete projects) will be complemented by a top-down analysis of potentials by 2040/2050.</p> <p>The identification of concrete decarbonisation potentials per company and the feasibility of their implementation are also an important aspect in the context of the New Climate Pact for Business (“Klimapakt fir Betriber”), notably through the Fit4Sustainability programme.</p>	
Type of policy instrument	Planning	
State of play	Implement	
Start of implementing	End of implementation	Observations
2022	n.e.s.	regular updating
Responsible entity/entities	MECO, MECB, FEDIL	
Reference document (s)		
Info complementary		

Title of the measure	No 511 Climate Pact for Business (SMEs) (Klimapakt fir Betriber)	
Description	<p>Climate Pact for Business – the Government will support companies in their efforts to decarbonise and the green transition through a structured and coordinated approach.</p> <p>The Climate Pact for Business (KPB – Klimapakt fir Betriber), aimed specifically at SMEs, is a strategic guidance platform for consultation and coordinated implementation of the projects and activities of different actors, as well as the management of some new programmes in support of the common objective of climate protection and energy transition by businesses. It provides for a voluntary commitment by companies to enable long-term monitoring of their decarbonisation and energy transition efforts.</p> <p>The KPB includes both existing and ongoing support, as well as programmes or coaching still to be created according to needs, in line with State aid rules.</p> <p>The KPB provides the overview and ensures the coherence of all services available to support businesses and the economy in their decarbonisation and the energy transition: advising, providing a toolkit, co-funding solutions and connecting (key actors and businesses as well as businesses with each other).</p> <p>The KPB is led by a steering committee and managed by the Luxinnovation and Klima-Agency agencies. The Steering Committee is composed of MECO, MECB, Klima- Agence, Luxinnovation, FDA, FEDIL, CdM, CdC, CLC.</p>	
Type of instrument	Voluntary agreement	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2023	2030	
Responsible entity/entities	Meco, MECB, Klima-Agence, Luxinnovation	
Reference (s)		
Info complementary		

Name of measure	No 512 Aid scheme for undertakings – environmental and climate protection	
Description	<p>The scheme supports environmental protection measures to incentivise companies to use natural resources rationally and reduce the environmental footprint of their production activities. Specifically targeted are measures to go beyond environmental standards, early adaptation to future environmental standards, energy efficiency, promotion of energy from renewable sources, high-efficiency cogeneration, efficient district heating and cooling, remediation of contaminated sites, recycling and reuse of waste, energy infrastructure and environmental studies. Undertakings investing in eco-technologies or in environmentally friendly processes may benefit from specific aid, the aid rate of which varies according to the type of investment and the size of the undertaking. Any investment with a high return and/or reduced return time is not eligible. The aid shall be granted in the form of capital subsidies or interest rate subsidies and shall be granted to all undertakings and natural persons authorised to be established.</p>	
Type of policy instrument	ØEconomy	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2017	n.e.s.	Revision planned for 2024/2025
Responsible entity/entities	MECO	
Reference (s)	Amended Law of 15 December 2017 on an aid scheme for environmental protection	
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2017/12/15/a1108/consolide/20201221	

Name of measure	No 513 Fit4Sustainability	
Description	This support and co-funding programme offers companies the opportunity to have an assessment of the environmental impact of their activities carried out, which will be supplemented by various recommendations to reduce this environmental impact. The environmental impact assessment may cover the following aspects: decarbonisation, water, circularity. It is addressed to all companies which have a registered office in Luxembourg and which carry out an economic activity as their principal activity. The aid is granted in the form of a capital grant.	
Type of instrument	ØEconomy	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2021	n.e.s.	
Responsible entity/entities	Meco, Luxinnovation	
Reference (s)	Amended Law of 15 December 2017 on an aid scheme for environmental protection	
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2017/12/15/a1108/consolide/20201221	

Title of the measure	No 514 SME Packages Sustainability	
Description	Programme and aid for the identification of a concrete solution to reduce the environmental impact of SMEs and generate savings by reducing energy or water consumption, improving waste management or reducing the carbon footprint.	
Type of policy instrument	ØEconomy	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2022		
Responsible entity/entities	Meco, Chamber of Commerce, Chamber of Metiers, House of Entrepreneurship	
Reference (s)	Amended Law of 9 August 2018 on an aid scheme for small and medium-sized enterprises	
Info complementary	https://guichet.public.lu/fr/entreprises/financement-aides/regime-sme-packages/packages-sustainability.html	

Name of measure	No 515 General aid for SMEs – Investment aid (revision)	
Description	<p>In order to promote and encourage the sustainable development of SMEs, the Government will study financial support adjustments in order to strengthen the energy and ecological transition of SMEs, as well as appropriate support methods. The Government will support SMEs in their decarbonisation efforts through the Klimapakt fir Betriber and will study the expansion of SME Packages' supply.</p> <p>To this end, the Government will adapt the framework law on State aid to small and medium-sized enterprises (SMEs) in order to respond to the current challenges faced by SMEs, taking into account the specific features of investments in initial business start-ups.</p>	
Type of instrument	ØEconomy	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
		implementation of the planned revision for 2025
Responsible entity/entities	MECO	
Reference (s)	Amended Law of 9 August 2018 on an aid scheme for small and medium-sized enterprises	
Info complementary		

Title of the measure	No 516 Aid scheme for undertakings – environmental and climate protection (Revision)	
Description	<p>In order to achieve the objectives of decarbonising companies in Luxembourg, the Government will make them available new aid schemes. To this end, the Government will propose a revision of the Law of 15 December 2017 on an aid scheme for environmental protection, on the basis of the General Block Exemption Regulation (GBER).</p> <p>The revision of the aid scheme follows an assessment of new opportunities in the field of decarbonisation, transport and charging infrastructure, hydrogen production, CCU (carbon capture and utilisation), energy performance contracting and the transition to a circular economy.</p> <p>The aid could take the form of a capital grant, a repayable advance or an interest subsidy. Some aid will be awarded on the basis of a competitive tendering procedure in order to have the greatest environmental impact thanks to the minimum aid needed.</p> <p>This aid scheme also targets SMEs, with a special focus on methods to support SMEs in their energy and green transition through the Klimapakt fir Betriber, see PAM No. 511.</p>	
Type of policy instrument	Economic	
State of progress	Planned	
Start of implementing	End of implementation	Observations
2025	n.e.s.	Draft law submitted in May 2024 and expected to enter into force at the beginning of 2025
Responsible entity/entities	MECO	
Reference (s)		
Info complementary		

Title of the measure	No 517 Operating assistance scheme for decarbonisation projects	
Description	To achieve the objectives of the NECP, companies, including industrial actors, need to invest in decarbonisation. However, some decarbonisation projects are not economically viable. This is due to the high operating costs of a decarbonised project compared to a carbon project (e.g. the price of hydrogen is higher than the price of gas). To remedy this, it is envisaged to implement an aid scheme, in one or more stages, to incentivise companies to invest in decarbonisation while closing the funding gap through state aid. This can take the form of a Contract for Difference (CfDs) or another form under the Temporary Crisis and Transition Framework (TCTF) or the 2022 Guidelines on State aid for climate, environmental protection and energy (CEEAG).	
Type of policy instrument	Economic	
State of progress	Planned	
Start of implementing	End of implementation	Observations
2024		
Responsible entity/entities	MECO	
Reference (s)		
Info complementary		

Title of the measure	No 518 Risk sharing mechanism for energy efficiency and enterprise decarbonisation projects	
Description	The de-risking instrument will make it possible to develop large-scale projects/investments to improve energy efficiency and decarbonisation and will be developed together with commercial banks, SNCI and energy suppliers.	
Type of instrument	Economic	
State of progress	Planned	
Start of implementing	End of implementation	Observations
Responsible entity/entities	Meco, SNCI, commercial banks	
Reference (s)		
Info complementary		

Title of the measure	No 519 Enterprise aid scheme – research, development and innovation	
Description	<p>The aid scheme supports investments or research, development and innovation operations and related activities (e.g. hydrogen or CCU projects (carbon capture and utilisation)). The scheme provides incentives for companies to invest in the development of new services or products and in the improvement of production processes and multi-sectoral specialisation in priority areas (e.g. sustainable technologies) and fosters the development of cutting-edge innovation capacities in areas of excellence. In addition, the scheme further promotes partnerships between private sector companies and public research laboratories. Companies and private research organisations carrying out R & D projects are eligible for aid in the form of a grant or repayable advance. The aid may cover a percentage of the eligible costs which varies according to the size of the undertaking and the type of project or programme. The aid is intended for private undertakings and research organisations established in Luxembourg and concerns the following activities: experimental development, basic research and industrial research.</p>	
Type of instrument	ØEconomy	
State of progress	Implementation, Planified	
Start of implementing	End of implementation	Observations
2017	n.e.s.	implementation of the revision based on the planned GBER for 2024
Responsible entity/entities	MECO	
Reference (s)	Law of 17 May 2017 on the promotion of research, development and innovation	
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2017/05/17/a544/consolide/20201221	

Title of the measure	No 520 Modernisation of the tax subsidy for investments made as part of an energy and ecological transition project	
Description	In implementation of the Tripartite Agreement of 28 September 2022, the Government adapted the existing framework for the tax subsidy for investment in order to modernise it in depth, with a view, in particular, to encourage investments made by companies in the context of a digital transformation project or an energy and ecological transition. This rearrangement has a constant budgetary impact.	
Type of instrument	Tax	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2024	n.e.s.	
Responsible entity/entities	MFIN, MECO	
Reference (s)	Tripartite Agreement of 28 September 2022 Law of 22 December 2023 amending the amended Law of 4 December 1967 on income tax	
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2023/12/22/a836/jo	

Name of measure	No 521 Revision of legislation to speed up permitting procedures for decarbonisation projects	
Description	<p>As decarbonisation projects are of major importance to counter climate change, the relevant legislative texts will be reviewed in order to identify situations where individual authorisation is not required or could be replaced by other legislative means or where the procedures for obtaining such an authorisation could be lighter or accelerated or even prioritised.</p> <p>The above analyses will be coordinated by MECB. If legislative texts are adapted, the relevant work will be initiated by the respective competent authorities.</p>	
Type of instrument	Regulatory	
State of progress	Planned	
Start of implementing	End of implementation	Observations
2024	n.e.s.	
Responsible entity/entities	MECB, MT, MAINT	
Reference (s)		
Info complementary		

Title of the measure	No 522 Circular Economy Strategy “Kreeslafwirtschaft Lëtzebuerg”	
Description	<p>Overconsumption of resources by our society generates significant GHG emissions across the product value chain, from raw material extraction to waste disposal. Smart application of the principles of the circular economy (CE) – reducing the material (and thus carbon) footprint, extending use and sharing, re-use, reuse and recycling or cascade use for biological resources – is essential to achieve carbon neutrality.</p> <p>In 2021, the “Kreeslafwirtschaft Lëtzebuerg” strategy was presented, describing the methodological tools and approaches to define EC roadmaps for key sectors (Fit4Sustainability programme, Product Circularity Data Sheet initiative, RGD Resource Centres, etc.). An electronic portal has been set up which explains the strategy and the toolbox and identifies key actors to implement these roadmaps, including state and municipal administrations, businesses, Societal Impact Societies (SIS) and citizens.</p> <p>As part of the implementation of the circular economy, the government plans to set up a dedicated national cell with adequate resources to coordinate and initiate projects in key sectors, in close cooperation with stakeholders. In addition, public business support programmes for investments in the circular economy will be strengthened.</p> <p>Circular economy principles will be integrated into public tenders to promote circular construction and encourage the use of sustainable materials. In addition, public buildings will be designed in such a way as to allow their use as a depot of materials to promote the reuse of building materials. Sustainability criteria will be integrated into public tenders.</p>	
Type of policy instrument	Information	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2020	n.e.s.	Continuous development
Responsible entity/entities	MECO, MECB, MFIN, MT, MY	
Reference (s)	Circular Economy Strategy Luxembourg, MEA, MECO, MECDD 2021 Coalition Agreement 2023-2028	
Info complementary	https://economie-circulaire.public.lu/fr.html https://economie-circulaire.public.lu/dam-assets/publications/2021/Strategie-economie-circulation-Luxembourg-FR.pdf	

Name of measure	No 523 Framework for Action for the Deployment of Carbon Capture, Utilisation and Storage Technologies	
Description	<p>To achieve climate neutrality by 2050 at the latest, carbon capture, utilisation and storage (CCUS) technologies are recognised as an important lever for the decarbonisation of hard-to-decarbonise manufacturing industries, where direct electrification or the use of hydrogen are technically or economically unfeasible.</p> <p>According to the 2023-2028 Coalition Agreement, the Government plans to assess the potential of CCUS technologies in Luxembourg and to create a framework to support their deployment under specific conditions and for specific industries, such as the cement industry.</p> <p>If necessary, an adequate CO₂ transport infrastructure will be developed. To this end, cooperation and coordination at national, regional and European level is essential for the deployment of CO₂ transport infrastructure to carbon storage and utilisation sites.</p>	
Type of policy instrument	Planning	
State of play	Scheduled	
Start of implementing	End of implementation	Observations
2024		
Responsible entity/entities	MECB, MECO	
Reference document (s)		
Info complementary		

Title of the measure	No 524 Regulation No 517/2014 (F-Gas II) for the reduction of emissions of fluorinated greenhouse gases	
Description	<p>Regulation No 517/2014 ('F- Gas II'), which entered into force on 1 January 2015, repeals and replaces Regulation No 842/2006 ('F-Gas'). It is based on the following provisions:</p> <ul style="list-style-type: none"> - strengthening the obligations related to the containment of equipment (leak checks, repair obligations), certification of personnel handling HFCs and obligation to recover during maintenance and dismantling of equipment; - the establishment of a mechanism for the gradual reduction of quantities HFCs placed on the market from 2015 to 2030 via a quota system. In 2030, the total quantity of HFCs placed on the market, in CO₂ equivalent, must correspond to 21 % of the average level between 2009 and 2012; - sectoral bans on the placing on the market of products and equipment containing fluorinated greenhouse gases exceeding a certain GWP; - a ban on the maintenance of refrigeration facilities with GWP fluids exceeding 2 500 from 1 January 2020. This also applies to heat pumps. (please note: proposal by the European Commission to revise Regulation (EU) No 517/2014 on fluorinated greenhouse gases in April 2022) 	
Type of instrument	Regulatory	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2015	2030	National law with no defined end date
Responsible entity/entities	MECB, AEV	
Reference document (s)	<p>Act of 22 June 2016</p> <p>a) laying down certain rules for the implementation and penalties of Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006;</p> <p>b) MO</p>	
Info complementary	http://data.legilux.public.lu/eli/etat/leg/loi/2016/06/22/n1/jo	

Name of measure	No 525 Reinforcing of the regulations on checking the leakage of refrigerating, climatic and thermodynamic equipment	
Description	Grand-Ducal Regulation of 22 June 2016 on (a) checks on refrigeration, air-conditioning and heat pump equipment powered by HFC, HCFC or CFC-type refrigerant fluids; (b) the inspection of air-conditioning systems strengthens Luxembourg's rules on checking the leakage of refrigeration, climate and thermodynamic equipment, complementing the provisions of the European F-Gas II Regulation. In particular, it requires increased frequency of leakage checks, specifies technical measures for carrying out checks and obliges large equipment to be equipped with an automated leak detection system. This measure helps to limit fugitive emissions from such equipment.	
Type of instrument	Regulatory	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2016		
Responsible entity/entities	MECB, AEV	
Reference (s)	Grand-Ducal Regulation of 22 June 2016 on (a) checks on refrigeration, air-conditioning and heat pump equipment powered by HFC, HCFC or CFC-type refrigerant fluids; (b) the inspection of air-conditioning systems.	
Info complementary	http://data.legilux.public.lu/eli/etat/leg/rgd/2016/06/22/n3/jo	

Title of the measure	No 526 Ratification of the Kigali Amendment	
Description	Luxembourg ratified the Kigali Amendment to the Montreal Protocol on 16 November 2017. While the Kigali Amendment broadly serves the same objectives as the EU F-Gas II Regulation, it covers a larger commitment period until 2036 (F-Gas II Regulation until 2030).	
Type of policy instrument	Regulatory	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2017	2036	
Responsible entity/entities	MECB, AEV	
Reference (s)	Act of 28 July 2017 approving the Kigali Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, adopted in Kigali on 15 October 2016.	
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2017/07/28/a705/jo	

Title of the measure	No 527 Business advice for the replacement of HFC-powered equipment with HFC free equipment and collective recovery of discontinuous aircraft – SuperDrecksKëscht action	
Description	In addition to the recovery of air-conditioning equipment and refrigerants, the SuperDrecksKëscht [®] action advises companies in their conversion to environmentally friendly refrigerants. The Council focuses on taking into account the ban on the use of all partially halogenated ozone-depleting refrigerant fluids (HCFCs) in accordance with Regulation (EC) No 1005/2009, as well as on the prevention of fluorinated gases, in line with Regulation (EC) No 842/2006. As a result, it is hoped to contribute to reducing the significant global warming potential of F-gases and to increase awareness and acceptance of alternatives for refrigerant and air-conditioning fluids.	
Type of policy instrument	Information	
State of progress	Implement	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MECB, AEV, SuperDrecksKëscht	
Reference document (s)		
Info complementary	https://sdk.lu/de/die-behandlung-von-kuhlgeraten/	

Title of the measure	No 528 Prohibition of certain fluorinated gases in air-conditioning systems in motor vehicles	
Description	Directive 2006/40/EC prohibits the use of fluorinated gases with a GWP of more than 150 in air-conditioning systems in motor vehicles. Since 1 January 2011, the air conditioning of all new vehicle types has to operate with a refrigerant with a GWP of less than 150. Since 1 January 2017, this ban applies to all new vehicles. This implies that car manufacturers replace refrigerant gas R-134a (GWP = 430) with R-1234yf gas (GWP = 4).	
Type of instrument	Regulatory	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2008	n.e.s.	
Responsible entity/entities	MMTP, SNCH, SNCA	
Reference (s)		
Info complementary	http://data.europa.eu/eli/dir/2006/40/oj	

Title of the measure	No 529 Regulation (EU) 2024/573 of the European Parliament and of the Council of 7 February 2024 on fluorinated greenhouse gases, amending Directive (EU) 2019/1937 and repealing Regulation (EU) No 517/2014	
Description	<p>Based on the findings of an evaluation of the Regulation, the European Commission has set the following objectives for the review:</p> <p>(1) Achieve additional F-gas emission reductions to contribute to the achievement of the 55 % target by 2030 and net carbon neutrality by 2050.</p> <p>(2) Fully align with the amended Kigali Protocol.</p> <p>(3) Facilitate the strengthening of implementation and enforcement of illegal trade, the functioning of the quota system and training needs on alternatives to F-gases.</p> <p>(4) Improve monitoring and reporting to fill existing gaps and improve the process and data quality for compliance.</p> <p>(5) Improve clarity and internal coherence to foster better implementation and understanding of the rules.</p>	
Type of policy instrument	Regulatory	
State of play	Under analysis	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MECB, AEV	
Reference (s)	Regulation (EU) 2024/573 of the European Parliament and of the Council of 7 February 2024 on fluorinated greenhouse gases, amending Directive (EU) 2019/1937 and repealing Regulation (EU) No 517/2014	
Info complementary		

3.1.1.5 pieces of waste

Title of the measure	No 601 Waste Law and the National Waste and Resource Management Plan (PNGDR)	
Description	<p>The amended Law of 21 March 2012 on waste, which transposes Directives 2008/98/EC and 2018/851/EC into national law, provides the legal basis for the legal framework for the overall management of waste and resources in Luxembourg. In addition to protecting human health and the environment in product production and waste management, the focus is on improving the efficient use of materials and waste (cf. order of priority of the waste hierarchy, the principles of self-sufficiency and proximity and facilitating the transition to the circular economy). At the same time, the Waste Act establishes framework conditions for waste management, including national and local administration and responsibilities, as well as technical and legal aspects (polluter pays principle; REP pathways).</p> <p>The legal basis was thoroughly reformed in 2022 with the five 'Circular Economy Package' package with the main objectives of waste prevention and reduction, aiming to ensure that the transition from waste management to a circular economy is reflected in the legal framework. The ban on landfilling untreated municipal waste, which aims to reduce landfill gases (including methane) by 2030, is an important step in the climate reform. A new aspect is the extension of extended producer responsibility schemes. In order to improve resource management, the consumption of disposable plastic products is also reassessed.</p> <p>The National Waste and Resource Management Plan (PNGDR) is the operational tool. The PNGDR is a general document which defines the main lines of waste management policy. It specifies the objectives of waste management and the measures to achieve them. A revision of the PNGDR approved by the Government in 2018 is currently under way and will probably be completed in Q3 2024.</p>	
Type of policy instrument	Regulatory, Planning	
State of play	Implementation, Planified	
Start of implementing	End of implementation	Observations
2018	n.e.s.	A revision of the PNGDR is ongoing and will probably be completed in Q3 2024
Responsible entity/entities	MECB, AEV, MECO, MECO	
Reference (s)	National Waste and Resource Management Plan	
Info complementary	https://environnement.public.lu/dam-Assets/documents/offall_a_Resourcen/PNGD/plan/PNGD.pdf	

Name of measure	No 602 Support for a circular economy “Null Offall Lëtzebuerg”	
Description	The strategy is linked to the implementation of the EU directives of the circular economy package and is at the same time a strategic and political initiative to prioritise the objectives set out in the PNGDR. The waste policy objective is to promote the circular economy in order to preserve natural resources. Waste prevention, reuse and reuse should be implemented as a matter of priority before recycling. The strategy places particular emphasis on food waste prevention.	
Type of instrument	Regulatory, Planning	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2020	n.e.s.	
Responsible entity/entities	MECB, AEV	
Reference (s)	Null-Offfall Strategy	
Info complementary	https://luxembourg.public.lu/fr/societe-et-culture/developpement-durable/null-offall-strategie-recyclation-economy-circulaire.html	

Title of the measure	No 603 Circular Economy Strategy “Kreeslafwirtschaft Lëtzebuerg”	
Description	See measure 522	
Type of instrument		
State of progress		
Start of implementing	End of implementation	Observations
Responsible entity/entities		
Reference document (s)		
Info complementary		

Title of the measure	No 604 Incineration of waste	
Description	<p>The Syndicat Intercommunal for the management of waste from households and similar waste in the municipalities of the cantons of Luxembourg, Esch and Capellen (Sidor), which comprises 34 municipalities in central and southern Luxembourg, uses municipal waste energy and recovers energy (heat distributed to Leudelange and Gasperich/Cloche d'Or; electricity injected into public networks). The change in national waste legislation provides for a ban on landfilling of municipal waste from 1 January 2030. Until now, the Muertendall landfill has been used as the only landfill for municipal waste disposal in Luxembourg. In view of the future ban on landfilling municipal waste, SIGRE needs to restructure with reflections on a new concept for the future operation of the Muertendall site in order to compensate for the absence of fractions from municipal waste, which were previously accepted for landfilling on site. Municipal waste from SIGRE and SIDEC will have to be heat-treated by SIDOR. The installation, which was modernised in 2011, will require renovation work after 2030, inter alia in order to be able to accept these additional amounts of waste. The target groups are SIDOR municipal waste and in the medium term for the whole of Luxembourg.</p>	
Type of policy instrument	Regulatory, Economic	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
1976	n.e.s.	
Responsible entity/entities	MECB, AEV	
Reference (s)	Articles of association of the 'Association intercommunale de la gestion des déchets from households and similar waste in the municipalities of the cantons of Luxembourg, Esch and Capellen' set up by Grand-Ducal Decree of 18 June 1971	
Info complementary	https://www.sidor.lu/	

Title of the measure	No 605 Methane recovery systems	
Description	Methane recovery systems were installed in 2000 and 2 002 in the landfill sites of Muertendall (managed by SIGRE) and Fridhaff (managed by SIDEC). The gas captured on-site is either burned with the torch or used for the generation of electricity and heat (combustion in a cogeneration plant). For some time, the recovered gas has been decreasing in quality in such a way that it has to be burned with the torch. Gas recovery must be continued after the closure of the landfill (Fridhaff has been closed since 2015, Muertendall closure is planned for 2030).	
Type of instrument	Regulatory, Economic	
State of play	Implement	
Start of implementing	End of implementation	Observations
2020		
Responsible entity/entities	MECB, AEV	
Reference (s)		
Info complementary		

Name of measure	No 606 Valuation of greenery waste	
Description	Wood-rich waste is collected and stored separately for recovery as a fuel source in wood chips or biomass plants. Pollutants produced during combustion are filtered in the combustion gases. Outdoor burning of green waste is prohibited for health and environmental reasons and is the subject of legal proceedings, as laid down in the amended Waste Act of 21 March 2012 and the Grand-Ducal Regulation of 18 December 2015.	
Type of policy instrument	Regulatory	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2015	n.e.s.	
Responsible entity/entities	MECB, AEV	
Reference document (s)		
Info complementary		

Title of the measure	No 607 Valorisation of organic waste	
Description	Bio-waste is collected separately for the purpose of recycling organic substances and nutrients in composting or anaerobic digestion plants (biogas installations) with the use of biogas, followed by material recovery of the compost or ferment obtained. The network of biogas installations increased over the period 2010-2015 to reach 23 installations in 2023. In addition, several installations, including Minett-Kompost, were connected to the natural gas distribution network in accordance with the Order of 15 December 2011. The rates of separate collection of organic waste are increased in order to treat it in fermentation plants to increase biogas production.	
Type of instrument	Regulatory	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2011	n.e.s.	Linked to slurry (agriculture) and market premium (energy)
Responsible entity/entities	MECB, AEV	
Reference (s)		
Info complementary		

Title of the measure	No 608 Reduction of single-use materials	
Description	Directive (EU) 2019/904 is implemented as part of the EU circular economy package. The EU's ban and reduction of certain single-use plastic products results in the reduction of fossil greenhouse gas emissions when treating these single-use plastic products (e.g. incineration of these products in residual waste or as an alternative fuel). As a result of Directive (EU) 2019/904, the single-use plastic fraction is reduced in waste.	
Type of instrument	Regulatory	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2021	n.e.s.	
Responsible entity/entities	MECB, AEV	
Reference document (s)	Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment	
Info complementary		

Title of the measure	No 609 Discharge	
Description	<p>The modern landfill requirements of Directive 1999/31/EC on the landfill of waste, which aim to prevent or reduce environmental damage caused by the landfill of municipal waste, were transposed into national legislation by the Grand-Ducal Regulation of 24 February 2003, as amended and corrected by the Grand-Ducal Regulation of 17 February 2006. In order to reduce methane emissions, the reform of the national waste law provides for a ban on landfilling as of 2030. Half-time, in line with the national implementation of Directive 1999/31/EC on the landfill of waste, waste streams are subject to aerobic treatments prior to landfilling in order to accelerate their decomposition. This treatment has been applied systematically since 1993 by SIGRE in Muertendall. At SIDEC in Fridhaff, an installation was set up in 2007 (the SIDEC landfill is closed in the meantime). The landfilling of municipal waste is prohibited from 2030. Recycling of waste to reduce the amount of waste disposed of is increased by incineration with energy recovery.</p>	
Type of policy instrument	Regulatory	
State of play	Implementation	
Start of implementing	End of implementation	Observations
1993	2030	
Responsible entity/entities	MECB, AEV	
Reference (s)		
Info complementary		

Name of measure	No 610 Inert load	
Description	<p>Landfills in the Grand Duchy of Luxembourg are subject to the provisions of the amended Grand-Ducal Regulation of 24 February 2003 on the landfill of waste. In 2023, Luxembourg had 14 regional landfills for inert waste, of which 8 are large-scale backfill sites with a defined purpose (e.g. backfilling of an old quarry), which are assimilated to landfills.</p> <p>Chapter 4 of the Null Offall Strategie includes 4 Axes for the prevention and management of construction waste: designing buildings as material depots, promoting construction methods that avoid excavations, extending the utility cycle of buildings, creating markets for construction products and materials</p>	
Type of instrument	Planning, regulatory	
State of play		
Start of implementing	End of implementation	Observations
Responsible entity/entities	MECB, AEV	
Reference document (s)		
Info complementary		

Title of the measure	No. 611 Waste water management	
Description	Proper management of urban waste water requires that it is collected and transported to scrubbing stations under the best possible conditions. The construction of separate networks (wastewater and rainwater) will be an important measure for the coming years (SWW 9). In addition, sanitation works to protect water courses during rainfall periods are built, in particular with the establishment of storm ponds and rainwater retention basins (SWW 4 and SWW 5).	
Type of policy instrument	Regulatory, Planning	
State of play	Adopted	
Start of implementing	End of implementation	Observations
2022	2027	
Responsible entity/entities	MECB, AGE, Municipalities/Wastewater Unions	
Reference (s)	Amended Water Act of 19 December 2008; Management plan for the Rhine and Meuse River Basin Districts (Luxembourg parts) and the programme of measures (2021-2027)	
Info complementary	https://eau.gouvernement.lu/fr/administration/directives/Directive-cadre-sur-leau/3e-cycle-(2021-2027)/elaboration-du-3e-plan-de-gestion-document-final.html	

Title of the measure	No 612 Wastewater purification	
Description	<p>The primary objective of prioritising urban water management measures is to connect to a public biological treatment plant those localities which are not yet, i.e. those whose waste water is discharged into the natural receiving environment without purification or only after mechanical purification. Here, it may also be necessary to build a new biological treatment plant to replace one or more mechanical treatment plants (SWW 1: Construction of STEP) and to carry out measurements on the sewerage network (SWW 9: and SWW 4: Storm basin). Modernisation and extension of existing biological treatment plants (SWW 2: Extension/adaptation of STEP) is another priority to ensure adequate treatment of collected waste water in the future as well.</p>	
Type of policy instrument	Regulatory, Planning	
State of play	Implementation	
Start of implementing	End of implementation	Observations
2015	2021	
Responsible entity/entities	MECB, AGE, Municipalities/Wastewater Unions	
Reference document (s)	Amended Water Act of 19 December 2008; Management plan for the Rhine and Meuse River Basin Districts (Luxembourg parts) and the programme of measures (2015-2021)	
Info complementary	https://eau.gouvernement.lu/fr/administration/directives/Directive-cadre-sur-leau/2e-cycle-(2015-2021)/Plan-de-gestion-destricts-hydrographique/la-version-freeze.html	

Name of measure	No 613 Wastewater purification	
Description	Prioritising urban water management measures is primarily aimed at connecting all localities to a public biological treatment plant. This requires the replacement of mechanical scrubbing stations and their extension and modernisation. (SWW 1 and SWW2) In order to address the issue of micro-pollutants, equipping a quaternary level of treatment at the main scrubbing stations is a priority for the coming years. (SWW 11)	
Type of policy instrument	Regulatory, Planning	
State of play	Adopted	
Start of implementing	End of implementation	Observations
2022	2027	
Responsible entity/entities	MECB, AGE, Municipalities/Wastewater Unions	
Reference (s)	Amended Water Act of 19 December 2008; Management plan for the Rhine and Meuse River Basin Districts (Luxembourg parts) and the programme of measures (2021-2027)	
Info complementary	https://eau.gouvernement.lu/fr/administration/directives/Directive-cadre-sur-leau/3e-cycle-(2021-2027)/elaboration-du-3e-plan-de-gestion-document-final.html	

Title of the measure	No 614 Strategy for the recovery of sewage sludge	
Description	An integrated strategy for the treatment of sewage sludge is developed to ensure safe disposal/recovery and to respond to the constant increase in sludge volume. Decentralised fluidified bed processing plants are planned and built, while strengthening the cooperation of all actors to ensure management at national level.	
Type of policy instrument	Planning	
State of progress	Scheduled	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MECB, AEV, AGE, Municipalities/Wastewater Unions	
Reference (s)		
Info complementary		

3.1.1.6 agriculture

Title of the measure	No 701 Aid for the reduction of livestock load	
Description	This intervention encourages a reduction in the cattle population on the holding. Fewer animals also mean less methane emissions during digestion, as well as less manure and manure. This measure contributes to improving the fodder autonomy of the Union.	
Type of instrument	ØEconomy	
State of play	Implementation	
Start of implementing	End of implementation	Observations
2023	n.e.s.	CAP (2023-2027)
Responsible entity/entities	MAAV, SER	
Reference (s)	NSP – Intervention code: 2.02.550 (measure 550)	
Info complementary	https://agriculture.public.lu/de/beihilfen/agrar-umwelt-und-klimamassnahmen/beihilfe-reducierung-rinderbestand.html	

Name of measure	No 702 Aid to promote the use of food additives to reduce methane emissions from digestion	
Description	This intervention promotes the use of food additives primarily in dairy cows with the aim of reducing methane emissions from digestion. The first food additives are expected to be authorised soon. However, before introducing this measure, it must be ensured that the use of such products is authorised and that the reduction is proven, without, however, adversely affecting animal health and welfare or causing harmful effects on the environment.	
Type of instrument	ØEconomy	
State of progress	Under analysis	
Start of implementing	End of implementation	Observations
		Implementation after 2024
Responsible entity/entities	MAAV, SER	
Reference document (s)		
Info complementary	In February 2022, the use of such an additive was recognised in the EU for dairy cows (Daily News 23/02/2022 (europa.eu)).	

Name of measure	No 703 Aid for the conversion and maintenance of organic farming	
Description	The objective of the intervention is to promote and promote organic agricultural production. This type of agriculture renounces the use of mineral fertilisers. Organic production follows the principle of a circular system. Extensive rotations with sowing protein crops or grassland, as well as the input of organic matter into the soil, contribute to carbon sequestration.	
Type of policy instrument	ØEconomy	
State of progress	Implement	
Start of implementing	End of implementation	Observations
1997	n.e.s.	Included in PAC since 1996, __DUMMY__ adapted conditions from 2021
Responsible entity/entities	MAAV, SER	
Reference (s)	NSP – Intervention code: 2.02.543 (measure 543)	
Info complementary	https://agriculture.public.lu/de/beihilfen/agr-ar-umwelt-und-klimamassnahmen/beihilfe-biologische-landwirtschaft.html	

Title of the measure	No 704 Aid for injection of manure and composting of manure	
Description	<p>This measure allows improvements in ammonia and nitrous losses as well as better recovery of organic materials as a result of the use of special processing and spreading equipment. Through direct burial, prior composting respectively, the actions contribute significantly to a reduction in ammonia emissions and as a consequence of indirect N₂O. The technique of composting manure represents different environmental benefits. Among other things, the urea and ammoniacal nitrogen contained in the manure is re-incorporated into the microbial mass. The losses of land application are practically zero, as the nitrogen of compots is almost entirely present in organic, non-volatile form. Although this measure aims to reduce air emissions, a better use of livestock manure is also a consequence of this measure.</p>	
Type of policy instrument	Economic	
State of play	Implementation	
Start of implementing	End of implementation	Observations
2002	n.e.s.	CAP: from 2002; conditions adapted from 2020 onwards; and conditions readjusted from 2023/24 following the strengthening of certain provisions of the Nitrates Regulation (see No 709)
Responsible entity/entities	MAAV, SER	
Reference (s)	NSP – Intervention code: 2.02.544 (measure 544)	
Info complementary	https://agriculture.public.lu/de/beihilfen/agrar-umwelt-und-klimamassnahmen/beihilfe-jaucheausbringung-kompostierung-mist.html	

Title of the measure	No 705 Aid for manure incorporation (eco-scheme)	
Description	With this measure, the farmer undertakes to incorporate manure within four hours of spreading. Rapid incorporation after spreading allows improvements in ammonia and nitrous losses, especially in fresh manure. It also makes it possible to make better use of manure and consequently to reduce indirect N ₂ O emissions. Although this measure aims to reduce air emissions, a better use of livestock manure is also a consequence of this measure.	
Type of policy instrument	ØEconomy	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2023	n.e.s.	CAP (2023-2027)
Responsible entity/entities	MAAV, SER	
Reference (s)	NSP – Intervention code: 1.02.518 (measure 518)	
Info complementary	https://agriculture.public.lu/de/beihilfen/oeko-regelungen/zeitnahe-einarbeitung-mist.html	

Title of the measure	No 706 Prime for sustainable and environmentally-friendly agriculture	
Description	The aim of this programme is to motivate the vast majority of farmers to put in place elements of the landscape structure, to apply best farming practices and to promote sustainable agriculture. Commitment for the entire area of the holding. The new premium (applicable from 2023) sees tighter conditions such as, for example, a reduction of the bovine load to 1,8 LU/ha instead of 2 LU/ha or the introduction of the residual nitrogen limit of 100 kg Nmin after the maize harvest.	
Type of instrument	ØEconomy	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
1996	n.e.s.	CAP: from 1996; adapted conditions from 2023
Responsible entity/entities	MAAV, SER	
Reference document (s)	NSP – Intervention code: 2.02.540 (measure 540)	
Info complementary	https://agriculture.public.lu/de/beihilfen/agrar-umwelt-und-klimamassnahmen/foerderpraemie-einstieg-nachhaltige-umweltfreundliche-landwirtschaft.html	

Name of measure	No 707 Agricultural investment aid – Agricultural/wine-growing and horticultural machinery and equipment	
Description	The aid shall be limited to innovative machinery and equipment, machinery which has a positive impact on water protection, is energy efficient or contributes to the protection of the environment. An example for innovative machinery is the special equipment for spreading environmentally friendly manure, which helps to reduce ammonia but also to better use organic fertilisers.	
Type of policy instrument	ØEconomy	
State of progress	Implement	
Start of implementing	End of implementation	Observations
1986	n.e.s.	Aid regularly adapted since 1986; adapted conditions from 2021
Responsible entity/entities	MAAV, ASTA	
Reference (s)	NSP – Intervention code: 2.04.712 Law of 2 August 2023 on support for the sustainable development of rural areas; Article 22	
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2023/08/02/a489/jo An increase of 10 percentage points shall be paid for the purchase of an electric traction vehicle;	

Name of measure	No 708 Agricultural investment aid – Fixed buildings and installations – Aid for modernisation, innovation or development investments in the processing and marketing of agricultural products	
Description	<p>Agriculture: The objective of the measure is to promote multifunctional, sustainable and competitive agriculture that is respectful of animal welfare, environmental protection and climate. Future livestock buildings must be at the forefront of animal welfare and environmental technology. More environmentally-friendly settlements help to reduce emissions of greenhouse gases and air pollutants. For investments in immovable property, a holistic analysis of the investment project is required (technical, agricultural, environmental, authorisation, financing).</p> <p>Processing and marketing of agricultural products: The objective of the measure is to increase the processing rate of local production and to improve the efficiency of production lines. For investments made as part of a carbon reduction approach, the aid rate shall be increased by 5 percentage points.</p>	
Type of instrument	ØEconomy	
State of play	Implementation	
Start of implementing	End of implementation	Observations
1986	n.e.s.	Aid regularly adapted since 1986; adapted conditions from 2023
Responsible entity/entities	MAAV, ASTA	
Reference (s)	NSP – Intervention code: 2.04.712 Law of 2 August 2023 on support for the sustainable development of rural areas; Article 21 Processing and marketing of agricultural products: Law of 2 August 2023 on support for the sustainable development of rural areas; Article 33	
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2023/08/02/a489/jo	

Title of the measure	No 709 Legal framework for the use of nitrogen fertilisers in agriculture	
Description	This measure prescribes the reduction of fertiliser use on arable land, grassland and pasture, as well as the application and storage techniques to be followed. Although the aim of the regulation is to reduce water pollution, a reduction in air emissions is also a consequence of that regulation. More stringent measures are in force in the drinking water protection zones delimited in accordance with Article 44 of the amended Water Act, covering around 17 % of the national territory. Certain provisions of the Nitrates Regulation are being strengthened, in particular with a view to transposing the NEC Directive (reduction of national emissions of certain atmospheric pollutants).	
Type of instrument	Regulatory	
State of progress	Planned	
Start of implementing	End of implementation	Observations
2025	n.e.s.	Implementation of the Nitrates Directive since 2000; adaptation of certain provisions of the Nitrates Regulation planned for 2025
Responsible entity/entities	MECB, AGE, AEV, ASTA	
Reference (s)	Amended Grand-Ducal Regulation of 24 November 2000 concerning the use of nitrogen fertilisers in agriculture. Amended Grand-Ducal Regulation of 9 July 2013 (a) on administrative measures in all protection areas for bodies of groundwater or parts of bodies	
Info complementary	https://legilux.public.lu/eli/etat/leg/rgd/2000/11/24/n5/jo	

Name of measure	No 710 Agricultural Council	
Description	The aim of this measure is to help farmers apply for support from advisory bodies that help them to find the best possible solutions for their farm based on their expertise. The range of advice proposed is very broad, ranging from the establishment of manure plans, arable crops/permanent grassland, feeding, optimising food rations and keeping animals; as well as monitoring of the holding agricultural for reachthe objectives climatic and environmental, etc. Less nitrogen inputs; appropriate nutrition, reduced nitrogen feed and improved herd management are examples that help to reduce greenhouse gas emissions.	
Type of instrument	Information	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2016	n.e.s.	Adapted conditions from 2020
Responsible entity/entities	MAAV	
Reference (s)	Ministerial Regulation of 28 February 2020 laying down the content of the advisory modules in the field of agriculture, the rate of aid and the maximum amount of aid and the minimum qualifications of providers	
Info complementary	https://legilux.public.lu/eli/etat/leg/rmin/2023/03/14/a195/jo	

Title of the measure	No 711 Legal framework for capping the number of head of livestock per holding	
Description	<p>This measure creates a legal framework to cap the number of head of livestock per holding based on AWU ('work units').</p> <p>As animal livestock has been identified as the main source of ammonia emissions from the agricultural sector, the Ministry intends to avoid a meticulous increase in the livestock population. Thus, in addition to the aid made available for the voluntary commitment of the agricultural sector to reduce emissions from the agricultural sector (ammonia, greenhouse gases, etc.), the legislature supplemented this approach with a livestock control system which provides for:</p> <ul style="list-style-type: none"> — to subject to prior authorisation from the Minister any increase in livestock which has the effect of increasing livestock production on the holding to more than two theoretical annual work units; — the authorisation is subject to compliance with reference values for specific indicators related to nitrogen management on the farm; and — to refuse an authorisation for an increase in livestock which has the effect of bringing livestock production on the holding to more than five annual work units. <p>In the short term, this measure means that the number of head of livestock will no longer be able to increase indefinitely and in the medium and long term it will lead to a reduction in national livestock, and will therefore contribute substantially to a reduction in greenhouse gases and air emissions, including ammonia.</p>	
Type of instrument	Regulatory	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2023	n.e.s.	
Responsible entity/entities	MY	
Reference (s)	Law of 2 August 2023 on support for the sustainable development of rural areas; Article 6. — Article 8	
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2023/08/02/a489/jo	

3.1.1.7 LULUCF

Title of the measure	No. 801 Forestry – forest management	
Description	This group includes all measures implemented or planned to optimise forest management. (see details in individual assumptions).	
Type of policy instrument	Regulatory	
State of progress	Implement	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MECB, ANF	
Reference (s)	Act of 23 August 2023 on Forests; Law of 18 July 2018 on the protection of nature and natural resources; 2th (2017-2021) and 3th (2023-2030) National Plan for Nature Protection	
Info complementary		

Title of the measure	No 802 Protection of total forest area	
Description	Article 13 of the Law of 18 July 2018 on the protection of nature and natural resources aims to protect existing carbon stocks in forests. Clearing is prohibited without prior authorisation and without compensation by afforestation of new forest areas. No change in the use of forest funds shall be permitted, unless authorised by the Minister, in the public interest, with a view to its replacement by the creation of a protected or habitat biotope within the meaning of Article 17 with a view to modifying the delimitation of the green area with a view to restructuring the agricultural parcel. Offsetting deforestation by afforestation of a forest of the same quality and area.	
Type of policy instrument	Regulatory	
State of play	Implementation	
Start of implementing	End of implementation	Observations
2018	n.e.s.	
Responsible entity/entities	MECB, ANF	
Reference document (s)	Law of 18 July 2018 on the protection of nature and natural resources.	
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2023/08/23/a544/jo	
	https://legilux.public.lu/eli/etat/leg/loi/2018/07/18/a771/consolide/20231001	

Title of the measure	No 803 Establishment of free-flowing forests without timber harvesting	
Description	<p>Article 17 of the Law of 23 August 2023 requires strict protection (no wood harvesting) of 5 % of public forest properties of more than 100 ha. This will lead to an additional strict protection of 2 000 ha of forest (currently 1 250 ha). This measure will be implemented as part of forest management plans.</p> <p>In the short term, this will lead to an increase in deadwood and thus an increase in carbon stock in the forestry sector. On the other hand, this measure reduces the total wood harvesting potential and the substitution effect for building materials or energy sources.</p>	
Type of policy instrument	Regulatory	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2022	n.e.s.	
Responsible entity/entities	MECB, ANF	
Reference (s)	Act of 23 August 2023 on Forests	
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2023/08/23/a544/jo	

Name of measure	No 804 Establishment of strictly protected areas in public forests with limited timber harvesting	
Description	<p>In line with the European Biodiversity Strategy, the PNP3 aims to protect 30 % of the national territory, of which 10 % is strictly protected (including all primary and virgin forests).</p> <p>This means that the PNP3 aims to create a network of forest protected areas (forest reserves) of a minimum of 30 % of all forests and 10 % of strictly protected forests. The objective is to increase the area of undisturbed forest areas, with limited exploitation. The PNP3 aims to designate an additional 7.500 ha of forest reserves (10.000 ha by 2030). In addition to these forest reserves, 10 % of forests are to be protected in the form of integral forest reserves, i.e. without any intervention.</p> <p>In the short term, this will lead to an increase in deadwood and thus an increase in carbon stock in the forestry sector. On the other hand, this measure reduces the total wood harvesting potential and the substitution effect for building materials or energy sources. Increase of Protected Areas of National Interest (ZPIN).</p>	
Type of instrument	Voluntary agreement	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2023	2030	
Responsible entity/entities	MECB, ANF	
Reference (s)	3th national plan on nature protection (2023-2030)	
Info complementary	https://environnement.public.lu/content/dam/environnement/documents/nature/Biodiversity/PNPN/pnbn-version-3.pdf	

Name of measure	No 805 Conservation of high biodiversity trees and deadwood in productive forests	
Description	<p>For private forest owners, conservation of high biodiversity trees and deadwood is subsidised through GDR 03/03/2022 in Article 19 (preservation of dead trees in the soil) and Article 17 (preservation of biotopes and standing dead trees).</p> <p>For public forests, the Law of 23 August 2023 on forests states in Article 33 that the principles of close-to-nature forestry are to be applied and include the conservation of dead trees, the conservation of trees of biological interest and the conservation of ageing islands. Increased conservation of high biodiversity trees and deadwood.</p>	
Type of policy instrument	Regulatory	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2023	n.e.s.	
Responsible entity/entities	MECB, ANF	
Reference (s)	Grand-Ducal Regulation of 3 March 2022 establishing a series of aid schemes for improving the protection and sustainable management of forest ecosystems	
Info complementary	RGD 03/03/2022: https://legilux.public.lu/eli/etat/leg/rgd/2022/03/03/a111/jo	

Title of the measure	No 806 Limitation of harvest levels in vulnerable public natural forest ecosystems	
Description	The PNPN3 and the public forest management rules require that wood harvesting in public folio forests be limited to 80 % of the increase for carbon sequestration and storage and to 60 % in climate broadleaved stands of public forests in order to enhance their resilience. This limitation currently applies to all public beech forests, accounting for 22 % of Luxembourg's total forest area (18.500 ha). This will lead to an increase of 3 m ³ of wood per hectare per year in these forests and should at least compensate for natural degradation by the impacts of climate change.	
Type of instrument	Voluntary agreement	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2023	2030	
Responsible entity (ies)	MECB, ANF	
Reference (s)	3th national plan on nature protection (2023-2030)	
Additional information	https://environnement.public.lu/content/dam/environnement/documents/natur/biodiversite/PNPN/pnnpn-version-3.pdf	

Title of the measure	No 807 Increased use of wood, derived from forests, as building material	
Description	<p>Article 38 of the Law of 23 August 2023 provides that a Grand-Ducal Regulation lays down the rules applicable to the sale of wood from public forests. The GDR of 25 September 2023 sets out all the measures applicable to the sale of wood from public forests.</p> <p>In addition, a platform called e-Holzhaff is being set up to facilitate the matching of supply and demand of stakeholders in the wood sector in Luxembourg.</p> <p>Only the sale of wood in Luxembourg and remaining in Luxembourg can be considered. A wood cluster study estimated that 25 % of the wood sold is used as material. This percentage could reach a maximum of 50 %.</p>	
Type of instrument	Regulatory	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2022	n.e.s.	
Responsible entity/entities	MECB, ANF	
Reference (s)	Grand-Ducal Regulation of 25 September 2023 on the sale of wood from public forests https://legilux.public.lu/eli/etat/leg/rgd/2023/09/25/a615/jo	
Info complementary	https://www.e-holzhaff.lu/de/produits	

Title of the measure	No 808 Sustainable forest management of public forests	
Description	Article 19 of the Law of 23 August on forests that public forest management is based on the principles of sustainable forest management. The RDG of 25 September 2023 defining the principles of close-to-nature forestry to be applied in public forests defines these principles and will replace the ministerial circular of 3 June 1999. However, for more than 15 years, the administration of nature and forests has already applied the principles of close-to-nature forestry described in the GDR of 25 September 2023. These principles include, inter alia, the preservation of mature and dead trees, avoiding monoculture and clear-cutting, etc.	
Type of instrument	Regulatory	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
1999	n.e.s.	
Responsible entity/entities	MECB, ANF	
Reference (s)	Helsinki Resolution (guideline H1) 1993 Act of 23 August 2023 on Forests https://legilux.public.lu/eli/etat/leg/loi/2023/08/23/a544/jo Grand-Ducal Regulation of 25 September 2023 laying down the principles of close-to-nature forestry to be applied in public forests https://legilux.public.lu/eli/etat/leg/rgd/2023/09/25/a618/jo	
Info complementary	https://www.europarl.europa.eu/workingpapers/agri/eurfo146_fr.htm https://www.foresteuropa.org/docs/MC/MC_helsinki_resolutionH1.pdf	

Title of the measure	No 809 Aid schemes for sustainable management of private forests	
Description	<p>Subsidies are granted to private owners of forest funds in the Grand-Ducal Regulation of 16 April 2021 introducing a premium for the provision of ecosystem services in forests. In that regulation, a premium, known as 'Klimabonus Bësch', is introduced for the management of areas with protected forest biotopes or habitats of Community interest.</p> <p>Subsidies are also provided for in the Grand-Ducal Regulation of 3 March 2022 establishing a series of aid schemes to improve the protection and sustainable management of forest ecosystems. Subsidies are granted for natural regeneration, the maintenance of young stands, the first selective thinning, the removal of wood using the horse or by cable, conversion into free-flowing forests, the preservation of biotope trees and standing dead trees, the conservation of ageing islands in forests, the restoration of the forest ecosystem through afforestation of agricultural land, the preservation of trees dead on the ground and reforestation by species selection and the mixing of species.</p> <p>The share of deadwood will increase by 20 % compared to 2 020 in 2040.</p>	
Type of policy instrument	ØEconomy	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2023	n.e.s.	
Responsible entity/entities	MECB, ANF	
Reference (s)	Grand-Ducal Regulation of 3 March 2022 establishing a series of aid schemes for improving the protection and sustainable management of forest ecosystems	
Info complementary	https://legilux.public.lu/eli/etat/leg/rgd/2022/03/03/a111/jo	

Title of the measure	No 810 Aid for agroforestry on agricultural land	
Description	The aim of this measure is to develop agroforestry in all its forms: intra- parcellar, bocage, sylvo-pastoralism, etc. It consists of 3 axes of action: Intercropping wood and fruit trees, woody short rotation intercropping, woody strips. The measure shall be accompanied by actions, advisory monitoring and research on agroforestry.	
Type of instrument	Regulatory, Economic, Information, Education, Research	
State of play	Implementation	
Start of implementing	End of implementation	Observations
2024	n.e.s.	
Responsible entity/entities	MAAV, MECB, SER, ANF, Our Natural Park	
Reference document (s)		
Info complementary	https://agriculture.public.lu/de/beihilfen/agrar-umwelt-und-klimamassnahmen/foerderpraemie-entwicklung-agroforst-systeme	

Title of the measure	No 811 Aid for the installation of catch crops and undersowing	
Description	This measure has positive effects on soil management and has a strong influence on the evolution of nitrate levels in soil, as it helps to combat nitrate erosion and leaching, as well as the input of organic matter into the soil, contribute to carbon sequestration.	
Type of policy instrument	ØEconomy	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2002	n.e.s.	Included in PAC since 2002; adapted conditions (2023-2027)
Responsible entity/entities	MAAV, SER	
Reference (s)	NSP – Intervention code: 1.02.515 (measure 515)	
Info complementary	https://agriculture.public.lu/de/beihilfen/oeko-regelungen/anbau-zwischenfruechten-untersaaten.html	

Title of the measure	No 812 Aid for the conversion of arable land into permanent grassland	
Description	The primary effect of this intervention is to avoid at least nitrate leaching and soil erosion. A side effect is carbon sequestration in soil (Conversion arable in grassland for 5 years (maintenance of arable status)).	
Type of instrument	Economic	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
1997	n.e.s.	Included in PAC since 1997; adapted conditions (2023-2027)
Responsible entity/entities	MAAV, SER	
Reference (s)	NSP – Intervention code: 2.02.551 (measure 551)	
Info complementary	https://agriculture.public.lu/de/beihilfen/agrar-umwelt-und-klimamassnahmen/beihilfe-umwandlung-ackän-dauergruenland.html	

Name of measure	No 813 Aid to promote crop rotation and diversification on arable land	
Description	The introduction of aid to promote crop rotation with the possibility of intercalating temporary grassland is envisaged. Temporary grasslands are particularly effective in sequestration of organic carbon in soils.	
Type of instrument	ØEconomy	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2015	n.e.s.	Adapted conditions (2023-2027)
Responsible entity/entities	MAAV, SER	
Reference document (s)	Intervention code: 3.02.548	
Info complementary	https://agriculture.public.lu/de/beihilfen/agr-ar-umwelt-und-klimamassnahmen/beihilfe-fruchtfolge-diversifizierung-ackerkulturen.html	

Title of the measure	N° 814 Prime for sustainable and environmentally-friendly agriculture (Viticulture)	
Description	The measure aims to promote integrated vine production, in particular to reduce the impact of vine cultivation on water, the environment and the climate. (in the past: maintenance of the landscape and the countryside (Peen) – Viticole sector). Thus, grasslands are promoted, which represents a commitment for the entire area of the holding.	
Type of instrument	ØEconomy	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
1996	n.e.s.	Included in PAC since 1996; adapted conditions (2023-2027)
Responsible entity/entities	MAAV, SER	
Reference (s)	NSP – Intervention code: 2.02.542 (measure 542)	
Info complementary	https://agriculture.public.lu/de/beihilfen/agr-ar-umwelt-und-klimamassnahmen/foerderpraemie-einstieg-nachhaltigen-umweltfreundlichen-weinbau.html	

Title of the measure	No 815 Aid to promote reduced tillage	
Description	The intervention aims to support direct sowing or reduced tillage in order to positively influence soil structure, erosion prevention and soil biological fertility. As these practices are also more energy-efficient than other tillage practices, they also contribute to the reduction of CO ₂ emissions.	
Type of instrument	ØEconomy	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2002	n.e.s.	Included in PAC since 2003
Responsible entity/entities	MAAV, SER	
Reference (s)	NSP – Intervention code: 2.02.549) (measure 549)	
Info complementary	https://agriculture.public.lu/de/beihilfen/agrar-umwelt-und-klimamassnahmen/beihilfe-eliminzierte-bodenbearbeitung.html	

Title of the measure	No 816 Aid for the conversion and maintenance of organic farming (MFA)	
Description	The objective of the intervention is to promote and promote organic agricultural production. This type of agriculture renounces the use of mineral fertilisers. Organic production follows the principle of a circular system. Extensive rotations with sowing protein crops or grassland, as well as the input of organic matter into the soil, contribute to carbon sequestration.	
Type of instrument	ØEconomy	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
1997	n.e.s.	CAP: from 1997; adapted conditions from 2021
Responsible entity/entities	MAAV, SER	
Reference (s)	NSP – Intervention code: 2.02.543 (measure 543)	
Info complementary	https://agriculture.public.lu/de/beihilfen/agrar-umwelt-und-klimamassnahmen/beihilfe-biologische-landwirtschaft.html	

Title of the measure	No 817 Aid for the installation of non-productive areas	
Description	The objective of the measure is to promote sustainable development and efficient management of natural resources such as water, soil and air. This measure has positive effects on soil management and has a strong influence on the evolution of nitrates in soils by combating nitrate erosion and leaching, as well as the input of organic matter into the soil, contribute to carbon sequestration.	
Type of instrument	ØEconomy	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2023	n.e.s.	CAP (2023-2027)
Responsible entity/entities	MAAV, SER	
Reference document (s)	NSP – Intervention code: 1.02.512 (measure 512)	
Info complementary	https://agriculture.public.lu/de/beihilfen/oeko-regelungen/anlage-nicht-productive-flaechen.html	

Name of measure	No 818 Aid for the installation of non-productive strips	
Description	The objective of the measure is to encourage the development of extensive bands along structural elements of the landscape, as well as other biotopes, at critical locations in terms of erosion and along watercourses. This measure has positive effects on soil management and has a strong influence on the evolution of nitrates in soils by combating nitrate erosion and leaching, as well as the input of organic matter into the soil, contribute to carbon sequestration.	
Type of instrument	ØEconomy	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
1997	n.e.s.	CAP: from 1997; CAP adapted conditions (2023-2027)
Responsible entity/entities	MAAV, SER	
Reference (s)	NSP – Intervention code: 1.02.513 (measure 513)	
Info complementary	https://agriculture.public.lu/de/beihilfen/oeko-regelungen/anlage-nicht-produktive-streifen.html	

Title of the measure	No 819 Urban land – Urban soil change, vegetation supports, in stable organic carbon to maximise their carbon stocks	
Description	<p>This measure aims to use urban green space soils as a reservoir of organic carbon by increasing their organic carbon content, without compromising their quality or causing environmental problems. In order to achieve this objective, it is suggested to achieve a significant change in stable organic carbon in existing soils or when introducing new green spaces.</p> <p>This measure is based on three complementary axes: (I) encourage managers and installers of public and private urban green spaces to amend existing soils or to build new soils enriched with stable organic carbon, (II) provide managers and creators of green spaces with a technical framework to maximise soil carbon stocks while maximising environmental co-benefits and (III) to regulate the production and marketing of stable forms of organic carbon (e.g. biochar, certain organic waste) compatible with the objectives of the measure: climate interests, agronomic interests and environmental and health innovation. Axis I could take the form of a new measure included in the Climate Pact, in particular in Part 3.3 Sustainable water supply and management, Subpart 3.3.2 Green space management, giving entitlement to a certain number of points when a certain amount of carbon is stored in green space soils.</p> <p>Axis II could take the form of a technical guide for managers and creators of green spaces with the technical provisions to be complied with in order to achieve the objectives of the measure.</p> <p>Axis III could take the form of an adaptation of legislation on waste and/or organic improvers to allow and regulate the use of stable organic materials to be used (biochar, stable organic waste).</p>	
Type of instrument	Voluntary agreement, research, regulation	
State of play	Under analysis	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MECB, AEV, Communes	
Reference (s)		
Info complementary		

Title of the measure	No 820 urbanised land – Prohibition of the installation of mineral cutlery for aesthetic purposes ('gravel gardens') and encouraging the conversion of existing gravel gardens	
Description	<p>The objective of the measure is to prevent land take which is considered unnecessary from the point of view of development, of the soil of the parcels accompanying private or public buildings, by maintaining or installing functional soil and permanent vegetation cover. Functional and vegetated soils will then be able to deliver much more efficiently compared to mineral soils, ecosystem services for regulating the global climate (organic carbon sequestration) and local (combating urban heat islands) and supporting biodiversity in and on the soil. The installation of a functional floor may be carried out in accordance with measure 819.</p> <p>The ban on the installation of mineral cutlery would be considered to be complied with when the surface from covered mineral this is parcel building support is less than a surface area or percentage to be defined of the accompanying parcel, excluding areas dedicated to parking vehicles. The measure could be integrated into the GAP or PAP or in the rules governing buildings in municipalities and would apply in the case of development or refurbishment requiring a building permit.</p> <p>Encouraging the conversion of mineral cover to permanent vegetation could take the form of a new measure included in the Climate Pact, in particular in Part 3.3 Sustainable water supply and management of green spaces, Subpart 3.3.2 Management of green spaces, or in the Nature Pact, giving entitlement to a number of points. It could also take the form of a subsidy distributed by the municipality. The measure would be considered to be complied with if the perennial vegetation area exceeds a percentage to be defined of the accompanying parcel, excluding the area dedicated to parking vehicles.</p> <p>The measure should promote the establishment of the largest possible vegetation cover, namely at least herbaceous vegetation cover and a maximum of tree vegetation cover, with an intermediate level consisting of tree vegetation cover.</p>	
Type of instrument	Regulatory	
State of progress	Under analysis	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MECB, AEV, Communes	
Reference (s)		

Info complementary	
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Title of the measure	No 821 urbanised land – Production of urban abandoned areas with the aim of producing non-food biomass (productive landscape)	
Description	<p>The objective of the measure is threefold: (a) installing perennial tree (e.g. miscanthus) or tree vegetation cover (hedges, very short wilt coppice, poplar) on urban stranded areas (e.g. plots accompanying industrial, commercial or transport installations, industrial and urban brownfield sites, former covered landfills) to greenurban and peri urban areas (measure 2.7. of PNPN3), (b) produce plant biomass through the maintenance and extensive exploitation of these areas based on coherent landscape management, (c) use the plant biomass produced to produce energy (biomass plant) and, where possible, green H₂ and biochar through the pyrolysis process. Biochar could then be used to implement measure 819.</p> <p>The implementation of this measure is based on 3 axes: (I) identify stranded areas with significant potential for implementing this measure, (II) remove regulatory and technical constraints to put stranded areas into production, and (III) encourage managers in stranded areas to put them into production.</p> <p>Axis I could take the form of a map identifying the abandoned areas and their potential for putting them into production.</p> <p>Axis II could take the form of a dedicated Grand-Ducal Regulation or an amendment of the legislation in force for the regulatory part and a technical guide to provide technical solutions.</p> <p>Axis III could take the form of a new measure included in the Climate Pact.</p>	
Type of instrument	Research, Regulation	
State of play	Under analysis	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MECB, AEV, ANF, MECO, Communes	
Reference document (s)		
Info complementary		

Name of measure	No 822 Aid schemes for ecosystem services of marshes and other wetlands of private owners (“Klimabonus-Mouer”)	
Description	<p>Different ecosystems play a key role for the environment and ecosystem services largely benefit society as nature-based solutions. Marshes, marshes, reeds, meadows and other wetlands absorb and store a lot of carbon and are a cradle of biodiversity. As provided for in the 2023-2028 coalition agreement, the Government will introduce an additional subsidy programme to support private owners in implementing measures to enhance biodiversity on their land, such as the capture and organic sequestration of CO₂. By actively supporting land owners for the preservation and creation of marshes, marshes, reeds, meadows and other wetlands through the establishment of a subsidy system, the Government will contribute to improving ecological connectivity. This will enable wetlands to fully deliver their ecosystem services by regulating the water regime, thus contributing to flood protection and limiting the effects of droughts.</p> <p>Like subsidies granted to private owners of forest funds via Grand-Ducal Regulation, a bonus, known as ‘Klimabonus-Mouer’, will be introduced for the conservation of areas with protected biotopes or habitats of Community interest linked to these wetlands.</p>	
Type of instrument	ØEconomy	
State of progress	Planned	
Start of implementing	End of implementation	Observations
2025/2026	n.e.s.	
Responsible entity/entities	MECB, ANF, AEV, AGE	
Reference (s)	Coalition agreement 2023-2028	
Info complementary		

Regarding the situation and progress to ensure reinforcements to higher levels/geolocated datasets, Luxembourg uses the 3 approach for land representation, based on geolocalised land use change data. The country has a large set of land use data, with a first map on land cover and land use already available for 1989. Subsequent updates were made in 1999, 2015, 2007, 2012, 2018 and 2021, thus ensuring a dense time series. Luxembourg has planned a three-year update cycle of national land cover and land use maps.

The methodology for exploiting geographically explicit data has been developed by space4environment (Kleeschulte et al. 2021, <https://download.data.public.lu/resources/changement-daffection-des->

terres/20220520-151041/lulucf-final-report-i1.0.pdf). This method involves the use of a 50 m grid point describing the LULUCF category for the reference years from 2021 to 1989. The approach works well with the available data and is open to the inclusion of additional ancillary information, such as that mentioned in Annex V to Regulation (EU) 2018/1999.

In addition, Luxembourg is developing a methodology to include agricultural management practices in its next inventory. Data on agricultural management practices are extracted from the Land Parcel Identification System (FLIK) and are also geographically explicit.

3.1.2 Renewables

The Government wishes to strengthen the momentum in the development of renewable energies, with a target rising from 25 to 37 % by 2030 following initiatives at European level, be it the Green Deal, the Fit for 55, REPowerEU and the revision of the Renewable Energy Directive, in order to reduce dependence on fossil fuels more effectively.

This heading therefore includes policies and measures to achieve this ambitious target, based in particular on two key technologies, namely wind (measure 224) and photovoltaic (measures 205 to 213), but also by creating a favourable framework for the deployment of renewable energy (measures 201 and 202), whether by facilitating procedures (measures 203 and 204) or by promoting other renewable energy sources such as biogas (measures 214 and 215), hydrogen (measures 216, 217 and 218), including biomass which over the last years has contributed to the development of renewable energy in the national territory.

In the field of renewable heating and cooling, a number of measures are planned, such as the facilitation of renewable district heating/cooling (measure 222) and geothermal energy (measure 223) or the promotion of renewable hydrogen (measures 216 to 218).

In addition to national efforts, mention should also be made of European cooperation in the form of the European renewable energy financing mechanism (measure 220) and statistical transfers (measure 221), which remains an essential pillar in achieving the 2030 target.

Title of the measure	No 201 Remuneration for electricity from renewable energy sources	
Description	<p>The main objective of this measure is to create a favourable framework for the continued deployment of renewable energy in view of the objectives set out in Directive 2018/2001, respectively its amendment by means of various operational aid instruments, in order to increase the share of renewable energy sources in the electricity and heat sector with a view to decarbonising the energy system. The regulatory framework is the amended Grand-Ducal Regulation of 1 August 2014 on the production of electricity based on renewable energy sources, which determines inter alia the connection to the electricity grid and the supply of electricity, the system of guarantees of origin and guaranteed remuneration (operational aid) in the form of feed-in tariffs or market premiums for electricity produced from wind, solar or hydroelectric power, biogas, sewage treatment plant gas, solid biomass and scrap wood. Wage levels vary depending on the renewable energy source and the electrical power of the installation. They are guaranteed for a period of 15 years from the date of first injection into the electricity grid. In addition, heat premiums for co-generated marketed heat and a slurry premium, which will be reformed through the biogas strategy with a focus on manure (measure 215), are planned. The Regulation also provides for the organisation of tenders for large-scale PV installations (measure 206). The last major adaptations of the Regulation were: (a) The extension of the circle of beneficiaries of tariffs for photovoltaic power stations of between 30 and 200 kW to all natural and legal persons (before only cooperative and civil societies; EN 2020); (b) Adjustment of tariffs for large biomass and discarded wood plants due to market developments (2022); (c) For 2023: suspension of pay slip due to surge in prices (2022); (D) Increase in tariffs for biogas plants to revitalise the sector. The costs of operational aid for renewable energy are compensated through the compensation mechanism. In the future, various ways of passing on these costs not only to electricity consumers but also to fossil fuel consumers such as natural gas and fuel oil need to be explored.</p> <p>As regards this Grand-Ducal Regulation, the government makes ad hoc and targeted adjustments (e.g. biogas, measure 215). In this context, a study on the “two-way contract for difference” has been finalised and a regular exchange with the European Commission is taking place with a view to possible implementation.</p>	
Type of instrument	ØEconomy	
State of progress	Implementation	
Start of implementing	End of implementation	Observations

2014	n.e.s.	regular revisions of the Regulation
Responsible entity/entities	MECO	
Reference document (s)	Amended Grand-Ducal Regulation of 1 August 2014 on the production of electricity from renewable energy sources	
Info complementary	https://legilux.public.lu/eli/etat/leg/rgd/2014/08/01/n1/jo	

Title of the measure	No 202 Awareness, information and advisory services on renewable energy sources	
Description	The Klima-Agency services accompany and facilitate the deployment of renewable energy projects, in particular through instruments such as free energy advice, a platform and website bringing together all the necessary information on renewable energy, the solar cadastre, the thermal cadastre, the 2.0 Climate Pact with municipalities, a Climate Pact for SMEs together with Luxinnovation, a manual of procedures informing about the different authorisation procedures to be launched for the various renewable energy technologies and the voluntary agreement concluded with the industrial sector with the participation of around 50 energy-intensive companies from Luxembourg's industrial and tertiary sectors.	
Type of instrument	Information	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
		continuous implementation
Responsible entity/entities	Meco, MECB, Other: Klima-Agence, Luxinnovation	
Reference (s)		
Info complementary	https://www.klima-agence.lu/fr/accueil	

Title of the measure	No 203 Revision of legislation with a view to abolishing, reducing or facilitating or speeding up permitting procedures	
Description	<p>Some factors limit the acceleration of the deployment of renewables, such as administrative procedures for permit applications, which is why Luxembourg intends to identify and remove barriers to the rapid development of renewables, significantly reduce approval times and simplify administrative procedures, as outlined in the 2023-2028 coalition agreement. A manual of procedures has already been drawn up which guides developers of renewable energy projects through authorisation procedures. With the help of this manual, major obstacles can be identified. DG Energy, in consultation with Klima-Agency, has been responsible for organising regular plenary meetings with all the actors responsible for granting authorisations in order to remove these obstacles.</p> <p>Where there are no deadlines in the legislative texts concerned, it is intended to set time limits for the competent authorities for the procedure for examining applications and authorisations and for taking a decision by the competent authority. In addition, the legislative texts concerned will be reviewed in order to identify situations where individual authorisation is not required or could be replaced by other legislative means, such as a grandducal regulation in which the procedure for obtaining such an authorisation could be simplified or accelerated or even prioritised. The deadlines laid down in Council Regulation (EU) 2022/2577 of 22 December 2022 establishing a framework to accelerate the deployment of renewable energy, valid for a period of 18 months, set deadlines for procedures in the field of wind, solar and heat pumps. These deadlines will serve as minimum basic criteria for the above analysis.</p> <p>As regards environmental permits, the above analyses will be coordinated by MECB. If legislative texts are adapted, the relevant work will be initiated by the respective competent authorities.</p>	
Type of instrument	Regulatory	
State of progress	Planned	
Start of implementing	End of implementation	Observations
2024		
Responsible entity/entities	MECO, MECB, MAINT, MT	
Reference (s)	Coalition agreement 2023-2028	
Info complementary	https://www.consilium.europa.eu/media/60326/st15176-en22.pdf	

https://eur-lex.europa.eu/legal-content/EN/TXT/? uri = COM% 3A2022 % 3A230 % 3 to & qid = 1653033742483
Manual of procedures: https://www.klima-agence.lu/fr/manuel-des-procedures – autorisations – projects – renewable energy

Title of the measure	No 204 Coordination of procedures for renewable energy decisions	
Description	<p>Authorisation procedures may be lengthy because of the complexity of the projects, which take some time to prepare, and the high number of applications of all kinds, which are in principle dealt with in accordance with the principle of first-in, first-out. As it is the last of the decisions that determines the timing of orders and construction works, it is desirable for all procedures to be completed closely. A coordination group shall be set up, under the direction of MECB, with members of relevant ministries and administrations in order to ensure parallel and coordinated processing of such requests, for which such consultation is required or requested.</p> <p>In order to identify barriers to permit procedures, a manual of procedures has been developed which serves as a guide for developers of renewable energy projects. The obstacles identified will be discussed with all those responsible for granting authorisations in plenary meetings organised by the MECB Energy DG in consultation with Klima- Agency.</p>	
Type of instrument	Information	
State of progress	Planned	
Start of implementing	End of implementation	Observations
2024		
Responsible entity/entities	MECB, MECO, MAINT	
Reference (s)		
Info complementary		

Title of the measure	No 205 Installing a photovoltaic system on all residential buildings	
Description	<p>The State will strengthen the obligation for the new building so that every new building is equipped with a photovoltaic installation covering a maximum part of the roof.</p> <p>With regard to existing buildings and in cases where people do not have the financial means to invest in a photovoltaic installation, the State will bear the cost of the photovoltaic installation. This measure has a double benefit: those who do not have the financial means can benefit from this measure and their electricity bill will be reduced by self-consumption. Once depreciated, the installation is offered to the owner (s) of the building. On the other hand, buildings that would not be equipped with photovoltaic installations in normal times will participate in the energy transition. The Ministry of Economy will develop ways of implementing the measure and covering investment costs. Before implementation, however, various legal issues remain to be clarified.</p> <p>The Government will also introduce the possibility of making residential roofs available to the State in order to install photovoltaic panels, for example by creating a register in which owners (of roofs suitable to accommodate a photovoltaic installation) can register. The arrangements, the constraints relating to it and the organisation of this register and the possible designation of a concessionaire are being examined.</p> <p>A standard for the photovoltaic installation for the new buildings will be introduced. The costs will be pre-financed by the State if the persons concerned are unable to finance the installation.</p> <p>In order to further boost the deployment of photovoltaic installations, the pre-financing system will be introduced under the “Klimabonus Wunnen” aid for photovoltaic installations (measure 309). Thus, the customer will have to pay only the difference between the total price of the installation and the subsidy granted. The system provides that the installer will deduct the amount of the subsidy from the invoice and will be reimbursed as soon as possible by the State. Rapid reimbursement can be ensured through the digitalisation of the procedure and a high degree of digital automation.</p>	
Type of instrument	Regulatory, budgetary	
State of progress	Under analysis	
Start of implementing	End of implementation	Observations
Responsible entity/entities	Meco, MECB (measure 309)	

Reference (s)	PM Speech on the State of the Nation 2022; Grand-Ducal Regulation of 9 June 2021 on the energy performance of buildings; PM Speech on the State of the Nation 2024
Info complementary	https://gouvernement.lu/fr/actualites/toutes_actualites/discours/2022/10-octobre/12-etat-de-la-nation.html

Title of the measure	N° 206 Calls for tender for large photovoltaic plants	
Description	<p>Since 2018, five calls for tender (AO) have been launched for photovoltaic plants > 500 kW (respectively > 200 kW), with the award of a market premium contract. This is in line with the State aid guidelines, which call for competition as the most appropriate means of promoting renewable energy sources in terms of cost-effectiveness. For these five tenders, approximately 81 MW could be awarded. Both instruments (“regular” and “on-farm” AOs) will be evaluated and depending on the results, the two systems will continue to operate in parallel, or a call for tenders will be put in place combining the two approaches. Other options/lots may be added, such as self-consumption with storage, shades with charging terminals, or light or façade photovoltaic. Following the first invitation to tender ‘self-consumption invitation to tender’, it must be stated that the tender was very successful. Further details can be found in measure 208. A second invitation to tender for own consumption was launched in July 2023, which was also very successful.</p>	
Type of instrument	ØEconomy	
State of progress	Implementation, Planned	
Start of implementing	End of implementation	Observations
2019		
Responsible entity/entities	MECO	
Reference (s)	<p>Amended Grand-Ducal Regulation of 1 August 2014 on the production of electricity from renewable energy sources</p> <p>Amended Law of 15 December 2017 on an aid scheme for environmental protection</p>	
Info complementary	https://legilux.public.lu/eli/etat/leg/rgd/2017/04/24/a481/jo	

Title of the measure	No 207 'PV ready' obligation for industrial and agricultural buildings	
Description	<p>Residential buildings and functional buildings are moving towards an implicit obligation to install photovoltaic panels in the light of the provisions of the amended Grand-Ducal Regulation of 9 June 2021 on the energy performance of buildings (measures 204 and 301). It is therefore important to also provide for an instrument for new industrial and agricultural buildings, with significant potential, while focusing on the following two key points, which are the static of the roof and the power of the transformer. It is intended to include this obligation in the recast of the amended Law of 5 August 1993 on the rational use of energy.</p> <p>Thus, from 1^{January} 2024 any industrial and agricultural building subject to a building permit must be designed in such a way as to be able to accommodate a photovoltaic installation on its roof.</p> <p>This measure concerns functional and agricultural buildings which are not automatically covered by the amended GDR of 9 June 2021 on the energy performance of buildings (measure 301).</p> <p>In addition, it is still up to the State to take an exemplary role. The State is installing photovoltaic panels on all its new buildings, particularly with a view to self-consumption. By 2030, the State therefore aims to cover the majority of the electricity consumption of its real estate by means of photovoltaic installations on national territory. This objective includes the project of equipping all public car parks with photovoltaic shells until 2030 (with the exception of possible cases of technical or regulatory impossibility).</p>	
Type of instrument	Regulatory	
State of progress	Under analysis	
Start of implementing	End of implementation	Observations
2023		implementation, planned for 2024/25
Responsible entity/entities	MECO, MAAV	
Reference (s)		
Info complementary		

Title of the measure	N° 208 Invitations to tender for photovoltaic plants in self-consumption mode	
Description	<p>In response to the situation of multiple crises, an instrument already envisaged but not yet put into practice has been advanced in its implementation: support and promote self-consumption among businesses and industry. To that end, an invitation to tender was launched in November 2022 specifically for self-consumption and awarding State aid in return for investment aid (and not with operational aid such as the ‘regular’ invitation to tender). This instrument was implemented as part of a package of measures dating back to autumn 2022 to address the energy crisis. This instrument should enable companies to secure at least part of their electricity bills.</p> <p>The separate call for tenders for own consumption was allocated a budget of EUR 30 million. This budget is divided into three lots at EUR 10 million each, differentiated according to power of power plants (30-200 kW, 200-500 kW, 500 kW – 5 MW) and with different maximum aid intensities (60-55-50 %). Projects are allocated on the basis of the price expressed in EUR/kWc, the amounts of which have also been capped (810-620-EUR 530/kWc).</p> <p>This tender was very successful with some 46 MW that could be awarded, requiring some EUR 16 million in State aid. Following this success, a second call with a budget of EUR 20 million was launched in July 2023. This call added a 4th lot, reserved for carports (car parks), the initial 3 lots remaining the same. The maximum intensities per lot were as follows: 55-50-45-40 %; and the maximum amounts as follows: 745-565-480-EUR 745/kW. The result was 33.4 MW of allocated power with a budget used of approximately EUR 12.4 million in State aid. Compared to regular tenders, it can be seen that the investment aid instrument was attractive, respectively that awareness among businesses was increased in this year of the 2022 energy crisis – and already slightly less in 2023 in view of the outcome.</p> <p>In the course of 2024/25, the evaluation and optimisation of the two instruments (“regular” and “on-farm” AO) will therefore continue.</p>	
Type of instrument	ØEconomy	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2022	n.e.s.	
Responsible entity/entities	MECO	
Reference (s)	Amended Law of 15 December 2017 on an aid scheme for environmental protection	

Info complementary	https://guichet.public.lu/fr/entreprises/financement-aides/aides-environment/call – photovoltaic/call- photovoltaic/aides- investment.html
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Title of the measure	N° 209 Draft invitation to tender for ground photovoltaic installations (agri-PV)	
Description	<p>On 22 October 2022, the Ministry of Energy and Spatial Planning launched a pilot invitation to tender for the construction and operation of new agrivoltaic power plants producing electricity from photovoltaic energy. The aim is for these plants (agri-PV) to have three advantages, namely the production of renewable electricity, the maintenance of agricultural production, which remains the main objective and an improvement of biodiversity for nature protection. With regard to electricity generation, the aim is to mobilise vague land where larger power installed than on roofs (and other sealed surfaces) is possible. The award is made with operational support, a market premium contract for the injection of the electricity produced.</p> <p>For this first call for tenders “agri-PV”, 22 tenders were submitted and 14 were selected for a capacity of 53 MW, a very good result. It was the first call for tenders PV in Luxembourg to be oversubscribed.</p> <p>On the basis of the results of the call for tenders for pilot projects, an evaluation is ongoing and will be finalised in the short term with a view to deciding on a future strategy for agri-PV.</p> <p>An analysis carried out at the end of 2023 showed that ambitious photovoltaic targets will be difficult to achieve without these large ground installations.</p>	
Type of instrument	ØEconomy	
State of progress	Planned, Implementation	
Start of implementing	End of implementation	Observations
2022		
Responsible entity/entities	MECO, MECB, MAAV	
Reference (s)		
Info complementary	https://guichet.public.lu/dam-assets/catalogue-pdf/appel-offres-ELECTRICITE/appel-offre-agripv.pdf	

Title of the measure	No 210 Framework for promoting self-consumption, energy communities and cooperatives	
Description	<p>The Government has gradually put in place a legislative framework to support the various facets of self-consumption and communities (amended Law of¹ August 2007 on the organisation of the electricity market). This law is in the process of being amended again to take account of feedback on the aspects mentioned and to adapt these concepts even better to practice.</p> <p>As regards the promotion of these concepts, the preparation of facilitators (model statutes, model agreements, explanation of the steps to set up a sharing group, etc.) is under way in close cooperation between Klima-Agency, ministries, regulator and network operators, all of which is steered by Klima-Agency. When these instruments are finalised, promotion will be intensified through targeted campaigns.</p> <p>At the Klima-Agency and the ILR regulator, the following pages with tools have summerstakes EN line in the meantime https://www.klima-agence.lu/fr/autoconsommation-collective https://www.klima-agence.lu/fr/communaut%C3%A9-%C3%A9nerg%C3%A9tique; https://www.weshareenergy.lu/.</p> <p>In addition, Klima-Agence generally encourages and supports Luxembourg society stakeholders through awareness-raising campaigns and its basic advisory service for energy and mobility (see also measure 317).</p>	
Type of instrument	Regulatory, Information	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
Responsible entity/entities	Meco, Other: Klima-Agence, ILR, Network Operators	
Reference (s)	Amended Law of 1 August 2007 on the organisation of the electricity market	
Info complementary	https://legilux.public.lu/eli/etat/leg/loi/2007/08/01/n14/jo	

Title of the measure	No 211 Solar Cadastre on Luxembourg Geoportal	
Description	The solar cadastre, provided for in the 2018-2023 government coalition agreement, was set up in 2020 and serves as a tool for the “Klima-Agence” to approach citizens. The cadastre is an interactive device for identifying and calculating the maximum capacity of the roofs. This cadastre, accessible to all, allows private individuals, market participants, network operators, administrations, etc. to plan projects more efficiently or integration into the network. It takes into account information such as the type of roof (flat roof, etc.) and building heights so that the user only needs to select their roof for an initial assessment of the feasibility and capacity that can be installed.	
Type of instrument	Information	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
Responsible entity/entities	Meco, Klima-Agency	
Reference (s)		
Info complementary	https://map.geoportal.lu/theme/energie?version=3&zoom=17&X=682156&Y=6379591 & Lang = lb & rotation = 0 & layers = 1813 & opacities = 1 & bgLayer = time = https://www.klima-agence.lu/fr/les-etapes-de-mon-projet/etapes-cles/produire-electricite-clean	

Title of the measure	No 212 Obligation to declare the income of a PV plant: increased limit from 4 kW to 30 kW	
Description	Since the sale of electricity is a commercial activity, the income generated by a PV plant must also be reported by natural persons. For the sake of simplification and by administrative tolerance, the threshold of installed capacity from which reporting is mandatory has increased from 4 kW to 10 kW from the fiscal year 2021 onwards. By a decision of the Tripartite Committee in March 2023 (see Circular of the Director of Contributions of 5 June 2023), this threshold is increased from 10 kW to 30 kW from the fiscal year 2023 onwards. The production of electricity subject to this threshold is considered to be an amateur activity and natural persons are therefore exempted from the reporting obligation.	
Type of instrument	Tax	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MFIN	
Reference (s)	Circular of the Director of Contributions L.I.R. No 14/2 of 5 June 2023 https://impotsdirects.public.lu/dam-assets/fr/legislation/legi23/lir-14-2-du-562023.pdf	
Info complementary	https://impotsdirects.public.lu/dam-assets/fr/legislation/legi21/2021-09-22-LIR-14-2-du-2292021.pdf	

Title of the measure	No 213 Reimbursement of the VAT rate for photovoltaic installations at 3 %	
Description	Reduction of the VAT rate (initially 17 %) on the supply and installation of photovoltaic panels at the super-reduced rate of 3 % as from ¹ January 2023. This applies to installations mounted on dwellings and buildings used for activities of general interest. The eligible components are modules, inverters, cabling, fixings, etc.	
Type of instrument	Regulatory	
State of progress	Implement	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MFIN, MECO	
Reference (s)	https://legilux.public.lu/eli/etat/leg/loi/2022/12/23/a649/jo	
Info complementary	https://pfi.public.lu/fr/publications.html	

Title of the measure	No 214 Remuneration for biogas injected into the natural gas network	
Description	The regulatory framework relating to the production, remuneration and marketing of biogas injected into the natural gas network lays down, inter alia, the organisation of the injection of biogas into the natural gas network and its distribution and marketing. The support mechanism guarantees the producer a remuneration for the biogas injected for a period of 15 years from the date of the first injection. As part of the national biogas strategy (measure 215), it is planned to revise the remuneration for the injection of biogas into the natural gas network by incentivising the recovery of livestock manure in existing and new plants.	
Type of instrument	ØEconomy	
State of progress	Implementation, Planned	
Start of implementing	End of implementation	Observations
2011		
Responsible entity/entities	MECO	
Reference (s)	Amended Grand-Ducal Regulation of 15 December 2011 on the production, compensation and marketing of biogas	
Info complementary	https://legilux.public.lu/eli/etat/leg/rgd/2011/12/15/n5/jo	

Title of the measure	No 215 biogas strategy and new incentives (financial and other) for biogas	
Description	<p>The national biogas strategy, approved by the Council of Government on 15 July 2022, was drawn up by the Ministry of Energy and Spatial Planning in consultation with the Ministry of the Environment, Climate and Sustainable Development and the Ministry of Agriculture, Viticulture and Rural Development. It is based on the results of a 2021 study on the potential and environmental aspects of biogas. The government has set itself the targets of using 50 % of the manure deposit with a maximum of 1 million tonnes per year, mobilising 75 % of the potential of bio-waste and greenery waste and limiting the area used for crop production to 1.500 ha. These targets allow gross biogas production to be increased to 330 GWh per year. For the implementation of the strategy, the following measures have been identified: (a) Revision of the remuneration for the production of electricity from biogas by encouraging the use of livestock manure in existing and new plants by amending the amended Grand-Ducal Regulation of 1 August 2014 on the production of electricity based on renewable energy sources; (b) Revision of remuneration for the injection of biomethane by encouraging the recovery of livestock manure in existing and new plants by amending the amended Grand-Ducal Regulation of 15 December 2011 on the production, remuneration and marketing of biogas; (c) Transposition of the sustainability and greenhouse gas saving criteria set out in Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources into national law; (D) Increase the rate of separate collection of bio-waste and anaerobic treatment; (e) Revision of the operating conditions of existing plants in order to reduce air emissions and increase plant safety; (f) Exclusion of livestock manure from abroad in the calculation of the share for the manure premium; (g) Establishing a robust and sustainable digestate management system to optimise their agricultural use and limit their impact on the environment; (h) Promotion of the construction of 'ready biogas' buildings; (I) Promotion of innovative projects to further reduce greenhouse gas emissions.</p>	
Type of instrument	Planning, economics	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2023		
Responsible entity/entities	MECO, MECB, MAAV	

Reference (s)	National Strategie für den Ausbau der Biogasproduktion in Luxemburg
Info complementary	https://meco.gouvernement.lu/dam-assets/le-ministere/Functions/Energie/Renewable Energy/Nationale-strategy-biogasproduktion-luxemburg-de-2023.pdf

Title of the measure	No 216 Hydrogen Strategy	
Description	<p>Description of the context of decarbonisation through hydrogen as part of the ambition to achieve climate neutrality by 2050; State of play and estimation of the decarbonisation potential through the use of hydrogen; seven key measures to promote the production, import and use of renewable hydrogen: 1 Contributing to the definition of the legal, regulatory and regulatory framework at EU level, 2. Cooperating with EU and non-EU Member States, 3. Identifying opportunities in Luxembourg – Research and Innovation, 4. Turning to action – Flagship projects to study and deliver, 5. Prioritising actions – Towards targeted decarbonisation by renewable hydrogen, 6. Developing instruments for a renewable hydrogen market, 7. Continuously implement and improve. A steering committee “Taskforce H2 Luxembourg” has been set up to monitor the strategy. Following the preparation foreseen in the 2020 NECP and the publication of Luxembourg’s hydrogen strategy in September 2021, the implementation of the seven measures listed above is also coordinated by the Directorate-General for Energy of the Ministry of Economy and in close consultation with the other jurisdictions concerned and with stakeholders. An update of this strategy, in consultation with all relevant ministries and in consultation with stakeholders, is planned for early 2025.</p>	
Type of instrument	Planning	
State of progress	Adopted	
Start of implementing	End of implementation	Observations
2021	n.e.s.	
Responsible entity/entities	Meco, Other: MECB	
Reference (s)	Luxembourg Hydrogen Strategy, MEA 2021	
Info complementary	https://gouvernement.lu/fr/actualites/toutes_actualites/communiqués/2021/09-septembre/27-turmes-hydrogene.html	

Title of the measure	No 217 Remuneration for the production of renewable hydrogen	
Description	<p>One of the priorities of the hydrogen strategy is to develop a concept of financial support in order to facilitate the implementation of pilot projects for renewable hydrogen production in Luxembourg. In the short term (before 2030) domestic production of a certain amount of hydrogen is significant, it has been shown that significant demand will emerge before a European hydrogen transport infrastructure, meeting this demand, is in place.</p> <p>A first key stage will be the organisation of a pilot call for tender for demonstrator projects to be launched at the end of summer 2024. As a result, initial feedback on experience is expected to be integrated into the development of a support instrument that will allow for regular tendering.</p>	
Type of instrument	ØEconomy	
State of progress	Planned	
Start of implementing	End of implementation	Observations
2024		
Responsible entity/entities	MECO	
Reference (s)	Luxembourg Hydrogen Strategy, MEA 2021	
Info complementary	https://gouvernement.lu/fr/actualites/toutes_actualites/communiqués/2021/09-septembre/27-turmes-hydrogene.html	

Title of the measure	No 218 Connection to a European hydrogen transport infrastructure	
Description	<p>Given the limited potential for hydrogen production on Luxembourg territory, the interesting potential for hydrogen transit through Luxembourg, and given the demand likely to evolve faster than expected in the industrial sector, it is important to position Luxembourg with a view to ensuring security of supply that is essential for the decarbonisation of non-electrified processes in industry and modes of transport that are difficult to electrify (in the short and medium term) and to invest substantially in the development of the network infrastructure. The Luxembourg government, in consultation with the authorities of neighbouring countries, is implementing an interconnected hydrogen pipeline (ideally with the three neighbouring countries) supplying renewable hydrogen in sufficient volumes and at competitive price. A draft law is in the legislative procedure to define an authorisation procedure so that a hydrogen network operator can be mandated to set up such a network in Luxembourg. Subsidies for such major energy infrastructure projects are provided for in a draft law introduced into the legislative procedure in May 2024 implementing the European GBER framework (General Block Exemption Regulation).</p> <p>On the occasion of the State visit to Belgium, Luxembourg's natural gas transmission system operator signed a letter of understanding with the hydrogen network operator in Belgium in April 2024 for the planning of a cross-border network.</p>	
Type of instrument	Planning	
State of progress	Planned	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MECO	
Reference (s)	Luxembourg Hydrogen Strategy, MEA 2021	
Info complementary	https://gouvernement.lu/fr/actualites/toutes_actualites/communiqués/2021/09-septembre/27-turmes-hydrogene.html	

Title of the measure	No 219 Facilitation of the use of long-term renewable electricity supply contracts through a risk-reduction instrument	
Description	<p>Facilitating the use of long-term renewable electricity supply contracts, long-term renewable power purchase agreements (RES PPPs), including cross-border ones, through de-risking instruments, in order to promote renewable electrification of large consumers in Luxembourg (large companies and industry); such contracts are a means to secure stable and planned renewable electricity prices in the medium and long term. The above-mentioned instrument will aim at reducing risk on the supply side (i.e. production and supply of renewable energy).</p> <p>A first real market demand for such contracts can be expected with the first renewable hydrogen demonstrators, as electrolyzers are likely to be at least partly fuelled with renewable electricity produced abroad.</p>	
Type of instrument	ØEconomy	
State of progress	Planned, Implementation	
Start of implementing	End of implementation	Observations
2023		
Responsible entity/entities	MECO	
Reference (s)		
Info complementary		

Title of the measure	N° 220 Cross-border cooperation: European Renewable Energy Financing Facility (REFM)	
Description	<p>The financial contribution to renewable energy production projects in other Member States of the European Union, or even third countries, is intended to increase the share of renewable energy in the European mix and generate renewable energy statistics for Luxembourg's balance sheet. The EU Renewable Energy Financing Facility (REFM) where three calls for applications have already been organised by the European Commission and in which Luxembourg participated as a contributing Member State each time. Following an unsuccessful first call for applications (<i>expression of interest</i>), a Member State, in this case Finland, applied for the second call with 8 PV projects to be carried out. The first steps on the third call also seem to be promising. Luxembourg will participate and will be able to benefit from the renewable energy statistics generated by these projects over the next 15 years. Luxembourg is the first country to participate in this innovative mechanism, further developing the idea of European cooperation in the field of renewable energy and strengthening an instrument that can increase Europe's energy independence in the medium and long term.</p> <p>In the long term, Luxembourg defends the idea, in various international committees, that this instrument will not only make it possible to achieve our renewable energy targets, but if other Member States also discover it, it will be able to catalyse the implementation of major projects, such as wind projects in the North Sea.</p>	
Type of instrument	Regulatory, budgetary	
State of progress	Implementation, Planified	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MECO	
Reference (s)		
Info complementary		

Title of the measure	No 221 Cooperation measures with EU Member States on renewable energy: Statistical Transfers	
Description	<p>Directive 2018/2001 allows Member States to use various cooperation mechanisms in order to contribute in the most effective way to the common binding EU renewable energy target by 2030 and also to contribute to their national targets. As a result of the Fit for 55 package and the RepowerEU plan, the Union's objectives have been revised upwards and reflected in Directive 2023/2413. As renewable energy potential is limited in Luxembourg, it will be increasingly important to turn to these European cooperation mechanisms. At present, various instruments are possible and are already being pursued and implemented by Luxembourg, such as transfers of renewable energy statistics: instrument used in the past with Estonia and Lithuania for the period 2018-2020 An agreement was concluded with Denmark on 3 October 2022 to cover the period 2021-2025. Further agreements are to be considered with a view to covering the period from 2026 to 2030.</p>	
Type of instrument	Regulatory	
State of progress	Implementation, Planified	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MECO	
Reference (s)		
Info complementary		

Title of the measure	No 222 Promotion of efficient district heating and cooling	
Description	<p>The Government intends to provide citizens and businesses with a wide range of solutions that are easy to implement and coordinated at national, regional and local level as alternatives to fossil fuel based heating systems and aims in particular at the massive development of decarbonised heat networks, in cooperation with the municipalities. The Government will remain open to technological developments and support the most efficient technologies in their respective fields, taking into account all factors and in particular environmental factors. The production, distribution and use of heat will be decarbonised by promoting geothermal energy, which will have a legal framework, as well as heating networks and hydrogen. This energy transition will be supported by substantial investments in the development of district heating infrastructure.</p> <p>The establishment of a legal framework for district heating is currently under legal analysis and the following issues will be addressed in this context:</p> <ul style="list-style-type: none"> - Establishment of a legal framework for district heating and cooling for the construction of such networks and laying down the terms and conditions for operators; - Definition of the tasks of the energy network operator and designation a supervisory authority (cf. electricity and gas); - Connection obligation for all buildings in the area the supply of the district heating network; - Analysis for the establishment of specific investment aid for construction of district heating networks at very low temperatures. <p>The Government will promote the extension of district heating networks and individual connections and will study the creation of a national company for the ownership, construction and operation of district heating networks, in compliance with competition law. Especially for existing sectors, the establishment of a district heating network is linked to economic risks, given that the cost-effective operation of a district heating network is directly linked to the number of connections. The connections will not be previsible made immediately when the network is set up, but in the event of renewal of individual heating systems.</p>	
Type of instrument	Regulatory	
State of progress	Under analysis	
Start of implementing	End of implementation	Observations
Responsible entity/entities	Meco, MECB, Communes, Klima-Agence (Climate Pact)	
Reference (s)		

Info complementary	
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Title of the measure	No 223 Promotion of medium and deep geothermal energy	
Description	<p>Geothermal energy is a technology to provide renewable heat and is used to decarbonise the heating sector. The potential of geothermal energy can be exploited through installations close to the surface (< 15 m), shallow probes (15-400 m) and medium-deep geothermal energy (> 400 m). Shallow geothermal energy is mainly used to provide heat to single-family houses and residences, while medium-deep geothermal energy can contribute to the supply of heat to buildings or neighbourhoods in need of high heat.</p> <p>In order to explore the potential of medium and deep geothermal energy in Luxembourg, several studies have been launched. These studies show a high potential in the south of the country, particularly in regions with high energy needs. While there are subsidy instruments in place to promote the exploitation of near-surface and shallow geothermal energy, the government aims to develop economic aid instruments to support the deployment of medium-deep geothermal energy. Various pilot projects have been launched, in particular, to make initial experiences in order to exploit this potential and in parallel in order to identify obstacles in Luxembourg.</p> <p>A seismic reflection analysis was carried out at the end of 2023 in southern Luxembourg. This analysis will allow the identification of the different geological layers and attribute them to certain depths. The resulting data can be used to develop and refine the 3D map of Luxembourg's geology. In order to minimise the risk of geothermal energy projects in Luxembourg, the government is planning a series of recognition boreholes (at depths and locations in Luxembourg that remain to be determined) which will provide key results (exact temperatures at different depths or the flow rate that is decisive for the heat that can be extracted).</p> <p>Finally, a three-dimensional model of geology in Luxembourg is being developed by the Geological Service of the State to prepare and speed up decisions on authorisation procedures and to provide planners with the geological parameters used to calculate the pre-dimensioning of geothermal drilling. This pre-dimensioning also serves to determine the economic aspects of the project in question.</p>	
Type of instrument	ØEconomy	
State of progress	In analysis, implementation	
Start of implementing	End of implementation	Observations
Responsible entity/entities	Meco, Geological Service	

Reference (s)	
Info complementary	

Title of the measure	No 224 Facilitation of authorisations for new sites for the installation of wind turbines	
Description	<p>Due to the limited national size and ambitious targets for renewable energy, it is essential to facilitate the authorisation of different (new) sites for the installation of wind turbines through different measures and technologies.</p> <p>For example, it is envisaged to reduce the scope of implementation between wind turbines and motorway axes, based for example on the criteria laid down in Belgium and the Netherlands, and to make it possible to install wind turbines in industrial areas. The feasibility of these measures is currently being explored and discussed with the competent authorities.</p> <p>Moreover, technological progress and the growing installed capacity of wind turbines make it possible to increase annual production hours. Innovative technologies allow the automatic detection of nearby fauna (birds, bats), so a rapid and targeted deactivation of the wind turbine is engaged.</p>	
Type of instrument	Regulatory	
State of progress	Under analysis	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MECO, MECB, ITM	
Reference (s)		
Additional info		

Title of the measure	No²²⁵ Assessment of the potential of forest biomass available for energy production	
Description	<p>Given the limited potential of forest biomass, an assessment of the national supply of forest biomass available for energy purposes is carried out for the period 2021-2030. That assessment shall take into account the sustainable biomass source available for energy and non-energy uses, the maintenance of national carbon sinks and forest ecosystems and the circular economy principle, the biomass cascading principle, and the waste hierarchy. In line with the biomass cascading principle, woody biomass will be used according to its highest economic and environmental added value. In this assessment, the compatibility of the planned use of forest biomass for energy production with the 2026-2030 targets and budgets will be analysed. On the basis of the results of this evaluation of the measures ensuring compatibility with national objectives and budgets will be identified.</p>	
Type of instrument	Regulatory, Planning, Economic	
State of progress	n.e.s.	
Start of implementing	End of implementation	Observations
2024		
Responsible entity/entities	MECO, MECB, ANF	
Reference (s)		
Additional info		

3.1.3 Other elements of the dimension

Luxembourg introduced some emergency aid under the ‘Solidaritéitspak’ tripartite agreements (March 2022, September 2022 and March 2023) in response to the energy crisis, aimed at alleviating household energy costs in the short term and limiting inflation, such as limiting the increase in gas prices, a subsidy for customers connected to a district heating network, a stabilisation of the electricity price, a subsidy on publicly accessible charging stations, a subsidy for the price of gasoil used as fuel and a subsidy for liquefied petroleum gas (domestic bulk propane) and some of these aid also targeted fossil fuels. All these aids were temporary and will expire by the end of 2024 at the latest.

At the UN climate conference in Dubai (COP28), Luxembourg joined an international coalition to phase out fossil fuel subsidies (<https://www.government.nl/topics/climate-change/news/2023/12/09/cop28-netherlands-launches-international-coalition-to-phase-out-fossil-fuel-subsidies>). In a joint declaration, the signatories notably committed to transparency by COP29 on their own fossil fuel subsidies by publishing an inventory. One objective is to make joint progress towards a comprehensive methodological framework. Signatories will also establish an international dialogue to share knowledge, develop national strategies for phasing out subsidies and work together to minimise carbon leakage and maintain a level playing field. This international dialogue can take place annually at COP meetings.

3.2 energy efficiency dimension

The energy efficiency *first principle anchored* in European legislation is indispensable for the achievement of the country's energy and climate objectives, given its demographic change and dynamic economy, characterised by significant growth. In the area of new buildings, Luxembourg has a leading role in the implementation of energy efficiency requirements for residential buildings and NZEBs. Any new construction (residential and functional buildings) must comply with the requirements of the amended Grand-Ducal Regulation of 9 June 2021 on the energy performance of buildings, which defines the 'nZEB' level (nearly Zero Energy Building).

Thanks to the continuous evolution of regulatory ambitions since the entry into force of the first regulation on the energy performance of residential buildings in 2007 and functional buildings in 2010, and, above all, the parallel evolution of the competences of the construction sector in Luxembourg, Luxembourg's nZEB is now one of the most ambitious in Europe and ensures that any new construction to which this regulation applies is automatically highly efficient in terms of energy efficiency and automatically decarbonised in terms of energy consumption during use of the building, due to the fact that the heat pump is the reference technology for the installation of heat and domestic hot water production.

In line with the European principle of '*energy efficiency first*', Luxembourg has paid particular attention to improving energy efficiency in buildings and expects to continue on this path.

Improving energy efficiency and decarbonising the stock of existing buildings is the biggest challenge in the coming years. By increasing the energy renovation rate of buildings and using all available smart technologies, this sector can make a significant contribution to a competitive economy with a climate-neutral impact. As the industrial sector accounts for 50 % of electricity consumption, this will also be at the heart of energy efficiency policy. Mobility efficiency (from internal combustion engines to much more efficient electric motors) also needs to be increased. In general, the social impact of these energy efficiency measures shall be taken into account and the new rules are socially integrated.

3.2.1. National energy efficiency obligation scheme and alternative policy measures in accordance with Articles 7a and 7b and Article 20(6) of Directive 2012/27/EU

Luxembourg transposed Article 7 of Directive 2012/27/EU into national law by introducing in 2015 an EEOS energy saving obligation scheme. Since its creation, the instrument has been reformed and optimised on several occasions, on the one hand to transpose amendments to the Energy Efficiency Directive and on the other hand to make improvements and make the mechanism more efficient and responsive to the needs of the sector.

The new EED (EU) 2023/1791 provides in its Article 8 (former Article 7) for an even more ambitious level of energy savings obligation until 2030 than foreseen by the revision of the 2018 Directive. In order to achieve this increased obligation level, Luxembourg intends to maintain the EEOS obligation scheme with the same level of cumulative energy savings to be achieved as foreseen by the reform of the EEOS in 2021. This contribution from the EEOS corresponds to a new energy saving to be achieved by all obligated parties of 250.000 MWh per year. In terms of cumulative energy savings over the period 2021-2030, EEOS is planned to reach 13.750 GWh, corresponding to 32 % of Luxembourg's overall cumulative energy savings obligation target (42.538 GWh) (Article 8 EED (EU) 2023/1791).

The following measures (listed with their reference number) give more details on the EEOS policy instrument:

Measure 120: Energy Efficiency Obligation Scheme (EEOS), a description of the scheme in place since 2015, for the first period (2015 to 2020).

Measure 121: Energy Efficiency Obligation Scheme (EEOS), Revision 2021 for the second period (2021-2030).

The EEOS energy efficiency obligation scheme shall be complemented by alternative policy measures. According to the modelling calculations, the remaining share of the overall cumulative target or 28.788 GWh (68 % of the overall target) can be almost entirely provided by the following alternative measure:

Measure # 105: Tax CO₂ on liquid fuels

This measure has the greatest impact on the reduction of energy consumption by 2030, even before the impact of the Energy Efficiency Obligation Scheme (EEOS) and will provide reductions in fuel consumption, representing a cumulative final energy saving between 2021 and 2030 of 27.970 GWh (66 % of the overall target).

Some other energy efficiency measures fulfilling the eligibility criteria for the energy savings obligation (formerly Article 7 EED) to be qualified as alternative policy measures also contribute to improving energy efficiency; these measures may, where appropriate, be taken into account for the achievement of the overall cumulative target. These measures are set out in Table 33 in Chapter 2.2. The potential to contribute to the achievement of the overall target for these measures is estimated within a range of values, after correcting the overlapping effects with measure EEOS No 121 or alternative measure No 105 CO₂ tax on liquid fuels.

List of alternative measures with their reference number:

Measure 307: Aid scheme Klimabonus Wunnen (residential buildings)

Measure 311: Individual housing aid scheme

Measure 313: Tax incentives for energy renovation of housing

Measure 314: Aid scheme for municipalities

Measure 405: Promoting public transport

Measure 406: Promotion of innovative mobility services

Measure 410: Promotion of electrification of the Luxembourg registered car fleet

Measure 420: Revised registration tax on road vehicles

Measure 423: Aid scheme for zero CO₂ emission vehicles

Measure 503: Voluntary agreement on improving energy efficiency in industry (up to and including 2023).

Measure 504: Voluntary agreement on decarbonisation and improvement of energy efficiency in industry (from 2024).

Title of the measure	No 120 Energy Efficiency Obligation Mechanism (EEOS)	
Description	<p>A legislative framework was put in place in 2015 to create an obligation mechanism for electricity and natural gas suppliers (obligated parties) to incentivise them to generate energy savings for consumers in Luxembourg. This mechanism, based on Article 7 of the EU Energy Efficiency Directive 2012/27/EU, obliges certain actors to make use of energy efficiency and ultimately consumers, their market knowledge and their expertise in the field of energy.</p> <p>The first period of the obligation mechanism shall cover the years 2015 to 2020, for a cumulative overall target expressed in terms of final energy consumption of 5.993 GWh equivalent to a new average annual saving of 285 GWh.</p> <p>The purpose of this mechanism is to initiate and promote energy saving projects by obligated parties, in particular through financial or non-financial incentives for energy efficiency investments in the industrial, buildings and transport sectors. To this end, all consumers – businesses, municipalities and individuals – are targeted. The mechanism is updated regularly, including on the basis of revisions of the EU Energy Efficiency Directive.</p>	
Type of instrument	Regulatory	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2015	n.e.s.	last renewal and reinforcement in 2021
Responsible entity/entities	MECO	
Reference (s)	Amended Law of 1 August 2007 on the organisation of the electricity market; Amended Law of 1 August 2007 on the organisation of the market in natural gas; Amended Grand-Ducal Regulation of 7 August 2015 on the operation of the energy efficiency obligation scheme	
Info complementary	https://legilux.public.lu/eli/etat/leg/rgd/2021/06/03/a419/jo	

Title of the measure	No 121 Energy Efficiency Obligation Mechanism (EEOS): revision 2021	
Description	<p>The energy efficiency obligation scheme, established in 2015 for a first period covering the years 2015 to 2020, shall be revised in 2021 for the second period covering the years 2021 to 2030. Electricity and natural gas suppliers are always the obligated parties to this mechanism.</p> <p>In order to facilitate compliance with the obligations for ‘small’ suppliers, the revision introduces a buy-out option allowing obligated parties to pay part (up to a maximum of 1.500 MWh per year) of their annual energy savings obligations by paying an amount equivalent to the investments required to meet the obligations.</p> <p>The 2021 revision also strengthens the obligation by introducing a penalty which is significantly more dissuasive than the fine provided for in the mechanism for the first period. Obligated parties that have not achieved their annual energy savings volumes will be obliged to pay a (discharge) penalty imposed by the regulator.</p> <p>The level of ambition (new energy savings to be achieved annually by obligated parties) has been maintained at the (average) level over the first period. The cumulative overall target expressed in terms of final energy consumption for the period from 2021 to 2030 is 13.750 GWh equivalent to a new average annual saving of 250 GWh.</p>	
Type of instrument	Regulatory	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
2015	n.e.s.	last renewal and reinforcement in 2021
Responsible entity/entities	MECO	
Reference (s)	Amended Law of 1 August 2007 on the organisation of the electricity market; Amended Law of 1 August 2007 on the organisation of the market in natural gas; Amended Grand-Ducal Regulation of 7 August 2015 on the operation of the energy efficiency obligation scheme	
Info complementary	https://legilux.public.lu/eli/etat/leg/rgd/2021/06/03/a419/jo	

3.2. II. Long-term strategy to foster the renovation of the national stock of residential and non-residential buildings, both public and private (1), including policies, measures and actions to stimulate cost-effective deep renovation, as well as policies and actions to target the worst performing segments of the national building stock, in accordance with Article 2a of Directive 2010/31/EU

Significantly increasing the annual renovation rate with a focus on deep renovation, which translates into a significant amount of energy actually saved compared to the situation before renovation, is the common

ambition of all current strategies, policies, measures, flagship actions, under development or to be developed.

The following measures listed with their reference number give more details on the various instruments supporting the ambitions of renovation:

Cross-cutting measures related to renovation

- Measure 106: Climate Pact 2.0 with municipalities
- Measure 113: Vocational training at secondary education level as part of the energy transition
- Measure 114: Awareness raising, information and advice to citizens promoting behavioural change and enabling framework for citizen engagement
- Measure 301: Regulations on the energy performance of buildings
- Measure 302: Fossil heating phase-out
- Measure 306: PRIMe House 2017 aid scheme
- Measure 307: Klimabonus Wunnen scheme
- Measure 308: Digitalisation of the Klimabonus aid scheme
- Measure 309: Pre-financing under the Klimabonus Wunnen scheme
- Measure 310: Climate Loan Scheme
- Measure No 311: Individual housing aid scheme
- Measure No 312: Stone aid scheme
- Measure No 313: Tax incentives for energy renovation of housing
- Measure No 314: Aid scheme for municipalities
- Measure No 315: Promoting sustainable construction
- Measure No 316: Long-term Building Renovation Strategy
- Measure No 317: Awareness raising, information, guides and consultancy services on buildings
- Measure No 318: Training of a skilled and sufficient workforce in the buildings sector
- Measure No 319: Municipalities' pioneering role in buildings
- Measure No 322: Reducing the environmental impacts of construction
- Measure No 323: Decarbonisation of construction sites
- Measure No 326: Harmonisation of urban planning rules

Specific measures for residential buildings

Improving the thermal envelope of a building is the most important measure to reduce the need for energy in a building → energy renovation works (thermal insulation).

Luxembourg does not include an obligation to renovate residential buildings, but introduces a strong incentive for renovation through financial and other incentives for co-ownership and for owners of rented dwellings. In order to specifically target the worst-performing residential buildings and to further intensify their energy renovation, these buildings will soon be able to receive tailor-made support from a national support entity.

Decarbonisation through the electrification of buildings by means of a heat pump also means a significant reduction in final energy consumption (excluding ambient heat) → switching to heat pumps, ideally combined with photovoltaic electricity generation (and self-consumption).

The European Directive EPBD ((EU) 2024/1275) provides for residential buildings: ‘... Each Member State shall establish a national trajectory for the gradual renovation of the residential building stock in accordance with the national roadmap, the targets for 2030, 2040 and 2050 included in the Member State’s national building renovation plan and the transformation of the national building stock into a zero-emission building stock by 2050.’; Luxembourg will be obliged to achieve the results in terms of improving the **average** primary energy consumption in kWh/(m² year) on the basis of the EPBD requirements, but this obligation does not automatically mean a renovation obligation for owners. An obligation to renovate residential buildings is not envisaged in Luxembourg, but the focus is on raising awareness and supporting energy renovation through policies and incentives.

- Measures No 120, Energy Efficiency Obligation Scheme (EEOS)
- Measure No 302: Fossil heating phase-out
- Measure No 306: Aid schemes PRIMe House (2017) and Klimabonus (2022)
- Measure No 310: Climate Loan Scheme
- Measure No 313: Tax incentives for energy renovation of housing
- Measure No 324: Minimum energy performance requirements for rented dwellings (proprietary incentives)
- Measure No 325: Facilitating energy works in buildings in co-ownership
- Measure No 327: National accompanying entity ‘energy renovation’ and ‘photovoltaic installations’ for residential buildings
- Measure No 328: Pilot project “Renovation of neighbourhoods – Differdange”

Measures specific to functional buildings

Energy renovation of functional buildings is more governed by national wishes and European obligations. Several types of obligations will be introduced, notably at the level of the public sector and also at private level, based on the requirements of the European EED (Energy Efficiency Directive, (EU) 2023/1791) and EPBD (Energy Performance of Buildings Directive, (EU) 2024/1275).

The European Directive EPBD ((EU) 2024/1275) provides for functional buildings: “Member States shall establish minimum energy performance standards for non-residential buildings that ensure that those buildings do not exceed the specified maximum energy performance threshold.

... The maximum thresholds shall be established on the basis of the non-residential building stock on¹ January 2020. ... Minimum energy performance standards shall ensure, as a minimum, that all non-residential buildings are below: (a) the 16 % threshold from 2030 onwards; and (b) the 26 % threshold from 2033 onwards. ”. Luxembourg will be obliged to achieve the results in terms of improving the average primary energy consumption in kWh/(m² year) on the basis of the requirements of the EPBD and in particular **all** the non-residential buildings concerned will have to comply with the maximum thresholds by the dates indicated. This obligation to renovate/decarbonise non-residential buildings will be transposed on the basis of a voluntary approach with incentives (policies and measures), followed by a mandatory phase for owners.

- Measure No 303: Energy renovation obligation for public buildings (owned by a public body)
- Measure No 304: Energy renovation obligation for functional buildings
- Measure No 319: Pioneering role of the State with regard to buildings
- Measure No 320: Pioneering role of the public sector in energy efficiency

Measure No 507: Energy audit obligation and monitoring/optimisation for functional buildings with a surface area greater than 1.000 m²

Measure No 508: 'Accelerated' fossil phase-out obligation for functional buildings (surface area above 1.000 m²) that are suitable for replacing fossil heating with a heat pump (heating system at starting temperature below or equal to 55 °C (CIE separately))

3.3 Security of energy supply dimension

The policies and measures put in place by the Ministry focus on improving security of supply in the electricity, gas, oil and hydrogen sectors in the future. This includes ensuring that the framework is properly and safely developed to achieve the ambitious climate targets described in Chapter 2 by maintaining a very high level of security of energy supply in Luxembourg.

Title of the measure	No 901 Report on security of supply in the electricity sector in Luxembourg	
Description	The Ministry of Economy of the Grand Duchy of Luxembourg, in accordance with Article 11 (3) of the Law on the organisation of the electricity market, which entered into force in August 2007, is responsible for drawing up a report on the security and quality of electricity supply every two years.	
Type of instrument	Information	
State of progress	Planned	
Start of implementing	End of implementation	Observations
		Updated every 2 years
Responsible entity/entities	MECO	
Reference (s)	Amended Law of 1 August 2007 on the organisation of the electricity market	
Info complementary		

Title of the measure	No 902 Report on security of supply in the gas sector in Luxembourg	
Description	The Ministry of Economy (MECO/DG Energy) of the Grand Duchy of Luxembourg is entrusted by Article 16 of the Law on the organisation of the gas market, which entered into force in August 2007, with the task of submitting a report on the safety and quality of natural gas supply every two years.	
Type of instrument	Information	
State of progress	Planned	
Start of implementing	End of implementation	Observations
		Updated every 2 years
Responsible entity/entities	MECO	
Reference (s)	Amended Law of 1 August 2007 on the organisation of the market in natural gas	
Info complementary		

Title of the measure	No 903 Luxembourg risk preparedness plan for the electricity sector	
Description	Regulation 2019/941 of the European Union on risk-preparedness in the electricity sector lays down the rules governing cooperation between Member States to prevent and manage electricity crises. Under Article 10 of that regulation, the Ministry responsible for energy as the Luxembourg competent authority, and in collaboration with various national services and neighbouring States, is to draw up a risk-preparedness plan in the electricity sector for the Grand Duchy of Luxembourg.	
Type of instrument	Planning	
State of progress	Adopted	
Start of implementing	End of implementation	Observations
		Updated every 4 years
Responsible entity/entities	MECO	
Reference (s)	EU Reg. 2019/941	
Info complementary		

Title of the measure	No 904 Emergency plan for the security of natural gas supply of Luxembourg	
Description	Regulation (EU) 2017/1938 of the European Parliament and of the Council of 25 October 2017 concerning measures to safeguard security of gas supply (hereinafter 'Regulation (EU) 2017/1938') requires each EU Member State to draw up an emergency plan containing the measures to be taken to eliminate or mitigate the impact of gas supply disruptions and to ensure the gas supply to so-called protected customers.	
Type of instrument	Planning	
State of progress	Adopted	
Start of implementing	End of implementation	Observations
		Updated every 4 years
Responsible entity/entities	MECO	
Reference (s)	EU Reg. 2017/1938	
Info complementary		

Title of the measure	No 905 Preventive action plan	
Description	Regulation (EU) 2017/1938 of the European Parliament and of the Council of 25 October 2017 concerning measures to safeguard security of gas supply (hereinafter referred to as “the Regulation”) requires each EU Member State to draw up a Preventional Action Plan (“PAP”) containing the measures necessary to eliminate or mitigate the risks identified in common and national risk assessments, including the effects of energy efficiency and demand-side measures.	
Type of instrument	Planning	
State of progress	Under analysis	
Start of implementing	End of implementation	Observations
		Updated every 4 years
Responsible entity/entities	MECO	
Reference (s)	Regulation (EU) 2017/1938	
Info complementary		

Title of the measure	No. 906 Petroleum reserve	
Description	This measure concerns the monitoring of oil reserves. As a member of the European Union and the International Energy Agency (IEA), Luxembourg is required to have an oil reserve corresponding to an average of 90 days of imports from the previous year. Importers of petroleum products are also subject to the national legal obligation to store eight days domestically, 37 days in the regional territory outside Luxembourg and the remaining quantities in the rest of the EU.	
Type of instrument	Regulatory	
State of progress	Under analysis	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MECO	
Reference (s)	Amended Law of 10 February 2015 on the organisation of the market in petroleum products	
Info complementary		

Title of the measure	No 907 PLEF Support Group “Security of Supply”	
Description	The Pentalateral Energy Forum (Pentalateral Energy Forum) is a framework for regional energy cooperation which has initiated several actions for greater electricity market integration and security of supply in Europe. The Luxembourg Presidency in 2022 was marked by the war in Ukraine and the energy crisis. The trust network between authorities and ministers from different countries has proven to be very useful in strengthening coordination on gas storage, for exchanging on energy saving campaigns and for comparing and improving the respective security of supply assessments in both gas and electricity.	
Type of instrument	Voluntary agreement	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MECO	
Reference (s)	https://benelux.int/files/7216/3845/2580/PENTA MoU def.pdf	
Info complementary		

Title of the measure	No 908 BeLux Crisis Group for natural gas	
Description	<p>Given the Belgium-Luxembourg common market area, cooperation between Belgium and Luxembourg is a key element in crisis management. Thus, close collaboration has taken place in the preparation of contingency plans in order to align parts such as the definition of protected customers and the structure and logic of the measures. In the event of a national or European crisis, the competent authorities of Luxembourg and Belgium, together with the TSOs of both countries, shall consult each other on a regular basis in order to provide a common picture of the gas supply situation in the Belgium-Luxembourg common market area and to decide, if necessary, on the measures to be taken.</p> <p>There is a political agreement to deepen cooperation by signing a duly detailed solidarity agreement as soon as possible.</p>	
Type of instrument	Voluntary agreement	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MECO	
Reference (s)		
Info complementary		

Title of the measure	No 909 EU Electricity Coordination Group	
Description	The group provides a platform for strategic exchanges between Member States, national regulators, ACER, ENTSOE and the Commission on electricity policy. The group may be convened flexibly when there is a need for strategic discussions and will complement the technical exchange between Member States' experts within the Cross-Border Committee.	
Type of instrument	Other	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MECO	
Reference (s)		
Info complementary		

Title of the measure	No 910 EU Gas Coordination Group	
Description	<p>The Gas Coordination Group should act as advisor to the Commission in order to facilitate the coordination of security of supply measures in the event of an emergency at Union or regional level. It is also the main body consulted by the Commission in the context of the preparation of preventive action plans and emergency plans. The Gas Coordination Group should monitor the adequacy and appropriateness of the measures to be taken under Regulation (EU) No 994/2010 and exchange all relevant information for the security of gas supply at national, regional and Union level.</p> <p>The group was set up by Regulation 994/2010 of the European Parliament and of the Council, which is now replaced by Regulation 2017/1938. Its composition and detailed rules of operation are laid down in Commission Decision 2006/791/EC.</p>	
Type of instrument	Other	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MECO	
Reference (s)		
Info complementary		

Title of the measure	No 911 Security of supply in the hydrogen sector in Luxembourg	
Description	Analysis of the security of supply of the future hydrogen sector to enable a safe and secure development of the hydrogen market in Luxembourg.	
Type of instrument	Information	
State of progress	Planned	
Start of implementing	End of implementation	Observations
2028		
Responsible entity/entities	MECO	
Reference (s)		
Info complementary		

Title of the measure	No 912 Network development plans	
Description	Set up network development plans for distribution networks, to support the integration of generating facilities using renewable energy sources, to facilitate the establishment of energy storage facilities and the electrification of the transport sector, and to provide network users with appropriate information on planned network extensions or improvements.	
Type of instrument	Regulatory	
State of progress	Planned	
Start of implementing	End of implementation	Observations
Responsible entity/entities	Network operators	
Reference (s)		
Info complementary		

3.4 Internal energy market dimension

The implementation of the whole Clean Energy Package makes a significant contribution to the overall strengthening of the European internal market. It updates, inter alia, the rules governing the functioning of the internal market in electricity and transmission and distribution networks.

3.4.1 Electricity infrastructure

In order to continue to have sufficient interconnection capacity to cope with the energy transition, whether on the consumption side or on the decentralised renewable electricity generation side, different projects will be implemented. Apart from efforts to upgrade the transmission capacity to transport renewable electricity generation from the north of the country to the centres of consumption in the centre and south of the country by upgrading existing lines, project 380 will ensure the necessary interconnections for access to the common market area with Germany.

Title of the measure	N° 1001 Project 380
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Description	In cooperation with the German transmission system operator Amprion, Creos plans to build an extra high voltage line of 380 kV from Bertrange to Aach (Germany) via Bofferdange and a transformation station 380/220/110-65-kV around Bofferdange/Altlinster. In the long term, the existing infrastructure, dating back to the 60s, will no longer be able to securely cover the ever-increasing electricity needs due to the country's strong economic and demographic development. This new construction project will modernise the network, ensure national security of supply and improve the quality of life of the population as a whole.	
Type of instrument	other	
State of progress	Implement	
Start of implementing	End of implementation	Observations
	2028	
Responsible entity/entities	Other (s): CREOS	
Reference (s)	https://www.creos-net.lu/creos-luxembourg/projets/380/projet-380.html	
Info complementary		

Title of the measure	No 1002 Reinforcing of the national high-voltage grid	
Description	In order to facilitate the integration of more electricity generation from renewable energy sources particularly in the north of the country, Creos plans to strengthen its high-voltage grid and eventually replace the 65 kV lines with 110 kV lines.	
Type of instrument	Other	
State of progress	Implement	
Start of implementing	End of implementation	Observations
Responsible entity/entities	Other (s): CREOS	
Reference (s)		
Info complementary		

3.4.2 Energy transmission infrastructure

The dismantling of the former steam gas turbine power plant (TGV) Twining has significantly reduced gas demand in peak periods. The existing gas infrastructure therefore remains able to cover current and foreseeable supply needs. Therefore, no further expansion of gas infrastructure is foreseen. Import capacity will be improved through other measures, such as transnational cooperation.

Although no further development measures are foreseen in conventional natural gas infrastructure, close collaboration with neighbouring countries is ongoing to optimise the use of existing gas infrastructure, especially in the event of a crisis. This coordination continues to take place both bilaterally, regionally (especially within the Gas Platform of the Pentalateral Energy Forum) and European (ENTSO-G).

The gas infrastructure is financed through the corresponding network charges approved by the Institut Luxembourgeois de Régulation (ILR). The use of EU funds is currently not foreseen.

The proposal for a Directive on common rules for the internal markets in renewable and natural gases and in hydrogen, presented in December 2021, lays down rules for the transmission, supply and storage of natural gas and for the transition from the natural gas system to a system based on renewable gases. It lays down common rules for the transport, supply and storage of hydrogen through the hydrogen system. She defines the organisational and operational arrangements

of this sector,	market access, criteria and	the procedures	applicable
	as regards the granting of		
of authorisations	for networks, supply and	storage of	hydrogen
	as well as the operation of		
systems. She	lays down rules for the purpose of the	implementation	gradual
	hydrogen system		

interconnected at Union level that contributes to the reduction of net greenhouse gas emissions from hard-to-decarbonise sectors, thereby promoting the decarbonisation of the Union's energy system.

This proposal for a directive, which is still following the European legislative procedure, will provide the basis for modelling the hydrogen market in which Luxembourg will actively position itself. A first step in this direction will therefore be the study on future hydrogen infrastructure needs in the Benelux region and interconnections with neighbouring regions, which will be finalised shortly.

3.4.3 Market integration

The introduction of the "BeLux" common gas market with Belgium in 2015 is one of the key measures to improve the integration of the Luxembourg gas market. This common gas market makes it easier for Luxembourg suppliers to access the Zeebrugge Liquefied Natural Gas Terminal Trading Platform and, beyond, to gas storage infrastructure. This promotes competition throughout the common market and ensures a more secure supply at lower cost to gas consumers.

Within the Pentalateral Energy Forum, the Market Integration Support Group will further develop the integration of electricity markets in the region. Indeed, this forum is a European pioneer, exploiting the full potential of transmission capacity by basing its capacity allocation methods on load flows. This will further improve market liquidity and ensure efficient congestion management and more generally ensure an efficient market at regional level. Opportunities for cross-border participation in capacity markets in France and Belgium are also being discussed. The Pentalateral Energy Forum is a framework for regional energy cooperation that has initiated several actions to further integrate the electricity market.

In the context of the common market area with Germany, Luxembourg actively supports the merger of electricity markets. The further development of the capacity calculation methodology and congestion management within the Core Region is a top priority for the day-ahead market. For the intraday market, there is both active participation in the integrated XBID platform and harmonisation of conditions for Luxembourg network users

compared to German framework conditions (in particular *Gate Closure Times*). The opening of access to the German and European balancing markets to users of the Luxembourg network has been partially completed and remains to be completed. A particular challenge, since, although the Creos transport network is a clean Scheduling Area, load-frequency control for the entire joint area is supported by the German company Amprion. Access by users of the Luxembourg network to the German and European balancing market will boost decentralised electricity generation in Luxembourg and create new marketing opportunities for households, businesses and industry in the field of demand management. Therefore, Luxembourg is also actively participating in the corresponding European Energy Exchange Platforms (MARI, PICASSO). In this context, reference should also be made to the Vianden pumping hydropower plant, which is directly connected to the German transmission network and contributes significantly to the stability of the system and security of supply in the Greater Region.

3.4.4 Facilitating the integration of new technologies and making the energy system more flexible

The energy transition requires increased flexibility at the different levels of the energy system and leads in particular in the electricity sector to a more active behaviour of network users.

In order to create a basis for this active participation of electricity consumers in the market, Luxembourg had legally obliged network operators to replace at least 95 % of all electricity meters with *smart meters by the end of 2020*. The obligation has been fulfilled and today more than 98 % of meters have been replaced by smart meters. The technical bases are therefore laid for, for example, the introduction of time-variable tariffs.

Title of the measure	No 1003 Smart Meter rollout	
Description	<p>The installation of smart meters throughout the country will contribute to the efficiency of the energy system and security of supply. National legislation foresees the deployment of smart meters of the order of 95 % in the electricity sector and 90 % in the gas sector by the end of 2020.</p> <p>As current meters have a lifetime of around a dozen years, a next generation of smart meters will start to be rolled out in the second half of the 2020s. An analysis of the functionalities required for this new generation of meters in the context of the future electricity system will be carried out ahead of this deployment.</p>	
Type of instrument	Regulatory	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
	2020	
Responsible entity/entities	Other	
Reference (s)	Amended Law of 1 August 2007 on the organisation of the electricity market	
Info complementary		

In addition, smart meters provide a technical basis that improves transparency, quality of service and efficiency

and offers opportunities for innovative energy services. This includes, for example, transparent access to own consumption data, improved commercial communication processes, boosting consumer flexibility and more efficient network operation. However, in order to take full advantage of these opportunities, it is necessary to further develop the data infrastructure. Thus, the amendment of 1^{August} 2007 on the design of the electricity market provided for the development of an energy data platform allowing, inter alia, authorised users (that is to say, the end user himself) to access relevant data on their electricity

consumption, taking into account all aspects of data protection which constitute an absolute priority. This platform is understood as a central tool for a strategy for developing flexibility in the electricity sector. Together with smart meters, this platform facilitates the creation of innovative products around flexibility and decentralised production.

Title of the measure	No 1004 Energy Data Platform	
Description	Implementation of a national IT energy data platform that will allow for greater transparency and efficiency of the electricity and natural gas market, facilitate new services such as demand response to system balancing, and help the market to benefit from technical and economic efficiency gains, in particular for large energy customers. It will also allow data protection to be respected as an integral feature of the processing carried out on the platform. Thus, the legal framework specifies, inter alia, the purposes of the platform, the implementing rules, the data to be seized, data protection and the rules on access to the platform and provides, inter alia, that the market communication is to be managed by that platform.	
Type of instrument	Regulatory	
State of progress	Implementation	
Start of implementing	End of implementation	Observations
	2026	
Responsible entity/entities	Other	
Reference (s)	Amended Law of 1 August 2007 on the organisation of the electricity market	
Info complementary		

Title of the measure	No 1005 Regulatory framework for aggregation	
Description	A regulatory framework for aggregator activity will be introduced following an amendment to the Electricity Market Design Act. This framework, the details of which will be developed by the regulator, will aim to clarify the role of aggregator, including its rights and responsibilities towards the customer and other market participant, in order to activate this market, which aims to enable customers to capitalise on their flexibility and thus become more active players in the energy transition. The possibility of enhancing flexibility will enable customers to develop their flexibility potential.	
Type of instrument	Regulatory	
State of progress	Implement	
Start of implementing	End of implementation	Observations
Responsible entity/entities	MECO, ILR	
Reference (s)	Amended Law of 1 August 2007 on the organisation of the electricity market	
Info complementary		

Title of the measure	No 1006 New tariff structure for network tariffs	
Description	<p>ILR plans to review the structure of network tariffs for customers of all voltage levels with a view to establishing a fair tariff structure conducive to the development of services that contribute to energy policy objectives, in particular:</p> <ul style="list-style-type: none"> • ensuring the reliability and quality of electricity supply, • the proportionate level of costs according to performance, • encouraging innovation and economic growth; • development of clean energy technologies • and, in general, encouraging all measures and behaviours that contribute to the decarbonisation of our societies. <p>By making it more reflective of the actual costs inflicted on the network by the various users, this new pricing method will be an element allowing for the development of the currently untapped flexibility potential for both household, professional and industrial customers.</p>	
Type of instrument	Regulatory	
State of advance	Implementation	
Start of implementing	End of implementation	Observations
	1 January 2025	
Entity (ies) responsible	ILR	
Reference (s)	Draft amendment to Regulation (EC) No E20/22/ILR of 26 May 2020 laying down the methods for fixing network tariffs	
Additional information	https://web.ilr.lu/FR/Professionnels/Electricite/Commun/Consultations/layouts/15/ILR.Internet/ConsultationsDetails.aspx?cid=117B85F1184-06D2-4B8E-9A21-0C545B8D293C	
	pertaining to the source = postings	

Title of the measure	No 1007 Dynamic electricity prices	
Description	An obligation to offer dynamic prices will be introduced for any supplier serving more than 15 000 customers. Dynamic prices are price formulae that reflect price changes in spot markets, including day-ahead and intraday markets, at intervals at least equivalent to the frequency of market settlement. The possibility for final customers to be exposed to such prices gives them the opportunity to capitalise on their flexibility	
Type of instrument	Regulatory	
State of progress	Implement	
Start of implementing	End of implementation	Observations
Responsible entity/entities	Meco, Other (s)	
Reference (s)	Amended Law of 1 August 2007 on the organisation of the electricity market	
Info complementary		

Existing regulations have been adapted to create the right framework for active consumer participation in the market.

The implementation of the Clean Energy Package under the amended Electricity Market Design Act of 1 August 2007 increases consumers' electricity flexibility. The amendments to this law, most recently in 2022, have regulated and promoted self-consumption based on renewable energy, whether individual or collective. In addition, the concept of energy communities has been introduced which enables it to produce, consume, store and sell the electricity produced by the generating units owned by it or its members, to organise the sharing, within the energy community, of the electricity produced by the generating units owned by that energy community or its members or shareholders, to access all relevant energy markets directly or through aggregation, and to provide energy efficiency related services, recharging services for electric vehicles or other energy services to its members or shareholders.

ILR publishes annual reports on the electricity and gas market. These reports analyse, in particular, the competitive situation in the markets based on the number of suppliers operating in Luxembourg and the switching rates of customers in different segments. In addition, ILR prepares an annual report on the conformity of electricity and gas supply prices with public service obligations.

Title of the measure	No 1008 Facilitation of power sharing and energy communities	
Description	Provided for by law since February 2021, energy communities and collective self-consumption will be encouraged by the legal framework and accompanying measures. Electricity sharing shall be facilitated by a platform managed by system operators allowing the allocation of energy quantities according to the needs of a sharing group. The Klima-Agency will advise citizens wishing to create energy communities and make available model agreements to facilitate such creation.	
Type of instrument	Regulatory, information	
State of progress	Implement	
Start of implementing	End of implementation	Observations
2021		
Responsible entity/entities	Meco, Klima-Agence, Network Manager	
Reference (s)	Amended Law of 1 August 2007 on the organisation of the electricity market	
Additional info		

Title of the measure	No 1009 Support for long-term contracts (power purchase agreements)	
Description	<p>As set out in Solidarités Pak 2.0 of 28 September 2022, this measure will encourage companies to source energy directly from renewable energy suppliers through <i>power purchase agreements</i> (PPPs).</p> <p>PPPs mainly favour the consumption of energy from renewable resources at stable prices which are currently below market prices. They thus contribute both to the competitiveness of companies in the current crisis and to the energy transition through the decarbonisation of production processes.</p> <p>In this context, the Government will develop new de-risking instruments for certain sectors particularly exposed to the risk of a competitive disadvantage due to the cost of energy due to the energy crisis. Through these instruments, these companies will be able to benefit from aid which will cover the difference between the market price and the price of energy paid under a PPP in the event that energy prices on the market fall below PPP prices.</p> <p>These changes will be made subject to approval by the relevant services of the European Commission.</p>	
Type of instrument	Regulatory	
State of progress	Implementation, Planified	
Start of implementing	End of implementation	Observations
2022	2024	
Responsible entity/entities	MECO	
Reference (s)	Solidaritésits Pak 2.0	
Additional info		

Title of the measure	No 1010 Express support mechanism for flexibility	
Description	Flexibility on the electricity demand side is a key element to enable the very large scale deployment of decentralised renewable generation in the electricity system. Although measures such as a new tariff structure (see measure No 1006) or the introduction of dynamic energy prices (measure No 1007) are intended to encourage the development of flexibility, these measures do not guarantee that sufficient flexibility is deployed on this basis. To this end, Regulation 2024/XXXX on improving the design of the EU electricity market provides for an assessment of the flexibility needs to be carried out by the regulator on the basis of a methodology to be developed at European level with the participation of network operators and the European Agency for the Cooperation of Energy Regulators (ACER). If this evaluation, to be carried out first in 2027, shows a need, an explicit mechanism to support flexibility will be introduced.	
Type of instrument	Regulatory	
State of progress	Planned	
Start of implementing	End of implementation	Observations
2024	2027	
Responsible entity/entities	MECO, ILR	
Reference (s)	Regulation 2024/XXXX on improving the design of the EU electricity market	
Additional info		

3.4.5 Energy poverty

Preventing and reducing energy needs is the key to minimising the risk that people do not have sufficient means to heat their homes or that they will not be able to pay their electricity, gas, water and heating bills.

Specific measures are targeted at households in energy poverty and/or low-income households.

Measure **No 317**: Awareness raising, information, guides and consultancy services on buildings

Measure **No 311**: Individual housing aid scheme

Measure **No 312**: Stone aid scheme

Measure **No 329**: Assistance to households in energy poverty

These measures are complementary to cross-cutting measures:

Measure **No 310**: Climate Loan Scheme

Measure **No 316**: Long-term Building Renovation Strategy

Measure **No 309**: Pre-financing under the Klimabonus Wunnen scheme

Measure **No 324**: Minimum energy performance requirements for rented dwellings
(incentives for owners)

Measure **No 405**: Promoting public transport

In the event that these measures are not sufficient, the current social assistance legislation stipulates that any person eligible for social assistance has the right to a minimum supply of domestic energy under specified conditions, if they are unable to cover the cost of their domestic energy.

3.5 Dimension Research, innovation and competitiveness

3.5.1 Specific R & D & I measures

The strategies and tools in place and the sample of public and private R & D & I activities highlighted in chapter 2.5 show the broad scope of the topics. Despite existing strategies, R & D & I capacities for the energy transition are often too fragmented and insufficiently coordinated, not allowing effective responses to interdisciplinary challenges to be produced on the one hand, and on the other hand to activate these responses and implement solutions. The NRF also recognised this lack of coordination and launched in early 2023 a new ncer project (National Centre of Excellence in Research) on energy transition and climate action (included as Measure No 115 below)⁴⁹.

Part of the proposed measures directly linked to R & D & I actors and taken over in Chapter 3.1 — The decarbonisation dimension therefore aims to strengthen collaborations.

interdisciplinary across the entire chain of maturity (from basic research to technological or regulatory implementation) and thus speed up the implementation of solutions produced by the public and private R & D & I ecosystem in Luxembourg. They will contribute to increasing the country's attractiveness to innovative talent and actors in all scientific and technological disciplines and to strengthening the competitiveness of actors. Two types of measures are prioritised for these purposes, measures to (1) provide incentives for inter- and transdisciplinary collaborations through federative funding and (2) strengthen the research teaching capacities of the University of Luxembourg through professors' chairs, which will also contribute to the development of existing academic ecosystems. R & D & I specific measures:

Measure 115: National Centre of Excellence in Research (ncer) for energy transition and climate action

Measure 116: Strategic R & D & I Programme for Governance of the Energy Transition and Climate Action

Measures 117: Support the establishment of research chairs and public-private or public-public partnerships at the University of Luxembourg and public research centres

Measure No 117 reflects the importance of the creation, dissemination and dissemination of knowledge and scientific and technological know-how at the level of initial (including academic) and continuing training, and even society as a whole. The systemic changes required to succeed in the energy transition require above all its ownership by all actors in society. It is important to note that the establishment of these chairs will be conditional on long-term third-party funding to ensure the involvement of public and private stakeholders, that the chairs will have to be integrated into the University's thematic development strategy and that they will ultimately have to be validated by the university's governing bodies.

These measures are in line with the R & D & I measures proposed in the 1st^{edition} of the NECP for the period 2021 to 2030 times below and contribute to making them more operational, namely:

- Rebuilding a research infrastructure involving all relevant actors in the field of research and innovation
- Continued increase in investment in energy research and development
Strengthening the efforts and capacity of national research institutes
Luxembourg as an international hub for climate solutions

⁴⁹ The Ministry of Higher Education and Research and the National Research Fund launch the National Centres of Excellence in Research programme – [gouvernement.lu//Le Government of Luxembourg \(https://gouvernement.lu/fr/actualites/toutes_actualites/communiqués/2023/01-janvier/24-meisch-pprogramme-recherche.html\)](https://gouvernement.lu/fr/actualites/toutes_actualites/communiqués/2023/01-janvier/24-meisch-pprogramme-recherche.html)

3.5.2 Other measures of the NECP related to R & D & I activities

Beyond the specific R & D & I measures many other measures of the NECP can rely on public and private R & D & I skills and vice versa feed into R & D & I activities. Indeed, the implementation of the ambitious objectives of the NECP relies heavily on accelerated technological and socio-economic innovation. Brief details of the examples adduced are as follows:

Measures No 106, 107, 108, 110 or 112, which propose alternative approaches to the development of the territory and urban planning and support the municipalities to be set up;
Measures No 215, 216, 222 or 223 for the development of renewable energy production and storage sectors,
Measures 316, 322 or 323 in relation to sustainable construction and renovation and the need to put in place life cycle assessment methodologies to assess the overall climate impacts of buildings,
Measures No 427, 510, 514, 523 or 513 relating to the decarbonisation of transport, logistics and industrial or artisanal production activities, including carbon capture, storage and utilisation technologies;
Measures 522, 602 and 603 aiming at more resource efficient management and a reduction in the associated carbon footprint through the principles of the circular economy.

It should be noted that the toolbox of policies and measures contained in Chapter 3.1.1.4 aims to foster the development of net-zero projects useful for energy-intensive industries.

3.5.3 Financing and cooperation

The objectives and means of financing R & D & I activities are described in Chapter 2.5, both at national and European level. Given the size of the country and the very strong organisational links with the Wielkoregion and Europe, collaboration with R & D & I actors beyond national borders is crucial for developing common solutions. These collaborations are in particular successfully supported by Luxinnovation: the 2022 MESR activity report provides information as well as 150 new Horizon Europe contracts involving Luxembourgish participants were signed in 2022.⁵⁰ The retention of Luxembourg's^{7th} place in the European innovation table in 2022, with a leading position in the ranking of the most attractive research systems⁵¹, also reflects the importance attached to international cooperation.

Two measures of the NECP specifically contribute to increasing the funding available for R & D & I activities related to the energy transition and climate action, namely:

Measure 103: Climate and Energy Fund, established by the Climate Law (Measure 101)

Measure 104: Just Transition Fund, a new financial instrument of the European Union's cohesion policy.

A number of NECP financial measures also contribute to ensuring affordable energy prices for companies, which is an important and equally important factor in helping companies to decarbonise their own activities. This includes a package of financial support measures, described in chapter 3.1.1.4 (decarbonisation dimension of industry) and chapter 3.4 (internal energy market dimension). There are also measures for decarbonised mobility and logistics (Nos 425, 426 and 427). The effects of these measures in terms of nationally competitive

2022 activity⁵⁰ report of the Ministry of Higher Education and Research (<https://gouvernement.lu/dam-assets/fr/publications/report-active/minist-enseignement-superieur-recherche/2022-rapport-activite-mesr/mes-rapport-annuel-2022.pdf>)

The⁵¹ three indicators under the heading 'attractiveness of the research system' are international scientific co-publications, quotes from scientific publications and the share of foreign doctoral candidates, see also https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard_en#european-innovation-scoreboard-2022.

energy prices are illustrated in Chapter 4.5.3 – Electricity and gas markets, energy prices.

4 current status and projections based on existing policies and measures. In order to create a sound analytical basis for Luxembourg’s energy and climate policy analysis, modelling has been entrusted to a group of national experts. The long-term projections have been drawn up by STATEC in collaboration with the Environment Administration (AEV), the Rural Economy Service (SER) and experts from the various ministries concerned. STATEC was tasked with modelling energy consumption and production as well as GHG emissions from combustion, while RES dealt with the agriculture sector and AEV the waste sector.

As requested by Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action, two scenarios were identified:

- The **WEM** (With Existing Measures) is **based on existing policies and measures, which were adopted until 31 December 2021**. It mainly consists of an extension of trends in historical data and is presented in **Chapter 4**.
- The **WAM (With Additional Measures) scenario incorporates additional (new and enhanced) policies and measures**, as described in Chapter 3. It is presented in **Chapter 5**.

The projections were made using a number of complementary tools. The main STATEC models are three:

- The Modux econometric model is used to prepare the macroeconomic projections that form the basis for the annual update of the Stability and Growth Programme in the context of the “European Semester”. The main results relate to economic and demographic growth, as well as fuel sales by 2028.
- The ThreeME general equilibrium model is used for the macroeconomic projections for 2050. It replicates Modux’s medium-term projections and is coupled with the NEAM energy model. Unlike the latter, ThreeME makes it possible to assess the impact of fiscal measures such as the CO₂ tax.
- The NEAM energy model allows energy consumption and GHG emissions to be projected, including all available information on flows and stocks of buildings and vehicles. For example, it makes it possible to assess the impact of measures concerning buildings, or the impact of electric cars or modal choice.
- A macrodemographic model of STATEC which considers the attraction of foreign workers according to economic determinants and subsequently determines the age structure of the population. The resulting macrodemographic scenarios are then replicated by the ThreeME and NEAM models.

Both scenarios (WEM and WAM) are based on a set of assumptions regarding the main exogenous factors. Overall, it should be noted that while the projections serve as guidance, as they take into account Luxembourg’s most current data and specificities, any long-term projection is always linked to inherent uncertainties. This is particularly true for a small open economic system such as Luxembourg. Therefore, decisions taken in partner countries or at European level, or even global developments, can lead to considerable changes in the assumptions underlying the scenarios presented in this plan.

4.1 Projected evolution of the main exogenous factors

In the WAM scenario, a more dynamic evolution of national demand elements related to the energy transition would have a small but positive impact on growth. As a result, GDP, population, employment and number of border residents are slightly higher in the WAM scenario than in WEM.

4.1.1 Macroeconomic forecasts

According to STATEC projections, Luxembourg’s population will increase in the WAM scenario from around 635 000 inhabitants in 2020 to around 751 000 in 2030, then to around 844 000 in 2040 and 930 000 in 2050. This is equivalent to an average growth of 1.7 % per year until 2030, which will then decrease to 1.2 % per year between 2030 and 2040 and to 1.2 % per year between 2040 and 2050. In total, Luxembourg’s population will increase by around 18 % by 2030 compared to 2020, by around 33 % by 2040 and 47 % by 2050.

Table 37: Population growth and Gross Domestic Product (GDP) in WEM and WAM scenarios

WEM	Units	2020	2025	2030	2035	2040	2045	2050
Population	Thousand	635	695	747	795	840	884	926
GDP	Annual average growth in%	— 0,9	3,0	2,0	2,1	2,3	2,1	2,0

WAM	Units	2020	2025	2030	2035	2040	2045	2050
Population	Thousand	635	699	751	798	844	888	930
GDP	Annual average growth in%	— 0,9	2,9	2,0	2,0	2,4	2,1	2,1

Sources: STATEC (2024)

According to Modux’s short-term projections (until 2025), STATEC modelling projects an annual growth rate of Gross Domestic Product of 2.9 % in the WAM scenario in 2025.

4.1.2 Assumptions about energy prices

As regards the assumptions about price trends in global and European energy markets, the European Commission recommendation⁵² was followed.

Table 38: Assumptions regarding price developments for fossil energy sources

	Unit	2020	2025	2030	2035	2040	2045	2050
Oil	EUR 2023/toe	320	520	582	645	663	718	825
Natural gas (NCV)		155	394	377	344	422	412	403
Coal		80	172	169	161	160	166	166

Sources: European Commission (2024)

4.2 Decarbonisation dimension

4.2.1 GHG emissions and removals

4.2.1.1 Changes in annual GHG emissions for the period 2005 to 2022

The evolution of annual GHG emissions from 2005 to 2022 is presented in Table 39. In **2022**, a total of 8.19 million tonnes CO_{2eq} were emitted, corresponding to a **reduction of 37 % compared to 2005**. **86 %** of emissions in 2022 (7.06 million tCO_{2eq}) are attributed to Luxembourg under the Effort Sharing Regulation⁵³, the scope of which is identical to that of the amended Climate Law of 15 December 2020 for the period 2021-2030 (**ESR emissions/Climate Law**). **14 %** (1.13 million tCO_{2eq}) are accounted for under the Emission Trading System⁵⁴ (**ETS**). Finally, in 2022, the balance of GHG emissions and removals from land use, land use change and forestry (Land Use, Land Use Change and Forestry)⁵⁵ amounted to -0.65 million tCO_{2eq} (**LULUCF**).

For **ESR emissions/Climate Law**, emissions in **2022** were lower than in 2021 (-12.5 %) and are 23.6 % below the 2019 level, respectively 30.2 % below the base year 2005 level. They are also 9.2 % lower than the 2022 emission allocation set under the Grand-Ducal Regulation of 22 June 2022 determining annual greenhouse gas emission allocations for the period up to 31 December 2030 (see also Figure 1). **The national emission reduction target for the year 2022 was therefore met, as was the case for the year 2021.**

Table 39: Historical GHG emissions and removals

(Thousand tonnes CO _{2eq} (AR5))	2005 *	2019	2020	2021	2022
Energy and manufacturing industries, construction	442	539	540	614	566
Transport	7164	6171	4618	4919	4217

⁵²European Commission (2024), Recommended parameters for reporting on GHG projections in 2025

⁵³R (EU) 2018/842 on binding annual GHG emission reductions by Member States from 2021 to 2030. This Regulation took over from Decision 406/2009/EC on the effort of Member States to reduce their greenhouse gas emissions (“Effort Sharing Decision”).

⁵⁴Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Union

⁵⁵R (EU) 2018/841 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry

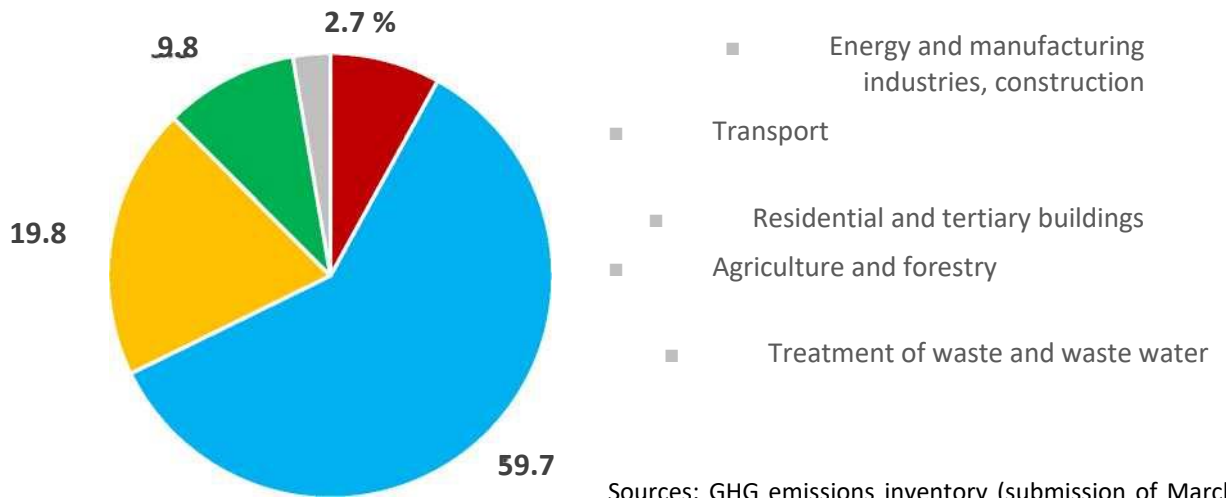
Residential and tertiary buildings	1630		1608	1587	1621	1395
Agriculture and forestry	696		710	721	717	689
Treatment of waste and waste water	184		207	194	193	192
ESR Emissions/Climate Law	10116		9235	7661	8065	7058
ETS EMISSIONS	2919		1496	1377	1317	1134
Emissions TOTALES – ESR/Climate Law	13035		10731	9037	9383	8192
LULUCF	– 572		– 367	– 451	– 608	– 648

* 2005 data are the figures for determining the national 2030 climate target as well as the sectoral targets, based on the verified inventory of 2021 and taking into account the current scope of the EU Emissions Trading System (EU-ETS).

Sources: GHG emissions inventory (submission of March 2024)

Furthermore, in 2022, ESR emissions/climate law were dominated by the transport sector (59.7 %), followed by buildings (19.8 %), agriculture (9.8 %), industry (8.0 %) and waste (2.7 %), as illustrated in Figure 20.

Figure 20: Sectoral breakdown of GHG emissions under the Climate Law in 2022

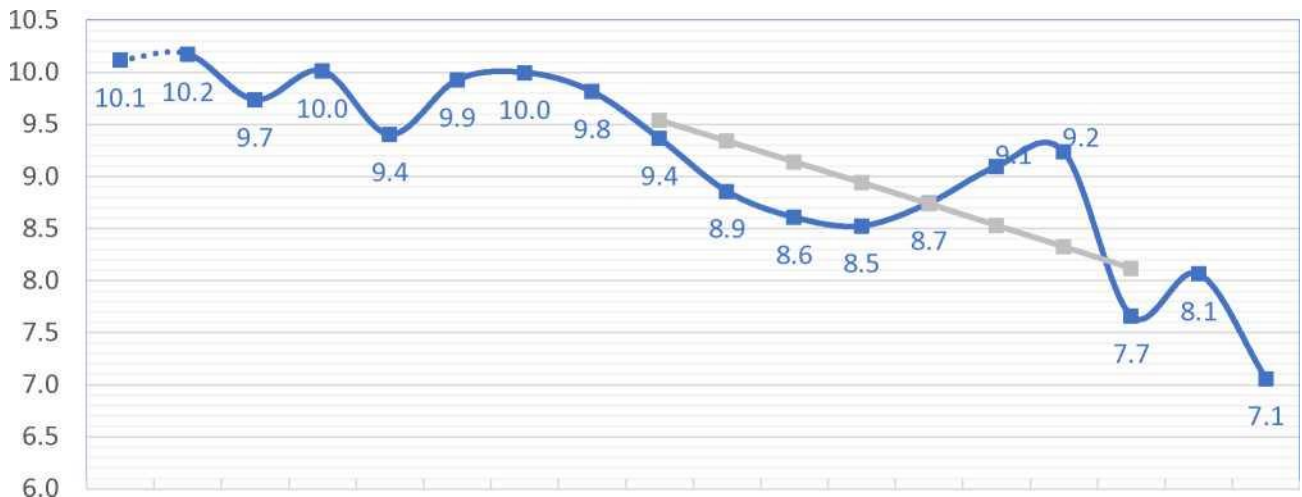


Sources: GHG emissions inventory (submission of March 2024)

Finally, the evolution of non-ETS emissions (ESR emissions/climate law) is shown in Figure 21 for the whole period between 2005 and 2022. It is compared to the trajectory of Decision 406/2009/EC on the effort of Member States to reduce their greenhouse gas emissions (ESD) from 2013 to 2020.



Figure 21: Evolution of non-ETS emissions (ESR emissions/Climate Law) for the period 2005 to 2022



Source: GHG emissions inventory (submission of March 2024)

4.2.1.2 projections based on existing policies and measures (WEM scenario)

The **WEM** (With Existing Measures) is **based on existing policies and measures, which were adopted until 31 December 2021**. The following tables show the results of the WEM projections for each of the 5 Climate Law sectors, for installations falling under the scope of the ETS Directive and for the LULUCF sector.

Table 40: Projections of GHG emissions and removals up to 2030 based on existing policies and measures (**WEM scenario**)

(Thousand tonnes CO _{2eq} (AR5))	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
	**	**								
Energy and manufacturing industries, construction	614	566	556	532	510	488	466	444	423	402
Transport	4919	4217	4494	4575	4550	4476	4401	4283	4152	4031
Residential and tertiary buildings	1621	1395	1663	1641	1610	1574	1545	1522	1489	1454
Agriculture and forestry	717	689	713	706	702	700	699	701	702	704
Treatment of waste and waste water	193	192	184	180	177	173	170	167	164	165
ESR Emissions/Climate Law	8065	7058	7610	7635	7549	7411	7282	7117	6930	6756
ETS EMISSIONS	1317	1134	1310	1304	1297	1291	1285	1279	1273	1268
Emissions TOTALES – ESR/Climate Law	9383	8192	8921	8938	8846	8702	8567	8396	8204	8023
LULUCF	– 608	– 648	– 398	– 360	– 327	– 306	– 278	– 266	– 235	– 201

* Emissions for the years 2021 and 2022 are observed data from the latest GHG emission inventory (submission of March 2024). Projections start from 2023 onwards.

Sources: STATEC, AEV & SER (2024)

Table 41: Projections of GHG emissions and removals up to 2050 based on existing policies and measures (**WEM scenario**)

(Thousand tonnes CO _{2eq} (AR5))	2025	2030	2035	2040	2045	2050
Energy and manufacturing industries, construction	510	402	324	256	216	188
Transport	4550	4031	3552	3250	3055	2883
Residential and tertiary buildings	1610	1454	1278	1105	939	741
Agriculture and forestry	702	704	711	705	698	692
Treatment of waste and waste water	177	165	167	169	171	171
ESR Emissions/Climate Law	7549	6756	6032	5485	5078	4675
ETS EMISSIONS	1297	1268	1242	1219	1210	1207
Emissions TOTALES – ESR/Climate Law	8846	8023	7274	6703	6287	5882
LULUCF	– 327	– 201	– 53	– 211	– 360	– 508
TOTAL stocktaking – ESR/Climate & LUCF	8519	7822	7221	6492	5928	5374

Sources: STATEC, AEV & SER (2024)

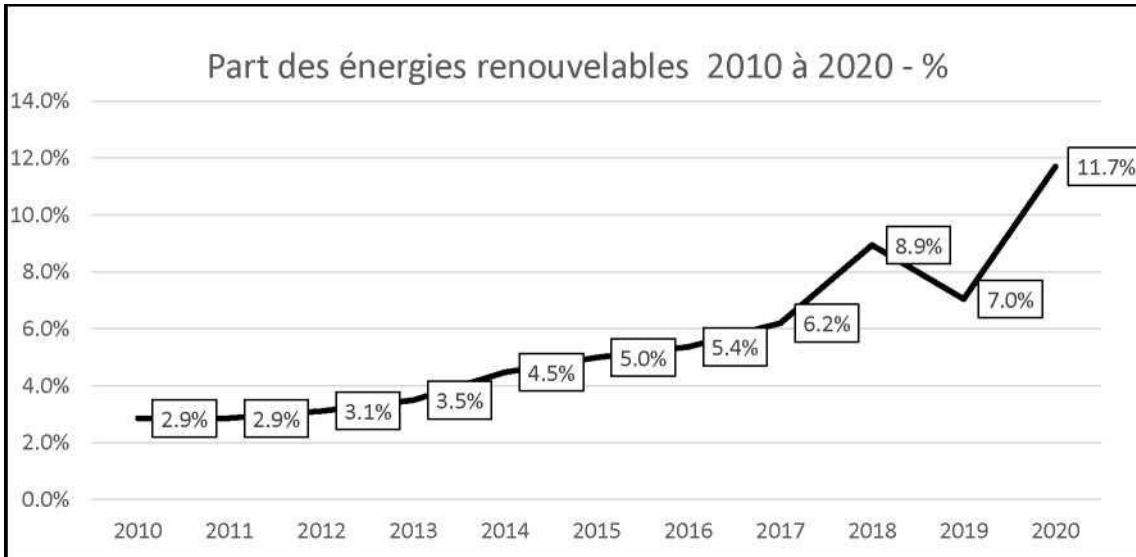
4.2.2 renewable energy

The Council of Government adopted the initial version of the National Climate and Energy Plan (NECP) on 20 May 2020. This plan describes policies and measures following a baseline and a baseline scenario which describes the ambitious national targets to be pursued to achieve a reduction in greenhouse gas emissions (55 %), a minimum share of renewable energy in Luxembourg's gross final energy consumption (25 %) and energy efficiency measures

(reducing energy consumption by 4044 %) by 2030. Details of sectoral targets and related technologies can be found in Chapter 2.1.2 Renewable energy. The following chapter describes the scenario with existing measures.

Baseline Situation: historical evolution of renewable energy production across sectors from 2010 to 2020

Figure 22: Share of renewable energy in gross final energy consumption: period 2010 to 2020, including European cooperation



Sources: EUROSTAT (SHARES)

Throughout the period 2010 to 2020 and driven by the Renewable Energy Action Plan (NREAP), the share of renewable energy has continuously increased (Figure 22). This graph includes both national production and European statistical transfers. The gap in 2019 is explained by the fact that no indicative trajectory or binding target was set and no statistical transfers took place.

In 2022, according to the figures published by EUROSTAT, the overall share of renewable energy in gross final energy consumption was 14.36 %, representing substantial growth over the last decade.

The evolution of the shares of renewable energy in the electricity, heat and transport sectors for the years 2017 to 2022 is set out in Table 42. During this period, the share of renewable energy almost doubled from 5.9 % to 11.23 % (without European cooperation).

Table 42: Share of renewable energy by sector between 2017 and 2022

EUROSTAT-SHARES	2017	2018	2019	2020	2021	2022
RES share, electricity sector%	8.1 %	9.1 %	10.9 %	13.9 %	14.2 %	15.94 %
RES share, heat sector%	7.5 %	8.5 %	8.9 %	12.7 %	12.9 %	15.41 %
RES share, sector transport (without multipliers)%	5.4 %	5.4 %	7.0 %	8.0 %	8.0 %	8.72 %
Total RES share — production/consumption%	5.9 %	6.2 %	7.0 %	10.1 %	9.9 %	11.23 %
Total RES share – RES cooperation included%	5.9 %	8.6 %	7.0 %	11.7 %	11.7 %	14.36 %

The distribution of renewable energy sources differs according to the feasibility of potential projects in the national territory. Due to its geography, territorial isolation and topography, Luxembourg focuses primarily on the deployment of wind, photovoltaic and biomass, while ensuring regional availability of raw material and compliance with sustainability and greenhouse gas emissions saving criteria and cascading use of biomass.

NECP 2020: comparative: reference Scenario (WEM) and Target Scenario (WAM)

Table 43: Share of renewable energy by sector by 2040 – NECP Baseline 2020

Referenzszenario

		EE-Energieerzeugung, Energiemengen absolut EE-Anteil, gemessen an (sektoraler) Nachfrage										
	Einheit	2020	2025	2030	2035	2Q4Q	Einheit	2020	2025	2030	2035	2040
EE-Strom		752	1.249	1.731	2.071	2.332		11.9 %	19.4 %	26.5 %	31.3 %	34.7 %
EE-Wärme		1.626	2.070	2.462	2.699	2.896		12.1 %	15.4 %	18.6 %	20.4 %	21.9 %
EE-Biokraftstoffe		1.855	1.892	1.993	1.450	1.450		7.7 %	8.0 %	8.0 %	5.6 %	5.5 %
EE-Verkehr, gesamt *		2.784	3.438	4.463	4.355	5.390	%	11.1 %	13.5 %	16.1 %	15.1 %	17.6 %
EE-Gesamt, national	GWh	4.232	5.211	6.187	6.221	6.679		9.2 %	11.2 %	12.9 %	12.8 %	13.5 %
EE-Kooperationsbedarf		1.000	2.917	4.833	4.833	4.833		2.2 %	6.2 %	10.1 %	9.9 %	9.7 %
EE-Gesamt, inkl. Kooperation		5.232	8.128	11.020	11.054	11.512		11.3 %	17.4 %	23.0 %	22.7 %	23.2 %
Vergleich: Bruttoend — energiebedarf **		46.119	46.717	47.913	48.773	49.650						

The referencescenario of the 2020 NECP based on the existing measures (WEM) is continuously but not sustained throughout the period 2030 to 2040. Renewable energy production increased from 6.187 GWh in 2030 (without European cooperation) to 6.679 GWh in 2040 – growth of 8 % over a period of 10 years (Table 43). This relatively low growth in the baseline shows the need for additional measures to accelerate the deployment of renewable energy.

Table 44: Share of renewable energy by sector by 2040 – NECP Target scenario 2020

Zielszenario Paris Art. 2.1a

	EE-Energieerzeugung, Energiemengen absolut					EE-Anteil, gemessen an (sektoraler) Nachfrage						
	Einheit	2020	2025	2030	2035	2040	Einheit	2020	2025	2030	2035	2040
EE-Strom	GWh	748	1.563	2.251	2.68ACC	3.150		11.9 %	23.5 %	33.6 %	38.8 %	45.4 %
EE-Wärme		1.626	2.03AC	2.551	2.495	2.609		13.7 %	19.9 %	30.5 %	35.8 %	47.1 %
EE-Biokraftstoffe		1.632	1.563	1.485	1.738	1.749		7.5 %	8.8 %	10.0 %	14.4 %	18.7 %
EE-Verkehr, gesamt *		2.581	3.755	4.769	7.391	9.587	%	11.3 %	18.4 %	25.6 %	40.4 %	54.3 %
EE Gesamt, national		4.006	5.156	6.287	6.914	7.508		9.4 %	13.9 %	19.6 %	24.8 %	31.9 %
EE-Kooperationsbedarf		1.000	1.374	1.748	1.748	1.748		2.3 %	3.7 %	5.4 %	6.3 %	7.4 %
EE-Gesamt, inkl. Kooperation		5.006	6.530	8.035	8.662	9.257		11.8 %	17.6 %	25.0 %	31.0 %	39.3 %
Vergleich: Bruttoendenergiebedarf **		42.587	37.203	32.141	27.926	23.526						

A comparison of the two scenarios shows that, from the outset, there was a clear political will to make progress in renewable energy production in the national territory. For 2030, total energy consumption is reduced significantly, in particular on the basis of energy efficiency measures. Therefore, the share of renewable energy in gross final energy consumption increases from 12.9 % to 19.6 % for the target scenario. For 2040, domestic renewable energy production increases by 830 GWh. The share of renewable energy increased from 13.5 % to 31.9 % (Table 44).

This significant gap between the two scenarios shows that the renewable energy targets are ambitious and have a significant impact on the share of renewables. The relative increases between the different scenarios are shown in Table 45.

Table 45: Relative differences between target and baseline scenario – 2020 NECP

Veränderung Zielszenario zu Referenzszenario

	EE-Energieerzeugung, Energiemengen absolut					EE-Anteil, gemessen an (sektoraler) Nachfrage						
	Einheit	2020	2025	2030	2035	2040	Einheit	2020	2025	2030	2035	2040
EE-Strom	Veränderung, bezogen auf Referenzszenario	—	25.2 %	30.0 %	29.4 %	35.0 %		— 0.1 %	21.1 %	26.4 %	24.0 %	31.0 %
EE-Wärme		0.0 %	— 1.9 %	3.6 %	— 7.6 %	— 9.9 %		13.4 %	29.2 %	63.8 %	75.6 %	114.6 %
EE-Biokraftstoffe		— 12.0 %	— 17.4 %	— 25.5 %	19.8 %	20.6 %		— 2.5 %	10.1 %	25.6 %	155.2 %	242.3 %
EE-Verkehr, gesamt *		—	9.2 %	6.9 %	69.7 %	77.9 %		1.9 %	36.2 %	59.3 %	168.1 %	208.9 %
EE-Gesamt, national		—	— 1.1 %	1.6 %	11.1 %	12.4 %		2.5 %	24.2 %	51.5 %	94.1 %	137.2 %
EE-Kooperationsbedarf		0.0 %	— 52.9 %	— 63.8 %	— 63.8 %	—		8.3 %	— 40.8 %	— 46.1 %	— 36.8 %	— 23.7 %
EE-Gesamt, inkl. Kooperation		—	— 4.3 %	— 19.7 %	— 27.1 %	— 21.6 %	19.6 %		3.6 %	0.9 %	8.7 %	36.9 %

- inkl. Multiplikationsfaktoren gemäß Berechnungslogik hinsichtlich des EE-Anteils im Verkehrssektor
 - Unter Berücksichtigung der Deckelung des Energiebedarfs für Flugverkehr: Das EU-Régulativ schreibt eine Deckelung bei der Berücksichtigung des Energiebedarfs des Flugverkehrs dar, sodass im Falle der Vergleichsweise kleiner Mitgliedsstaaten yesterday keine Verzerrung bzw. Pönalwirkung absehen würde. Der Energiebedarf für Flugverkehr liegt bei beiden Szenarien im Jahr 2030 bei 5.936 GWh - aufgrund der Deckelung werden für jedoch nur 2.216 GWh für die Ermittlung des Bruttoendenergiebedarfs berücksichtigt. Im Falle Luxemburgs bedingt dies folglich eine merkbare Verminderung des dis Bezugsgröße für den gesamten EE-Anteil relevanten Bruttoendenergiebedarfs - ohne Flugverkehrsdeckelung käme dieser beispielsweise gemäß Zielszenario im Jahr 2030 bei 35.861 GWh zu liegen, mit Berücksichtigung der Deckelung ergeben sich die angegebenen 32.141 GWh.

Evolution of the production of energy from renewable sources by sector by 2040 following the With Existing measures (WEM) scenario

In this chapter, developments in renewable energy production in the various sectors are presented for the WEM scenario. The WEM and WAM (With Additional Measures) scenarios are modelled on the NEAM model developed by STATEC.

WEM scenario – Renewable electricity sector

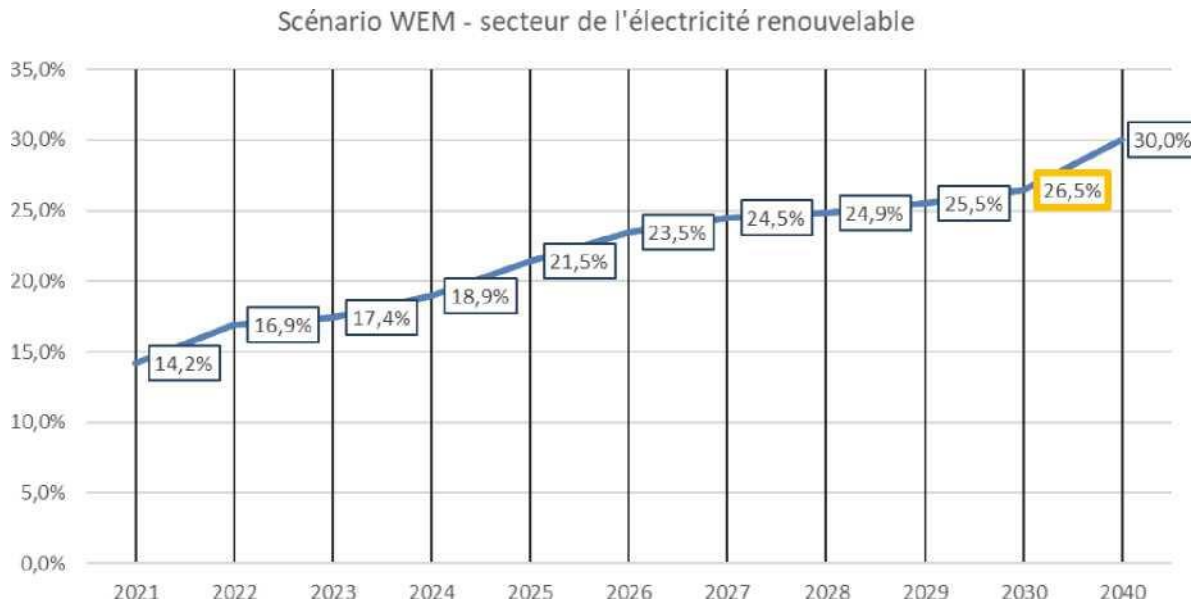
Table 46: Projected evolution of renewable sources/technologies in the **renewable electricity sector by 2040 – WEM scenario**

WEM scenario – GWh	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Hydroelectric power	104	104	104	104	104	100	100	100	103	103	102
Eolien	315	328	348	417	540	640	679	692	726	785	1016
Photovoltaic	180	303	322	362	419	475	516	544	569	592	838
Renewable waste	43	43	44	45	46	47	48	49	49	50	60
Biogas *	62	63	63	63	63	63	64	64	64	64	65
Solid biomass * *	285	290	298	306	314	323	331	340	348	356	428
RES production	989	1131	1180	1297	1486	1648	1738	1788	1859	1950	2508
Consumption – EI	6954	6687	6775	6846	6924	7014	7101	7189	7278	7369	8358
RES share – Electricity – %	14.2 %	16.9 %	17.4 %	18.9 %	21.5 %	23.5 %	24.5 %	24.9 %	25.5 %	26.5 %	30.0 %

Sources: STATEC-MECO modelling/DG Energy 2024

In the WEM scenario, the generation of electricity from renewable sources is mainly driven by wind and photovoltaic. Between 2030 and 2040, PV grew by more than 40 %, while wind power grew by 30 %. Solid biomass grew only slightly between 2021 and 2040, with a total growth of 50 % over the two decades. Hydropower, renewable waste and biogas sectors show only very low growth in the years 2021 to 2040. With existing measures, the share of renewable energy in the electricity sector increased to 30 % in 2040 (Figure 23).

Figure 23: WEM scenario – Renewable electricity sector developments 2021-2030 and 2040



Sources: Scenario modelling WEM STATEC-MECO/DG Energy 2024, MECO Graph/DG Energy

WEM Scenario – Renewable Heat Sector

Table 47: Projected evolution of renewable sources/technologies in the renewable heat sector by 2040 – WEM scenario

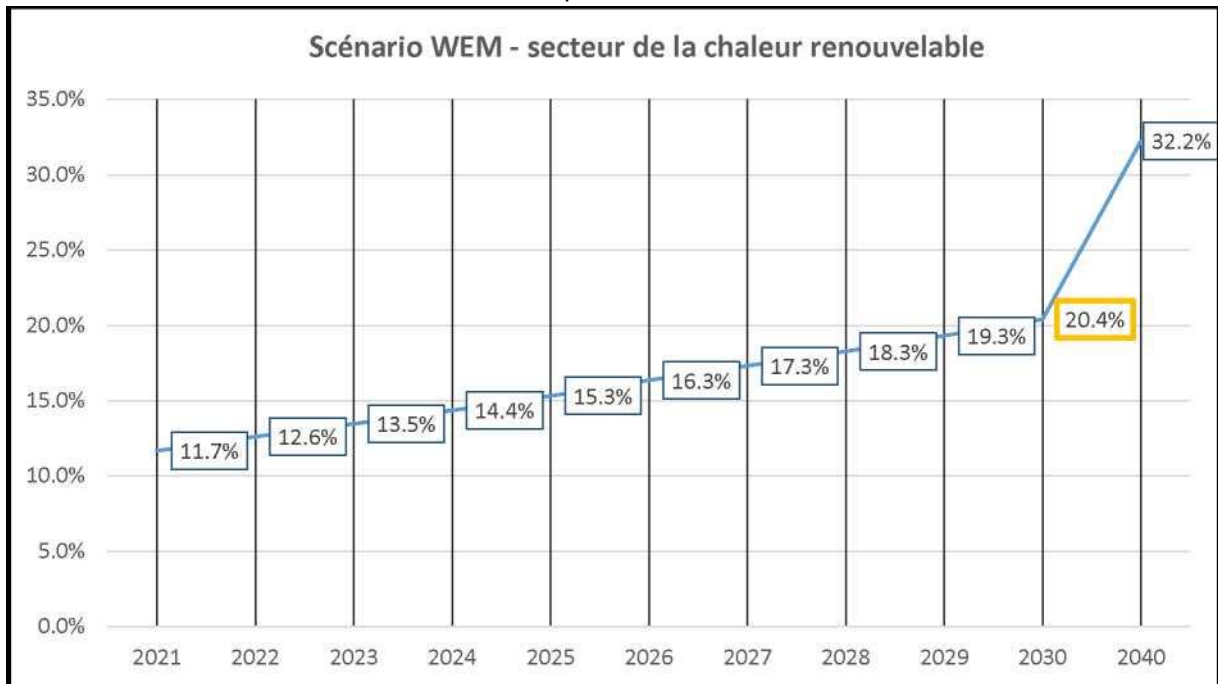
WEM scenario – GWh	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Biogas (centralised) – biomethane	30	30	30	30	30	30	30	31	31	31	32
Solid biomass (centralised)	1203	1.226	1.262	1.296	1.330	1.367	1.401	1.436	1.471	1.505	1.810
Solid biomass (decentralised)	175	175	173	173	172	171	170	170	169	168	158
Renewable waste (centralised)	12	12	12	12	13	13	13	13	13	14	16
Solar heating panels	31	35	35	35	35	35	35	35	35	35	35
Heat pumps (PAC)	54	137	209	274	336	397	457	519	581	643	1.242
Hydrogen renewable (Industry)	0	0	0	0	0	0	0	0	0	0	0
RES consumption	1506	1615	1721	1819	1916	2013	2107	2204	2300	2396	3293
Consumption –ch	13277	12808	12790	12677	12510	12322	12180	12075	11917	11750	10219
RES share – heat sector%	11.3 %	12.6 %	13.5 %	14.4 %	15.3 %	16.3 %	17.3 %	18.3 %	19.3 %	20.4 %	32.2 %

Sources: STATEC-MECO modelling/DG Energy 2024

In the WEM scenario of renewable heat production, the importance of heat pumps is becoming increasingly visible, in particular for decarbonising the building sector. Among the different renewable heat sources, heat pumps played an almost negligible role in 2021 (4 % 367/450 share

of all renewable heat sources), although in 2040 their share increased to 37.8 % (Table 47) The use of solid biomass as a transitional renewable energy source remains important, especially in the industrial sector and district or communal heating networks. Renewable heat from biomass remains predominant until 2040. Figure 24 shows the evolution of the share of renewable energy in the heat sector between 2021-2030 and 2040.

Figure 24: WEM scenario – Renewable heat sector development 2021-2030 and 2040



Source: STATEC-MECO modelling/DG Energy 2024, MECO Graph/DG Energy

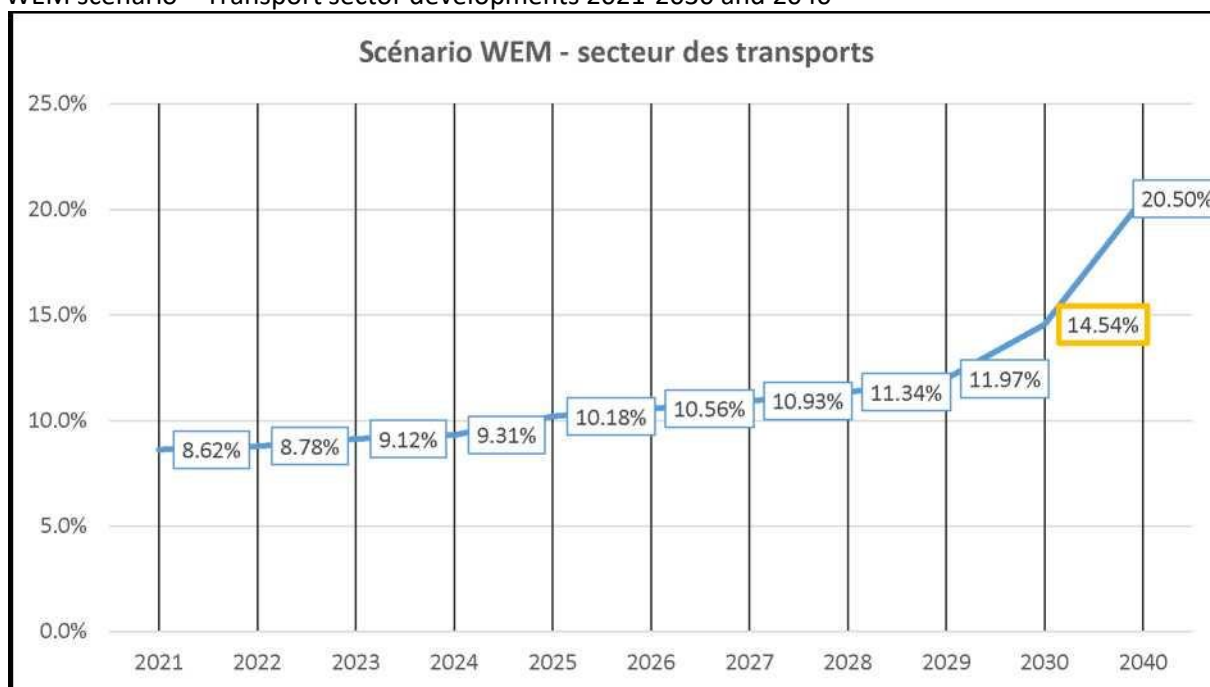
WEM scenario – GWh	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Biofuel incorporation rate%	7.7 %	8.0 %	8.0 %	8.4 %	8.8 %	9.0 %	9.2 %	9.4 %	9.7 %	10.0 %	10.0 %
Fossil fuels	20327	18125	18809	19147	19044	18732	18419	17923	17376	16867	13596
Share of biofuels – road transport	1699	1583	1644	1767	1853	1872	1890	1889	1901	1914	1603
— <i>Single counting biofuels</i>	1103	989	1028	1052	1053	1040	1027	1005	980	957	802
— <i>Double counting biofuels</i>	596	593	617	715	800	832	863	884	921	957	802
— <i>Advanced biofuels</i>	5	9	19	19	95	94	92	90	87	295	238
<i>Share of advanced biofuels –</i>	0.0 %	0.1 %	0.2 %	0.2 %	0.9 %	0.9 %	0.9 %	0.9 %	0.9 %	3.1 %	3.0 %
RFNBO route	0	0	0	0	0	0	0	0	0	0	0
<i>Share RFNBO **</i>	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %
Electricity Transport	173	208	242	284	332	383	433	485	536	588	1079
Renewable share	19	29	34	48	58	73	93	114	131	146	305
— <i>ENR transport</i>	4	6	17	24	29	44	56	68	92	103	275
— <i>ENR rail</i>	15	23	28	38	46	58	74	91	105	117	244
<i>Share of advanced biofuels and RFNBO **</i>	0.0 %	0.1 %	0.2 %	0.2 %	0.9 %	0.9 %	0.9 %	0.9 %	0.9 %	3.1 %	3.0 %
Consumption – calculation of overall share *	1718	1612	1679	1815	1910	1945	1983	2003	2032	2061	1908
Consumption – transport calculation **	1901	1738	1875	1959	2144	2196	2245	2278	2346	2784	3287
Consumption–tr.	22065	19783	20556	21040	21052	20800	20547	20092	19597	19141	16034
Share of transport sector	8.6 %	8.8 %	9.1 %	9.3 %	10.2 %	10.6 %	10.9 %	11.3 %	12.0 %	14.5 %	20.5 %

WEM scenario – Transport sector

Table 48: Projected evolution of renewable sources/technologies in **the transport sector by 2040 – WEM scenario**

In the WEM scenario of the transport sector, the share of fossil fuels remains high by 2040, making the share of electricity difficult to achieve. Fossil fuel consumption therefore remains predominant at 13.596 GWh (84.7 % of total transport consumption) compared to electricity, which is 12 times lower than that of fossil fuels (1.079 GWh – 6.7 % of total transport consumption) (Table 48). First-generation biofuels also retain the advantage over advanced biofuels. The WEM scenario does not model the potential of renewable hydrogen to decarbonise the transport sector. Figure 25 shows the evolution of the share of renewable energy in the transport sector between 2021-2030 and 2040.

Figure 25: WEM scenario – Transport sector developments 2021-2030 and 2040



Sources: STATEC-MECO modelling/DG Energy 2024, MECO Graph/DG Energy

WEM Scenario – Indicative and Overall Objective

Table 49: Overall share of renewable energy and European cooperation by 2040 – WEM scenario

WEM scenario – GWh	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
National RES production	4212	4358	4580	4932	5313	5609	5831	5998	6192	6406	7710
European cooperation	800	1300	1000	0	2000	1850	2700	2350	2350	3700	4000
of which statistical transfers	800	1300	1000	0	1850	1500	2050	1400	1000	1950	1000
of which REFM	0	0	0	0	150	350	650	950	1350	1750	3000
RES production + European cooperation	5012	5658	5580	4932	7313	7459	8531	8348	8542	10106	11710
Final energy consumption	48199	45712	46665	47072	46999	46710	46461	46068	45572	45106	42388
Aviation	7414	7820	7986	8056	8126	8196	8266	8335	8403	8472	9074
– Current share Aviation –%	15.4 %	17.1 %	17.1 %	17.1 %	17.3 %	17.5 %	17.8 %	18.1 %	18.4 %	18.8 %	21.4 %
– Aviation threshold –%	6.18 %	6.18 %	6.18 %	6.18 %	6.18 %	6.18 %	6.18 %	6.18 %	6.18 %	6.18 %	6.18 %
Adjusted gross final energy consumption	43763	40717	41563	41925	41777	41400	41067	40581	39985	39422	35933
Overall RES share	11.5 %	13.9 %	13.4 %	11.8 %	17.5 %	18.0 %	20.8 %	20.6 %	21.4 %	25.6 %	32.6 %
Indicative trajectory and overall target	11.0 %	13.5 %	11.0 %	11.0 %	17.0 %	11.0 %	20.1 %	11.0 %	11.0 %	25.0 %	32.6 %

Sources: STATEC-MECO modelling/DG Energy 2024

While the overall share of renewable energy in final energy consumption increases over the period 2021 to 2040, it requires a significant input of statistical transfers (respectively from the statistics acquired under the REFM) except to reach the 25 % already foreseen in the 2020 NECP.

The quantities needed in terms of European cooperation represent more than 50 % in 2030, as in 2040 (Table 49).

Table 50: Share of sectors and overall share with or without cooperation – WEM scenario

WEM scenario – GWh	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
RES share – electricity sector	14.2 %	16.9 %	17.4 %	18.9 %	21.5 %	23.5 %	24.5 %	24.9 %	25.5 %	26.5 %	30.0 %
RES share – heat sector	11.3 %	12.6 %	13.5 %	14.4 %	15.3 %	16.3 %	17.3 %	18.3 %	19.3 %	20.4 %	32.2 %
Share ENR – Transport *	8.6 %	8.8 %	9.1 %	9.3 %	10.2 %	10.6 %	10.9 %	11.3 %	12.0 %	14.5 %	20.5 %
European cooperation	800	0	0	0	0	0	0	0	0	0	4000
Overall RES share – without cooperation	9.6 %	10.7 %	11.0 %	11.8 %	12.7 %	13.5 %	14.2 %	14.8 %	15.5 %	16.3 %	21.5 %
Overall RES share – with cooperation	11.5 %	13.9 %	13.4 %	11.8 %	17.5 %	18.0 %	20.8 %	20.6 %	21.4 %	25.6 %	32.6 %
Indicative trajectory and overall target	11.0 %	13.5 %	11.0 %	11.0 %	17.0 %	11.0 %	20.1 %	11.0 %	11.0 %	25.0 %	32.6 %

* with multipliers (Article 27 Directive 2018/2001/EC)

Sources: STATEC-MECO modelling/DG Energy 2024

The sectoral shares of renewable electricity and heat increased between 2021 and 2040. In the transport sector, the share of fossil fuels remains high and the share of electricity in the transport sector remains too low to counteract this trend.

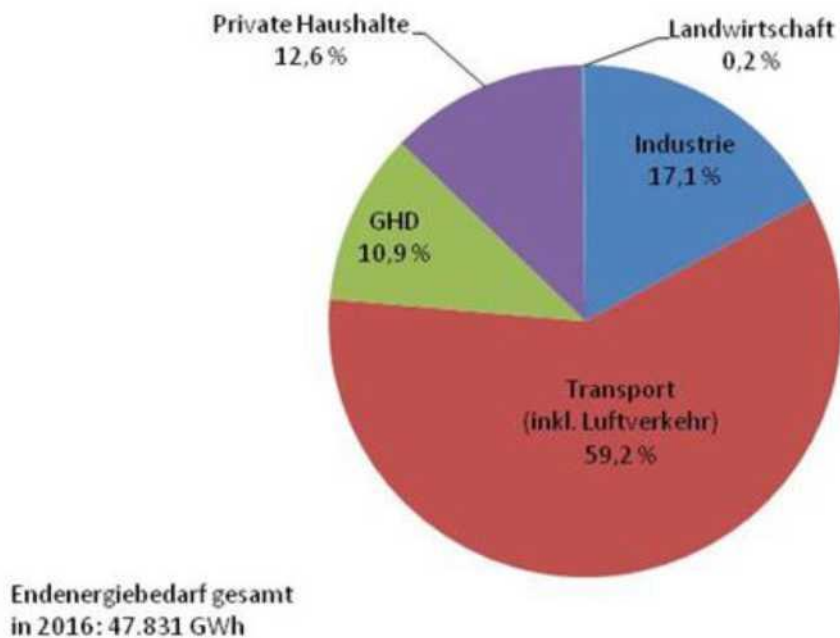
With the contribution of European cooperation, the WEM scenario reaches a 32.6 % share of renewable energy in gross final energy consumption in 2040, and almost one third of the energy needed will therefore come from renewable sources, with the electricity sector in the first place (Table 50).

4.3 energy efficiency dimension

Baseline of energy consumption in Luxembourg

In 2016, Luxembourg's final energy consumption was around 48 TWh (Statec 2018). The transport sector accounts for the largest share of final energy consumption in Luxembourg, accounting for 59 % (Figure 26:). Foreign road transport accounts for the largest share, around 34 %. In the energy statistics, this figure corresponds to the quantity of fuel purchased by all owners of non-resident vehicles in Luxembourg. It also includes transit traffic of lorries and cars, as well as border residents whose cars are not registered in Luxembourg. At the same time, air transport accounts for around 12 % of total final energy consumption, reducing the share of inland road transport to around 13 % of Luxembourg's final energy consumption. While agriculture accounts for the lowest share of final energy consumption, around 0.2 %, industry consumes the largest share of energy in Luxembourg at just over 17 %.

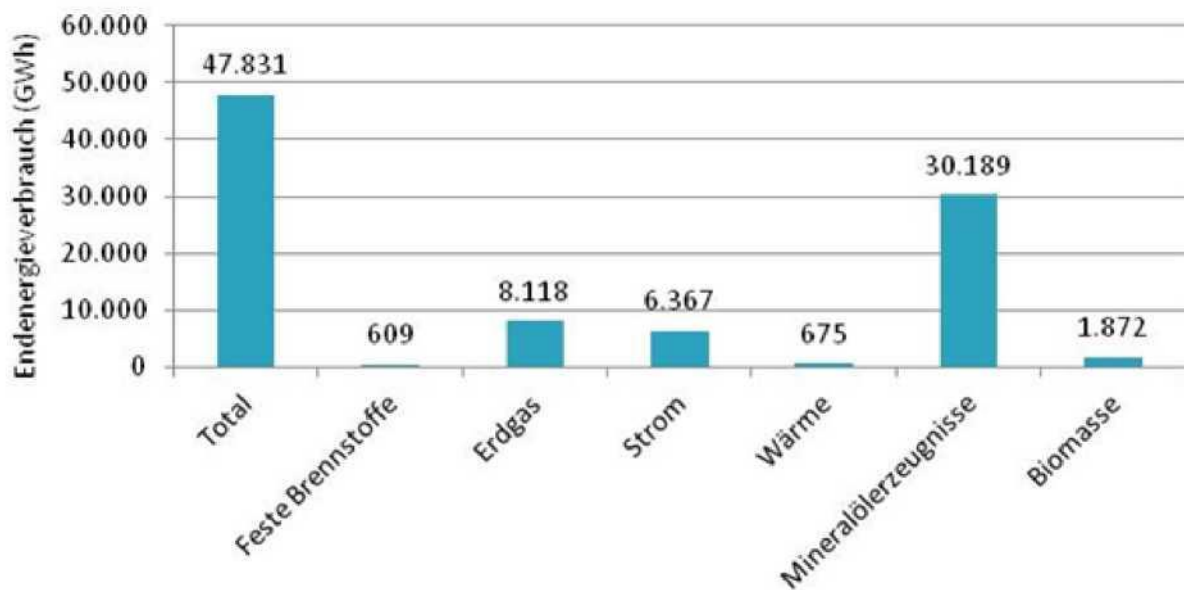
Figure 26: Final energy consumption in Luxembourg in 2016, broken down by industry, households, manufacturing, trade and services, transport and agriculture



Sources: IREES according to Statec 2018

In 2016, Luxembourg's energy consumption was dominated by the need for petroleum products (63 %). Energy needs were also met through natural gas (17 %), electricity (13 %) and biomass (4 %) (Figure 27).

Figure 27: Final energy consumption in Luxembourg in 2016, by type of energy source



Sources: IREES according to Statec 2018

Notes: this representation does not take into account possible large electricity consumers likely to settle in Luxembourg in the near or more likely future.

Current potential for the application of high-efficiency cogeneration and efficient district heating and cooling

In 2015, cogeneration generated almost 326 GWh of electricity and 527 GWh of heat in Luxembourg. Cogeneration systems can supply heat up to 500 °C (Klobasa, Steinbach & Pudlik 2016).

The following areas also present potential for the use of high-efficiency cogeneration:

- Decentralised cogeneration systems in buildings;
- Use of cogeneration in industry;
- Supply of district heating networks and cogeneration plants.

The economic potential resulting from the use of CHP plants and the supply of district heating networks depends mainly on the evolution of renovation activities in the buildings sector and thus on the evolution of the heating needs of buildings in general. In the area of decentralised energy supply to buildings, the use of cogeneration corresponds to an electrical performance of less than 500 kW. Due to the heating and cooling needs of buildings, the still untapped economic potential for high-efficiency cogeneration and the supply of heat networks lies mainly in residential buildings.

Today, around 50 % of economic cogeneration potentials in the buildings sector are developed through existing collective heating concepts. Therefore, in Luxembourg, the building sector alone represents an economic cogeneration potential of around 1 170 GWh of useful energy (Klobasa, Steinbach & Pudlik 2016).

At the same time, industry is expected to have relatively low economic potential of around 500 GWh of final energy and 425 GWh of useful energy by 2030 (Table 51). Relevant sectors include the chemical industry, the wood industry and the food industry. However, the exploitation of this industrial potential requires excellent geographical conditions and long periods of operation (Klobasa, Steinbach & Pudlik 2016).

Table 51: Additional potential for CHP heat production in industry by 2030 compared to industry's final energy consumption

Sektor	Brennstoffbedarf in GWh		KWK-geeignet für $\Delta T \geq 50^\circ\text{C}$ pertaining to 5 Wh		KWK-Bestand in GWh 2014	To ΔT -potenzial in GWh 2030
	2014	2030	2014	2030		
Stahl	1.670	1.422	67	57		
Steine/Erden	1.094	589	164	88		
Chemie	319	295	316	292		210
Textil	226	208	226	208		
Holz	274	253	274	253	65	150
Nahrung & Genussmittel	61	57	60	56		25
Metallerzeugung & -bearbeitung	77	71	0	0		
Metallerzeugung & -bearbeitung	13	12	13	12		
Papier	11	47	50	46		
Sonstige	157	154	145	134	122	115
Summe	3,952	3,107	1,315	1 – 146	187	500
	KWK-Wärme *					425
	KWK-Strom **					255

Notes: eigene Abschätzung, * Umrechnung Endenergie in KWK-Nutzwärme mit 0,85, ** KWK-Strom & m mit Stromkennzahl 0,6 berechnet

Sources: Klobasa, Steinbach & Pudlik 2016

Evolution of energy consumption in Luxembourg by 2040 following the With Existing Measures (WEM) scenario

Table 52: Final energy consumption of the various sectors provided for in the WEM scenario for the years 2030 and 2040

Sector	Unit	2030	2040
Manufacturing and construction (ETS + Non-ETS)	GWh	6 549	6 353
Transport	GWh	25 926	23 749
Households (including residential buildings)	GWh	5 944	5 165
Trade and services (including tertiary buildings)	GWh	5 558	5 058
Agriculture	GWh	62	62
Total final energy consumption *	GWh	44 040	40 387

* excluding ambient heat, with international aviation

Sources: STATEC modelling 2024

The projections of the energy consumption of the Reference Scenario (WEM) and the Target Scenario (WAM) for 2030 and 2040 have been modelled using the STATEC NEAM and ThreeME models. The NEAM model takes into account current national projections for economic developments and thus changes in population, jobs, number of border residents, residential areas, tertiary, industrial and construction activities, etc., as specified in Chapter 2.2.

The sectors which are taken into account for monitoring Luxembourg's final energy consumption (and which are distinguished in the modelling of the various projections) are:

- households (including residential buildings), referred to as 'private Haushalte' in the 2020 NECP;
- manufacturing and construction, referred to as "Industry" in the 2020 NECP;
- trade and services (including tertiary buildings), called 'Gewerbe, Handel, Dienstleistungen' in the 2020 NECP;
- transport (including international aviation).

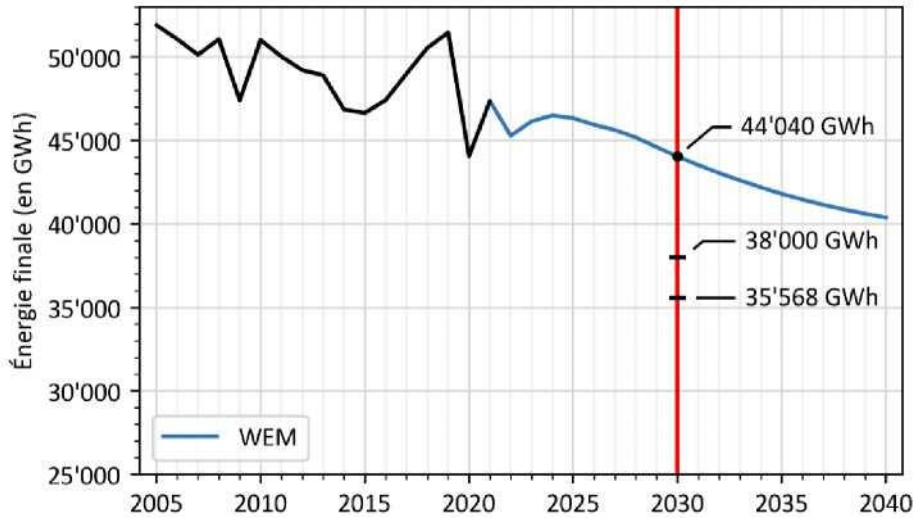
In terms of greenhouse gas emissions, part of the industry and transport sectors fall under the EU Emissions Trading System (ETS). However, the household sector and the trade and services sector are not governed by this system and are therefore non-ETS sectors.

Table 52 shows the final energy consumption of the WEM scenario for the years 2030 and 2040 broken down by sector. The corresponding trajectories are shown in Figures 28 to 33. The final energy considered here is final energy excluding ambient heat, including international aviation.

Total all sectors

Figure 28 shows that, according to the WEM scenario, total final energy consumption will increase to 46 '501 GWh in 2024 before there is a continuous decrease until 2040. The 44 '040 GWh in 2030 exceeds the target range from 38' 000 to 35 '568 GWh corresponding to the energy efficiency improvement range of -40 to -44 % compared to REF2007 defined as national target in the 2020 NECP.

Figure 28: WEM scenario – Total final energy consumption



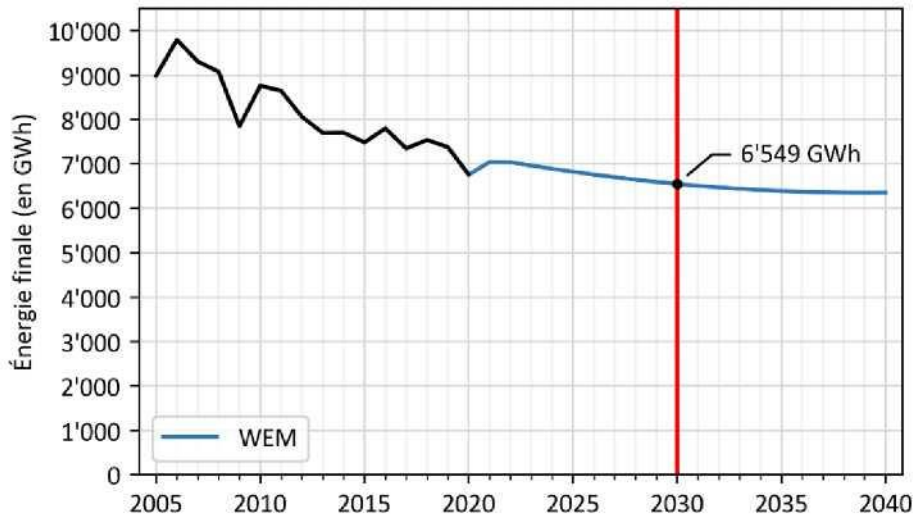
Sources: Modelling STATEC 2024, MECO/DG Energy

Manufacturing and construction

Based on cyclical projections, the continued increase in manufacturing and construction activities almost entirely counterbalances the improvement in energy efficiency in this sector, which explains the almost constant final energy consumption between 2020 and 2040 (see Figure 29).

According to the model, this increase in activity occurs mainly at the level of non-HTA companies and there is hardly any change at the level of HTA companies.

Figure 29: WEM Scenario – Manufacturing and Construction

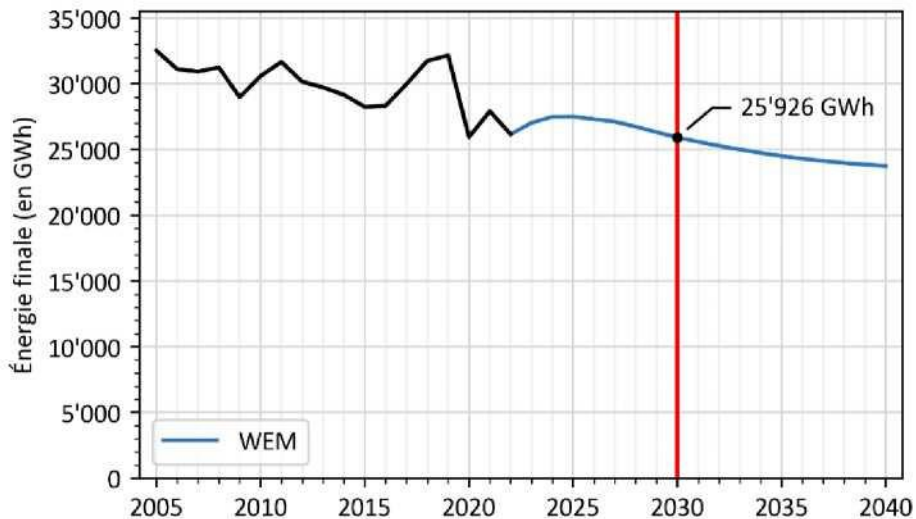


Source: Modelling STATEC 2024, MECO/DG Energy

Transport

The strong development of the aviation sector (passenger and freight transport) counterbalances some of the improvements in energy efficiency. According to the WEM scenario shown in Figure 30, the final energy consumption of transport will increase until 2025 before starting to decrease.

Figure 30: WEM Scenario – Transport

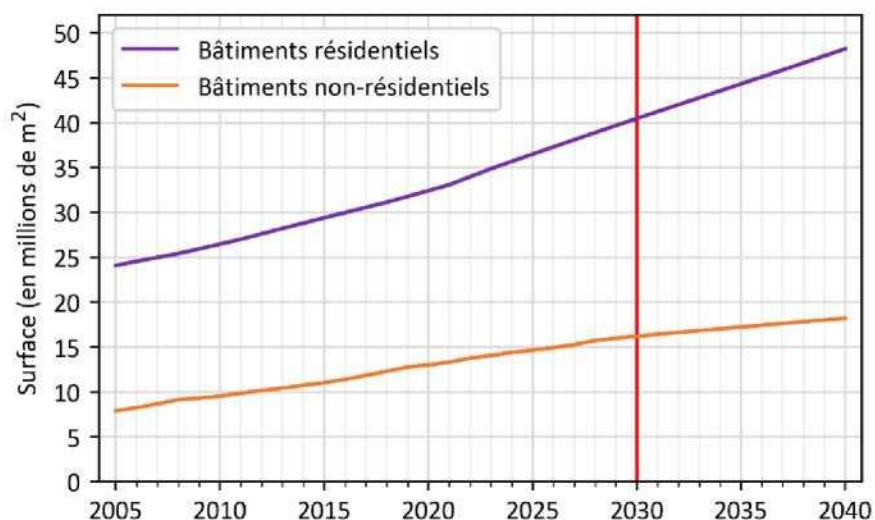


Sources: Modelling STATEC 2024, MECO/DG Energy

Households (including residential buildings)

For the household sector, as well as for the trade and services sector, the strong changes in building surfaces (as shown in Figure 31) need to be taken into account when interpreting the evolution of the final energy consumption of these two sectors.

Figure 31: Evolution of building surfaces – Residential buildings (household sector) and tertiary buildings (Trade and Services Sector)

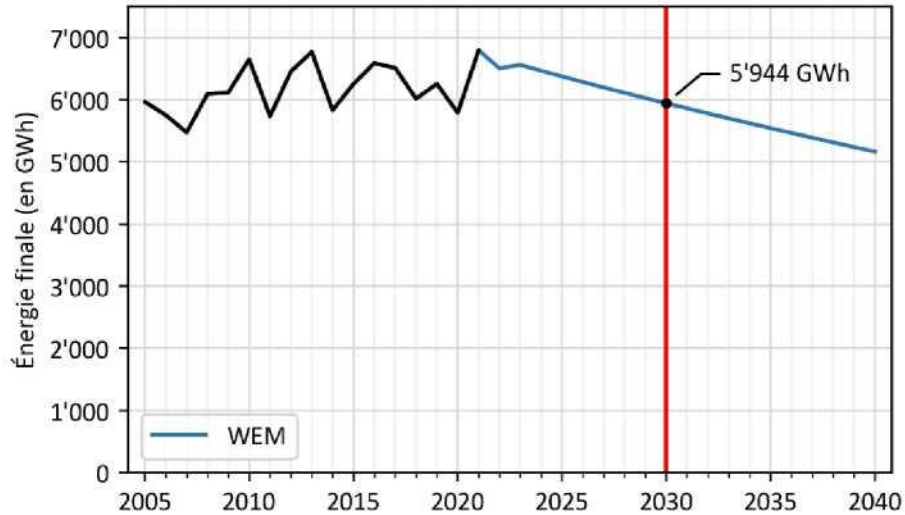


Sources: Modelling STATEC 2024, MECO/DG Energy. Energy consumed by households is largely directly related to use, i.e. mainly heating residential buildings.

The decarbonisation of buildings through electrification, i.e. the replacement of fossil heating systems with renewable

energy systems, including heat pumps, has a direct impact on GHG emissions and also implies a reduction in final energy consumption (see Figure 32). Ambient heat operated by a heat pump is not counted as final energy and replacing fossil based heating with a heat pump therefore means a significant reduction in energy consumption.

Figure 32: WEM Scenario – Households



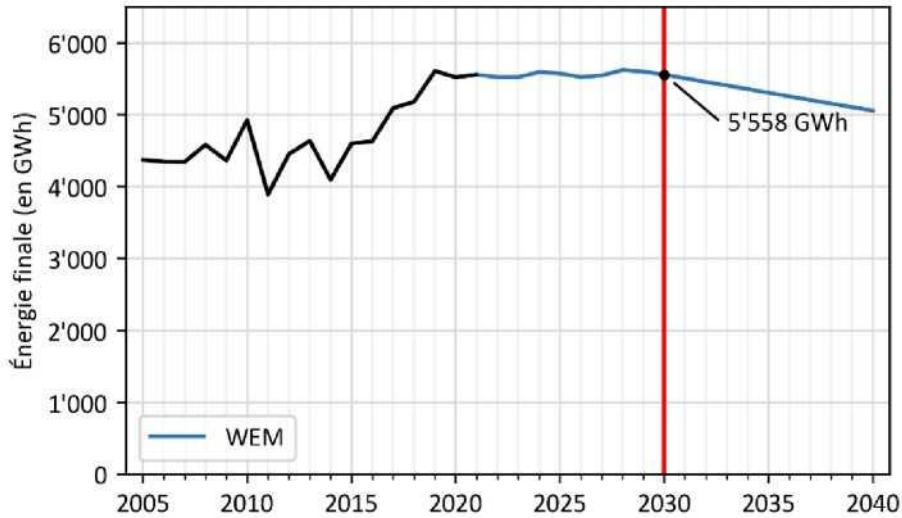
Sources: Modelling STATEC 2024, MECO/DG Energy

Trade and services (including tertiary buildings)

The trade and services sector includes tertiary buildings but also all trade and service activities (which are not specifically attributed to another sector).

The decarbonisation of buildings through electrification, i.e. the replacement of fossil heating systems with renewable energy systems, including heat pumps, has a direct impact on GHG emissions and also implies reducing the final energy need of buildings. That effect is affected by other factors such as economic growth, so that, in the WEM scenario, the sector’s final energy consumption does not decrease, as shown in Figure 33.

Figure 33: WEM Scenario – Trade and Services

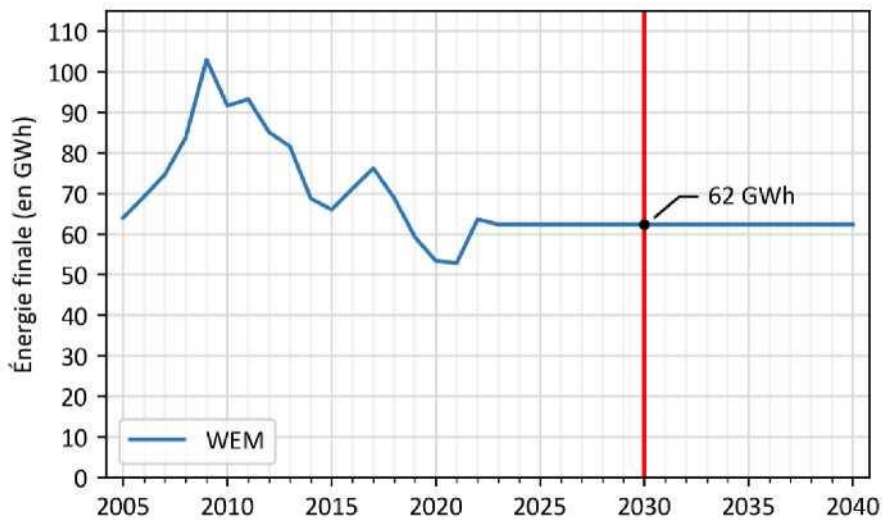


Sources: Modelling STATEC 2024, MECO/DG Energy

Agriculture

The agriculture sector has a negligible final energy consumption compared to the other sectors considered above. Figure 34 shows the evolution of its final energy consumption up to 2040.

Figure 34: WEM Scenario – Agriculture



Sources: Modelling STATEC 2024, MECO/DG Energy

4.4 security of energy supply dimension

Following Russia's invasion of Ukraine in February 2022, Europe faced a significant drop in the supply of Russian natural gas. The reduction of supply entails a risk to the security of energy supply and a high level of prices and strong fluctuations in energy markets. As natural gas-fired power plants are often needed to meet electricity demand when it reaches its peak during the day or when volumes of electricity produced from other sources are not sufficient to cover demand, high gas prices translate into high electricity prices across Europe. Other factors, such as the absence of rain or the unavailability of nuclear power plants, contributed to a tense situation for winter 2022-2023 with tighter

than usual electricity capacity margins across Europe.⁵⁶

The energy crisis has led to the need to introduce extraordinary measures to ensure security of energy supply. The European Union and its Member States have managed to respond by taking measures in the field of gas storage, demand reduction and diversification of supply routes to successfully prevent supply disruptions.

For Luxembourg, coordination of measures and sharing of relevant information at European level is essential. In addition, Luxembourg benefits from significant regional collaboration in the framework of the Pentalateral Energy Forum, as well as from the common markets between Belgium and Luxembourg for natural gas and between Germany and Luxembourg for electricity.

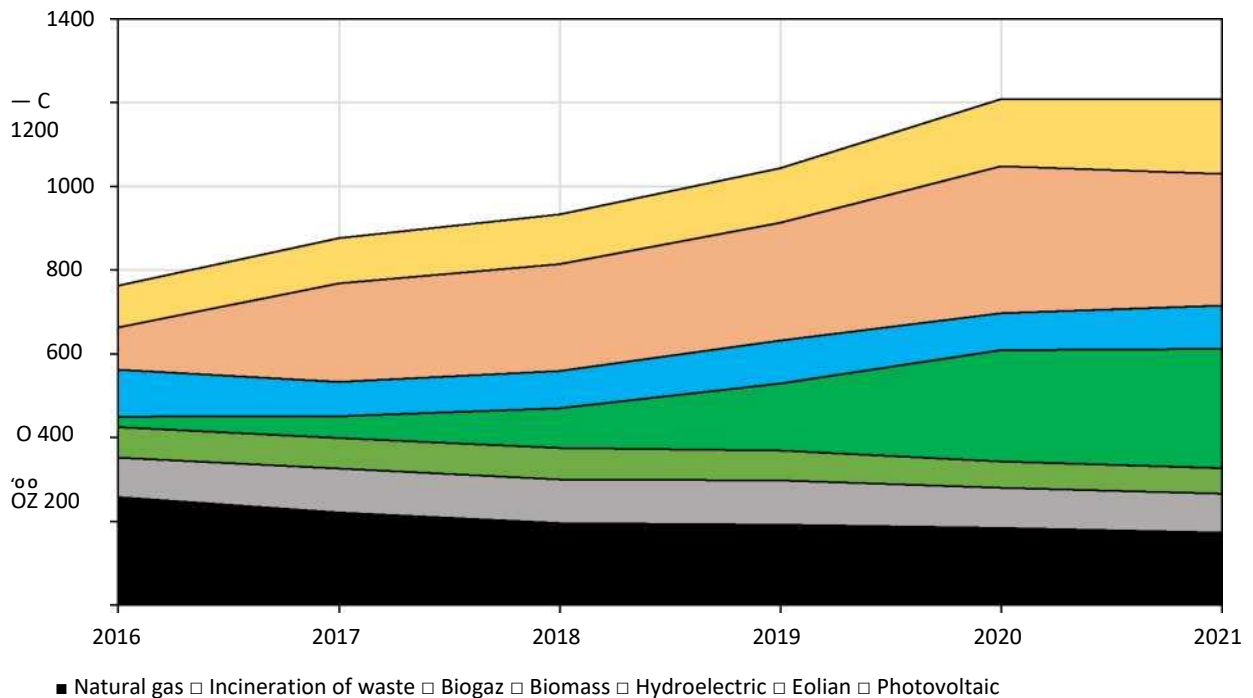
At national level, a significant number of activities and measures have been initiated respectively by the relevant stakeholders, including the Ministry of Economy (MECO/DG Energy), the High Commissioner for National Protection, and the network operators, in order to monitor, manage and anticipate the crisis.

As a result, and despite the geopolitical situation and the resulting energy crisis, security of supply in Luxembourg therefore remains at a very high level.

4.4.1 Domestic production and consumption

This section deals with national electricity and gas production and consumption. As regards the electricity sector, over the years Luxembourg has achieved a significant increase in national electricity production, thanks to the continuous development of renewable energy while reducing electricity from fossil and non-renewable sources. Figure 35 shows the evolution of domestic electricity production from 2016 to 2021. Overall, production increased by 37 % from 2016 to 2021. The share of renewable energy in Luxembourg's electricity production mix increased from around 54 % in 2016 to 78 % in 2021. The main increases were achieved through the expansion of wind energy and biomass, closely followed by solar energy. By contrast, the production of electricity from gas in cogeneration plants was reduced by 33 % over the same period.

Figure 35: Total electricity production of the country injected into the grid (source: ILR)



The tables below show the targets for domestic electricity generation for each energy source and the projected electricity consumption with current policies and measures until 2040. As mentioned, a continuous increase in renewable electricity generation is expected, in particular for wind and solar energy.

Table 53: Projections for domestic production and electricity consumption – WEM scenario (values in GWh).

Electricity WEM Scenario	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Hydro	104	104	104	104	100	100	100	103	103	102
Wind	328	348	417	540	640	679	692	726	785	1016
Photovoltaic	303	322	362	419	475	516	544	569	592	838
Biogas	63	63	63	63	63	64	64	64	64	65
Biomass	290	298	306	314	323	331	340	348	356	428
Natural gas 1	164	156	147	138	130	121	112	104	95	9
Waste incineration	72	73	74	76	77	79	80	81	83	97
Total production	1324	1365	1473	1654	1808	1890	1931	1995	2078	2554
Consumption	6604	6709	6832	6932	7029	7155	7310	7424	7532	8678

To further improve security of supply and meet Luxembourg's ambitious climate targets, the new policies and measures aim at a faster development of renewable energy. The tables below show the new national targets for electricity generation and electricity consumption.

Table 54: Projections for domestic electricity generation – WAM scenario (GWh values).

Electricity WAM Scenario	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Hydro	104	104	104	104	104	103	103	103	103	102
Wind	330	430	511	699	800	867	903	962	1043	1368
Photovoltaic	316	390	480	580	680	780	890	1000	1112	1574
Renewable waste	43	44	45	46	47	48	49	49	50	60
Biogas	67	71	75	79	84	88	92	96	100	100
Biomass	285	290	540	554	568	582	596	610	624	734
Natural gas 1	157	142	126	110	94	79	63	47	31	0
Waste incineration	72	73	74	76	77	79	80	81	83	97
Total production	1370	1535	1948	2241	2450	2622	2773	2946	3143	4035

Table 55: Forecast of total electricity consumption – WAM scenario (values in GWh).

Electricity WAM Scenario	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Manufacturing and construction	2880	2936	2958	3322	3494	3592	3691	3702	3701	3955
Transport	198	243	301	371	445	520	597	676	755	1757
Residential buildings	961	969	1000	907	905	933	962	1039	1088	1701
Tertiary buildings	1889	1916	2216	2247	2340	2408	2496	2545	2582	2856
Total consumption electricity;	5928	6063	6475	6847	7184	7453	7747	7961	8126	10268

As regards the gas sector, Luxembourg does not extract its own gas. The country covers its gas needs through the transmission networks of upstream system operators in Belgium and Germany, which in turn provide access to production facilities. Deliveries are made by network operators and/or through commercial and delivery companies. Luxembourg also does not have gas storage facilities on national territory. Therefore, the necessary gas volume and storage capacities are used in other countries, in particular in the countries of transmission and transit from which the gas usually originates.

As regards the country's gas consumption, the figure below shows the consumption from 2016 to 2021 for the different sectors. While 2020 was marked by Covid-19 and a particularly low demand, the country's total consumption was around 8 500 GWh in 2021. It shows that the industrial and residential sectors account for around two thirds of total gas consumption.

Figure 36: Total gas consumption of the country by sector (source: STATEC)

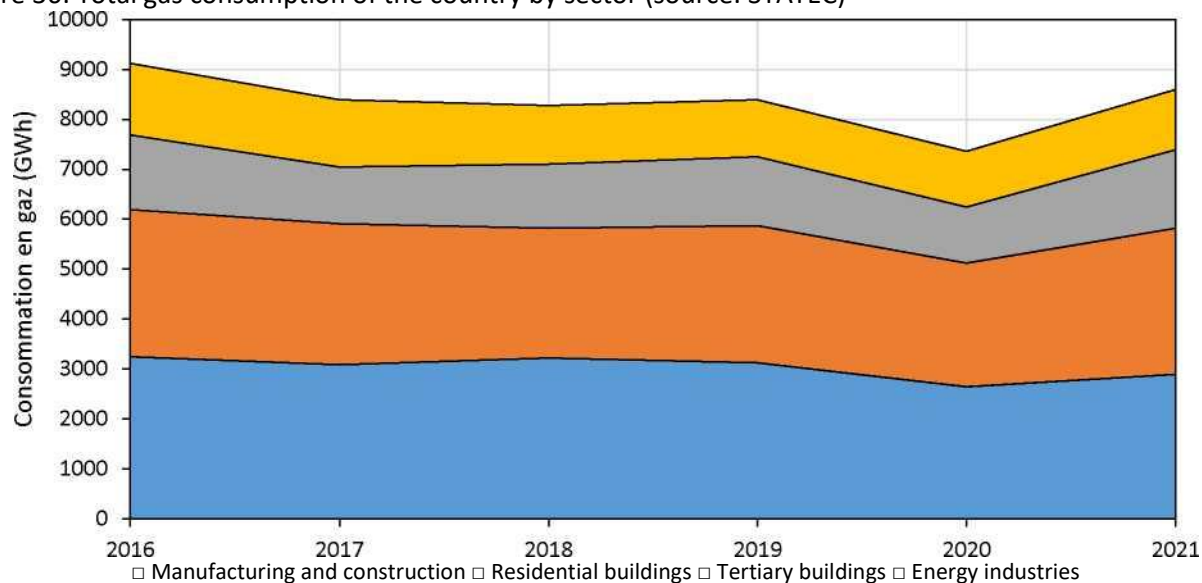


Table 56 m counts the country's projected consumption until 2040 with the current policies and measures in place.

Table 56: Country Total Gas Consumption Forecast – WEM Scenario (GWh values)

Natural gas 1 WEM Scenario	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Manufacturing and construction	2831	2753	2677	2602	2530	2460	2392	2325	2261	1712
Residential buildings	3122	3200	3167	3138	3110	3082	3054	3025	2997	2712
Tertiary buildings	1265	1258	1274	1266	1249	1249	1261	1250	1233	1048
Energy industries	1148	1088	1027	967	906	846	786	725	665	60
Total consumption of natural gas	8366	8299	8145	7974	7795	7636	7492	7325	7155	5533

With the new measures, a faster reduction in gas consumption is expected in all sectors. In the industrial sector, key measures to reduce gas consumption include electrification of processes and improving energy efficiency. As regards the real estate sector, the application of strict thermal insulation and heating standards for buildings, as well as the implementation of a renovation strategy, will allow a phase-out of natural gas. In addition, in the electricity sector, a gradual transition of gas-based electricity generation will be achieved through a significant increase in the production of electricity from renewable sources.

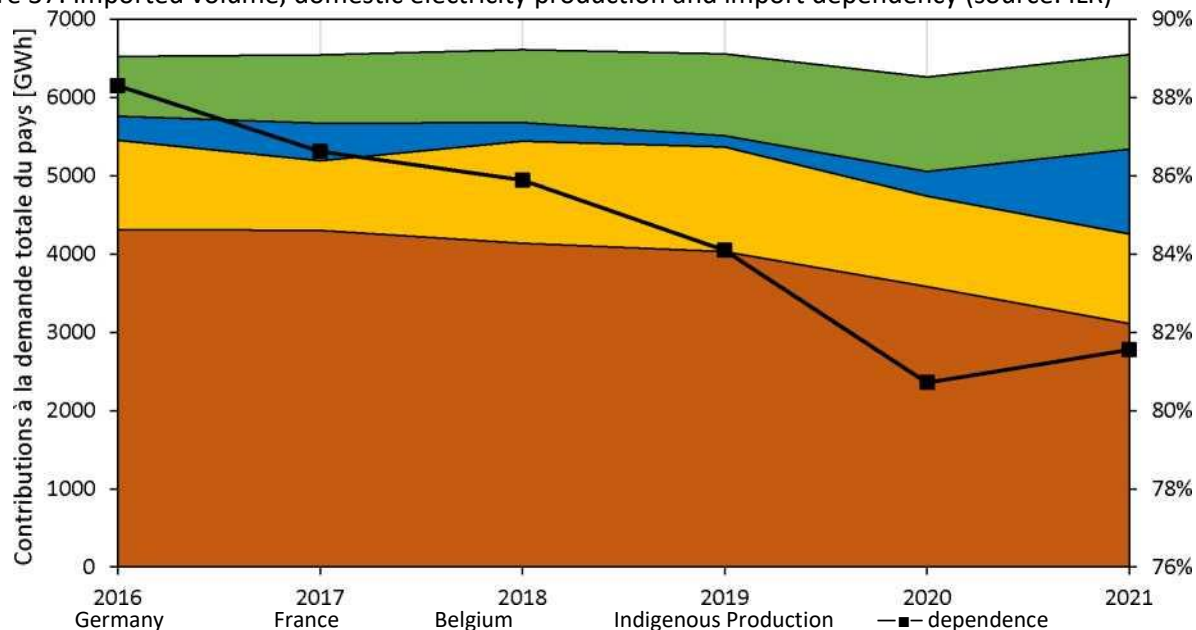
Table 57: Country Total Gas Consumption Forecast – WAM Scenario (GWh values)

Natural gas 1 WAM Scenario	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Manufacturing and construction	2066	2309	2239	2149	2068	1989	1877	1793	1674	182
Residential buildings	2992	2968	2920	2650	2622	2600	2552	2528	2455	1508
Tertiary buildings	964	891	970	905	834	776	726	661	594	0
Energy industries	939	805	716	626	537	447	358	268	179	0
Total consumption of natural gas	6961	6972	6844	6330	6061	5813	5513	5250	4902	1690

4.4.2 Import dependency

Import dependency in the electricity sector results from the country's total electricity consumption minus domestic production. Figure 37 shows the evolution of dependency for the years 2016 to 2021. Due to the increase in domestic production, the volume of imported electricity decreased over the years from around 90 % to around 80 %. Germany remains the main source of imported electricity, accounting for around 60 % of net imports.

Figure 37: Imported volume, domestic electricity production and import dependency (source: ILR)



With the current measures (WEM scenario), import dependency is expected to continue to decrease to around 70 % in 2040 as shown in the table below.

Table 58: Projections for import dependency – WEM scenario

Electricity WEM Scenario		2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Consumption	GWh	6604	6709	6832	6932	7029	7155	7310	7424	7532	8678
Electricity production	GWh	1324	1365	1473	1654	1808	1890	1931	1995	2078	2554
domestic Net import volume	GWh	5281	5345	5359	5278	5220	5265	5378	5429	5454	6124
Dependency		80.0 %	79.7 %	78.4 %	76.1 %	74.3 %	73.6 %	73.6 %	73.1 %	72.4 %	70.6 %

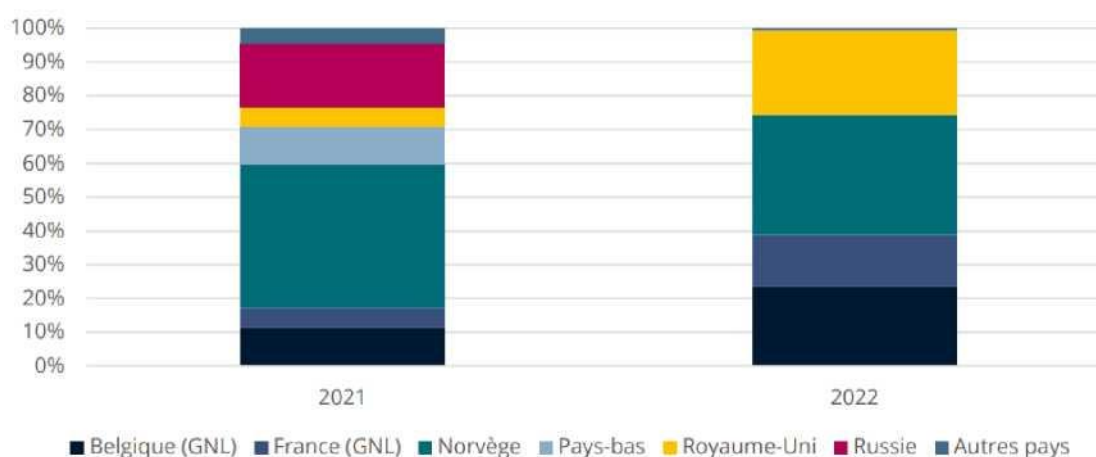
Luxembourg’s new targets aim to accelerate and strengthen the development of renewable energy in the country, thus further reducing the dependence on electricity imports, as shown in the following table.

Table 59: Projections for import dependency – WAM scenario

Electricity WAM Scenario		2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Consumption	GWh	5928	6063	6475	6847	7184	7453	7747	7961	8126	10268
Production electricity;	GWh	1370	1535	1948	2241	2450	2622	2773	2946	3143	4034
domestic Volume imported		4558	4528	4527	4606	4734	4831	4974	5015	4983	6234
Volume import _{GWh}											
Dependency		76.9 %	74.7 %	69.9 %	67.3 %	65.9 %	64.8 %	64.2 %	63.0 %	61.3 %	60.7 %

As regards the gas sector, since Luxembourg imports all its gas needs, it is entirely dependent on imports. The volume of imports therefore depends only on gas consumption. The majority of imported gas comes from Belgium, with which Luxembourg shares a common market, the rest of the imported gas comes from Germany. The figure below shows the breakdown of imports into Luxembourg as well as the changes between 2021 and 2022.

Figure 38: Distribution of natural gas imports into Luxembourg in 2021 and 2022 (source: STATEC)



4.4.3 Security of Supply

4.4.3.1 Electricity sector

Legal framework

At national level, security of supply in the electricity sector is regulated by the Law of 1 August 2007 on the organisation of the electricity market, giving specific roles and responsibilities, in particular, to system operators, the Minister responsible for energy, the Government Commissioner for Energy, and the regulator.

For an overview of the security of supply monitoring, the Ministry publishes every two years a report on security of supply in the electricity sector⁵⁷. In this context, and according to the provisions of Article 11 of the Electricity Market Act, security of supply is to be understood as an overall term that reflects the overall view of the supply of final customers, and includes the entire value chain, i.e. the production, trading, transmission, sale and distribution of electricity.

At European level, there are also regulations governing security of supply, crisis prevention and risk management. For example, Regulation (EU) 2017/2196 establishes a network code setting out the applicable requirements in order to safeguard operational security, prevent the spread or degradation of an incident with the aim of avoiding large-scale disruption and blackout status, and enabling the rapid restoration of the electricity system from an emergency or blackout state. Regulation (EU) 2019/941 of the European Parliament and of the Council of 5 June 2019 on risk prevention in the electricity sector lays down rules for cooperation between Member States to prevent, prepare and manage electricity crises in a spirit of solidarity and transparency, taking full account of the requirements of a competitive internal market in electricity. In this context, Luxembourg has drawn up a national plan of risk preparations described in more detail in this chapter.

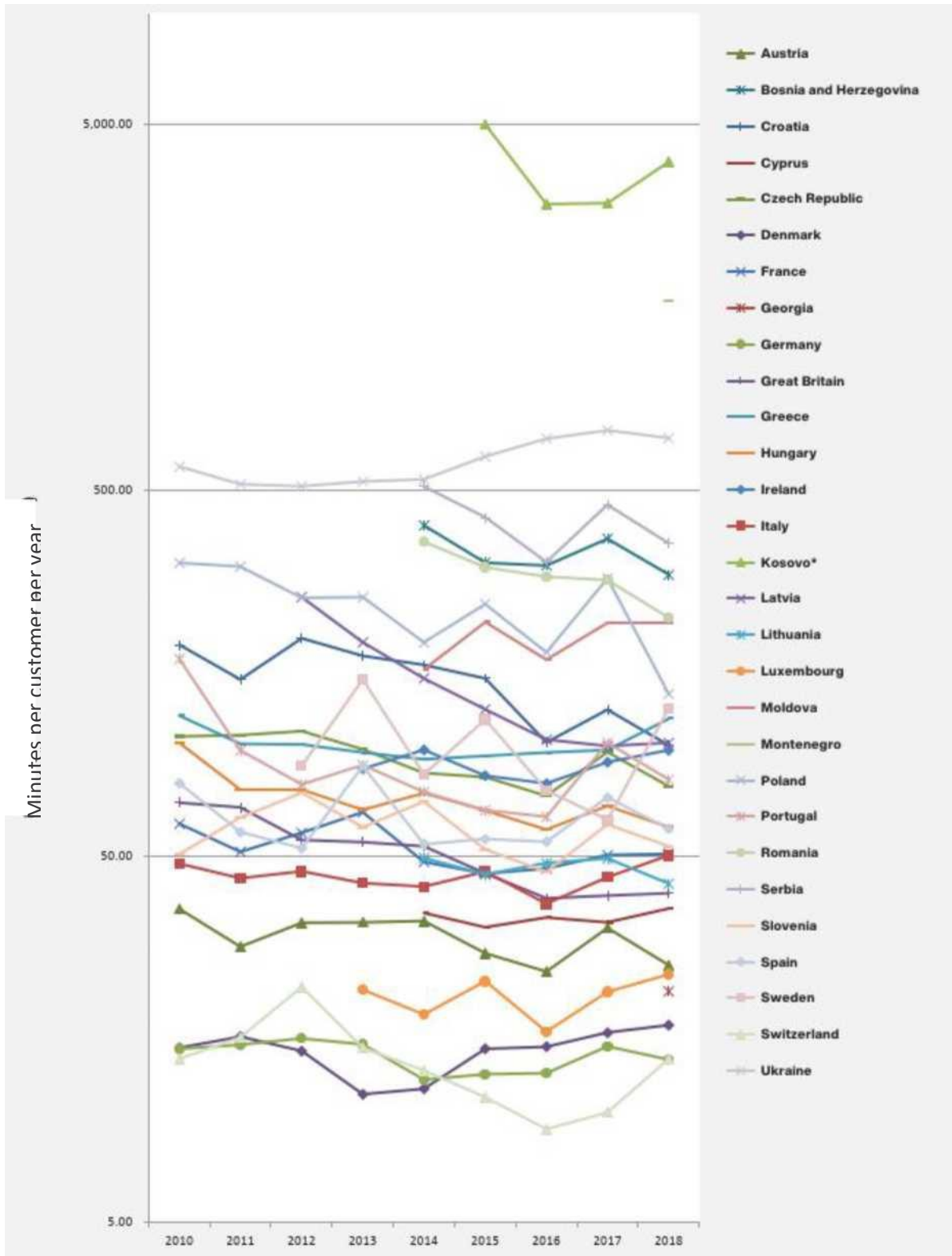
Current status

Compared to other countries in Europe and elsewhere, the quality of supply is very high in Luxembourg. In 2021, the average duration of interruptions per connection point was 13.9 minutes per year⁵⁸. By way of comparison, the figure below shows the average duration of interruptions per connection point in European countries from 2010 to 2018, it can be seen that Luxembourg has continuously achieved a very high supply quality.

⁵⁷ Bericht über die Versorgungssicherheit im Strombereich in Luxemburg 2022: <https://meco.gouvernement.lu/dam-Assets/le-ministere/functions/energie/electricite/mea-vsberdanostrom2022.pdf>

⁵⁸ ILR, Key electricity market figures: <https://assets.ilr.lu/energie/Documents/ILRLU-1685561960-998.pdf>

Figure 39: Average duration of interruptions per connection point in Europe.⁵⁸



⁵⁸ 7th CEER-ECRB Benchmarking report on the quality of electricity and gas supply 2022: <https://www.ceer.eu/documents/104400/-/-/15277cb7-3ffe-8498-99bb-6f083e3ceecb>

Risk preparedness

A risk preparedness plan in the electricity sector was first established in 2021. Different national crisis scenarios have been identified as particularly critical in terms of impact and probability for Luxembourg, which can be grouped into the following categories:

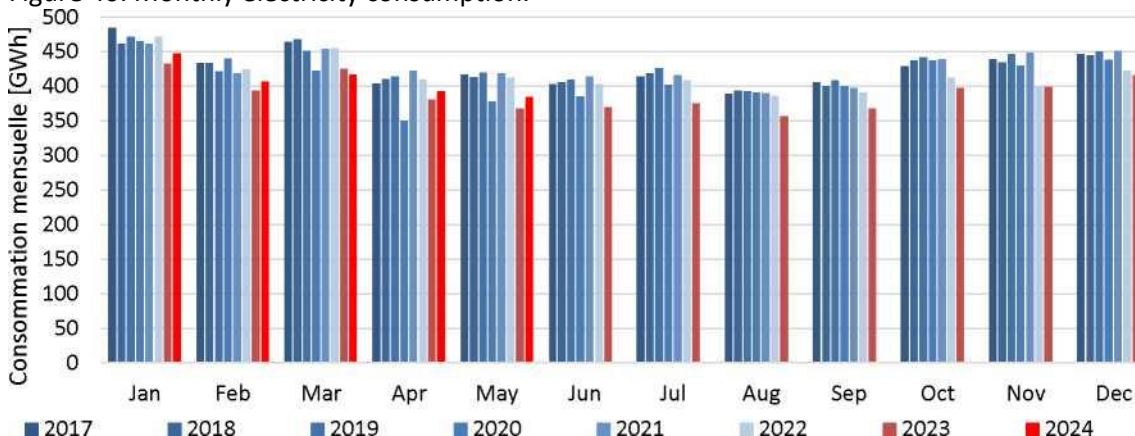
- Cyber-attacks or physical attacks on critical network resources
- Weather phenomena
- Serious technical accidents (telecommunications failure or nuclear accidents)

Due to the energy crisis, the plan was updated in December 2022⁵⁹ to introduce new measures in case the country faces a shortage of supply. One of the tools introduced is the StroumMonitor, an electricity monitor that qualifies the national level of electricity supply in Luxembourg. Clear signals from the system operator Creos Luxembourg S.A. guide consumers to take the right steps and ensure a secure supply of electricity to all. The StroumMonitor makes it possible to alert the population to electricity shortages. In addition, it also indicates the peak hours of daily consumption.

The Risk Preparedness Plan also includes a joint regional chapter, which has been established in the framework of the Pentilateral Energy Forum. The common chapter identifies common risk scenarios and strengthens the cooperation of Member States. In addition, in 2022, a common communication framework and a catalogue of measures were developed and agreed to further improve communication and cooperation between Member States. With the current version of the plan and the government's existing emergency response plans, Luxembourg has reached a mature and high level of risk preparedness in the electricity sector.

The energy crisis also led to the adoption of Council Regulation (EU) 2022/1854 of 6 October 2022 on an emergency intervention to address high energy prices. Among other things, the Regulation prescribes a mandatory 5 % reduction in electricity consumption during peak hours from 1 December 2022 until 31 March 2023. The StroumMonitor is one of the tools for addressing the need to reduce electricity consumption, with the result shown below:

Figure 40: Monthly electricity consumption.



In addition, that Regulation also introduced a measure to introduce a cap on the market revenues that certain producers derive from the production of electricity and to redistribute them in a targeted manner to final electricity customers. The respective draft law is currently in the legislative procedure.

⁵⁹ Luxembourg risk preparedness plan for the electricity sector:

<https://gouvernement.lu/dam-Assets/documents/actualites/2022/12-decembre/09-securite-apvisionnement-electricite/riskpreparednessplan-lu-update20221207.pdf>

Assessment of future security of supply

In the long run, Luxembourg is less dependent on electricity imports than before, but some dependency remains. Therefore, Luxembourg's security of supply depends on the security of supply of the rest of Europe. The European Resource Adequacy Assessment (ERAA) is the reference analysis for security of supply by European legislation. Given that Luxembourg's security of supply depends in particular on the available production capacity of neighbouring countries, the European analysis is particularly relevant for drawing conclusions in relation to Luxembourg's security of supply. It also takes into account variables such as available renewable generation plants, unexpected failures of equipment or lines, or fluctuations in demand depending on temperature. According to the latest edition of the analysis published at the end of 2022, the risks for Luxembourg are not to be excluded at 100 %, but very low. This is in particular linked to the fact that Germany is planning medium- and long-term measures to ensure security of supply by developing renewable energy and, where appropriate, reserve capacity.

In addition to the above report, Germany's Federal Network Agency published in early 2023 its report on the development of security of supply in the electricity sector for the Luxembourg – Germany common market until 2031. This report shows that in the selected scenarios security of electricity supply can be ensured between 2025 and 2031. The report analyses different scenarios, including an early phase-out of coal by 2030. In addition, the scenarios took into account, inter alia, the war in Ukraine and the resulting increase in gas prices. In order for security of electricity supply to be guaranteed, a series of developments on the generation and grid side need to be pursued. In particular, an accelerated deployment of renewable energy is needed.

Security of supply for consumers applies to both sufficient generation capacity and sufficient grid capacity. Market results show for the Germany-Luxembourg common market until the 2030s or 2031s that demand can be met at any time during any hour of the year. Network-side analyses show that by respecting the current network extension target dates and exploiting the potential available for congestion management, it is possible to ensure network operation without congestion.

In addition to the current state of security of supply, the above mentioned report on security of supply in the electricity sector also provides a detailed analysis of the state of the electricity system and the developments needed to ensure security of supply in the coming years. Project 380, which involves the construction of a 380 kV interconnection with Germany to cover Germany's future electricity demand, is particularly important. Overall, the report also concludes that security in Luxembourg will remain at a very high level as the necessary measures and plans are implemented. Given Luxembourg's continued dependence on electricity imports, a well-integrated internal market is essential for Luxembourg to support its security of supply and the further development of renewable energies in the Germany-Luxembourg common market is vital for maintaining security of supply.

4.4.3.2 Gas sector

Legal framework

As regards security of gas supply, Article 16 of the Law on the organisation of the gas market, which entered into force in August 2007, entrusts the Ministry of Economy (MECO/DG Energy) of the Grand Duchy of Luxembourg with the task of drawing up a report every two years on the security and quality of natural gas supply. According to the provisions of Article 16 of the Gas Market Act, security of supply is to be understood as an overall term that reflects the overall view of customers' supply. Security of supply in Luxembourg is addressed taking into account all stages of the value chain, from production and import to trading, transport and storage, sale and distribution of gas.

There are also different legal frameworks at European level for security of gas supply. The framework was defined inter

60 BNetzA, Versorgungssicherheit Strom, Stand und Entwicklung der Versorgungssicherheit im Bereich der Versorgung mit Elektrizität (2023): [https://www.bmwk.de/Redaktion/DE/Downloads/V/versorgungssicherheitsbericht-strom.pdf?__blob=publicationFile & v = 4](https://www.bmwk.de/Redaktion/DE/Downloads/V/versorgungssicherheitsbericht-strom.pdf?__blob=publicationFile&v=4)

alia by Regulation (EU) 2017/1938 of the European Parliament and of the Council on measures to safeguard the security of gas supply and to repeal Regulation (EU) No 994/2010, but was significantly extended in the context of the 2022 energy crisis, as further described below.

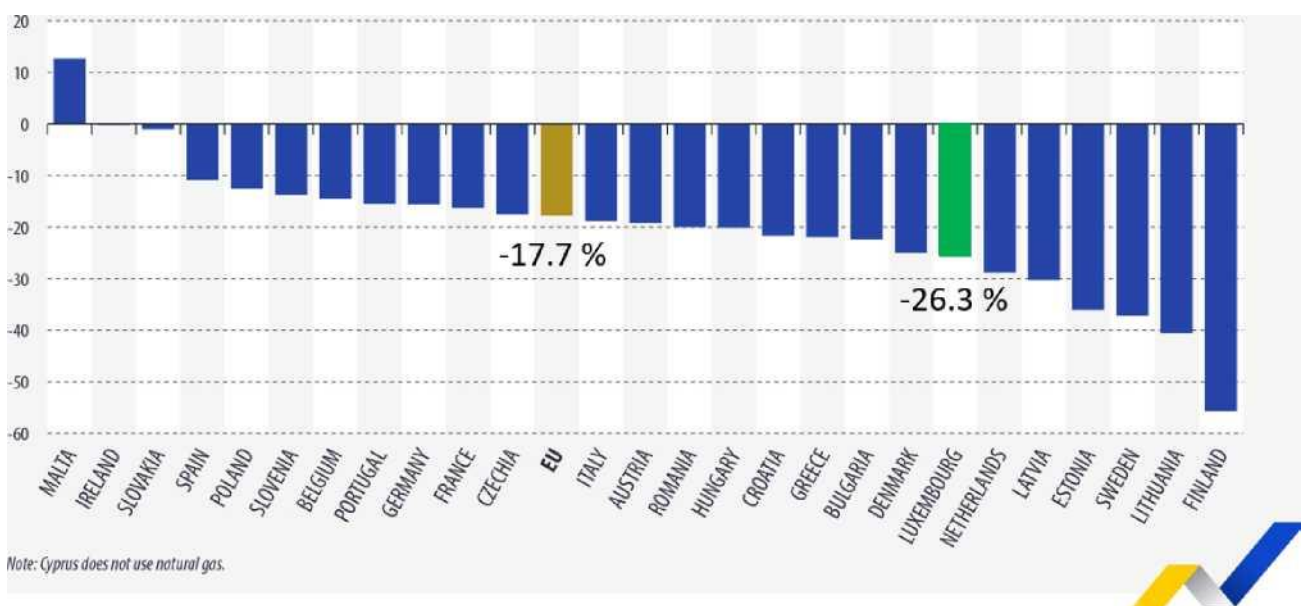
Situation today

As the energy crisis has led to extremely high prices and concerns about gas shortages, a number of EU and national measures to reduce dependence on Russian gas and prevent possible gas shortages have recently entered into force. To help identify appropriate measures, ENTSO-G carried out simulations on security of supply in Europe. In particular, simulations showed the importance of gas storage in Europe. Gas storage is particularly important during winters to cover increased gas demand. To avoid potential shortages in winter 2022-2023 and subsequent winters, a high level of gas storage was needed before the start of winter. Regulation (EU) 2022/1032 of the European Parliament and of the Council of 29 June 2022 amending Regulations (EU) 2017/1938 and (EC) 715/2009 with regard to gas storage established the requirement that European storage levels must be filled to a maximum of 80 % by 1 November for 2022 and 90 % from 2023. As Luxembourg does not have gas storage, it is obliged to contribute to the obligation to store gas in other Member States. In order to fulfil these obligations under the Regulation, a legal provision has been introduced for suppliers active in Luxembourg to conclude arrangements for the storage of natural gas in Member States of the European Union with underground storage of natural gas at the rate of 15 % of their average supplies over the last five years to their customers in Luxembourg on 1 November each year.

Another important result that ENTSO-G simulations have shown was that a reduction in gas demand in Europe is necessary to avoid potential shortages. Consequently, the European Council introduced Regulation (EU) 2022/1369 of 5 August 2022 on coordinated demand reduction measures for gas, which aims to reduce gas demand for all Member States at national level by -15 % for the period from 1 August 2021 to 31 March 2022 compared to the average consumption over the period from 1 August to 31 March of the previous 5 years (2017 to 2022). In order to achieve this goal, the Luxembourg government launched the energy-saving campaign⁶¹ “Zesumme spueren – Zesammenhalen”, which aims to raise awareness and encourage the whole of society to save energy. At the end of 2022, the cumulative reduction in natural gas consumption since 1 August was around -29 % compared to the reference period for the years 2017 to 2022. The figure below shows the reductions in demand achieved by the Member States up to January 2023.

Figure 41: Reducing natural gas consumption in Europe from August 2022 to January 2023 (source: Eurostat)

Natural gas consumption reduction (August 2022-March 2023 vs. 2017-2022 average) %



61 Energy-saving campaign “Zesumme spueren – Zesammenhalen”: <https://zesumme-spueren.lu/>

eurostatra

In order to improve the coordinated procurement of gas, Council Regulation (EU) 2022/2576 of 19 December 2022 enhancing solidarity through better coordination of gas purchases, reliable price benchmarks and cross-border exchanges of gas was adopted. The Regulation improves transparency and exchange of information on gas purchases by natural gas undertakings or undertakings consuming gas established in the Union or authorities of Member States intending to tender to purchase gas or to open negotiations with natural gas producers or suppliers from third countries for the purchase of gas. In addition, Member States should require that volumes equivalent to at least 15 % of their storage filling target for next year, or around 13.5 billion cubic metres for the Union as a whole, are included by their companies in the demand aggregation process. Member States without underground storage facilities on their territory, such as Luxembourg, should participate in the demand aggregation process with volumes equivalent to 15 % of their burden sharing obligation under Article 6c of Regulation (EU) No 2017/1938 of the European Parliament and of the Council.

Another measure to protect final customers from high prices was introduced by Council Regulation (EU) 2022/2578 of 22 December 2022 establishing a market correction mechanism to protect citizens of the Union and the economy from excessively high prices. The market correction mechanism will be automatically activated if the following conditions occur. The price of the month ahead on the Title Transfer Facility (TTF) exceeds EUR 180/MWh over three working days and the TTF price of the month ahead is EUR 35 higher than a global LNG reference price for the same three working days. From the day following the publication of a market correction notice, market operators shall not accept TTF derivatives that expire in the period from the expiry date of the front-month TTF derivative to that of the front-year TTF derivative and whose price is EUR 35 higher than the reference price published by ACER on the previous day ('dynamic bidding limit'), and TTF derivatives market participants may not submit orders for those TTF derivatives. If the reference price is below EUR 145/MWh, the dynamic bidding limit shall remain equal to EUR 145 and EUR 35.

Thanks to the rapid response of the European Union and strong coordination between Member States, security of supply was maintained throughout 2022, which is also a solid basis for future winters. However, the situation will need to be monitored very closely, with the possibility of introducing additional measures.

Risk preparedness

Regulation (EU) 2017/1938 of the European Parliament and of the Council on measures to ensure security of gas supply and repealing Regulation (EU) No 994/2010 requires Member States to carry out a comprehensive risk assessment of the risks that endanger the security of gas supply in their Member State, in particular taking into account all national and regional circumstances as regards system configuration, flow load, capacity and different consumption scenarios. The same regulation also provides that Member States have a 'Preventive Action Plan⁶²' and an 'Emergency Plan' to respond to possible crises in the gas sector.

In particular, the Emergency Plan⁶³ was updated in 2022 in particular with the context of the war in Ukraine and the resulting change in gas supply in Europe. The update contains a clear definition of protected customers and the priority levels assigned to 4 categories of customers under the different measures to be adopted depending on the situation. Protected customers are all household customers, essential services (health care services; essential social support services; emergency and safety services) as well as district heating installations, to the extent that they provide heating to protected customers, and only for the volumes necessary for the heating of those protected customers. Every measure must be taken in order to avoid load shedding of protected customers, but they are required to contribute to reducing consumption. Luxembourg's emergency plan for the security of gas supply sets out three national crisis levels

62 Preventive action plan on security of natural gas supply in Luxembourg (2020): <https://mea.gouvernement.lu/dam-assets/energie/gaz/GAZ-Plan-d-action-preventif-gaz-naturel-version-2020.pdf>

63 Security of natural gas supply emergency plan for Luxembourg (2022): <https://gouvernement.lu/dam-assets/documents/actualites/2022/10-octobre/19-turmes-plan-urgence/lu-plan-durgence-gaz-version-20221019-final.pdf>

as well as the measures to be taken to eliminate or mitigate the impact of gas supply disruptions.

Assessment of future security of supply

As all gas needs from Luxembourg are imported, the European internal market and geopolitical stability in Europe are of utmost importance for Luxembourg. As described in the previous sections, most of the gas is imported from Belgium, with which Luxembourg shares a common market. A diversified supply of gas entering the Belgium-Luxembourg common market area is essential to enable a resilient and reliable supply chain. As a significant flow of gas from Russia to Europe has been interrupted, a much greater dependence on LNG is expected on the gas market in Europe. As Europe will source gas from the global LNG market, it is more exposed to the volatility of global LNG prices. Moreover, as other countries such as China are very active in the LNG market and have already established long-term contracts with many suppliers, the volumes of LNG available are relatively low. The resulting LNG available on the market is therefore highly dependent on China's industrial production forecasts.

As described in the previous sections, gas storage will play an important role in maintaining security of supply, especially during winters. A coordinated filling of gas storage in Europe by all Member States will be necessary to ensure that a 90 % filling level is reached by 1 November before each winter, as required by Regulation (EU) 2022/1032.

An effective way of reducing Luxembourg's dependence on gas imports is to increase energy efficiency and encourage the switch from gas to electricity in all sectors of society. In all scenarios concerning gas consumption in Luxembourg, the objective is to reduce consumption and thus reduce dependence on gas imports. In particular with the new policies and measures, a rapid transition from gas to other energy sources is expected.

4.5 internal energy market dimension

4.5.1 Electricity interconnectivity

Luxembourg is currently directly connected to its three neighbouring countries.

- Creos' transmission network is connected to the neighbouring German transmission network (stations of BAULER and Trèves) via two 220 kV double lines with a total nominal transmission capacity of 2 300 MW
- Sotel's industrial network is connected to Elia's Belgian transmission network via a double line of 220 kV and the French high-voltage electricity grid via a coupling line. The total interconnection capacity of the industrial network is 850 MW.

At the end of 2017, the entry into operation of the Schiffflange transformer and the possibility of using a circuit from the 220 kV line to Aubange by Creos enabled Luxembourg to be integrated into the European transport network, also enabling the Creos network to be permanently connected to the Belgian transport network from a technical point of view. As the Elia and Creos network suppliers control Schiffflange's phase-shifting converter, it is possible to coordinate the flow of electricity between Belgium and Germany via the Luxembourg transmission system. This enhanced link with the Belgian transmission network contributes in particular to greater security of supply. Although marketing in the context of European market coupling is not foreseen in the near future, this will be reviewed as part of the further development of crisis management.

In order to strengthen the interconnection with the German transmission system operated by Amprion, Creos plans to build a new extra high voltage line of 380 kV from Bertrange to Aach (Germany) via Bofferdange and a transformation station 380/220/110-65-kV around Bofferdange/Altlinster, which would replace the existing 220 kV line at that level.

The level of interconnection is calculated using three different methods. To this end, interconnection capacity (n-0) shall be linked to:

- peak load
- total installed production capacity

- total installed generation capacity from RES

Irrespective of the concrete definition of the level of interconnection, Luxembourg is well above the targets for 2020 and 2030.

Table 60: Luxembourg interconnection level

	2020	2022	2030	2040
<i>Interconnection capacity in N-0 – Total Luxembourg [MW]</i>	3150	3150	6650	7050
<i>Peak load – Total Luxembourg (MW)</i>	1123	1128	1600	2050
Total electricity generation capacity [MW]	487	677	1866	3226
RES electricity generation capacity [MW]	402	580	1823	3226
Load interconnection level [%]	280 %	279 %	416 %	344 %
Interconnection level of total production [%]	647 %	465 %	356 %	232 %
Level of interconnection of RES generation [%]	784 %	543 %	364 %	232 %

Sources: CREOS

4.5.2 Energy transmission infrastructure

Analysis – Gas

Luxemburg currently has network connection points with its three neighbouring countries, as shown in Figure 42. The transmission network covers approximately 280 km of high-pressure pipelines and a total of 58 distribution stations (pressure control stations) and 4 border posts to downstream networks. In recent years, only minor improvements have been made to the transmission network, as the expansion of the main axes has been completed. According to Creos, only isolated compactions will take place at the level of the distribution network in the future. There are therefore no significant changes in the aggregate pipeline lengths in the coming years.

Figure 42: Mapping of the supply situation in Luxembourg



Sources: CREOS

Table 61 illustrates developments in technical capacity at existing and planned interconnection points by Creos.

Due to relatively low demand, the Esch-sur-Alzette border interconnection point was closed in 2013, but could be reactivated if necessary. However, this interconnection point only supplies a small region and is not connected to the Creos transmission network.

The non-interruptible entry capacity at the Remich interconnection point is currently limited to 88 000 Nm³/h.

Therefore, the safe and non-interruptible transport capacity (n-1) is currently 268 000 Nm³/h. According to Creos, the current peak load of the group of protected customers is around 140 000 Nm³/h. Thus, Luxembourg would therefore fulfil its infrastructure obligations under Regulation (EU) 2017/1938. However, due to the small number of interconnection points, this regulation is not binding on the country. It still intends to comply with it in order to ensure the supply of gas to protected customers.

Due to the closure of the Twinerg plant and the resulting sharp drop in gas consumption, Creos sees no need to increase its capacity.

Mr CREOS is of the opinion that there will be no gas intensive industry in Luxembourg.

Table 61: Existing and future technical capacities of interconnection points

	2021	2030	2040
Esch/Alzette (FR)	20.000	20.000	20.000
Remich (DE)	150.000	150.000	150.000
Arm (BE)	110.000	110.000	110.000
Petange (BE)	70.000	70.000	70.000
Sum	350.000	350.000	350.000

Sources: CREOS

4.5.3 Electricity and gas markets, energy prices

The Luxembourg electricity market currently has 19 licensed suppliers, of which 12 were active in the market in 2021. For the gas market, the number of authorised suppliers is 12, of which 7 are active.

Current electricity and gas prices for final customers are indicated below.

Table 62: Evolution of electricity and gas prices for final customers.

	2017- S2	2018- S1	2018- S2	2019- S1	2019- S2	2020- S1	2020- S2	2021- S1	2021- S2	2022- S1	2022- S2
Average natural gas price for the household customer [EUR/kWh]	0.0398	0.0411	0.0429	0.0448	0.0414	0.0412	0.0366	0.0438	0.0639	0.0856	0.0891
Average price of natural gas for the non-household customer [EUR/kWh]	0.0338	0.0345	0.0359	0.0361	0.0307	0.0328	0.0308	0.0347	0.0492	0.0847	0.1225
Average electricity price for the household customer	0.1618	0.1671	0.1691	0.1798	0.1799	0.1986	0.1985	0.1988	0.1989	0.2017	0.2017
Average electricity price for the non-household customer	0.0873	0.0905	0.0914	0.0975	0.0983	0.1009	0.1020	0.1037	0.1058	0.1404	0.1638

Sources: Eurostat

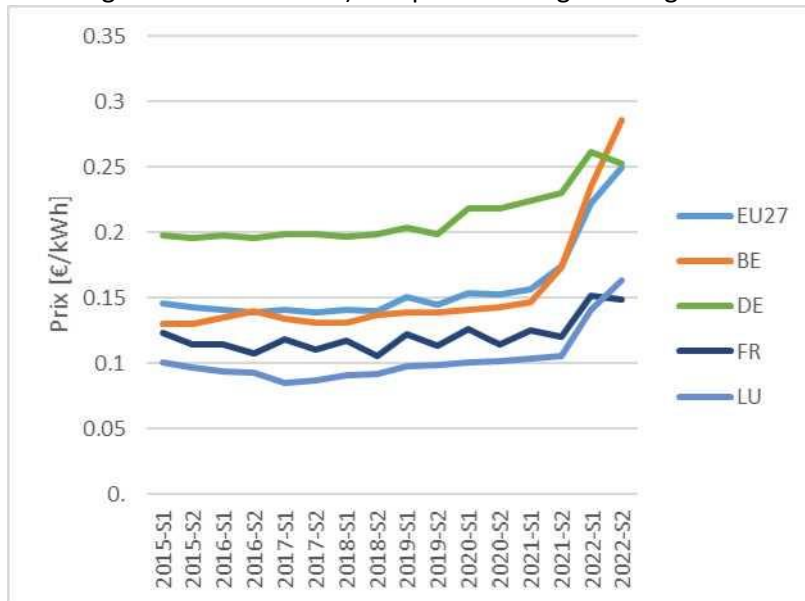
Remarks:

1. Natural gas household customer: Band D2: 20 GJ Annual &ls200 GJ
2. Non-household customer natural gas: Band I3: 10 000 GJ Annual &ls100 000 GJ

3. Household electricity customer: Band DC: 2 500 kWh annual necessitated 5 000 kWh
4. Non-household electricity customer: Band IC: 500 MWh – annual consumption -2 000 MWh

In addition to the table above, the following graph shows the evolution of the electricity price for non-household customers (Band IC: 500 MWh of annual consumption -2 000 MWh, including all taxes and levies) compared to neighbouring countries from 2015 onwards.

Figure 43: Electricity prices for non-household customers (Band IC: 500 MWh of annual total utilisation of 2 000 MWh, including all taxes and levies) compared to neighbouring countries from 2015 onwards



Sources: Eurostat

4.6 research, innovation and competitiveness dimension

As argued in Chapters 2.5 and 3.5, R & D & I activities are at different levels of TRL or upstream or downstream of complex value chains, of which Luxembourg only covers a small part. Although the proposed measures will enhance the R & D & I ecosystem in Luxembourg, their concrete impacts on the energy transition and climate action are difficult to quantify or even impossible to model. However, MESR is working on scoreboards and indicators to better identify funding, resources, staff and results related to the NECP flagship themes.

5. Impact assessment of planned policies and measures

In order to carry out the impact assessment of policies and measures on a sound analytical basis, modelling has been entrusted to a group of national experts composed of STATEC, experts from the various ministries concerned, the Environment Administration and the Rural Economy Service. The approach is further described in the introduction to Chapter 4.

5.1 Impacts of planned policies and measures on the energy system and GHG emissions and removals, with comparison with projections based on existing policies and measures

In addition to the With Existing Measures (WEM) scenario based on existing policies and measures, having been adopted until 31 December 2021, and presented in Chapter 4, the impact assessment identified the **WAM (With Additional Measures) scenario incorporating additional (new and enhanced) policies and measures** as described in Chapter 3. This chapter presents the assessment of the impacts of planned policies and measures (WAM scenario) on GHG emissions and removals (Chapter 5.1.1), energy consumption (Chapter 5.1.2) and renewable energy (Chapter 5.1.3). Each time the effects of the WAM scenario are compared to the WEM scenario.

5.1.1 GHG emissions and removals

The results of projections of GHG emissions and removals based on planned policies and measures (WAM scenario) are compiled in Table 63 and Table 64 for each of the 5 sectors of the Climate Law (**ESR emissions/Climate Law**: emissions attributed to Luxembourg under the Effort Sharing Regulation (EU) 2018/842), for installations falling under the scope of the ETS Directive (**ETS emissions**) and for the LULUCF sector.

Table 63: Projections of GHG emissions and removals up to 2030 based on additional (new and enhanced) policies and measures (**WAM scenario**)

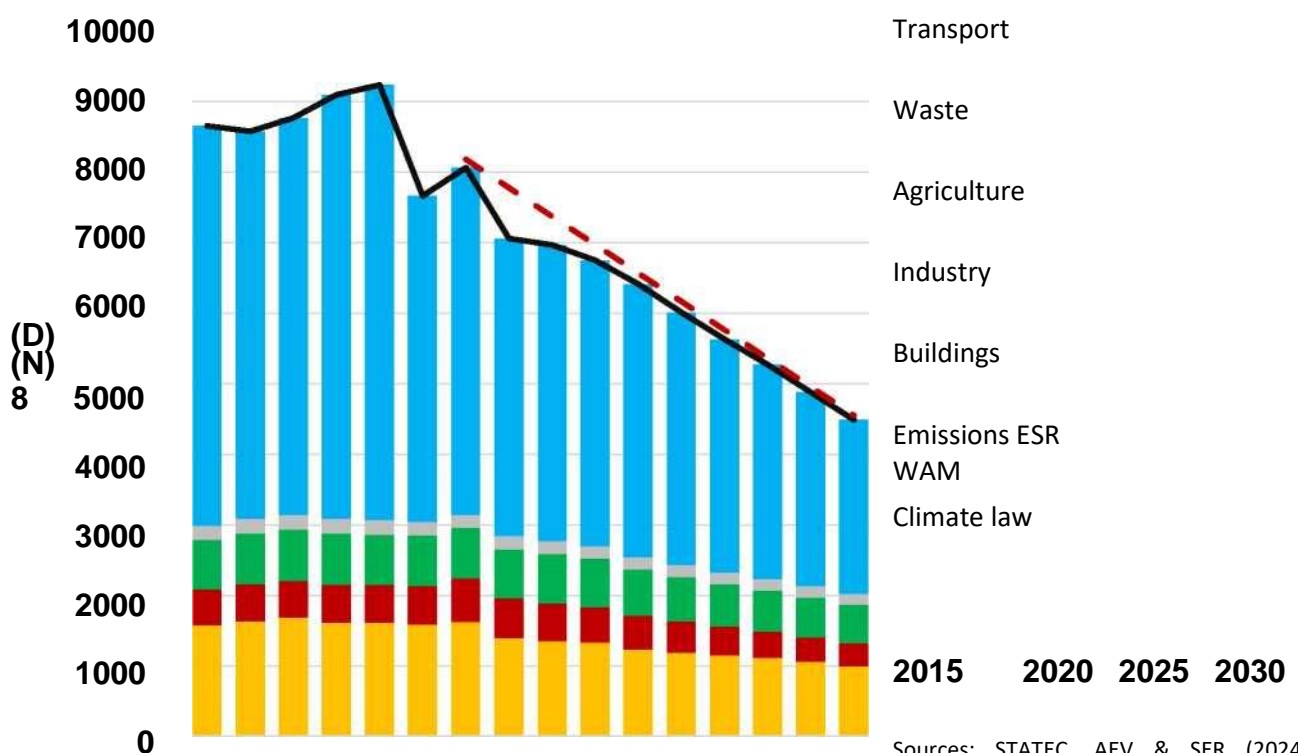
(Thousand tonnes CO _{2eq} (AR5))	2021 * *	2022 * *	2023	2024	2025	2026	2027	2028	2029	2030
Energy and manufacturing industries, construction	614	566	539	506	474	439	408	378	351	325
Transport	4919	4217	4195	4055	3872	3587	3306	3042	2751	2467
Residential and tertiary buildings	1621	1395	1343	1328	1234	1187	1147	1107	1054	993
Agriculture and forestry	717	689	707	682	658	630	604	583	563	545
Treatment of waste and waste water	193	192	182	178	174	170	166	161	157	157
ESR Emissions/Climate Law	8065	7058	6966	6749	6410	6013	5631	5271	4877	4487
ETS EMISSIONS	1317	1134	1251	1245	1246	1242	1225	1196	1172	1137
Emissions TOTALES – ESR/Climate Law	9383	8192	8218	7994	7656	7255	6856	6467	5050	5625
LULUCF	– 608	– 648	– 435	– 426	– 431	– 439	– 432	– 442	– 436	– 430

* Emissions for the years 2021 and 2022 are observed data in the latest greenhouse gas emission inventory. Projections start from 2023 onwards.

Source: STATEC, AEV & SER (2024)

Comparing the projected ESR emissions/climate law in the WAM scenario with annual emission allocations for 2030 (according to the Grand-Ducal Regulation of 22 June 2022 determining annual greenhouse gas emission allocations for the period up to 31 December 2030), the projected emissions for 2030 are approximately 1 % lower than the emission allocation for that year. Compared to the base year 2005, emissions in 2030 would be reduced by 56 %, while the national climate target is to reduce emissions by 55 % by 2030 compared to 2005. **The national emission reduction target would therefore be met in 2030**, thanks to additional (new and strengthened) policies and measures, while in the WEM scenario emissions would only be reduced by 33 % (see Figure 44 and Figure 45).

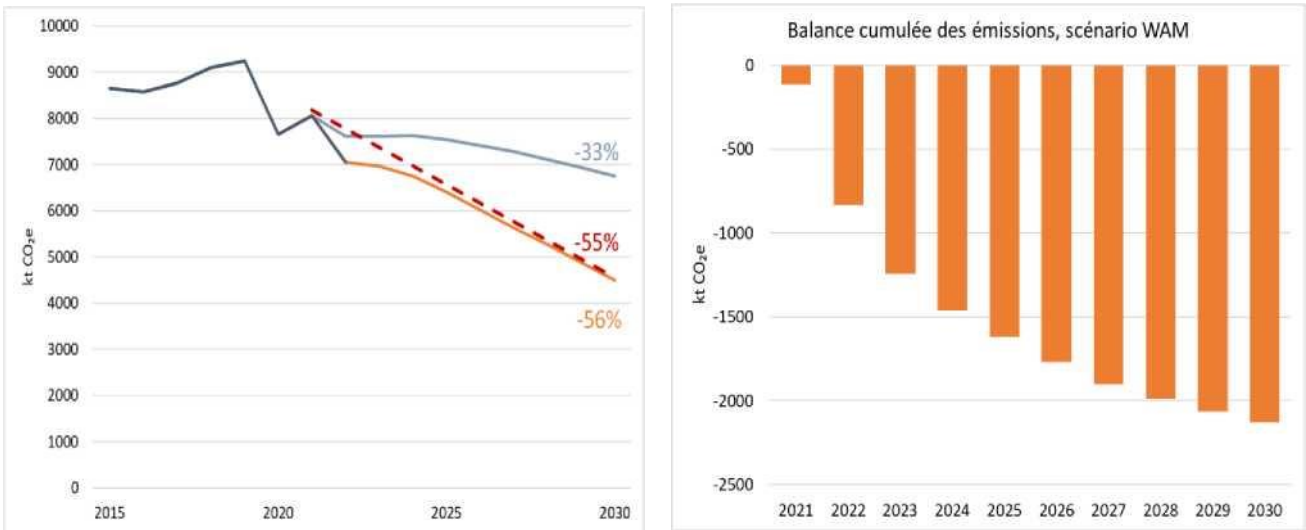
Figure 44: WAM projection of ESR emissions/Climate Law compared to the trajectory of annual emission allocations for 2030 (Climate Law) with historical emissions from 2015 to 2022



Sources: STATEC, AEV & SER (2024); GHG emissions inventory (submission of March 2024); Grand-Ducal Regulation of 22 June 2022 determining annual greenhouse gas emission allocations for the period up to 31 December 2030 (Climate Law)

Similarly, in the WAM scenario, the projected ESR emissions/climate law comply with the annual emission allocations for each year from 2021 to 2030. Over the whole period, the WAM scenario combines a bonus of around 2 100 kt CO_{2eq} compared to the trajectory of annual emission allocations (see Figure 45), which corresponds to around 3.4 % of the total emission budget. Thus, **the national climate target would be well met over the period from 2021 to 2030**.

Figure 45: WAM projection (in orange) and WEM projection (in grey) of ESR emissions/Climate Law compared to the trajectory (in red) of annual emission allocations for 2030 (Climate Law) with historical emissions from 2015 to 2022 cumulatively balanced emissions in the WAM scenario compared to annual emission allocations for 2030



Sources: STATEC, AEV & SER (2024); GHG emissions inventory (submission of March 2024); Grand-Ducal Regulation of 22 June 2022 determining annual greenhouse gas emission allocations for the period up to 31 December 2030 (Climate Law)

Finally, for the LULUCF sector, the reinforced target for 2030 is to achieve a total net absorption of -403 kt CO_{2eq} (see 2.1.1). According to the results of the WAM scenario (see Table 64), **LULUCF would also be achieved in 2030.**

In conclusion, the additional (new and reinforced) policies and measures of the update of the NECP (WAM scenario) would achieve the 2030 national climate targets of the Climate Law.

The results of projections of GHG emissions and removals based on planned policies and measures (WAM scenario) for 2 050 are compiled in Table 64 and discussed in Chapter 5.4.

Table 64: Projections of GHG emissions and removals up to 2050 based on additional (new and enhanced) policies and measures (WAM scenario)

(Thousand tonnes CO _{2eq} (AR5))	2025	2030	2035	2040	2045	2050
Energy and manufacturing industries, construction	474	325	249	172	111	98
Transport	3872	2467	1170	321	78	37
Residential and tertiary buildings	1234	993	702	427	261	96
Agriculture and forestry	658	545	528	511	496	484
Treatment of waste and waste water	174	157	156	154	155	158
ESR Emissions/Climate Law	6410	4487	2805	1584	1100	873
ETS EMISSIONS	1246	1137	886	487	500	519
Emissions TOTALES – ESR/Climate Law	7656	5625	3692	2071	1600	1392
LULUCF	- 431	- 430	- 256	- 428	- 493	- 660
TOTAL stocktaking – ESR/Climate &LUCF	7225	5195	3435	1643	1107	732

Sources: STATEC, AEV & SER (2024)

5.1.2 Evolution of energy consumption in Luxembourg by 2040 following the WAM (With Additional Measures) scenario

Table 65 shows the final energy consumption of the WAM scenario for the years 2030 and 2040 broken down by sector. The corresponding trajectories are shown in Figures 46 to 58. These figures make it possible to compare the WAM scenario with the WEM scenario presented in Chapter 4 and place it in relation to the objectives of the 2020 NECP. The

final energy considered here is final energy excluding ambient heat, including international aviation.

Table 65: Final energy consumption of the various sectors in the WAM scenario for the years 2030 and 2040

Sector	Unit	2030	2040
Manufacturing and construction (ETS + Non-ETS)	GWh	6 587	6 414
Transport	GWh	20 300	14 545
Households (including residential buildings)	GWh	5 570	4 621
Trade and services (including tertiary buildings)	GWh	4 434	3 531
Agriculture	GWh	58	58
Total final energy consumption *	GWh	36 949	29 168

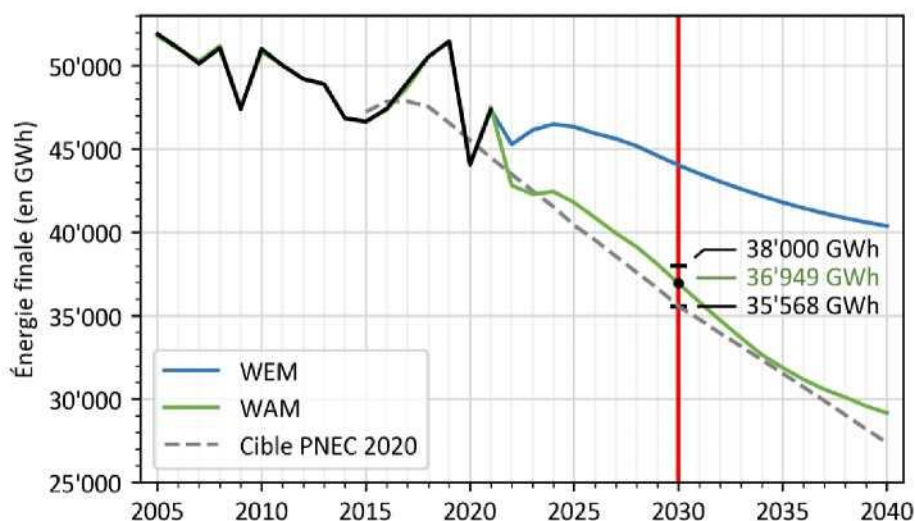
* excluding ambient heat, with international aviation

Sources: STATEC modelling 2024

Total all sectors

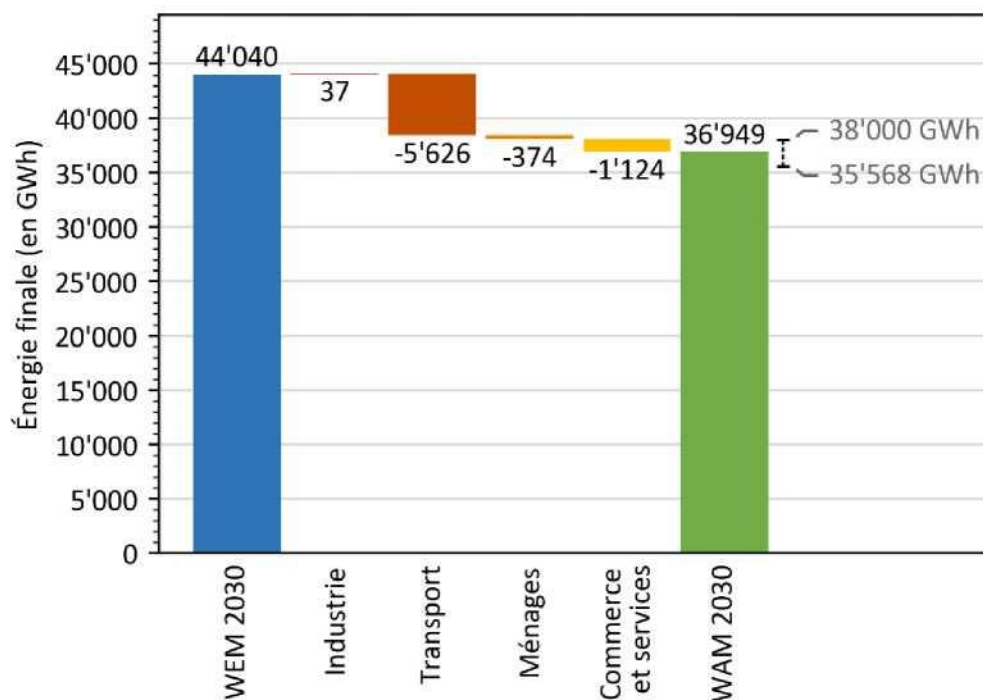
The overall energy efficiency target for all sectors modelled in the WAM scenario is shown in Figure 46. The ambitious target for final energy consumption of 36 949 GWh in 2030 corresponds to a reduction of 42 % compared to the REF2007 scenario and is therefore within the energy efficiency improvement range of -40 to -44 % compared to the REF2007 benchmark defined as a national target in the 2020 NECP.

Figure 46: Evolution PNEC 2020 vs WEM vs WAM – TOTAL all sectors



Sources: Modelling STATEC 2024, MECO/DG Energy

Figure 47: Comparison between WEM and WAM – Total Final Energy Consumption in 2030



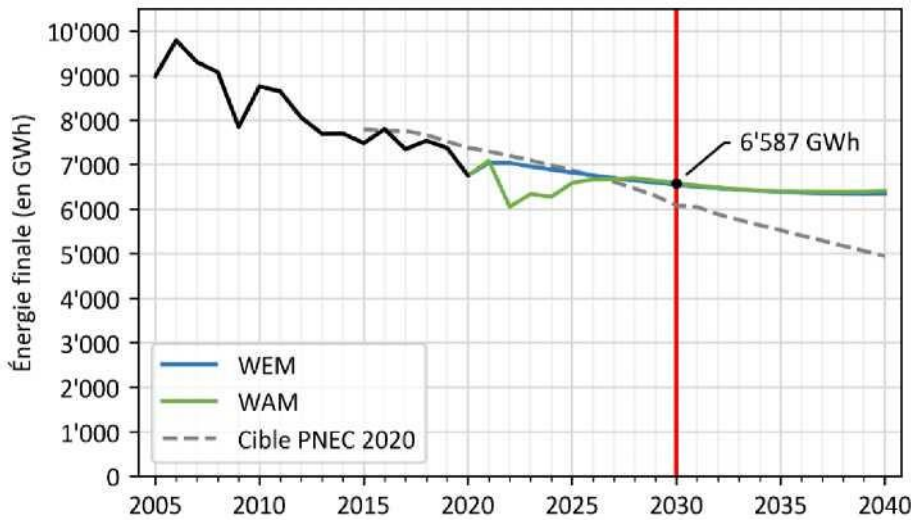
Sources: Modelling STATEC 2024, MECO/DG Energy

Manufacturing industries and construction

On the basis of cyclical projections, the continued increase in manufacturing and construction activities largely counterbalances the improvement in energy efficiency in this sector, which explains the almost constant final energy consumption between 2020 and 2040, with slight fluctuations.

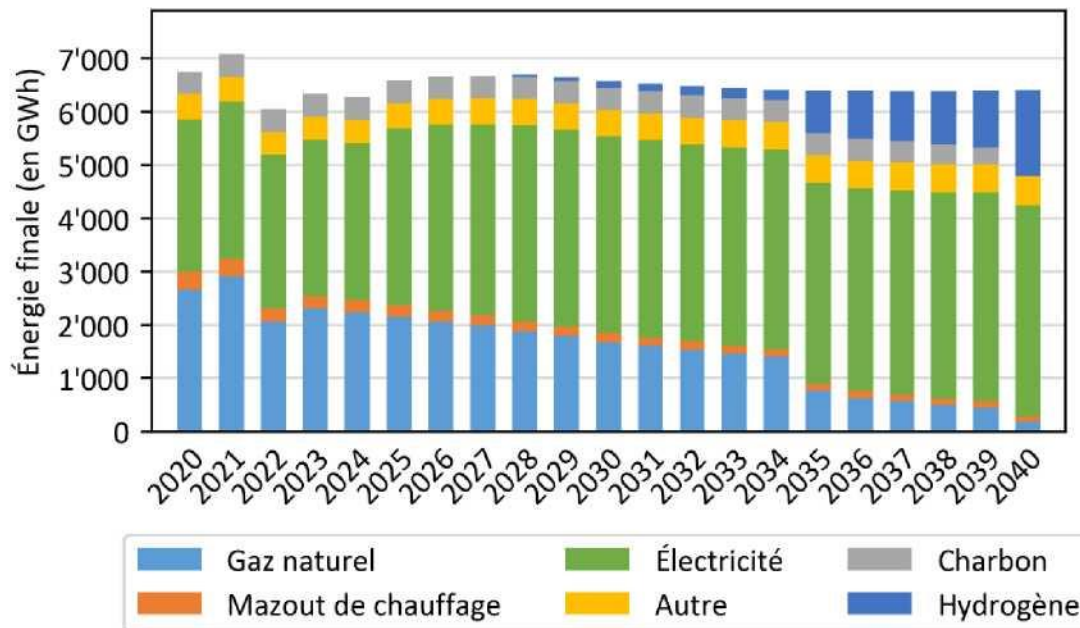
It should be noted that the increase in activities is mainly carried out at the level of non-HTA companies and that there is hardly any change at the level of HTA companies.

Figure 48: Evolution PNEC 2020 vs WEM vs WAM – Manufacturing and Construction



Sources: Modelling STATEC 2024, MECO/DG Energy

Figure 49: WAM evolution by energy carrier – Manufacturing and construction



Sources: Modelling STATEC 2024, MECO/DG Energy

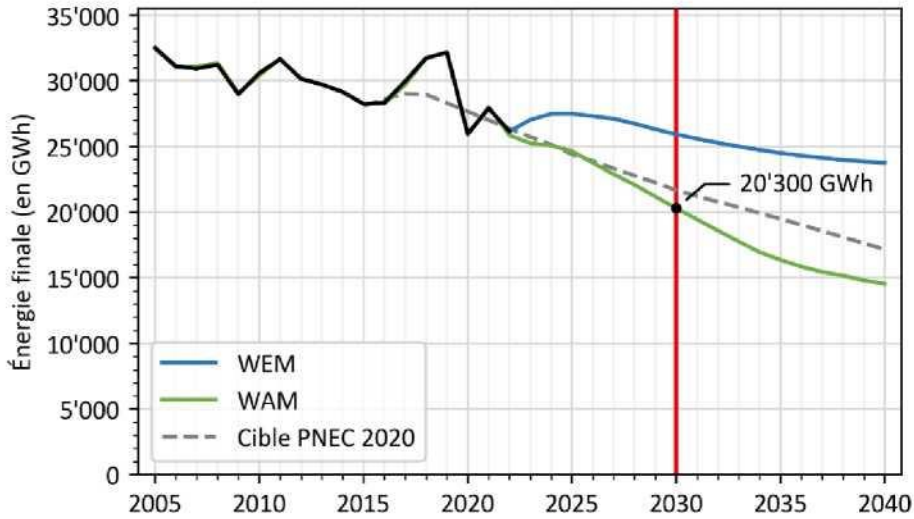
Transport

The sharp decline in final energy consumption in the transport sector is primarily influenced by the modulation of the CO₂ tax according to the evolution of the fuel price differential vis-à-vis neighbouring countries (road transport fuels).

The electrification of the transport sector has an average influence on final energy consumption, but has a significant impact on the reduction of the sector's GHG emissions. The strong development

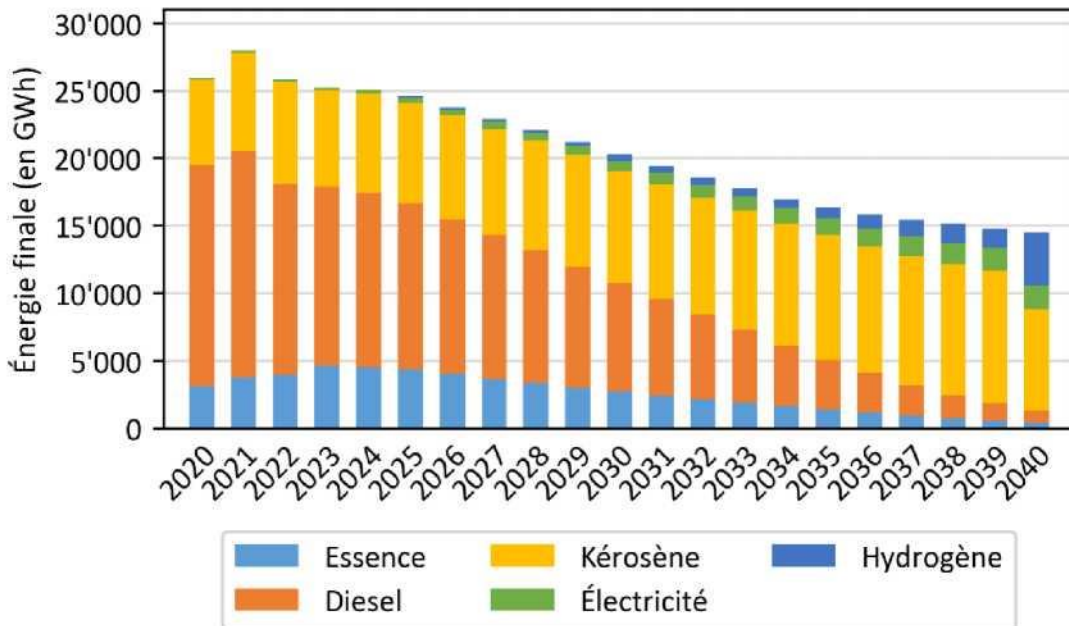
of the aviation sector (passenger and freight transport) counterbalances some of the improvements in energy efficiency.

Figure 50 : Évolution PNEC 2020 vs WEM vs WAM – Transport



Sources: Modelling STATEC 2024, MECO/DG Energy

Figure 51: WAM evolution by energy carrier – Transport



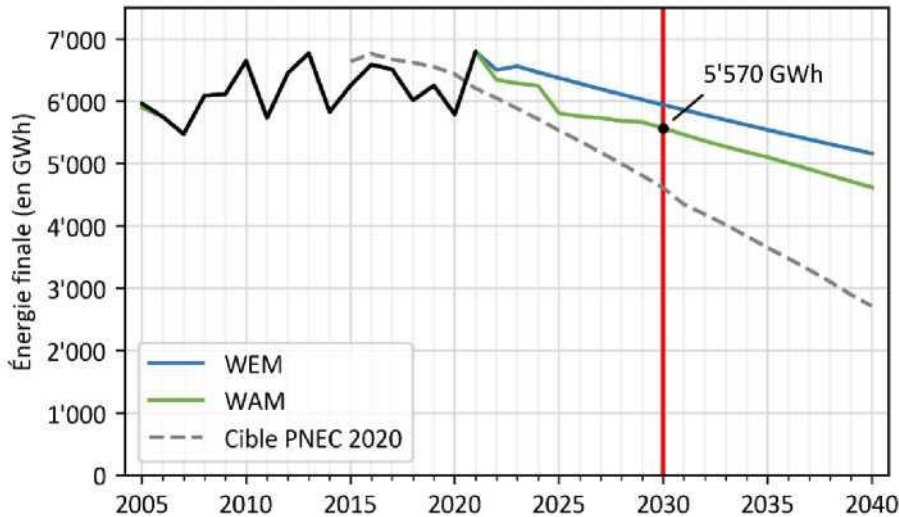
Sources: Modelling STATEC 2024, MECO/DG Energy

Households (including residential buildings)

The energy consumed by households is largely directly linked to the use (heating) of residential buildings.

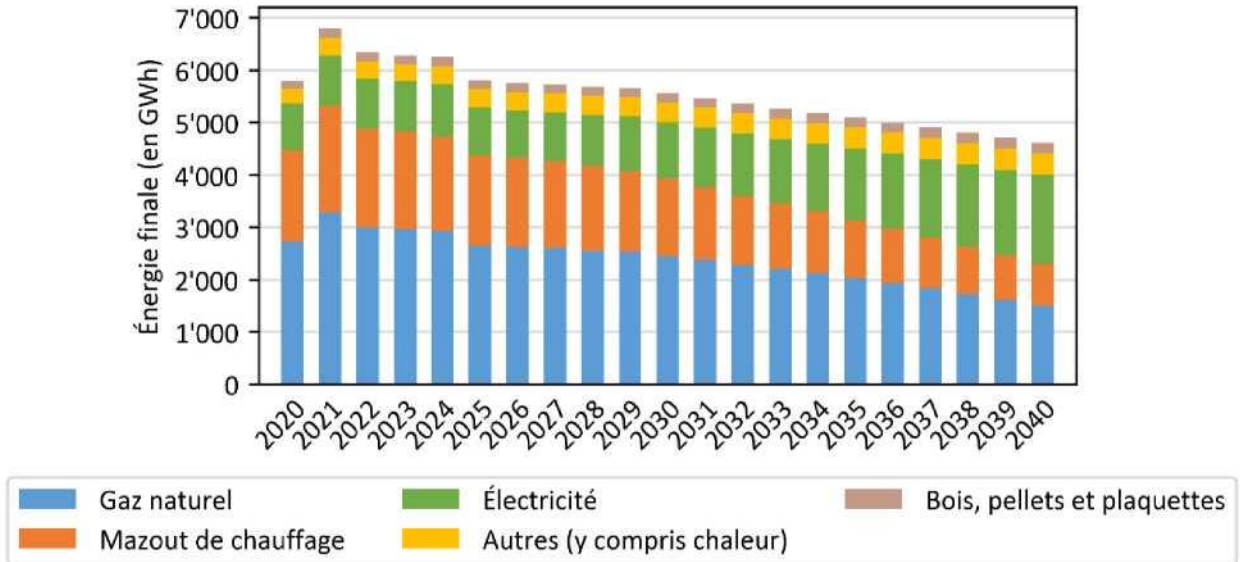
The decarbonisation of buildings through electrification, i.e. the replacement of fossil heating systems with renewable energy systems and in particular by heat pumps has a direct effect on GHG emissions and, specifically for heat pumps, on the reduction of final energy consumed (as ambient heat used by a heat pump is not counted as final energy (FEC without ambient heat)).

Figure 52: Evolution PNEC 2020 vs WEM vs WAM – Households



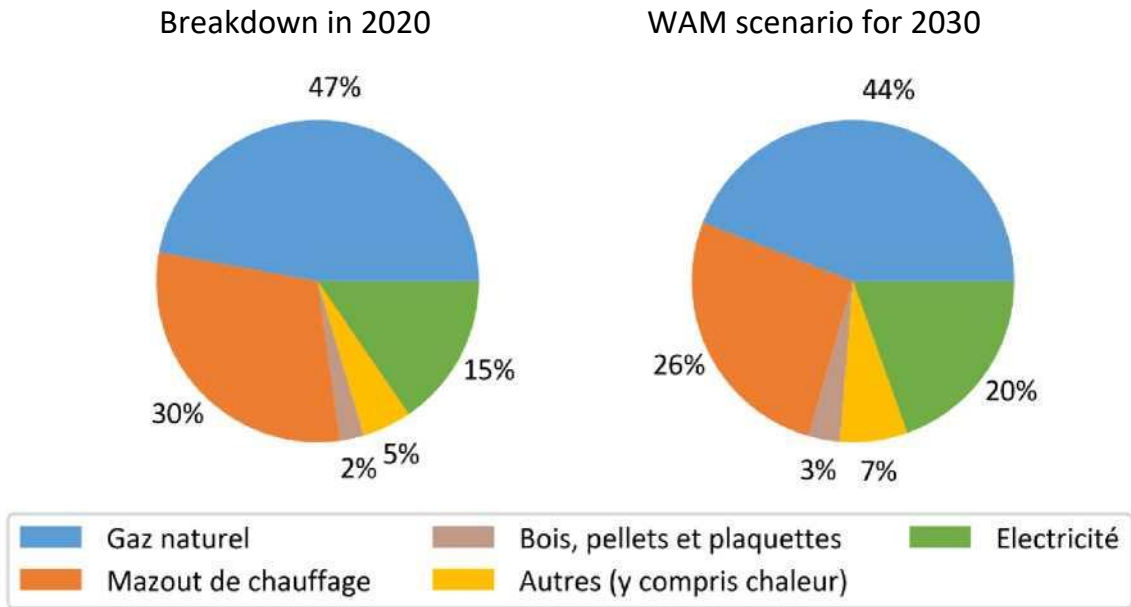
Sources: Modelling STATEC 2024, MECO/DG Energy

Figure 53: WAM evolution by energy carrier – Households



Source: Modelling STATEC 2024, MECO/DG Energy

Figure 54: Distribution by energy carrier – Households



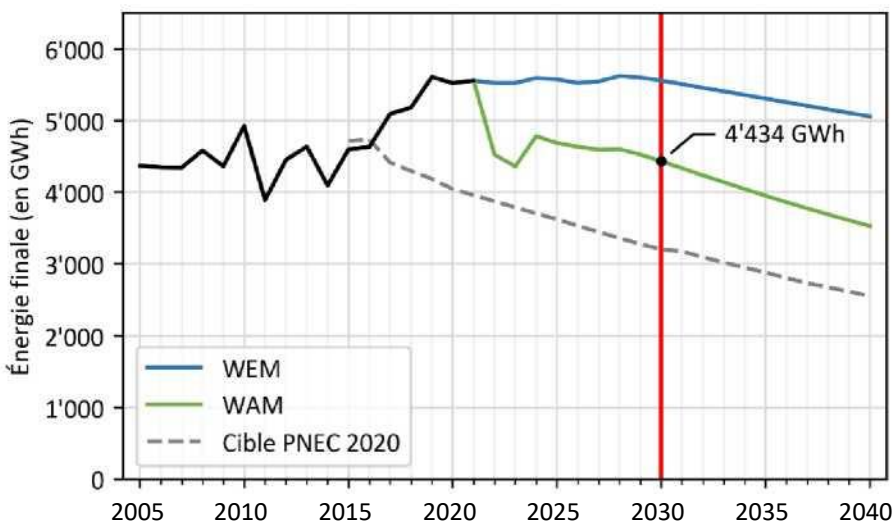
Sources: Modelling STATEC 2024, MECO/DG Energy

Shops and services (including tertiary buildings)

This sector includes tertiary buildings but also all commercial activities and services (which are not specifically attributed to another sector).

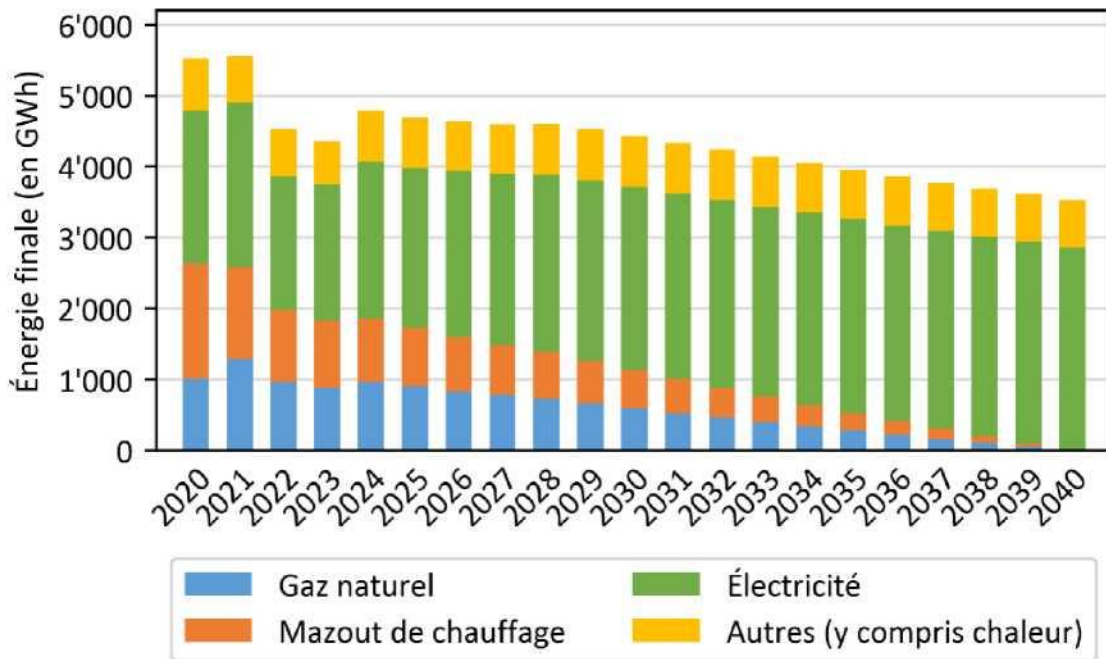
The decarbonisation of buildings through electrification, i.e. the replacement of fossil heating systems with renewable energy systems and in particular by heat pumps has a direct effect on GHG emissions and, specifically for heat pumps, on the reduction of final energy consumed (as ambient heat used by a heat pump is not counted as final energy (FEC without ambient heat)).

Figure 55: Evolution PNEC 2020 vs WEM vs WAM – Commerces and services



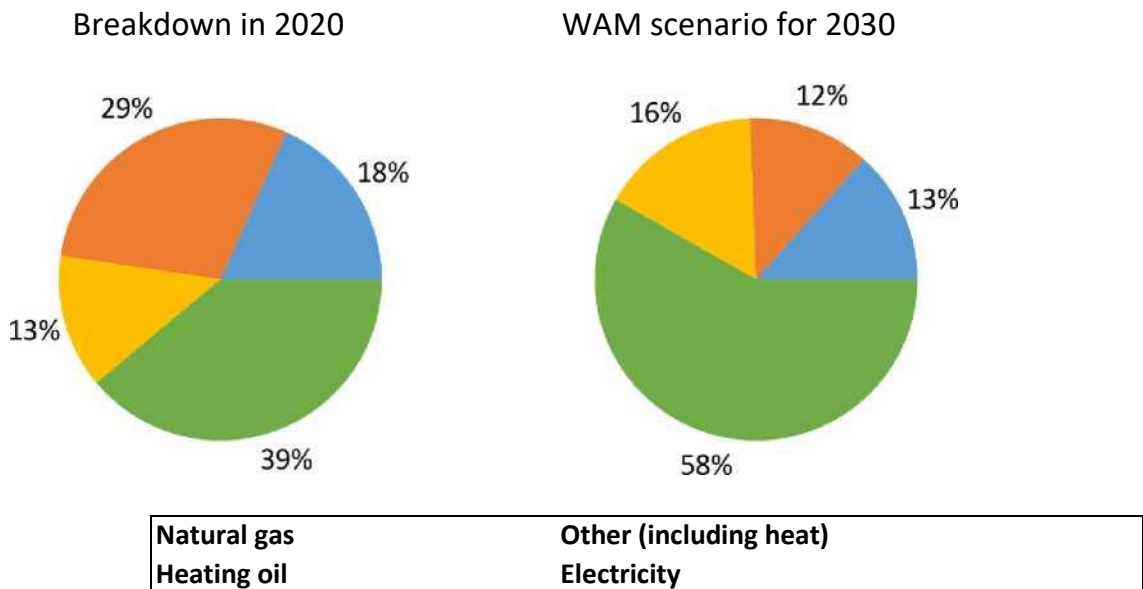
Source: Modelling STATEC 2024, MECO/DG Energy

Figure 56: WAM evolution by energy carrier – Commerces and services



Sources: Modelling STATEC 2024, MECO/DG Energy

Figure 57: Breakdown by energy carrier – Commerces and services

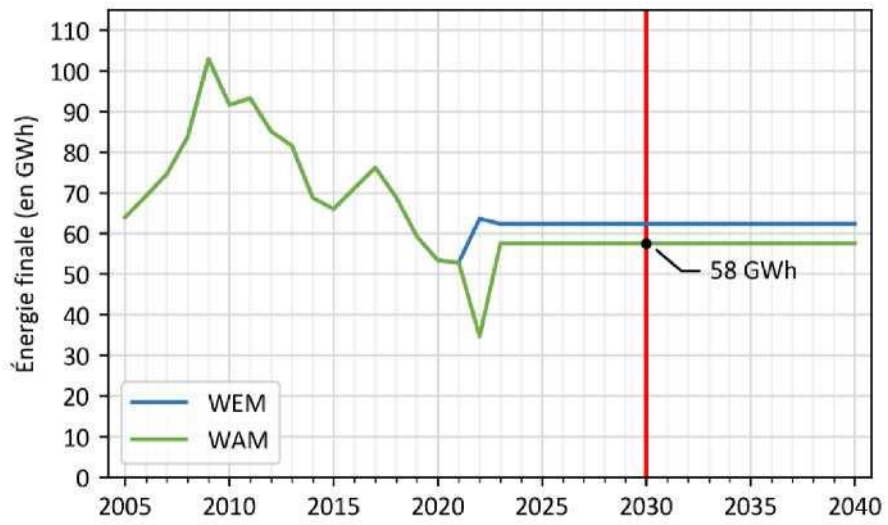


Sources: Modelling STATEC 2024, MECO/DG Energy

Agriculture

The agriculture sector has a relatively low final energy consumption compared to the other sectors considered above. Figure 58 shows the evolution of its final energy consumption up to 2040.

Figure 58: WAM Scenario – Agriculture



Sources: Modelling STATEC 2024, MECO/DG Energy

5.1.3 renewable energy

The 2020 NECP was adopted by the Government in Council at its meeting of 20 May 2020 and forms the basis for Luxembourg's climate and energy policy, a roadmap already put into practice by the adoption of laws and regulations, strategies and programmes and projects in the various fields.

The target scenario of the 2020 NECP indicated the trajectory to reach a 25 % share of renewable energy compared to gross final energy consumption by 2030. In addition to the almost exponential development of renewable energies, a significant increase in energy efficiency and consequently a reduction in consumption will therefore be necessary.

This section focuses on the so-called additional measures to further promote the development of renewable energy and increase their contribution. Specifically, the focus is on energy production and the resulting share of renewable energy according to the updated NECP target scenario (37 % renewable energy in the energy mix for 2030), thus with the additional measures presented in Chapter 3, compared to the baseline scenario, with existing measures.

Trends in the production of energy from renewable sources according to the various sectors by 2040 according to the WAM (With Additional Measures) scenario

In the next chapter, developments in the production of renewable energy in the different sectors according to the WAM scenario for 2040 are presented. The WAM scenario has been modelled by STATEC using the NEAM model and taking into account the measures proposed in Chapter 3. In Chapter 2, some details and expected impacts of the implementation of these policies and measures are also described under the chapters on developments in the different renewable energy sources.

WAM scenario – Renewable electricity sector

Table 66: Projected evolution of renewable sources/technologies in the **renewable electricity sector by 2040 – WAM scenario and comparison to WEM scenario**

Wam scenario – GWh	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Hydroelectric power	104	104	104	104	104	103	103	103	103	103	102
Eolien	315	330	430	511	699	800	867	903	962	1043	1368
Photovoltaic	180	316	390	480	580	680	780	890	1000	1112	1574
Renewable waste	43	43	44	45	46	47	48	49	49	50	60
Biogas	62	67	71	75	79	84	88	92	96	100	100
Solid biomass	285	285	290	540	554	568	582	596	610	624	734
RES generation – electricity sector	989	1145	1329	1755	2062	2282	2468	2633	2820	3032	3937
Consumption – electricity sector	6954	6120	6209	6564	6866	7129	7322	7538	7673	7756	8884
RES share – electricity sector	14.2 %	18.7 %	21.4 %	26.7 %	30.0 %	32.0 %	33.7 %	34.9 %	36.8 %	39.1 %	44.3 %

Sources: STATEC-MECO modelling/DG Energy 2024

WEM scenario:

WEM	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
RES share – Electricity –%	14.2 %	16.9 %	17.4 %	18.9 %	21.5 %	23.5 %	24.5 %	24.9 %	25.5 %	26.5 %	30.0 %

The increase in the share of renewable electricity is driven by photovoltaic and wind power throughout the period from 2021 to 2040. The WAM scenario is supported by policies and measures aimed, inter alia, at extending large photovoltaic installations, promoting self-consumption, *PV-ready* for new industrial and agricultural buildings, and supporting wind power by speeding up and facilitating permitting procedures. A general overview is given in Chapter 2 and all measures can be found in Chapter 3.

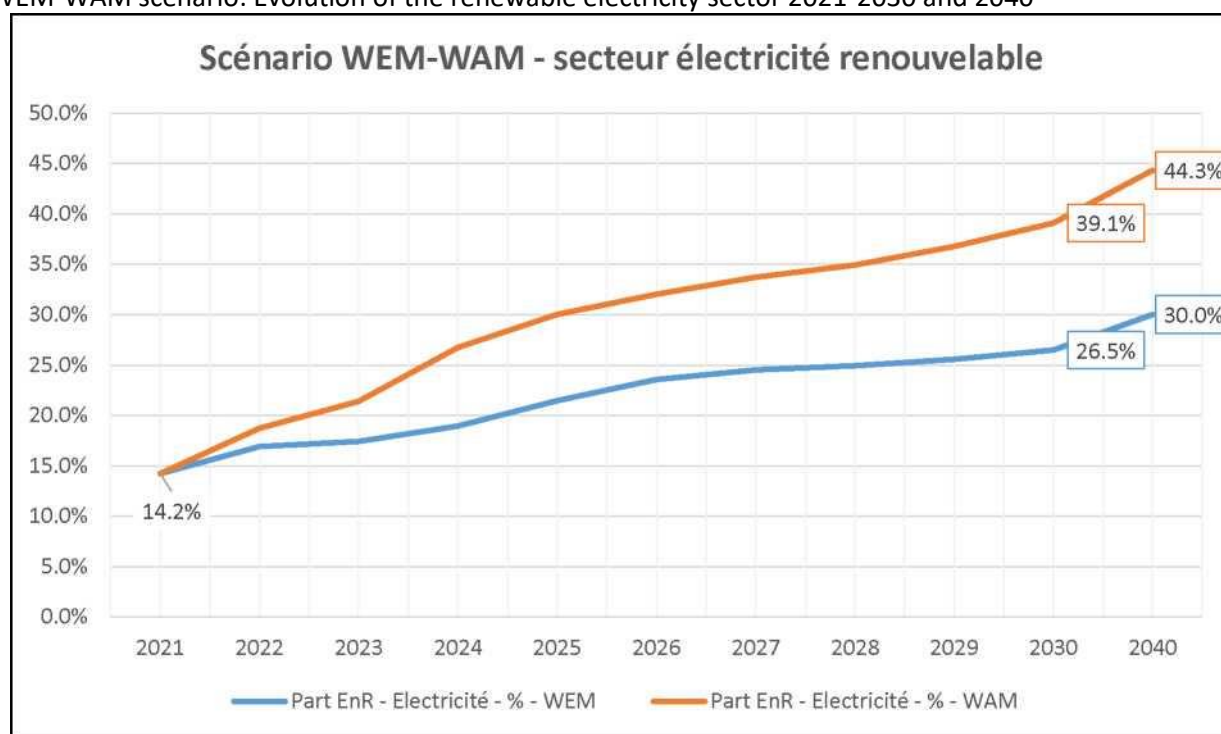
Compared to WEM, hydropower and renewable waste remain unchanged, as the available potential is already exploited and additional installations of these technologies are not foreseen.

By 2040, electricity produced from wind energy increased from 1.016 GWh to 1.368 GWh, photovoltaic from 838 GWh to 1.574 GWh, biogas from 65 to 100 GWh and solid biomass from 428 to 734 GWh compared to the WEM scenario (Table 66). These differences underline that a large part of the measures focuses on these technologies and above all on solar energy.

For example, for 2030 the share of renewable energy in the electricity sector increased from 26.5 % (WEM) to 39.1 % (WAM) and for 2040, from 30 % to 44.3 % according to the modelling.

A significant factor influencing the share of renewables in the electricity sector is the electricity consumption that increases by around 14.5 % between 2030 and 2040 (WAM scenario).

Figure 59: WEM-WAM scenario: Evolution of the renewable electricity sector 2021-2030 and 2040



Source : Modélisation STATEC-MECO/DG Energie 2024

WAM Scenario – Renewable Heat Sector

Table 67: Projected evolution of renewable sources/technologies in the renewable heat sector by 2040 – WAM scenario

Wam scenario – GWh	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Biogas (centralised) – biomethane	30	119	125	132	138	145	151	158	164	170	170
Solid biomass (centralised)	1203	1300	1310	2050	2068	2103	2139	2177	2217	2259	1697
Solid biomass (decentralised)	132	150	170	190	210	230	250	270	290	310	192
Renewable waste (centralised)	12	12	12	12	13	13	13	13	13	14	16
Solar heating panels	31	35	40	45	50	55	60	65	70	75	100
Heat pumps (PAC)	54	216	315	438	522	824	999	1177	1376	1555	3.361
RFNBO (Industry)	0	0	0	0	0	0	0	35	63	130	1.610
RES consumption – heating/cooling sector	1463	1832	1973	2867	3001	3369	3612	3895	4194	4514	7147
Consumption – heating/cooling sector	11388	11891	11979	12100	11624	11651	11598	11522	11457	11270	8883
RES share – heat sector	11.2 %	15.4 %	16.5 %	23.7 %	25.8 %	28.9 %	31.1 %	33.8 %	36.6 %	40.1 %	80.5 %
Article 23-2023/2413	0.2 %	4.3 %	1.1 %	7.2 %	2.1 %	3.1 %	2.2 %	2.7 %	2.8 %	3.4 %	/
Average	3.0 %					2.8 %					
Annex I (a)	2.9 %										

Sources: STATEC-MECO modelling/DG Energy 2024

WEM scenario:

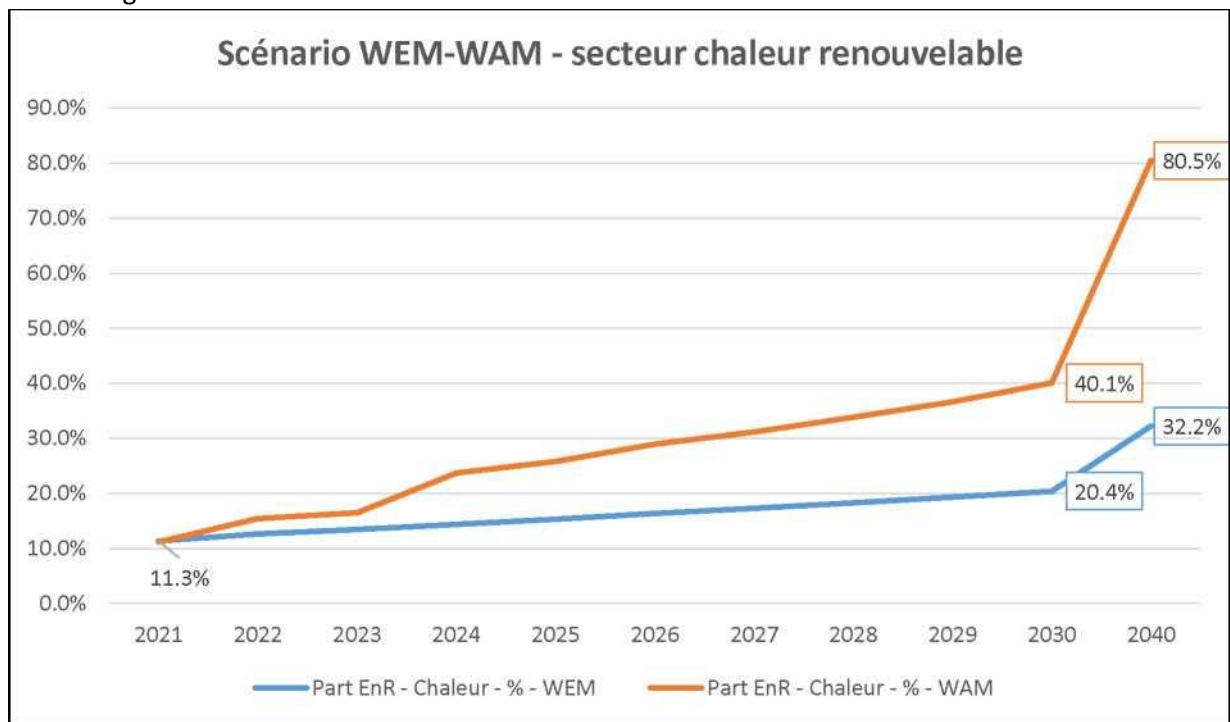
WEM	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Share ENR – Heat –%	11.3 %	12.6 %	13.5 %	14.4 %	15.3 %	16.3 %	17.3 %	18.3 %	19.3 %	20.4 %	32.2 %

Compared to the WEM scenario, the WAM scenario is distinguished primarily by its heat input through heat pumps, whether they are used in the residential or tertiary buildings sector with the objective of decarbonising buildings through electrification, combined with photovoltaic electricity production (and by optimising the self-consumption of this electricity) (Table 67). For 2030, WEM modelling is 643 GWh significantly lower in terms of heat produced from heat pumps, compared to the WAM scenario (1.555 GWh). Between 2030 and 2040, the deployment of heat pumps will be much more pronounced with the proposed measures, resulting in 3.361 GWh produced (WAM) instead of 1.242 GWh (WEM).

In addition to heat pumps, renewable hydrogen (as a priority for industrial processes) plays a role in decarbonising the industrial sector, especially from 2030 onwards. By 2035, and in consultation with the development of a network in the Greater Region, the commissioning of a hydrogen line is planned. With 1.610 GWh modelled for 2040, renewable hydrogen contributes substantially to decarbonising the heat sector (industrial processes).

On the other hand, the centralised production of energy from biogas, respectively, the use of biomethane has increased sharply as a result of the additional measures (WAM: 170 GWh; WEM: 32 GWh). Heat production from solid biomass (centralised and decentralised) as a transitional technology tends to decrease as a result of the accelerated development of heat pumps. Production from solar thermal panels is also subject to slight increases in the WAM scenario compared to the WEM scenario. Figure 60 shows the evolution of the share of renewable energy in the heat sector in both scenarios.

Figure 60: WEM-WAM Scenario Renewable Heat Sector Evolution 2021-2030 and 2040



Sources: STATEC-MECO modelling/DG Energy 2024

WAM Scenario – Transport/Aviation Sector

Table 68: Projected evolution of renewable sources/technologies in the transport sector by 2040 – WAM scenario

Transport Sector	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Biofuel incorporation rate%	7.7 %	8.0 %	8.0 %	8.4 %	8.8 %	9.0 %	9.2 %	9.4 %	9.7 %	10.0 %	6.0 %
Fossil fuels	18831	16599	16507	15974	15221	14093	12983	11942	10798	9687	1262
Share of biofuels – road transport	1581	1466	1452	1489	1501	1435	1365	1300	1233	1162	247
— <i>Single counting biofuels</i>	1047	830	825	799	761	705	649	597	540	145	0
— <i>Double counting biofuels</i>	534	618	609	655	655	571	419	288	185	271	0
— <i>Advanced biofuels</i>	0	18	18	35	85	159	297	415	509	746	247
<i>Share of advanced biofuels –% **</i>	0.0 %	0.2 %	0.2 %	0.4 %	1.0 %	2.0 %	4.0 %	6.0 %	8.0 %	12.8 %	12.0 %
RFNBO route	0	0	2	10	15	17	22	47	72	98	1000
<i>Road/Rail – RFNBO share</i>	0.0 %	0.0 %	0.0 %	0.1 %	0.2 %	0.2 %	0.3 %	0.7 %	1.1 %	1.7 %	24.3 %
Electricity Transport	172	198	243	301	371	445	520	597	676	755	1757
Renewable share	19	28	34	56	79	119	156	191	228	264	779
— <i>ENR transport</i>	4	8	13	26	39	71	98	128	159	211	701
— <i>ENR rail</i>	15	20	21	26	27	37	41	45	47	53	78
<i>Share of advanced biofuels and RFNBO **</i>	0.0 %	0.2 %	0.2 %	0.5 %	1.2 %	2.2 %	4.3 %	6.7 %	9.1 %	14.5 %	36.3 %
Consumption – calculation of overall share	1600	1493	1489	1556	1596	1571	1544	1538	1533	1524	2026
Consumption – calculation of the transport sector	1860	1551	1567	1635	1740	1938	2243	2571	2838	3151	2026
Consumption – transport sector	22768	18324	18154	17732	17060	15943	14841	13831	12713	11622	4122
Share of transport sector	8.2 %	8.5 %	8.6 %	9.2 %	10.2 %	12.2 %	15.1 %	18.6 %	22.3 %	27.1 %	49.1 %

* without multipliers

** with multipliers (Article 27 Directive 2018/2001/EC)

Aviation sector											
Aviation sector	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
<i>Fossil kerosene</i>	7253	7528	7099	7347	7423	7657	7884	8104	8318	8254	7457
<i>sustainable aviation fuels and RFNBO</i>	0	0	0	0	152	219	289	363	441	521	3522
Total consumption – air transport	7253	7528	7099	7347	7585	7817	8041	8259	8471	8678	10360
<i>Aviation – SAF share</i>	0.0 %	0.0 %	0.0 %	0.0 %	2.0 %	2.0 %	2.0 %	2.0 %	2.0 %	6.0 %	34.0 %
— <i>of which RFNBO</i>	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %	1.2 %	10.0 %

WEM scenario:

WEM	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
Share EnR – Transport –%	8.6 %	8.8 %	9.1 %	9.3 %	10.2 %	10.6 %	10.9 %	11.3 %	12.0 %	14.5 %	20.5 %

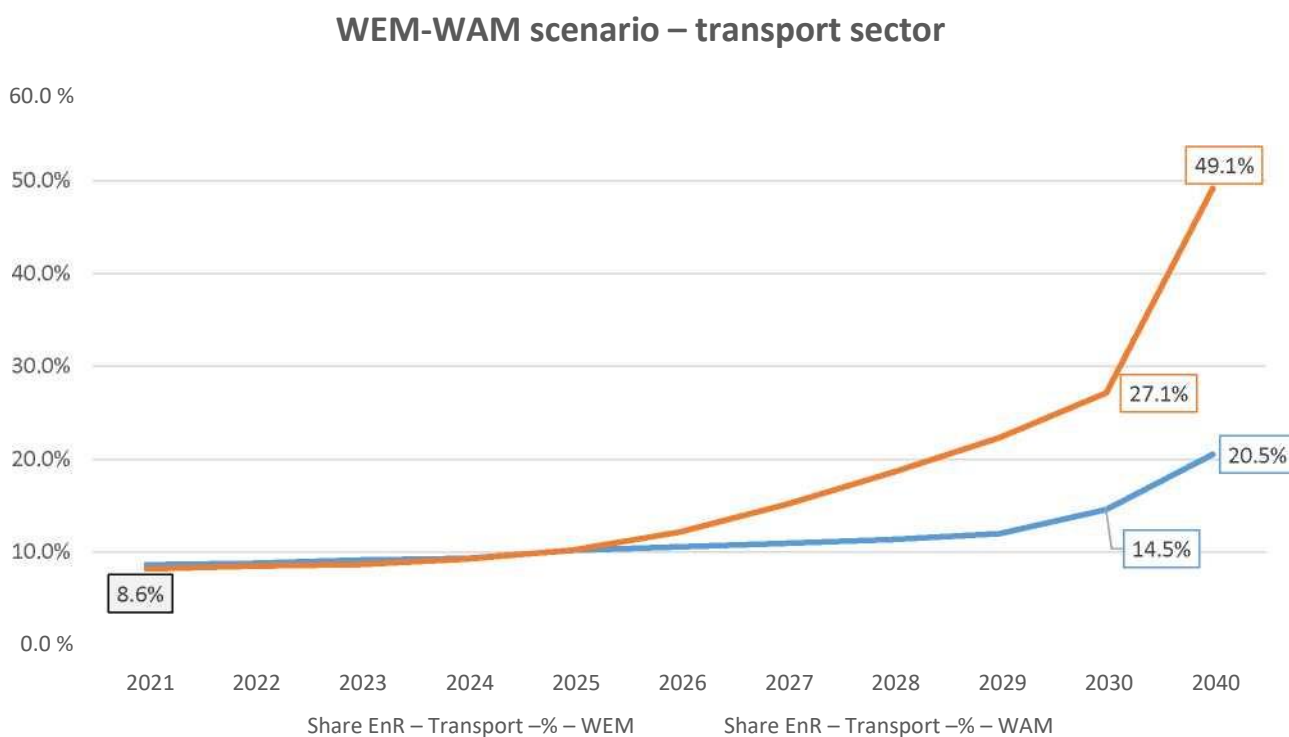
Compared to the WEM scenario, the share of renewable energy is increasing significantly thanks to the additional measures, from 20.5 % to 49.1 % in 2040; this is partly due to a reduction in total consumption modelled for 2040 and above all due to the significant decrease in fossil fuel consumption. In the WAM scenario, fossil fuel consumption will decrease from 6.536 GWh to 791 GWh between 2030 and 2040.

The transport sector is undergoing decarbonisation primarily through the electrification of the car fleet. . The additional measures lead to electricity consumption in the transport sector at 1.757 GWh of electricity in 2040.

In addition to electrification, the input of renewable hydrogen and its renewable derivatives contribute to the decarbonisation of road transport, with a total consumption of 1.000 GWh – which is not considered in the WEM scenario.

The increased electrification in this scenario, the deployment of renewable hydrogen and the significant decrease in fossil fuels explain the significant difference in 2040 of the WAM scenario compared to the WEM scenario (Figure 61).

Figure 61: WEM-WAM scenario: Evolution of the transport sector 2021-2030 and 2040



WAM Scenario – Indicative and Overall Objective

Table 69: Overall share of renewable energy and European cooperation by 2040 – WAM scenario

Indicative trajectory and overall target	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
National RES production	4052	4470	4790	6177	6658	7222	7624	8066	8548	9069	13110
European cooperation	800	1200	0	0	1800	1700	2600	2000	2000	2900	2800
<i>of which statistical transfers</i>	800	1200	0	0	1800	1500	2100	1200	800	1300	0
<i>of which REFM</i>	0	0	0	0	0	200	500	800	1200	1600	2800
RES production + European cooperation	4852	5670	4790	6177	8458	8922	10224	10066	10548	11969	15910
Final energy consumption	47787	43425	43006	43281	42704	42099	41340	40699	39844	38134	31145
Aviation	7253	7528	7099	7347	7585	7817	8041	8259	8471	8678	10360
— Current share Aviation	15.2 %	17.3 %	16.5 %	17.0 %	17.8 %	18.6 %	19.5 %	20.3 %	21.3 %	22.8 %	33.3 %
— Aviation threshold = 6.18 %	6.18 %	6.18 %	6.18 %	6.18 %	6.18 %	6.18 %	6.18 %	6.18 %	6.18 %	6.18 %	6.18 %
Adjusted gross final energy consumption	43488	38580	38565	38610	37758	36884	35854	34955	33835	31812	22710
Overall RES share	11.2 %	14.7 %	12.4 %	16.0 %	22.4 %	24.2 %	28.5 %	28.8 %	31.2 %	37.6 %	70.1 %
Indicative trajectory and overall target	11.0 %	13.5 %	11.0 %	11.0 %	22.0 %	11.0 %	28.0 %	11.0 %	11.0 %	37.0 %	70.1 %

Sources: STATEC-MECO modelling/DG Energy 2024 WEM scenario:

WEM	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
RES share	11.5 %	13.9 %	13.4 %	11.8 %	17.5 %	18.0 %	20.8 %	20.6 %	21.4 %	25.6 %	32.6 %

Comparing the scenarios for national renewable energy production in 2030, there is an increase of 12 percentage points between the WEM scenario and WAM, due in particular to the recent recommendation of the European Commission of 18 December 2023 and following the target set by Directive 2023/2413. In terms of cooperation needs, there is a decrease in relation to WEM, mainly due to a significant decrease in adjusted gross final energy consumption. The additional measures significantly increase the share of renewable energy in gross final energy consumption in order to achieve the more ambitious targets without substantially increasing the need for statistical transfers and cooperation under the REFM.

Table 70: Share of renewable energy by sector and overall by 2040 – WAM and WEM scenario

WEM scenario – GWh	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
RES share – electricity sector	14.2 %	16.9 %	17.4 %	18.9 %	21.5 %	23.5 %	24.5 %	24.9 %	25.5 %	26.5 %	30.0 %
RES share – heat sector	11.3 %	12.6 %	13.5 %	14.4 %	15.3 %	16.3 %	17.3 %	18.3 %	19.3 %	20.4 %	32.2 %
Share ENR – Transport *	8.6 %	8.8 %	9.1 %	9.3 %	10.2 %	10.6 %	10.9 %	11.3 %	12.0 %	14.5 %	20.5 %
Overall RES share – without cooperation	9.6 %	10.7 %	11.0 %	11.8 %	12.7 %	13.5 %	14.2 %	14.8 %	15.5 %	16.3 %	21.5 %
Overall RES share – with cooperation	11.5 %	13.9 %	13.4 %	11.8 %	17.5 %	18.0 %	20.8 %	20.6 %	21.4 %	25.6 %	32.6 %
Indicative trajectory and overall target	11.0 %	13.5 %	11.0 %	11.0 %	17.0 %	11.0 %	20.1 %	11.0 %	11.0 %	25.0 %	32.6 %
Wam Scenario – GWh	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
RES share – electricity sector	14.2 %	18.7 %	21.4 %	26.7 %	30.0 %	32.0 %	33.7 %	34.9 %	36.8 %	39.1 %	44.3 %
RES share – heat sector	11.2 %	15.4 %	16.5 %	23.7 %	25.8 %	28.9 %	31.1 %	33.8 %	36.6 %	40.1 %	80.5 %
Share ENR – Transport *	8.2 %	8.5 %	8.6 %	9.2 %	10.2 %	12.2 %	15.1 %	18.6 %	22.3 %	27.1 %	49.1 %
Overall RES share – without cooperation	9.3 %	11.6 %	12.4 %	16.0 %	17.6 %	19.6 %	21.3 %	23.1 %	25.3 %	28.5 %	57.7 %
Overall RES share – with cooperation	11.1 %	14.7 %	12.4 %	16.0 %	22.4 %	24.2 %	28.5 %	28.8 %	31.2 %	37.6 %	70.1 %
Indicative trajectory and overall target	11.0 %	13.5 %	11.0 %	11.0 %	22.0 %	11.0 %	28.0 %	11.0 %	11.0 %	37.0 %	70.1 %

* with multipliers (Article 27 Directive 2018/2001/EC)

Sources: STATEC-MECO modelling/DG Energy 2024

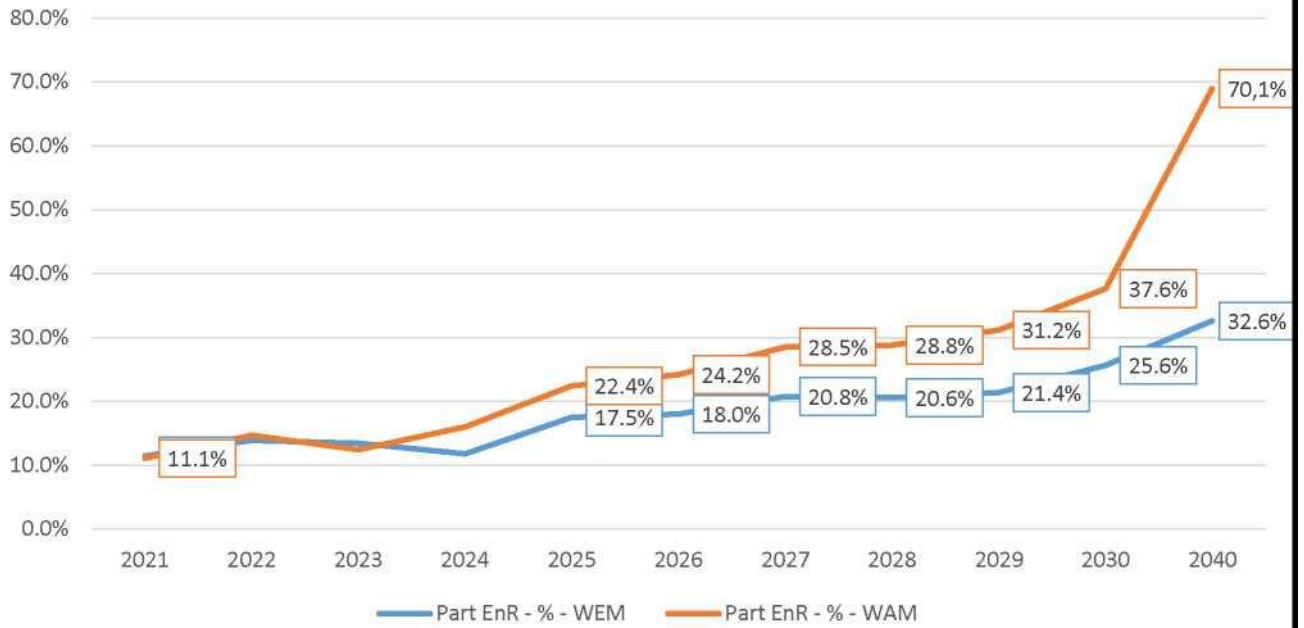
At sectoral level, renewable energy production in the renewable electricity sector increases significantly by 10 points in 2040 and the share of the renewable heat sector is twice as high in the WAM scenario in 2030 and is growing dramatically in 2040, in particular thanks to the input of heat pumps and renewable hydrogen and its derived products (Table 71). The transport sector is growing by almost 5 percentage points in 2030 and, supported by electromobility and renewable hydrogen and its derivatives, shows a significant increase of more than 50 percentage points in 2040 in the WAM scenario.

Table 71: Comparative: Share of renewable energy by sector and overall by 2040 – WAM and WEM scenario

WAM-WEM compares –%	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2040
RES share – electricity sector	0.0 %	0.0 %	4.0 %	7.8 %	8.6 %	8.5 %	9.2 %	10.0 %	11.2 %	12.6 %	14.3 %
RES share – heat sector	—	2.8 %	3.0 %	9.3 %	10.5 %	12.6 %	13.8 %	15.5 %	17.3 %	19.7 %	48.2 %
Share ENR – Transport *	—	—	—	—	0.0 %	1.6 %	4.2 %	7.3 %	10.4 %	12.6 %	28.7 %
Overall RES share – without cooperation	—	—	—	—	—	—	—	—	—	—	—
	0.3 %	0.9 %	1.4 %	4.2 %	4.9 %	6.0 %	7.1 %	8.3 %	9.8 %	12.3 %	36.3 %
Overall RES share – with cooperation	—	—	—	—	—	—	—	—	—	—	—
	0.4 %	0.8 %	1.0 %	4.2 %	4.9 %	6.2 %	7.7 %	8.2 %	9.8 %	12.0 %	36.4 %

Figure 62 below compares the evolution of the overall share of renewables of the two scenarios. Figure 62: WEM-WAM scenario: — Evolution of the overall share 2021-2030 and 2040

Scénario WEM-WAM - part globale des énergies renouvelables



5.2 macroeconomic impacts of planned policies and measures and investment needs

5.2.1 Introduction

The NECP aims to increase energy efficiency and reduce greenhouse gas emissions. Beyond emissions, consideration should be given to the possible impact of this transition on the Luxembourg economy. The energy transition implies a transformation of the whole economy, comparable to industrial revolutions. The macroeconomic impact could therefore be considerable.

It should be noted that it is not a matter of assessing the impact and usefulness of climate action in general, as various reports have already shown that the cost of inaction would considerably exceed that of actions to contain climate change (e.g. Stern, 2007 or OECD, 2012). Moreover, given the global dimension of warming, such an approach would make little sense if the analysis were limited to Luxembourg. The main objective of this analysis is narrower, focusing on the macroeconomic impact of the update of the Luxembourg NECP. The assessment is carried out against the With Existing Measures (WEM), which includes all measures adopted before 31.12.2021.

This analysis will briefly review the results of international studies and then focus on the effects of the With Additional Measures (WAM) scenario on the Luxembourg economy by 2030. Beyond the impact on economic growth, the analysis will also address the expected impact on employment, government revenue and expenditure and the situation of households. It will also detail the private and public investments needed to accelerate Luxembourg's energy transition. Finally, some uncertainties surrounding the assessments of the NECP will be highlighted, with alternative scenarios.

5.2.2 Low impact of the energy transition on economic growth

5.2.2.1 *The impact of the transition at international level*

An increasing number of studies are looking at the economic impact of the energy transition. A common element of these studies is that substantial investments are needed for the transition to carbon neutrality, as carbon neutrality leads to a capital substitution of fossil energy expenditure. It is precisely these additional investments that will largely determine the impact of the transition on GDP.

Indeed, the additional investments made act as fiscal injections that stimulate the economy. The energy transition would thus represent a positive demand shock, leading to additional activity. Indeed, the initial stimulus of increased investment is passed through the whole economy through a traditional multiplier effect: the additional demand would lead to higher production, requiring more labour so that employment would increase, which would have a positive effect on income and promote consumption, boosting activity again. In this way, GDP in the WAM scenario could be higher than in the WEM scenario.

However, these mechanisms consider that investments to achieve climate neutrality are (at least partially) additional and do not replace other investments or consumption. On the other hand, if the funds required for the transition were to crowd out other productive investments, this would limit the positive impact on activity. Thus, the way in which investments in the energy transition would be realised, and modelled, strongly influences the estimated impact on GDP.

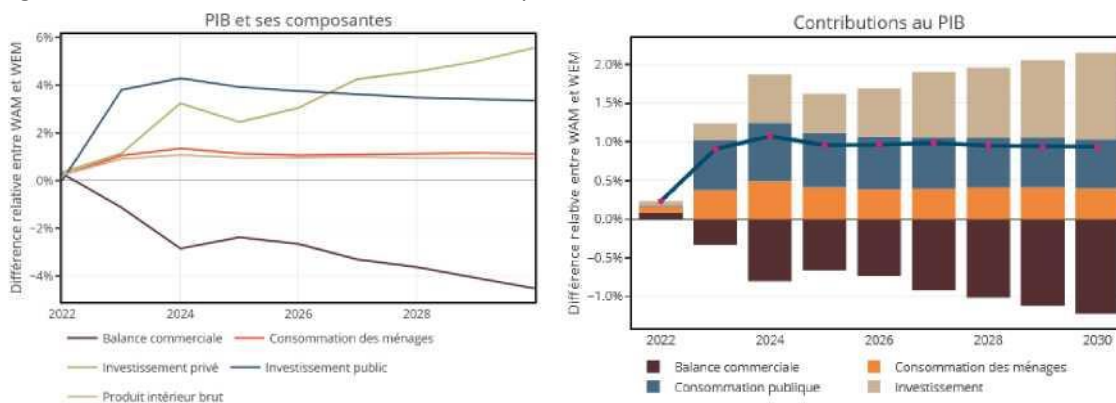
Table 73: Impact of the energy transition on GDP according to various studies in the Annex represents estimates of the impact of the transition on GDP according to different studies. Variations in results between studies can be explained in particular by different (more or less ambitious) baselines, separate measures put in place to achieve climate targets (more or less stimulating for 420/450).

economy), a different geographical and temporal scope and models with different specifications used in the assessment. However, they also reflect the significant uncertainty attached to any assessment of the macroeconomic effects of the transition.

The studies under consideration show a small effect on real GDP, which is slightly positive in most cases. By 2050, estimates of the impact of the energy transition are between -1.3 % and + 3.8 %, and the effect would be even more limited by 2 030 (from -0.4 % to + 2.5 %). These results represent the cumulative impact on growth over a long period, meaning that the annual GDP growth differential is close to zero between the baseline and the transition scenario.

5.2.2.2 NECP measures would support Luxembourg’s growth by 2030

Figure 63: More favourable real GDP developments in WAM scenario



Sources: STATEC

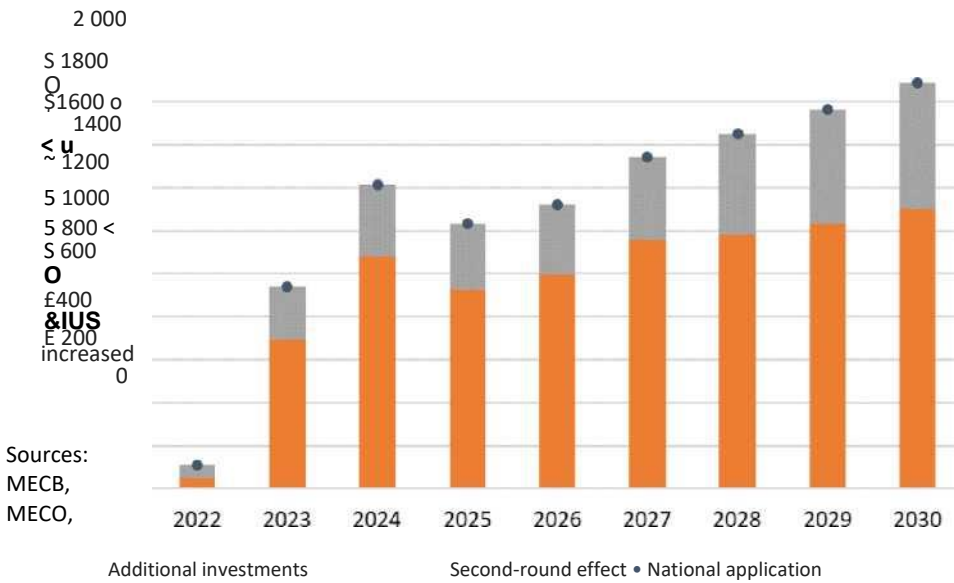
STATEC projections show that GDP would be almost 1 % higher in 2 030 in the WAM scenario than WEM, so that the new NECP would have a slight positive impact on Luxembourg’s growth. The more dynamic evolution of domestic demand leads to this positive impact, with the major positive contribution from private investment, followed by public investment and household consumption. In addition to the direct effect of investments⁶⁴ on domestic demand and thus GDP, they trigger second-round effects in the economy (as described in Section 5.2.2.1).

Thus, in 2030, the gap in national demand between WAM and WEM exceeds the additional investment gap of around 45 %. Macroeconomic close mainly amplifies household consumption⁶⁵ and, to a lesser extent, business investment. Thus, through the additional investments and the loop generated, national demand is 2.8 % higher in WAM than WEM in 2030.

⁶⁴The additional investments for the transition to carbon neutrality (i.e. those made in the WAM in addition to WEM) are analysed in detail in a subsequent section of this chapter.

⁶⁵The second-round effect is the strongest for households, for which in 2030 the additional investment initially determined would account for only 16 % of the consumption gap between WAM and WEM.

Figure 64: Additional investments for transition, amplified by loop effects

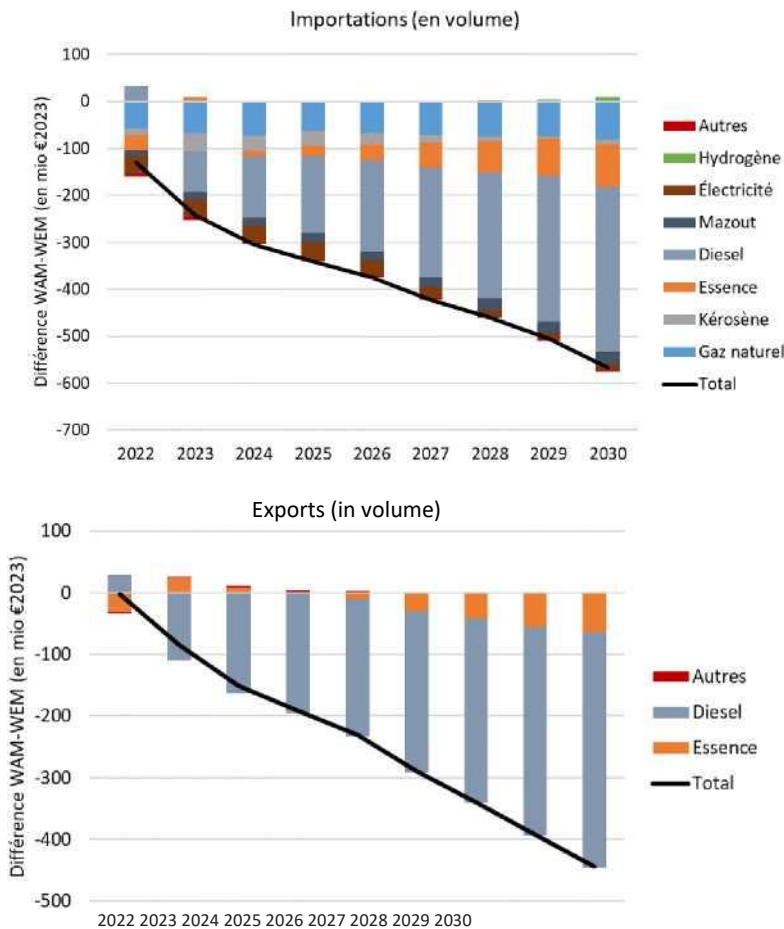


To meet this additional demand, imports would increase so that the trade balance would deteriorate in the WAM scenario compared to WEM, which significantly limits the increase in GDP. As with domestic demand, second-round effects amplify the deterioration of the external balance. This well-known result reflects the reduced multiplier effect of investments in small, highly open economies.

5.2.2.3 Improving the energy balance...

Decarbonisation translates into a decrease in the use of fully imported fossil fuels, which is reflected in the energy component of the trade balance. The impact depends on several factors that form an integral part of the scenarios developed by STATEC, such as the consumption of different types of energy (influenced by the fossil and electricity price trajectory, see section 5.2.4.3.) as well as national energy production.

Figure 65: Decrease in imports and exports in WAM compared to WEM



Sources: STATEC

The decline in fuel sales to non-residents⁶⁶ leads to a simultaneous fall in imports and exports. The impact on the energy balance therefore reflects the decline in residents' consumption, driven in particular by the electrification of the national fleet and the rise of heat pumps. Electrification thus leads to a gradual decrease in fossil imports, while the associated energy efficiency gains⁶⁷ and the projected increase in electricity production in Luxembourg would avoid an increase in electricity imports by 2030.

In the late 2020s, hydrogen imports could slowly start to emerge. Hydrogen is set to play an increasing role in the decarbonisation, especially of industry, in the coming decades.

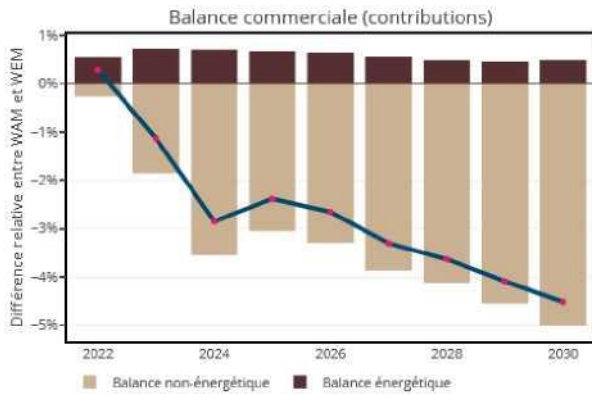
Overall, the decline in energy imports would exceed that of exports, so that the energy balance in volume would be less loss-making in the WAM scenario than WEM. It should also be noted that the reduction in fossil imports leads to less energy dependency on non-European countries, often associated with risks of geopolitical tensions, while electricity imports come from the partner countries of the European electricity market.

⁶⁶The decline in imports and exports is particularly marked for diesel (see Section 5.2.4.3.).
⁶⁷An electric car or heat pump is 3 to 4 times more efficient than the corresponding fossil technologies.

5.2.2.4 ... but a deterioration in the trade balance

The full impact of the transition on the trade balance depends on both the energy and non-energy components. While the energy balance is improving (imports fall more than exports, see above), non-energy elements deteriorate significantly.

Figure 66: The non-energy component would take the trade balance down

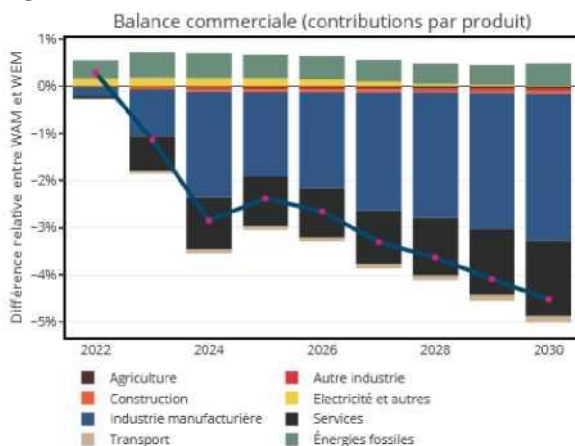


Sources: STATEC

This is particularly the case because changes in equipment (heat pumps, photovoltaic panels, etc.) are needed to achieve the above mentioned energy savings and the desired emission reductions. These investment goods, being mainly imported and having a price still higher than their fossil equivalent (at least in the coming years), degrade the trade balance. However, the total impact of these imports on GDP would be neutral as they are at the same time additional investment or expenditure⁶⁸.

As with domestic demand, second-round effects influence the results on external balance. For example, there is an increase in imports of services (largely input consumption) due to higher domestic production, which weighs on the trade balance. In the end, the trade balance would be around 4.5 % lower in the WAM scenario than WEM.

Figure 67: Deterioration of the trade balance

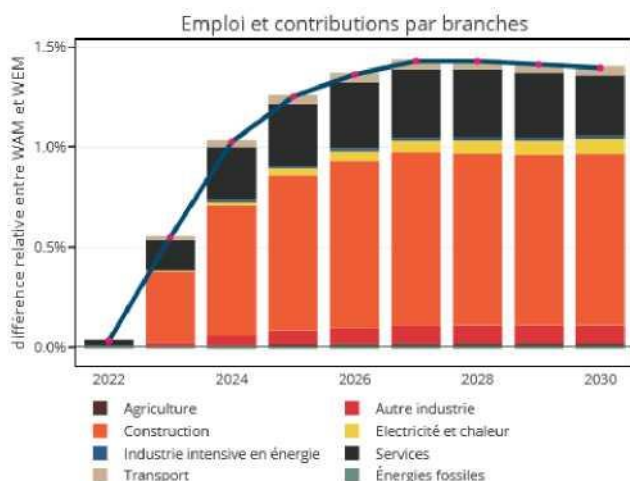


Sources: STATEC

5.2.2.5 Higher employment in 2030 especially in construction

Figure 68: Strong positive contribution of construction to employment

⁶⁸On the expenditure side, GDP is composed of final consumption, investment, public expenditure and the trade balance: $GDP = C + I + G + (X - M)$.



Source: STATEC

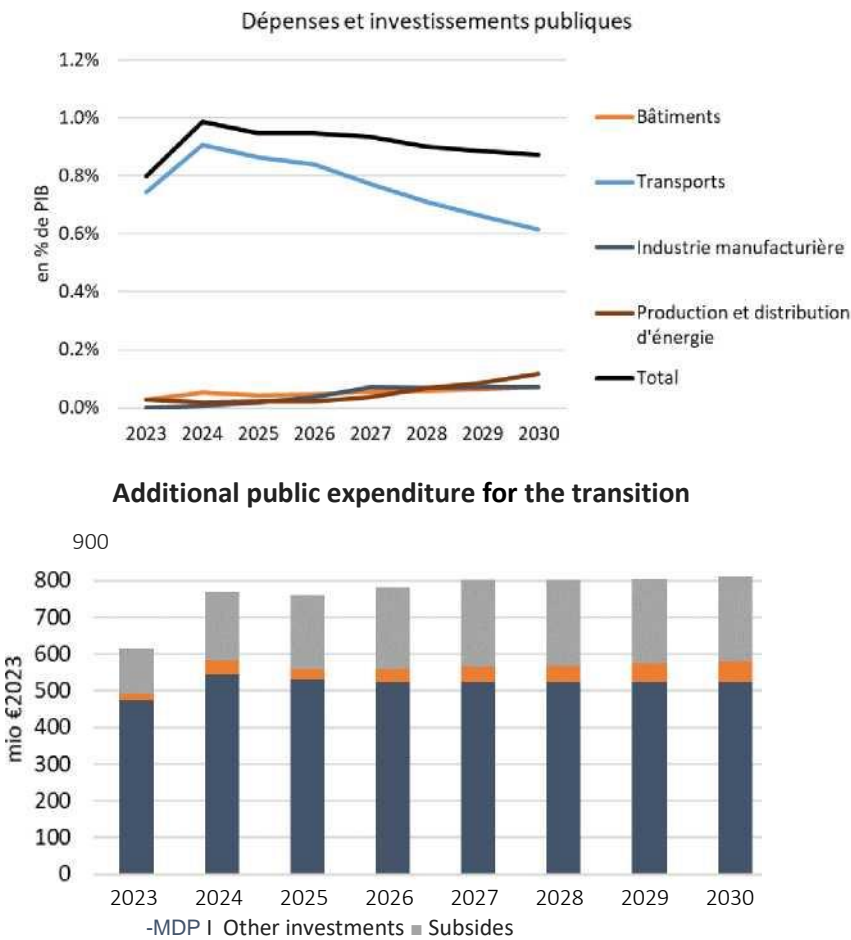
The transition to carbon neutrality would have a positive impact on employment in Luxembourg, which would be 1.4 % higher in 2030. This increase in employment is closely linked to the multiplier effect mentioned above, as the increase in demand (driven by additional investment) leads to higher production, leading to higher employment. This is particularly the case in construction, which is directly concerned by additional investments (e.g. energy renovations, mobility infrastructure, etc.), which are mainly aimed at domestic businesses. On the other hand, investments in industrial products (e.g. heat pumps) are directly imported, so the impact on employment in industry is lower.

5.2.2.6 Public expenditure: continued State support for the energy transition

All investments linked to the NECP have a direct or indirect impact on government expenditure. In addition to public investment, private investment would indeed be stimulated by state subsidies. Moreover, since government expenditure would be financed by loans and the public deficit would deteriorate (see below), debt servicing expenditure would increase slightly in the WAM compared with WEM.

Public investment includes renovation of public buildings and investment in mobility infrastructure. They would represent an additional EUR 550-600 million per year. The subsidies concern subsidies for residential renovation, vehicles and electric charging infrastructure, subsidies for industry and support for renewable energy. Additional subsidies would increase considerably to around EUR 230 million in 2030. Thus, government expenditure on the NECP is estimated at just under 1 % of GDP in the current decade, of which approximately two thirds are nevertheless linked to the National Mobility Plan (MDP), already adopted before the NECP. Overall, also taking into account the closing effects, public expenditure in WAM would be 3 % higher than WEM.

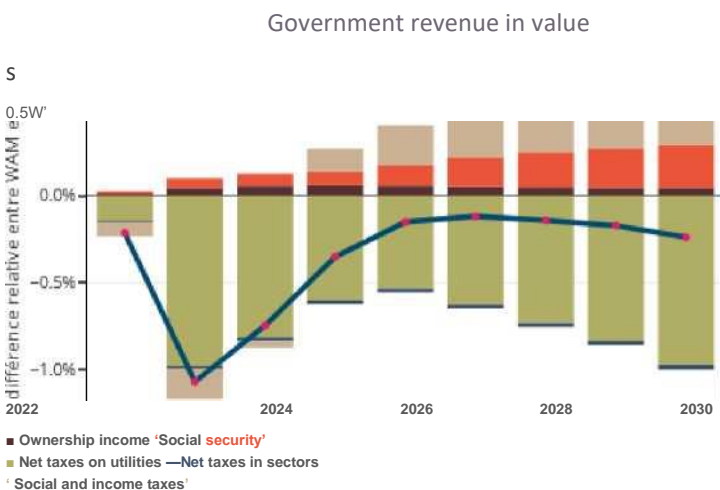
Figure 69: Significant public expenditure on the transition, especially on transport



Sources: MECB, MECO, STATEC

5.2.2.7 Decrease in government revenue as a result of lower taxes on motor fuels

Figure 70: Contributions to the decrease in government revenue



Source: STATEC

In addition to public expenditure, the NECP measures would also have an impact on government revenue. Indeed, with the decrease in fuel sales, the corresponding excise revenue would decrease compared to the baseline scenario. This decline in traditional excise duties would only be partially offset by the increase in

revenue from the CO₂ tax. It can be noted that in 2023 and 2024 the gap between WAM and WEM would be particularly strong since, in addition to these effects, the temporary reduction in the VAT rate (in 2023) and the energy crisis and the measures taken as a result are included in the WAM scenario but not in the WEM.

However, this fall in government revenue on goods would be mitigated by higher household revenues and social contributions. This would mainly result from the increase in employment in WAM compared with WEM (see above).

Overall, the transition would have a certain impact on the budget, with the general government balance as a % of GDP at 1.35 percentage points lower in 2030. On the one hand, there would be less revenue and on the other hand much higher expenditure. It would primarily be the latter, i.e. the additional investment for the transition, that would affect the public balance.

Figure 71: The public balance would be lower in the WAM scenario



Sources: STATEC

5.2.2.8 Households would consume more in a transition scenario

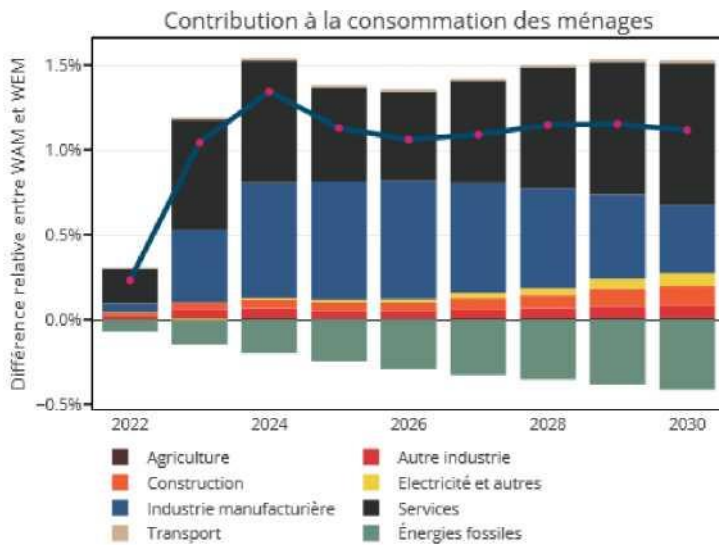
Figure 72: Increase in household disposable income



Sources: STATEC

Households would benefit overall from the energy transition. Household consumption would be higher in WAM than WEM, initially mainly due to additional investments directly linked to the transition. Thereafter, consumption would remain higher due to increasing household disposable income. The main reason behind this increase would be higher labour incomes. On the one hand, there would be more people in employment and less unemployment, i.e. more people receiving a salary, which would help to increase disposable income. On the other hand, a tighter labour market with a lower unemployment rate also contributes to higher real wages.

Figure 73: Increase in household consumption, depending on the products concerned



Sources: STATEC

Goods affected by the increase in consumption include both products directly affected by the transition and products affected only indirectly. The consumption of manufactured and construction products is increasing, linked in particular to purchases of electric cars, photovoltaic panels or renovations, precisely with the aim of reducing emissions. For example, there is a reduction in fossil fuel consumption, without an equivalent increase in electricity, given the efficiency gains achieved during the transition. However, the increase in services is explained by the fact that around two thirds of household consumption is spent on services and therefore the increase in disposable income leads to higher consumption of services.

5.2.2.9 Lower energy bills as a consequence of the energy transition

Two effects would influence household energy expenditure in the WAM scenario. The volume effect would generally be negative due to energy efficiency gains, notably linked to the electrification of heating and transport, implying lower fossil energy consumption but increasing electricity consumption. On the other hand, the price effect would be positive, as the majority of prices would increase by 2030 compared to 2023.

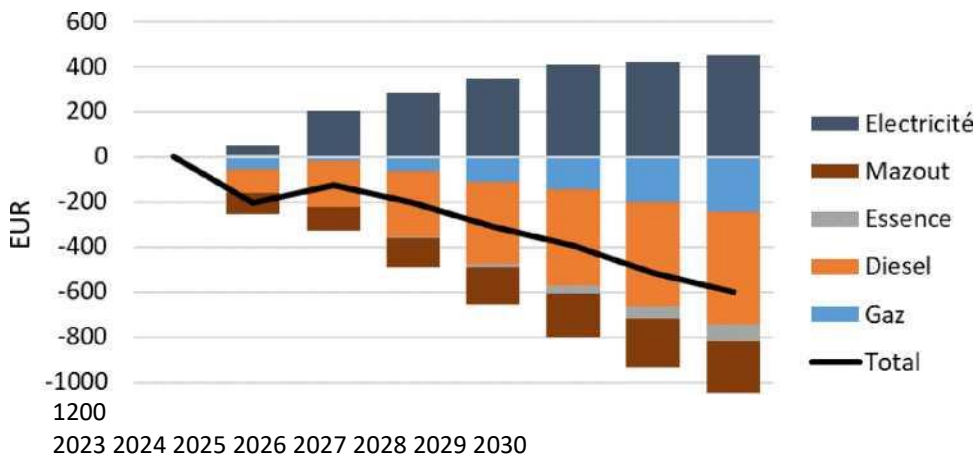
For fuel oil and gas, the volume effect of decreasing household consumption would dominate the upward effect of the CO₂ tax, leading to lower energy expenditure for these two carriers by 2030. On the other hand, electrification of the car fleet would result in a decrease in diesel and petrol consumption. The net effect would thus be negative for fossil fuels. For electricity, the volume effect would be positive thanks to continued electrification. This effect would be further strengthened by 2030 by an equally positive price effect, mainly due to the projected price increase in 2025. The net effect for electricity would therefore be positive.

The energy transition would thus reduce household energy bills as electrification would lead to lower consumption. This downward effect would outweigh not only the upward effect of the bill for fossil fuels⁶⁹, but also the increase in the energy bill for electricity due to its increased consumption.

Figure 74: Household energy bills would ease

Expenditure per household: Difference with 2023

⁶⁹See Part 5.2.4.2.

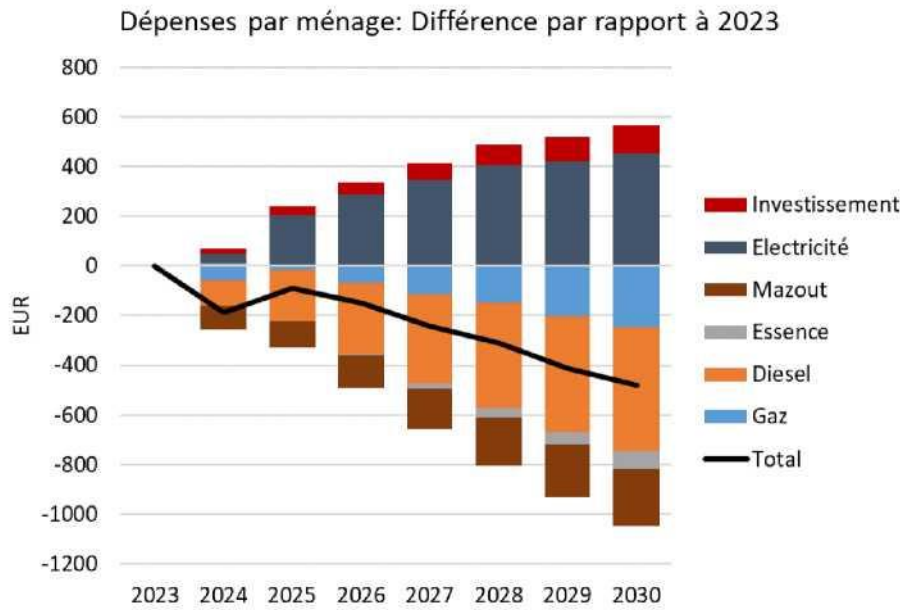


Sources: STATEC

Moreover, energy consumption and related expenditure would decrease more strongly in the WAM scenario than in the WEM scenario. The more pronounced reduction in energy expenditure in the WAM scenario means that households would have more money at their disposal for alternative uses. Reallocation to other products and services, whose import content would be lower than for fossil fuels (for which it is close to 100 %), would have a favourable impact on the country's economic activity.

The energy transition would gradually materialise in lower energy expenditure, requiring technological investments (heat pumps, electric cars, etc.). These additional household investments (after subsidies) can be amortised over 20 years, making it possible to compare them with the annual energy bill. It can be seen that reducing energy expenditure would outweigh the cost of additional investment.

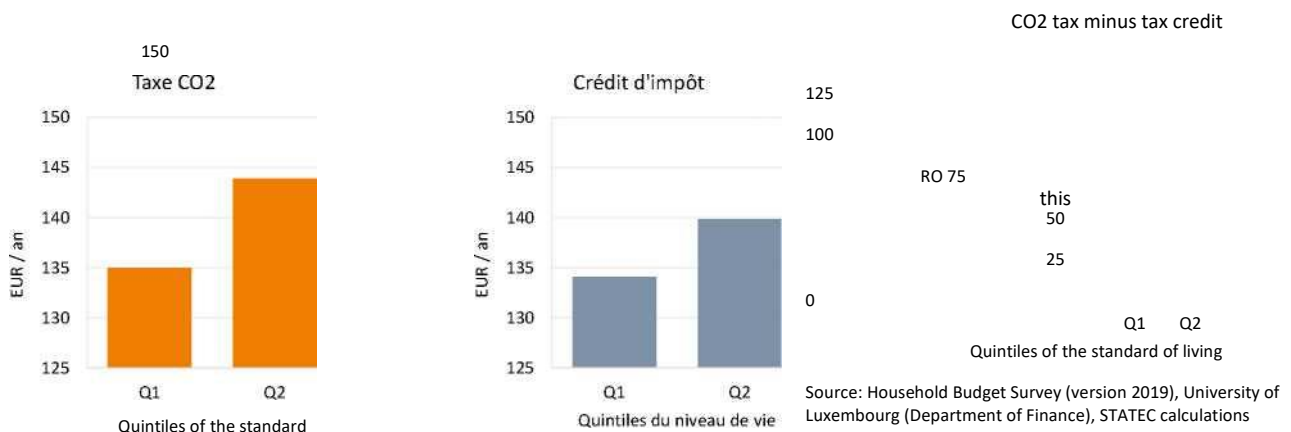
Figure 75: Lower energy expenditure overcompensates for higher investment



Sources: STATEC

The CO₂ tax increases fossil fuels, which represent a relatively higher share of low-income households' expenditure (in absolute terms, the opposite). In order to support smaller households, it was decided to devote half of the revenue generated by the CO₂ tax to social compensation for lower income quintiles (via a tax credit and the expensive living allowance)^{70,71}. When the CO₂ tax was introduced, STATEC had already analysed the question^{70 71 72} and found that the tax credit should make it possible to offset the CO₂ tax for the first quintiles, so that their average budget would not be negatively affected during the transition. In addition to the average expenditure, it should be noted that there are necessarily differences at the level of individual households, in particular depending on the type of heating or the use of a thermal vehicle.

Figure 76: The tax credit offsets the CO₂ tax for the lowest income



5.2.3 additional investments by 2030: bottom-up calculation from the NECP trajectories The additional investments and expenditure required to achieve the objectives of the NECP are estimated by a bottom-up calculation, considering the different quantifiable measures. To make these calculations, unit costs have been

⁷⁰The ThreeMe model does not distinguish between the different quintiles of households, therefore the compensation is currently modelled as benefiting all households.

⁷¹The other half of the revenues will be directly used to finance climate measures.

⁷²CF. Evaluation of the impact of the CO₂ tax, STATEC (2020).

determined for renovations and new decarbonised technologies (heat pumps, electric cars, etc.). Unit costs are then multiplied by the evolution of the volume in question, based on STATEC projections. These calculations were made for both scenarios, but the analysis focuses only on additional investments in the WAM scenario, compared to the WEM baseline.

The amounts are expressed in constant EUR for the year 2023 (EUR 2023) and include private and public investment. Overall, investment is projected to increase gradually over the decade, reaching around 1.4 % of GDP in 2030 (see Chart 18). Combined over the period, investment and expenditure would amount to EUR 8.5 billion 2 023 billion.

To summarise, investments have been grouped according to the FIU emission sectors⁷³, namely transport, energy production and distribution, buildings and industry. These categories make it possible to assess which emissions would be reduced by additional investment.

Table 72: Additional investment and expenditure required for the energy transition would amount to EUR 8.5 billion by 2030

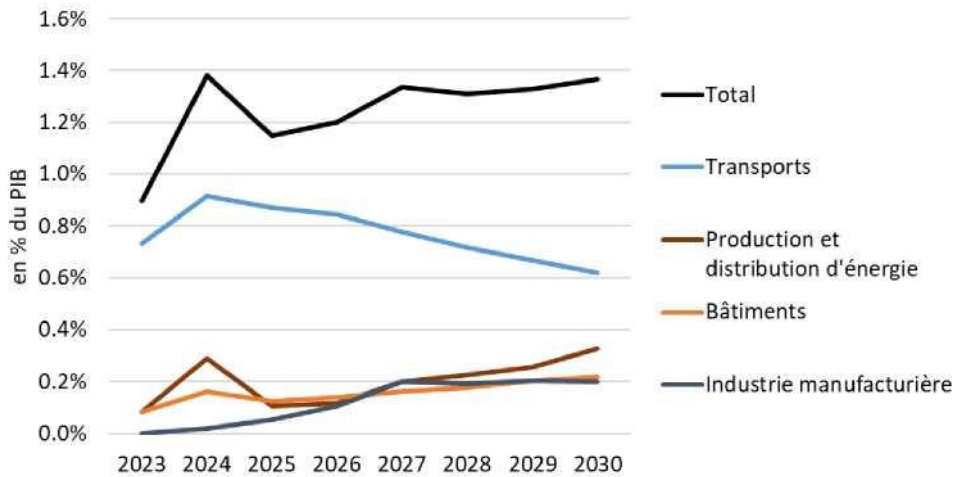
Additional investments and expenditure (million EUR 2023)	2023	2024	2025	2026	2027	2028	2029	2030	Total
Buildings	62	125	99	113	139	156	184	201	1 080
Transport	563	714	699	698	666	637	606	575	5 159
Manufacturing	0	14	43	86	171	171	186	186	857
Energy Generation and Supply	63	226	83	95	169	201	232	303	1 373
Total	689	1 080	924	992	1 146	1 165	1 208	1 265	8 469

Sources: MECB, MECO, STATEC

The transport sector would concentrate the majority of investments, representing between 0.6 % and 0.9 % of GDP by 2030. This is primarily the investment needed to develop the transport infrastructure foreseen under the National Mobility Plan (MDP). The energy sector would require investments of up to 0.4 % of GDP in 2030 and industry and buildings would require investments of around 0.2 % of GDP.

⁷³Common Reporting Format, an international nomenclature used to report GHG emissions.

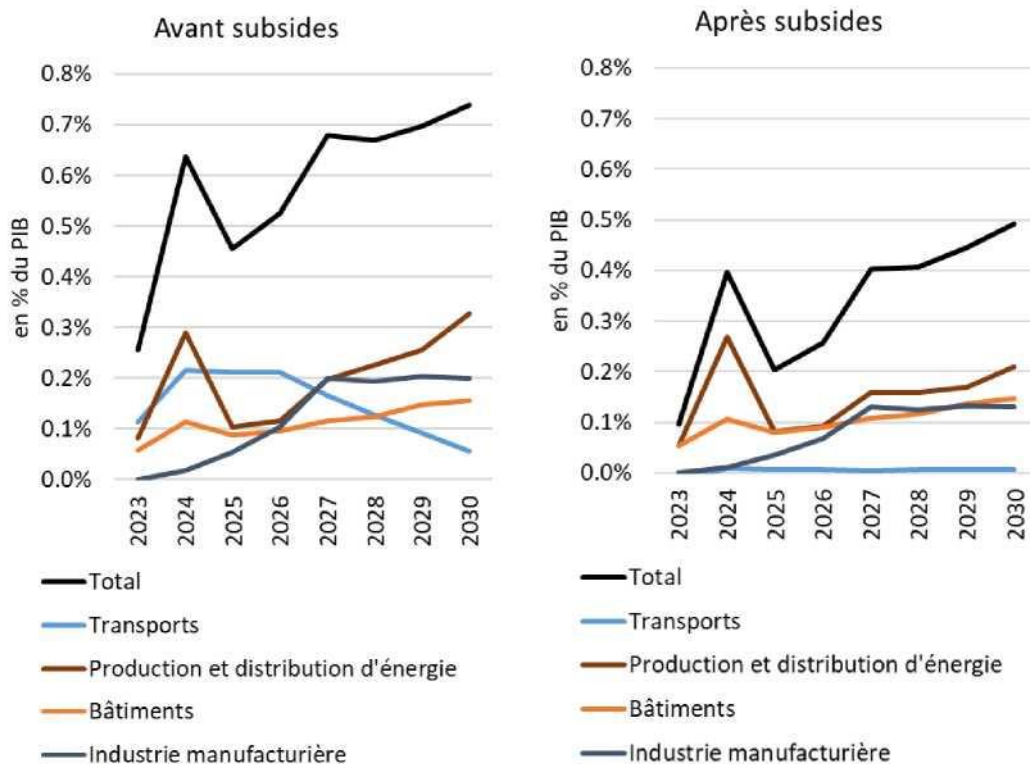
Figure 77: Total expenditure would gradually increase by 2030



Sources: MECB, MECO, STATEC

Private investment, before subsidies, would account for about half of total investment. After state subsidies, these investments would account for only one third (around 0.5 % of GDP in 2030), distributed similarly in the buildings, energy and industry sectors.

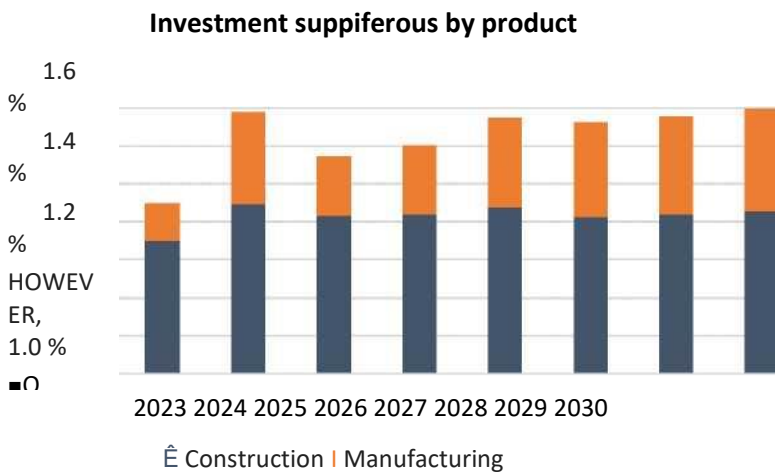
Figure 78: Private investment would reach 0.5 % of GDP in 2030



Sources: MECB, MECO, STATEC

In order to better understand the macroeconomic effects, investments can also be classified by product concerned. The statistical classification of products associated with activities (CPA) is the classification of goods and services in force at EU level. There would be two which attract the full amount of additional investment: construction and manufactured goods. Indeed, renovations and mobility infrastructure mainly concern construction, while many other products, such as electric cars, charging stations, wind turbines, etc. are manufactured products.

Figure 79: Additional investments mainly concern manufactured industrial goods and construction



The economic impact of these two types of investment differs significantly. Thus, investment in construction is directed mainly at local businesses, with significant side effects, through the increase in employment in this sector. By contrast, manufactured goods are largely imported, which neutralises the impact of its investments on economic activity.

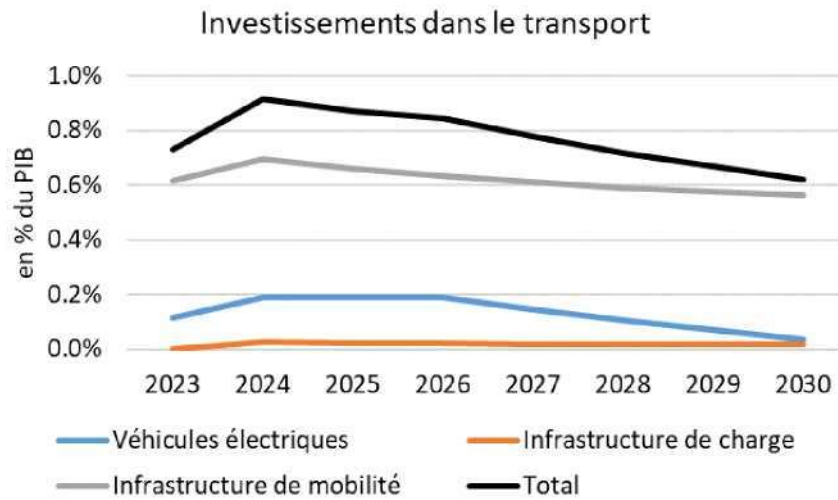
In the remainder of the study, additional investments are again classified by emission sector, which makes it possible to better link with the measures decided under the NECP and the nature of the investments.

5.2.3.1 *Transportation: Infrastructure would require significant investment*

Most investments in transport would be used to improve and develop mobility infrastructure to enable efficient multimodal mobility. The rapid electrification of cars would also represent additional expenditure as electric models are currently even more expensive than thermal models. However, this cost gap is closing and according to the Global EV Outlook 2023 (IEA, 2023), parity would be reached at the end of the decade. It was assumed that subsidies in this area would evolve downwards, by analogy with the price differential. This would mean that the additional costs of electric cars would be borne by the State, not by households and businesses. Charging infrastructure, for which investments were already high in the baseline scenario (EUR 60 million in 2030 in the 2020 NECP), would also require additional investments. The number of terminals⁷⁴ to be installed is assumed to be proportional to the number of new electric cars registered and the costs vary depending on the location of the installation (residential, business or public domain).

⁷⁴The total number of additional charging stations would be around 8 000 on average per year from 2025 (of which 70 % would be private Walloon charging stations, 25 % of Walloon charging points within companies and 5 % public charging stations).

Figure 80: Investments in transport, which are high in the short term, would decline over time



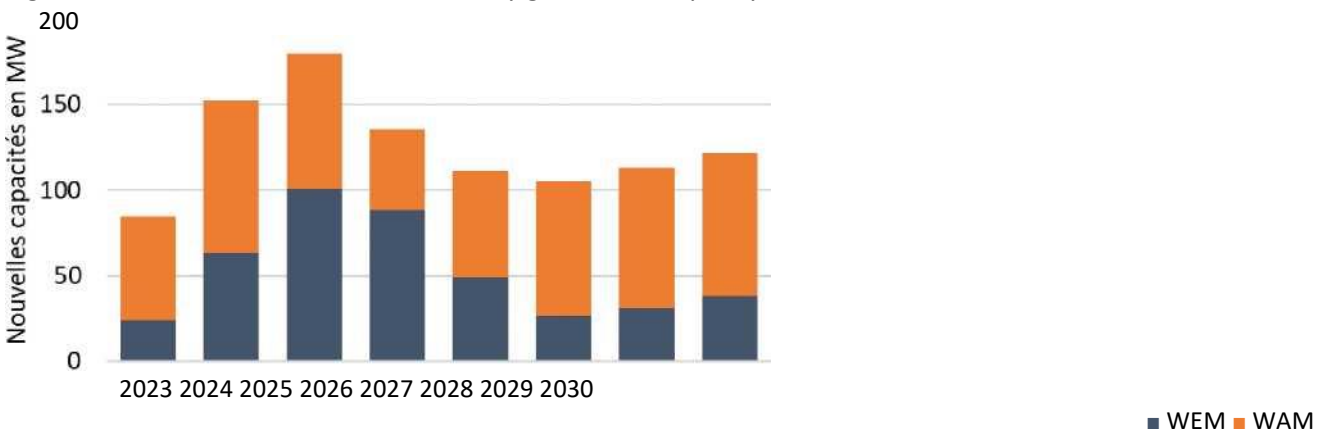
Sources : MECB, MECO, STATEC

5.2.3.2 Energy production and distribution: financing the expansion of renewable energy production

In terms of energy production, the expansion of renewable energy would concentrate the majority of the additional investments. The cost of the planned increase of approximately two thirds of the current PV and wind power generation capacity is estimated at around EUR 325 million and EUR 115 million of cumulative additional investments, respectively. In addition, the promotion of electricity produced through biomass and biogas is estimated at around EUR 300 million. In total, by adding investments in centralised renewable heat production of almost EUR 350 million, the cumulative additional investments in energy production would amount to more than EUR one billion by 2030.

The reinforcement and expansion of the electricity grid, which is necessary to enable the electrification of the Luxembourg economy, as well as the development of a hydrogen network, would constitute cumulative additional investments of EUR 400 million (EUR 240 million and EUR 150 million for electricity and hydrogen respectively).

Figure 81: Increase of renewable electricity generation capacity



Sources: MECO, STATEC

5.2.3.3 Buildings: a gradual increase in investment

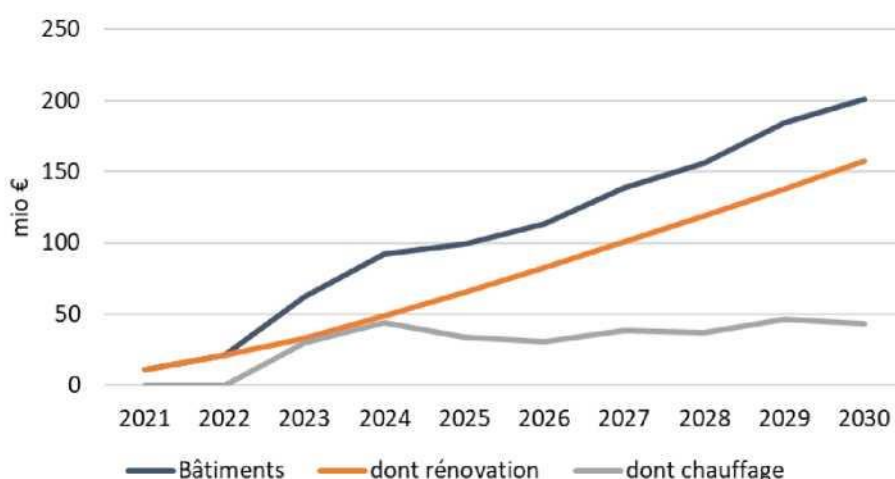
For the building sector, which includes residential and tertiary buildings, decarbonisation is slower due to the lifetime of buildings and technical installations. Investment in this area would increase over time and would initially be concentrated mainly in the service sector, particularly as a result of planned energy audits and the

replacement of fossil boilers in large tertiary buildings. Another factor that would increase investment in functional buildings compared to residential is the higher cost of an energy renovation, estimated at EUR 1.000/m² for functional buildings compared to EUR 350-750/m² for a residential building (the cost would vary depending on the extent of renovation).

In the residential sector, the transition to heat pumps when replacing fossil boilers would gain momentum towards the end of the 2020s (heat pumps are already the reference in all new buildings). This would gradually disappear fossil boilers as a result of incentives supported by subsidies and favourable market developments for renewable heating systems, so that half of the replacements⁷⁵ would be made with renewable systems⁷⁶ by 2030, corresponding to around 2 500 additional heat pumps per year in 2030.

While renovation rates would be constant in the residential sector, the overall renovation rate would decrease slightly over time due to an increasing share of apartments for which the renovation rate is lower (compared to individual houses). If total renovation expenditure increases in the building sector as a whole, this is because the renovation rate increases in the tertiary sector⁷⁷.

Figure 82: Continuous increase in investments in the buildings sector



Sources: MECO, STATEC

5.2.3.4 Industry: ambitious decarbonisation dependent on the supply of renewable hydrogen

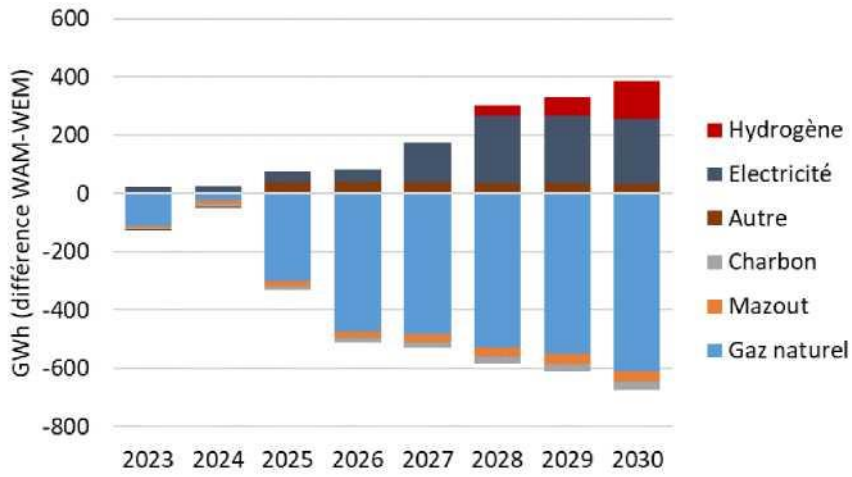
The industry would require additional investments with a similar size to buildings. On the one hand, industry would invest in more efficient processes to improve their energy efficiency. On the other hand, they would decarbonise their production chain, either through electrification or by using hydrogen for processes requiring high temperatures. However, hydrogen is expected to contribute only marginally to the energy transition by 2030, as supply could only be ensured after that date (production still very limited and transport infrastructure still missing). Investments in the industry sector have been determined by estimating the subsidies that would be allocated to industrial projects in the coming years, the latter generally covering 35 % of the investment. The Ministry of Economy has thus estimated that industry would make additional investments of around EUR 850 million cumulatively by 2030.

Figure 83: Reducing fossil fuels in industry

⁷⁵An annual replacement rate of fossil boilers of 4 % was chosen (corresponding to an average lifetime of 25 years).

⁷⁶STATEC does not have real time figures on this matter, but estimates that 95 % of these replacements would consist of heat pumps and 5 % of wood heaters.

⁷⁷Additional renovations in the tertiary sector account for around 95 % of total investments related to building renovation.

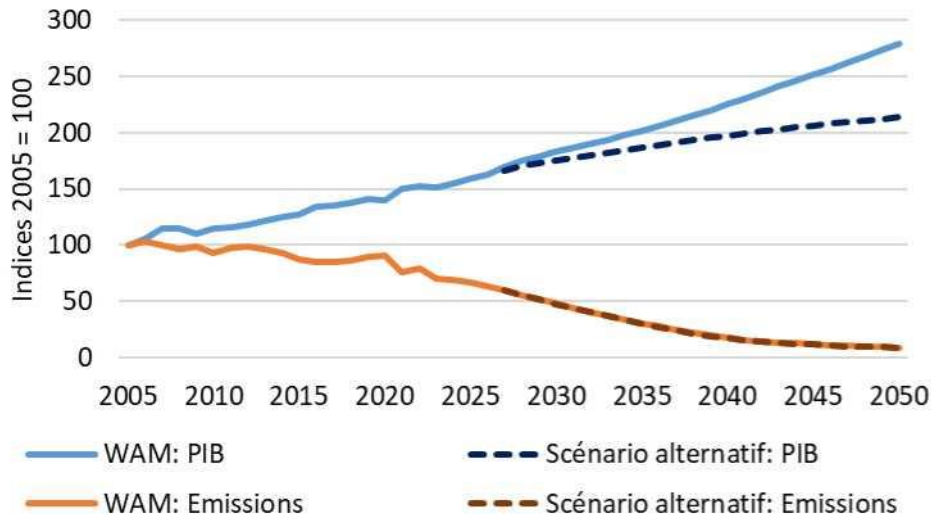


Sources: STATEC

5.2.4 long-term forecast surrounded by uncertainties

5.2.4.1 GDP growth

Figure 84: A reduction in emissions that is almost insensitive to the GDP trajectory

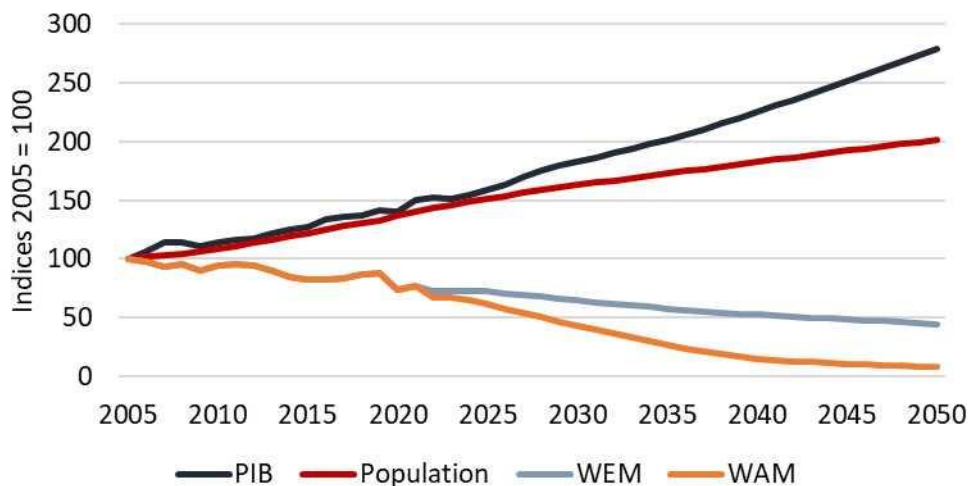


Sources: STATEC

The scenarios developed illustrate that energy efficiency and decarbonisation technologies will play a key role in achieving climate, energy efficiency and renewable energy targets. Efficiency gains would thus decouple energy consumption from economic and demographic growth. Energy consumption would stagnate in the long term, while annual GDP growth would be 2 % by 2050 as a result of an ageing population. At the same time, the deployment of decarbonised technologies, including heat pumps and zero-emission vehicles now produced on a global industrial scale, would reduce GHG emissions by substituting electricity for fossil energy. Renewable energy would continue to grow: the increase in electricity production would be faster than its consumption, leading to an improvement in energy independence in the coming years.

STATEC revised downwards the population and GDP growth projections compared to the demographic scenario used for the preparation of the draft update of the NECP in 2023. Current projections predict a population of almost 930 000 inhabitants in 2050, compared to 1 020 000 in the draft update. As regards GDP growth, current projections estimate long-term annual growth of around 2 %, instead of the previously estimated 2.75 %. However, this revision of macro-demographic projections only marginally affects long-term emissions, as confirmed by a sensitivity analysis. In an alternative scenario with lower economic growth (around one percentage point less on average), emissions would remain almost unchanged in the long term. In this analysis, GDP in 2050 is 23 % lower than in the WAM scenario in 2050, but emissions would only be 2 % lower than in the WAM scenario. The same applies to energy consumption, which would fall by less than 6 % in the counterfactual scenario with lower economic growth.

Figure 85: Decoupling of activity from emissions



Sources: STATEC

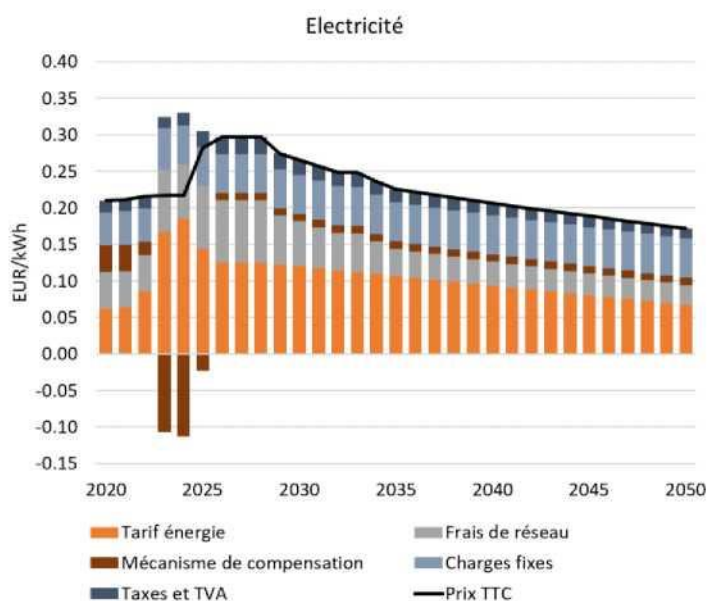
5.2.4.2 Electricity price assumptions for 2050

Energy prices play an important role in the transition to a sustainable low-carbon economy. In particular, it is the relative evolution of renewable energy prices relative to fossil fuel prices. They directly influence consumer and industrial behaviour, which ensures the economic profitability of green technologies and renewable energy sources.

High prices for fossil fuels would incentivise consumers and industries to reduce their consumption and invest in renewable or high-energy efficient technologies. This contributes to reducing greenhouse gas emissions, while fostering innovation and competitiveness in the green technology sector. Conversely, high prices for renewable energy can hamper this process and slow down the green transition.

In heating, the relative price of electricity relative to fuel oil and gas is a key factor in ensuring the transition to heat pumps, which is essential for decarbonising the buildings sector. For transport, the price of electricity relative to fuel, as well as the relative price of fuel in Luxembourg relative to abroad, play an incentive role.

Figure 86: Decrease in electricity price in the long term



Sources: STATEC

Electricity prices for consumers are expected to decrease in the long term, despite an increase in the short

term. This trend is based on several assumptions concerning the different components of the electricity price, namely the energy tariff, the network charges, the contribution to the compensation mechanism, fixed charges and taxes (electricity tax and VAT).

The electricity tariff, purchased on the German stock market according to the purchasing strategy of local suppliers, would continue to rise as a result of the delayed effects of the energy crisis, but is expected to decrease by 2050 thanks to increased use of renewable energy, which is cheaper than fossil fuels⁷⁸. Network charges, which cover transmission and distribution costs, had experienced significant increases in 2023⁷⁹, but are expected to decrease in the long term under the assumption of an inverse relationship between the level of network use and unit network costs (per kWh). Indeed, an increase in consumption on the grid would reduce the costs to be paid per kWh. Thus, with the projected increase in electricity consumption in the NECP WAM scenario, network costs would decrease by 2050. The contribution to the compensation mechanism⁸⁰, used to absorb tariff increases in 2023 and 2024, should be reduced to zero in the coming years. The fixed charges, together with the amount of the electricity tax and the VAT rate, are assumed to remain constant over time.

5.2.4.3 Fossil heating would become increasingly expensive in the long term

Fossil fuel prices would follow an opposite path to electricity. This increase could be explained by several factors: the annual increase in the CO₂ tax on gas and fuel oil, as well as the increase in the prices of gross fossil fuels.

In addition to the CO₂ tax, the gas price includes the energy tariff, network charges, fixed charges and other taxes, including VAT. The latter are expected to remain constant over time. The energy tariff, reflecting the cost of purchasing gas on international markets⁸¹, had increased by almost 120 % in 2022⁸², but would return to pre-crisis levels by 2040. By 2050, the gas tariff would decrease slightly, in line with international crude⁸³ gas price projections. Network charges would continuously increase due to the inverse relationship between the level of network use and unit network costs, as already discussed above. Indeed, with the projected decrease in gas consumption in the WAM scenario, network costs would increase significantly per m³. In view of this increasing increase approaching 2050 (with gas consumption tending to zero), a price cap was assumed from 2045 onwards.

The price of fuel oil includes, in addition to the CO₂ tax, the gross price of Brent, other taxes and VAT. As the latter would remain constant over time, the increase in the price of fuel oil is explained, apart from the CO₂ tax, by an increase in the gross energy price, which increases by analogy with the Brent crude oil price⁸⁴.

Figure 87: Long-term increase in the price of fossil fuels

⁷⁸In line with the simulations of the PRIMES model used by the European Commission in the reference scenario.

⁷⁹This is due in particular to increases in the costs of ancillary services to be borne by the transmission system operator and for the compensation of online losses.

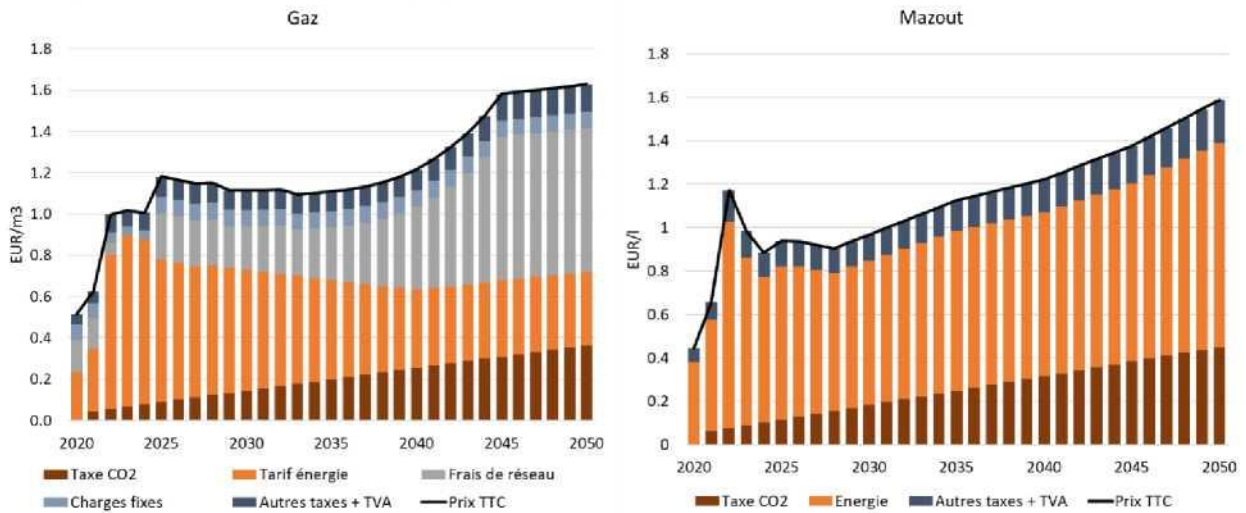
⁸⁰According to Institut Luxembourgeois de Régulation (ILR), 'the contribution to the compensation mechanism serves to share equally among all consumers the additional purchase costs that network operators are required to pay under feed-in contracts for electricity from renewable energy sources or high-efficiency cogeneration with guaranteed remuneration'.

⁸¹This price can fluctuate depending on global geopolitical and economic conditions.

⁸²Solidaritétspak 2.0 limited the gas tariff adjustment to 15 % in 2023.

⁸³Recommendations by the European Commission. See Annex 1 – Recommended parameters for reporting on GHG projections in 2025.

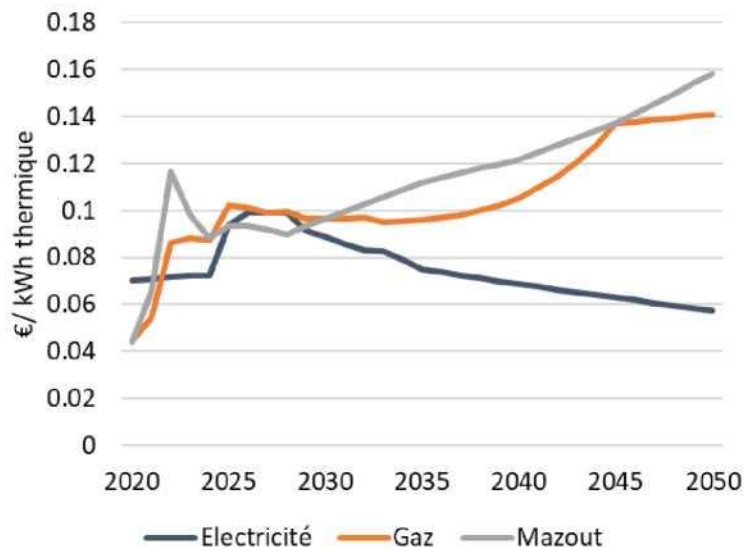
⁸⁴In line with the trend in international oil prices as described in the harmonised values recommended by the European Commission Cf. Annex 1 – Recommended parameters for reporting on GHG projections in 2025.



Sources: STATEC

The assumed price evolution of electric and fossil heating would imply that electricity would become more competitive than fossil fuels. Compared to fossil boilers, heat pumps are significantly more efficient, producing three times more thermal energy than they consume electricity, as they use ambient heat from the environment.

Figure 88: Heat pump heating would become increasingly competitive with rising fossil fuel prices⁸⁵

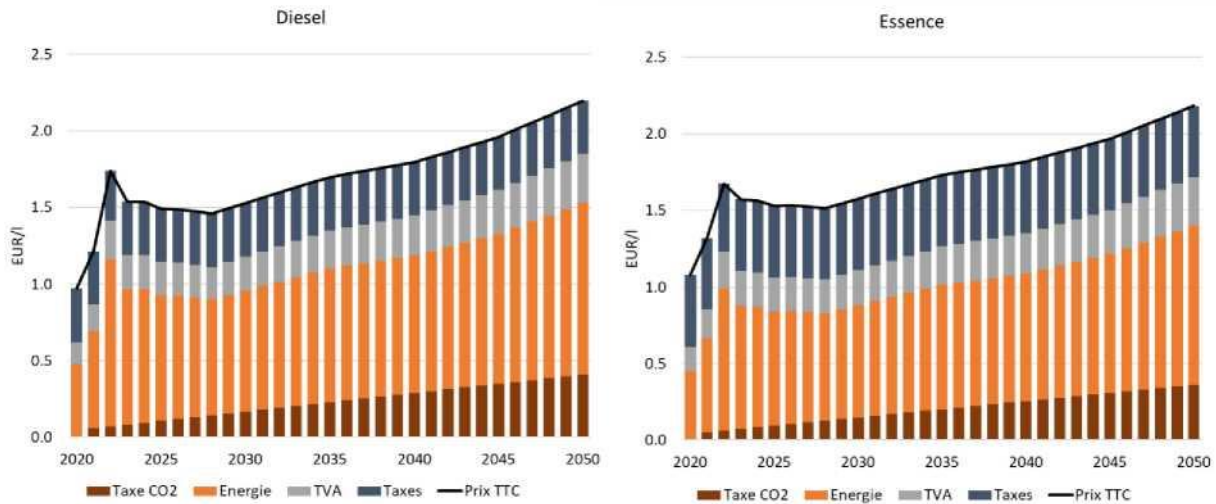


Sources: STATEC

5.2.4.4 The price differential at the pump: a major cross-border issue

Fuel prices, made up of the same components as heating oil, follow a similar trajectory, pushed up by the CO₂ tax and the increase in Brent prices. The relative price of fuels relative to electricity, as well as the overall cost of purchasing electric vehicles compared to thermal vehicles, are factors that determine the profitability of an electric car compared to a thermal vehicle. The comparison of the cost per kilometre of diesel and petrol confirms that electricity is more profitable, as the gap widens considerably over time.

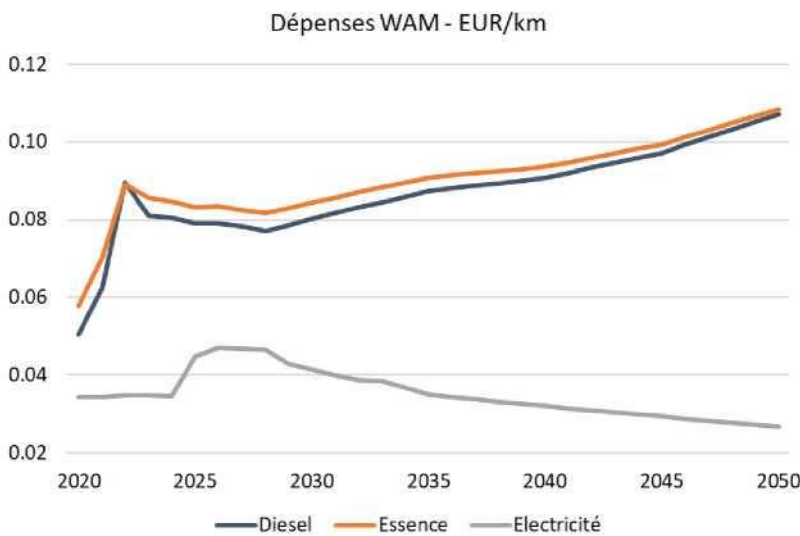
Figure 89: Increase in fuel prices



Sources: STATEC

⁸⁵ costs in EUR/kWh of energy excluding initial investment costs

Figure 90: The electric car would remain the cheapest car for use

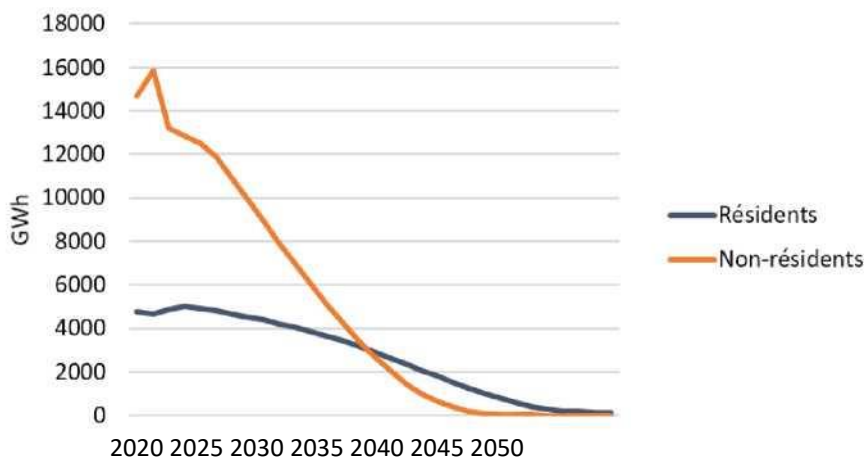


Source : STATEC

Another important element from a cross-border perspective is the price differential between Luxembourg and its neighbouring countries. A specific feature of the transport sector is that the majority of the emissions attributed to Luxembourg come from non-residents. Around two thirds of fuel sales are thus made to international carriers or private persons in transit or resident in the border region. These sales are mainly due to lower pump prices in Luxembourg than in neighbouring countries.

The reaction of non-residents to price differentials is pronounced ('elastic' in economic jargon), making the instrument of a tax such as that on CO₂ emissions particularly effective. With no change in policy in neighbouring countries, each increase of EUR 5 per tCO₂ in the tax in Luxembourg reduces the price differential with neighbouring countries by just over EUR 1 cents. The succession of annual tax increases⁸⁵ would gradually reduce price differentials and imply an increasingly sharp decline in fuel sales to non-residents.

Figure 91: Fuel sales would disappear by 2050



Sources: STATEC

5.2.5 Conclusion

The NECP aims to decarbonise the Luxembourg economy. This transition requires capital substitution for fossil fuel expenditure, which requires significant additional investment. They constitute injections into the economic circuit and could thus lead to a higher activity. Indeed, most international studies estimate that the transition

⁸⁵In the WAM scenario, a continuous increase in the CO₂ tax was assumed from EUR 30 in 2023 to EUR 165 by 2050.

would have a positive but limited impact on GDP. The impact assessment carried out for Luxembourg also leads to a slightly positive impact of the NECP on GDP and employment in Luxembourg by 2030.

A bottom-up figure of the additional investment and expenditure required comes to an amount of up to 1.4 % of GDP in 2030. This investment and expenditure would be mobilised by both private and public actors. In addition to public investment, the State would financially support the efforts of businesses and households. In addition to the increases in public expenditure, the fall in fuel sales would lead to a reduction in government revenue. The general government balance as a share of GDP would deteriorate to 1.3 percentage points by 2030. Households, on the other hand, would benefit from lower energy expenditure. Moreover, this decrease would be more pronounced than the required increase in investment.

Overall, the energy transition would drastically reduce emissions and have a slight positive impact on activity by 2030, but due to the decoupling of emissions from economic activity, a slightly different trajectory from GDP would not undermine national climate targets.

5.2.6 Annexes

Table 73: Impact of the energy transition on GDP according to various studies

Study	Horizon	Region	Impact on GDP
European Commission (2018) (JRC-GEM-E3 model)	2050	EU	– 0.6 % (fragmented action); – 1.3 % (overall action)
European Commission (2018) (E3ME model)	2050	EU	+ 1.5 % (fragmented action); + 2.2 % (overall action)
European Commission (2018) (QUEST model)	2050	EU	+ 0.7 %
European Commission (2020) (JRC-GEM-E3 model)	2030	EU	– 0.4 %; –0.3 %
European Commission (2020) (E3ME model)	2030	EU	+ 0.2 %; + 0.5 %
European Commission (2020) (QUEST model)	2030	EU	– 0.3 %; + 0.1 %
OECD (2017)	2050	Advanced importers of fossil fuels	+ 2.2 %
Pisani-Ferry & Mahfouz (2023)	2040	France	+ 1 %; –1 % (without resp. with productivity shock)
Callonnec & Cancé (2022)	2030	France	+ 2.5 %
Callonnec & Cancé (2022)	2050	France	+ 3.8 %
Federal Planning Office (2016)	2030	Belgium	+ 1.9 %; + 2.5 %
NGFS (2022) (NiGEM model)	2050	Europe	+ 1.7 %
NGFS (2022) (NiGEM model)	2050	Germany	+ 0.6 %
NGFS (2022) (NiGEM model)	2050	France	+ 2.1 %
NGFS (2022) (NiGEM model)	2050	Belgium	+ 2.4 %

Sources: as indicated in the table. If more than one impact estimate is given, they refer to different configurations.

5.2.7 Bibliography

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5.3 Impact of planned policies and measures on other Member States and regional cooperation

Luxembourg is part of the European Union's internal energy market. Due to its size and demographic and geographical characteristics, Luxembourg depends in more than one way on developments in other European countries, and in particular in neighbouring countries. For the same reasons, Luxembourg's direct influence on the rest of the European energy market can be considered low. An exception is the Vianden pumping plant, which makes an important contribution to the security of supply of the central European electricity system.

Due to the importance of regional and European integration, Luxembourg proactively engages at different levels, in particular in the framework of the Penta and the NSEC. For more details on these regional cooperation and the impact on the respective neighbouring countries, see Chapters 1.4.1 and 1.4.2.

5.4 Contribution of planned policies and measures to the achievement of the Union’s climate-neutrality objective

The amended Climate Law of 15 December 2020 stipulates **climate neutrality**, which is to achieve net zero emissions, **by 2050 at the latest** as Luxembourg’s long-term climate target. The WAM projections for 2050 (see Table 74 and Figure 92) suggest that **the policies and measures of the update of the NECP would already approach climate neutrality in 2050**. Indeed, in the WAM scenario, total net emissions of around 0.7 Mt CO_{2eq} remain in 2050, summing up all GHG emissions and removals, representing a reduction of more than 94 % compared to 2005.

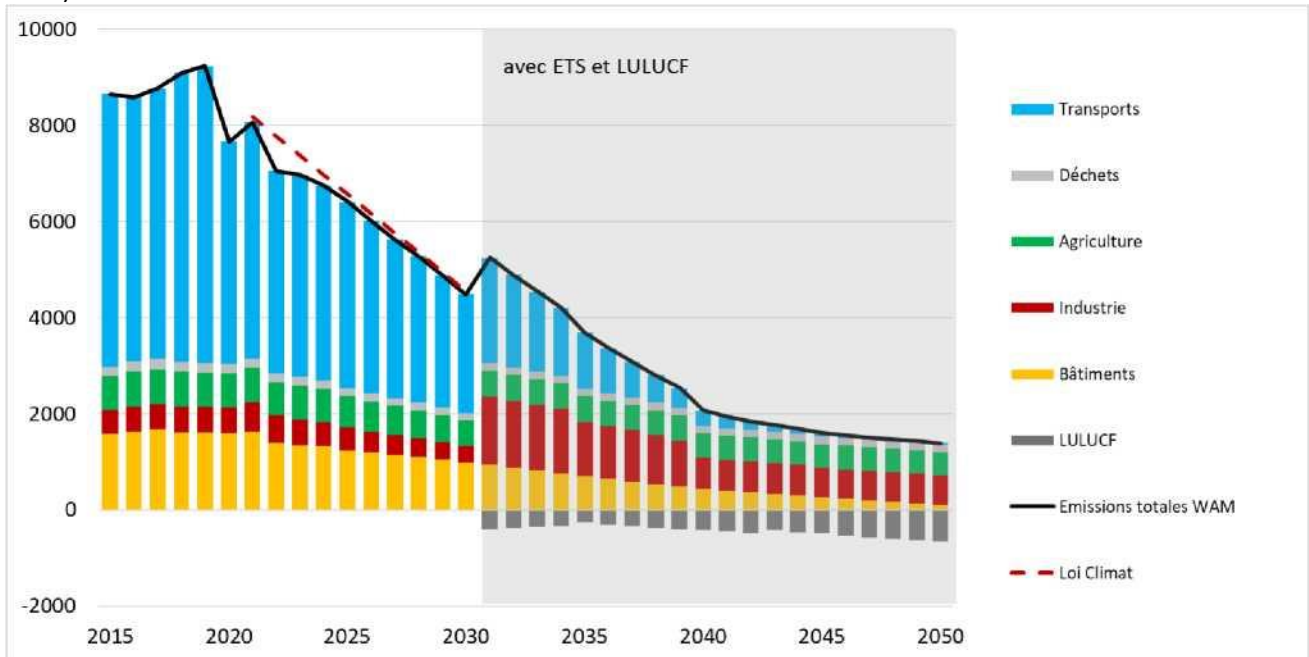
Table 74: Projections of GHG emissions and removals up to 2050 based on additional (new and enhanced) policies and measures (**WAM scenario**)

(Thousand tonnes CO _{2eq} (AR5))	2025	2030	2035	2040	2045	2050
Energy and manufacturing industries, construction	474	325	249	172	111	98
Transport	3872	2467	1170	321	78	37
Residential and tertiary buildings	1234	993	702	427	261	96
Agriculture and forestry	658	545	528	511	496	484
Treatment of waste and waste water	174	157	156	154	155	158
ESR Emissions/Climate Law	6410	4487	2805	1584	1100	873
ETS EMISSIONS	1246	1137	886	487	500	519
Emissions TOTALES – ESR/Climate Law	7656	5625	3692	2071	1600	1392
LULUCF	– 431	– 430	– 256	– 428	– 493	– 660
TOTAL stocktaking – ESR/Climate &LUCF	7225	5195	3435	1643	1107	732

Sources: STATEC, AEV & SER (2024)

These sectors with the highest residual emissions in 2050 are industry (ETS and non-ETS) and agriculture. Although additional efforts, measures and solutions are needed and possible, it seems difficult or even impossible to reduce emissions in these two sectors to zero due to emissions from certain industrial processes or livestock farming. **In order to fill the gap, it is all the more important to consolidate natural carbon sinks (LULUCF) and to develop carbon capture, utilisation and storage (CCUS) technologies.** It should be noted that these technologies have not yet been taken into account in the projections.

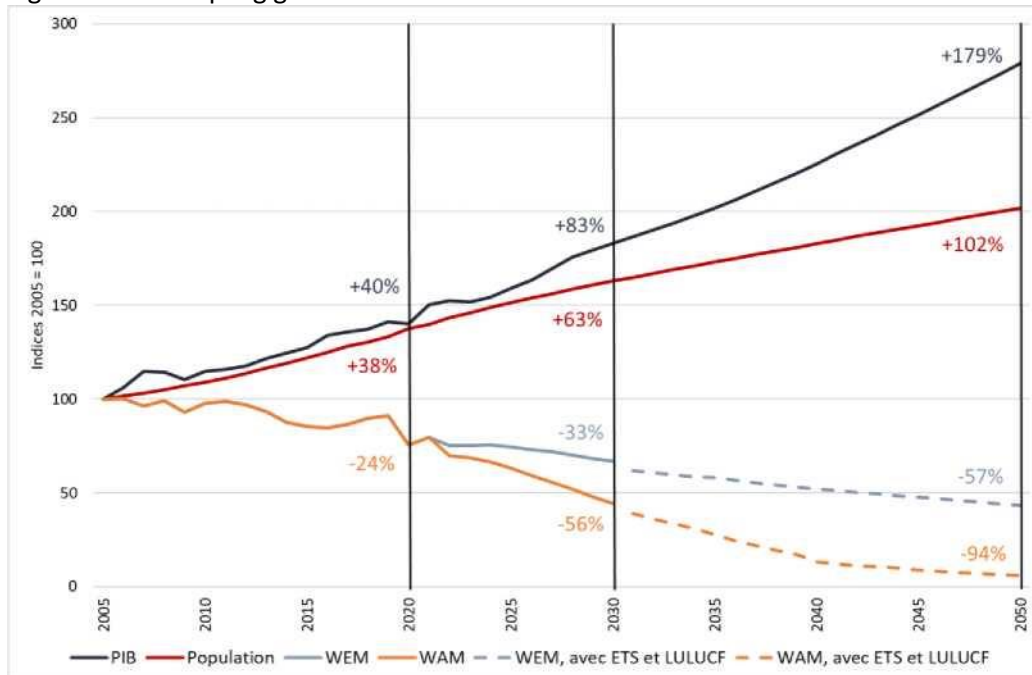
Figure 92: WAM projection of total emissions and removals (ESR emissions/climate law + ETS emissions + LULUCF net removals) from 2031 to 2050 (with WAM projection of ESR emissions/Climate Law compared to the trajectory of annual emission allocations for 2030 (Climate Law) and historical emissions from 2015 to 2022)



Sources: STATEC, AEV & SER (2024); GHG emissions inventory (submission of March 2024); Climate law

Luxembourg’s projected population growth is another major challenge facing the objective of climate neutrality. However, as illustrated in Figure 93, projections suggest that a **decoupling of population growth from GHG emissions** is possible.

Figure 93: Decoupling growth from GHG emissions



Sources: STATEC (2024)

List of abbreviations

EIB	European Investment Bank
BIM	Building Information Modelling
EED	Energy Efficiency Directive (EU) 2023/1791 (Energy Efficiency Directive)
EPBD	Energy Performance of Buildings Directive (EU) 2024/1275
HTA	EU Emissions Trading System
FEC	Final Energy Consumption (final energy consumption)
NRFS	National Research Fund
GHG	Serre Effect Gas
IPCC	Intergovernmental Expert Group on Climate Change (IPCC)
kt CO ₂ eq	kilotonnes carbon dioxide equivalents
LISER	Luxembourg Institute for Socio-Economic Research
LIST	Luxembourg Institute of Science and Technology
LULUCF	Land Use, Land Use Change and Forestry (LULUCF)
MAAV	Ministry of Agriculture, Food and Viticulture
MDIGI	Ministry of Digitalisation
MY	Ministry of State
MECB	Ministry of the Environment, Climate and Biodiversity
MECO	Ministry of the Economy
MENEJ	Ministry of National Education, Childhood and Youth
MEASURE	Ministry of Higher Education and Research
MFSVA	Ministry of Family Affairs, Solidarity, Living Together and Welcome
MFIN	Ministry of Finance
MFP	Ministry of Civil Service
MAINT	Ministry of Home Affairs
MLOGAT	Ministry of Housing and Spatial Planning
MMTP	Ministry of Mobility and Public Works

M3S	Ministry of Health and Social Security
MT	Ministry of Labour
MT CO _{2eq}	million tonnes of carbon dioxide equivalent
NCER	National Centre of Excellence in Research
NSEC	North Seas Energy Cooperation
NZEB	nearly Zero Energy Building
PEC	Primary Energy Consumption
GDP	Gross Domestic Product
SMES	Small and medium-sized enterprises
PNEC	Luxembourg's integrated national energy and climate plan for the period 20212030
RED	Renewable Energy Directive (EU) 2018/2001
R & D & I	Research, development and innovation
TRL	Technology Readiness Level
EU	European Union
WAM	With Additional Measures
WEM	With Existing Measures