Energy and Climate Modelling and Energy System Integration in Latvia

DLV 4 -Energy system integration pathway and policy roadmap

Final Report

RTU FACULTY OF ELECTRICAL AND ENVIRONMENTAL SCIENCE

Trinomics

E3Modelling Energy Economy Environment

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In association with:

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CONTENTS

Acronyms

AAU	Assigned Amount Units
BECCS	Bioenergy with carbon capture and storage
BEMIP	Baltic Energy Market Interconnection Plan
CCfD	Carbon contract for difference
CCS	Carbon capture and storage
CCU	Carbon capture and utilisation
CEER	Council of European Energy Regulators
CF	Cohesion Fund
CFLA	Central Finance and Contracting Agency
CHP	Combined heat and power
CNG	Compressed natural gas
CO_2	Carbon dioxide
DH	District heating
DSO	Distribution system operator
EIA	Environmental impact assessment
EKII	Emission Allowance Auction Instrument
EMFF	European Maritime and Fisheries Fund
ERDF	European Regional Development Fund
ESF	European Social Fund
ESR	Effort Sharing Regulation
ETS	Emission trading system
EU	European Union
EUSBSR	EU Strategy for the Baltic Sea Region
EV	Electric vehicle
FCEV	Fuel Cell Electric Vehicle
FCH JU	Fuel Cells and Hydrogen Joint Undertaking
FiT	Feed in tariff
GDP	Gross domestic product
GHG	Greenhouse gas
GIPL	Gas Interconnection Poland-Lithuania
ICE	Internal combustion engine
IPPU	Industrial processes and product use
KPFI	Climate Change Financial Instrument
ktoe	Kilo ton oil equivalent
LNG	Liquefied natural gas
LTS	Long Term Strategy
LTRS	Long Term Renovation Strategy
LULUCF	Land Use, Land-Use Change and Forestry
LV	Latvia
LVIF	Latvian Environmental Investment Fund
MoA	Ministry of Agriculture

MoCE	Ministry of Climate and Energy
MoE	Ministry of Economics
MoF	Ministry of Finance
MoEPRD	Ministry of Environmental Protection and Regional Development
NECP	National energy and climate plan
NIP	National Industrial Policy
NRT	Natural resource tax
OECD	Organisation for Economic Co-operation and Development
PPA	Power purchase agreement
PV	Photovoltaic
RAB	Regulatory asset base
RES	Renewable energy sources
RES-E	Electricity from renewable energy sources
RRF	Recovery and resilience fund
RRP	Recovery and resilience plan
TJ	Terajoule
TSO	Transmission system operator
UGS	Underground gas storage
VAT	Value added tax
WAM	With additional measures
WEM	With existing measures

Executive summary

With the new European Green Deal, climate and environment are at the top of the political agenda. The main objective of the European Green Deal is reaching a climate neutral Europe (that is, net-zero greenhouse gas emissions, GHG)) by 2050. In order to set the EU on a sustainable path to achieve climate neutrality by 2050, in September 2020 the Commission has proposed an EU-wide, economy-wide net GHG reduction target by 2030 compared to 1990 of at least 55%. In line with new target and with the even more ambitious objectives set by RePowerEU, Latvia's national energy and climate plan (NECP) will have to be updated. It is necessary to develop analytical tools and modelling instruments for projection of different development scenarios to support the complex transition to climate neutrality.

The aim of the analysis presented in this document is to provide the Ministry of Economics with an initial scenario for decarbonisation based on a cost-effective integrated energy system.

Key limitations

When reading the results of this analysis, it should be considered that:

- The TIMES model developed for this assignment considers only energy-related emissions;
- The models have been built specifically for this assignment, and in the context of this project there is limited time and budget for perfecting them;
- the quantification and assessment of the socio-economic implications of energy and climate policies is a complex task because of the uncertainties and inter-dependencies of multiple systems that must be taken into account.
- The current energy crisis in the EU introduces a very significant element of uncertainty. Gas prices have reached peaks of 10 times the historical price, and there is as yet no clarity on the level they are going to be in the next 3 to 5 years. Gas prices, and actors' expectations about their future level, have a very significant impact on the technology mix and they drive other key inputs (such as the electricity price);
- Given the scope of this analysis (economy-wide and long-term) it will be unwise to give a big weight to the cost and impacts of a single policy in the short term. The model can give an indication of the ballpark costs and impacts, and on the size of investments needed to drive technology transitions, but often single assumptions have a large weight on the result. For example, it is assumed that a subsidy covering (on average) 75% of investment costs will be sufficient to drive a any number of building renovations, but there may be some short-term limits to the ability of the supply chain to deliver at the level estimated by the model.
- Further, the set of actions included in the WAM scenario have been discussed with a limited number of stakeholders (largely, various government departments), but these have not been subjected to a full consultation process. This should be undertaken before the action plan is finalised.

Main findings and conclusions

According to the TIMES self-optimising simulation, the most cost effective decarbonisation pathway for Latvia relies extensively on energy efficiency and electrification. In order to meet the 2030 targets, the model prioritises energy efficiency in buildings, as that is where the cheapest energy savings can be achieved. After 2030, the model prioritises fuel switch across all other sectors, with the transport sector trailing behind and being the major emitter in 2050.

Meeting the 2030 energy efficiency targets and lowering energy-related emissions towards net zero requires a very ambitious set of policies. The policy mix analysed in this report (chapter 5) aims to provide a balanced approach that reflects the trajectory emerging from the TIMES self-optimisation and the preferences expressed by the Latvia government. This includes significant increases in subsidies to households and business, a wide-ranging approach to the transport sector (investments in infrastructure, taxes and subsidies, information campaigns) and a strong support for the deployment of substantial quantities of offshore wind.

In order to meet the net zero target, some sectors and technologies will have to act as sink - i.e. net absorber of emissions. The LULUCF sector (via expansion of forested area and peatlands and reduction of forest exploitation) and the agricultural sector (reducing the amount of methane and nitrous oxides emissions deriving from farming practices) are the best candidates to compensate emissions in other sectors. Other potential technologies are bioenergy + CCS and CO_2 air capture, but they are very expensive, requiring either very high initial investments or very high ongoing costs.

The current dependence on gas can be significantly reduced in the medium term with a combination of electrification and energy efficiency. Biomethane injections would significantly reduce the carbon impacts of gas usage, but it is expected that the need for natural gas will be still important in 2050.

Recommendations

Based on the objectives of this assignments, and on the results of the analysis presented in this report, the Ministry of Economics, and the Latvian Government in general, should:

- **Reassess the contribution of LULUCF and agriculture to decarbonisation**. These sectors can provide significant contribution to reducing net emissions by acting as a sink. However, energy system modelling (developed as part of this project) is not the right tool to analyse this potential and best policies to tap into it.
- **Discuss the actions proposed and their implications (financial, political) more thoroughly across government departments and with stakeholders.** This would ensure that the strategy proposed has a broad support, which will be necessary to ensure its long term success.
- **Further analyse the actions proposed in the action plan in isolation**. This assignment looked at the combined effect of several actions across the total emissions from Latvia's energy use. However, each actions should be analysed on its own once the actions have been defined more precisely (for example, with budgets, implementation periods, responsible bodies, and so on).

1 Introduction

With the new European Green Deal, climate and environment are at the top of the political agenda. The main objective of the European Green Deal is reaching a climate neutral Europe (that is, net-zero greenhouse gas emissions, GHG)) by 2050. In order to set the EU on a sustainable path to achieve climate neutrality by 2050, in September 2020 the Commission has proposed an EU-wide, economy-wide net GHG reduction target by 2030 compared to 1990 of at least 55%. In line with new target and with the new targets set by the RePower EU strategy, Latvia's national energy and climate plan (NECP) will have to be updated. It is necessary to develop analytical tools and modelling instruments for projection of different development scenarios to support the complex transition to climate neutrality.

1.1 Objective

This deliverable aims to assess and recommend an optimal pathway for decarbonisation based on a cost-effective integrated energy system, developing a related roadmap for policymakers and scenarios with existing measures' (WEM) and a 'with additional measures' (WAM) that will feed into Latvia's 2030 NECP.

1.2 What is sector integration

The European Commission integration strategy[1] defines integration *as the planning and operating of the energy system "as a whole", across multiple energy carriers, infrastructures, and consumption sectors*. Measures aimed at fostering sector integration aim at:

- **Creating a more circular energy system**, promoting energy efficiency, encouraging the reuse of waste heat from industrial sites, improve synergies between energy infrastructures and incentivising the use of agriculture residues to produce sustainable biogas and biofuels.
- **Accelerating the use of electricity produced from renewable sources,** increasing also the use of renewable electricity in buildings, transport and industry for instance through heat pumps, electric vehicles and furnaces. Also, deployment of charging stations for electric vehicles and the injection of renewable electricity in the network
- **Promoting renewable and low-carbon fuels, including hydrogen, for sectors that are hard to decarbonise.** This includes increasing the use of sustainable biomass and biofuels, green hydrogen, and synthetic fuels, enabling carbon capture, storage and use and other innovative technologies
- **Adapting energy markets and infrastructure to a more complex, integrated energy system,** ensuring equal treatment for all energy carriers, making electricity and gas markets fit for decarbonisation, informing consumers about their options to supporting digital energy services, including smart meters for homes and smart chargers for electric vehicles. Further, it is necessary to support research and innovation to create new synergies in the energy system.

[1] EUR-Lex - 52020DC0299 - EN - EUR-Lex (europa.eu)

1.3 Report structure

The report is structured as follows:

- Chapter 1 provides a brief introduction to the report, its objective and the methodology;
- Chapter 2 summarises Latvia's current situation and expected evolution;
- Chapter 3 provides Latvia's decarbonization policy landscape and the main challenges and barriers;
- Chapter 4 introduces Latvia's baseline trends, the set of policies evaluated in the policy scenario (WAM), the modelling results (energy system modelling and macroeconomic modelling), sensitivity analysis and other considerations;
- Chapter 5 provides the policy roadmap and action plan, where the policies assessed in the modelling exercise are brought to life with more practical considerations.

2 Assessment of Latvia's current situation and its projected evolution

This section presents an overview of the current economic, energy, energy generation and GHG emissions situation and outlook in Latvia.

2.1 Economic status and outlook

2.1.1 *Historical development*

Latvia's population has undergone continuous decline since its restored independence in 1990, from 2.7 million inhabitants in 1990 to 1.9 million in 2020,[2] mostly due to a high rate of emigration first to countries in the Commonwealth of Independent States in the 90's and then to European Union countries since the turn of the century. Nonetheless, Latvia's GDP has undergone a significant increase: +86% between 2000 and 2020.[3]

The main economic sectors of the country, based on value added, are wholesale and retail trade, manufacturing, information & communication, and transportation & storage respectively –Latvia is a major hub in the Baltic region and beyond via its ports, rail, roads and airport.[4]

General government spending totalled 43.2% of GDP in 2020 (on the rise since 2012 – from 2012 to 2019 it was around 37-39%. The main destinations of government spending in 2020 were: social protection (13.5% of GDP), economic affairs (7% of GDP) education (5.9% of GDP), health (4.8% of GDP) and general public services (4% of GDP).[5]

Latvia's investments rate was in the ballpark of 25% of GDP in 2021, on the rise from previous years (at around 20% since 2016).[6]

2.1.2 *Economic outlook*

An overview of expected long-term economic trends, as modelled for this assignment, is presented in section 4.1.1.

Other existing macroeconomic outlooks such as Eurostat suggest a continuation of the population decline, with the population declining to 1.1 million by 2080.[7] The OECD suggests in parallel a continuous GDP growth until 2030 (+23% from 2020); however, followed by an abrupt growth rate decline from 2030 onwards (-1% between 2030 and 2060).[8]

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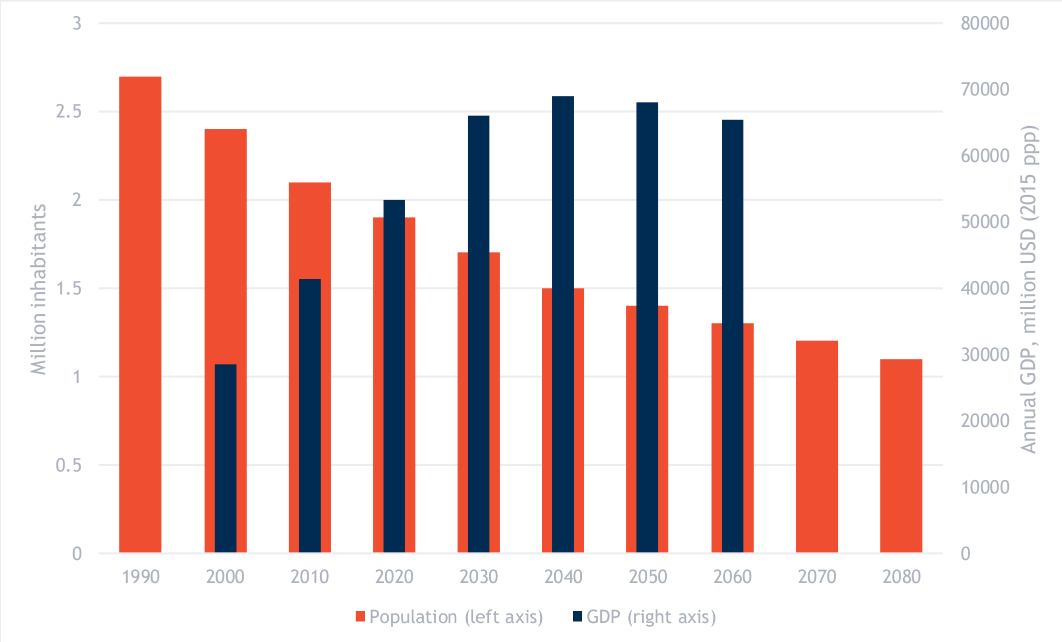
[2] Eurostat (2022), Total population
[3] Reaching 53 369 million USD in 2020 (2015 PPP). OECD (2021), OECD Economic Outlook: Statistics and Projections
[4] Eurostat (2022), Value Added by NACE Rev.2
[5] OECD (2022), General government spending
[6] CEIC (2022), Latvia Investment: % of GDP
[7] Eurostat (2022), Total population
[8] OECD (2021), OECD Economic Outlook: Statistics and Projections

Figure 2-1 Latvia historical and projected GDP and population per OECD and Eurostat, 1990-2080



Sources: GDP historical data and projections: OECD, 2021. Population historical data and projections: Eurostat, 2022.

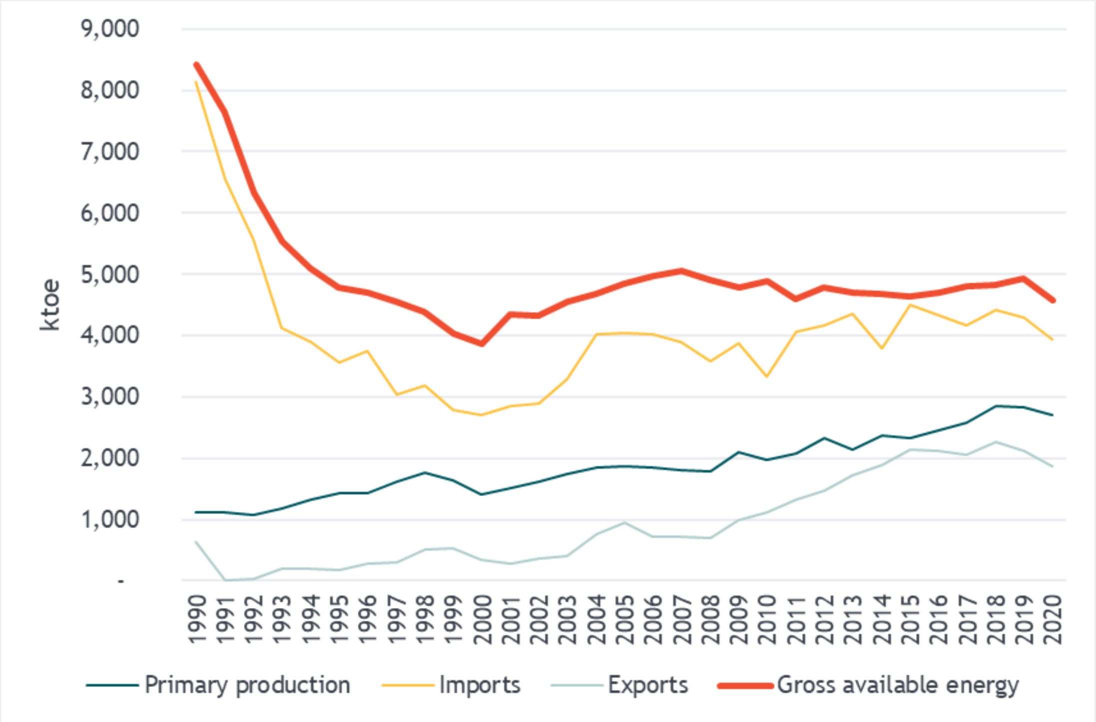
2.2 Energy demand

2.2.1 *Historical energy demand*

General trends

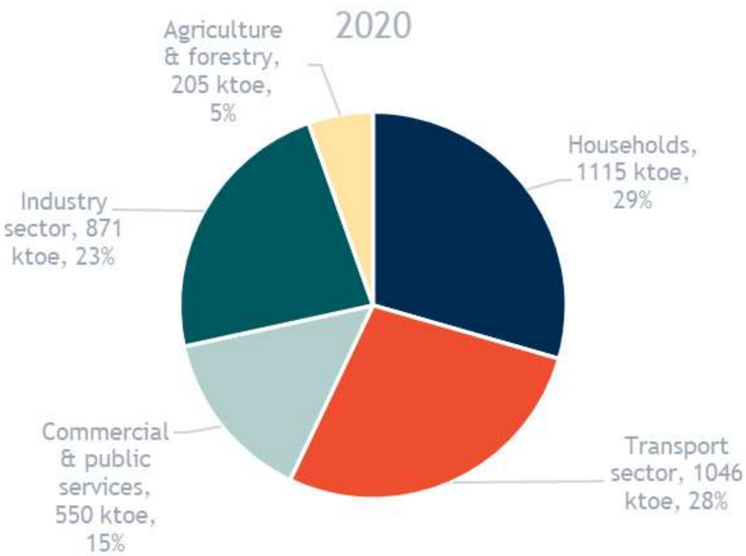
Since its restored independence in 1991, Latvia's energy demand ('gross available energy') has substantially decreased due to the deindustrialisation following the collapse of the Soviet Union, but has slightly picked up again after 2000. Since 2010, it has remained broadly stable, with a small drop only in 2020. During the same time, primary production of energy, imports and exports have all increased (Figure 2-2). In 2020, 4 568 ktoe were available for consumption. Over the same period, final energy consumption almost halved from 6 418 ktoe in 1990 to 3 885 in 2020.

Figure 2-2 Gross available energy, Primary production and Imports/Exports[9]



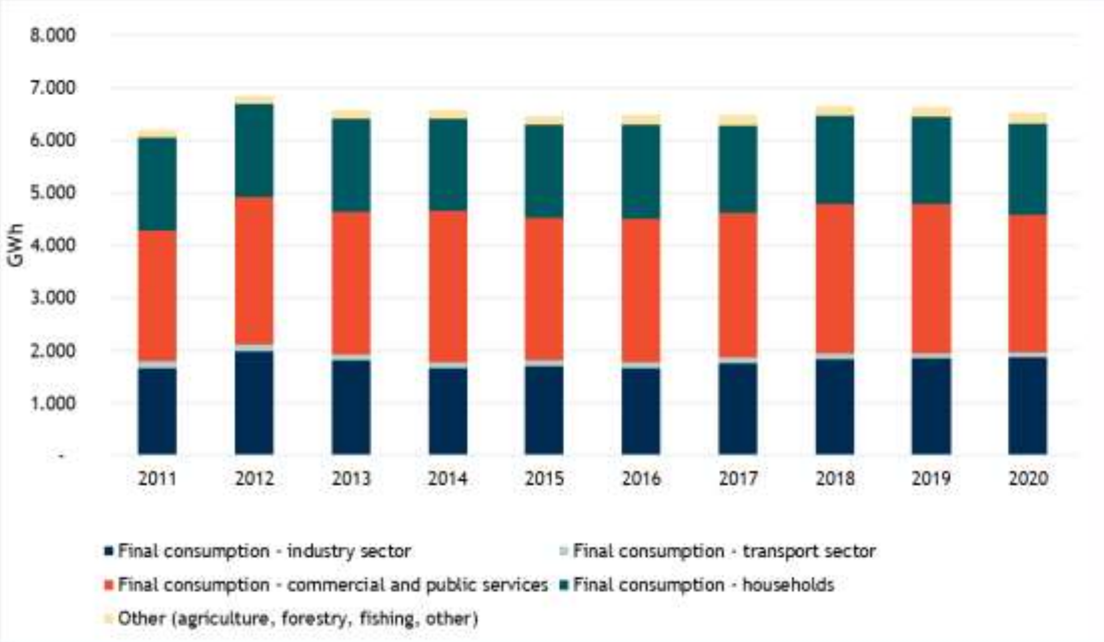
Households (29%) and transport (28%) together accounted for almost 60% of overall energy use in 2020, with industry (23%) and commercial services (15%) being responsible for an additional 38% of consumption (Figure). The share of energy use by sector has not undergone significant changes between 2010 and 2020.

Figure 2-3 Final energy use by sector in 2020[10]



[9] Eurostat (2022), Energy balances
[10] Eurostat (2022), Energy balances

Figure 2-4 Final electricity consumption by sector[11]



Overall, the share of primary energy consumption by fuel in Latvia over the years 2017-2020 was split between around one-third biomass, one quarter natural gas and one quarter diesel fuel, while the rest was split between other renewables (mostly hydro) and other fossils.[12] The ratio of renewable energy in Latvia was 42% in 2020 and 2021.[13]

Historic energy demand in key sectors

Transport

The transport energy demand has historically fluctuated, declining significantly as the country underwent deindustrialization in the 1990s, but since the turn of the century it has been relatively stable. In 2020, transport share of final energy consumption was 27 % (43 773 TJ).[14] The modal split of road transport shows that passenger cars dominate the fleet in Latvia and currently passenger car stock is dominated by internal combustion engines, leading to a dependency on oil products in the sector (around 93 % in 2020). With 41 523 TJ of oil products in final consumption in 2020, the sector represented close to 80 % of the total oil product final consumption of the country.[15] Renewable energy (from both biofuels and electricity) is on the rise in the sector, and in 2020 made up 6.7 % of energy used in the transport sector.[16] Biofuel use in the sector is on the rise, largely thanks to changes in legislation, that have raised biofuels blend requirements in petrol and diesel, and in 2020 accounted for 4.3 % of sector's energy consumption.[17] Electricity use has been decreasing from 547 TJ in 2000 to 340 TJ in 2020, but has recently been on the rise thanks to a shift towards electric and hybrid passenger

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[11] Eurostat (2022), Energy balances
[12] Latvia-TIMES model
[13] Official statistics of Latvia (2022), Press release: Last year 51 % of the total electricity generated in Latvia were produced in CHP plants & Eurostat SHARES tool - SHARES summary results 2021
[14] Eurostat SHARES tool - SHARES summary results 2021
[15] Eurostat SHARES tool - SHARES summary results 2021
[16] Eurostat SHARES tool - SHARES summary results 2021
[17] Oficiālās statistikas portāls (2021), AER patēriņš 2020. gadā samazinājās par 1,3 % & Eurostat SHARES tool - SHARES summary results 2021

cars.[18] Natural gas use in the transport sector is negligible, although growing since 2018 (increase from 2 TJ in 2018, to 55 TJ in 2021).[19]

Latvia is one of the EU Member States with the lowest passenger car ownership rates (390 passenger cars per thousand inhabitants – nearly half of Luxemburg's rate (682 passenger cars per thousand inhabitants), which is the EU country with the highest rate). Latvia's passenger car stock reached 739 000 units in 2020, with an annual increase since 2015. Diesel (compression-ignition) powertrains represent around two-thirds of the passenger car stock, and spark-ignition powertrains represent around one-third. Electric cars make up a very small portion of the passenger car stock, but recently there has been an upwards trend. In 2021, 480 new battery electric passenger cars were registered in the country, and from 2020 to 2021 the total electric car stock almost doubled, from 1 205 cars to 2 106 cars[20]. The vast majority of the passenger car fleet (close to 80%) in 2020 was over 10 years old.[21]

87.7 % of passenger traffic took place on cars in 2020 (on the rise since 2000), while the land-transport modal share of buses, motor coaches, trolley buses and rail combined decreased from 23.1 % in 2000 to 12.3 % in 2020.[22] Road modes represent the vast majority of the country's transport energy consumption, with 55% due to cars and 34% to trucks and light vehicles.[23]

The carbon intensity of road transport energy consumption has remained the same since the 1990s, at 70 gCO_2/MJ.[24] However, Odyssee-Mure data suggests that the technical energy efficiency of the transport sector overall in Latvia has improved by about 27% between 2000 and 2018.[25]

Industry

Final energy consumption in the industry sector drastically dropped between 1990 and 1994, suggesting heavy post-socialist deindustrialisation after independence was restored and the Soviet Union collapsed. Final energy consumption has remained relatively stable since, with a slight upwards trend in the 2010s, totalling 36 463 TJ in 2020 (22.5 % of total final energy consumption).[26]

The sector relied for 6 709 TJ (18.4%) on electricity, 4 049 TJ-gross (11.1%) on natural gas, 2 130 TJ (5.8%) on oil products, 803 TJ (2.2%) on coal in 2020.[27] The main energy source for the sector is however direct use of renewables and biofuels[28]: almost half, or 48.3% (over 17 628 TJ), of the final energy consumption in the sector was relying on this energy source in 2020.[29]

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[18] Eurostat SHARES tool – SHARES summary results 2021
[19] Official Statistics Portal, Energy balance
[20] Eurostat (2022), Passenger cars in the EU
[21] Eurostat (2022), Passenger cars in the EU https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Passenger_cars_in_the_EU
[22] Eurostat (2022), Modal split of inland passenger transport
[23] Odysee-Mure (2021), Profile: Latvia
[24] IEA (2020), Country profile: Latvia
[25] Odysee-Mure (2021), Profile: Latvia
[26] IEA (2020), Country profile: Latvia
[27] Eurostat SHARES tool – SHARES summary results 2021
[28] Direct use means that biomass use for power or heat used in the industry sector is not accounted for.
[29] Eurostat SHARES tool – SHARES summary results 2021

The wood and wood products sector was the main driver of industrial energy consumption in Latvia (57.5% of the industry sector) in 2020, followed by non-metallic minerals. Steelmaking fell considerably between 2000 and 2018.[30]

The carbon intensity of industry energy consumption has considerably improved between 1994 and 2019, reaching 19 gCO_2/MJ in 2019.[31]

Residential sector and commercial and public services sector

Final energy consumption in the residential sector has undergone a downward trend since the 1990s, reaching 49 749 TJ by 2019, which represented about 30% of total final consumption (the first energy consuming sector, ahead of transport, industry and commercial and public services). The commercial and public services sector's share of total final energy consumption was 14% in 2019. [32]

The residential sector relied for 5 938 TJ (12%) on electricity, 5 151 TJ-gross (10%) on natural gas, and 2 228 TJ (4%) on oil products, in 2019.[33] Similar to the industry sector, direct use of biomass is central in the residential sector (over 40% of the sector's final energy consumption in 2017), and also accounted for 14% of the commercial sector's final energy consumption in 2017.[34]

Space heating (for a large part through district heating) accounted for 68% of the buildings' sector consumption in 2018. Energy efficiency gains in space heating between 2001 and 2018 (-35% energy use per m^2) has driven the overall decrease in dwelling energy consumption of 0.4%/year observed since 2000 and more than compensated the trend towards larger homes with increased water heating, electrical appliances and lighting energy needs. In office/non-residential buildings, electricity consumption per employee has undergone a sharp increase since 2000 (+ 41%) due to the multiplication of ICT devices in use.[35]

2.2.2 *Energy demand projections*

Latvia's NECP 2021-2030 projects a slight decrease of total final energy consumption over the decade (reaching 156 PJ by 2030). The agriculture, forestry and fishing sector see its final energy consumption increase until 2030, while all other sectors undergo a reduction of final energy consumption. Demand for liquid fossil fuels, used for a large part in the transport sector, is reduced thanks to energy efficiency and alternative powertrain penetration in the sector, but liquid fossil fuels remain the main energy source (around one-third) in total final energy demand by 2030.[36]

2.3 Energy supply

2.3.1 *Historical electricity and heat generation by fuel and technology*

Electricity generated in Latvia has fluctuated around 500 ktoe per year since 2011, but it has been on a steady decline between 2017 and 2020, with an increasing share of electricity demand being covered by imports. Virtually all electricity generated in Latvia comes from two sources: gas and hydro. This allows

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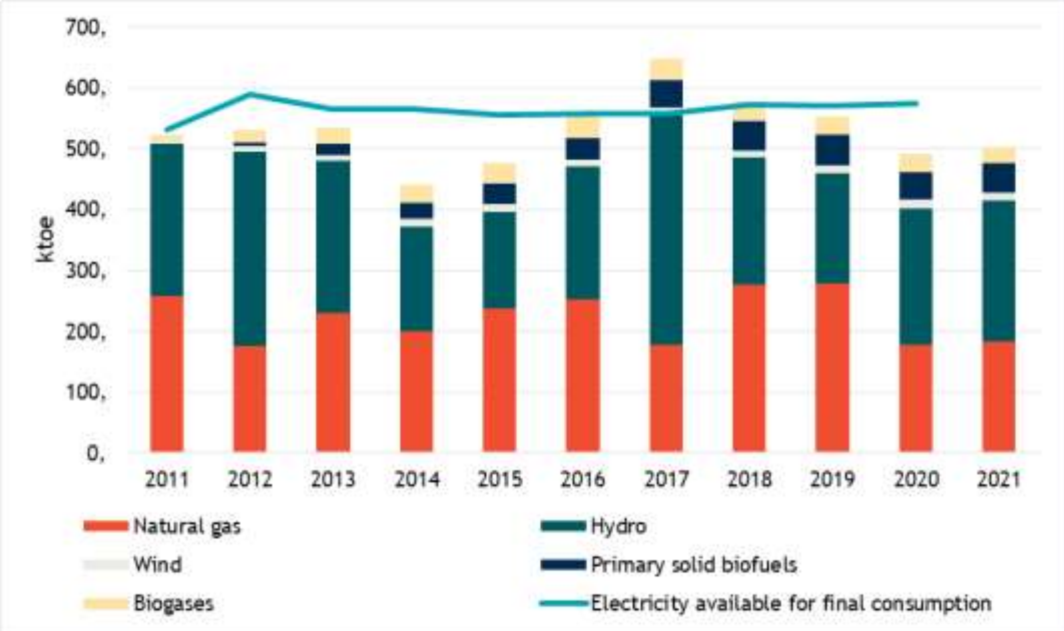
[30] Eurostat SHARES tool – SHARES summary results 2021
[31] IEA (2020), Country profile: Latvia
[32] IEA (2020), Country profile: Latvia
[33] IEA (2020), Country profile: Latvia
[34] Source: TIMES-LV model base year data
[35] Odysee-Mure (2021) Profile: Latvia (Buildings)
[36] Cabinet of Ministers (2020), Latvia's National Energy and Climate Plan

Latvia to boast a high share of renewables in its generation mix. Latvia achieved a 63.7 % share in electricity generation from renewable energy sources in 2020, and thus is well-positioned to overachieve its goal of >60% by 2030.[37,38]

Figure 2-5 Electricity production by source and available electricity for consumption[39]



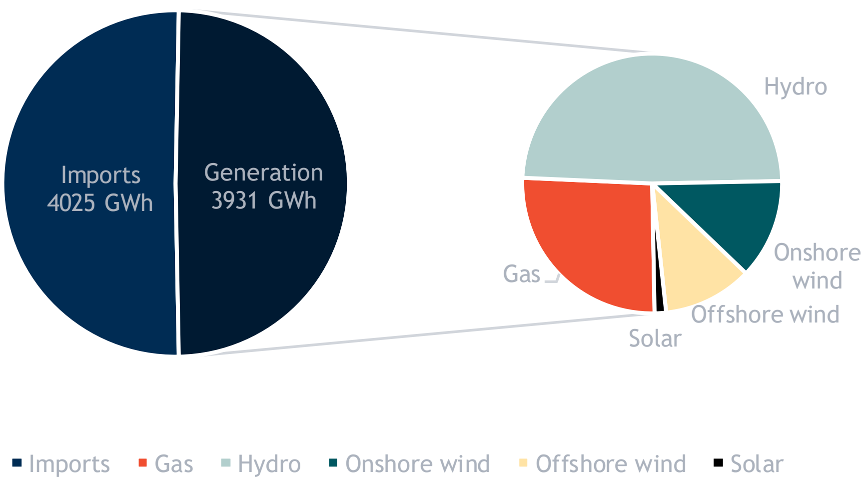
In 2021, 51% of the total electricity and 66% of the total heat generated in Latvia was produced in Latvia's 153 CHP plants[40]. Of these, four large (>20 MW) CHP plants produce the majority of heat and electricity, while the total number and capacity of plants has been decreasing in the last few years. However, only 12% of the installed capacity (152 MW out of 1 268 MW) uses renewable sources, and the electrical capacity of CHP plants using renewables has dropped by 4.5 MW in 2021 compared to 2020. Nevertheless, in 2021, 29% of the electricity produced in CHP plants came from renewable sources (862 GWh out of 2 990 GWh). The main fuel used in CHP plants is natural gas, followed by fuelwood (biomass) and biogas.

2.3.2 *Electricity and heat generation projections*

A recent modelling simulation carried out by the three Baltic TSOs (Elering, AST, Litgrid) foresees the following generation breakdown in 2030 for Latvia (see figure 2-6). The simulation is in line with the NECPs estimates. The analysis indicates that Latvia is expected to have the lowest total generation of the three Baltic states and a large generation deficit (50%), but with 75% of generation coming from renewables.

[37] Cabinet of Ministers (2020), Latvia's National Energy and Climate Plan
[38] Oficiālās statistikas portāls (2021), AER patēriņš 2020. gadā samazinājās par 1,3 %
[39] Eurostat (2022), Energy balances
[40] Official statistics of Latvia (2022), Press release: Last year 51 % of the total electricity generated in Latvia were produced in CHP plants

Figure 2-6 Forecast electricity supply in Latvia by 2030 with generation breakdown by source, GWh[41]



2.4 Greenhouse gas emissions

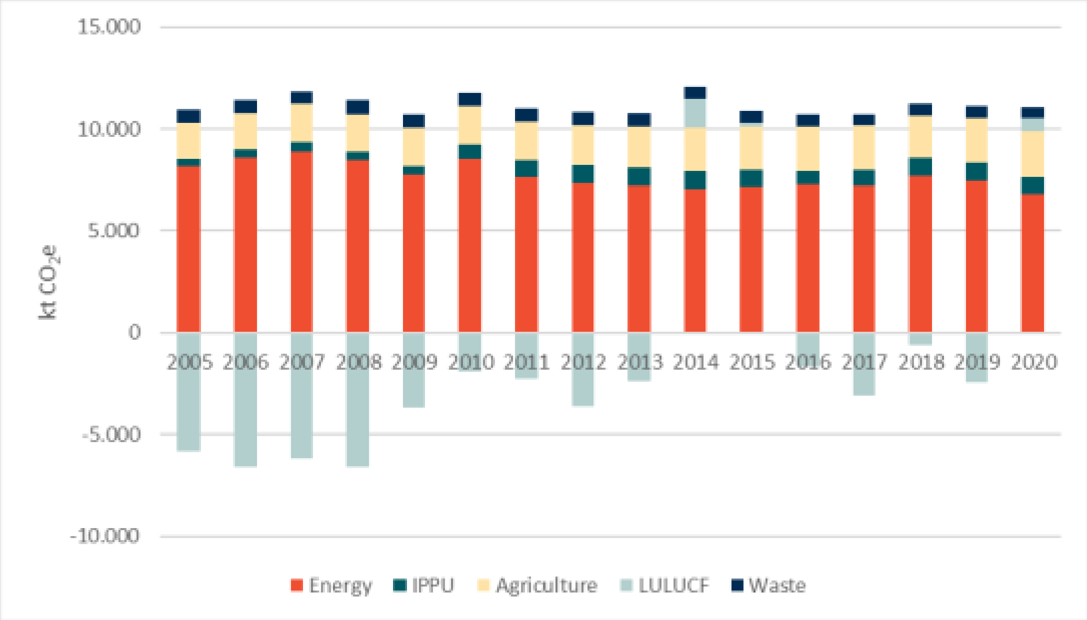
2.4.1 *Historical greenhouse gas emissions*

General trends

Latvia accounts for only 0.3 % of total EU GHG emissions.[42] Latvia's total GHG emissions (excluding LULUCF) declined by 59.6% between 1990 and 2020, most of the reduction occurring due to the deindustrialization in the 1990s. Since 2005, the total GHG emissions (excluding LULUCF) have held quite steady and by 2020 GHG emissions had declined only by 4.5%.[43] Nonetheless, Latvia overachieved the non-ETS sector GHG emissions reduction goal, as laid out in the Effort Sharing Regulation, which allowed Latvia to increase its emissions by 17 % by 2020, compared to 2005. The carbon intensity of Latvia's economy is higher than the EU average but has declined since 2005.

[41] AST (2021), Baltic reserve capacity market study
[42] European Parliament (2021), Climate action in Latvia
[43] Cabinet of Ministers (2023), Par siltumnīcefekta gāzu emisiju samazināšanas un oglekļa dioksīda piesaistes saistību izpildi

Figure 2-7 GHG emissions by sector[44]



In contrast to the EU average and to other Member States, the percentage of GHG emissions covered by the EU Emissions trading scheme (ETS) is quite low – in 2020, only 19.3% of all GHG emissions were covered by the EU ETS.[45] The ratio of sectors is also not typical, as about 71% of GHG emissions covered in 2020 were from the energy sector, and the remaining from industry.

The energy sector (excluding transport) is the largest emitter of GHG in Latvia, with 35.1% of all emissions in 2020 coming from this sector. GHG emissions between 2005 and 2020 have decreased by 33.9%, in large part thanks to fuel switching from coal and liquid fossil fuels to biomass and natural gas.[46]

The second largest emitter of GHG is the transport sector, with 29.8% of all emissions in 2020.[47] Between 2005 and 2020 transport GHG emissions have decreased by 0.14%. However, until 2019 there was a fluctuating GHG emissions increase (driven also by the 2008 economic recession) and the decrease of emissions in 2020 was caused mainly by lockdowns and the limits on citizen mobility that they entailed, which is reflected in the decrease of road transport and railway emissions.

The Industrial Processes and Product Use (IPPU) sector contributed 8.3% of the total GHG emissions in Latvia in 2020. Emissions from IPPU have increased by 134% since 2005, with significant fluctuations after 2010. The increase in IPPU GHG emissions can be explained by the development of Latvian industry – increase in construction activities and industrial production of building materials.

The Agriculture sector also has a large share of total GHG emissions in Latvia, contributing 21.5% in 2020. Since 2005, the sector has seen an increase of 25.5% in GHG emissions. The two largest sources of

[44] Latvia report to UNFCCC (2022), National Inventory Report (NIR)
[45] Cabinet of Ministers (2023), Par siltumnīcefekta gāzu emisiju samazināšanas un oglekļa dioksīda piesaistes saistību izpildi
[46] Latvia report to UNFCCC (2022), National Inventory Report (NIR)
[47] Latvia report to UNFCCC (2022), National Inventory Report (NIR)

GHG emissions in the sector are agricultural soils and enteric fermentation. Changes in GHG emissions are significantly impacted by the number of farmed animals.

Waste is the smallest sector in terms of GHG emission contributions, with 5.2% of total GHG emissions in 2020. Since 2005, waste GHG emissions have decreased by 12.6%. Fluctuations in GHG emissions from this sector could be explained by changes in the economic circumstances.

The manufacturing industries and construction sector showed the biggest percentage reduction (42%) in emissions over the period.

LULUCF sector

The contribution of Latvia's LULUCF sector to the country's total CO_2 emissions has been negative for 13 out the last 15 years, i.e., Latvia's LULUCF sector led to net removals of CO_2 from the atmosphere rather than net emissions (Figure 2-7). This is due to the large forested areas. However, the rate of withdrawal has been decreasing, and some recent analysis shows that forested area in the Baltic has undergone significant losses since 1990[48] and even more since 2015.[49] This has led to a trend of reduced aggregated net removals of the GHG emissions – removals were reduced by 111% in 2020 in comparison with 2005. This is mostly due to an increase in harvest rates in mature forests, which is closely tied to the wood and wood products sector being a key part of industry and undergoing expansion.
Land use emissions are due primarily to wetlands, since the peat industry is one of the most GHG-intensive industries. According to the 2020 semester report for Latvia,[50] GHG emissions from wetlands and peat extraction constitute around 14.5% of Latvia's total GHG emissions. The use of peat in the energy sector is very minor, and it is mostly used in horticulture (including exports). However, peatlands are also an important economic activity. On average 1 800 workers are employed in peat extraction, increasing to 2 500 during the extraction season.

2.4.2 *Projected greenhouse gas emissions*

Latvia's GHG emissions as projected in the report for Latvia's achievement of climate neutrality (Figure) suggest that GHG emissions will peak by 2030, and reach a similar level in 2050 as in 2015 (around 12 000 $ktCO_{2eq}$). Contrary to when LULUCF GHG emissions used to be net-negative, the LULUCF sector is expected to be a major driver of emissions throughout the projection period (due to the drastic reduction in emissions absorption from forest land), followed by the agriculture, transport and energy sectors.

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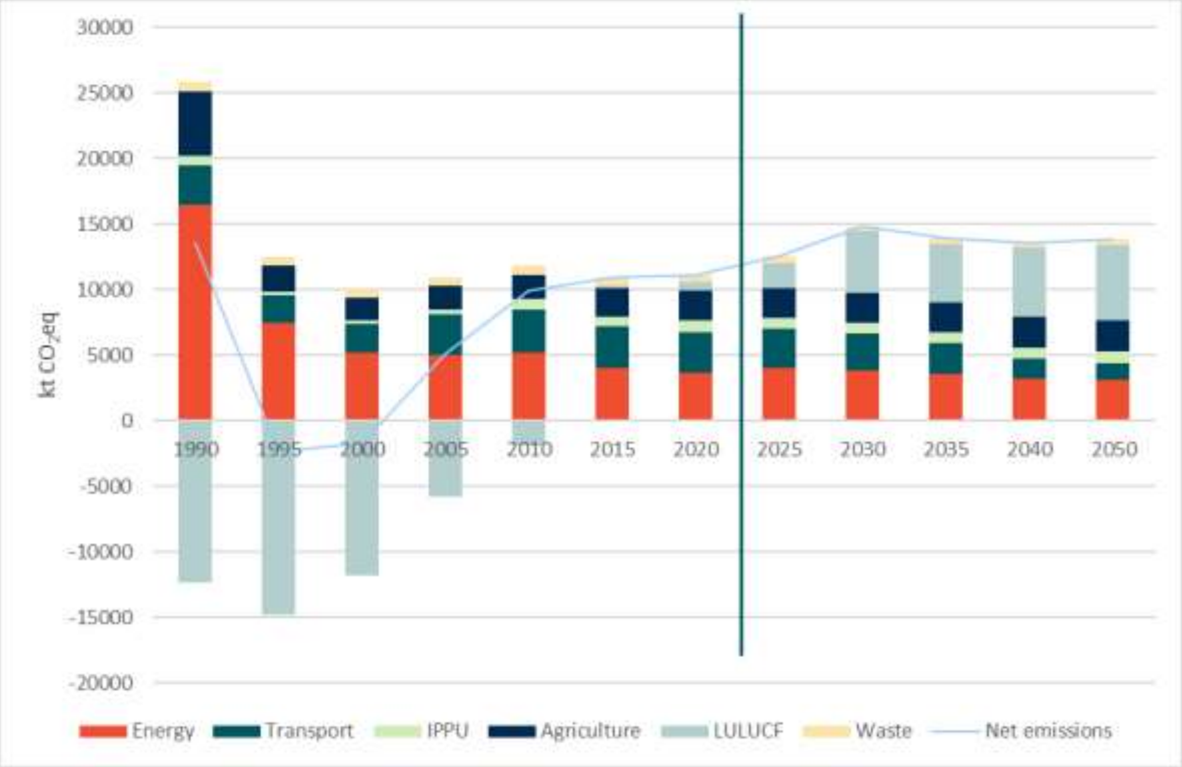
[48] Forest Europe (2020) State of Europe's forests 2020. https://foresteurope.org/wp-content/uploads/2016/08/SoEF_2020.pdf
[49] https://www.biomassafeiten.nl/wp-content/uploads/2020/09/2020-04-23_nieuws_nature-forest-clearing-eu.pdf
[50] European Commission (2020), SWD(2020) 513 final: Country Report Latvia 2020

Figure 2-8 Total amount of GHG emissions of Latvia (until 2020) and projection (for 2025-2050) under the scenario "with current measures" (1990-2050)[51]



According to Latvia's amended 2021 report on national projections of anthropogenic GHG emissions by sources and removals by sinks, with existing measures if no extra action is taken, GHG emissions will peak by 2030, and will not decrease below 2010 levels. Contrary to when LULUCF GHG emissions used to be negative, the LULUCF sector is expected to be a major driver of emissions throughout the projection period (due to the drastic reduction in emissions absorption from forest land), followed by the energy, agriculture and transport sectors.

According to the Effort Sharing Regulation (ESR), Latvia's non-ETS GHG emissions reductions target was set to be a 6% decrease in GHG emissions compared to 2005 GHG emissions. This was also reflected in the original NECP. This goal is could be achieved with existing measures according to the latest projections.[52] 2030 will be the first time when Latvia will have to achieve a net reduction of its non-ETS GHG emissions compared to 2005 (the 2020 target under the ESR allowed an emissions increase).[53] Furthermore, according to the ESR revision that took place under the "Fit for 55" legislative package, Latvia's non-ETS GHG emissions reductions target has been increased to be -17%. Currently, this goal cannot be achieved with either the existing or additional measures that are included in the 2020 version of Latvia's National Energy and Climate Plan.

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[51] Source: Latvia report to UNFCCC (2022), National Inventory Report (NIR) & 2022.gada atjauninātais 2021.gada ziņojuma par politikām, pasākumiem un SEG prognozēm kopsavilkums (2022)
[52] 2022.gada atjauninātais 2021.gada ziņojuma par politikām, pasākumiem un SEG prognozēm kopsavilkums (2022)
[53] Summary of the Commission assessment of the draft National Energy and Climate Plan 2021-2030, Latvia

3 Latvia's decarbonisation policy landscape and planned infrastructure development

This chapter introduces the Latvian policy landscape (key institutions, strategies and polices). It also presents an overview of key barriers and risks towards Latvia's decarbonisation.

3.1 Roles and responsibilities related to decarbonisation strategies

Several ministries are currently responsible for energy and climate action, as depicted below. The **Ministry of Environmental Protection and Regional Development** (MoEPRD) coordinates implementation of policies that aim to reduce GHG emissions. The **Ministry of Economics** (MoE) is responsible for development of the policy for the use of renewable energy, promotion of energy efficiency, as well as energy security and the internal energy market. Together, MoEPRD and MoE are responsible for matters related to innovation and competitiveness. Energy infrastructure planning is in the remit of the MoEPRD, but also involve the MoE and the Ministry of Agriculture (MoA).

MoEPRD also manages the **Environmental Investment Fund,** which provides financial services, programme management, supervision, cooperation, awareness. In particular, it offers support with the funds distributed via the **Emission Allowance Auction Instrument** (EKII). EKII is a state budget program aiming to contribute to the prevention of climate change, adaptation to climate change and reduction of GHG emissions (see textbox). The **Climate Change Financial Instrument (KPFI)** was EKII's predecessor.

Textbox 1 Environmental Investment Fund[54] and the Emission Allowance Auction Instrument [55]

The Latvian Environmental Investment Fund (LVIF) aims to reduce environmental pollution by promoting the implementation of environmental protection projects and increasing the capacity of local governments and joint-stock companies to prepare and implement high-quality and effective environmental protection projects. The fund provides financial services to support environmentally friendly municipal and private sector projects (i.e., loans); manages development cooperation projects; monitors the implementation of projects financed by KPFI and EKII.

The Emission Allowance Auction Instrument (EKII) aims to contribute to the prevention of global climate change, adaptation to the effects of climate change and the reduction of GHG emissions through:

- improving the energy efficiency of buildings in both the public and private sectors;
- the development and deployment of renewable energy technologies; and
- implementing integrated solutions to reduce GHG emissions.

EKII is financed from the auctioning of state-owned European Union Emission Allowances and European Union Aviation Emission Allowances. The financial instrument funding is disbursed via open project tenders. Until now, seven projects have been established, but more can be expected.

Table 3-1 EKII projects and their objectives

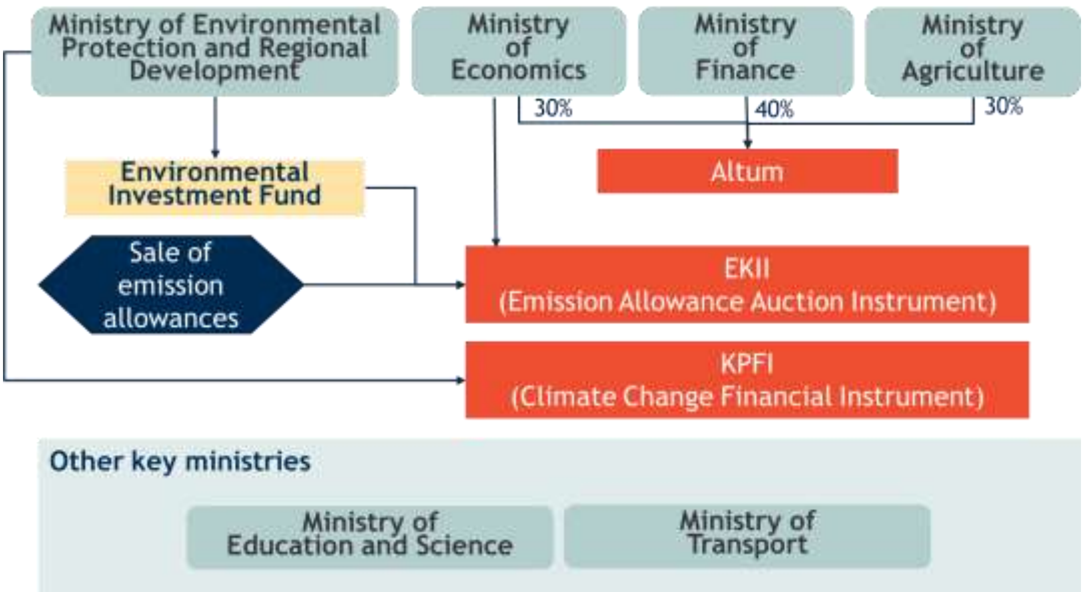
Name	Title

[54] Environmental Investment Fund (2022), Homepage Environmental Investment Fund
[55] Emission Allowance Auction Instrument (2022), Information on the Auctioning Instrument of Emission Allowances

	EKII-1	Reduction of greenhouse gas emissions in protected architectural monuments of national importance	
	EKII-2	Reducing greenhouse gas emissions - in low energy buildings	
	EKII-3	Reducing greenhouse gas emissions with smart urban technologies	
	EKII-4	Reducing greenhouse gas emissions by developing the construction of self-sufficient energy buildings	
	EKII-5	Reducing greenhouse gas emissions in the transport sector - support for the purchase of zero-emission and low-emission vehicles	
	EKII-6	Reducing greenhouse gas emissions from households - support for the use of renewable energy sources. €30 million available for the duration of the project[56].	
	EKII-7	GHG emission reduction in municipal public territory lighting infrastructure	

The **Ministry of Finance** (MoF) is responsible for **Altum**,[57] the state development financial institution that provides financing through financial instruments (loans, guarantees, investments in venture capital funds, etc.) in areas that the state has identified as important and supportable, and in which sufficient funding from credit institutions is not available. MoF is the majority shareholder (with 40% of the shares), while MoE and MoA are also shareholders of ALTUM (with 30% each). Latvian and EU funding is used to implement the programs.

Figure 3-1 Main ministries responsible for energy and climate action and key financial instruments[58]



Following parliamentary elections in October of 2022, the new coalition government made a decision to bring energy and climate action under one institution. On January 1, 2023 a new **Ministry of Climate and Energy** (MoCE) was established, and it is now responsible for both the coordination of implementation of policies that aim to reduce GHG emissions and the development policies for the use of renewable energy, promotion and energy efficiency, as well as energy security and the internal

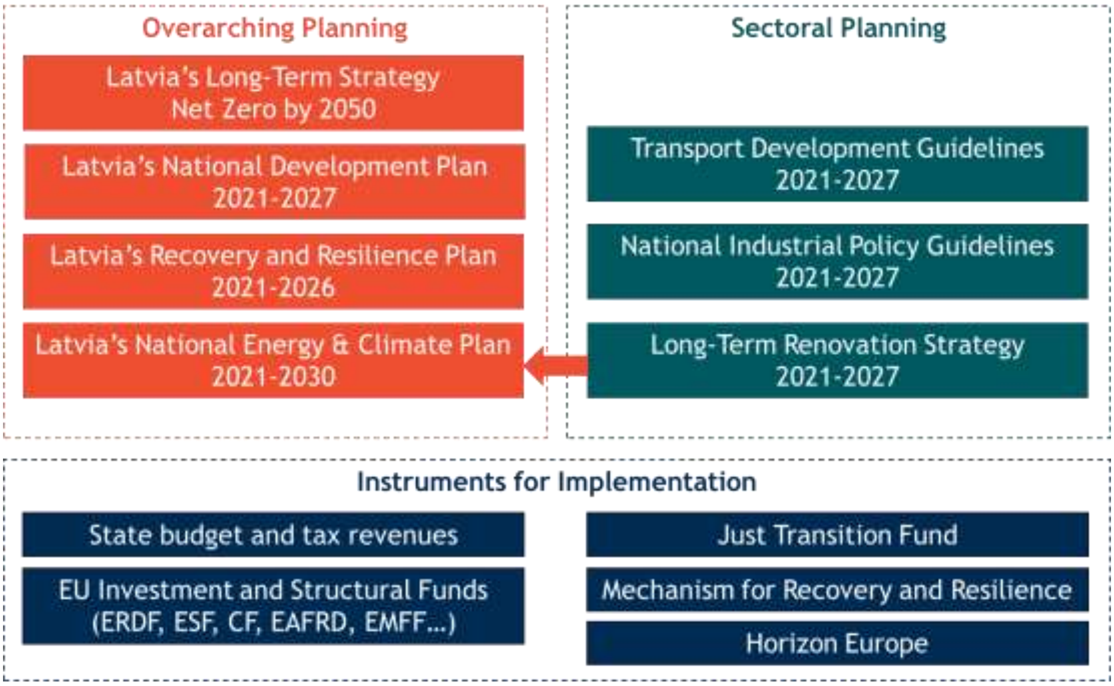
[56] Cabinet of Ministers (2022), Emisijas kvotu izsolīšanas instrumenta finansēto projektu atklāta konkursa "Siltumnīcefekta gāzu emisiju samazināšana mājsaimniecībās - atbalsts atjaunojamo energoresursu izmantošanai" nolikums
[57] Altum, Who we are
[58] Trinomics' own elaboration

energy market. The MoCE has also been tasked with the management of the Environmental Investment Fund, to ensure continuous implementation of EKII projects. Sectoral ministries are still key in implementation GHG emission reduction policies in their sectors.

3.2 Key strategies and policies

The image below provides an overview of the main strategies and policies at the national level supporting Latvia's decarbonisation.

Figure 3-2 Key decarbonisation strategies



Latvia's Long-Term Strategy[59], published in 2019, establishes the overarching decarbonisation targets, aiming for net zero by 2050. The LTS presents two main approaches to achieving climate neutrality: 1) technological solutions which focus on direct reductions of GHG emissions by replacing technologies and improving processes in all main sectors, including via innovation; and 2) change of lifestyle, which focuses on indirect reduction via voluntary changes and via incentives (e.g., fiscal measures).

Textbox 2 Latvia's decarbonisation targets

The LTS sets the decarbonisation targets[60] as follows:

- CO_2 emissions reductions of 65% by 2030 & 85% by 2040 excluding land use sector
- GHG emissions from land use 1 047 ktCO_2eq by 2030 and net zero by 2040
- Total GHG emissions reduction of 38% by 2030 (+/- 5%), -76% by 2040 (+/- 5%) and net zero by 2050

[59] Ministry for Environmental Protection and Regional Development (2019), Informative Report: Strategy of Latvia for the Achievement of Climate Neutrality by 2050
[60] Base year: 1990

Latvia's national development plan for 2021-2027[61], approved in 2020, is the country's main medium-term development planning document. One of the plan's priorities is to improve the quality of the living environment and boost regional development. Under this priority, the focus is on nature and the environment, the technological environment and services, and also balanced regional development. Several measures are identified, including the reduction of GHG emissions by means of climate change mitigation actions and technological breakthroughs, increased carbon sequestration, the introduction of changes to the public transport network with a special focus on the railway system, and the promotion of local mobility.[62]

Latvia's **National Energy and Climate Plan 2021-2030**[63], published in 2020, defines Latvia's targets and performance measures in several sectors or activities, including the reduction of GHG emissions and the increase in the share of RES, improving energy efficiency, as well as improving innovation, research and competitiveness. Its main objective is to ensure the transition to a competitive low carbon economy by developing a balanced and effective energy policy based on market principles, which promotes further development of the Latvian economy and welfare of the society.

3.3 The Baltic sea region energy system

In this report various ways of interaction and cooperation between different countries and groups of countries surrounding the Baltic Sea are mentioned. This section aims to collate this information and thereby provide an overview of relevant cross-border developments as well as national initiatives which may influence Latvia's system integration roadmap.

This is because the interdependence and compatibility between the countries has resulted in a general orientation towards regionalisation, as can be seen in the wide scope of existing regional projects and initiatives. With respect to their energy systems, they share a similar history, current situation and future plans, resulting in the same challenges and needs in the short, medium and long-term.[64] By making use of this, investment costs for a decarbonised and integrated energy system can be lowered and profitability and efficiency can be increased.

Examples for specific similarities are the pronounced usage today and in the future of bioenergy, plans for off-shore wind parks and pipeline infrastructure and the need to increase interconnections in the region and with Europe. Furthermore, the domestic markets in this region are small, and a unified energy market promises significant benefits for all market participants, such as higher profits, increased security of supply and more competition.

3.3.1 *Energy markets*

Cooperation within the Baltic sea region dates back to the 1990s. Since 2009, there is a joint **EU Strategy for the Baltic Sea Region (EUSBSR),** bringing together eight EU Member States: Denmark, Estonia, Finland, Latvia, Lithuania, Poland, Sweden and Germany.[65] Relevant objectives of the strategy include 'Connecting the region' and 'Increasing prosperity', while relevant sub-objectives are 'Reliable

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[61] Cross-Sectoral Coordination Center (2020), National Development Plan of Latvia for 2021-2027
[62] Cross-Sectoral Coordination Center (2020), National Development Plan of Latvia for 2021-2027
[63] Ministry of Economics (2021), National Energy and Climate Plan for 2021-2030
European Commission, National energy and climate plans (NECPs)
[64] Final-pdf-Baltic-Nordic-Roadmap.pdf (nordicenergy.org)
[65] EP (2022), Briefing: An EU Strategy for the Baltic Sea Region

energy markets', 'Improved global competitiveness of the Baltic Sea region' and 'Climate change adaptation, risk prevention and management'.[66] The Interreg Baltic Sea Programme supports the implementation of the Strategy. The current Programme (2021-2027) is structured along four priorities and nine objectives, one of which is 'Energy Transition'.[67] Similarly, the Interreg Baltic Sea Programme 2014-2020 focuses on:

- Improved framework conditions for spatial planning of renewable energy projects;
- Developed a new plan for a coordinated meshed offshore electricity grid in the Baltic Sea;
- Developed a tool for decision support to harvest and use forest residues for energy production.[68]

Within the overarching aim to integrate and decarbonise the regional energy system, the **Baltic Energy Market Interconnection Plan (BEMIP)** is a comprehensive initiative, addressing many energy-related areas. Specifically, these are, energy efficiency, renewable energy, off-shore energy production & transmission, electricity and gas markets and infrastructure. The aim is to modernise the energy system in the region and to increase connectivity among participating countries and with Europe.[69] Participating countries are Denmark, Germany, Estonia, Latvia, Lithuania, Poland, Finland and Sweden, with Norway as an observer. BEMIP enables the harnessing of the renewable energy potential of the Baltic Sea and through new infrastructure allows better trade and cooperation between countries in the region. This enhances security of supply and reduces dependence of the Baltic countries onto Russia. Exemplary projects in the BEMIP are the construction and renovation of power transmission lines, building new off-shore wind parks and deciding on common rules for the energy market. Next to the BEMIP multiple other initiatives are pursuing the same goals. For example, the **Regional Investment Plan for the Baltic Sea**, aims to achieve the EU climate targets, enhance the power to gas capacities and tackle the issue of fluctuating availability of RES. Involved countries are Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Norway, Poland and Sweden.[70]

3.3.2 *Research and innovation*

In order to achieve the strategic goals of decarbonisation and integration of the national and regional energy systems further energy research and innovation in a range of areas is required. The Baltic/Nordic states already cooperate in this respect. The Baltic-Nordic Roadmap for Co-operation on Clean Energy Technologies[71], for example, aims to identify the most relevant initiatives, in terms of synergies and development potential, and to provide a roadmap for timely establishment and/or reinforcement of Baltic-Nordic collaborations, in order to effectively contribute to the energy transition. Some of the central areas for collaboration of the Roadmap include:

- Development of an integrated power system as well as potential for system integration of CCS/CCU/BECCS
- The potential role of hydrogen, from a system perspective
- Advanced utilisation of biomass for energy and bio-products
- Electrification of transport, starting with strategies for developing charging infrastructure, then turning to heavy transport, maritime transport and battery recycling

[66] EP (2022), Briefing: An EU Strategy for the Baltic Sea Region
[67] Interreg Baltic Sea Region 2021 – 2027 development – Programme Document
[68] Interreg (2021), Factsheet: Sustainable Energy in the Baltic Sea Region
[69] bemip_action_plan_2021__0.pdf (europa.eu)
[70] Regional Investment Plan 2022, Baltic Sea (windows.net)
[71] Nordic Energy Research (2022), Baltic-Nordic Roadmap for Co-operation on Clean Energy Technologies

3.3.3 *Hydrogen*

While hydrogen projects are discussed elsewhere, it is valuable to go into the regional implications given that the Baltic Sea has a potential of 93GW of off-shore wind energy usable for the production of hydrogen.[72] The usage of this potential will become particularly important in the medium and long term (from 2030 onwards).[73] To optimally implement this, regional cooperation is necessary for example regarding the construction of infrastructure, the operations of wind parks or cross-border transport. In this vein, various EU-funded projects started to explore the possibilities for hydrogen (hyTrEc[74], NHCRE[75], H2Nodes[76]). Following this the Port of Tallinn has developed a hydrogen strategy.[77] Importantly, regional formats such as the Nordic-Baltic Cooperation or the Baltic Sea Region Hydrogen network are also in place already.[78] On top of those public ambitions, private initiatives exist such as the European Hydrogen Backbone.[79]

When comparing the approaches of the different Nordic and Baltic countries towards hydrogen it is apparent that all countries are aware of it but the political capital invested differs. An overview provided by FleishmanHillard categorises these countries, based on the existence and detail of national strategies and legal frameworks, as follows:[80]

- Sweden, Denmark & Norway → frontrunners
- Finland, Estonia & Lithuania → developers
- Latvia → laggard

This categorisation is based upon the existence of a national strategy and a legal framework dedicated to hydrogen. Sweden, Denmark and Norway have adopted such strategies and laws as well as clear headline targets. Finland, Estonia and Lithuania have not formalised their ambitions in this manner, however, various societal actors are active in exploring the opportunities of hydrogen. Relevant for Latvia is that Lithuania's goal is to become a producer and exporter of hydrogen. This can be used in the Latvian transport sector. For this it is necessary, as mentioned above, that Latvia increases its effort to create a framework in which hydrogen can be taken up. Crucial in this regard is the construction of a refuelling infrastructure.

3.3.4 *Biomass*

At European level, bioenergy is absolutely crucial, as roughly 60% of the renewable energy consumed in the EU belongs in this category. From the different sources of bioenergy, the most important one is solid biomass. This is even more the case in the Nordic and Baltic countries, who are among those MSs who produce and consume most bioenergy per capita.

In Estonia and Lithuania bioenergy represents roughly 20% of total energy supply while in Finland it is up to 35%. In all three countries bioenergy, more specifically solid biomass, is the dominant renewable

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[72] Significant developments on offshore wind in the Baltic Sea | WindEurope
[73] Final-pdf-Baltic-Nordic-Roadmap.pdf (nordicenergy.org)
[74] HyTrEc2, Interreg VB North Sea Region Programme
[75] Network for Hydrogen in Combination with Renewable Energysources - Interreg Baltic Sea Region (interreg-baltic.eu)
[76] H2NODES - H2Nodes
[77] Port of Tallinn (2021), Hydrogen Strategy
[78] Baltic Sea Region Hydrogen Network
[79] The European Hydrogen Backbone (EHB) initiative
[80] FH-National-Hydrogen-Strategies-Report-2022.pdf (fleishmanhillard.eu)

energy carrier and most commonly employed for heating. In Estonia the use of bioenergy is planned to remain stable while solar and wind are predicted to grow significantly. On the other hand, Finland and Lithuania plan to use bioenergy as important pillar or the attainment of their renewable energy targets. Finland also uses bioenergy to phase out fossil fuels in its industry.

Baltpool, a private company established in Lithuania[81], offers the possibility to trade biomass between the Baltic countries and envisions to expand its business to the entire region, that is including Poland, Denmark, Sweden and Finland. This trading platform could become important for the region and Latvia in various ways. Firstly, biomass is an energy carrier that is most commonly domestically produced and consumed. Via this platform international trade could be increased and given the large proportions of forest area in most Nordic/Baltic countries there is extensive potential. Secondly, in turn, this supports the countries in securing their energy needs.

An overall risk factor to the widespread usage of biomass for energy production are the voices urging to include it into the ETS, which could considerably raise prices. However, due to the fact that many MS rely on biomass to a large degree for their share of RE, it is unlikely that this will find a political majority. Nevertheless, it should be expected at some point. One the longer term, it may be possible to continue using biomass combined with CCS technology, which can achieve negative emissions.

3.3.5 *CCS/CCU*

In general, CCS/CCU are technologies which, although available, are not sufficiently developed nor economical today. However, it is expected that they will become more important in the late 2020s and earlier 30s, which means that should be included in the planning today.[82] The application of this technology will be focused on large industrial plants with significant emissions, which means that countries with a high concentration of emissions onto a few companies, and particularly individual facilities – such as the Baltics, have a strong use case for CCS/CCU.

The situation of CCS in Latvia is dealt with in more detail in section 3.5.8 of this report. Regarding Estonia, Lithuania and Finland, so far no industrial application of CCS/CCU exists, with the storage of CO_2 being a prohibited activity in Estonia and Lithuania. All three countries have potential for the use of CCS, but significant differences exist between the countries.

- **Estonia's** does not possess usable potential sites due to its geography.[83] Despite this, there is some degree of interest and research[84] in CCS/CCU, particularly because currently electricity is produced to 70% with shale oil and shale gas. Nevertheless, Industrial stakeholders, are hesitant due to the legal framework, lack of geographical potential and high costs.[85]
- In **Finland,** CCS/CCU has not gained much traction partly due to the relatively small share of coal and gas in its energy mix, which are also predicted to play a small role in the future.[86]. Nevertheless, individual actors from the private sector have been conducting research and are

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[81] International Biomass Exchange | BALTPOOL
[82] *Final-pdf-Baltic-Nordic-Roadmap.pdf (nordicenergy.org)
[83] *Final-pdf-Baltic-Nordic-Roadmap.pdf (nordicenergy.org)
[84] Estonia's Eighth National Communication Under the United Nations Framework Convention on Climate Change (unfccc.int)
[85] *Final-pdf-Baltic-Nordic-Roadmap.pdf (nordicenergy.org) & Assessment
[86] PowerPoint Presentation (energia.fi)

proposing different ways of application.[87] As mentioned above, the Finish ambitions to become carbon negative can be supported when combining CCS with biomass.

- In **Lithuania**, various important companies with high emissions are already conducting research regarding CCS, given the availability of potential storage sites.[88] The sites are also in proximity to existing pipelines as well as the Port of Klaipeda. Some industrial stakeholders view this port as potential centre for a Baltic region-wide infrastructure.[89] Should the legal framework be changed, companies and academia could become more active and begin investments and applied research. The concentration of emissions among emitters in Lithuania is less pronounced than in Estonia, but still high with five companies emitting 67% of national CO_2 emissions.[90]

3.3.6 *Overall assessment*

Overall the implications of this assessment for Latvia are as follows. A country not participating in this dense network of regional initiatives risks facing higher costs in the future and missing out on opportunities for business. Latvia should consider increasing its activity regarding hydrogen. This market is developing right now and missing out on the opportunity to shape its rules and infrastructure might backfire in the future. Latvia's status as road transport hub could be weakened, if its neighbours introduce hydrogen as fuel for heavy-duty vehicles and Latvia does not expand its fuelling infrastructure. Secondly, investments in R&I for CCS/CCU for bioenergy are an opportunity. Bioenergy is widespread in the region and many countries are planning to even expand its use, ensuring the existence of a customer base, but it is a high risk strategy, given the implications for deforestation and the scepticism among many stakeholders at EU level (which means EU support for bioenergy may decrease in the coming years).

3.4 The transport sector

The Transport Development Guidelines for 2021-2027[91] is a medium-term policy planning document for the development of the transport sector, aiming at meeting the sustainable needs of human mobility, while contributing to the economic growth of the country.

Both the NECP and the RRP include several actions aimed at the transport sector. Latvia's NECP includes a long list of measures attempting to reduce the growing carbon emissions from the transport sector, in particular from the private road vehicles by focusing on:

- **Reducing use of private vehicles** (by increasing public transport capacity, supporting infrastructure, cycling infrastructure);
- **Promoting alternative fuels/electrification** (research, infrastructure, fiscal advantages). Latvia's NECP considers hydrogen as a long-term alternative fuel to replace petroleum products for transport while the shift to electrical vehicles, biofuels and CNG/LNG are expected to happen in the medium term.

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[87] Summary of sector-specific low-carbon roadmaps (valtioneuvosto.fi), BECCU - From carbon dioxide to chemistry feedstocks & Vantaa Energy | Vantaan Energia
[88] Carbon capture in the Baltic States (civitta.fi) & Roadmap
[89] Assessment
[90] Assessment
[91] Cabinet of Ministers (2021), On the Transport Development Guidelines 2021-2027

Overall, while the NECP covers several key issues in Latvia, some commentators have rated this proposal as rather limited. For example, key limitations identified by Transport & Environment[92] include no reference to measures targeting vans, trucks and the aviation sector; support for natural gas vehicles; only generic reference to environmentally friendly buses and no additional measure was identified.

Some of the key policies launched in the last few years include:

- Fiscal policies aimed at promoting the purchase of electric vehicles. Electric vehicles (EVs) pay no registration tax (€40) and no annual road tax (between €84 and €120).
- a support mechanism for the purchase of EVs. It offers a grant of €4 500 for the purchase of new electric cars, and €2 250 for used electric cars and plug-in hybrids. The budget is around €10 million, available for the period from 2022 to 31 December 2023.

All policies identified in the RRP and NECP aimed at the transport sector are listed in Table 3-2.

Table 3-2 Implementation status of RRP and NECP policies

Measure	Source	Status
Greening the Riga Metropolitan Range Transport System (€295 million) to be funded by RRF	RRP[93]	To be implemented
Zero-emission vehicles for municipal services to be funded by RRF	RRP	Possible implementation within emission allowances auctioning instrument[94]
Charging points (2060 points by 2026) to be funded by RRF	RRP	Programme announced by JSC "Sadales Tīkli"
Supporting sustainable infrastructure development	NECP	Implemented
Promoting and supporting the purchase of low-emission vehicles and zero emission vehicles by individuals or merchants, and encouraging the movement of low-emission and zero emission vehicles in big cities	NECP	Implemented within emission allowances auctioning instrument with the possibility to prolong the application
Reviewing rates of excise duty and the conditions for applying it to fuels within tax policy guidelines framework	NECP	To be implemented[95]
Supporting research into alternative fuels (advanced biofuels, hydrogen, electricity, etc. non-emission fuels), production and infrastructure technologies and the development of innovative solutions for their integration into the energy system, as well as the development of mobility, transport systems and logistical solutions to improve energy efficiency and environmental sustainability	NECP	Implemented
Reviewing the tax conditions applicable to vehicles within the framework of the tax guidelines	NECP	To be implemented[96]

[92] Transport & Environment (2019), Draft National Energy and Climate Plans transport ranking
[93] Council of the European Union (2021), Annex to the COUNCIL IMPLEMENTING DECISION on the approval of the assessment of the recovery and resilience plan for Latvia
[94] The investment proposal is in preparation. Will be submitted to ECB in 2023
[95] The tax policy guidelines are still to be reviewed within new government framework. The tax rates will be reviewed within new Energy taxation directive to be in force in 2023
[96] The tax policy guidelines are still to be reviewed within new government framework. The tax rates will be reviewed within new Energy taxation directive to be in force in 2023

Measure	Source	Status
Improving public transport capacity in large cities, developing Park & Ride infrastructure construction, and promoting the use of rail transport as a modern and environmentally friendly public transport system	NECP, NDP2027 & RRP	To be implemented[97]
The development of velocities and velo infrastructure by developing and improving the availability of bike rental places, building additional and restoring waterways	NECP & RRP	Not implemented
Encouraging the creation of multimodal points	NECP, NDP2027 & RRP	Not implemented
Development of electronic systems and tools, including the establishment of a single platform for the transition to a zero emission or low-emission environmentally friendly transport system (e.g., through alternative fuels, renewable fuels etc.)	NECP	Not implemented
Increasing the number of low-emission and zero emission vehicles through public procurement services and deliveries	NECP	Implemented[98]
Imposing an obligation on fuel suppliers to sell the RES, combined with an obligation to reduce life cycle GHG emissions per unit of energy supplied	NECP	To be implemented[99]

Table 3-3 Future subsidy policies (2021-2027)

Supported activities	Start implementation	Subsidy (€m)	Coordinator institution
Support for private electric vehicles	2022	10.0	VIF
Support for electric buses	2025	10.0	MoEPRD
Support for non-emission vehicles (public transport)	2027	24.39	MoEPRD
Support for EV charging infrastructure for light duty vehicles	2025	35.0	Ministry of Economics
Support for electric trains	2026	74.0	Ministry of Transport

3.5 The energy sector

Latvia's NECP lists planned policies for the energy sector under three main headlines: commercial scale generation, measures to promote self-consumption and energy security. Some of the listed actions include substantial funding, such as almost €300 million for the support of innovative energy generation solutions, €530 million for strengthening energy security and €300 million to support the upgrade of the electricity and gas network.

[97] NDP2027 and RRP (PAM1) envisage development of PT (including EV buses, trams) and P&R, as well as development of passenger railway including battery-EMU train
[98] New requirements were introduced in public procurement law in accordance to clean vehicles directive. New law is already taken into account in new public procurement procedures
[99] Draft law is submitted to Cabinet of Ministers with possible approval by the Parliament by the middle of 2023

Table 3-4 Implementation status of RRP and NECP policies

Measure	Source	Status
Generation		
Development of offshore wind parks, in cooperation with Estonia and Lithuania	NECP	Ongoing with EE, finalised not earlier than 2030 No plans with LT
Actions to simplify the planning process for renewables, including review of spatial planning and EIA requirements (cost approx. €0.1 million)	NECP	Ongoing
Simplification of conditions for building onshore wind parks	NECP	Implemented
Promoting the use of solar energy in electricity generation for commercial operators, for up to €15 million	NECP	Ongoing
Support the development of innovative and energy-efficient solutions to increase the share of RES in the energy system (electricity, heating, cooling). The programme should be funded via EU structural funds and provide up to €292 million	NECP	Ongoing
Promote the marketing of RES electricity (information campaigns and creation of a framework for PPAs, certificates and other renewable generation guarantees)	NECP	Ongoing
Carrying out the necessary assessments for the further development of RES electricity, including the necessity for providing support to new technologies (the measure only covers the assessment part)	NECP	No information
Self-consumption		
legal framework for promoting self-generation and self-consumption	NECP	Ongoing
promote the use of the net electricity system (net billing/net metering)	NECP	Ongoing - soon to be implemented
energy communities and AE communities	NECP	Ongoing
RES technologies in agricultural holdings	NECP	Ongoing
Promoting the use of RES technologies in the public sector	NECP	Ongoing
Promote the efficiency of electricity distribution and transmission tariff methodologies	NECP	No information
Energy security		
Various actions to improve energy security, for a total investment of €530 million. Actions include supporting alternative generation, interconnections, markets for demand response and so on	NECP	Ongoing
modernise infrastructure, including upgrading of connections, smart metering, completion of the Pļaviņu HES project (hydroelectric plant) for a total investment of €300 million	NECP	Ongoing
Framework for partial support for energy supply costs for protected users	NECP	Ongoing
RRP		
Modernisation of electricity transmission and distribution networks (€80 million investments)[100] [101]	RRP	Ongoing

[100] Council of the European Union (2021), Annex to the COUNCIL IMPLEMENTING DECISION on the approval of the assessment of the recovery and resilience plan for Latvia
[101] CINEA (2020), CEF Energy: Reinforcing the internal grid infrastructure of Latvia

Other major ongoing developments include:

- Integration of the electricity networks of the Baltic States and their synchronisation with European networks. Full synchronisation with the rest of the EU is expected to happen in 2025, while integration of the Baltic market is already ongoing, for example via the single Baltic balancing market.
- De-synchronisation from BRELL (Belarus, Russia, Estonia, Latvia, Lithuania) is planned for 2025, but in October, 2022 the Latvian government decided to stop importing electricity from Russia and Belarus.
- Development or renovation of several gas and electricity interconnectors with Latvia, Lithuania and Sweden.

In Latvia there is one gas DSO, 1 gas TSO, 1 electricity TSO and 11 electricity DSO. The gas assets are largely owned by the private sector, while the energy assets are owned by the State. They are remunerated according to a RAB model by the Public Utilities Commission, the independent regulator.[102]

3.5.1 *Feed-in tariffs*

Latvia's commercial RES support scheme has been suspended for new applications since 2012, but some wind, bioenergy and hydro generators are receiving subsidies because of contracts signed under earlier schemes. Currently there are no plans for a new support scheme targeted at commercial generators (although some actions in the NECP hint at the fact that new schemes are being considered), while incentives for renewable generation aimed mostly at self-consumption are available under EKII. Nevertheless, there is ongoing work to reduce entry barriers and obstacles for RES generators to compete in open market.[103]

According to a CEER report,[104] in 2018 13.8% of gross electricity generated in Latvia was receiving support (compared with an EU average of 19.2%), amounting to just under 1TWh. Total expenditure for renewable electricity support in 2018 amounted to €95 million, equivalent to an average support of €14.19 per MWh of electricity generated (compared to an EU average of €19.12 per MWh). The weighted average support level in Latvia in 2019 by technology amounted to:

Table 3-4 Support level by technology in Latvia in 2019[105]

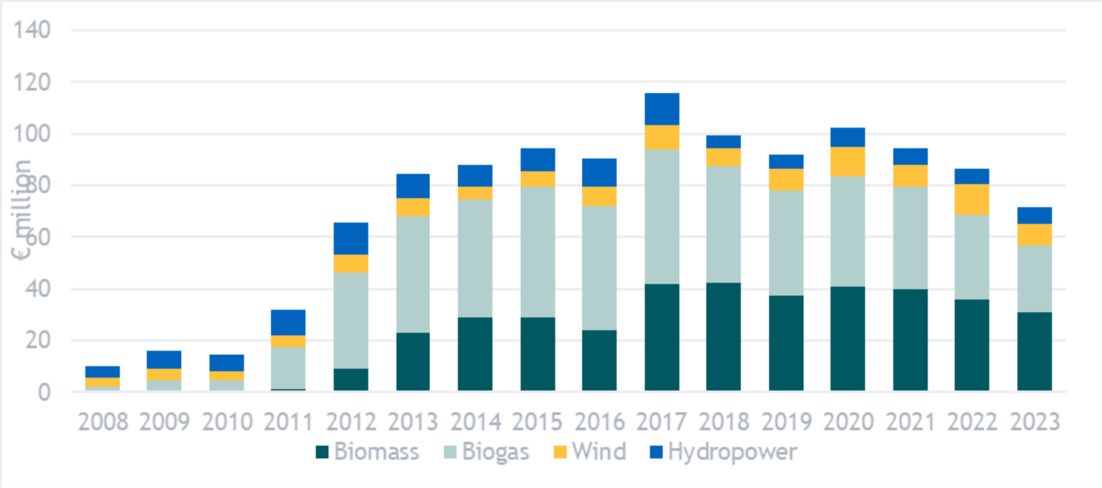
Technology	Average support	Amount of energy supported (GWh)
Bioenergy	€112.55/MWh	687
Hydropower	€95.15/MWh	59
Onshore wind	€59.41/MWh	137
Total	€103.14/MWh	883

A key issue identified by stakeholders is that in Latvia renewable subsidies are skewed towards bioenergy, which comes predominantly from forest fuelwood. In 2020, 42% of feed-in tariffs were

[102] CEER (2020), Report on Regulatory Frameworks for European Energy Networks 2019
[103] CEER (2021), Status Review of Renewable Support Schemes in Europe for 2019 and 2019
[104] CEER (2021), Status Review of Renewable Support Schemes in Europe for 2019 and 2019
[105] CEER (2021), Status Review of Renewable Support Schemes in Europe for 2019 and 2019

awarded to biomass installations and 42% were awarded to biogas (€83.5 million in total). Biomass installations also received €5 million in capacity payments. Figure shows the amount of subsidies received by year by technology via feed-in tariffs (and forecast up to 2023 based on current contracts). Latvia awards also a subsidy to high efficiency CHP powered by Natural gas (not included in the figure).

Figure 3-3 Feed-in tariffs to renewable and efficient cogeneration technologies[106]



3.5.2 *Net metering*

Net-metering is available since 2017 (for systems up to 10 kWp) via Latvenergo (a state-owned generator and supplier), also in conjunction with an interest-free purchase finance scheme. The scheme allows users to net-off both energy use and network charges (these are calculated on net energy used, rather than total energy imported). New regulations for the net metering system were adopted in 2020 that made microgeneration more economically convenient for households. Extension of net metering to legal entities (previously only households were allowed) and remote production sites is expected in 2022, with the adoption of amendments in the Electricity Market Law.[107]

3.5.3 *Electricity infrastructure*

Key aspects and recent developments of Latvia's electricity infrastructure are:

- The third 330 kV Estonia-Latvia electric power transmission line from Harku, Estonia, to Riga, Latvia is currently being developed. Financed in part by the EU with €112 million, equivalent to 65% of the project's planned €172 million total cost. This adds about 660 MW of transmission capacity and became operational in 2021.[108]
- Two further key projects are to be implemented in the coming years:
    - Electricity transmission network connection "Riga CHPP-2 – Riga HPP";
    - Reconstruction of existing Estonia – Latvia 330 kV interconnections
- In total, in 2018 Latvia had an incoming interconnection capacity of 1 750 MW and an outgoing capacity of 1550 MW. Of these, 900 MW and 1 300 MW where with EU Member States, respectively.

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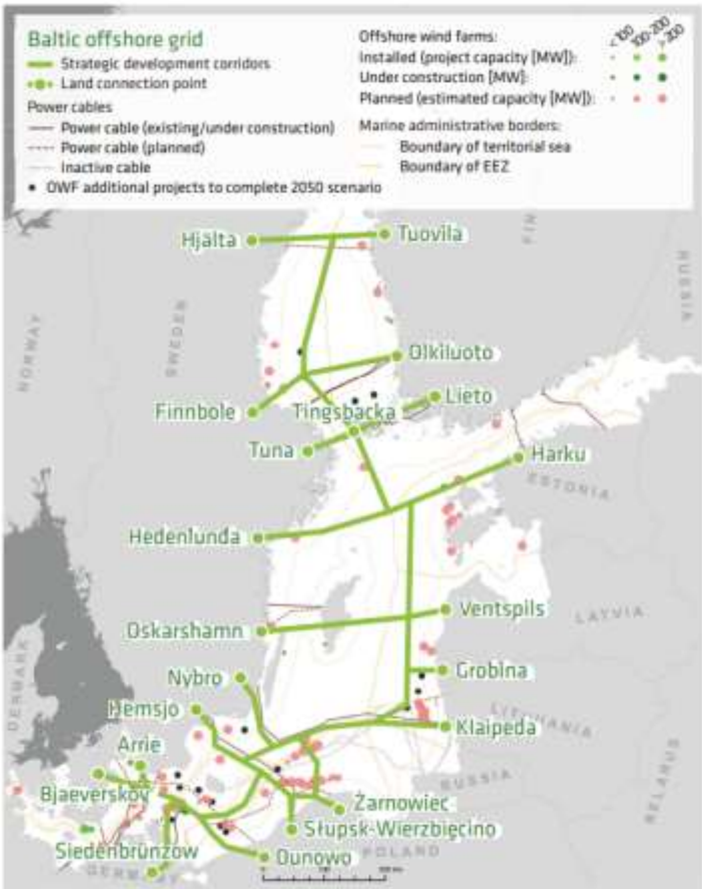
[106] Data from: Enerdata (2021), Study on energy subsidies and other government interventions in the European Union published by European Commission (DG ENER). Data from 2021 onwards is forecast
[107] Zaļā brīvība (2021), What 2021 brought for renewables in Latvia
[108] Estonian Public Broadcasting (2021), New €170-million electricity connection links Estonia and Latvia

- Across its 8 interconnectors, Latvia has an export capacity of 411 MW to Lithuania and an import capacity of 1188 MW[109] from Estonia and 188 MW to Russia. In 2022 the Baltic states have agreed not to purchase electricity from Russia.[110]
- Latvia is part of the Baltic balancing system, together with Estonia and Lithuania.
- In 2025 Latvia and the other Baltic states will synchronise with the continental European network.
- All the generated electricity, regardless of the method of its acquisition, is provided with equal opportunities to access the grid (no preferential treatment for renewables).
- Sadales tīkls is the gas and electricity TSO and DSO.
- Elering launched an initiative to develop an offshore network connected to Latvia (Elwind), so that a 1 GW offshore wind farm can be deployed by private investors in the pre-developed marina areas. There are plans to further expand the offshore network to open up new areas favourable to other cooperation programmes.[111] Several other Nordic countries are involved in the initiative.[112]

Figure 3-4 The Baltic Offshore Grid concept 2050[113]



3.5.4 *Gas infrastructure*

[109] Including the new 600 MW interconnector
[110] AST (2022), The situation in the energy system
[111] Elering (2021), Elering will start surveying the potential routes for connecting the Estonian-Latvian offshore network to the onshore power grid
[112] EnergiNet (2020), TSOs agreed to strengthen cooperation for the future of offshore grid in the Baltic Sea
[113] Elering (2021), Security of supply: Report 2020 extract

Key aspects and recent developments of Latvia's gas infrastructure are:

- The natural gas transmission system of Latvia is connected to the natural gas transmission systems of three neighbouring countries: Estonia, Russia and Lithuania.
- Inčukalns Underground Gas Storage (UGS) represents the largest available gas storage in the Baltic Sea region. Inčukalns UGS is natural, aquifer type storage with compressor injection but natural withdrawal. An EU-funded project is currently upgrading the facility.[114] The UGS allows for smoothing the seasonal mismatches between gas supply and demand.[115]
- Latvia has a transmission connection to Lithuania and has reached a long-term term agreement on the use of the Klaipeda Liquefied Natural Gas (LNG) Terminal in Lithuania. Additionally, Latvia also signed up for gas supplied from the first ship that was scheduled to arrive in the LNG storage and regasification ship at the terminal in Finland's Inga (previously – Paldiski planned floating station in Estonia).[116]
- In the period from 2020 to 2029, the following projects are to be implemented for the development of the Latvian and Baltic natural gas network:
    - The construction of the Estonia – Latvia interconnection (Balticconector) is completed, and the link started operations on 1 January 2020;
    - The Improvement of the Latvia – Estonia interconnection (Karksi) was completed in 2020;
    - Improvement of operations of the Inčukalns UGS facility (the project will be completed by 2025);
    - Improvement of the Latvia – Lithuania interconnection (the project will be completed by 2023);
    - Construction of the Poland – Lithuania interconnection (GIPL) (operational on 1 May 2022 connecting the Baltic market with Poland).[117]
- In 2022, the Latvian cabinet decided to develop an LNG terminal in the country. In February of 2023 the government rejected the proposal for the development of "Skulte LNG Terminal". The ministry of Climate and Energy continues to explore options for the development of the terminal, including potentially having the State build it.[118]

3.5.5 *Wind power*

The large potential capacity for offshore wind development in the Baltic sea could generate sufficient excess MWh to allow the production of significant amount of hydrogen. The Baltic Environmental Forum Latvia carried out an assessment of the ideal location for offshore wind farms.[119] The proposed areas are located 20 km from the cost and provides sufficient area for the deployment of 2.9 GW of offshore wind capacity.

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[114] Conexus (2018), Enhancement of Inčukalns UGS
[115] European Commission (2022), SWD(2022) 619: 2022 Country Report - Latvia accompanying the document Recommendation for a COUNCIL RECOMMENDATION on the 2022 National Reform Programme of Latvia and delivering a Council opinion on the 2022 Stability Programme of Latvia
[116] Baltic News Network (2022), Minister: LNG tanker ship's station in Finland and not Estonia will not affect Latvia's situation
[117] European Commission (2022), SWD(2022) 619, 2022 Country Report - Latvia accompanying the document Recommendation for a COUNCIL RECOMMENDATION on the 2022 National Reform Programme of Latvia and delivering a Council opinion on the 2022 Stability Programme of Latvia
[118] Latvijas Sabiedriskie Mediji (2023), Valdība noraida Skultes gāzes termināļa attīstītāja piedāvātos sadarbības nosacījumus
[119] Land Sea Act, Trade-offs and balanced use of land-sea resources (Latvian Case)

Concerning onshore wind, the government has recently decided to get directly involved in the development of wind farms, via a joint venture (Latvijas vēja parki SIA) between the fully state-owned companies Latvenergo (energy generator and supplier) and Latvijas Valsts meži (forest management company).[120,121] The joint venture aims to develop at least 800 MW (providing around 2.7 TWh/year) on forest land owned or managed by Latvijas valsts meži AS, for an expected total investment of €940 million. Revenues from the sale of electricity will go towards the national general budget, but will also be shared with municipalities located near the installation. Studies to identify the right sites are currently being carried out; these will be followed by an accelerated application process, while the procurement of the turbines is expected to start in 2024[122].

No direct support from the general budget is expected for the project – these will be financed entirely by the two companies involved.

3.5.6 *Bioenergy, biogas, biomethane and biofuels*

Latvia's 2020 energy balances show that over 90% (2 450 ktoe) of energy production was bioenergy in various forms, largely made of *Primary solid biofuels* (2 285 ktoe). Over half of all bioenergy produced (1 378 ktoe) is then exported. Biogases amounted to 80 ktoe, with none blended in natural gas, while 49 ktoe of biofuels was blended in liquid biofuels. Latvia used 901 ktoe of natural gas in 2020, 62% of which went to electricity and heat generation. 323 ktoe went to final consumption, with the largest users being the commercial and residential sector (34% of natural gas for final consumption each) and the industrial sector (30%). Natural gas use in the transport sector was insignificant (below 1%).[123]

A report developed within the project Baltic Biogas Circles[124], presents a comprehensive picture of the biogas situation in Latvia:

- Public support scheme has been very effective in driving up the number of biogas plants (there were 49 in 2021, up from 7 in 2010), mostly CHP.
- Of the 49 plants in operation, one plant uses sewage sludge while two plants use food production wastewater. Six plants are operating in municipal landfills.
- The main raw material for biogas production is agricultural and food waste and energy crops like maize. Of agricultural feedstock, manure from cattle, pigs and poultry is used, as well as maize and grass silage and remains in grain driers dropout. A variety of food production waste, vegetable waste, greenhouse waste, non-standard potatoes, damaged food, slaughterhouse waste and residues of milk processing also is utilised.

The report raises a major concern with the current situation, due to the fact that support for biogas plants has been significantly reduced, and soon even the plants covered by the current support scheme (FiT) will be left without support and risk closing. The decline is already happening, given that at least 10 plants have closed since 2015, and more are expected to close soon when they reach the 10-year mark under the support scheme.

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[120] Latvenergo (2022), National joint venture Latvijas vēja parki SIA - for Latvia's energy independence, security and stability
[121] Balticwind.eu (2022), Latvia will increase energy independence, less bureaucracy for wind projects is predicted
[122] TV3 (2022), „Latvian wind parks“ could start producing electricity in 2026
[123] Energy balance
[124] Biogas-in-the-Baltic-Sea-Region-Current-state-of-affairs-2021-1.pdf (biofuelregion.se)

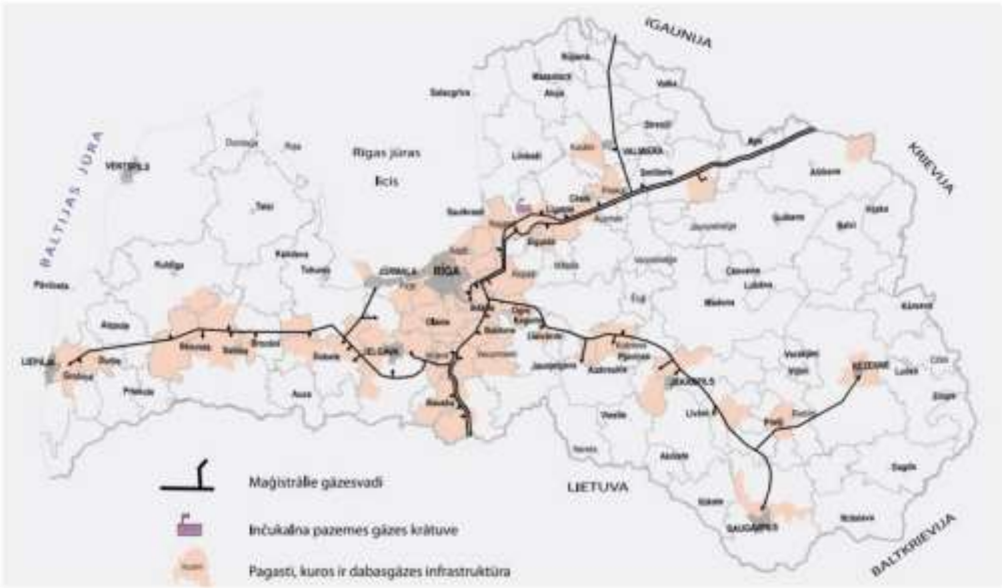
According to a recent report published by the European biogas association[125], Europe has the potential to produce up to 41 bcm of biomethane in 2030 and 151 bcm in 2050. While the report does not provide data specific for Latvia, it is noticeable that the report uses a sustainable removal rates of only 11% for Latvia, while all other countries have rates above 30% and many even above 40%. The sustainable removal rate is derived from the study: *Integrated and spatially explicit assessment of sustainable crop residues potential in Europe*[126], which defines sustainable potential as the minimum between technically feasible and environmentally sound crop residues withdrawal rate, with the value being driven down by the environmental criteria in Latvia. Essentially, only a fraction of what can be technically collected should be actually collected to be considered sustainable. The report however did not consider other sources of biogas, such as manure and waste.

Bioenergy in transport

Besides heat and electricity, bioenergy can play an important role in transport, both as a liquid (blend) and as a gas (biomethane in CNG vehicles). Latvia has one of the lowest shares of energy from renewable sources in transport with a share of 6.7% in 2021 (up from 4% in the previous years), compared with 10% across the EU and 12.2% in Estonia. Latvia's 2030 target requires reaching a share of RES in transport of 14%, and at least 3.5% share of advanced biofuels in final energy use. Biomethane can indeed play an important role in transport. A recent report from RTU[127] analyses the opportunities and solutions to exploit biogas in transport, including the technical and economical aspects of the production of biomethane. As part of the analysis, RTU showed that, given the current advantages awarded to CHP plants via FiTs, it is more convenient for a biomass plant to produce biogas for CHP and sell heat and electricity rather than producing biomethane. To incentivise the production of biomethane, a subsidy of 25% on top of the final cost of one unit of biomethane is needed. In order to exploit biomethane for road transport (as CNG), the study suggest also that some form of support would be needed for the purchasing of vehicles, while refuelling infrastructure should be deployed along the current gas mains to reduce cost (see Figure 3-5).

[125] Guidehouse_GfC_report_design (europeanbiogas.eu)
[126] N. Scarlat et al. (2019), Integrated and spatially explicit assessment of sustainable crop residues potential in Europe, https://www.sciencedirect.com/science/article/abs/pii/S0961953419300303
[127] D-3.2.-Assessing-the-potential-of-biogas-for-transport_third-version.pdf (rtu.lv)

Figure 3-5 Natural Gas infrastructure Latvia[128]



Looking at the supply chain, the RTU study concludes that, considering economic feasibility, substrate efficiency and environmental friendliness, pig manure is the most suitable raw material, closely followed by poultry manure. Significantly less suitable are wood and organic waste. This result aligns with the study from Scarlat et al. (see above), which sees little potential from crops and residue-based bioenergy.

The RTU study also analysed different policy options to incentivise the production and use of biomethane. The majority of options considered fail to bring the cost of production sufficiently down, with biomethane costing about 50% more than natural gas. However, the study was carried out when the cost of natural gas was substantially lower than it is now. The study then analysed five policy scenarios which includes different instruments applied at different strengths. The results of the scenarios analysed are those presented in the table below

Table 3-5 result of the 5 policy scenarios analysed

Scenario	Description	Production of biomethane (GWh)	Financial support needed (€ million)	Financial support per unit (€/MWh)
1	Subsidy to raw material vary between €5.5 m/year and €7.8 m/year, total cost reach €10.4 m in 2030	66.6	76.3	1 145
2	Subsidies to raw material. Total support of €71.4 m between 2020 and 2030.	333.3	84.3	253
3	As scenario 2 + FiT premium of €15/MWh. Capex subsidies of €17.3 m between 2020 and 2030.	505.7	91.8	182
4	Abolition of the electricity FiT in 2021 and mandatory procurement (saving of €58 m). FiT costs reach €3.5 m/year in 2030, increase excise duty on NG	1 245	-39.5	-32
5	FiT at 30/MWh, total cost of €72.6 m between 2020 and 2030	2 421	14.5	6

[128] AS Latvijas Gaze. Figures and facts, Annual Report 2014

The best scenario is the fourth one, where the removal of the support for biogas electricity significantly reduces government costs and makes the production of biomethane more advantageous than production and use of biogas.

The study concludes that:

- Latvia produces sufficient raw material, in particular manure from animal farms, to significantly increase the production of biomethane;
- Waste landfill gas and waste water treatment plants offers also untapped potential for biogas production. The investment costs to setup a biogas production and biomethane treatment plants can be easily recovered
- The location of new biogas plants is important into their profitability, as it can reduce cost for sourcing raw material and the cost of sale (injection in the network or direct sale). New plants should be located near the existing gas transmission network but also close to major farming areas and landfill/sewage treatment sites.
- Current support for generating electricity from biogas and natural gas negatively affect the economic case for biomethane. These support scheme should be reviewed, or increased support should be provided specifically for biomethane.
- The best opportunities for the use of biomethane in transport lie with urban fleet (buses, waste lorries).
- Biomethane cost remains above the historic price of natural gas[129]. Policy instruments to make biomethane competitive in the long term include FiTs (€30/MWh), termination of the mandatory procurement of electricity and an increase in the excise duty for natural gas.
- There is good potential to use biomethane as CNG, but public support should go to the purchase of such vehicles and to the setup of a refuelling network.
- A national action plan for the development of biomethane should be published and include:
  - Protection of locally produced biogas against imports;
  - Review to the taxation and incentives for the production of biogas and biomethane;
  - Development of a public procurement system for biomethane
  - Deployment of infrastructure.

Since the study was published, some central and local administrations have indeed opted for biomethane. As part of the measures presented under the NRRP, Latvia is investing in biomethane facilities for grid injection (including upgrade to biogas plants) and in purchasing biomethane vehicles (for a cost of over €40 million).[130]

Waste as a source

Annex IV includes an overview of waste policies and potential in Latvia. The overview suggests that in Latvia there is substantial potential to better exploit waste as a resource, in particularly the share of organic waste (34%) of urban waste collection, that could contribute as a feedstock to the production of biogas and biomethane. While in the short term the best option lies with capturing fugitive methane emissions from landfill, in the long term a careful organic waste collection system could provide biogas plants located near urban areas with regular inputs of raw material. No study that estimates this

[129] but in line (or below) the current gas prices seen in Europe
[130] Latvia prepares for biomethane production / Article (lsm.lv)

potential cold be identified, but – considering the share of bioenergy from waste in other EU countries – this potential is likely to be very limited.

3.5.7 *Hydrogen*

The EU Commission and many Member States have been considering the deployment of Hydrogen production and use infrastructure for some time, and the current energy crisis has provided further inputs to these efforts. In the REPowerEU Communication, the EC has set a goal to produce 10Mt/year of hydrogen in the EU and to import another 10Mt/year by 2035.[131] In the energy transition hydrogen is predicted to play a major role in substituting fossil fuels in some sectors which are difficult to electrify. Introducing hydrogen into the society and economy and turning it from a niche product to a commonly used fuel requires adjustments on many levels. Certain aspects of those adjustments possess important cross-border elements, which have to be addressed in order to reap the full benefits of hydrogen. One such aspect is the continent-wide transportation of hydrogen through pipelines.

The EU has funded several initiative to explore hydrogen in networks in the Baltic area (hyTrEc[132], NHCRE[133], H2Nodes[134]). The Port of Tallin now plans to develop a green supply for the industrial parks of Muuga Harbour and Paldiski South Harbour based on hydrogen. This includes a hydrogen terminal, a storage facility of 25 000 cbm and a possible link to offshore wind farm to an electrolyser for the production on site.[135] The Port of Tallin has now extended cooperation to the Port of Gdynia in Poland.

The Latvian government has stated on multiple occasions that it is aware of the benefits hydrogen can bring and that it is willing to move towards its use in the long-term.[136] However, at the same time, no concrete initiative at government level is currently active, nor there are clear commitments to participate to EU initiatives. Furthermore, the Latvian NECP does not mention a general roadmap or specific hydrogen projects, especially not on a larger scale. However, there is a handful of small-scale hydrogen projects in Latvia. For example, Riga has trolleybuses equipped with a fuel cell which complements the electric engine of this model. Those busses are fuelled with hydrogen produced at the only hydrogen fuelling station in the Baltics.[137] The capital has also joined the European Clean Hydrogen Alliance, which is backed up by a €430 billion investment fund.

There are many factors making Latvia an attractive country for the production, use and transport of hydrogen, as well as, factors why hydrogen could benefit Latvia. Private entities have already established the Latvian Hydrogen Association.[138] Concerning international partners, Latvia has established formats available to it, such as the Nordic-Baltic Cooperation or the Baltic Sea Region

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[131] European Commission (DG ENER), Hydrogen
[132] European Commission (2018), HyTrEc: a unified hydrogen strategy for the North Baltic Sea Region
[133] Interreg – Baltic Sea Region (2017), NHCRE
[134] H2Nodes aims to support the growth of new hydrogen infrastructure in Arnhem, Riga and Pärnu, centred on the development of strong local activity by engaging key stakeholders, fostering a positive market-led route to clean urban transport and rising numbers of FCEVs along the TEN-T corridors. Source: https://www.h2nodes.eu/
[135] &Flux (2021), Hydrogen strategy – discovering the road towards a new green value proposition published by: Port of Tallinn
[136] Green Tech Cluster, Hydrogen in Latvia
European Commission (DG ENER), Hydrogen
Ministry for Environmental protection and Regional Development (2017), A strategy for low carbon development in Latvia by 2050
Trinomics (2020), Opportunities for Hydrogen Energy Technologies Considering the National Energy & Climate Plans
[137] Green Tech Cluster, Hydrogen in Latvia
[138] Latvian Hydrogen Association, Hydrogen

Hydrogen network.[139] In the latter, the aforementioned Latvian Hydrogen Association is already involved. Latvia also participates in the Baltic Sea Hydrogen Network project[140] (financed by the Swedish Institute), with aims to “build an extensive, multinational, multilevel and cross sectoral network/partnership regarding Hydrogen around the Baltic Sea”, and that is expected to mobilize early users and increase awareness of Hydrogen as an energy carrier in the Baltic Sea Region.

Regarding the production of hydrogen, Latvia is an excellent location. It possesses a greater potential for the production of RES than its consumption of electricity.[141] There is already important infrastructure in place, which can be integrated with the hydrogen economy, reducing the necessity for CAPEX and the associated risks. For example, the ports of Riga, Liepaja and Ventspils are attractive locations for the production, storage and demand for hydrogen.[142] Importantly, Latvia would most likely not have to bear the entirety of costs it faces through the hydrogen transition, while at the same time, potentially benefitting significantly. For example, the EC stated as goal the installation of electrolysers with a combined power of 40GW for the production of renewable hydrogen. [143] To support the nascent hydrogen sector the EC has various funding instruments available, such as REPowerEU, Horizon or RRF. Hence, Latvia would not have to finance the development of the hydrogen sector on its own but can rely on international support. Once developed hydrogen can benefit Latvia in different ways. For example, through export revenues or by using it to achieve environmental goals.

Regarding the use of hydrogen in Latvia, the main area for application would be the transport sector.[144] According to one study with two different scenarios, Latvia could use hydrogen to fuel between 4100-8200 passenger cars, 20-40 busses, 200-400 lorries, 40-80 heavy duty vehicles and 2-10 trains[145]. Hydrogen might also have a promising application in the building sector. In conjunction with what presented below concerning district heating, Latvia would benefit from diversifying the fuels for its cogeneration plants, in order to not be vulnerable towards legislation changing the status of biomass. This could be achieved with hydrogen and mitigate the risks described in that text. Based on the aforementioned scenarios, Latvia could operate 180-780 micro CHP plants and 4-38 large plants with hydrogen.[146]

An obstacle to the uptake of hydrogen in Latvia is the lack of suitable storage sites and distribution network. It can be stored in salt caverns which to date, do not exist in Latvia. Furthermore, there are no underground salt layers that could provide suitable storage opportunities for hydrogen.[147] Regarding the usage of existing pipelines in Latvia for hydrogen, and therefore, not any longer for natural gas, should be done with some caution.

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[139] Trinomics (2020), Opportunities for Hydrogen Energy Technologies Considering the National Energy & Climate Plans
Interreg Baltic Sea Region, Network for Hydrogen in Combination with Renewable Energysources
[140] Swedish Institute BSRHN; Baltic Sea Region Hydrogen Network.
[141] Trinomics (2020), Opportunities for Hydrogen Energy Technologies Considering the National Energy & Climate Plans
[142] Green Tech Cluster, Hydrogen in Latvia
[143] Fraunhofer et al. (2021) Terms of Reference – Hydrogen Import and Storage
[144] Trinomics (2020), Opportunities for hydrogen Energy Technologies Considering the National Energy & Climate Plans Fact Sheet Latvia
[145] Trinomics (2020), Opportunities for hydrogen Energy Technologies Considering the National Energy & Climate Plans Fact Sheet Latvia
[146] Trinomics (2020), Opportunities for hydrogen Energy Technologies Considering the National Energy & Climate Plans Fact Sheet Latvia
[147] Trinomics (2020), Opportunities for hydrogen Energy Technologies Considering the National Energy & Climate Plans Fact Sheet Latvia

According to *Opportunities for Hydrogen Energy Technologies*[148], there is a great margin for building up dedicated renewable electricity plants for hydrogen production via electrolysis in Latvia, given its huge potential for renewable generation. However, there is no information on the feasibility of adapting the methane infrastructure network to hydrogen. While currently there are no investments, the scenario assessment performed for the FCH JU[149] forecasts between 46 and 210 GWh per year could be utilised, mostly in the transport sector. This would require between 17 MW and 76 MW of electrolysers and between 8 and 17 refuelling stations. Producing these quantities will require between 73 GWh and 333 GWh of renewable electricity generation. Given the high share of renewable energy (40% of gross energy consumption), and the availability of hydro storage, the production of green hydrogen can be achieved more easily than in other Member States. Cumulative investments in hydrogen technologies are estimated at €0.1 – €0.3 billion until 2030, while annual expenditure would amount to €10 - €40 million (including end user appliances as well as power and gas grids). Deployment of renewable hydrogen would lead to 0.1-0.3 TWh/a of avoided imports, and thus reduce import dependency by 0.2-0.5% (in volume terms) in 2030, depending on the scenario.

Executive VP Vestager has launched IPCEI Hy2Tech in the summer of 2022, a project which Latvia is not yet part of, contrary to its neighbour Estonia.[150] An example of a continent-wide private sector initiative is the European Hydrogen Backbone, launched by a group of 31 energy infrastructure operators.[151] Their plan is to create a Europe-wide network of pipelines, consisting of five arms running towards central Europe. The infrastructure should consist roughly to two thirds out of repurposed pipelines while the last third should be newly constructed. According to this consortium five pipelines can transport 10Mt or 330TWh, representing half of the Commission target regarding hydrogen use until 2035.[152] Specific to Latvia, this project envisions new pipelines connecting it with Estonia and Lithuania and using an already existing pipeline in central Latvia. In the bigger picture this pipeline should connect the area around the Gulf of Bothnia with the rest of Europe. Importantly, a second connection below the Baltic Sea is envisioned. While it is desirable to have residual capacities, a risk for Latvia is that as soon as one pipeline has been established the drive to construct the second decreases amongst the partner countries and companies, leaving Latvia without proper connection to the Backbone project. The consortium proposing the Backbone project stated that, because so much of the Baltic arm of the European Backbone project has to be newly built, it is crucial that the governments, societies and companies actively participate in the development of this project.[153]

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[148] Trinomics (2020), Opportunities for hydrogen Energy Technologies Considering the National Energy & Climate Plans Fact Sheet Latvia
[149] Trinomics (2020), Opportunities for hydrogen Energy Technologies Considering the National Energy & Climate Plans Fact Sheet Latvia
[150] European Commission (DG COMP) (2022), Remarks by Executive Vice-President Vestager (europa.eu)
[151] The European Hydrogen Backbone (EHB) initiative, The European Hydrogen Backbone (EHB) initiative
[152] European Commission (DG ENER), Hydrogen - The European Hydrogen Backbone (EHB) initiative (2022), European Hydrogen Backbone - A European hydrogen infrastructure vision covering 28 countries
[153] The European Hydrogen Backbone (EHB) initiative (2022), European Hydrogen Backbone - A European hydrogen infrastructure vision covering 28 countries

Figure 3-6 Hydrogen pipelines in the Baltics

Yellow: newly built pipeline
Black: repurposed pipeline
Blue: subsea pipeline
European Hydrogen Backbone Report

Outside the European Backbone, projects have been launched in Latvia's neighbourhood. A pipeline project has been launched to connect hydrogen hubs in Finland and Sweden via Raahe and Lulea "BotH2nia hydrogen industrial zone").[154] Furthermore, the Port of Tallinn is planning to use hydrogen as fuel for industrial parks.[155]

3.5.8 *Carbon Capture and Storage (CCS)*

Potential applications of CCS in Latvia

For CCS to be economically feasible it is necessary to have large emissions concentrated on one facility (where the capture technology can be installed) and ideally other large point source emissions, so that transport infrastructure to a CO_2 storage site can be shared. In Latvia two companies are particularly suited for that, Latvenergo and SCHWENK Latvija.[156] Regarding the former, the CHP plants CHPP-1 and CHPP-2 in the Riga region are potential use cases. Annual emissions in 2019 were, respectively, 320.822t/CO_2 and 897.677t/CO_2.[157] Regarding the latter, the cement plant in Brocēni should be considered. Its annual emissions in 2019 were 794.019t/CO_2.[158] Importantly, SCHWENK Latvija has already stated its interest in exploring the CCS technology, given its possession of a strongly emitting plant, the plant Brocēni should be explored as first application of CCS in Latvia.

[154] Energate messenger (2022), New plans for Swedish-Finnish hydrogen pipeline
Energy news (2022), Raahe to produce hydrogen for Baltic Sea hydrogen pipeline
[155] Port of Tallinn ((2021), Hydrogen strategy - discovering the road towards a new green value proposition
[156] Assessment of current state, past experiences and potential for CCS deployment in the CEE region - Latvia
[157] Assessment of current state, past experiences and potential for CCS deployment in the CEE region - Latvia
[158] Assessment of current state, past experiences and potential for CCS deployment in the CEE region - Latvia

On and off-shore CO_2 storage sites

Regarding on-shore storage, as can be seen on the map produced as part of a recent study, Latvia possess a number of potential storage sites for captured CO_2. These are located, particularly, in western Latvia. Moreover, many sites are also in proximity to the industrial facilities pointed out above. Further research into which of these locations is best suited for the storage of CO_2 is necessary. Much of the geological assessments has been conducted during the Soviet era. Depending on the model, the total on-shore storage capacity lies in between 790Mt and 404Mt. The largest facilities are Ziemeļblīdene, Blīdene and Dobele, in the optimistic scenario each is estimated to possess more than 100Mt capacity, in the conservative estimation all three are above 50Mt and Ziemeļblīdene above 70Mt. This means, in practice, the highest emitting plant mentioned above, CHPP-2, could store its emissions for 8 to 16 years in Ziemeļblīdene.

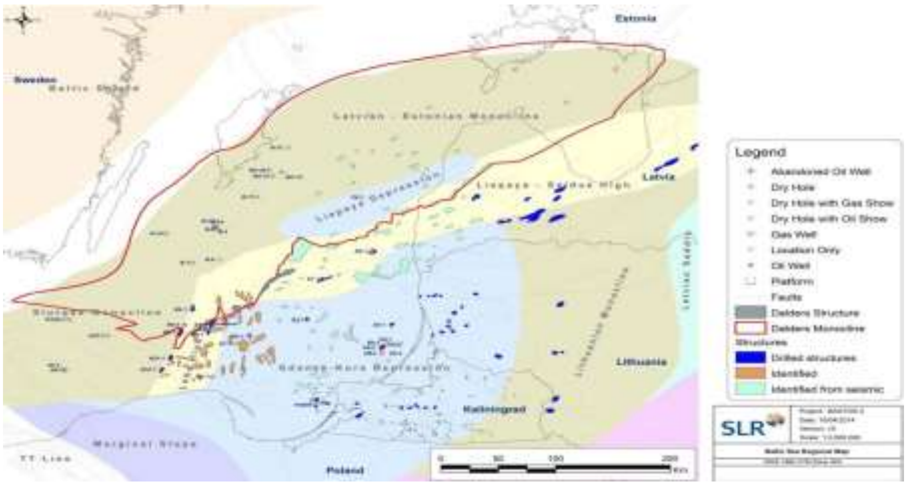
Table 3-6 Potential On-Shore Storage Sites for CCS[159]

Structure	Area, km^2	CO_2 capacity, Mt (optimistic scenario)	CO_2 capacity, Mt (conservative scenario)
Aizpute	51	31	14
Blīdene	43	112	58
Ziemeļblīdene	95	142	74
Degole	41	41	21
Dobele	67	105	56
Ēdole	19	16	7
Kalvene	19	27	14
Liepāja	40	31	6
Lūku-Dūku	50	75	40
Ziemeļkuldīga	18	21	13
Ziemeļlīgatne	30	41	23
Dienvidkandava	69	82	44
Snēpele	26	31	17
Usma	20	5	2
Vērgale	10	9	5
Viesātu	19	21	10
Total	**617**	**790**	**404**

The theoretical estimate for off-shore storage potential in Latvian waters is approximately equivalent to the on-shore potential. However, the potential of the Baltic Sea in general, is significantly higher.[160] The Dalders Monocline (the area in the red circle) has a theoretical potential of above 1900Mt. Off-shore storage brings two key advantages. Firstly, it is likely to be met with less opposition, as it is far away from settlements. Secondly, other countries in the region can also use those sites and, therefore, costs can be shared. The BASTOR project has already started to explore this potential.

[159] CCS4CEE (2021), Assessment of current state, past experiences and potential for CCS deployment in the CEE region - Latvia
[160] ACCS4CEE (2021), Assessment of current state, past experiences and potential for CCS deployment in the CEE region - Latvia

Figure 3-7 Potential Off-Shore Storage Areas[161]



Opportunities for cross-border operations

The potential for cross-border operations with Estonia and Lithuania exists in principle. Both Latvia and Lithuania possess potential storage sites of significant volume. In Estonia the geological conditions are assessed as unsuitable. However, in order to use the potential the regulatory framework needs to be adjusted, as today all three Baltic states prohibit the underground storage of CO_2 for industrial applications.[162] Therefore, Latvia, should it be the first mover it could take the lead on the development CCS/CCU and offer storage services to its neighbours. This opportunity is amplified, because it possess the largest storage potential.[163]

Cooperation with the wider Baltic/Nordic region is feasible and attractive due to the geological conditions, potential demand and political conditions. A study conducted by O'Neill et al. (2014) pointed out an overall large storage potential in different areas of the Baltic Sea.[164] Demand for storage could be between 50 to 100 Mt/CO_2 per year.[165] Multiple countries have stated their interest and conducted research.[166] For example, Sweden and Finland were involved in the *BASTOR* project and are currently receiving funding form the EU to advance CCS projects. In Sweden, *the Beccs Stockholm project* is funded, a biomass plant equipped with CCS and in the SHARC for blue hydrogen and off-shore storage of capture carbon.[167] The Swedish project has a total cost of 2.7 billion euro. It received 180 million euro from the Innovation Fund, covering almost half of its CAPEX. For the Finnish project, total costs are not given, but support from the EU amounts to 88 million euro. Beyond Finland and Sweden also Denmark has stated its willingness to invest across multiple governmental programmes. Poland is now also entering the market, relying on EU funds.[168] Similarly to Sweden, CAPEX is almost entirely covered through the Innovation Fund.[169] Potential financial support from the EU is significant, the EU

[161] O'Neill et al. (2014), Geological Storage of CO2 in the Southern Baltic Sea
[162] CCS4CEE (2021), Assessment of current state, past experiences and potential for CCS deployment in the CEE region - Estonia & CCS4CEE (2021), Assessment of current state, past experiences and potential for CCS deployment in the CEE region - Lithuania
[163] ACCS4CEE (2021), Assessment of current state, past experiences and potential for CCS deployment in the CEE region - Latvia
[164] O'Neill et al. (2014), Geological Storage of CO2 in the Southern Baltic Sea
[165] BASTOR -Baltic Sea Storage of CO2 (Presentation regional workshop)
[166] Global CCS Institute (2022), Status Report 2022
[167] Innovation Fund (2022) Beccs Stockholm & Innovation Fund (2022) SHARC
[168] BASTOR -Baltic Sea Storage of CO2 (Presentation regional workshop) & Global CCS Institute (2022), Status Report 2022
[169] Innovation Fund (2022) Kujawy Cement Plant

Innovation Fund has a total volume of 1 billion euro.[170] Secondly, such projects can facilitate the construction of an integrated off-shore infrastructure for the transmission of gas between the countries in the region. Lastly, as mentioned above, Latvia could then share the costs with partner countries and would potentially still benefit from low transport costs, as many of the storage sites are close to its coast.

3.6 Buildings and industry

3.6.1 *Energy efficiency and on-site renewable generation*

Latvia's NECP and NRRP include several measures targeted at buildings, including residential, public, commercial and industrial sector. Measures target primarily energy performance, and usually also include RES generation, DH and waste heat, while measures aimed at industry also capture energy efficiency in industrial processes.

Table 3-6 Measures proposed in NECP and NRRP

Measure	Source	Status
Laying down conditions for the installation of RES technologies in the performance of energy performance measures for buildings[171]	NECP	Implemented
Providing investment links to energy efficiency measures for buildings[172]T	NECP	Ongoing
Promoting the use of RES and improving energy efficiency in district heating (DH), also customizing DH for cooling in buildings[173]	NECP	Ongoing
Promoting the use of RES and improving energy efficiency in industry and economic operators, also customizing DH for cooling in buildings[174]	NECP	Ongoing
Supporting the development of innovative technologies and services for improving energy efficiency in buildings, energy supply and production and for increasing the share of RES in energy consumption	NECP	Ongoing
Implementing Directive 2010/31/EU and Directive 2012/27ES as regards energy efficiency requirements and conditions	NECP	Ongoing
Improving the energy efficiency of multiapartment buildings and transition to renewable energy technologies (€40 million).[175]	RRP	Ongoing
Aiming to reduce energy building use by at least 30%. Total funding for energy efficiency in private and public buildings amounts to €248 million.[176]	RRP	Ongoing

Support for energy efficiency and renewable energy in buildings are key elements of Latvia's decarbonisation strategy. The tables below list different subsidies issued in the past and approved for the coming years. Some of the unwanted consequences of subsidies for energy efficiency is that they have supported the installation of gas-powered CHP in the past (see also FiTs).

[170] European Commission (2022), €3 billion call under the EU Innovation Fund
[171] Latvia-TIMES model
[172] The RTU/E3M report notes that for increasing EE in state public buildings investment support is provide for a wide range of beneficiaries, both providing state services and fulfilling state delegated tasks.
[173] Mentioned in RTU/E3M report
[174] Mentioned in RTU/E3M report
[175] Council of the European Union (2021), Annex to the COUNCIL IMPLEMENTING DECISION on the approval of the assessment of the recovery and resilience plan for Latvia
[176] Council of the European Union (2021), Annex to the COUNCIL IMPLEMENTING DECISION on the approval of the assessment of the recovery and resilience plan for Latvia

Table 3-7 Energy efficiency subsidy schemes (2017-2021)[177]

Sector	Supported activities	Amount of subsidy (2017-2021)	Responsible body
District heating	To increase the energy efficiency at the heat source	10 MEUR	CFLA
	To increase the energy efficiency in transmission	15 MEUR	CFLA
	To switch to RES	20 MEUR	CFLA
Residential	To increase the energy efficiency of buildings	156 MEUR	ALTUM
Industrial	To increase the energy efficiency and implement RES	11.67 MEUR	CFLA
Commercial/ Public	To increase the energy efficiency and implement RES	33.8 MEUR	CFLA

Table 3-8 Future subsidy policies (2021-2027)[178]

Sector (in model)	Supported activities	Start	Subsidy (€m)	Coordinator institution
Residential	To increase the energy efficiency of apartment buildings	2024	229.63	ALTUM
	To increase the energy efficiency of private buildings and RES	2022	5.64	ALTUM
Industrial	To increase the energy efficiency and implement RES	2024	166.38	ALTUM
Commercial /Public	To increase the energy efficiency and implement RES in governmental buildings	2024	176.21	CFLA
	To increase the energy efficiency and implement RES in municipality buildings	2024	29.304	MoEPRD

Some of the future measures have already started:

- Currently, ALTUM has subsidy programme for improving energy efficiency in private houses (pilot programme?).[179] The support includes guarantees, technical assistance and grants, only to be used for measures that will result in energy efficiency savings. The programme aims to support 250 homeowners, with up to €5 000 in grant and €1 000 in technical assistance
- ALTUM also provides a subsidy scheme for apartment buildings.[180] It offers an EU grant of 50% of the eligible cost and a guarantee of up to 80% of any loan taken.

3.6.2 *Residential sector*

The NECP mentions several measures tailored to the residential building sector, mainly aimed at promoting energy efficiency and RES technologies, and it also tackles energy poverty (see textbox). Latvia's long-term strategy for the renovation of buildings[181] is part of Latvia's NECP.

Table 3-9 Implementation status of LTRS and NECP policies

Measure	Source	Status

[177] Support schemes included in the models
[178] Support schemes included in the models
[179] ALTUM (2021), Applications open for ALTUM's Energy Efficiency Improvement Programme for Private Houses
[180] ALTUM, Energy efficiency of apartment buildings 2016-2023
[181] Latvia Long-term strategy for the renovation of buildings

Renovation target (8 100 residential apartment buildings by 2040)	LTRS	
Continuing to promote energy efficiency improvements in residential buildings	NECP	Implemented[182]
Implementing energy efficiency improvement measures in private houses or small building complexes, and promoting the efficient use of resources	NECP	Implemented
Promoting the use of RES and the improvement of energy efficiency in local heating (LH) and individual heating, as well as implementing and promoting local and individual cooling systems	NECP	Implemented
Developing a long-term solution for improving energy efficiency of the Latvian Residential Fund	NECP	Ongoing

Textbox 3 Energy poverty

Since 2021, Latvia's Energy Law includes the definition of energy poverty, which mandates institutions take the matter in consideration when developing new policies. In 2016, 22% of Latvia's population was a risk of energy poverty, and various NECP policies aim to reduce the proportion of households which underheat their homes to less than 7.5% (by 2030) by improving energy efficiency of their homes and by increasing the number of electricity consumers on special tariffs. In particular, Latvia aims a *Comprehensive implementation and application of the social dimension in energy and climate policy* which means an obligation to always consider the impact on energy poverty when drafting new legislation and when defining new local spatial development plans, to ensure the principle of fair transition is respected. Further, another measure in the NECP aims at developing *an efficient and optimal framework for partial support for energy supply costs for protected users.*

In 2017, 93 700 inhabitants (4.8% of the population) received support via the housing allowance, for a total cost to municipalities amounting to €16.5 million.[183] The "housing allowance" helps households to cover the costs of electricity and heating.

Latvia has also implemented an obligation scheme on electricity providers[184] that had sold at least 10GW of electricity in 2016 or afterwards. In the initial phase, the uptake of the scheme has been below expectations, and the savings claimed by suppliers by 2020 (392 GWh) had been accumulated mostly by delivering information measures and smart metering.

3.6.3 *Public sector*

The public sector should lead by example and show ambition with regards to decarbonisation. The RRP and NECP highlight the need to promote energy efficiency and RES technologies in public buildings, both within national and municipal context.

Table 3-10 main NECP and RRP policies aimed at public sector's buildings

Measure	Source	Status
Improving municipal buildings and infrastructure by promoting the transition to renewable energy technologies and improving energy efficiency (€27.8 million+€16.8 million), aiming at reducing consumption by 30% by providing loan reimbursable at 50%	RRP[185]	Ongoing

[182] Measures 1.2, 1.4 and 2.4 are indicated in the RTU/E3M report.
[183] Ministry for Economics (2021), National Energy and Climate Plan for 2021-2030
[184] Ramboll, Case study: Energy efficiency obligation scheme Latvia
[185] Council of the European Union (2021), Annex to the COUNCIL IMPLEMENTING DECISION on the approval of the assessment of the recovery and resilience plan for Latvia

Continuing the promotion of energy efficiency improvements in public buildings	NECP	Ongoing
Continuing to support the introduction of energy efficiency improvement measures in municipal buildings	NECP	Ongoing
Promoting the use of RES technologies in the public sector	NECP	Ongoing

3.6.4 *Industrial sector*

The NECP includes measures tailored to the industrial sector, focused on improving efficiency and promoting the use of RES technologies in heating and cooling, and industry. The National Industrial Policy Guidelines 2021-2027[186] are a medium-term policy planning document covering all sectors of the economy and setting the goals and directions for promoting economic growth, both domestically and internationally. The goal of NIP is to increase the volume of exports to €22 billion in 2023 and to €27 billion in 2027. Its sub-goal is to increase the amount of expenditure for R&D to €300 million in 2023 and to €600 million in 2027.

Table 3-11 Main NECP and RRP policies aimed at industry

Measure	Source	Status
Establishing a prioritisation assessment of the measures to be taken, i.e. assessing whether it is technically feasible or economically justified or legally feasible to install non-emission RES technologies (wind, solar, heat pumps and cold pumps)	NECP	Implemented
Promoting the use of RES and improving energy efficiency in industry and economic operators, also customizing DH for cooling in buildings	NECP	Implemented
Reviewing rates of natural resources tax (NRT) and their conditions for application within framework of tax guidelines	NECP	Implemented
Reviewing rates of excise duty and the conditions for applying it to fuels within tax policy guidelines framework	NECP	Implemented
Assessing options for improving the heating market	NECP	Unclear

Large energy users are (partially) exempted from making their full electricity-related surcharge payments. The measure costs €7 million.[187]

3.7 Cross-cutting

3.7.1 *Fiscal measures*

The Latvia tax system includes 14 taxes, 7 of which can be considered environmental/energy taxes: excise duty, VAT, electricity tax, VOT, NRT, customs tax, subsidised electricity tax. Total tax revenues directly related to energy consumption and creation of GHG emissions in 2018 amounted to €717.8 million, which makes up around 8% of general budget revenue.[188] €129 million in fossil fuel subsidies was paid by Latvia in 2019.

Latvia’s NECP describes a varied set of fiscal policies and measures, with one measure falling under direction of action 4 “Promoting self-generation, self-consumption and AE communities” and the other

[186] Cabinet of Ministers (2021), On the National Industrial Policy Guidelines 2021-2027
[187] PV Magazine (2021), Latvian plan to exempt big energy consumers from renewables surcharge approved by EU
[188] Data from: Enerdata (2021), Study on energy subsidies and other government interventions in the European Union published by European Commission (DG ENER). Data from 2021 onwards is forecast

measures being part of direction of action 11, being “Improving the “greening” and attractiveness of the tax system for energy efficiency and RES technologies”.

Table 3-12 Main fiscal NECP policies

Measure	Source	Status
Reviewing rates of natural resources tax (NRT) and their conditions for application within framework of tax guidelines[189]	NECP	Implemented
Reviewing rates of excise duty and the conditions for applying it to fuels within tax policy guidelines framework[190]	NECP	Implemented
Reviewing tax conditions applicable to vehicles within the framework of tax guidelines[191]	NECP	Not implemented
Development of legal framework for promoting self-generation and self-consumption of energy, including a fair framework for the application of appropriate taxation for self-consumers	NECP	Ongoing
Addressing the reduction of the tax burden on households for energy efficiency improvement measures within the framework of tax policy guidelines	NECP	Not implemented
Reviewing environmental and energy tax exemptions and incentives within tax policy guidelines framework	NECP	Not implemented
Assessing the system of application of the “polluter pays” principle	NECP	Ongoing

3.7.2 *Other*

Latvia’s NECP calls for the “Sustainable use of resources and reduction of GHG emissions and increasing CO_2 removal in land use, land use change and forestry [LULUCF] sector” under Direction of action 9. The following measures related to agriculture and land use have been identified:

Table 3-13 Other relevant policies

Measure	Source
Ensure that the total area of forests is not reduced in forest development planning	NECP
Support the creation of new orchards	NECP
Promoting the development of forests and the quality of the crop in naturally overgrown areas	NECP
Encourage the replacement of unproductive low-carbon forest stands	NECP
Encourage the rehabilitation of forest stands destroyed by natural disasters	NECP
Encourage young-adult felling	NECP
Improving the quality of forestry land and forest-friendly lands	NECP
Encourage recultivation of historically used peat harvesting sites by selecting the most appropriate type of recultivation	NECP
Promoting wood use in construction	NECP
Encourage the use of cascading principle in the use of wood and biomaterials	NECP
Increase forest output by 25% by 2050 compared to 2018	NECP

[189] The “Base scenario policies for sharing AD” document mentions 2022 NRT numbers for 2022, 2030 and 2050.
[190] The RTU/E3M report notes that fossil tax rates have been approved in 2022, which are assumed to remain constant until 2050. Includes: diesel; gasoline; LPG; natural gas; white spirit; kerosene; residual fuel oils.
[191] The RTU/E3M report notes that for the transport sector, registration tax and exploitation taxes associated with emitted CO_2 emissions have changed from 2017-2021, but are not expected to change until 2050.

Support the development of innovative technologies and solutions to promote resource efficiency, GHG emissions reduction/CO 2 deployment in forestry activities	NECP

3.8 Key barriers and risks

This section focuses on the long-term risks related to a lack of action on decarbonisation; followed on the main challenges towards decarbonisation and specific barriers for the transport, energy, building and industrial sectors.

3.8.1 *Long-term risks in case of insufficient acting on decarbonization*

Latvia's LTS[192] highlights that – unless sufficient action is taken - the air temperature in Latvia will increase on average by 3.5 °C to 5.5 °C by the end of the century[193] which would cause uncharacteristic and extreme weather conditions to happen more frequently.[194] Climate change would also lead to losses in the fields of health, civil protection, agriculture and forestry, tourism and landscape planning, construction and planning of infrastructure, as well as biological diversity and ecosystem services.
The urban environment (i.e. cities) will be most often subject to climate change related risks such as floods, sea-level rise, heat waves, insufficiency of drinking water, drought, extreme precipitation, and storms. As mitigation, local governments have performed vulnerability risk assessments and identified measures for adaptation to climate change.[195]

3.8.2 *Challenges to decarbonisation*

Latvia faces a number of barriers and risks towards decarbonisation. According to its NECP, there are three key challenges:

- The need to maintain **low energy costs**;
- **Energy security** and the availability of generating capacities in the Baltic area, as fossil fuel power plants are closed.
- Accessing the untapped potential of **zero-emission technologies for electricity production**, in particular solar, onshore wind and offshore wind.

3.8.3 *Barriers towards decarbonising the transport sector*

According to Latvia's Country Semester Report[196], sustainable mobility measures, as included in Latvia's RRP, can further reduce energy dependence on oil. According to the baseline (WEM scenario), transport accounts for 25% of the final energy consumption by 2050.

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[192] Ministry for Environmental Protection and Regional Development (2019), Informative Report: Strategy of Latvia for the Achievement of Climate Neutrality by 2050
[193] According to a 2017 report by Latvian Environment, Geology and Meteorology Centre
[194] More specific risks listed in the LTS are: "changes of the vegetation period, increased fire hazard, proliferation of pests and pathogens, tree diseases, expulsion of local species, entering of new species, spread of diseases of the respiratory system, flood caused by precipitation, wind surges, extremely strong wind gusts, occurrence of disturbances in electricity supply, reduction of frost, black frost, drying of soil, eutrophication, damages to infrastructures, overheating of equipment, spread of infectious diseases, and heat strokes".
[195] Ministry for Environmental Protection and Regional Development (2019), Informative Report: Strategy of Latvia for the Achievement of Climate Neutrality by 2050
[196] European Commission (2022), SWD(2022) 619, 2022 Country Report – Latvia accompanying the document Recommendation for a COUNCIL RECOMMENDATION on the 2022 National Reform Programme of Latvia and delivering a Council opinion on the 2022 Stability Programme of Latvia

Latvia's LTS[197] highlights that heavy traffic in which fossil energy sources are the dominating fuel is generating not only GHG emissions, but also has a negative impact on air quality. Further, three out of four cars registrations in Latvia are imported second-hand cars. The used car market is dominated by internal combustion engines (ICE). Although the new cars registered in Latvia generate less emissions, Latvia still is in second place in the EU in relation to the use of most carbon intensive cars.[198] Diesel oil remains the main fuel type in the baseline (WEM scenario), accounting for 90% of energy consumption in the transport sector in 2020 and expected to account for 66% by 2050. Further, we may assume that in absence of new policy, a large share of vehicle acquisition will remain used imported ICE vehicles.[199]

Latvia's NECP considers hydrogen as a long-term alternative fuel to replace petroleum products for transport while the shift to electrical vehicles, biofuels and CNG/LNG are expected to happen in the medium term. However, the NECP identifies the low GDP per capita as well as low personal income compared to other Member States as a major obstacle to the development of electric mobility. Consumers' opinion of EVs is very positive, with a 2020 survey registering 79% of users in favour of electric mobility and even a quarter of Latvians planning to purchase an electric car in the following five years. However, the survey highlighted that the main barriers perceived by potential users are: underdeveloped charging network, comparatively high initial expenses, potential mileage and length of charge.[200] Latvians noted in surveys that the main obstacle for purchasing an electric vehicle is the high price that does not outweigh the benefits it provides.

The uptake of biofuels and electric vehicles in the baseline (WEM scenario) is limited to 4% and 2% respectively of the sector's final energy consumption. In 2021, less than 0.5% (around 2 500 cars) of all vehicles registered in Latvia were electric or hybrid[201] while in 2020 there were 1 500.[202] While the baseline (WEM scenario) foresees an increase in EV energy consumption from around 300 TJ in 2020 to 900 TJ in 2030 and 1200 TJ in 2050, the shift to non-fossil fuel transport is expected to remain very slow in the absence of more ambitious policy to phase out ICE vehicles.

With regards to hydrogen in the transport sector, an overarching hydrogen roadmap has not yet been developed.[203] In line with this, the baseline foresees no share of FCEVs.

On the other hand, jet fuel represented around 11% of the transport sector's final energy use in Latvia in 2017,[204] with high GHG emissions associated. While we see a decline in the baseline, jet fuel still represents 10% of the sector's FEC by 2050. The transition to low-carbon alternative fuels is essential for meeting climate objectives.

[197] Ministry for Environmental Protection and Regional Development (2019), Informative Report: Strategy of Latvia for the Achievement of Climate Neutrality by 2050
[198] Ministry for Environmental Protection and Regional Development (2019), Informative Report: Strategy of Latvia for the Achievement of Climate Neutrality by 2050
[199] In 2021 of over 20,000 new road vehicles were registered in Latvia of which 14,652 new cars. However, once use imported vehicles are included, new passenger car registrations amounted to 65,713 and total vehicles registered were 80,000; this means that 75% of registrations in Latvia are of used vehicles. Central Statistical Office (2022), Transport in Latvia 2022
[200] Finance Latvia Association (2020), Baltic Survey: Lithuanians Support the Use of Electric Cars More than Latvians and Estonians
[201] Central Statistical Office (2022), Transport in Latvia 2022
[202] Central Statistical Office (2021), Transport in Latvia 2021
[203] World Energy Council (2021) Working Paper: National Hydrogen Strategies
[204] RTU TIMES Latvia model Baseline scenario, as of 03/03/23, aligned with energy balances.

3.8.4 *Barriers towards decarbonising the energy sector*

Energy security

Latvia's 2022 Country Report[205] highlights that 34% of Latvia's energy mix consists of oil and 22% of gas, which is mostly imported from Russia. Given the current geopolitical context, Latvia's historical reliance on Russian gas is a risk to its security of supply.

Latvia does have access to an alternative supply source thanks to its gas connection with Lithuania which can access other gas routes through the Klaipeda LNG terminal, but this may be insufficient in the long term. Energy solidarity agreements with both Estonia and Lithuania aim to ensure gas supply between the Baltics in case of a supply shortage.[206] According to the 2022 Country Report[207], an upgrade of interconnectors is however necessary to ensure gas flows at maximum capacity. At the same time, the promotion and deployment of RES as well as the improvement of energy efficiency will enhance and facilitate energy security while reducing the dependence of Latvia on import of fossil energy resources.[208]

According to Latvia's NECP, security of supply should be maintained. It also states that, in the context of energy security, it is also important to consider cybersecurity aspects of the energy system as key infrastructure such as power plants, power grids and pipelines are controlled digitally and are exposed to the risk of cyberattacks.

Zero-emission technologies for electricity production

According to Latvia's Country Semester Report,[209] Latvia should focus on tapping the solar and wind potential, and in particular could accelerate the deployment of offshore wind parks, including jointly with neighbouring Member States. However, in order to deploy renewable energy installations for the production of electricity in Latvia, according to Resmonitor,[210] the following barriers should be addressed:

- Taxes
    - Unstable tax system and additional fees[211]
    - Taxes affect the profitability of self-consumption models

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[205] European Commission (2022), SWD(2022) 619, 2022 Country Report - Latvia accompanying the document Recommendation for a COUNCIL RECOMMENDATION on the 2022 National Reform Programme of Latvia and delivering a Council opinion on the 2022 Stability Programme of Latvia
[206] European Commission (2022), SWD(2022) 619, 2022 Country Report - Latvia accompanying the document Recommendation for a COUNCIL RECOMMENDATION on the 2022 National Reform Programme of Latvia and delivering a Council opinion on the 2022 Stability Programme of Latvia
[207] European Commission (2022), SWD(2022) 619, 2022 Country Report - Latvia accompanying the document Recommendation for a COUNCIL RECOMMENDATION on the 2022 National Reform Programme of Latvia and delivering a Council opinion on the 2022 Stability Programme of Latvia
[208] Ministry for Environmental Protection and Regional Development (2019), Informative Report: Strategy of Latvia for the Achievement of Climate Neutrality by 2050 & European Commission (2022), SWD(2022) 619, 2022 Country Report - Latvia accompanying the document Recommendation for a COUNCIL RECOMMENDATION on the 2022 National Reform Programme of Latvia and delivering a Council opinion on the 2022 Stability Programme of Latvia
[209] European Commission (2022), SWD(2022) 619, 2022 Country Report - Latvia accompanying the document Recommendation for a COUNCIL RECOMMENDATION on the 2022 National Reform Programme of Latvia and delivering a Council opinion on the 2022 Stability Programme of Latvia
[210] RES Policy Monitoring Database (2022), Barriers
[211] On 2014 the Law on Taxation of Subsidized Electricity was adopted. The tax was meant to be applied to companies that received financial support for generating electricity from renewable energy sources or that produced electricity in CHP plants on taxable income earned from 1 January 2014 to 31 December 2017, although the Law is still in force. On 2020, new amendments to the Electricity Market Law came into force, according to which all electricity producers who benefit from the feed-in tariff have to pay a fee (€ 0.40/kW in 2020) for monitoring the use of state support for renewable electricity generation. On 2021, new amendments to Electricity Market Law came into force, which obliged project developers to pay the monthly connection fee. According to Resmonitor, with the unconfirmed plans to abolish the feed-in tariff and new changes in the regulations, there is uncertainty about the future, including new additional fees or new additional tax.

    - The tax system does not encourage the self-consumption of renewable energy[212]
- Costs and financing
    - Renewable energy is not cost-competitive
    - Insufficient support of self-consumption of RE
    - Imbalanced distribution of grid connection costs
- Strategy and planning
    - Wrong signals to society and lack of information
    - Lack of long-term predictability
    - Limited wind power development due to spatial planning regulations and administrative issues
    - Local opposition to wind projects (NIMBY) impedes project completion

Energy infrastructure planning is a challenge almost everywhere in Europe, in particular the planning and approval process of new renewable installations such as medium and large scale solar PVs and wind farms, and to a lesser extent also of biogas/biomass installations. In Latvia, planning issues are the remit of the MoEPRD, but also involve the MoE and the MoA. The specific analysis carried out for Latvia[213] covers onshore wind, roof-top PV and biomass and highlights that:

- the process of site selection and obtaining all the necessary permits for renewable installations is complex, regulated by a number of different laws and subordinate regulations. Further, there is no one-stop shop in Latvia, which means developers have to deal with multiple stakeholders. In particular, this is a severe barrier for onshore wind.
- Regarding roof-top PV, local building authorities lack a common understanding of how to coordinate the installation of these systems, and it is not fully clear to what extent they should even be involved in this process.
- Recent legislative changes that have shortened the time period in which construction of RES-E plant with a capacity exceeding 1 MW must begin after obtaining the licence (from 2 years to 6 months), which developers deem too short.

In Latvia, specific issues that affect in particular onshore wind are:[214]

- **Excessive fragmentation of rural land ownership** means that project developers have to reach an agreement with several landowners. Data protection rules make the process of reaching out to the owners even more complex.
- **Use restriction**, for example on agricultural land and forest areas.
- **Local opposition**, which has already been the cause of cancellation for a few onshore wind projects.[215] While there is general support for renewables, including onshore wind, the administrative process requires developers to seek the approval of local government, the competent authorities and the public, the relevant state authority, or (in some cases) other

[212] For example, households which have installed renewable energy technologies are not granted any tax incentives or exemptions (i.e. reduced real estate tax rate or a refund of property income tax). Similarly, these investments are not subject to a reduced VAT rate. Furthermore, they may increase the cadastral value of the property, which could increase the real estate tax rate.
[213] RES Simplify (2020), Technical support for RES policy development and implementation -Simplification of permission and administrative procedures for RES installations
[214] RES Policy Monitoring Database (2021), Limited wind power development due to spatial planning regulations and administrative issues in Latvia
[215] RES Policy Monitoring Database (2021), Local opposition to wind projects (NIMBY) impedes project completion in Latvia

authorities as specified in the law. Opposition from even one of the stakeholders means that the project can be rejected.

The challenges and future perspectives concerning planning issues have been examined in a BEA-APP project in 2019 (see figure).[216]

Figure 3-8 Central aspects for spatial planning[217]

Planning
- Designated areas for renewable energies
- Standard planning processes

Society
- Models for participation in spatial planning

Economy
- Economic participation models

Other and cross-cutting
- Natural renewable energy sources
- Grid capacity regarded in spatial planning
- Capacity and height of installations regarded in spatial planning
- Conflict potential

3.8.5 *Barriers towards decarbonising the buildings and industrial sectors*

Together, Latvia's residential, commercial and industrial sectors account for 65% of final energy consumption. In particular, industrial energy consumption is expected to increase by 50% between 2017 and 2050. According to Latvia's Country Semester Report[218], the energy efficiency measures (in buildings and industry) could be reinforced, and would lead to reduced energy consumption and thus energy dependence. Further, Latvia's LTS discusses how improvement of energy efficiency of residential buildings will reduce the risk of poverty.[219] However, Latvia's LTRS[220] highlights the main barriers to the renovation of buildings:

- A perceived risk remains for investors and the private sector, limiting the mobilisation of investments into renovations.
- Lack of resources to evidence the economic and technical need for insulation (e.g. energy audit cost) is one of the obstacles preventing citizens to move towards energy efficient housing. In some cases, local governments provide support with the preparation of technical documentation.

With regards the renovation of non-residential buildings, Latvia's LTRS[221] highlights the following barriers:

- for public buildings, despite the available funding, the renovation process is relatively slow. Obstacles remain such as the framing of priority rankings for buildings. Further, public buildings -up to 2020- were not using the ESCO service.

[216] Baltic Energy Areas (2019), Renewable energy and spatial planning: challenges and future perspectives
[217] Baltic Energy Areas (2019), Renewable energy and spatial planning: challenges and future perspectives
[218] European Commission (2022), SWD(2022) 619, 2022 Country Report - Latvia accompanying the document Recommendation for a COUNCIL RECOMMENDATION on the 2022 National Reform Programme of Latvia and delivering a Council opinion on the 2022 Stability Programme of Latvia
[219] Information report: Long-term strategy for the renovation of buildings
[220] Information report: Long-term strategy for the renovation of buildings
[221] Information report: Long-term strategy for the renovation of buildings

- Limited experience and knowledge within the manufacturing sector on energy efficiency improvement measures;
- “Entrepreneurs prefer to change plant as a priority, rather than to take targeted energy-efficiency measures in manufacturing buildings.”

In terms of natural gas consumption, this is expected to remain marginal or disappear completely from for the residential sector, considering already a negligible share of natural gas in the residential buildings’ final energy consumption as of 2026 (this includes only natural gas used directly in premises, and not natural gas used in district heating). However, natural gas consumption remains around 10% of final energy consumption of the commercial sector up to 2050. For industry, the share is consistently around 15% until 2035 after which it steeply declines to 3% by 2050. Further policy measures would be needed to reduce natural gas consumption in those sectors.[222]

Regarding renewable heat and district heating, technologies require major initial investments and need clear rules for the investment decisions to be taken.[223] In particular, for district heating, the significant costs to retrofit a system are a very major barrier.[224] Important to note that currently 14 000 GWh of thermal energy is being produced in individual heating systems, compared to 8 000 GWh per year in district heating.[225]

3.8.6 *Other barriers*

Latvia’s LTS[226] mentions **lack public information and awareness raising** as a key barrier, stating that there is a lack of information regarding climate change, the related risks as well as the mitigation actions that should be taken. Latvia had one of the lowest levels of awareness of climate change as a global problem among the EU states, though awareness is increasing. According to the LTS, public information and awareness raising regarding climate change is one of the most significant measures for increasing interest and motivation of inhabitants to become involved in solving the issues related to climate change.

The assessment of Latvia’s LTS found that the lack of information regarding the legal nature of the LTS – i.e. whether it is a legally binding target - poses a risks of lack of action for it to be fully effective in Latvia’s decarbonisation.[227]

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[222] Other fossil fuels are also phased out in the baseline.
[223] RTU (2020), Development of Heating and Cooling Systems in Latvia
[224] RTU (2020), Development of Heating and Cooling Systems in Latvia
[225] RTU (2020), Development of Heating and Cooling Systems in Latvia
[226] Ministry for Environmental Protection and Regional Development (2019), Informative Report: Strategy of Latvia for the Achievement of Climate Neutrality by 2050
[227] Ricardo Energy & Environment (2019), Assessment of the Long-Term Strategies of EU Member States

4 Latvia's system integration pathway

This section provides the assumptions and key results of the first analysis done to identify Latvia's optimal pathway for decarbonisation based on a cost-effective integrated energy system.

4.1 Methodology

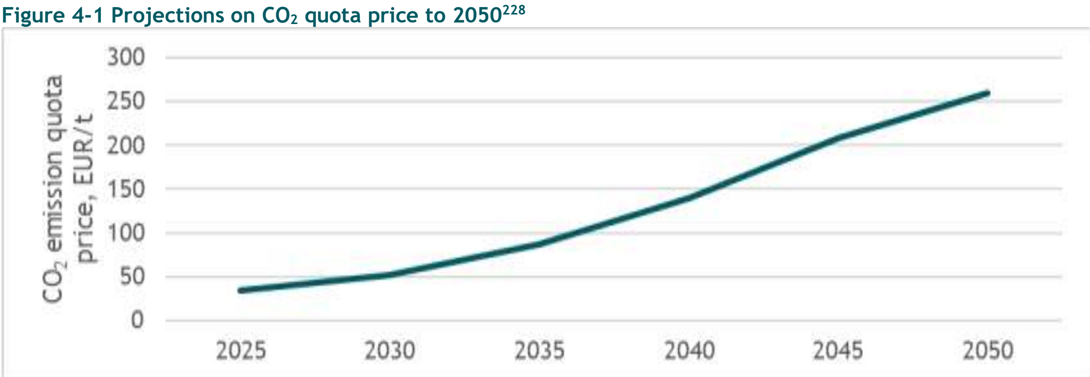
The newly developed TIMES-Latvia and CGE modelling systems, along with the chosen baseline (see Deliverables 2 and 3 of this project) were used to model Latvia's energy system integration pathway. The following sections provide the assumptions, model runs and limitations.

4.1.1 *Key assumptions*

Carbon emissions price and energy sector

The price of carbon emissions is one of the key driver of decarbonisation of the power and industrial sector. Latvia is considered a price taker in the ETS market, so the EU-ETS price as simulated in the EC Fit-for-55 scenario is used (see figure). For emissions in the non-ETS sector, the current cost of 12 €/tCO_2 imposed on emissions from the non-ETS sector in Latvia is assumed to remain stable throughout the period considered.

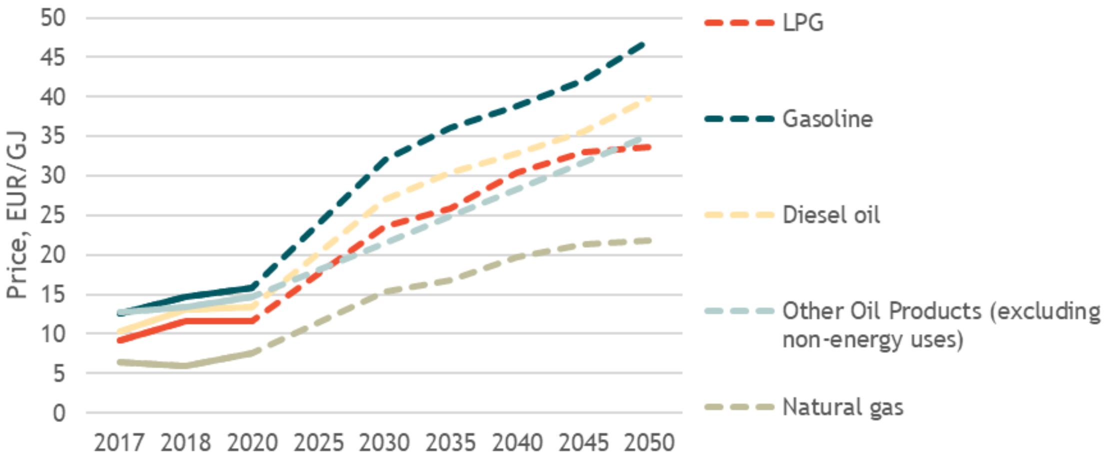
Figure 4-1 Projections on CO_2 quota price to 2050[228]



The projections on fossil fuel resource price have also been derived from the European Union Reference Scenario 2020 which uses projections of international fossil fuel prices produced by the global model POLES-JRC, an analysis conducted by the JRC in the Global Energy and Climate Outlook (GECO) report (see Figure 4-2). All fuels show substantial increase in their price up to 2050.

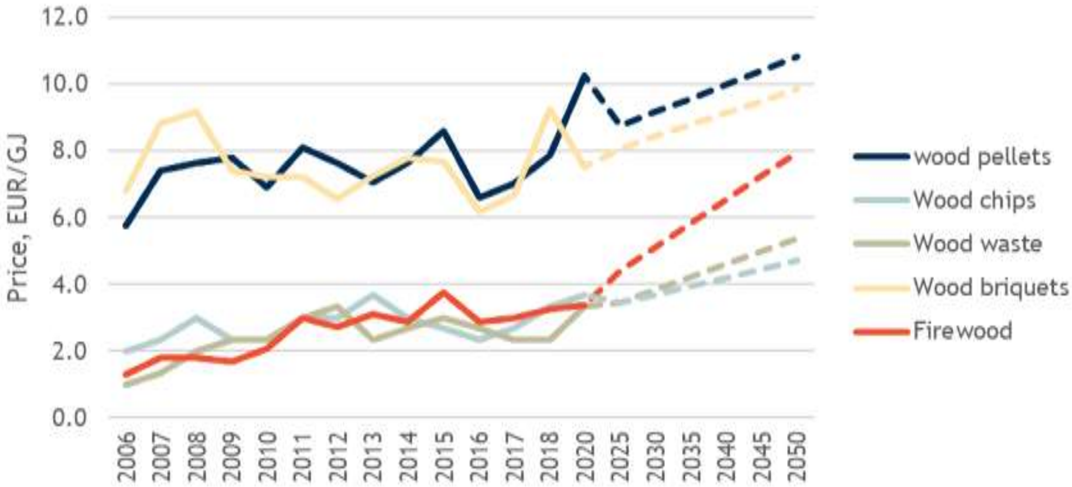
[228] DLV2-3 Baseline and Soft-link report

Figure 4-2 Projections on main fossil fuel prices to 2050 according to EU Reference scenario[229]



Price projections have also been used for bioresources, which cover a significant part of energy demand in Latvia. The price forecasts have been derived from the historical price development trends (see Figure 4-3).

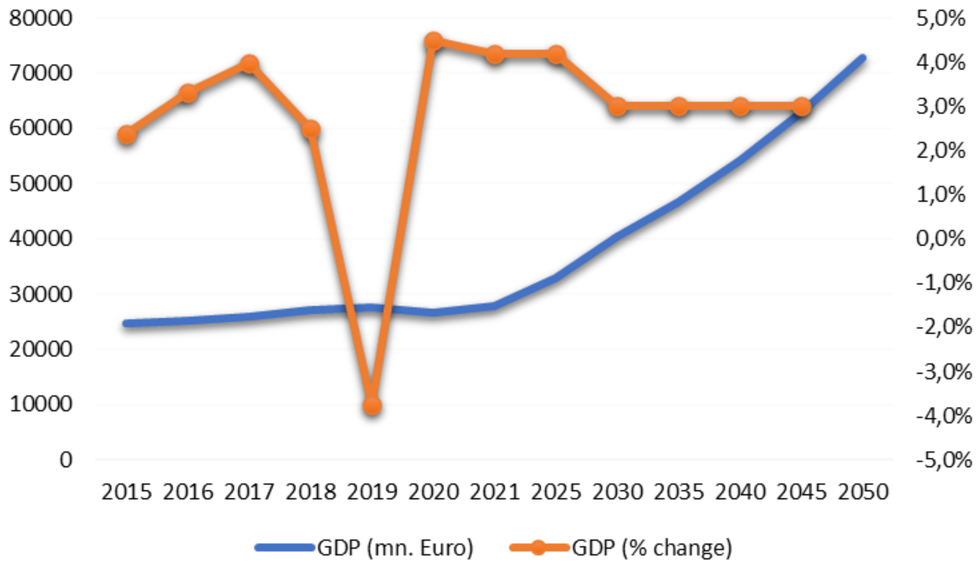
Figure 4-3 Projections on biomass prices to 2050 according to historical price development trends



[229] DLV2-3 Baseline and Soft-link report.

Economy, Population and Labour Market

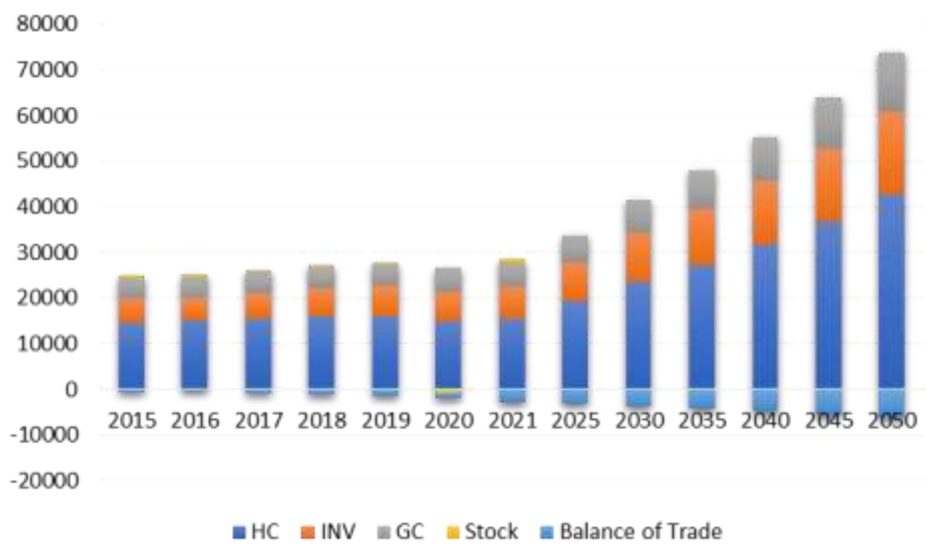
Figure 4-4 Latvian GDP 2010-2050 (Source: E3-Modelling based on MoE report, EUROSTAT (up until 2020))[230]



Note: the blue line ("GDP (mn. Euro)") relates to the left axis; the orange line ("GDP (% change)") relates to the right axis.

The Latvian economy is projected to follow a balanced growth pathway where gross fixed capital formation and private expenditures grow by an average of 3.2% annually over the 2025-2050 period.

Figure 4-5 Latvian GDP 2010-2050 by component (Source: E3-Modelling based on MoE report)[231]



Employment projections are presented in the table below. Although unemployment rate decreases over time, employment is driven by the trends on active population which drops by 35% in 2050 when compared to 2005 levels.

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[230] DLV2-3 Baseline and Soft-link report
[231] DLV2-3 Baseline and Soft-link report

Table 4-1 Employment in Latvia (1 000s persons)[232]

	2015	2020	2025	2030	2035	2040	2045	2050
Employed persons	888	838	806	740	689	647	612	580

Further macroeconomic indicators are presented in 4.5.2, together with the baseline and WAM results.

Constraints and objectives

A number of high-level directions and conditions embedded into the pathway (thus policy directions considered for the WAM scenario) are the following:

- Significant phase-down of natural gas imports by 2030.
- Russian oil and gas imports to be substituted by Norwegian and US imports from around 2022-2025.
- Although difficult, an increase of the electrification of heating in order to accompany the phase-out of natural gas and to some extent biomass.
- No price caps to be implemented: the energy market is to be fully open and integrated with the Nordic region (Finland, Sweden, Norway, Denmark, …) and the Baltics. There will also be electricity imports from Poland and Germany.
- The uptake of hydrogen will depend on the availability of electricity in sufficient quantities to produce it.
- Nuclear, mainly through SMR, is a long-term goal – in the shorter term, there will be difficulties and constraints with regards to some key materials as import bans from Russia will be active and materials from other suppliers are likely to be very costly.
- No restrictions to be imposed on renewable technologies.
- Should inflation continue in the short-term (next 18 months) a decrease in spending should be observed.
- No new fossil-based district heating after 2026. Any gas use will rather be used for electricity generation-demand balancing purposes.

4.1.2 *Model runs*

The TIMES and CGE models have been built specifically for this assignment, and were completed just before the work for this deliverable started. Therefore, several adjustments and refinements had to be made before the models could produce realistic results. While there are still some adjustments to be made, the results presented here are sufficient to begin a discussion over the policies and measures to be explored via the modelling, and help identify which elements of the models that should be further refined.

Initially, several test runs of the TIMES models were carried out in order to develop a robust timeline. Given TIMES' structure, it is often difficult to foresee how the model would react to even small changes in inputs and methodologies, which is why several attempts were necessary. Adjustments had to be made, for example, because of unrealistic gas consumption timeline, very variable imports/exports of electricity and so on.

[232] DLV2-3 Baseline and Soft-link report

Once the team reached a baseline projection that was deemed sufficiently reliable, TIMES was run in self-optimisation mode, with the imposition of the EU 2030 energy efficiency targets and a near net zero GHG emission level in 2050. Under this methodology, the model identified the sectors and fuels where GHG and energy savings are cheaper, although the trajectories produced are in many cases unrealistic. However, the results used could be used for:

- identify which sectors and fuel should be targeted first, and to what extent
- help calibrating the policies.

This is a top-down approach, where the model distributes the effort among sectors according to price and other assumptions.

Following this phase, the team carried out several runs to try and replicate the results of the self-optimisation run via a bottom-up approach, i.e. by calibrating the various policies and measures listed in section 4.4. This was done by, for example, increasing the size of a subsidy package, increasing a cost (natural resource tax, vehicle taxes) or imposing a stronger threshold (regulatory measures). The policies were calibrated not to achieve exactly the 2030 and 2050 targets, but to make significant progress towards achieving them (see section 4.5.1). This is for two reasons:

- stimulate a discussion on the additional policies or effort required, based on the initial results;
- avoid overshooting the target. I.e., it may be more appropriate to devise some corrective actions around the year 2025 and 2026, after the effectiveness of the proposed measures has been tested on the real world.

4.1.3 *Limitations and caveats*

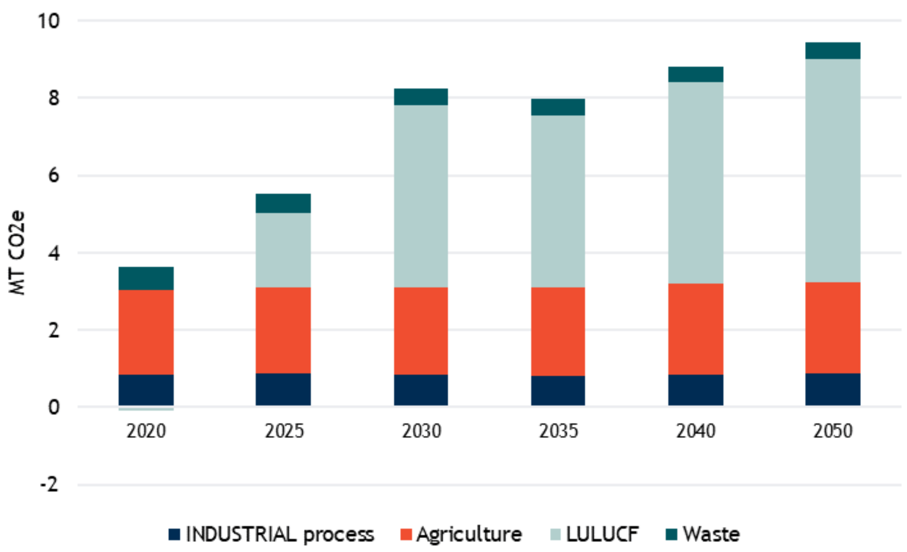
It is important to consider that the data presented here, and the modelling methodology in general, suffer from some limitations that have to be borne in mind when analysing the results:

- The analysis provided does not consider GHG emissions for LULUCF (the TIMES energy model primarily allows to model energy-related emissions, although the model developed does include non-energy emissions in the transport, industry, and agriculture sectors). LULUCF emissions are expected to contribute positively to the GHG balance by 2050 - i.e. being a net absorber of GHG emission rather than emitter.
- The models have been built specifically for this assignment, and in the context of this project there is limited time and budget for perfecting them. However, the project was devised so that the Ministry of Economics would, at the end of it, take ownership of the model and further improve them.
- The current energy crisis in the EU introduces a very significant element of uncertainty. Gas prices have reached peaks of 10 times the historical price, and there is as yet no clarity on the level they are going to be in the next 3 to 5 years. Gas prices, and actors' expectations about their future level, have a very significant impact on the technology mix and they drive other key inputs (such as the electricity price).
- Given the scope of this analysis (economy-wide and long-term) it will be unwise to give a big weight to the cost and impacts of a single policy in the short term. The model can give an indication of the ballpark costs and impact, and on the size of investments needed to drive technology transitions, but often single assumptions have a huge weight on the result. For example, it is assumed that a subsidy covering (on average) 75% of investment cost will be sufficient to drive a any number of building renovations, but:

- the rate of subsidy to drive a certain amount of renovation should follow a curve, as the marginal rate required would be higher for each subsequent renovation;
- if gas and electricity cost stay high, probably a lower subsidy rate will be sufficient, but if they decrease to historical level, it may instead not be sufficient;
- a very high subsidy rate may generate inflation for the interested sectors (construction sector), which will increase the cost of the policy;
- there may be some short-term limits to the ability of the supply chain to deliver at the level estimated by the model.

- Due to the longer-than-expected time spent on finalising the baseline, it was not possible to carry out sensitivity analysis on some of the key drivers, which would help to assign a degree of robustness to the results.
- GHG emissions trends presented for the remaining of this report and based on the modelling do not include emissions from waste, LULUCF and non-energy related emissions from agriculture, and industrial processes. These are expected to follow the trend presented in Figure , which clearly points to the expected major role played by LULUCF (in 2050, LULUCF emissions will be responsible for 43% of all Latvian emissions).

Figure 4-6 Non-energy GHG emissions by sector (baseline)[233]



4.2 Baseline trends

This section presents different trends to illustrate the baseline trajectory at country and at sector level. The macroeconomic analysis of the baseline is presented in 4.5.2, together with the WAM results.

4.2.1 *Energy supply*

Primary energy consumption

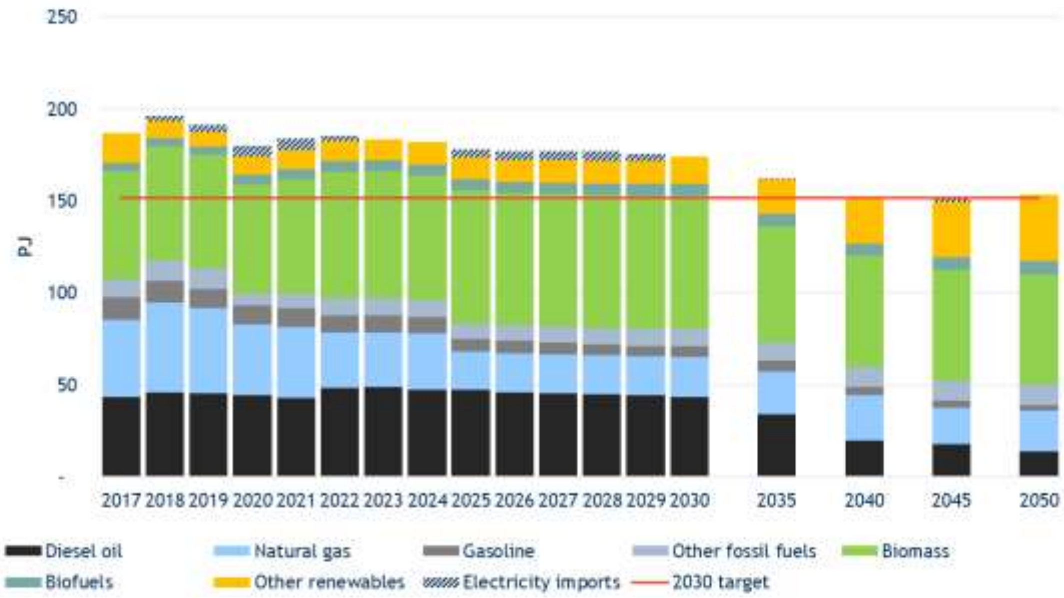
The baseline forecast for primary energy consumption shows a relatively flat trend over time, going from 180 PJ in 2020 to 153 PJ in 2050. The increase in energy demand from growing economic activity

[233] Latvia-TIMES model – projected GHG emissions from non-modelled sectors

is compensated only in part by a baseline energy efficiency trend, driven mostly by substitution for obsolescence (replacing an old product for a new, more efficient one).

In 2020, fossil fuels represented 55% of primary energy consumption, while renewables accounted for 42% and electricity imports for 3%. In the long term, renewables, and in particular bioenergy, will provide the majority of Primary Energy Consumption, bringing the renewable share at 54% and 67% in 2030 and in 2050, respectively. Gas consumption is expected to decrease substantially after 2040, and then remains decrease to 14 PJ per year in 2050 (9% of national consumption).

Figure 4-7 Primary energy consumption (2017-2050)[234]



Electricity

Total energy generated by the power sector is expected to follow a variable trajectory up to 2030, when substantial wind capacity is expected to come online. From then onwards, electricity generation follows a slow but steady increase until 2050, with total generation (and therefore demand) expected to be 32% higher in 2050 compared to 2020. Fossil fuels (mainly natural gas) are expected to almost disappear by 2025 from the generation mix, from a 25% share in 2020. The deployment of large amount of wind from 2027 and then from 2030 reduces significantly electricity imports, but also reduces the diversification of its power supply: in 2035, 73% of Latvian electricity production will come from wind and hydro. However, while production of hydro is steady over the years (10 PJ/year), wind is expected to increase over time and deliver 59% of all power generated in Latvia in 2050; solar PV[235] is also expected to substantially increase its output from 2030 onwards, delivering up to 13% of total electricity demand in 2050. On the other hand, biogas and biomass only appear to provide marginal contribution after 2030.

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[234] Latvia-TIMES model
[235] Solar PV generation incudes distributed generation for self-consumption (e.g., rooftop solar) but does not include electricity generated for self-consumption (i.e., all electricity generated and consumed on site).

Figure 4-8 Power generation by source[236]

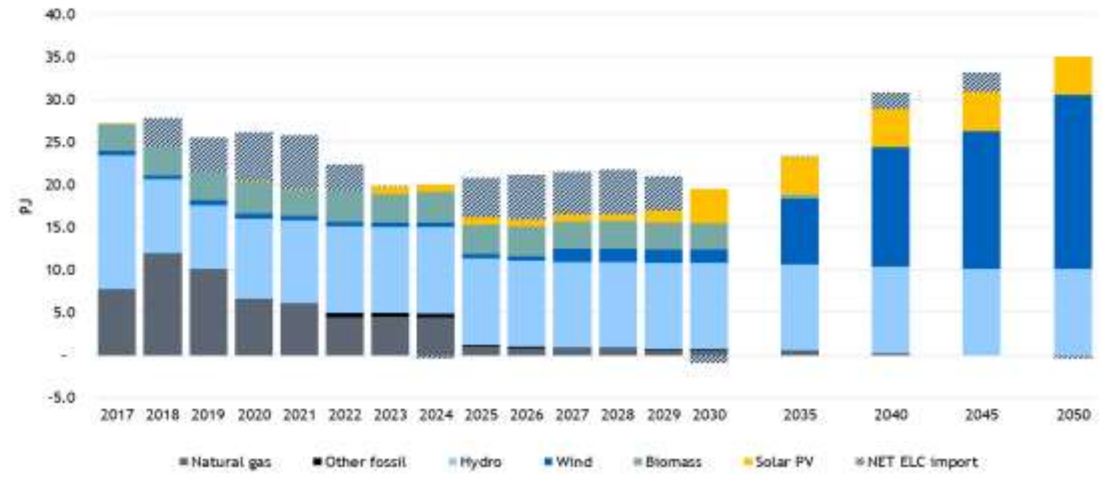


Figure 4-9 Installed power generation capacity by source[237]

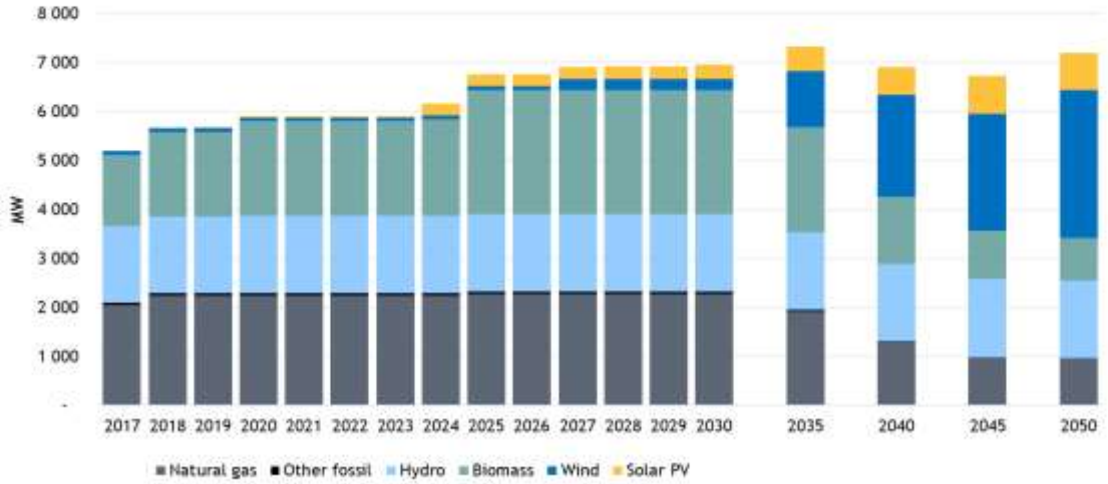
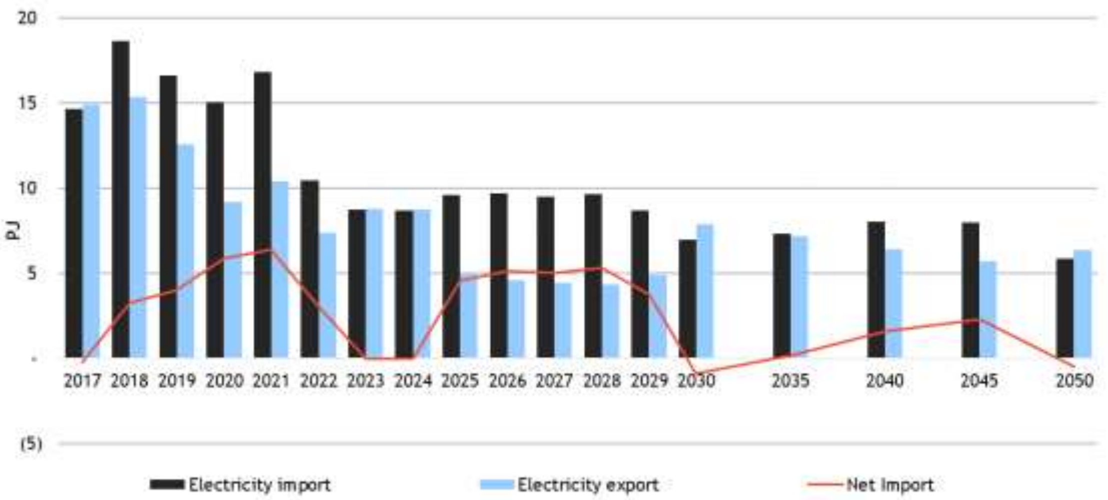


Figure 4-10 Electricity imports, exports and net balance[238]



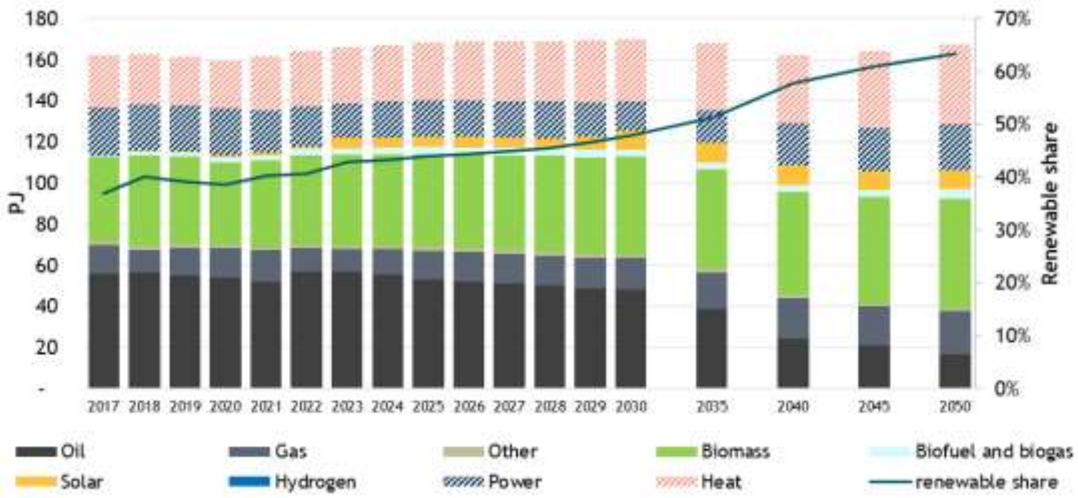
The modelling analysis also shows the emergence of battery storage to support the integration of the increasing share of renewables. Figure shows the growing amount of capacity, from 586 MW in 2025 to a peak of 1 200 MW in 2045.

Figure 4-11 Electricity storage capacity and utilisation[239]

Fuels

Figure 4-12Figure shows main fuel's groups distribution in final energy consumption across all sectors. Biomass is the fuel with the highest share in 2020 (30%) followed by Oil (namely diesel, petrol and other oil-based fuels) (29%). Gas provided 19% of energy needs in final energy use in 2020. Excluding heat and power use, the share of renewable fuels in 2020 was 40%. This is expected to increase to 60% in 2030 and 69% in 2050 (the share of renewables in heat and power is discussed in the previous sections). In the long term, the combined share of oil and gas is expected to decrease to 31% in 2030 and to 21% in 2050. The main drivers of this trend are the electrification process in transport and heat generation and improved energy efficiency. The baseline projection expects that no hydrogen will be used in the energy mix at any point of the period considered.

Figure 4-12 Fuels in final energy use[240]



[236] LATVIA-TIMES model
[237] LATVIA-TIMES model
[238] LATVIA-TIMES model
[239] LATVIA-TIMES model
[240] LATVIA-TIMES model. Note: the renewable share does not include heat and power use

4.2.2 *Energy demand*

From the dip in 2020, total energy consumption across sectors is expected to regularly increase over time, from 160 PJ in 2020 to 168 PJ in 2028, then decrease over time. However, across sectors are expected very different trends: industry and agriculture are expected to grow by 2050 by 34% and 20% respectively. On the other hand, the residential sector and the transport sector are expected to reduce consumption by 14%, while the commercial sector would first decrease then increase again its total energy use.

Figure 4-13 Final energy use by sector (2017-2050)[241]

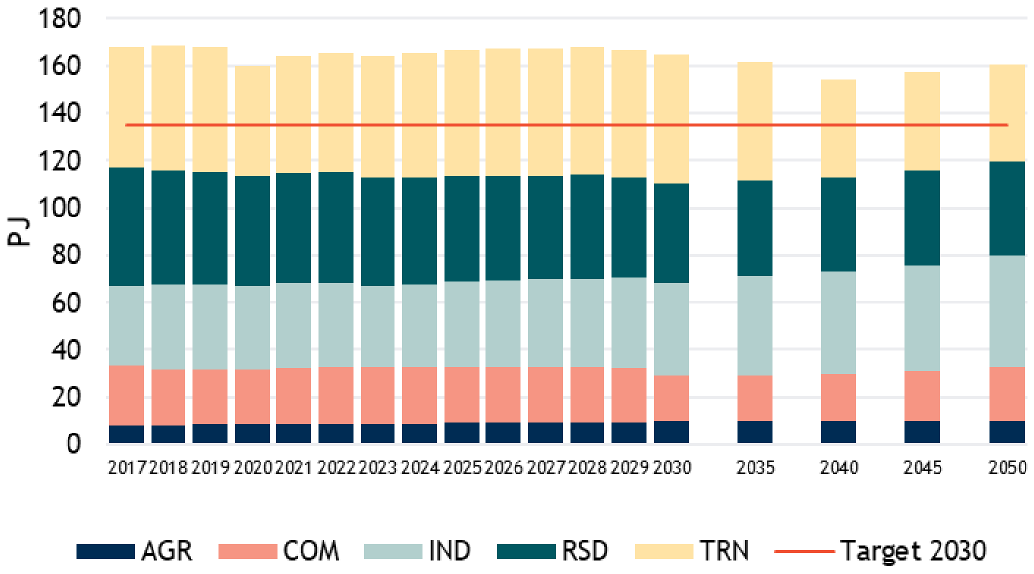
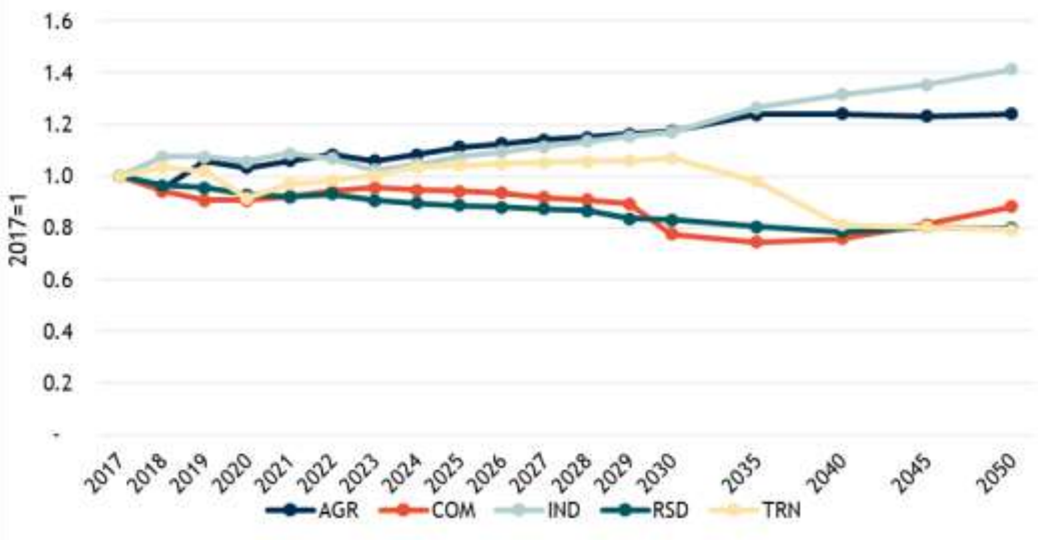


Figure 4-14 Final energy use change by sector (2017=1) [242]

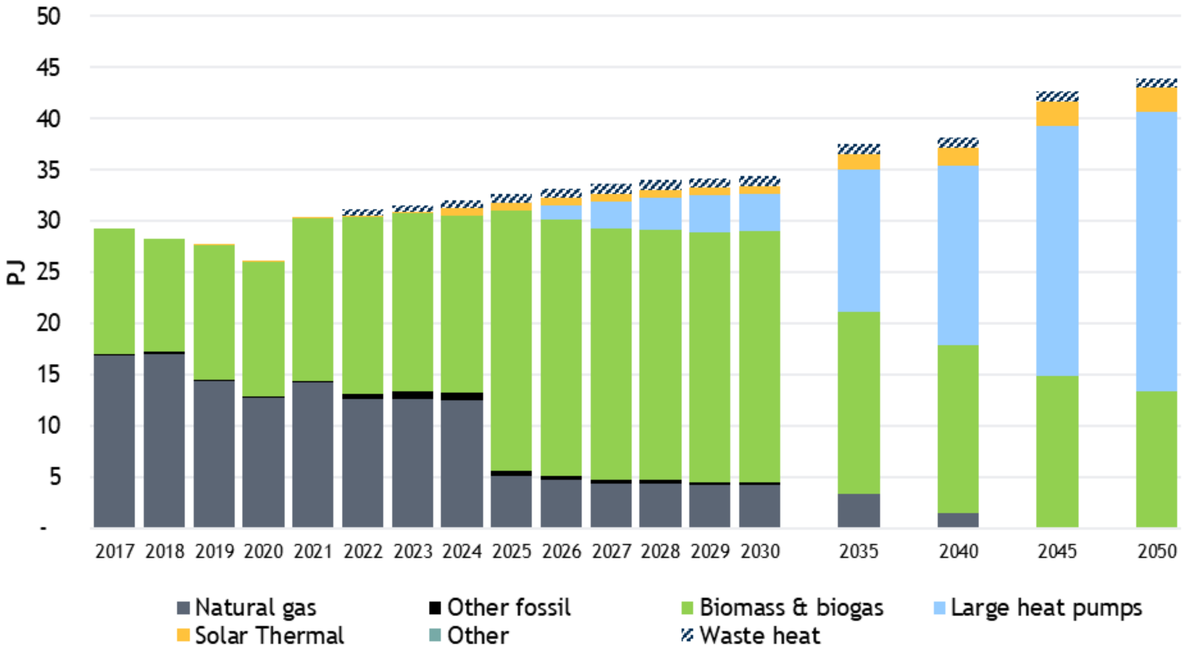


[241] LATVIA-TIMES model
[242] LATVIA-TIMES model

Heat (centralised production)

Figure 4-15Figure shows the baseline trajectory for centralised production of heat (district heating).[243] The figure does not include heat produced in single buildings (such as via gas boilers in homes or heat pumps in commercial establishment) or industrial heat. Total heat generation is expected to increase by 32% and 69% by 2030 and 2050, respectively, compared by 2020. However, total heat generation in 2020 was down compared to previous years. Currently gas, biomass and biogas provide 99% of heat production, with a slight majority for natural gas. However, by 2030, it is expected that biomass will be the dominant fuel, reaching 73% of total generation, supplemented by an emerging share of commercial-scale heat pumps (expected at 9% by 2030). Heat pumps are then expected to continue to grow substantially up to 2050, when they could provide 62% of centralised heat production, with biomass and biogas decreasing to 30% of total heat generation. Solar thermal will also emerge starting in the mid-twenties, and reach up to 5% of total generation by 2050.

Figure 4-15 Heat production by fuel (district heating) [244]



When looking at end-user consumption, the quantities of heat presentedFigure will be lower due to system losses, but the model also expects a certain amount of waste heat could be exploited. On average, in the baseline, losses amount to around 10.5% of heat generated throughout the period considered, while waste heat amount to around 3% of delivered heat (generation minus losses).

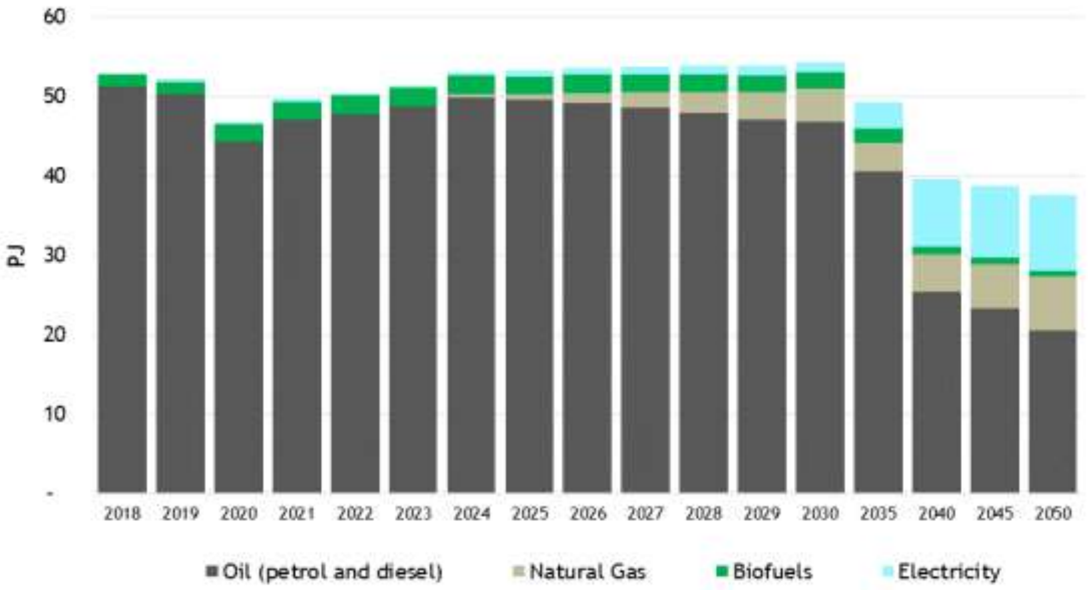
Transport sector

Energy use in the transport sector is expected to remain broadly stable until 2030, and then start a rapid decrease, with final energy use expected to be 20% lower in 2050 compared to 2020. Compared to other sectors, no significant penetration of renewables or electricity is included: in 2020, only 5% of energy use in transport came from renewables or electricity, and the share of renewable and electricity is expected to increase only up to 6% in 2030; however, the rapid changes expected after 2040 would increase the share of biofuels and electricity in transport to 20% in 2050. During the period considered,

[243] This excludes heat generation at the end use, for example through electrified devices or via individual gas boilers.
[244] LATVIA-TIMES model

diesel solidly retains its dominant share, and no other fuels (such as hydrogen) are expected to contribute significantly.

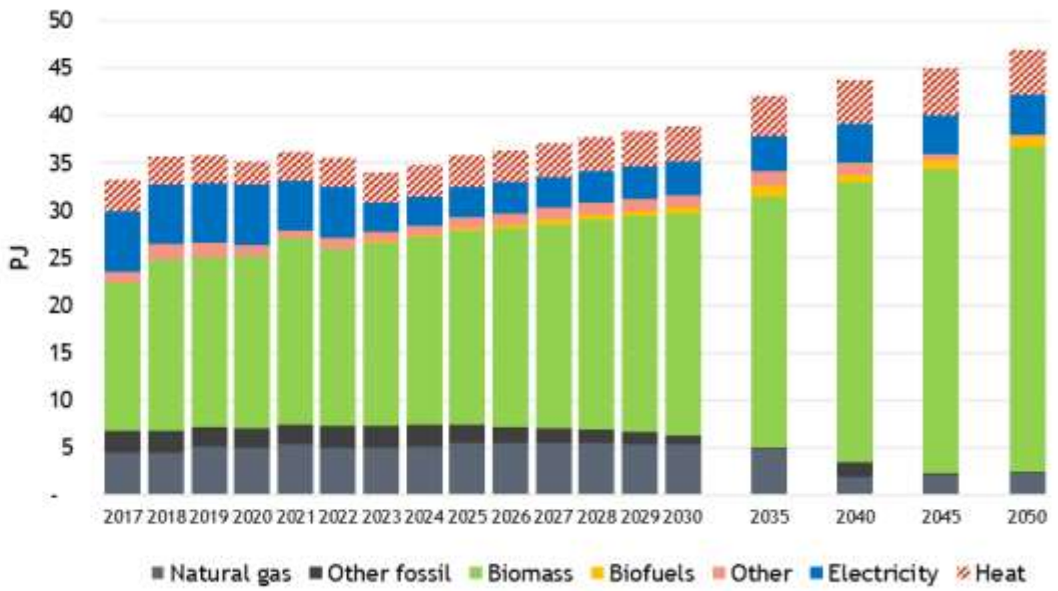
Figure 4-16 Energy use by fuel in the transport sector[245]



Industry sector

The industrial sector is the only sector where renewables are already a majority, reaching 73% of final energy use (excluding heat and electricity) by 2020. In the baseline, the share of renewables is expected to reach 94% in 2050, with among them biomass being the dominant throughout the period considered.[246] Final energy use in 2050 is expected to grow by 42% compared to 2020.

Figure 4-17 Energy use by fuel in the industrial sector[247]

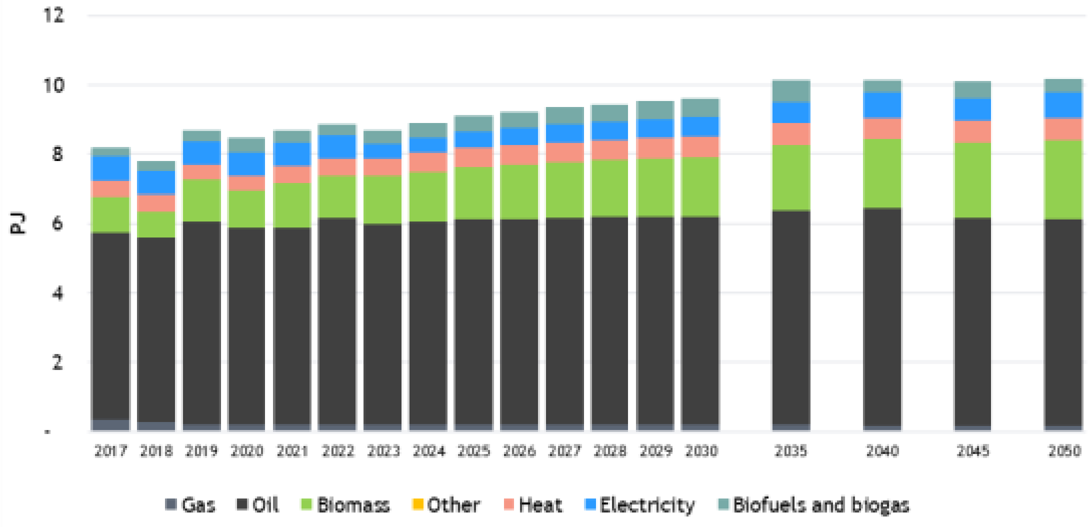


[245] LATVIA-TIMES model
[246] LATVIA -TIMES model
[247] LATVIA -TIMES model

Agricultural sector

Energy use in agriculture is expected to increase by 24% in 2050, with the mix of fuel used remaining broadly the same it was in 2020. Diesel oil is by far the dominant fuel, representing 68% of energy use in 2020 and 57% in 2050.

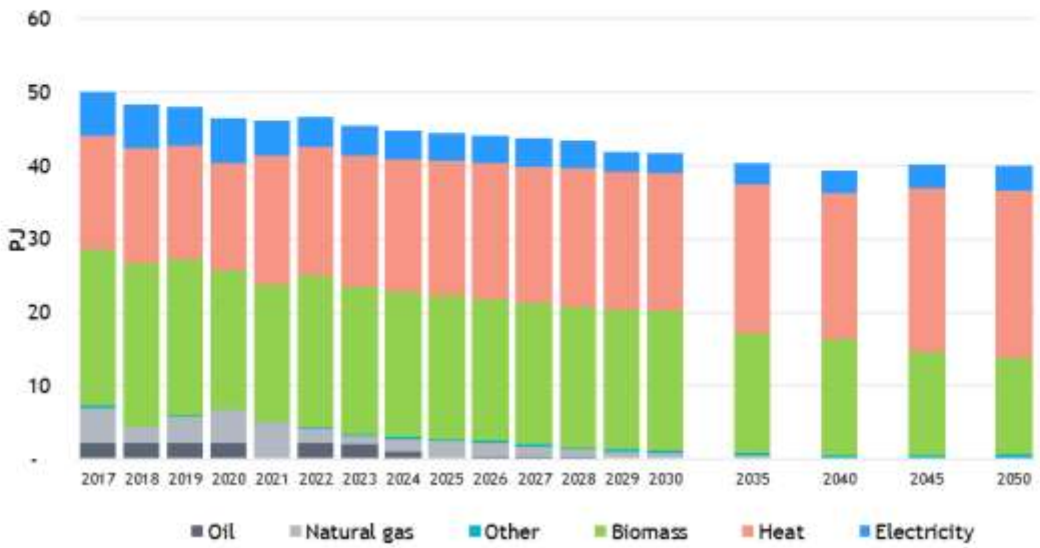
Figure 4-18 Energy use by fuel in the agriculture sector[248]



Residential sector

Baseline trends in the residential sector are more positive than those seen in other sectors: overall energy use is expected to decrease over time (decrease of 10% in 2050, compared to 2020), while the share of renewables, already quite high in 2020, at 74% (excluding imported heat (district heating) and electricity), is also expected to increase up to 92% in 2050. By 2050, imported heat and power are also expected to be renewable (see sections above on heat and electricity generationFigure).

Figure 4-19 Energy use by fuel in the residential sector[249]

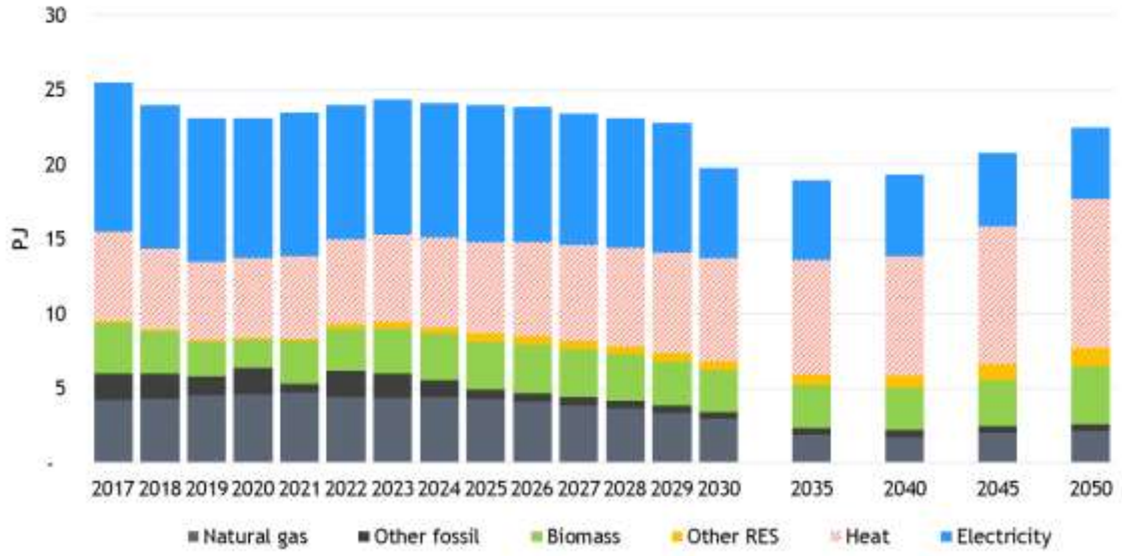


[248] LATVIA-TIMES model
[249] LATVIA-TIMES model

Commercial sector

Energy use in the commercial sector is expected to first decline then go back up near current levels towards 2050. Renewable share increases from around 25% in 2020 to 66% in 2050, while district heating is expected to increase from 23% in 2020 to 44% in 2050. On the other hand, electricity share is expected to decrease from 39% in 2020 to 16% in 2050 because on-site generation replacing electricity demand from the network.[250] The decrease in energy use is due to improved insulation, to waste heat and district heating replacing electric heating.

Figure 4-20 Energy use by fuel in the commercial sector[251]

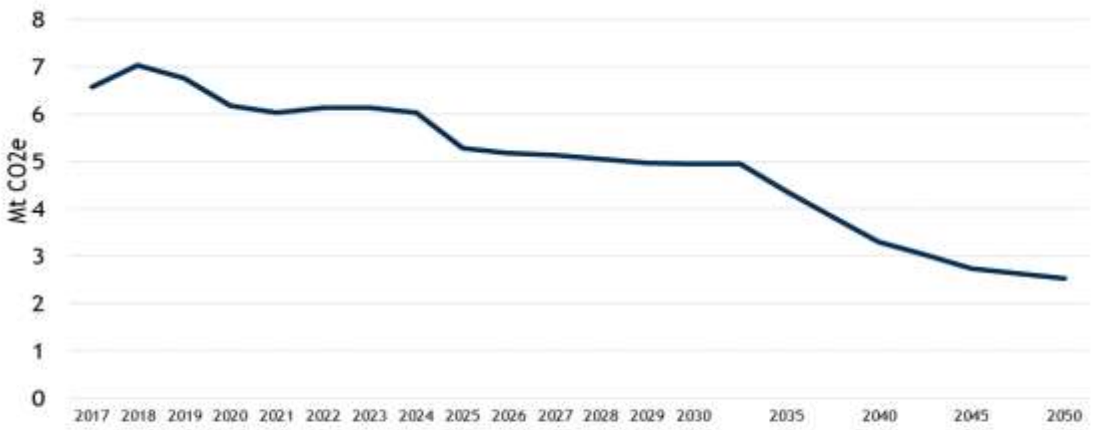


4.2.3 *Greenhouse gas emissions projections*

According to the model results, total greenhouse gas emissions are expected to decrease in the baseline, from 7 Mt CO_2 equivalent to around 3 Mt CO_2 equivalent by 2050 for the sectors considered. As described in 4.1.3, non-energy emissions (such as LULUCF) are not included in this estimate.

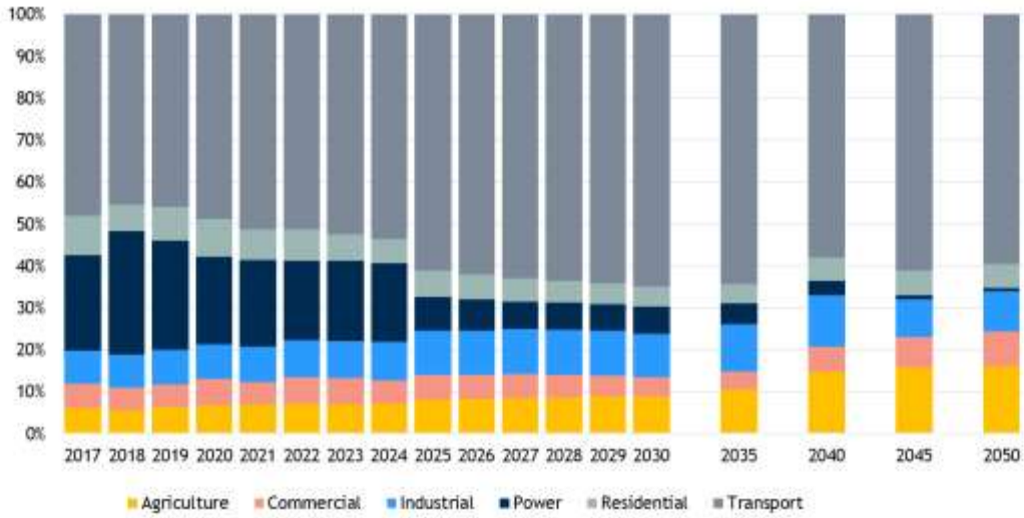
[250] As discussed in previous sections, onsite generation and consumption in building is not added to final energy consumption. This is because onsite generation is built as part of energy efficiency measures (and subsidies).
[251] LATVIA-TIMES model

Figure 4-21 Total GHG emissions[252]



In terms of sectoral emissions, power and transport sectors together account together for around 70% of GHG emissions in 2020. Over time, the share of GHG emissions from the power sector decreases significantly in the baseline (from 21% of total GHG emissions in 2020 to 1% in 2050); while the share of transport emissions goes from 48% to 63% of total GHG emissions. Absolute transport emissions remain stable at around 3 kt CO_2eq from 2020 to 2035, decreasing only to 1.8 kt CO_2eq by 2050.

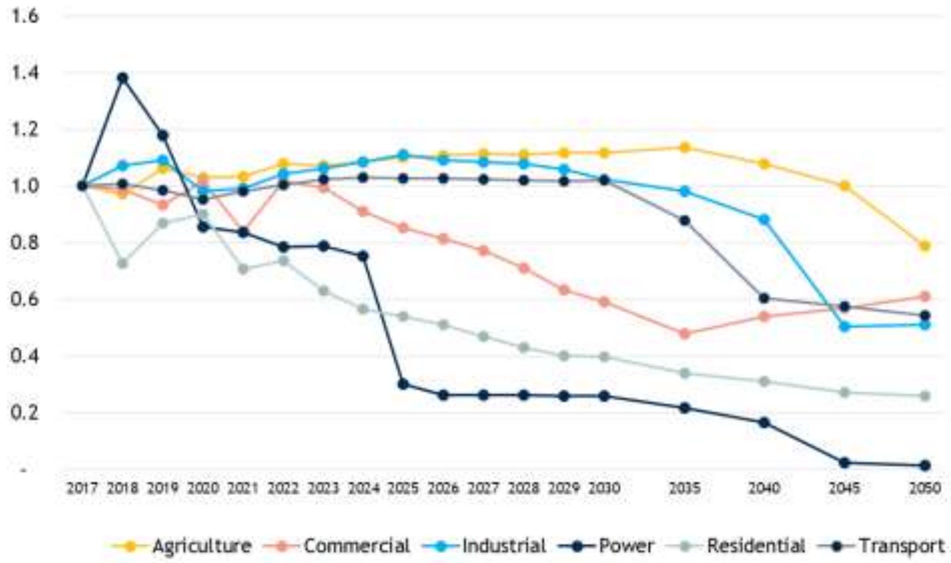
Figure 4-22 Share of sectoral GHG emissions[253]



The commercial and power sectors have steep declines by 2025 in terms of GHG emissions, while there is a more gradual decline in emissions from the residential sector. Emissions from both industrial and transport sectors only decline by 2040. The emissions from the agricultural sector remain stable throughout the time period.

[252] LATVIA-TIMES model
[253] LATVIA-TIMES model

Figure 4-23 GHG emissions change by sector (2017=1)[254]



The macroeconomic analysis of the baseline is presented in 4.5.2, together with the WAM results.

4.3 Self-optimisation run

In a self-optimisation run, the model chooses the cheapest energy mix that meets the constraints imposed, based on the technology costs and energy prices included as part of the assumptions. The additional constraints included (besides the technical and baseline constraints) are:

- 2030 targets (FEC, PEC), as included in REPowerEU strategy.
- 2050 target (CO_2e emissions) – set as 90% reduction from baseline.

The headline results of the self-optimisation run are presented below. These are to be used to understand which sectors, fuels and technologies should by targeted by policies and measures in the bottom-up approach.

Error! Reference source not found. Figure 4-24 shows that the model optimises for achieving the 2030 target by resorting to power imports, which reduces the consumption of primary energy, as well as increasing the share of wind. Following 2030, primary energy consumption continues to decrease, but at a lower late, as there is no target beyond 2030 that would drive further reductions.

[254] LATVIA-TIMES model

Figure 4-24 Primary energy consumption[255]

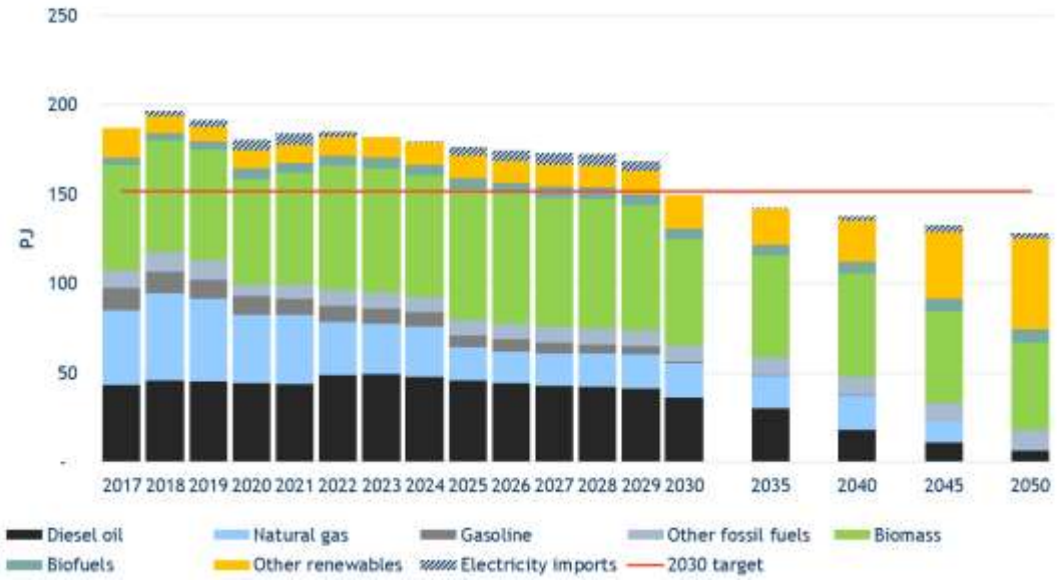
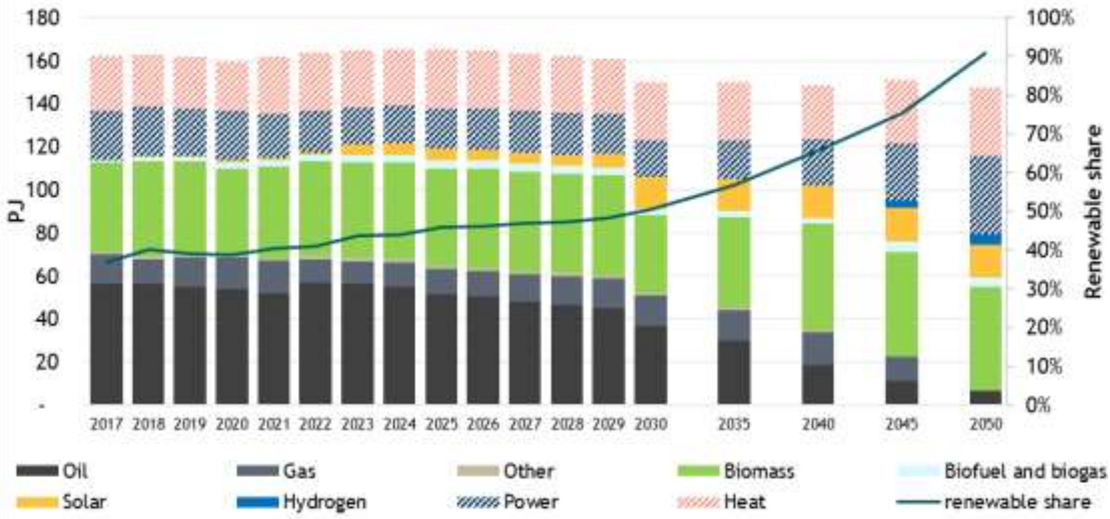


Figure 4-25Figure 4-25 shows of the total and the composition of Final Energy consumption change in response to targets. As for primary energy consumption, the model achieves the target by suddenly switching to power imports, which reduces consumption of biomass and oil in power generation.

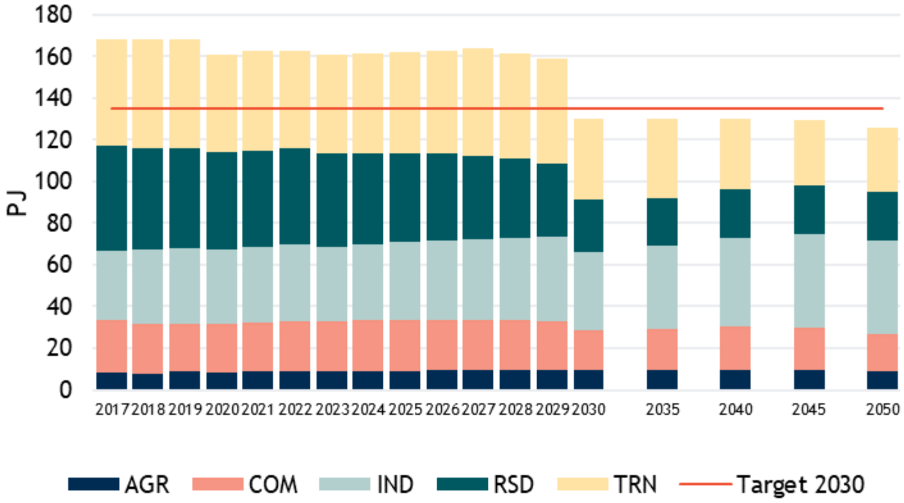
Figure 4-25 Final energy consumption[256]



The model finds that the cheaper way to reduce energy use is to act on the residential sector, with a reduction of 22 PJ by 2030 compared to 2020 (-51%)Figure . By switching all residential single family buildings from biomass boilers to heat pumps and renovating only part of apartment buildings. Other substantial reductions in percentage terms are achieved in the Commercial sector (-25%), but this amount to only 4 PJ. On the other hand, final energy use in agriculture and industry is increasing by 18% and 13%, respectively. Compared to the baseline, the biggest reductions are in the residential sector (-40%) and transport sector (-18%), while reductions in all other sectors are equal or below 6%.

[255] LATVIA-TIMES model
[256] LATVIA-TIMES model

Figure 4-26 Final energy use by sector[257]



In terms of carbon emissions (Figure 4-27Figure 4-27), the self-optimisation run shows that the most cost-efficient way to decrease emissions by 90% by 2050 is to focus first on power sector and last on the transport sector. The transport sector, currently responsible for almost half of Latvian GHG emissions, will increase its relative share of GHG emissions as other sectors achieve energy savings, reaching 73% in 2030 and 86% in 2050. Another key trend observable is the decarbonisation of the power sector in the mid '20s, with the deployment of large capacities of wind.

Figure 4-27 GHG emissions by sector[258]

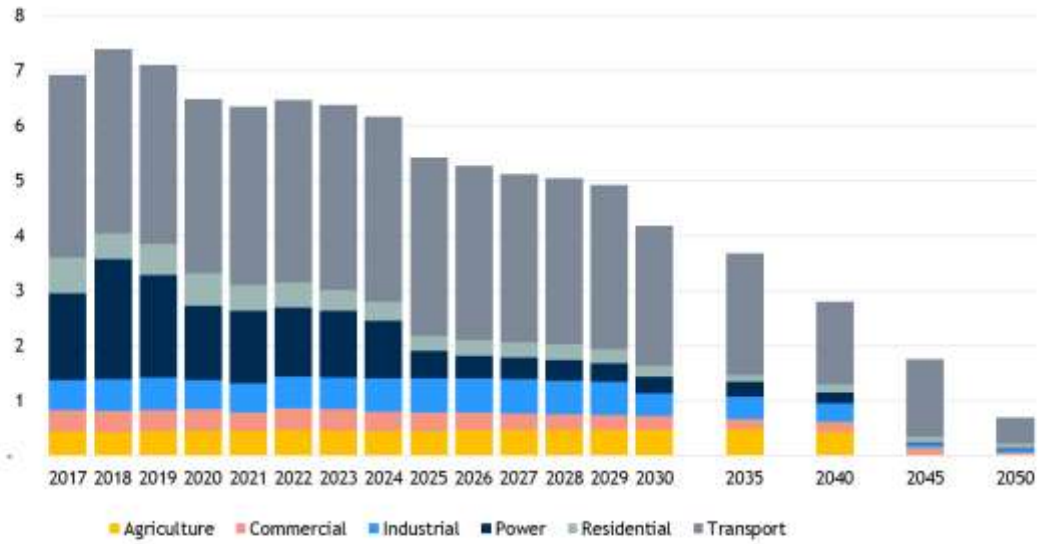


Table 4-2 shows percentages reduction from the baseline in 2030 and 2050. While the agriculture and commercial sector are laggard in 2030, by 2050 they are the sectors that manage to achieve the largest reduction in relative terms.

[257] LATVIA-TIMES model
[258] LATVIA-TIMES model

Table 4-2 Percentage reduction in emissions from baseline

	2030	2050
Agriculture	-2%	-95%
Commercial	+5%	-84%
Industrial	-26%	-76%
Power	-26%	-45%
Residential	-23%	-45%
Transport	-25%	-74%

4.4 Policies and actions explored

Following the submission of the NECP, the European Commission provided several recommendations that should be considered during this update.[259] The recommendations covered:

- The need to develop further the strategy for CO_2 emissions reduction in the non-ETS sector, particularly LULUCF;
- Increase the 2030 renewable share target to at least 50%;
- Increase ambition concerning energy efficiency and reduction of primary energy consumption;
- Clarify measures supporting the energy security objectives;
- Define forward-looking objectives and targets concerning market integration;
- Clarify the national objectives and funding targets in research, innovation and competitiveness;
- Intensify regional cooperation.

Other recommendations concern the level of details provided over energy subsidies, environmental impact (especially air quality) and just and fair transition.

Policies and actions explored can be classified in the following categories:

- **Cross-cutting**: fiscal policies (tax increase & tax rebates); fuel switch and system integration (e.g., power-to-x); research and development; reskilling programmes;
- Sector specific:
  - **Energy sector**: decarbonisation of the electricity supply (via incentives and regulation); promotion of alternative sources (e.g., hydrogen);
  - **Building and heat**: improvement in energy efficiency, fuel switch (electrification of heat, use of renewable sources);
  - **Transport**: modal shift, electrification of private and public transport;
  - **Agriculture**: electrification and energy efficiency;[260]
  - **Industry**: energy efficiency, including reutilisation of waste heat; fuel switch; renewable generation;
  - **Waste management**.

[259] European Commission (2019), Commission Recommendation of 18 June 2019 on the draft integrated National Energy and Climate Plan of Latvia covering the period 2021-2030 (2019/C297/14)
[260] LULUCF is not included in the analysis.

The tables below provide an overview of the policies modelled in the WAM and WEM scenarios.

Table 4-3 Comparative table of policies/measures modelled in the Baseline (WEM scenario) and in the WAM scenario

Policy types and sector		Action (modelled in WAM scenario)	In Baseline (measure modelled in WEM scenario)
Fiscal policies		• No change in fossil taxation (excise taxes) nor to ETS CO_2 price from baseline • Increased natural resource tax (non-ETS sectors) • Bonus/malus scheme for light-duty vehicles • Temporary reduction of road and registration tax for EVs	• Fossil taxation (excise taxes) as approved by 2022 (and assumed constant in the modelling period until 2050). • Natural resource tax on the use of coal. • Vehicle registration tax and exploitation taxes associated with CO_2 emissions (including gradual changes in the period 2017-21, then constant to 2050. • Excise tax reductions for diesel fuel used in the agriculture sector, for biodiesel and natural gas used in industrial processes. • No natural resources tax in the household sector. • No vehicle tax on electric and hydrogen-fuelled vehicles.
Subsidies	Energy efficiency in buildings	• Subsidy scheme for energy efficiency in private buildings (extension from baseline subsidy) • Subsidy scheme for energy efficiency in government and municipal buildings - medical, universities, cultural, offices (extension from baseline subsidy)	• Energy efficiency in residential buildings subsidy 2017-21 (156 MEUR) • Energy efficiency in apartment buildings subsidy 2024-27 (229.63 MEUR) • Energy efficiency and RES in private buildings subsidy 2022-27 (5.64 MEUR) • Energy efficiency and RES in commercial and public buildings subsidy 2017-21 (33.8 MEUR) • Energy efficiency and RES in government buildings subsidy 2024-27 (176.21 MEUR) • Energy efficiency and RES in municipal buildings subsidy 2024-27 (29.30 MEUR)
	Energy efficiency in industrial processes	Subsidy scheme for energy efficiency in industrial processes (extension from baseline subsidy)	Energy efficiency and RES in industry subsidy 2017-21 (11.67 MEUR) Energy efficiency and RES in industry subsidy 2024-27 (166.38 MEUR)
	Renewable electricity generation	-	RES power subsidy 2024-27 (23.49 MEUR)
	Renewable heat	Subsidy scheme for heat pumps	District heating subsidy 2017-21 (45 MEUR)
	Electric vehicles and charging	Subsidy scheme for new electric buses (extension from baseline subsidy)	Private electric vehicles subsidy 2022-27 (10 MEUR) Electric buses subsidy 2025-27 (10 MEUR) EV charging infrastructure for light-duty vehicles subsidy 2025-27 (35 MEUR)
	Public transport	Subsidy scheme for zero-emission public transport (extension from baseline subsidy) Subsidy scheme for electric trains (extension from baseline subsidy)	Zero-emission vehicles in public transport subsidy 2027 (24.39 MEUR) Electric railway infrastructure subsidy 2026-27 (74 MEUR)
	Alternative fuels	Subsidy scheme for biomethane production (extension from baseline subsidy)	Biomethane production subsidy 2024-27 (21.75 MEUR)
Regulation	Buildings	Minimum efficiency standards for new housing and commercial	Minimum performance standards for space heating for new/refurbished buildings

		buildings (more stringent compared to baseline performance standards) Ban on low-efficiency appliances for residential and commercial buildings	
	Transport	Zero and low emission zones ICE vehicle sales phase-out Enhanced vehicle labelling Increased blend share for biofuels	-
Programmes	Transport	Rapid electrification of urban services and government fleets Promotion of shorter distances and non-motorised transport	-
	Energy generation	Planning process reform Biogas and biomass: improving organic waste management	-
	Research (alternative fuels)	Extend research, including specific research on alternative fuels	-

The tables below provide an overview and further detail (compared to the above Table 4-3) of the main policies per sector included in the modelling analysis and provide some key details on how they have been modelled.

4.4.1 *Transport*

Table 4-3 Measures modelled (non-subsidy)

Policy modelled (*corresponding policy in section 5.2.1, if different title*)	Short description and expected effects	Model parameter modified	Change of the model parameter	Time-frame
Zero and low emission zones	Zero-emission zones allow mobility in specific areas to be fully or near-fully covered by transport modes with zero tailpipe emissions. They encourage vehicles technology shift as well as modal shift (to e.g. non-motorised modes, public transport). They may have positive impacts beyond the zone itself, in influencing the vehicle purchase decision of drivers living both inside and outside of the zone, and in influencing the resale value of non-zero emission vehicles.	Public transport load factor (number of passengers per unit of public transport activity)	Increase by 20% on short and medium distances	From 2024
		Cycling and walking availability factor	Increase by 20%	From 2024
		Cycling and walking comfort factor	Increase by 20%	From 2024
		EV comfort factor	Increase by 10%	From 2024
Phase-out of new ICE vehicles sales	Only alternative powertrain vehicles are allowed for new sale as of 2035-2045, which would force the adoption of low-emission vehicle technologies, in particular electric vehicles.	New LDV sales - LPG, gasoline, diesel oil, gasoline hybrid, diesel oil hybrid, natural gas	Decrease to 0 (no new sales)	From 2035
		Second-hand imported natural gas LDV sales	Decrease to 0 (no new sales)	From 2035
		Second-hand imported LDV sales - LPG, gasoline, diesel oil, gasoline hybrid, diesel oil hybrid	Decrease to 0 (no new sales)	From 2040
		New bus sales - LPG, gasoline,	Decrease to 0 (no new sales)	From 2035

		diesel oil, natural gas		
		New diesel oil hybrid bus sales	Decrease to 0 (no new sales)	From 2040
		New diesel oil train sales	Decrease to 0 (no new sales)	From 2045
		New light and heavy trucks sales - LPG, gasoline, diesel oil, natural gas	Decrease to 0 (no new sales)	From 2040
Enhanced vehicle labelling	Better consumer information on car energy and emissions performance influences the attractiveness of different car models to consumers. It favours the attractiveness of energy efficient and low-emission models such as electric vehicles.	Electric vehicle comfort factor	Increase by 10%	From 2024
Rapid electrification of urban services and government fleets	This involves electrifying vehicles belonging to public administrations as well as fleets of vehicles delivering public or commercial services (e.g. garbage trucks, public transport, taxis, delivery vehicles). Urban services and government fleets are among the easiest transport sectors to electrify and to initiate a larger-scale electrification of transport through technology-proving, example-making, and cost reductions as the number of electric vehicles deployed grow. This measure can effectively be shaped as conventional vehicle bans or mandatory adoption rates of alternative vehicles.	Number of internal combustion engine buses on short distance trips	Decrease to 0 (ban)	From 2027
		Share of light commercial electric trucks	All light commercial trucks in urban areas electrified	Progre-ssive from 2024 (1%) to 2027 (5%[261])
Promotion of shorter distances and non-motorised transport (*Extend and scale-up TDG 2021-27 beyond 2027: enhancement of public transport infrastructure, electrification of transport, further development of railways in order to encourage modal shift*)	This policy aims to contain the increase in total motorised transport demand despite population and GDP growth and as a result contain energy demand and GHG emissions growth in the transport sector.	Total motorised transport passenger-km	Asymptotic	From 2019
		Share of public transport	Increased filling levels of buses. For short and medium-distance buses it was increased by 30 % compared to baseline.	From 2035
Increased blend share for biofuels	This policy aims to develop domestic biofuels industry and decrease reliance on fossil imports.	Blend share for biofuels	15% for biodiesel 10% for bioethanol	From 2025

Table 4-4 Subsidy schemes modelled

Subsidy scheme (*corresponding policy in section 5.2.1,5.2.1, if different title*)	Short description	Mechanism modelled

[261] 5% is assumed to be the share of urban vehicles within light commercial trucks.

Subsidy scheme for new electric buses (*Extend and improve zero-emission vehicle incentive schemes*)	This subsidy scheme supports the investment in new electric buses for intercity transport.	New electric buses are 100% subsidised, with a ceiling for total subsidies offered of €3 million/year from 2025 to 2030, and of €5 million/year from 2031 to 2050.
Subsidy scheme for zero-emission public transport (*Extend and improve zero-emission vehicle incentive schemes*)	This subsidy scheme supports the investment in zero-emission public transport in urban areas.	New zero-emission public transport vehicles are 100% subsidised, with a ceiling for total subsidies offered of €5 million/year from 2025 to 2050.
Subsidy scheme for electric trains (*Extend and improve zero-emission vehicle incentive schemes*)	This subsidy scheme supports the investment in new electric trains and passenger railway lines electrification.	New electric trains are 100% subsidised, with a ceiling for total subsidies offered of €5 million/year from 2025 to 2050.
Bonus/malus scheme for light-duty vehicles (*Extend and improve zero-emission vehicle incentive schemes*)	This scheme supports the investment in new electric light-duty vehicles (cars and light commercial vehicles) by lowering the costs to invest and maintain them while increasing the same costs for fossil fuel vehicles.	See equations in section 5.2.1.

4.4.2 *Low-carbon energy*

Table 4-5 Measures modelled (non-subsidy)

Policy modelled *(corresponding policy in section 5.2.2 or 5.2.4, if different title)*	Short description and expected effects	Model parameter modified	Qualitative change of the model parameter	Timeframe
Planning process reform	A planning process reform would aim to make the planning process for low-carbon energy lighter, which would in turn would lower project costs and expected financial returns for investors, and shorten development time.	Project development time	Decrease by 25%	From 2024
Biogas and biomass: improving organic waste management	Better organic waste management looks to a more effective organic waste valorisation into biomass feedstock and biogas for energy purposes.	Biogas (landfill gas) availability	Increase by 20%	Between 2025 and 2050, gradually
Extend research, including specific research on alternative fuels	More research is expected to indirectly accelerate the penetration of alternative technologies to the market and decrease their cost.	Biofuel price (domestic production)	Decrease by 20%	From 2025
		Hydrogen plants fixed costs	Decrease by 20%	From 2025

Table 4-6 Subsidy schemes modelled

Subsidy scheme *(corresponding policy in section 5.2.2 or 5.2.4, if different title)*	Short description	Mechanism modelled
Subsidy scheme for biomethane production (*Subsidy scheme for alternative fuels*)	This subsidy scheme supports the investment in biomethane production. The measure modelled finances 50% of new biomethane production capacity (up to a yearly ceiling).	New biomethane production capacity is subsidised at 50%, with a ceiling for total subsidies offered of €10 million/year from 2028 to 2030 and €5 million/year from 2031 to 2050.
Subsidy scheme for heat pumps (*Support scheme for renewable heat*)	This subsidy scheme supports the investment in heat pumps in the residential and commercial sectors.	The measure modelled finances 50% of investments in heat pumps in the residential and commercial sectors between 2025 and 2050.

4.4.3 *Residential and commercial sectors*

Table 4-7 Measures modelled (non-subsidy)

Policy modelled *(corresponding policy in section*	Short description and expected effects	Model parameter modified	Qualitative change of the	Timeframe

5.2.3, if different title)			model parameter	
Minimum efficiency standards for new housing and commercial buildings	More stringent efficiency standards in new buildings leads to reduced energy use per square meter as the building stock is gradually expanding and/or being replaced.	New residential and commercial buildings energy use per square meter	Decrease by 20%	From 2027
Ban on low-efficiency appliances for residential and commercial buildings (*Minimum efficiency standards for new housing and commercial buildings*)	A ban on low-efficiency appliances (in particular, biomass for water heating and cooking) is expected to accelerate the penetration on high-efficiency appliances and contribute to reducing the energy intensity of the residential and commercial sectors.	Installation of technologies for ventilation, cooling, lightning, electric appliances, with the lowest energy efficiency rating	Decrease to 0 - ban	From 2027

Table 4-8 Subsidy schemes modelled

Subsidy scheme (*corresponding policy in section 5.2.3, if different title*)	Short description	Quantified mechanism
Subsidy scheme for energy efficiency in buildings (*Subsidy scheme for energy efficiency in residential buildings - Subsidy scheme for energy efficiency in commercial buildings*)	The subsidy scheme aims to accelerate the energy renovation of residential and commercial buildings and leads to lower energy use per square meter.	65% of renovation costs are subsidised, up to a ceiling of 2.7 million m^2 per year for apartment buildings, and 2.5 million m^2 per year for single-family homes, from 2024.
Subsidy scheme for energy efficiency in government and municipal buildings - medical, universities, cultural, offices (*Support scheme for energy efficiency in commercial buildings*)	The subsidy scheme aims to accelerate the energy renovation of government and municipal buildings and lead to lower energy use per square meter.	65% of renovation costs are subsidised, from 2024.

4.4.4 *Industry*

Table 4-9 Subsidy schemes modelled

Subsidy scheme (*corresponding policy in sections 5.2.3, if different title*)	Short description	Mechanism modelled
Subsidy scheme for energy efficiency in industrial processes (*Support scheme for energy efficiency in industrial processes and businesses*)	This subsidy scheme supports the investment in industrial processes that have high energy efficiency performance or that rely on renewable resources other than biomass.	The measure modelled finances 50% of such industrial processes, up to a yearly ceiling of €14.4 million from 2027 to 2030, and €7.2 million from 2031 to 2050.

4.5 The system integration pathway results

This section presents the results of the analysis of policies and reforms, modelled starting from the baseline and the self-optimisation results presented in the previous section.

4.5.1 *Energy system modelling*

Overall reductions

Figure Figure 4-28 and Figure 4-29Figure present the overall results of the policies modelled against the baseline and the 2030 targets for both Primary Energy Consumption (target equivalent to 152 PJ in 2030) and Final Energy Consumption (target equivalent to 135 PJ in 2030). They show a reduction of

10% and 12%, respectively, against the baseline, but they both fall short of the targeted value for 2030. To reach the target, PEC and FEC should be reduced by a further by 3% and 6%, respectively, against the baseline.[262]

Figure 4-28 Primary energy consumption projections (baseline, WAM and targets)[263]

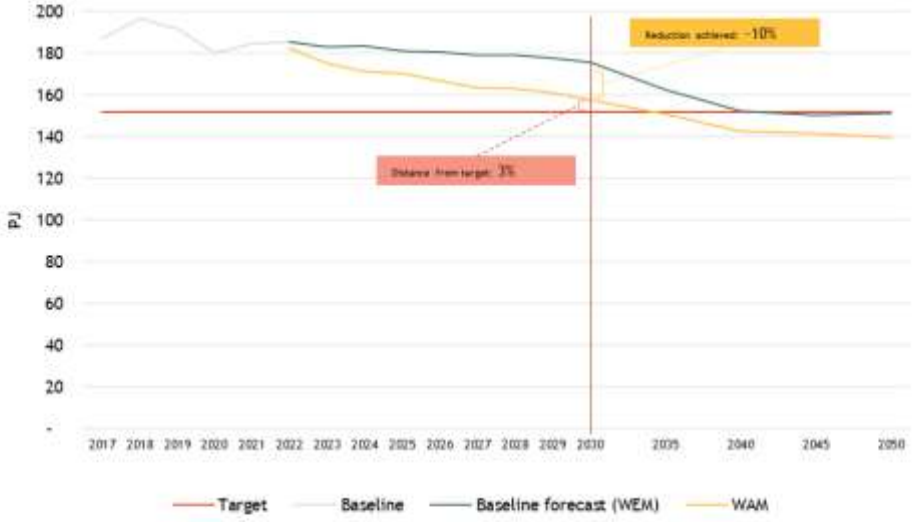
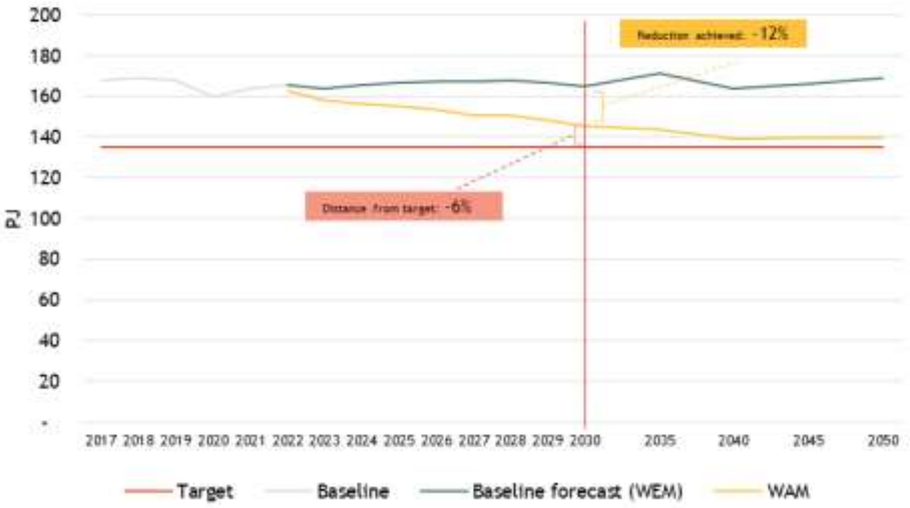


Figure 4-29 Final energy consumption projections (baseline, WAM and targets) [264]



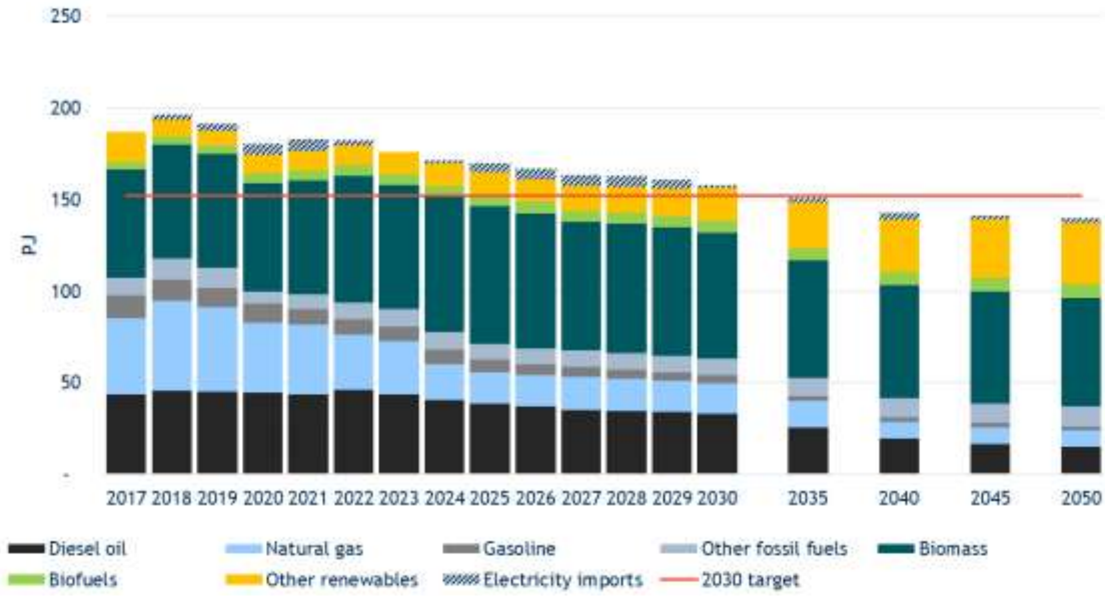
Primary energy consumption

The WAM forecast for primary energy consumption shows a decreasing trend over time, going from 180 PJ in 2020 to 152 PJ in 2050. In the long term, renewables, and in particular bioenergy, will provide the majority of Primary Energy Consumption, bringing the renewable share at 59% and 72% in 2030 and in 2050, respectively[265]. Gas consumption is expected to decrease substantially from 38 PJ in 2020 to 9 PJ

[262] The percentages are calculated with respect to the target. So, for example, total required reduction for PEC is 13%, of which 10% is achieved by the current policies and 3% has not yet been identified.
[263] LATVIA-TIMES model.
[264] LATVIA-TIMES model. Onsite energy use (mostly solar PV, but also some wind) is excluded from the total as this is considered as part of energy efficiency measures
[265] Electricity imports are excluded from this estimate

in 2050. Primary energy consumption in the WAM scenario is around 8% lower by 2050 than in the WEM scenario.

Figure 4-30 Primary energy consumption (2017-2050)[266]



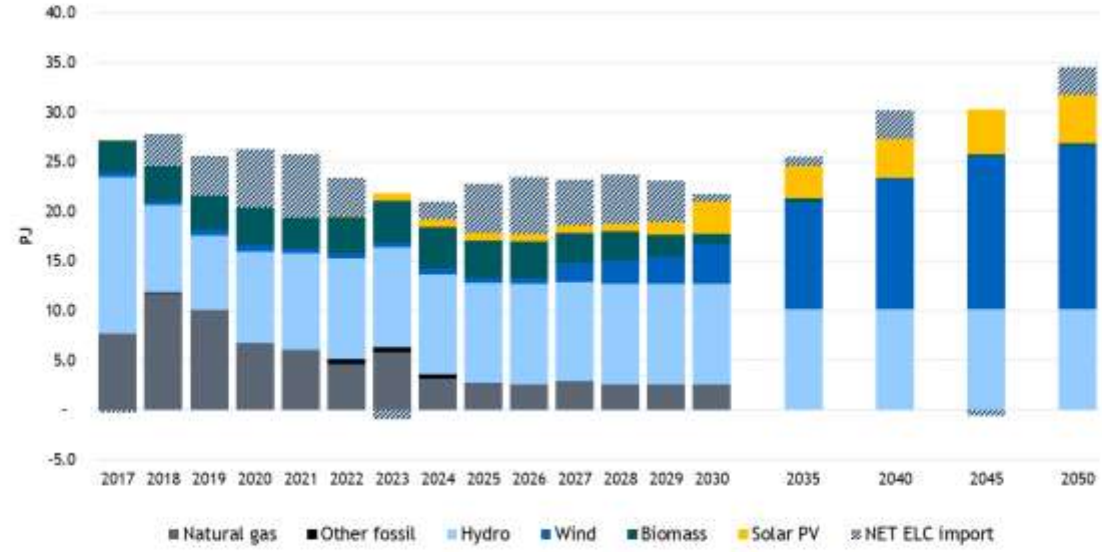
Compared to the baseline, in 2030, the largest relative reductions are seen in the use of other fossil fuels (-33%, but just over 0.2 PJ), gasoline (-25%, a reduction of 1.4 PJ) and diesel (-24%, but with a reduction of 10 PJ). In 2050, the biggest relative reductions against the baseline are for natural gas (-58%, a reduction of 13 PJ) and for gasoline (-33%, a reduction of 1 PJ). Also renewables show a decrease compared to the baseline (-2.8 PJ), mostly due to lower total energy demand.

Electricity

As in the baseline, total energy generated by the power sector is expected to follow a variable trajectory up to 2030, after which substantial wind capacity is expected to come online. From then onwards, electricity generation follows a steady increase until 2050. Fossil fuels (mainly natural gas) are expected to almost disappear by 2030 from the generation mix. By 2030, wind and hydro are expected to supply 66% of the total electricity. As in the baseline, hydro production remains steady (at 10 PJ/year). However, wind and solar PV[267] increase steeply going from 2% and 0% of electricity production in 2020, respectively, to 19% and 15% by 2030 and 48% and 14% by 2050. As in the baseline, biomass only provides marginal contribution after 2040. Neither carbon capture and storage (CCS) nor nuclear power are expected to be part of the energy matrix in the WAM scenario.

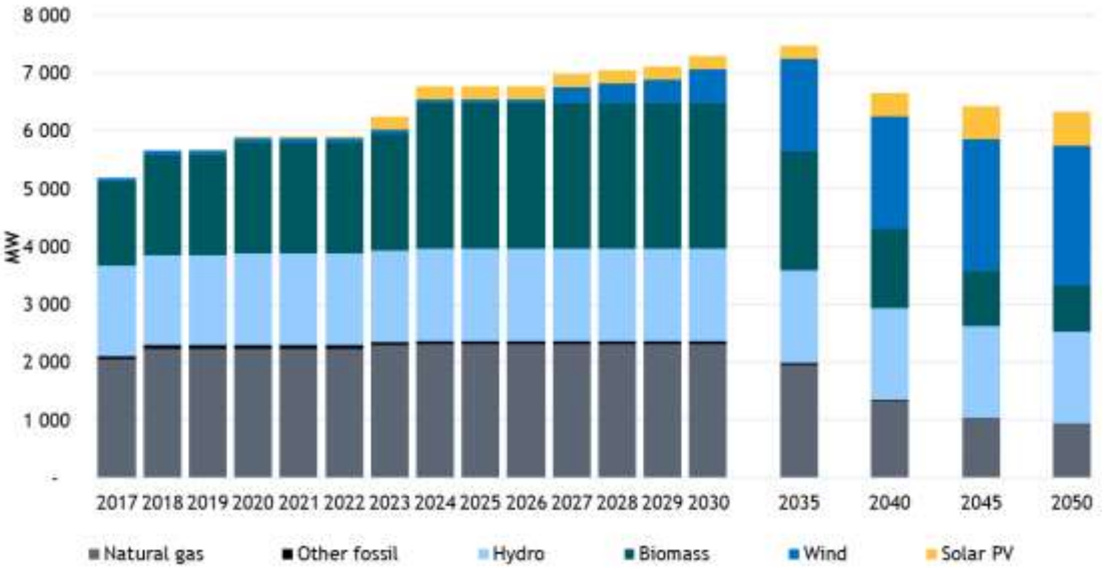
[266] LATVIA-TIMES model
[267] Solar PV generation incudes distributed generation for self-consumption (e.g., rooftop solar) but does not include electricity generated for self-consumption (i.e., all electricity generated and consumed on site).

Figure 4-31 Power generation by source[268]



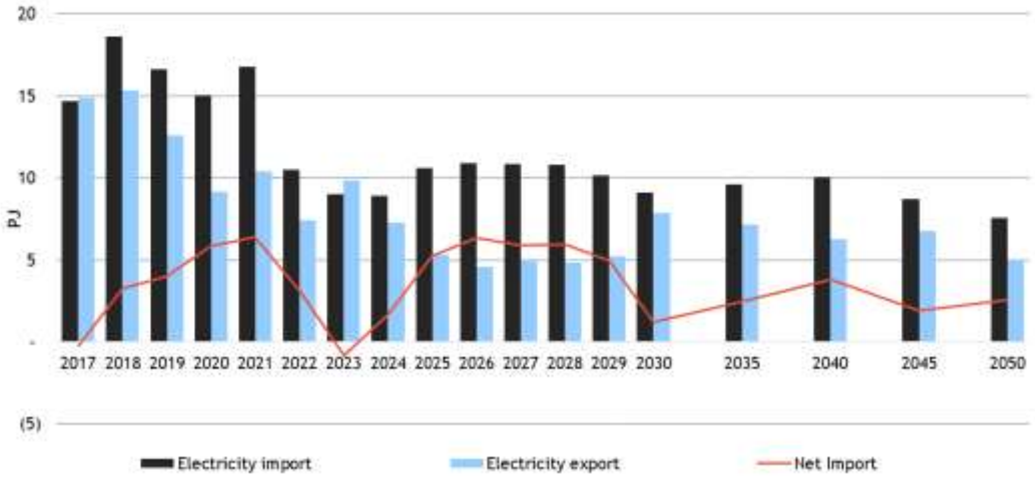
The WAM scenario expects slightly higher installed capacities than in the baseline by 2050, mainly due to higher wind installed capacities, boosted by the planning process reform policy modelled, which reduces project development time.

Figure 4-32 Installed capacity by source[269]



[268] LATVIA-TIMES model
[269] LATVIA-TIMES model

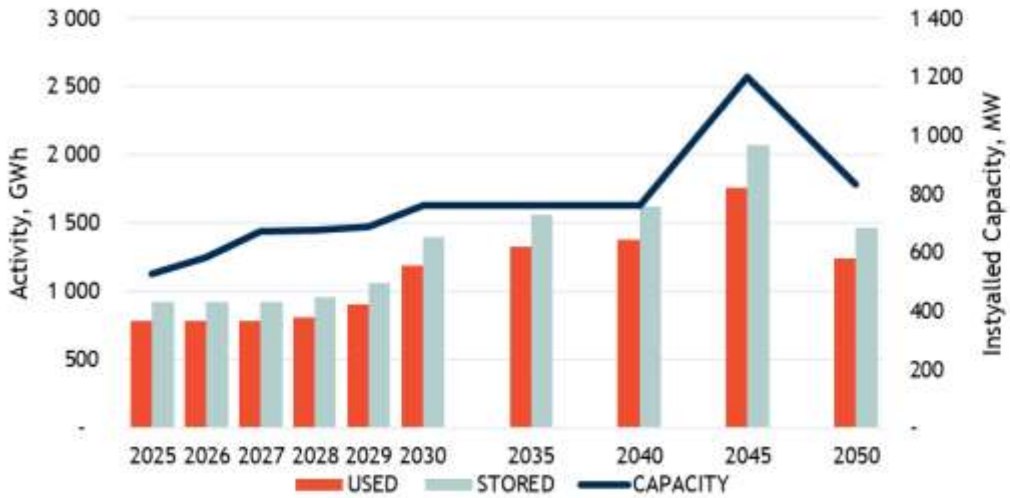
Figure 4-33 Electricity imports, exports and net balance[270]



In the WAM scenario, power exports and net imports are not too different than in the baseline, while after 2025 power imports are slightly higher in the WAM than they were in the baseline.[271]

The modelling analysis also shows the emergence of battery storage to support the integration of the increasing share of renewables. Figure 4-34 Figure shows the growing amount of capacity, roughly doubling each 10 years to reach 1.2 GW in 2050. These figures are not significantly different to baseline trends.

Figure 4-34 Installed capacity and utilisation of storage technologies[272]



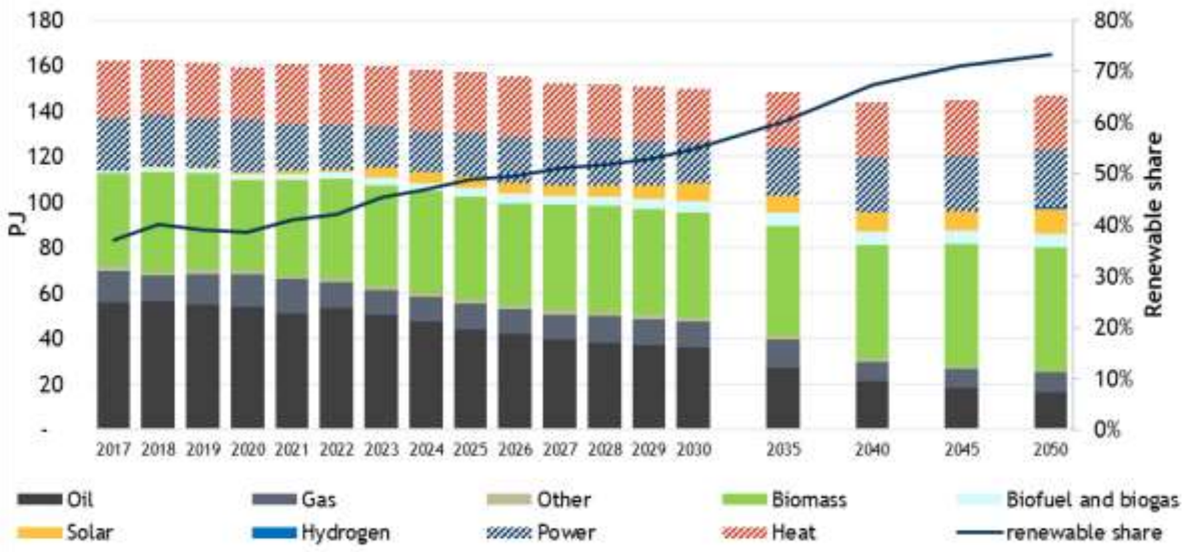
Fuels

Figure 4-35Figure shows main fuel's groups distribution in final energy consumption across all sectors. Excluding heat and power use, the share of renewable fuels increases from 40% in 2020 to 56% in 2030 and 74% in 2050. In the long term, the combined share of oil and gas is expected to decrease to 17% by

[270] LATVIA-TIMES model
[271] However, electricity generation is higher in the WAM scenario by 2050 by 14%, compared to the WEM scenario.
[272] LATVIA-TIMES model

2050. Compared to the baseline, the WAM only show a very limited amount of hydrogen being used in transport in 2050.

Figure 4-35 Fuels in final energy use[273,274]



In the WAM scenario, final biogas/biomethane consumption is somewhat boosted thanks to increased biogas availability compared to the WEM scenario, and the subsidy scheme for biomethane production, which is being used close to its full extent between 2028 and 2050. Their combined share of direct use in the total fuel mix (i.e. power and heat aside) does not surpass 4% by 2050. In addition, no hydrogen is used and biofuels remain very marginal in total final energy consumption by 2050 in the WAM scenario. One reason for this is the use of electricity for the decarbonisation and energy efficiency of the transport sector, instead of alternative liquid/gaseous fuels.

Energy demand

In the WAM scenario, total energy consumption across sectors is expected to regularly decrease over time, from 160 PJ in 2020 to 140 PJ in 2050. However, trends across sectors in the WAM scenario are very different: industry and agriculture are expected to grow by 2050 by 33% and 19% respectively. On the other hand, the commercial, transport and the residential sector are expected to reduce consumption by 3%, 25% and 46% respectively.

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[273] the renewable share does not include heat and power use or hydrogen
[274] LATVIA-TIMES model

Figure 4-36 Final energy use by sector (2017-2050)[275]

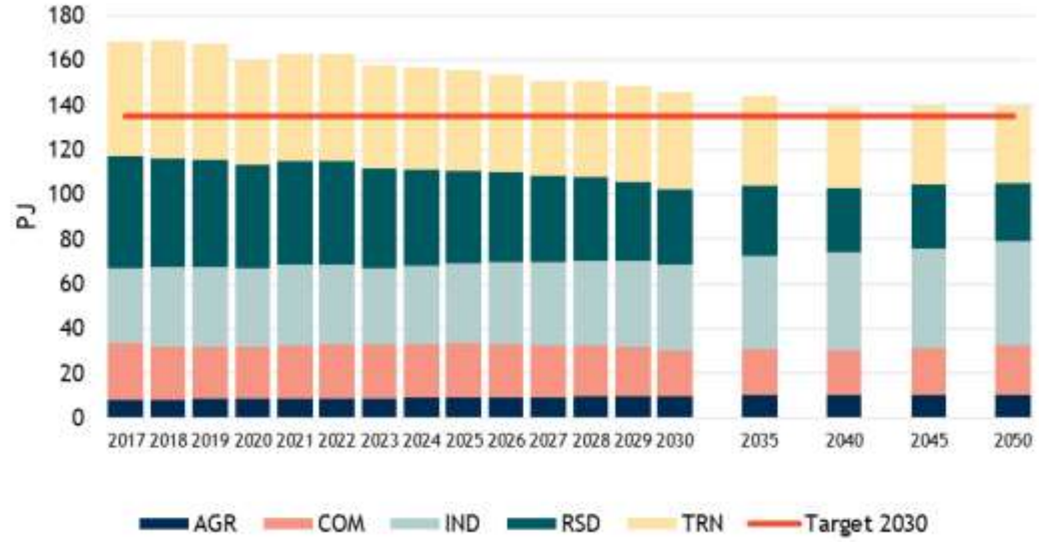
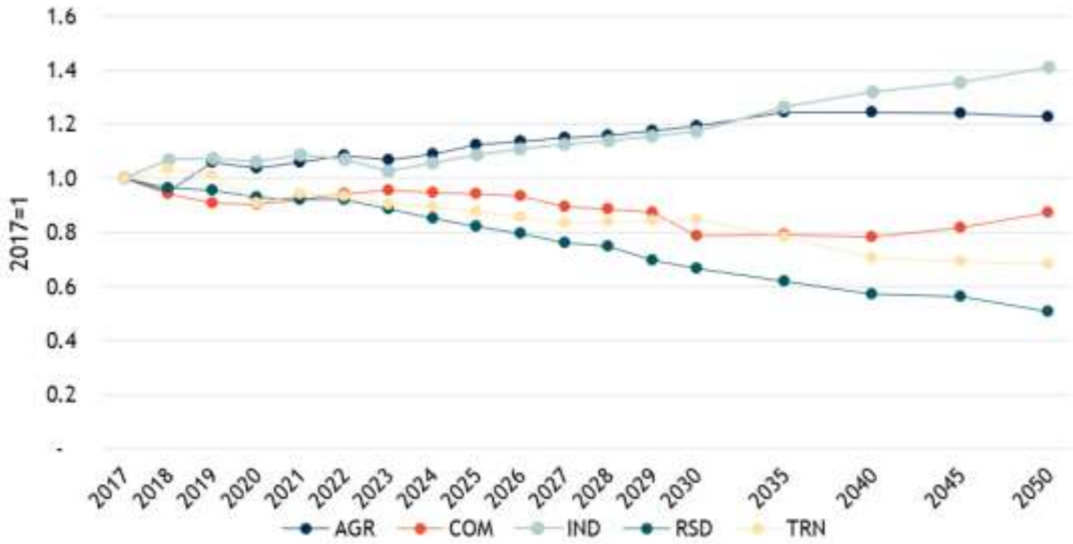


Figure 4-37 Final energy use change by sector (2017=1)[276]



Heat (centralised production)

Figure 4-38Figure 4-38 shows the WAM trajectory for centralised production of heat.[277] In contrast to the baseline, total heat generation is expected to remain somewhat stable at 30 PJ (decreasing 10% by 2030 and remaining around the same level until 2050). Natural gas is expected to be phased out significantly reduced by 2024 and phased out by 2045, while biomass will first increase its share, then decrease it after 2030 (going from 50% in 2020, to 78% in 2030, 58% in 2040 and 46% by 2050). As in the baseline, there is an emerging share of commercial-scale heat pumps in the WAM scenario (expected at 24% by 2035 and at 45% by 2050, equivalent to 7 PJ and 12 PJ, respectively), thanks to substantial support to the technology via dedicated support schemes. Solar thermal will also emerge, starting in the mid-twenties, and reach up to 6% of total generation by 2050, while waste heat is expected to remain at around 1 PJ (3% of heat generation) throughout the period considered.

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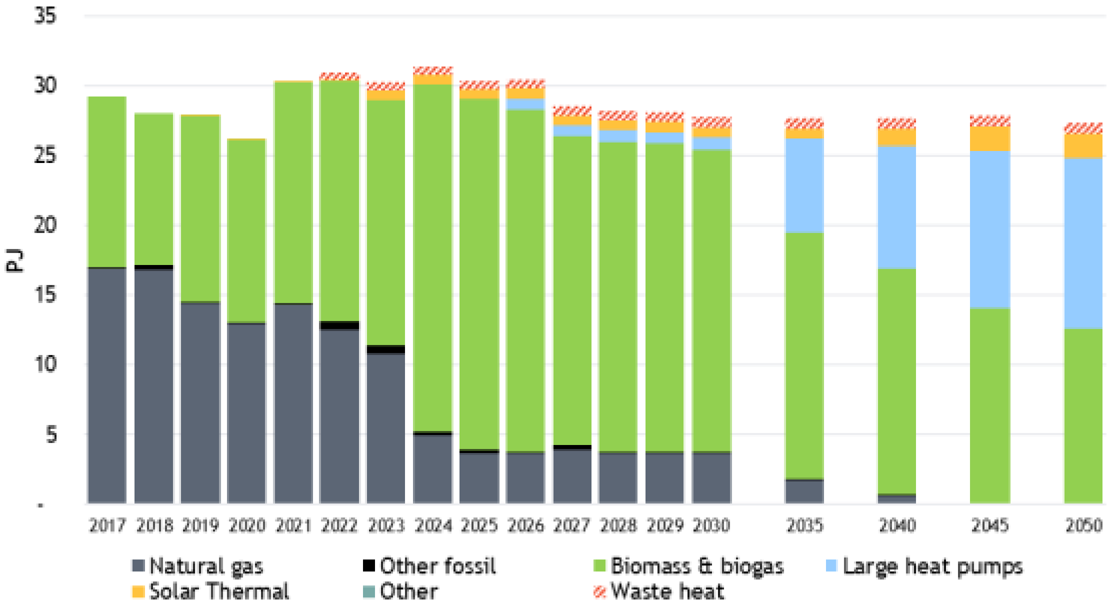
[275] LATVIA-TIMES model
[276] LATVIA-TIMES model
[277] The figure does not include heat produced in single buildings (such as via gas boilers in homes or heat pumps in commercial establishment) or industrial heat.

Figure 4-38 Heat production by fuel[278]



When looking at end-user consumption, the quantities of heat presented in Figure 4-38 will be lower due to system losses. On average, losses in the WAM amount to around 10.5% of heat generated throughout the period considered. These figures are unchanged from the baseline.

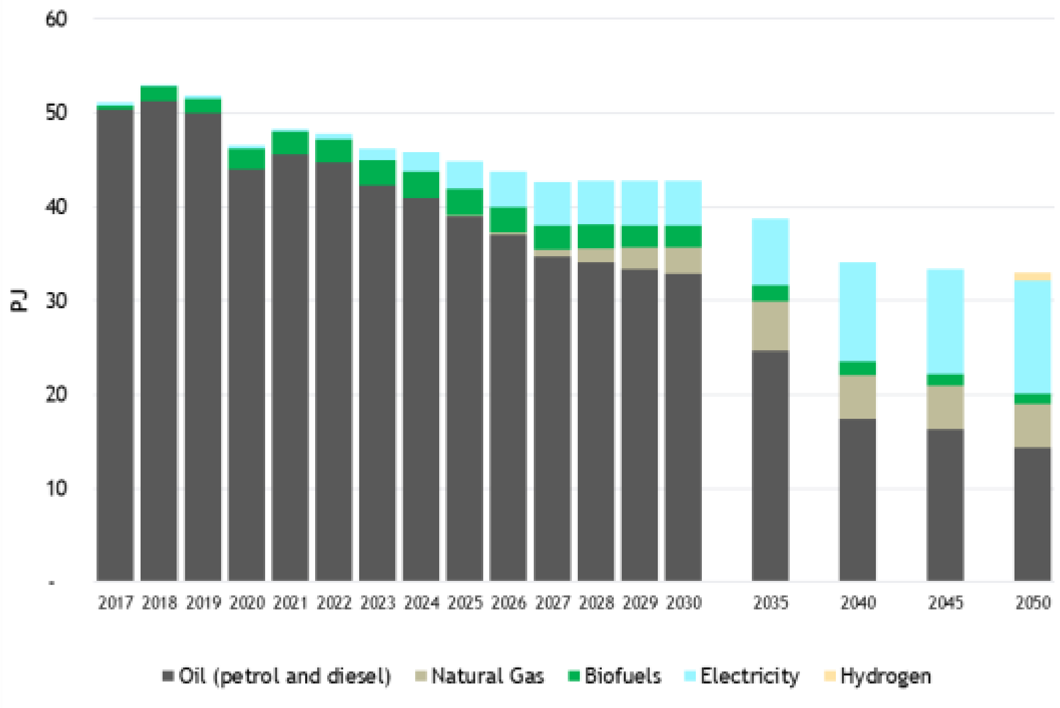
In comparison with the WEM scenario, the WAM scenario sees a larger share of biomass and lower share of large heat pumps in final consumption, but this is mainly due to significantly lower heat demand driven by energy efficiency measures, which sees total heat demand in 2050 going from 44 PJ to 27 PJ (38% reduction). Essentially, the model maintains the same biomass generation level (around 13 PJ per year in 2050, but fewer heat pumps are needed to satisfy the remaining demand.

Transport sector

In the WAM scenario, the transport sector is expected to maintain its total energy use up to 2030, then decrease between 2030 and 2040, and stabilise at about 33 PJ from 2040 (29% lower in 2050 compared to 2020). The share of renewables is expected to increase up to 17% in 2030 (above the EU 14% target) and 40% by 2050. As in the baseline, diesel remains dominant, though by 2050 electricity use due to electric vehicle penetration is almost as high. Hydrogen consumption in the transport sector only reached 900 TJ (3% of transport fuels) in 2050.

[278] LATVIA-TIMES model

Figure 4-39 Energy use by fuel in the transport sector[279]



The measures modelled in favour of alternative fuels/powertrains and in particular electrification have led to an increase of electricity in the sector's final energy consumption from 19% by 2050 in the WEM scenario to 24% in the WAM scenario. The policies also lead to significant reductions in energy use, and achieve substantial GHG emissions reductions for the sector, which are more than halved compared to the WEM scenario, by 2050 (2.9 $MtCO_{2eq}$ in the baseline compared to 1.8 $MtCO_{2eq}$ in the WAM). Residual emissions in the sector in 2050 in the WAM scenario are 1.2 tCO_{2eq}.

While total passenger-kilometres (pkm) have been kept constant throughout the period observed as an assumption, between 2020 and 2050 there is a significant redistribution among transport modes. The share of PKM made by car decreases substantially from 78% in 2020 to 57% in 2050, while public transport sees a change in the opposite direction (increase from 17% to 40%). The share of PKM by bike or foot remains stable throughout the period considered. Compared to the WAM, an additional 15% of trips are made by public transport.

For freight transport, total tonne-kilometres (tkm) transported remain unchanged between the WEM and WAM scenarios, but electrification, and to a smaller extent hydrogen, penetrate this subsector towards the end of the projection period (2040-2050) (which was not the case in the WEM scenario): by 2050, 55% of total freight tkm are realized on alternative fuels (natural gas/biomethane 31%, electricity 15%, biofuels 5%, hydrogen 4%).

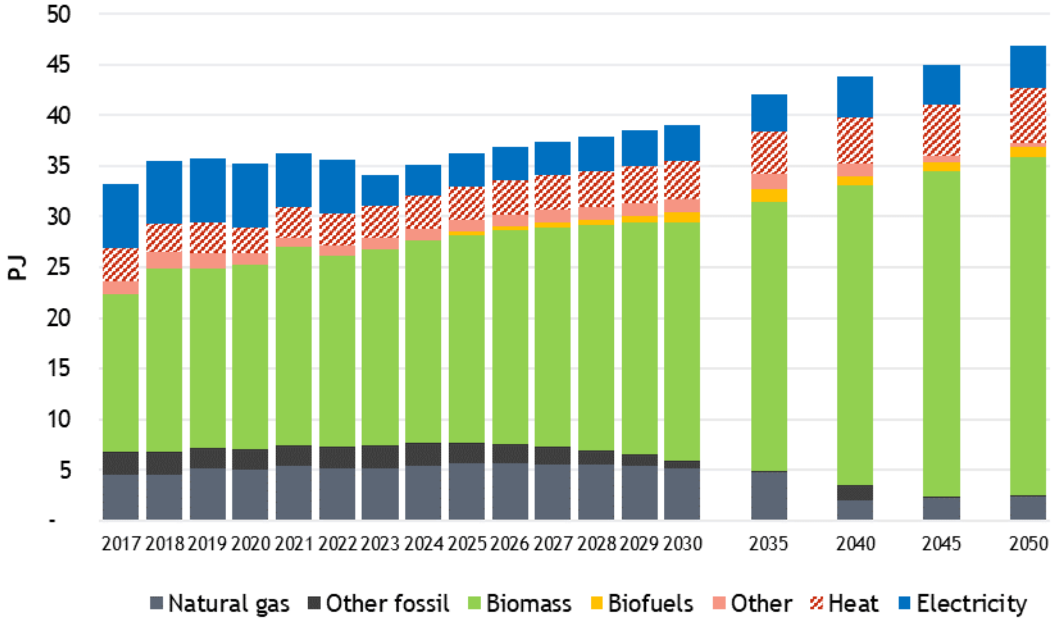
Industry sector

The industrial sector in the baseline already had a majority share of renewable energy use. As such, there is limited change in the WAM scenario. Renewables reach 74% of final energy use (excluding heat and electricity) in 2020 and are expected to reach 94% by 2050 in the WAM scenario. As in the baseline,

[279] LATVIA-TIMES model

biomass remains the dominant fuel throughout the period considered. Final energy use in 2050 is expected to grow by 42% compared to 2020.

Figure 4-40 Energy use by fuel in the industrial sector[280]



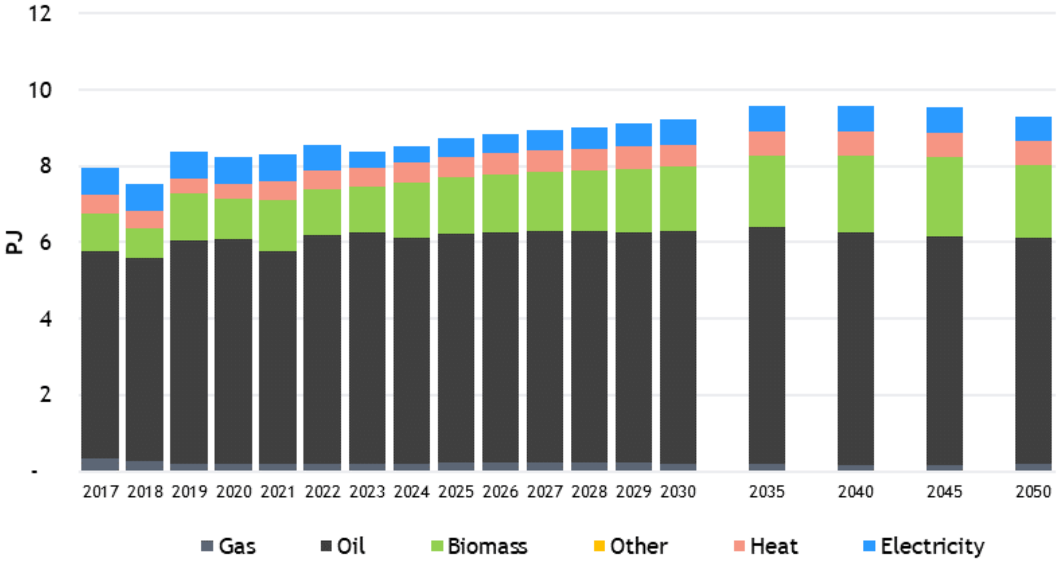
Despite an increase in subsidies for energy efficiency in the industrial sector throughout the projection period compared to the WEM scenario, the overall amount of subsidies for energy efficiency for this sector remains marginal in comparison to subsidies spent on the residential sector (see section "Residential sector"). The total energy demand and energy demand structure in the sector remains largely unchanged between the WEM and the WAM scenarios, as do the sector's GHG emissions, throughout the projection period. However it is worth recalling that GHG emissions already drastically reduce in the industry sector in the WEM scenario as of 2040-2045 (Figure).

Agricultural sector

Energy use in agriculture is expected to increase by 23% in 2050, with the mix of fuel used remaining broadly the same it was in 2020. Diesel oil is by far the dominant fuel, representing 64% of energy use in 2020 and around 57% in 2050. There is very limited change compared to the baseline.

[280] LATVIA-TIMES model

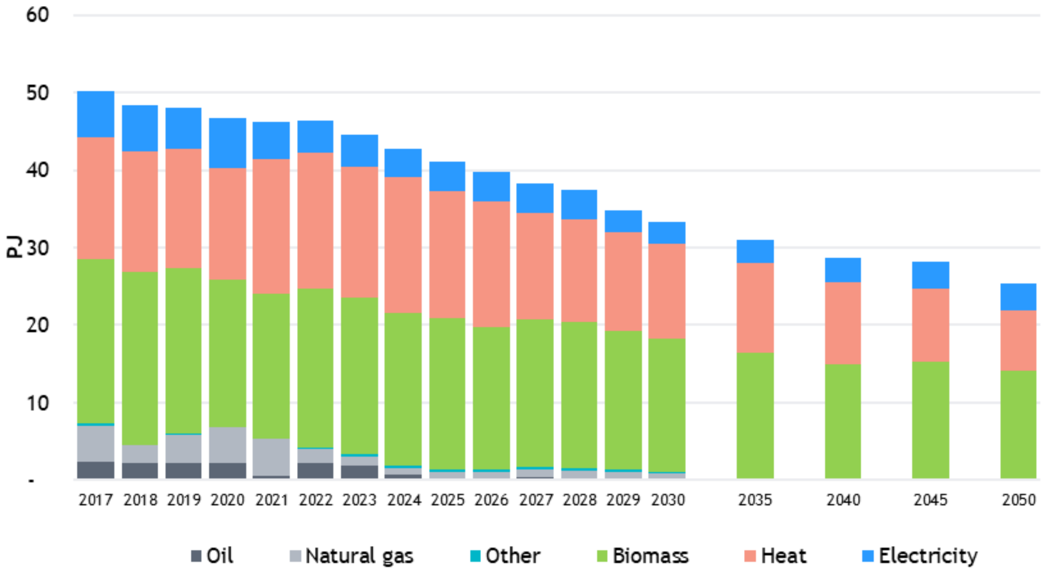
Figure 4-41 Energy use by fuel in the agriculture sector[281]



Residential sector

Similarly to baseline trends, WAM scenario trends in the residential sector are much more positive than those seen in other sectors: overall energy use is expected to decrease over time (decrease of 38% in 2050 compared to 2020), while the share of renewables, already quite high in 2020, at 74% (excluding power and electricity), is also expected to increase up to 99% in 2050. By that time, also district heating and power are expected to be renewable, see Figure).

Figure 4-42 Energy use by fuel in the residential sector[282]

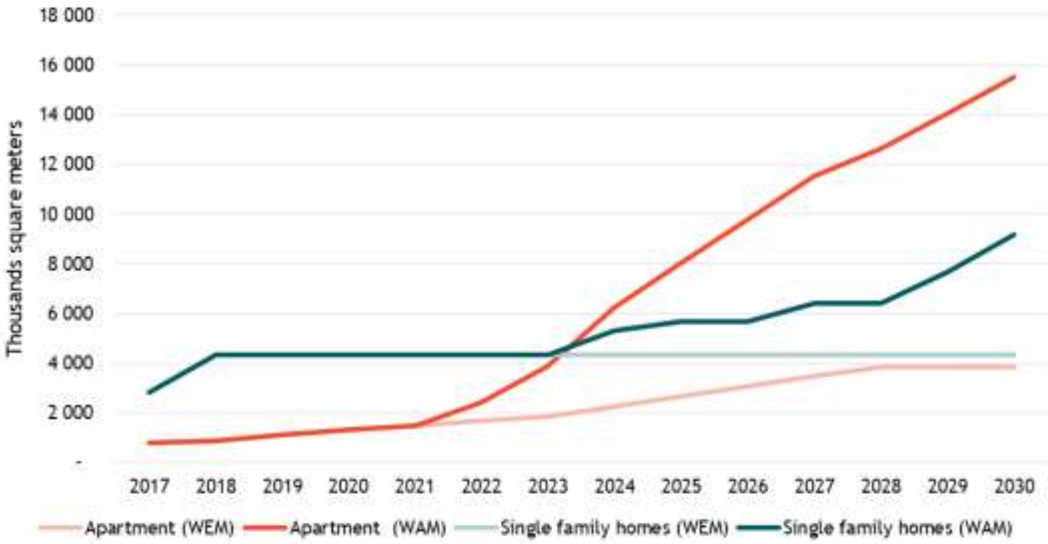


In this sector, the policies modelled in the WAM scenario allow for significant energy use reductions (one-third less than in the WEM scenario). This reduction in energy use is essentially due to a significant reduction in heat and biomass demand, driven by energy efficiency standards and subsidies and the ban on low-efficiency appliances. The measures proposed for buildings are expected to significantly drive

[281] LATVIA-TIMES model
[282] LATVIA-TIMES model

up the refurbishment of existing buildings, and to increase the uptake of renewable energies for heating purposes. New minimum efficiency thresholds will have effect in the long term, while refurbishment and fuel switch are expected to delivery results already for 2030. Figure shows the expected increase of residential building renovations due to a bigger budget for subsidies. Due to the higher effectiveness, the model opts to refurbish first mostly blocks of flats, but slowly also single-family homes follow up; by 2030, it is expected that 65% and 37% of the apartment buildings and single family homes existing in 2020 and below energy efficiency standard (i.e., not new or already refurbished) will be refurbished.

Figure 4-43 Projected renovation in baseline (WEM) and following the policy measures (to 2030)[283]



TIMES analysis shows that refurbishment of residential buildings is one of the key measures that will enable Latvia to reach its 2030 targets.

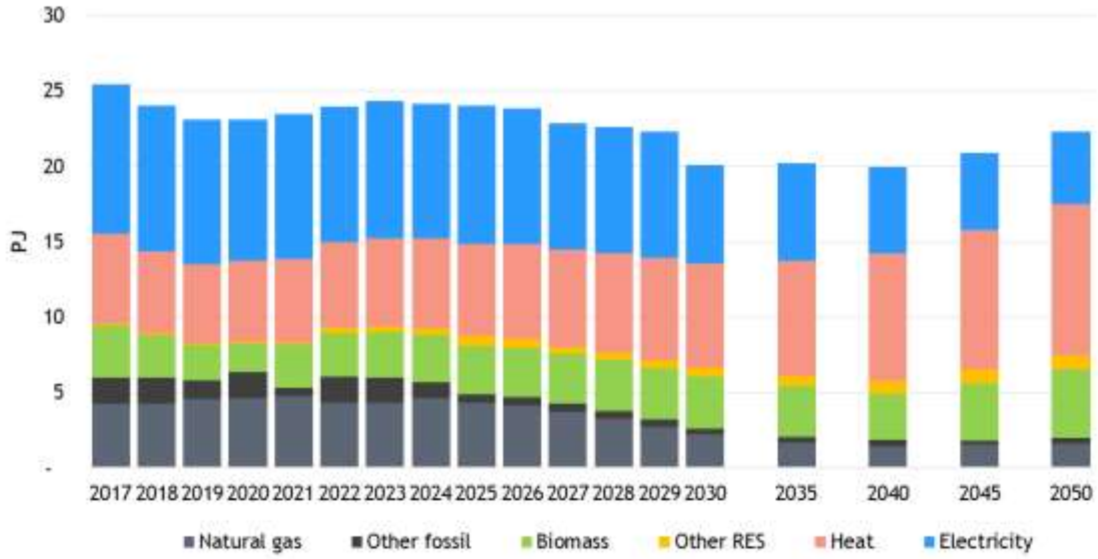
The total amount of annual subsidies used for energy efficiency in the residential sector in the WAM scenario increases significantly compared to the WEM scenario. The largest share is taken up by energy efficiency subsidies, which are expected to amount to an additional €4.85 bn by 2050. Other subsidies are expected to support specific technologies such as heat pumps and rooftop PVs, but to a lesser extent. To some extent, the high investment in energy efficiency is dampening the request for PVs and heat pumps, as these technologies are to some extent conflicting.

Commercial sector

Energy use in the commercial sector in the WAM scenario is expected to fluctuate over time. Renewable share increases from around 28% in 2020 to 82% in 2050, while imported heat is expected to increase from 23% in 2020 to 39% in 2050. On the other hand, grid electricity share is expected to decrease from 40% in 2020 to 19% in 2050, but onsite generation and self-consumption is expected to increase substantially, from 438 TJ in 2020 to 3.25 PJ in 2050, which more than compensate the decrease in grid electricity use (essentially, total consumption of electricity will be higher in 2050 that it was in 2020).

[283] LATVIA-TIMES model

Figure 4-44 Energy use by fuel in the commercial sector[284]

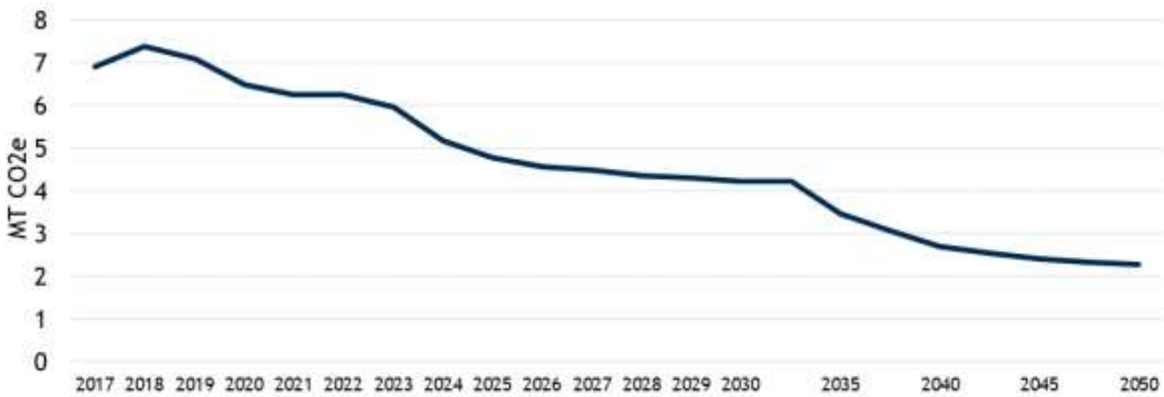


The total energy demand (see above) and structure of energy demand in the commercial sector remains largely unchanged between the WEM and WAM scenarios (except for a more rapid reduction of natural gas use in the sector, and larger remaining biomass use, in the WAM scenario compared to the WEM scenario, by 2050). Subsidy expenses for heat pumps in this sector amount to €83 million between 2020 and 2050 (suggesting the same private investment, in line with the subsidy's structure).

Greenhouse gas emissions projections

Total greenhouse gas emissions are expected to decrease in the WAM scenario, from 6.5 Mt CO_2 equivalent in 2020 to 2.3 Mt CO_2 equivalent by 2050.

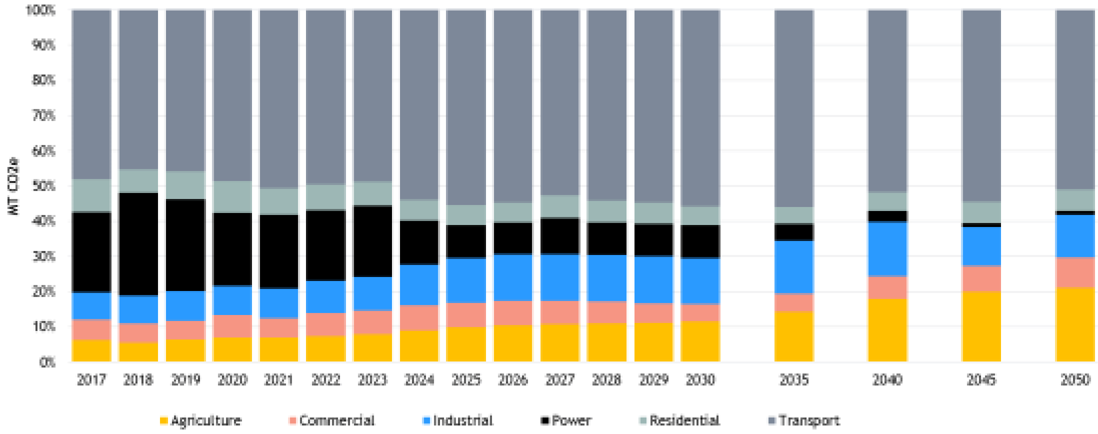
Figure 4-45 Total GHG emissions[285]



[284] LATVIA-TIMES model
[285] LATVIA-TIMES model

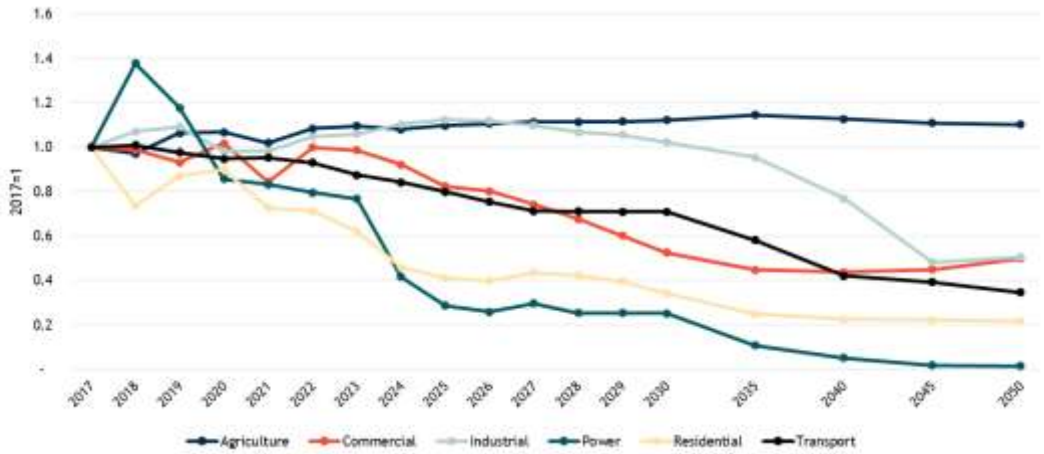
In terms of sectoral emissions, power and transport sectors together account for around 70% of the emissions in 2020. Overtime, the share of GHG emissions from the power sector decreases significantly in the WAM scenario (from 21% of total GHG emissions in 2020 to 1% in 2050); while the share of transport emissions goes from 49% to 51% of total GHG emissions.

Figure 4-46 Share of sectoral GHG emissions[286]



The residential and power sectors have steep declines by 2025 in terms of GHG emissions, while there is a more gradual decline in emissions from the commercial and transport sector. Emissions from industry only decline after 2040, while emissions from the agricultural sector remain stable slightly above current level of emissions.

Figure 4-47 GHG emissions change by sector (2017=1) [287]



[286] LATVIA-TIMES model
[287] LATVIA-TIMES model

Table 4-4 shows that, in 2030, the relative reductions in GHG emissions compared to the baseline are larger in the residential (-14%) and transport sector (-30%), but in absolute term reductions are more substantial in the transport sector (-1.45 Mt) and in the power sector (-239 kt). On the other hand, in 2050, relative reductions are larger in the transport (-36%) and commercial sector (-18%), but again the transport sector is where the more substantial reductions in kt are achieved (-654 kt).

Table 4-4 Relative and absolute change in GHG emissions from baseline

	Change from baseline (%)		Change from baseline (kt)	
	2030	2050	2030	2050
Agriculture	1%	40%	13	136
Commercial	-11%	-18%	-58	-44
Industrial	0%	-1%	-38	-2
Power	-3%	-5%	-239	-1
Residential	-14%	-16%	-97	-27
Transport	-30%	-36%	-1 452	-654

Further analysis of GHG emissions is presented in Annex III.

Investments

TIMES allows to estimate the investments required by each sector to satisfy the demand, driven by exogenous factors, such as population and GDP growth. It is also possible to estimate the investments required to implement the additional policies assessed via the model (WAM scenario). Table 4-5 shows the baseline and additional investments required to implement the additional measures. It shows that to implement the policies examined investments will have to increase by a third (+17.7 billion), cumulatively, over the period 2023 to 2050. However, as the majority of the measures evaluated are aimed at meeting the 2030 energy targets, the investment profile is not homogenous over time, but is heavily front-loaded before 2030, to the point that the following two five-year periods see total investments reduced compared to the baseline.

Significant expansion in investments are expected to happen in all sectors considered, in particular the residential sector (from €781 million to €5.2 billion, +667%) and the commercial sector (+125%), while investments in the transport and power sector are expected to double compared to the baseline.

Table 4-5 Investments by sector in the baseline and in the WAM scenario (€ million)

	2023-2030	2031-2035	2036-2040	2041-2045	2046-2050	Cumulative
Baseline investments						
AGR	94	117	84	256	240	791
COM	1 607	1 107	941	1 294	1 250	6 198
IND	211	140	200	605	329	1 486
RSD	781	358	619	246	629	2 633
PWR	4 173	3 243	250	1 928	1 948	11 543
TRN	8 232	5 791	9 236	2 166	4 387	29 813
Total baseline	**15 099**	**10 756**	**11 330**	**6 496**	**8 783**	**52 464**

Additional investments						
AGR	110	-17	-6	4	-32	58
COM	2 012	-173	87	128	-36	2 017
IND	203	3	-20	32	39	258
RSD	5 206	588	778	736	744	8 052
PWR	4 031	-1 196	809	-935	961	3 670
TRN	8 334	-534	-4 970	354	442	3 626
Total additional	**19 895**	**-1 330**	**-3 323**	**319**	**2 118**	**17 680**
Total	**34 994**	**9 427**	**8 007**	**6 815**	**10 900**	**70 144**

4.5.2 *Macroeconomic modelling*

The GEM-E3-LV[288] model is a recursive dynamic CGE model that extents up to 2050 in 5 year time steps and it is fully calibrated to 2015 EUROSTAT Input-Output tables and national accounts. The model is specific to Latvia but also captures the bilateral trade of Latvia with the EU and the rest of the world (grouped in 5 regions). Bilateral trade is modelled using the Armington assumption (domestically produced goods and imported goods are considered as imperfect substitutes). The model has been extended to explicitly represent the clean energy technology manufacturers and features bottom-up representation of the power generation sector – facilitating the soft link with the TIMES energy system model. The soft-link allows the energy system models (Latvia TIMES and the CGE model) to work together, so that macroeconomic and energy projections are aligned and evolve in a coordinated fashion.

GEM-E3-LV is used to assess the economic and employment implications of the policy scenario “With Additional Measures (WAM)”, quantified with the TIMES energy model. GEM-E3-LV receives the respective investments and changes in the energy mix as input and computes the impacts on GDP, production and employment. The labour market is separated into five occupation/skills categories with endogenous labour supply and unemployment rates.

Methodology

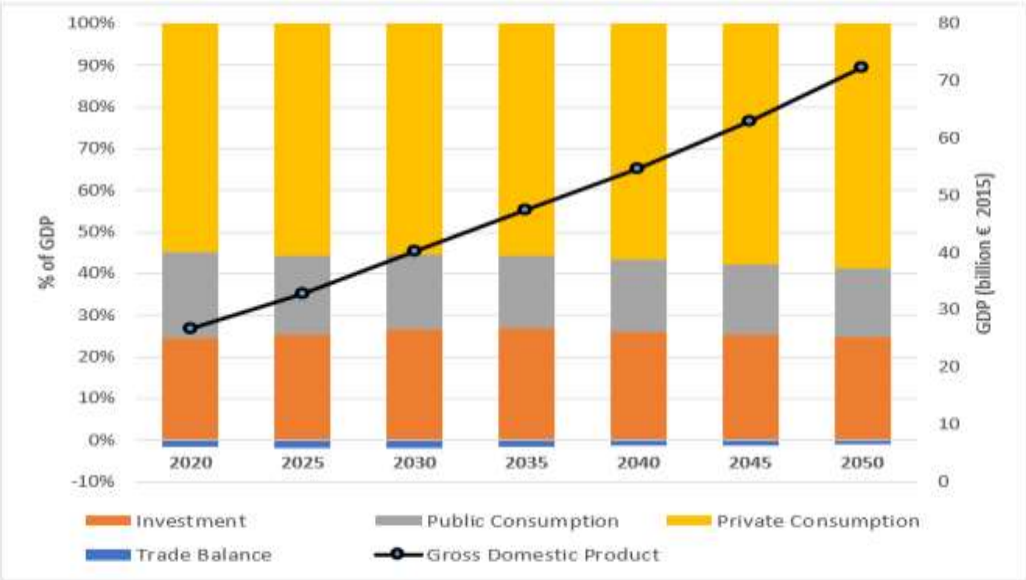
The GEM-E3-LV model has been soft linked with the TIMES energy system model in order to assess the economic implications of a WEM and WAM scenarios (detailed description available at “DLV2-DLV3 common report: Definition of the Baseline (WEM) scenario in the TIMES and CGE models”). The linking process is essential the calibration of GEM-E3-LV to the fuel mix (per economic activity) as derived from TIMES. The model calculates how the new energy mix, associated investments and prices affect production costs, competitiveness, the trade balance and households disposable income in order to calculate the net economic and employment impact. The impact is mainly driven by how reallocation of resources on different economic activities that are characterized by different multipliers affect income, productivity and growth.

[288] For a complete model documentation please check: “The GEM-E3-LV model Energy and Climate Modelling and Energy System Integration in Latvia DLV5 model manual report”.

WEM scenario

The annual GDP growth rate in the WEM scenario is projected to 3.4% for the period 2020 – 2050. The main drivers are private consumption and investment, which grow by 3.6% and 3.4% respectively on an annual basis. Government consumption is projected to increase at a slower pace (2.6%) and a slight improvement in the trade deficit is foreseen – from 1.6% of GDP in 2020 to 1% in 2050. **Error! Reference source not found.** presents the GDP projection and the components for the period 2020 – 2050 in the WEM scenario.

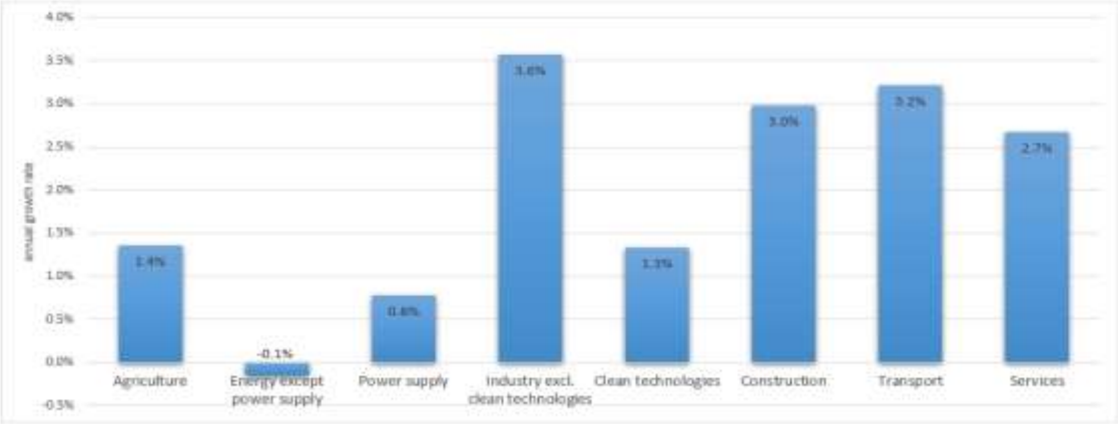
Figure 4-48 GDP and main components in the WEM scenario[289]



At the sectoral level and for the same period the highest annual growth rate is projected for the industry sector, driven by the production of wood products. Clean energy technologies such as PV equipment, wind equipment, batteries and electric vehicles are projected to have a small market share and modest growth rates. This is because it is assumed that these technologies are mostly imported. **Error! Reference source not found.** presents the projection of sectoral production in the WEM scenario.

[289] Source: GEM-E3-LV

Figure 4-49 Sectoral production in the WEM scenario[290]



WAM scenario

Via the soft-link series, GEM-E3-LV receives as input from TIMES the changes in the energy mix, in power generation investment, household operation of vehicles, and household expenditures for energy efficiency and appliances.

The impacts of the WAM scenario on GDP are presented in **Error! Reference source not found.** (WAM-nPBN, no public budget neutrality) and **Error! Reference source not found.** (WAM-PBN, public budget neutrality). It is found that significant factor on the overall economic adjustment is the source of financing of the additional investments. In the WAM-nPBN case the cumulative impact on GDP over the period examined (2020-2050) is found to be positive (0.23% as compared to the WEM case). This is mainly driven by the energy efficiency improvements and the demand stimulus effect of subsidies (which in this variant are financed through debt – increasing the public deficit). In the variant where the household expenditures are not financed by debt (e.g. government have to increase taxation to provide household subsidies), then the impact on GDP is negative when compared to the WEM case. This is mainly due to: i) the capital expenditures are higher in the case of the WAM scenario meaning that in the early years less income is available for other consumption purposes – non energy related, ii) that the redirection of demand addresses sectors with lower multipliers.

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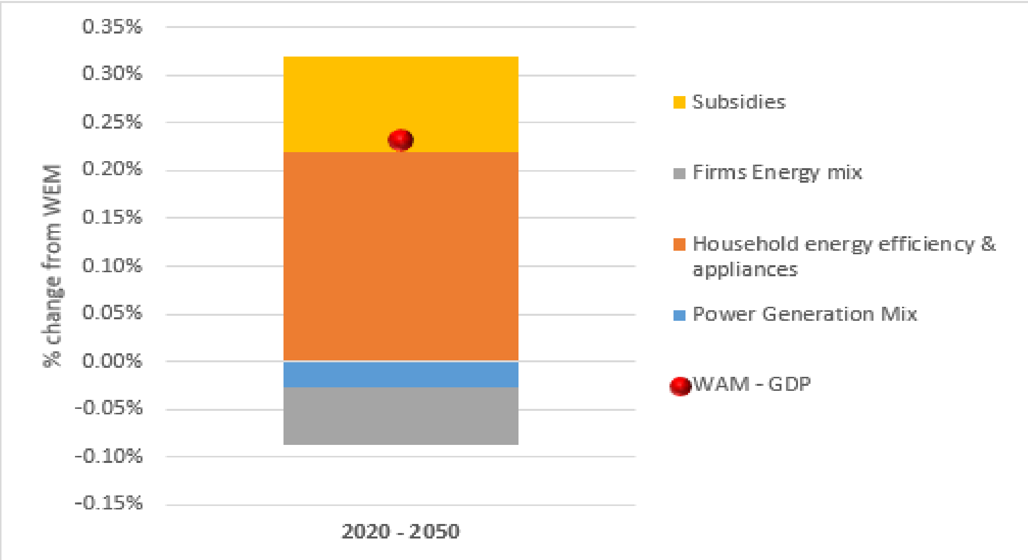
290 Source: GEM-E3-LV

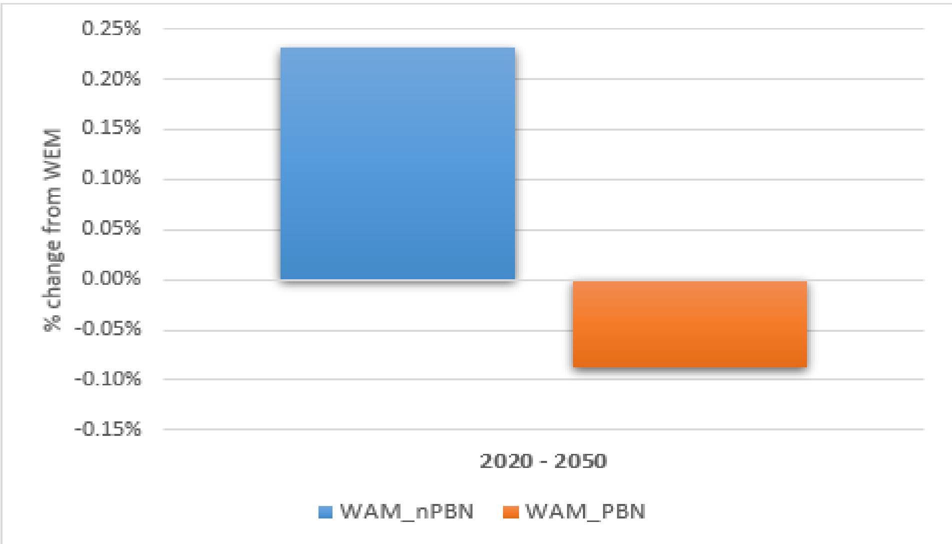
Figure 4-50 GDP impacts of WAM (no budget neutrality)[291]



To examine the role of subsidies financing in the adjustment process, an additional (budget neutral) scenario was designed, in which the state increases indirect taxes so as to collect the money required to provide the subsidies.

In this variant the impact on GDP is negative, i.e., -0.09% of GDP. The negative GDP impact is notable in the medium term; this is because the energy transition requires significant financing hence increase of indirect taxes. The impact on GDP becomes less acute over time because of the energy efficiency gains that medium-term investment implies in the long term but also due to the transformation of the energy system from a high OPEX low CAPEX profile to a high CAPEX low OPEX profile.

Figure 4-51 GDP impacts of WAM (budget neutrality)[292]

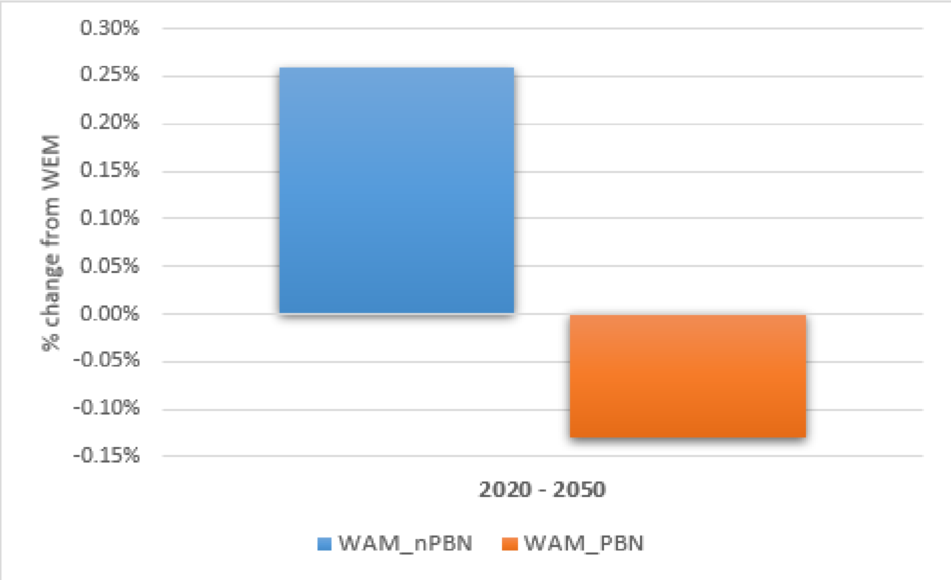


[291] Source: GEM-E3-LV

[292] Source: GEM-E3-LV

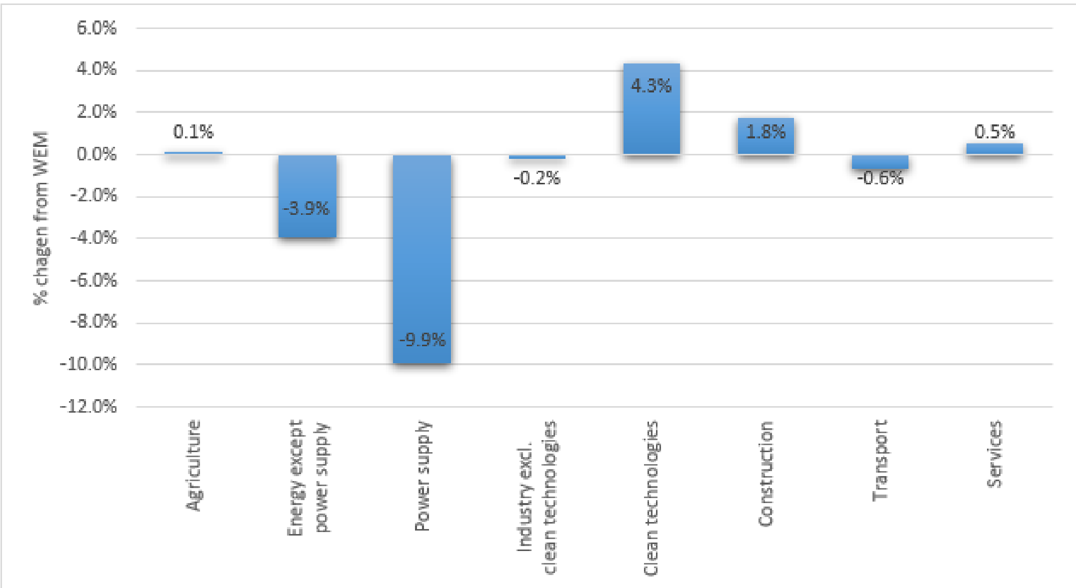
The impact on employment is presented in **Error! Reference source not found.**. Employment impacts largely follow the aggregate impact on activity. Hence employment increases by 0.26% and falls by 0.13% in the WAM-nPBN and WAM-PBN scenarios respectively.

Figure 4-52 Employment impacts of WAM-nPBN and WAM-PBN[293]



At a sectoral level the main sectors that benefit from the transition are construction and clean energy technologies. Power supply in GEM-E3-LV model includes both electricity and heat energy. Based on the energy model results, there is a high reduction in the heat supply (-23% in cumulative terms, 2020 – 2050) and a moderate increase in electricity (1.6% in cumulative terms, 2020 – 2050).

Figure 4-53 Sectoral production WAM-nPBN (in cumulative terms, 2020 - 2050)[294]

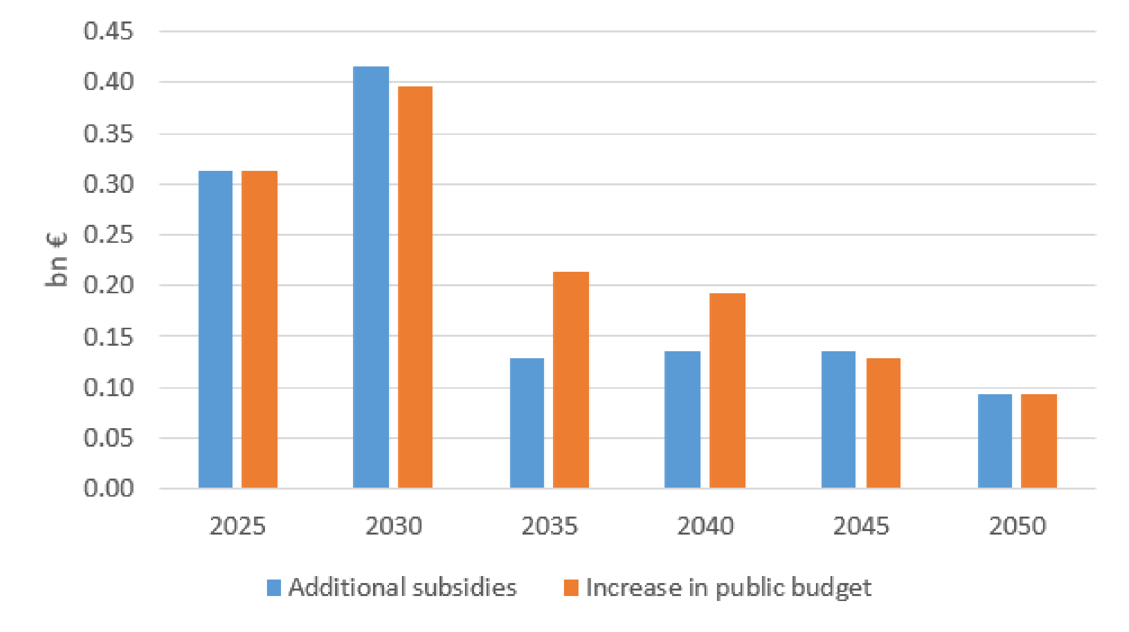


[293] Source: GEM-E3-LV

[294] Source: GEM-E3-LV

The additional subsidies required to perform the energy transition amount to €197 million on average by year until 2050. This has a negative impact on public deficit, which is highly affected by the amount of subsidies. Another major channel that increase the public deficit is the lower indirect taxes due to less demand for oil products. On the contrary, the positive impact of WAM-nPBN on GDP increases revenues from other taxes – mitigating the overall negative impact on deficit (**Error! Reference source not found.**).

Figure 4-54 Additional subsidies and change in public deficit in WAM-nPBN[295]



4.6 Sensitivity analysis

Hydrogen

Hydrogen is included in the model as a potential fuel with applications to different sectors. It is characterised by the following parameters:

Technology Description	Lifetime	Investment cost 2018	Fixed O&M costs 2018	Variable O&M costs	Efficiency	Availability factor
Renewable fuels – 1) production of hydrogen by means of electrolysis	years	Thousand €/MW	Thousand €/MW	thsd.EUR/TJ		
Hydrogen production via alkaline electrolysis (AEC)	25	65000	13	-	0.64	1
Hydrogen production via polymer electrolyte membrane electrolysis cells (PEMECs) or simply polymer electrolyte membrane (PEM)	25	95000	37	-	0.58	1
Hydrogen production via solid oxide electrolysis (SOEC)	10	4490	539	-	0.76	1

The model can choose to produce and use hydrogen instead of other technologies and can pick up among the three technology options provided. However, very limited hydrogen use appears in the self optimisation and in the WAM scenario (4.5 PJ and 0.9 PJ, respectively, equivalent to 3.5% and 0.6% of

295 Source: GEM-E3-LV

final energy use), while in the baseline no hydrogen is used. In the self optimisation scenario, hydrogen emerges as a fuel in 2045, and reaches up to 3.5% of FEC in 2050 (4.5 PJ). In 2050, hydrogen is used in agriculture (3.4 PJ per year), in the commercial sector (1.1 PJ per year), and in the transport sector (0.01PJ). In the WAM scenario, only minimal amount of hydrogen are used in transport. The results in the self-optimisation and in the WAM scenario emerge without any policy specifically aimed at promoting hydrogen, but simply out of the regulations and incentives introduced in each sector.

As part of the modelling exercise, a dedicated hydrogen scenario was modelled, imposing the deployment of higher installed capacities higher installed capacities (5 MW in 2035, 15 MW in 2040, 35 MW in 2045, and 75 MW in 2050). Table 4-6 shows the difference in PEC between the two WAM scenario and the dedicated H2 scenario. It shows that deploying hydrogen would significantly reduce the consumption of Natural gas and diesel, but require more wind, solar and biomass generation to provide the energy for the electrolysis process. The analysis also shows how the model is accounting for the different perspective in earlier years, and modifying investment decisions ahead of the time when the new capacity comes online. This is a realistic outcome, as plans to produce hydrogen will be known ahead of time, and investment decisions in earlier years would reflect that.

Table 4-6 Difference in Primary energy use between the WAM scenario and the dedicated H2 scenario (TJ)

	2025	2030	2035	2040	2045	2050
WIND	-	-161	147	256	1 459	1 945
SOLAR	-39	13	12	17	22	167
BIOMAS	-1	-70	-16	-1	115	114
net POWER Import	94	129	-49	320	-33	83
OIL	2	-	0	-	6	48
LPG	6	-13	-1	-15	0	25
BIOFUEL	-0	-0	13	11	13	13
GASOLINE	-0	-0	9	-6	1	-26
NATURAL GAS	-66	6	-158	-274	-638	-1 191
DIESEL	34	37	-54	-420	-1 817	-2 507

In terms of use, hydrogen is expected to be initially taken up mostly in agriculture starting in 2035 ad growing up to 2.7 PJ in 2050 and in the transport sector (1 PJ in 2050).

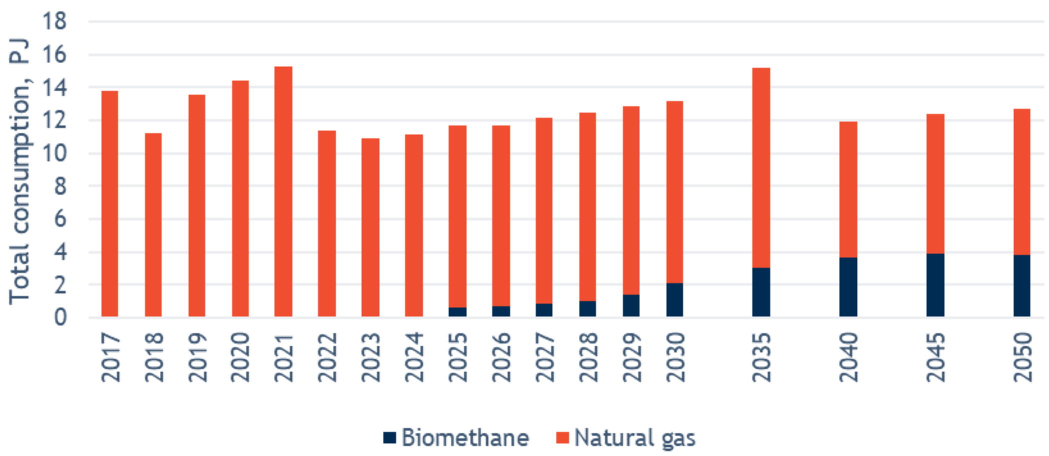
In terms of total investments, the H2 scenario appears slightly more expensive (0.08%, an additional €24 million). The majority of additional investments are expected to happen in 2045 and 2050 in the Power sector (€215 million in 2045 and €598 million in 2050) and in the agriculture sector (€135 million in 2045 and €45 million in 2050), but these will be compensated by reduced investments in previous years, in particular in the residential sector (minus €25 million cumulatively) and in the Industrial sector (minus €1.6 million cumulatively).

4.7 Other considerations regarding infrastructure needs

Natural gas

Natural gas use in the WAM scenario decreases gradually from 14 PJ in 2020 to 9 PJ in 2050. The use of natural gas is partially compensated by biogas/biomethane, which starts penetrating from 2025 and reaches in 2050 around 4 PJ – around 30% of total gas use in the same year.[296] In 2022, modelled natural gas consumption decreases by 20% compared to 2021 due to a significant price increase, which is similar to actual trend (preliminary statistics for 2022 shows that the consumption of natural gas in Latvia has decreased by 15%). The increase in natural gas consumption in 2035 is related to increased use in transport for light duty vehicles, but soon after this trend is compensated by a steep decrease in the industrial sector (wood product industry). In parallel, hydrogen, another alternative gaseous fuel, also only marginally penetrate the energy system by 2050 (with 1400 TJ of final consumption)Figure . These trends are broadly similar to the WEM scenario, but the increased rate of the biomethane obligation in the WAM sees the latter replacing a larger amount of natural gas. This poses an important question as to the long-term use of the existing natural gas network and infrastructure in the country, given the expected drop in gaseous fuels demand. Under the scenarios considered in this analysis, biogas/biomethane and hydrogen demand will not grow significantly enough by 2050 to compensate for the phase-out of natural gas and would not justify a large-scale reutilisation and/or repurposing of natural gas infrastructure.

Figure 4-55 Use of gas infrastructure (WAM)

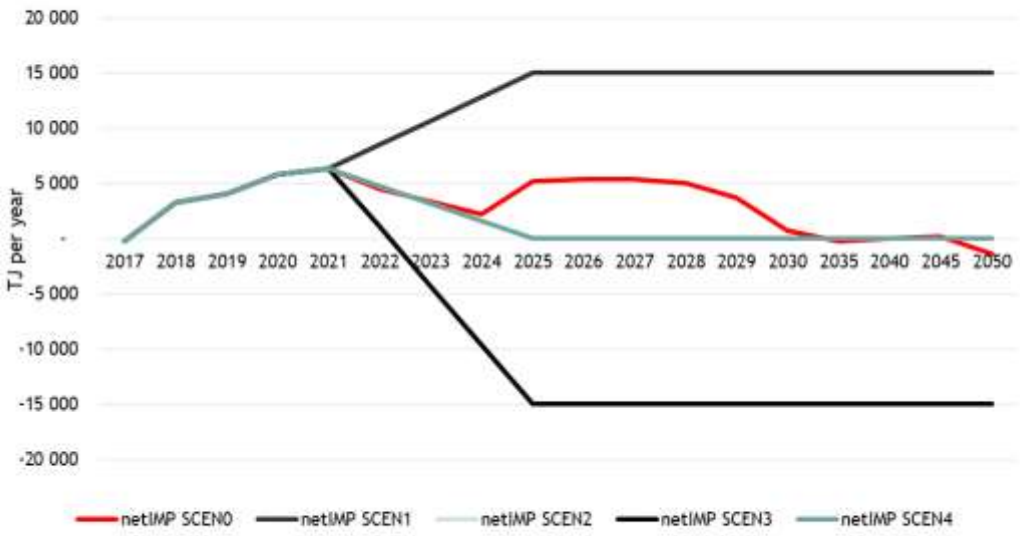


Electricity

In order to explore the need to reinforcement to the power transmission network, four separate extreme scenarios were analysed.[297] Across the four scenarios considered, in one case both imports and exports forced to reach 15 000 TJ per year, while in another scenario they only imports peak at 15 000 TJ and on another is exports that peak at 15 000 TJ. The 15 000 TJ is a forced limit imposed on the model based on the historical average recorded since 2010, so under these scenarios and under the TIMES-LV model resolution no additional interconnectors are required. Net imports also change substantially across scenarios.

[296] LATVIA-TIMES model
[297] The model is not able to evaluate the need for reinforcements to the distribution network.

Figure 4-56 Net imports across scenarios[298]



[298] LATVIA-TIMES model

5 Policy Roadmap and Action Plan

This roadmap aims to support Latvian authorities to plan for short-term actions and to identify longer-term policies and strategies required to support a decarbonisation pathway up to 2050, as described during the modelling exercise. Given the limited scope of this exercise, the scenario, policy mix and roadmap presented here are to be intended as a first step to arrive at the correct policy mix, fully endorsed by the Latvian government and by key Latvian stakeholders. As part of this project, the contractor is delivering the energy system model and the macroeconomic model used to carry out this analysis, with the data and assumptions used to model the baseline and policies (see section 4.4). This means that the Latvian authorities will be able to adjust the policy mix and roadmap proposed here to better fit stakeholders' feedback and budgetary constraints.

5.1 Strategic approach an objectives of the roadmap

The table below provides the key targets from the LTS in terms of GHG emissions, as well as the implications for each sector.

Table 5-1 NECP estimates for GHG reduction

GHG emission reduction and CO_2 removals of the decarbonisation dimension	Actual value 2017[299]	Target value 2020	Target value 2030
Total GHG emission reductions			
% to 1990.g.	% to 1990.g.	% to 1990.g.	% to 1990.g.
Mt CO_2 eq.	Mt CO_2 eq.	Mt CO_2 eq.	Mt CO_2 eq.
GHG emission reductions from non-ETS activities[300]			
% to 2005.g.	+8,4	+17	-6
Mt CO2 eq.	9,3	10	8
Reduction of GHG emissions from ETS activities			
% to 2005.g.	-28,2	-21	-
Mt CO2 eq.	2,0	2,3	-
LULUCF accounting categories (million units)[301][302]	-	-	3,1[303]
Reduction of life cycle GHG emission intensity of transport energy (%)	0,8	6	≥6

Renewable targets

Table 5-2 presents the renewable targets as per different policy documents, and their values in 2020.

Table 5-2 Renewable targets (percentage)

	Actual value	NECP target	Fit for 55 targets[304]	REPoweEU targets[305]
	2020	2030	2030	2030
Renewables share in final energy consumption	42.1	50	~62	70

[299] Ministry of Environmental Protection and Regional Development (2019), Latvia 2019 National Inventory Report
[300] Pursuant to Articles 5, 7, 10 and 11 of Regulation 2018/842 2018/842
[301] GHG emission reductions and CO_2 target for pegging in the LULUCF accounting categories in 2030
[302] Pursuant to Article 12 of Regulation 2018/841
[303] Rule 2018/841; Rule 2018/842 of Rules of Procedure
[304] Initial assessment based on 2020 data and targets approved in June TTE Energy Council
[305] In RED4 targets are set only for overall Union renewables shares. It is expected that MS will have to increase the ambitions to reach REPowerEU targets

	Actual value	NECP target	Fit for 55 targets[304]	REPoweEU targets[305]
	2020	2030	2030	2030
Indicative renewables share in electricity	53.4	>60	>70	>70
renewables share in heating and cooling	57.1	57.6	69	75
Renewables shares in buildings	57.2		68	75
Renewables shares in industry	58.7		70	75
Renewables shares in district heating and cooling	56.6	-	77	80
Renewables share in transport (with multipliers)	6.7	7[306]	29[307]	35
Advanced biofuels share in transport (with multipliers)	0.9	3.5	4.4	5
Renewable fuels of non-biological origin share in transport (with multipliers)	0	-	5.2	6

Energy efficiency

Table 5-3 presents the energy efficiency targets as per different policy documents, and their values in 2020.

Table 5-3 Primary and final consumption and cumulative energy savings, GWh (PJ)

	Actual value	NECP target	Fit for 55 target[308]	REPowerEU target[309]
	2020	2030	2030	2030
Primary energy consumption	49 586 (179)	45 833 (165)	<44 140 (159)	<42 200 (152)
Final energy consumption	44 837 (161)	40 278 (145)	<39 312 (142)	<37 584 (135)
Cumulative energy savings	10 439 (38)	20 472 (74)	26 355 (95)	-

The analysis of the baseline shows which sectors contribute the most to energy use and carbon emissions, while the analysis of the self-optimisation scenario shows in which sectors energy and carbon savings can be achieved at the lowest cost for the economy. Therefore, the actions explored in the system integration pathway focus on these areas, while the policy roadmap and action plan included in this section provide more details on how to put these actions into practice.

The recommendations from the European Commission to the Latvian government[310] include a specific suggestion to *Reduce overall reliance on fossil fuels and diversify imports of fossil fuels by accelerating the deployment of renewables, ensuring sufficient interconnection capacity, diversifying energy supplies and routes and reducing overall energy consumption through ambitious energy efficiency measures*. Further, based on feedback from the Ministry of Economics, the strategy focus on incentives and support to various sectors, rather than imposing strict regulations and limits.

This roadmap has been developed to support the following key objectives:

- Decarbonise the Latvian economy by 2050;

[306] 1st generation biofuels are excluded from scope
[307] Including 1st generation biofuels
[308] Initial estimations – 9% below 2030 consumptions from EU Reference Scenario 2030 data for Latvia
[309] Initial estimations – 13% below 2030 consumptions from EU Reference Scenario 2030 data for Latvia
[310] https://commission.europa.eu/publications/2022-european-semester-country-specific-recommendations-commission-recommendations_en (Latvia)

- Achieve the 2030 EU energy efficiency and renewable targets;
- Keep energy costs affordable; and
- Reduce energy dependence, in particular imports from non-EU countries.

To further clarify the above points, it is necessary to consider that:

- The analysis presented in chapter 4 does not include all sectors of the economy (for example, LULUCF is excluded). The 2050 targets are labelled net zero because it is reasonable to expect that most sectors will emit even after 2050, but these GHG emissions will be compensated by negative emissions in other sectors (sink). The more likely candidate for this role is the LULUCF sector, which means the 5 sectors considered here (residential, industry, commercial, power and agriculture) are, altogether, expect to emit smaller quantities of GHG in 2050.
- Based on the modelling, the 2030 energy efficiency targets appear very difficult to reach. This is realistic conclusion, as energy use reduction requires many small interventions in buildings and in energy-using processes and goods, which are very difficult to drive in the short term without significantly affecting the welfare of Latvian citizens and economic development. For example, the 2022 increase in energy prices has reduced gas use, but this happened after consumer prices more than doubled and the economy took a significant hit.
- The measures presented here will have to be further developed by the Latvian Government, and aligned to other government priorities and constraints, such as budgetary limits. Further, the expected impact of these measures may be larger or smaller than the effect predicted in Chapter 4.

5.2 Priority areas

In order to achieve the above objectives and based on the modelling analysis (see section 4.3), focus should be placed on the following priority areas:

- Transport;
- Electricity system and renewable electricity;
- Buildings & Industry.

The following sections present, for each of the priority areas, a list of concrete actions to support decarbonisation of the Latvian economy and reducing energy dependence, while focusing on energy affordability. The actions are grouped into: regulatory measures; investments (including infrastructure investments as well as funding and incentives); and organisational and social programmes (including those focused on awareness raising). Below a brief overview:

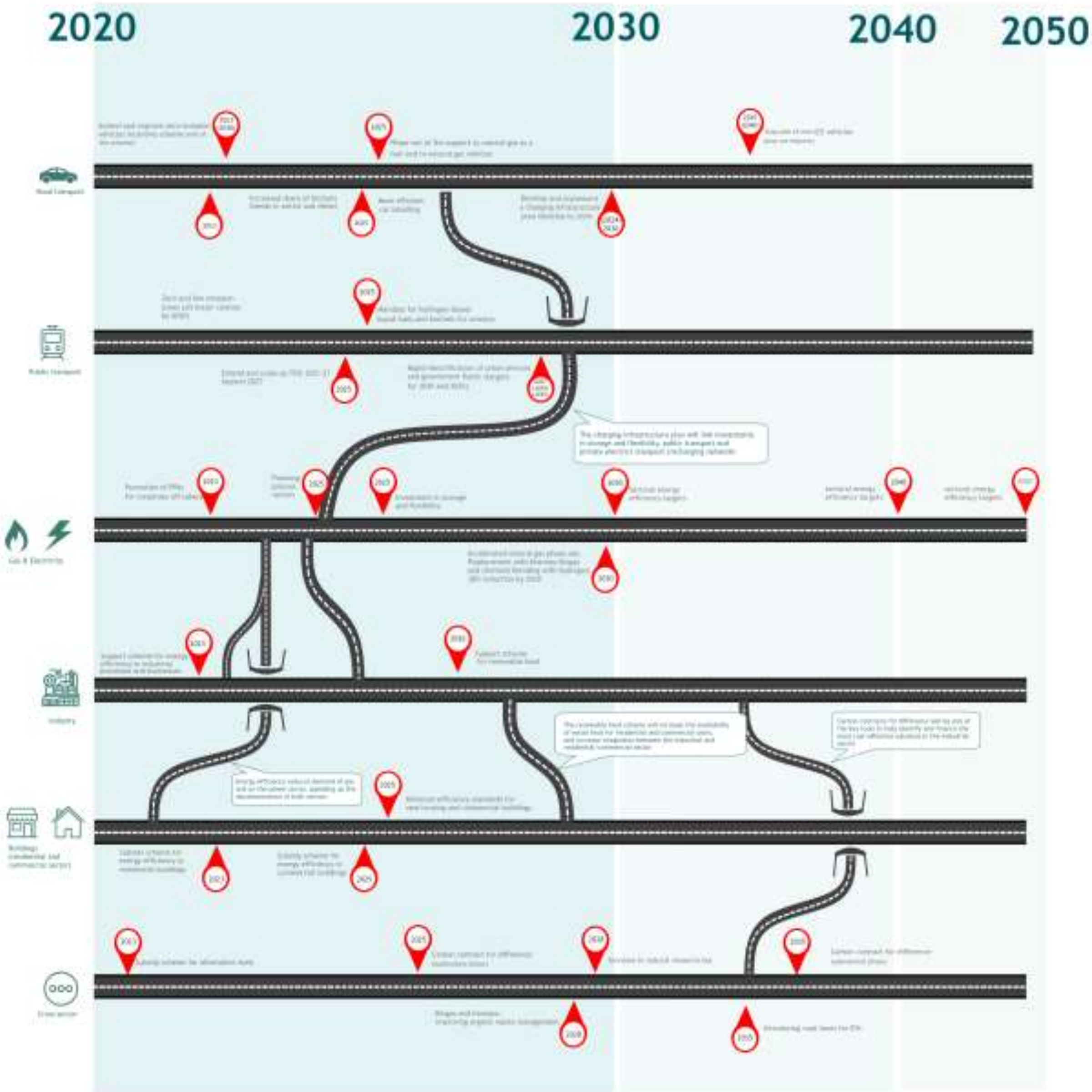
Table 5-4 Summary of proposed actions by sector and type

Sector	Type	Action & timeline
Transport	Regulation	♦ Phase-out of the support to natural gas as a fuel and to natural gas vehicles by 2025 ♦ Phase-out of ICE vehicle sales from 2035[311] ♦ Mandate for hydrogen-based liquid fuels and biofuels for aviation from 2025 to 2050, with 5-year milestones ♦ Zero-emission zones, starting in 2024 with the aim to have the vast majority of urban centres as Zero-emission zones by 2030 ♦ Increased blend share for biofuels from 2025
	Investments & incentives	♦ Extend and improve zero-emission vehicle incentive scheme from 2023 ♦ Rapid electrification of urban services and government fleets with targets for 2027, 2030 and 2035 ♦ Extend and scale-up TDG 2021-27 beyond 2027: enhancement of public transport infrastructure, electrification of transport, further development of railways in order to encourage modal shift
	Programmes	♦ Develop and implement a charging infrastructure plan (Plan by 2024, implementation by 2030) ♦ Enhanced vehicle labelling from 2025
Energy sector	Regulation	♦ Introduce more ambitious EE targets at sectoral level for 2030, 2040 and 2050
	Investments & incentives	♦ Investment in storage and flexibility from 2025
	Programmes	♦ Planning process reform from 2024 ♦ Promotion of PPAs for corporate off-takers from 2023
Building and industry sectors	Regulation	♦ Minimum efficiency standards for new housing and commercial buildings by 2025
	Investments & incentives	♦ Subsidy scheme for energy efficiency in residential buildings up to 2050 ♦ Subsidy scheme for energy efficiency in commercial buildings from 2025 ♦ Support scheme for energy efficiency in industrial processes and businesses up to 2050 ♦ Support scheme for renewable heat up to 2035
	Programmes	♦ Accelerated natural gas phase-out (replacement by biomass/biogas and (limited) blending with hydrogen) with 28% reduction by 2030 and 59% by 2050
Cross-cutting	Regulation	♦ Increase in natural resource tax by 2028 ♦ Carbon contract for difference by 2025, with auctions every 3 years
	Investments & incentives	♦ Subsidy scheme for alternative fuels from 2023 with gradual phase-out from 2030
	Programmes	♦ Biogas and biomass: improving organic waste management (2021-2028, with increasing effects to 2050) ♦ Extend research, including specific research on alternative fuels from 2025

[311] In line with the EU council decision of June 2022 (EurActiv (2022), EU nations approve end to combustion engine sales by 2035).

For each action, we include a description, the responsible stakeholder implementing the measure, other stakeholders affected; the suggested implementation timeline; and an assessment of the expected costs and revenues. Where relevant, best practice examples and sources are included.

Figure 5-1 The roadmap



5.2.1 *Actions in the transport sector*

Measure	Phase-out of the support to natural gas as a fuel and to natural gas vehicles
Type	Supporting measure Regulation
Implementing organisation	Ministry of Economy or Ministry of Climate and Energy
Other stakeholders affected	NG vehicle owners and potential vehicle buyers
Timeline	Full phase-out by 2025

Costs/revenues	Low implementation cost as few vehicles affected
Motivation	Given the availability of electric vehicles and the supply challenges related to gas, it does not make sense anymore to support gas as a transport fuel, given cleaner and cheaper alternatives exist.
Description	
Phase-out of the support to natural gas as a fuel and to natural gas vehicles by 2025. Of the 759 000 passenger cars registered in Latvia at the end of 2021, 21 000 were gas vehicles (with gas being either the main or secondary fuel), equivalent to 2.5%.[312] Less than 350 vehicles currently are powered only by gas. The measure would: • Make illegal vehicles powered only by gas by 2025. Owners will be offered a market price for their vehicle (plus grant) if they accept to pass to a low emission vehicle • Dual-fuel vehicles will be allowed to run only on their fuel other than gas This measure was not modelled individually, but it would be included in the ICE vehicle phase-out by 2035.	

Measure	Phase-out of new ICE vehicles sales
Type	Primary measure. EU driven measure[313]. Regulation
Implementing organisation	Ministry of transport
Other stakeholders affected	ICE vehicle owners and potential vehicle buyers
Timeline	Phase-out of new sales of cars by 2035, phase-out of imports by 2040.
Costs/revenues	Low implementation cost
Motivation	The number of governments committing to phase out the sale (or registration) of new ICE passenger vehicles continues to rise.[314] In 2022, the EU parliament voted to ban the sale of new ICE by 2035, as part of the Fit-for-55 package (although the measure is still in the process of being approved). The measure will be accompanied by the removal of all incentives for zero and low emissions vehicles once the policy is in place.[315] In 2021 a total of over 20 000 new road vehicles were registered in Latvia of which 14 652 new cars[316]. However, once use imported vehicles are included, new passenger car registrations amounted to 65 713 and total vehicles registered were 80 000; this means that 75% of registrations in Latvia are of used vehicles.
Best practices	As of the start of 2021, 14 countries had announced plans to phase out sales of ICE vehicles. Another 31 regional and municipal governments around the world announced similar plans.[317]
Description	

[312] Central Statistical Office (2022), Transport in Latvia 2022
[313] In line with the EU council decision of June 2022 (EurActiv (2022), EU nations approve end to combustion engine sales by 2035).
[314] ICCT (2021), Update on government targets for phasing out new sales of internal combustion engine passenger cars
[315] European Parliament (2022), CO2 emission standards for new cars and vans
[316] Central Statistical Office (2022), Transport in Latvia 2022
[317] NetZero Pathfinders (2022), Internal Combustion Engine Vehicle Sales Phase-Outs: U.K.

Phase-out of the sale of new ICE vehicles by 2035, in line with EU trajectory.[318] There will also be a limit to used ICE vehicles imported into the country. This measure will ban the registration of new road vehicles (in line with EU proposal) but will also require a minimum performance standard for imported vehicles equivalent to the one imposed 5 years earlier for new vehicles. As the target applies to car manufacturers (which are not responsible for the sale of used vehicles), a practical way to implement the measure is to impose a ban on the import of vehicles older than 5 years, or with consumption which is above the EU average consumption recorded in 2030. Essentially, in 2035 imported cars will have to be less than 5 years old or very efficient, and in 2040 all imported cars will have to be zero or low emissions vehicles. The measure also plans with the phase-out of new ICE and hybrid bus, truck and train sales between 2035 and 2045 (see Table 4-4). This measure would allow to reach full electrification of private land transport by 2050, and increase the electrification rate of non-private land transport (in conjunction with other transport measures as detailed in section 4.4 and according to WEM and WAM scenario results).

Measure	Mandate for hydrogen-based liquid fuels and biofuels for aviation
Type	Supporting measure. EU driven measure. Regulation
Implementing organisation	Ministry of transport
Other stakeholders affected	Aviation transport sector
Timeline	2025-2050 with 5-year intermediate milestones
Costs/revenues	Low implementation cost for the Ministry. Costs mostly borne by airlines (and possibly passed on to consumers of air travel). Needs for infrastructure investments need to be borne in mind, however with blendable liquid alternative fuels these may be minimised.
Motivation	Fossil jet fuel represents 12% of the transport sector's final energy use in Latvia in 2017,[319] with high GHG emissions associated. The transition of transport fossil fuels to low-carbon alternative fuels is essential for meeting climate objectives.
Best practices	ReFuelEU proposal
Description	
In line with Fit-for-55 policy proposals ReFuelEU[320] (and the Renewable Energy Directive revision), a Sustainable Aviation Fuel (SAF)[321] mandate is put in place: • From 1 January 2025, a minimum share of 2% of SAF; • From 1 January 2030, a minimum share of 5% of SAF, of which a minimum share of 0.7% of synthetic aviation fuels; • From 1 January 2035, a minimum share of 20% of SAF, of which a minimum share of 5% of synthetic aviation fuels;	

[318] EurActiv (2022), EU nations approve end to combustion engine sales by 2035
[319] RTU LATVIA-TIMES MODEL Latvia model Baseline scenario, as of 13/09/22, aligned with energy balances.
[320] European Commission (2020), Sustainable aviation fuels – ReFuelEU Aviation (including Proposal for a regulation - COM(2021)561 and Annex - COM(2021)561)
[321] Drop-in aviation fuels that are either synthetic aviation fuels or biofuels.

- From 1 January 2040, a minimum share of 32% of SAF, of which a minimum share of 8% of synthetic aviation fuels;
- From 1 January 2045, a minimum volume share of 38% of SAF, of which a minimum share of 11% of synthetic aviation fuels;
- From 1 January 2050, a minimum volume share of 63% of SAF, of which a minimum share of 28% of synthetic aviation fuels.

This measure may be implemented at national level including for domestic flights, although for maximum efficiency it would be driven at international level and including international flights (domestic aviation accounting for a very small share of national final energy consumption). Given the limitations in the Latvia-TIMES model, this policy is not included in the WAM scenario.

Measure	Zero and low emission zones
Type	Supporting measure Regulation
Implementing organisation	Ministry of Environmental Protection and Regional Development, municipalities, and Ministry of Transport
Other stakeholders affected	Road transport sector
Timeline	2024, with the aim to have the vast majority of urban centres as Zero-emission zones by 2030. This would imply a phased implementation, starting with the Riga metropolis and gradually applied elsewhere, starting with larger urban centres, then moving to smaller ones.
Costs/revenues	Low administrative costs, could generate revenues if a charge to non-EVs is applied
Motivation	Zero-emission zones have positive impacts beyond the zone itself, in influencing the vehicle purchase decision of drivers living outside of the zone, and in influencing the resale value of ICE vehicles. Besides the climate benefits, other benefits include air quality improvements, reductions in traffic and car ownership, better quality of life and stronger local economy.[322]
Best practices	The Clean Cities campaign has defined a 7-step approach towards setting up effective low-emission zones based on European best practice examples. [323] It highlights that well-designed LEZs should: • Be as large, stringent, and well-enforced as London's ULEZ, • Be as inclusive, well-communicated and forward-looking as Amsterdam's LEZ • Provide at least as many alternatives and support measures as Paris, • Combine it with a general overhaul of traffic plans like Ghent, • Strike a flexible balance through capped daily passes like in Brussels. [324]
Description	
Implement zero-emission zones in all major urban centres (e.g., all towns above 20 000 people), including more space for non-motorised mobility or micro-mobility (bikes, e-bikes, e-scooters). Considering the limit of 20 000 people, this measure should affect 10-12 cities and towns and over 60% of the Latvia population.	

[322] CLEAN CITIES campaign (2022), The 7 steps to create effective low-emission zones
[323] CLEAN CITIES campaign (2022), The 7 steps to create effective low-emission zones
[324] CLEAN CITIES campaign (2022), The 7 steps to create effective low-emission zones

This measure was modelled by modifying the comfort factors of different transport modes. Zero-emission zones would: • increase the attractiveness of public transport, cycling and zero-emissions vehicles • reduce the attractiveness of ICE vehicles

Measure	Increased blend share for biofuels
Type	Supporting measure Regulation
Implementing organisation	Ministry of transport
Other stakeholders affected	Road transport sector
Timeline	From 2025
Costs/revenues	Low additional cost, since a blend is already considered in the baseline
Motivation	Replace fossil fuels with European production of biofuels
Description	
Increasing the biofuel blend requirement from 9% up to 15% for biodiesel and to 10% for bioethanol. This policy should not require retrofitting or engine adaptations to gasoline and diesel vehicles on the market.	

Measure	Extend and improve zero-emission vehicle incentives
Type	Primary measure Investment: Incentive
Implementing organisation	Ministry of transport
Other stakeholders affected	Potential vehicle buyers
Timeline	2023-2050
Costs/revenues	The Bonus-Malus measure should be cost-neutral in the long term. Costs of the various direct subsidies are provided in the description below.
Motivation	In 2021, less than 0.5% (around 2 500 cars) of all vehicles registered in Latvia were electric or hybrid.[325] In 2020 they were 1 500.[326] Further, over 75% of registrations were for used imported vehicles. At EU level, Europe's post-2020 standards include a "benchmark" standard to further incentivize the sale of ZEVs. If at least 15% of a manufacturer's new passenger cars and vans are zero- and low-emission (below 50 grams of CO_2 per kilometre) in 2025 (and 35% for cars and 30% for vans in 2030), then the company's CO_2 targets are relaxed.[327]
Best practices	Norway has had the most success in shifting to ZEVs in large part by offering generous taxation benefits to ZEVs, including exemption from VAT since 2001, enabling EVs to be equivalent in total cost of ownership for many segments in 2020.[328] Germany has set a target of a net-zero emission transport sector by 2045 and provides substantial support: On the demand side, a subsidy of up to €6 000

[325] Central Statistical Office (2022), Transport in Latvia 2022
[326] Central Statistical Office (2022), Transport in Latvia 2022
[327] ZEV alliance & ICCT (2021), Supporting governments with 100% ZEV targets
[328] ZEV alliance & ICCT (2021), Supporting governments with 100% ZEV targets

	for a new car, matched by €3 000 from the vehicle manufacturer. The government is also supporting growth of the charging ecosystem by providing €900 for private chargers, funding fast charging, and setting standards (e.g., for payment) to improve competition and user experience.[329]

Description

To improve the strength and financial sustainability of the support for low emissions vehicles, a revenue-neutral feebate scheme on the purchase price and annual road tax will be introduced, with increasing malus according to gCO_2/km of the vehicle, similar to the Bonus-Malus scheme in place in France (the Malus can go up to several tens of thousands euros to be added to the purchase price)[330] and in Belgium[331] (taxation based on the CO_2 emissions, fuel type and EU emission standard of the vehicle). Purchase taxes will apply to all vehicles registered for the first time in Latvia.

The current €10 million subsidy scheme by VIF[332] will be integrated with the malus element of the scheme, which will go to replenish the budget for the following year. So the annual incentive budget will be: income from malus purchase taxes from previous year + additional income from EKII (current source of funding).

Current (€/vehicle)

Tax	Technology	2023	2030	2050
Vehicle registration tax* (Single payment)	Electric vehicles	0	0	0
	Fossil fuel vehicles	40	40	40
Average vehicle road tax* (Annual)	Diesel fuel vehicle	84	84	84
	Gasoline vehicle	120	120	120
	LPG and natural gas vehicle	108	108	108

Proposed (€/vehicle)

Tax	Technology	2023	2030	2040	2050
Vehicle registration tax* (Single payment)	Electric vehicles	-5000 to -2000	-2,000 to 0	100	300
	Fossil fuel vehicles	+10*g CO_2 above 120 g CO_2 /km	+30*g CO_2 above 100 g CO_2 /km	Ban	Ban
Average vehicle road tax* (Annual)	Fossil fuel vehicles	100+5*g CO_2 above 120 g CO_2 /km	100+15*g CO_2 above 100 g CO_2 /km	100+25*g CO_2 above 80 g CO_2 /km	100+50*g CO_2 above 60 g CO_2 /km
	Electric and low carbon vehicles	0	0	0.07*kg vehicle mass	0.07*kg vehicle mass

Further details on the proposal:

- In the long term, EVs will also be taxed, as to encourage shift to public transport
- Incentives would vary for new EVs depending on vehicle parameters (e.g., vehicle power in kW)
- From next year, fossil fuel vehicles would pay a registration tax malus based on CO_2 emissions per km above the threshold of 120 gCO_2/km. For example, an SUV with a consumption of 180 gCO_2/km would pay €100 (base fee) plus €10*(180-120)= €100 + €600 = €700
- For road tax of fossil fuel vehicles, the calculation will be similar to the above

[329] ZEV alliance & ICCT (2021), Supporting governments with 100% ZEV targets
[330] Further information about the French Bonus-Malus scheme is available here: ACEA (2021), Tax Guide 2021
[331] ACEA (2020), CO2-based motor vehicle taxes in the European Union
[332] See Table 3-3.

Modelling estimates that this scheme would in fact bring in revenue as vehicle registration tax when applied to light duty vehicles. A similar approach will be applied for light freight trucks. Modelling estimates this would imply around €230 million up to 2030. Finally, this would also cover extending subsidies for electric buses, with around € 1.7 million/year up to 2027. Zero-emission vehicles incentives also cover subsidy schemes to public transport vehicles, including electric trains, with expenses around €100 million between 2025 and 2050.

Measure	Rapid electrification of urban services and government fleets
Type	Primary measure. EU driven measure (CVD[333]). Programme: Public fleets
Implementing organisation	Ministry of transport
Other stakeholders affected	Local administrations, publicly owned companies, private companies involved in the delivery of public services
Timeline	2027, 2030 and 2035
Costs/revenues	Medium-high
Motivation	Converting public fleet generates a number of benefits: • Direct saving of substantial amount of CO_2 • Provide exemplary role for public, other businesses and professional. By seeing commercial EVs in operation they would assess in first person the maturity of the technology, as well as its benefits • Improved urban air quality • If combined with compulsory purchase of green electricity for public administration, it will ensure a large demand for green electricity, driving further generation investments • It would require Local Authorities to develop charging infrastructure, which could be also made available to general public
Best practices	Amsterdam, Bergen, London, Oslo, Paris, and many other cities have set electrification goals for public transportation (mostly buses) and municipal fleets over different time horizons. For example, Paris set objectives of a 90% electric municipal fleet in 2021 and a 100% zero-emission public transportation system in 2025[334]
Description	
This programme aims to invest in the rapid electrification of urban services and government fleets, complying with the Clean Vehicles Directive, and will be made of a series of instrument. <u>Regulation</u>:	

[333] Directive (EU) 2019/1161 Clean Vehicles Directive
[334] International Council on Clean Transportation (2021), Update on electric vehicle uptake in European cities

- by 2027, all new and used vehicles purchased by central and local government, and by publicly owned companies will be electric or low carbon vehicles
- by 2030, all new and used vehicles purchased by private companies for the delivery of urban services (waste removal, water and sewage, buses..) will be electric or low carbon vehicles
- by 2035, all vehicles in central and local government fleet will be electric or low carbon

Investment: to support the purchase of electric and low carbon vehicles, appropriate grants will be made available to administrations and to providers of public services.

Support: enhanced access to information for local administrations with e.g. a dedicated central contact point and website for EV-related information (models adapted to the administration's needs, process for EV procurement, …), plus establish a joint purchasing platform for all public fleets (this may help decision-making, access to negotiated prices, etc).[335] The central government will also attempt negotiate prices for specific categories of vehicles with manufacturers. In order to model this policy, several assumptions had to be included in the WAM scenario, so the modelled policy does not fully reflect the proposal presented here.

Measure	Extend and scale-up TDG 2021-27 beyond 2027
Type	Primary measure. Investment: infrastructure
Implementing organisation	Ministry of transport, Local administrations
Other stakeholders affected	Passenger and freight transport stakeholders, including individuals and businesses (mostly for freight).
Timeline	2028-2050
Costs/revenues	Cost involved in implementing the strategy could be high
Motivation	The current Transport Development Guidelines[336] aims at improving mobility options and safety while also achieving environmental and climate targets. It is essential that this is pursued in time.

Description

Enhancement of public transport infrastructure, electrification of transport in priority across the TEN-T network which are the largest traffic corridors, further development of railways in order to encourage modal shift. Significantly advance the electrification of the railway network by 2040 (in line with the progressive phase-out of ICE trains from 2045 – see measure 'Phase-out of new ICE vehicle sales'), with priority on the highest traffic corridors.

- **National level:** single ticket at national level, valid across different transport modes and private services; discounts for different users; large advantages for season ticket holders.
- **Urban transport**: enhancement of public transport via: increased number of services; modal exchanges; integration with public individual transport modes (e-bikes, e-scooters); extension of pedestrian areas and restricted access roads.
- **Intercity**: increase buses frequency; car sharing/car pooling
- **Sub-urban and rural**: car sharing/car pooling; alternative modes (e-bikes, e-scooters)

Main outcomes:

- Increased load factor on public transport;

[335] For example, a number of U.S. cities have established an *EV purchasing collaborative* that aims to facilitate EV deployment in municipal fleets (Electrification Coalition, Climate mayors EV purchasing collaborative)
[336] Cabinet of Ministers (2021), On the Transport Development Guidelines 2021-2027

- Continued growth in modal share of public transport vs. car until 2050; - Continued growth in modal share of rail vs. road until 2050. The WAM results also show a near-fully electrified railway network by 2040, as a result of the combination of policies modelled, although this may not be fully realistic in reality.

Measure	Develop a charging infrastructure plan (and the charging infrastructure network)
Type	Primary measure. EU driven measure (AFIR[337]) Programme: Planning
Implementing organisation	Ministry of Transport, Ministry of Climate and Energy
Other stakeholders affected	TSO, DSOs, EV owners, charging operators
Timeline	Plan by 2024, Implementation by 2030
Costs/revenues	Low (implementation costs may be high)
Best practices	See BEUC report https://www.beuc.eu/sites/default/files/publications/beuc-x-2019-060_new_label_to_choose_the_best_and_cleanest_car_models.pdf
Description	
Coordinate the development of a charging infrastructure plan together with the TSO, both for publicly accessible and non-publicly accessible charging infrastructure deployment. This could go hand-in-hand with the introduction of incentives for recharging point installation, in particular in buildings, for which incentives do not yet exist. Together with this plan, it is recommended that Latvia is more ambitious in the transposition of the EPBD, for example with Article 8(3) that states that "Member States shall lay down requirements for the installation of a minimum number of recharging points for all non-residential buildings with more than twenty parking spaces, by 1 January 2025". Currently, the legislation transposes these provisions "a minima", only for public buildings.[338,339] Develop the plan in line with the Alternative Fuels Infrastructure Regulation (AFIR) proposal[340], in particular: - Implement a fleet-based target for light-duty vehicles and deploy publicly accessible charging infrastructure accordingly (1 kW/BEV and 0.66 kW/PHEV);[341] - Offer quality publicly accessible charging options at least every 60km along the TEN-T network going through Latvia;[342] - Ensure the interoperability of the charging infrastructure[343] and the possibly to use the publicly accessible charging infrastructure on an ad-hoc basis using a common payment instrument.[344] - Include charging infrastructure for trucks in the plan;[345] Latvia's NRRP foresees the installation of 2060 charging points by 2026, as part of the programme for Modernising the electricity transmission and distribution networks. It was not possible to model the effect of this measure in the WAM scenario.	

[337] Alternative Fuels Infrastructure Regulation - COM/2021/559 final
[338] i.e., buildings in which more than 50% of the total area of the building is a public premise or premises for the provision of a public function, or an engineering structure intended for public use (for example, stages, stadiums).
[339] Promotion of e-mobility through buildings policy, Final report.
[340] COM(2021) 559 final. AFIR proposal
[341] COM(2021) 559 final. AFIR proposal Article 3.1.
[342] Further details in AFIR proposal Article 3.2.(a) and (b).
[343] AFIR proposal Article 7.2 and Annex II.
[344] Further details in AFIR proposal Article 5.2.
[345] Further details in AFIR proposal Article 4.

Measure	Enhanced vehicle labelling
Type	Supporting measure Programme: Information
Implementing organisation	Ministry of Economy
Other stakeholders affected	Car retailers, manufacturers
Timeline	From 2025
Costs/revenues	Limited implementation costs for manufacturers
Motivation	Citizens' awareness has been recognised as one of the key challenges to more sustainable purchase. A standard label will support users in their choice by drawing the attention to key environmental performance indicators and ongoing costs
Best practices	Finland
Description	
Implement more efficient vehicle labelling going beyond EU requirements of the Car Labelling Directive. It is suggested that Latvia implements a clear labelling system, for example adoption of the letter-based rating of the EU energy label design (currently Latvia has no specific format for its car-labelling system).[346] A good example is the Finnish label[347] which provides taxation, running costs, fiscal incentives and safety. Given the large share of used imports in Latvia (larger than domestic new registrations), it is recommended that the car labelling system is extended to used vehicles so as to capture all car registrations in the country.[348] It is also recommended that for used vehicles a factor that estimated the loss of performance due to age is also included.	

5.2.2 *Actions in the energy sector*

Measure	Introduce more ambitious EE targets
Type	Primary measure. EU driven measure. Regulation
Implementing organisation	Ministry of Economics
Other stakeholders affected	Energy generators, self-generators, all sectors
Timeline	Targets to 2030, 2040 and 2050
Costs/revenues	The costs of meeting the targets will be borne by households (for the residential sector) and by business for the commercial, industrial and transport sector
Motivation	Latvia's NECP sets energy efficiency and RES targets for 2030 in accordance with the EED and RED. The proposed EED recast and COM(2022) 222 aim to introduce an even more ambitious energy saving target binding at EU level as well as a benchmarking system for Member States to set their national indicative contributions to the binding EU target.
Description	

[346] Ricardo Energy & Environment (2016), Evaluation of Directive 1999/94/EC ("the car labelling Directive") published by: European Commission (DG CLIMA)
[347] BEUC (2019), A new label to help people choose the best and cleanest car models, today and tomorrow
[348] Ricardo Energy & Environment (2016), Evaluation of Directive 1999/94/EC ("the car labelling Directive") published by: European Commission (DG CLIMA)

Fully transpose the EED and establish a more ambitious target for energy savings in line with the EED recast proposal.

This includes increasing the current 0.8% (reduction in annual final energy consumption) to 1.5%. New targets should be set at sectorial level, at least for the sectors using the majority of energy: buildings, industry and transport.

The recommended target levels are based on the WAM projections shown below and on the following considerations:

- the building sector should be able to reach the energy reduction target thanks to the renovation support scheme described in section 5.2.3;
- the industrial sector is expected to grow and increase its energy use both in the baseline and WAM scenario, which is why instead of a reduction target it shows a max increase target. However, a more ambitious policy should consider an agreement with the industrial sector to reduce the increase energy use for example at 1% per year (essentially, any expansion should be made with an increased in energy use of 80% compared to the current average);
- the transport sector target should be placed on large users, primarily private and public fleets.

Figure 5-2 Expected energy reduction in WAM scenario

	FEC (TJ)		Reduction by 2030 in WAM	average annual reduction
	2020	2030		
Residential	*47 211*	*35 560*	*24%*	*2.8%*
Commercial	*23 504*	*22 433*	*5%*	*0.5%*
Buildings	70 712	57 993	18%	2.0%
Industry	38 202	44 930	-18%	-1.6%
Transport	47 404	44 312	7%	0.7%

Based on the above considerations, the following annual targets are suggested:

- Buildings: -2%.
- Industry: +1.5%
- Transport: -1%

Measure	Facilitate investment in storage and flexibility
Type	Primary measure. Reform
Implementing organisation	MOE, Public Utilities Commission (Sabiedrisko pakalpojumu regulēšanas komisija), TSO
Other stakeholders affected	Electricity market service providers
Timeline	2025
Costs/revenues	Limited implementation cost shared across market actors
Motivation	Baltic countries have high flexibility needs not because of the RES shares but because of lack of other resources, and they depend on cross-border exchanges

	for covering flexibility needs.[349] A DG ENER study[350] found that Latvia would need around 0.7 TWh of flexibility in the daily timeframe; 0.4 TWh in the weekly timeframe and around 1TWh in the annual time frame by 2030. At the time of the study, the main flexibility potential available would be the interconnection LV-EE (500 MW) and the installation of 40MW of batteries – with CCGT also providing flexibility across timeframes. Another study[351] found that there is no regulatory framework for storage in Latvia. Further, it highlighted that grid and taxation aspects (double charging of network tariffs, net metering for renewable energy producers with small connections) limit the business case for storage, front- and behind-the-meter.
Best practices	Member States such as Belgium, Finland, France, the Netherlands, Poland, Portugal and Spain have dedicated R&I budgets for energy storage.

Description

The aim of this measure is to provide an enabling environment and level playing field to different flexibility and storage investments, and further foster the deployment of storage and flexibility options via the Baltic balancing market. Latvia should focus on adequate implementation of the clean energy package in order to enable storage and other flexible technologies to participate in energy and ancillary services markets as well as in eventual capacity mechanisms, and to be remunerated in a transparent, non-discriminatory way. In particular by:

- Ensuring that storage is coherently defined across the national legal framework and harmoniously across the Baltic and Nordic markets
- Developing a long-term policy strategy for system flexibility, which aims to
- bring into different markets prosumers, in particular via Demand Response and via dynamic electricity prices and time-of-use grid tariffs
- Eliminate possible barriers to the deployment of storage and its participation in schemes to support capacity, such as double charging and double taxation of grid tariffs;
- Phase out net metering in the medium term, in favour of net billing schemes;
- thoroughly assess network investments vs the procurement of flexibility from other resources
- Guarantee the interoperability of flexibility resources and access to data

Measure	Planning process reform
Type	Supporting measure. Regulation
Implementing organisation	Ministry of Economics;
Other stakeholders affected	other ministries; local administrations
Timeline	From 2024
Costs/revenues	Limited staff costs
Motivation	Speeding up the planning process is one of the key priorities across the EU, as it has been acknowledged as one of the main bottlenecks that are slowing down the uptake of renewables. Developers in many Member States are facing still too long pre-development times and face barriers mainly related to process-related issues, conflicting public goods, third party issues and grid issues[352]. Resmonitor highlights several strategy and planning barriers in Latvia, from lack of information and lack

[349] ASSET (2019), Which, where, when and how much flexibility and storage do we need to meet 2030 goals?
[350] Artelys (2017), Mainstreaming RES - Flexibility portfolios. Design of flexibility portfolios at MS level to facilitate a cost-efficient integration of high share renewables.
[351] Trinomics et al. (2020), Study on energy storage – Contribution to the security of the electricity supply in Europe
[352] RES Simplify (2021), Technical support for RES policy development and implementation - Simplification of permission and administrative procedures for RES installations

	of long-term predictability to spatial planning regulations (i.e. use restriction), fragmentation of rural land ownership and administrative issues.[353] The specific analysis carried out for Latvia[354] covers onshore wind, roof-top PV and biomass and highlights that: • the process of site selection and obtaining all the necessary permits for renewable installations is complex, regulated by a number of different laws and subordinate regulations. Further, there is no one-stop shop in Latvia, which means developers have to deal with multiple stakeholders. In particular, this is a severe barrier for onshore wind. • Regarding roof-top PV, local building authorities lack a common understanding of how to coordinate the installation of these systems, and it is not fully clear to what extent they should even be involved in this process. • recent legislative changes that have shortened the time period in which construction of RES-E plant with a capacity exceeding 1 MW must begin after obtaining the licence (from 2 years to 6 months), which developers deem too short. As part of the implementation of the NECP (in particular, the measure …) Latvia has already introduced some simplifications, including shortening the EIA process, the creation of a SPOC (the State Building Inspection Authority, which will take over responsibilities currently at municipal level), and the designation of renewable projects as project of national interest.[355]
Best practices	Planning tool in France, TSO accommodating RES needs in Finland, approval of PV systems and components in Austria and allowance of stealth wind turbines in previously restricted radar areas in France[356] Also see: EC recommendation on speeding up permit-granting procedures for renewable energy projects and facilitating Power Purchase Agreements[357] and Guidance[358], as well as RES-Simplify project[359]

Description
A reform of the planning process should include a review of the current system to consider: • the findings and recommendations provided by the RES-Simplify project[360], in particular concerning the creation of one-stop shops, speeding up of environmental impact assessment time (currently requires between 12 and 24 months), and clarifying the role of local administration concerning rooftop PVs.

[353] RES Policy Monitoring Database (2022), Barriers
[354] RES Simplify (2020), Technical support for RES policy development and implementation - Simplification of permission and administrative procedures for RES installations
[355] Balticwind.EU (2022), Latvia will increase energy independence, less bureaucracy for wind projects is predicted
[356] RES Policy Monitoring Database (2022), Barriers and best practices for wind and solar electricity in the EU27 and UK.
[357] European Commission (2022), COMMISSION RECOMMENDATION of 18.5.2022 on speeding up permit-granting procedures for renewable energy projects and facilitating Power Purchase Agreements {SWD(2022) 149 final} - {SWD(2022) 151 final}
[358] European Commission (2022), Guidance to Member States on good practices to speed up permit-granting procedures for renewable energy projects and on facilitating Power Purchase Agreements
[359] RES Simplify (2020), Technical support for RES policy development and implementation - Simplification of permission and administrative procedures for RES installations
[360] RES Simplify (2020), Technical support for RES policy development and implementation - Simplification of permission and administrative procedures for RES installations

- European Commission's Guidance to Member States on good practices to speed up permit-granting procedures for renewable energy projects[361]

A reform of the planning progress has been included in the TIMES modelling by shortening the building and approval time at technology level.

Approval and building time improvement following planning process reform:

Technology	Approval and building time (years)	
	Baseline	WAM
Hydro	2	1.5
Wind (onshore/offshore)	3	2.25
Solar	1	0.75
CHP and heating plants	2	1.5
Electrolysers	3	2.25

Measure	Promotion of PPAs for corporate off-takers
Type	Primary measure. Reform
Implementing organisation	Ministry of Economics or Ministry of Climate and Energy
Other stakeholders affected	Corporate off-takers (Businesses/ Industry)
Timeline	2023
Costs/revenues	Low
Motivation	PPA can be an effective way to finance new renewable installations, to shield non-residential consumers against variable energy prices, and to allow them to produce their good and services more sustainably. However, there is currently a lack of a proper PPA offer due to a number of reasons, first of all the lack of experience of different actors involved, and challenges related to lenders' requirements.
Best practices	See EC guidelines[362] EC recommendation on speeding up permit-granting procedures for renewable energy projects and facilitating Power Purchase Agreements[363]
Description	
A Corporate Power Purchase Agreement (PPA) is a long-term contract under which a business agrees to purchase electricity directly from a renewable energy generator. The electricity can be delivered virtually (Virtual PPA) or physically (Physical PPA). PPAs provide financial certainty for the project developers facilitating financing. At the same time, they allow corporates to fulfil their climate targets.	

[361] European Commission (2022), COMMISSION STAFF WORKING DOCUMENT Guidance to Member States on good practices to speed up permit-granting procedures for renewable energy projects and on facilitating Power Purchase Agreements Accompanying the document Commission Recommendation on speeding up permit-granting procedures for renewable energy projects and facilitating Power Purchase Agreements
[362] European Commission (2022), Guidance to Member States on good practices to speed up permit-granting procedures for renewable energy projects and on facilitating Power Purchase Agreements
[363] European Commission (2022), COMMISSION RECOMMENDATION of 18.5.2022 on speeding up permit-granting procedures for renewable energy projects and facilitating Power Purchase Agreements {SWD(2022) 149 final} - {SWD(2022) 151 final}

A guide published recently by the European Commission[364] recommends to:

- Address regulatory issues, which are one of the main barriers. To do so, Member States could: conduct a detailed assessment of current barriers faced by developers and purchasers; Announce an indicative volume of renewables deployment, which is expected to be financed through power purchase agreements (see Ireland); allow projects currently under public support schemes to the holidays from these and sell through PPAs (see Poland); allow the issuing of Guarantees of Origin in public support schemes.
- Facilitate the participation of SMEs. To do so, Latvia should consider actions such as: establishing a public platform to increase transparency on the price, volume, types and parties involved; Ensure implementation of the EU Taxonomy Regulation; Flexible contracting for SMEs, including specific guidance for contract termination fees for small enterprises; Enable multiple supply contracts; de-risk PPAs via credit guarantees or insurances, and encourage national banks to support developers with appropriate products; allow energy communities and small business parks to collectively sell and purchase energy via PPAs
- Promoting cross-border renewable PPAs, by removing regulatory barriers, in particular related to the guarantee of origin. In particular, Latvia should consider the opportunity to open up the PPAs market within the Baltic, as part of the ongoing cooperation.

PPAs have many risks associated with them, which have traditionally been handled by utilities, developers and energy traders and are now owned by corporates. RE-Source – the European platform for corporate renewable energy sourcing, provides tools for risk mitigation which could be taken into account.[365]

This measure was not explicitly modelled in TIMES, as it was not possible to identify and quantify robust drivers to be used as input. PPAs are unlikely to drive substantial new renewable generation by themselves, but they are likely to reduce the risks (and so the costs) for installations that may emerge thanks to market forces. The expected uptake of renewable in the power sector appears ambitious enough (see section 4.5.1- Electricity).

5.2.3 *Actions in buildings and industrial sector*

Measure	Minimum efficiency standards for new housing and commercial buildings
Type	Primary measure. EU driven measure. Regulation
Implementing organisation	Ministry of Economics
Other stakeholders affected	Residential and commercial sector
Timeline	By 2025
Costs/revenues	Low implementation cost
Motivation	The EPBD requires MSs to take the necessary measures to ensure that minimum energy performance requirements for buildings achieve cost optimal levels (i.e. the energy performance level which leads to the lowest global cost). This means that when assessing cost efficiency, the whole package of measures and lifecycle should be considered and not just the up-front investment.
Best practice	Netherlands' regulation on energy performance of buildings[366]

[364] European Commission (2022), Guidance to Member States on good practices to speed up permit-granting procedures for renewable energy projects and on facilitating Power Purchase Agreements
[365] RE-Source (2020), Risk mitigation for corporate renewables PPAs.
[366] CE Delft (2022), The natural gas phase-out in the Netherlands

	UK's EPC regulations for landlords[367] Other examples provided in the EC's Good practice in energy efficiency[368]
Description	

Introducing higher minimum energy efficiency standards (and associated labelling requirements) for new commercial and residential buildings in the context of the EPBD's energy performance certificates.[369]

Introducing minimum standards and guidelines for all new buildings focusing on measures that offer a good return (short payback period) to building owners, such as: LEDs and light sensors, roof insulation, double glazing, shading elements, grey/rainwater storage, air source heat pumps, solar water heating etc.
The focus on regulation should be accompanied by a renewed focus on enforcement, through more frequent inspections and checks, and focus on skills certification and training. Together, the regulation and enforcement aspects aim to achieve a more energy efficient design of buildings becoming an inherent process in planning.

The introduction of a minimum standards for rented accommodation and commercial buildings should be considered (UK model). The standard may become increasingly stringent over time.

The modelled outcomes of this measure are presented together with the outcomes of the next measure (*Subsidy scheme for energy efficiency in residential buildings*)

Measure	Subsidy scheme for energy efficiency in residential buildings
Type	Primary measure. EU driven measure. Investment: subsidy
Implementing organisation	Ministry of Economics or Ministry of Climate and Energy
Other stakeholders affected	Residential and commercial sector
Timeline	Up to 2050
Costs/revenues	Very high (€2.85 billion additional to current scheme. Further funding after 2030 required up to €4.8 billion)
Motivation	Subsidies for energy efficiency in buildings are expected to play a significant role in supporting efforts towards better energy efficiency for households and businesses. The aim of incentives is to bridge the gap between the cost of a traditional renovation and of a high efficiency renovation, keeping into account running cost of the building. Energy efficiency in buildings is regulated by the Energy Efficiency Directive and by the Energy Performance of Buildings Directive, both of which impose stringent renovation targets to Member States
Best practices	Ireland Better Energy Homes Scheme[370]
Description	

Incentives will be deployed according to funds availability, but their individual amount (the share of the cost of the measure supported by public funds) will progressively decrease as technology costs come down and the technology becomes more established. Incentives will be targeted primarily at existing buildings (retrofit) but in

[367] Bluedrop Services (2021), New EPC Regulations for Landlords in 2025.
[368] https://op.europa.eu/en/publication-detail/-/publication/54b16aac-2982-11e7-ab65-01aa75ed71a1/language-en/format-PDF/source-67528950
[369] Building energy labels have been used in the EU since 2002. These labels, ranging from G (worst-performing) to A (best-performing) indicate how energy efficient buildings are. Attributes such as fossil energy use and renewable energy production are also used in determining the label of a building.
[370] Swyft Energy, The Better Energy Homes Scheme

exceptional circumstances they may also support new buildings that aim to go significantly beyond minimum requirements.

Measures supported will include those measures which, while cost effective, have long payback period: roof insulation in single-family dwellings, ASHPs and AWHPs, solar water heaters; higher-efficiency glazing, wall insulation (including pre-insulated blocks), sustainable materials. While the details of the scheme are not yet defined (for example, to what extent each technology will be supported), the aim is to support the most effective solution according to the characteristics of the dwelling, exploit natural trigger points, and incentivise the installation of multiple measures at the same time, to reduce inconvenience and take advantage of possible cost reductions.

Similar to the approach used in other countries, the main requirement for accessing the scheme could be that the building improves by at least 2 or 3 efficiency classes after the intervention, that consumption is reduced by at least 30%, or that after renovation the building reaches a certain minimum standard.

The Latvia LTRS estimates total financing needs at €7.54 billion and a funding gap of over €1.5 billion in the next 10 year[371], a large share of which will have to come via government support.

Funding gap for apartment buildings (LTRS):

Total funding gap for residential apartment buildings	
Variables	**Values**
Total number and area of apartment buildings	38 600[94] 54.4 million m^2
Number and area of apartment houses where it is possible to carry out cost-effective recovery[95]	27 000 37.8 million m^2
Cost of energy efficiency improvements and other emergency renovation works in EUR/m^2	EUR 200/m^2
Total financial need	EUR 7.54 billion
Share of houses potentially interested in energy efficiency measures	60%
Total investment cost (actual financing needed)	**EUR 4.52 billion** (60% of EUR 7.54 billion)
Potential funding required over 10 years	EUR 1.5 billion (1/3 of total investment)

Latvia NRRP makes available €40 million to be spent for multi-apartment buildings by 2024, which is substantially below the amount estimated by the LTRS.

In order to obtain the results presented in section 4.5.1, subsidies are expected to reach a cumulative total of €2.9 billion by 2030 (including subsidies already planned before the introduction of this extended scheme), if it is assumed that incentives will have to cover 65% of renovation costs. This means that homeowners are expected to invest a further €1 billion over the period considered for building renovation, which brings the total to €4 billion, very close to the original estimate in the LTRS.

Additional funding is also to be provided for the installation of rooftop PV. This is expected to be around €25 million.

[371] information Report: Long-term strategy for the renovation of buildings

Measure	Support scheme for energy efficiency in commercial buildings
Type	Primary measure. EU driven measure. Investment: subsidy
Implementing organisation	Ministry of Economics or Ministry of Climate and Energy
Other stakeholders affected	Commercial sector
Timeline	Starting in 2025
Costs/revenues	High (additional €114 million to 2030, total of €290 million up to 2050)
Motivation	Commercial buildings and processes were responsible for 14% of final energy use in Latvia in 2020. Similar to residential buildings, the Energy Efficiency Directive and the Energy Performance of Buildings Directive impose stringent renovation targets to Member States. Also, the Energy Efficiency Directive requires large energy users to perform regular energy audits or to have in place a certified energy management system, while Member States should also encourage SMEs to perform energy audits.
Best practices	
Description	
A scheme to support energy efficiency in buildings aimed at the commercial sector (including government buildings) could take a similar form to a residential scheme, where the funding is aimed at deep renovation so to achieve significant energy savings in each building affected. Additional to current support schemes for the commercial sector, the support modelled is estimated at around €115 million cumulative up to 2030, and then around €6 million per year after 2035. Throughout the period considered (2023-2050) this support would cumulatively add up to €290 million extra to the current €77 million funding (included in the baseline estimates).	

Measure	Support scheme for energy efficiency in industrial processes and businesses
Type	Supporting measure Investment: Support scheme
Implementing organisation	Ministry of Economics or Ministry of Climate and Energy
Other stakeholders affected	Industry and commercial sector
Timeline	Up to 2050
Costs/revenues	Medium (€57 million to 2030, €94 million to 2050)
Motivation	Industry is responsible for 23% of final energy use in Latvia. The Energy Efficiency Directive requires large energy users to perform regular energy audits or to have in place a certified energy management system, while Member States should also encourage SMEs to perform energy audits.
Best practices	Italy's industry plan 4.0[372]; Germany's Federal funding for energy efficiency in industry
Description	

[372] Ministry of Economic Development, Piano Nazionale - Industria 4.0

Supporting businesses requesting bank loans to invest in new capital goods, machinery, plant, factory equipment which improve energy efficiency in industrial process. The support could consist of fiscal support (e.g. tax credits on energy efficiency related R&D or hyper-depreciation where assets are overvalued for depreciation purposes), financial support (e.g. partially covering the interest rate on bank loans) or grants/subsidies. The support scheme for energy efficiency would: ○ Create training and accreditation system for energy auditors, open to auditors with international experience ○ Provide financial support for large users that intend to implement measures with long and medium payback period via a grant covering 40% of the implementation cost + a guaranteed loan for the remaining part of the investment. The condition for the grant and loan is that beneficiaries have implemented actions with short payback period identified in the same audit (the actions implemented must allow to generate at least 50% of the savings achievable by all measures with short payback period identified) or achieve 30% of energy savings compared to the baseline. The grant provided could either be upfront or provided as a tax credit ○ Provide financial support to SMEs that intend to implement long- and medium payback period measures identified in the energy audit, as long as they have implemented measures with short payback period (same conditions as for large users). In case measures are implemented, the grant will also cover the cost of the audit (not mandatory for SMEs and small users). The grants would be funded via the NRRP €72.4 million[373] plus EKII fund (as it currently happens), but will be further extended from the general budget to allow broader actions.

Measure	Support scheme for renewable heat
Type	Supporting measure. Investment: subsidy
Implementing organisation	Ministry of Economics
Other stakeholders affected	Residential and commercial sector
Timeline	From 2026 to 2035
Costs/revenues	Medium (~€600M[374])
Motivation	The 2020 RTU's study *Development of heating and cooling systems in Latvia*[375] provides a detailed overview of heating needs and opportunities across the country, and analysis a series of policy options to reduce and decarbonise the production of heat. The analysis focusses on DH, although it recognises that currently 14 000 GWh of thermal energy is being produced in individual heating systems, compared to 8 000 GWh per year in DH. According to this analysis, support in the form of subsidies has a greater impact on key indicators as compared to higher taxes, while most beneficial policies under a number of criteria are programmes for the integration of residual heat, CO_2 tax; excise tax; and support for capital investments (i.e., integrating market returns for investors).

[373] Council of the European Union (2021), Annex to the COUNCIL IMPLEMENTING DECISION on the approval of the assessment of the recovery and resilience plan for Latvia
[374] Estimate assuming extension of proposed measures from 2030 to 2035 (maintaining average annual support levels), and following assumptions from RTU (2020), Development of Heating and Cooling Systems in Latvia
[375] RTU (2020), Development of Heating and Cooling Systems in Latvia

Best practices	UK's Domestic Renewable Heat Incentive[376] NL's sustainable energy transition subsidy scheme (SDE++)[377]

Description

Introduce a financial incentive to promote the use of renewable heat in buildings. Financial support could be allocated for the integration of renewable energy sources into district and individual heating, and funding made available for the replacement of DH networks and the promotion of the transition to low-temperature district heating.

The scheme could support capital investments, given most technologies for renewable heat require major initial investments. In this support model, investors are compensated for capital investment, while the production and sale of energy follows market principles.[378] The support would take the form of a one-time grant for the installation of the renewable heating system or as quarterly payments over a number of years for clean, renewable heat their systems are estimated to produce.

- **Support for the integration of renewable energy sources into district heating, local and individual heating**. Funding can be made available for the integration of biomass, solar collectors, heat pumps and residual heat. Support level can be 40% of capital expenditure for DH or 20% for local and individual heating systems.
- **Aid for the replacement of DH networks and the promotion of the transition to low temperature heating.** Support level can be 40% of capital expenditure.

The scheme will also include specific support for providers of waste heat – e.g. support perspective users of renewable heat to identify options for waste heat reuse.

Heat pump subsidies (€100 million by 2050 in the residential and commercial sectors) can contribute to the significant emissions reductions in the residential sector, and continue to be relevant until 2050, even with a private investment requested for half of the CAPEX (according to the WEM and WAM scenario results).

Measure	Accelerated natural gas phase-out (replacement by biomass/biogas and (limited) blending with hydrogen)
Type	Primary measure. EU driven (RePowerEU). Programme
Implementing organisation	Ministry of Climate and Environment or Ministry of Economics
Other stakeholders affected	Gas TSO & DSOs / Buildings and industrial sectors
Timeline	By 2027
Costs/revenues	Low implementation cost
Motivation	Natural gas covers 21.6% of Latvia's energy need, and this comes entirely from Russia. Given the current EU's commitment to stop all imports of gas from Russia, Latvia needs to find alternatives sufficient to cover one fifth of its energy needs. REPower EU aims to reduce dependency from Russian gas by saving energy, replacing gas and oil with clean energy; diversifying our energy supplies. Latvia's opportunity to reduce this share should focus on:

[376] Ofgem, Domestic Renewable Heat Incentive (Domestic RHI)
[377] Netherlands Enterprise Agency, Sustainable energy transition subsidy scheme (SDE++)
[378] RTU (2020), Development of Heating and Cooling Systems in Latvia

	• Aiming to replace Russian imports with LNG imports via Lithuania, but also gas imports from Estonia and Finland (although historically they also relied extensively on Russia) • Reduce gas use in power generation by deploying renewables, in particular begin the exploitation of offshore wind opportunities • Pursue energy efficiency more aggressively in those sectors that rely on gas. According to Eurostat's energy balances,[379] Latvia imports 10.5 TWh of gas, of which 6.5 are used as transformation input and 3.7 are available for final consumption; of the latter, 68% (2.6 TWh) are used in households and commercial buildings and 30% (1.1 TWh) are used in industry. Of the 6.5 TWh used as transformation input, 65% (4.3 TWh) is used in CHP plants and 32% (2.0 TWh) in commercial district heating (heat only). The 2020 RTU's study *Development of heating and cooling systems in Latvia*[380] mentions that targets and policies related to heat supply should be considered as a package (and not as individual measures). Further, it highlights that the development of district and local heating and the transition of DH to a fourth generation system must be incorporated into strategic long-term planning documents
Best practice	Netherlands' gas phase-out[381] The Netherlands has set a biomethane consumption target of 2 bcm. Additionally, a 20% biomethane blending rate must be achieved by 2030 (1.6 bcm of the 2 bcm target). The biomethane will have to be produced domestically and be injected into the gas grid.[382]

Description

Accelerated natural gas phase-out: Replacement by biomass/biogas and (limited) blending with hydrogen.

The plan should focus on:

- Reducing natural gas consumption where possible:
  - Convert DH to heat pumps
  - Convert building heating and cooking system to electric (support through grants)
  - Electrify low heat industrial processes and consider option to convert high heat processes to hydrogen or biomass
  - Focus on new gas-free dwellings and limit connections of new construction to the gas grid[383]
- Increasing the production of biogas
- Evaluating options for the production and use of hydrogen, including blending in the gas network

The plan should involve stakeholders active in the power and gas networks, as they will have to:

- Prepare a long-term plan for the dismissal of the gas network, tailored to different regions in the country, in order to

[379] Eurostat (2022), Energy balances
[380] RTU (2020), Development of Heating and Cooling Systems in Latvia
[381] CE Delft (2022), The natural gas phase-out in the Netherlands
[382] Gas for climate (2022), Manual for national biomethane strategies
[383] From international experience, most homes that are gas-free are relatively new homes that were gas-free from the moment they were built. From this we can conclude that the requirement for new homes to be gas-free is an important and effective step to increase the number of gas-free homes.

- Prepare a long-term plan to reinforce the power network to allow the required level of electrification of heat and transport

In the modelled results it is not possible to estimate directly the effect of this policy, as in practice it will be implemented via different measures. However, it is possible to observe a combined effect of 28% reduction in gas use compared to the baseline by 2030 and a 59% reduction by 2050. This is due to a range of factors, including the increase in biomethane share as discussed in section 4.7.

Table 5-5 Gas use in baseline and WAM scenario

5.2.4 *Other actions/cross-cutting actions*

Measure	Increase in natural resource tax (NRT)
Type	Primary measure Regulation
Implementing organisation	Ministry of Finance and State Revenue Service (SRS)
Other stakeholders affected	Those who: • acquire or produce taxable natural resources; • use the useful properties of the depths of the earth; • emit polluting substances into the environment or dispose of waste; • use water resources for electricity production; • sell or use goods harmful to the environment in economic activity, etc
Timeline	2028
Costs/revenues	Increase in revenue
Motivation	Taxes are the most effective way to reduce negative externalities, but are politically difficult to be introduced. Having a tax system already in place is an opportunity that should be exploited. Further, the European Green Deal

	acknowledges the crucial role of taxation in the transition to a greener and more sustainable economy.[384]
Description	
The purpose of the natural resource tax is to promote the economically efficient use of natural resources, limit environmental pollution, reduce the production and sale of environmentally polluting products, promote the introduction of new, environmentally friendly technologies, support the sustainable development of the national economy, as well as financially ensure environmental protection measures.[385] The activities upon which the NRT is imposed can be divided into the following groups: waste disposal, water abstraction, aggregates, air and water pollution, packaging, harmful goods and coal, coke and lignite.[386] The NRT was already revised in the context of the NECP. However, given the more ambitious targets in place, a further increase in the tax rate and in the number of activities involved could be considered and planned for the next 5 years. Information concerning the tax shared with the public and stakeholders should link to subsidy and support schemes available to improve efficiency and reduce emissions. Currently NRT covers installations that are not covered by the ETS, as a complementary measure to ETS, with the tax rate being 15 € per tonne of CO_2 emitted. However, given that the cost of one ETS allowance has increased at significantly in 2022, the NRT for installations not covered by the ETS should be revised to close the gap of cost per tonne of CO_2 emitted between ETS and non-ETS installations. In the TIMES WAM modelling, the current cost imposed on emissions from the non-ETS sector in Latvia is assumed to increase up to €25/tCO_2 by 2050.	

Measure	Carbon contract for difference (CCfD)
Type	Supporting measure Regulation
Implementing organisation	Ministry of Economics or Ministry of Climate and Energy
Other stakeholders affected	Industry
Timeline	2025, with auctions every 3 years
Costs/revenues	Variable - depend largely on carbon price
Motivation	A carbon contract for different (CCfD) is an unambiguous way to support decarbonisation investment and allow competition across sectors to find the cheapest carbon savings. A scheme well designed will allow to: • identify cheapest savings • support private investors that decide to invest in new and more expensive technologies • provide an “insurance policy” towards higher cost of carbon credits in the long term
Best practices	• Climate Strategies et al (2020). Policy brief: Carbon Contracts for Differences: their role in European industrial decarbonization[387] • ICF (2020), Industrial Innovation: Pathways to deep decarbonisation of Industry - Policy implications[388]

[384] EEA briefing (2022), The role of (environmental) taxation in supporting sustainability transitions
[385] State Revenue Service, Strategy, plan, reports - archived page
[386] Jurušs, M. & Brizga, J. (2017), Assessment of the Environmental Tax System in Latvia
[387] Climate Friendly Materials Platform (2020), Carbon Contracts for Differences: their role in European industrial decarbonisation
[388] ICF (2020), Industrial Innovation: Pathways to deep decarbonisation of Industry Part 3: Policy implications

	• Netherland's SDE++

Description
CCfDs are a funding mechanism where governments guarantee a fixed price to investors for CO_2 emission reductions over a given time period. Generally, the price offered will be above the current price levels in the EU ETS, but in line with long term expected price growth. CCFDs reduce uncertainty around carbon prices for investors, and provide certain revenue streams to decarbonisation technologies. The resources provided above list a number of design and harmonization options to consider when setting up a CCfD. Given the novelty of the initiative, MoE and/or MoCE should implement the measure using a gradual process. Suggested steps include: • launch a consultation with industry • develop a methodology to evaluate CO_2 savings from different projects. This should consider methodologies developed in other MSs, ad internationally accepted methodologies • Start a roundtable with other Baltic countries to evaluate whether a joint Baltic scheme would be feasible • launch a pilot programme, with limited budget and negotiated prices, aiming to involve at least 5 projects from different sectors • based on the lessons learned from the pilot, set up an auction to award long-term contracts. New auctions should be held regularly (e.g., max every three years) While it was not possible to include this measure as part of the main scenario modelling, some of the effect of this measure have been assessed in the sensitivity dedicated the hydrogen deployment, as it is expected the measure would support this type of solutions. Details over the modelling assumptions and results are provided in section 4.6.

Measure	Introduce a subsidy scheme for alternative fuels
Type	Primary measure Financial/subsidy
Implementing organisation	Ministry of Finance
Other stakeholders affected	Consumers, businesses
Timeline	From 2023 with reduction from 2030
Costs/revenues	Induces a cost for the state, which may be compensated by the compete phase-out of any fossil fuel subsidies and possibly an increase in fossil fuel taxation in the long term.
Motivation	At early market stage, alternative fuel subsidies aim to accelerate the competitiveness of alternative fuels vs. fossil fuels and hence their adoption by individuals and businesses, and decreases investment risks for alternative fuel suppliers.
Best practices	• Alternative fuels infrastructure support: Germany (for inland ports in Sachsen), France ("Zero Fumes Stopover" plan). • The "Low-Emission Transport Fund", Poland • Investment premium for new vessels, Germany (for equipping inland vessels powered by alternative fuels). • Port due discounts, The Netherlands (inland or sea harbour due discounts for vessels powered by alternative fuels in the ports of Amsterdam and Rotterdam, without detailing the amounts).

	• Retrofitting, Germany (for inland vessels powered by alternative fuels), Hungary (for maritime and inland vessels powered by alternative fuels, including electricity, by 2030). • State guarantees: Spain (for the conversion to low-emission vessels).
Description	
The aim of a subsidy scheme to support alternative fuels is to ensure that applications were electrification is not an option can also move to low carbon options, and to provide low-carbon alternatives to existing fossil fuel uses such as natural gas. This may affect all sectors currently reliant on liquid/gaseous fossil fuels. An effective implementation option is to apply subsidies on a EUR/MJ basis at sale, for a limited period of time or until each subsidised alternative fuel reaches predefined market penetration threshold, after which the subsidy should be phased-out in order to not distort market forces and ensure that such a measure is temporary and financially sustainable for the government. Subsidies for alternative fuels should not exist in parallel of any fossil fuel subsidies and should ideally be paired with fossil fuel taxes that reflect their environmental and climate impact. This measure was modelled in the WAM modelling exercise as an extension of the baseline's subsidy scheme for biomethane production, with around €45 million used up to 2050 (with € 1 million/year from 2031 onwards), supposing an equal amount of private investments. The uptake of biomethane is also expected to be boosted by an extension and strengthening of the biomethane obligation (thus contributing to replace natural gas and reach 3.8 PJ per year by 2050).	

Measure	Biogas and biomass: improving organic waste management
Type	Supporting measure. EU driven measure. Programme (Investment + information)
Implementing organisation	Ministry of Environmental Protection and Regional Development
Other stakeholders affected	Bio-waste producers, municipalities
Timeline	2021-2028
Costs	€25 million per year (40 thousand tpa, estimated cost of €625/ton processing capacity) [389]
Motivation	The revised Waste Framework Directive requires a separate biowaste collection or recycling at the source by 31 December 2023 (Directive 2018/851/EU, §10). This means that all municipalities must plan and implement separate biowaste collection schemes.[390] Bio-waste is a key waste stream with a high potential for contributing to a more circular economy, delivering biogas. Anaerobic digestion makes the best use of organic materials by producing renewable energy and organic fertilizer while closing the nutrients cycle and reducing greenhouse gas emissions. At EU level, treatment of separately collected bio-waste is dominated by composting, but anaerobic digestion, with biogas production, is increasing. According to EEA data, Latvia's bio-waste capture rate

[389] GEO Consultants (2020), Assessment of investment needs for the development of the national waste management plan for 2021-2028

[390] Interreg (2021), A policy brief from the Policy Learning Platform on Environment and Resource Efficiency

	was just over 20% in 2017, compared to the EU average of around 50%. Similarly, treatment capacity for Latvia was low compared to other countries with just over 50kg/person (while countries like Croatia, Austria, France, Slovenia and Sweden have over 250kg/person treatment capacity). [391] Separate collection of bio-waste is basically not implemented in Latvia. [392] A few pilot projects are in place, such as in the municipality of Adazi.[393] The landfill tax (known as the natural resources tax) increased from €12/t in 2016 to €25/t in 2017, and a further increase to €50/t was planned by 2020 and to €95 for 2023, but refunds are not linked to the implementation of separate collection schemes. The new Waste Management Law, introduced mandatory separate collection of biodegradable waste from 2021. The recently approved (end-2019) act on waste management in the city of Riga states that key waste fractions, including biodegradable waste, shall be collected separately. [394] RTU participated in the OptiWaMag project triggering a self-assessment of the Latvian waste management system in 2020 and the revision of the National Waste Management Plan (NWMP) that now also encompasses separate collection, recycling and reuse of waste as a prerequisite of a circular economy of resources. The NWMP 2021-2028 was officially adopted by the Cabinet of Ministers of Latvia in January 2021. With regard to bio-waste, the new NWMP features the separate collection of biological waste from 2023; the use of specialised containers near multi-apartment residential buildings and of composting containers near single-family houses in Riga city was planned to start in 2021[395]
Best practices	Some best practices on food waste management include Milan's door-to-door food waste collection (in a large, dense city); economic instruments to encourage separate collection of food waste (landfill tax in Catalonia); networking to promote food waste collection (Reseau compost plus in France).[396] Options for separate collection of waste are the Pay-as-you-throw (PAYT) tariff schemes to reduce the residual waste fraction where most biowaste is ending up today. The new Know-as-you throw (KAYT) concept is being introduced as a parallel information system to increase the awareness of citizens on their waste

[391] EEA (2020), Bio-waste in Europe – turning challenges into opportunities. EEA Report No 04/2020
[392] Zero-waste Europe (2020), Bio-waste generation in the EU: Current capture levels and future potential
[393] Adazi is currently one of the few municipalities in Latvia that has publicly available containers for biodegradable waste. There are 36 sorting stations with large bins, to collect commingled garden and food waste. This project has been implemented by the company Eco Baltia and funded by the EU cohesion fund.
[394] Zero-waste Europe (2020), Bio-waste generation in the EU: Current capture levels and future potential
[395] Interreg (2021), A policy brief from the Policy Learning Platform on Environment and Resource Efficiency
[396] Zero-waste Europe (2020), Bio-waste generation in the EU: Current capture levels and future potential

	generation, savings and individual behaviour compared to the average.[397]
Description	

This measure should entail the **quick and efficient implementation of the Waste Framework Directive to force separate collection of organic waste streams and its treatment according to the waste hierarchy**. For municipalities to plan and implement separate collection schemes, Latvia could:

- Provide support, guidance and best practices for the municipalities
- Invest in the necessary infrastructure

As stated in national waste management plan for 2021-2028, there is a need for **additional processing capacity**: including the construction of separate facilities for the recycling of bio-waste and food waste collected from wholesale bases, logistics centres, markets, food businesses, including supermarkets and catering; as well as the construction of equipment that ensures the production of high-quality energy resources, e.g. natural gas quality biomethane.[398]

This measure translates in the WAM modelling by an increased availability of biogas (landfill gas) (of 20% between 2025 and 2050). Further analysis on waste potential is presented in Annex IV and in section Hydrogen

Hydrogen is included in the model as a potential fuel with applications to different sectors. It is characterised by the following parameters:

Technology Description	Lifetime	Investment cost 2018	Fixed O&M costs 2018	Variable O&M costs	Efficiency	Availability factor
Renewable fuels – 1) production of hydrogen by means of electrolysis	years	Thousand €/MW	Thousand €/MW	thsd.EUR/TJ		
Hydrogen production via alkaline electrolysis (AEC)	25	65000	13	-	0.64	1
Hydrogen production via polymer electrolyte membrane electrolysis cells (PEMECs) or simply polymer electrolyte membrane (PEM)	25	95000	37	-	0.58	1
Hydrogen production via solid oxide electrolysis (SOEC)	10	4490	539	-	0.76	1

The model can choose to produce and use hydrogen instead of other technologies and can pick up among the three technology options provided. However, very limited hydrogen use appears in the self optimisation and in the WAM scenario (4.5 PJ and 0.9 PJ, respectively, equivalent to 3.5% and 0.6% of final energy use), while in the baseline no hydrogen is used. In the self optimisation scenario, hydrogen emerges as a fuel in 2045, and reaches up to 3.5% of FEC in 2050 (4.5 PJ). In 2050, hydrogen is used in agriculture (3.4 PJ per year), in the commercial sector (1.1 PJ per year), and in the transport sector (0.01PJ). In the WAM scenario, only minimal amount of hydrogen are used in transport. The results in the self-optimisation and in the WAM scenario emerge without any policy specifically aimed at promoting hydrogen, but simply out of the regulations and incentives introduced in each sector.

As part of the modelling exercise, a dedicated hydrogen scenario was modelled, imposing the deployment of higher installed capacities higher installed capacities (5 MW in 2035, 15 MW in 2040, 35 MW in 2045, and 75 MW in 2050). Table 4-6 shows the difference in PEC between the two WAM scenario and the

[397] Interreg (2021), A policy brief from the Policy Learning Platform on Environment and Resource Efficiency
[398] GEO Consultants (2020), Assessment of investment needs for the development of the national waste management plan for 2021-2028

dedicated H2 scenario. It shows that deploying hydrogen would significantly reduce the consumption of Natural gas and diesel, but require more wind, solar and biomass generation to provide the energy for the electrolysis process. The analysis also shows how the model is accounting for the different perspective in earlier years, and modifying investment decisions ahead of the time when the new capacity comes online. This is a realistic outcome, as plans to produce hydrogen will be known ahead of time, and investment decisions in earlier years would reflect that.

Table 4-6 Difference in Primary energy use between the WAM scenario and the dedicated H2 scenario (TJ)

	2025	2030	2035	2040	2045	2050
WIND	-	-161	147	256	1 459	1 945
SOLAR	-39	13	12	17	22	167
BIOMAS	-1	-70	-16	-1	115	114
net POWER Import	94	129	-49	320	-33	83
OIL	2	-	0	-	6	48
LPG	6	-13	-1	-15	0	25
BIOFUEL	-0	-0	13	11	13	13
GASOLINE	-0	-0	9	-6	1	-26
NATURAL GAS	-66	6	-158	-274	-638	-1 191
DIESEL	34	37	-54	-420	-1 817	-2 507

In terms of use, hydrogen is expected to be initially taken up mostly in agriculture starting in 2035 ad growing up to 2.7 PJ in 2050 and in the transport sector (1 PJ in 2050).

In terms of total investments, the H2 scenario appears slightly more expensive (0.08%, an additional €24 million). The majority of additional investments are expected to happen in 2045 and 2050 in the Power sector (€215 million in 2045 and €598 million in 2050) and in the agriculture sector (€135 million in 2045 and €45 million in 2050), but these will be compensated by reduced investments in previous years, in particular in the residential sector (minus €25 million cumulatively) and in the Industrial sector (minus €1.6 million cumulatively).

Other considerations regarding infrastructure needs0.

Measure	Extend research, including specific research on alternative fuels
Type	Supporting measure Investment
Implementing organisation	Ministry of Education and Science Ministry of Economics
Other stakeholders affected	• Latvian Research Council • Central Finance and Contracting agency of Latvia • MoT • ZM • MoEPRD • MoF
Timeline	From 2025
Costs/revenues	Could be flexible over the years, and co-financed via EU grants

Motivation	Latvia's NECP includes a measure to '*Support research into alternative fuels (advanced biofuels, hydrogen, electricity, etc. non-emission fuels), production and infrastructure technologies and the development of innovative solutions*', for a budget of €233.5 million from EU Structural Funds, State budget including EAAI, national budget and private funding. Latvia has a State Research Programme on 'Energy', which launched 4 calls in 2018 (for around 5 M EUR)- including one focused on "Renewable and local energy sources".[399] However, no explicit mention of alternative fuels was made.
Best practices[400]	Germany: "Maritime Research Programme/Maritime Agenda 2025" (budget undisclosed; 2018-n.d.), eventually targeting hydrogen, LNG and methanol. Sweden: "Shipping programme" and "Swedish Transport Administration's industry programme Sustainable shipping". United Kingdom: "Maritime Innovation Fund."
Description	
Include alternative fuels explicitly in upcoming research calls under the he newly formed MoCE SRP on climate and energy. Relaunch research calls and broaden scope to cover funding listed in the NECP for: • research, development and demonstration projects for alternative fuel extraction and supply and storage technologies capable of working and operating on market principles. • development of new technologies, solutions and user-centred products and services that contribute to increasing the share of alternative fuels in transport, as well as the development of mobility, transport systems and logistical solutions to improve energy efficiency and environmental sustainability, which can work and operate on market principles. • promote mutual cooperation between economic operators, higher education institutions and research organisations, national and local authorities, NGOs, etc. to improve the energy efficiency of the mobility and transport system This measure was modelled in TIMES, through a 20% additional cut to domestic biofuel production costs and to hydrogen plant fixed costs from 2025 onwards, although only minimal impacts are visible.	

5.3 Comparison with measures included in the EU strategy on energy system integration

In 2020, the EC published the Communication 2020/299 Powering a climate-neutral economy: An EU Strategy for Energy System Integration.[401] The strategy sets out a vision on how to accelerate the transition towards a more integrated energy system, one that supports a climate neutral economy at the least cost across sectors – while strengthening energy security, protecting health and the environment, and promoting growth, innovation and global industrial leadership. The Strategy also proposes concrete policy and legislative measures at EU level to gradually shape a new integrated energy system, included in Table 5-6. The table shows a comparison between the EU system integration strategy and the measures proposed in this chapter.

[399] Latvian Council of Science, Energy
[400] Joint Research Centre & Piksel (2022), An Analysis of Trends and Policies Promoting Alternative Fuel Vessels and Their Refueling Infrastructure in Europe
[401] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=COM:2020:299:FIN

Table 5-6 System integration strategy concepts and measures and comparison with measures included in the WAM scenario

EU integration strategy concept	EU integration strategy measures	WAM measure
Create a more circular energy system. Too much energy or resources are wasted in our current system. We require a new approach to reduce these losses and direct them to other purposes.	Promote energy efficiency	Several measures, mostly subsidies, are dedicated to energy efficiency
	Encourage the reuse of waste heat from industrial sites and data centres	Dedicated support scheme for renewable heat, plus renewable heat to be included in other schemes aimed at building and industry
	Improve synergies between energy infrastructures with the revision of the Trans-European Network in Energy Regulation	
	Incentivise the use of agriculture residues to produce sustainable biogas and biofuels	This is covered by the measure: Biogas and biomass: improving organic waste management
Accelerate the use of electricity produced from renewable sources. To meet our emissions reduction goals we need to generate more electricity from renewables to power buildings, industry, and transport, which traditionally relied on fossil fuels.	Increase the generation of renewable electricity	Some actions to support renewable deployment, but model expect this will happen mostly due to cost effectiveness
	Increase the use of renewable electricity in buildings, transport and industry for instance through heat pumps, electric vehicles and furnaces	The strategy achieves substantial increase in bioenergy and electrification in heat
	Accelerate the development of charging stations for electric vehicles and the injection of renewable electricity in the network	Charging station plan included in the strategy
Promote renewable and low-carbon fuels, including hydrogen, for sectors that are hard to decarbonise. Some sectors, like heavy transport and industry, are harder to convert to electricity, so we need to invest in cleaner fuels to power them.	Unlock the potential of sustainable biomass and biofuels, green hydrogen, and synthetic fuels	Latvia is one of the EU countries with the highest use of biomass, and already plans to increase this further. This strategy does not foresee additional measures to incentivise this
	Enable carbon capture, storage and use to support deep decarbonisation, for example in cement production	Given the high wind potential, and the limited industrial emissions, it is unlikely that CCS is a cost-efficient solution for Latvia.
	Clearly define and classify different fuels to support market uptake and transparency	This is done at EU level
	Promote innovative projects based on low-carbon fuels, such as hydrogen-fuelled clean steel plants	This can be supported via the schemes planned in the plan (the schemes are open to different solution to decarbonise)
Adapt energy markets and infrastructure to a more complex, integrated energy system. In an integrated energy system, consumers and investors should be able to choose the option that best matches their need, based on prices that reflect the true cost and efficiency.	Ensure equal treatment for all energy carriers, making electricity and gas markets fit for decarbonisation, for example with respect to taxation	Increase in taxation are considered politically unappealing at this stage, and have therefore not being considered
	Better inform consumers about their options to interact with the energy market and the sustainability of the products they consume	The action has been targeted at the transport sector, where it is more likely to have an impact
	Support digital energy services, including smart meters for homes and smart chargers for electric vehicles	Smart charging is a key part of the transport strategy. Smart meters are currently being deployed in Latvia.
	Support research and innovation to create new synergies in the energy system	Support for R&I is included in this strategy

The Strategy also defines system integration as: *the planning and operating of the energy system "as a whole", across multiple energy carriers, infrastructures, and consumption sectors, by creating stronger links between them with the objective of delivering low-carbon, reliable and resource-efficient energy services, at the least possible cost for society.*

Below, we discuss how the proposed policies contribute to create stronger links across energy carriers, infrastructure and consumption sector:

- Energy efficiency: by promoting energy savings in buildings and industry, the residential, commercial and industrial sector are freeing-up energy resources (such as gas) to be used in other applications more difficult to decarbonise, such as high-heat industrial processes. Further, reducing energy use means funds to be invested in energy generation for those sectors could be directed towards alternative applications;
- Electrification: the proposed pathway expects substantial electrification of heat and transport sector. Power generation will happen to some extent directly on buildings (e.g., rooftop PVs), which will contribute to overall generation via their excess production.
- Energy efficiency and renewable heat schemes are also expected to improve the use of waste heat, and improve integration between the industrial and commercial/residential sector, although the model expect a rather limited uptake of this option.
- Policies aimed at decarbonising the transport sector will incentivise the uptake of biomethane and biofuels, next to electrification, so that existing ICE vehicles will also run on an increased share of renewables. Biomethane refuelling points will rely on the existing gas distribution network, so to ensure the lifetime of the gas network can be extended even while the use of gas in power generation and heating is reduced.

5.4 Additional steps and policies to be analysed

The policies proposed in chapter 5 and modelled according to the analysis presented in chapter 4 do not reach the 2030 energy efficiency and 2050 decarbonisation targets, although they make significant progress towards both. This is because of a number of reasons, such as the assumptions used (many of which are rather uncertain at this point in time) and the limited data available to estimate with precision the effect of these policies in Latvia. However, given the large sums of public investment needed, we believe that a cautious approach should be taken – i.e., it is possible to push the model fully meet the targets, but this requires financial commitments and extreme regulatory changes that have a high chance to be very inefficient and politically unacceptable.

The Ministry of Economics should consider the following steps to ensure the targets are met:

1. This analysis should be repeated shortly, so that by 2027 new measures (or changes to current measures) can be put in place to achieve the 2030 targets
2. The analysis should be complemented by a similar exercise concerning LULUCF and other non-energy emissions. The forestry sector in particular has great potential to support the net zero objective, making cheaper to decarbonise for all other sectors. However, current plans to exploit forestry resources further suggests that LULUCF will become a net emitter, requiring even further efforts to all other sectors. This will be a strategy with highly negative outcomes, as the additional revenues generated by export of wood products will require all other sectors of the economy to decarbonise completely, at much higher cost. The first actions that should be explored beyond this study therefore concern increasing the sink capacity of forests, peatlands and other natural areas, and limit commercial exploitation.
3. Other actions that should be explored further are:
    a. Early decarbonisation of the industrial sector. This may happen in different forms, for example via grants, state participations, regulatory measures (limits) and public infrastructure (such as CCS).

b. Further actions to reduce energy use in the commercial sector.

6 Annexes

6.1 Annex I - Detailed modelling assumptions and results

See Deliverable 2 and 3 reports.

6.2 Annex II - WEM and WAM projections

See separate Microsoft Excel spreadsheets provided.

6.3 Annex III - GHG emissions

This section presents some further details on GHG emissions by sector.

Figure 6-1 Baseline and WAM projection for GHG in ETs and non ETs sector

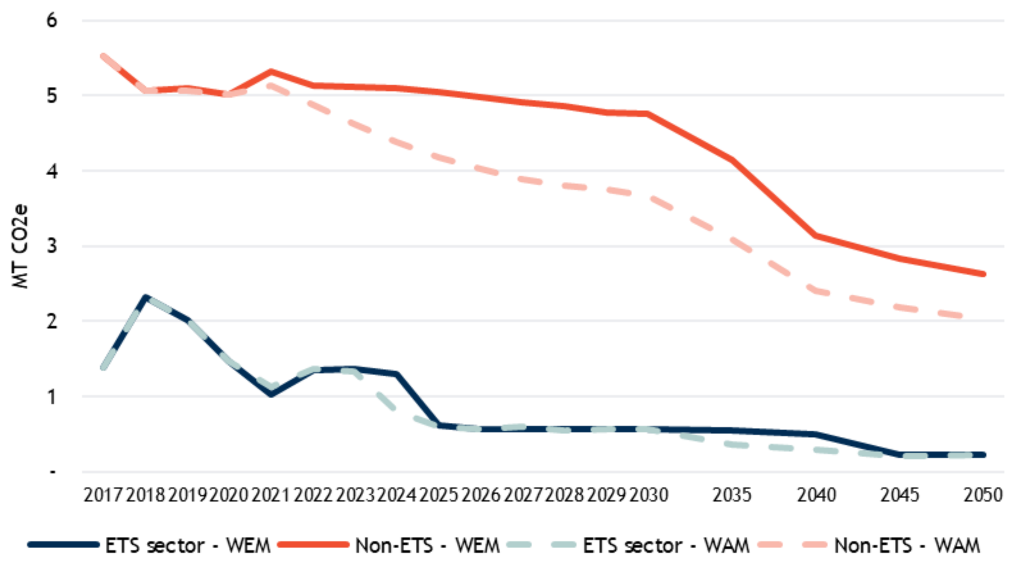


Figure 6-2 GHG emissions by sector

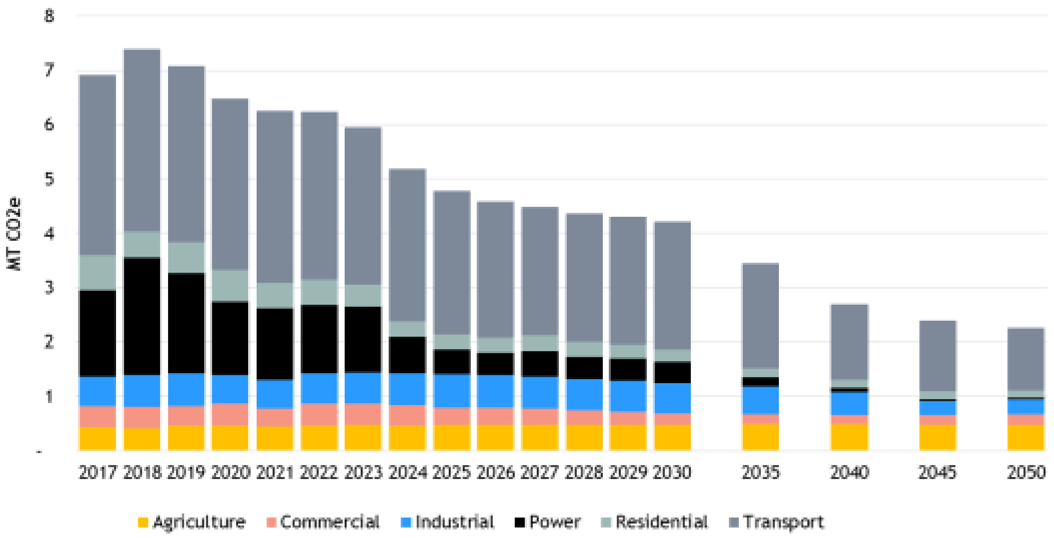
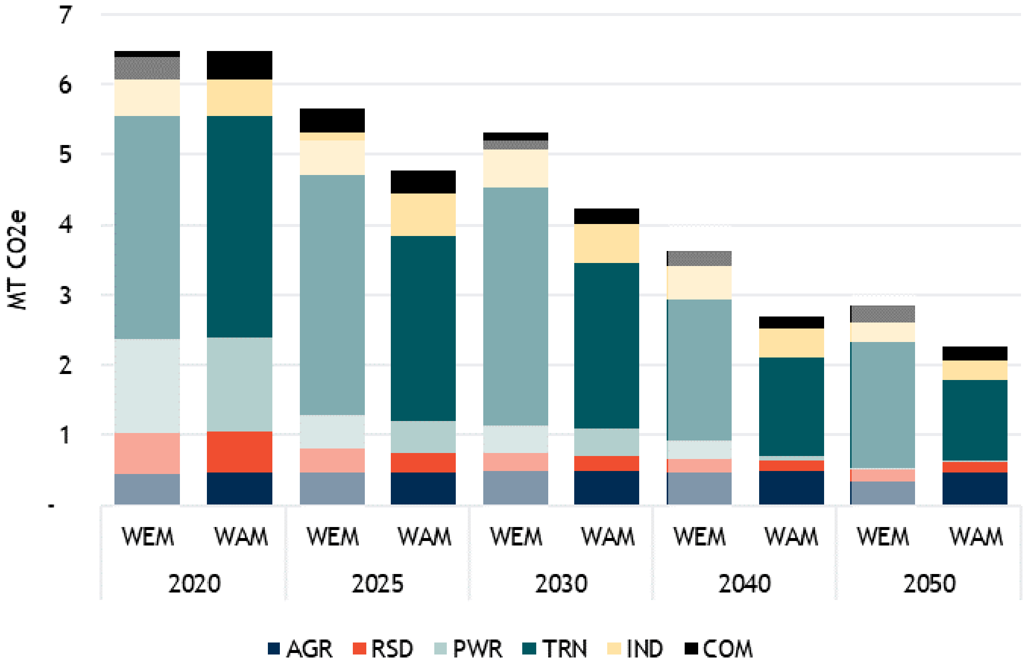


Figure 6-3 WEM and WAM emissions by sector



6.4 Annex IV - Answer to other TOR questions

6.4.1 *Centralised district heating*

Latvian heating supply

The Latvian heating network is supplied by 633 boiler houses and 175 cogeneration plants which produced 8247GWh of thermal energy in 2018, cogeneration was 5892 GWh. CHP grew by 20% since 2008 and now constitutes 71% of total heat production.[402]

The energy sources used to heat buildings in 2018 were biomass (41.5%), DH (30.5%) and natural gas (8.9%). The number of boiler houses to burn biomass increased from 241 to 306 (between 2010 and 2018) which increased the installed capacity from 597.6 MW to 994.2 MW. In contrast, only 0.1% of heat was produced through electricity in 2018. The switch from natural gas to biomass is an important factor in reducing the GHG emissions, it is estimated to save 80 kt CO_2 eq by 2030 when compared to 2017.[403]

Latvia's strong reliance on natural gas is decreasing, as biomass replaces gas as fuel for energy production. In 2010, gas was used for 81% of electricity and heat, while in 2018 it dropped to 59%.[404] Biomass constituted 93,5% of RE in used for the production of thermal and electric energy. Because of these large shares of cogeneration and RE the Latvian government states the maximum share of heat production has been reached at certain plants. Therefore, authorities decided not to further promote biomass deployment at national level but rather to focus efforts on specific regions.

State of DH in Latvia

Latvia is one of the Member States with large DH network. According to Eurostat from 11 675 km of low-efficiency DH networks in Europe, 3 500 km were located in Latvia (second only to Romania)[405], while figures for the length of high efficiency network are not available for Latvia. The NECP for 2021-2030 states that the heating network in Latvia has a total length of around 2 000 km.[406]

The Latvian DH system is significantly affected by the age of the installations. On average 11.7% of thermal energy are lost in the DH networks. This figure rises to 15.7% in Daugvapils. Most DH parts were built more than 25 years ago and the efficiency of such installations begins to decrease significantly after seven years.[407] Hence, there is significant potential in focusing on modernisation. Of the abovementioned 2000km, 238km have been modernised from 2007 to 2020.[408]

Problems for DH

Despite having a fairly consolidated DH infrastructure, Latvia faces problems in further developing and modernizing it. The NECP describes the following problems for an expansion of DH usage:[409] DH networks are costly infrastructure, both regarding investments as well as operations, therefore, due to budgetary considerations, especially local and municipal administrations can be hesitant to construct or upgrade them. Furthermore, DH networks only make sense in areas with a sufficiently high concentration of customers. Otherwise, the distance the heat has to be transported, results in

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[402] Cabinet of Ministers (2021), National Energy and Climate Plan for 2021-2030
[403] Cabinet of Ministers (2021), National Energy and Climate Plan for 2021-2030
[404] Cabinet of Ministers (2021), National Energy and Climate Plan for 2021-2030
[405] Eurostat (2022), Number and length of district networks by type of network and efficiency of network
[406] Cabinet of Ministers (2021), National Energy and Climate Plan for 2021-2030
[407] Cabinet of Ministers (2021), National Energy and Climate Plan for 2021-2030
[408] Cabinet of Ministers (2021), National Energy and Climate Plan for 2021-2030
[409] Cabinet of Ministers (2021), National Energy and Climate Plan for 2021-2030

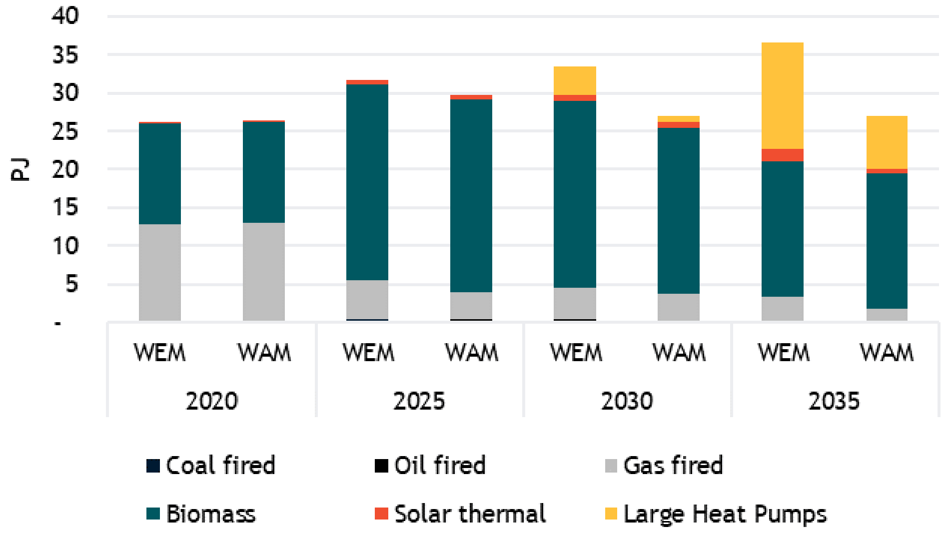
economically unviable heat loss. This circumstance makes households the ideal customers for DH, however, in this group there is a level of scepticism, as there are cheaper local and individual heating options available.

Possible solutions for mentioned in the NECP are to attract EU investment to support building and upgrading, economic incentives for consumers, optimized process for operations and maintenance and awareness for the benefits of energy efficiency measures, in the broad sense, within the local and municipal administration

DH in modelling results

The figure below shows the expected breakdown by source of heating provided via DH. The results of the modelling are counterintuitive, as the aggressive renovation policies in the residential sector drive a substantial decrease in energy demand for heat, as well as a slower uptake of large heat pumps. The model seems to still prefer biomass up to the same level as in the baseline, even though biomass as a limited resource which is more constrained than electricity.

Figure 6-4 Commercial-scale heating by source



What are the Latvian policy goals?

Regarding the ambitions of the Latvian government concerning the DH networks in the country there are two elements to consider. Firstly, Latvia reached the 2020 goal for the share of RES in its DH network in 2017.[410] A crucial factor in this success was the abovementioned reliance on CHP and burning of biomass. Secondly, back in 2009, the priority of the government was set on further developing the existing network, rather than construct new networks.[411] This means, for example, increasing the efficiency by limiting heat loss or increasing the share of RES in the DH networks.

[410] Cabinet of Ministers (2021), National Energy and Climate Plan for 2021-2030
[411] Ministry of Economics (2010), Information Report - Republic of Latvia National Renewable Energy Action Plan for implementing Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC by 2020

In its NECP for 2021-2030, the Latvian government gives DH a prominent role. There is a number of goals directly and indirectly related to the progression of this technology. Goals include: [412]

- Equip at least 2000 multi-apartment buildings and 5000 private houses with zero-emissions RES technology or connect them to a renovated DH network.
- Create district cooling (DC) networks.
- Renovate DH networks.
- Assessments of the possibility to connect local/individual heating to DH.
- Increase the share of non-biomass RES in DH and replace natural gas entirely with biomass.

An important project that embodies most of the goals for the future development of DH is the heat production plant Salaspils Siltums. It combines solar and biomass to produce thermal energy which are delivered through a DH system to the cities of Salaspils and Saulkalne. It is also equipped with a gas boiler for peak load times.[413] In Salaspils, 85% of 18 000 inhabitants are being supplied with heat through this system. In total, 90% of the energy used is renewable, with 20% stemming from solar energy.[414] The tariff that is being paid for 1 MWh in November 2022 is 89.59€ (with state support 78.79€)[415] which, compared to other DH networks in Latvia, is at the lower end of the price range.[416]

Interactions between Latvian and EU policy-making

The Latvian approach to DH is in line with the current legislative framework of the EU. However, there are currently amendments being done on the Energy Efficiency Directive (EED) and the Renewable Energy Directive (RED) which could have significant impact on Latvia.

Regarding the EED there is a range of smaller amendments, such as regarding Article 11(9), which would mean that MSs could obligate companies to conduct an assessment of the potential to connect to a DH network. The amendments with a larger impact on Latvia regard mainly obligations to modernize the existing DH infrastructure. However, as mentioned above, this is already a priority of the Latvian government. Therefore, no drastic changes in course should be necessary to comply with the new version of the EED, assuming that there are no major surprises throughout the process.

The situation is somewhat different regarding the proposed changes to the RED. Some of these includes a redefinition of what type of biomass is considered sustainable, for example to exclude primary wood from the definition, which is a substantial part of biomass use in Latvia.[417] The two potential outcomes of this for Latvia are, firstly, a setback in its progress towards goals regarding the use of RES, as primary wood would not be counted towards the RES target, and, secondly, an increase in price for sustainable biomass, resulting in an increase of heating costs. This could be especially troubling, as the NECP mentions the price for DH heat as reason why consumers are hesitant to use DH. Further, the proposed amendments to the RED include lowering the limit to comply with the sustainability criteria from 20 MW to 5 MW, which means many more DH plants will have to comply with the sustainability criteria.

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[412] Cabinet of Ministers (2021), National Energy and Climate Plan for 2021-2030
[413] Thermos (2021), District Heating & Cooling Case Studies
[414] Bankwatch Network (2019), First large-scale solar district heating plant in the Baltics opens in Latvia
[415] Tariffs - Salaspils Siltums
[416] Salaspils Siltums (2022), Heating energy tariffs of SIA "Salaspils Siltums") (excluding VAT*) in Salaspils and Saulkalne
[417] EurActiv (2022), EP ban on primary woody biomass puts 20% of Europe's RES at risk

In conjunction with the described proposed amendments of the RED, the EED may also have substantial impacts. This may happen through tightening the requirements for efficient cogeneration, the requirements for efficient DH and, as mentioned above, whether certain types of biomass continue to be considered sustainable. In an extreme scenario for Latvia, a large proportion of its cogeneration could lose its definition as "efficient CHP", and would not be counted towards the renewable target. This outcome is closely tied to the definition of woody biomass, which is among the most important RES in Latvia, especially for heating purposes.[418] This would mean that the investments into the use of biomass to achieve sustainability goals was in vain and new investments e.g., into solar energy for heat production would have to be made. On the other hand, it is unlikely that zero/low-carbon technologies would be caught by such an amendment. Therefore, it is advisable for the long-term benefits of the investments to modernise the DH system in Latvia with a strong focus towards those energy carriers.

6.4.2 *Municipal waste treatment*

Latvian waste system

The Latvian waste system is governed by the following policies:

- Waste Management Law[419]
- Natural Resources Tax Act[420]
- Packaging Law[421]
- Law on the Management of End-of-Life Vehicles[422]
- National Waste Management Plan 2021-2028[423]

Those policies are adopted and implemented mainly by the following authorities:[424]

- Ministry of Environmental Protection and Regional Development (VARAM)
- State Environmental Service of the Republic of Latvia (VVD)
- Latvian Centre for Environment, Geology and Meteorology (LVĢMC)

Latvia is split into 10 regions for waste management (AARs), although the government is currently considering reducing them from five or seven.[425] Within those AARs, regions and municipalities carry some degree of responsibility, such as the obligation to produce their own waste management plans or collection schemes.

Plans for the development of the waste system

The National Plan for Waste Management 2021-2028 states that annually between 200 000 and 220 000 tons of waste suitable for energy recovery are being produced. According to EU law, by 2035, 65% should be recycled and by 2035 only 10% of municipal waste can be landfilled.[426] In order to stay within this 10% limit, Latvia requires an additional treatment capacity for energy recovery from municipal waste of 90 000 tons per year. To support this increase, the National Plan proposes the construction of three new sites for energy recovery resulting in an increase of capacity by at least 150 000 tons annually:

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[418] Cabinet of Ministers (2021), National Energy and Climate Plan for 2021-2030
[419] Saeima (2010), Waste Management Law
[420] Saeima (2005), Natural Resources Tax Act
[421] Saeima (2001), Packaging Law
[422] Saeima (2004), The Law on the Management of End-of-Life Vehicles
[423] Cabinet of Ministers (2021), National Waste Management Plan for 2021-2028
[424] Cabinet of Ministers (2021), National Waste Management Plan for 2021-2028
[425] Cabinet of Ministers (2021), National Waste Management Plan for 2021-2028
[426] European Parliament & Council of the European Union (2018) Waste Framework Directive & European Parliament & Council of the European Union (2018), Landfill Directive

- Central Latvian AAR, Riga: 110000t/year
- Latgale AAR, Daugavpils: 20000t/year
- Vidzeme AAR, Valmiera: 20000t/year

All three facilities are supposed to incinerate the non-recyclable proportion of the waste and generate electricity. Currently, Latvia only possesses one facility for energy recovery.[427] The amount of waste treated in this facility has strongly increased. In 2013, it was 1 644 tons and by 2019 26 130 tons.[428] The amount of municipal waste in Latvia has been increasing over the past years. Furthermore, the proportion of municipal waste in landfills (i.e., an entirely unproductive waste treatment) is significant. In the sector of waste treatment there are important opportunities for Latvia, as well as certain risks associated with the current focus on energy recovery. The risks derive, firstly, from a potential conflict between the National Plan and the framework established by EU law. The Waste Framework Directive, ranks energy recovery as undesirable option for waste treatment.[429] The hierarchy for waste treatment is as follows: prevention, preparing for re-use, recycling, other recovery (e.g., energy recovery) and disposal. The National Plan gives a detailed explanation of the reasons behind the Latvian position, such as a concentration of recycling infrastructure, the waste of energy when disposing non-recyclable waste in landfills or the necessity to incinerate a certain proportion in order to not overstep the 10% goal for landfills.[430] Nevertheless, the construction of further facilities for waste recovery operations could be an economic risk for Latvia as it is plausible that at some point the waste treatment hierarchy will be strengthened further. Depending on the outcome of such a process, this could result in the three new facilities becoming sunken investments, in the worst case, or that they have to operate at less than their ideal capacity.

Potential benefits of developing recycling capacities

On the other hand, extending the re-use/recycling capacities in Latvia could prove to be an economic opportunity. This approach would not be exposed to the same risk as recovery operations in a potential amendment of the Waste Framework Directive. Furthermore, this could become a new economic sector, in which the frontrunners have the opportunity to sell their services, technology and knowledge to other countries around the globe to improve their waste treatment capabilities. At the same time there is potential to reap benefits for the Latvian society, as a new economic sector could bring jobs, money and opportunities. For example, Latvia exports more waste than it imports and, thereby, has a constant net outflow of resources from it country which could be changed with better waste treatment capacities. Furthermore, it could also increase its imports.[431] Lastly, it is possible that a transition to a circular economy brings a strategic advantage, as the necessity to import raw materials for production decreases. Given the orientation of the European Commission it is also more likely that it would financially support the construction of new reuse/recycling plants than recovery plants, lowering the CAPEX of Latvia. Between 2014 and 2020 the EC spent almost 900 million euro on waste minimisation, sorting and recycling, while 2 billion were planned, showing that funds are still available.[432]

The National Plan states that the recycling infrastructure is currently concentrated around Riga, causing difficulties to recycle waste from the peripheral areas of the country. The same is true for the energy recovery infrastructure which, according to Eurostat, amount to a single plant. Furthermore, from the

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[427] Eurostat (2022), Number and capacity of recovery and disposal facilities by NUTS 2 regions
[428] Cabinet of Ministers (2021), National Waste Management Plan for 2021-2028 Table 2.11
[429] Waste Framework Directive EUR-Lex
[430] Cabinet of Ministers (2021), National Waste Management Plan for 2021-2028
[431] Cabinet of Ministers (2021), National Waste Management Plan for 2021-2028
[432] European Commission (DG REGIO), In profile: EU support to waste management

three newly planned incineration facilities, one will be located close to Riga and two in the east of the country, leaving the west without infrastructure. Consequently, it does not matter whether reuse/recycling or energy recovery is chosen in both cases new infrastructure will be required.

Lastly, it is not necessarily the case that reuse/recycling and energy recovery are diametrically opposed options. For example, improved recycling processes could result in better separation of organic and non-organic waste. The latter category could undergo reuse/recycling treatment while the former is used as feedstock for the production of biogas. This approach appears to be feasible based on the information provided in the following table, as substantial percentages of the municipal waste are based on materials which are in principle recyclable and roughly one third would remain for biogas production:[433]

Table 6-1 Composition of municipal waste

Fraction of municipal waste	Content of municipal waste (of municipal waste composition), %
Biodegradable waste	34.2
Paper waste	8
Plastic waste	12.9
Glass waste	9.2
Metal waste	3.7
Packaging waste	21.8
Inert waste	10.8
Hazardous waste	2.2
Other waste (wood, textiles, rubber, waste hygiene products)	14.7

Such a diversified approach, based on different waste treatment operations, is especially important when dealing with goods that possess as much variance as municipal waste. The opportunity offered by this approach is that it allows a balance to be struck between the maximisation of the benefit that can be generated from waste treatment while simultaneously minimising the environmental impact of those operations. This happens by administering a suitable treatment to every category of waste listed above. The current Latvian approach is sensible in that it wants to reduce the size of the proportion disposed in landfills and use for energy production. Furthermore, it needs to be recognised that the Latvian waste system already achieves recycling rates of more than 30%. However, this also means that a recycling rate of 65% is still a long way off. Given the sheer size of municipal waste, it is a promising category to increase recycling rates.

In the short-term adding further incineration capacity does make sense. However, in the long-term it can result in sunken assets. Also from the perspective of using waste as resource, and doing so most efficiently, recycling is the most promising option and can be recommended as the investment choice by the Latvian government.

[433] Cabinet of Ministers (2021), National Waste Management Plan for 2021-2028 Table 2.10

6.4.3 *Transport sector decarbonisation*

Historical evolution

According to an Ecofys study[434], "the transport sector is the only sector in the EU in which almost no climate progress has been made to date and that also anticipates the highest growth rate in the coming decade".

According to an analysis by Nordic Energy Research[435], energy consumption per passenger car is increasing in Latvia.[436] Similarly, Latvian freight vehicles have increased their energy consumption between 2007 and 2017, partly due to the increase in the performance level of their fleets (bigger and faster vehicles) and the withdrawal of old vehicles in 2010.

Figure 6-5 Energy consumed (TJ) per passenger car[437]

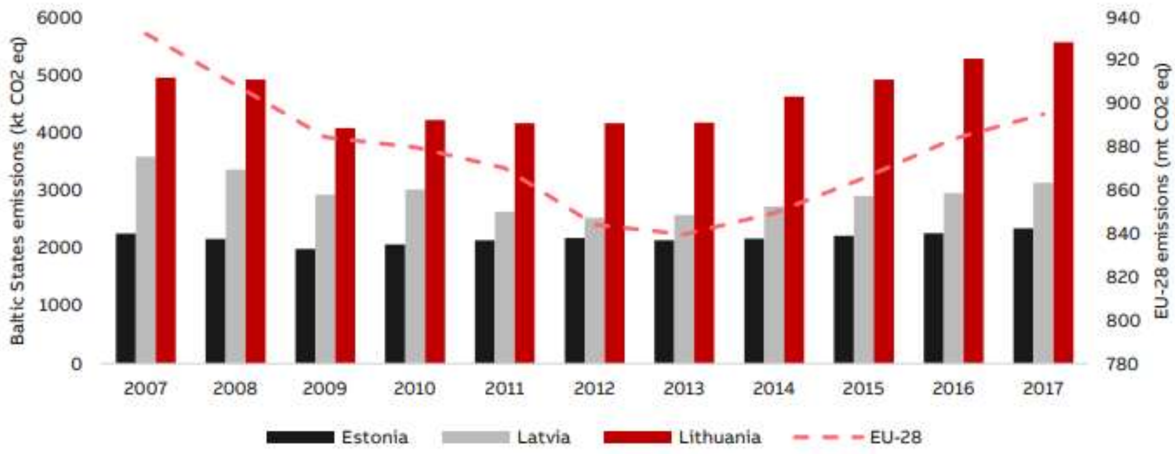
Year	Estonia	Latvia	Lithuania	Poland	Finland
2007	36.19	30.84	28.32	22.11	65.45
2008	33.25	28.66	26.64	21.56	60.61
2009	32.68	26.81	21.40	21.43	57.20
2010	31.57	37.32	22.48	22.53	57.44
2011	30.51	34.72	20.95	21.54	55.44
2012	29.87	34.01	21.40	20.30	52.92
2013	28.55	32.47	21.39	18.81	52.11
2014	28.34	33.35	33.48	18.28	49.82
2015	28.72	34.17	33.97	18.75	49.07
2016	28.56	35.37	34.92	19.75	48.78
2017	29.09	35.64	34.91	21.16	47.45

The black line represents the years of old cars withdrawal

The decarbonisation of the transport sector, which accounts for around 30% of FEC in Latvia, represents a major energy and environmental challenge, as the road transport sector depends almost exclusively on fossil fuels. Passenger cars are the road transport mode that produces the highest GHG emissions (around 60% of total road emissions in 2017 in the Baltic States), followed by "heavy duty trucks" (accounting for 32% of total Baltic road transport emissions in 2017).[438]

[434] Ecofys (2019), 2030 Transport decarbonisation options
[435] Nordic Energy Research (2020), Transport Statistical Data and Projections in The Baltic States
[436] Prior to the withdrawal of old cars in 2010, Latvia appears to be performing well in terms of energy consumed per passenger car; however, the withdrawals were implemented to remove inoperative and inefficient vehicles.
[437] Nordic Energy Research (2020), Transport Statistical Data and Projections in The Baltic States
[438] Nordic Energy Research (2020), Transport Statistical Data and Projections in The Baltic States

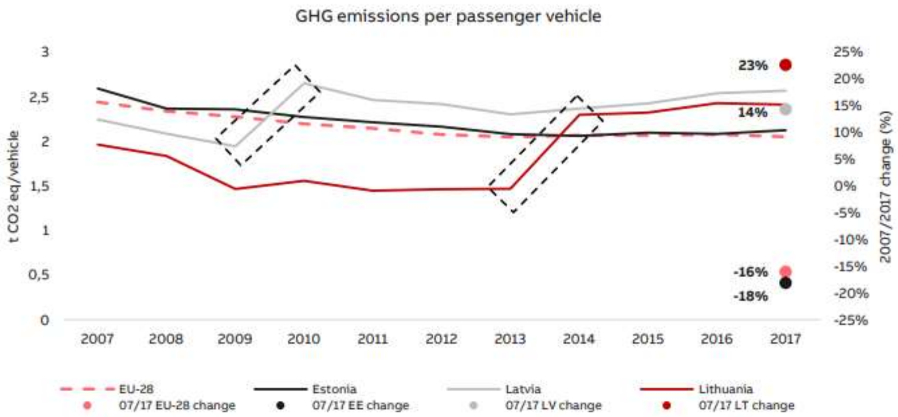
Figure 6-6 Road transport GHG emissions evolution[439]



Source: UNFCCC, 2018

The Baltic States are dominated by a carbon-intensive fleet, where each vehicle, either passenger or freight, produces higher GHG emissions than the EU average.[440] Latvia was below the EU average before the old car withdrawals, after which the ratio increased drastically both for passenger and freight.[441]

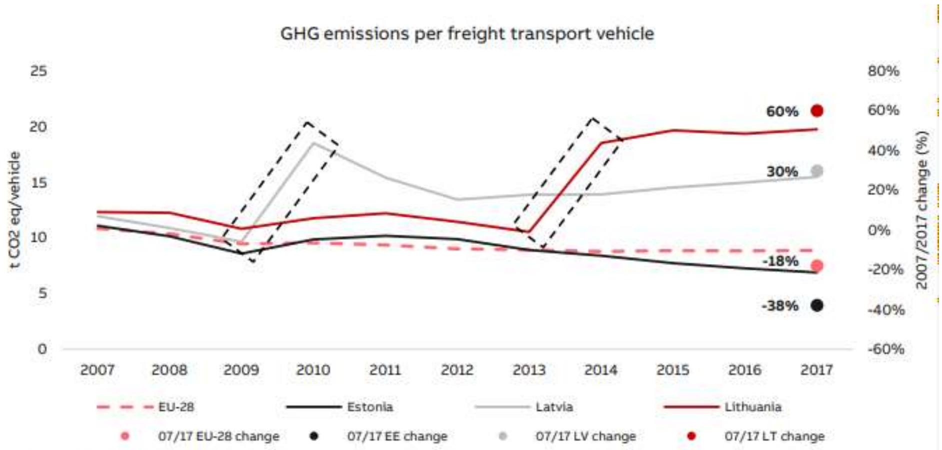
Figure 6-7 GHG emissions per passenger vehicle in Baltic countries, 2007-17



Source: UNFCCC, 2018

[439] Nordic Energy Research (2020), Transport Statistical Data and Projections in The Baltic States
[440] Nordic Energy Research (2020), Transport Statistical Data and Projections in The Baltic States
[441] Nordic Energy Research (2020), Transport Statistical Data and Projections in The Baltic States

Figure 6-8 GHG emissions per freight transport vehicle in Baltic countries, 2007-17



Source: UNFCCC, 2018

Prospects for future decarbonisation

Electrification and biofuels are the only realistic options for large-scale decarbonisation to 2030 in the transport sector[442][443]. However, Latvia did not meet its 2020 target of 10% share of energy from renewable sources in transport and remains a long way of meeting the 14% by 2030 target (as per RED and RED II respectively).[444] The share of renewables has gone from only 2.5% in 2017 to around 7% in 2020.[445] In terms of EV infrastructure, Latvia has only 596 recharging points, though this amount has doubled since 2019.[446]

The energy transition in the transport sector is driven by electrification in both the WEM and WAM scenarios (although to a lesser extent in WEM) (section 4.5.1). The modelling results suggest that it is the technology competing best from a cost-perspective, compared to other potential alternatives such as biofuels/biogas and hydrogen, bearing in mind the measures for such fuels taken in both scenarios (hydrogen and biogas/biomethane use is somewhat more prevalent in the WAM scenario than in WEM, although they do not penetrate the transport sector as significantly as electricity).

Road transport electrification and decarbonisation makes progress thanks to the short- and mid-term transition of light-duty vehicles to electric vehicles (the effects of a 2035 ICE ban become clearly visible only from 2045-2050). This is accompanied (with a slight delay compared to light-duty vehicles) by the electrification of heavier-duty vehicles, starting from those with shorter daily trips and fixed routes and schedules, making charging planning easier and cheaper (these vehicles can charge at depots and with relatively slow recharging points), such as buses or refuse trucks. Such a shift is likely to be in line with technology shifts in other European countries (i.e. with increased prioritisation, market development and model offer for electric vehicles, vs. other powertrains such as gas or hydrogen vehicles). Although electric vehicles in most cases have clearly lower GHG emissions impacts than internal combustion

[442] Ecofys (2019), 2030 Transport decarbonisation options
[443] However, deploying biofuels on a large scale in road transport by 2030 leads to risks of lock-in in ICE road vehicles and is not compatible with the EU 2035 ban on ICE car sales and may impede the sustainable decarbonisation of transport and of other sectors post-2030 - see discussion on availability of sustainable alternative fuels towards the end of this section.
[444] Nordic Energy Research (2020), Transport Statistical Data and Projections in The Baltic States & Eurostat
[445] Nordic Energy Research (2020), Transport Statistical Data and Projections in The Baltic States & Eurostat
[446] European Alternative Fuels Observatory

engine vehicles, their deployment should go in par with the deep decarbonisation of the power sector, to fully achieve their near-zero emission potential.

It is also important, for the transport sector to actively contribute to the country's decarbonisation, to avoid unnecessary motorised activity or shift it to less energy-intensive/non-motorised modes, hence promote mass transport such as urban public transport or trains for longer distances (in the WAM scenario, it is assumed that Latvia's total motorised passenger activity does not continue growing after 2019). The heaviest modes (e.g. shipping and aviation, possibly a subset of heavy-duty freight road transport) will likely continue to rely on liquid/gaseous fuels. For those, low-carbon options such as biogas/biofuels and low-carbon hydrogen (or derivatives) will be key, with attention to be paid to the availability of sustainable feedstock and resources to make such alternative fuels, and bearing in mind that some of these fuels (e.g. biogas) may also have a use in significant quantities in other sectors (e.g. heating).

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