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Sweden's updated National Energy and Climate Plan 2021-2030

Reporting under Council Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directive 94/22/EC of the European Parliament and of the Council, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU, Council Directive 2009/119/EC and (EU) 2015/652 and repealing European Parliament and Council Regulation (EU) No 525/2013.

Introduction

The Governance of the Energy Union and Climate Action Regulation – the so-called Governance Regulation (EU) 2018/1999 – requires EU Member States to develop an integrated national energy and climate plan every ten years, starting in 2019, to demonstrate how Member States will achieve their contribution to the EU's energy and climate objectives. The Governance Regulation (Article 14) requires the plans to be updated by 30 June 2024 and every ten years thereafter.

Sweden's updated National Energy and Climate Plan (NECP) has been updated in relation to the draft that the government reported to the European Commission in summer 2023. Updates have been made on the basis of current policies, both at national level and some of the new requirements of recast EU directives and regulations. The plan has also been updated, to the extent possible, taking into account the recommendations Sweden received from the European Commission in December 2023 on the draft of this updated plan.

Many pieces of EU legislation in the field of climate and energy have recently been renegotiated. Objectives and requirements have been strengthened in many areas.
The implementation in Sweden of the new legislation has, for obvious reasons, not been ready for the submission of this plan. Implementation follows the timelines set out in the respective legislation.

In 2023, the Swedish Environmental Protection Agency and the Swedish Energy Agency have developed new climate and energy scenarios. The energy scenarios are also used to inform the climate scenarios, which are reported to the European Commission in a different order in the context of climate reporting. The scenario presented in the plan (referred to as the 'Bass scenario') is, unless otherwise specified, based on the Commission's recommended assumptions on the price evolution of fossil fuels and allowances. The scenario is based on the adopted energy and climate policy instruments in Sweden until 30 June 2023. The plan also presents a case of sensitivity (sensitivity case transport). For the sensitivity case, no full scenario has been made and only energy consumption in the transport sector has been adjusted.

The plan is divided into five dimensions: Greenhouse gas emission reductions (including Renewable Energy), Energy Efficiency, Energy Security, Internal Energy Market, Research, Innovation and Competitiveness. For all dimensions, the plan describes national objectives and targets (**Chapter 2**), policies and measures (**Chapter 3**) and the state of play of existing policies and measures and projections based thereon (**Chapter 4**). The plan also presents an overview of the plan and the procedure for its establishment (**Chapter 1**), as well as an impact assessment of planned policies and measures (**Chapter 5**).

The dimension of **reducing greenhouse gas emissions** presents, among other things, Sweden's development towards Sweden's commitment under the revised EU Effort Sharing Regulation (ESR)[1] in the non-trading sector, Sweden's commitments in the EU land use sector under the revised LULUCF Regulation in[2] and Sweden's contribution to the 2030 renewable energy target under the revised Renewables Directive3.

Based on the baseline scenario and sensitivity case for the transport sector developed and based on adopted instruments, Sweden's EU target of 50 % emission reduction in 2 030 in the ESR sector is not met. According to the baseline scenario, emissions decrease to around 25.3 million tonnes of carbon dioxide equivalent by 2030. In the case of sensitivity, emissions further decrease to around 24.3 million tonnes of carbon dioxide equivalent in 2030. According to the ESR, Sweden is to reduce emissions by 50 % by 2030 compared to 2005, which means a reduction from 31.3 million tonnes of carbon dioxide equivalent in 2021 to 21.6 million tonnes in 2030. By saving surplus 2023-2021 as well as the use of EU ETS allowances, an accumulated deficit of around 9-1 million tonnes is provisionally estimated for the period 2021-2030, depending on the baseline scenario or sensitivity cases. See Section 4.2.1.2.

The LULUCF Regulation requires Sweden's total net carbon dioxide equivalent removals to be just under 4 million tonnes higher in 2030 compared to the average level in the period 2016-2018. Based on the last year

[1] Council Regulation (EU) 2023/857 of the European Parliament and of the Council of 19 April 2023 amending Regulation (EU) 2018/842 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) 2018/1999.

[2] Council Regulation (EU) 2023/839 of the European Parliament and of the Council of 19 April 2023 amending Regulation (EU) 201 8/84 1 as regards the scope, simplifying the reporting and enforcement rules, and setting out the targets of the Member States for 2030 and Regulation (EU) 201 8/1999 as regards improvement in monitoring, reporting, tracking of progress and review.

reporting means that Sweden needs to achieve net removals of just under 49 million tonnes of carbon dioxide equivalent by 2030. In order to highlight the uncertainties surrounding the development of net removals, scenarios with different growth assumptions have been developed for forest land. Under the average growth scenario for forest land, the total net removals from the LULUCF sector are estimated at around 42 million tonnes of carbon dioxide equivalent in 2030, bringing the distance to the target in 2030 of around 7 million tonnes of carbon dioxide equivalent. Under the scenario of reduced growth, total net removals would be around 29 million tonnes of carbon dioxide equivalent, bringing the gap to the target in 2030 to around 19 million tonnes of carbon dioxide equivalent. For the period 2021-2025, there is no clear picture yet as Sweden is expected to make technical corrections

Directive (EU) 2023/2413 of the3 European Parliament and of the Council of 18 October 2023 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652.

to the forest reference level. See also Section 4.2.1.2.

The share of renewable energy in relation to energy consumption, as calculated in the Renewable Energy Directive, increases in the baseline from 66 % in 2022 to 67 % in 2030 (Figure 25). In addition to renewable electricity production, a large share of fossil-free electricity is produced in the nuclear power plants in Sweden. Fossil free nuclear electricity production is estimated at 52 TWh in 2030. This means that the share of fossil-free energy (nuclear and renewable energy combined) in Sweden is expected to reach 78 % in 2030. It is in line with the share of fossil-free renewable energy that Sweden would contribute if the objective criteria under the Governance Regulation were used to calculate Sweden's contribution. The plan also presents the achievement of the sub-targets for renewable energy contained in the revised Renewables Directive. See Section 4.2.2.2.

The **energy efficiency** dimension presents Sweden's progress towards the indicative national energy efficiency contribution and cumulative end-use energy savings (energy savings) under the revised Energy Efficiency Directive (EED).4

Sweden's indicative national contribution to the Union target, notified to the European Commission in early February 2024, amounts to 350 TWh for final energy consumption. The contribution is based on the formula set out in Annex 1 to the Directive, but is based on the Energy Agency's long-term scenarios (see description of assumptions for the scenario in section 4.1) instead of the EU reference scenario in order to take into account the national circumstances mentioned in Article 4 (3) (e) of the Directive. The European Commission announced in March 2024 a corrected indicative national contribution for Sweden amounting to 296 TWh. However, Sweden estimates that the European Commission's corrected national contributions are based on a baseline scenario that does not fully include current assessments of the increasing electricity consumption in Sweden to decarbonise. The scenario does not take into account the need to increase energy consumption to enable electrification and climate transition in Sweden's industrial sector. See also Section 2.2.1.1.

The recast Energy Efficiency Directive requires Sweden to achieve cumulative energy savings of 237 TWh over the period 2021-2030. The current methodology for calculating compliance with the bait, which only takes into account the effects of taxes, results in cumulative energy savings of around 170 TWh. There are thus 67 TWh of savings, against the savings requirement to be achieved in Sweden for the same period. As part of the implementation of the recently revised Directive, Sweden is currently analysing the instruments to be included in meeting the energy savings target. See Section 3.2.1.1.

For the **Energy Security**, **Internal Energy Market** and **Research, Innovation and**

Directive (EU) 2023/1791 of the4 European Parliament and of the Council of 13 September 2023 on energy efficiency and amending Regulation (EU) 2023/955 (recast).

Competitiveness dimensions, there are no objectives to follow up in the same way as in the above elements. However, the following paragraphs briefly describe the major updates made in the dimensions since the last draft was submitted to the European Commission in 2023.

The **energy security** dimension has been updated, the oil and gas parts have been slightly developed and the text has been supplemented with wording on nuclear energy from an energy security perspective.

The texts in the **internal energy market** dimension have been updated and supplemented, inter alia, with regard to the government decision to establish an electricity market inquiry, flexibility, permitting processes and shorter lead times for electricity grids, energy poverty and developments in the field of hydrogen.

The **research, innovation and competitiveness** dimension has been updated around current projects. Government announced

the Energy Research Bill is also highlighted as an important prerequisite for the plans to move forward.

The current policy is described in detail in **Chapter 1** based on what has been communicated in the Government's Climate Action Plan and the Energy Policy Direction Bill. Texts on consultation and involvement in the preparation of the plan have also been expanded to describe how industry, authorities and civil society have been involved in the preparation of the various policy orientations.

In **Chapter 5**, the evidence has been developed by describing the impact of existing and planned policies. The evidence has been complemented in particular by macroeconomic effects, distributional effects, investment and a specific deepening of skills supply issues.

Content

OVERVIEW AND PROCEDURE FOR DRAWING UP THE PLAN

1.1 Summary

1.1.1 Political, economic, environmental and social context

The integrated energy and climate plan builds on Sweden's existing targets and adopted policies and measures for the energy and climate area and scenarios based on them. The plan is mainly based on the climate policy framework, energy policy orientations and objectives (see section 1.2).

1.1.2 Strategy on the five dimensions of the Energy Union

Overall, the Swedish energy and climate policy is well consistent with the ambition of the five dimensions of the Energy Union. Sweden's energy policy is based on the same three pillars as energy cooperation within the EU. The policy is aimed at combining environmental sustainability, competitiveness and security of supply. The energy policy will therefore create the right conditions for efficient and sustainable energy use and a cost-effective Swedish energy supply system with low negative impacts on health, environment and climate, and facilitate the transition to an ecologically sustainable society.

1.1.3 Overview table with key objectives, policies and measures in the plan

See Table 1 for an overview of Sweden's quantified and Riksdag national targets for energy and climate policy. In Government Bill 2023/24: 105 the long-term direction of the Energy Policy (see Chapter 1.2.1.7), the Government has also proposed new objectives for planning and security of supply of electricity and announced a review of the energy efficiency target. The government has also announced a revision of the national interim climate targets for 2030.

Table 1 Overview of numerical and Riksdag bound national targets for energy and climate policy.

Objective	Target year	Base year
Sweden shall have no net emissions of greenhouse gases into the atmosphere, in order to achieve negative emissions thereafter. The objective is to achieve greenhouse gas emissions (excluding: LULUCF) from Swedish territory shall be at least 85 % lower by 2045 than emissions in 1990. No more than 15 % of emission reductions may be achieved through accompanying measures	2045	1990
75 % reduction in emissions from sectors outside the EU ETS. Up to 2 % through accompanying measures[1].	2040	1990
63 % reduction in emissions from sectors outside the EU ETS. Up to 8 % through accompanying measures[1].	2030	1990

70 % reduction of emissions in the transport sector	2030	2010
100 % fossil-free electricity generation	2040	
50 % more efficient energy use in[2].	2030	2005

[1] Accompanying measures include carbon removals in forests and land as a result of additional measures, emission reductions implemented outside Sweden's borders, and carbon capture and storage from the combustion of biofuels, known as bio-CCS.

[2] Expressed as energy input in relation to GDP.

The overall objective of energy policy is to create the conditions for efficient and sustainable energy use and a cost-effective Swedish energy supply with low negative impacts on health, the environment and climate and to facilitate the transition to an ecologically sustainable society (Bill. 2017/18: 228 direction of energy policy). The objective is based on the same three pillars of energy cooperation in the EU and aims to reconcile security of supply, competitiveness and environmental sustainability.

The Riksdag's overall objective for energy research and innovation is to contribute to meeting set energy and climate objectives, long-term energy and climate policies and energy-related environmental policy objectives (Bill. 2016/17: 66 energy research and innovation for ecological sustainability, competitiveness and security of supply). For further details, see section 2.5.

For information on policies and measures, see Chapter 3.

1.2 Overview of current policy situation

1.2.1 National and Union energy system and policy context of the national plan

1.2.1.1 Sweden's climate policy framework

In June 2017, the Riksdag adopted a climate policy framework for Sweden through Government Bill 2016/17: 146 A climate policy framework for Sweden.
The framework consists of national climate targets, a climate law and a climate policy council. The climate policy framework creates long-term conditions for business and society. For details on Sweden's national climate targets, see Chapter 2.1.1.

1.2.1.2 Climate Law

The Climate Act (2017: 720) regulates the government's climate policy work, what it should aim for and how it is to be carried out. Section 3 of the Climate Act states that the Government's work on climate policy is to be based on the long-term emission target set by the Riksdag. The work must also be carried out in such a way as to enable climate and budgetary policy objectives to interact with each other. In addition, the Act contains provisions on when and how the Government is to follow up on climate policy and to report its planned measures to the Riksdag.

In accordance with Section 4 of the Climate Act, the Government must present an annual climate report to the Riksdag in the Budget Bill. In accordance with Section 5 of the Climate Act, the Government shall present a climate policy action plan in the year following regular parliamentary elections. In the action plan, the government sets out its policies to achieve the climate targets during the mandate. In December 2023, the latest Climate Action Plan was presented.5 6

1.2.1.3 Climate Policy Council

The Climate Policy Council, which is part of the climate policy framework, is composed of members with high scientific competence in the fields of climate, climate policy, economics, social sciences and behavioural sciences. The Council's task is to assess how the government's overall policy is compatible with the climate objectives decided by the Riksdag and the Government and to contribute to an increased discussion on climate policy in society. In March 2024, the Council submitted its latest annual report to the government.[6]

1.2.1.4 Sweden's fiscal framework

The Swedish fiscal framework consists of laws and practices aimed at ensuring the long-term sustainability and transparency of fiscal policies. The framework governs the state budget process, which in turn sets the framework for the implementation of Swedish energy and climate policies.

1.2.1.5 Stability policy

Under the new Riksbank Act (2022: 1568), the Riksbank must identify threats to sustainable development that affect the conditions for the Riksbank's activities – the main objective of which is price stability, but without prejudice to this must also contribute to the balanced development of production and employment. The Riksbank shall contribute to the stability and efficiency of the financial system. According to the Riksbank, this includes identifying and assessing risks related to climate change.7 8

1.2.1.6 Budgetary process

The budgetary process is mainly governed by the Instrument of Government (1974: 152), the Riksdag Act (2014: 801) and the Budget Act (2011: 203). The regulations require the Government to submit a Spring Financial Bill and a Budget Bill to the Riksdag in the year before the beginning of the financial year. The Spring Bill is submitted in April and includes the government's proposed economic and fiscal policy guidelines for the following year, including an assessment of the level of a government expenditure ceiling for the final year of

5SKR. 2023/24: 59, the Government's Climate Action Plan – all the way to net zero; https://www.regeringen.se/contentassets/990c26a040184c46acc66f89af34437f/232405900webb.pdf (2023).
7Riksbank, *Riksbank Climate Report January 2023.* https://www.riksbank.se/globalassets/media/rapporter/klimatrapport/2023/klimatrapport-pdf/riksbankens- climate report-2023.pdf (2023).

the forecast period, which is three years later. After the guidelines of the Spring Bill have been decided by the Riksdag, they are translated by the Government into a concrete budget bill submitted in the autumn of the same year. In the course of the current financial year, the Government may propose amendments to the central government budget in a so-called amending budget.

1.2.1.7 Direction of the Government

Whereas on 18 October 2022, a coalition government composed of ministers from the Moderates, the Christian Democrats and the Liberals took office; Government

[6] climate Policy Council, *2024 report of the Climate Policy Council,* https://www.klimatpolitiskaradet.se/wp-content/uploads/2024/03/klimatpolitiskaradetsrapport2024.pdf (2024), cooperates in the Riksdag with the Swedish Democrats. The cooperation parties reached an agreement in October 2022 on the political direction of the 2022-2026 term of office, known as the 'Time Agreement'.[8] The agreement includes six cooperation projects in the framework of which political reforms will be prepared and implemented. The *climate and energy* cooperation project focuses, among other things, on increasing the amount of programmable and fossil-free power generation in the energy system, not least by strengthening the conditions for new nuclear power and increasing the pace of charging infrastructure deployment. The time agreement announced that the energy policy target would be changed from 100 % "renewable" to 100 % "fossil-free" electricity production in 2040, which is now adopted in the Riksdag (Bill. 2022/23: 99 spring amending budget 2023).
Planning in the field of energy shall also be based on an increase in electricity use with a projected electricity demand of at least 300 TWh in 2045.

Government Climate Action Plan

In accordance with the Climate Law, the government presented its Climate Action Plan in December 2023.9 The Climate Action Plan sets out how climate policy work should take place during the mandate, including the agreed and planned measures that the government intends to take to improve the conditions for households and businesses to make the necessary decisions to achieve the national and global climate targets and Sweden's climate commitments to the EU. The Climate Action Plan outlines the basis for the government's climate policy with three points:

- A global issue requires global answers. It is through international cooperation, knowledge sharing and free trade that we can achieve a successful climate transition. The EU is a key player both to influence emissions within the Union and to drive the world. Without the involvement of giants such as the US, China, India and Brazil, we cannot meet this global challenge.
- Technology development and a massive increase in the use of climate-neutral electricity are prerequisites for the transition in Sweden and in all other countries. In Sweden,

9 Government letter 2023/24: 59, *The Government's Climate Action Plan – all the way to net zero*. https://www.regeringen.se/contentassets/990c26a040184c46acc66f89af34437f/232405900webb.pdf (2023).

nuclear expansion is the single most important measure to reduce our emissions nationally through the electrification of transport.

[8] Government, *Government's political priorities,* https://www.regeringen.se/artiklar/2022/11/regeringens- political-priority/ (2022).

and industry. The government's roadmap for new nuclear power is a crucial piece of puzzle.

• The climate transition can only succeed if it takes place in a growing economy. The legitimacy of citizens is a prerequisite for the transition, which is also based on the ability to find effective instruments, where the conditions and living standards of individuals, households and businesses do not stagnate, and where the whole country and all groups of society have equal opportunities in the transition. Efforts will therefore be made where we get the most emission reductions – climate policy needs to become more cost-effective."

The Climate Action Plan also describes how the Government sees how Sweden's commitments within the EU should be met. The Government considers that it is difficult to reach Sweden's commitments under the ESR and LULUCF through measures in Sweden alone and considers that the commitments should be achieved in a cost-effective and socio-economically efficient manner. Further measures to reduce emissions and increase removals are deemed necessary. In addition, flexibilities existing under ESR and LULUCF should be used to enable cost-effective implementation. This does not mean that Sweden should stop the pace at home, but help where the efforts make the most difference. Sweden has also notified the Commission of a wish to use the flexibility available through the transfer of emission allowances from the EU ETS to the ESR.

Examples and areas of action highlighted are:

"*Electrification – a prerequisite for the transition*

The government is investing billions in electrification with, for example, Climate Leap, which, among other things, provides grants for charging infrastructure and has also increased investment in Industriklivet that supports research, innovation and investment in new technologies.

In the 2024 memorandum of appropriations, the Government has decided on several mandates to accelerate the electrification of the transport sector. This includes promoting the roll-out of home charging in multi-apartment buildings and identifying municipalities that create the conditions for the electrification of shipping."

“The*energy system needs to evolve to cope with the transition*

To achieve the green transition and boost Sweden’s competitiveness, Sweden needs to significantly increase the production of fossil-free electricity, strengthen security of supply so that households and businesses can get electricity when they need, where they need at affordable prices. Sweden therefore needs to plan to meet an electricity demand of at least 300 terawatt-hours (TWh) in 2045. In order to make it easier for companies to switch, simplified and more efficient permit procedures for environmental assessment are also needed.”

“Nuclear energy is a prerequisite for reaching climate objectives

Nuclear power has the potential to produce the vast amounts of fossil-free electricity that is a prerequisite for the climate transition. The construction of new nuclear power reactors provides improved conditions for the electrification of the transport sector and industry, which relies on a strong power system. The ability to build nuclear power reactors in new locations opens up new planning of the power system.”

Find out more about nuclear power in the section ‘Nuclear power’ below.

“A fossil-free economy with sustainable value chains and increased production

Fossil freedom and circularity go hand in hand. The new economy is strongly in need of sustainable and fossil-free value chains for materials and products. To reduce emissions from conventional combustion engines as well as industrial processes, fossil-free fuels and fuels will be necessary for a long time to come. Sweden contributes to global climate action by promoting a rapid transition to circular and bio-based value chains where natural resources are used more efficiently and where waste and logging residues from, for example, the forestry industry can be processed into key fossil-free fuels and other refinery and petrochemical feedstocks. The government will work to take measures to phase out the use of coal, oil and fossil gas both as fuel and as feedstock. In some applications or uses, this will take time. Achieving the objectives of the Paris Agreement will require large amounts of negative emissions. Thanks to an extensive bioeconomy and large point sources of biocarbon, Sweden has a good potential for negative emissions through biocarbon storage (bio-CCS).”

“*CCS is a key technology*

CCS is identified by both the International Energy Agency (IEA) and the Intergovernmental Panel on Climate Change (IPCC) as a prerequisite for reaching the 1.5 °C objective of the Paris Agreement. The storage of captured CO2 is regulated at EU level by Directive 2009/31/EC of 23 April 2009 on the geological storage of carbon dioxide. The Directive has been transposed into Swedish legislation by means of the Ordinance (2014: 21) on the

geological storage of carbon dioxide. CCS technology is relevant for large point emissions, i.e. direct emissions of environmental pollutants limited to a number of major sources. However, as technology evolves and costs decrease, smaller installations may also be considered. The entire CCS chain, i.e. capture, transport and storage, is already in operation, but its implementation remains limited. The prospects for further technological development and thus lower costs are assessed as good."

In the context of the Commission's Communication on Industrial Carbon Management was presented in February 2024, the Government has further clarified its views on CCS and CCU. The explanatory memorandum (2023/24: FPM47) states, among other things, that "Carbon Capture and Storage (CCS) from fossil, biogenic or atmospheric origin, and carbon capture and utilisation (CCU) are important technologies that will be needed in both Sweden and the rest of the world in order to meet the climate targets set by the countries", and "Climate policy is to remove emissions that can be removed effectively, reduce emissions that cannot be removed altogether with significant volumes of negative emissions. CCS on fossil CO2 should be used where relevant. Measures taken to promote the CCUS should avoid lock-in in the continued use of fossil fuels and raw materials. The use of CCS and CCU should take into account, inter alia, circular economy, resource efficiency, socio-economic efficiency and life-cycle climate impacts."

For more information on carbon capture and storage (CCS) and bio-CCS, see section 3.1.1.1.

"Increased construction in wood and bio-based materials

[...] Approximately 90 % of single-family houses and 10-20 % of apartment buildings are built mainly in wood. Wood is also otherwise used in construction. Methods are available to manage, for example, fire and acoustics in wooden buildings and to build wooden hauls. Wooden hauls have started to be built in Sweden. Trästad Association

Sweden, including initiatives, has contributed to spreading knowledge and inspiration to increase wood construction in Sweden. Multi-dwelling buildings built in wood have increased from 10 % of multi-dwelling building construction in 2016 to 20 % in 2019-2020. Sweden's skills and products in wood building can be exported and reduce emissions abroad. Construction in wood creates a carbon sink over time and at the same time has a substitution effect, i.e. replacing non-renewable material. There are currently limited economic incentives to increase the storage of biogenic carbon in buildings."

"Sweden should be involved from the start in the implementation of the ETS 2

The strengthened rules for the EU Emissions Trading System (EU ETS) will accelerate the pace of the climate transition. Sweden should participate from the start in the implementation

of the new ETS, EU ETS 2 and include the combustion of fuels in all additional sectors beyond those that are mandatorily covered by the EU ETS 2. The Government intends to come back with proposals aimed at ensuring that consumers and businesses are fully compensated for the effects on fuel prices. The Government also intends to make use of the possibility to exempt ferry services between Gotland and other parts of Sweden until 2030."

'A broad policy investigation shall be established:

In order to help achieve the Swedish climate neutrality target for 2045, measures need to be taken to phase out the use of coal, oil and fossil gas as fuel as well as feedstock. In Government Bill 2023/24: 28 Reducing the reduction obligation for petrol and diesel, the Government makes it clear that previous legislation places disproportionate emphasis on the fact that the reduction obligation must contribute to achieving the intermediate target for domestic transport, without sufficiently taking into account the impact on other social objectives. Therefore, for the period 2027-2030, an inquiry is set up in 2024 to analyse and provide evidence on whether and, if so, what instruments can be designed to ensure that Sweden's commitments in the EU are reached in a cost-effective and socio-economically efficient way to ensure that excessive costs for households and businesses are not incurred with the risk of serious impact on the competitiveness of Swedish companies."

Energy Policy Orientation Bill

In March 2024, the government presented an energy policy bill (Bill. 2023/24: 105 long-term orientation of energy policy), which proposed to the Riksdag two new energy policy objectives (see below), but also clarified the policy direction in the areas of developed energy planning, electricity market development, electricity generation, electricity grids, heat markets, bioenergy, waste, peat and CCS, gas, liquid fuels, efficient energy use, preparedness, increased robustness, etc. At the same time, a referral to the Council on Legislation for a clearer authorisation process for electricity networks was presented (Government Bill. 2023/24: 88 a clearer authorisation process for electricity grids). The Riksdag has now adopted the new energy policy objectives. For more information on its background and content, see section 4.5.2.

'Planning*objectives for the electricity system*
The planning of the Swedish electricity system shall provide the conditions to supply the electricity needed for increased electrification and to enable the green transition.

The Government's assessment: The Government currently sees that Sweden should plan to be able to meet an electricity demand of at least 300 TWh in 2045. The need for electricity in different geographical areas should be clarified for the years 2030, 2035, 2040 and 2045 and followed up at regular control posts starting in 2030.'

‘*Electricity system supply security targets*
The Swedish electricity system must have the ability to supply electricity where demand is available, in a timely manner and in sufficient quantity, to the extent that it is socio-economically efficient. Removing unjustified barriers to the electricity system in order to create the conditions for an efficient market that promotes competitive prices.

The Government’s assessment: The Swedish National Grid should be given overall responsibility for the regular follow-up of the supply safety target and for taking or proposing the necessary measures to achieve the supply safety objective. In-depth follow-up should be carried out at regular inspection posts starting in 2030.”

“Notice on the review of the energy efficiency target
Sweden’s energy efficiency targets should be revised in order to promote more clearly the socio-economically efficient use of energy and the efficient use of the energy system contributing to the green transition.”

Nuclear

On 28 September 2023, the Government presented Bill 2023/24: 19 New Nuclear Power in Sweden – a first step. The Bill puts forward proposals aimed at extending the conditions for authorising the construction and operation of new nuclear power reactors. The proposals consist of removing the provision in the Environmental Code (1998: 808) which states that the Government may only authorise a new nuclear power reactor if it replaces a permanently shut down reactor and is constructed at a site where any of the existing reactors is located. It shall be possible to allow more than 10 reactors operating simultaneously and elsewhere.

In November 2023, the Government presented a roadmap for new nuclear power in Sweden. In[10], the objective is to achieve new nuclear power by 2035 with a power of around 2 500 MW, corresponding to at least two large-scale reactors. By 2045, the objective is to have an effect equivalent to, for example, about ten large-scale reactors. The Comitology Directive on New Nuclear Power in Sweden – a second step presented on 2 November 2023 tasked a special investigator to review the current rules to facilitate new nuclear power.10 The11 12 investigation consists of four parts. The first part concerns how the licensing of nuclear power reactors can be made more efficient with clarity and shorter probation periods. The second part aims to review the application fee to the Swedish Radiation Safety Authority. The investigator shall propose the changes needed for an effective charging that takes into account new reactor types such as SMRs. The third part consists of analysing whether the existing nuclear waste programme needs to be adapted and developed for waste from new reactors. The fourth and final part consists of analysing and assessing whether the

10DIR. 2023: 155, *New nuclear power in Sweden – a second step;* https://www.regeringen.se/contentassets/39d7bbcfe5bd4835abd963198ed56394/231102-kommittedirektiv---ny-karnkraft-i-sverige-one second step.pdf (2023).

regulatory framework for preparedness and planning zones needs to be adapted for new reactors. The mandates on licensing and fees shall be submitted by 30 December 2024, the mission on nuclear waste and spent fuel on 29 August 2025 and the mission on preparedness on 27 February 2026. The aim is to reach the government

[10] Government, *Government launches a roadmap for new nuclear power in Sweden*, https://www.regeringen.se/pressmeddelanden/2023/11/regeringen-lanserar-en-fardplan-for-ny-karnkraft-i- sverige/ (2023).

the target is that Sweden will have 100 % fossil-free electricity production by 2040. Radiation protection and nuclear safety requirements shall remain unchanged.

In November 2023, the Government also commissioned the National Debt Office to take preparatory measures to provide state credit guarantees for investments in new nuclear energy.[12].. Read more on nuclear investments in section 5.3.3.

In order to strengthen the conditions for investment in new nuclear power, an investigator was set up in December 2023 to develop and propose financing and risk-sharing models for new nuclear reactors to enable competitive electricity market players to build new nuclear power. The aim is to create the economic conditions that lay the foundations for investment in new nuclear power.[13]

In January 2024, a nuclear coordinator was also appointed to support the government in establishing new nuclear power and identifying promotion measures. The coordinator shall, inter alia, support the Government Offices in following up and analysing progress in the development of nuclear power, identifying the need for complementary measures to advance the work, as a contact point for stakeholders and actors in the nuclear sector and liaise with them with a view to increasing the pace of establishment of new nuclear power. The report must be completed by 31 December 2026 at the latest.13 14

Hydrogen

The Government estimates that fossil-free hydrogen will be an important part of Sweden's future energy system and is a prerequisite for decarbonising industry and will be important for reducing emissions from, inter alia, heavy transport. Swedish production of fossil-free hydrogen requires a large deployment of fossil-free electricity production. Regulatory frameworks already exist to test the construction of hydrogen pipelines in Sweden, but others

[12] Government, *Mandate to take preparatory steps to provide state credit guarantees for investments in new nuclear energy;* https://www.regeringen.se/contentassets/5bf1e1b788074276a39d92461a325589/uppdrag-att-vidta- preparatory

13DIR. 2024: *1, National Nuclear Deployment Coordinator;* https://www.regeringen.se/contentassets/364833615c8d41 5fac8e930001 7aafee/en-national coordinators re-for- rollout – karnkraft-dir.-20241.pdf (2024).

atgarder-for-attorna-stalla-ut-sovereign credit guarantees – for-investor-i-ny-karnkraft.pdf (2023).

[13] Government, *Financing and risk-sharing for investments in new nuclear power reactors, https://www.regeringen.se/contentassets/6eb5486c07cb4730b450a4c986b43afd/uppdragsbeskrivning- mission-om-finance* and risk-sharing – av-karnkraft.pdf (2023).

regulatory frameworks and instruments need to be reviewed and developed as the use of hydrogen increases in society. The Government therefore considers that state intervention for hydrogen should be guided by certain principles:

- The use of fossil-free hydrogen shall contribute to the transition to fossil-free energy systems and industrial processes.
- The use of hydrogen shall focus on socially beneficial applications where more resource and cost-effective alternatives are not available.
- Hydrogen production must be effectively integrated with electricity and heating systems and contribute to the security of energy supply in Sweden.
- Hydrogen infrastructure shall be deployed in a way that facilitates the climate transition and safeguards Sweden's competitive energy prices.

Investments

There is a variety of measures and policies that can enable the necessary investments. Chapter 5 shows the result of a modelling of investments in electricity production as well as the network investments reported in Svenska kraftnät's system development plan during the planning period for the years 2022-2031.[15]

Studies, surveys, roadmaps, etc. inform policy decisions that, together with other factors, can help societal actors to make the right investment decisions. The study "Financing the green transition of industry" of August 2022 proposed strengthening skills, supporting the financing process, securing more venture capital for state actors and extending the guarantee framework.15 16 17

Public funding for the energy and climate transition takes place in several policy areas, such as research, infrastructure and the co-financing of investments in private activities. In order to broadly monitor central government expenditure, information on the central government budget is available from the National Financial Management Authority (ESV) with:

[15] Swedish National Grid, *System Development Plan 2022-2031,* https://www.svk.se/siteassets/om-oss/rapporter/2021/svk_System Development Plan_2022-2031.pdf (2021). Thesplit into 27 spending areas and sub-levels, contributing jointly and in various parts to the achievement of climate

15Government, *Finance for the green transition of the business sector;* https://www.regeringen.se/contentassets/8958684b52c44c2a8d2d09ae340d559f/finansiering-av-naringslivets-grona-change/ (2022).

and energy targets.[17]

The presentation of the real economy's distribution of expenditure in the 2023 central government budget states that investments account for five per cent and[18] investments are described as expenditure on the acquisition of infrastructure, durable tangible assets such as buildings and machinery, intangible assets such as software, valuables, financial assets and changes in inventories to be used in production. The State's total expenditure on investment activities amounted to SEK 61 955 million in 2023, which is an increase of SEK 10 325 million (20 %) compared to 2022.

The National Debt Office is an authority which lends funds to public authorities for investments in fixed assets used in the activities of the State. The total amount of such investment loans increased by SEK 4 649 million.18 In the State budget, investment loans were projected to increase by SEK 1 000 million, which is SEK 3 649 million lower than the outturn. Here too, the data are broken down by expenditure area.

Broad enabling actions for green business investments

The Swedish National Debt Office is tasked with issuing state credit guarantees for new loans taken out by companies with credit institutions to finance large industrial investments in Sweden and which contribute to achieving the objectives of the environmental targets scheme and the climate policy framework. The mission is implemented in accordance with the Ordinance (2021: 524) on State Credit Guarantees for Green Investments, which entered into force on 22 June 2021. The guarantee framework amounts to SEK 80 billion in 2024. In order to benefit from a guarantee, the loan must amount to at least SEK 500 million. The guarantee covers up to 80 % of the loan. The credit guarantees can be issued in SEK, EUR or USD. The maximum duration of the guarantee is 15 years.

Almi AB is a Swedish state private equity firm and, as a complement to the private market, will contribute to the development and financing of small and medium-sized enterprises. Almi's activities include loans, business development and venture capital through its subsidiary Almi Invest. The aim of Almi's activities is to strengthen the development of Swedish business and promote sustainable growth.

[17] Swedish National Financial Management Authority, Statistics, https://www.esv.se/statistik-och-data/statistik/ (2024).

[18] Swedish National Financial Management *Authority (ESV), real economic distribution of appropriations in the 2023 central*government budget, https://www.esv.se/statistik-och-data/statistik/realekonomisk-fordelning/ (2024).

Almi AB is the parent company of a group with operational activities in 16 regional subsidiaries as well as private equity activities in Almi Invest AB.

18 Riksgälden, *Statistics on guarantees and loans,* https://www.riksgalden.se/sv/statistik/statistik-om-riksgaldens-garantier-andlan/ (2024).

Conference of the Parties to the United Nations Framework Convention on Climate Change (COP)

The 28th Conference of the United Nations Framework Convention on Climate Change (COP28) in December 2023 held the Global Stocktake to take stock of developments at global level in relation to the Paris Agreement objectives on climate change adaptation and emission reductions to limit global temperature increase. The review also aimed at providing further guidance to the countries of the world in the future towards these objectives. According to decisions taken at the conference, countries in the world are called upon, inter alia, to switch away from fossil fuels; tripling the installed capacity of renewable energy and double the annual rate of energy efficiency measures by 2030; accelerating low and zero emission technologies including renewables, nuclear power, reduction and uptake technologies such as CCS, CCUS and storage, as well as green hydrogen; phasing out inefficient fossil fuel subsidies that do not address energy poverty or just transition as soon as possible.

Circular economy

The Government considers that the circular economy is crucial for both the environment and the climate transition and an important tool for increasing both resource efficiency and Swedish competitiveness. The driving force of business is an important success factor. The Circular Economy Delegation is an advisory body to the government to contribute to the transition of industry to a circular economy.19 20

Sweden's national strategy for circular economy sets the direction for transforming production, consumption and business models into non-toxic, fossil-free and circular material cycles. The government has therefore set up a committee to examine in which areas and how economic instruments can be used to promote the transition to a circular economy.
The inquiry shall focus on areas with a significant impact on the environment or climate, where policies can promote such a transition in a significant and socio-economically efficient way. The mandate does not include the submission of legislative proposals. The Committee shall inter alia:

- analyse in which areas, such as material flows, product groups or services, it is appropriate to use economic instruments to promote the transition to a circular economy;
- propose appropriate economic instruments for the areas identified and the reasons for the chosen instruments; and
- where relevant, explain why an analysed area is less suitable for economic instruments to foster the transition to a circular economy.

Circular Economy19 *Delegation, Circular Economy Delegation;* https://www.delegationcirkularekonomi.se/ (2024).

The mission has been extended and is due to be reported on 30 September 2024.[21]

Adaptation to climate change

In March 2024, the government submitted a new national strategy and action plan on adaptation to climate change to the Riksdag.21 The strategy outlines the government's focus on adaptation to climate change: *With socio-economically effective, strategic and action-oriented adaptation to climate change, society works well in the changing climate. The natural environment has a good capacity to recover and ecosystem resilience has been strengthened. Societal actors, including private and public at all administrative levels, manage risks, vulnerabilities and opportunities in decision-making. Adaptation to climate change is integrated into relevant activities and responsibilities*. The strategy also outlines mechanisms for coordinating, monitoring, evaluating and revising the work on adaptation to climate change. The strategy was complemented by a National Climate Adaptation Action Plan focusing on what the government intends to do over the next five years to create the conditions for climate change adaptation. Based on the societal implications anticipated by research, the government identifies ten that will need to be addressed.

The work on adaptation to climate change covers a wide range of topics and is largely governed by existing legal frameworks, frameworks and objectives, both national and international. This includes, for example, the objectives of the 2030 Agenda and the Global Sustainable Development Goals, the Paris Agreement and the Sendai Framework for Disaster Reduction.

The European Commission adopted a new strategy on adaptation to climate change in February 2021. The strategy aims to make Europe more resilient to climate change:

[21] DIR. 2023: 141, *Supplementary Directive to the Committee on Economic Instruments for a Circular Economy (Fi 2022: 14)* https://www.regeringen.se/contentassets/ddde67c4fca14f2db328169b0d38901 3/till Agent Directive-Commody-for-en-circular-economic-dir.-2023141.pdf (2023). Change and has four main objectives: making adaptation smarter; speeding up adaptation; greater integration of adaptation into relevant policy areas; stepping up international action on adaptation to climate change. The European Parliament and Council Regulation (EU) 2021/1119 ('European Climate Law') provides a framework for making progress towards the global goal on adaptation set out in Article 7 of the Paris Agreement.22 23Sweden's new strategy and action plan on adaptation to climate change builds on the requirements of the EU Climate Law and the EU Strategy on Adaptation to Climate Change to take into account specific vulnerabilities in relevant sectors. For more information on adaptation, see section 3.1.3.2.

Just transition

The Government's Climate Action Plan, see Section 1.2.1, describes that the understanding

21 Government letter 2023/24: 97, *National Strategy and Government Action Plan on Adaptation to Climate Change,* https://www.regeringen.se/rattsliga-dokument/skrivelse/2024/03/skr.-20232497 (2024).

Council Regulation (EU) 2021/11 of the European22 Parliament and of the Council of 30 June 2021 establishing a framework for: achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 201 8/1 999.

of the need for a just transition that is accepted and perceived as reasonable by broad groups over time has been strengthened. The Government further considers that measures should be taken to promote a just climate transition and intends to analyse how the Social Climate Fund can best be used in Sweden to enable ambitious climate policies and create acceptance of climate policy instruments. The Government intends to further flesh out this work in the Social Climate Plan to be submitted to the European Commission by 30 June 2025.

Sweden's general welfare policy is the tool for sharing and equal opportunities. Swedish *labour market policy* aims to ensure that all people who can have the opportunity to participate in the labour market, provide security and facilitate labour market transitions. Labour market policies include measures to get young people into employment, matching jobseekers and vacancies, labour market policy programmes, unemployment insurance and the European Social Fund. In the case of unemployment, workers have the possibility to receive unemployment insurance benefits while looking for a job. Transition and skills support enables support in the form of advice and guidance to, inter alia, facilitate transition and transition to new employment or training for both employees and employees whose employment is about to expire or be terminated. In 2022, a new public outplacement grant was introduced, allowing workers to study with, in most cases, the least

1.1.1 % of the salary for up to one year to strengthen their position in the labour market. *Social* security provides financial security at different stages of life and includes health insurance, pensions and parental insurance and parental allowances. As an ultimate safety net, there is the possibility to seek *financial assistance* for households facing difficulties in subsistence (see further section 3.4.4).

In addition to its general welfare policy, Sweden benefits from *the EU Just Transition Fund*. Under the Fund, Sweden has identified industries and regions with very high carbon emissions where efforts are necessary to reduce emissions and tackle the social, employment, economic and environmental impacts of the transition. The industries identified are the steel industry in Norrbotten, the mineral industry in Gotland and the metallurgical industry in Västerbotten, with EUR[24] million of total funding being EU aid in[25].

1.1.2 Current energy and climate policies and measures relating to the five dimensions of the Energy Union

See Chapter 3 for information on policies and measures.

1.1.3 Key issues of cross-border relevance

Sweden participates in the well-integrated Nordic electricity market, which is interconnected with the rest of Europe and with Denmark for gas.

The Nordic Council of Ministers is the official cooperation body of the Nordic governments.24 The Council is working towards common Nordic solutions in areas where the Nordic countries can achieve greater results by working together than by solving tasks separately. The Nordic Council of Ministers' vision that the Nordic region will be the most sustainable and integrated region in the world by 2030 is guiding activity. In 2024, a new Joint Action Plan (2030-2025) for the vision of the Nordic Council of Ministers will be adopted, based on the programmes for all areas of cooperation that will be decided by the responsible Council of Ministers in 2024.

[24] The Swedish Agency *for Economic and Regional Growth, the Just Transition Fund*; https://tillvaxtverket.se/tillvaxtverket/omtillvaxtverket/eufonder/fondenforenrattvisomstallning.1909.html (2024).

[25] European Commission, *EU Cohesion Policy: EUR 155.7 million for a just climate transition in Sweden*, https://ec.europa.eu/commission/presscorner/detail/sv/ip_22_5316 (2022).

Nordic Energy Research, is the platform for joint energy research and policy development under the Nordic Council of Ministers and is jointly funded by the Nordic governments.

1.2.4 administrative structure for the implementation of national energy and climate policies

1.2.4.1 Tasks and responsibilities of public authorities

The Ministry of Climate and Enterprise is responsible for climate, environment, energy, business and innovation issues. The Ministry's area of responsibility also includes radiation safety, Agenda 2030 and outdoor life and the transition to a circular economy. Each ministry's area of responsibility includes a number of state authorities responsible for implementing the regulations and carrying out the tasks and tasks decided upon by the government. The Government Offices also administers a number of companies, wholly or partly owned by the State. There are also a number of foundations and other organisations formed by the State or under the influence of the State.25

An investigator was given a mandate in June 2023 to review the tasks and responsibilities of the Swedish Power Network, the Energy Agency, the Energy Market Inspectorate and the National Electrical Safety Agency. As regards the National Electrical Safety Board, the investigator shall also consider whether there are alternative ways of organising the activity. It also includes analysing whether the authorities' management arrangements are fit for purpose. A starting point for investigative work is to seek to refine the tasks and responsibilities of the authorities, in particular on the basis of what follows from the EU

24 Nordic Council of Ministers, *Nordic Cooperation,* https://www.norden.org/sv/nordiska-ministerradet (2024).
25 Government, *Authorities and Others,* https://www.regeringen.se/myndigheter-med-flera/#1291 (2024).

acquis in the field of energy. The mission was finalised on 29 March 2024.26

For energy and climate, the relevant authorities for the implementation of national policies include:

The Swedish Energy Agency (Energimyndigheten) is the managing authority for questions concerning the supply and use of energy in society. In accordance with Ordinance (2014: 520) containing instructions for the Swedish Energy Agency, the Authority's task is, inter alia, to work towards reconciling ecological sustainability, competitiveness and security of supply in energy systems that are sustainable and cost-effective with a low impact on health, the environment and climate.
The Swedish Energy Agency is also the emergency response authority and the sectoral authority responsible under the Ordinance (2022: 524) on state authorities' preparedness.

TheEnvironmental Protection Agency is the environmental management authority in the field of climate and air, soil, biodiversity, contaminated sites, cycles and waste, environmental monitoring and environmental research. In accordance with Ordinance (2012: 989) containing instructions for the Environmental Protection Agency, the Environmental Protection Agency has a central role in environmental work and must act as a driving force, support and assembly in the implementation of environmental policy.

The Environmental Protection Agency shall work to ensure that the generational objective for environmental work and the environmental quality objectives set by the Riksdag are met and, if necessary, shall propose measures for the development of environmental work. The Environmental Protection Agency shall promote sustainable development on the basis of the generational objective and environmental quality objectives and thus contribute to the implementation of Agenda 2030 adopted by the Member States of the United Nations in Ordinance (2022: 187). The Swedish Environmental Protection Agency is also the emergency response authority under Ordinance (2022: 524) on state authorities' preparedness.

TheGeological Survey of Sweden (SGU) is the managing authority for questions concerning the geological nature of the country and the management of minerals. The authority deals with cases under, inter alia, the mineral legislation and legislation on the continental shelf. Within its area of activity, the authority shall provide documentation for the application of

26 Government, *Review of authorities' tasks and responsibilities in the field of energy – Interim report Svenska kraftnät,* https://legacy.altinget.se/misc/myndighetsoversynen-delrapport-svenska-kraftnat.pdf (2023), Government, *Review of authorities' tasks and responsibilities in the field of energy – Interim report* The*Swedish Energy Agency*, https://legacy.altinget.se/misc/myndighetsoversynen-delrapport-energimyndigheten.pdf (2023), and the Government, *Review of authorities' tasks and responsibilities in the field of energy – interim report on the Energy Market Inspectorate and the National Electrical Safety Board;* https://www.elsakerhetsverket.se/contentassets/07f6ce753097428d95538755e8202b4a/myndighetsoversynen – interim report-ei-and-electricity.pdf (2024).

Chapters 5-3 of the Environmental Code and the Planning and Building Act (2010: 900).

In accordance with Ordinance (2016: 742) containing instructions for the Energy Market Inspectorate, the Energy Market Inspectorate is responsible for:

1. supervision, regulation and licensing in accordance with the Electricity Act (1997: 857), the Natural Gas Act (2005: 403) and the Act (1978: 160) on certain pipelines,

2. the supervision and regulations in accordance with the District Heating Act (2008: 263) and the District Cooling Act (2022: 332); and

3. supervision under the Act on Intervention against Market Abuse in the Trading of Wholesale Energy Products Act (2013: 385).

The Energy Market Inspectorate is also responsible for establishing and publishing a supervisory policy.

The Swedish Business Authority's Swedish National Grid (Svenska kraftnät) has the task of managing, operating and developing a cost-effective, secure and environmentally friendly power transmission system in a commercial manner, selling transmission capacity and otherwise carrying out activities linked to the power transmission system (Ordinance (2007: 1119) containing instructions for Affärsverket svenska kraftnät § 1). In accordance with Chapter 8, Section 1 of the Electricity Act and Section 6 of the Ordinance (2023: 241) on the national electricity system, the Swedish National Electricity Network is the system operator. The Swedish National Grid Network is the electricity preparedness authority pursuant to the Electricity Preparedness Act (1997: 288) and the Emergency Response Authority under the Ordinance on state authorities' preparedness.

The Swedish Meteorological and Hydrological Institute (SMHI) is the managing authority for meteorological, climatic, hydrological and oceanographic matters, in accordance with Ordinance (2009: 974) laying down instructions for the Swedish Meteorological and Hydrological Institute. The SMHI is the emergency response authority in accordance with the Ordinance (2022: 524) on state authorities' preparedness.

In accordance with Ordinance (2009: 1393) containing instructions for the Forest Agency, the Forest Agencyis the managing authority for forestry matters and is responsible for ensuring that the country's forests are managed in such a way that the forestry policy objectives decided by the Riksdag can be achieved. The local anchoring of the authority is important.

TheSwedish Board of Agriculture (SBA), in accordance with Ordinance (2009: 1464) laying down instructions for the Swedish Board of Agriculture, the Management Authority in the

field of agriculture, fisheries and related rural development, is responsible for working towards sustainable development, good animal welfare, a dynamic and competitive industry throughout the country and food production for the benefit of consumers. The Authority is the emergency response authority under the Ordinance on State Authorities Preparedness.

In accordance with Ordinance (2010: 185) containing instructions for the Transport Administration, the Transport Administrationshall be responsible for long-term infrastructure planning for road traffic, rail traffic, shipping and aviation, and for the construction and operation of state roads and railways on the basis of a cross-modal perspective. The Administration may also be responsible, by agreement with the Swedish Maritime Administration, for implementing infrastructure projects in fairways, locks and canals.

The Transport Administration shall promote the basic accessibility of inter-regional public transport. By taking a community-building approach, the Transport Administration shall create the conditions for a socio-economically efficient and internationally competitive transport system that is sustainable in the long term. The Transport Administration shall endeavour to ensure that transport policy objectives are achieved. The Transport Administration is also the emergency authority and the sectoral authority responsible under the Ordinance (2022: 524) on state authorities' preparedness.

In accordance with Ordinance (2008: 1300) containing instructions for theTransport Agency, the Swedish Transport Agency has the main task of being responsible for regulations, licensing and supervision in the field of transport. The Transport Agency shall endeavour to ensure that transport policy objectives are achieved. Its activities shall have a particular focus on contributing towards an international, competitive, green and safe transport system. The Authority is the emergency response authority under the Ordinance on State Authorities Preparedness.

In accordance with Ordinance (2010: 186) containing instructions for TransportAnalysis, Transport Analysis has as its main task, on the basis of the transport policy objectives, to evaluate and analyse and report on the impact of proposed and implemented measures in the field of transport. It shall also be responsible for collecting, compiling and disseminating statistics in the field of transport. The authority shall, within its remit, assist the Government with documentation and recommendations.

In accordance with Ordinance(2016: 1048) containing instructions for the Authority for Growth Policy Assessments and Analysis, the Authority for Growth Policy Assessments and Analysis (Tillväxtanalys) has the task of developing and providing qualified knowledge base for growth policy, by carrying out, promoting and supporting the production of evaluations and analyses. From various perspectives, the Authority shall evaluate, analyse and report on the impact of the State's efforts towards sustainable national and regional growth and

business development. The Authority shall draw up decision-making documents and recommendations for the development, review and effectiveness of government measures and, if relevant, point to major trade-offs.

The Authority shall focus in particular on the cumulative impact of growth and industrial policy interventions.

In accordance with Ordinance (2009: 145) containing instructions for the Agency for Economic and Regional Growth, itsmain tasks are to promote sustainable business development and sustainable regional growth in all parts of the country and to implement parts of European cohesion policy.

The Agency for Economic and Regional Growth shall:

1. develop and implement actions promoting entrepreneurship, sustainable growth and development of enterprises, strengthening competitiveness and simplification for enterprises;
2. implement actions that promote active regional growth in the counties and develop and improve in that work the conditions for dialogue, cooperation and learning between the various relevant actors at national, regional and local level; and
3. be responsible for the coordination, management and development of the implementation of the European Regional Development Fund and the Just Transition Fund in Sweden under the European cohesion policy. The Agency for Economic and Regional Growth shall work to ensure that the government's objectives for industrial policy and regional growth policy are met.

In accordance with the Ordinance (2022: 208) containing instructions for theNational Board of Housing, Building and Planning, the National Board of Housing, Building and Planning is the managing authority for questions concerning:

1. built environment;
2. land and water management;
3. spatial planning;
4. building construction and management;
5. accommodation; and
6. housing financing

According to the Ordinance(2009: 1024) containing instructions for the Research Council for the Environment, Territorial Industries and Societal Building (Formas), the Research Council for the Environment, Area Industries and Societal Building shall promote and support basic research and needs-driven research in the fields of environment, territorial industries and community-building. The research supported shall be of the highest scientific quality and relevant to the Council's responsibilities. Formas may also finance innovation activities to a certain extent.

By means of systematic evaluation, analysis and compilation of the results of published research, it will also produce evidence that can provide scientific support for the development of cost-effective instruments and measures in order to achieve the generational objective for environmental work and the environmental quality objectives set by the Riksdag.

County Administrative Boards – Sweden is divided into 21 counties. It is clear from the Ordinance (2017: 868) containing instructions from County Administrative Boards that there is one county administrative board responsible for the state administration in the county, to the extent that no other authority is responsible for specific management tasks.

According to the terms of reference, the county administrative boards are to work, among other things, to ensure that national objectives have an impact in the county, while taking into account regional circumstances and conditions, work across the board and, within the authority's remit, coordinate various societal interests and the actions of state authorities, promote cooperation between municipalities, regions, state authorities and other relevant actors in the county, within the authority's remit, to be responsible for the supervisory tasks assigned to it by the Riksdag or the Government. The county administrative board has the task of coordinating the work at regional level with adaptation to a changing climate. The county administrative boards have tasks in the fields of energy and climate and, in accordance with the Ordinance (2017: 870) on the county administrative boards' crisis preparedness and tasks for and during increased preparedness, are responsible for crisis preparedness and tasks before and during increased preparedness.

In addition, there are a number of authorities that play a major role in the implementation of energy and climate policies.

1.2.4.2 role of municipalities and regions

Municipalities are important in Sweden's climate action through proximity to citizens and through their responsibilities for, for example, spatial planning, local transport infrastructure, construction and environmental supervision. Municipalities are major employers in charge of school and care and in many cases own real estate and energy companies. Municipalities drive local development in cooperation with businesses, organisations, citizens and other stakeholders, thereby contributing to the achievement of national and local objectives. There are numerous initiatives at local level to contribute to Sweden's national climate targets.

Under the Ordinance (1997: 1322) on grants for municipal energy and climate advice, grants may be given to municipalities which are therefore required to provide locally and regionally adapted knowledge of energy efficiency, energy use and climate impact and on the conditions for changing energy use in premises and housing. Climate and energy advice may also cover the carriage of passengers and goods. The advice is for private individuals, small

and medium-sized enterprises, housing associations, private multi-dwelling owners and associations.

According to the 2024 Ordinance, the Swedish Energy Agency must analyse how municipal energy and climate advice can be developed with regard to the Renewable Energy Directive (Renewable Energy Directive)[29] and the Energy Efficiency Directive2728. The mandate includes reviewing the current regulation and proposing how advice could also include measures to reduce vulnerability for single-family owners, organisations and SMEs, including in the event of high energy prices. The part of the mandate that links to the revised Directives has been reported to the Government Offices (Ministry of Climate and Enterprise) on 24 May 2024. The contract must be reported to the Government Offices (Ministry of Climate and Enterprise) by 2 September 2024 at the latest.

According to Act (1977: 439) on municipal energy planning, every municipality must establish an up-to-date plan for the supply, distribution and use of energy. A municipality can influence the production, distribution and use of energy in various ways, depending on its role as a public actor, information provider, property owner, employer or owner of an energy company. The planning shall promote energy efficiency and ensure a safe and adequate supply of energy. Municipalities also play an important role as enablers of spatial planning, both overview planning and detailed planning. In accordance with the Act (2006: 544) on Measures of Municipalities and Regions before and in

[29] Directive (EU) 2023/2413 of the European Parliament and of the Council of 18 October 2023 amending Directive (EU) 201 8/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652.

According to the Government, regional and local energy planning needs to be developed to clarify, among other things, what the national energy and climate targets mean at regional and local level. The County Administrative Board of Västra Götaland and the Energy Agency were given a mandate in July 2023 to develop regional and local energy planning.[31]

The regions, one for each county, are important in Sweden's climate action on the basis of their responsibilities for health care, public transport, culture and regional development.29 'Regional development work' means efforts to create sustainable regional growth and development, in accordance with the Ordinance (2017: 583) on regional development work. The Stockholm Region, the Skåne Region and the Halland Region are also responsible for

Directive (EU) 2023/1 of the27 European Parliament and of the Council 791 of 13 September 2023 on energy efficiency and amending Regulation (EU) 2023/995 (recast).
Regional Development Responsibility29 Act (2010: 630).

regional spatial planning.

The county administrative boards are tasked with leading and coordinating the regional implementation of energy and climate policy by, inter alia, developing regional energy planning and promoting climate action. This includes, inter alia, offering support to and fostering synergies between municipalities and other local and regional actors in energy planning and climate action. Within the planning process, the County Administrative Board is responsible for advising the municipality, coordinating and representing the State's interests and providing planning documents. The county administrative boards play an important role in coordinating state authorities' actions within the authority's remit and in promoting cooperation between actors at different levels of administration within their activities.

1.3 Consultation and involvement of national bodies; Union bodies and the results thereof

1.3.1 Involvement of the national parliament

Sweden's integrated energy and climate plan is based on regulations, targets and instruments adopted by the Riksdag and the Government.

[31] Government, *Engagement to develop regional and local energy planning,* https://www.regeringen.se/contentassets/61e90a90955d4bf88e61e4875a7b442f/kn2023-03646.pdf (2023).

1.3.1.1 Legislative process

Proposals for new legislation may be prepared by a public government inquiry, by an authority or within the Government Offices. Public state investigations submit proposals for law/legislative amendments to the Government in reports which are normally sent for consultation to the relevant authorities, organisations, municipalities and other stakeholders who may submit comments. Even those who have not received the referral have the right to submit comments.
The comments will then be part of the preparation file for further work by the Swedish Government Offices on the matter. Legislative proposals are then drawn up in the form of a referral to the Council on Legislation. This is submitted to the Council on Legislation, which examines the Government's proposals.

The Government then processes the proposal and then submits it as a bill to the Riksdag. A proposal may also come from one or more individual members of Parliament.

One or more committees of the Riksdag may comment on the proposal (committee report).

The Riksdag votes on the proposal. If a majority in the Riksdag votes in favour of the proposal, the new legislation is issued in the Swedish Code of Statutes (SFS).

1.3.1.2 Referral

Allowing authorities, organisations and others to express their views on government matters has long been an important element of the Swedish policy-making process. Obtaining such opinions is a means of meeting the preparation requirement laid down in Chapter 7, Section 2 of the Instrument of Government: 'When preparing government cases, the necessary information and opinions shall be obtained from the relevant authorities. Information and opinions shall also be obtained from local authorities as necessary. Associations and individuals shall also, to the extent necessary, be given the opportunity to express their views.'

By providing public authorities, organisations and others with proposals, proposals can be comprehensively highlighted and their implications clarified. This increases the quality of the work of the Government and the Riksdag, to the benefit of democracy, the rule of law and efficiency. A referral is normally made so that the Government Offices send the proposal in the form of a report or a memorandum for an opinion to the recipient (the consultation body), together with a list of all the bodies consulted. As a rule, the proposal is also available on the Government's website. The referral may be limited to a specific part of the report or memo. The person who receives such a referral may:

of course, comment also on the other elements. The intention of limiting the referral is to facilitate the work of the consultation body. Conversely, of course, a referral body can always adequately limit its opinion.

Authorities under the Government are obliged to respond to referrals. However, an authority decides under its own responsibility whether it has any observations to make. If the authority does not have any comments on the proposals or considers that it is not concerned by them, it is sufficient to inform it accordingly.

For other bodies, such as municipalities, organisations and businesses, the consultation is a call for evidence. It is of course important that all those who can contribute their views also do so to ensure that the basis for the Government's and the Riksdag's positions is as comprehensive as possible.

It is not only the consultation bodies to which the Government Offices sent the proposal for an opinion that can comment on the proposal.

The opportunity to comment on a proposal is always open to anyone who has comments on it.

1.3.2 Involvement of local and regional authorities

Local and regional authorities are involved in the same way as other stakeholders.

1.3.3 Consultations with stakeholders, including the social partners, and engagement of civil society and the general public

To ensure that the draft updated NECP was made available to the public, it was published on the websites of the Government and Energy Agency.30 In autumn 2023, stakeholders had the opportunity to comment on the draft sent to the European Commission in summer 2023 via the Swedish Energy Agency's website. The Swedish Energy Agency informed on its website that input was requested for the national energy and climate plan (NECP) by 24 November 2023. Through the Energy Agency's subscription service, the same information was sent to all subscribers of the Energy Agency's news. Comments were to be submitted in writing to the e-mail address set up for that purpose. Seven written inputs were received from various organisations and individuals.

In order to make the final updated national energy and climate plan available to the Swedish Government Offices on 17 April 2024, this was published on the Swedish Energy Agency's website.31 32

The Swedish Energy Agency, in cooperation with the Government Offices, organised a hearing on 7 May 2024 at which stakeholders were given the opportunity to comment on the updated draft. The invitation was closed on 22 April to a hundred trade associations and associations, together with a call for written input by 13 May to the email address established for that purpose. The hearing was attended by around 25 interest and industry associations and representatives from the Swedish Energy Agency, the Environmental Protection Agency and the Ministry of Climate and Enterprise. Thirteen written inputs were received from various organisations and private individuals.

A summary of the overall views can be found in *the Summary of* **National Consultations**.

The politically decided objectives and instruments described in the present plan have been subject to the standard consultation procedure, which gives interested parties and the public the opportunity to comment. The Prime Minister's memorandum entitled 'Reply for consultation – On referrals of reports and other proposals from the Government Offices' (SB memo 2021: 1) describes how and why referrals are sent and how the responses to the

30 Government Offices, *Draft updated National Energy and Climate Plan for Sweden, https://www.regeringen.se/artiklar/2023/09/utkast-pa-uppdaterad-nationell-energi--och-klimatplan-for-sverige/* (2023) and Energy Agency, *Please provide comments: Draft updated National Energy and Climate Plan,* https://www.energimyndigheten.se/nyhetsarkiv/2023/utkast-pa-uppdaterad-nationell-energi--och-klimatplan-- oppet-for-synpunk/ (2023).
31 Swedish Energy Agency, *RemisResponse and Mission*, https://www.energimyndigheten.se/remissvar-och-uppdrag/ (2024).

consultation are technically dealt with in the further preparatory work.

The following are descriptions of consultations for selected processes where civil society and the general public have been given the opportunity to comment on key objectives, policies and measures.

1.3.3.1 Government Climate Action Plan

As described in section 1.2.1, the government presented a new climate policy action plan in December 2023. Ahead of this, the government tasked the three authorities Tillväxtanalys, Transport Analysis and the Uppsala County Administrative Board to produce evidence with analyses and proposals for policies and other measures for the climate transition of the business sector, the climate transition of transport and local and regional climate transition. The tasks have been carried out in cooperation with a number of authorities, including the Environmental Protection Agency, the Energy Agency and the Transport Administration. In addition, the Environmental Protection Agency has been tasked with preparing a document for the climate action plan.

The documents have been sent for consultation to a total of about 100 different actors in the public, private and non-profit sectors. The documents have been publicly available on the websites of the Government and the authorities and it has been possible for stakeholders outside the consultation list, as well as the general public, to respond to the consultation. All responses to the consultation are publicly available.[35, 36, 37]

An inquiry was set up in June 2023 to analyse Swedish climate policy based on the Fit for 55 and to provide an analytical basis for the Government's climate action plan. The mission was given to Professor John Hassler, who presented in October 2023 46 proposals for the climate transition in light of Fit for 55.33

In addition to the above documents, as part of the preparation of the climate action plan, the Government has invited both sectoral business roundtables and a national climate meeting with, inter alia, Swedish companies and trade unions, researchers, the public sector.

In addition, the Environmental Protection Agency has been tasked, in accordance with the Climate Act, to prepare a basis for the Government's climate policy action plan and a

[35] Government, *Remiss on Disclosing the evidence on the industrial climate change position for the upcoming Climate*

33 HASSLER, John. *Sweden's climate strategy 46 proposals for the climate transition in light* of Fit for 55.

Policy HYPERLINK "https://www.regeringen.se/remisser/2022/12/remiss-om-redovisning-av-underlaget-om-naringslivets-klimatsomstallning-infor-den-kommande-klimatpolitiska-handlingsplanen/"Action Plan, https://www.regeringen.se/remisser/2022/12/remiss-om-redovisning-av-.

[36] Government, Remiss *Transport Analysis Report 2022: 14 – Proposal leading to the climate transition of the transport sector,* https://www.regeringen.se/remisser/2022/12/trafikanalys-rapport-202214--forslag-som- leder-to-transport sector-climate change/(2022).

[37] Government, Reflection *of the report on local and regional climate transition in view of the upcoming climate policy action plan, https://www.regeringen.se/remisser/2022/12/remiss-av-rapport-underlag-om-*local and regional climate-changement-commission-development-climate policy-action/(2022),basis for the Government's climate reporting. The mission was reported to the Government Offices on 13 April 2023.34

1.3.3.2 Government's National Strategy and Action Plan on Adaptation to Climate Change

In March 2024, the government presented a new national strategy and action plan on adaptation to climate change, see Chapter 3.1.3.2. In its work on the strategy, the Government has consulted the Sami Parliament in accordance with the Act on Consultation with the Sami people (2022: 66). The Act on Consultation on Issues concerning the Sami People, which entered into force in 2022, aims to ensure the right of Sami people to participate in decision-making processes at all levels of society and to empower Sami in matters that specifically affect them.

1.3.3.3 Government energy policy bill

In March 2024, the government presented the Energy Policy Orientation Bill, see Chapter 1.2.1. As part of the process, the Ministry of Climate and Enterprise organised several roundtables with representatives from the energy industry, industry, relevant energy authorities, Västra Götaland County Administrative Board and Malmö Municipality. A memo proposing the two new energy policy objectives was circulated to a wide range including the energy industry, industry, academy, public authorities, environmental organisations and regional and local representatives. The political leadership also conducted talks with all parliamentary parties with a view to the preparation of the Bill.

1.3.4 Consultation with other Member States

The Ministry of Climate and Enterprise has discussed the design of the updated NECP with the other Nordic Member States and an in-depth discussion has taken place with Finland. Discussions have included the recently revised legislation and how it is addressed in the updated NECPs, the management of the European Commission's draft recommendations, and the process for the development of the plan in the broader sense. The discussion has also touched on the dimensions of security of energy supply and the internal electricity market. See also section 1.4.

The[34] Environmental Protection Agency. *Supporting documents for the Government's upcoming climate action plan and climate report,* https://www.naturvardsverket.se/4acd42/contentassets/4c414b0778e9409fb2836fc4d3dc6259/underlag - to the Government – Commission Climate Action Plan and Climate Accounting –2023-04-13.pdf (2023).

1.3.5 Iterative process with the Commission

Sweden has participated in the meetings of the technical working group set up by the European Commission to support Member States in preparing an update of their integrated energy and climate plans. There has also been a meeting between the Ministry of Climate and Enterprise and the European Commission to discuss the recommendations issued by the Commission to Sweden's draft updated National Energy and Climate Plan. Of the European Commission's 23 recommendations in total, several concern for clearer plans and indications as regards Sweden's implementation of the recently revised Renewables Directive.

1.4 Regional cooperation in preparing the plan

1.4.1 Elements subject to joint or coordinated planning with other Member States

The Nordic Ministers adopted a vision for the Nordic Council of Ministers on 20 August 2019. To make the vision a reality, three strategic areas were prioritised within the work of the Nordic Council of Ministers over the next four years: a green Nordic, a competitive Nordic and a socially sustainable Nordic.

In the Green Nordic Strategy Area, a number of activities are ongoing, aiming at joint or coordinated planning, which can contribute to the preparation and fulfilment of the Nordic countries' integrated energy and climate plans.

To improve the conditions for reaching the 2030 targets, a Nordic Energy Policy Cooperation Programme 24-2022 has been developed which includes a range of themes such as renewable energy (with a focus on research and analysis), electrification of different sectors, system integration and interconnectivity of different sectors, cooperation on offshore wind, closer cooperation on hydrogen strategies and carbon capture, utilisation and storage (CCUS).

Ministers responsible for energy meet regularly in the framework of the North Sea Energy Cooperation (NSEC), which aims to promote regional cooperation on offshore renewable energy. In 2023, the NSEC consisted of Belgium, Denmark, France, Germany, Ireland, Luxembourg, the Netherlands;

Norway and Sweden, with the participation of the European Commission. See **North Sea Energy Cooperation**– *regional cooperation on offshore* **renewable energy** for an in-depth description of the cooperation.

Another regional cooperation is the Baltic Energy Market Interconnection Plan (BEMIP) created by a Memorandum of Understanding between the European Commission and eight Member States (Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland and Sweden) and Norway (as observer). The objective of cooperation is to interconnect the gas

and electricity markets of the countries. In 2020, a dedicated group was created to develop cooperation in offshore wind in the Baltic Sea.

1.4.2 Information on how regional cooperation is taken into account in the plan

Cooperation between the Nordic countries on energy and climate issues has been beneficial for the work of many parts of the plan. The interconnected Nordic electricity market is reflected in the scenarios used in the present plan.

NATIONAL OBJECTIVES AND TARGETS

2.1 GHG emission reduction dimension

2.1.1 GHG emissions and removals

2.1.1.1 The information referred to in Article 4(a) (1)

Member State's binding national greenhouse gas emission targets and annual binding national limit values under Regulation (EU) 2018/842

The non-trading sector, consists of emission sectors that are not included in the EU Emissions Trading System (EU ETS) or the Land Use, Land Use Change and Forestry (LULUCF) Regulation. Examples of sectors that are not part of the EU ETS or LULUCF are heating of dwellings and premises, agriculture and domestic transport (excluding domestic aviation). Each Member State has a national bait under the EU Effort Sharing Regulation, also known as the ESR. Sweden's contribution under effort-sharing is to reduce these emissions by 50 % in 2030 compared to emissions in 2005.

Responsibility for emission reductions under the ESR implies not only a commitment for the year 2030 but also an annual commitment for the years 2021 to 2030. The allocated allowance for the years 2021 to 2025 has already been determined40 41 and in 2025 allocation for the rest of the period shall be determined.

In order to reach the commitments, some flexibilities can also be applied, such as the transfer of emission units between years and between Member States, from the ETS, as well as between the ESRB and LULUCF Regulation. Sweden and some other Member States have the possibility to make limited use of EU ETS emission allowances to reach the ESR commitment. Sweden has notified the European Commission of the intention to use this flexibility, giving the possibility of using EU ETS allowances equivalent to 0.87 million tonnes per year in 2025-2030.

Member State's commitments and national targets for net greenhouse gas removals pursuant to Article 4(1) and (4.2) of Regulation (EU) 2018/841

In 2023, the EU has decided on a revised LULUCF Regulation.[41]. The revision is part of achieving the objectives of the EU Climate Law.42 43The revised Regulation covers two commitment periods, 2021-2025 and 2026-2030. The revised LULUCF Regulation maintains

40Commission Implementing Decision (EU) 2023/1 31 9 of 28 June 2023 amending Implementing Decision (EU) 2020/2126 to revise Member States' annual emission allocations for the period from 2023 to 2030.

Council Regulation (EU) 2021/111 of the European42 Parliament and of the Council of 30 June 2021 establishing a framework for: achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 20 1 8/1 999 ('European Climate Law').

the approach for the first commitment period 2025-2021 decided in 2018.

The starting point for the first commitment period of the LULUCF Regulation is that each Member State undertakes to ensure that the LULUCF sector does not result in accounted emission reductions or increases in emissions, known as 'no-debit' targets. The starting point for the land use category forestry is the period 2000-2009. The revised LULUCF Regulation means that all Member States have a commitment to reduce net emissions or increase net removals by 2 030 in order for the EU to increase net removals at an aggregated level to 310 million tonnes of carbon dioxide equivalent. Sweden has a commitment to increase net removals by almost 4 million tonnes of carbon dioxide equivalent by 2018 compared to the average of the reference period 2030-2016. In addition to the commitment for the year 2030, during the period from 2026 to 2029, Member States shall have annual net removals within a collection budget. The trajectory for the period 2029-2026 shall be set in 2025.

In order to reach the targets in the LULUCF sector, different flexibilities may be used. In the period 2021-2025, provided that the LULUCF sector in the EU as a whole reaches its "no-debit" target, Sweden may, if necessary, use *flexibility for managed forest land* under Article 13. In addition, Sweden may, under certain conditions, exclude emissions related to natural disturbances under Article 10.

In the period 2026-2030, provided that the LULUCF sector in the EU as a whole reaches its target, Sweden may, where appropriate, use the *land use mechanism for the period* 2026-2030, Article 13(b). If necessary, Sweden may also use:

[41] European Parliament and Council Regulation (EU) 2018/841 of 30 May 201 8 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision 529/2013/EU.

Article 13(b) (6) for additional compensation as the proportion of organogenic soils[43] in Sweden is exceptionally high compared to the Union average.

In addition to these flexibilities, there are also possibilities for transfer between the LULUCF Regulation and the ESF Regulation, as well as to acquire emission allowances from other Member States.

Section 3.1.1.1 sets out which specific measures have been planned or put in place to ensure the conservation or enhancement of land-based carbon sinks and reservoirs, as well as to reduce the vulnerability of land to natural disturbances. Sweden intends to make use of all available flexibilities if necessary.

Where applicable to meet the objectives and targets of the Energy Union and the long-term Union greenhouse gas emissions commitments consistent with the Paris

Agreement, other objectives and targets, including sector targets and adaptation goals.

Milestones for the transition to a circular economy

Sweden has decided on a number of milestones in the environmental targets system which, if measures and policies are put in place to achieve them, can contribute to the transition to a circular economy and reduce climate emissions.

- The proportion of reusable packaging placed on the market in Sweden for the first time shall increase by at least 20 % from 2022 to 2026 and by at least 30 % from 2022 to 2030. No specific policies or measures are in place except for activities to offer reusable food boxes and cups.

- Food waste shall be reduced so that overall food waste is reduced by at least 20 % by weight per capita from 2020 to 2025. No specific instruments are in place, but Sweden has a national action plan to reduce food waste, which has been developed in cooperation between the National Food Agency, the Swedish Board of Agriculture and the Environmental Protection Agency.44 45

[43] contains organic material, i.e. material that was originally alive. They are formed where more organic residues accumulate than can decompose. In particular, organogenic soils are formed in wet environments.

- By 2025, the preparing for re-use and recycling of municipal waste shall increase to at least 55 % by weight, 2030 to at least 60 % by weight and 2035 to at least 65 % by weight. The sorting requirements in Chapter 3 of the Waste Ordinance are intended to contribute to this intermediate objective.

- Preparation for re-use, recycling and other recovery of non-hazardous construction and demolition waste, excluding soil and stone, shall be at least 70 % by weight annually by 2025.[45 the sorting requirement] for construction and demolition waste aims to contribute to the intermediate target.

Air care policy

Sweden's emission reduction commitments to be achieved by 2020 and 2030 come from the Directive on the reduction of national emissions of certain atmospheric pollutants, also known as the "ceiling directive"46, which regulates emissions of sulphur dioxide (SO2), nitrogen oxides (NOx), volatile organic compounds excluding methane (NMVOC), particulate matter

44 NFA, *National Action Plan to reduce food waste in Sweden,* https://www.livsmedelsverket.se/foretagande-regler-kontroll/regler-for-livsmedelsforetag/matsvinn-requests/reports and publications (2023).

Directive (EU) 2016/2284 of the46 European Parliament and of the Council of 14 December 2016 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC.

(PM2,5) and ammonia (NH3). There is also a so-called indicative target for 2025 where emissions are to decrease linearly between 2020 and 2030. Sweden's commitments for 2020 and 2 030 are shown in Table 2 and Table 3.

Table 2 Sweden's commitment under the Cap Directive for 2020 and 2030 as a percentage with 2005 as its base year.

Air Pollution	Decrease to 2020 [%]	Decrease to 2030 [%]
NOx	36	66
SO2	22	22
NMVOC	25	36
NH3	15	17
PM2,5	19	19

[45] Government, *Circular Economy – Action Plan for the Transformation of Sweden*, https://www.regeringen.se/contentassets/4875dd887fd34edabd8c1d928a04f7ba/cirkular-ekonomi- ActionPlan for Omstallning-av-sverige.pdf (2021).

Table 3 shows a comparison between the emission commitment of the cap directive and statistics as well as the latest projected scenarios (reported in 2023) for future emissions of air pollutants.47 48

Table 3 Statistics and projected emissions in kton for years with a commitment or target, how much emissions should/should be by commitment/target and the respective gap.[48]

	NOx (kton)	SO_2 (kton)	NMVOC (kton)	NH_3 (kton)	PM2,5 (kton)
Statistics 2020	102,6	14,6	109,1	52,0	16,9
Commitment 2020	116,0	26,8	129,3	48,8	25,4
Gap 2020	—	—	—	3,2	—
Scenario 2025	87,1	14,4	99,9	50,8	15,2
Objective 2025	88,8	26,8	119,8	48,2	25,4
Gap 2025	—	—	—	2,6	—
Scenario 2030	71,6	13,9	93,9	48,4	14,0
Commitment 2030	61,6	26,8	110,3	47,6	25,4
Gap 2030	10,0	—	—	0,7	—

For the indicative target for 2025, Sweden exceeds ammonia emissions by 2,6 kton, and by 2030 the commitment will be exceeded by around 0,7 kton according to the gap analysis. By 2025 and 2030, ammonia emissions need to decrease by around 5 % and 1.5 % compared to projected emissions in the 2025 and 2030 scenarios in order to meet the indicative target and the commitment. For NOx, the situation has improved compared to the first air pollution control programme.49 According to the latest scenario, Sweden is now expected to meet the indicative target by 2025. However, the scenario indicates that Sweden does not reach the commitment by 2030 under the current governance. NOx emissions need to be further reduced by about 10 kton by 2030, corresponding to an emission reduction of around 14 % compared to projected emissions in the 2030 scenario.

2.1.2 renewable energy

2.1.2.1 The information referred to in Article 4(a) (2);

In order to achieve the Union's binding target of at least 42.5 % renewable energy in 2030 as

47 European Environment Agency, *National Emission reduction Commitments Directive (NECD (EU) 2016/2284)*, https://cdr.eionet.europa.eu/se/eu/nec_revised/ (2024).
The48 inventory was reported on 9 February 2023 and the scenarios of 4 March 2023.
The49 Swedish Environmental Protection Agency, *National Air Pollution Control Programme;* https://www.naturvardsverket.se/4ac1 AA/contentassets/7caf92437f0f4e828cd2ee35f91254b1/regeringsbeslut – National Aircraft Programme.pdf (2019).

set out in Article 3 of the revised Renewable Energy Directive, each Member State shall contribute to that target in terms of its share of energy from renewable sources in gross final consumption of energy in 2030, with an indicative trajectory for that contribution from 2021 onwards. Member States shall also aim to further increase the share for the Union to collectively achieve 45 % renewable energy by 2030.

By 2022, the indicative trajectory shall reach a reference point of at least 18 % of the total increase in the share of energy from renewable sources, expressed as the difference between the Member State's binding 2020 national target and its contribution to the 2030 target. By 2025, the indicative trajectory shall reach a reference point of at least 43 % of the total increase in the share of energy from renewable sources and a reference point of at least 65 % by 2027. By 2030, the Member State shall reach or exceed the planned contribution. In addition, each Member State is free to set higher ambitions for national policy purposes.

Sweden does not have a national target for the share of renewable energy by 2030. In Sweden's previous integrated energy and climate plan submitted to the European Commission in 2019, the Swedish Energy Agency's long-term scenarios from 2018 were used as the basis for a national contribution to the Union's common 2030 target.50 The Swedish Energy Agency's reference scenario with recommended conditions from the EU then pointed to a share of renewable energy in relation to gross energy consumption of 65 % in 2030 using the calculation method at that time.

The Swedish Energy Agency's latest scenario analysis from 2023 used for this plan achieves a 67 % share of renewable energy in 2 030 in the Bassscenario.51 Table 4 presents the reference points in the trajectory for different years.

Table 4 Sweden's indicative trajectory for the share of renewable energy in gross final consumption for 2022, 2025 and 2027 based on results in the baseline scenario with assumptions from the Governance Regulation,%.

	Baseline scenario (%)
Objective 2020	**49**
18 % of Objective 2022	*52*
43 % of Objective 2025	*57*
65 % of Objective 2027	*61*
Contribution 2030	**67**

The Swedish Energy Agency has also made a case of sensitivity which shows similar results. Assumptions for the baseline scenario and sensitivity cases are further described in section 4.1.

50Swedish Energy Agency, *Scenarios on Sweden's Energy System 2018*, *ER 2019: 7*.
51Swedish Energy Agency, *Updated long-term scenarios 2023,* 2023.

In addition to renewable electricity production, a large proportion of fossil-free electricity is produced in the nuclear power plants in Sweden. Fossil free nuclear electricity production is estimated at 52 TWh in 2030. This means that the share of fossil-free energy (nuclear and renewable energy combined) amounts to 78 %. It is in line with the share of fossil-free renewable energy that Sweden would contribute under the Governance Regulation.

Section 4.2.2.2 presents the scenario for the renewable component by 2030 looking at 2040.

2.1.2.2 Estimated trajectories for the sectoral share of renewable energy in final energy consumption from 2021 to 2 030 in the electricity, heating and cooling and transport sector

Results in the latest scenario are described in detail in Section 4.2.2 including trajectories for renewable shares in the electricity, heating and cooling sectors and for transport including trajectories for the new renewable targets in industry, hydrogen in industry, buildings, district heating/cooling, emission reduction, and share of advanced biofuels and renewable liquid and gaseous transport fuels of non-biological origin (RFNBO)52 in the transport sector, as well as the target for RFNBO in maritime transport.

2.1.2.3 Estimated trajectories per renewable energy technology that the Member State expects to use to achieve the overall and sectoral renewable energy trajectories in the period 2030-2021, including the expected total gross final energy consumption per sector in Mtoe and total planned installed capacity in MW (broken down by new capacity and repowering) per technology and sector

Sweden has no quantified targets for specific renewable energy technologies. The future development of profitability and competition between different renewable energy technologies is driven by market developments. The results in the underlying baseline scenario are presented below.

In the baseline scenario of December 2023, an estimated distribution of renewable energy by technology and energy use, in total and by sector, has been developed for 2030. A case of sensitivity for the transport sector has also been developed and is presented in text. This breakdown is presented in section 4.2.2.

The expected total gross final energy consumption53 increases in this scenario – from 34,0 Mtoe in 2020 to 38,9 Mtoe in 2030. In the heating and cooling sector, energy consumption increases from 15,7 Mtoe in 2020 to 16,8 Mtoe in 2030. In the transport sector, energy consumption (excluding double counting) decreases slightly from 6,5 Mtoe in 2020 to 6,4 Mtoe in 2030. In the electricity sector, electricity consumption increases from 11,9 Mtoe in

Renewable52 Fuels of Non-Biological Origin – Renewable liquid and gaseous transport fuels of non-biological origin.
The53 denominator in the calculation of the share of renewable energy.

2020 to almost 17,8 Mtoe in 2030.

The total installed electricity generation capacity increases from 41 GW in 2020 to 67 GW in 2 030 in the scenario, as shown in Figure 1 Installed capacity per power type in the Energy Agency's scenario, 2020-2030, GW. The installed capacity of wind power, which according to the scenario is most likely to grow by 14 GW between 2020 and 2030, as can be seen from Figure 1. Solar power increases in the scenario over the same period by just under 8 GW. The scenario model lacks information on how the additional capacity will be allocated to new plants and upgrades of existing ones.

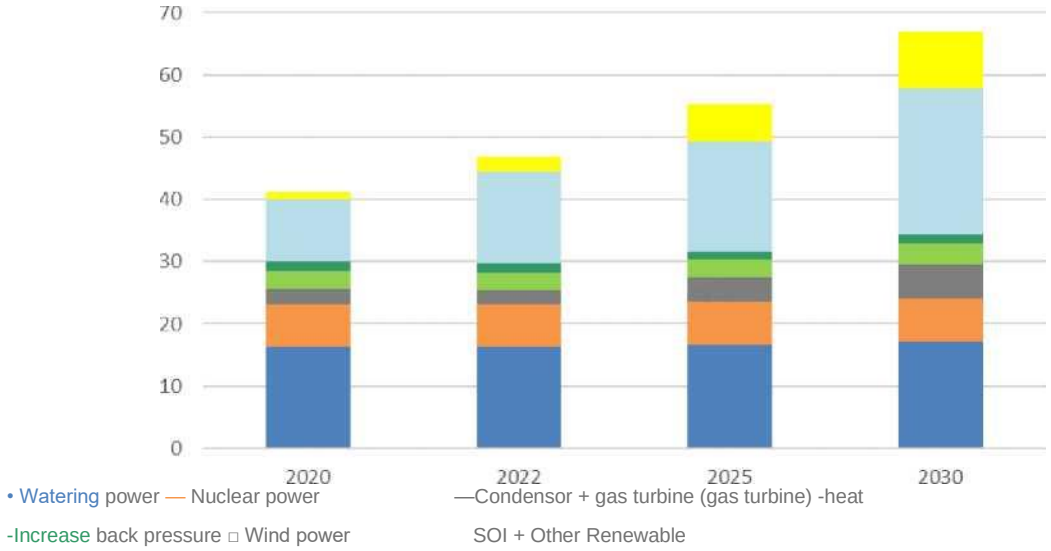


Figure 1 Installed capacity per power type in the Energy Agency's scenario, 2020-2030, GW.
Source: The Swedish Energy Agency.
Note: The model results assume normal operation, which means that the need for reserve power is likely to be underestimated.

2.1.2.4 Estimated trajectories on bioenergy demand, disaggregated between heat, electricity and transport, and on biomass supply by feedstocks and origin (distinguishing between domestic production and imports). In the case of forest biomass, an assessment of its origin and impact on the LULUCF sink

In the Energy Agency's baseline scenario, the total use of bioenergy decreases by 22.5 TWh between 2022 and 2025 and is estimated to be just over 133 TWh in 2025. The use of bioenergy is estimated to remain relatively stable in 2030, reaching just over 134 TWh. The total use of bioenergy is expected to remain at a similar level after 2030, reaching just over 133 TWh in 2040, as shown in Figure 2 below.

In the heating and cooling sector, the use of bioenergy decreases by just over 9.5 TWh between 2022 and 2025, before decreasing by a further 2 TWh, to just over 106 TWh in

2030. The reduction takes place both in the category of solid biofuels, declines54 and bioliquids.

In the transport sector, the use of bioenergy is reduced, mainly in the bioliquids category by just over 10.5 TWh between 2022 and 2025. The use of bioliquids is expected to decrease by:

a further 1.5 TWh by 2030 and then further decrease by just over
3 TWh by 2040. The decrease is mainly due to a decrease in the use of hydrogenated vegetable oil (HVO) (around 13 TWh), which is currently primarily produced from waste and residues.[55] Total use of bioenergy in the transport sector is expected to decrease by just over 4 TWh between 2040-2030, due to expected increased electrification of the transport sector that reduces overall fuel demand.55

In the electricity sector, only a marginal increase in bioenergy consumption is expected by 1 TWh between 2022 and 2040.

Currently there are imports into Sweden of biomass feedstock for all three user sectors, in particular biofuels for the transport sector. Section 3.1.2.7 provides more information on biomass production and imports.

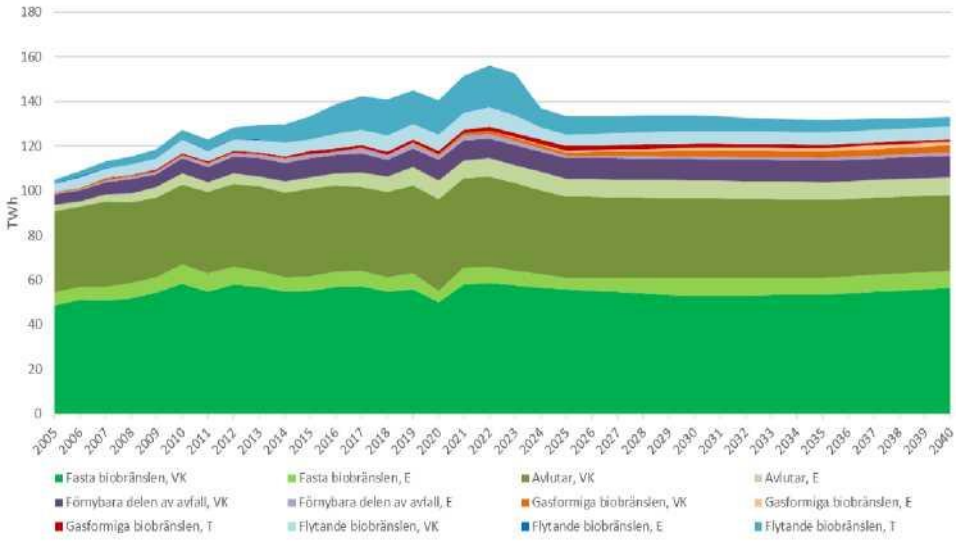


Figure 2 Use of bioenergy in the heating and cooling, electricity and transport sectors by type of biomass between 2040-2005 and assessment in the Energy Agency's 2040 scenario, TWh.
Source: The Swedish Energy Agency.
Note: T = Transport, E = El, and VK = Heat and cold.

Net removals in LULUCF are not expected to be significantly affected by developments in the use of biofuels.

54Sludges are a residue in the production of pulp.
The55 scenario only takes into account the levels decided so far for the reduction obligation.

Biofuel use in Sweden is largely made up of residual flows from the forestry industry used for the industry's own needs. For the rest:

[55] Swedish Energy Agency, *Drivmedels2022*, *ER 2023:* 19, https://energimyndigheten.a-w2m.se/FolderContents.mvc/Download?ResourceId=216291 (2023). Theuse of biofuels for district heating production is a large item. The use for biofuel production is low and the plans for increased production are based on the use of residual flows, but may lead to an increase in the extraction of branches and peaks. Branches and peaks degrade within a relatively short period of time in nature56 and leaving more branches and peaks in forests instead of being used as biofuels, the carbon pool "litter" would increase, but to a small extent. The opposite is true of increased exploitation of branches and peaks. Both the government and industry seek to increase the degree of value added and innovation in the bioeconomy, for example by promoting construction in wood. The amount of damaged wood of insufficient quality for industrial further processing is counteracted by forestry interventions, see section on Governance and measures to reduce forest vulnerability. See more on biomass supply and its use in Section 3.1.2.7.

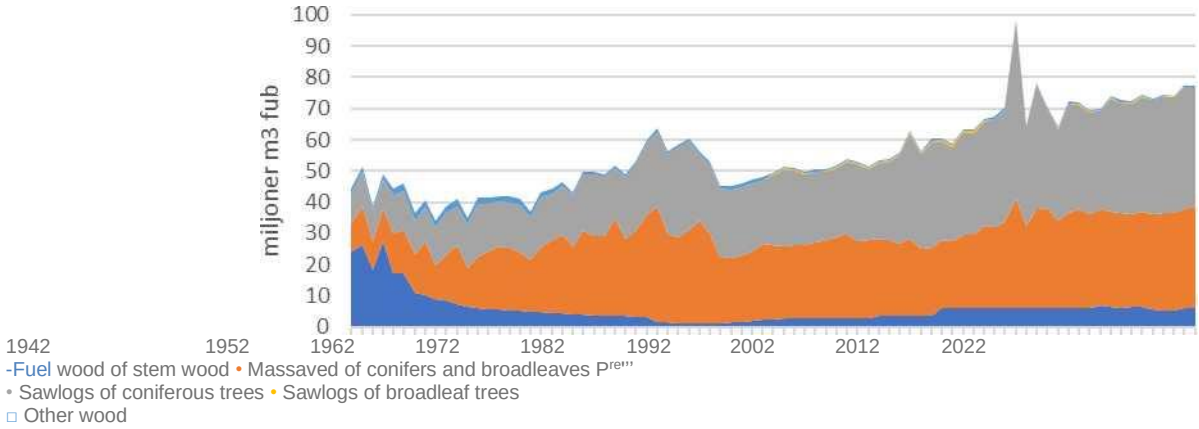


Figure 3. Proportion of net felling broken down by assortment.

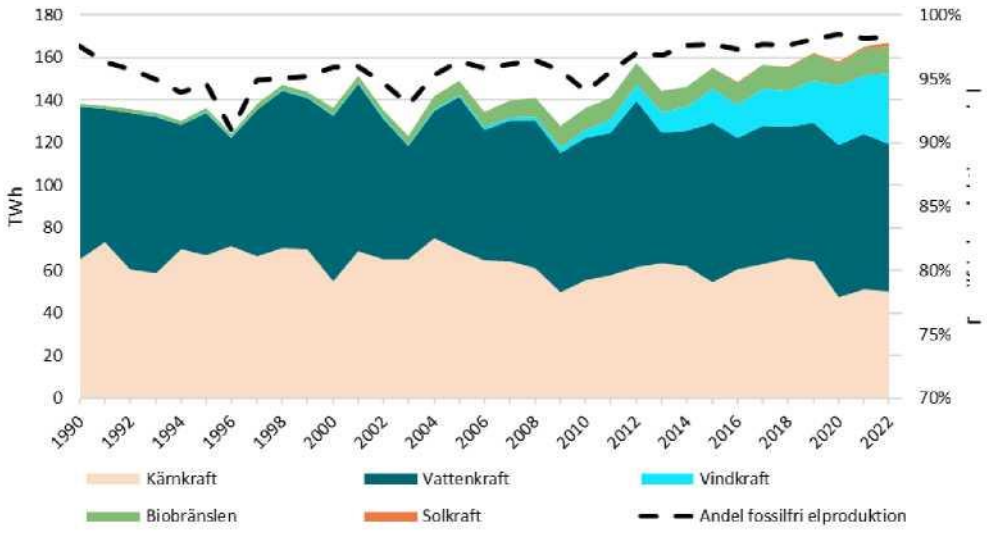
2.1.2.5 where applicable, other national trajectories and targets, including long-term and sector-specific trajectories and targets (e.g. share of renewable energy in district heating, renewable energy use in buildings, renewable energy produced by cities, renewable energy communities and renewable self-consumers, energy recovered from digestion sludge in the context of sewage treatment).

Sweden has a national energy policy target of 100 % fossil-free electricity generation by 2040. In 2 022.170 TWh of electricity was produced and the share of fossil-free was just over 98 %, see Figure 4. Electricity generation consists of:

41 % hydropower, 29 % nuclear, 19 % wind, 7 % biopower and just over 1 % solar power. Fossil fuel electricity generation was just under 3 TWh and represents 1.7 % of total

56See specified by species/region in Table 4: https://www.regeringen.se/contentassets/38eaf6f23f284fb0a440b0742fe7bcf7/national-forestry-accounting- plan-for-sweden/

electricity production in 2022. Fossil fuels mainly consist of the fossil component of waste,



as well as small amounts of peat, coal including waste gases from steel production, oil products and, finally, natural gas.

2.2 Dimension energy efficiency

Fossil-free electricity

2.2.1 The information referred to in Article 4(b);

2.2.1.1 The indicative national energy efficiency contribution to achieve the Union's energy efficiency target of at least 32.5 % in 2030 referred to in Articles 1.1 and 3.5 of Directive 2012/27/EU, based on either primary or final energy consumption, primary or final energy savings, or energy intensity

Figure 4 Fossil-free electricity generation, TWh (left axis) and share of fossil-free electricity generation (not normally corrected) in relation to total electricity generation 2022-1990,%.
Source: Swedish Energy Agency, Calculation of Annual Energy Balances.

Indicative national energy efficiency contribution

In September 2023, the EU adopted a revised Energy Efficiency Directive. The recast

directive increases the ambition of the EU's 2030 energy efficiency target. The target is expressed as a fixed cap for EU energy consumption by 2030 and amounts to 763 Mtoe for final energy consumption and 992,5 Mtoe for primary (input) energy, which is 11.7 % lower than the 2030 EU reference scenario for energy consumption developed in 2020. For final consumption, the target is binding at Union level while it is indicative for primary energy.

Sweden's indicative national contribution to the Union target, notified to the European Commission in early February 2024, amounts to 350 TWh for final energy consumption. The contribution is based on the formula set out in Annex 1 to the Directive, but is based on the Energy Agency's long-term scenarios (see description of assumptions for the scenario in section 4.1) instead of the EU reference scenario in order to take into account the national circumstances mentioned in Article 4 (3) (e) of the Directive.

Sweden's assessment is that the EU baseline underestimates the likely final energy consumption by 2030 by just under 70 TWh, which has a major impact on the final result when calculating the contribution using the formula in Annex I. This scenario does not take into account the need to increase energy consumption to enable electrification and climate transition in Sweden's industrial sector.

Table 5 shows energy consumption in 2022 according to statistics (Eurostat) and 2030 corresponding to the indicative national contribution communicated by Sweden for 2030, as well as a linear trajectory between these years. Figures are provided for both final and primary (input) energy.

Table 5 National indicative contribution [TWh] for final and primary energy based on Long-term scenarios (Bass scenario). Statistics for 2022 and linear evolution to estimated data for the 2030 grant.

	FEC (final)	PEC (primary)
	Contributions based on Long-term scenarios	**Contributions based on Long-term scenarios**
2022	360	494
2023	359	492
2024	358	490
2025	356	488
2026	355	486
2027	354	484
2028	353	482
2029	351	480
2030	350	479

The European Commission announced in March 2024 a corrected indicative national contribution for Sweden amounting to 296 TWh. However, Sweden estimates that the European Commission's corrected national contributions are based on a baseline scenario that does not fully include current assessments of the increasing electricity consumption in

Sweden, resulting from the ongoing climate transition and decarbonisation. According to Article 4 (2) and recital 13, Member States shall take into account national circumstances such as the energy needs of the industry. In addition, one of the overarching objectives of the Directive is to contribute to the security of energy supply in the Union by reducing dependence on imported energy, including fossil fuels.

Table 6 shows energy consumption in 2022 on the basis of statistics (Eurostat) and 2030 corresponding to the estimated contribution according to the European Commission's corrected data, as well as a linear trend between these years. Figures are provided for both final and primary (input) energy. The correction by the European Commission refers only to final energy. It is not clear from the Directive how this affects the contribution expressed in primary energy. The contribution expressed in primary energy is therefore presented below, both according to the Commission's initial calculations and with a percentage correction corresponding to the correction made for final energy.

Table 6 National indicative contribution [TWh] for final and primary energy based on Commission data. Statistics for 2022 and linear evolution to estimated data for the 2030 grant.

	FEC (final)	**PEC (primary)**	**PEC (primary)**
	Contributions based on corrected data	**Contribution based on EU Commission calculations**	**Contribution based on EU Commission calculations + correction**
2022	360	494	494
2023	352	484	484
2024	344	473	475
2025	336	463	465
2026	328	453	455
2027	320	443	446
2028	312	432	436
2029	304	422	427
2030	296	412	417

In their national energy efficiency contributions, Member States shall indicate the shares of primary and final energy consumption of end-use sectors, as defined in the Statistical Regulation57, including industry, households, services and transport. Member States shall also provide forecasts of energy consumption in the information and communication technology (ICT) sector.

Table 7 shows the percentage breakdown between sectors of final energy consumption for 2022 according to statistics58 and for 2030 according to the Swedish Energy Agency's long-term scenarios. Without developing a target-based scenario, no conclusions can be drawn on

57European Parliament and Council Regulation (EC) No 1099/2008 of 22 October 2008 on energy statistics.
58Annual energy balances and annual energy statistics (electricity, gas and district heating), Swedish Energy Agency.

the allocation of the contribution between sectors. However, the breakdown according to statistics for 2022 and in the long-term scenarios for 2030 can serve as an approximation.

Table 7 Final energy consumption in 2022 (statistics) and 2030 according to the Swedish Energy Agency's long-term scenarios, by sector [%]

	2022	2030
Industry	38 %	44 %
Households	23 %	20 %
Service activities, etc.	15 %	14 %
Transportation	24 %	21 %
ICT	1 %	1 %
Total final energy consumption	100 %	100 %

Sweden's national energy intensity target

Sweden has a national target of 50 % more efficient energy use by 2030 compared to 2005. The target is expressed as a cross-sectoral reduction target, i.e. the ratio between input (primary) energy and real GDP. Between 2005 and 2022, energy intensity has decreased by 38 %, see Figure 5, which shows outturn towards the target.

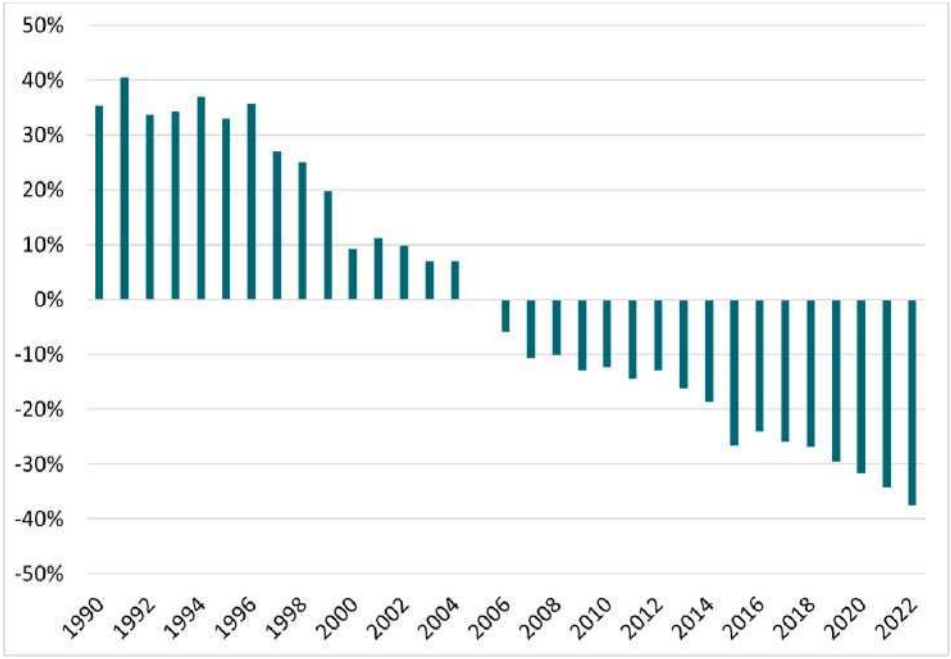


Figure 5 Normal year adjusted energy intensity relative to base year 2005 at constant prices, 1990-2021,%. Source: The Swedish Energy Agency.

In the Energy Agency's scenarios, the energy intensity of the baseline scenario (see Chapter 4) is reduced by 43 % by 2030 compared to 2005.59 The development of energy intensity depends, in addition to the development of GDP, on primary energy consumption, which in turn depends on renewable energy measures, energy efficiency measures, structural changes in industry, the share of nuclear power and general economic developments.

The Energy Policy Bill considers that Sweden's energy efficiency targets should be reviewed with a view to promoting more clearly the use of energy in socio-economic terms and the efficient use of the energy system that contributes to the green transition. The reason for the Government's assessment is that Sweden's current energy efficiency target is not adapted to the green transition of industry through electrification or to the target of 100 % fossil-free electricity production in 2040. National energy efficiency policies also need to be aligned with the EU directives that have recently been revised or are in the process of being revised.

2.2.1.2 The cumulative end-use energy savings to be achieved over the period 2030-2021 under Article 7(1)(b) on energy savings obligations under Directive 2012/27/EU

The revised Energy Efficiency Directive, which entered into force in 2023, requires Member States to achieve cumulative end-use energy savings for the entire obligation period 2030-2021 corresponding on average to 1.49 % of final energy consumption as an average of

59Scenarios are mainly in energy terms, not physical units, with base year statistics from the national energy balances (official statistics). The scenarios are made for both energy input and final consumption, so no conversion factors for, for example, electricity and district heating are needed in the calculations.

Member States' final energy consumption for the years 2016-2018. The savings requirement is gradually increasing over the period as follows:

- **0.8 %** for sub-period 2021-2023
- **1.3 %** for sub-period 2024-2025
- **1.5 %** for sub-period 2025-2027
- **1.9 %** for sub-period 2028-2030

Table 8 illustrates how the savings requirement for the savings requirements period 2030-2021 is calculated for Sweden based on Eurostat statistics on final energy consumption in Sweden for the years 2016-2018.60

Table 8 Calculation of the cumulative savings requirement for the period 2030-2021 based on average final energy consumption for Sweden for the years 2018-2016 (373 TWh), in TWh.

	Percent	TWh	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
2021	0.8 %	3	3	3	3	3	3	3	3	3	3	3
2022	0.8 %	3		3	3	3	3	3	3	3	3	3
2023	0.8 %	3			3	3	3	3	3	3	3	3
2024	1.3 %	4,9				4,9	4,9	4,9	4,9	4,9	4,9	4,9
2025	1.3 %	4,9					4,9	4,9	4,9	4,9	4,9	4,9
2026	1.5 %	5,6						5,6	5,6	5,6	5,6	5,6
2027	1.5 %	5,6							5,6	5,6	5,6	5,6
2028	1.9 %	7,1								7,1	7,1	7,1
2029	1.9 %	7,1									7,1	7,1
2030	1.9 %	7,1										7,1
Total year (TWh)			**3**	**6**	**9**	**13,9**	**18,8**	**24,4**	**30**	**37,1**	**44,2**	**51,3**
						Total Savings (TWh)						**237**

As shown in the table, this means that Sweden's total cumulative energy savings requirement for the period 2030-2021 amounts to 237 TWh.

2.2.1.3 The indicative milestones for a long-term renovation strategy for the national stock of residential and non-residential buildings, both public and private, together with the roadmap with nationally defined measurable progress indicators, an evidence-based estimate of expected energy savings and wider benefits, and the contribution to the Union's energy efficiency target under Directive 2012/27/EU in accordance with Article 2(a) of Directive 2010/31/EU

The recast Energy Performance of Buildings Directive replaces the national renovation strategy with a national building renovation plan, which aims to ensure that Member States reach the goal of a zero-emission building stock by 2050. This is a work that the Directive

60 Eurostat, *Simplified energy balances,* https://ec.europa.eu/eurostat/databrowser/view/nrg_bal_s/default/table?lang=en (2024).

requires to be reported as part of the NECP. The first building renovation plan shall be reported by 31 December 2026.

Sweden reported its long-term renovation strategy, including the indicative milestones, to the European Commission in 2020.61

The indicative milestones are:

1) Lower energy use in the building stock (kWh/m²) than at the immediately preceding milestones for 2030, 2040 and 2050.

2) Higher share of buildings with energy performance classes A-C and below

share of energy performance classes E-G for the years 2030, 2040 and 2050 than at the immediately preceding milestone with the 2020 rating.

3) Share of fossil fuels used in the building stock should not exceed 1 % in 2030 and 0 % in 2040 and 2050.

The progress indicators for paragraph 1) are:

a. Temperature-corrected energy consumption (kWh/m², year) for heating and hot water in single-family houses, multi-dwelling buildings and premises.

b. Use of electricity for buildings (kWh/m², year)

c. Specific energy consumption (kWh/m², year) for single-family houses, multi-dwelling buildings and premises

d. Share of buildings with direct-acting electricity

e. Energy consumption for heating and hot water in single-family houses, multi-dwelling buildings and premises (TWh)

The progress indicators for point 2) are the distribution of energy classes for single-family houses, residential buildings and premises at the respective milestone compared to 2020. For paragraph 3), the progress indicator is the share of fossil fuels in the building stock.

An estimate of expected energy savings has been made by Chalmers Industry Technology (CIT) through scenarios in the HEFTIG simulation programme. The reference scenarios show how energy consumption in the building can be developed, provided that existing or

61 Government, *Sweden's Third National Strategy for Energy Efficiency Renovation,* https://energy.ec.europa.eu/document/download/cb712599-aacc-4f55-9fe9-547556a8d7ed_en?filename=se_2020_ltrs.pdf (2020).

equivalent instruments continue to apply and that building owners work in the same way as today on energy efficiency improvements and renovation in their buildings. Reference scenarios have been developed for apartment buildings, schools and offices. Scenarios for other premises and single-family houses are missing.

Heat purchased, that is to say, purchased energy for heating and hot water including electricity for heat pumps but excluding real estate energy, is estimated to reduce by a total of 3 221 GWh between 2020 and 2 030 in multi-dwelling buildings, schools and offices in the renovation strategy. This represents a decrease of just over 9 % over the period. Under the same scenarios, electricity purchased, i.e. household electricity, real estate electricity and operational electricity, but excluding electricity for heat pumps, is estimated to be able to decrease by a total of 298 GWh between 2020 and 2 030 in multi-dwelling buildings, schools and offices. This represents a decrease of just under 2 % over the period.

In terms of wider benefits, the renovation strategy states that more ambitious energy-efficient renovations can lead to different types of side effects (positive as well as negative) in addition to the more direct effect in terms of reduced energy consumption and improved net operating capacity. These side effects are usually divided into economic, social or environmental impacts (see below). However, all these effects are translatable in terms of socio-economic added value or added costs. Positive side effects (added value) for the benefit of the occupants, but for which they do not have to pay (for example, increased area attractiveness not reflected in the rent) result in an increased consumer surplus for residents. There may also be side effects in terms of external effects, i.e. impacts which are not priced or internalised in current market prices, and which represent an increased benefit or cost for third parties, in this case society at large. Examples include improved health, reductions in social problems and reductions in crime in the areas concerned. As these effects result in a reduction in public spending, they benefit society as a whole. Since there are side effects that fall outside the real estate economic calculation base (such as those mentioned above), this means that theeconomic viability of the property with energy-efficient renovation differs from, and is likely to underestimate, the socio-economic benefit of this.

2.2.1.4 the total floor area to be renovated or the equivalent annual energy savings to be achieved in 2021-2030 pursuant to Article 5 of Directive 2012/27/EU on the exemplary role of public sector buildings

The revised Energy Efficiency Directive increases the ambition of Member States' energy efficiency improvements in public administration. A new requirement is introduced in a new article (Article 5) for public bodies' final energy consumption to be reduced annually by at least 1.9 % compared to 2021. The requirement in Article 6 (formerly Article 5) for at least 3 % of the floor area of buildings owned by public bodies to be renovated annually exists. Although the requirement itself has not been tightened, it increases the level of ambition as a result of the introduction of a new and broader definition of 'public bodies'.

The Government has instructed the Swedish Energy Agency to prepare the basis for the implementation of Article 5 and 6 in Sweden.62 The mandate includes identifying the actors covered in the new definition of public bodies, proposing baseline scenario for 2021 for Article 5, and proposing annual energy consumption monitoring and energy savings from renovation measures for public bodies under the Articles. The final report is to be presented by 14 June 2024.

2.2.2 the indicative milestones for 2030, 2040 and 2050, nationally defined measurable progress indicators, an evidence-based estimate of expected energy savings and wider benefits and their contribution to the Union's energy efficiency targets as set out in the roadmaps set out in the long-term renovation strategies for the national stock of residential and non-residential buildings, both public and private, in accordance with Article 2(a) of Directive 2010/31/EU

See Section 2.2.1.3.

2.2.3 where applicable, other national objectives, including long-term objectives or strategies and sector-specific targets and national objectives in areas such as energy efficiency in the transport sector and with regard to heating and cooling.

Sweden has no additional national objectives in the field of energy efficiency.

2.3 Dimension energy security

2.3.1 The information referred to in Article 4 c

2.3.1.1 National objectives with regard to:

— **increased diversification of energy sources and supplies from third countries;**

the aim may be to reduce dependence on energy imports;

— **increasing the flexibility of the national energy system, and**

— **management of limited or interrupted energy supply from someone energy source, with a view to increasing the resilience of regional and national energy systems, with a timeframe for when the objectives should be met;**

In terms of objectives relating to the management of limited or interrupted energy supplies, the responsibility for security of energy supply is shared between a wide range of actors. The

62 Government, *Mandate to prepare evidence for the implementation of Article 5 and 6 of the recast Energy Efficiency Directive, https://www.regeringen.se/regeringsuppdrag/2023/11/uppdrag-att-ta-fram-, supporting information on the implementation of Articles 5* and 6-i-recast Directive (2023).

three basic principles of Swedish crisis management are:

- Liability principle: The person responsible for an activity under normal circumstances shall have it during an emergency situation.
- Principle of equality: During a crisis, activities should operate in a similar way as in normal times – as far as possible. Operations shall also be carried out, where possible, at the same location as under normal conditions.
- Proximity: A crisis shall be dealt with where it occurs and by those most closely affected and responsible.

Security of energy supply, together with ecological sustainability and competitiveness, is the overall objective of Swedish energy policy.

Security of energy supply is an integral part of the response to societal crisispreparedness and civil defence. The total defence decisions for the years 2021 to 2025 state that the starting point for planning total defence should be to be able to deal with a security policy crisis in Europe and Sweden's neighbourhood that seriously disrupts the functioning of society, as well as war during part of this period, for a period of at least three months. Energy supply is one of the most important societal functions and needs to be adapted to meet the expectations of total defence (Bill. 2020/21: 30 defence in total 2021-2025).

Energy markets, which are increasingly international, play an important role in preventing and alleviating disruptions and shortages.

In addition to the requirements and criteria laid down in Union legislation and the objectives of overall defence planning, there are no specific national targets to reduce dependence on energy imports from third countries. Energy supply depends on well-functioning energy markets, where energy is traded freely both within Sweden and between Sweden and other countries as far as possible.

For national objectives to increase the flexibility of the national energy system see Section 2.3.4.

Power supply

In accordance with the requirements of the Risk Preparedness Ordinance for electricity, Sweden has a risk-preparedness plan for the electricity sector.[64]

The Electricity Market Regulation requires all Member States with a capacity mechanism to define a supply security target in the form of a reliability standard.63 Since 2003, Sweden

63European Parliament and Council Regulation (EU) 2019/943 of 5 June 201 9 on the internal market for electricity.

has had a capacity mechanism in the form of a power reserve in order to manage peak electricity consumption;

[64] Council Regulation (EU) No 209/941 of the European Parliament and of the Council of 5 June 2019 on risk-preparedness in the electricity sector and repealing Directive 2005/89/EC.

this is generally done in winter, see section 3.3 for more information. On 17 November 2022, the Government adopted a reliability standard for Sweden, which amounts to one hour per year.[66]. This corresponds to a reliability target whereby the production and import of electricity should be able to cover all the expected consumption needs of 99.989 % of the time.

Planning and operation of the transmission network is carried out according to the so-called "n-1" criterion, which means that the failure of an individual component shall not affect the supply of electricity. If such a failure occurs, the consequences shall be remedied within 15 minutes and the electricity system shall be ready for any new failure. This requires access to support services and remedial measures, as well as a rapidly available active disruption reserve.[67]. If the network is damaged, the necessary repair measures must be initiated without delay.

In the case of electricity blackouts, there is an objective in the form of a functional requirement directed at network owners. The functional requirement states that power cuts shall not exceed 24 hours unless this is due to reasons beyond the control of the electricity network companies.

The security of supply of the electricity system should also include sufficient regional capacity for island operation as well as capacity to rapidly restore the system after disruption.64 65 66

Electricity shortages and power shortages are described in more detail in Section 3.3.

64Prop. 2023/24: 105, *long-term orientation* of energy policy; https://www.regeringen.se/contentassets/2fd0739890d8484b8129d3c0e678f24d/energipolitikens-langsiktiga-direction-prop.-202324105.pdf (2024).

Analyses of future power adequacy are described in Section 4.4.

[66] The Government, *Establishment of the reliability standard for Sweden and mandate to calculate annually the reliability standard for Sweden*, *I2022/02083*; regeringen.se/contentassets/692194a2cace4eca8158b1d65a7c5e6a/uppdrag-att-arligen-berakna- reliability standarme-for-sverige/(2022).

[67] Failure of production or failure of the transmission network leads to disturbances in the operation of the electricity system. In the event that the regulatory power market is not sufficient to remedy the disturbance, Affärsverket Sveriges kraftnät activates the disruption reserve to bring the system into balance. At present, the reserve consists mainly of gas turbines located in the southern bidding zones (SE3 and SE4).

Oil supply

As regards oil supply, through the IEP agreement of[69 and the Oil] Storage Directive[70], Sweden is to maintain emergency stocks equivalent to 90 days of net imports. More information on this can be found in section 3.3.

Gas supply

As regards gas supply, the Gas Supply Regulation requires protected customers67 to have access to gas for at least 30 days in the event of a supply disruption or disruption. Sweden has chosen to include only households connected to the western Swedish gas network in the definition of protected customers, which represents 2 % of Swedish gas consumption.

Work on ensuring security of supply in the western Swedish gas system has continued in accordance with the requirements of EU regulations, and has been carried out in the framework of the Swedish Energy Agency's role as the competent authority for gas in Sweden, with the related supervisory role.

Cooperation between the Energy Agency and the European Commission, as well as Member States, has increased significantly in 2023 and more cooperation meetings have been carried out at EU level in view of the external situation. On 8 May 2023, an agreement was signed with Denmark on the necessary technical, legal and financial arrangements for a request for solidarity measures under Article 15 of the Gas Supply Regulation.

However, further measures are needed to strengthen the redundancy of the network, as events in our outside world show continued vulnerability of gas infrastructure and the Swedish

Council Regulation (EU) 2017/1938 of the European67 Parliament and of the Council of 25 October 201 concerning measures to safeguard the security of gas supply and repealing Regulation (EU) No 994/2010.

Energy Agency is currently working on the issue of enhanced security of supply, and with issues related to alternatives to the pipeline natural gas, mainly domestically produced upgraded biogas and liquefied natural gas (LNG). An interruption would affect, inter alia, the western Swedish petrochemical industry.

69 International Energy Agency (IEA) Agreement on a Joint Energy Programme.

70 Council Directive 2009/119/EC of 14 September 2009 imposing an obligation on Member States to maintain minimum stocks of crude oil and/or petroleum products;

71 3.2 national objectives for increasing the diversification of energy sources and supplies from third countries, with a view to increasing the resilience of regional and national energy systems

See Section 2.3.1.

72 3.3 where applicable, national objectives to reduce dependence on energy imports from third countries, with a view to increasing the resilience of national and regional energy systems

See Section 2.3.1.

73 3.4 national objectives to increase the flexibility of the national energy system, in particular through the deployment of domestic energy sources, demand response and energy storage

Sweden has no specific national objectives to increase the flexibility of the national energy system or to promote the deployment of domestic energy sources, demand response and energy storage.

Existing emergency oil stocks are based on the objectives of minimum stocks set out in the Oil Storage Directive68 and the agreement on an international energy programme requiring members of the International Energy Agency (IEA) to maintain oil stocks equivalent to at least 90 days of net imports.

2.4 Dimension internal energy market

2.4.1 Electricity interconnectivity

2.4.1.1 The level of electricity interconnection for which the Member State seeks

68Council Directive 2009/119/EC of 14 September 2009 imposing an obligation on Member States to maintain minimum stocks of crude oil and/or petroleum products;

2030 taking into account an electricity interconnection target of at least 15 % for 2030, with a strategy setting the level from 2021 onwards in close cooperation with the Member States concerned, taking into account the 10 % interconnection target for 2020 and the following indicators of urgency:

1. Price differential in the wholesale market exceeding an indicative threshold of EUR 2/MWh between Member States, regions or bidding zones;

2. Nominal transmission capacity of interconnectors below 30 % of peak load;

3. Nominal transmission capacity of interconnectors below 30 % of installed renewable generation.

Each new interconnector shall be subject to a socio-economic and environmental cost-benefit analysis and shall only be carried out if the potential benefits outweigh the costs.

Sweden has no explicit national target for interconnection level by 2030. Sweden had an interconnection69 level of 22 % by the end of 2022/202370, which is higher than the EU target for 2030.

Table 9 shows annual average prices for 2023 for Swedish and neighbouring bidding zones, as well as price differences between bidding zones. Prices in each bidding zone vary from year to year and depend heavily on weather conditions.71 Price levels, and therefore the differences between Swedish bidding zones and mainly continental Europe, are also influenced by global fuel prices such as coal and natural gas. This is one of the reasons why price levels in recent years (2023-2021) have been significantly higher and more volatile than in the past. This also means that the differences between certain bidding zones may vary from year to year. As can be seen from the table, several of the bidding zone borders have experienced price differences well above EUR 2/MWh in 2023 as an annual average.

In the years 2021-2023, electricity prices have been driven up as a consequence of the war in Ukraine and the resulting loss of gas supplies from Russia to Europe. This created, in particular in 2021 and 2022, high levels of energy supply uncertainty and extreme volatility in natural gas prices. These have a direct effect on the cost of electricity production in several northern European countries and thus also affect the Nordic and Swedish electricity markets. The Nordic market has been even closer to the rest of Europe in recent years. In 2021, North Sea Link, a HVDC connection with a capacity of 1 400 MW between Norway and the UK, was completed. In the same year, the commercial operation of NordLink, which connects Norway and Germany to a 1 400 MW HVDC cable, started. These two connections have led

69Interconnection ratio = installed transmission capacity abroad/installed electricity generation capacity.
70Svenska kraftnät, power balance on the Swedish electricity market, report 2023.
71Hydropower run-off, wind power production and heating needs depending on temperature.

to changes in import and export flows in the Nordic region and have increased the volume of East-West flows through Sweden. In 2023, Viking Link, between Denmark (Jylland, DK1) and the United Kingdom, also became operational. This also has a capacity of 1 400 MW. All of these links link price developments in parts of the Nordic region more closely to price levels in the United Kingdom and Germany respectively.

Table 9 Annual average prices in 2023, EUR/MWh and price differential between neighbouring bidding zones.

Bidding zones		Electricity price (EUR/MWh)		Difference
Area 1	Area 2	Area 1	Area 2	Difference
SE1	SE2	39,98	39,98	0
SE2	SE3	39,98	51,71	— 11,73
SE3	SE4	51,71	64,89	— 13,18
SE1	FI	39,98	56,50	— 16,52
SE3	FI	51,71	56,50	— 4,79
SE3	DK1	51,71	86,83	— 35,12
SE4	DK2	64,89	81,26	— 16,37
SE3	NO1	51,71	66,96	— 15,25
SE2	NO3	39,98	38,56	1,42
SE1	NO4	39,98	29,95	10,03
SE4	LT	64,89	94,44	— 29,55
SE4	PL	64,89	111,65	— 46,76
SE4	THEY	64,89	95,18	— 30,29

Source: Nordpool.

Table 9 indicates that in principle all area borders could benefit from increased transmission capacity. However, as 2022 and 2023 prices are to be regarded to a large extent as the result of a European energy crisis, the results of the table should not be seen as indicative of where grid expansion is required.

Some projects are ongoing or planned to be implemented until 2030. These include a third AC connection (Aurora Line) to Finland (SE1-FI). Further reinforcements in the internal Swedish core network are being carried out on a continuous basis to enable both further connections for industrial establishments and increased trade with the rest of the world.

The Swedish National Grid carries out continuous analyses of new connections or reinvestment of existing connections. Each new interconnector shall be subject to a socio-economic and environmental cost-benefit analysis and shall only be carried out if the potential benefits outweigh the costs. When analysing possible new or enhanced links, a socio-economic cost-benefit assessment of the link in the assessed future market situation shall be carried out. The current price picture may provide an indication of what needs may exist, but the analysis needs to be based on the market situation 10-30 years ahead.

Table 10 shows how the Transmission Capacity (NTC) relates to peak load.

In all cases, the quota exceeds the required minimum level of 30 %.

Table 10. NTC (Net Transfer Capacity) Import latter Export, peak load, [MW] in 2023.

	NTC Import [MW]	NTC Export [MW]	Peak load [MW]	Imports/ Peak load	Exports/ Peak load
SE1	5 100	5 100	1 780	287 %	287 %
SE2	11 450	11 900	2 750	416 %	432 %
SE3	14 160	17 510	15 200	93 %	115 %
SE4	9 810	6 015	4 350	226 %	138 %
SEE	**10 325**	**10 325**	**24 080**	**43 %**	**43 %**

Source: eSen and Svenska kraftnät.

Table 11 shows how the NTC relates to the amount of renewable capacity.72 In all cases for the respective bidding zones, the quota exceeds the required minimum level of 30 %. However, for Sweden as a whole vis-à-vis the rest of the world, the ratio is 28 %.

Table 11. NTC (Net Transfer Capacity), RES (Renewable Energy Sources), [MW]. In 2023.

	NTC Import [MW]	NTC Export [MW]	RES73 [MW]	Imports/RES	Export/RES
SE1	5 100	5 100	8 480	60 %	60 %
SE2	11 450	11 900	14 724	78 %	81 %
SE3	14 160	17 510	9 418	150 %	186 %
SE4	9 810	6 015	4 232	232 %	142 %
SEE	**10 325**	**10 325**	**36 854**	**28 %**	**28 %**

Source: Swedish power grids and the Swedish Energy Agency's processing.

2.4.2 Energy transmission infrastructure

2.4.2.1 Key electricity and gas transmission infrastructure projects and, where relevant, modernisation projects, needed to achieve objectives and targets in the five dimensions of the Energy Union

Electricity transmission

Svenska kraftnät is a state enterprise that operates, manages and develops the Swedish transmission network. The Swedish National Grid is responsible for maintaining the instantaneous power balance and operational security in the Swedish electricity network and is certified as TSO74 by the Energy Market Inspectorate. The current system development

72 In Sweden, renewable power generation consists of hydropower, wind power, solar power and thermal power. For cogeneration, approximately 80 % of the input fuel is renewable. The contribution of cogeneration to renewable capacity has therefore been calculated as 80 % of total installed thermal power.
73 1 January 2023.
74 TSO = Transmission System Operator or TSO in Swedish.

plan75 lasts until 2031 and describes, among other things, the Swedish Power Network Network Network Network Network Network Network Network Network76Network Network network network development plan, which is available in its entirety on the website of the Swedish Power Network. Some of the major network development projects are:

- The system reinforcement of Västra Götaland is a programme with measures to meet the significantly increased demand for extraction in Västra Götaland.

- The Stockholm System Strengthening is an investment programme with measures to meet the need for electricity supply to the Stockholm region in the long term.
- The North-South programme77 includes some 50 different projects aimed at: to increase cross-zonal capacity in 2 and 3 by 2040.
- A comprehensive network development programme is also ongoing for what is called Fossilfrit Övre Norrland, a coherent effort to connect industrial projects and enable the transition.
- Gotland link: In the memorandum of appropriations for the financial year 2023, the Swedish National Grid Network has been given the task of extending the transmission network to Gotland. The deployment shall ensure a transmission network point on Gotland in good time before the current supply is phased out due to age.

Hydrogen

Several parts of the actions on FossilFree Övre Norrland (see above) are linked to the expected increase in electricity demand in the area and the plans for hydrogen production. The most concrete public plans for the production and use of hydrogen are in Norrbotten County. Even in terms of volume, production and use are expected to be the highest. The most significant are the investments linked to the steel industry and the production of fossil-free steel. The companies LKAB, SSAB and Vattenfall cooperate on fossil-free steel through the Hybrit joint venture project and H2 Green Steel (H2GS) also invest in the production of fossil-free steel. The Swedish National Grid is interacting in these plans with Nordion, which is carrying out extensive development work on future hydrogen infrastructure in, inter alia, northern Sweden.

Since March 2023, the Swedish Energy Agency has been tasked with coordinating the work on hydrogen in Sweden.78 The mission aims to strengthen cooperation between national authorities and provide analysis and discussion on strategic pathways for Sweden as a hydrogen nation. This also includes clarifying roles and responsibilities in the field of hydrogen, developing national advice and recommendations for the management of hydrogen

75Swedish National Grid – System Development Plan 2022-2031.
76 Swedish National Grid, *Network Development Plan* 2024-2033, https://www.svk.se/siteassets/om-oss/rapporter/2023/svk_natdevelop_2024-2033.pdf (2023).
77 Swedish National Grid, *Program NordSouth.* https://www.svk.se/nordsyd (2021).
78 Swedish Energy Agency, *National Coordination Hydrogen,* https://www.energimyndigheten.se/klimat--miljo/sveriges-Electrification/Mission In-Electrification/National Coordination vatgas/(2024).

and hydrogen pipelines, and reviewing existing economic instruments in this area. The Swedish Energy Agency's recently published partial reporting of the mandate provides an overview of the state of play of plans for hydrogen and hydrogen infrastructure in various parts of Sweden.79

Gas transfer

The western Swedish gas system extends from Trelleborg in the south to Stenungsund in the north and a small piece east towards Jönköping. The gas comes to Sweden via a pipeline from Danish Drakan. In Sweden, the transmission network is owned and operated by Swedegas AB, which also has system balance responsibility. A few large consumers are connected directly to the transmission network.

The80LNG plant in the Port of Gothenburg became operational in autumn 2018 and mainly provides gas for shipping. The LNG terminal is not connected to the western Swedish gas network.

2.4.2.2 Where applicable, planned important infrastructure projects other than projects of common interest

A new third AC management81 is currently being planned between Sweden (SE1) and Finland.

The latest version of the Nordic Network Development Plan82 was published in 2023. The report from the four Nordic TSOs (Energinet, Fingrid, Statnett and Svenska kraftnät) describes the main drivers of major changes that the Nordic power system is undergoing, as well as planned and ongoing projects implemented to meet the challenges arising from the changes in the power system.

2.4.3 Market integration

2.4.3.1 National objectives related to other aspects of the internal energy market such as increased system flexibility, in particular regarding the promotion of competitively determined electricity prices in accordance with relevant sector-specific legislation, market integration and coupling to increase the tradable capacity of existing interconnectors, smart grids, aggregation, demand response, storage, distributed generation, mechanisms for dispatching, redispatching and containment of allocated capacity, as well as real-time price signals, including a timeframe for when the objectives are

79 Swedish Energy Agency, *Vätgas and hydrogen infrastructure in the Swedish energy system, ER 2024:* 07, https://www.energimyndigheten.se/495df0/contentassets/24fbf4b9b9274babb05f232c66a2f537/rapport_vatga s-och-vatgas infrastructure.pdf (2024).
80LNG = liquefied natural gas.
81AC = Alternating current.
82Statnett, Fingrid, Energinet and Svenska kraftnät – Nordic Grid Development Perspective 2023.

to be met

Sweden does not have national specific objectives on market integration but is continuously working on and developing market integration measures and participates in Nordic cooperation in this area.

In the framework of the Nordic Council of Ministers, a Nordic Electricity Market Forum83 has been established as a place for closer dialogue between political and non-political stakeholders, as well as between different types of stakeholders in the Nordic electricity market. An action plan to reach a vision by84 2030 has been developed, which among others highlights areas of development around flexibility, correct price signals, sector integration, network development and resource adequacy.

Key elements and milestones of the Action Plan are and have been:

- Nordic Balancing Model (NBM), phased implementation to 2024
- Single price model, introduced November 2021
- 15 minutes settlement period, to be inserted in Q2 2024
- Nordic Capacity Market for AFRR85 (Automatic Frequency Restoration), launched in December 2022
- Nordic Capacity Market for86 MFRR, planned to start 2024/2025
- Nordic energy market mFRR, to be introduced December 2024

Until now, balancing controls have been planned and traded on an hourly basis and any changes within the operating hours are managed using system operators' balancing reserves. A settlement period of 15 minutes will allow all parties in the power market to plan and trade their own balance more accurately, thereby allowing for a more efficient use of power resources and the grid. It is also expected to reduce the deviations that TSO needs to deal with, as the operators themselves are given the opportunity to manage their balancing within the hour better than in the past.

Together with the other Nordic TSOs, Svenska kraftnät is working to introduce the new capacity calculation method (flow-based method) in the capacity calculation region Nordic. Parallel runs have been ongoing since Q2 2023 and the estimated start is currently planned in autumn 2024. Flow-based capacity calculation and allocation allow for better use of the existing network while also providing additional tools to TSO to monitor operational security.

83 Nordic Council of Ministers, *Nordic Cooperation,* https://www.norden.org/sv/nordiska-ministerradet (2024).
84 Nordic Electricity Market Forum, *2030 Vision for the Nordic Electricity Market,* https://nordicelforum.org/wordpress/wp-content/uploads/2021/09/Vision-for-the-nordic-electricity-market-EN_2.pdf (2024).
85Stands for 'automatic Frequency Restoration Reserves'.
86Stands for "Frequency Restoration Reserves".

The Swedish National Grid System no longer has an exemption (derogation) as regards compliance with the so-called '70 %' rule in the Electricity Market Regulation. This means that Svenska kraftnät has not provided the Energy Market Inspectorate and ACER with the result that they consider it necessary with an exemption. In those periods where sufficient capacity is challenging to maintain without specific measures, Svenska kraftnät may need to make more use of trading and redispatching than in the past in order to comply with the rules. With the exception of periods of decommissioning of nuclear power plants in Sydsverige, Svenska kraftnät has generally been able to meet the requirement to allocate at least 70 % of the capacity of critical network elements to cross-border flows.

In 2021-2022, when the new east-west flows clearly appeared in the first few years, Svenska kraftnät was unable to maintain full capacities (in terms of NTC) on all borders to/from SE3. In particular, flows from Finland to Norway and Denmark increased. This was due not least to the entry into operation of the Norwegian cables to the UK and Germany. In order not to risk overloads at the points of the network burdened by bothnorth-south and east-west flows, Svenska kraftnät restricted the market's ability to trade in an east-west direction. With the help of grid reinforcements and the so-called summa allocation to NO1 and DK1, Svenska kraftnät has managed to increase the available capacity over time and to distribute them more efficiently.

2.4.3.2 Where applicable, national objectives related to non-discriminatory participationof renewable energy, demand response and storage, including via aggregation, in all energy markets, including a timeframe for the fulfilment of the objectives

Sweden has no specific objectives for this. However, there is a provision in Chapter 3, Section 16 of the Electricity Act stating that electricity network companies may not impose technical requirements or other conditions that make it difficult to provide services in the form of changes in electricity consumption, unless the condition is justified by the safe, reliable and efficient operation of the collecting system.

In addition, there is an additional provision (Chapter 5, Section 11 of the Electricity Act) under which, when determining the amount of electricity network charges that electricity network companies may charge to customers, account must be taken of the extent to which network activities are carried out in a manner that is compatible with or contributes to the efficient use of the electricity network. This provision shall be an incentive for electricity grid companies to make it easier for customers to provide services that offer greater opportunities for demand response through, for example, new technological solutions.

2.4.3.3 Where applicable, national objectives to ensure that consumers participate in the energy system and benefit from self-generation and new technologies, including smart meters

Sweden has no specific objective in this regard.

On 1 November 2018, new requirements were introduced into the Ordinance (1999: 716) on the measurement, calculation and reporting of transferred electricity (the Measurement Ordinance), which applies from 2025. The new requirements concern functions of electricity meters, metering systems and equipment. The functional requirements set out in the Measurement Ordinance must be met by network companies by 1 January 2025 and shall include measurement systems and equipment for all low-voltage electricity users.

Functional requirements for measurement systems and equipment:

- allow electricity users to easily access data such as power used, which facilitates customers interested in energy savings and who want to be active in the electricity market;
- promotes reliable and efficient network operation and enables greater and cheaper integration of microgeneration, such as solar;
- enables a developed market for energy services of different kinds.

2.4.3.4 National objectives with regard to ensuring the adequacy of electricity systems, and as regards the flexibility of the energy system with regard to renewable energy production, including a timeframe for when the targets are to be met

In November 2022, the Government set the reliability standard for Sweden at one hour per year, inter alia in the light of provisions in the Electricity Market Ordinance.[91] At the same time, the Government instructed the Energy Market Inspectorate to calculate the reliability standard annually.[92] The Energy Market Inspectorate must also, when carrying out the task, engage in a dialogue with Affärsverket Sverige kraftnät, the Swedish Energy Agency and, where relevant, with other stakeholders. The Energy Market Inspectorate shall report on two occasions, on the one hand, by 1 January 2024 and, on the other hand, by 1 January 2025.[93] Svenska kraftnät regularly, in cooperation with ENTSO-E, draws up forecasts of future resource adequacy in the Swedish electricity system.

In March 2023, Swedish power grids presented an analysis87 which led to a proposal that Sweden should put in place a market-wide capacity mechanism to ensure resource adequacy and compliance with the reliability standard in the coming decades. The reliability standard is calculated on the basis of current market conditions and Sweden currently has no shortcoming in relation to the standard. The Swedish power network's proposal is therefore intended to address a projected future resource insufficiency, which is feared that demand for

87 Swedish Power Grid, *The future capacity mechanism to ensure resource adequacy in the electricity market*, https://www.svk.se/siteassets/om-oss/rapporter/2023/framtidens-kapacitetsmekanism-for-att-sakerstalla- resource-to-power market_svk-2022_3774.pdf (2023).

electricity may increase faster than supply in the future. The proposal for the introduction of a market-wide capacity mechanism was referred in summer 2023 and further prepared

91 Council Regulation (EC) No 714/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the network for cross-border exchanges in electricity and repealing Regulation (EC) No 1228/2003) and the Agency Regulation.

92 Government, *definition of the reliability standard for Sweden and task to calculate annually the reliability standard for Sweden*, regeringen.se/contentassets/692194a2cace4eca8158b1d65a7c5e6a/uppdrag-att-arligen-berakna- reliability standardsmen-for-sverige/(2022).

93 The Energy Market Inspectorate calculated the reliability standard at 1.16 hour per year in this year's update. As this does not differ significantly from the agreed standard of 1 hour per year, the Energy Market Inspectorate does not propose a new reliability standard.

within the Government Offices. No decision has yet been taken, but in March 2024 the Ministry of Climate and Enterprise presented a memorandum assessing that there should be a capacity mechanism for the electricity market in Sweden even after 15 March 2025, when the current power reserve ceases to exist. The memorandum also includes a proposal for a new law on the financing of a capacity mechanism for the electricity market. The proposal requires shippers to pay a fee to Affärsverket Sverige kraftnät in order to cover the plant's costs under contracts concluded by the plant in order to have a capacity mechanism in place.88

In parallel to the preparation of this proposal, Svenska kraftnät has also proposed an adjustment to the current regulation on power reserve, so that it can be extended and also used after the expiry date currently foreseen in March 2025.

94 4.3.5 where applicable, national objectives to protect energy consumers and improve the competitiveness of the retail energy sector

Sweden has no specific national objectives in this area.

2.4.4 energy poverty

Where applicable, national objectives with regard to energy poverty, including a timeframe for when the objectives are to be met

There are no national targets for energy poverty in Sweden, but there are social and energy market legislation in place to protect vulnerable households and customers described in section 3.4.4. Section 1.2.1.7 provides a summary of Sweden's general welfare and labour market policy.

In Sweden, the Swedish Energy Agency is working to implement new EU legislative

88 Government, *An electricity market capacity mechanism https://www.regeringen.se/contentassets/021 745c61f414fcbbd841fb341f43d3e/memoria -en- capacity Mechanism for* Electricity Market.pdf (2024).

requirements in this area through parts of the Government's mandate to produce evidence for the implementation of Article 8, 10 and parts of Article 24 of the recast Energy Efficiency Directive. The elements related to energy poverty are set out in Table 12. The assignments are to be delivered to the Government Offices in December 2024.

Table 12 Forms on energy poverty from government missions.

Legal acts EU	Terms of reference from the Government Offices
Energy Efficiency Directive, Article 24 Electricity Market Directive Article 28	Analyse the different funding opportunities across the EU requiring Member States to have a definition of energy poverty. Put the concept of energy poverty in relation to the concept of vulnerable customers. Proposed definitions. Analyse whether there is an existing network that could meet the requirements of Article 24(4). In the absence of such an existing network, analyse and propose how a network could be formed and which authority should be in charge of the network. The analysis shall include an estimate of the costs of the different options.
Energy Efficiency Directive, Article 8(3)	Analyse and make suggestions on how the concept of energy poverty as referred to in Article 2(52) can be measured and followed up. The proposal shall take into account the indicators set out in Article 8(3)(a) to (d) and the European Commission Recommendations (EU) 2020/1563 of 20 October 2023 and (EU) 2023/2407 of 14 October 2020 on energy poverty.

2.5 Dimension research, innovation and competitiveness

2.5.1 National objectives and funding targets for public and, where relevant, private research and innovation related to the Energy Union, including, where appropriate, a timeframe for the achievement of the objectives

The overall objective of energy research and innovation is to contribute to the achievement of set energy and climate objectives, long-term energy and climate policies and energy-related environmental policy objectives. The focus on energy research efforts is areas that have the potential for growth and for exports.

Long-term energy and climate policies and energy-related environmental policy objectives are described in Chapter 1.

According to Government Bill 2016/17: 66 Energy research and innovation for ecological sustainability, competitiveness and security of supply, research and innovation in the field of energy shall also:

- building up the scientific and technical knowledge and skills needed to enable, through the application of new technologies and services, a transition to a long-term sustainable energy system in Sweden, characterised by reconciling ecological sustainability, competitiveness and security of supply;
- develop technologies and services that can be commercialised through Swedish

industry, thus contributing to sustainable growth and the transformation and development of the energy system both in Sweden and in other markets; and contribute to and benefit from international cooperation in the field of energy.

Energy research and innovation also contributes to the general research policy objective that Sweden should be one of the world's leading research and innovation countries and a leading knowledge hub, with high-quality research, higher education and innovation leading to the development and well-being of society, the competitiveness of industry and responding to the societal challenges we face, both in Sweden and globally.[96]

According to the Energy Policy Long-Term Orientation Bill (Bill. 2023/24: 105) energy research and innovation is important for a rapid and effective climate transition and for achieving energy, climate and environmental objectives. The Government considers that research in the field of nuclear technology has long been lagging behind in Sweden and considers that increased support for innovation and research in nuclear power is a priority to strengthen national competence in nuclear power and related radiation safety areas. During the current term of office, the Government intends to come back to the Riksdag with a bill on energy research and innovation in parallel to the Research and Innovation Policy Bill. The Government intends to come back with proposals for long-term funding for nuclear research.89 90

[96] prop. 2016/17: *50, Collaborative knowledge – addressing societal challenges and strengthening competitiveness*, https://data.riksdagen.se/fil/276B2209-A8A3-411E-AF7F-1706658FB9EB (2016), p. 34.

2.5.2 where available, national 2050 targets for the promotion of clean energy technologies and, where appropriate, national objectives including long-term targets (for 2050) for the deployment of low-carbon technologies inter alia for decarbonising energy- and carbon-intensive industrial sectors and, where applicable, for related carbon transport and storage infrastructure

Sweden has no specific national objectives in these areas. See section 2.5.1 for general objectives for energy research. Section 3.1.1.1 describes Sweden's plans for CCS/CCU in more

89Prop. 2023/24: 105, *long-term orientation* of energy policy; https://www.regeringen.se/contentassets/2fd0739890d8484b8129d3c0e678f24d/energipolitikens -lang-surveillance – direction-prop.-202324105.pdf (2024).

detail. See further section " Nuclear power for nuclear energy policy".

2.5.3 where applicable, national competitiveness objectives The objective of enterprise policy is to strengthen Swedish competitiveness and create the conditions for more jobs in more and growing companies.[98]

In addition, the Riksdag's climate policy framework states that Sweden must demonstrate that it is possible to reconcile the climate transition with welfare and good competitiveness.91

[98] prop. 2014/15: *1, Budget Bill 2015,* https://www.regeringen.se/contentassets/f479a257aa694bf097a3806bbdf6ff19/forslag-till-statens-budget-for- 2015-finansplan-tax-fragments- Chapter 1-7/(2014), op. cit. 24.

INSTRUMENTS AND MEASURES

3.1 GHG emission reduction dimension

3.1.1 GHG emissions and removals

1 .1.1.1 policies and measures to achieve the target set under Regulation (EU) 2018/842 referred to in paragraph 2.1.1 and policies and measures to comply with Regulation (EU) 2018/841, covering all key emitting sectors and sectors for enhancing removals, with a view to the Union's climate-neutrality objective set out in Article 2(1) of Regulation (EU) 2021/1119;

91Prop. 2016/17: 146, *a climate policy framework for Sweden*; https://www.regeringen.se/contentassets/480ed767687b4b7ba6c960f9c1d4857f/ett-klimatpolitiskt-ramverk- for-sverige-prop.-201617146 (2017), p. 23.

Several policy areas and measures that have an impact on the above mentioned climate objectives (see sections 1.1.3 and 2.1.1.1) exist at EU level, such as the EU ETS, the Fuel Quality Directive, emission requirements for new vehicles, the F-gas Regulation, the Landfill Directive and the Common Agricultural Policy. These are not further described here.

Furthermore, several policies and measures targeting renewable energy, energy efficiency and research and demonstration (see further sections 3.1.2, 3.2 and 3.3) also affect the reduction of greenhouse gas emissions in Sweden.

Cross-sectoral policies and measures

Energy and CO2 tax

The Swedish system for the taxation of fuels and electricity is governed by the Energy Tax Act (1994: 1776). Fuels are taxed with a combination of energy tax and carbon tax and electricity are taxed with energy tax. The taxes that mainly affect greenhouse gas emissions in Sweden are energy taxes and CO2 taxes on fuels. These are described below.

Energy taxes on petrol and diesel were introduced in 1924 and 1937 respectively. Fuels used for heating and electricity were subject to an energy tax in the 1950s. The purpose of the energy tax was initially purely fiscal. For a long time, the aim has also been to steer energy consumption in line with Sweden's energy efficiency and renewable energy targets.92 The energy tax on motor fuels also aims to internalise external costs from traffic, such as road wear and noise. The energy tax on fuel varies depending on whether it is used as motor fuel or for heating purposes. The level of taxation for heating fuels also varies between households, the manufacturing industry and the energy supply sector, see Table 13 for current tax levels.

Carbon tax, based on the fossil content of the fuel, was introduced in Sweden in 1991 and aims to reduce carbon dioxide emissions. No CO2 tax is levied on sustainable bioliquids, except those used under the reduction obligation for petrol and diesel and certain taxable bio-oils used for heating purposes.

VAT (25 %) is calculated on the price of fuel and excise duties. To take account of inflation, the energy and carbon tax on fuels is adjusted according to changes in the consumer price index (CPI). In order not to erode the steering effect of taxes, a further indexation for petrol and diesel was introduced in 2017 based on the evolution of Gross Domestic Product (GDP), but[101] GDP indexation has not been effective for several years after 2020.

On 1 January 2024, the energy tax on petrol (environmental class 1) was reduced by SEK 1 and SEK 31 per litre compared to the level that would have applied from 2024 under the indexation rules in force. The sum of the energy and carbon dioxide tax on such petrol was then SEK 60

The92 energy efficiency target and the 2020 renewal target are set out in the Bill. 2008/09: 162 and 163.

per litre in 2024 than in 2023. The energy tax on diesel (environmental class 1) was reduced by SEK 341 per cubic metre compared to the level that would have applied from 2024. The energy tax on diesel in other environmental classes was amended accordingly. On January 2025, excise duty on petrol will be reduced by a further SEK 25 per litre compared to the 2024 level).93

Due to, inter alia, the risk of carbon leakage, that is to say, the relocation of activities and their emissions outside national borders, certain sectors are subject to reduced or tax exemptions.

Sweden applies tax exemptions for sustainable biofuels in some cases. Both energy and carbon tax exemptions apply to clean and high-blended sustainable bioliquids. Sweden has State aid approval for the current tax relief for liquid clean and high-blended biofuels

[101] The GDP indexation for petrol and diesel is designed as a flat rate of 2 percentage points, in addition to adjustments for the CPI. This additional recalculation takes place both of the energy tax and the CO2 tax, but is expressed as an increase in the energy tax.

until the end of 2026.94 However, for biogas and biogas, the General Court, which is the first instance of the Court of Justice of the European Union, annulled the decision on the Swedish tax exemption.95 The Swedish Government is working to obtain new authorisations on the spot.96 On 30 January 2024, the European Commission launched an in-depth review to assess Sweden's tax exemptions for biogas and biogasol in line with EU State aid rules.97 Biofuels incorporated into petrol or diesel are subject to the reduction obligation and are therefore subject to the same tax per litre as the fossil fuel in which it is involved. Table 13 shows the relevant excise duty levels.98 99 100

Table 13 Energy and carbon tax levels in 2024 per unit volume.

	Energy tax	Carbon tax	Total
Electricity (öre/kWh)			42,8
Fuel oil (SEK/m³)	305	3 887	4 192
Diesel, MK1 (SEK/m³)	1 470	2 723	4 193
Petrol, MK1 (SEK/l)	2,57	3,14	5,71
Coal (kr/1000 kg)	833	3 608	4 441
Natural gas (kr/	1209/0	3 104/3 104	4 313/

93 Government Bill 2023/24: 24 Reducing the tax on petrol and diesel and reducing the tax on agricultural diesel.
94 Government, *Tax exemption for pure and high-blended biofuels until 2026*, https://regeringen.se/pressmeddelanden/2022/12/skattebefrielse-for-rena-och-hoginblandade-biodrivmedel- to andmed-2026/ (2022).
95Case T-626/20 Landwärme GmbH v European Commission.
96 Government, *Government is contacting the European Commission to save the tax exemption for biogas*, https://www.regeringen.se/pressmeddelanden/2023/03/regeringen-kontaktar-eu-kommissionen-for-att-radda- tax-exempt for biogas (2023).
97 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52024AS56908&qid=1709627803840.
The Energy Tax98 Act (1994: 1776).
99Municipalities concerned: Norrbotten county: all municipalities, Västerbotten County: all municipalities, Jämtland County: all municipalities, Västernorrland County: Sollefteå, Ånge, Örnskare vik, Gävleborg County:
Ljusdal, Dalarna County: Malung-Sälens, Mora, Orsa, Älvdalen, Värmland County: Torsby.

1 000 m³)	3 104

Excise duties on electricity are 9,6 öre lower per kWh for, inter alia, households and services in certain municipalities in northern Sweden.[108]

Excise duties on natural gas distinguish for heating (left digit) and transport purposes (right digit).

Fossil fuels for national and international commercial shipping, rail, aviation and fisheries are not subject to any energy or CO2 tax. Since 1 January 2023, all fossil fuels are exempted from CO2 tax if they are used for the production of heat in thermal or combined thermal power plants covered by the EU ETS. In the case of fuel use for heat production in CHP plants not covered by the trading system, carbon dioxide tax is levied at the level of the general level of taxation, see the current levels of taxation in Table 13.

Fuel used for electricity production is exempt from both energy and carbon dioxide tax, but the use of electricity is generally taxed with energy tax on electricity, see the current level of taxation in Table 13.

Certain processes in the manufacturing industry, such as metallurgical and mineralogical processes, as well as fuels used for the production of energy products, are fully exempted from energy and CO2 taxes. Fuel used in the manufacturing industry covered by the EU ETS is fully exempt from CO2 tax.

Diesel consumed in agricultural, forestry or aquaculture work machinery is exempted for part of the CO2 tax. The amount of the tax exemption has varied over time. Since 2022, the tax exemption for diesel consumed in work machinery in agriculture, forestry or aquaculture has been extended to cover, in whole or in part, both energy and carbon dioxide taxes. The tax reduction is now (2024) for diesel (MK1) SEK 3 926/m in^3.

Climate Leap

Since 2015, all types of organisations can apply for support for local and regional climate investments under the so-called Climate Leap.[109]. The applications are in competition with each other based on the estimated greenhouse gas reduction per crown invested. Examples of eligible investments include charging infrastructure for electric vehicles, biogas plants, substitution of oil with biofuel or district heating, extension of smaller district heating networks, air gas destruction in healthcare, cycle paths and bicycle infrastructure. The Environmental Protection Agency's memorandum of appropriations101 for 2024 announced that the allocation for 2024 is increased from SEK 3.7 billion previously planned to SEK 4.9 billion, with SEK 0.5 billion specifically dedicated to charging infrastructure. The 2024 Budget Bill proposed to increase the allocation for 2025 from SEK 1 billion to approximately SEK 3 billion and the allocation for 2026 from SEK 0.5 billion to approximately SEK 3 billion. Climate Leap has been extended

101 Ekomonistyrningsverket, Regulatory *letter for the 2024 financial year concerning the Swedish Environmental Protection*Agency, https://www.esv.se/statsliggaren/regleringsbrev/Index?rbId=24153 (2023).

until 2028. The category of action contributing to the maximum annual

[109] investments in sectors included in the EU ETS can be eligible but only if they lead to an increased use of waste heat.

the reduction (approximately 850 thousand tonnes of CO2e) comes from investments in the circular economy and waste sectors.

The Environmental Code and the Planning and Building Act

The Environmental Code, the overarching objective of which is to promote sustainable development, brings together horizontal environmental legislation. When applying the Code, Sweden's environmental quality objectives, including limited climate impact (see section 2.1.1), must be indicative. The Environmental Code contains, among other things, general rules of consideration that must be complied with in all activities and measures. The Code also requires the use of best available techniques. Major environmentally hazardous activities are subject to a permit requirement. The permit assessment process includes the assessment of direct and indirect environmental impacts, as well as energy management, and for installations not included in the EU ETS, also includes greenhouse gas emissions. However, for activities included in the EU ETS, CO2 emission values may not be required. Town and country planning is largely governed by the Planning and Building Act (2010: 900). The Planning and Building Act requires that environmental and climate aspects be taken into account in planning. Some infrastructure projects, instead, are examined in accordance with the Environmental Code, the Road Act (1971: 948), the Construction of Railways Act (1995: 1649), directly or by taking into account other legislation.

Communication on climate change

Swedish authorities have a long experience in using communication for the public sector, industry and citizens alike. Some examples are the following.

- TheSwedish Environmental Protection Agency's website www.naturvardsverket.se is a hub for statistics and facts on emissions, which is widely used by politicians, the media, businesses, organisations and researchers.

- The Swedish Meteorological and Hydrological Institute (SMHI) develops and distributes information on weather, water and climate change. The National Knowledge Centre on Adaptation to Climate Change, at the SMHI, has launched a Swedish Climate Change Portal, with facts and guidance on adaptation to climate change, www.klimatanpassning.se. Behind the website is the Government Network for Adaptation to Climate Change.

- The Swedish Energy Agency provides information to citizens and businesses alike and advice on more efficient energy use, secure and sustainable energy supply and is responsible, inter alia, for an informative website, www.energimyndigheten.se.

- TheForest Agency and the Swedish Board of Agriculture (SBA) offer e-services and digital information to land and forest owners, forest workers and farmers on how to reduce the climate impact of forestry, agriculture and climate adaptation, www.skogsstyrelsen.se and www.jordbruksverket.se.

- TheTransport Administration is implementing information and awareness-raising measures to help achieve the intermediate target for domestic transport and to create the conditions for Sweden to have net-zero emissions by 2045, www.trafikverket.se.

- TheSwedish Transport Agency provides information on rules relating to the climate impact of transport, as well as on national and international work carried out in road, air and maritime transport, www.transportstyrelsen.se.

- The Swedish Civil Contingencies Agency (MSB) works to prevent and manage accidents, crises and consequences of war, including coordination between stakeholders and communication to the public, www.msb.se.

- The Crisis information.se webpage is a service that gathers up to date information to the public from relevant authorities, including on preparedness for climate-related crises.

- Panorama is a web-based tool that visualises Sweden's climate transition, www.panorama-sverige.se. The user can follow which parts of society are changing and how it happens. The tool also shows what is needed for Sweden to reach the net zero target by 2045, including measures in the circular economy such as reducing food waste.

Fossil-free Sweden

The State initiative FossilFree Sweden, launched in 2016, aims to strengthen the transition of industry to fossil freedom. The mission includes increasing interaction with and support for cities and regions, and increasing engagement in international processes where the initiative can make a valuable contribution. The initiative is open to all those presenting the declaration and today brings together over 500 stakeholders from business, municipalities, other public actors and civil society. The declaration commits the operators to present concrete measures to reduce emissions.

In cooperation with FossilFree Sweden, industry sectors have developed 22 so-called roadmaps for fossil-free competitiveness between 2018 and 2020.102 The objectives of the roadmaps are to build a stronger industry and create more jobs and export opportunities by becoming fossil-free. The roadmaps show opportunities, identify barriers and propose solutions, with most roadmaps including circular economy, both through their own commitments and policy proposals. Together, they give an idea of what a fossil-free industry will look like.

102 Fossil-free Sweden, *Roadmap,* https://fossilfrittsverige.se/fardplaner/ (2024).

Fossil-free Sweden is now focusing on the implementation of the roadmaps and submits an annual follow-up report to the Government on the developments in each roadmap. To facilitate the implementation of the roadmaps, FossilFree Sweden is also developing cross-sectoral and cross-sectorial strategies to address common problems and challenges and foster Swedish competitiveness in the international market. To date, FossilFree Sweden has presented 5 strategies; Sustainable Battery Value Chain Strategy, Hydrogen Strategy, Biostrategy, Financing Strategy and Strategy for a more efficient use of energy and impact. Work on a CCS/bio-CCS strategy was also launched in 2023. The strategy has been submitted to Minister for Climate and Environment Pourmokhtari on 7 May 2024.

Regional climate and energy strategies

The county administrative boards lead and coordinate the regional implementation of climate and energy policies.103 Based on the long-term energy and climate policy objectives adopted by the Riksdag, regional climate and energy strategies have been developed by the county administrative boards in cooperation with other regional and local actors to contribute to effective measures and synergies. According to the memorandum of appropriations for 2024, the county administrative boards must, among other things, revise the regional energy and climate strategies in the light of the new energy policy objectives. In addition, the county administrative boards contribute to the work on environmental assessment and monitoring, local and regional spatial planning, regional development and growth policy, and infrastructure planning.

Public procurement

The Government has stated in the national procurement strategy that Sweden should be at the forefront and remain a model for green public procurement and that a life-cycle approach should be taken into account in the different stages of the procurement. The possibilities and requirements to take account of environmental and climate considerations in procurement are set out in the procurement legislation, including the Act (2016: 1145) on public procurement, the Act (2011: 846) on environmental requirements in the procurement of cars and certain services in road transport and the related Ordinance (2022: 315) on environmental requirements in the procurement of cars and certain services in road transport. Public purchases that stimulate the development of circular and fossil-free goods and services are included in the Climate Action Plan.

Carbon capture and storage (CCS) and bio-CCS

Carbon Capture and Storage (CCS) is a chain of technologies aimed at capturing CO2 from

103Swedish National Financial Management *Authority, Regulatory letter for the 2024 financial year concerning the county administrative boards, (*2024).

high-concentration flue-gas streams from, for example, energy installations or other industries, transporting the captured CO2 to a storage site and injecting it for permanent storage in a geological formation. CCS aims to reduce CO2 emissions to the atmosphere.

Bio-CCS refers to the same chain of technologies as other CCS but where the installations and/or industries from which the CO2 is captured use biomass as feedstock and/or fuel (e.g. from by-products from forestry and sawmills or household waste as fuel). As emissions from biomass combustion are counted as zero, bioCCS gives rise to negative emissions.

This is possible by the fact that the biomass producing the collected CO2 has brought in the same amount of CO2 during its lifetime, which in turn means that emissions from biomass combustion are counted as zero. By permanently storing this biogenic carbon in underground formations, the carbon cycle is broken, resulting in a net removal of CO2 from the atmosphere (i.e. what is often referred to as negative emissions). Bio-CCS is sometimes also mentioned as BECCS (bioenergy with carbon capture and storage).

The potential for bio-CCS in Sweden is based on the large emission points for biogenic CO2. The main discharge points are the chemical pulp mill (kraft pulp mill) where incineration takes place as part of chemical recycling. Sweden also has many CHP and heat plants that use by-products from the forestry and sawmill industry or household waste as fuel, which may also be relevant for bio-CCS. The total theoretical potential in Sweden is large, up to 20-30 million tonnes of CO2 per year from kraft pulp mills and CHP plants. The Climate Policy Road Selection Committee (SOU 2020: 4) concludes that the realisable potential for bio-CCS in Sweden amounts to at least 10 million tonnes of biogenic carbon per year from a 2045 perspective.

Sweden has a number of policies and measures, decided and planned, which aim to create the conditions for investments in CCS and thus interact with the achievement of the EU's overall climate objectives and contribute to emission reductions in the EU ETS. Since 2021, the Swedish Energy Agency has been mandated to be a national centre for carbon capture and storage (CCS) in[113], thereby promoting the effective application of CCS in Sweden. In addition, in the memorandum of appropriations for 2023,104 105 the Government instructed the SGU to investigate suitable sites for permanent carbon storage in Sweden. Sweden is not expected to have a national storage capacity by 2030.

Investment aid for both fossil CCS and bio-CCS is provided in the context of Industry Life (see section 3.5.3 for more details). The Industriklivet has so far supported some 80 projects.

The Government has decided to introduce an *aid for bio-CCS through reverse auctions.* Before

Geological Survey of104 Sweden, *Geological conditions for CO2 storage in Sweden;* https://www.sgu.se/samhallsplanering/ccs-koldioxidlagring/geologiska-forutsattningar-for-koldioxidlagring-i- sverige/ (2023).

the aid can be put into effect, it must be approved by the European Commission. The Government Offices sent a formal notification on 9 April.

[113] Swedish Energy *Agency, National Centre for CCS,* https://www.energimyndigheten.se/klimat-- miljo/ccs/nationellt-cent-for-ccs/ (2023).

on State aid testing of the bio-CCS support scheme by reverse auction to the European Commission.[115]

It is intended that through State aid for bio-CCS, operators receive support for both investment and operation. The support will be distributed through the so-called reverse auction where operators bid for how much CO2 they can capture and store and at what cost. The operator (s) able to deliver bio-CCS to the lowest bid and comply with the eligibility conditions will be awarded aid. The Swedish Energy Agency is designated as an auctioneer and can distribute SEK 36 billion over the period 2026-2046 to the operators who win the reverse auctions.

The scenarios presented in Chapter 4 contain assumptions for the implementation of CCS in several industrial installations as well as CCS in the electricity and district heating sector. By 2030, the scenarios include CCS assumptions with more than 1.5 million tonnes of carbon dioxide equivalent capture. The installations are located at the water and the CO2 is expected to be transported by ship to Norway for storage. The estimated amount of biogenic carbon that could be captured by bio-CCS from 2030 onwards is 1,2-2.2 million tonnes.

Transport sector

Reduction obligation

In order to promote the use of biofuels, a reduction obligation for petrol and diesel was introduced on 1 July 2018.106 This means that every year all fuel suppliers must reduce greenhouse gas emissions from a life-cycle perspective from petrol and diesel by a certain percentage through a gradual increase in biofuel blending, see Table 14.

Table 14 reduction levels 2018-2024 under the Act on the reduction of greenhouse gas emissions from certain fossil fuels.

Year	2018	2019	2020	2021	2022	2023	2024
Diesel	19.30 %	20 %	21 %	26 %	30 %	30 %	6 %
Gasoline	2.6 %	2.6 %	4.2 %	6 %	7.8 %	7.8 %	6 %

106Act (2017: 1 201) on the reduction of greenhouse gas emissions from certain fossil fuels.

[115] Swedish Energy Agency, *Support for bio-CCS through reverse auction,* https://www.energimyndigheten.se/klimat--miljo/ccs/statligt-stod-for-bio-ccs/ (2024).

Until 2022 there was a gradual increase in the reduction obligation and in 2023 the level of reduction was phased out at the 2022 level. In 2023, the Riksdag took a decision to reduce the reduction obligation to 6 % for 2024-2026 and to abolish the reduction levels for 2030-2027. The Government intends to come back to the Riksdag on the reduction levels for 2027-2030. Other measures that are socio-economically effective should also be considered. The Government has announced in the Climate Action Plan that an inquiry will be set up in 2024 to analyse and provide evidence on whether and, if so, what instruments can be designed to ensure that Sweden's commitments in the EU are achieved in a cost-effective and socio-economically efficient manner.
The Swedish Energy Agency's scenarios for energy and emissions reported in Chapter 4 are based on the agreed reduction of the reduction obligation to 2026 of 6 %, and a 6 % level assumed for the scenario calculations also by 2030. The Swedish Energy Agency's assumption is due to the fact that there is an incentive for a certain amount of biofuel incorporation into petrol and diesel regardless of the level of the reduction obligation for 2027-2030.

CO2-based vehicle tax and increased vehicle tax for new petrol and diesel vehicles

In order to incentivise car buyers to choose cars, vans, buses and caravans with low CO2 emissions, the annual vehicle tax is differentiated according to the CO2 emissions of the vehicle per kilometre. This means that vehicles with lower CO2 emissions are taxed less than vehicles with higher emissions.

For new light petrol and diesel vehicles, an increased amount of CO2, known as malus, is levied in the first three years as part of the annual vehicletax. The aim is to increase the share of vehicles with lower CO2 emissions. For new cars, the increased amount of carbon dioxide is the sum of SEK 107 per gram of carbon dioxide emitted per kilometre in excess of 75 grams and up to and including 125 grams, and SEK 132 per gram of carbon dioxide in excess of 125 grams.

Reduced benefit value for green cars

The benefit of being able to use the employer's car for private journeys is generally taxable and the value is calculated on the basis of a special flat rate. In order to facilitate the introduction of green cars into the market, there is a specific reduction in the preferential value for electric, hydrogen, plug-in hybrids and gas cars. The reduction means that the benefit value is lower

than the market value of the benefit.

Pumping Act

In order to make renewable fuels available, Section 3 of the Act (2005: 1248) on the obligation to provide renewable fuels requires that service stations with sales of more than 1 500 m^3 petrol or diesel must offer at least one kind of renewable fuel. The Government has announced in its Climate Action Plan to establish an investigation to review the pumping law. The analysis will cover the requirements for the provision of renewable fuels, including whether the requirement should be broadened to include fossil-free fuels, not least in sparsely populated areas.

Environmental information on fuel

Since 2020, Section 11a of the Fuel Ordinance (2011: 346) has required consumers at the fuel pump to receive information on the climate impact and origin of fuel. The provision means that fuel suppliers are obliged to provide the information to consumers, based on the information they report annually to the Swedish Energy Agency in accordance with the Fuel Act (2011: 319). Environmental information shall be available at the pump and shall provide comprehensive information on the life-cycle greenhouse gas emissions of fuels as well as on raw materials and their country of origin. More detailed information shall be provided on the fuel suppliers' websites. The Government has also instructed the Energy Agency to analyse and propose a vehicle label for light vehicles. In addition to tailpipe emissions, the vehicle label shall also show the energy efficiency and lifecycle emissions of the vehicle. The aim is to create an easily understandable system that helps buyers to make informed choices in the choice of climate-smart vehicles.

Bioogase support for the production of biogas upgraded to biomethane

In order to accelerate the energy transition and decarbonisation, a support for the upgrading of biogas was introduced in 2018 so that it can be used in vehicles. In 2022, the aid was made more long-term by the Ordinance (2022: 225) on State aid for the production of certain biogas and Article 43 of EU Block Exemption[Regulation] 117 on State aid for the production of biogas upgraded to biomethane, i.e. aid for the quality required for feeding into a methane distribution network. Anyone who conforms biomethane can benefit from additional support under the Regulation. From 2024, support for the production of biogas from manure is also granted on the basis of this Ordinance. The allocation for these three aids in the 2024 Budget Bill (spending area 21) amounted to SEK 900 million in[118].

Electric bus premium and climate premium

The electric bus premium is a State aid for public transport operators purchasing electric buses with a transport capacity of more than 14 passengers. The premium is normally granted for

20 % of the purchase price of the electric bus. The Government has decided to phase out aid for urban electric buses (class I) until 30 June 2025, but that the aid will continue to be available for regional and long-distance buses (classes II and III). The climate premium is an aid to promote the market introduction of environmental work machinery, zero-emission heavy goods vehicles, eco-trucks, light electric trucks and vehicle gas trucks. The allocation for the electric bus premium and the climate premium is common and totalled SEK 576 million in 2023. Of the allocation, a maximum of SEK 260 million can be spent on electric buses. For the reinforcement and extension of the climate premium for heavy vehicles and work machines, the government has allocated a total of SEK 992 million in 2 024,1493 and SEK 2 033 million in 2026.

The aid for light electric trucks was introduced in February 2024 and applies for 3 years. Anyone buying a light electric lorry can receive up to SEK 50 000 in aid per lorry. The amount will subsequently be degressive and at the end of 2025 the aid is planned to be phased out.107 The allocation for light electric trucks is SEK 450 million SEK 2 025.550 million in 2025 and SEK 660 million in 2026.

Urban environmental agreements

In 2015, the Government introduced special support to promote sustainable urban environments, known as the Urban Environment Agreements (Ordinance (2015: 579) on aid to promote sustainable urban environments). The urban environment agreements were terminated with the adoption of:

[117] Commission Regulation (EU) No 651/2014 of 17 June 2014 declaring certain categories of aid compatible with the internal market in application of Articles 1 07 and 108 of the Treaty.

[118] Prop. 2023/24: *1, Budget Bill 2024*, regeringen.se/contentassets/e1afccd2ec7e42f6af3b651 091df1 39c/Budget Bill -for-2024-hela- dokumentet-prop.2023241.pdf (2023), op. cit. 21.

of the Budget Bill 2024. Decommissioning means that no new aid is granted and the City Environment Agreements will eventually be phased out. The support provided opportunities for municipalities and regions to receive up to 50 % of state co-financing for public transport infrastructure and from 2017 also for cycling. From 2019, measures for freight transport solutions were also included.

Environmental compensation for rail freight

Since 2018, the Government has allocated funds to an environmental compensation for rail freight transport (Ordinance (2018: 675) on environmental compensation for rail freight transport). The aim is to strengthen the competitiveness of rail and contribute to the shift of freight transport from road to rail. Since 2021, the aid is paid quarterly for transport work

107Ordinance (2020: 750) on State aid for certain environmental vehicles.

carried out to all legal persons authorised under the Railways Act to operate or organise transport services on Swedish rail networks, except for the transport of iron ore. The Transport Administration has followed up the aid in 2020 and 2023 and will carry out a further follow-up in 2026. During the period 2018-2020, a total of SEK 763 million was allocated for this purpose. During the period 2021-2025, SEK 550 million per year has been allocated. In addition, for 2022 a further SEK 697 million was committed, bringing the total aid for 2022 to SEK 1 247 million.

Investment aid for the transfer of freight transport to rail and maritime transport – ecobonus

Since 2018, the government has allocated funding for the shift of freight transport to maritime transport. The objective of the aid is to promote, through better coordination between the modes of transport, the shift of freight transport to sea or intermodal transport with a lower impact on the climate than transport by road lorry. The aid has an annual budget of SEK 100 million, which expires in 2024. A broadened ECOBONUS is now planned, including overshuffling to rail. The implementation of the aid is subject to the approval of the European Commission and the notification of the aid is ongoing in 2023/2024.[120] Ecoobonus has been evaluated for the 2022-2018 funding period.[121]

Public procurement of transport

Since 2009, passenger cars purchased or concluded by a government authority are to be environmentally friendly cars, see Ordinance (2020: 486) on environmental and road safety requirements for public authorities' cars. Many municipalities and companies apply, on a voluntary basis, the same requirements for the purchase and leasing of vehicles.

The Act (2011: 846) on environmental requirements for the procurement of cars and certain services in the field of road transport implements Directive (EU) 2019/1161 amending Directive (2009/33) on the promotion of clean and energy-efficient road transport vehicles. The Directive requires Member States to ensure that contracts awarded following the procurement of vehicles and certain services, including public transport, comply with a minimum share of green vehicles, known as 'minimum targets'.

The Public Procurement Authority provides criteria for public procurement of passenger transport, freight transport, fuel, tyres, public transport and vehicles to support the way purchasers can set requirements. The Swedish Transport Agency annually assesses compliance with the Act (2011: 846) on environmental requirements in the procurement of cars, etc.108

Coordination of charging infrastructure and renewable fuels

108 Swedish Transport *Agency, Summary of public*authorities' cars, https://www.transportstyrelsen.se/sv/vagtrafik/statistik/Uppfoljning-myndigheters-bilar/sammanstallningar-.

The Swedish Energy Agency is tasked with providing information on the location of recharging points and coordinating support for charging infrastructure for recharging vehicles and renewable fuel infrastructure requiring dedicated infrastructure, such as clean biodiesel, E85, vehicle gas and hydrogen. The work also includes supporting the Environmental Protection Agency in support of Climate Leap with, among other things, expertise and advice on prioritisation and information on geographical distribution and evaluation of aid granted.

[120] Swedish Transport Administration, *ecobonus – environmental compensation for the transfer of goods to sea,* https://bransch.trafikverket.se/tjanster/ansok-om/ansok-om-miljokompensation-for-overflyttning-av-gods-till- sjofart/(2023).

[121] Swedish Transport *Administration, Ecoobonus Evaluation of the 2022-2018 funding period,* https://trafikverket.diva-portal.org/smash/get/diva2:1802038/FULLTEXT01.pdf (2023).

In early 2024, the Swedish Energy Agency received a national coordination mission for charging infrastructure, covering support, statistics, information and knowledge dissemination. The mission also includes actively monitoring developments with a view to proposing regulatory changes at both national and EU level as appropriate. Providing knowledge support to various actors is also an important element, for example Sweden's municipalities play an important role at local level. In 2024, the Swedish Energy Agency is working to build and develop national coordination for recharging infrastructure.

Support for recharging and hydrogen refuelling infrastructure

Individuals wishing to install a charging box at home can benefit from a tax reduction for the installation of green technologies (see 3.1.2). Climate Leap can also provide support to operators who want to install charging stations for residents and employees of homes and workplaces, formerly known as 'Ladda Bilen'. Climate Leap can also support public charging stations and non-public charging stations for vehicles other than passenger cars, such as depot charging for trucks. In 2024, Climate Leap has been allocated an allocation of SEK 4.9 billion, of which SEK 500 million is dedicated to an investment in charging infrastructure. In 2023, SEK 823 million was allocated aid to a total of 56 928 new recharging points. Of these, SEK 226 million was distributed to 841 public recharging points for light and heavy-duty vehicles and non-public recharging points for vehicles other than passenger cars. SEK 597 million was granted to 56 087 non-public recharging points for residents and employees.

In addition, for audiences recharging of heavy-duty vehicles and hydrogen refuelling of heavy-duty vehicles, the programme includes regional electrification pilots.
In 2022, the Swedish Energy Agency granted aid under that programme to 140 recharging stations, 12 hydrogen refuelling stations and a combined recharging and hydrogen refuelling station for a total amount of SEK 1.4 billion. An additional SEK 1.4 billion is allocated to the regional electrification pilots in the coming years and the Swedish Energy Agency plans to

publish these funds in 2023 and 2024.

In order to ensure basic access to recharging infrastructure for fast charging of electric vehicles throughout the country, where such infrastructure is not otherwise deployed, SEK 90 million has been allocated to the Transport Administration's so-called White Longor Support.

Air travel tax

On 1 April 2018, a tax on air travel was introduced in Sweden with the aim of helping to reduce the climate impact of air transport, by means of the Air Travel Tax Act (2017: 1200). The tax is designed as a tax on commercial air travel and is payable on passengers departing from an airport in Sweden. The operating air carrier is liable to tax. Different amounts are charged according to the final destination of the passenger, divided into three groups (for 2024: SEK 76, 315 or SEK 504).

Reduction obligation for flights

Since 1 July 2021, aviation kerosene has been subject to a reduction obligation. The reduction obligation obliges suppliers of jet kerosene to blend biofuels into fossil kerosene. The requirement for interference started at 0.8 % in 2021 and is 3.5 % in 2024 and is set to increase progressively to 27 % in 2030. Sweden will review the existing national reduction obligation for kerosene in the light of the provisions of the EU Regulation ReFuelEU Aviation.

Environmental management fees for take-off and landing

At airports covered by the Airport Charges Act (2011: 866), namely Arlanda and Landvetter, since the 2022 charges, take-off and landing charges must be differentiated according to the impact of aircraft on the climate.
The differentiation shall be made in such a way as to reduce the climate impact of the aircraft.

Night trains abroad

On 24 July 2020, the Government instructed the Transport Administration, in accordance with the provisions of European Parliament and Council Regulation (EC) No 1370/2007 of 23 October 2007 on public passenger transport services by rail and by road and repealing Council Regulation (EEC) No 1191/69 and (EEC) No 1107/70, to procure and award contracts for night train services.109 110111 A contract was signed between the Transport Administration and SJ AB which regulates traffic between Stockholm and Hamburg. The starting point for the service is that it will run on the days on which commercial services on the route are not operated during

109Government, *Mission to award a contract for night train services through Sweden and Denmark which: contributes to the establishment of international night train connections with daily departures from Sweden to others European countries*, https://regeringen.se/regeringsuppdrag/2020/07/uppdrag-att-genomfora-en-upphandling- – night-time traffic/(2020).

the period from 1 August 2022 to 30 July 2026, with the possibility of an extension of two years.[124]

Scrappage payment

The Government's Climate Action Plan of December 2023 states that a temporary scrapping premium for older cars with an internal combustion engine will be introduced. It is stated that the premium should be conditional on the purchase or lease of an electric car. The Government has therefore set aside SEK 250 million per year in 2024 and 2 025 in the Budget Bill for[125].

Waste sector and circular economy

Ban on landfilling combustible and organic matter and collection of methane

In accordance with the Ordinance (2001: 512) on the landfill of waste, landfilling of combustible and organic matter is prohibited. The Regulation also regulates the collection and disposal of methane gas from landfills.

Waste tax

In 2000, a landfill waste tax was introduced112. The tax has been gradually increased and, from 2025 onwards, it takes place through an annual CPI mark-up. The tax in 2024 amounts to SEK 725/tonne of waste entering a waste facility (landfill).

Sorting requirements

Chapter 3 of the Waste Ordinance (2020: 614) contains a number of requirements for separate high-grading in order to increase the amount of waste prepared for re-use or recycling and thus reduce incineration. Such requirements exist, inter alia, for bio-waste, recycled paper, textile waste (to enter into force on 1 January 2025), packaging waste, electrical and electronic equipment, end-of-life cars, tyres, fishing gear and construction and demolition waste. In addition, there is a prohibition on incinerating such waste which has been separately collected for the purpose of:

[124] Swedish Transport Administration, Final report, *Procurement of night trains to Europe (2022: 170)*, https://trafikverket.diva- portal.org/smash/get/diva2:1707609/FULLTEXT01.pdf (2022).

[125] Prop. 2023/24: *1, Budget Bill 2024* , https://www.regeringen.se/rattsliga- document/proposition/2023/09/prop.-2023241 (2023).

preparing for re-use or recycling (Chapter 3, Section 19). Several of the sorting requirements are linked to the introduction of the requirements of the Waste Directive in Article 11.

The Waste Tax112 Act (1999: 673).

Producer responsibility

The Extended Producer Responsibility (EPR) legislation will encourage companies to develop products that are resource-efficient, easy to recycle and free from environmentally hazardous substances. In this way, Sweden and other EU countries will receive less waste as well as cleaner waste. In total, eleven product groups are covered by extended producer responsibility (EPR) under a series of regulations, with[127] promoting the sorting, collection and recycling of waste streams. The aim is also to reduce the amount of waste. In addition, there are voluntary commitments, similar to producer responsibility, for office paper and agricultural plastics.

Collection of bio-waste

As of 1 January 2024, requirements for high-grading and separate collection of bio-waste from households and businesses apply. The requirements are linked to the introduction of Article 22 of the Waste Directive (2008/98/EC) on bio-waste and require EU Member States to ensure that bio-waste is either separated and recycled at source, or collected separately and not mixed with other types of waste.113 114From 1 January 2024, it also requires packaging to be emptied of its contents in order to be subsequently recycled. The provision can be found in Chapter 3, Section 4a of the Waste Ordinance.

Measures for the sustainable use of single-use plastic products

To reduce the littering of single-use items and resource consumption, the government has introduced a number of regulations to implement EU Directive 2019/904. Ordinance (2021: 996) on single-use products aims to reduce littering and promote a circular economy. This Ordinance provides, inter alia, that anyone who makes a beverage available on the Swedish market in a mug that is a single-use product must offer an opportunity to obtain the beverage.

[127] Ordinance (2021: 999) on producer responsibility for balloons, Ordinance (2008: 834) on producer responsibility for batteries, Ordinance (2023: 132) on producer responsibility for cars, Ordinance (2023: 133) on producer responsibility for tyres, Ordinance (2022: 1276) on producer responsibility for electrical equipment, Ordinance (2021: 1 001) on producer responsibility for fishing gear, Ordinance (2022: 1274) on producer responsibility for packaging, Ordinance (2021: 998) on producer responsibility for certain tobacco products and filters, Ordinance (2021: 1 000) on producer responsibility for wet wipes, Ordinance (2009: 1031) on producer responsibility for medicinal products, and Ordinance (2007: 1 93) on producer responsibility for certain radioactive products and orphan sources, served in a reusable mug. The same applies to fast food served in a disposable food box. The attractions are also included. The Regulation also regulates a number of prohibitions on the use of certain products and sets a target for cups and food boxes that are single-use plastic products to be reduced by 50 % from 2026 compared to consumption in 2022. In addition to the Single Use Products Regulation, there are also regulations on producer responsibility for balloons, wet wipes, tobacco products and filters and fishing gear.[129] Sweden currently also has a tax on plastic carrier bags. However, the Riksdag has decided to abolish the tax by repealing the Act (2020: 32) on the tax on plastic carrier bags on 1

113 Swedish Environmental Protection Agency, *Requirements for separate collection of bio-waste,* https://www.naturvardsverket.se/vagledning-och-residue/pa-separate-waste collection/bio-waste-collection (2024).

November 2024.

Municipal waste management plans

In accordance with the Environmental Code, all municipalities must have a waste management plan covering all types of waste and the measures needed to manage the waste in an environmentally and resource-appropriate way. The waste management plan shall include, inter alia, measures to reduce the quantity and hazardousness of the waste.115

National waste management plan and waste prevention programme

The Swedish Environmental Protection Agency is responsible for ensuring that there is a national waste management plan and a waste prevention programme that meet the requirements of the EU Waste Directive. The plan contains a description of the waste targets and adopted policies and measures, as well as an analysis of the development and need for the necessary infrastructure for the collection and treatment of waste according to the waste hierarchy in order to achieve the objectives set out in the Waste Directive.

Other circular economy measures

In addition to measures in the waste sector, further measures are described in Sweden's circular economy strategy.116 Four areas where action is of particular importance are in sustainable production and product design, non-toxic and circular cycles, sustainable ways of consuming and using materials;

[129] Swedish Environmental Protection Agency, *Single use plastics and other single-use products*, https://www.naturvardsverket.se/vagledning-och-stod/plast/engangsplast (2024).

products and services, as well as circular economy as a driver for industry and other stakeholders through actions promoting innovation and circular business models. Priority streams are plastics, textiles, food, renewable and bio-based raw materials, the construction and real estate sector and innovation critical metals and minerals. For example, measures are included to increase the share of circular and fossil-free procurement, to reduce plastic waste and to separate textile waste collection. In addition, the Swedish Environmental Protection Agency is responsible for national plastic coordination aimed at promoting a more sustainable use of plastics117 118 119 and for the Agency to work towards a socio-economically efficient transition to a circular economy. Both missions aim in the long term to contribute to the

The115 Swedish Environmental Protection Agency's regulations (2006: 6) on municipal waste management plans on waste prevention and management.

116 Government, *Circular Economy – Action Plan for the Transformation of Sweden, https://www.regeringen.se/contentassets/4875dd887fd34edabd8c1d928a04f7ba/cirkular-ekonomi-* ActionPlan for Omstallning-av-sverige.pdf (2021).

The117 Swedish Environmental Protection *Agency, the Swedish Environmental Protection Agency's roadmap for sustainable use of plastics;* https://www.naturvardsverket.se/amnesomraden/plast/hallbar-plastanvandning/naturvardsverkets-fardplan-for-en-hallbar plastics/(2024).

achievement of climate objectives.

Agriculture sector

CAP Strategic Plan 2023-2027

On 28 October 2022, the European Commission approved the Swedish CAP Strategic Plan 2023-2027. At the start, the plan has a total budget (EU and state budget) of approximately SEK 60 billion for the years 2027-2023. The plan is about increasing productivity, profitability and competitiveness in the sector, as well as prioritising animal welfare and increasing environmental and climate ambition. The aim is also to contribute to the development of the rest of Sweden's rural areas so that it is possible to live and work there.

The Strategic Plan allows for investments and management measures on individual farms, such as the construction of wetlands and irrigation ponds, investment in new technologies and cover drainage, the cultivation of intermediate crops, grazing land management, precision cultivation and the maintenance of wetlands. There are also basic conditions for receiving the aid, such as crop rotation requirements, the disposal of environmental surfaces, Winter green land and the protection of peatlands. Actions for skills development and coordination of agricultural knowledge and innovation systems are other important components of the Strategic Plan.

The Strategic Plan also states that climate action in agriculture is also implemented with national support, outside the strategic plan. Examples are investment aid from Climate Leap and rewetting agreements. More information on these can be found later in this section.

The Common Agricultural Policy Network (CAP network) is also part of Sweden's strategic plan and is located at the Board of Agriculture.
The network brings together actors at local, regional and central level to facilitate the implementation of the Strategic Plan and contribute to the exchange of information and experience in the areas in which the Plan operates. The network also works on innovation support (EIP-agri) and promoting innovation.

Conditionality
The strategic plan includes a set of conditionality (GAEC). These are rules with which farmers' aid applicants need to comply in order to obtain full payment of the aid.
Some of the PRCs are primarily aimed at reducing the leakage of plant nutrients. By reducing nitrogen leakage, indirect emissions of nitrous gases are also reduced. The baseline conditions that can lead to the reduction of indirect air gas emissions are GAEC 6[133], 7[134] and 8120.

120GAEC 8 includes a requirement for environmental surfaces. The beneficiaries of the requirements shall have environmental surfaces on at least 4 % of the arable land. Environmental surfaces include grazed fallow, flowering fallow, covered field edge, flowering field edge and green fertilisation crops. Both grown and flowering field edge must be at least 2 metres wide.

Investment aid

Under the Strategic Plan, farmers can apply for investment aid linked to increased competitiveness. This aid includes investments to reduce ammonia departure through manure acidification, slurry injection units and for roofs in manure treatment plants. Reduced ammonia emissions also lead to reduced indirect emissions of nitrous gases. Investment aid for the construction of new buildings, for example, often leads to energy savings and efficiencies.

Annual Environmental Allowances (Eco schemes)

The Strategic Plan provides for a one-year *environmental compensation for catch crops*. The Aid Area covers the nitrate vulnerable zones. A growing catch crop absorbs nitrogen and reduces the risk of high nitrate concentrations in the soil and can therefore:

[133] GAEC 6 requires a prescribed share of arable land to be covered in sensitive periods. The percentage of land cover varies across geographical areas. Authorised soil cover includes grass, certain crops harvested late, autumn sowing, intermediate crops, arable land unprocessed after cereal and oilseed cultivation (stubble).

[134] GAEC 7 means that on one third of arable land there must be annual swaps between annual crops. Perennial crops such as grassland are exempted from the requirement of annual crop replacement. No one year crop may be grown for more than three consecutive years on the same parcel. Derogations exist for maize and fresh potatoes,

reducing the risk of odour formation. A catch crop also secures carbon during autumn and winter when the soil is otherwise bare or stubble. A risk element is the breaking of the catch crop, as the incorporation of a nitrogen catch crop may increase the risk of formation of odour.

Environmental compensation for spring processing contributes to a reduction in nitrogen leakage, which at that time also leads to a reduction in indirect greenhouse gas emissions.

In large parts of Sweden there is *environmental compensation for intermediate crops* with the aim of contributing to increased carbon storage.

As of 2023, a one-year *environmental payment for precision farming* is in place to help adapt fertilisation to crop needs and to avoid that unused plant nutrients remain in the soil, at risk of leaching. In order to obtain the compensation, applicants must, among other things, draw up a plant cultivation plan and analyse their land and manure and their plant nutrient use.

Multiannual environmental payments

The strategic plan also provides for the possibility of seeking environmental compensation within the NVZ for protection zones against water areas or for adapted protection zones built on parts of the parcel where surface run-off and erosion may occur. For both water protection zones and adapted protection zones, they must be sown with grass or grasses mixed with leguminous crops. It is also permitted to blend seed mixtures that benefit insects. The protection zone shall remain intact throughout the five-year commitment period. The aid reduces nitrogen losses and thus reduces indirect emissions of nitrous gases and carbon sequestration.

Knowledge hub for environment and climate in the Swedish Board of Agriculture

A national knowledge hub for the environment and climate linked to agriculture is located at the Board of Agriculture. The Hub coordinates efforts to acquire, build and disseminate knowledge in relevant areas with a view to supporting advisory actors that can be channelled to individual farms. The hub includes supporting the Greppa Industry advisory campaign.

Climate advice in Greppa Industry

The advisory service 'Greppa Säringen' is carried out in cooperation between the Board of Agriculture, the advisory companies, the Lantbrukarnas Riksförbundet and the county administrative boards. The targets are reduced emissions of climate gases, reduced eutrophication, safe use of plant protection products and increased biodiversity.

The climate collet is individual advice to agricultural holdings with the aim of providing an understanding of the company's climate impact and of the opportunities available to reduce the climate footprint. Greenhouse gas emissions are calculated on the basis of input and output on the farm. The advice includes a climate calculation in the Vera programme, developed and managed by the Swedish Board of Agriculture within Greppa Nindustri. From 2022, there is also an opportunity to follow up on Climate collen.

The Energy Collagen is the energy advisory service within the Swedish Confederation of Industry. Group advice is offered which can be combined with individual advice to livestock farms. The group advice consists of two meetings where an energy survey is carried out and compares energy use and measures with others. The individual advice given to livestock farms involves the help of an adviser to review how energy is used on the farm between the meetings of the group advice. The main objective of the energy package is to reduce emissions from agricultural energy use.

The Board of Agriculture finances advice to produce biogas.
The advice consists of group meetings, the possibility of forming biogas networks and individual advice. The advice aims to increase interest in investing in biogas plants which in turn lead to substitution benefits where biogas can replace fossil energy and can also contribute to the reduction of greenhouse gas emissions in the agricultural sector.

There are also other advice that promotes resource efficiency in the Greppa industry. One of the greatest potential for agriculture to reduce its climate impact is by becoming more resource efficient at all stages, reducing the climate footprint of what is produced on the farm. There are various types of advice that work on efficiency of production based on several environmental objectives. Advice is adapted according to the type of production. In 2023, Greppa Enterprise launched a new sustainability analysis to give farmers a better insight into the current situation and how the farm is located in relation to other comparable farms. The sustainability analysis covers the six main areas of eutrophication, soil health, plant protection, biodiversity, climate

and energy. Animal producers can obtain advice within the Swedish Confederation on, inter alia, the livestock and external environment, control of feed states, grazing strategies and nitrogen strategies related to livestock manure. All this aims to improve and improve the efficiency of production, resulting in lower emissions per unit of output. For crop growers, there is advice on plant nutrient balance, nitrogen strategy, soil content and fertility and soil compaction. There are also water-related advice on the review of drainage and the maintenance of ditches. Advice can, by reducing nitrogen use, reduce direct emissions of nitrous gas, while other advice that leads to increased productivity linked, for example, to soil health results in a lower climate impact per kilogram of product.

Knowledge hubs of animal production

Knowledge hubs of animal production are a state-funded knowledge hub established at the Swedish research institute RISE.121 The Kunskapsnavet's aim is to strengthen the productivity, profitability and competitiveness of Swedish livestock production. The knowledge hub, together with the industry, will contribute to the knowledge that needs to be developed in order to continue developing Swedish production. Measures to increase productivity include those that increase the fertility of animals, improve animal health and reduce mortality. These measures are mainly implemented because they are profitable, but they have a positive side effect in reducing the climate and air impact per kilogram of food produced.

Climate Leap

In order to contribute to more climate-efficient and sustainable food production, farmers can apply for investment aid from Climate Leap (see previous section). Applications from farms have increased each year until 2022, but slightly decreased in 2023 when Climate Leap had only one call for proposals. Eligible measures mainly concern switching from fossil fuels to renewable energy in boilers used for drying cereals and heating houses and greenhouses, switching from diesel to electricity in feeding, fertilisation and irrigation equipment, as well as investments in manure based biogas production. Several of these measures mainly contribute to emission reductions in other sectors. If the digestion of livestock manure and the storage of digested manure is carried out with the best available techniques and based on existing recommendations, the measure can also provide an overall climate benefit in the agricultural sector in terms of reducing greenhouse gas emissions from both storage and application of manure. With the development of new measures and improved calculation methods, more measures to reduce emissions from the agricultural sector can be envisaged.

Aid for the production of biogas from manure

The mission of121 RISE is to promote sustainable growth in Sweden by strengthening the competitiveness and innovation of the economy and contributing to the innovative development of society.

More and more biogas is produced from manure. In addition to the fact that aid for investments in new biogas plants can be granted through Climate Leap, production aid is also provided. A specific aid for biogas production from manure was introduced in 2015. The support for manure based biogas aims, on the one hand, at stimulating the production of renewable energy and, on the other hand, at reducing methane gas emissions from livestock manure. From 2024, the aid is managed by the Swedish Energy Agency. This support has previously been dealt with by the Board of Agriculture. The aid is managed together with other production aid for biogas and the joint allocation for these aids is SEK 900 million per year for 2026-2024, of which SEK 250 million in 2024 is dedicated to the production of manure based biogas. For 2024, SEK 145 million was requested for aid for a production of 0.36 TWh. The aid is production aid and is granted in accordance with the Ordinance (2022: 225) on aid for the production of certain biogas, as well as Article 43 of EU block exemption Regulation 651/2014 (GBER). The aid is paid in advance and reported back the following year.

Instruments related to nitrogen and ammonia

Measures to improve nitrogen utilisation, reduce nitrogen leaching from arable land and ammonia drainage from mineral and livestock manure reduce the risk of direct aerobic deposition, but also indirectly nitrous deposition from nitrogen or ammonia leaching. There are a number of requirements and policies linked to both nitrogen leaching and ammonia that can have positive effects on the indirect emissions of nitrous gases. Discharges of nitrates are covered, inter alia, by the Nitrates Directive, the Helsinki Convention and the Water Framework Directive. The Nitrates Directive has been transposed in Sweden by the Environmental Code, the Ordinance (1998: 915) on environmental concerns in agriculture and the Swedish Board of Agriculture's regulations and general guidelines (SJVFS 2004: 62) on environmental concerns in agriculture as regards plant nutrients. Several of the measures related to the Helsinki Convention are similar to those of the Nitrates Directive and have been transposed in Sweden accordingly. Ammonia emissions are covered by the Cap Directive, the LRTAP Convention and the Industrial Emissions Directive. The Swedish Board of Agriculture's regulations and general advice (SJVFS 2004: 62) on environmental concerns in agriculture as regards plant nutrients regulates measures to reduce ammonia loss in accordance with the LRTAP Convention. These measures mainly concern the storage and application of livestock manure and may also have an impact on methane and odour gas departure from the manure.

Land use, land use change and forestry (LULUCF)

Forest Management Act

The Forestry Act (1979: 429) has two overarching equal objectives: supporting production and protecting the environment. The production target means that forests and woodland are used efficiently and responsibly so that they deliver sustainable yields. The focus on forest

production shall be given flexibility in the use of the forests produced. The environmental objective is to maintain the natural productive capacity of forest land. The biodiversity and genetic diversity of forests shall be safeguarded and protected, the cultural environmental values of forests shall be safeguarded and environmental considerations shall be taken into account in forest management. Further clarification of the requirements of the Act can be found in the Forestry Ordinance and the Forestry Agency's regulations. The Forest Agency also decides on general advice on the sections of the Act. The regulations are binding rules that need to be introduced, while the general advice provides general recommendations on how a regulation should be applied.

Relevant regulation exists in the Forestry Act to ensure that carbon sinks and reservoirs in forests are maintained or improved. The Forestry Act contains provisions to ensure that forests are managed in such a way as to produce good yields and that, in the construction of new forest/regeneration, the regeneration measures that may be needed to ensure the regeneration of a forest of satisfactory density and quality in the rest (1 and respectively. SECTION 6). In addition, new forests must be built after felling when the wood producing capacity of the land is not exploited (Section 5) and harvesting on productive forest land must be suitable for the regeneration of new forests or promote forest development as regulated by regulations on the minimum age for felling and on how harvesting is to be carried out (Chapter 3, Section 10 of the Swedish Forest Agency's Regulations and General Advice (SKSFS 2011: 7) to the Forestry Act).

The Forestry Act also contains provisions that can reduce the vulnerability of forests to natural or ecosystem disturbances driven by climate change and thus contribute to ensuring the conservation or enhancement of carbon sinks and carbon stores in forests (see section on 'Governance and measures to reduce forest vulnerability').

Advice and training on forest management

The Forest Agency provides information to forest owners to manage their forests on the basis of the property conditions and the owner's own objectives. Management advice is also provided on the impact of climate change and adaptation in forests (see section 'Governance and measures to reduce forest vulnerability'), as well as on management to promote forest growth.[137]

Policies and measures to reduce forest vulnerability

To reduce the vulnerability of forests to natural disturbances or ecosystem disturbances driven by climate change, different types of policies and measures are introduced. The relevant regulation is contained in the provisions of the Forestry Act that regeneration measures must create the conditions for satisfactory wood production, which may include taking into account

resistance to infestation by forest pests in the construction of forest stands and that tree species selection must take into account the conditions of the plant site, including climate.[138]. In addition, only forest reproductive material may be used which can provide forest stands that are well placed to develop well and which can use the land for satisfactory wood production, which means that the climate of the growing area is taken into account122. Regulations to minimise occurrence and combat forest pests can be found in Chapter 6 of the Forestry Agency's Regulations for the Forestry Act, which requires damaged wood to be taken in order to avoid insect infestation, and in Chapter 3 and related general advice where derogations are made.

[137] Swedish Forest Agency, *Annual Accounts 2022,*https://www.skogsstyrelsen.se/globalassets/om-oss/var-Activities/Arsaccounts-2022.pdf (2023).

[138] Sections 6-6a of the Forestry Act, Sections 4-6 of the Forestry Ordinance, Chapter 2 of the Forestry Agency's Regulations and General Advice (SKSFS 2011: 7) to the Forestry Act, and the Forestry Agency, *Analysis of regulations according to the need for adaptation to climate change in forests and forestry*,https://www.skogsstyrelsen.se/globalassets/om- us/reports/rapporter-2023/rapport-2023 – 17-analys-av-regulations-utifran-needsv-adaptation – i- footwear and forestry system.pdf (2023).

some rules on harvesting may be allowed to encourage the harvesting of damaged trees and thus avoid insect infestation.

Further provisions can be found in the Plant Health Act (2022: 725) and regulations for those who implement mainly the EU Regulation on protective measures against pests of plants in Sweden. It sets out which plant pests are to be controlled in accordance with EU and supplementary Swedish regulations, respectively, in Sweden.

Regulations to reduce the risk of forest fire are laid down in Chapter 2, Section 7b of the Accident Prevention Act (2003: 789), which provides that a county administrative board or municipality may impose a heating ban to prevent forest fires when the risk of fire is higher due to dry and warm weather. Fire prevention also involves surveillance and after-extinguishing of fire-fire-fired fire-fills when any fire is extinguished. The forest owner is responsible for surveillance and in fire areas at the end of the rescue operation.

Infrastructure such as forest car roads also helps to combat and reduce the impact of forest fires, as well as resources such as airplanes, helicopters, forest fire depots, forest fire equipment, etc. The evacuation of forest and land fires is carried out as early as possible using forest fire guarding aircrafts and satellite. From 2022, satellite detection is used that can directly alert emergency services via SOS Alarm if a fire is detected.

Measures to prevent and mitigate damage caused by natural disturbances on forest land also entail the provision of information to the public in the form of advice and input data. Major

Chapter122 2, Section 16 of the Swedish Forestry Agency's Regulations and General Advice (SKSFS 2011: 7) to the Forestry Act.

damage events that have affected Swedish forests over the past 10 years, such as drought and subsequent infestation of spruce bark beetles, have led to the rapid development of relevant information, a work which is still ongoing.
Examples of these are:

- Input data based on geo-data: digital map to facilitate the identification and control of forest damage such as maps on the risk of spruce bark beetle and fire risk maps in[140], ongoing Forest Agency project "Geodata for forest damage".[141]

- Statistics on damage due to natural lesions.[142].

- Advisory campaigns and courses for forest owners aimed at increasing: tree species mix on properties that do not already have it; share of mixed forests; the use of more resistant forest reproductive material; roostery control (biological); dry pine; increase natural regeneration to maintain genetic variation; free-riding on land with an increased risk of breeds and landslides (including damage to infrastructure); proportion of deciduous trees strategically placed can reduce fire risk.[143].

- Supporting documents in the form of reports and guidelines.[144]

- Work carried out at SLU Skogsskaderum.[145]

- Cooperation with other stakeholders within the framework of the Forest Agency's Central Forest Protection Committee. Sweden's work to prevent or limit the consequences of natural disturbances is mainly based on the principle of "freedom under responsibility", leading to the voluntary implementation of most measures, including the measures proposed in the general advice to the Forestry Act. The number of instruments requiring measures to be implemented is limited to the regulations relating to the Forestry Act and the requirement to respect fuel bans.

Sweden's national forest programme

The strategy for Sweden's national forest programme was adopted by the Government on 17 May 2018.123 The124 work of the National Forest Programme Strategy is guided by the vision of the programme: "Forests, the green gold, will contribute to jobs and sustainable growth throughout the country, as well as to the development of a growing bioeconomy." The strategy has developed an action plan which includes:

[140] Swedish Forest Agency, *Map,* https://kartor.skogsstyrelsen.se/kartor/ (2024).

[141] SMHI, fire *risk forecasts,* https://www.smhi.se/vader/varningar-och-brandrisk/brandrisk (2024).

[142] See, for example, *the Forest Agency, forest damage in Sweden in 2021*,https://www.skogsstyrelsen.se/globalassets/om- oss /reports/rapporter-2022202120202019 2018/rapport-2022 – 06-forest damage i-sverige-2021.pdf (2022), and the Forest Agency's ongoing project "Inventory, monitoring and statistics on forest damage".

123Government, *Strategy for Sweden's National Forest Programme;* https://www.regeringen.se/contentassets/34c91971 5e0b4285a5da5b51f38b28af/20180524_hela.pdf (2018).

[143] Skogsstyrelsen, *Forest Meetings and Advice,* https://www.skogsstyrelsen.se/aga-skog/radgivning/ (2024).

[144] Forexample, guidelines at https://www.skogforsk.se/kunskap/temasidor/skogsbrand/

[145] Swedish University ofAgricultural Sciences, *SLU Skogsskacenter,* https://www.slu.se/centrumbildningar-och-project/Final Forest Centre/ (2024).

concrete measures based on the Forest Programme's vision and objective[147]. The availability of sustainable biomass from Swedish forests has an important role to play in the further transition to a fossil-free society.

Environmental Code

The Environmental Code contains rules on, inter alia, the protection of areas, environmentally hazardous activities, water operations, genetic engineering, chemical products and waste (see Section 3.1.1.2) The majority of rules in the Environmental Code are general. In order to clarify the rules, the Government has issued a large number of regulations. Forests are affected, inter alia, by regulations on site protection, species protection and notification for consultation. Land drainage is also regulated in the Environmental Code.
The Environmental Code is applied in parallel with the Forestry Act, but takes precedence in some respects. The Environmental Code helps to maintain and increase coal stores and sinks.

Nature reserves, conservation contracts and voluntary provisions

In Sweden, forests and land are devoted to biodiversity conservation and outdoor life. It involves both caring for and preserving valuable natural environments and protecting, restoring or newly creating valuable natural environments.

Conservation of protected nature can take the form of national parks, nature reserves, nature conservation contracts, biotope protection and voluntary reserves. In Sweden, nature reserves are one of the most common ways of protecting valuable nature in the long term. Chapter 7 of the Environmental Code sets out the rules for the creation of nature reserves. The Environmental Protection Agency pays compensation to landowners and the county administrative board decides on the creation of state nature reserves. Municipalities can also form nature reserves.

Nature conservation contracts are civil law contracts.125 The property owner and the State or a municipality agree on a certain amount of financial compensation for the property owner against the latter's abandonment of certain measures, such as forestry. Often, the agreement also contains an agreement that certain management measures may be carried out by the State. Swedish Forest Agency and Environmental Protection Agency

[147] Government, *Action Plan for Sweden's National Forest Programme 2018*;

125 Swedish Environmental Protection *Agency, Nature* Conservation Agreement,https://www.naturvardsverket.se/vagledning-och-stod/skyddad- Nature/ Nature agreement/(2024).

https://www.regeringen.se/contentassets/96a3c0c104094493a3e2b21c4877d701/handlingsplan -for-sveriges- nationella-forest programme-2018.pdf (2018).

guide together how to proceed. For the owner of the land, it shall not matter which authority is agreed.

Rules on soil drainage

The Environmental Code contains rules on land drainage that can help reduce greenhouse gas emissions from peatlands. Soil drainage is the measures carried out to remove water (drainage soil) or protect against water. On woodland, this is mainly a case of excavation of new ditches. Soil drainage does not include protective drainage after felling aimed at removing excess water for a limited period of time in order to provide good conditions for the plants. For the measure to be a land drainage within the meaning of the Environmental Code, the aim of the measure must be to permanently increase the suitability of the land for a particular purpose, such as cultivation, building, peat removal, road construction, gardening or golf courses.

Since 1986, land drainage has been a water activity subject to a permit requirement in the whole of Sweden under the Environmental Code, and in most southern Sweden it also prohibits land drainage. The ban on land drainage means more stringent conservation protection and that the assessment of land drainage must be carried out in two stages. First, a derogation from the land drainage ban is required and then authorisation for the measure if an exemption is granted.

In the rest of the country, in places specifically protected under the Ramsar Convention126127, land drainage is prohibited. Protecting carbon-rich peatlands from land drainage helps to reduce greenhouse gas emissions in the LULUCF sector.

Rewetting of drained wetlands

The protection and restoration of carbon-rich peatlands is beneficial for reducing greenhouse gas emissions, enhancing biodiversity, balancing water flows and reducing eutrophication. From 2021 to 2023, support was provided for the restoration and rewetting of drained wetlands. During the period SEK 200 million per year was invested in order to build up the activity and also carry out measures. In connection with the development of activities, IT-based information support was also developed, including for follow-up. The Government has:

In 2024, additional funds were allocated to strengthen the restoration of wetlands in Sweden. The allocation, support for rewetting wetlands, is increased by SEK 155 million for 2024. For 2025, the allocation is expected to increase by SEK 235 million and for 2026-2030 the allocation is expected to increase by SEK 375 million.

The126 Ramsar Convention is a global nature conservation convention to conserve wetlands and aquatic environments and use them sustainably. Source: https://www.naturvardsverket.se/om-miljoarbetet/internationellt-environmental work/International Environment Conventions/ vatland Convention/(2024).

Peatlands play a major role in reducing greenhouse gas emissions in the LULUCF sector, but these characteristics are removed by drainage.
The Wetland Action allocates funds to various types of measures. The Forest Agency receives funds for targeted rewetting measures (see paragraph below) on forest peatlands with the aim of reducing greenhouse gas emissions. In the context of protected nature, funds are obtained to restore and restore wetlands for biodiversity, under LONA[150] and LOVA, funds128 can be sought, inter alia, for the construction or restoration of wetlands for multiple purposes.

In 2022, a total of 531 items covering just over 2 100 hectares were rewetted excluding the CAP, which was estimated to result in a reduction of 3 900 tonnes of carbon dioxide equivalent. In 2023, the area rewetted was comparable to the previous year (about 100 hectares less), but the impact is estimated to be greater.129 In total, 588 objects covering just under 2 100 hectares were restored in 2023. The total emission reduction is estimated at 6 200 tonnes of carbon dioxide equivalent. The increase compared to 2022 indicates that a larger share of the area was made up of land generating higher GHG emissions. The results also show that more of the rewetting has taken place on arable land, which is positive from an emission reduction point of view.

Forestry Agency's rewetting agreement

Since 2022, the Forest Agency130 (as part of the funding for *the rewetting of wetlands*) has been administering aid for the rewetting of organic woodland (peatlands) through what is called rewetting agreements. The duration of these contracts is 50 years. Because the aim of the rewetting agreements is climate benefits

[150] Swedish Environmental Protection Agency, *LONA – Local Nature Conservation* Action. https://www.naturvardsverket.se/bidrag/lona/ (2024).

priority is given to fertile peatlands as they leak the most greenhouse gases. Rewetting projects are prioritised according to a list and land owners are reimbursed on the basis of a flat rate based on the forest's bonus and the location of the forest in the country. Rewetting contracts may also be written on abandoned agricultural land.
The level of compensation is based on the value of the land as forest land and not as agricultural land.

Additional LULUCF measures

In 2022 additional directives (Dir. 2022: 126) were asked to propose a strategy with

128 Swedish Agency for Marine and Water Management, *LOVA – Local Water Management Projects, https://www.havochvatten.se/bidrag- publication* and funding /Marine and Water Environment – 1 11/lova-lokala-vattenvardsprojekt.html (2024).
Swedish University of Agricultural129 Sciences, rewetting 2023, (2024).
130 Forestry Agency, *Implementation of measures to rewetting drained wetlands, interim report*, https://www.skogsstyrelsen.se/globalassets/om-oss/rapporter/rapporter-2023/2023-02-delrapport--att- genomfora-atgarder-for-att-atervata-utdikade-vatmarker.pdf (2023).

intermediate targets, policies and measures that contribute to Sweden's EU commitments on biodiversity and net greenhouse gas removals from the land use sector (LULUCF). The additional mission will be presented in December 2024.

CAP Strategic Plan 2027-2023, agricultural land in the LULUCF sector

The CAP Strategic Plan 2027-2023 is an important component to work on increasing carbon sequestration on agricultural land. The strategic plan is described in detail under the heading 'Agriculture sector'. Below are various elements of the plan that link to the LULUCF sector and a brief description of the objectives.

CAP conditionality on protection of wetlands and peatlands (GAEC 2)
There is a conditionality directly linked to the LULUCF sector, GAEC 2. This basic condition means that farmers must comply with Swedish legislation on water activities and land drainage. It also includes a ban on black trees on peatlands and a ban on keeping permanent grasslands on peatlands more frequently than every four years. Both the ban on black trees and ploughing of grassland are considered to affect small areas, but with a positive impact on soil carbon.

The requirements of GAEC 6 and 7 (see under the heading on the agricultural sector) may lead to a certain increase in the area of grassland and fallow, resulting in an increase in carbon storage. Depending on the environmental area chosen by farmers, carbon storage can either increase or decrease.

Environmental compensation for the management of wetlands and ponds
The Strategic Plan provides for environmental compensation for the management of wetlands and ponds. The compensation is paid for the management of constructed wetlands. The aim is to maintain the function of the constructed wetland so that the expected environmental impact of the wetland remains.

Investment aid for water management measures
Under the investment aid for water management measures, it is possible to seek funding for the construction and restoration of wetlands and ponds to increase nitrogen or phosphorus retention or to benefit biodiversity. Although the focus of this measure is not climate, some of the wetlands built can be achieved by rewetting drained organogenic soils. This is also included in LOVA and LONA (see above).

Other investment aid
Within the Strategic Plan, there are several different investment aid that can have positive effects on carbon storage.

Energy crops
This category includes aid for planting and closing energy crops (salix, hybrid asp and poplar).

The climate impact of energy crops consists of two parts. On the one hand, energy can replace fossil fuels and, on the other hand, the cultivation of energy crops leads to an increase in soil carbon storage compared to annual crops.

Covering and construction of lime filter ditches
Both cover drainage and limestone filter ditches are expected to increase production by improving soil conditions. The effect of the measures, compared to production, is then expected to lead to a reduction in greenhouse gas emissions per kilogram of product. Increased biomass production per hectare can also contribute to increased carbon sequestration per unit area. The impact of the cover on soil conditions can also contribute to better nitrogen utilisation and reduced working needs in tillage. Indirectly, this can reduce the impact on the climate by reducing the need for mineral fertilisers and fuel for agricultural machinery. Improved nitrogen utilisation may also mean less degassing from the soil.

Irrigation ponds
The impact on greenhouse gas emissions is expected to be positive. Irrigation enabled by the construction of new irrigation ponds should lead to secure production or increase in production on those soils where new irrigation ensures sufficient soil moisture for crops during the growing season. An increase in biomass production per hectare is expected to contribute to increased carbon sequestration per unit area. Access to irrigation can bring climate benefits during extreme dry rough when irrigation can ensure that the expected harvest is not lost, in whole or in part. As a result, already undertaken climate-impacting activities and inputs, such as tillage, seeds and fertilisation, contribute to increased production.

Annual Environmental Allowances (Ecoschemes)
The Strategic Plan provides for annual environmental payments for both intermediate and catch crops, where the main objective of support for catch crops is to reduce nutrient leakage and where the main objective of support for intermediate crops is to increase carbon storage. However, both have a positive impact on carbon storage. The interest in these allowances has been high. The compensation for intermediate crops has a target value of 13 000 hectares, while the area applied for is 63 000 ha. For catch crops, the target value is 125 000 ha, while the area applied for is 80 000 ha. If the areas for these payments are combined, the target is more than 100 %. The Board of Agriculture has calculated the impact of this compensation as part of an impact assessment of the strategic plan. Recalculated on the claimed area, the climate benefit would be 176 kton CO2 per year.

Advice

Crop management advice, both private and publicly funded, often provides advice on soil fertility, increased carbon sequestration and its importance for soil structure as well as drainage and reduced risk of soil compaction. In Greppa Industry (as described in 3.1.1.5), advice on

drainage, drainage compaction and soil content contributes to increased production, which in turn leads to increased carbon storage. The module 'fertility and carbon storage' is the one with the strongest link to carbon storage.

Policies and measures to reduce the vulnerability of agricultural land

Swedish Board of Agriculture's responsibilities and work on water management

Established in 2017, competence centres for sustainable water management in agriculture are a mission of the Food Strategy. Work under this mission focuses on increasing the competence of the authorities in this area through cooperation, thereby affecting the rules and conditions for the management of water in agriculture. In parallel to the work of the Competence Centre, skills development on water management is also ongoing under the CAP. This work is targeted at farmers, advisors and entrepreneurs. In addition to the above, many more functions within the Board of Agriculture have a link, perhaps somewhat more indirectly but nevertheless important, to water management issues.

Plant Protection Council

The Board of Agriculture works regionally with plant protection centres in five different regions in Sweden. Plant protection centres provide advice on weeds, diseases and insects in professional farming of agricultural crops, vegetables, fruit, berries and glasshouse crops. The data collected by plant protection centres can be used over time to monitor the distribution of existing and new plant pests and are therefore important to monitor the effects of a changing climate. The CAP also provides for different types of support. In particular, investment aid targeted at greenhouse enterprises may be relevant to adapted plant protection.

EU instruments in addition to the CAP

EU policies are the[154] Deforestation Regulation, the131 Renewables Directive and the recently adopted Carbon Removal Certificate Framework (CRCF). National implementation of the Deforestation Ordinance and the Renewables Directive is ongoing both through an investigation (Dir. 2023: 82) and various assignments to authorities. The CRCF can create the conditions for more investment in measures that contribute to increased net removals on forest and agricultural land. The level of interest in Sweden is not yet known, but the conditions for landowners through the balance between administrative burden and compensation are likely to be an important factor.

Development of the greenhouse gas inventory and MRV132 for measures

Directive (EU) 2018/2001 of the131 European Parliament and of the Council of 1 1 December 2018 on the promotion of the use of energy from renewable sources (Renewables Directive)
132Measurement, reporting and verification.

The requirements for Member States' greenhouse gas inventories for the LULUCF sector are increasing from 2028. From 2028, the calculations shall be based on tier 2 (tier 2) at least and preferably level 3 based on IPCC methodological guidelines133 as regulated in Article 26(3) Part 3 of Annex V to the Governance Regulation. According to the same

[154] European Parliament and Council Regulation (EU) 2023/1115 of 31 May 2023 on the making available on the Union market as well as export from the Union of certain commodities and products associated with deforestation and forest degradation and repealing Regulation (EU) No 995/2010 Member States shall also be encouraged to explore synergies and opportunities to consolidate reporting with other relevant policy areas and seek greenhouse gas inventories that allow functionality with relevant electronic databases and geographic information systems, including:

- A system for the monitoring of land use units with high-carbon stock land, as defined in Article 29(4) of Directive (EU) 2018/2001; This refers to forest land deforested after 2008 or wetlands drained after 2008.
- A system for monitoring protected land use units;
- A system for monitoring land use units subject to restoration;
- A system for monitoring certain designated land use units with a high risk of climate change impact.

Greenhouse gas inventory

The LULUCF Regulation requires the 2028 GHG inventory calculations to be based on tier 2 (tier 2) at the lowest and preferably level 3 based on IPCC methodological guidelines. Sweden already uses levels 2 and 3 calculations for virtually all emissions and removals in the LULUCF sector134 135 except for organogenic soils calculated with Tier 1. Sweden will calculate emissions from organogenic soils with a higher level from 2025 onwards. Furthermore, methodologies need to be developed for calculating emissions from fires, ditches and fertilisation of forest land, which are also estimated using level 1 methods.

The production of the greenhouse gas inventory includes continuous work to improve statistics for all sectors, including the LULUCF sector. The Swedish Environmental Protection Agency, which is the responsible authority for producing the greenhouse gas inventory, has a long ongoing improvement work with defined process and requirements for prioritising development projects, based on the available budget for the improvement work. These improvements are mainly made on the basis of review comments from the EU and the UNFCCC reviews, suggestions for improvement received through the national independent review or self-initiated

133Tier describes the level of the methodology used for the calculation of greenhouse gas emissions or removals within the greenhouse gas inventory. Tier 1 is a simple method with high uncertainty and less accuracy, and tier 3 is an advanced approach that reflects the realities of the country more accurately and less uncertain.
134Table 6.1.a and 6.1.b Status of reporting of carbon pools, other emissions, methodological tiers and key categories according to approach 1, CRF 4. Sweden's National Inventory Report 2024.

improvements based on business intelligence. Several reports of these development projects are published on the[159] website of the SMED and/or in Diva[160].

In 2023 and 2024, a government mission is ongoing in[161] to obtain improved annual statistics for the LULUCF sector and in particular for forest land and living biomass. The mandate includes analysing the possibility of developing the Swedish system for the inventory and reporting of removals and emissions from the LULUCF sector in order to reduce uncertainties and differences between different years of reporting and to achieve a system that captures the effects of measures more quickly and in a safer manner. Developments should include both field inventory and wider use of satellite-based systems and other remote solutions. The idea is to introduce the improved methodology for calculation in the reporting to the EU and the UNFCCC in 2025.

Impact of different policies/measures

Work on improved methodologies for estimating the impact of LULUCF policies and measures has been ongoing for a few years. In 2022, the Government mission "Underground for strategic planning of increased carbon sink" was delivered in[162] and shortly after the Forest Agency delivered reports "Overview of measures for increased carbon sink in forests" in[163] and "Impact analysis of the impact of some forest measures on the carbon sink"136137138. These reports include exploring how the impact of the measures being processed can be estimated based on existing published evidence and model simulations. There have also been developments.

[159] Swedish Environmental Emissions Data – SMED

[160] Digital Scientific Archives, http://www.diva-portal.org/smash/search.jsf?dswid=-6897 (2024).

[161] KN2023/03832.

[162] Swedish Forest Agency, *Strategic Planning Bill for increasing carbon sink,* https://www.skogsstyrelsen.se/globalassets/om-oss/rapporter/rapporter-2022202120202019 2018/rapport-2022-14-dossier -for-strategic-planning for-ocad-kolsanka.pdf (2022).

[163] Swedish Forest Agency, *Overview of measures to increase forest carbon sink,* https://www.skogsstyrelsen.se/globalassets/om-oss/rapporter/rapporter-2022202120202019 2018/rapport-2022-15-Oface-to-atgarder-for-ocad carbon sanka-i-skogen.pdf (2022). Methods to quantify the effect of growing intermediate/catch crops both in terms of reducing nitrogen emissions and increasing carbon sequestration.[165]

The Government has given a mandate to the Environmental Protection Agency to review the possibility of developing a system that tracks the effectiveness of policies and measures more quickly and safely. The Government has also given a mandate to the Board of Agriculture to develop methods for mapping the climate impact in agriculture of measures and trials that are

The136 Forest Agency, *Impact analysis of the impact of some forest measures on the carbon sink;* https://www.skogsstyrelsen.se/globalassets/om-oss/rapporter/rapporter-2023/rapport-2023-10-effektanalys-av-nagra-forest-atgarders-paverkan-pa-carbsankan.pdf (2023).

or may be carried out by farmers, in order to increase the climate efficiency of agriculture. The methodologies shall also include how the climate impact of the measures can be assessed.

The[166] Climate Adaptation Regulation requires relevant authorities to carry out a climate and vulnerability assessment, which then forms the basis for the development of both government targets and action plans on adaptation. The climate and vulnerability assessment and the action plan shall be updated at least every five years. In the report "Adaptation to climate change in forests and forestry", the Forest Agency analysed the vulnerability of forests and forestry to climate change and has developed impact targets and proposals for adaptation measures in consultation with the sector. In the ongoing project "Follow-up to the Forest Agency's work on climate change adaptation"[167], the action plan and the authority's objectives are to be followed up, measures implemented in forestry are identified, the climate and vulnerability assessment updated and the authorities' objectives evaluated and, if necessary, revised.

Effects of natural disturbances

As regards the effects of natural disturbances, the Swedish Environmental Protection Agency, SLU and the Forestry Agency have, in the context of a government mandate,139 reviewed Sweden's ability to follow up and possibly quantify the impact of various disturbances. The system that Sweden currently has, with the national forest tariff and land inventory as the backbone, provides Sweden with a stable basis and an opportunity to estimate natural disturbances. Geo-data and remote sensing can be used to complement estimates of impacts of natural

[165] SLU 2023, Ecohydrology 179, Helena Aronsson, Maria Ernfors, Thomas Kätterer, Martin Bolinder, Sven- Erik Svensson, David Hansson, Thomas Prade and Göran Bergkvist, intermediate crops in crop sequencing – for carbon storage and efficient nitrogen utilisation, and SLU 2022, Lena Engström and Mats Söderström, estimate aerial biomass for intermediate crops using remote sensing data

[166] Ordinance (2018: 1428) on authorities' efforts to adapt to climate change.

[167] Swedish Forest Agency, *Adaptation of Forests and Forestry, https://www.skogsstyrelsen.se/globalassets/om-oss/rapporter/rapporter-2022202120202019201 8/rapport- 2019-23-Adaptation* to Climate Change Adaptation and Forestry.pdf (2020).

disturbances based on data from the National Forest Tariff, provide information on the geographical position of the damage and follow up on the natural disturbance. For examples of Geodata see the section on "Governance and measures to reduce forest vulnerability".

Synergies and opportunities to consolidate reporting with other relevant policy areas

For the moment, there is no coordinated national requirement to work to consolidate LULUCF reporting with other relevant policy areas. However, the use of different types of maps and linked data is a long developed way of working. A government mission is currently underway in[169], looking more specifically at opportunities to highlight other policy areas together with

139NV-23-03739, Government assignment on natural disturbances for accounting under the LULUCF Regulation.

LULUCF.

The Swedish University of Agricultural Sciences (SLU) has produced a digital data base for coal stores throughout Sweden, which can be combined with other map documents in[170]. Currently, a number of municipalities (e.g. Stockholm, Uppsala, Strängnäs) use the evidence to include information on the LULUCF sector in their plans. It should also be possible to use the evidence for monitoring in accordance with Article 29(4) of Directive (EU) 2018/2001.

The Environmental Protection Agency has digitised maps140 141 that can be used for monitoring protected land use units and land use units subject to restoration. These maps may also be combined with carbon reservoirs as requested in the Governance Regulation Article 26, Annex V, Part 3.

Sweden's work to find suitable locations for action and follow-up on these uses a combination of several databases and maps. Sweden's rewetting work uses, for example, map material from SGU's soil species map, SMHI's soil water maps, SLU's dike maps, the National Land Cover Data (NMD) and others to find the most suitable soils for rewetting and/or rewetting and the construction of new wetlands. All these maps are analysed and then contacted landowners. Are

[169] KN2023/03832.

170 Swedish University ofAgricultural Sciences, *SLU Coolkartor – mapping of Sweden's coal stores and change of coal* storage in land,https://www.slu.se/miljoanalys/statistik-och-miljodata/sok-data/slu-kolkartor/ (2023). Theobject of the municipality or state is contacted if they were to be affected by an increase in the groundwater level. When the Environmental Protection Agency estimates the impact of rewetting, we are based on how it was before the rewetting (NMD map) and then information is obtained on the proportion of the object that lies on peatland (SGU and SLU maps). For the calculation of net emission reductions, the emission factors developed are used. Work is ongoing at Gothenburg University on climate and rewetting.[172]

171 .1.2 where relevant, regional cooperation in this field;

In January 2019, the Nordic ministers adopted a declaration committing the countries to work towards carbon neutrality in the Nordic countries. The declaration identifies a large number of areas for increased Nordic cooperation and work has started to identify new possible areas of cooperation. In August 2019, ministers also adopted a new vision for Nordic cooperation, making the Nordic region the most sustainable and integrated region in the world by 2030. Action in the field of climate change is also at its core. Nordic companies and Nordic sustainability solutions have great potential to play a key role in the green transition of the global economy.

Nordic experiences and know-how can help promote ambition under the Paris Agreement and

140 Swedish Environmental Protection Agency, *map tool Protected Nature,* https://www.naturvardsverket.se/verktyg-och-Chanster/Kartor-Karttanster/Mapping Tooling Protected Nature/(2023).

also foster dialogue with other countries in international negotiations. The Nordic Environment and Climate Cooperation Programme 2024-2019, negotiated under Swedish leadership, therefore aims to ensure that the Nordic countries contribute to the ambitious implementation of the Paris Agreement and continue to be frontrunners in the necessary climate transition. In 2022, the Nordic Council of Ministers committed to working towards a green and equal Nordic region.142

The Nordic Environmental Finance Corporation (NEFCO) plays an important role in the green transition. The focus areas of NEFCO climate, green growth, the Baltic Sea and the Arctic and Barents are well in line with the government's priorities. Furthermore, NEFCO is the only Nordic institution accredited to the Green Climate Fund (GCF), which enables and facilitates the implementation of climate action by Nordic actors through cooperation with the Fund. The Nordic eco-label 'Svanen' is further

172 Peatlands, climate and rewetting to reduce emissions and promote carbon sequestration, Åsa Kasimir and Amelie Lindgren.

an example of Nordic cooperation that makes it easier for businesses and consumers to market and demand 'green' and climate-friendly products.

173 .1.3 where applicable, financing measures including Union support and the use of Union funds in this area at national level, without prejudice to State aid rules;

European Regional Development Fund (ERDF)

With the help of the European Regional Development Fund (ERDF), various actors can run projects for the environment, climate, entrepreneurship, skills, innovation or broadband access. Projects can be very different but the objective is the same: Sustainable development and employment in all regions of Europe. The Swedish Agency for Economic and Regional Growth allocates SEK 8 billion in the 2021-2027 programming period to projects that will lead to investments in sustainable development and employment throughout Sweden.143

There are eight regional programmes and one national programme. Sweden has chosen to work in the Regional Fund towards three policy objectives. All strands work towards the first two objectives. Only the Upper Norrland and Mellersta Norrland programmes address the third policy objective:

1. A smarter Europe – All programmes (Research and Innovation144, Digitalisation and

142Nordic Council of Ministers – A Green and Gender-Equal Nordic Region (2022).
143 Swedish Agency for Economic and *Regional*Growth, https://tillvaxtverket.se/tillvaxtverket/omtillvaxtverket/eufonder/regionalfonden.3510.html (2024).
1441.1 strengthen research and innovation.

Bredband145, Enterprise and Industry146, Skills provision)

2. A greener Europe – All programmes (Environment147, Climate148)

3. A more connected Europe – Upper Norrland and Mellersta Norrland (Transport and Resande149) programmes only

In the 2021-2027 programming period, investments mainly go to the different thematic areas presented in brackets in the above list. Under each thematic area and policy objective, there are specific objectives in which Sweden has chosen to work towards 13 of these (see footnotes). At the time of writing, a mid-term review of the implementation of the Regional Fund programme is ongoing, which will be completed in 2025. This review will take into account progress in the implementation of the National Energy and Climate Plan. There is some possibility to reallocate funds between different objectives if necessary, but there is no result from the review as it has just started.

Since 2021, Climate Leap and Industrial Leap (see Sections 3.1.1.1 and 3.5.3.2 respectively) are part of the green relaunch of a climate-smart society after the COVID-19 pandemic and are part of the EU's Recovery and Resilience Facility (RRF).

3.1.2 renewable energy

3.1.2.1 Policies and measures to achieve the national contribution to the Union-level binding 2030 target for renewable energy and the trajectories set out in Article 4(a) (2) and, where applicable or relevant, the elements referred to in paragraph 2.1.2, including sector-specific and technology-specific measures

Electricity certification scheme

The purpose of the electricity certification scheme150 has been to stimulate the deployment of renewable electricity. The system has been in place in Sweden since 2003 and since 2012 it has been in common with Norway. The countries had a common target for the electricity certification scheme to contribute to 28.4 TWh of renewable electricity production by the end of 2020. Sweden committed to finance 15.2 TWh and Norway 13.2 TWh, but it was up to the market to decide where and when the new production would take place.

In 2017, the Swedish Government decided to extend the electricity certificate system until 2045

1451.2 reap the benefits of digitalisation, 1.5 Develop digital accessibility.
1461.3 strengthen the growth and competitiveness of small and medium-sized enterprises.
1472.1 promoting energy efficiency, 2.2 Promoting renewable energy, 2. 3 developing smart energy systems, 2.6 Promoting circular economy, 2.8 Promoting sustainable urban mobility.
1482.4 adapting to climate change.
1493.1 developing sustainable European transport networks (TEN-T), 3.2 Developing sustainable regional and local transport networks including cross-border transport.
The150 Energy Agency, *the electricity certificate* system, https://www.energimyndigheten.se/fornybart/styrmedel-for-electricity production/electricity certification/(2023).

and to introduce a target of an additional 18 TWh by 2030 applicable only to Sweden. The rapid deployment of renewable electricity production led to the target being reached already in March 2021. In the autumn of 2020, a change was made to the effect that plants operating after 31 December 2 021 are no longer eligible for electricity certificates and that the system will end in 2035.

Under the scheme, electricity producers whose electricity production meets the requirements of the Electricity Certificate Act (2011: 1200) receive an electricity certificate for each megawatt-hour (MWh) of electricity they produce. The electricity certificates can then be sold on an open market, which gives an additional revenue to the electricity producer. Demand for electricity certificates is created by the obligation for electricity suppliers, certain electricity users and certain electro-intensive industries registered with the Energy Agency to purchase electricity certificates corresponding to a certain proportion (quota) of their electricity sales or use and to cancel them annually.

Tax reduction for microgeneration of renewable electricity

In order to make it easier for individuals and businesses to invest in electricity generation from renewable energy sources for their own use, micro-producers can benefit from a tax reduction for microproduction of renewable electricity since 2015.151

The tax credit base consists of the kilowatt-hours of renewable electricity that the producer has fed into the connection point during the calendar year. However, the base can never exceed the kilowatt-hours taken at the connection point. The connection point shall have a hedge of not more than 100 amperes. The tax reduction amounts to the basis of assessment above multiplied by SEK 60. The tax reduction ceiling is SEK 18 000/year.

Reduced energy tax on micro-generation of renewable electricity for self-use

Exemptions applies to electricity produced in an installation with an installed power output of less than 100 kW by a producer with a total installed generator power of less than 100 kW and which has not been transferred to a collecting system, which is covered by a network concession and has been issued pursuant to Chapter 2 of the Electricity Act.

For electric power produced from wind or waves, the installed generator power of 100 kW shall correspond to 250 kW installed generator power, solar is 500 kW installed peak power and another power source without generator shall be 100 kW installed power. Where electrical power is produced from different sources, the installed power shall be added together.

If the total power output of the producer exceeds 100 kW or equivalent, but the individual installation does not do so and the electricity has not been transferred to the network subject to

Chapter151 67, Sections 27-33 of the Income Tax Act (1999: 1229).

a concession, the energy tax may be fully deducted.

Tax credit for green technologies

On 1 January 2021, a tax credit was introduced for the installation of green technologies.152 153Tax reduction is granted by 20 % for the installation of networked photovoltaic systems, 50 % for the installation of self-generated electricity storage systems and 50 % for the installation of recharging points for electric vehicles. The basis for the tax reduction is the cost of labour and materials, including VAT. The total tax reduction may not exceed SEK 50 000 per person per year.

The tax reduction for green technologies replaced the previous State aid that individuals could apply for in connection with the installation of photovoltaic cells, the installation of self-generated electricity storage systems and the installation of the recharging point for electric vehicles.

Energy tax rebate for electricity after battery storage

From 1 January 2019, under the Energy Tax Act (1994: 1776), there is the possibility of applying for a refund of energy tax on electricity fed out of a licensed electricity network, stored and fed back to the same licensed electricity network again. This is to avoid double taxation.

3.1.2.2 Where relevant, specific measures for regional cooperation as well as, as an alternative, the estimated excess production of energy from renewable sources that could be transferred to other Member States in order to achieve the national contribution and trajectories referred to in paragraph 2.1.2;

Sweden and Norway have a single electricity certificate market since 2012, governed by a bilateral agreement between the countries (see section 3.1.2.1).

Under the agreement between Sweden and Norway, reporting shall be based on a 50 % allocation of electricity production to each country, until each party has credited 13.2 TWh each. Then credited

Sweden 100 % of the remaining electricity production (Article 14, paragraph 2)· 184. With the cut-off date introduced for new plants after 31 December 2021, the system has entered a closed phase. In 2022, the year after the cut-off date, production equivalent to 35.4 TWh in Sweden and 21.2 TWh in Norway had become operational, showing that the targets set under the electricity certification scheme were reached and exceeded. As installations are approved for electricity certificates for 15 years before being phased out of the system, the approved standard

152Swedish Tax Agency, *Green Technology;* https://www.skatteverket.se/privat/fastigheterochbostad/gronteknik.4.676f48841 75c97df41 92860.html (2024).

annual production under the electricity certification scheme will now decrease every year. In 2023, it decreased by 1.0 TWh.

3.1.2.3 Specific measures of financial support, including, where applicable, Union support and the use of Union funds to promote the production and use of energy from renewable sources in the electricity, heating and cooling and transport sectors

See various instruments in the form of aid in Sections 3.1.1.1 and 3.1.2.1. In addition, the Connecting Europe Facility (CEF) aims to address shortcomings, mainly in cross-border areas, in the European transport, energy and telecommunications networks. The Fund is intended to contribute to improved competitiveness in the EU and to economic, social and territorial cohesion and has over the years granted funding to Swedish projects. In 2024, it is possible to apply for CEF support for measures in the field of alternative fuels for Swedish operators. Projects may include recharging stations for heavy duty vehicles, electricity and hydrogen to airports and bunkering of ammonia and methanol in ports, a total of EUR 780 million is searchable for Swedish operators in the period 2024-2025.[In] energy, CEF has granted EUR 84.5 million in aid to Svenska kraftnät for the construction of 400 kV lines between Sweden and Finland, Aurora Line. This is a joint project with Fingrid and aims to remove cross-border bottlenecks in electricity transmission.154 155 156

[184] Prop. 2016/17: *187, Agreement amending the agreement between Sweden and Norway on a single electricity certificate market*.

[185] Swedish Transport Administration, *Apply for a grant from the Connecting Europe Facility (CEF),* https://bransch.trafikverket.se/tjanster/ansok-om/ansok-om-bidrag/finansiering/ (2024).

[186] **.2.4 where applicable, the assessment of the support for electricity from renewable sources to be implemented by Member States pursuant to Article 6(4) of Directive (EU) 2018/2001**

An evaluation of State aid for solar cells has been carried out in 2023. The aid scheme was in force between 2009 and 2020, the evaluation concludes that the aid has contributed to the deployment of networked solar cells in Sweden. In total, SEK 3.7 billion of aid has been paid and annual electricity production from solar cells has increased during the support period. When state aid for solar cells was introduced in 2009, the total installed power was just over 9 MW and when the aid was closed in 2020, the total installed power was just over 1 100 MW.[187] Other support schemes for electricity from renewable energy sources have not yet been evaluated, but are likely to be evaluated in the future. Article 6(4) of the Renewables

154European Commission, *Construction and Commissioning of the Aurora Line, the 3 rd AC Interconnection Finland-Sweden,* https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/projects-details/43251567/101069619/CEF2027 (2024).

Directive requires Member States to evaluate, at least every five years, the effectiveness of their support schemes for electricity from renewable sources and their main distributional impact on different consumer groups as well as on investments. Member States shall include the evaluation in relevant updates of their national energy and climate plans and progress reports in accordance with the Governance Regulation.[188]

[187] **.2.5 specific measures to establish one or more contact points, streamline administrative procedures, provide information and training and facilitate the use of PPAs**

A summary of the policies and measures under the enabling framework that Member States have to take in accordance with Articles 21.6 and 22.5 of Directive (EU) 2018/2001 to promote and facilitate the development of self-consumption and renewable energy communities;

Introduction of one or more contact points

The Swedish Energy Agency has introduced a contact point for permitting, exemption and notification procedures linked to renewable energy.157 158

[188] Ordinance (2009: 689) on State aid for solar cells.

[189] Regulation 201 8/1 999 (EU) of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directive 94/22/EC of the European Parliament and of the Council, 98/70/EC, 2009/31/EC, 2009/73/EC, 2012/27/EU, 2010/31/EU and 2013/30/EU, Council Directive 2009/119/EC and (EU) 2015/652 of the European Parliament and of the Council and repealing Council Regulation (EU) No 525/2013.

Maritime spatial plans

On 17 June 2015, the Government adopted a Maritime Spatial Planning Ordinance (2015: 400), which regulates how state maritime spatial planning is to be implemented in Sweden. In line with the Regulation, the Agency for Marine and Water Management prepared maritime spatial plans for the Gulf of Bothnia, the Baltic Sea and the North Sea which were submitted to the Government at the end of 2019. The Government adopted maritime spatial plans for these areas on 10 February 2022. A maritime spatial plan provides guidance on the use of the areas covered by the plan and used by authorities, municipalities and regions in planning and assessing claims within the MSP area.[190] The aim of the maritime spatial plans is to contribute to long-term sustainable development in which marine resources are used sustainably and industries can develop while achieving a good marine environment.

157 Swedish Energy Agency, *Authorisation and Review,* https://www.energimyndigheten.se/fornybart/tillstand-och-tests/ (2023).

Offshore wind energy

On behalf of the Government, the Swedish Energy Agency has coordinated the process of identifying new areas suitable for offshore wind, with the aim of enabling an additional 90 TWh of annual electricity production compared to existing maritime spatial plans in[191]. The work has been carried out in dialogue with eight other authorities with the aim of both identifying new possible areas and developing solutions where there are conflicts between wind power and other interests such as fisheries and nature conservation. The mission was reported to the Government on 31 March 2023.[192] The planning documents produced are an important starting point for further work by the Agency for Marine and Water Management to prepare a proposal for new maritime spatial plans by December 2024.

On behalf of the Government, the Swedish Energy Agency and the Agency for Marine and Water Management have compiled knowledge of the conditions and possible measures for the coexistence of offshore wind power, professional fishing, aquaculture and nature conservation.159 The co-employment shall serve as a basis for environmental impact assessments, planning and permit processes.

[190] Agency for Marine and Water Management, *Maritime plans*, https://www.havochvatten.se/vagledning-foreskrifter-och-Acts/wagon lines/maritime plants.html (2024).

[191] The Swedish Energy Agency, *Energy extraction in maritime spatial plans;* https://www.energimyndigheten.se/fornybart/elproduktion/vindkraft/nya-omraden-for-energiutvinning-i- maritime plants/(2023).

[192] Swedish Energy Agency, *Priority of energy interest and solutions for co-existence crucial for offshore wind energy deployment*, https://www.energimyndigheten.se/nyhetsarkiv/2023/prioritering-av-energiintresset- and-losningar-for-coexistence – avgorande-offshore base/(2023).

Wind roller

The wind farm model is an interactive map service for the establishment of wind power in Sweden. The service facilitates the installation of wind power by, inter alia, displaying existing and planned wind turbines and map warehouses with information on wind mapping and protected areas. The wind farm model is a cooperation between the Energy Agency and the Swedish county administrative boards.160 161

Solel Portal – Guide on photovoltaic cells

The Energy Agency manages and operates Solel portalen.se. The portal gathers factual and independent information on photovoltaic installations, from the pre-installation planning phase to the decommissioning of an installation. The target group is mainly single-family owners and small businesses with industrial properties. The aim of the portal is to make it easier for potential photovoltaic consumers to make prudent investment decisions. The Swedish Energy

159 Agency for Marine and Water *Management, Samestence between offshore wind, professional fishing, aquaculture and nature conservation*,https://www.havochvatten.se/download/18.6e7a8a391867f09cba2589f0/1677683507574/rapport - 2-2023 coexistence.pdf (2023).

The160 Swedish Energy Agency, *windscreen,* https://www.energimyndigheten.se/fornybart/elproduktion/vindkraft/vindbrukskollen/ (2023).

Agency regularly updates the Solel portal.

The Solel portal was developed by the Energy Agency on behalf of the Government. The work on the portal was carried out in consultation with several authorities with relevant information in the field.

No building permit requirement for solar installations

As a rule, no building permit is required in the detailed area to assemble a photovoltaic or solar collector installation on a building if it follows the shape of the building. However, municipalities may lay down other requirements in the development plan. The building permit exemption does not apply to buildings in built-up areas which are particularly valuable from historical, cultural, environmental or artistic point of view, nor in or adjacent to areas of national interest in the field of general defence.

In the past, planning and building legislation lacked specific rules on solar photovoltaic and solar thermal installations and guiding case law, which meant that the conditions for solar installations were different in different municipalities.

Areas of national interest to optimise land use

The Swedish Energy Agency is responsible for identifying national interests for energy production and distribution, which must be particularly appropriate from a national perspective.

Energy production includes areas for large scale installations capable of producing large amounts of energy or power, but also installations that can provide balance and regulatory requirements or are needed in areas where energy consumption is high. Today, there are eight areas designated for energy production.

For energy distribution, provisions on national interests shall apply to areas of installations which are part of wider coherent energy distribution systems of national interest. The Swedish Energy Agency has recently been tasked with reviewing identified national interests for fossil-free energy production. The mandate is implemented on the basis of Article 15(b) of the Renewables Directive, which announces that Member States shall carry out a coordinated mapping of renewable energy on their territory, in order to meet the Union 2030 target for renewable energy set out in Article 3(1) of the Renewable Energy Directive. The mandate also includes reviewing acceleration areas for renewable energy deployment in accordance with Article 15(c) of the Renewables Directive. The designation of renewables acceleration areas shall enable future designation of areas with potential for renewable energy deployment and the Swedish Energy Agency shall give particular priority to larger interlinked areas. The mission is to be finalised by the Government on 25 October 2025.[195]

The identification of national interest in wind farms, which has been carried out since 2004 with

the last update in 2015, has had an important impact on the valuation of wind power in relation to other interests in spatial planning.162 163Today there are 313 national areas of interest for wind farms, including 284 areas on land and 29 at sea and in lakes. The total claim is 7 600 km in^2 excluding building and accounts for just over 1.5 % of Sweden's surface area including Swedish territorial waters.

[195]the Government, the *Swedish Energy Agency will review its national interests and map areas for energy production and distribution, https://www.regeringen.se/pressmeddelanden/2024/03/energimyndigheten-ska-se- over-sina-national stakeholders and* cartels – omraden-for-energy production and distribution (2024).

Reassessment of hydropower

Hydropower shall be provided with modern environmental conditions in a coordinated manner with maximum benefits for the aquatic environment and for national efficient access to hydropower. The Swedish power grid was tasked, together with the Swedish Energy Agency and the Swedish Agency for Marine and Water Management, to identify the impact that testing for modern environmental conditions for hydropower can have on the electricity system. In its mandate, the authority would identify and describe what negative impact on hydropower capabilities is acceptable from an electricity system perspective in order to maintain security of electricity supply in Sweden. The report was finalised in September 2023.[197] Nio energy companies that own hydropower have created hydropower's environmental fund Sverige AB. All those covered by the national plan and carrying out water activities for the production of hydropower electricity in Sweden will be able to apply for financial compensation from the Fund to finance the environmental measures that will be required in the context of the review.

Renewable power purchase agreements

There are no specific policies or other measures to facilitate a wider uptake of renewables power purchase agreements. According to information from market participants, the use of such agreements is widespread in Sweden and has played an important role in the development of wind power.

3.1.2.6 assessment of the need to build new infrastructure for district heating and cooling from renewable energy sources

The Swedish district heating system is already well developed and district heating competes with other forms of heating. The assessment of the need and profitability of new district heating and cooling infrastructure is carried out by the owners. Sweden therefore sees no need for measures for district heating networks in accordance with Article 20(3) of the revised Renewables Directive.

However, the Swedish Energy Agency has developed a district and combined heat and power

The162 Swedish Energy Agency, *National interests in energy production;* https://www.energimyndigheten.se/fornybart/tillstand-och-provning/riksintressen-for-energi/ (2023).

strategy which shows that district and cogeneration will play an important role in the future, in particular on the basis of the variability resulting from increased electricity production from solar and wind power. District and cogeneration also contributes to Swedish self-sufficiency and a secure energy system.164 165

[197] Swedish National Grid, *Finding the impact of hydropower review on the electricity system*, https://www.svk.se/siteassets/om-oss/rapporter/2023/slutrapport-20230926-nap-vattenkraft.pdf (2023).

3.1.2.7 where appropriate, specific measures to promote the use of energy from biomass, in particular for the valorisation of new biomass, taking into account:

— biomass availability, including sustainable biomass: both domestic potential and imports from third countries

— other biomass uses by other sectors (agriculture and forest-based sectors); as well as measures for the sustainability of biomass production and use

The previous government set up an inquiry to develop a strategy to promote the development of a sustainable, competitive and growing bioeconomy. On 1 December 2023, the final report of the inquiry was presented, proposing a series of measures, follow-up and evaluation. On 29 March 2023, an interim report entitled 'Renewable in the idea' (SOU2023: 15) was also presented which proposed measures to promote the efficient production of biofuels based on domestic feedstocks in Sweden. The raw materials envisaged include biomass.[199, 200]

Climate Leap and Industrial Leap (see 3.1.1.1 and 3.5.3.2 respectively) both contribute to promoting bioenergy use. For example, Climate Leap provides support for conversion from fossil fuels into biofuels and biofuels and can be applied for by companies, organisations, municipalities and regions alike.[201].. The allocation for climate life has been increased by SEK 800 million to SEK 2 024.2 billion in 2025 and SEK 2.5 billion by 2026. Industry funding has been increased by 100 million in 2024-2025 and the budget is SEK 1 457 million in 2024 and SEK 1 357 million in 2025. In 202· biomass is one of the technology tracks for the transition. An example of a project granted aid in the Industrial Leap is an actor that develops large scale production of biochar.166

[199] Thegovernment, *Peter Kullgren, has received the final report of the* Bioeconomy Inquiry, https://www.regeringen.se/pressmeddelanden/2023/12/peter-kullgren-har-tagit-emot-bioekonomiutredningens- final betance/(2023).

[200] SOU 2023: 15. *Renewable in the idea, a policy proposal to strengthen the bioeconomy*. https://www.regeringen.se/contentassets/5351ab1c7862465ba9b6999e16d5a9cd/delbetankande-av- bioeconomy

164 Swedish Energy Agency, *district and cogeneration strategy,* https://www.energimyndigheten.se/klimat--million/sveriges-electrification/mission-in-electrification/fjarr-kraftvarmestrategi/ (2024).
166 Swedish Energy Agency, *Industriklivet,* https://www.industriklivet.se/ (2024).

investigationen-sou-202315.pdf (2023).

[201] Swedish Environmental Protection Agency, *What you can receive support through Climate Leap,* https://www.naturvardsverket.se/amnesomraden/klimatomstallningen/klimatklivet/vad-du-kan-fa-stod-for- genom-klivet/(2024).

[202] Government, *Expenditure Area 20 Climate, Environment and Nature,* https://www.regeringen.se/contentassets/e1afccd2ec7e42f6af3b651091df139c/utgiftsomrade-20-klimat-miljo- and-nat.pdf (2023).

There are several research activities in the field of bioenergy, such as the Bio + innovation and research programme. Cinema +, managed by the Swedish Energy Agency, aims to develop bio-based value chains and solutions to help Sweden achieve the energy and climate policy objectives. The programme runs until the end of 2027 and has a budget of SEK 511 million. An example of a project supported under the programme is an operator of a project aimed at raising awareness of how sustainable biomass extraction from different forest ecosystems can be carried out and[204] research actions related to bioenergy are further described in section 4.6.

A study by the University of Lund in 2021 estimates that biomass availability could increase by 27-37 TWh per year by 2030.[In] particular, it is estimated that the potential could increase most of thepotential for abundance and by-products from the forestry industry such as bark and shavings. At the same time, the harvesting of the grove has been somewhat limited, as knowledge of how much branches and peaks can be harvested in a sustainable way has been updated. Stumps have been excluded from the potential until 2030, in line with Article 29 of the Third Revised Renewables Directive, which states that harvesting of stumps should be avoided. However, there are several uncertainties in the longer term, which may affect the abstraction and availability of biomass for energy purposes. Regulatory uncertainty, climate change and the adaptability of forest owners can affect the availability of biomass. The current sustainability criteria still mean that the input of forest by-products and residues for energy purposes is expected to increase.[206]

As regards imports and exports of forest biomass for energy purposes, the majority of biomass fuels used in Sweden are also produced in Sweden. Imported biomass fuels represent only a minor part.167 168Import and export volumes of biomass fuels follow factors such as weather, seasonality, prices and availability on the world market. The colder weather in winter means an increase in imports of some biomass fuels for:

[204] Bio +, *About Bio +,* https://bioplusportalen.se/om-bio/ (2024).

[205] Ballesson, P. (2021). *Potential for increased input of indigenous biomass into a growing Swedish bioeconomy – an update*. University of Lund. Department for Environment and Energy Systems. — https://lup.lub.lu.se/search/files/96470174/B_rjesson_P._2021_._Rapport_nr_121_Milj_and_energy system_Lunds_university.pdf (2021).

[206] Ballesson, P., Björnsson, L. (Red.) (2024). *Bioenergy perspectives: The future role of biomass in a changing world.* (IMES/EESS Report 133; No. Report No 133). Environment and Energy Systems, LTH, University of Lund. https://lucris.lub.lu.se/ws/portalfiles/portal/1 73047105/Rapport_133_2024_Perspectives_pa_bioenerg.pdf (2024).

energy purposes in the winter months, at the same time, during the summer, have net exports of

167 Swedish Energy Agency, *Energilat 2022, ET 2022: 09,* https://energimyndigheten.a-w2m.se/Home.mvc?ResourceId=212535 (2023).

certain biomass fuels.[208] Russia's war against Ukraine and subsequent sanctions against Russia and Belarus have resulted in the loss of imported biomass fuels from these countries to the EU. This in turn has led to an increase in trade with, for example, Sweden, affecting the import and export balance of biomass fuels.
In summary, the availability of biomass fuels in Sweden is estimated to be relatively stable, with some increases and declines from year to year in[209].

Sweden is taking action to ensure that the use of biomass fuels is carried out in accordance with Article 29 of the revised Renewable Energy Directive. The Swedish Forest Agency, as well as other relevant authorities such as the Swedish Energy Agency, are responsible for ensuring compliance with the updated EU legislation. The Forest Agency has been mandated in the memorandum of appropriations to evaluate whether Sweden can continue to meet the new criteria set out in the third revised Renewables Directive and, if necessary, to propose the necessary legislative amendments.[210] The forestry sector uses most of the approximately 75 TWh/year of residues and by-products emitted in sawmills, pulp and paper mills for internal energy use, only around 20 TWh/year is used outside the forest industry. In agriculture, around 21 TWh of residues are produced annually from straw and blast. Only a small proportion of these residues are used for the production of biogas and other energy production. Biomass fuels used from agriculture are mainly in the form of biofuels, on the one hand, ethyl alcohol produced from wheat 2.5 TWh/year and, on the other hand, RME produced from rapeseed 1,5-2 TWh/year, and biogas produced from, inter alia, manure. In 2009, the production of biogas from manure has been sixfold since[211] and Sweden's total biogas production of just over 2.3 TWh in 2022 was produced from manure.169

[208] Swedish Energy *Agency, State of energy markets, biofuels, biogas and solid biofuels, March 2024,* - https://trk.idrelay.com/res/mail/2930/50142/f55b7ccc-a583-4c89-abbf-9319b029c2b3.pdf (2024).

[209] The Swedish Energy Agency, *Production, import and export of unprocessed wood fuels*; https://www.energimyndigheten.se/EN0122 (2024), and Statistics Sweden, imports *and exports of goods by CN 2,4,6 level, adjusted, confidential. Month 2000M01 to 2024M01,* – https://www.statistikdatabasen.scb.se/pxweb/sv/ssd/START__HA__HA0201__HA0201B/ImpExpKNTotMan/ (2024).

[210] Swedish National Financial Management Authority, *Regulatory Letter 2024 Swedish Forest*Agency, https://www.esv.se/statsliggaren/regleringsbrev/Index?rbId=24087 (2023).

[211] Fossil-free Sweden, *Strategy for fossil-free competitiveness,* https://fossilfrittsverige.se/wp-content/uploads/2021/11/Fossilfritt-Sveriges-biostrategi.pdf (2021).

3.1.3 other elements of the dimension

3.1.3.1 Where applicable, national policies and measures affecting the EU ETS sector and assessment of complementarity and impact on the EU ETS

The policies most directly affecting emissions within the EU ETS are: – Energy tax on cogeneration and heat production, see 3.1.1. — Support for renewable electricity

169 Energigas Sweden, *Production of biogas and digestate and its use in 2022*, https://www.energigas.se/media/ztlh34w0/biogasstatistikrapport_2022_webbs2.pdf (2023).

generation, see 3.1.2.

Energy mapping in large companies, see 3.2.

– Energy tax for industry, see 3.1.1.

— Industry, see 3.5.3.

These instruments complement the EU ETS primarily by promoting technology springs and energy efficiency. The instruments thus contribute to reducing emissions from Swedish installations within the system. This in turn means that more allowances can be placed in the market stability reserve and eventually cancelled, thus reducing overall emissions from the EU ETS.

Indirect impacts on the EU ETS and the possibility of transition have pre-emptive measures, such as increasing electricity supply, short permitting processes and implementing skills supply measures.

3.1.3.2 Policies and measures to achieve other national objectives, where applicable

Air quality

In February 2023, the Government decided to update Sweden's national air pollution control programme, which sets out how Sweden intends to implement measures and instruments to meet the emission reduction requirements under the Cap Directive. The170 programme includes measures and policies to reduce emissions of nitrogen oxides and ammonia. A large proportion of measures and policies in the updated programme are climate action, in particular measures and policies that reduce NOx emissions. The impact of these measures and policies on emissions will depend on the extent to which possible synergies are managed. However, the measures and policies included are not sufficient for Sweden to meet its commitments and the programme will need to be further complemented.

As regards environmental quality standards for outdoor air under the Air Quality Ordinance (2010: 477) and the EU air quality limit values under Directive 2008/50/EC on ambient air quality and cleaner air for Europe, more measures are needed to reduce concentrations of nitrogen dioxide and particulate matter (PM10) in congested areas. In the field of air pollution control, other measures to improve air quality will be required in the longer term, particularly particulate matter, black carbon, ground-level ozone and benzo (a) pyrene, as well as reducing the deposition of acidifying and eutrophicating substances in order to protect human health and the environment.

Adaptation to climatechange – Creating the conditions for adaptation – cooperation

170Government, *National Air Pollution Control Programme;* https://www.naturvardsverket.se/490939/contentassets/31642c0d64e845d881d7770ee9237815/regeringsbesl ut-2024.pdf (2024).

structures, stakeholder involvement and action plans The recently adopted Strategy and Action Plan on Adaptation to Climate Change provides the basis for the government's work on adaptation to climate change over the next five years. The implementation of the strategy will facilitate faster implementation of preventive measures, but also help to provide better evidence and analysis to inform decisions at different levels of society. Responsibility for adaptation to climate change lies primarily at the local level, where land and property owners are responsible for the protection of their property and municipalities are responsible for spatial planning. The risks and vulnerabilities to climate change impacts that need to be addressed are therefore best assessed at local level.

Cost-effective climate adaptation measures need to be made in cooperation between different property owners – private or public – different municipalities or on other land over which the municipality does not have control. The Government has therefore appointed a special investigator to analyse and, if necessary, propose new or adapted legislation in order to implement effective climate adaptation measures. The aim is to contribute to a society that is better equipped for the effects of climate change. The investigator shall also identify possible funding models to share costs over the long term among the actors benefiting from the climate adaptation measure. The final report is due to be submitted to the Government on 30 April 2025.

Authorities' work on adaptation to climate change

Many Swedish authorities play an important role in climate change adaptation through their respective sectoral responsibilities. They work on prevention by building knowledge and improving resilience. The Ordinance (2018: 1428) on authorities' climate adaptation regulates 32 national authorities and all 21 county administrative boards work on climate adaptation. Authorities covered by the Regulation shall initiate, support and evaluate the work on adaptation to climate change as part of their mandate. If the authority manages or maintains state property, the authority shall also adapt that activity to a changing climate. The authorities are also required, within their remit, to develop targets and action plans to help the government achieve its climate adaptation targets.

In addition, the county administrative boards are responsible for coordinating regional climate adaptation efforts and for initiating, supporting and monitoring municipalities' work on climate adaptation, analysing how the county and neighbouring counties are affected by climate change, supporting and monitoring the work of sectoral regional authorities on climate adaptation, and contributing to and producing evidence for increased knowledge and planning. Adaptation to climate change is also part of other tasks of county administrative boards, such as town and country planning and supervision of overview and detailed plans under the Planning and Building Act.

There is a network of authorities for the authorities dealing with adaptation to climate change.

The network works for coordination and knowledge exchange and the secretariat is managed by SMHI. There are also thematic networks for national cooperation as well as regional networks.

The authorities' work on adaptation to climate change is reported to the SMHI, which compiles the results and reports annually to the government.
According to the SMHI analysis, the authorities' action plans included proposed measures for 2022 430. Most of the measures are analytical in nature, followed by guidance/organisational, informative and, to a minimum extent, technical or nature-based measures.

Some examples of the work carried out by the Swedish authorities are set out below.

The National Board of Housing, Building and Planning is responsible for coordinating work on adaptation to climate change in the built environment. In this function, he is in charge of:

- Support municipalities in their efforts to adapt the built environment to climate change.
- Identify the need for evidence and guidance for climate adaptation of new and existing settlements.
- Develop skills in this field.
- Coordinate evidence provided by expert authorities and research on climate impacts and adaptation of settlements and present the evidence in a user-friendly way.
- Promote and guide the tools and processes relevant to climate adaptation of the built environment.
- Monitor developments in the field of adaptation to climate change and analyse the implications for new and existing settlements.

The task is carried out in cooperation between the National Board of Housing, Building and Planning, the Swedish Geotechnics Institute (SGI), the Swedish Civil Contingencies Agency (MSB) and the county administrative boards.

In 2012, the government tasked the SMHI to set up the National Knowledge Centre on Adaptation to Climate Change to assist municipalities, regions, authorities and other stakeholders with their climate adaptation efforts. The National Knowledge Centre serves as a node for knowledge on climate adaptation by collecting, developing and making available knowledge on climateadaptation. In 2023, the Centre has been allocated a budget of approximately SEK 20 million for this work.

A future changing climate is expected to increase the power and frequency of weather-related disturbances, which will put increasing demands on society's overall ability to prevent and respond to disruptions in energy supply.

The Swedish Energy Agency is tasked with working on security of energy supply and crisis

preparedness. The Swedish Energy Agency's Action Plan on Adaptation to Climate Change highlights that climate change adaptation is up to date in the context of security of energy supply and crisis preparedness, with a focus on ensuring Sweden's ability to produce and supply electricity and energy even when climate changes. The Swedish Energy Agency stresses that it is of great importance that the issue of adaptation to climate change continues to be addressed from an all-risk perspective in line with other risk management, with the aim of achieving a more robust energy system and an increased capacity for society to prevent and mitigate the consequences of possible disruptions and disruptions to energy supply.

The Swedish National Grid and the National Electrical Safety Board are also covered by Ordinance (2018: 1428) on authorities' work on climate adaptation. The Swedish National Grid has carried out a climate and vulnerability assessment (SVK 2021/251), which highlights how the electricity system may be affected by a change in climate. The report is intended to inform the Swedish Power Network's further work to prioritise and ensure that tomorrow's electricity system is robust despite the major changes ahead. The National Electrical Safety Agency's action plan on adaptation to climate change highlights a number of electrical safety risks associated with a changing climate and sets a target for the authority to help prevent electricity accidents affecting people, animals or property from becoming more common in the future climate.

Whereas forestry is heavily affected by climate change, including an increased risk of forest fires and storm damage, as well as increased occurrence of pests, diseases and invasive species; On the basis of its climate and vulnerability assessment, the Forest Agency has developed three objectives, which the Agency must work in its action plan to achieve:

- Damage is mitigated in the near term by well functioning surveillance and crisis preparedness systems.
- Damage is prevented in the long term and cost-efficient by location-appropriate and storm-safe forests with a high degree of variation.
- Forestry is developed in such a way that damage to the environment and other social values does not increase over time.

The Government announces in the National Strategy and the Government's Action Plan on Adaptation to Climate Change (Skr. 2023/24: 97) that the Government will work to ensure that the Forest Agency, in cooperation with the forestry sector and other authorities, continues to work on adapting forests and forestry practices and measures so that forests of the future can withstand damage caused by climate change. In addition, active forest management contributes to the implementation of regeneration measures, which can have a positive impact on the resilience of climate change impacts.

Knowledge transfer and risk assessment

Pooling and communicating knowledge and creating the conditions for effectively tackling

climate-related challenges is a key task for society. Developing and disseminating knowledge of methods and working models, which can improve and improve the effectiveness of action, is essential for effective adaptation to climate change. Through the allocation 1: 10 Climate change adaptation, in spending area 20 Climate, environment and nature, the government finances, among other things, the work of public authorities on prevention and awareness-raising. The funds go to targeted knowledge bases, guidance documents, maps, mapping services, coordination and inter-agency projects, among others.

The SMHINational Knowledge Centre on Adaptation to Climate Change serves as a node for knowledge on climate change adaptation in Sweden. The web platform www.klimatanpassning.se is run by the Knowledge Centre and provides information on the impact of changing climate change on society, climate adaptation tools as well as examples of implemented climate adaptation actions and information on current activities.

The Rossby Center at SMHI is working on climate research and has developed national and regional climate scenarios up to 2100. The SMHI Climate Scenario Service presents how the climate has evolved in Sweden until 2018 and how the climate can evolve in Sweden in the 2000s. The View Service is based on observations as well as scenarios from several regional climate models driven by multiple global climate models.

The MSB has developed a web service called the Flood Portal, which contains information from flood maps and spatial data in accordance with the Flood Risk Ordinance (2009: 956) and a database of natural disasters that occurred.

The SGI, in cooperation with seven other authorities, has developed joint maps of geotechnical risks and tools to assess climate risks. In June 2021, the SGI and the MSB presented a joint government mission to identify specific risk areas for race, landslides, erosion and flooding that are climate-related. The report identifies ten national risk areas, ranked on the basis of an aggregation of the likelihood and consequence of collapse, landslides, erosion and flooding that are climate-related.171

Implementation

The government focuses on creating better conditions for implementing concrete climate adaptation measures.

The EU's climate adaptation strategy (COM (2021) 82 final) highlights that nature-based solutions are particularly suited to building resilience to climate change. Nature-based solutions are often cost-effective in climate adaptation efforts, especially as they often contribute to other

171 SGI and MSB, *Risks for Race, Lake, Erosion and Flood, Reporting of Government assignments pursuant to Government Decision M2019/0124/K,* https://www.msb.se/siteassets/dokument/om-msb/vart-Mission/regeringsuppdrag/2021/ru-riskomraden.pdf (2021).

positive impacts such as increasing greenhouse gas removals and storage, enhancing biodiversity or having a positive impact on human health. The Government's strategy on adaptation to climate change highlights in particular that the Government will work towards greater use of nature-based solutions in water security.

The Government also decides on assignments related to various measures to sectoral authorities. However, climate change adaptation is often cross-sectoral, which means that the work is usually carried out in collaboration between several actors and sectors at national, regional and local level.

Sweden has a well-established and well functioning framework for working on disaster risk reduction, including work in crisis preparedness teams. The work is coordinated by the MSB. Cooperation is encouraged at all levels and between sectors and stakeholders involved in land use planning, risk management, natural disasters and climate change adaptation, in order to reduce risks and improve preparedness.

Several collaborative fora are currently active in Sweden, where sectoral authorities and other stakeholders can share experiences and plan important actions. These fora include the Government Agency Network on Adaptation to Climate Change, the Government Network of Stranderosion, the Committee on Design Flows for Dams in a Climate Change Perspective, the Delegation for Race and Defence, and the National Drinking Water Network.

Sweden's municipalities are required to carry out risk and vulnerability assessments as part of their work to deal with extraordinary events and crises.
Such analyses also include events affected by a changing climate.

Every year, the government spends funds through the state budget that finances measures that either directly or indirectly have a climate adaptation dimension.

The Ordinance (2018: 213) on aid for the securing of meadows at the Göta River entered into force in 2018. Under this Ordinance, municipalities may apply for grants from the Swedish Geotechnical Institute for Climate Investment Measures which help to improve stability conditions along the Göta Elvdvalley. The purpose of the grant is to protect human life and health and to prevent damage to property and the environment.

In a built environment where the risk of natural disasters is particularly high, municipalities can apply for state funding for preventive measures. The Government has set aside approximately SEK 520 million annually for 2023-2025 for measures taken to prevent landslides and other natural disasters. The funding, which is administered by the MSB, can be made up to 60 % of the costs, or up to a maximum of 60 % of the value of the object at risk. Natural disasters are mainly related to race, landslides and flooding.

Evaluation and audit

Monitoring and evaluation of Sweden's work on adaptation to climate change takes place with the support of the National Council of Experts on Adaptation to Climate Change and the SMHI.

The National Council of Experts on Adaptation to Climate Change was set up in 2018 and is tasked with deciding every five years on a report to inform the government with a view to revising the National Strategy on Adaptation to Climate Change. The Council of Experts submitted its first report to the Government in February 2022. The report includes, in accordance with the mandate of the Council of Experts, proposals to focus national efforts on adaptation, a prioritisation of adaptation action based on an assessment of risk, costs and benefits, a summary analysis of the impacts of climate change on society, and a follow-up and evaluation of national efforts on adaptation to climate change. Overall, the report contains around 170 proposals to the Government on further work on adaptation to climate change in Sweden.

The Council of Experts served as the basis for the government's strategy and action plan on adaptation to climate change.

Follow-up and evaluation of Sweden's climate adaptation work is a key element in assessing how the work needs to be developed and which measures should be prioritised. The SMHI has been tasked, in cooperation with the Swedish Environmental Protection Agency, to develop a proposal for a national monitoring system for climate change adaptation to enable evaluation of socio-economic risks and vulnerabilities linked to a changing climate. In addition, the National Council of Experts on Adaptation to Climate Change will carry out a national climate and vulnerability assessment. The aim of the analysis is to be able to systematically identify and analyse Sweden's vulnerabilities, risks and opportunities arising from a changing climate in the future. Among other things, the analysis will feed into the next report of the Council of Experts, which in turn will serve as a basis for revising Sweden's climate adaptation strategy.

3.1.3.3 Policies and measures to achieve low-emission mobility (including electric mobility)

Policies and measures for the transport sector are described in section 3.1.1.1.

3.1.3.4 Where applicable, national policies, timelines and measures planned to phase out energy subsidies, in particular for fossil fuels

There is currently no agreed definition of fossil fuel subsidies, both nationally in Sweden and internationally. However, a commonly used method for identifying and measuring support for fossil fuels is offered by the OECD, which, for Sweden, means that such support is, in principle, exclusively measured in terms of tax expenditure. According to this definition, Sweden is expected to reduce its support for fossil fuels by more than one third from 2019 to 2025. The sharp decrease is due to a fall in tax expenditure on diesel in the transport sector as a

result of the 2023 decided reduction of the energy tax on petrol for 2024 and 2025. The example illustrates the difficulties in measuring and tracking the evolution of a country's tax expenditure as a proxy for its fossil fuel subsidies, as the OECD itself now underlines. Against this background, it is not obvious to what extent Sweden has any energy or fossil fuel subsidies within the tax system.

Sweden has not adopted time-bound targets for phasing out any energy or fossil fuel subsidies. Sweden stands behind

The EU's objective of climate neutrality by 2050 and has a national target of emissions neutrality in 2045. The Government's assessment is that fossil petrol and diesel will in principle need to be phased out by the year for the long-term climate target, i.e. by 2045. See also section 4.6.4.

3.2 Dimension energy efficiency

The instruments that exist in Sweden and are directly aimed at improving energy efficiency often stem from EU directives (including ecodesign rules, energy labelling and energy mapping requirements). Energy taxation and EU emissions trading also provide incentives for energy efficiency improvements. Other instruments for energy efficiency are municipal energy and climate advice, aid for energy efficiency in single-family houses, and tax reductions on the labour cost of repairs, maintenance and conversions and ancillary buildings in dwellings.

There are also some instruments that directly require a minimum level of energy efficiency. This applies, on the one hand, to new construction and some conversions and, on the other hand, to the 60s of product groups (including white goods, electronics and certain industrial equipment) covered by EU ecodesign and energy labelling requirements.

There are also instruments other than those mentioned in this chapter that can contribute to increased energy efficiency. For example, Climate Leap (see section 3.1.1.1) may support energy efficiency measures. Climate Leap support is provided for a wide range of measures, but only physical investments (i.e. not behavioural impacts).

3.2.1 Planned policies, measures and programmes to achieve the indicative national energy efficiency contributions for 2030 as well as other objectives referred to in point 2.2, including planned measures and instruments (also of a financial nature) to promote the energy performance of buildings, in particular with regard to the following:

3.2.1.1 Energy efficiency obligation schemes and alternative policy measures pursuant to Articles 8, 10 and of Directive EU 2023/1791 to be developed in accordance with Annex V

Alternative policy measures

Article 8(2) of the recast Energy Efficiency Directive requires Member States to achieve the energy savings required under paragraph 8.1 of that Article either by establishing an energy efficiency obligation scheme referred to in Article 9 or by adopting alternative policy measures referred to in Article 10. Member States may combine an energy efficiency obligation scheme with alternative policy measures. Member States shall ensure that the energy savings resulting from the policy measures referred to in Articles 9, 10 and 30.14 are calculated in accordance with Annex V.

Sweden has so far chosen to achieve its energy savings obligation by applying energy and carbon tax at levels beyond those provided for in the Energy Tax Directive.[215]

Swedish tax levels

The current tax rates, as set out in or resulting from the Energy Tax Act (1994: 1776), are set out in Section 3.1.1.1. Instead, Table 15 shows the evolution of energy and carbon taxes on fossil fuels and electricity for the period 2022-2012 expressed as an amount per energy amount (öre/kWh).

Table 15 Energy and carbon dioxide tax on fuels and electricity on 1 January each year 2012-2024, öre/kWh (2022 price level).

	2012	2018	2019	2020	2021	2022	2023	2024
Electricity	34,3	37,5	38,6	39,1	38,6	36,0	36,1	38,8
Fuel oil	46,6	47,4	47,5	48,1	47,4	44,3	37,7	38,2
Diesel	56,4	52,4	52,5	53,2	52,4	49,0	38,3	38,8
Gasoline	73,5	83,9	80,3	81,4	80,3	74,9	63,9	56,8
Coal	52,0	52,8	53,0	53,6	52,9	49,4	49,5	53,2
Natural gas	34,9	35,5	35,6	36,0	35,5	33,2	33,2	35,7

For households, VAT of 25 % is also charged on the energy price inclusive of taxes. As a rule, businesses have a full right to deduct such input VAT.

EU minimum levels of taxation

The EU minimum levels of taxation applicable to motor fuels are set out in Table A of Annex I to the Energy Taxation Directive.172 Table B of that annex sets out the minimum rates:

[215] Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity.

172Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity.

tiers for motor fuels used for the purposes set out in Article 8(2) of the Directive. Table C of the Annex sets out minimum levels of taxation applicable to heating fuels and electricity. The EU minimum levels of taxation are presented in Table 16 and Table 17. The minimum levels of taxation have not changed after 2010.

Table 16 EU minimum rates for fuels and electricity.

		Unit of tax rate	Tax rate
Motor fuels			
	Leaded petrol	EUR/1000 litres	421
	Unleaded petrol)	EUR/1000 litres	359
	Diesel	EUR/1000 litres	330
	Kerosene	EUR/1000 litres	330
	LPG	EUR/1000 kg	125
	Natural gas	EUR/GJ gross calorific value	2,6
	Motor fuels used for the purposes of Article 8(2) (agriculture, stationary engines, construction, etc.)		
	Diesel	EUR/1000 litres	21
	Kerosene	EUR/1000 litres	21
	LPG	EUR/1000 kg	41
	Natural gas	EUR/GJ gross calorific value	0,3
	Heating fuels and electricity		
	Diesel	EUR/1000 litres	21
	Heavy fuel oil, heating	EUR/1000 kg	15
	Kerosene	EUR/1000 litres	0
	LPG	EUR/1000 kg	0
	Natural gas	EUR/GJ gross calorific value	0,15
	Coal and coke	EUR/GJ	0,15
	Electricity, professional use	EUR/MWh	0,5
	Electricity, non-professional use	EUR/MWh	1,0

Table 17 Value of the minimum levels of taxation in the Energy Tax Directive, in SEK for petrol, diesel andnon-business electricity[217]

Year	Motor fuels		Non-professional electricity
	kr/l petrol	SEK/l diesel	öre/kWh
2022	3,91	3,59	1,09

[217] conversion has been carried out using calorific values for different fuels according to the Energy situation in figures 2023, as well as the ECB's official exchange rate for 2022 as of the first business day in October: SEK 10,8815/EUR.

Estimated impact of policies to achieve energy savings obligations

Article 8(2) of the recast EED states that Member States are to ensure that the savings resulting

from policy measures referred to in Articles 9, 10 and 30.14 are calculated in accordance with Annex V. Article 8(14) (a) of that Directive requires Member States to demonstrate that energy savings are not counted twice in cases where the impacts of policy measures (policies) or individual measures overlap.

Overall on energy saving calculation

Sweden applies a wide range of complementary instruments. The actual measures taken to improve the efficiency of energy use are the result of the interaction of these instruments.

In order to completely avoid the risk of double counting of energy savings from different complementary instruments, Sweden calculates the impact of different instruments as a package. The starting point for the Swedish energy efficiency policy is that the impact on price signals through the application of general energy and CO2 taxes is the basic instrument. The overall impact of the instruments applied in Sweden is therefore calculated in accordance with the methodology set out in the Directive for calculating the impact of energy and CO2 taxes. Thus, the impact of the other complementary instruments described in Chapter 3 will not be monitored and calculated in the context of Article 8 and 10 of the recast EED. This approach to the calculation and follow-up of energy savings is applied only for the implementation of the provisions of Article 8 and 10 of the Directive.

Methodology for calculating energy savings from taxes

The Directive does not set out a detailed calculation method, but it is clearfrom the provisions that only energy savings resulting from taxation measures exceeding the minimum levels of taxation applicable to fuels under the obligations of the Energy Tax Directive or the VAT Directive are to be taken into account. In addition, it is stated that current and representative official data on price elasticity shall be used to calculate the impact of taxes.

The energy savings that can be credited are the savings resulting from the price difference resulting from the fact that Swedish taxlevels are higher than the EU minimum levels of taxation for energy and CO2 taxes and VAT respectively. Slightly simplified, energy savings are calculated by multiplying the price difference by price elasticity and energyuse.

Article 8 or 10 of the recast Energy Efficiency Directive does not require the cumulative amount of energy savings to be achieved through the use of new instruments, but it is to be achieved through new measures. These may result from new and/or existing instruments. The levels of Swedish energy and CO2 taxes have been higher than the EU minimum levels of taxation for a long time. Taxes have contributed and will continue to contribute to energy savings, both by stimulating behavioural change and by investing in energy-efficient technologies. A crucial issue for the calculation of policy effects is the starting date to be used. The energy efficiency measures taken in 2 021 are an effect of the tax levels (and other instruments) that existed in 2021, but also of the tax levels and instruments that existed in 2020

and before. The taxes introduced in 2021 and later produce effects beyond 2030.

Since Sweden takes into account the impact of taxes on energy savings in the period 2020-2014, 2014 should also be the starting year for the calculations 2030-2021. In order to calculate the impact of taxes, energy savings over the period 2030-2014 should be counter-assessed, i.e. compared under an alternative scenario of reducing tax levels to the EU minimum levels of taxation as of 1 January 2014, when the Directive's savings requirements were originally introduced. The guiding effect of the higher levels of taxation then lies in their contribution to keeping energy consumption down, compared to the alternative scenario in which taxes are reduced. The cumulative energy savings are then the difference between the scenarios, which is the increase in energy consumption resulting from reduced taxes (see Figure 6). If we were to also include the effects of taxes introduced before 2 014 in the period 2030-2014, energy savings would have been much higher. This is because the full effect of the price differential would have already been reached in 2014 and would remain.

Figure 6 Energy saving due to differences between the Swedish tax level and the minimum level of taxation.

As mentioned, the price-increasing effect of taxes has an impact in both the short and the long term. In order to capture that impact, energy savings should, as far as possible, be calculated dynamically and cumulatively taking into account both short- and long-term price elasticity.

As regards the use of long-term price elasticity, the calculation method does not assume that the full effect is achieved already in the first year following the introduction of a tax increase. In a dynamic model, this is not a risk, but where a dynamic model is not available, assumptions need to be made about how long it takes to reach full power and how it develops over time. Such integration may take different shapes. More detailed information on the calculation models, price elasticity, etc. used for calculating energy savings of Swedish instruments in different sectors is provided in the following section. Calculations are made for different fuels/energy carriers in the residential and service sectors (excluding area-related industries), transport and industry.

Econometric estimates of short and long-term price elasticities were made in 2013 for electricity use in housing and servicing173 and for the use of petrol and diesel in the transport sector.174 175It can be noted that these estimates result in elasticities which are lower than previous estimates from 2008 (see SOU 2008: 25 Annex 5). New short and long-term price elasticities have since been estimated

the Swedish Energy Agency in 2019 refers to the period 1975-2017 for the use of electricity in dwellings and services and 2017-1976 for the transport sector.[220] The Swedish Energy Agency has based its estimates on the models used in 2013 for energy demand. The resulting price elasticities have been used and processed for the present power calculations, in accordance with the Swedish Energy Agency's memorandum.[221]. Weighted price elasticity of fuels is used to calculate industrial effects. Fuel elasticity other than electricity was estimated for different industries by Brännlund and Lundgren (2011)[222] and the elasticity of different industries was weighted to one fuel elasticity.

As regards data for calculation and subsequent follow-ups, actual final energy consumption is used for 2014-2022. The average final energy consumption for the period 2022-2018 is then used for 2023-2030. Actual energy prices, taxes and VAT are used for 2014-2022,[all] of which are expressed as constant prices at the 2022 level. Current conversion factors are used to convert petrol and diesel prices from SEK/litre to öre/kWh and vice versa.

For the counterfactual baseline[224], EU minimum levels of taxation for energy taxes and VAT are collected from the respective Directives. The EU minimum tax levels per fuel have been converted to öre/kWh using the official exchange rate in force, see Table 17. This level is used for the whole period 2021-2030. The EU VAT Directive states that the minimum standard tax rate is 15 %, compared to the Swedish level of 25 %.
The amount of VAT based on the EU minimum level of taxation has been calculated on the basis of the Swedish energy price176 and the minimum standard level of taxation allowed. The total minimum price has then been compared with the Swedish energy price including excise duty and VAT.

The impact of the price difference between excise duties and VAT in Sweden and the EU is calculated for each year. It is worth noting that the price difference to:

[220] Swedish Energy Agency – PM 2019: Calculation methodology for the impact of energy and CO2 taxes on energy consumption (ref. 2018-12739).

[221] Ibid.

[222] Elasticities by industry (source: https://www.diva-portal.org/smash/get/diva2:557885/FULLTEXT01.pdf)

173Brännlund (2013) the housing *sector's electricity demand in Sweden*, Report to the Ministry of Finance.
174Fuel lund (2013*) The effects on energy saving from taxes on motor fuels: The Swedish case*, CERE Working Paper 2013: 6.
176Excluding Swedish tax and VAT.

[223] Swedish Energy Agency – Energy situation in figures 2019.

[224] Under the Directive, energy savings can only be counted if they result from taxation measures exceeding the minimum levels of taxation applicable within the EU.

as a result of the above assumptions, from 2022 onwards, the same annual but indicative effect is the same from that year onwards.

The description and results of calculations of energy savings in the housing and services, industry and transport sectors are presented in *Annex 1*. All data are updated annually by the Swedish Energy Agency in connection with the publication of new official statistics.

Overall assessment of energy savings from Swedish instruments

The total annual and cumulative energy savings of Swedish instruments, calculated as the effect of higher levels of taxation for energy and carbon tax and VAT respectively in Sweden compared to the EU minimum tax levels, are shown in Table 18. The table shows that the total amount of cumulative energy savings from Swedish instruments over the whole period 2030-2021 is estimated at around 167 TWh. This results in a gap of around 70 TWh against the savings requirement (237 TWh) to be achieved in Sweden for the same period.

Table 18 Annual and cumulative energy savings from Swedish policies for the period 2021-2030.

	2021 – 2030	EED beting	Gap
Bos	126,1		
Transports	36,0		
Industry	4,5		
Sum	166,6	237,0	70,4

The Government has instructed the Swedish Energy Agency to prepare the basis for Sweden's implementation of Article 8 'energy saving obligation', Article 10 'Alternative policy measures' and parts of Article 24 'Strengthening and protecting vulnerable customers and reducing energy poverty'. In the interim report of 17 April 2024, the authority produced the calculations of energy savings according to the tax method set out above. In the final report of 22 December 2024, the Authority shall propose one or more methods covering savings from all energy carriers and instruments and, if:

Sweden does not meet the requirement with existing instruments, develop proposals for additional instruments to achieve the energy savings obligation.177

1 .2.1.2 long-term renovation strategy supporting the renovation of the national stock of residential and non-residential buildings, both public and

177 Government, *Mandate to prepare evidence for the implementation of Article 8, 10 and parts of Article 24 of the recast Energy Efficiency Directive, https://www.regeringen.se/regeringsuppdrag/2024/01/uppdrag-att-*, ta-for-supplements- Article 8-10-and-delar-by Article -24-i-recasted-Directive for- energy/(2024).

private, including policies, measures and actions to stimulate cost-effective deep renovations as well as policies and actions to address the worst performing segments of the national building stock, in accordance with Article 2(a) of Directive 2010/31/EU

Sweden reported its long-term renovation strategy in line with Article 2(a) of the Energy Performance of Buildings Directive in 2020.178 The recast Energy Performance of Buildings Directive replaces the national renovation strategy with a national building renovation plan, which aims to ensure that Member States reach the goal of a zero-emission building stock by 2050. This is a work that the Directive requires to be reported as part of the NECP. The first building renovation plan shall be reported by 31 December 2026.

The National Board of Housing, Building and Planning's Building Rules (BBR)

The Planning and Building Act lays down requirements for buildings. The rules apply both to-new buildings and to changes to buildings. The National Board of Housing, Building and Planning's Building Rules (BBR)179 contain implementing measures for the Planning and Building Act in the form of rules on housing design, accessibility and usability, fire protection, hygiene, health, the environment, water and waste management, noise protection, safety in use and energy management.

The building regulations contain requirements for energy management, which set the limits for maximum permitted energy use in buildings. A requirement concerns limit values for the building's energy consumption (primary energy capital) expressed as kWh per square metre floor area per year. The requirement covers energy for heating, comfort cooling, domestic hot water and real estate energy and is specified for normal use of the building. The requirements for primary energy capital are currently 90-100 kWh/m^2 for single-family houses depending on their size, i.e. single-dwelling and two-dwelling buildings, 75 kWh/m^2 for multi-dwelling buildings and 70 kWh/m^2 for residential buildings.

Rot rebates

The root deduction is a tax credit of 30 % of the labour cost of repairs, maintenance, alterations and ancillary buildings in dwellings. The deduction was introduced in 2008 on the grounds that it would stimulate labour supply and reduce undeclared work.[229] Some of the measures covered also contribute to more efficient energy use.[230] A natural effect of the root deduction is that it creates incentives for property owners to carry out further renovations. The maximum aid is SEK 50 000 per person per year. The option is offered to owners of single-family houses, owner-occupied apartments and holiday homes, as well as owners of tenant-ownerships.

The Riksdag has decided on a proposal to temporarily increase the ceiling for the root fee and

Directive 2010/31/EU of the178 European Parliament and of the Council of 19 May 2010 on the energy performance of buildings.
179Swedish National Board of Housing, Building and Planning's statutes (BFS 2011: 6, including amendments up to and including BFS 2020: 4).

to introduce, on a temporary basis, separate ceilings for the root and root-back deductions (Bill. 2023/24: 86 temporarily increased ceiling for the routing allowance). The proposal was announced in the 2024 Budget Bill to support the construction sector in the current recession. The provisions will enter into force on 1 July 2024 and expire at the end of December 2024.

The proposal provides that the ceiling for the root-fee should be SEK 75 000 per person and the ceiling for the root-fee is SEK 75 000 per person in 2024. This is to be compared with the current regulation, where the ceiling for the root deduction is SEK 50 000 and the common ceiling amounts to SEK 75 000. However, up to 30 June 2024, a maximum of SEK 50 000 may be used for root-deductions and a maximum of SEK 75 000 in total for root and rut deductions.180

National Renovation Centre (NRC)

The National Renovation Centre (NRC) works with industry and academia to support building stakeholders through knowledge building and dissemination of information. This is to implement an efficient renovation process. The aim is to increase the number of existing buildings.

[229] Prop. 2006/07: 94 tax credits for household services, etc., bet. 2006/07: SkU15, rskr 2006/07: 181 and Government Bill. 2008/09: 97 measures for jobs and transition, bet. 2008/09: FiU1 8, rskr. 2008/09:183.

[230] Forhouse owners, the right to a tax deduction is for example granted for the drilling and installation of geothermal systems, along with the replacement of windows, doors and taps, additional insulation and the installation and replacement of ventilation systems. For individual tenants, only work relating to repairs, conversions and extensions that is carried out in the apartment gives entitlement to a tax deduction. See more on http://skatteverket.se.

environmentally, economically and socially sustainable in a life-cycle approach with an improved or maintained function to meet the demands of users and public authorities.[232].

Information Centre for Sustainable Construction

The Information Centre for Sustainable Building (ICHB) is a mandate from the National Board of Housing, Building and Planning on the initiative of the Government. The ICHB shall promote greater energy efficiency in renovation and energy-efficient construction with sustainable materials and low life-cycle climate impact. The platform publishes research, results and experiences that can be used to make sustainable decisions. The platform has a library with a searchable database.

The database contains documents in the form of scientific reports, studies and other publications. The project provides free information on sustainable construction to help building owners and entrepreneurs build and renovate sustainably. The focus is on energy efficiency, material choice and life-cycle thinking.181

180Government Bill (2023/24: 86) Temporary increase of the ceiling for the root-surcharge.
The National Board of181 *Housing, Building and Planning, task of setting up an information centre for sustainable*

Individual metering and billing

In Sweden, so-called hot rent is normally applied in apartments, i.e. tenants and tenant-owners pay for the electricity they use, but costs for heating and hot water are included in the rent and the monthly fee. As a result of the EU Energy Efficiency Directive, rules have been introduced in the Act (2014: 267) on energy measurement in buildings. The rules require multi-dwelling buildings with the worst energy performance to install sub-metering and billing systems for heating, cooling and hot water, if technically feasible and the building owner does not plan to improve the energy performance of the building so that it no longer meets the requirements.

[232] Lund University of Technology, *National Building Renovation Centre,* http://www.renoveringscentrum.lth.se/ (2024).

3.2.1.3 Description of policies and measures to promote energy services in the public sector and measures to remove regulatory and non-regulatory barriers to the use of energy performance contracting and other energy efficiency service models

Information dissemination

The Swedish Energy Agency has the task of promoting the market for energy services in Sweden. The Energy Efficiency Directive requires Member States to promote the energy services market and make it available to companies and organisations wishing to reduce their energy use. The Swedish Energy Agency works, among other things, to disseminate information on energy services, to clarify what it means by energy services and to monitor developments in the market.182

The Swedish Energy Agency also coordinates several needs-owner networks to promote energy efficiency in the building stock. The networks include customer groups for multi-dwelling buildings (BeBo183), commercial and public premises (BeLok184), single-family house manufacturers (BeSmå185) and a network to promote new and conversion to low-energy buildings (low energy186). The aim of the networks is to create a meeting place and platform

construction, https://www.boverket.se/sv/byggande/uppdrag/uppdrag-att-inratta-ett-informationscentrum-for-hallbart-build/(2023).
182 Swedish Energy Agency, *Energy Services*, https://www.energimyndigheten.se/energieffektivisering/jag-vill- Energisera-min-organisation/wagon line and hjalp/ Energy-janster/(2018).
183 Bebo, *Housing,* https://www.bebostad.se/ (2024).
184 *BeLok, Belok is driving development,* https://belok.se/ (2024).
185 BeSmå, *Welcome to the BeSmå network,* https://energieffektivasmahus.se/ (2024).
186 Flame, *flame – for energy efficient buildings,* https://laganbygg.se/ (2024).

for public authorities, industry and academia to jointly develop energy-efficient practices, develop good practices and carry out demonstrations. Networks work on testing, introducing and evaluating new technologies, models and products, implementing technology procurements and bridging market knowledge barriers. The networks also serve as a platform for meeting, bringing together different industry stakeholders, public authorities and academia to create new cooperation and increased engagement.187

Energy Efficiency Council

The Energy Efficiency Council is responsible for strengthening government cooperation and the implementation and monitoring of measures and instruments to meet the objectives set by the Riksdag for energy efficiency. The Energy Efficiency Council is advisory and meets four times a year.188

3.2.1.4 Other planned policies, measures and programmes to achieve the indicative national energy efficiency contributions for 2030 and other objectives referred to in paragraph 2.2 (e.g. measures to promote the role of public buildings as role models and energy-efficient public procurement, measures to promote energy audits and management systems, consumer information and training measures and other measures to promote energy efficiency)

In addition to the energy efficiency provisions decided at European level and implemented in Sweden, the following policies and measures are also available in Sweden.

Municipal energy and climate advice

State funds go to municipalities for local climate and energy advice to individuals, associations and SMEs. The local climate and energy advisors, who are present in almost all Swedish municipalities, provide objective and locally adapted information and advice on energy efficiency measures, energy use and climate-related issues in buildings and households.189

Work is ongoing on how energy and climate advice can and needs to be developed in the light of the revised Energy Efficiency Directive as well as the revised Renewables Directive. The Swedish Energy Agency is tasked with reviewing the current regulation and making proposals on how the advice may also include measures to reduce vulnerability for single-family owners, organisations and small and medium-sized enterprises, including in the event of high energy prices. The assignment was presented on 24 May 2024 and finalised on 2 September 2024.

Financial support is also provided to 14 regional energy agencies that coordinate energy and

187 Swedish Energy Agency, *Nätverket,* https://www.energimyndigheten.se/energieffektivisering/jag-vill- Energisera-min-organisation/ natverk-bestallargroup/(2023).
188 Swedish Energy Agency, *Energy Efficiency* Council, https://www.energimyndigheten.se/om- oss/organisation/energy efficiency rared/(2019).
189 Swedish Energy Agency, *Energy and Climate Advisory Service,* https://www.energimyndigheten.se/energieffektivisering/jag-vill-energieffektivisera-hemma/energi--och- climate change/(2022).

climate advisors. The Energy Agencies initiate and participate in several projects on energy efficiency and renewable energy sources, funded by the EU, county administrative boards, regions and other organisations. The offices cooperate regionally with businesses, county administrative boards, municipalities and others, for example in developing plans and strategies.

Environmental inspections and inspection guidance

The Environmental Code entered into force in 1998. At that time, the requirement for energy management and the use of renewable energy sources became more important, as it was highlighted in a rule of consideration, which is the cornerstone of the Environmental Code. According to the Environmental Code, all operators must manage energy and primarily use renewable energy sources. This means that operators must:

- gain knowledge of energy use;
- identify possible measures; and
- implement reasonable measures on an ongoing basis.

Enforcement authorities shall monitor compliance with the principle of economy. They are also tasked with providing advice. Authorities have the right to request the information necessary for supervision, such as mapping, analysis and measures. It is therefore particularly important that the work on energy management is documented. In accordance with the Environmental Supervision Ordinance (2011: 13), since 2011 the Swedish Energy Agency has had a supervisory responsibility for matters relating to operators' self-monitoring in relation to the management of energy and the use of renewable energy sources. The work involves providing support and advice to the operational supervisory authorities, municipalities and county administrative boards, as well as coordinating, following up and evaluating operational supervision.

Energy audits in large companies

The Act (2014: 266) on energy audits in large companies aims to promote increased energy efficiency. The Act is part of meeting the requirements of the EU Energy Efficiency Directive for Member States. The Act requires large companies to carry out energy audits, which must include information on total energy use and propose cost-effective measures to improve energy efficiency. The mapping must be carried out at least every four years.190 The legislation will need to be revised in the context of the implementation of the revised Energy Efficiency Directive.

Stakeholder cooperation in local energy efficiency nodes

In order to systematically use and reuse residual energy, mainly heat, local activities are

The190 Swedish Energy Agency, *energy mapping in large companies*; https://www.energimyndigheten.se/energieffektivisering/jag-vill-energieffektivisera-min- organisation/energy carding/energy chartering-i-stora-foretag/(2024).

encouraged to work together on both high and low-value residual heat, not least that produced in some large industrial installations and which can be controlled to the district heating network or other operators who can benefit from it. This initiative can be said to be related to the technology procurement teams described above, but the activities take place at local, i.e. municipal, level. Today there are seven strategies with a total of more than 100 actors representing different user sectors.

Energy declarations

The Act (2006: 985) on the energy certification of buildings regulates the use of energy certificates in Sweden. The National Board of Housing, Building and Planning has developed implementing rules and supervises the declarations and the independence of energy experts. An energy performance certificate shall be drawn up for a building when selling, renting and new construction and for large buildings frequently visited by the public. The energy declaration is made by an independent expert on behalf of the owner and is valid for 10 years.

An energy certificate contains information on the energy use of the building and is addressed to prospective house buyers or tenants. Energy certificates shall make purchasers aware of energy consumption so that it is taken into account in the purchase. The energy certificate shall also include proposals for measures to reduce energy consumption if proposed by the energy expert. In total, at the beginning of 2024, there were just over 716 000 energy– declared buildings registered in the National Board of Housing, Building and Planning's database.191 192

Following the new recast of the Energy Performance of Buildings Directive (EPBD), the energy certification system will need to be redesigned. In the energy policy bill, the Government considers that the system of energy certificates should be reviewed and adapted on the basis of the revised Energy Performance of Buildings Directive and in order to effectively contribute to energy efficient buildings with sustainable heating solutions. Among other things, the energy classes need to be adapted in order to achieve better harmonisation between Member States.

Aid for energy efficiency in single-family houses

In the 2023 budget, the Government allocated approximately SEK 1.2 billion in 2025-2023 to support the conversion of heating systems and energy-efficient renovation of single-family houses that are today heated with direct-acting electricity or gas. This may include façade and vinification or replacement of windows and doors. Grants may be granted for both heating system measures with possible addition of measures for the building envelope. The grant may amount to 50 % of the eligible costs, up to a maximum of SEK 30 000 per approved application. The maximum grant is SEK 60 000. The grant is managed by the county administrative boards with the support of the National Board of Housing, Building and

Swedish National Board of191 Housing, Building and Planning, *Annual Accounts 2022;* https://www.boverket.se/globalassets/publikationer/dokument/2023/boverkets-arsredovisning-2022.pdf (2023).

Planning.[244]

Information campaigns

The Swedish authorities, in particular the Swedish Energy Agency, have developed web-based tools to disseminate targeted information on energy use and energy efficiency improvements.[245].. Information campaigns are aimed at households, businesses and public authorities alike. An example is *Energilyften*, a free web training on low-energy building aimed at clients, architects, engineers, construction project managers, managers and operational technicians.[246]

In 2022, the Swedish Energy Agency launched an information campaign "Each kilowatt-hour counts" to raise awareness in society, reduce the use of electricity and reduce the price of electricity. At the same time, an energy efficiency193 campaign for single-family owners was also launched in 2022 as part of a government mission.

3.2.1.5 Where applicable, a description of policies and measures to promote the role of local energy communities in contributing to the implementation of the policies and measures described in points (i), (ii), (iii) and (iv)

Article 22(4) of the Renewables Directive requires Member States to provide an enabling framework to promote and facilitate:

244 Government, *Ordinance on grants for energy efficiency in single-family houses enters into force on 3 July,* https://www.regeringen.se/pressmeddelanden/2023/07/forordningen-om-bidrag-for-energieffektivisering-i- smahus-trader-i-kraft-den-3-juli/ (2023).

245 Swedish Energy Agency, *Energy Efficiency,* https://www.energimyndigheten.se/energieffektivisering/ (2023).

246 Swedish Energy Agency, *Energilyften,* http://www.energimyndigheten.se/energieffektivisering/jag-arbetar-med- energy efficiency/construction/ energyft/(2024).

development of renewable energy communities; In 2022, the Government considered that there are energy communities in Sweden and that there are no obstacles to the formation of new ones. Against this background, the Government did not propose any new legislation on the basis of the provisions on energy communities in the Electricity Market Directive and the Renewables Directive. However, it is now considered that there is reason to look at the issue again and the Government has tasked the Swedish Energy Agency with examining the conditions for setting up and operating in renewable energy communities and citizen energy communities and whether further efforts are needed to promote such communities.194 The report will be presented on 2 September 2024.

193 Swedish Energy Agency, *Husguiden – for those who want to make your house more* energyefficient, https://www.energimyndigheten.se/energieffektivisering/husguid en-for-dig-som-vill-energisera-ditt/(2023).
194 Government, *Mission to investigate the conditions for energy communities and the possible need* for promotion measures, https://www.regeringen.se/contentassets/25cdd7ec1f3c417398d2b8c7d50eb435/uppdrag-.

247 .1.6 description of measures to exploit the energy efficiency potential of gas and electricity infrastructure

Electricity Act

The Electricity Act was amended in 2014 to meet the requirements of the Energy Efficiency Directive. Chapter 3, Section 16a (current Chapter 3, Section 41) of the Electricity Act introduced a provision under which electricity network companies may not impose technical requirements or other conditions that make it difficult to provide services in the form of changes in electricity consumption, unless the condition is justified by the safe, reliable and efficient operation of the collecting system. This avoids that network tariffs would prevent, for example, the application of demand response to balancing services and the purchase of additional services.

Chapter 4, Section 26 of the Electricity Act has also introduced provisions requiring network tariffs to be designed in a way that is compatible with efficient use of the electricity network and efficient electricity production and use.

Regulatory model for network operators

In2014, the economic regulation of electricity network operators introduced incentives to encourage energy efficiency through theEnergy Market Inspectorate's prior publication (EIFS 2019: 4) on what is meant by the quality of network operations and what is meant by efficient use of the electricity network when setting a revenue framework. These incentives mean that network operators that make improvements in the level of network losses and capacity use and thus contribute to energy efficiency receive a bonus in the regulation.

3.2.2 Regional cooperation in this area, where appropriate

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3.2.3 Financing measures, including Union support and the use of Union funds, in this area at national level

In addition to the national financing measures described earlier in the chapter, relevant EU funding is also available through the European Regional Development Fund (ERDF). The European Regional Development Fund (ERDF) aims to strengthen economic and social cohesion within the EU by reducing regional disparities. Within this framework, energy efficiency measures can, inter alia, be carried out. See section 3.1.1.3 for a description of the Swedish regional fund programme.

3.3 Dimension energy security

3.3.1 Policies and measures relating to: the elements set out in point 2.3.

3.3.1.1 Power supply

Measures to strengthen risk preparedness for electricity

Since 5 January 2020, the Swedish Energy Agency has been the competent authority for electricity in Sweden in accordance with the EU Regulation on risk-preparedness in the electricity sector.195 The background to the Regulation is the more interconnected electricity markets and systems, with the result that the management of electricity crises can no longer be considered a purely national task. Article 10 of the RR requires the competent authority in each Member State to draw up a risk-preparedness plan for electricity. The latest version of a risk-preparedness plan was adopted on 14 December 2022. The risk-preparedness plan includes a description of the most relevant electricity crisis scenarios for Sweden and the measures that may be taken to deal with an electricity crisis, as well as a description of how responsibilities are allocated.

Measures relating to electrical power cuts

The Swedish National Grid is the Swedish electricity emergency authority and is working to strengthen the electricity supply so that it can cope with severe pressures. The Swedish National Grid System ensures that measures are taken to improve preparedness, that there are trained staff and that resources are available for repair work and communication equipment. For the funding of preparedness actions, see section 3.3.3.

Under Chapter 4, Section 20 of the Electricity Act, there are requirements against the network owner that interruptions may not exceed 24 hours unless this is caused by a factor outside the control of the network owner. If an interruption lasts longer than 12 hours, customers are entitled to compensation, see Chapter 10, Section 10 of the Electricity Act.

In addition, measures are being taken to raise public awareness of appropriate domestic preparedness measures in order to mitigate the consequences of blackouts.196 197

Measures related to electricity shortages

The Swedish Energy Agency is working on crisis management measures to prevent electricity shortages and to mitigate the consequences of shortages. These measures include, inter alia, a national information campaign to encourage electricity users to voluntarily reduce their

195 Swedish Energy Agency, *Risk preparedness in the electricity sector,* https://www.energimyndigheten.se/trygg- Energy forsorjning/el/risk-preparedness in the electricitysector/ (2022).
196 Swedish Energy Agency, *Ela vbrott,* https://www.energimyndigheten.se/trygg-energiforsorjning/el/elavbrott/ (2022).

consumption and thus avoid shortages. If this is insufficient, there is a plan for how a future rationing system could be designed. The Swedish Energy Agency is the responsible authority for measures concerning electricity shortages.

Measures on lack of power

The basis for avoiding a lack of impact is that market players act in balance. When this is not sufficient, the Swedish system operator, Svenska kraftnät, has a number of technical and commercial mechanisms at its disposal to maintain a balance in the electricity system.

If the regular mechanisms available to Svenska kraftnät are not sufficient, the power reserve is available in winter.
The power reserve is created by Svenska kraftnät entering into agreements with electricity producers to maintain a specific generation capacity. The Power Reserve Act (2003: 436) applies until 15 March 2025. In March 2024, the Government presented a proposal for a new capacity mechanism.[251] The memorandum states that there should be a capacity mechanism for the electricity market in Sweden even after 15 March 2025, when the current power reserve will cease to exist. The memorandum also includes a proposal for a new law on the financing of a capacity mechanism for the electricity market.

If mechanisms are not sufficient, the last resort is load disconnection (MFK), which means that part of the consumption is disconnected to avoid system failure. In order to mitigate the impact on society, a methodology for planning and prioritising essential electricity users, Styrel, has been developed.[252]

Response to the Energy Crisis 2022-2023

A number of interrelated global factors in 2022, such as the suspension of gas supplies from Russia to Europe and the divestment of nuclear power in France, led to an increase in the price of electricity. In response to the energy crisis, a crisis regulation was adopted at EU level to address high energy prices.198 199

The Emergency Regulation required Member States to reduce electricity consumption by at least 5 % during peak hours and requested to reduce overall electricity demand by at least 10 % by 31 March 2023. Member States were free to choose the appropriate measures to reduce consumption in order to achieve both targets during this period.

The Government, together with the Energy Agency and the Swedish National Grid, has communicated to society about the risk of manual disconnection of electricity users during

198Council Regulation (EU) 2022/1854 of 6 October 2022 on an emergency intervention (the 'Emergency Regulation') in order to:
tackling high energy prices.

winter 2022/2023 due to the risk of lack of power during peak hours.

Several actions implemented in 2022/2023 are presented below:

[251] The Government, *A capacity mechanism for the electricity market;* https://www.regeringen.se/contentassets/021 745c61f414fcbbd841fb341f43d3e/Memo ona-on- Capacity Mechanm-for-el Market.pdf (2024).

[252] Swedish Energy Agency, *Styrel – prioritising essential electricity users*, https://www.energimyndigheten.se/trygg-energiforsorjning/el/styrel/ (2023).

- The Government instructed state authorities with ten or more employees to take possible and appropriate energy saving measures until 31 March 2023.[254] The Swedish Energy Agency has compiled the measures taken by some 200 authorities and followed up on the results achieved monthly, from September 2022 to May 2023.[255]

- The Swedish Energy Agency launched an information campaign "Each kilowatt-hour counts" to raise awareness in society, reduce the use of electricity and reduce the price of electricity.

- The Swedish Energy Agency launched an[energy efficiency campaign in 256] for single-family owners in 2022 as part of a government mandate.

- On 10 November 2022, in order to meet the requirements of the Emergency Intervention Regulation for reduced power peaks during peak hours, the Government instructed Svenska kraftnät to set peak hours for electricity equivalent to at least 10 % of all hours in the period from 1 December 2022 to 31 March 2023[257] and to procure consumption flexibility during the specified peak hours. Swedish National Grid set peak hours between 08: 00: – 10: 59 and 16: 00 – 18: 59 for Monday.[258]

- On behalf of the Government, the Swedish electricity grid investigated the possibility of procuring consumption flexibility and scheduled electricity generation in southern Sweden, with the aim of countering exceptionally high electricity costs.200 201 202

[254] Government, *Mission to implement energy saving measures in the State administration*, https://www.regeringen.se/regeringsuppdrag/2022/09/uppdrag-att-vidta-energibesparingsatgarder-inom-den- statliga-forvaltning/ (2022).

[255] Swedish Energy Agency, *Energy saving in the public sector – important contribution to a sustainable energy system*, https://www.energimyndigheten.se/nyhetsarkiv/2023/energibesparing-inom-offentlig-sektor--viktigt-bidrag-till- one-hallbart energy system/(2023).

[256] Swedish Energy Agency, *Husguiden – for those who want to make your house more* energyefficient, https://www.energimyndigheten.se/energieffektivisering/husguiden ---for-dig-som-vill-energisera-ditt/(2023).

[257] Government, *Engagement to procure consumption flexibility during peak hours*, https://www.regeringen.se/regeringsuppdrag/2022/11/uppdrag-att-genomfora-upphandling-av- on-peak hours flexibility/

200Swedish National Grid, *Engagement to prepare further procurement of demand flexibility and programmable electricity generation in southern Sweden*, https://www.svk.se/siteassets/om-oss/rapporter/2022/uppdrag-att-forbereda-further procurement-off-farm flexibility and planerbar-electricity production-i-sodra-sverige.pdf (2022).

(2022).

[258] Swedish National Grid, *Reporting of fixed peak hours in connection with government assignments to procure consumption flexibility during peak hours*, https://www.svk.se/siteassets/om- vi/rapporter/2022/rapport-regeringsuppdrag-dnr-i2022 – 02043.pdf (2022).

The Energy Market Inspectorate approved Svenska kraftnät's application to use congestion revenues for demand reduction measures.[260]

- In winter 2022/2023, the Swedish power grid carried out procurements for mothshopping and redispatching.[261]

- On 1 March 2023, a tax on excess revenues from electricity was introduced to allow Sweden to apply the revenue cap to certain electricity producers that was part of the Emergency Ordinance.[262].[263]. The tax on excess electricity revenues limited the revenues of certain electricity producers between 1 March and 30 June 2023.

- On 18 August 2022, the Government instructed Svenska kraftnät to design a model for using revenues from capacity charges to support electricity users financially.[264] On 16 November 2022, the Energy Market Inspectorate approved an application from Svenska kraftnät to use congestion revenues up to SEK 55.6 billion to finance electricity support to final electricity customers.203 204205 The first electricity aid was paid to approximately 4.2 million households in bidding zones 3 and 4 and the calculation of the electricity aid was based on the consumption that had occurred in the period October 2021 to September 2 022 in southern Sweden. Disbursements started at the end of February and, on 7 March 2023, approximately 98 % of the eligible beneficiaries had benefited from the electricity aid.

- On 22 December 2022, the Government instructed Svenska kraftnät to submit a new application to the Energy Market Inspectorate for Electricity Aid to Companies by 4 January 2023 at the latest and

[260] TheEnergy Market Inspectorate, *Ei approves Svenska kraftnät's application to use congestion revenues for demand reduction measures*, https://ei.se/om-oss/nyheter/2022/2022-12-16-ei-godkanner-svenska- kraftnats-ansokan-om-ta-handlingsintakter-to-atgarder-for-post-fragemaking (2022).

[261] Swedish power grids*, trade and redispatching increase capacity*, https://www.svk.se/press-och- news/news/allmanna-nyheter/2023/mothandel-och-omdirigering-hojer-kapaciteten/ (2023).

[262] Government Bill 2022: 23/58, *Extraordinary amending budget for 2023 – Temporary tax on the surplus revenues of certain electricity producers*, https://www.regeringen.se/rattsliga-dokument/proposition/2023/02/prop.- 20222358

[263] Act (2023: 75) on tax on excess revenues from electricity.

[264] Swedish National Grid, *Accounting in connection with government assignments to apply for the use of congestion revenues to finance emergency measures for consumers and businesses,*https://www.svk.se/siteassets/om- We/vart-assignments/government /nodatarships/account-ru-nodatgarder.pdf (2022).Legal entities.[266]. The new application would take into account the previous decisions of the Energy Market Inspectorate, as well as the EU regulatory framework linked to the ongoing crisis. On 11 January 2023, the Energy Market Inspectorate decided to approve Svenska kraftnät's application to use congestion revenues to support electricity customers who are traders and legal entities in bidding zones 3 and 4. On 5 May 2023, the European Commission approved the Government's State aid notification regarding electricity aid

The203 Energy Market Inspectorate, *Ei approves Svenska kraftnät's application to use congestion revenues* in*support of traders and legal persons*, https://ei.se/om-oss/nyheter/2023/2023-01-11-ei-godkanner-Svenska-kraftnats-ansocan-om-ot-ta-applicant-nectas-to-stod-for-naringside care- and juridical HYPERLINK "https://ei.se/om-oss/nyheter/2023/2023-01-11-ei-godkanner-svenska-kraftnats-ansokan-om-att-fa-anvanda-flaskhalsintakter-till-stod-for-naringsidkare-och-juridiska-personer"persons (2023).

to undertakings and on 8 May 2023 the Government adopted the Ordinance on electricity aid to undertakings. The electricity aid for companies is administered by the Swedish Tax Agency, and between 30 May and 25 September 2023, traders and legal persons were able to apply for the electricity aid.[267] applications were received by Skatteverket, 117 318 of which were granted and approximately SEK 18 000 000 000 were paid out in total.

- On 16 February 2023, the Government decided on targeted electricity aid to electro-intensive undertakings, see Ordinance (2023: 66) on electricity cost aid to certain particularly affected undertakings. Under Paragraph 20 of that regulation, electro-intensive undertakings could submit an application for electricity aid to the Energy Agency by 18 June 2023 at the latest. In total, 876 electro-intensive companies in Sweden applied for aid for high electricity costs and SEK 756 million have been paid.206

- On 22 December 2022, the Government commissioned Svenska kraftnät to investigate electricity support to households throughout the country during the period November to December 2022. On 3 February 2023, the Energy Market Inspectorate decided to approve the request to use congestion revenues also for this purpose.207 208 209 210

[266] Government, *Mission to apply for the use of congestion income to finance emergency measures for traders and legal persons, https://www.regeringen.se/regeringsuppdrag/2022/12/uppdrag-att-* ansoka-om-ta-intakter-fran-overlose-finance-nodatgarder-for-naringsidkare- and- juridical persons/ (2022).

[267] Swedish Tax Agency, *Electricity Support to Companies,* https://skatteverket.se/foretag/drivaforetag/statligtstod/elstodtillforetag.4.48cfd2121 85efbb440b298f.html (2024).

Measures to strengthen security of supply

On 15 December 2022, the Government gave a mandate to the Swedish National Grid and the Energy Agency to step up work on strengthening security of supply in the energy sector in the short and long term.[270].

The Swedish National Grid was tasked with the support of the Energy Agency:

- Implement preparatory measures to extend the power reserve or prepare corresponding contracts with electricity generators in order to ensure resource adequacy in line with the reliability standard for Sweden until 16 March 2025; The interim mission was presented in April 2023.[271]

- As part of ensuring security of electricity supply, propose the design of capacity mechanisms with the conditions to replace the power reserve and ensure resource adequacy beyond 16 March 2 025 in accordance with the reliability standard for Sweden. The interim mission was presented in March 2023.[272]

The206 Swedish Energy *Agency, electricity-intensive companies received 756 million electricity cost* support, https://www.energimyndigheten.se/nyhetsarkiv/2023/elintensiva-foretag-har-fatt-756-miljoner-i- electricity costod/(2023).
The207 Energy Market Inspectorate, ***Ei approves Svenska kraftnät's application to use congestion revenues to finance electricity support to natural persons,*** https://ei.se/om-oss/nyheter/2023/2023-02-03-ei-godkanner-Svenska-kraftnats-ansocan-om-applicant-necksintakter-for-att-financier- elstod-to-physician people (2023).

- Identify, as part of ensuring operational security, sufficient electricity and transmission capacity in the short and long term, how power generation contributes and interacts to secure security of electricity supply. The report was presented on 29 December 2023.211 212

The Swedish Energy Agency was tasked, in consultation with the Swedish National Grid Network:

- Identify the potential of existing and unused electricity generation and identified reasons for not making it available to the electricity market. The interim mission was presented in March 2023.

[270] Government, *Mission to strengthen security of supply in the energy sector,* https://www.regeringen.se/regeringsuppdrag/2022/12/uppdrag-att-starka-forsorjningstryggheten-i- the energy sector/(2022).

[271] Swedish National Grid, *Extension of the Power Reserve Report on Government assignments to strengthen security of supply in the energy sector – lot 1*,https://www.svk.se/siteassets/om- oss /rapporter/2023/rapport-starka-forsorjningstryggheten-deluppdrag-1 – 23-28.pdf (2023).

[272] Swedish Power Grid, *The future capacity mechanism to ensure resource adequacy in the electricity market*, https://www.svk.se/siteassets/om-oss/rapporter/2023/framtidens-kapacitetsmekanism-for-att-sakerstalla- resource-to-power market_svk-2022_3774.pdf (2023).

- Analyse the energy supply needs for total defence. The Swedish Energy Agency shall propose a division of Sweden into geographical areas for which it must be possible to identify normal energy needs and to estimate energy needs for the total defence.[274] The mission was presented in Dec 2023[275].

Nuclear

Sweden currently has six nuclear power reactors in operation and the Government has proposed that rules that hinder the expansion of nuclear power be changed to allow the construction of several reactors and new locations. The proposal to remove the provision in the Environmental Code prohibiting the construction of nuclear reactors in places other than those where nuclear power already exists. In addition, the Government proposes to remove the provision limiting the number of reactors in operation to ten.[276] The Government also proposes that a special investigator review the current rules to facilitate new nuclear power.[277] In addition, a national coordinator has been appointed to support the government's efforts to promote new nuclear power with a view to achieving efficient deployment.[278]

Vattenfall, which operates five out of six current reactors in Sweden, is of the opinion that these will be able to operate for many years as long as they meet all safety requirements and are in technical good condition and economically viable. For these reactors, there are no decisions on

211 Swedish National Grid, *Strengthening security of supply – sub-mission 3,* https://www.svk.se/siteassets/om-us/rapporter/2023/rapport-starka-forsorjningstryggheten-deluppdrag-3---1.0.pdf (2023).

abducted operating time.213 214

Vattenfall and Uniper, which operates the nuclear power plants in Sweden, have both taken steps not to be dependent on Russian uranium and nuclear fuel. Vattenfall has stopped planned supplies of Russian nuclear fuel and will not carry out any new purchases from Russia. The decision is not considered to affect:

274 Government, *Mission on Energy Supply for Comprehensive Defence,* https://www.regeringen.se/regeringsuppdrag/2023/08/uppdrag-om-energiforsorjning-for-totalforsvaret/ (2023).

275 Swedish Energy Agency, Energy *Supply for Total Defence,*https://www.energimyndigheten.se/remissvar-och-Mission/Download/? documentName = Energif% C3 % B6rs% C3 % B6rjning% 20f% C3 % B6R% 20total% C3 % B6rsvaret% 20 (2023-204165) -1703162771273.pdf -id = 1972 (2023).

276 The Government, *the Government facilitates the expansion of new nuclear power;* https://www.regeringen.se/pressmeddelanden/2023/06/regeringen-underlattar-utbyggnaden-av-ny-karnkraft/ (2023).

277 Government, *New Nuclear Power in Sweden – a second step,* https://www.regeringen.se/rattsliga-document/kommittedirektiv/2023/11/dir.-2023155 (2023).

278 Government, *National Nuclear Development Coordinator, https://www.regeringen.se/rattsliga-document/kommittedirektiv/2024/01/dir.-20241* (2024).

280 Uniper purchases nuclear fuel from Westinghouse in Västerås and the country of origin of the uranium is Kazakhstan. The main provider of enrichment services is UK URENCO, a smaller part of the uranium has been enriched in Russia. These deliveries have been suspended indefinitely.215 The owners of Swedish nuclear power plants have a purchasing strategy to be independent of individual countries and suppliers and have alternative suppliers of nuclear fuel.

No country in the world has yet built any spent fuel repository. Finland, Sweden and France are the countries at the forefront of the process. Swedish nuclear fuel management SKB works closely with its sister organisation in Finland, Posiva.216 The Government has decided to submit a bill to the Riksdag on financing the involvement of municipalities in nuclear waste management which the Riksdag has adopted (Bill. 2023/24: 41 financing of municipalities' involvement in issues of completion). The Government would like the Nuclear Waste Fund to be able to cover more costs for activities at municipalities when setting up a spent fuel repository and the extension of the repository for low- and intermediate-level waste.

3.3.1.2 gas supply

The Gas Supply Regulation imposes security of supply requirements for natural gas.217 Based on the Regulation and the Swedish legislation, a risk assessment218 has been carried out which

213 Water fall, *Climate change and nuclear energy are debated again,* https://group.vattenfall.com/se/nyheter-och-press/nyheter/201 9/klimat-och-karnkraft-debatteras-igen (2019).
215 Uniper, *Official Statement on the War in Ukraine, https://www.uniper.energy/sverige/nyheter/officiellt-* Statement Co-ordination-de-War i-Ukrain/(2022).
216 SKB, *International,* https://skb.se/projekt-for-framtiden/internationellt/ (2024).
Council Regulation (EU) 2017/1938 of the European217 Parliament and of the Council of 25 October 2017 concerning measures to safeguard the security of gas supply and repealing Regulation (EU) No 994/2010.
218Law (2012: (273) on security of natural gas supply and Ordinance (2012: 275) on security of natural gas supply.

forms the basis of a national preventive action plan219 and national emergency plan. The Preventive Action Plan was updated in spring 2023, and the national emergency plan in autumn 2022. The Swedish Energy Agency has also been working on revising its regulations with a view to identifying actors in the gas market, primary consumers. By strengthening the possibility of regulatory oversight of natural gas consumers, security of supply and energy preparedness are assessed.

[280] Vattenfall, *Vattenfall stops deliveries of Russian nuclear fuel,* https://group.vattenfall.com/se/nyheter-och-press/nyheter/2022/vattenfall-stoppar-leveranser-av-ryskt-karnbransle (2022).

The regulations and general advice drawn up by the Swedish Energy Agency today220 impose certain requirements on natural gas undertakings and large natural gas consumers. The requirements aim to increase preparedness for possible gas supply crises, thus ensuring gas supply to household customers, who benefit from special protection under the Gas Supply Regulation.

In its work on security of supply, the Swedish Energy Agency has continuously increased its work on solidarity under the Gas Supply Regulation (Article 13(10)), as well as cooperation with the European Commission and several Member States, including Denmark. Sweden and Denmark concluded on 8 May 2023 a bilateral solidarity agreement under EU Regulation 2017/1938 (Article 13(10)). The Swedish Energy Agency has also increased cooperation and information exchange with industry stakeholders.

The Swedish Energy Agency has also coordinated the reduction in gas consumption in accordance with the Council Regulation on the reduction of gas use221, and ensured that the requirement of at least 90 % filling gas storage was met by 1 November 2023. At the end of March 2024, consumption moderation stood at 23.5 %.

In February 2023, the government introduced a gas price support to households connected to the western Swedish gas network to support consumers due to high gas prices. The Government allocated the equivalent of SEK 150 million to the Energy Agency and the aid could be applied for in two rounds in 2023. Money for the aid was paid out by the Energy Agency and was sought by the gas network companies to distribute to the gas customers concerned. Eligible compensation was deemed to correspond to the level of compensation for electricity aid in bidding zone 4. A total of SEK 135 million was paid in 2 023 in compensation to gas customers connected to the grid (including compensation to the gas network companies for administrative

219This corresponds to the requirement of Article 6(1) of Regulation (2017/1938) to introduce a so-called “risk preparedness plan”.
220The Swedish Energy Agency’s regulations and general advice (STEMFS 2016: 1) on security of natural gas supply.
221Council Regulation (EU) 2022/1369 of 5 August 2022 on coordinated demand-reduction measures for gas

costs for managing the aid).

3.3.1.3 oil supply

Through the IEP agreement222 and the Oil Storage Directive, Sweden is223 to maintain emergency stocks equivalent to 90 days of net imports. The quantity of oil stocks for supply crises is determined once a year by the Swedish Energy Agency, which determines who is responsible for storage and how much individual storage is to be. The amount of the storage obligation is based on what the person liable for storage has sold or consumed in the previous base year. A storage year runs from 1 July to 30 June of the following year. Emergency stocks also include biofuels if they are involved in storage fuels for sale or consumption or if they are stored in Sweden and the person responsible for storage can demonstrate that they are intended to be blended with storage fuels and are to be used as propellant.

Emergency stocks are part of the companies' normal stocks, known as commercial stocks, and are primarily a market-regulating tool to supply the market with fuel in the event of a shortage of fuel. It is therefore not a stockpile for heightened alert and extreme war.

3.3.1.4 information security

Implementation of the NIS Directive

The Directive on network and information security (NIS)224 has been transposed into Swedish law by means of the Act (2018: 1174) on information security for essential and digital services, the NIS Act, together with its regulations and regulations.

The NIS Act aims to achieve a high level of security of networks and information systems for essential services in the sectors of energy, transport, banking, financial market infrastructure, healthcare, drinking water supply and distribution, digital infrastructure and digital services. The Swedish Civil Contingencies Agency (MSB), has the coordinating role for the work on the Act, and the sub-sectors have specific supervisory authorities. In short, the Act requires operators of essential services to report to regulatory authorities, to report incidents and to carry out systematic information security work.

The Swedish Energy Agency is designated by the Government as the supervisory authority for the energy sector in Sweden in accordance with the NIS Act. This means that the authority must supervise that operators of essential services in the energy sector comply with the provisions of the NIS Act and the regulations issued pursuant thereto, and may impose fines. The Swedish Energy Agency has developed regulations and general advice on risk analysis and security

222International Energy Agency (IEA) Agreement on a Joint Energy Programme.
223Council Directive 2009/11 9/EG of 14 September 2009 imposing an obligation on Member States to maintain minimum stocks of crude oil and/or petroleum products.
Directive (EU) 2016/1148 of the224 European Parliament and of the Council of 6 July 2016 concerning measures for a high common level of security of network and information systems across the Union.

measures for networks and information systems in the energy sector (STEMFS 2021: 3), which entered into force on 1 March 2022. In January 2023, a guide to the Regulation was published on how the regulations and general advice can be translated into practical action.

The NIS 2 Directive must be transposed into Swedish law by 17 October 2024. The updated Directive increases the scope, tightening and more detailed requirements for information security work and incident reporting, increasing supervisory powers and sanctions, and increasing requirements for effective cooperation and information sharing. For the energy sector, the Directive includes district heating, cooling and hydrogen in its provisions. In addition, it also includes new subsectors in electricity and oil, such as NEMs, CSUs and charging operators.

National strategy on information and cybersecurity of society

The government has a national strategy on how to develop and strengthen information and cybersecurity in Sweden.225 The strategy sets objectives in priority areas and will help create long-term conditions for societal actors to work effectively on information and cybersecurity and to raise awareness and knowledge across society. The NIS2 Directive requires the government to develop a new national cybersecurity strategy. As part of this, Member States shall in particular adopt guidelines in a number of areas.

3.3.2 Regional cooperation in this area

Work on security of supply and crisis management measures is based on the geographic spread of the market. Given the global nature of oil and fuel markets, cooperation on crisis management measures takes place globally, including cooperation within the International Energy Agency (IEA). If there is a potential risk of oil and fuel shortages, such a situation is analysed in Sweden and the EU as well as within the IEA. The IEA assesses the degree of impact of a supply disruption on the market and analyses whether emergency stocks should be deployed. The IEA can propose measures, such as collective action, but Sweden is responsible for deciding on possible measures concerning its own country.

As the Swedish electricity system is synchronous with the other Nordic countries, cooperation on various crisis management measures takes place to a large extent in the Nordic region. NordBER is a cooperation involving electricity preparedness issues between the Nordic energy and electricity emergency authorities and system operators. From Sweden, two authorities are involved, the Swedish Energy Agency and the Swedish National Grid Network.

As regards gas supply, regional cooperation between Sweden and Denmark has taken place for a long time. The EU Gas Supply Regulation formalises regional cooperation by dividing

225 Government, *National Strategy for Society Information and Cybersecurity, https://www.regeringen.se/regeringens-politik/krisberedskap/nationell-strategi-for-samhallets-informations--* and-Cyber objectives/ (2023).

Member States into different regional risk groups with a view to developing joint regional risk assessments and thus strengthening cooperation in case of disruptions or disruptions with a regional impact. Sweden is part of three of these groups.226 Transmission network managers in Sweden and Denmark have entered into a joint balancing zone which will increase regional cooperation.

3.3.3 Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

The Swedish National Grid is given a budget allocation for contingency measures. A certain part of the appropriation is also used for administrative costs linked to the Swedish Power Network's activities as a contingency authority, funding for research and data relating to Svenska kraftnät's mission to promote the country's dam safety. This appropriation is largely financed by fees paid through the electricity network owners. For 2024, Svenska kraftnät was allocated SEK 675 million in electricity contingency funds.

Crisis management measures consist of actions aimed at preventing, resisting and managing disruptions in electricity supply that can lead to severe pressures on society. The measures could include, for example, technical reinforcement measures, enhanced physical protection of vital facilities, strengthening IT security, acquisition of repair facilities and training.

The Swedish Energy Agency has been provided with funds for energy preparedness measures as part of the work to rebuild civil defence and strengthen robustness in the energy sector. For 2024, SEK 54 million was allocated to the Swedish Energy Agency. A new Civil Crisis Preparedness and Civil Defence Structure was introduced on 1 October 2022, which includes, inter alia, the introduction of civil areas with civil area management boards, preparedness authorities, preparedness sectors and sectoral authorities. The aim is to strengthen Sweden's resilience and ability to cope with peacetime crisis situations as well as increased preparedness.

3.4 Dimension internal energy market

On 25 January 2024, the Government decided to appoint a special investigator to analyse and propose how the Swedish electricity market can evolve and be regulated with the aim of clarifying system responsibility, increasing security of supply and robustness, creating long-term planning conditions and providing fossil-free power and flexible resources with market conform remuneration for the benefits they contribute.227 228

226Group 1 consists of Denmark, Germany, Luxembourg and the Netherlands, group 2 consists of Belgium, the Czech Republic, Denmark, Germany, France, Luxembourg, the Netherlands, Austria and Slovakia, and group 3 consists of Belgium, Denmark, Germany, Ireland, Spain, France, Italy, Luxembourg, the Netherlands, Portugal and the United Kingdom.
227DIR 2024: 12, *An electricity system with clear system responsibility, high security of supply and long-term planning conditions;*
https://www.regeringen.se/contentassets/888e0847d26f4303b920240558efe4b5/ett-elsystem-med-tydligt- system-hog delivery objective- and langsitigas-planning forattningar-dir.-202412.pdf (2024).

The investigator shall inter alia:

- propose ways in which the financial electricity market, long-term power purchase agreements, capacity mechanisms and ancillary services markets can develop;
- propose how to introduce and clarify the terms “transmission system operator” and “distribution system operator”;
- propose how the market participant’s balancing service provider can be regulated;
- propose how the system of designated electricity contracts in the retail market can be phased out; and
- submit the necessary legislative proposals.

The report must be completed by 25 April 2025 at the latest.

3.4.1 Electricity infrastructure

3.4.1.1 Policies and measures to achieve the targeted level of interconnection set out in Article 4(d)

As described in section 2.4, the Swedish interconnection quota is:

3.4.1.2 % in 2022/2023, which is higher than the EU target of 15 % by 2030.

The Swedish power grid builds connections to other countries based on socio-economic cost-benefit assessments.

The design and construction of a third AC connection to Finland (Aurora Line planned to start in 2025) is currently under way.

In addition, an additional pipeline (Aurora Line 2) is being considered for commissioning in the early 2030s.

An analysis of planned and new connections is carried out on an ongoing basis and is presented when the Swedish National Network Network Network Network Network Network Network Network network network network network network network network network network network network network network network is analysed every two years.[294]

3.4.1.3 Regional cooperation in this area

The Swedish National Grid cooperates with other European transmission system operators through the European Network of Transmission System Operators for Electricity (ENTSO-E). The Swedish National Grid contributes to the various products of ENTSO- Es, such as the Ten Year Development Plan (TYNDP) and also participates in various ENTSO-E working groups.

In addition, Svenska kraftnät, together with the other Nordic transmission system operators, produces joint Nordic network development plans every two years. The last one was published

in November 2023.229 It reports planned and ongoing projects.

[294] Swedish National Grid, *Network Development Plan* 2024-2033, https://www.svk.se/siteassets/om-oss/rapporter/2023/svk_natdevelop_2024-2033.pdf (2023).

3.4.1.4 Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

The planned AC[link in 296] (400 kV) between Sweden (SE1) and Finland has PCI status in[297] and has thus received EU funding.230 Funding also comes from the capacity fees collected by Svenska kraftnät.

3.4.2 Energy transmission infrastructure

3.4.2.1 Policies and measures related to the elements set out in paragraph 2.4.2, including, where applicable, specific measures to enable the implementation of projects of common interest and other important infrastructure projects

Continuous work is taking place on the removal of structural bottlenecks and the identification of critical network elements in the transmission network, which, in various scenarios, risk limiting trade opportunities between bidding areas. Similarly, regional and local network companies are responsible for developing and adapting their respective networks to changing operational needs. Structural, that is to say regular bottlenecks, are reinforced if it is considered to be economically viable. However, there is no justification for strengthening the electricity grid to such a level that no bottleneck occurs. Strengthening the electricity grid to minimise bottlenecks is a long-term measure. There are also more short-term tools to be used to address bottlenecks. This includes, inter alia, trading and rerouting. There are also possibilities to redirect flows on a more technical basis on a temporary or permanent basis, when new flow patterns emerge that the network was not originally adapted to manage.

229Statnett, Fingrid, Energinet and Svenska kraftnät – Nordic Grid Development Perspective 2023.
230 Svenska kraftnät, *Aurora Line, is granted EUR 1.3 billion in EU funding,* https://www.svk.se/utveckling-av- the power system/transmission network/transmission network/aurora-line/investigation/aurora-line grant-13- billion-i-emedi/(2022).

3.4.2.2 Regional cooperation in this area

See Section 3.4.1.2.

296 Swedish National Grid, *New line between Sweden and Finland, https://www.svk.se/utveckling-av-* the power system/transmission network/transmission network/aurora-line/ om-project/(2023).

297 European Commission, *Projects of Common Interest*, https://energy.ec.europa.eu/topics/infrastructure/projects-common-interest_en (2024).

298 .2.3 where applicable, financing measures in this area at national level, including Union support and the use of Union funds;

Since 1 May 2015, a regulation has been in place to allow regional network companies to apply for so-called 'grid enhancement loans'.231 The aim of the new regulatory framework is to facilitate the connection of large projects with fossil-free production to the grid.

The network enhancement loan is a solution whereby the regional network companies can, under certain conditions, obtain a loan from Svenska kraftnät. The loan relates to the part of the grid reinforcement cost that may facilitate the continued connection of electricity generation in the future. Unlike the previous regulatory framework, this means that a connecting operator will only have to bear the costs corresponding to the capacity needed for its own project.

3.4.3 market integration

3.4.3.1 Policies and measures related to the elements set out in point 2.4.3.

As shown in section 2.4.3, Sweden has no national objectives in terms of market integration. Measures contributing to areas of market integration, although there are no national targets, are described in the next sections.

3.4.3.2 Measures to increase the flexibility of the energy system for renewable energy generation such as smart grids, aggregation, demand response, storage, distributed generation, mechanisms for dispatching, redispatching and limiting allocated capacity, as well as real-time price signals, including the deployment of intraday coupling and cross-border balancing markets

In an electricity market with a higher share of renewable electricity generation in the form of wind and solar power, the challenges for the electricity system are also increasing. Household customers and industries can help solve some of the challenges when they can be flexible in their electricity use. A flexible electricity system can be a cost-effective opportunity to maintain

231Ordinance (2015: 213) on loans to grid companies to facilitate connection of renewable electricity production.

a balance between generation and consumption instead of, for example, additional investments in generation capacity. Balancing responsibility is a key in this respect, as it is shippers who have an incentive to reduce their costs by activating flexible resources under market conditions. In a future electricity market with a higher share of renewable and variable electricity generation, it will be important to use all flexibility resources in the electricity system, i.e. flexible generation, storage and demand response.

Since 4 August 2022, the Energy Market Inspectorate, together with the Swedish National Grid Network, the Swedish Energy Agency and the Swedish Board for Accreditation and Technical Control, had the task of promoting a more flexible electricity system. This mission included promoting flexibility as well as an analysis if further action is needed to realise the potential for flexibility, as well as an action plan for their implementation. The mission was finalised on 15 December 2023.232 The report's findings show that the need for flexibility for short-term power balancing and for long-term energy displacement is increasing in all Swedish bidding zones by winter 2030/2031. The report presents an action plan with around 40 measures aimed at promoting flexibility.

Sweden cooperates within the Nordic countries on demand-side response issues and also participates in international cooperation in this area. The Energy Market Inspectorate continuously monitors developments in the field of demand response to ensure that the regulatory frameworks are designed in a way that enables demand response.

On 1 July 2022, legislative amendments entered into force, including taking into account the extent to which flexibility services are used and improving the efficiency of operations when determining the revenue framework for a network activity.

Work is ongoing according to the network codes with shorter settlement times and developed imbalance pricing. These can lead to better incentives for operators to develop business models for so-called explicit demand response. Explicit demand response allows customers to sell their flexibility in established marketplaces via aggregators. The energy released in this way can be offered in different marketplaces (e.g. intraday or regulatory power market) or used for other purposes (e.g. local grid utility). Flexibility can thus be useful in the market.

In order for customers to be able to adapt their electricity consumption to hourly variations in the price of electricity, known as implicit demand response, correct price signals need to be provided to the customer through, for example, an hourly price233agreement, but also through network tariffs. With hourly rate agreements there is a real possibility and incentive for customers to steer their consumption so that more electricity is used when the price is lower and

232 Swedish Energy Agency, *Promoting flexible electricity use*, https://www.energimyndigheten.se/klimat-- miljo /sveriges-electrification/out-electrification/flexible electrification/flexible electricity/(2023).
233Hourly price agreements mean that the customer is charged for his actual hourly consumption instead of a standardised consumption profile.

less electricity when the price is higher. Two measures have been implemented to promote the use of hourly rate contracts.

Since 1 January 2020, customers on hourly rates have been set off on a daily basis per hour, which means that they are not set off at a flat rate. This is a consequence of amendments made to the Ordinance (1999: 716) on the measurement, calculation and reporting of transferred electricity (the Measurement Ordinance). A customer who requests hourly measurement under the Measurement Ordinance (Section 6c) shall also be deducted daily per hour.

As a result of the amendments to the Electricity Act and the Measurement Ordinance (1999: 716) adopted by the Government in 2022, the Energy Market Inspectorate has developed new regulations on the measurement, calculation and reporting of transferred electricity. The new rules follow the requirement in the EU Balance Regulation, which states that the time period for the settlement of electricity imbalances is 15 minutes. The new measurement regulations for electricity entered into force on 1 November 2023.

In addition to the cancelled flat-rate settlement for customers, hourly rate agreements are included in the electricity price package, which is an independent price comparator and is operated by the Energy Market Inspectorate.234 This is achieved by amending the Energy Market Inspectorate's regulations and general advice on electricity suppliers' obligation to provide information on prices and supply terms applied to electricity users to include hourly variable price contracts.235 The display of these contracts on the electricity price package increases the availability for Swedish consumers to choose this form of contract.

In Sweden, the introduction of 15-minute products and the settlement period based on the same time unit is ongoing. This is described in more detail in section 2.4.

As regards market coupling and sharing of balancing resources, there are several ongoing projects. Several of them fall under the Nordic Joint Nordic Balancing Model (NBM) programme. The Swedish National Grid has also been involved in the development of the European balancing platforms MARI and Picasso and the market arrangements and methods underpinning them. It is currently uncertain when Svenska kraftnät will connect to the two platforms.

In the Energy Policy Orientation Bill (Bill. 2023/24: 105 long-term orientation of the energy policy), the Government considers that, in order for the electricity system to be used more efficiently, flexibility in the system needs to be increased. Electrification adds new electricity use by electricity users whose flexibility should be effectively harnessed. Electricity consumption data and tariffs should be efficiently and securely collected, managed and used in

234 Electricity price package, www.elpriskollen.se (2024).
The235 Energy Market Inspectorate's regulations and general advice (EIFS 2013: 7) on the obligation of electricity suppliers to provide information on prices and supply conditions applied to electricity users.

order to facilitate increased flexibility in the electricity system.

3.4.3.3 Where applicable, measures to ensure non-discriminatory participation of renewable energy, demand response and storage, including via aggregation, in all energy markets

No specific measures as discrimination is not allowed in the Nordic electricity system. However, the Energy Market Inspectorate has formulated an236 action plan to improve the functioning of the market. This was done in 2020 and aims to remove barriers to the proper functioning of the market. The action plan needs to be implemented before some form of capacity mechanism can be put in place. The Action Plan includes measures and the development of energy markets in particular for balancing products, which would allow more types of resources and actors to participate in trade.

3.4.3.4 Policies and measures to protect consumers, in particular vulnerable consumers and, where applicable, consumers in energy poverty, and to improve competitiveness and increase competition in retail energy markets

The Swedish definition of vulnerable customers is set out in the Ordinance (2016: 742) containing instructions for the Energy Market Inspectorate and reads "vulnerable customers" means persons who are permanently unable to pay for the electricity or natural gas transmitted or supplied to them for non-business purposes". On the Swedish electricity and natural gas market, this category of consumers is protected in such a way that the consumer has the possibility of receiving financial assistance to pay electricity and natural gas bills.

There are also provisions in the Electricity Act, the Distance Heating Act (2008: 263) and the Natural Gas Act (2005: 403) which protect consumers who risk being disconnected from the electricity, heat or natural gas network due to a lack of payment or other material breach of contract. The provisions mean that the disconnection undertaking must first follow a certain regulatory approach. This includes, inter alia, the consumer's right to accurate information from the business, the possibility for the consumer to rectify without disconnection, and the fact that the company must send a notice to the social services of the municipality where the consumer lives for a certain period of time before the disconnection can occur.

In addition, the Energy Market Inspectorate operates a price comparison website237, the electricity price collet, in order to strengthen consumers' position in the electricity market and consumers' access to objective information. Consumers can compare prices and conditions on the most common contracts of all suppliers. The ability to compare prices and other factors that may influence the choice of supplier is a prerequisite for active customers to have their

236 Energy Market Inspectorate, *Implementation Plan with timeline to improve the functioning* of theelectricity market, https://ei.se/download/18.6f9b6b2617714873b45f0df5/1613487240033/Genomf%C3%B6randeplan-med- timeline -f% C3 % B6r-f% C3 % B6rb% C3 % A4ttra electricity market function-Ei-R2020-09.pdf (2020).
237 See www.elpriskollen.se

information needs met.

In April 2022, the Government mandated the Energy Market Inspectorate to draft draft legislation to counter oschysst business practices in the electricity trading market. In a report submitted to the Government in February 2023, the Energy Market Inspectorate has made several proposals to increase the protection of electricity users.238 The proposals will also contribute to increased market confidence and competition on a more level playing field between the different players in the electricity trading market. This report and the proposals it contains are now being prepared within the Government Offices.

On 31 January 2024, the Energy Market Inspectorate presented a memorandum with a look through to the district heating market with a particular focus on customer protection in the current regulatory framework. The memorandum proposes possible measures to strengthen customer protection which the authority sees as interesting for further discussion with customer representatives and industry representatives intended to be used as a basis for further discussion on the matter.[307] On 21 March, the Government decided to instruct the Energy Market Inspectorate to analyse the need for enhanced customer protection in the district heating market and to propose and implement measures to strengthen the position of district heating.[308]

In the memorandum of appropriations for 2022, the Government instructed the Energy Market Inspectorate to evaluate the regulation of designated electricity contracts.
The Energy Market Inspectorate submitted a report in 2022 to the Government in June[309]. The report describes the evolution of the designated prices as well as the proportion of customers on designated contracts since 2017. The possibility of limiting the assigned prices is analysed together with alternative ways of developing the current allocation system.

The electricity market inquiry launched in January 2024 includes looking at the regulation of the system of designated electricity contracts.[310].

- propose how the system of designated electricity contracts in the retail market can be phased out;
- propose how vulnerable customers can be given the opportunity to conclude a contract for the supply of electricity; and
- submit the necessary legislative proposals.

3.4.3.5 Description of measures to enable and develop demand response, including measures on tariffs supporting dynamic pricing

Since 2018, under Chapter 4, Sections 4a to 4b of the Electricity Act, electricity network companies have the possibility to test new tariffs in the framework of a pilot project.

238Energy Market Inspectorate, *Oschyssta Commercial Practices: A report with legislative proposals*, Ei R2023: 01.

The Energy Market Inspectorate has previously noted in a report239 that:

[307] Energy Market *Inspectorate, Implementation of the district heating market – An analysis of customer protection,* https://ei.se/download/18.76bbf3bf18d54be176612c8/1706682919555/Genomlysning-av- fj% C3 % A4rrv% C3 % A4rmemarknadsen-Ei-PM2024-01.pdf (2024).

[308] Government, *Mission to analyse the need for enhanced customer protection in the district heating market,* https://www.regeringen.se/contentassets/d22d6994f3c142d9b2e78490f981994c/uppdrag -att-analysera- needsvet-one-forstarkt-customer protect-pa-fjarrvarmemarknadsen.pdf (2024).

[309] Designated electricity contracts – Evaluation of the 2017 regulation and ways forward for an improved electricity market, Ei R2022: 05.

[310] DIR 2024: 12, *An electricity system with clear system responsibility, high security of supply and long-term planning conditions;* https://www.regeringen.se/contentassets/888e0847d26f4303b920240558efe4b5/ett-elsystem-med-tydligt- system-hog supply responsibility- and langsitigas-planning forattningar-dir.-202412.pdf (2024). Electricity grid tariffsare a good instrument for exploiting the demand response available from customers.

The provision in the Electricity Act allows electricity grid companies to test, on a smaller number of customers within a category of customers, tariffs that can stimulate more efficient grid use through demand response. In this way, electricity grid companies can test and develop tariffs so that they can stimulate the type of flexibility needed in their own network area.

This provision derogates from the requirement of uniform network tariffs. However, tariffs still need to be objective and non-discriminatory and designed in a way that is compatible with efficient use of the electricity grid and efficient electricity generation and use.

In March 2022, the Energy Market Inspectorate issued regulations and general guidelines (EIFS 2022: 1) on the design of network tariffs for efficient use of the electricity network. The purpose of these regulations is to contribute to a more efficient use of the electricity network, thus helping to meet society's electricity needs at the lowest possible cost. In addition, the Energy Market Inspectorate may issue regulations on how electricity network companies are to inform electricity users about the nature of the charges and the possibilities for customers to influence their costs by changing conditions or changing consumption patterns.

Following a previous government mandate, the Energy Market Inspectorate continued the so-called EFFEKT dialogue,240 241 which aims to increase knowledge and promote dialogue between the Energy Market Inspectorate, aggregators, network companies, regions and municipalities, and operators of different market platforms. The dialogue is important to identify how regulatory frameworks and methodologies need to be developed to create a well-functioning market where aggregators can offer their flexibility and support services. This may concern issues related to both the existing markets and the new flexibility markets under development. The purpose of the Dialogue Forum is to raise issues that may need to be taken further and to raise awareness of the value of demand response by several actors. The aim is also to avoid structures that hamper the participation of operators, do not contribute to efficient

239Measures to increase demand response in the Swedish electricity system (Ei R 2016: 15).
Energy240 Market *Inspectorate, EFFEKT Dialogue on Energy and Effectiveness,* https://ei.se/om-us/project/pagaende/effect-dialogene-dial-om-energy- and effect # query/* (2024).

pricing or are not sustainable in the long term.

3.4.4 energy poverty

1 .4.4.1 where applicable, policies and measures to achieve the objectives set out in paragraph 2.4.4;

In accordance with its instructions (SFS 2016: 742), the Energy Market Inspectorate shall pay particular attention to the position of vulnerable customers in the electricity and natural gas markets when fulfilling its mandate. The Authority defines vulnerable customers as 'persons who are permanently unable to pay for the electricity or natural gas transmitted or supplied to them for purposes which are outside their economic activity'. On the Swedish electricity and natural gas market, this category of consumers is protected by the Social Services Act (2001: 453) in such a way that the consumer is entitled to receive financial assistance to meet his electricity and natural gas supply. Both Chapter 11 of the Electricity Act and Chapter 8 of the Natural Gas Act also contain provisions that protect consumers who risk being disconnected from the electricity or natural gas network due to a lack of payment or other material breach of contract. It states that the consumer's electricity may be disconnected in the event of a material breach of the contract, such as failure to pay its invoices. Before disconnecting, the electricity grid company must contact the social welfare committee of the municipality where the consumer lives. The communication to the Social Welfare Board makes it possible to check whether the consumer is entitled to income support and thus to prevent a disconnection.

Under Chapter 4, Section 1 of the Social Services Act (2001: 453), persons who are unable to meet their needs themselves, or can otherwise have them met, are entitled to social assistance. The responsibility for paying income support lies with each municipality. According to the National Board of Health and Welfare in[313], just over SEK 10.8 billion was paid to households in 2022, a decrease of 7.6 % compared to 2021. 242The number of beneficiaries in 2022 was almost 300 000, including 97 000 women, 101 000 men and 102 000 children.

Social assistance is paid, in accordance with Chapter 4, Section 3 of the Social Services Act, to cover reasonable costs for:

313 National Board of Health andWelfare, *Statistics on financial* assistance,https://www.socialstyrelsen.se/statistik-och-data/statistics/all statistic/ economic-bistand/(2023).

- food, clothing and footwear, play and leisure, consumables, health and hygiene, daily newspaper and telephone
- accommodation, household services, work trips, home insurance, trade union

242Refers to all adults and children living in financially assisted households, including beneficiaries with unknown gender and incomplete personal identification number. Beneficiaries are counted once in the country.

membership and unemployment fund membership.

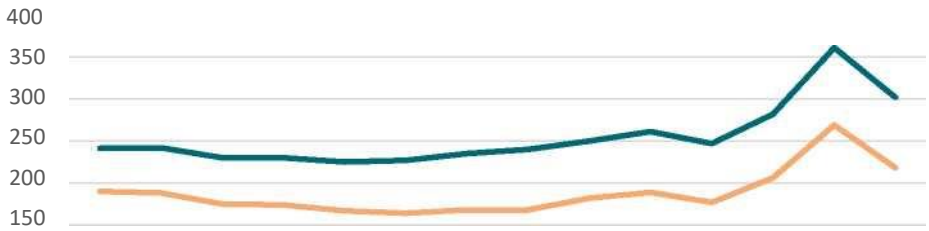
Reasonable costs are calculated according to a national standard on the basis of official price surveys of the basic consumption of different household types. The National Board of Health and Welfare's general advice on financial assistance (SOSFS 2013: 1) mentions that reasonable costs for items outside the National Standard may be related to housing costs. It is stated that, in assessing what constitutes a reasonable cost of housing, the Social Welfare Board must take into account the actual cost and housing needs of the individual, taking into account, inter alia, the cost of heating. It also appears that the Social Welfare Board should, as a rule, accept the individual's actual household electricity costs if the costs are reasonable.

Energy poverty is a complex multi-dimensional concept, but three factors tend to be seen as driving forces: low income, low energy efficiency of the dwelling and high energy prices.

In the process of adapting EU legislation to Swedish circumstances, the concepts need to be further discussed and a definition developed to identify and follow up the relevant groups. Statistics from the existing support schemes and the studies available in this area are not sufficient to provide the necessary measurability to quantify and monitor developments in line with the legal requirements.

For the time being, due to a lack of data and the possibility to link relevant data, the basic understanding is that low-income households are more difficult to face high prices. Other parameters that need to be taken into account include, for example, the size of the dwelling, the form of dwelling, energy performance, household type, as well as issues affecting households' room for manoeuvre/resilience over their situation within different timeframes. For example, housing supply, knowledge, cyclical conditions and interest rates and where you live in the country.

The proportion of people aged over 20 with low economic standards in Sweden was twelve% in 2022. Two figures are shown below, a time series of prices for the most common energy goods faced by households in the context of housing (Figure 7) and a time series on the share of households with low economic standards243 (Figure 8) broken down by some household types.



243Low economic standards, share of people with income, 60 % of median income.

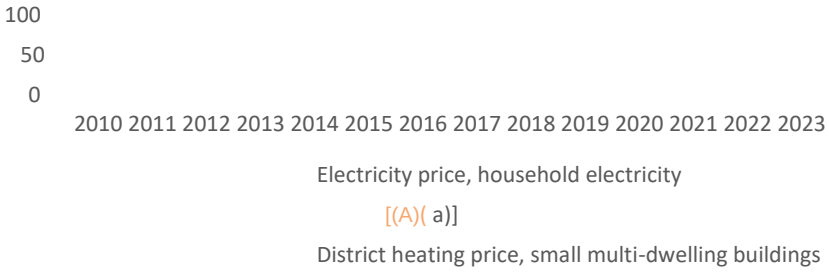


Figure 7 Evolution of selected energy prices for household customers including tax and VAT, 2023-1996, öre per kWh in 2023 price level.

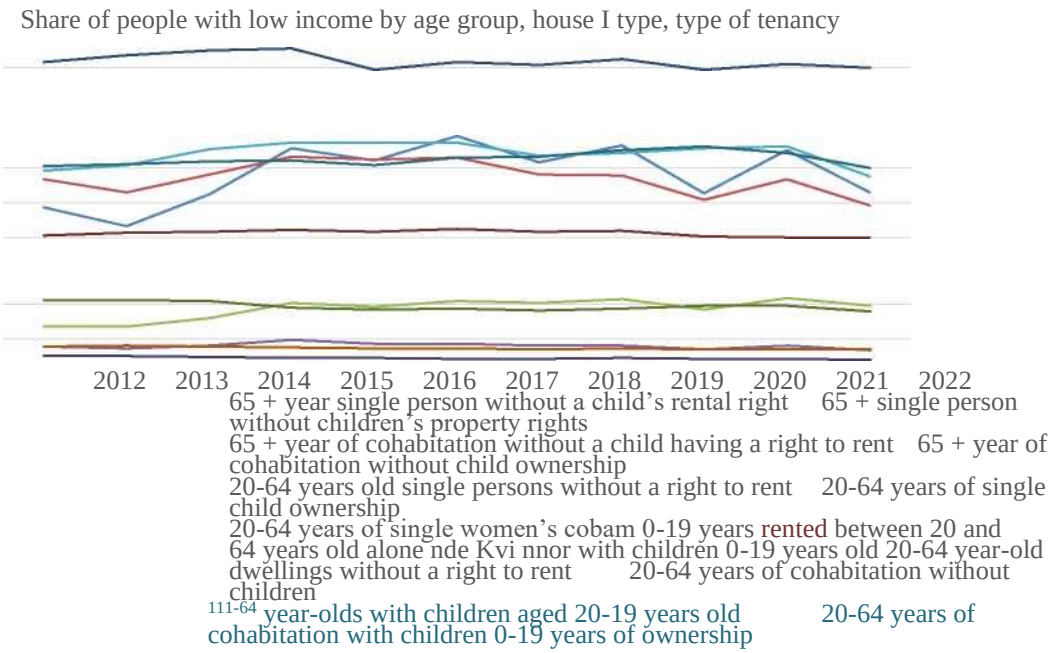


Figure 8 Percentage of people with low economic standards by age group, household type and form of tenure,%.

The increase in the price of essential goods such as energy impacts harder on household groups with lower margins, among other things because they have less room for efficiency in their consumption, they have less or no overconsumption to reduce, show research studies.[316] Households with smaller margins owning their dwellings also find it more difficult to finance the investments needed to improve the energy efficiency of their homes. Households renting their housing have limited opportunities in Sweden to improve energy efficiency due to the dominance of so-called "hot rent". Those households are referred to the choices made by the property owner. For low-income households already living in energy-efficient housing, it is often not possible to reduce energy consumption through behavioural changes at increased prices, as they have already put pressure on their consumption. This is particularly true for households with younger children, sick, retired or others who, for various reasons, spend a lot of time at home.

The Swedish National Agency for Statistics Sweden (Statistics Sweden) sample survey 'Households' housing expenditure shows the share of heating in the total housing cost for households in Sweden that own their single-family house.[317]. note that the data have a high margin of error due to sample size. For the year 2021, the share of the total housing cost paid by households living in single-family houses with property rights in heating was as follows: single persons without children 27 %, cohabitation without children 27 %, single persons with children 23 %, cohabitation with children 18 %.

In addition to social policies, different types of support have been provided to households – whether in poverty or not – to mitigate the impact of high energy prices in 2021 and 2022 (see further section 3.3.1):

- *The* electricity aid provided compensation for household electricity costs in the months of November and December 2022.[318]
- *Support* for gas prices has also been introduced for gas consumers to mitigate the effects of high gas prices, which is administered by the Swedish Energy Agency.244

[316] Heindl P. (2015), Measuring Fuel Poverty: General Considerations and Application to German Household Data, Public Finance Analysis, Vol. 71, No. 2 (June 2015), pp. 178-215.

[317] Statistical Authority SCB, ***Households' Housing Expenditure,*** https://www.scb.se/hitta-statistik/statistik-efter-amne/Business-allens-Economics/Short-all expenditure/Household expenditure/(2024).

[318] Government, *New electricity support for households across the country,* https://www.regeringen.se/pressmeddelanden/2023/01/nytt-elstod-till-hushall-i-hela-landet/ (2023).

- The Swedish Energy Agency launched an *information campaign* "Each kilowatt-hour counts" to raise awareness in society, reduce the use of electricity and reduce the price of electricity.
- The Swedish Energy Agency *launched*an information campaign on energy efficiency for single-family owners in 2022 as part of a government mission.

3.5 Dimension research, innovation and competitiveness

3.5.1 Policies and measures related to the elements set out in point 2.5.

1 .5.1.1 policy orientation and implementation of research and innovation

The Government presents the direction for energy research and innovation in specific energy research bills, which are normally submitted to the Riksdag every four years, i.e. once every term of office. The funds are distributed in the annual budget bills. The most recent Bill for the area was presented in 2016.

The overall research and innovation policy is presented in the dedicated research and

244Ordinance (2023: 116) on gas price support.

innovation proposals, which are also presented every four years. The last one was prop. 2020/21: 60 research, freedom, future – knowledge and innovation for Sweden. In connection with this Bill, the Government also presented major reinforcements to research and innovation in the period 2021-2024. Preparation of the forthcoming proposal focusing on energy research and innovation is ongoing. In October 2023, the Swedish Energy Agency submitted its supporting documents.245

The Swedish Energy Agency is responsible for promoting research and innovation in the form of a strategically designed concerted effort that spans the whole innovation system, in close cooperation with, and in addition to, other energy policies and other instruments aimed at achieving climate and energy objectives and energy-related environmental policy.

320 Swedish Energy Agency, *Husguiden – for those who want to make your house more* energyefficient, https://www.energimyndigheten.se/energieffektivisering/husguiden---for-dig-som-vill-energisera-ditt/(2023).

321 Energy research and innovation for ecological sustainability, competitiveness and security of supply (Prop. 2016/17:66).

targets. The Swedish Energy Agency's research and innovation activities have both a national and international focus, and cooperation takes place with other research funders on issues that cover several sectors of society.

In addition to energy research, since 2018 the Swedish Energy Agency has also been responsible for the Industrial Leap initiative to support industry's climate transition. Industry includes both research and innovation aid and investment aid in new technologies to enable industry to both reduce its own emissions and contribute to the climate transition in society through its products.

In 2022, the Swedish Energy Agency was given a coordinating sectoral responsibility in the field of energy security. The changing world context has increased the importance of security of supply, energy security and resilience, thus increasing the scope of a wide range of research efforts. In the same year, the Swedish Energy Agency was entrusted with several new tasks under the national electrification strategy adopted by the Government in February 2022. In the 2023 Budget Bill, the Swedish Energy Agency received funds to carry out a nuclear research effort. This has resulted in several initiatives and calls for proposals in this area.

In addition to the Swedish Energy Agency's efforts, there are also other actors that fund research and innovation relevant to the transition of energy systems. Examples include the Formas State Research Council, the Vinnova Innovation System Agency, the State Research Council for Basic Research and the Foundation for Environmental Strategic Research (Mistra). The private operator Energiforsk, owned by a number of energy industry associations, also

245 Swedish Energy Agency, *Strategic Priority in Energy Research and Innovation, Energy Agency's R & I for a sustainable transition,* https://www.regeringen.se/contentassets/5eee3b9b4a32457ea9a5fae3cf2e0bbc/energimyndigheten.pdf (2023).

funds research and innovation relevant to the transformation of the energy system.

To meet the climate challenge, research in a wide range of disciplines as well as interdisciplinary and cross-sectoral research and innovation is needed. Research contributing to meeting climate targets and leading Sweden towards a fossil-free welfare society spans many areas. It is funded by a number of Swedish research funders and expert authorities, but also by municipalities, county councils, private and public foundations and private funders from industry and within the EU, as well as by other international organisations.

TheResearch Council for Environment, Area Industries and Societal Building (Formas) is a State Research Council for Sustainable Development, which the Government, in cooperation with other research funders and societal stakeholders, tasked in 2017 with implementing a 10-year national research programme on climate and sustainable community-building, respectively. These efforts are based on a strategic research agenda.246 The programme is based on the sustainability objectives of the 2030 Agenda, the national environmental objectives and other relevant national targets. In 2024, the programme funds amount to at least SEK 355 million. The programme is implemented in cooperation between several actors, including the Swedish Energy Agency.

Through the Environmental Research Facility, the Swedish Environmental Protection Agency finances needs-oriented, evidence-based scientific research with high practical environmental relevance for approximately SEK 94 million annually, which will support both the Swedish Environmental Protection Agency and the Agency for Marine and Water Management.

3.5.2 Where applicable, cooperation with other Member States in this area, including, where appropriate, information on how the SETPlan's objectives and policies are translated into a national context

3.5.2.1 Cooperation with other Member States

International cooperation on energy research and innovation is increasingly important to complement national efforts to achieve the national objectives and is particularly important for a small country such as Sweden. Cooperation in research, innovation and development with other countries largely takes place within the EU and its various instruments. These include the EU Framework Programme for Research and Innovation (Horizon Europe) and the work of the Strategic Energy Technology Plan (SET Plan).247 Cooperation also takes place in other international fora such as the International Energy Agency (IEA) and Mission Innovation (MI).

The SET Plan includes six priority areas and 14 working groups to accelerate the

246 Formas, *Knowledge for a comprehensive climate transition, https://formas.se/download/18.464f1e6517dc281eb12193b4/1641978321399/r5-2021-kunskap-for-en-* penetrating climate change.pdf (2024).
247 European Commission, *SETIS – SET plan information system*, https://setis.ec.europa.eu/actions- towards-implementing-integrated-set-plan (2024).

transformation of the energy system. Each working group has developed objectives and implementation plans at EU level. Participation is voluntary, but Sweden actively participates in the SET Plan Steering Group and in relevant and national priority areas in order to best link national objectives to EU targets. Sweden is currently reviewing its participation in the various working groups of SET Planet and participates to a greater or lesser extent in the work of the following working groups: geothermal, smart cities, energy systems, energy efficiency in buildings, sustainable and efficient energy use in industry, batteries for mobility, bioenergy and renewable fuels, carbon storage and use, and green hydrogen. The work involves linking parts of the national research programme (activities under our thematic areas), i.e. our thematic and strategic research and innovation efforts in these areas, in order to contribute to the efforts and objectives jointly developed in current areas of the SET Plan. Work on the two partnerships (CETPartnership and DUTPartnership) described below includes a dialogue with SET Plan working groups on the preparation of the calls for proposals.

Swedish stakeholders are also involved in some of the EU's technology and innovation platforms. ETIP Bioenergy, ETIP Ocean energy, ETIP Renewable Heating and Cooling and ETIP Smart Networks for Energy Transition. The platforms are led by industry and work towards the implementation of activities in the respective areas of action of the SET Plan.

Under the EU's Horizon Europe Framework Programme, a number of partnership programmes have been launched in which Sweden participates. The Swedish Energy Agency, together with Austria, is chairing the new Clean Energy Transition Partnership (CETPartnership), which brings together around 70 research programmes from 30 countries and regions. The partnership foresees, among other things, annual research and innovation calls for research and innovation funding from outside Europe and associated countries to Horizon Europe. This is done, inter alia, through cooperation with Mission Innovation.248 In the first call for proposals, Sweden finances projects dealing with carbon capture, district heating, ocean energy, offshore wind and solar collectors. These link to several of the Swedish Energy Agency's national programmes where they are expected to strengthen international cooperation and knowledge transfer within them.

Driving Urban Transitions (DUT) is another Horizon Europe partnership programme in which the Swedish Energy Agency participates and interacts with the Swedish authorities Vinnova, Formas and the Strategic Innovation Agenda Viable Cities. The DUTPartnership brings together more than 60 national and regional authorities and departments from the 27 EU countries. Building on the work of JPI Urban Europe, the partnership aims to drive urban development towards a sustainable future and to help urban decision-makers, businesses and community actors to act and contribute to urban transition. The DUTPartnership envisages strategic activities and annual calls for proposals in three thematic areas, which are energy-

248 Mission Innovation, *Mission Innovation*, https://www.mission-innovation.net/ (2024).

positive neighbourhoods, the 15-minute city and circular urban economies. The Swedish Energy Agency is the national contact point for the theme of energy positive neighbourhoods where the activities are coordinated with Viable Cities.

Nordic cooperation

Sweden participates in the Nordic Energy Research (NEF), a joint energy research and analysis institution under the Nordic Council of Ministers. The main focus is that all NEF activities should promote Nordic energy cooperation, utility and profiling. The NEF supports areas of energy research that are of common interest to Nordic stakeholders and have a potential for trans-national research cooperation. The NEF finances and coordinates research and provides administrative expertise, networking and advice. The NEF also has a role as a call coordinator for CETPartnerships' calls.

As an example of NEF's activities, the organisation has published funding in 2023 for the call for proposals "Hydrogen Valleys as Energy Hubs – by 2030 and 2040", which will use the equivalent of NOK 170 million for Nordic cooperation projects on hydrogen, ammonia and electro-fuels.

3.5.3 Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

The Government finances research, innovation and business development in the field of energy through dedicated funds distributed by the Swedish Energy Agency. According to the Budget Bill for 2024 (spending area 21), the allocation amounted to SEK 1.45 billion.249 Private operators financed by the Energy Agency also contribute a large part of their own funding to the projects carried out.

3.5.3.1 The Energy Agency's tool spans the entire innovation system with energy in focus

The Swedish Energy Agency's research and innovation activities (R & I) can be broadly divided into four main types of activity, which together work to fulfil the mission. The thematic R & I programmes make up the majority of the Authority's R & I portfolio. The R & I projects funded under these programmes provide grants for both basic research and more applied technological research projects. The projects also lead to product development projects and, to a certain extent, to market implementation projects.[327]

Examples of current thematic R & I programmes:

- Bio +[328]
- Electricity system of the future[329]
- Human, Energy System and Society (MESAM)[330]

249See Government Bill. (2023/24: 1) Budget Bill for 2024, as amended. 21.

- Energy and climate transition of industry[331]
- Sustainable transport systems (first call for proposals in 2023)[332]
- Termo – heating and cooling for the future energy system[333]
- Resource-efficient construction (first call for proposals in 2023)[334]
- Fossil-free flights for the future[335]
- Battery Fund programme250

The Swedish Energy Agency also has activities and programmes that focus specifically on skills building. Within these programmes, centres of excellence and a post-graduate school, the training of doctoral candidates is a

[327] Beneficiary survey 2022. We follow up our projects through an annual survey to our beneficiaries. In the 2022 survey, more than 900 project managers replied and provided valuable information on the impact of the funded projects.

[328] Swedish Energy Agency, *Bio +*, https://www.energimyndigheten.se/forskning-och- innovation/research/bioenergy/bio/ bio/(2023).

[329] Swedish Energy Agency, *Future* Electricity Systems, https://www.energimyndigheten.se/forskning-och-innovation/research/electricity systems/electricity system/(2022).

[330] https://mesam.se/ (2024).

[331] Swedish Energy Agency, *Industry's energy and climate transition,* https://www.energimyndigheten.se/forskning- and-innovation/research/industry/industry-energy and climate change/(2024).

[332] Swedish Energy Agency, *Sustainable Transport Systems*, https://www.energimyndigheten.se/forskning-och-innovation/research/transport/hallbara transport system/(2023).

[333] Swedish Energy Agency, *Termo – heating and cooling in the energy system of the*future, https://www.energimyndigheten.se/utlysningar/varme-och-kyla-i-framtidens-energisystem/ (2024).

[334] Swedish Energy Agency, *Resource-efficient settlements,* https://www.energimyndigheten.se/forskning-och-innovation/research/housing/research- and innovation-for-resource buildings/(2023).

[335] Swedish Energy Agency, *FossilFree Flight for the future*, https://www.energimyndigheten.se/utlysningar/fossilfritt- fly-for-intenden-2023/(2023).

important part. In 2023, 90 doctoral candidates were funded in total under these schemes. In line with the intention of the efforts, research is also largely focused on contributing to basic research and to more applied research projects. Projects funded under these programmes largely lead to results that are used in investigations, regulatory frameworks, permit cases, policy decisions and/or instruments. This is an important aspect of the Swedish Energy Agency's R & I funding and there are also research projects with this focus under the thematic R & I programmes.

The Swedish Energy Agency also has tools aimed at increasing the commercialisation and business development of new technologies and solutions, targeted at higher education institutions and companies of different sizes and phases.
The Swedish Energy Agency's follow-up shows that projects in this category to a very large extent, almost 90 %, pass on results to product development projects and results that can be taken forward to market implementation. This also includes efforts to promote international

250 Swedish Energy Agency, *Batterifond programme,* https://www.energimyndigheten.se/forskning-och-innovation/research/electricity system/battery fund programme/(2022).

business development and Swedish exports.

Main demonstration and sustainable business development programmes:

- Pilot and demonstration
- Innovation commercialisation programme

Energy issues are sometimes integrated into other issues mainly in other sectors of society. Examples include the automotive industry, cities and urban development, and the circular economy. Therefore, there are also long-term collaborations with other funders. The programmes run together with others have their main focus on passing on the results to more technologically applicable research and product development projects. The main programmes in collaboration with other government research funders are:

- Automotive Strategic Research and Innovation (FFI)251
- SIP Viable Cities252
- SIP Ref: Source253
- Impact Innovation254

In addition, the Swedish Energy Agency has active international and European cooperation, both in the context of the various programmes and through horizontal actions (see further below in the section).

The Swedish Energy Agency's support for research and innovation takes place in close cooperation with universities, industry and other social actors. A key principle of the Agency's research funding is that the actions should be co-financed with the actors receiving the Agency's support.

3.5.3.2 Industrial Life – Resource optimisation, energy efficiency and carbon neutrality in industry

To support the transition, the government decided in 2017 on Industrial Leap, a long-term effort to reduce industrial greenhouse gas emissions. In 2019, the original mandate was extended to allow for the financing of measures that contribute to negative greenhouse gas emissions, and in 2021 the effort was extended to include strategically important activities such as biofuels, plastic recycling refineries, hydrogen production, recycling facilities and battery production.255

251 Swedish Energy Agency, *Vehicle Strategic Research and Innovation (FFI),* https://www.energimyndigheten.se/forskning-och-innovation/forskning/transporter/fordonsstrategisk-forskning- and-innovation-ffi/(2023).
252 Viable Cities, https://viablecities.se/ (2024).
253 R: Source, https://resource-sip.se/ (2024).
254 Impact Innovation, https://impactinnovation.se/en/ (2024).
255Sweco Sverige AB, *Five years with Industriklivet Part 1: Evaluation*;

The focus of the action has also been changed so that support can be given to measures that contribute to the reduction of greenhouse gas emissions indirectly linked to industrial processes. It supports companies from research and innovation projects to demonstration and full-scale facilities. The total size of the Industrial Leap is approximately SEK 1 457 million in 2024 and can finance projects running until 2031. The annual budget is decided in conjunction with the Budget Bill. Projects approved in 2023 include fossil-free steel production, biofuel production, inter alia for aviation, hydrogen, recycling, zero-emission burn lime production and CCS. As a complement to the main technological tracks, projects in the field of recycling for increased material efficiency and circular economy are also funded.

Part of this is HYBRIT (Hydrogen Breakthrough Ironmaking Technology), which brings together research and pilot studies to achieve fossil-free steel production from iron ore.

3.5.3.3 Other funders

The Transport Administration funds the research and innovation platform Triple F (Fossil Free Freight) to contribute256to the transition of the freight transport system to fossil freedom. Triple F focuses on three challenges: a more transport efficient society, energy-efficient and fossil-free vehicles and craft, and an increased share of renewable fuels. The expected result is the overall interaction and knowledge building that contributes to reducing the greenhouse gas emissions of freight transport.

3.5.3.4 Union support and use of Union funds

In 2023, for selected societal challenges under Horizon Europe, Sweden has been granted the funding, in euro, as shown in Table 21.257 258 259

Table 19 Funds awarded in 2023 to Swedish actors under Horizon Europe [EUR].

Climate, energy and mobility	EUR 49 590 000

https://www.energimyndigheten.se/49b590/globalassets/forskning--innovation/industri/industriklivet/fem-ar- med-industrial klivet-2018-2022---output report.pdf (2023).

Sweden also receives co-funding from Horizon Europe for the projects funded by the Energy Agency in the framework of their calls for proposals, as well as grants for participation in the CapaCITIES project, some EUR 3.33 million in[344], through the two Clean Energy Transition and Driving Urban Transitions partnerships.

Swedish actors in eleven projects have also received a total of EUR 36.65 million in support from the EU Innovation Fund.[345]

256 Triple F – Fossil Free Freight, https://triplef.lindholmen.se/ (2024).
257Data published in the European Commission's eCORDA database as of 21 March 2022.
The258 Swedish *Energy Agency, the Swedish Energy Agency is the leader in two new partnerships under Horizon Europe*, https://www.energimyndigheten.se/nyhetsarkiv/2023/energimyndigheten-ar-ledande-i-tva-nya-partnerskap- in-horizont-europa/(2024).
259 European Commission, *Innovation Fund Project Portfolio – Innovation Fund – Portfolio of signed*projects, https://dashboard.tech.ec.europa.eu/qs_digit_dashboard_mt/public/sense/app/6e4815c8-1f4c-4664-b9ca-8454f77d758d/sheet/bac47ac8-b5c7-4cd1-87ad-9f8d6eae/state/analysis (2024).

In addition, since 2021, industrial life has been part of the green relaunch of a climate-smart society after the COVID-19 pandemic and is part of the EU's Recovery and Resilience Facility (RRF).

STATE OF PLAY OF EXISTING POLICIES AND MEASURES AND PROJECTIONS BASED ON THEM

In 2023, the Swedish Environmental Protection Agency and the Swedish Energy Agency have developed new climate and energy scenarios. The energy scenarios are used to inform the climate scenarios, which are reported to the European Commission in the context of climate reporting. The scenario (in the plan referred to as the ‘Bass scenario’) presented here is, unless otherwise specified, based on the Commission’s recommended assumptions on the price evolution of fossil fuels and emission allowances. The scenario is based on the adopted energy and climate policy instruments in Sweden until 30 June 2023. The plan also presents a case of sensitivity (in the plan referred to as ‘sensitivity case transport’). For the sensitivity case, no full scenario has been made and only energy consumption in the transport sector has been adjusted. The reason for this is that more recent statistics have shown a different trend compared to what was initially adopted in the Basscenario. This makes a difference, in particular, between emissions from the transport sector. We consider that the sensitivity case shows a more likely development, but there are still significant uncertainties about future developments in the transport sector. See Figure 9 for the difference in energy consumption between the Bass scenario and sensitivity cases of transport. The conditions presented in section 4.1 do not differ between the Bass scenario and sensitivity cases of transport.

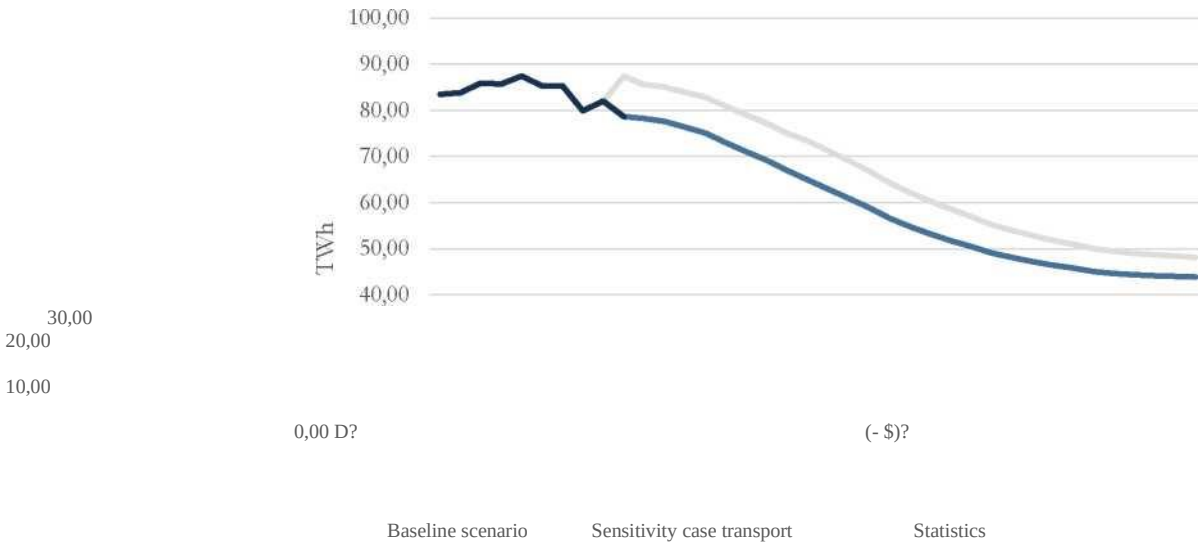


Figure 9 Energy use in the transport sector, statistics and projected developments up to 2050 for the baseline and sensitivity cases, TWh.

4.1 Estimated evolution of main exogenous factors such as: influences the evolution of energy systems and greenhouse gas emissions

4.1.1 Macroeconomic forecasts (GDP and population growth)

Potential for economic development are produced by the Institute of Economic Affairs using their equilibrium model EMEC346, see Chapter 0 for more information on this model. These macroeconomic projections then underpin the long-term climate and energy scenarios. The evolution of Gross Domestic Product (GDP) and population growth are important factors for future energy use and the impact on greenhouse gas emissions.

The evolution of GDP is modelled in EMEC and the evolution from 2019 to 2050 is presented in Table 20.

Table 20 Average annual percentage evolution of GDP in the EconoMen scenarios from EMEC.

Year	2019 – 2035	2035 – 2050
GDP developments	1,76	1,71

Demographic trends for the period 2050-2020 have been developed by Statistics Sweden (Statistics Sweden) and are presented in Table 21.347

Table 21 Adoption of demographic trends.

Year	2020	2030	2040	2050

346Environmental Medium Term Economic Model.
347SCB – The future population of Sweden 2022-2070, Demographic reports 2022: 4.

Population	10 379 000	10 917 000	11 365 000	11 836 000

4.1.2 Sectoral changes expected to affect the energy system and greenhouse gas emissions

The scenarios are based on the assumption that there is widespread electrification of society as part of the transition to reach the climate targets.

4.1.2.1 Transport sector

Climate objectives in the transport sector should be achieved mainly through the electrification of the transport sector, but also through the increased use of fossil-free fuels. In the transport sector, the demand for electric vehicles and related infrastructure is increasing, contributing to an increase in electricity demand. Compared to previously developed scenarios, there have been some changes. Changes in the reduction obligation affect the use of biofuels and fossil fuels in the sector. The updated road traffic scenarios are also based on an updated forecast where new car sales are expected to be significantly lower than in the previous forecast. This possible reduced turnover rate of the vehicle fleet may imply a lower rate of electrification compared to previous scenarios. Effects of updated petrol and diesel price scenarios have been incorporated into the analysis. The updates include new levels of the reduction obligation, the price impact of ETS 2 from 2027 and the continued reduction of the energy tax.

Refuel EU Aviation is reflected in the scenario where the blending of renewable fuels increases from 3 % to 70 % in 2050. The requirement is expected to increase costs and thus reduce demand for air travel with the highest impact after 2030. The equivalent regulation for maritime transport is FuelEU Maritime, which requires emission reductions of 2 % in 2025 to 80 % in 2050. Similarly to air transport, this is expected to lead to a price increase and reduce demand.

4.1.2.2 Industrial sector

In the industrial sector, electrification takes place as industries shift their production and the start-up of various electricity-intensive activities. Higher demand for products that are sustainably produced or contribute to the climate transition leads to further increased industrial production of, for example, fossil-free steel, electric fuels and batteries. These goods are electro-intensive to produce and the use of electricity is rising sharply. More carbon capture projects are also covered. Barriers related to new electricity generation, grid deployment and critical materials are assumed to be solved. Compared to previously developed scenarios, some changes have occurred such as a change in the reduction obligation affecting the use of biofuels and fossil fuels for work machinery used in industry and the adoption of an increased phase-out of fossil crude oil and biofuel production. For the rest of industry, increased decarbonisation is also assumed as an assumed consequence of ETS 2 and investment support via the Climate Leap. Fossil fuels are replaced by biofuels. This is in line with assumptions in other sectors such as agriculture and construction.

4.1.2.3 Housing and services sector

Housing and services include the households, services, agriculture, forestry, fisheries and construction sectors. Developments in the residential and service sector can mainly be explained by more efficient energy use in buildings and the conversion of buildings with direct-acting electricity to other forms of energy. Overall, energy consumption can be expected to increase due to new construction, but this trend is partly offset by the fact that new buildings are more energy efficient. The electrification of work machinery in the sector leads to a reduction in energy consumption while the expected establishment of data centres leads to an increase in electricity consumption.

The updated scenarios largely follow developments in previous scenarios but with some changes. A change in the reduction obligation leads to an increase in the use of fossil fuels for work machinery in the sector and a reduction in the use of biofuels. The scenarios also provide for a clearer phase-out of fuel oils (in favour of biofuels) in agriculture, forestry and construction, although it has a very small impact on overall energy consumption.

4.1.2.4 Supply and use

As the scenarios assume a strong increase in electricity demand, all electricity generation needs to increase. Some conditions have changed in the scenarios compared to previous scenarios. In the scenarios, all 6 nuclear power reactors are assumed to have the possibility of lifetime extension compared to the adoption of 3 reactors in previous scenarios. In previous scenarios, when developing offshore wind power, it was assumed that connection to land would be financed by the State (or the electricity customer community) and not by wind power operators. It represented aid of just under 20 % of the total investment cost. Funding for connecting offshore wind has been removed, resulting in lower electricity generation from offshore wind compared to previous scenarios. Electricity production in CHP plants has been adapted to the Swedish Energy Agency's short-term forecasts, resulting in a reduction in production in 2025 and a lower use of biofuels.

4.1.3 Global energy trends, international fossil fuel prices, EU ETS carbon price

Climate and energy scenarios use fossil fuel and carbon price developments in the EU ETS provided by the European Commission. These price scenarios come from the European Commission's modelling exercise for reference scenarios348 and are recommended to be used by Member States to increase the comparability of results across Member States.

Fossil fuel prices as well as emission allowance prices used in the scenario are presented in

348 European Commission, *EU Reference Scenario 2020,* https://energy.ec.europa.eu/data-and- analysis/energy-modelling/eu-reference-scenario 2020_en (2024).

Table 22, Table 23, Table 24 and Table 25.

Table 22 Adopted world prices for crude oil, EUR/BOE (barrel oil equivalent), real (2020) prices.

Year	2020	2030	2040	2050
Price [EUR/BOE]	37	88	93	112

Source: European Commission.

Table 23 Adopted world market prices for coal EUR/tonne, real (2020) prices.

Year	2020	2030	2040	2050
Price [EUR/tonne]	40	78	83	93

Source: Commission

Table 24 Adopted world prices for natural gas, EUR/MWh, real (2020) prices.

Year	2020	2030	2040	2050
Price [EUR/MWh]	11	41	41	42

Source: Commission

Table 25 Adopted carbon allowance prices, EUR/tonne CO2, real (2020) prices.

Year	2020	2030	2040	2050
Price [EUR/tCO2]	24	80	85	160

Source: Commission

4.1.4 Evolution of technology costs

In the development of the energy and climate scenarios, cost development assumptions are made for different current technologies. These assumptions are important for the outcome of the scenarios and play a major role in the future evolution of different technologies. The energy supply in the scenarios is modelled in the Times-Nordic energy system model.349

4.1.4.1 Nuclear

Estimated costs for new nuclear power can be found in Table 26. With selected assumptions for discount rate, operating time, construction time, maintenance costs and availability, etc., the total production cost of new nuclear power is around 60-65 öre/kWh.350 The nuclear waste tax financing the future repository is a relatively small part of the total cost, approximately 4

349 Profu, https://profu.se/ (2024).
350Energiforsk, *El from new plants – Report 2021: 714.* (2021).

öre/kWh electricity. Please note that the assumptions are large

uncertainties. The cost estimate dates back to 2021 and may have been affected by changes that have taken place since then.

Table 26 Costs for new nuclear energy adopted.

Investment cost (SEK/kW electricity)	Fixed D -U (SEK/kW electricity)	Variable D -U and fuel cost (SEK/MWh electricity)	Useful life (years)
50 000	550	100	50

Note: The cost of operation and maintenance is borne by the U.

4.1.4.2 Water power

It is assumed that there will be no expansion351 of the annual production capacity of hydropower, so the question of technology costs is not relevant for this type of power. It should be added, however, that there are several announced plans for so-called "power expansion", which may increase the ability of hydropower to deliver power to the electricity grid when it is most needed.

4.1.4.3 Wind

There are a number of ongoing wind energy expansion projects that will be completed in the coming years and in 2025 it is estimated that there are around 50 TWh of wind power. For wind power, the model includes 12 different onshore classes and 9 different offshore classes in Sweden. The model adds system integration costs (e.g. reserve capacity and some grid expansion), especially in the case of very large volumes of wind power. In addition, the model takes some account of the fact that the accumulation capacity changes to the worse when the share of wind energy reaches a certain limit (the more wind power in the system, the more the electricity price the wind turbines receive). See Figure 10 for the estimated production cost of new wind power in Sweden.

As a351 result of climate change, the run-off is expected to increase, which is estimated to result in an increase in electricity production of 2 TWh, while hydropower's greening with new environmental conditions is assumed to reduce production by 1.5 TWh. Overall, this means that electricity production from hydropower increases by 0.5 TWh over the model period.

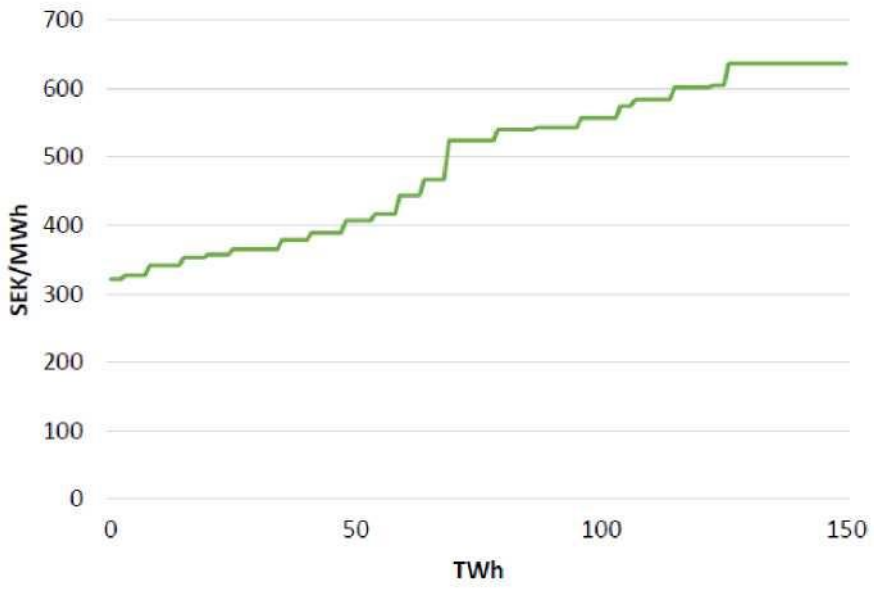


Figure 10 Estimated production cost of new wind power in Sweden, given 25 years of lifetime and 6 % discount rate (real).
Source: The Swedish Energy Agency.

The approximately 50 TWh of wind power available in 2025 can be replaced by new turbines when the existing turbines end of life due to age. Thus, this happens for a relatively large part of the existing park at the end of the model period. The new turbines are assumed to have a higher utilisation time than the old ones, as well as the possibility of reusing part of the in-situ infrastructure such as roads, connection to electricity grids, etc. As a result, the investment cost of such replacement projects is assumed to represent approximately 80 % of the corresponding investment cost of a plant built on a completely new site.

4.1.4.4 Solar power

Investments in new solar are described with several cost classes for different types of sun applications. The evidence is based on a study carried out by the consultancy Profu for the Energy Agency in 2018.352 Since then, some updates have been made concerning, inter alia, costs. The various cost classes cover sun on roofs (houses, apartment buildings and premises) as well as freed photovoltaic parks on land, see Figure 11. All investments include a lifetime of 30 years and a discount rate of 6 % real.

352Profu, *Teknic-economic cost assessment of solar cells in Sweden*, 2018.

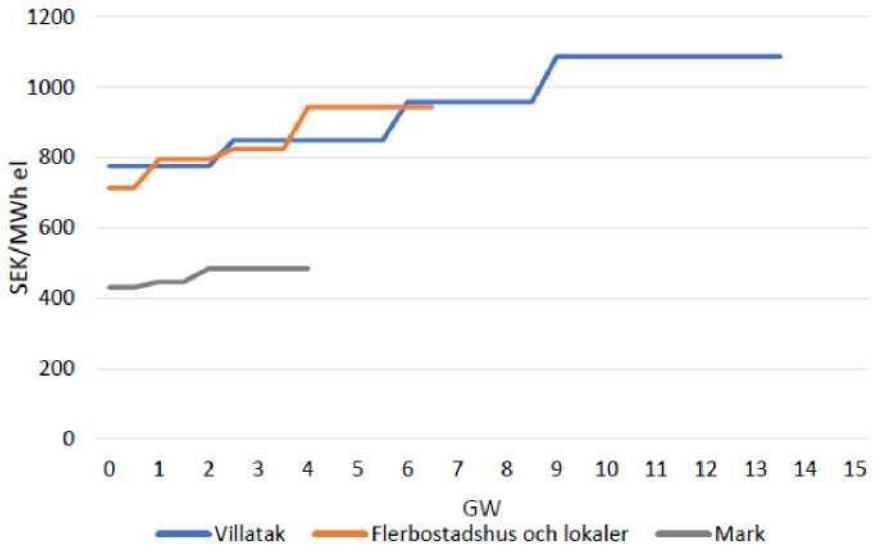


Figure 11 Estimated production costs and potential for solar in Sweden on houses, multi-dwelling buildings and premises and on land (lifetime 30 years and discount rate 6 % real).
Source: The Swedish Energy Agency.

4.1.4.5 Biofuel based electricity generation

Estimated data for a conventional biofuel cogeneration plant can be found in Table 27. With flue-gas condensation, which is assumed for these plants, the total efficiency is approximately 110-105 % calculated on the basis of the lower calorific value.

Table 27 Estimated data for a conventional biofuel CHP plant with smoke gas condensation in three sizes (some parameters, such as efficiency and alfavor are assumed to evolve over time).

	Investing (SEK/kW electricity)	Fixed D -U (SEK/kW electricity)	Floating D -U (SEK/MWh electricity)	Impact rate (%)	Alfavor	Useful life (years)
Large turbine (approx. 80 MW of electricity)	25 500	380	80	30-32 (electricity)	0,38 – 0,41	30
Medium power plant (approx.	34 500	580	85	28-30 (electricity)	0,35 – 0,39	30
Small work (approx. 10 MW of electricity)	45 000	920	85	25-27 (electricity)	0,32 – 0,34	30

Source: The Swedish Energy Agency.
Note: The cost of operation and maintenance is borne by the U.

4.1.4.6 gas power

Only around 0.3 GW of gas power is assumed to remain operational in Sweden. New gas power can be developed in Sweden through new investments if the model finds these profitable. The input data for gas-based power and cogeneration is presented in Table 28. Efficiency evolves over time.

Table 28 Estimated data for gas-based power and combined heat and power generation.

	Investing (SEK/kW electricity)	Fixed D -U (SEK/kW electricity)	Floating D -U (SEK/MWh electricity)	Efficiency (%)	Alfavor	Useful life (years)
Condensation force	7 000	40	15	55 – 62	—	30
Cogeneration, large	9 500	70	20	45-50 (electricity)	1,1	30
Cogeneration, small	12 500	120	25	45-50 (electricity)	1	30

Note: The cost of operation and maintenance is borne by the U.

4.1.4.7 District heating – Heat water boilers

Table 29 presents key data for two typical hot water boilers, one solid fuel fired and one gas-fired (fuel costs and instruments are fuel-specific and added to the model but are not reported in the table).

Table 29 Estimated production costs for district heating in heating plants (hot water boilers).

	Investing (SEK/kW heat)	Fixed D -U (SEK/kW heat)	Variable D -U (SEK/MWh heat)	Impactrate (%)	Useful life (years)
Natural gas	4 000	25	15	90	30
Biofuel, peat or coal	8 000	100	20	90 – 95	30

Note: The cost of operation and maintenance is borne by the U.

4.2 GHG emission reductiondimension

4.2.1 GHG emissions and removals

4.2.1.1 Trends in current greenhouse gas emissions and removals in the EU ETS, under the Effort Sharing Regulation, LULUCF and in different energy sectors

Total greenhouse gas emissions and removals

Greenhouse gas emissions (excluding LULUCF) within Sweden's borders were 45.2 million tonnes of carbon dioxide equivalent in 2022.353 This represents a decrease of 5.3 % compared to 2021. Compared to 1990, total climate emissions have now fallen by 37 %. Emissions have fluctuated since 1990 between a peak of 77.0 million tonnes of carbon dioxide equivalent in 1996 and a lowest level of 46.3 million tonnes of carbon dioxide equivalent in 2020. Annual variations are mainly due to temperature fluctuations, precipitation patterns and cyclical cycles, but due to emission reduction measures, the trend has been to reduce emissions over time. In Sweden, there is a net carbon removal in the land use sector. Net removals in the LULUCF sector in 2022 were 41 million tonnes of carbon dioxide equivalent, which is 10 million tonnes of carbon dioxide equivalent lower than in 1990. Over the period 1990-2022, net removals averaged around 50 million tonnes of carbon dioxide equivalent per year, but the variation is relatively high over time. Since the late 2010s, net removals in the sector have been lower.

For total emissions and removals within Sweden, see Figure 12.

353All the information in this section comes from the Swedish Environmental Protection Agency – National Inventory Report Sweden 2023, Greenhouse gasemission Inventory 2021-1990.

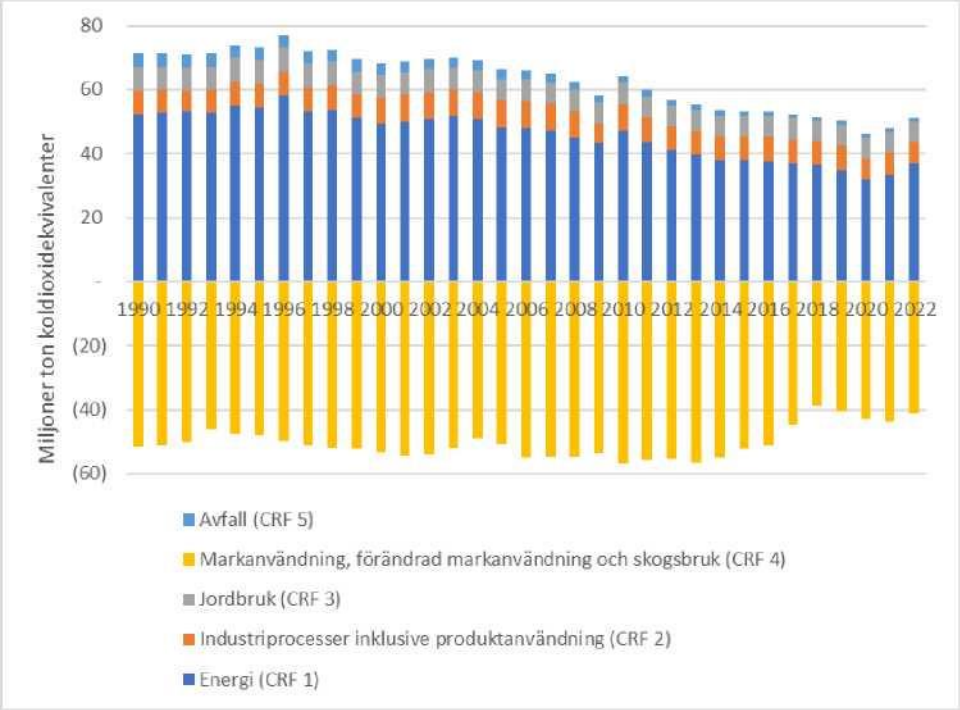


Figure 12 Total emissions and removals within Sweden in 1990-2022

In 2021, carbon dioxide (CO2) emissions (excluding LULUCF) from fossil origin amounted to 35.2 million tonnes, corresponding to approximately 80 % of total greenhouse gas emissions, calculated as carbon dioxide equivalent.

Methane (CH4)emissions amounted to 4.5 million tonnes of carbon dioxide equivalent (equivalent to 9.5 % of total emissions), nitrogen dioxide (N2O) emissions 3.9 million tonnes of carbon dioxide equivalent (around eight% of total emissions) and fluorinated hydrocarbons 0.9 million tonnes of carbon dioxide equivalent (almost two% of total emissions). The distribution of the contribution between different greenhouse gases has been similar throughout the entire series from 1990 to 2021. For emissions by greenhouse gas, see Figure 13.

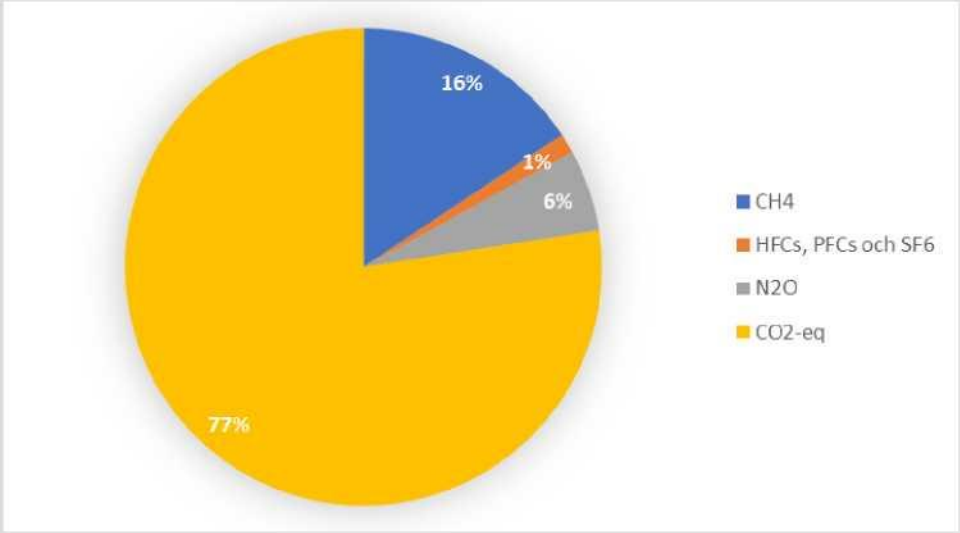


Figure 13 Emissions (excluding LULUCF) in 2022 broken down by greenhouse gas expressed in carbon dioxide equivalent.

Emissions and removals by sector

The largest emissions in 2021 were in the energy sector (69 %), agriculture (14 %) and industrial processes including product use (15 %). For emissions by sector see Figure 14.

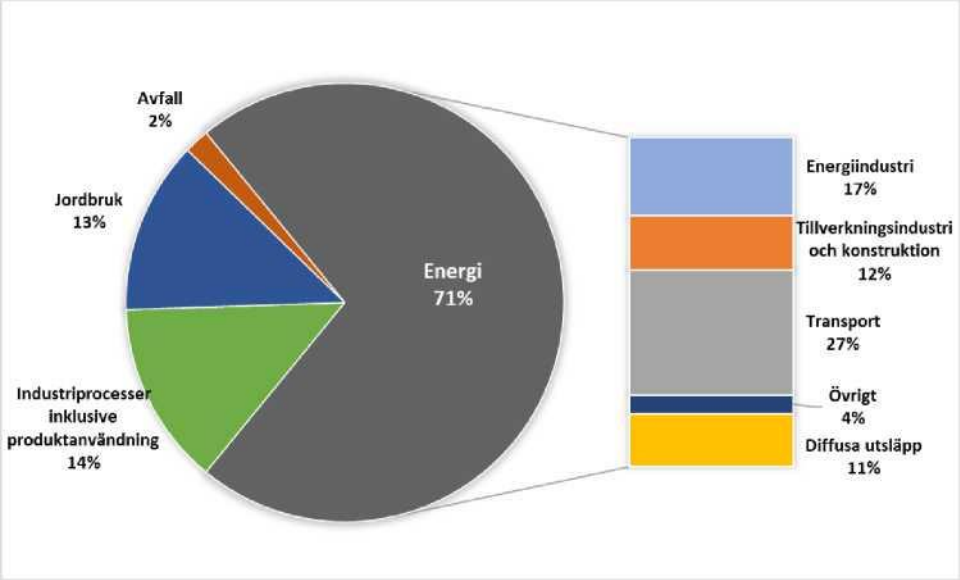


Figure 14 Emissions (excluding LULUCF) in 2022 by sector.

Emissions have decreased by 33 % between 1990 and 2021. The largest contribution to emission reductions since 1990 comes from the heating of homes and premises. The main measures that have contributed to this are the expansion of district heating networks, increased use of biofuels and the shift from oil-fired boilers to both heat pumps and district heating. Industrial emissions are influenced by the economic cycle and have been decreasing since 2010 due to an increased use of electricity and biofuels in the form of forest residues and energy efficiency. The measures that have had an impact on emissions development have been implemented over a long period of time and started to some extent already before 1990.

Emissions in the non-trading sector

Greenhouse gas emissions in the non-trading sector were around 27 million tonnes of carbon dioxide equivalent in 2022. This means a reduction of 5.6 % between 2021 and 2022 and a decrease of 41 % since 1990. Emissions in the non-trading sector mainly consist of emissions from domestic transport (49 %), agriculture (24 %) and working machinery (10 %). Emission reductions in recent years in the non-trading sector have mainly come from the transport sector, where the blending of biofuels has contributed to the highest emission reductions.

Emissions from Swedish installations within the EU ETS

Emissions from Swedish installations included in the EU ETS amounted to 18.7 million tonnes in 2021. Emissions from stationary installations have decreased by 18 % between 2005 and 2021. Domestic aviation included in the ETS has also decreased by 18 %. However, developments differ between sectors and time periods. In electricity and district heating, emissions have decreased by around 26 % since 2005, with reduced use of fossil fuels being a major cause.

Emissions in the sector can vary from year to year, mainly due to differences in temperature and precipitation.

4.2.1.2 projections of sectoral developments based on existing policies and measures of the Member States and the Union at least until 2040 (including for 2030)

Total greenhouse gas emissions in Sweden were 45.2 million tonnes of carbon dioxide equivalent in 2022, 37 % lower than the 1990 level. According to the baseline scenario of adopted policies, total emissions are projected to decrease by around 45 % by 2030 compared to 1990 levels and by around 65 % by 2040. In the case of sensitivity for the transport sector with lower fuel use, total emissions decrease by around 47 % by 2030 and by around 66 % by 2040. See Figure 15 and Table 30.

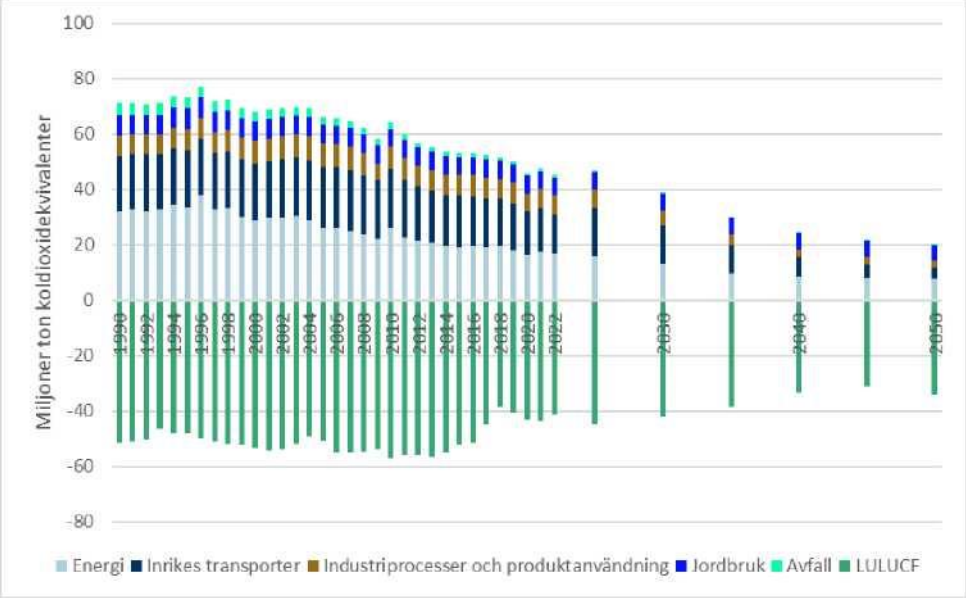


Figure 15 Historical greenhouse gas emissions and removals in 1990-2022 by sector and scenarios of policies decided. For the scenario of total net removals from the LULUCF sector, scenario options assuming average growth of forest land, million tonnes of carbon dioxide equivalent are presented.

Table 30 Historical greenhouse gas emissions and removals by sector in 1990 and 2022 and scenarios with adopted policies

and scenario options with lower fuel use in the transport sector. Emissions broken down for the EU ETS and ESR with intervals for ESR emissions depending on the scenario. For the LULUCF sector, the total net removals scenario is presented in ranges for scenario options assuming average growth and reduced growth of forest land (Mt CO2-eq).

	1990	2022	2025	2030	2035	2040	2045	2050
Energy excluding transport	32,2	16,9	*16,2*	*13,2*	*9,6*	*8,4*	*8,0*	*7,8*
Domestic transport	20,0	14,0	*17,1*	*13,9*	*10,2*	*7,0*	*4,9*	*3,7*
Industrial processes and product use	7,4	6,9	*6,7*	*5,2*	*3,9*	*2,9*	*2,9*	*2,9*
Agriculture	7,4	6,5	*6,3*	*6,0*	*5,9*	*5,8*	*5,7*	*5,6*
Waste	4,1	0,9	*0,9*	*0,8*	*0,7*	*0,6*	*0,6*	*0,5*
Total emissions	**71,3**	**45,2**	***47,2***	***39,2***	***30,2***	***24,8***	***22,0***	***20,5***
Total emissions options	**71,3**	**45,2**	***46,0***	***38,1***	***29,4***	***24,2***	***21,7***	***20,3***
EU ETS emissions incl. aviation		18,0	*17,3*	*13,8*	*9,6*	*8,1*	*7,8*	*7,7*
ESR Emissions		27,3	*28,7 – 29,8*	*24,3 – 25,3*	*19,8 – 20,6*	*16,2 – 16,7*	*13,8 – 14,2*	*12,5 – 12,7*
Total LULUCF net removals	— 51 41	—	*— 33--45*	*— 29--42*	*— 25--38*	*— 18--33*	*— 16--31*	*— 20--34*

Emissions from the ESR sector were 27.3 million tonnes of carbon dioxide equivalent in 2022, 37 % lower than in 2005. According to the baseline scenario, emissions decrease to around 25.3 million tonnes of carbon dioxide equivalent by 2030. In the case of sensitivity for the transport sector, emissions further decrease to around 24.3 million tonnes of carbon dioxide equivalent in 2030. According to the ESR, Sweden is to reduce emissions by 50 % by 2030 compared to 2005, which means a reduction from 31.3 million tonnes of carbon dioxide equivalent in 2021 to 21.6 million tonnes in 2030. Allocations for 2025-2021 have been established and allocation for 2025-2026 is to be decided in 2030. Sweden can use flexibilities such as transfers between years and countries, as well as allowances from the EU ETS. Sweden has notified the European Commission of the use of EU ETS allowances, amounting to 5.2 million tonnes in total for the period 2025-2030. By saving surplus 2023-2021 as well as the use of EU ETS allowances, an accumulated deficit of around 9-1 million tonnes is provisionally estimated for the period 2021-2030, depending on whether the baseline scenario or the sensitivity case is taken as a starting point. See Figure 16.

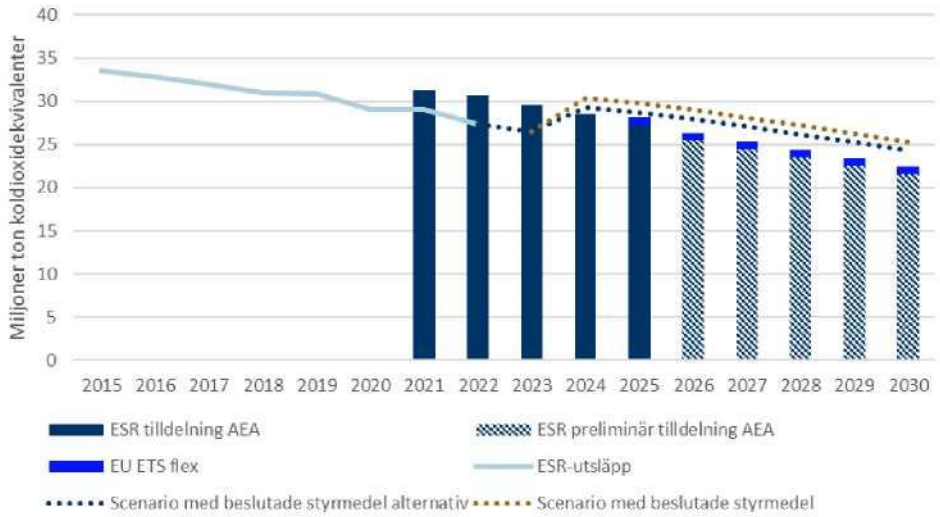


Figure 16 ESR emissions 201 5-2022, scenario for ESR emissions with adopted policies and alternative with lower fuel use in the transport sector (sensitivity case), AEA allocation 2025-2021 and preliminary allocation AEA 2030-2025, EU ETS emission units, million tonnes of carbon dioxide equivalent.

The Government has announced in the Climate Action Plan that an inquiry will be set up in 2024 to analyse and provide evidence on whether and, if so, what instruments can be designed to ensure that Sweden's commitments in the EU are achieved in a cost-effective and socio-economically efficient manner. This includes using the flexibility mechanisms of the ESR in order to achieve the objectives in the most cost-effective way. Residual emissions that remain after this should be addressed by changes in policies directed towards the consumption of petrol and diesel. In parallel, the Government will also analyse possible other cost-effective measures to reduce emissions in the ESR (including those announced in the Climate Action Plan).

Over the period 1990-2022, net removals averaged around 50 million tonnes of carbon dioxide equivalent per year, but the variation is relatively high over time. In 2022, net removals were around 41 million tonnes of carbon dioxide equivalent. The drought that occurred in 2018 and the recent infestation of spruce bark beetles, which evolved as a result of the situation around 2018, may also continue to have a major impact on the development of net intake in the coming years.

The LULUCF Regulation requires Sweden's total net carbon dioxide equivalent removals to be just under 4 million tonnes higher in 2030 compared to the average level in the period 2016-2018. Based on the last year's reporting, this means that Sweden needs to achieve net removals of 49 million tonnes of carbon dioxide equivalent in 2030. In order to highlight the uncertainties surrounding the development of net removals, scenarios with different growth assumptions have been developed for forest land.

Under the average growth scenario for forest land, the total net removals from the LULUCF sector are estimated at around 42 million tonnes of carbon dioxide equivalent in 2030, bringing the distance to the target in 2030 of around 7 million tonnes of carbon dioxide equivalent. Under the scenario of reduced growth, total net removals would be around 29 million tonnes of carbon dioxide equivalent, bringing the gap to the target in

2030 to around 19 million tonnes of carbon dioxide equivalent, see Figure 17. The final fulfilment of the undertaking will only take place in 2032.

In addition to point target 2030, net removals in the period 2026-2029 shall be less than a predetermined budget, the size of which is determined in 2025. Under the Medium Growth scenario, the deficit would be around 14 million tonnes over the period compared to a provisional budget for 2026-2029. In the scenario of reduced growth, the deficit is larger. Once again, final fulfilment will only take place in 2032.

In the period from 2021 to 2025, the sum of net accounting emissions, for a number of land accounting categories354, shall not exceed the sum of net accounting removals, for the same land accounting categories, the EU no- debit rule. When summing net emissions and removals from the land accounting categories afforested land and deforested land for the years 2021-2025 based on the Medium Growth scenario, Sweden is estimated to account for a deficit of 14 million tonnes of carbon dioxide equivalent for deforested land and a surplus equivalent to 3 million tonnes of carbon dioxide equivalent for afforested land. The two land accounting categories taken together are therefore estimated to have a total shortfall of 11 million tonnes of carbon dioxide equivalent over the period.

Comparing net emissions and removals from managed cropland and managed grassland in the period from 2021 to 2025 with the corresponding emissions and removals for the base period from 2005 to 2009, the accounted emissions and removals from managed cropland are on a total accounted deficit of 1.7 million tonnes of carbon dioxide equivalent while the emissions and removals from managed grassland ports are in a recorded deficit of 0.7 million tonnes of carbon dioxide equivalent.

According to the accounting rules, net emissions and removals from managed forest land are also to be compared to the forest reference level of the Member State (FRL). For the period 2025-2021, there is not yet a clear picture of the situation as regards the achievement of targets, as Sweden is expected to have to make technical corrections to the forest reference level. It is therefore not yet clear what the scenario for the overall target achievement for all land categories for the period 2025-2021 is.

In order to meet the commitment, flexibilities can also be used, see Section 2.1.1.1. Sweden intends to use available flexibilities if needed.

354Land accounting categories are afforested land (land converted from cropland, grassland, wetland and settlement to forest land), deforested land (land converted from forest to cropland, grassland, wetland and settlement), as well as managed cropland, managed grassland, managed wetland and managed forest land (these categories are the same as CBC forest land, cropland, grassland and wetland).

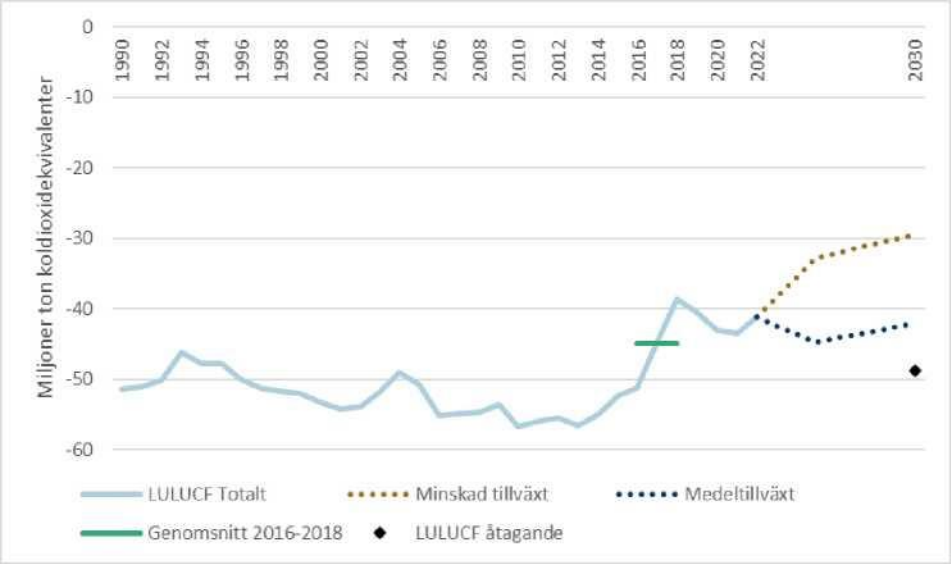


Figure 17 Net removals from the LULUCF sector 2022-1990, scenario of adopted policies with medium growth and reduced growth, average net removals in 2016-2018 and commitment 2030, million tonnes of carbon dioxide equivalent.

In 2022 additional directives (Dir. 2022: 126) were asked to propose a strategy with intermediate targets, policies and measures that contribute to Sweden's EU commitments on biodiversity and net greenhouse gas removals from the land use sector (LULUCF). The additional mission will be presented in December 2024.

4.2.2 renewable energy

4.2.2.1 Current share of renewable energy in gross final energy consumption and in different sectors (heating and cooling, electricity and transport) and per technology in each of these sectors

Table 31 shows the evolution of the overall share of renewable energy as well as the share in the electricity, transport and heating/cooling sectors355 since 2005. The shares shown in the table are from the official reporting done in Shares356, the calculation tool used in the Renewables Directive. The table has also been supplemented by an overall share of fossil-free, for comparison. That share is calculated on the basis of the same calculation method as the total renewable share, with the difference that production from nuclear power has also been added to the calculation.

Table 31 Share of renewable energy according to the calculation methodology of the Renewable Energy Directive in total and per sector, as well as own calculations for fossil-free share, 2005-2022,%.

	Electricity	Heating/cooling	Transports	Total share of renewable	Total share of fossil-free
2005	50.9 %	49.0 %	6.6 %	40.0 %	56.8 %

355The heating and cooling sector includes industry, housing and services, and district heating.
356Shares is a calculation tool that harmonises the calculation method for all Member States.
The tool is provided by Eurostat and prevents Member States from using different methods for calculating renewable shares.

2006	51.8 %	52.5 %	7.5 %	41.7 %	57.5 %
2007	53.2 %	54.5 %	8.4 %	43.2 %	58.7 %
2008	53.7 %	55.8 %	8.7 %	43.9 %	58.9 %
2009	58.3 %	59.2 %	9.4 %	47.0 %	59.7 %
2010	55.8 %	57.1 %	9.6 %	46.1 %	59.1 %
2011	59.6 %	58.5 %	11.9 %	47.6 %	61.8 %
2012	59.8 %	60.6 %	13.8 %	49.4 %	64.2 %
2013	61.7 %	61.7 %	15.3 %	50.2 %	65.8 %
2014	63.2 %	62.6 %	18.8 %	51.2 %	66.9 %
2015	65.7 %	63.2 %	21.5 %	52.2 %	65.8 %
2016	64.9 %	63.4 %	26.6 %	52.6 %	67.4 %
2017	65.9 %	63.6 %	26.8 %	53.4 %	68.7 %
2018	66.2 %	63.3 %	29.7 %	53.9 %	70.0 %
2019	71.2 %	64.4 %	30.3 %	55.8 %	71.6 %
2020	74.5 %	66.4 %	31.9 %	60.2 %	72.2 %
2021	75.8 %	68.8 %	28.6 %	62.7 %	75.2 %
2022	83.3 %	69.4 %	29.2 %	66.0 %	78.6 %

Source: Shares

The new renewable and emission reduction targets in the Third Renewables Directive are presented with an estimated calculation method in section 4.2.2.2.

Total share of renewable energy by technology/energy source

The target for Sweden in 2020 was 49 % renewable energy relative to gross energy consumption, which was significantly exceeded by 11 percentage points. The share has since then continued to grow to 66 % in 2022, see Figure 18. This is 3,3 percentage points higher than in 2021. Sweden has had a higher share of renewable since 2005 than the indicative trajectory357 for 2020.

For the 2030 EU target, there is an indicative trajectory to be followed by Member States. According to the indicative trajectory, at least 18 % of the increase between 2020 and 2030 is to be reached in 2022. Depending on Sweden's approach to the 2030 renewal premium, this level is amended. For example, if the renewable contribution is 70 %, the share in 2022 shall be at least 53 % according to the indicative trajectory. The scenarios achieve a share of 67 % and 68 % respectively in 2030. See Figure 18.

357The indicative trajectory is a calculated trajectory for the share of renewable, whose formula is set out in the Renewable Energy Directive (REDI). The trajectory indicates the rate at which the share should increase in each Member State.

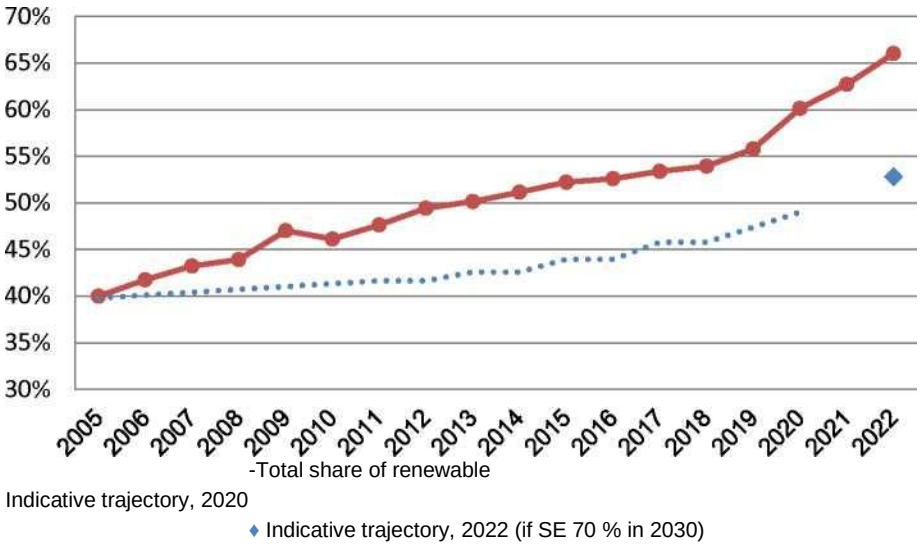


Figure 18 Evolution of the share of renewable energy in 2005-2022 and indicative trajectories for 2020 and 2022 (if SE contribution is 70 % in 2030),%.

The share of renewable energy depends both on the overall development of energy use and on the specific use of renewable energy. In 2022, energy consumption was 399 TWh compared to 409 TWh in 2021. The decrease in the last year can largely be explained by high prices of, inter alia, electricity and natural gas stemming from the supply shock to natural gas from Russia that occurred after the war of aggression against Ukraine, but also by the economic context of high interest rates and inflation. In 2005, the corresponding energy consumption was 413 TWh and has remained relatively stable at around 400 TWh, even though the population increased by 1.5 million or 16 % over the same period.

The amount of renewable energy used in Sweden in 2022 was 263 TWh according to the calculation methodology of the Renewable Energy Directive. This is 7 TWh more than in 2021 and the increase is mainly due to the continued expansion of wind power, but also the increased use of solar, biofuels and heat pumps. Since 2005, the increase is 98 TWh. It is the use of biofuels and hydropower that makes the greatest contribution to the high use of renewable energy, as shown by **error! Do not find the reference source**. The contribution of heat pumps has increased from 7 TWh in 2005 to 19 TWh in 2022.358

358Heat pumps are included here as absorbed heat with certain limitations.

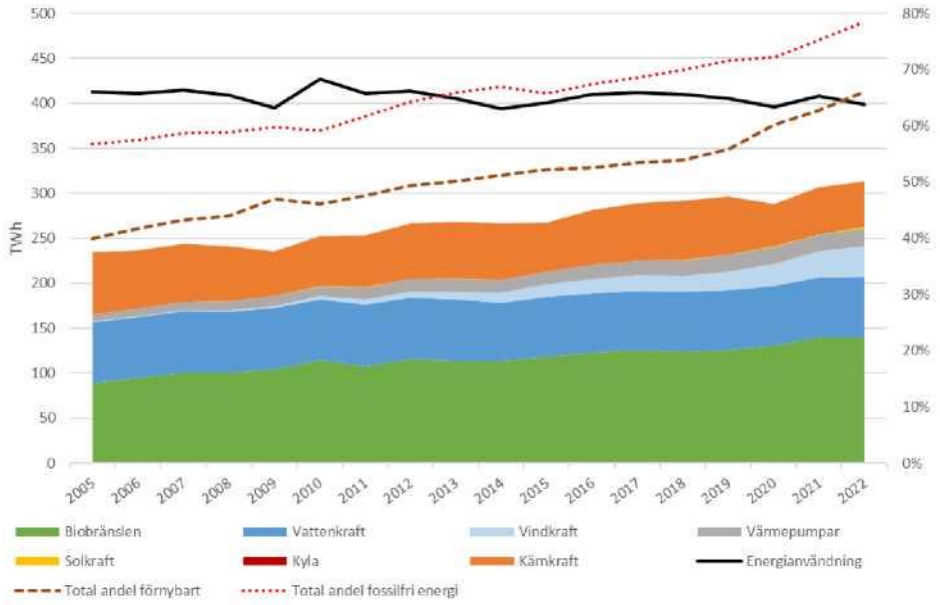


Figure 19 Renewable energy and energy use under the Renewables Directive and shares of renewable and fossil-free energy (right axis), 2005-2022, TWh and%.

Biofuels represent today, and have been responsible for the largest share of renewable energy used in Sweden since 2005. In 2022, biofuels accounted for 53 % of renewable energy according to the calculation method of the Renewable Energy Directive. Biofuels are mainly used in industry and for district heating production. The largest increase in recent years has been in the transport sector, where biofuels have been used to a greater extent. This is a development that has changed from 2024 when the reduction obligation for biofuels has been lowered. The use of biofuels by sector is shown in Figure 20.

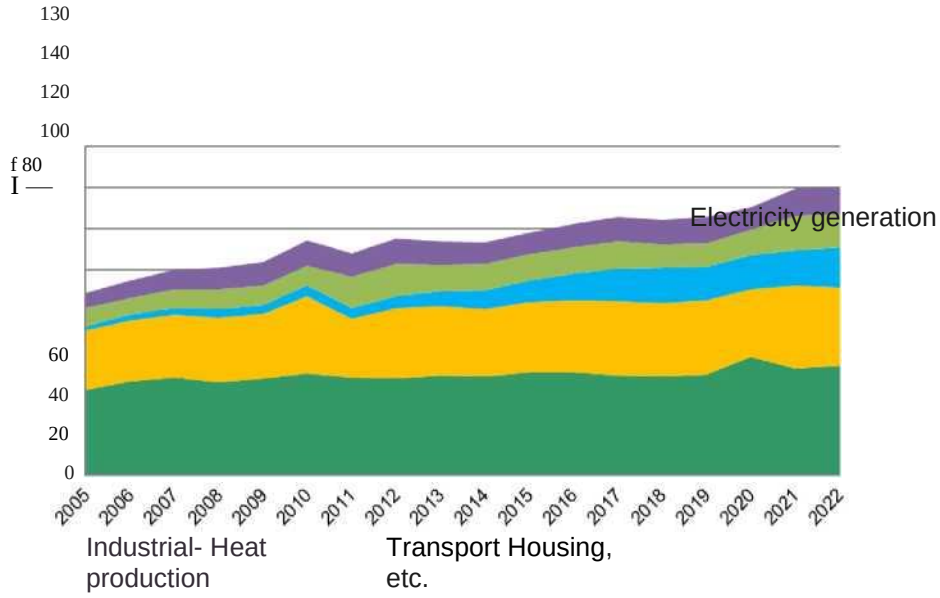


Figure 20 Use of biofuels by sector, 2005-2022, TWh

Hydropower represents the next largest contribution to a high share of renewable energy both historically and in 2022, accounting for 26 % of renewable energy. Wind is the renewable energy source with the highest growth rate since 2005 and represents 13 % of renewable energy in 2022. The contribution of heat pumps is 7 % in 2022. Solar is responsible for 0.8 % of renewable energy.

Share of renewable electricity generation by energy source/technology

The share of renewable electricity generation in relation to total electricity consumption was 83.3 % in 2022, almost 8 percentage points higher than in 2021. In 2005, the share was 51 %. The increase in the share of renewable electricity is mainly explained by an increase in wind energy production. The share of fossil electricity production is very low at 1.7 % in 2022.

In 2022, renewable electricity production359 amounted to 116 TWh, with hydropower accounting for 68 TWh360, wind power for 34 TWh361 and biofuel electricity production in CHP plants and in industry for 11 TWh. More than 98 % of wind power is made up of

359 electricity production from hydropower and wind power is temperature corrected according to the method of the Renewables Directive.
360Temperature corrected value, actual production was 64.6 TWh.
361Temperature corrected value, actual production was 17.6 TWh.

onshore wind power. Solar power accounts for 2 TWh and the remaining 2 TWh have been produced with the renewable part of waste and bio-oils.

Electricity consumption has decreased slightly since 2005, from 151 TWh to 140 TWh in 2022, even though the population increased by 1.5 million or 16 % over the same period. The high electricity prices in recent years have contributed to lower electricity consumption in the last year. Figure 21 shows the evolution of renewable electricity production and use.

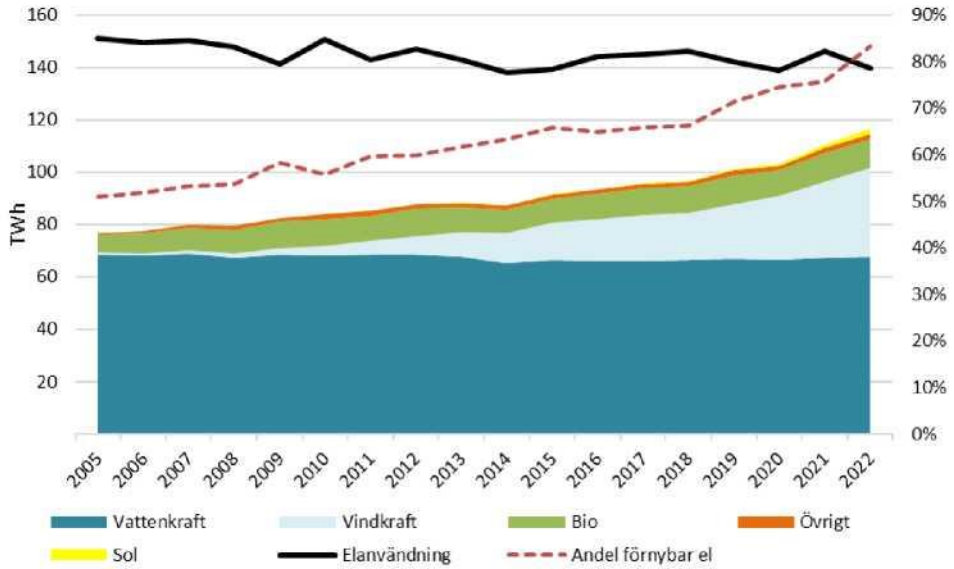


Figure 21 Renewable electricity generation, total electricity use and share of renewable electricity (right axis), 2005-2022, TWh and%.

As Sweden has a high share of nuclear electricity, the fossil-free share of electricity generation in relation to total electricity consumption was 98 % in 2022, which is 15 percentage points higher than the renewable share (see Figure 4 in Section 2.1.2.5).

Renewable share in transport by energy source

In 2022, according to the calculation method set out in the Renewable Energy Directive, the share of renewable energy in the transport sector was just over 29 %, as shown in Figure 22. The share of renewable energy is half a percentage point higher than in 2021 and is due to a slight decrease in energy consumption and a slight increase in the use of renewable energy. The share of renewable energy has increased sharply in the transport sector in Sweden since 2005, when the share was 6.6 %.

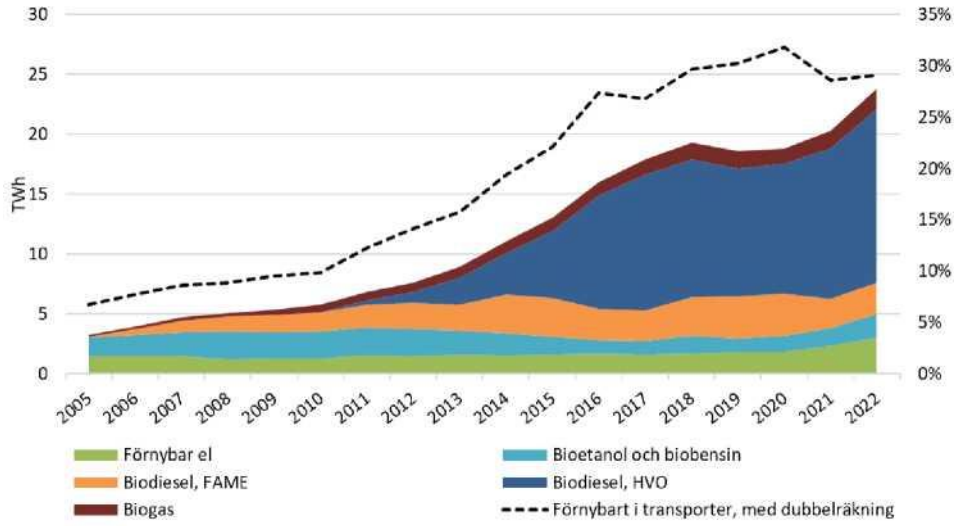


Figure 22 Actual use of renewable fuels and electricity (TWh) as well as the share of renewable energy with double counting in the transport sector (%), 2005-2022.

In particular, the use of biofuels generates the high share of renewable energy in the transport sector. It is mainly biodiesel in the form of HVO that was used in 2022 and has increased sharply since 2010. As HVO in its chemical composition is identical to fossil diesel, it can be mixed at high levels with fossil diesel, which is also the main use. The second largest biofuel is biodiesel in the form of fatty acid methyl ester (FAME)362 followed by biogas and ethanol. The use of electricity for vehicles is also increasing, which has a major impact on the calculation of the renewable share, as renewable electricity consumption may be counted twice in 4.

Biofuels produced from certain feedstocks may be double-counted under the Renewable Energy Directive. The renewable part of the electricity used in transport is also rewarded in the calculation method of the Renewable Energy Directive.

362Fatty Acid Methyl Esters (FAME).

Renewable share in the heating and cooling sector by technology/energy source

The share of renewable energy in the heating and cooling sector363 in relation to energy consumption was 69.4 % in 2022.

0,6 percentage points higher than in 2021, as shown in Figure 23. In 2005, the share was 49 %.

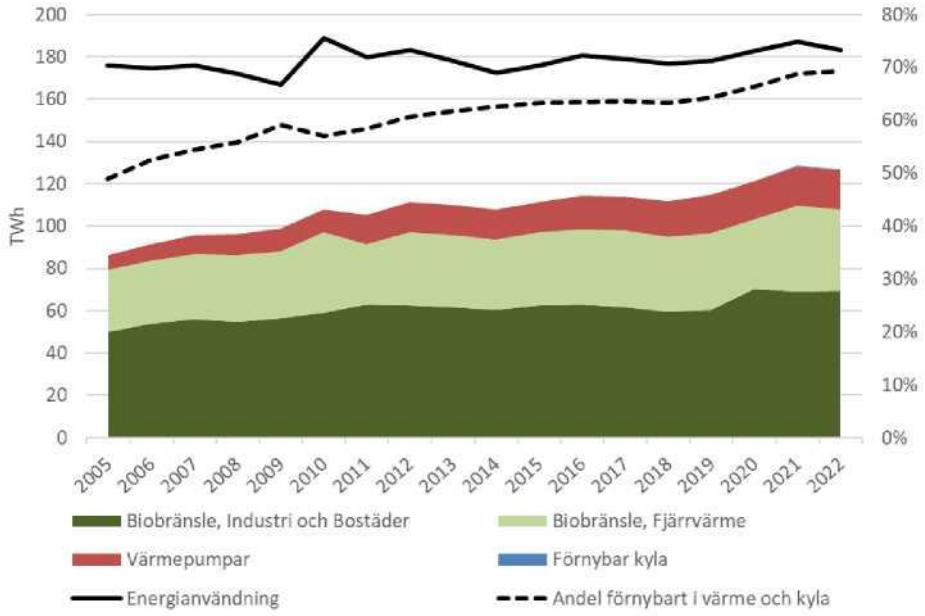


Figure 23 Renewable energy and energy use in the heating and cooling sector, 2005-2022, TWh.

The amount of renewable energy for heating and cooling was 127 TWh in 2022, an increase compared to 2005, when it was 86 TWh. Renewable energy is mainly made up of biofuels, which account for 85 % of renewable energy, followed by heat pumps accounting for 15 %.364 Over the same period, total energy consumption in the sector has increased from 176 TWh to 183 TWh.

4.2.2.2 Indicative projections of developments based on existing policies for 2030 (with a 2040 perspective)

The latest long-term energy scenarios are published in the report Scenarios on Sweden's energy system in 2023.365 The higher electrification scenario is then updated in December 2023.366 The update mainly concerns the use of electricity, the production of electricity and the reduced biofuel blending obligation in the transport sector, this scenario is referred to below as the *baseline scenario*. The biofuel incorporation rate is 6 % from 2024, and the

The heating and cooling sector363 includes industry, residential and service etc., as well as district heating, but excludes the use of electricity in these sectors.

364Also includes a small amount of solar heat.

365Swedish Energy Agency – Scenarios on Sweden's energy system 2023 (ER 2023: 07).

366 Swedish Energy Agency, *Long-term scenarios,* https://www.energimyndigheten.se/statistik/prognoser-och-scenarios/ langsikts/(2024).

incorporation level then applies to the entire scenario period. There has also been a case of sensitivity for the transport sector, which is also reported and referred to as cases *of sensitivity for the transport sector*. For further description of assumptions for scenarios and sensitivity cases see Section 4.1.

Thecalculations for renewable shares are based on changes made to the Third Renewables Directive. The calculations are based on an estimated methodology for the new objectives in the Directive, as there is currently no guidance on how to calculate them precisely, as well as changes in the methods of calculation shown. Among other things, the renewable electricity used to produce hydrogen, for example, is not to be included in the calculation, but the renewable hydrogen produced shall be counted where it is used. For the target calculations in some articles, there are also options for whether renewable electricity used in heat pumps and electric boilers and whether waste heat and cold are to be included in the calculations. It shall be stated in the NECP whether Member States intend to include them in the calculation or not. The calculations for all renewable targets in the baseline scenario, sensitivity cases for the transport sector and an estimate of the total share of renewable including nuclear power are summarised in Figure 24 and Table 32 to Table 34 below. Each target calculation is then described separately in the subsequent sections.

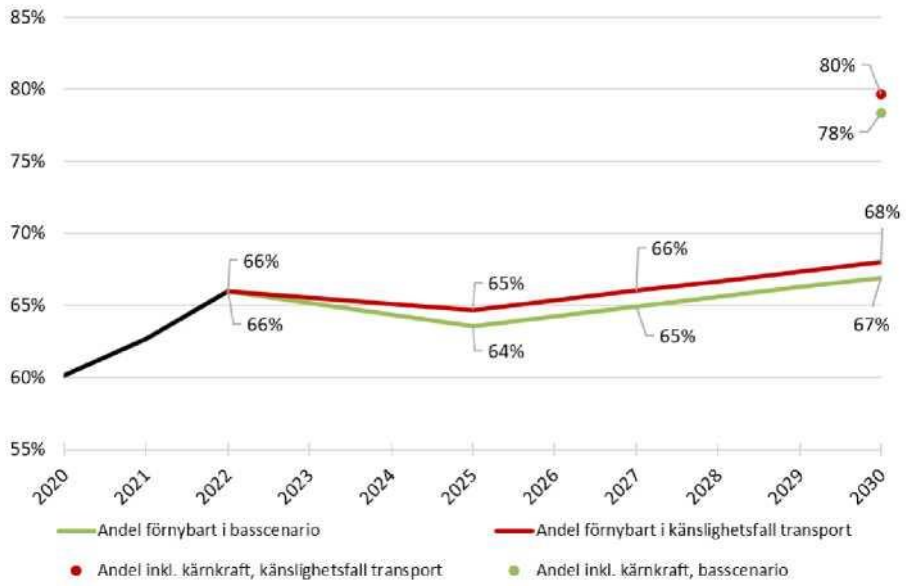


Figure 24 Total share of renewable energy by 2022 and 2 030 in baseline scenario and sensitivity cases of transport, with and without nuclear,%, 2020-2030.

Table 32 Share of renewable energy in 2022, shares in baseline scenario and sensitivity cases of transport (in brackets where the share changes) 2040-2025 and share with and without nuclear power in 2030,%.

	2022	2025	2030	2035	2040
Total share of renewable	66 %	64 % *(65 %)*	67 % *(68 %)*	73 % *(74 %)*	76 %
Including nuclear energy 2030			78 % *(80 %)*		
Electricity	83 %	86 % *(87 %)*	81 % *(82 %)*	82 % *(83 %)*	79 % *(80 %)*
Transportation367	29 %	33 % *(31 %)*	46 % *(43 %)*	61 % *(60 %)*	72 %

367The share of renewable in the transport sector includes double counting of certain fuels as calculated in the Renewable Energy Directive.

Note: See further reasoning later in the section on the cases of RFNBO.

Total share of renewable energy

The share of renewable energy in relation to energy consumption increases in the baseline from 66 % in 2022 to 67 % in 2030, as shown in Figure 25. The share is then projected to continue to increase to 76 % in 2 040 in the scenario.

In addition to renewable electricity production, a large proportion of fossil-free electricity is produced in the nuclear power plants in Sweden. On fossil-free electricity generation barely

Heating and cooling	69 %	72 %	79 %	85 %	88 %

Table 33 Share of renewable energy for industry, buildings and district heating/cooling and emission reductions in the transport sector according to the estimated calculation methodology for new targets in REDIII, 2022-2017, as well as in baseline scenario and sensitivity cases of transport (in brackets where the share changes) in 2040-2025,%.

	Industry	Buildings	District heating/cooling	Transport, emission reduction
2017	56 %	75 %	76 %	
2018	57 %	74 %	74 %	
2019	57 %	75 %	76 %	
2020	64 %	76 %	72 %	
2021	61 %	80 %	81 %	
2022	64 %	81 %	81 %	
2025	68 %	90 %	78 %	— 24 % *(-21 %)*
2030	74 %	89 %	80 %	— 36 % *(-33 %)*
2035	81 %	90 % *(91 %)*	81 %	— 43 % *(-42 %)*
2040	82 % *(83 %)*	90 % *(91 %)*	82 %	— 54 % *(-53 %)*

Table 34 Other RFNBO/Hydrogen targets in transport, shipping and industry in baseline scenario and sensitivity cases of transport (in brackets where the share changes) 2030-2025,%.

	2025	2030
Without double counting in the denominator		
RFNBO + advanced biofuels and biogas in transport	5.4 % *(5.3 %)*	5.6 %
Of which RFNBO		0 %
Double counting in the denominator		
RFNBO + advanced biofuels and biogas in transport	4.5 %	4.1 % *(4.2 %)*
Of which RFNBO		0 %
RFNBO of the energy use of shipping		
Renewable RFNBO/hydrogen in industry	(42 %)	(42 %)

52 TWh of existing reactors is included in the calculation:

11 percentage points and the share of fossil-free is then 78 % in 2030.

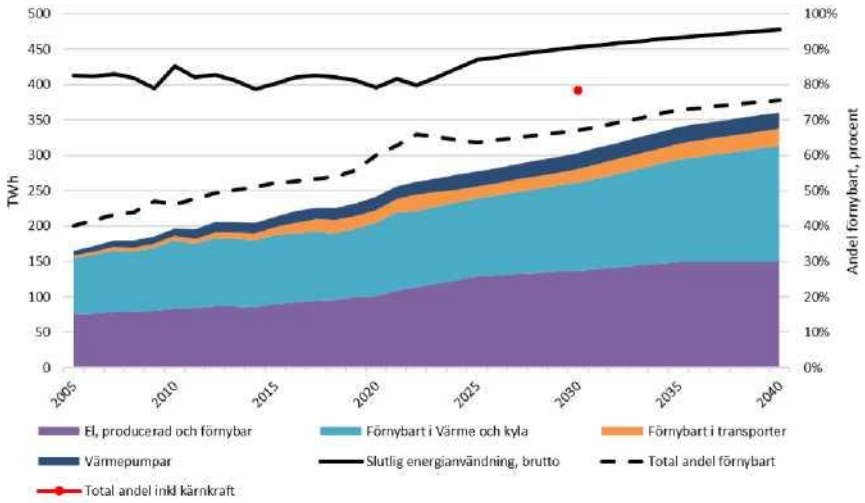


Figure 25 Renewable energy by sector, energy consumption and share of renewable in scenario, 2005-2040, TWh.

In the baseline scenario, renewable energy increases by 65 TWh between 2020 and 2030. The largest increase occurs in the renewable electricity generation sector, which increases by 36 TWh, followed by the heating/cooling sector,368 which increases by 21 TWh and absorbed renewable energy in heat pumps increases by just over 4 TWh. In the transport sector, renewable energy increases by 1 TWh between 2022 and 2030. The overall renewable share target does not include double counting for the transport sector.

The actual increase in renewable electricity production is 64 TWh, but as renewable electricity used for the production of electrofuels/hydrogen is to be excluded, the increase is 36 TWh. In particular, wind energy is increasing (+ 50 TWh) but also solar (+ 8 TWh) and biopower (+ 6 TWh), as can be seen in Figure 26, where the contribution to the share of renewable energy is shown instead by type of power.

In the heating/cooling sector, the largest increase occurs in the industry, where the use of renewable hydrogen is now included in the calculation and which in the baseline scenario is 17 TWh in 2030. Waste heat shall not be included in the total renewable share.

In the transport sector, the use of renewable energy is increasing by 1 TWh. The fact that the increase is not greater is due to a significant reduction in the reduction obligation in 2024, which, in the baseline scenario, results in a sharp reduction in the use of biofuels while the use of renewable electricity increases by just over 7 TWh in 2020-2030.

A difference to previous scenarios to be noted is that the denominator, energy consumption, is now increasing instead of remaining stable as before. The denominator of the calculation

368Includes industry, dwellings and services, etc., and district heating production.

increases in the base scenario by 57 TWh in 2020-2030. The increase is mainly taking place in the industry where the conversion of existing activities is ongoing and new industries are established. Electricity distribution losses increase in line with increased generation and use of electricity. Foreign flights are assumed to recover from low levels in 2020.

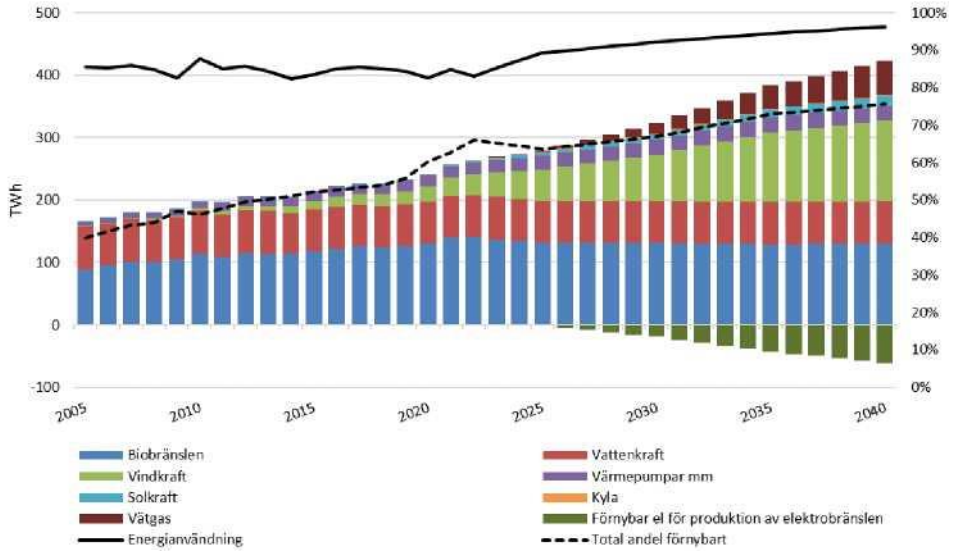


Figure 26 Renewable energy by energy source, energy consumption and share of renewable in the baseline scenario, 2005-2040, TWh.

In case of sensitivity for transport, energy consumption in the transport sector is lower than in the baseline scenario. In particular, the use of fossil fuels is lower, while the use of biofuels is only marginally lower. Electricity use is also lower in the case of sensitivity. This is even if renewable energy is 1 TWh lower in the case of sensitivity, the overall share of renewable energy is higher as the energy consumption is 9 TWh lower. See also Table 32.

Share of renewable electricity generation

The share of renewable electricity generation under the Renewable Energy Directive falls in the baseline from 83 % in 2022 to 81 % in 2030, as shown by:

Figure 27. After 2025, the share of renewable energy is declining as the use of electricity is growing at a faster pace than renewable electricity generation. Increased electricity use is due both to the electrification of industry and transport, together with the establishment and construction of new industries in Sweden.

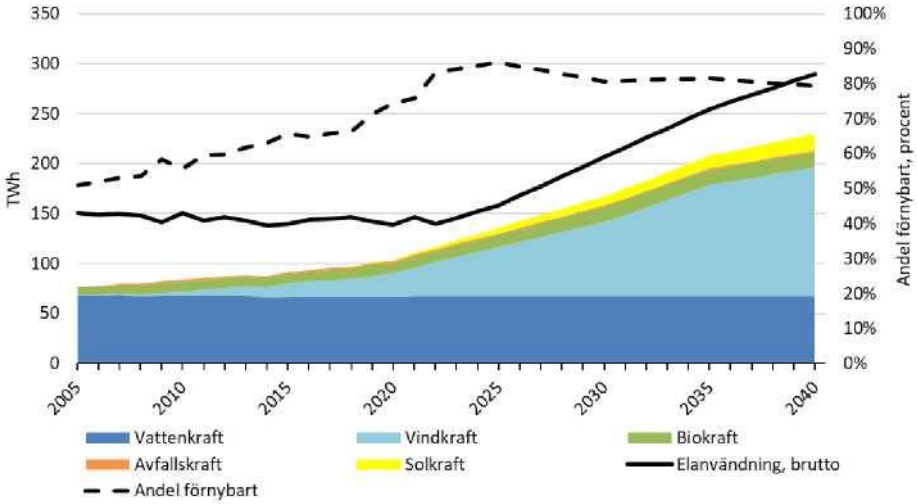


Figure 27 Renewable electricity generation, electricity use and share of renewable in the baseline scenario, 2005-2040, TWh.

It is the electricity production from wind that increases most in the baseline scenario between 2022 and 2030 by 40 TWh. The total amount of wind energy in 2030 under the baseline scenario is 74 TWh.369 Solar power is expected to increase by 7 TWh while biopower is expected to increase its production by 4 TWh over the same period. The outcome depends on the assumptions of the model, in particular as regards the prices of future technologies and electricity. Of course, the outcome may be different and, after 2030, new nuclear power could also be built that could affect the expansion and share of renewable electricity. According to the calculation methodology of the Directive, the share of renewable electricity used to calculate the targeted sectors of transport, district heating and cooling, industry and buildings shall be calculated as an average of the share of electricity for the previous two years. Therefore, as the scenario only takes downwards every five years, the share for 2030 has been used as a conservative calculation as this share was lower than in 2025.

Sweden has no targets for different types of renewable power. For offshore wind, there are many planned projects by several actors that are at different stages of the permit granting process. Currently, three wind farms have:

The Swedish Economic Zone was granted a licence with a total installed power of 2.2 GW, which is estimated to be capable of producing around 9 TWh annually,[370,] 370 371 the projects are located in the electricity price zones SE3 and SE4 and have the potential to be operational by 2030.372 In addition, 17 permit tests are awaiting preparation to be decided by

369Of which offshore wind accounts for 4.6 TWh.
370 Government, *Offshore Wind Power*, https://www.regeringen.se/regeringens-politik/miljo-och- Climate/Offshore Winds/(2024).
371 County Administrative Boards, *Wind* farming footwear, https://vbk.lansstyrelsen.se/ (2024).
The372 newspaper Energi, *Sweden does not have a clear plan for sea-pig power,* https://www.energi.se/artiklar/2024/februari-2024/sverige-saknar-tydlig-plan-for-havsvindkraften/ (2024).

the Government. In addition to these, there are also several permit applications within the territorial sea where two projects have been granted permits.

In February 2022, maritime spatial plans were adopted which include offshore energy areas. According to the Swedish Energy Agency's previous estimate, offshore wind could enable 20-30 TWh of annual electricity production.373 In March 2023, the mission "Proposals for suitable energy extraction areas for maritime spatial plans" was presented 374 to enable an additional 90 TWh of offshore electricity generation. Based on the Swedish Energy Agency and other authorities' proposals, new maritime spatial plans must be submitted by the Swedish Agency for Marine and Water Management by 31 December 2024.

In November 2023, the government presented a roadmap for new nuclear power in Sweden.375 According to the Roadmap, the objective is to reach new nuclear power by 2035 with a power of around 2 500 MW, corresponding to at least two large-scale reactors. By 2045, the objective is to have an effect equivalent to, for example, about ten large-scale reactors. In January 2024, a nuclear coordinator was also appointed to support the government in the establishment of new nuclear power and to identify promotional measures.376 In order to strengthen the conditions for investment in new nuclear power, a study will draw up proposals for a risk-sharing and financing model in which the State shares the risk.377 The 2024 Budget Bill also proposed the introduction of State credit guarantees for loans to be used for nuclear investment up to SEK 400 billion.378

Renewable share in the transport sector

Member States may choose whether the target for the transport sector is to be renewable energy of at least 29 % or at least 14.5 % reduction in emissions compared to a reference value for 2030. Both targets are presented below.

The baseline scenario is based on the assumption that the quota in the reduction obligation system is assumed to be 6 % from 2024 and throughout the period, leading to a sharp decrease in biofuel use compared to historical years and previous scenarios. When calculating the renewable share, the renewable electricity and certain biofuels, depending on the

373 Sea – and Water Agency, *Maritime plans for the Gulf of Bothnia, the Baltic Sea and* the North Sea, https://www.havochvatten.se/download/18.467841c617ec7248f0d9e080/1644851465691/Havsplaner decided on 2022-02-10.pdf (2022).
374Swedish Energy Agency, 2023. *Proposals for suitable energy extraction areas for maritime spatial plans*; I 2023: 12.
375 Government, *Government launches a roadmap for new nuclear power in Sweden,* https://www.regeringen.se/pressmeddelanden/2023/11/regeringen-lanserar-en-fardplan-for-ny-karnkraft-i- sverige/ (2023).
376 The Government, *Mr Carl BERGLÖF is appointed National Nuclear Coordinator,* https://www.regeringen.se/pressmeddelanden/2024/01/carl-berglof-utses-till-nationell-karnkraftssamordnare/ (2024).
377 Government, *Financing and risk-sharing for investments in new nuclear reactors, https://www.regeringen.se/pressmeddelanden/2023/12/finansiering-och-riskdelning-vid-investeringar-i-nya-* Knoft reactors /(2023).
378Government, *Mandate to take preparatory steps to provide state credit guarantees for investments in new nuclear energy;* https://www.regeringen.se/contentassets/5bf1e1b788074276a39d92461a325589/uppdrag-att-vidta- preparatory atgarder-for-attorna-stalla-ut-sovereign credit guarantees – for-investor-i-ny-karnkraft.pdf (2023).

feedstock, may be double-counted.379 Double counting shall also be included in the denominator, energy consumption. Biofuels must then comply with380 existing sustainability requirements and double counting depending on the feedstock they are produced from or where they are used. The distribution of sustainable fuels between feedstocks is based on the actual distribution in 2022 and applies throughout the scenario cycle.

According to the calculation methodology of the Renewable Energy Directive, the proportion of renewable energy in the domestic transport sector is estimated to increase from 29 % in 2022 to 46 % in 2030, as shown in Figure 28.

The use of renewable electricity is estimated to be just over 10 TWh of which 8 TWh is used in vehicles in 2030. As Sweden has a high share of renewable electricity production, this means that a large part of electricity use in the transport sector becomes renewable. Renewable electricity used for track-based transport can be counted twice in 1,5 and vehicle use times 4, so it has a significant impact on the share of renewable energy in the sector where electricity alone gives a share of 32 % in 2030.

In the baseline scenario, the use of biofuels is reduced, mainly in the form of HVO, which decreases by 7 TWh from 2022 to 2030, when HVO

379The fuels that reduce climate emissions most tend to be those that can also be double-counted. See list of raw materials under Annex IX of the European Parliament and Council Directive (EU) 2018/2001 of 1 1 December 2018 on the promotion of the use of energy from renewable sources.
380 Swedish Energy Agency, *Sustainable Fuels*, https://www.energimyndigheten.se/fornybart/hallbarhetskriterier/ (2023).

was largely low in diesel in order to achieve the reduction obligation. Approximately half of the HVO used in 2022 cannot be double-counted because of the raw materials produced by this HVO.

Total actual energy consumption in the transport sector decreases during the scenario period, but as double counting is also to be included in the denominator, the energy consumption in the calculation increases, resulting in a lower share of renewable energy in the transport sector than the actual consumption would have given.

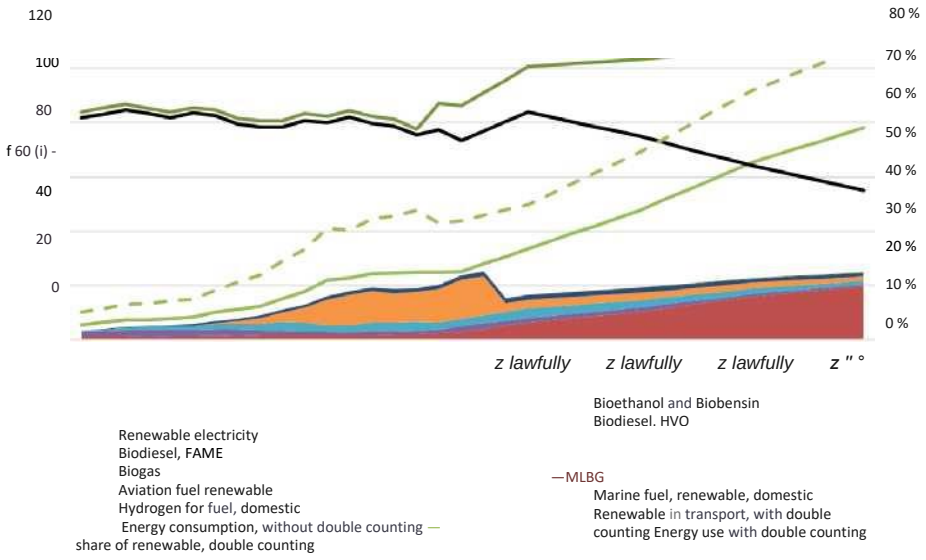


Figure 28 Actual use of renewable energy per fuel/electricity (field) and total with double counting, energy consumption with and without double counting and share of renewable energy in transport including double counting, 2022-2005 and in baseline scenario by 2040, TWh and%.

In case of sensitivity for transport, actual energy consumption in the transport sector is lower than in the baseline scenario. In particular, the use of fossil fuels is lower, while the use of biofuels is only marginally lower. The use of electricity in vehicles is also lower in the case of sensitivity. By multiplying the renewable electricity used in vehicles by 4 in the calculation, it affects the share of renewable energy in the sector relatively more than in other sectors, resulting in a lower share of renewable in the transport sector. The use of biofuels is slightly lower in the case of sensitivity, which also contributes to a lower share of renewable energy for the transport sector.

Other new objectives in the transport sector

For the transport sector, there are several targets around renewable shares, one of which is for Member States to ensure that the share of RFNBO + advanced biofuels and biogas is at least 1 % in 2025 and 5.5 % in 2030.

If the denominator of the targets above is to be the energy consumption in the transport sector without double counting, these targets are met in the baseline scenario and are respectively 5.4 % and 5.6 % in 2025 and 2030. The targets are then met only by advanced biofuels.

If the denominator of the targets is to be the energy consumption in the transport sector including double counting, countries with a higher proportion of double counting need to achieve a larger amount of RFNBO + advanced fuels in order to reach the target. The proportion in the baseline scenario is then 4.5 % and 4.1 % respectively in 2025 and 2030.

Furthermore, 1 % of the target of 5.5 % above must come from RFNBO 2030. In order to reach the target of 1 % RFNBO in the transport sector, use needs to be 0,7-1 TWh in 2030 depending on whether the denominator is without or with double counting in the baseline scenario. As the denominator currently includes double counting, it is assumed to do so also for future years. The reduction target in the transport sector is not affected by the double counting.

1 % RFNBO of energy consumption in the transport sector corresponds to 0,7-1 TWh in the baseline scenario, the higher value if it is double counting in the denominator. In case of sensitivity, transport is between 0,7 and 0.9 TWh. In the scenarios, there is no RFNBO as a fuel. A rough assessment is that around 1 % of heavy traffic and buses (or 25 % of new zero-emission vehicles) could be RFNBO vehicles, which would result in approximately 0.2 TWh regardless of the scenario.

A further objective is for Member States to strive to ensure that RFNBO accounts for at least 1.2 % of the energy consumption of shipping in 2030. In order to reach the target, the use of RFNBO for domestic shipping needs to be approximately 0.014 TWh in 2 030 in the baseline scenario. In the scenarios, there is no RFNBO as a fuel for shipping. A rough assessment is that 1 % can be made up of RFNBO in shipping, resulting in 0.012 TWh regardless of the scenario.

In *the case of transport sensitivity*, the use of biofuels is slightly lower. The proportion of RFNBO + advanced biofuels and biogas is slightly lower in the case of sensitivity, in particular for 2025 when it is 5.3 % and barely 5.6 % in 2030, as the denominator is made up of energy consumption in the transport sector without double counting. If the denominator includes the double counting, the corresponding shares are 4.5 % and 4.2 % respectively. The denominator with or without double counting plays a greater role than the sensitivity case for the transport sector.

In order to achieve the objective of RFNBO in shipping in the case of transport sensitivity, the use of RFNBO needs to be 0.017 TWh in 2 030 in the sensitivity case.

Reduction of emissions in the transport sector, new target

If the emission reduction target is chosen for the transport sector, it is at least 14.5 % emission reduction for renewable fuels and electricity relative to a reference value (fossil fuel comparator emissions from transport) 2030.

In the baseline scenario, the emission reduction is 24 % in 2025 and 46 % for 2030, see Figure 29. The use of renewable electricity in vehicles accounts for most of the reduction, as double counting is also included in this target. After 2030, the calculation for the renewable electricity becomes less favourable, but nevertheless the reduction in emissions will be higher to reach 54 % in 2 040 in the baseline scenario.

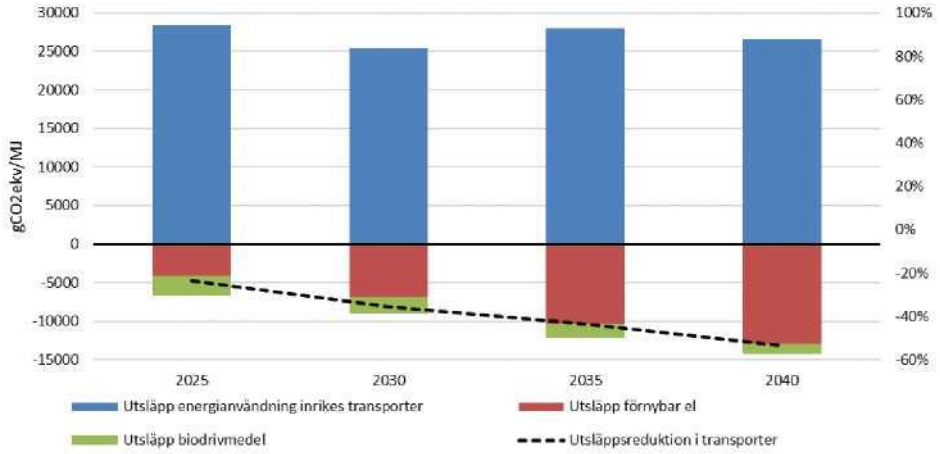


Figure 29 Total emissions in the transport sector, emission reduction for renewable fuels in the calculation (gCO2eq/MJ) and emission reduction (%), 2025-2040.

In the calculation based on the baseline scenario, values found in the Directive have been used and actual values from the sustainable fuels system should be used for monitoring.

In case of sensitivity for transport, actual energy consumption in the transport sector is lower than in the baseline scenario. In particular, the use of fossil fuels is lower, while the use of biofuels is only marginally lower. The use of electricity in vehicles is also lower in the case of sensitivity. However, the renewable electricity used in vehicles is managed favourably in the calculation and even if emission reductions are lower than in the baseline scenario, the reduction will be 33 % in 2 030 in the sensitivity case. The 14.5 % target is met.

Renewable share in the heating and cooling sector

Position on renewable electricity and waste heat and cold in Article 23

Article 23 of the Renewables Directive has two objectives. A binding annual growth rate target and an indicative target. Countries above a threshold of 60 % renewable in the sector do not need to meet the binding annual increase target, while those exceeding 50 % need to

achieve only half of it. As Sweden is above 60 % renewable, Sweden is considered to have met the binding target and therefore does not need to implement the annual growth rate. On the other hand, Sweden has an indicative target of increasing the share of renewable heating and cooling of 0,7 percentage points annually between 2021 and 2030, as set out in Annex Ia of the Directive.

Article 23 of the Renewable Energy Directive requires Member States to consider whether waste heat and cold and renewable electricity with efficiency above 100 % (which electricity for heat pumps is deemed to have) should be included in the calculation in the annual increase requirements for the periods 2025-2021 and 2026-2030. If included, they may only form part of the growth rate. Member States shall indicate whether they choose to include renewable electricity and/or waste heat and cold to the target in the national energy and climate plan.

However, renewable electricity and waste heat and cold shall not be counted towards the indicative contributions of countries set out in Annex Ia or towards the total share of the sector renewable, but only towards the annual increase targets.

As Sweden has more than 60 % renewable energy in district heating and cooling systems (81 % in 2022), the systems are efficient under Article 26 of the Energy Efficiency Directive. Sweden therefore complies with the requirement in Article 24(10)(c) of the Renewables Directive that 90 % of final energy consumption in district heating and cooling systems is to take place in efficient systems and only needs to implement paragraph 1 of Article 24. The share of renewable energy in the heating and cooling sector is projected to increase from 66 % in 2020 and just over 69 % in 2022 to 74 % in 2030, as shown in Figure 30.

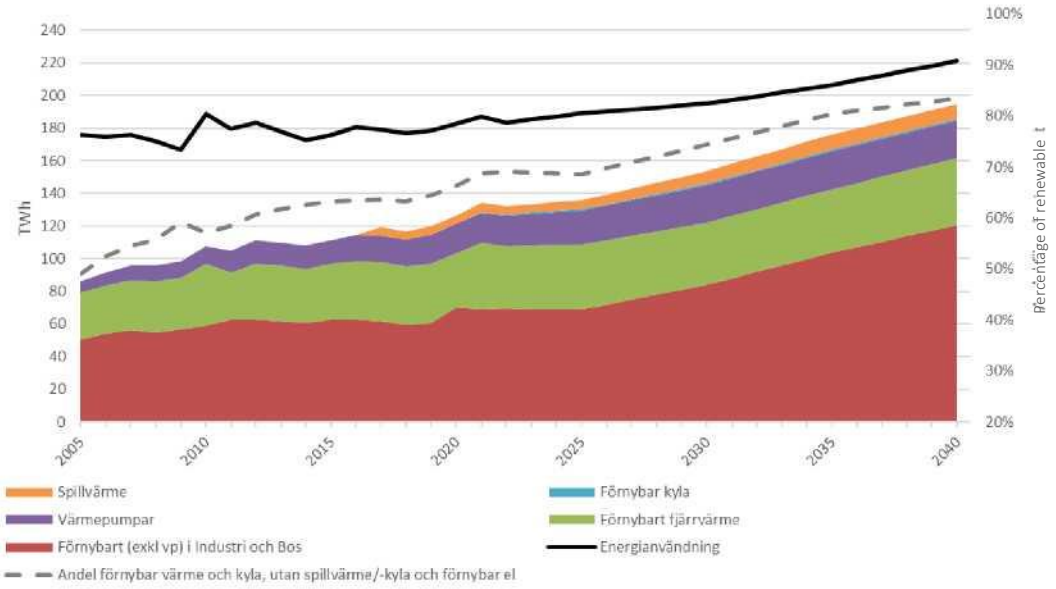


Figure 30 Renewable energy and energy use and share of renewable without waste heat, cold and renewable electricity in the heating and cooling sector in the baseline scenario, 2040-2017, TWh and%.

Energy used in the sector is largely renewable already today, but the use of renewable energy is still expected to increase by 24 TWh between 2020 and 2030. Total energy consumption is projected to increase over the same period but at a lower rate than renewable energy, increasing the share of renewable energy. In particular, hydrogen is made on renewable electricity and can now be counted as a contributor to the increase. The use of biofuels in industry is also increasing, while it is declining in housing. The use of heat pumps is also increasing, but not to the same extent.

As Sweden has a renewable share of more than 60 % renewable, Sweden is considered to have met the annual growth rate target. By contrast, Sweden has an indicative target of increasing the share of renewable heating and cooling of 0,7 percentage points annually between 2021 and 2030. According to the baseline scenario, Sweden has an average annual growth rate of 0,8 percentage points (without waste heat/cool and renewable electricity) over the whole period, allowing Sweden to meet its indicative target.

Plastic heat use in Sweden is 4.6 TWh in 2020 and 5.3 TWh in 2022 and increases in the baseline to 7.8 TWh in 2030. Renewable electricity used for large heat pumps in the district heating network is just under 1 TWh for the whole period.

In case of transport sensitivity, the share of renewable electricity is slightly higher. Since neither transport nor electricity is included in the heating and cooling sector, the proportion of renewable energy in the sensitivity case is not affected.

Renewable in industry, new target

The revised Renewable Energy Directive adds an ambitious target for the share of renewable energy in industry. The share of renewable in relation to industrial energy consumption (including non-energy uses381) is projected to increase from 64 % in 2020 to 74 % in 2030 under the baseline scenario.

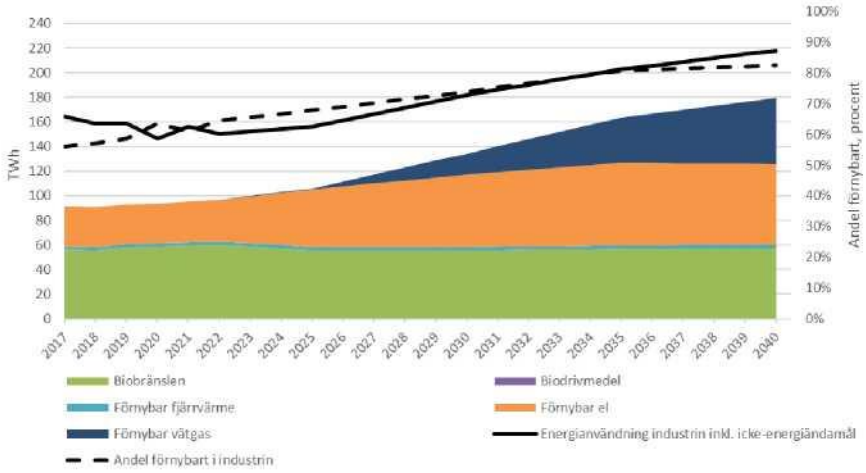


Figure 31 Renewable energy and energy use (including non-energy purposes) and share of renewable energy in the industrial sector, 2040-2017, TWh and%.

The industrial sector in Sweden already has a very high share of renewable energy with high biofuel and electricity use. According to the scenario, renewable energy still increases by 41 TWh between 2020 and 2030, while total energy consumption (including hydrogen and non-energy purposes) in the sector increases by 35 TWh, see Figure 31. The increase in renewable energy comes mainly from increased electricity use, but also a large share of renewable hydrogen is added in the scenario, while biofuel use is slightly reduced. In the scenario calculation, all additional hydrogen used in the sector is assumed to be produced from electricity taken from the grid, of which the renewable share of hydrogen is based on renewable electricity share.

Member States shall endeavour to increase the annual indicative share of energy from renewable sources in final energy consumption and in energy for non-energy purposes by at least 1,6 percentage points on average between the periods 2021 to 2025 and from 2026 to 2030.382 Under the scenario, the average increase in the first period is 0,8 percentage points and 1,2 percentage points in the second period the average increase over the whole period 2030-2021 would be 1 percentage point.

According to Article 22(a) of the Renewable Energy Directive, waste heat may be included

381Energy consumption for non-energy purposes is allocated around 70 % to the industrial sector. Non-energy related purpose refers to the use of fuels used as feedstock in an industrial process instead of using fuels for energy products.
382The reference year for the period 2021-2025 and 2021-2030 is the renewable share for 2020, which was 64 %.

for part of the annual growth rate. Waste heat is indirectly included in the calculation by including it in the share of renewable district heating. As the use of district heating in industry is very low, around 3 TWh, relative to total energy consumption, it is of little importance. Moreover, Member States do not have to communicate the choices made in the National Energy and Climate Plan.

The Directive requires Member States to ensure that hydrogen used in industry (including non-energy purposes) consists of a certain share of renewable liquid and gaseous transport fuels of non-biological origin (RFNBO). According to the Directive, the minimum requirement is 42 % in 2030 and 60 % in 2035. In the scenario, all additional hydrogen used in industry is estimated to be renewable by 2040, so the share of renewable hydrogen far exceeds the target levels in 2030 and 2035. The assessment is based on the hydrogen projects planned today, where production will largely take place by taking electricity directly from the grid. Electricity production today and in the scenario is almost fossil-free and all bidding zones are expected to continue to meet the emission intensity requirements for electricity generation.

In case of transport sensitivity, the share of renewable electricity is slightly higher. This in turn has an impact on the share of renewable industry that is marginally higher.

Renewable in buildings, new target

The revised Renewables Directive adds an indicative target of383 49 % renewable share of final energy in buildings by 2030. The Directive requires each Member State to decide on an indicative national contribution to the share of energy from renewable sources including energy produced on or near buildings and electricity taken from the grid from the final energy consumption of buildings that contributes to reaching the EU common indicative target of 49 %.

The renewable share of buildings increases according to the baseline from 76 % in 2020 to 89 % in 2030 and is therefore well above the indicative target, as shown in Figure 32. Overall, renewable energy increases by 27 TWh over the period, while total final energy consumption increases by 10 TWh. According to the baseline scenario, the use of renewable electricity from grids is increasing most. Solar on and near buildings, heat absorbed from heat pumps and district heating use are also increasing over the period, while biofuel use remains at the same level. In the baseline scenario, it is assumed that around 10 % of all solar capacity in Sweden are larger photovoltaic parks while the remaining capacity is available on roofs or near buildings.

383As buildings are not a separate statistical area, it has been assumed that households, public and other activities are included in the category Buildings (minus fuel).

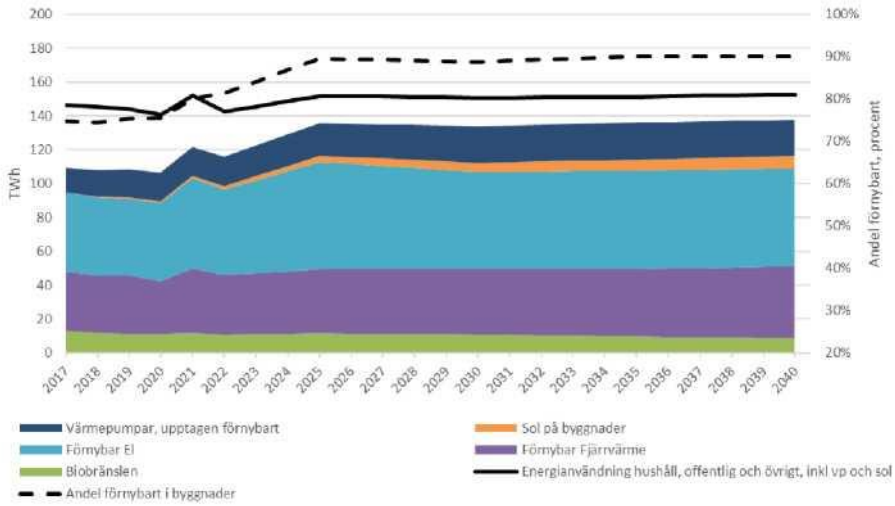


Figure 32 Renewable energy and energy use and share of renewable energy in buildings, 2017-2040, TWh and%.

In case of sensitivity to transport, the share of renewable electricity is slightly higher. This in turn affects the share of renewable energy in buildings that are marginally higher.

Renewable energy in district heating and cooling, new target

The Third Renewables Directive adds a target for Member States to aim to increase the share of renewable energy in district heating and cooling by 2,2 percentage points annually starting from the 2020 share by 2030. Countries with a renewable share of more than 60 % are deemed to have met the target and thus do not need to aim for the rate of increase.

The exact manner in which the share is to be calculated is not fully clear and the following calculation for the renewable numerator includes district heating produced using renewable fuels along the same lines of calculation in existing targets. It also includes absorbed renewable heat with large heat pumps and waste heat. The denominator is total district heating and cooling production.

Position on renewable electricity in Article 24

Article 24 of the Renewables Directive requires Member States to consider whether renewable electricity used for district heating generation (which is here interpreted as renewable electricity for electric boilers and electricity input for large heat pumps) should be included in the annual growth rate target. Member States shall communicate the choice in the national energy and climate plan.

Since Sweden has over 60 % (81 % in 2022) of renewable energy in district heating and cooling systems, the systems are efficient in accordance with Article 26 of the Energy Efficiency Directive. Sweden therefore complies with the requirement in Article 24(10)(c) that 90 % of final energy consumption in district heating and cooling systems must take place in efficient systems and only needs to implement paragraph 1 of that Article.

District heating production in Sweden is already mainly renewable with an estimated renewable share of 72 % in 2020 and 81 % in both 2021 and 2022 and thus well above 60 %, which means that the target is already considered to be met. In the baseline scenario, the share is 80 % in 2030 and for the period after 2030 it remains at just over 80 % and reaches 82 % in 2040, as shown in Figure 33. Non-renewable production consists mainly of the fossil fraction of waste, a smaller amount of waste gases from steel production which disappears as steel production moves to hydrogen, and a small proportion of oils.

The annual growth rate of Member States shall aim to take as a starting point the 2020 share estimated at 72 %. Although Sweden does not need to increase its share renewable, there is a rate of increase. In the baseline scenario, the renewable share increases annually on average 0,8 percentage points (excluding renewable electricity) to 2030.

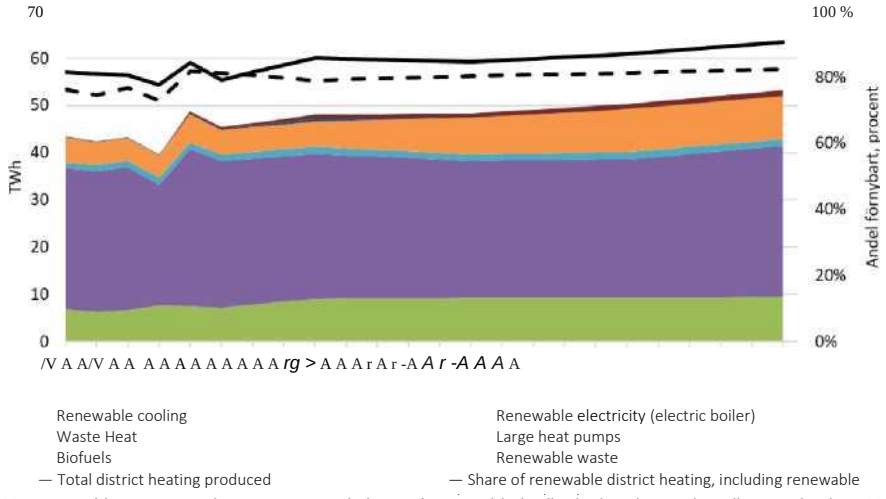


Figure 33 Renewable energy and energy use and share of renewable in district heating and cooling production, 2040-2017, TWh and%.

Renewable electricity used for large heat pumps in the district heating network is just under 1 TWh for the whole period. Electric boilers account for a very small part of around 0.2 TWh today and, in addition, they disappear to 2 030 in the baseline scenario.

4.3 Dimension energy efficiency

4.3.1 Current primary and final energy consumption in the economy and by sector (including industry, households, services and transport)

Total and final energy consumption across the economy and per sector is presented in Table 35.

Table 35 Energy consumption 2019-2021 [TWh].

	2019	2020	2021
Primary energy consumption	533	480	510
Final energy consumption	367	355	369
Industry	127	130	129
Households	86	84	92
Service	70	71	74
Transportation	82	77	80

Source: Eurostat

4.3.2 Current potential for the application of high-efficiency cogeneration and efficient district heating and cooling

The latest comprehensive assessment384 under Article 14 of the then version of the Energy Efficiency Directive was carried out in 2020. A corresponding assessment shall be made under Article 25 of the recast Energy Efficiency Directive. It states that each Member State must submit a comprehensive heating and cooling assessment to the European Commission as part of its integrated national energy and climate plan. Due to the short time that has elapsed since the recast Directive entered into force, it has not been possible to carry out such a comprehensive assessment of sufficient quality to be included in the NECP. Sweden therefore intends to provide supplementary information on these elements ex post.

Values used for calculation of efficiency of cogeneration and primary energy savings shall be determined on the basis of the expected or actual operation of the unit under normal conditions of use. High-efficiency cogeneration shall result in primary energy savings of at least 10 % compared to the reference values for separate production of heat and electricity.

In Sweden, it was already established in 2005, pursuant to the CHP Directive, that the existing Swedish CHP plants are highly efficient and that almost all Swedish CHP plants have an efficiency of the order of 90 %. Sweden's assessment is therefore that the Swedish CHP plants meet the criterion for high-efficiency CHP plants. There is therefore no potential in Sweden to increase the share of high-efficiency cogeneration since all CHP is already high efficiency. On the other hand, there is a potential to replace heat water production with high-efficiency cogeneration.

According to the Swedish Energy Agency's scenarios, the supply of district heating increases

384Swedish Energy Agency – Comprehensive assessment of heating and cooling potential (ER 2020: 34).

slightly to 2030, reaching 60 TWh as the heat base increases (compared to 56 TWh in 2020). In reality, however, it is difficult to know how efficiency, heat pumps and EU directives affect district heating and thus also cogeneration. Electricity production from district heat and power is expected to increase to just under 12 TWh while industrial backpressure is reduced to just over 6 TWh. Overall, total electricity production from cogeneration remains at around the current level.

The recast EED includes a new definition of what can be classified as efficient district heating and cooling. Gradually tightened criteria are introduced in installations between 2027 and 2050 to achieve more energy efficient use of heating and cooling and to increase the renewable share of energy input. Based on energy input, installations shall gradually phase out fossil-based district heating, consisting of only 100 % renewable energy, 100 % waste heat or a combination of these by 2050. Based on the amount of emissions, these shall be gradually reduced from 200 g/kWh in 2025 to 0 g/kWh in 2050. The Swedish Energy Agency considers that all Swedish district heating can be classified as efficient until 2045, but that further measures are needed by 2050. Thus, if a waste cogeneration system, in which fossil plastics still represent a fraction of waste streams entering the installations, is to be counted as "efficient", carbon capture (CCS) is required to reduce emissions to 0 g/kWh, or that the emissions of waste are not counted towards the emissions of district heating. See section 4.2.2.2 for an assessment of the share of renewable heating and cooling in the context of the recast Renewable Energy Directive.

4.3.3 Projections taking into account existing energy efficiency policies, measures and programmes under point 1.2 (ii) for primary and final energy consumption for each sector at least until 2040 (including for 2030)

Figure 34 shows the baseline scenario for Sweden's final energy consumption by 2040, broken down by sector. The scenario is based on policies and measures decided on 30 June 2023.

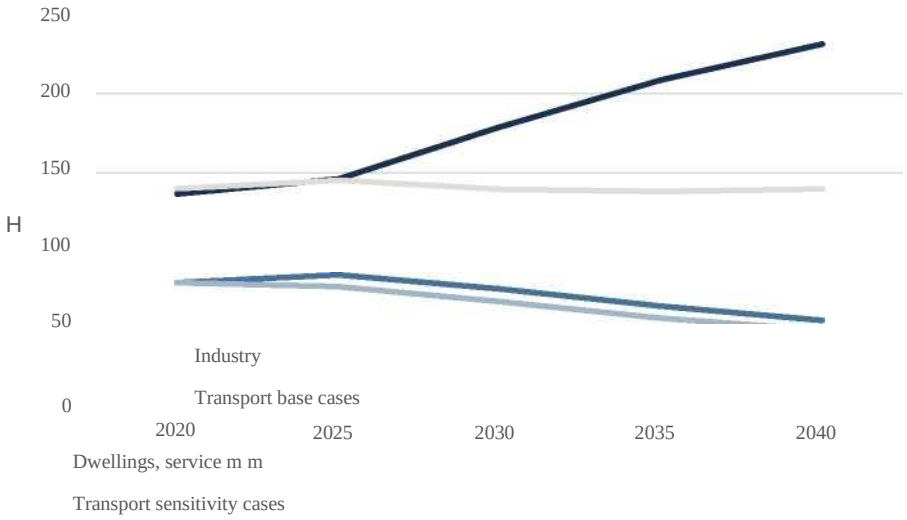


Figure 34 Scenario (and cases of sensitivity) for energy consumption 2040-2020 for industry, transport (including international aviation) and housing and services, etc., TWh.

Energy consumption in the housing and services sector is assumed to remain relatively stable until 2040. This is due, among other things, to energy efficiency improvements in buildings, conversion from direct-acting electricity to heat pump and electrification of work machines. By contrast, increased electricity consumption in data centres leads to an increase in energy consumption, resulting in total consumption in the sector of around 140 TWh in 2040.

Energy use is also decreasing in the transport sector by 2040 due to the increased energy efficiency of vehicles, aircraft and vessels and, in particular, an increase in the use of electric vehicles. In the base case, there is a decrease from 79 TWh in 2020 to 55 TWh in 2040. In the case of sensitivity for the transport sector, a slightly higher reduction in energy consumption is seen, to 49 TWh.

By contrast, energy consumption in the industrial sector is expected to increase sharply. The increase in energy consumption is mainly due to increased electricity consumption, mainly in the iron and steel industry. It is mainly the production of hydrogen through electrolysis that

contributes to the increased use of electricity. Use changes from 136 TWh in 2020 to 231 TWh in 2040.

4.3.4 Cost-optimal levels of minimum energy performance requirements stemming from national calculations, in accordance with Article 5 of Directive 2010/31/EU

Table 36 shows the cost-optimal levels of minimum energy performance requirements for existing and new buildings as calculated by the National Board of Housing, Building and Planning.385 The results are shown as a range, depending on the type of heating, with the minimum requirements in force in brackets. However, the minimum energy performance requirement may be adapted in case of modification of an existing building.

Table 36 Cost-optimal levels and minimum energy performance requirements.

Cost-optimal level of primary energy (EPpet) kWh/m^{2}Atemp year	
Existing buildings:	
— Single-family houses	104-175 (90)
— Multi-dwelling buildings	74-121 (75)
— Premises	85-107 (70)
New buildings	
— Single-family houses	85-88 (90)
— Multi-dwelling buildings	67-70 (75)
— Premises	66-70 (70)

4.4 Dimension energy security

4.4.1 Current energy mix, indigenous energy sources, import dependency; including relevant risks

The energy mix in Sweden is dominated by biofuels, crude oil and petroleumproducts, nuclear fuel and hydropower.386 Important indigenous energy sources are hydropower, biofuels, wind power and heat absorbed from heat

Swedish National Board of385 Housing, Building and Planning (2023). *Control station of the rules on the energy performance of buildings* (report 2023: 12).
386All statistics are based on the Swedish Energy Agency – Energy situation in figures 2023.

pumps. Biofuels accounted for 30 % of energy input in 2022.387 The evolution of total energy supply in 2005-2022 is shown in Figure 35.

However, a large proportion of energy input depends on imports such as nuclear fuel and fossil fuels such as oil, where the latter is widely used in the transport sector. In total, fossil fuels accounted for 25 % of energy input in 2022. The self-sufficiency rate of energy, defined as the ratio of indigenous energy to total energy input, has increased in recent years, reaching 51 % in 2021.

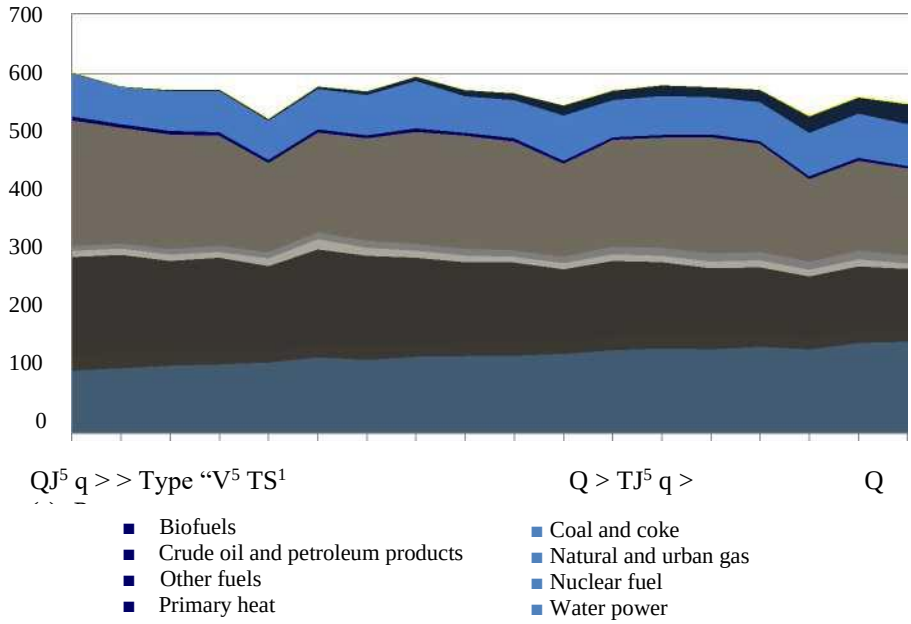


Figure 35 Total energy input by type of energy, TWh, 2005-2022.
Source: Swedish Energy Agency, Energilstat in figures 2023.

Swedish electricity production is mainly based on hydropower and nuclear power, which represented respectively 41 % and 29 % of total electricity production in 2022. The expansion of wind energy continues, accounting for 19 % of total electricity production in 2022.

387Excluding net imports.

4.4.2 projections of developments based on existing policies and measures at least until 2040 (including for 2030)

Figure 36 shows the total supply by energy carrier in 2020 to 2040 on the basis of the scenarios developed. The energy input is increasing over the period, mainly due to electrification in industry.

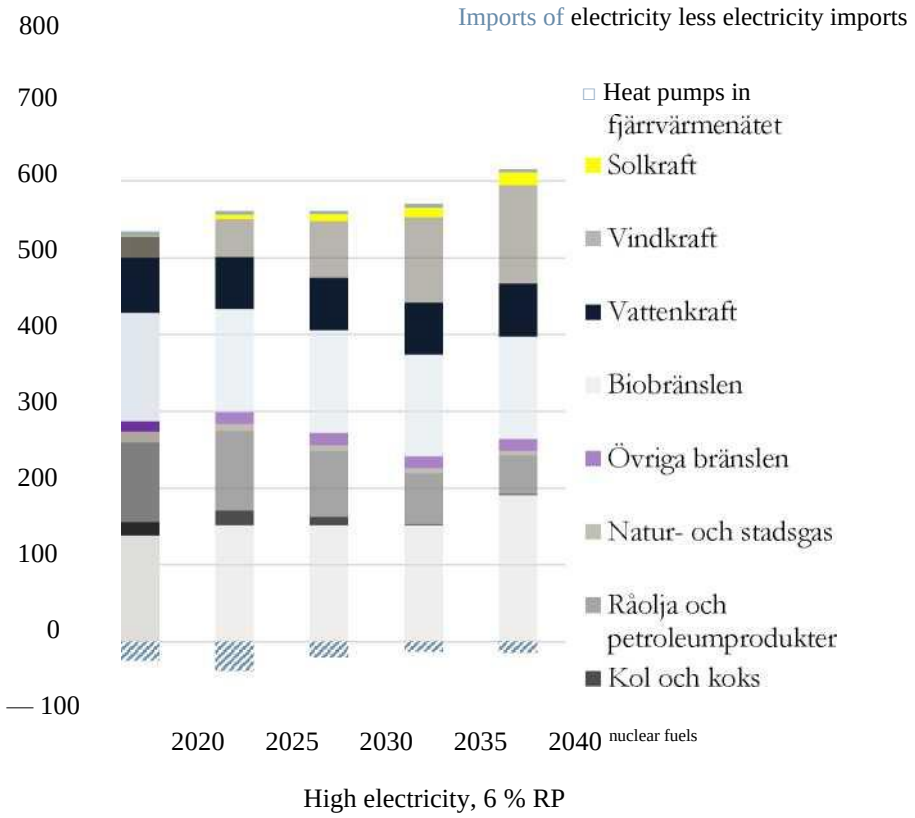


Figure 36 Total input by energy carrier based on the scenarios, TWh, 2020-2040.
Source: The Swedish Energy Agency.

In the scenario there is an expansion of renewable electricity generation while existing nuclear power is assumed to remain in place until 2040, while new nuclear power is deployed and all 6 existing reactors are prolonged for life. The wind energy expansion amounts to 129 TWh in 2040 and solar power is just over 17 TWh in 2040.

The use of biofuels is estimated to decrease slightly over the period due to changes in the reduction obligation and amounts to 134 TWh in 2040. The use of petroleum products is decreasing over time and is 2 040 in scenarios 50 TWh. This reduction is driven primarily by developments in the transport sector where increased electrification and efficiency reduces demand for fossil-fuelled vehicles and vessels. The use of coal, coke, etc. is falling sharply and land at only 1 TWh in 2040, mainly due to developments in the iron and steel industry.

Sweden remains a large net exporter of electricity, but the continued increase in domestic demand leads to a decrease in net exports until 2040 when they land at 15 TWh in the scenario.

4.4.2.1 Analyses of future power adequacy

The Swedish power grid continuously analyses the future power adequacy of Sweden in the short and long term. The evaluation of power adequacy can be done using two different methods, a static method388 or a dynamic method389.

On the basis of the static method, Svenska kraftnät estimated that the power balance for winter 2023/2024 would be -1 400 MW a normal year winter and -3 100 MW for a twenty-year winter.390 A negative power balance means that electricity consumption during the winter hour with the highest electricity consumption exceeds the expected available domestic production. It therefore says something about the need for imports during the hour with the highest electricity consumption.

Swedish power grids have also assessed power adequacy using the dynamic approach, including in the Business Authority's recent long-term market analysis.391 See also Table 37. When production and imports are insufficient, power shortages occur, presented as Loss of Load Expectation (LOLE) and Expected Energy Not Served (EENS). The392 table shows the simulated power shortage in the model for increasing level of flexibility.
Due to the large volume of hydrogen, two steps are reported (half and all hydrogen respectively are considered flexible). In stage F3, 30 % of all industrial loads are assumed to be flexible and a proportion of electric vehicles that are flexible. It should be pointed out that the

388The static method compares the estimated maximum consumption with the expected available production at peak hours. This is called an effect balance and is done for a normal, 10-year-old (cold winter that returns on average once every ten years) and a 20-year winter.
389When assessing power adequacy in accordance with the dynamic methodology (also known as the probabilistic method), the entire electricity system is simulated in an electricity market model with cross-zonal (and country) connections and consumption and generation units. The model simulates a large number of weather years, i.e. when wind, water and consumption, etc. vary. This methodology thus takes into account imports/export capacities between bidding zones, both national and foreign generation resources, as well as unplanned interruptions of both generation and transmission links.
390Swedish National Grid – Power balance on the Swedish electricity market, Report 2023.
391Swedish National Grid – Long-term market analysis 2024.
The392 LOLE is measured in hours per year while EENS is measured in MWh per year. In reality, it corresponds to load disconnection.

simulation without any flexibility is not done because it is a realistic scenario, i.e. that no consumption flexibility will be available, but only as a comparison to quantify the impact of the different flexibility steps.

Table 37 modelled power shortages in Sweden at increasing level of flexibility and under different scenarios.393 The figures for LOLE show the value of the Swedish electricity price area with the highest number of hours with power shortages. The EENS shows the sum of the expected shortfall in the country's four electricity price zones.

Lack of power in Sweden 2025		2035				2045			
		SF	MA	EP	EF	SF	MA	EP	EF
LOLE (h/is)									
No flexibility	0.4	1	23	350	1004	110	285	1815	1863
F1: half of hydrogen		0.2	9	21	79	48	29	49	285
F2: all hydrogen		0.1	3.7	0.6	3.2	18	10.1	0.1	13
F3: certain industry/EV		0.0	1.7	0.0	0.0	0.5	5.8	0.0	0.2
F4: Datacenter		0.0	1.3	0.0	0.0	0 2	4.7	0.0	0.1
EENS (GWh/is)									
No flexibility	0.1	1	19	288	695	151	201	2839	3518
F1: half of hydrogen		0	5	17	48	54	23	51	386
F2: all hydrogen		0.0	1.3	0.4	2.5	16.9	4.0	0.0	14.9
F3: certain industry/EV		0.0	02	0.0	0.0	0.5	0.9	0.0	0.4
F4: Datacenter		0.0	0.1	0.0	0.0	0 2	0.5	0.0	0.1

Source: Swedish National Grid – Long-term market analysis 2024.

The simulation results show that flexibility is necessary for a functioning system already in 2035 for the majority of the scenarios in the long-term market analysis. This is expected given the sharp increase in electricity demand. The SF scenario with the lowest electricity consumption is an exception. However, the assumptions of flexibility are a major factor of uncertainty and the different levels of flexibility lead to very large differences in simulated power shortages. At the higher flex levels, only the FM scenario receives a LOLE exceeding 1 hour per year.394

393SF = Small-scale renewable, FM = Roadmap mixate, EP = Electrification plantable, EF = Electrical construction renewable.

On behalf of the Government, the394 Energy Market Inspectorate developed a reliability standard as part of the implementation of Ordinance 2019/943 on the internal market for electricity. It was decided in May 2021 to 1.0 hours of power scarcity per year.

4.5 Dimension of the internal market

4.5.1 Electricity interconnectivity

4.5.1.1 Current level of interconnection and main interconnectors

Sweden had an interconnection ratio of 22 % at the end of 2022/2023.[395] Total import capacity is 10 325 MW and installed generation capacity amounted to 47 000 MW. Existing relations with neighbouring countries are shown in Table 38.

Table 38 Daily connections and import capacity (max NTC).

From	Type	Name	MW
Denmark	AC		1 700
Denmark	HVDC	Konti-Skan 1-2	715
Finland	AC		1 100
Finland	HVDC	Fenno-Skan 1-2	1 200
Lithuania	HVDC	Nordbalt	700
Norway	AC		3 695
Poland	HVDC	Swe-Pol link	600
Germany	HVDC	Baltic cable	615
Total			10 325

Forecasts of requirements for increased interconnection (including for 2030)

By 2027, the electricity interconnection level is expected to decrease despite Sweden increasing interconnections with neighbouring countries. New planned connections are shown in Table 39. The reason for a decrease in the level of electricity interconnection is the strong expansion of domestic renewable generation, which is expected to take place, thus contributing to a reduction in the ratio.

Table 39 New connections to 2027.

From	Type	Name	MW
Finland	AC	3th AC	900
Total			1600

After 2027, there are no further planned foreign connections. However, analysis shows that further connections can be profitable to build from a socio-economic perspective, especially in the light of the fact that several scenario analyses show a sharp increase in electricity needs already by 2035.

395 Swedish National Grid, *Power Balance in the Swedish electricity market, Report 2023,* https://www.svk.se/siteassets/om-oss/rapporter/2023/kraftbalansen-pa-den-svenska-elmarknaden-rapport- 2023.pdf (2023).

4.5.2 Energy transmission infrastructure

4.5.2.1 Key characteristics of the existing electricity and gas transmission infrastructure

Existing electricity infrastructure

Sweden is an elongated country with electricity use mainly in the south and the main electricity production, in the form of hydropower, in the north. There are hours when the transfer from north to south is not sufficient to make the whole country a price area. As a result, Sweden is divided into four bidding zones based on the structural bottlenecks present in the grid, see Figure 35. Structural bottlenecks are to be removed, but it is not socially justified to always guarantee the same price throughout Sweden.

Figure 37 bidding zones.
Source: Nordpool and the Energy Agency's processing.

The transmission network, as shown in Figure 38, was originally designed to be able to transfer electricity from northern to southern Sweden. As a result of major changes, not only within Sweden, where energy is produced and used, flows have changed in recent years. Traditional flow patterns have been complemented by new and shifts between them over time are also becoming more frequent.

For example, despite the structural need for more electricity generation in southern Sweden, where most of the use so far takes place, wind power is built mainly in northern Sweden thanks to good project locations. Offshore wind plans have a greater south centre of gravity. Nuclear power is currently located in bidding zone 3, but the Government is working to amend the regulatory framework so that nuclear power plants can be built in locations other than today.396 With announced industrial efforts in northern Sweden, we may see in the future a northerly flow that justifies the expansion of electricity grid capacity to the north.

396 Government, *New Nuclear Power in Sweden – a first step,* https://www.regeringen.se/contentassets/4e94b54e75114406aca6ca199fe4d80a/promemoria-ny-karnkraft-i- sverige-ett-forsta-ste.pdf (2023).

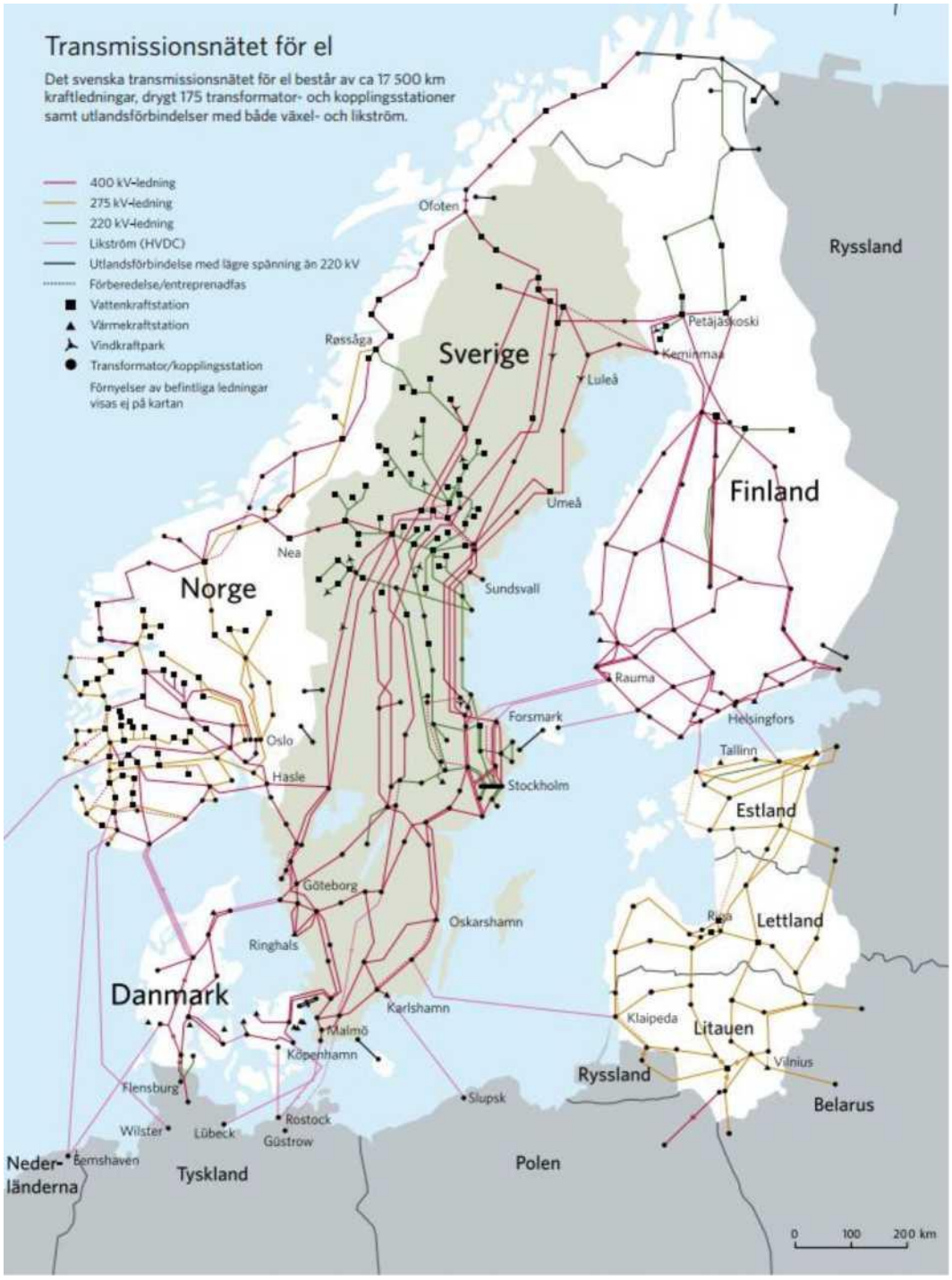


Figure 38 Electricity transmission network 2023. Source: Swedish National Grid.

Gas infrastructure

The Swedish gas system is small compared to most other national natural gas networks in Europe. Only 30 of Sweden's 290 municipalities have access to the western Swedish gas network. The gas comes to Sweden via the Danish Dramaker. In Sweden, the transmission network is owned and operated by Swedegas AB, which also has balancing responsibility in the Swedish natural gas network. The balance responsibility structure changed with the introduction of a common balancing zone between Sweden and Denmark on 1 April 2019. Imbalances are being adjusted by Swedegas AB and Energinet's jointly owned Balancing Area Manager (BAM).

There is also an urban and automotive gas network in the Stockholm area, which is owned by the gas network Stockholm AB. The production and supply of gas to the urban gas network mainly takes place from a gasification plant in Stockholm, from which both biogas and converted liquefied natural gas (LNG) are supplied.

There are also smaller regional and local gas networks across Sweden. Many of the small local networks are mainly used to transport biogas intended for vehicles from a production plant to refuelling points.

4.5.2.2 Projections for network deployment requirements at least until 2040 (including for 2030)

Future needs for network deployment

Electricity grids

The Swedish National Grid Network has a 10-year network extension plan397, which is updated every two years. In addition to this, the realisation of maritime spatial plans may imply further network expansion over the next 10 years.

The basis for the development of the grid deployment plan is different scenarios398 extending up to 2050. The main elements of the scenarios relate to power generation and electricity use. Flexibility is becoming increasingly important in a system with a high proportion of weather-dependent variable electricity production.

At European level, scenarios for future development of power systems and electricity market are developed by ENTSO-E399, partly based on the different system operators' own scenarios. These scenarios are, on the one hand, at European level and, on the other hand, at

397 Swedish National Grid, *Network Development Plan* 2024-2033, https://www.svk.se/siteassets/om-oss/rapporter/2023/svk_natdevelop_2024-2033.pdf (2023).
398 Swedish National Grid, *Long-term market analysis,* https://www.svk.se/siteassets/om-oss/rapporter/2024/lma_2024.pdf (2024).
399ENTSOE OHIM EntsoG – TYNDP 2018, Scenario Report.

regional level, for Sweden within the Baltic Sea region (RGBS).

Network and capacity reinforcement and deployment are already being prepared and ongoing in many parts of the country and at all levels of the system; transmission, regional and distribution networks. This work will continue in the coming decades as both electricity use and electricity generation are expected to rise markedly. Large volumes of new connections will need to be implemented and the grid as a whole will need to be reinforced to be able to manage the flows that will occur between production and demand facilities. The overall balance across the Nordic region also influences the flows that arise and need to be managed in the Swedish electricity network. Over the next decade, the Swedish Power Network's plans include a combination of new and reinvestment, which results in the construction of approximately 1 500 km of new lines and some 30 new stations. In addition, over 2 500 km of lines are renewed and about half of the Swedish power network almost 200 stations are renewed.

The development and strengthening of the Swedish electricity networks depends to a large extent on efficient permitting processes. Both Svenska kraftnät and the Energimarknadsininspektionen run large and priority projects to improve the efficiency of their internal processes concerning the application and granting of permits. They also work together to reduce the sequential parts of a common process and to work in parallel as much as possible. In the process of reforming permitting processes, other network owners in the country also contribute and participate, whose activities are of course also concerned. In 2024-2023, both the Swedish National Grid Network and the Energy Market Inspectorate have reported significant progress in shortening permit procedures.

In March 2023, a Government Bill on a clearer licensing process for electricity networks was also presented (Bill. 2023/24: 88 a clearer authorisation process for electricity grids). The Bill makes legislative proposals aimed at contributing to a clearer and faster process for the renewal, strengthening and expansion of electricity grids. The proposals concern high-power lines that require a network concession for a line, as the authorisation process for such lines is longer than for the other networks. When assessing the general suitability of a management in the context of a network concession for a line, only certain specified aspects shall be taken into account. In order to make the permit examination clearer and thereby shorten lead times in the permit process, the Government shall be able to issue regulations on the choice of technology between establishing an overhead line or a ground or submarine cable. In addition, it is proposed to exempt the construction and maintenance of power lines with network concessions for lines from the prohibitions in the Environmental Code against impacts on areas covered by general biotope or beach protection. The proposed date of entry into force of the amendments is 1 July 2024.

Gas network

There are currently no forecasts for the development of the Swedish natural gas network. On the other hand, there is a significant activity, not least in northern Sweden, around the possibilities of establishing fixed infrastructure dedicated to hydrogen. There are currently no final investment decisions taken, but a large number of stakeholders have shown interest in connecting to a future network that Nordion plans to build together with Gasgrid Finland.

4.5.3 Electricity and gas markets, energy prices

4.5.3.1 Current situation of electricity and gas markets, including energy prices

Electricity market

The electricity market consists of a wholesale and a retail market. On the wholesale market, electricity suppliers, producers and major consumers trade in electricity. Sweden's transmission system is linked to Denmark, Norway, Finland, Germany, Poland and Lithuania and indirectly to the whole of Europe. The largest market place for the wholesale market is the European day-ahead market. Access to this market is currently offered by both NordPool and EPEX Spot. In the day-ahead market, trading takes place through an auction process that takes into account transmission capacity in the electricity grid between Sweden's four bidding zones and the capacity for exchanges with the other countries to which Sweden is currently linked. In addition, within the European market coupling there is also an intraday market where operators can adjust their positions closer to the hours of operation if necessary. A number of shippers have financial responsibility for balancing management at the planning stage, but during the hours of operation, Svenska kraftnät is responsible for keeping the electricity system in balance and performs the necessary up- and down-regulation via trading in balancing power in the real time market currently operated together with the other Nordic system operators. Within a few years, the Nordic countries will gradually join the common European balancing platforms.

The cost of electricity for final customers consists of the energy price (as determined by the respective electricity supplier), electricity network price, energy tax and VAT. In addition to the above costs, several retailers charge their customers with a fixed annual fee. The annual fee usually varies between SEK 100 and SEK 500. All costs are subject to VAT.

Suppliers are obliged to purchase electricity certificates corresponding to a certain ratio of their customers' electricity consumption. The electricity certificate fee has been included in the electricity trade price since 2007, but in recent years, electricity certificates have fallen so low that the additional cost of the quota obligation is currently almost negligible.

Figure 39 shows variable prices for a typical customer of 20 000 kWh in bidding zone SE3 versus spot and system price.

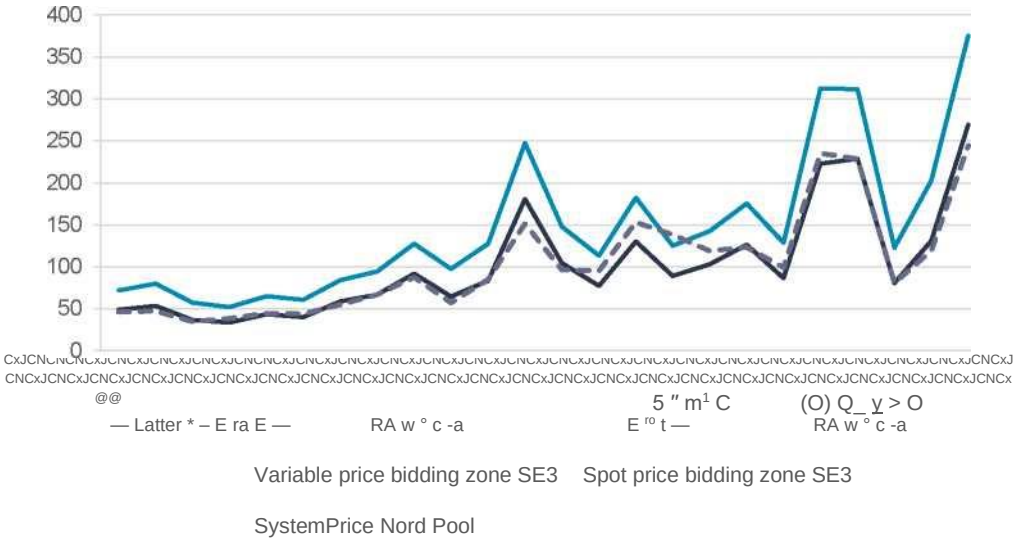
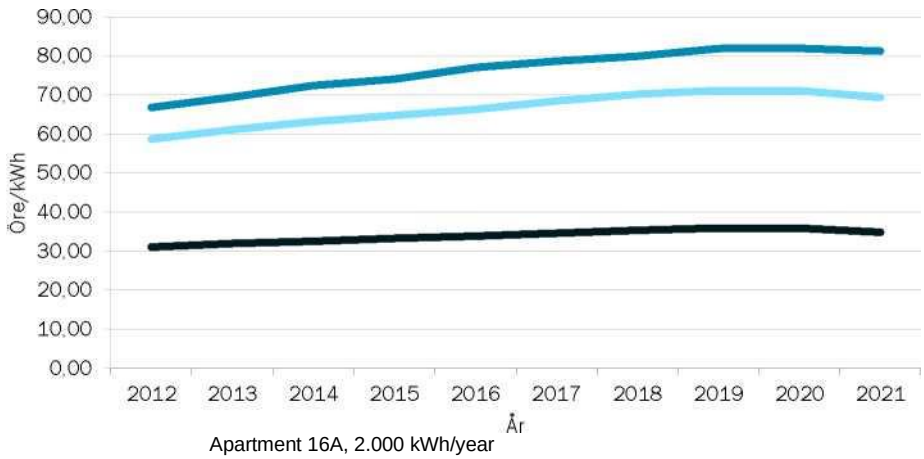


Figure 39 Driving price for typical customer 20 000 kWh/year in SE3 relative to spot and system price, öre/kWh. Source: Energy Market Inspectorate, Nord Pool.

Electricity network tariffs consist of a fixed (i.e. non-volume dependent) and a variable cost (transmission fee). VAT is payable both on the fixed subscription fee and on the variable transmission fee.

Figure 40 shows the evolution of network charges for different types of household customers in recent years. Between 2020 and 2021, the fees in real terms decreased on average by 0.8 % for apartment customers, 2.4 % for villakers with a hedge of 16 A and by 2.8 % for villaks with hedging of 20 A. In Swedish krona, this corresponded to a reduction of approximately SEK 14, SEK 84 and SEK 201 over the year.



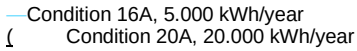


Figure 40 Real development of network charges for household customers.400 Source: The Energy Market Inspectorate.

Gas market

Natural gas was introduced into Sweden only in 1985 and today accounts for around three% of Sweden's total energy consumption. Gas is mainly used as process fuel and feedstock in industry, for power and district heatingproduction and as a fuel for vehicles.

In Sweden, gas is distributed through a larger natural gas network along the west coast, a smaller gas network in Stockholm, a number of small local gas networks and via refuelling points and LNG terminals. Only the western Swedish gas network and the Stockholm gas network are covered by the Natural Gas Act and therefore also by:

Supervision by the Energy Market Inspectorate. Only the western Swedish gas network is connected to the European gas network.

Sweden does not have its own natural gas production but is dependent on imports via a pipeline from Denmark and on LNG transported by ship.
However, Sweden has a certain share of its own production of biogas401 which is to a certain extent upgraded to be blended with natural gas in the grid, liquefied or used as a vehicle gas.

The western Swedish gas system is small compared to most other gas networks in Europe and consists of approximately 60 km of transmission line and about 300 km of distribution line. The network extends from Trelleborg in the south to Stenungssund in the north and a small piece east into Småland.

Due to the Swedish network design, the Swedish gas market is closely linked to the Danish gas market. The balancing operators in the Swedish gas system are also active on the Danish gas market. Since 2020, natural gas has been traded mainly on the European Energy Exchange (EEX), where the PEGAS trading platform is integrated.

Consequently, competition, price developments and transparency in the Swedish gas market depend to a large extent on developments in Denmark. The connection of the Swedish gas market to the Danish market became even stronger on 1 April 2019, when a common balancing zone between the countries was established. The project, Joint Balancing Zone402,

400The average of the 2021 price level, not weighted.
401 Swedish biogas production was 2.3 TWh in 2022. Overall, total biogas use in Sweden was just over 4.4 TWh in 2022. Total LBG use increased by 142 % in 2022 – mainly due to the rapid market development of biogas heavy goods vehicles. At the same time, 3.1 million tonnes of nutrient digestate were produced, with 90 % used as fertiliser in agriculture. Source: Energigas Sverige, *Statistics on biogas,* https://www.energigas.se/fakta-om-gas/biogas/statistik-om-biogas/ (2023).
402 Swedegas, *Joint Balancing Zone*, https://swedegas.se/underwebbar/swedegas/vara- Chanster/System Responsibility/Joint-Balancing-Zone (2024).

started in 2017 and has been implemented in cooperation with final customers, gas suppliers, network owners and regulatory authorities in Sweden and Denmark. The purpose of the common balancing zone is to increase the efficiency of cross-border trade between the Swedish and Danish markets and to harmonise balancing procedures.

Under the Natural Gas Act, the Energy Market Inspectorate must examine the contractual conditions for balancing responsibility so that they meet the requirements of objective and non-discriminatory nature. The latest Balance Responsibility Agreement was approved by the Energy Market Inspectorate at the end of 2021 due to changes in the contractual terms linked to future accession to the Baltic Pipe.

On EEX, an operator can trade gas on the day of delivery, the day before, for weekend and for the following month, as well as forward contracts with delivery up to six years ahead. All trading takes place in physical delivery and the operators must have contracts with the Danish transmission network operator Energinet.

Gas balancing takes place within the joint balancing zone in Sweden and Denmark and is managed by the Balancing Area Manager (BAM), which uses the Danish virtual trading point ETF to manage the balancing of the gas market. BAM is jointly administered by Energinet and Swedegas.

In order to transport the gas to Sweden, an operator needs to book capacity in Dramaker. The capacity of the transfer is auctioned in Energinet's regular capacity auctions. In order to be able to transport gas from Denmark to Sweden, shippers must also be registered as shippers with Energinet. Due to the low consumption relative to the transmission capacity of the system, there is no risk of congestion problems in transmission with the current consumption. Even in Sweden, gas can be sold on to consumers such as industries and gas distributors.

4.5.3.2 Projections of developments based on existing policies and measures at least until 2040 (including for 2030)

A development of the electricity price is being developed in the energy scenarios. The electricity price is modelled in the Times-Nordic model and is based on fossil fuel price assumptions as well as emission allowance prices obtained by the European Commission.

The evolution of electricity prices for the base fall is shown in Figure 41. The electricity price is calculated as an annual average for Sweden, which is treated as a price area.

The increase in the electricity price in the scenario is due to an increase in electricity demand, increased market coupling towards the continent, and rising fuel and emission allowances prices.

Figure 41 Electricity price developments under the Swedish Energy Agency's Lower electrification scenario, SEK/MWh.

4.6 Dimension research, innovation and competitiveness

4.6.1 The state of play in the low-carbon technologies sector and, as far as possible, its position on the global market (this analysis should be carried out at Union or global level)

The strategy for Sweden's external trade, investment and global competitiveness identifies energy technology and energy transition as areas that open up major export opportunities. Sweden supports business development, commercialisation and deployment of new energy technologies and services by companies in different development phases. Sweden was the second highest on the European Innovation Scoreboard in 2023.403

Below are a number of examples of projects and actions financed from the Energy Agency's research and innovation envelope.

Pilot and demonstration efforts can determine whether innovation can be implemented and reach the market. Here are a number of examples of projects supported by the Energy Agency's pilot and demonstration programme in 2023:404

- System Demonstration of Emission Free Soil Workout

403 European Commission, *European Innovation Scoreboard*, https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard_en#european- innovation-scoreboarding 2023 (2024).
404 Swedish Energy Agency, *Pilot and Demonstration Projects,* https://www.energimyndigheten.se/forskning-och-innovation/stod-to-affarsideer-test and launch/pilot and demonstration projects/(2023).

- Renewable dimethyl ether as an alternative to fossil LPG in industrial heating
- Drone based thinning can make Swedish forestry more efficient
- Energy-efficient and sustainable waste water treatment using enzymes
- Innovative recycling technologies make the battery value chain more circular
- Future energy storage with zinc ion batteries.

Sweden is active in innovation projects to make the energy-intensive industry more energy and resource efficient and ultimately free of CO2 emissions. There is a good chance to become a leader in the transition to a sustainable energy system. One example of this is that Swedish projects have been successful in the EU Innovation Fund's calls for proposals. Support from the Energy Agency has contributed to the development of these projects.

Among the **centres** of excellence financed by the Swedish Energy Agency are the Akademiskt-industrial nuclear initiative to achieve a future sustainable energy supply, which started in 2022. The Centre, jointly run by higher education institutions and companies, identifies the conditions for small modular nuclear reactors (SMRs) in Sweden. Research in the Centre is carried out on the one hand in the field of nuclear technology and, on the other hand, in the legislative and regulatory environment, security issues and new uses of SMR technology.

Examples of actions related to **energy systems in society** are the research project *"navigating fair claims – between riot, strikes and status quo*", funded under the Swedish Energy Agency's R & I programme "Thinnia, Energy Systems and Society" (MESAM).

In the building area, one example is the development of a planning basis for the energy renovation of existing multi-dwelling buildings. The project helps building owners to generate multi-annual maintenance plans for their buildings so that they can be optimised and evaluated based on both life-cycle costs and energy and CO2 emissions. In this way, they can plan maintenance and renovation measures according to the company's financial circumstances in order to achieve energy and climate objectives in a more cost-effective manner.

In the field of **transport**, a project developing a digital communication platform has been funded. The system automatically allocates keepers to ships going into port in order to reduce stress for berth. The ships are provided with a guaranteed prepared berth at a certain time, which allows the route to be planned in advance and ships can reduce speed and thus fuel consumption between 5 % and 20 %. The new system will also allow the port to plan its activities better and more efficiently.

In the **field** of bioenergy, one example is the cost-effective and sustainable storage of forest

chips and solid by-products. The result is a method for the cost-effective, sustainable and fire-safe handling of residues from forestry and industry. The effect is to attenuate the degradation of organogenic material leading to lower emissions of climate gases, increased use and value of forest residues and reduced risk of self-ignition in chip eyes.

The Swedish Energy Agency also supports companies in the framework of **business development and commercialisation** programmes. Examples of such projects include Autonoma, electric road freight transport and climate-adapted wooden wind towers.

In addition, several actions are being carried out in collaboration between several public actors. One example is Impact Innovation, which is jointly funded by the Energy Agency, Formas and Vinnova. Five new programmes run jointly by public actors and companies received funding in February 2024. Two programmes are particularly relevant for climate and energy: Net Zero Industry Programme, which aims to accelerate the development of the Swedish manufacturing industry towards net zero emissions, as well as the Metals and Minerals to contribute to sustainable and resilient metal and mineral supply.

Electrically powered aircraft have the potential to contribute to reducing both direct aviation emissions and high height effects mainly on shorter distances, which may be interesting, inter alia, for routes procured by the State for reasons of transport policy. The state supports the development of new innovative solutions in this area in various ways. One example is the Elise project funded by Vinnova, which has resulted, among other things, in the development of an electric aircraft.

4.6.2 Public and, where available, private expenditure on research and innovation in favour of low-carbon technologies, current number of patents and current number of researchers

4.6.2.1 Public and private expenditure

State funding for research and development was estimated at SEK 46.8 billion in 2023. Of this, the funds for the National Energy Research and Innovation Programme in the field of energy amounted to SEK 1.3 billion.405

The breakdown of funds granted under the national energy research and innovation programme (in SEK million) and industry funding, as a percentage of the total funding for 2023-2021, is shown in Table 40.

405Statistics Agency SCB, *Estimated R & D funds and total appropriations in the State budget by spending area. Years 1998-2024*; https://www.statistikdatabasen.scb.se/pxweb/sv/ssd/START__UF__UF0306__UF0306A/SBAUtg/ (data extracted on 15 March 2024).

Table 40 Public and private funding under the National Energy Research and Innovation Programme 2023-2021;

	2021	2022	2023
Swedish Energy Agency	SEK 1 272 million (47 %)	SEK 1 264 million (50 %)	SEK 1 176 million (59 %)
Companies/industry bodies	SEK 1 434 million (53 %)	SEK 1 264 million (50 %)	SEK 817 million (41 %)
Total government and corporate financing	**SEK 2 706 million (100 %)**	**SEK 2 528 million (100 %)**	**SEK 1 993 million (100 %)**

Source: 2023 annual accounts of the Energy Agency

4.6.2.2 Number of patents

The number of energy-related Swedish patent applications in the period 2019-2022 was 893 national and 1 080 international.

4.6.2.3 Number of researchers

In 2023, the number of active doctoral candidates and senior researchers employed in projects funded at least 20 % by

the National Energy Research and Innovation Programme in the field of energy amounted to 1 078, down from 2022. The proportion of women in 2023 was around 35 %.406

4.6.3 Breakdown of the current price components constituting the three main price components (energy, networks and taxes/levies)

The electricity price that a final customer faces consists of three main components: electricity trading price, network charge and tax (energy tax and VAT). The energy tax is paid per kWh and VAT is calculated on the total price of the electricity, the network charge and the energy tax. In the first half of 2023, the average price of a typical apartment customer (1 000-2 500 kWh in use per year) was 339 öre/kWh, see Figure 42. The main share of electricity trading costs was 35 %.

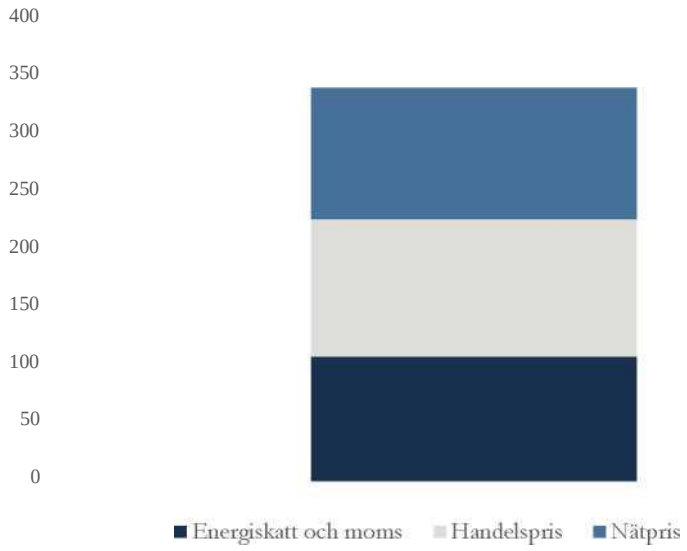


Figure 42. Breakdown of the components of the electricity price for a typical apartment customer (1 000-2 500 kWh in annual consumption) in the first half of 2023.
Source: Central Statistical Office.

2023406 annual report of the Energy Agency.

For a typical villacund (15 000 kWh or more in use per year), the total average cost was 218 öre/kWh for the first half of 2023, see Figure 43. For this group of customers, the largest share (41 %) was the cost of trading in electricity.

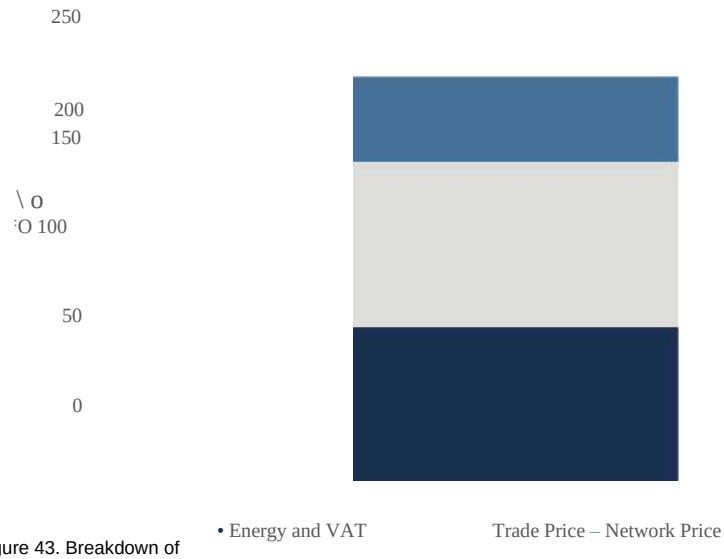


Figure 43. Breakdown of the components of the electricity price for a typical villacund (15 000 kWh or more in annual consumption) in the first half of 2023. Source: Central Statistical Office.

4.6.4 Description of energy subsidies, including for fossil fuels

In the Government's letter Accounting for tax expenditure (SEK. 2023/24407: 98) sets out the sectoral rules contained in the tax legislation and its estimated impact on tax revenue. The tax expenditure is calculated as the tax reduction multiplied by the base (tax base) according to the non-tax method. The amount of the tax reduction results from the comparator applied to each tax expense. The comparator used in the calculation of tax expenditure is essentially based on the principle of uniform taxation.

In this context, it should be noted that tax expenditure cannot be equated with support on the expenditure side. Typically, tax expenditure should not be compared between countries in the absence of internationally accepted standards of comparison. For example, a tax rate lower than the comparator in the tax expenditure accounting may be high from an international perspective, so that a tax expenditure is not by definition to be regarded as an aid or a subsidy. For the reasons set out in section 3.1.3.4, it may also be difficult to meaningfully compare tax expenditure over time. The usefulness of relying on the tax expenditure account as a basis for determining the amount of possible energy subsidies in Sweden – and in particular fossil fuel subsidies – is therefore questionable.

407 Government letter 2022/23: 98, *Accounting for tax expenditure in 2023*, https://www.regeringen.se/contentassets/fd3a1 7fe8cfb437c946fdc5fde60aa92/redovisning -av-tax expenditure – 2023-skr.-20222398.pdf (2023).

5 IMPACT ASSESSMENT OF PLANNED INSTRUMENTS AND MEASURES

This chapter describes the impact of planned policies on the energy system and greenhouse gas emissions, as well as socio-economic impacts of adopted policies.

Socio-economic impacts presented in section 5.3 are described with results from the Environmental Medium-Term Economic Model (EMEC). The policies and assumptions modelled in EMEC are broadly consistent with those for the energy system modelling in TIMES-Nordic, which is the baseline scenario described in Chapter 4. Important deviations are briefly described here and closer in section 5.2.

The policies that are assessed as *planned policies* based on the EU definition408 and thus included in the scenarios for planned policies in this chapter are presented in Table 41.

Table 41 Planned policies included in the scenario results described in Chapter 5.

Sector	Instruments	Scenario
Transportation	Strengthened CO2 requirements for heavy-duty road vehicles in the EU. Increased reduction from 2030 % to 45 % and 90 % from 2040 onwards.	Long-term energy scenario with planned instruments

The policy affecting the development of the energy system in the scenario of planned instruments is the EU's strengthened CO2 requirements for heavy-duty road vehicles. The European Commission's proposal of 22 February 2023 strengthens the requirements to cover all categories of road vehicles above 3.5 tonnes. Emissions from new vehicles are proposed to decrease from 2019 levels by 45 % from 2030, 65 % from 2035 and further tightened to 90 % from 2040 onwards.

Model results on the impact of the tightened CO2 requirement on heavy-duty road vehicles on the social economy (section 5.3) are currently not possible, due to the limitations in EMEC for electric heavy-duty transport.

For the socio-economic outcomes, only a scenario of approximative modelling of budgetary efforts is presented in BP24 and the announcement from the Climate Action Plan that Sweden will participate in ETS2 from 2027. This is compared to a scenario without these decisions.

5.1 Impacts of planned policies and measures described in section 3 on energy systems and greenhouse gas emissions

408Planned policies and measures are options under discussion and having a realistic chance of being adopted and implemented after the date of submission of the national plan. Therefore, the projections under section 5.1.1 shall include not only implemented and adopted policies and measures (projections based on existing policies and measures), but also planned policies and measures.

and removals and a comparison with projections based on existing policies and measures (as described in section 4)

5.1.1 Projections of the evolution of energy systems and greenhouse gas emissions and removals and, where relevant, emissions of air pollutants pursuant to Directive (EU) 2016/2284 under the planned policies and measures at least until 10 years after the period covered by the plan (including for the last year of the period covered by the plan), including relevant policies and measures at Union level

5.1.1.1 Energy system

Compared to the baseline scenario, the planned policies scenario implies a slightly lower energy consumption. This is because tightened CO2 requirements for heavy goods vehicles increase the rate of electrification in the transport sector, contributing to energy efficiency compared to the baseline scenario, see Table 42. The table reports final energy consumption from the energy balance, which excludes self-consumption of electricity and heat in the energy sector, transmission losses and international flights. This differs from reported final energy consumption in 4.2.2.2, which follows the calculation methodology in the Renewable Energy Directive and 4.3.3 which reports energy consumption in accordance with the Energy Efficiency Directive.

Table 42 Energy use by sector in the baseline and projected policies and measures scenario (in brackets) 2040-2025, TWh.

	2025	**2030**	**2035**	**2040**
Final energy consumption	375 (375)	393 (393)	411 (410)	426 (424)
Industry	146	178,7	209	231
Housing and services	145	139,3	138	139
Transportation	84 (84)	74,9 (74,5)	64 (63)	55 (53)

Energy consumption decreases by 1 TWh by 2035 and 2 TWh by 2040 compared to the baseline scenario. The lower energy consumption in the transport sector has a corresponding impact in total final energy consumption.

In the energy scenario with planned instruments, the share of renewable energy in the transport sector increases from 81 % to 82 % in 2035 compared to the baseline and rises to 74 % compared to 72 % in 2040, see Table 43. Other sectors of the energy system are affected to a very limited extent.

Table 43 Share of renewable energy in 2022, shares in baseline scenario and scenario with planned instruments (in brackets) and share with and without nuclear power in 2030. 2025-2040. %.

	2022	2025	2030	2035	2040

Total share of renewable	66 %	64 % *(64 %)*	67 % *(67 %)*	73 % *(73 %)*	76 % (76 %)
Including nuclear enerav 2030			80 % *(80 %)*		
Electricity	83 %	86 % *(86 %)*	81 % *(81 %)*	82 % *(81 %)*	79 % *(79 %)*
Transportation409	29 %	33 % *(33 %)*	46 % *(46 %)*	61 % *(62 %)*	72 % (74 %)
Heating and cooling	69 %	72 % (72 %)	79 % (79 %)	85 % (85 %)	88 % (88 %)

The emission reduction according to the estimated calculation methodology for new targets in the Third Renewables Directive increases from 54 % in the baseline to 56 % in 2 040 in the scenario of the tightened CO2 requirements for heavy-duty road vehicles.

The tightening of CO2 requirements leads to an increase in the use of electricity in transport. For heavy goods vehicles, electricity consumption increases from 0.64 TWh to 0.76 TWh in 2030 with the tightened carbon dioxide requirement. Increase by 2040

409The share of renewable in the transport sector includes double counting of certain fuels as calculated in the Renewable Energy Directive.

the electricity consumption of heavy goods vehicles to 3.25 TWh in the planned policy scenario compared to 2.16 TWh in the baseline scenario, see Figure 44.

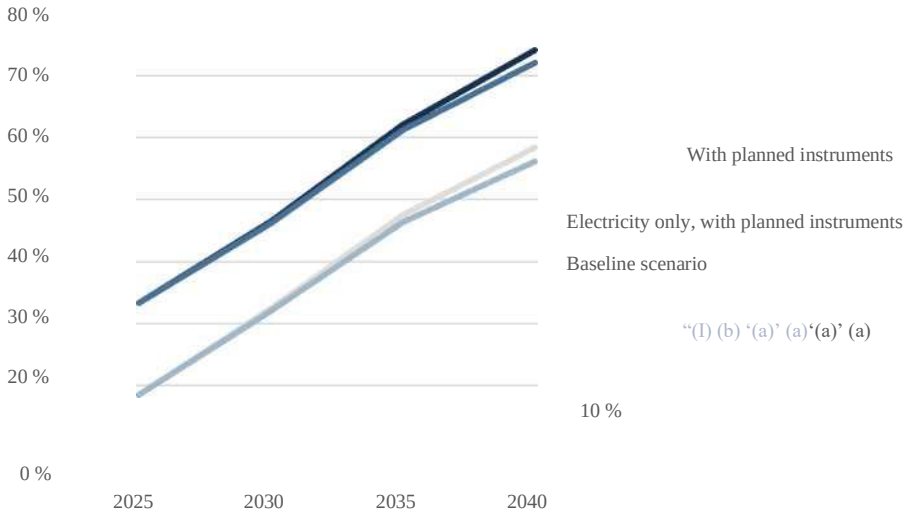


Figure 44 Share of renewable energy in the transport sector. In the Bass-scenario total and separately with only electricity use and planned policies in total and separately with pure electricity use, 2025-2040 %.

Total electricity consumption increases by 2 TWh by 2040 with planned policies compared to the baseline scenario. From 282 TWh to 284 TWh. The distribution of electricity generation by type of production is not affected as the resulting electricity demand is imported into the model.

5.1.1.2 GHG emissions

According to the baseline scenario and sensitivity cases with adopted policies, total emissions are projected to decrease to 38,1-39.2 million tonnes of carbon dioxide equivalent in 2030, depending on alternatives. See Section 4.2.1.2. In the scenario of planned policies, which includes the upcoming EU CO2 requirements for heavy-duty vehicles, emissions decrease by an additional 0.1 million tonnes in 2030. The carbon emissions requirements require a 45 % reduction in carbon dioxide emissions by 2030 compared to the reference period 2019-2020, and the requirements are then extended to 90 % in 2040. In 2040, the reduction in emissions will be a further 0.6 million tonnes compared to the scenarios of adopted instruments.

5.1.2 Assessment of interactions between policies (between existing and planned policies and measures within a policy dimension and between existing and planned policies and measures of different dimensions) at least until the last year of the period covered by the plan, in particular to provide a good understanding of the impact of

energy efficiency and saving measures on the size of the energy system and to reduce the risk of unnecessary investments in energy supply

The EU's tightened CO2 requirements for heavy transport increases the electrification rate in the transport sector in the scenario of planned policies. Higher electrification assumes that the charging infrastructure for heavy-duty road vehicles is deployed at a higher rate. In order to allow for the rapid deployment of charging infrastructure, the Climate Leap aid has been reinforced to a total allocation of SEK 4.9 billion in 2024, of which SEK 500 million is specifically dedicated to investments in charging infrastructure. This includes non-public charging stations such as depot charging. A related issue is that the deployment of public charging infrastructure, and in particular power charging such as depot charging for electric trucks, is limited by long lead times and uncertainty about the connection of charging infrastructure to the grid. Information on where and when there is sufficient capacity in the electricity grid is considered insufficient.410 The Swedish Government has therefore set up an inquiry to propose measures on how lead times can be shortened.

In addition, for the public recharging of heavy-duty vehicles, the regional electrification pilots programme is available. The Swedish Energy Agency has granted aid for the deployment of 139 charging stations which are planned to be operational by 2024. Additional funds will be launched in 2024.

The EU's tightened CO2 requirements for heavy-duty road vehicles are helping to reinforce an existing efficiency trend in transport. Existing CO2 and energy taxes on fuels create incentives for energy efficiency, energy saving and electrification in transport. The strengthened carbon requirement at EU level reinforces that trend and leads to lower energy consumption as well as lower greenhouse gas emissions in the scenario of planned policies described in the previous section.

5.1.3 Assessment of interactions between existing and planned national policies and measures, and between those policies and measures and Union policy measures in the field of climate and energy

The interaction between national and EU policies and measures is highly relevant and needs to be taken into account in order to maintain the effectiveness of national policies.

As governance at EU level has increased and become increasingly ambitious, the role of national policies is changing. More focus is placed at national level on the introduction of policies and measures aimed at creating the right conditions for the transition. The focus

410Energy Market Inspectorate, *Shorter lead times for connecting new recharging points to the electricity grid,* Ei R2022: 08.

within the EU will be on developing policies to achieve the climate neutrality objective as well as the national net-zero target in a cost-effective way.

The scenarios presented in section 4.2.1.2 show that Sweden, with adopted policies, is estimated to have emissions of just over 20 million tonnes, excluding accompanying measures, in 2045. The gap to net zero, using the maximum amount of authorised accompanying measures, is around 11 million tonnes. The remaining emissions consist of emissions from industry, electricity and district heating, transport, work machinery and agriculture. Significantly reducing greenhouse gas emissions from agriculture in a cost-effective and competitively neutral way is more difficult than in other sectors. The current assessment is therefore that residual emissions from the agricultural sector need to be compensated by the use of accompanying measures and that it is above all the remaining sectors whose emissions need to be reduced in order to reach the net-zero target. By reaching its national net zero target by 2045, Sweden is contributing to the achievement of the EU's 2050 climate neutrality objective.

Emissions from industry, electricity and district heating, transport and work machinery are covered by one of the two EU ETS, EU ETS1 and ETS2 as of 2027. The way in which these systems continue to evolve in the EU after 2030 is of great importance for Sweden to reach its climate targets. When overall policies are in place for cost-effective emission reductions in all emission sectors, climate policy will increasingly focus on how to create a socially efficient structural change in the context of an increasingly shrinking emission space, with increased or maintained prosperity.

An example where national enabling instruments play an important role is in the implementation of new technologies. The EU has an ambitious target of achieving net-zero emissions by 2050, which will require the application of carbon capture and storage (CCS and BECCS) technologies to meet. The use of CCS is encouraged by the EU ETS providing an incentive to introduce cost-effective measures to reduce greenhouse gas emissions in CHP installations, process and base industries. Companies covered by the EU ETS do not have to pay for fossil CO2 emissions captured and stored permanently. However, the price of allowances is not always deemed to achieve a level that provides sufficient incentives to invest in CCS technology.411 There is no incentive for BECCS. Furthermore, there is a great potential for the further development of CCS technologies that can lead to lower carbon capture costs. By supporting the development of new technologies at an early stage with national funds, Sweden contributes to the further development of the technology and that the climate neutrality objective can become a reality. For more information, see section 3.1.1.1.

411 SNS Analysis, *Towards net-zero emissions – how can carbon capture contribute*, https://kth.diva-portal.org/smash/get/diva2:1814284/FULLTEXT01.pdf (2023).

5.2 Macroeconomic and, to the extent possible, health, environment, education, skills and social impacts, including with regard to the just transition (in terms of costs and benefits and cost-effectiveness) of the planned policies and measures addressed in section 3, at least until the last year of the period covered by the plan, including comparison with projections based on existing policies and measures

This section describes the socio-economic, health, environmental, educational and skills impacts of adopted and planned climate and energy policies and measures. First, the methodology used to estimate socio-economic impacts is presented. The methodology is followed by a description of the macroeconomic impact of the method of introducing the EU ETS 2 in Sweden. It then presents the distributional economic effects of the method of policy decisions. Finally, it outlines the educational, skills and health and environmental impacts of the energy transition.

5.2.1 Socio-economic impact

5.2.1.1 Method

Macroeconomic and socio-economic impacts of climate and energy policies and measures have been estimated using the Environmental Medium Term Economic Model (EMEC). EMEC, like other computable general equilibrum models, is suitable for studying the impact of industrial change and economic growth on major changes in the environment or policy. One of the advantages of the model is that it captures the interaction between different parts of the economy and the results reported is consistent with the economics of general economic equilibrium and412 the Swedish national and environmental accounts.

In EMEC, the Swedish economy is divided into 34 economic sectors and one public sector. Each industry/sector requires goods and services as well as labour, fixed capital, energy and materials as input factors in their output. Companies are expected to minimise their costs to reach a certain level of production. Households are divided into six household groups according to income (above/below median income) and place of residence (rural, urban or metropolitan).413 Households demand goods, services and leisure for private consumption and are assumed to take their decisions to maximise their benefits given prices and income. The model deals mainly with exogenous treatment abroad. The trade balance (exports minus imports) is assumed to be given in the long term and world market prices are exogenous.

412This means that for all products, services and production factors, the Council has a balance where supply corresponds to demand, and that all economic activities show zero and income balance. Zero profit is a microtheory concept that describes the performance in which the minimum rate of return required by companies on capital is met. This does not mean that companies go plus minus zero in terms of recorded results. Minimum rates of return are in turn determined by the opportunity cost of the same capital.

413 EMEC is based on SKR's municipal group division from 2017. See Swedish Association of Local Authorities and Regions*, Local Government Division 2017 – Recast of Swedish municipalities and county councils,* https://skr.se/download/18.2f6c078f1840e44be6faffc/1666797822526/7585-455- 7.pdf (2016).

The base year in the EMEC is based on the national and environmental accounts for 2019, which are assumed to reflect the latest available year when the Swedish economy was in balance. All prices are expressed as constant prices at the 2019 general price level. The reference scenario should reflect a possible evolution of the Swedish economy given certain assumptions concerning, inter alia, productivity developments (including energy efficiency), labour supply and developments in the world.414 In addition, the baseline scenario contains a series of assumptions around energy and environment policy – the base year's policy remains firm and policy changes already agreed are being implemented.415 In order to analyse the macroeconomic and socio-economic impacts of adopted policies, the outcomes in a comparative scenario are compared to the baseline scenario. The scenarios are presented in more detail in Table 44.

Table 44 Description of model scenarios.

Model scenarios
***Baseline scenario* (S1)**
Essentially the same assumptions as in the energy system baseline scenario
ETS 2 is not introduced in this scenario
Energy and CO2 taxes with fixed tax rates and indexation of CPI and GDP
Reduction obligation with fixed incorporation levels (constant 6 % reduction obligation level from 2024 to 2050)
Introduction of an exogenous "cross-subsidisation" to reflect how the EU CO2 requirements drive faster growth of the share of electric cars in new car sales
Introduction of CBAM
***Comparison scenario with policy decisions* (*S2*): S1 + EU ETS 2 and approximative modelling of budgetary efforts for Climate Leap and Industrial Leap**
Introduction of EU ETS 2 from 2027 to 2050, with a price cap of EUR 45 per tonne416
Approximative modelling of budgetary efforts for climate and industrial life in BP24

The new emissions trading system is a policy decided at EU level and will be implemented in Sweden from 2027 and therefore appears to be a relevant and reasonable comparator.

The EU ETS 2 is a separate trading system from the EU ETS (also known as ETS 1), with its own cap and allowances. The EU ETS rules have been adopted and the Swedish law and the Ordinance are scheduled to enter into force in November 2024. Emissions trading starts in 2027. ETS 2 includes carbon dioxide emissions from the combustion of fuels from road

414Energy consumption in EMEC is broadly consistent with the assumptions made in the Energy Agency's scenarios for the energy system. There is a discrepancy in the fact that EMEC does not model the production of sponges of iron for export. This leads to lower electricity consumption and somewhat lower electricity prices than in energy scenarios. However, the model allows production of fossil-free steel from 2030.
415 Institute of Economic *Affairs, Working paper 156: The Environmental Medium-Term Economic (EMEC) Model: Version 4,* https://www.konj.se/download/18.1103032187eb22f7b5a19c9/1684222962438/Working%20paper%20156%20The% 20Environmental% 20Medium-Term% 20Economic% 20 (EMEC)% 20Model.pdf (2023).
416ETS 2 is modelled as a price premium on carbon emissions, specifically from the sectors covered by the scheme (e.g. transport). The assumption of a price cap of EUR 45 is based on how the system is regulated under Article 30(h) of the ETS Directive. In constant prices at the 2019 general price level.

transport, residential and commercial or public premises. ETS 2 also covers emissions from the combustion of fuels in those parts of the energy, manufacturing and construction industry that are not already included in ETS 1. Member States have the possibility to include additional sectors in ETS 2. Sweden intends to further include incineration in the following sectors: fishing, agriculture, forestry and aquaculture, rail transport and working machinery in ports and airports. With the introduction of ETS 2, a so-called Social Climate Fund (SKF) is established, partly financed from the ETS 2 revenues and whose funds can be used to support vulnerable households.

5.2.1.2 Macroeconomic impact of adopted instruments

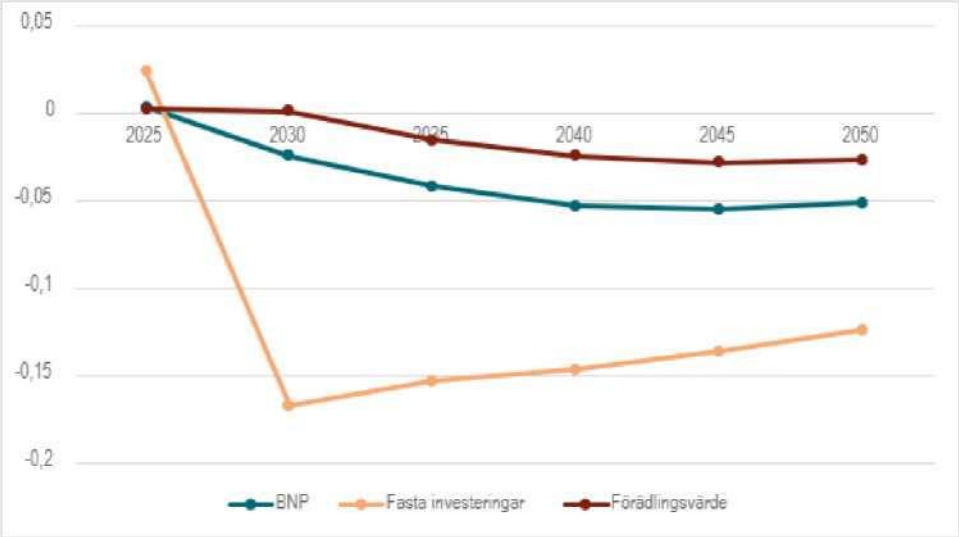


Figure 45 Percentage change in GDP, value added and fixed investment between the baseline and the comparison scenario S2, expressed in constant prices (2019 general price level).
Source: Institute of Economic Affairs (calculations with EMEC).

Figure 45 shows the percentage difference in GDP, value added and fixed investment in 2025-2050 between the reference and the comparison scenario S2.
The introduction of an ETS targeted at the ESR sector has a limited impact on macroeconomic indicators such as GDP in the model. Fixed investment is decreasing slightly more, but the difference remains marginal. As the price cap of EUR 45 per tonne is maintained throughout the period, the trading system has a small but relatively constant effect on the indicators until 2050. 417

The assumption of a constant ETS 2 allowance price is simplified but has been made in the absence of a specified ETS 2 price trajectory after 2030.
The European Commission has since communicated that ETS 2 prices can be expected to

At the time of modelling, the417 European Commission had not indicated a price trajectory for the ETS in 2, with the result that the price cap of EUR 45 is assumed to last for the period.

follow ETS 1 shadow prices. The impact on the macro economy described in this section is therefore likely to be underestimated, given that actual ETS 2 emission allowance prices are likely to be higher than EUR 45 per tonne after 2030.

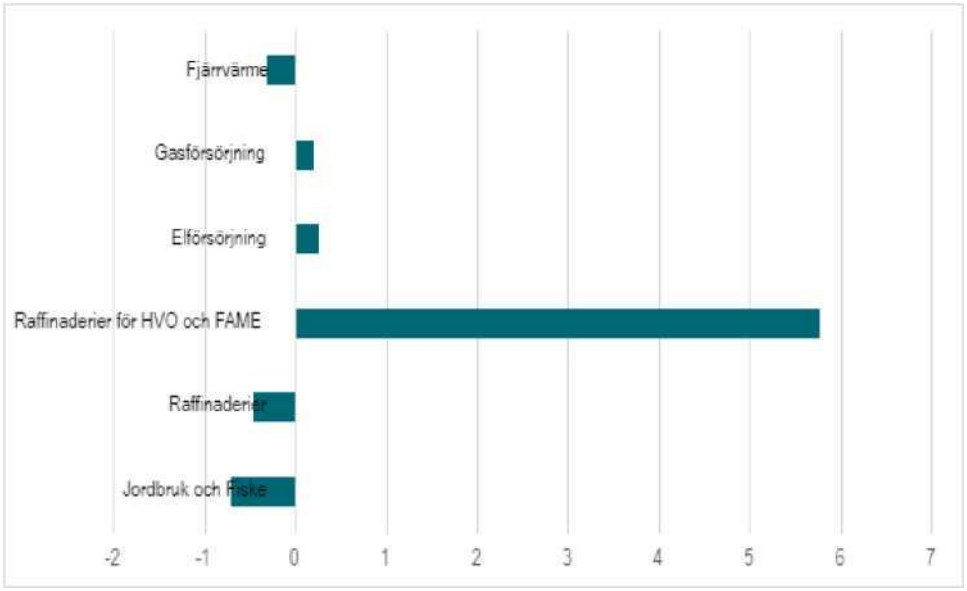


Figure 46 Percentage change in Swedish gross output in 2 030 in industries negatively and positively affected compared to the reference S1 scenario, expressed in constant prices (201 9 general price level). The figure only contains the result for those industries affected by more than ± 0.2 % in 2030.
Source: Institute of Economic Affairs (calculations with EMEC).

Figure 46 shows an increase of just under six% of the production of the biofuel refineries compared to the baseline. The EU ETS 2 provides a price premium on the fossil content of fuels, which provides an incentive for substitution against biofuels such as HVO and FAME. It contributes to a higher demand for these products for transport.
Results linked to biofuels are sensitive to a model-specific assumption in EMEC that sellers of transport services cannot substitute for heavy electric vehicles. The lack of representation of electric trucks in the model can contribute to a higher use of biofuels and production in these sectors than would otherwise have been the case.

As some agricultural and fisheries inputs are fossil, such as agricultural diesel, the introduction of the EU ETS 2 means that the model leads to a reduction in production in the sector, all else being equal. With the increase in fuel prices as a result of the introduction of the ETS in 2, households are confronted with increased fuel costs, which is a significant item for lower-income households living outside large cities and dependent on cars. In order to adapt to the increase in fuel costs, households are forced to reprioritise their consumption, which means that households that spend a higher share of income on fuel purchases reduce spending on other goods and services.

Distributional effects of adopted policies

Figure 47 shows the percentage change in household benefits in 2030 resulting from the introduction of EU ETS 2 (S2 scenario) where ETS 2 is introduced from 2027. Changes in household benefits are relatively small and similar. However, one trend is that households in the more sparsely populated categories of intermediate cities (B) and rural areas (C) experience a greater decline in welfare compared to households in metropolitan areas (A). Households with an income below the median (low in the figure) see a greater decline in welfare in the scenarios than higher income households. The EU ETS 2 thus has a regressive effect in terms of benefit level. The introduction of ETS 2 leads in the scenarios to approximately eight% higher prices of low-blended petrol and diesel compared to the baseline in 2030.

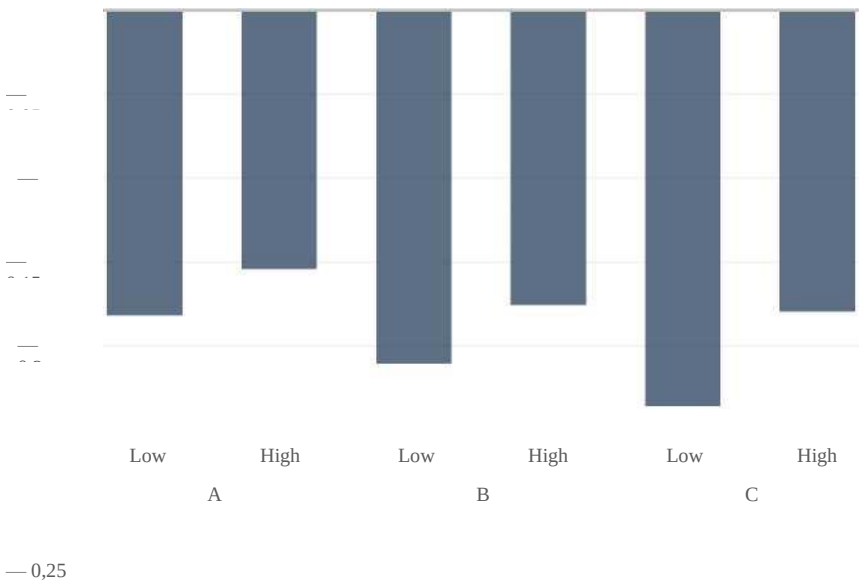


Figure 47. Percentage difference in household benefits for 2030 relative scenario Defined policy (S2) + EU-ETS 2.

Note:
A = metropolitan areas, B = medium cities, C = smaller/rural, Low = below median income, High = above median income. Scenario Relevant Policy (S2) + EU-ETS 2 entails the introduction of ETS 2 from 2027 to 2050, with a constant price of EUR 45 per tonne, without annual reallocation of revenues from the Social Climate Fund to GLES1 household groups and mid-1.
Source: Institute of Economic Affairs (calculations with EMEC).

Note that the relatively small differences are partly explained by the fact that EMEC does not differentiate between households that have a car and do not have a car, and that the model represents only two income groups. The negative impact on household benefits can therefore be assumed to be higher for car-borne households whose consumption is more affected by rising fuel prices, and households with lower incomes than the model represents. Taking into account that heterogeneous effects are hidden by the model's household aggregation, as well as other uncertainties, the focus should be on the direction and relationship between scenarios rather than specific benefit levels.

With the introduction of ETS 2, the so-called Social Climate Fund (SKF) is established and will enter into force on 1 January 2026, one year before the start of the trading scheme, and remains in force until 2032. Resources from the Fund shall be used to support financially vulnerable households, small businesses and transport buyers by financing measures and investments that mitigate the impact of the fossil fuel price increases expected to result from the new trading system, decarbonise and provide improved access to zero-emission mobility and transport.

Examples of measures that can be financed by the Fund include support for zero-emission vehicles, affordable and accessible public transport and energy efficiency measures in

buildings. A smaller part of the Fund's resources can also be used, in combination with the above measures, for temporary direct income support that reduces the impact of price increases.

5.2.1.3 The impact of the energy and climate transition on education and skills provision

The transformation of the energy system requires new sustainable energy production, policy and regulatory development and infrastructure investments. A key element of this challenge is to address the issue of skills supply so that skills shortages do not become an obstacle to electrification. The Government has tasked the Swedish Energy Agency with coordinating a national pool of power on skills supply for electrification. In 2023, the Energy Agency presented an interim report418 focusing on short-term skills needs in electrification. The report forms the basis for further work within the mission and is based on a compilation of existing knowledge and interviews and provides a snapshot of the expected employment effects of electrification in a shorter time horizon. The main conclusions of the report are:

- The electrification of society concerns a wide range of occupations and skills.
- Whereas the lack of gender structure with few women complicates the supply of skills;
- Electrification affects industries differently and generates different skills needs.
- Additional skills needs arise downstream from planned investments.
- Several identified shortage occupations can lead to bottlenecks for the electrification of society.
- Increased demand for both traditional and new skills profiles.
- Lack of attractiveness and low examination rates of relevant educational pathways for multiple shortage occupations.
- Larger employers usually find, recruit and train labour more easily than smaller employers.
- Strong competition for labour between sectors affects the conditions for successful electrification.

The report further shows that electrification in a range of major industrial efforts, electricity generation, infrastructure and support services generates different skills needs and employment effects.

The employment effects on wind power arise mainly when a wind farm is set up, but also during operation, maintenance and development. Offshore wind can create partially new skills needs linking to ports, specialised infrastructure and large operational organisations. Solar power requires initial work for the installation of photovoltaic cells and the employment effects arise mainly from the establishment of new photovoltaic installations or

418Swedish Energy Agency, *Skills supply for electrification,* ER 2023: 21.

parks. The effects on employment in nuclear and hydropower are considered to be less significant in the short term but need to be addressed from a longer term perspective in further investigation work. The electricity grid faces major upgrading and deployment needs and skills needs are high at all levels.

The iron and steel industry is facing a major transformation in which processes will be electrified. In order to build, operate and develop the activities currently envisaged, labour needs are extensive and permanent. The battery industry is characterised by the rapidly evolving battery value chain and its production capacity is being expanded and requires a wealth of skills. The demand for specialised technical knowledge and skills is increasing in the automotive sector, which is one of the key sectors of electrification.

Licensing and analysis authorities play an important role in the creation and development of electricity grids, power types and industrial installations.
Skills shortages and increased workload at this stage risk creating bottlenecks in the permitting process.

Figure 48 shows 35 shortage occupations that are particularly important for electrification that the analysis has identified. Whereas several of the shortage occupations are characterised by a high average age and a large gender gap, with a majority of men already working in the profession; A large number of trainings and pathways are linked to the identified shortages. In terms of number of employees, the highest number of people with upper secondary/vocational education is needed. At upper secondary level, vocational education and training in electricity, energy and industrial technologies are most relevant to shortages. At higher VET level, there are a large number of relevant training courses for shortages, but these are today characterised by a low number of applicants and a low level of examination. At post-secondary level, civil and tertiary engineering are the most relevant for work in:

electrification and again the examination rate is low. There are also informal training courses organised or funded entirely by the employers themselves.[419].

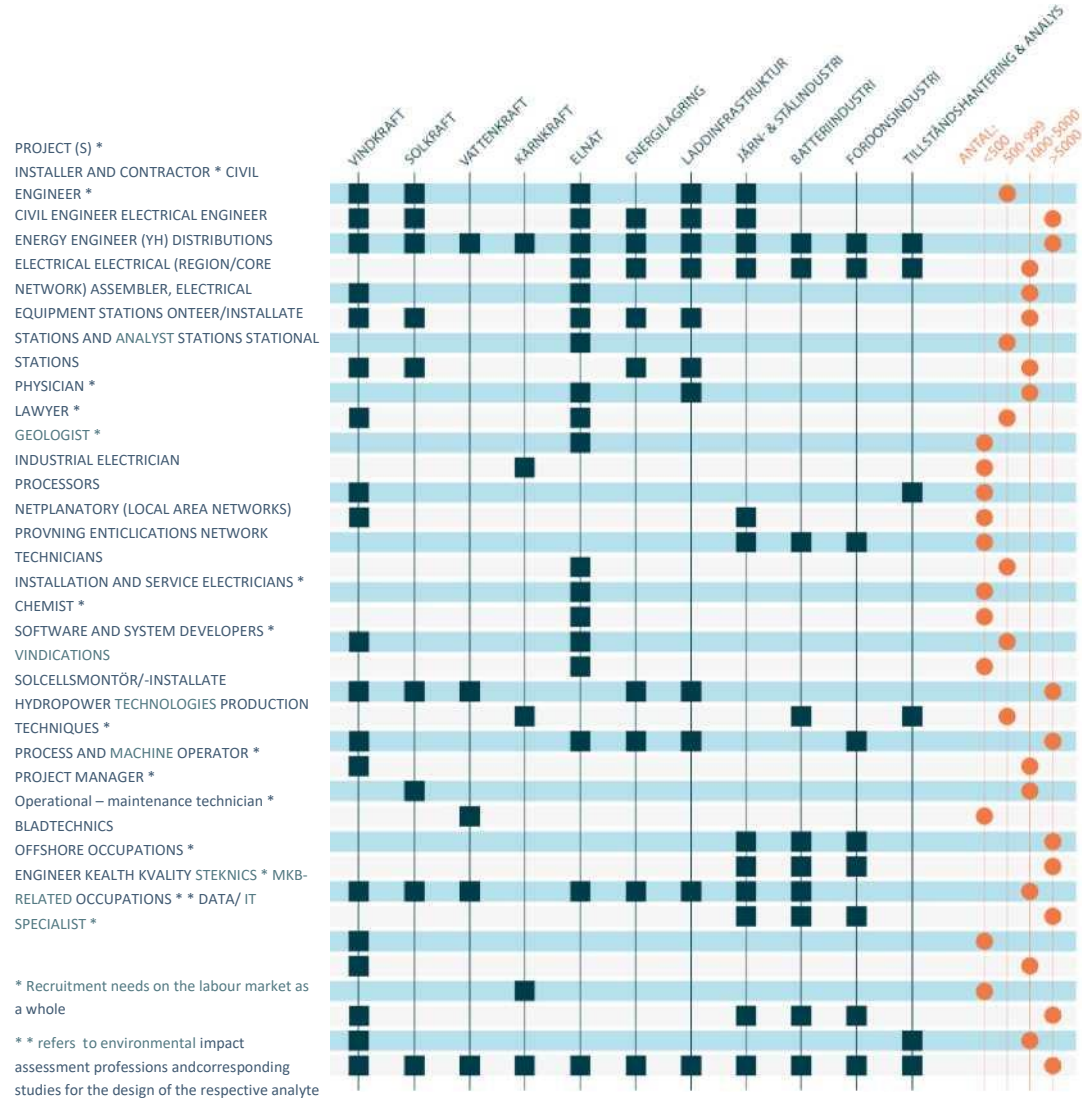


Figure 48 Summary of shortage occupations per analyte. Source: Skills supply for electrification, ER 2023: 21.

The availability of a workforce with the right skills is an important prerequisite for the implementation of climate policy. The green transition is a structural change in large parts of the Swedish economy. The transition is transforming Swedish industry through new

[419] Ibid.

processes, technologies and skills needs, especially in the case of large business start-ups and

expansion. It requires engineers, researchers, installers and operational staff with expertise in new technologies and industrial areas, as well as improved digital skills for technology development and more sustainable processes. It is important to develop these skills throughout the labour market, including the private and public sectors, in manufacturing, transport, construction, etc.

Regional skills provision work and cooperation between authorities for skills provision

Since 2022, under the Regional Development Responsibility Act (2010: 630), it has been the task of the municipalities of Gotland and the municipalities of Gotland to set targets and priorities for the provision of regional skills. Regions play a key role in strategically supporting skills development in both the private and public sectors at regional level. This includes assessing current and future skills needs in the regions through active dialogue with employers and industry representatives from both the private and public sectors. Regions also organise employer dialogues and create forums to discuss current and future skills needs. These assessments serve as a basis for dialogue with education and training providers throughout the education and training chain, from primary to higher education, to ensure that education and training meets the needs of the labour market.419

Cooperation between authorities on skills provision also plays an important role in establishing joint administrative structures to work on the issue of skills.420 The National Agency for Higher Vocational Education (MYh) is responsible for the administrative coordination of cooperation between authorities for the proper provision of skills. Within the framework of cooperation, there are seven working groups, including the group for Northern Sweden. The group is dedicated to raising awareness among participating authorities about each other's skills supply efforts that support sustainable development and the green transition in northern Sweden. By identifying and exploiting synergies, the group aims to initiate and strengthen cooperation between authorities in the region. In addition, the Group seeks to increase the potential of ideas, skills and networks that can accelerate development and economic growth.

Validation

Validation is a key component of skills provision, where individuals' knowledge is

419 Swedish Association of Local Authorities and Regions, Enterprise Skills Supply https://skr.se/skr/naringslivarbetedigitalisering/naringslivforetagsklimat/naringslivetskompetensforsorjning.183 6.html (2023).

420In 2022, the administrative cooperation on skills provision and lifelong learning that had previously been formalised on the self-initiated basis of the Swedish Agency for Higher Vocational Education (MYh). This was because the PES, the Swedish Agency for Vocational Education and Training, the Swedish National Board of Education, the Swedish ESF Council, the Swedish Agency for Economic and Regional Growth, the University Chancellery and the Council for Higher Education were tasked by the Government to cooperate with a view to contributing to a well-functioning supply of skills. Source: Authority for Higher Vocational Education, Report 2023: Reporting back on government assignments on administrative coordination of cooperation between authorities for a well-functioning supply of skills; https://assets.myh.se/docs/publikationer/aterrapporteringar/aterrapportering-av-regeringsuppdrag-om- administrative-coordination – Own-for-en-val-functioning- competencyforsorjning.pdf (2023).

systematically assessed, regardless of how, where or when this knowledge was acquired. Validation takes place within the Comvux and the College of Vocational Education, as well as in higher education, as well as through sector-specific validation processes. Under the Validation Ordinance (2022: 1549), MYh is responsible for monitoring, supporting and coordinating validation work at both national and regional level, in education and employment. Within the framework of inter-agency cooperation, the Validation Group is one of seven working groups working on promoting the use and development of validation in education and the world of work. The group disseminates information and knowledge on validation issues through seminars, joint publications and supporting materials.421

STEM strategy

The Government intends to develop a so called. STEM (science, technology, engineering and mathematics) approach spanning the whole education system from early childhood education to post-graduate education and research. In early 2024, the government has invited various stakeholders to a roundtable to receive input and proposals for the upcoming STEM strategy, which will be presented by the end of 2024.422

Further expansion of the number of training places in adult vocational education and vocational education and training institutions

In order to address the continuing high skills needs, enable transition and promote labour market matching, the government has increased the number of training places in adult vocational education and training.

University of Vocational Education. In the Budget Bill for 2024, SEK 1 362 million is added to strengthen regional vocational head and SEK 385 million is added for higher vocational education for 2024. According to MYh, more than 40 000 new training places have been awarded in 477 training courses, of which 124 were awarded in the field of Technology and Manufacturing in 2024.423

Mission to the Swedish National Agency for the University of Vocational Education on Swedish competitiveness and the energy and climate transition

The Government has tasked the Authority for Higher Vocational Education with analysing and reporting on how the training offer of the University of Vocational Education may need to be adapted in the longer term in view of the energy and climate transition in relation to the future skills needs of the labour market and Swedish competitiveness. The authority shall also report on the contribution of the vocational college's education to the climate transition.

421 Authority for Higher Vocational Education, Administrative Cooperation for Skills, https://www.myh.se/om- We /cooperation and cooperation projects/authorities' cooperation (2024).
422 Government, *Roundtable on the government's STEM strategy,* https://www.regeringen.se/pressmeddelanden/2024/02/rundabordssamtal-om-regeringens-stem-strategi/ (2024).
423 Government, Historian *expansion of the University of Vocational Education,* https://www.regeringen.se/pressmeddelanden/2024/01/historisk-utbyggnad-av-yrkeshogskolan/ (2024).

In particular, the Authority shall take into account how the mission could focus on more educated staff in the area of growth enhancing STEM. The report should be presented no later than 6 September 2024.424

More investment in technical training

In order to meet the skills needs resulting from the green and digital transformation of industry, as well as the large business start-ups and expansions underway in Sweden, the Government, with the Budget Bill for 2024, has made various efforts in education and research to strengthen the engineering country Sweden and to meet the high skills needs. In 2024, SEK 62 million was added, including study finance, for the permanent expansion of civil engineering and advanced training at Uppsala University, Lund University and Chalmers University of Technology, Aktiebolag. In addition, there are efforts to develop advanced level training to meet skills needs in fast-growing technology areas such as battery technology and electrification.425

Strengthening mid-career transition opportunities

The green transition also requires the transformation of skills in the existing workforce. The high needs for skills mean that the transition and further education opportunities in higher education institutions also need to be improved. To facilitate transition through education in the middle of the world of work, a new outplacement grant was introduced as of 2022. All courses in Sweden giving entitlement to study finance also give entitlement to outplacement aid. This can be, for example, courses at higher vocational schools, universities, comvus and folk colleges. The most demanded training measures are training courses and further training courses for professionals at higher education level, as well as short courses with training places at higher VET level. The support may be provided for training which is likely to strengthen the future position of the individual in the labour market taking into account labour market needs. The support will thus address skills shortages in both business and welfare and strengthen Sweden's competitiveness.

In order to improve further training opportunities for professionals with specialist skills, the Government has proposed to invest in short-term training courses for professionals in the Budget Bill for 2024. The initial focus should be on battery, technology and green transition courses.426

In December 2021, the Government tasked the PES with strengthening, developing

424 Government letter 2023/24: 59, *The Government's Climate Action Plan – all the way to net*zero, https://www.regeringen.se/contentassets/990c26a040184c46acc66f89af34437f/232405900webb.pdf (2023).
425 The Government, *the Government is working together to strengthen the engineering country of*Sweden, https://www.regeringen.se/pressmeddelanden/2023/09/regeringen-kraftsamlar-for-att-starka-ingenjorslandet-sverige/(2023).
426 Government letter 2023/24: 59, *The Government's Climate Action Plan – all the way to net*zero, https://www.regeringen.se/contentassets/990c26a040184c46acc66f89af34437f/232405900webb.pdf (2023).

and intensifying its work at national, regional and local level in order to contribute to an improved and more efficient supply of skills in connection with large business start-ups and company expansion, as well as to provide services and support to jobseekers and employers and to affected regions and municipalities.

It should be possible to scale up the working methods and methods that the Agency considers to be successful and contribute to the Agency's work on more effective matching in general. Subsequently, as part of its work, the Public Employment Service has also set up a national coordination function for the provision of skills for large business start-ups and business expansion throughout the country. According to the Employment Agency's memorandum of appropriations for 2023, the authority is to continue to develop its work on skills provision for large business start-ups and company expansion. Since the end of the year, the role of the National EmploymentService for skills provision in large business start-ups and business expansion has been working on ways and methods to improve the efficiency of matching and help meet the recruitment needs arising from large start-ups and expansion. The Public Employment Service's Office for Transformation and Matching is primarily involved in the provision of skills to those municipalities in the counties of Norrbotten and Västerbotten that are currently in the middle of or facing large business start-ups and business expansion in the context of the green transition. The common feature of these municipalities is that industrial efforts are of the rank that it creates a societal transformation in which, according to the PES, the effects and skills shortages extend to the whole of society.

There is a need for a special focus on vocational training in municipal adult education at upper secondary level in the case of business start-ups or company expansion mainly in sparsely populated counties, but secondly also in the case of start-ups or company expansions that are large in a national comparison, or, thirdly, that are large for the municipalities that have or are facing them. The Government is therefore proposing a new State subsidy for this purpose, applicable from 2024.

Other authorities also play an important role in facilitating skills provisionfor large business start-ups and business expansion. The Swedish Agency for Economic and Regional Growth has the task of assisting regions and municipalities in giving notice and reconversion in the business sector, as well as major business start-ups and business expansion. Cooperation between authorities for the provision of skills therefore continues to play an important role.

In order to ensure the supply of skills, attractive housing and habitats need to be developed. When new labour and skills need to be recruited from other places and countries, it is a major challenge for municipalities to quickly plan, build and manage new housing and good habitats. The Government Offices have therefore commissioned an investigator to promote the coordination of state efforts that are conducive to sustainable community building and

rapid population development in the counties of Norrbotten and Västerbotten, in the transformation of society as a result of major business start-ups and company expansion there.427

Cooperation between authorities to attract and retain international competence for business representatives, authorities and regions has highlighted the need for greater coordination of authorities' various processes and efforts to attract and establish internationally required skills and their families. In order to improve the ability of companies to hire and retain foreign labour, the government proposed in the Budget Bill for 2024 to strengthen the coordination of state authorities' processes and work linked to attracting and retaining internationally required skills.428

5.2.1.4 Effects on health and the environment

The achievement of energy and climate policy objectives has both synergies and trade-offs with health and the environment. It mentions only a few of the areas and the potential impacts.

The Swedish Energy Agency's report on the future electrified society summarises the environmental and living effects that electrification can lead to in the following points:429

- Electrification, in particular in the transport and industrial sectors, can lead to significant reductions in greenhouse gas emissions and air pollution resulting from the combustion of fossil fuels. In addition to effects in Sweden, a reduction in the use of fossil fuels can also have positive environmental effects in the countries where fossil fuels are currently extracted.

- The shift from the use of fossil fuels to electricity will have an impact on energy use in the different sectors. In the transport sector, there is a clear effect of electrification where switching to the use of more efficient electric motors reduces energy use in the sector. In the industrial sector, electrification of manufacturing processes and increased use of hydrogen in industry means that energy use increases instead.

- Electrification will increase the need for various metals and minerals for example for the production of batteries, solar cells, wind turbines and electrolysers. Whereas the extraction and enrichment of metals and minerals is a major source of environmental pressure and can have a negative impact on both natural environments and human living conditions, as well as the risk of releasing substances that disturb the environment into soil and water;

- The expansion of the infrastructure that will be required to bring about the electrification of society will lead to increased land claims. Increased land use can

427Ibid.
428Ibid.
429Swedish Energy Agency, *Future electrified society – Analysis for sustainable electrification, ER 2021*: 28.

negatively affect natural, human and landscape environments and create barriers that can affect biodiversity.

In its report on the environmental effects of the electrification of transport, the Environmental Protection Agency states that, overall, increased electrification will generally have positive effects on several Swedish environmental objectives in addition to the climate objective.430 However, there are several exceptions where, instead, target conflicts may arise, which are mainly linked to the establishment of new mining activities. The environmental quality objective 'Good quality groundwater' and 'Live lakes and rivers' are two objectives that may be negatively affected by the increased metal demand for electrification. If this is the case, it depends on the extent to which demand for metals for batteries is satisfied by the expansion of Swedish mining, which in many cases has a local impact on water courses and groundwater. In the same vein, there are risks of significant impacts on the objectives of free environment and rich flora and fauna as a result of mining. At the same time, allowing new mining activities in the mountain world could be adversely affected. By exploiting mining and refining of metals and minerals abroad, the impact on Swedish environmental quality objectives is largely avoided, but overall, it can result in greater environmental and health impacts as the regulation of activities may be more underdeveloped abroad. Sweden's generational objectives in the environmental targets system state that instruments and measures to resolve environmental problems in Sweden must be designed in such a way that Sweden does not export environmental problems. There is a risk that this will be made more difficult if activities such as mining, metal processing and battery manufacturing, which are currently mainly carried out abroad, are allowed and expanded in Sweden.

The Public Health Agency has analysed the impact of climate change on public health and has developed targets and an action plan to adapt its activities to climate change.431 In Sweden, the main risks to public health in terms of both severity and probability are considered to be heatwaves and tick-borne infections. Furthermore, severe health consequences result from mosquite-borne infections and forest fires, even if they are considered to be less likely to occur. Climate change is highly likely to lead to more zero-reviews, more floods and lower drinking water quality. In addition, an increase in water and food borne infections, roagar-borne infections and pollen allergies is expected.

The Authority also points out that achieving energy and climate policy objectives is key to combating climate change and also contributes positively to air quality and thus to improving public health. Several processes causing greenhouse gas emissions also cause emissions of

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The *Environmental430 Protection Agency, Environmental effects of electrification of transport – Report on Government assignment NV-21-09921;* https://www.naturvardsverket.se/4accac/contentassets/3a1f5d541 8b043699cfedd13563f2b2a/account-ru-environmental effect electrification en-transporter.pdf (2023).

Public431 Health Agency, *Public health in a changing climate – Public Health Agency's objectives and action plan on adaptation to climate change* 2024-2021, https://www.folkhalsomyndigheten.se/publikationer-och- material/publications archives/ f/Folkhalsa-i-ett-forandrat-climat/(2021).

other air pollutants, including nitrogen oxides (NO_x), sulphur dioxide (SO_2), small particulate matter ($PM_{2,5}$), ammonia (NH_3) and volatile organic compounds excluding methane (NMVOC). These air pollutants have a negative impact on both the environment and public health. The environment is affected by deterioration of air quality, acidification, eutrophication, plant damage, biodiversity loss, forest damage and climate change.
The effects of air pollution on public health can be significant. Deterioration of air quality can lead to early deaths with diseases affecting the cardiovascular system, respiratory tract and increasing the risk of cancer.432

Figure 49 shows the historical evolution of emissions of nitrogen oxides (NO_x), sulphur dioxide (SO_2), small particulate matter ($PM_{2,5}$), ammonia (NH_3) and volatile organic compounds excluding methane (NMVOC) up to 2021. The figure shows that Sweden has made significant progress in reducing air pollution since 2005.

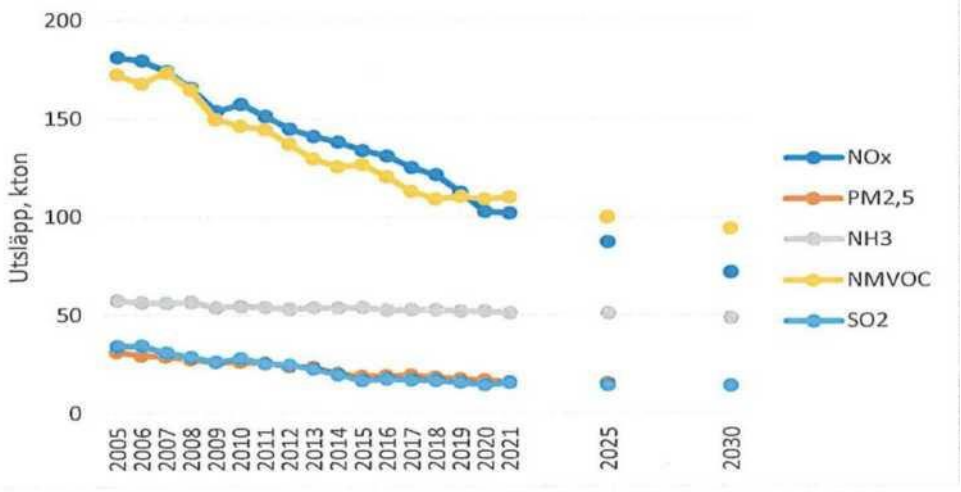

Figure 49 Scenario for emissions of different air pollutants from 2005 to 2030.
Source: Sweden's revised air pollution control programme in 2024.

In February 2024, the Government established Sweden's second, revised, national air pollution control programme.433 The aim of the programme is to report on how Sweden will meet its commitments to reduce certain atmospheric pollutants in order to meet its commitments under the Cap Directive. At the same time, it will contribute to improving air quality at local level and reduce negative impacts on biodiversity and its ecosystem services. In addition, the air pollution control programme shall be coordinated with the Swedish climate and energy policy. The areas of action covered in the revised air pollution control programme are essentially the same areas as those concerned in Sweden's first air pollution control programme, i.e. measures to reduce emissions of NO_x and NH_3. In addition to these

432 European Environment Agency, *Harm to human health from air pollution in Europe: Burden of disease 2023,* https://www.eea.europa.eu/publications/harm-to-human-health-from-air-pollution (2023).
433Government, *National Air Management Programme;* https://www.naturvardsverket.se/490939/contentassets/31642c0d64e845d881d7770ee9237815/regeringsbesl ut-2024.pdf (2024).

proposals, the revised Air Pollution Control Programme also presents other policies and measures affecting NO_x and NH_3 emissions from the Budget Bill for 2024 (Government Bill. 2023/24: 1), from Sweden's CAP Strategic Plan and Climate Action Plan.434 For more information on air protection policy, see section 2.1.1.

5.3 Overview of investment needs

5.3.1 existing investment flows and future investment assumptions with respect to planned policies and measures

Investments in electricity generation

The calculation results in this section are based on the baseline scenario presented in Chapter 4.

Investments in the model are calculated through a large number of electricity generation technologies (for example, several different technology classes in wind power). The respective production technologies have been evaluated separately and subsequently grouped into the main groups hydropower, nuclear power, cogeneration (within district heating systems), industrial back pressure, wind power, solar, and condensation production and gas turbines. Only investments in electricity generation are included in the compilation. Any capital costs of existing production facilities, which are not yet depreciated, are not included in the recapitulative statement.

Figure 50 shows new investments in production capacity for each model year. 435

434Ibid.

In fact,435 each model year describes a period of 5 years, i.e. model year 2030 covers, for example, the years 2027,5 to 2032,5. The investments in the figure are thus made over a period of five years and not every year during the respective five-year period. This means, for example, that between 2037,5 and 2042,5 investments amount to around 10 GW of electricity production.

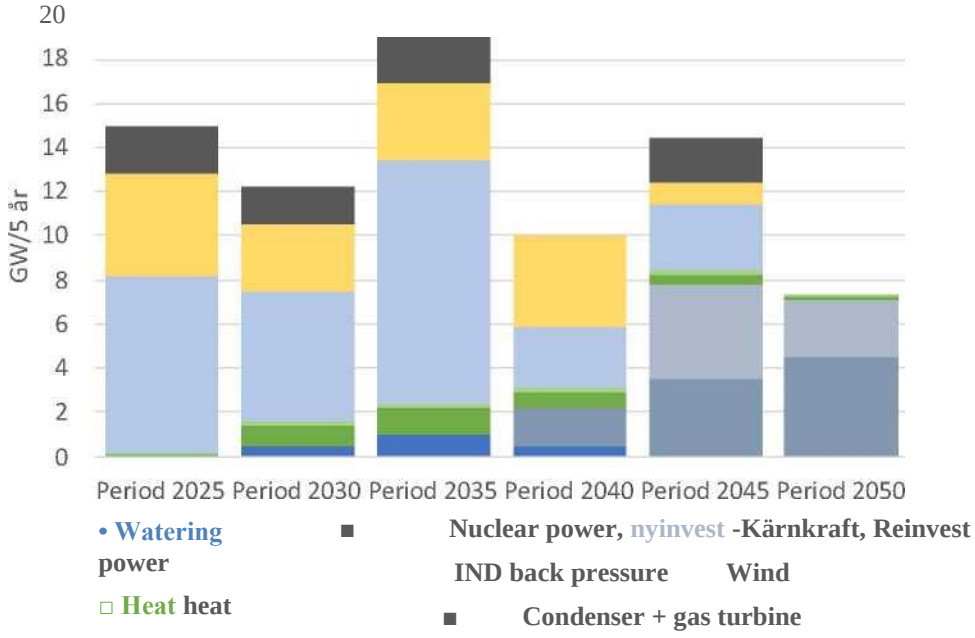

Figure 50 Capacity investments, additional GW per five-year period. Source: The Swedish Energy Agency.

It should be mentioned that investment in capacity does not say anything about the total installed capacity. The sum of new investments over a longer period may exceed the installed capacity. Some of the investments are made to replace previous investments that have fallen in the age line (technical lifetime) and which have different periods of utilisation (that is to say, other energy-to-capacity conditions). Investments in nuclear energy are both initial investments and lifetime extensions, from 35 years of technical lifetime to 60 years. According to the Government's Road Map for New Nuclear Power in Sweden, the objective is to achieve new nuclear power by 2035 with a power of around 2 500 MW, which corresponds to at least two large-scale reactors. By 2045, the objective is to have an effect equivalent to, for example, about ten large-scale reactors.

Figure 51 presents investments in monetary terms. It is assumed that the entire investment is charged to the model year in which the investment is made. This refers to the immediate investment cost, that is to say, the investment costs excluding interest costs during the construction period. As in Figure 50, each model year actually consists of a five-year period. It is during that period that the investment is charged. In order to receive the annual investment in a given year, it is divided by five in the five-year period (model year) within which the year is located.

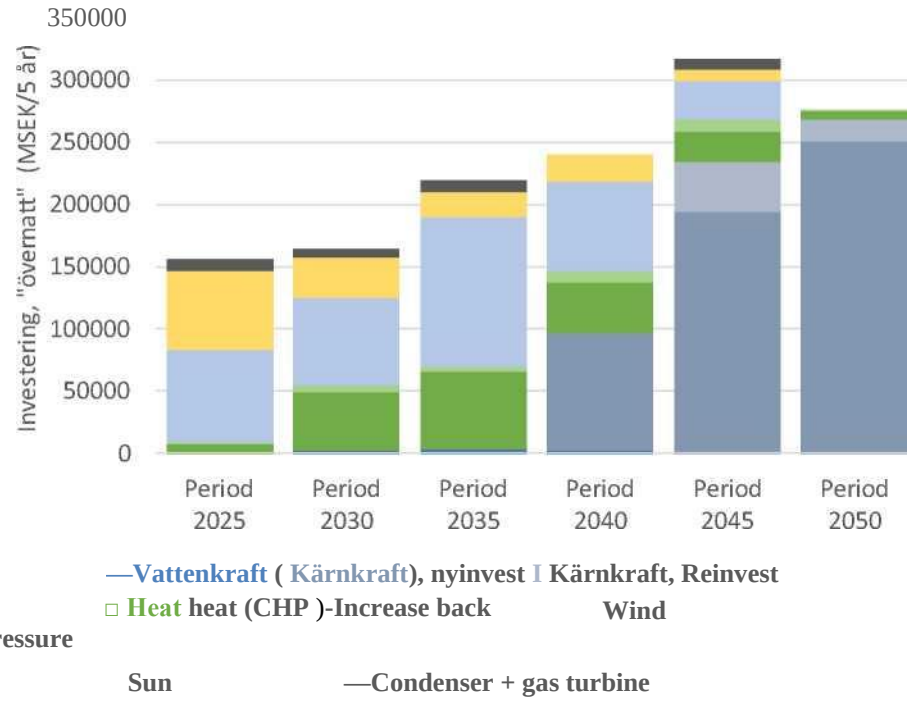

Figure 51 Investments in SEK million per five-year period, charged to the model years (five-year period) in which the investment is made ('overnight' cost).
Source: The Swedish Energy Agency.

Although investments in capacity, expressed in GW, in CHP are smaller than investments in wind power, for example (see Figure 50), the difference in the amount of investment in SEK between wind power and cogeneration is clearly smaller. This is because the entire CHP investment – including that related to the district heating production – is allocated to electricity production. For example, for waste cogeneration, the specific investment cost, per unit of electricity, is very high. If parts of the investment cost are allocated to heat production, which may be reasonable, the cost attributed to electricity generation is obviously less. However, there is no objective unequivocal answer to how such an allocation should be made.

An alternative way of calculating investments is to annualise436 them over the economic lifetime of each investment and given the discount rate of each investment. This is shown in Figure 52, where each individual investment is annualised

An436 annualised cost is an annual cost (payment) which includes an interest expense (based on the discount rate) and an amortisation. This means that the investment is repaid in equal amounts each year (the annual cost) over the economic life of the investment.

and allocated to the respective technology group. In other words, the annualised investment cost is the same as the annual cost of capital. Here it is the single calendar year that applies and not five-year periods as in previous figures. Excludes the costs associated with historical investments where part of the economic life span still remains. Thus, it is not a total cost of capital for electricity generation that is shown, but only for new investments from 2020 onwards, but not those that have already been decided today. It is therefore not possible to determine from Figure 52 whether the total capital costs linked to electricity generation increase or decrease in the long term.

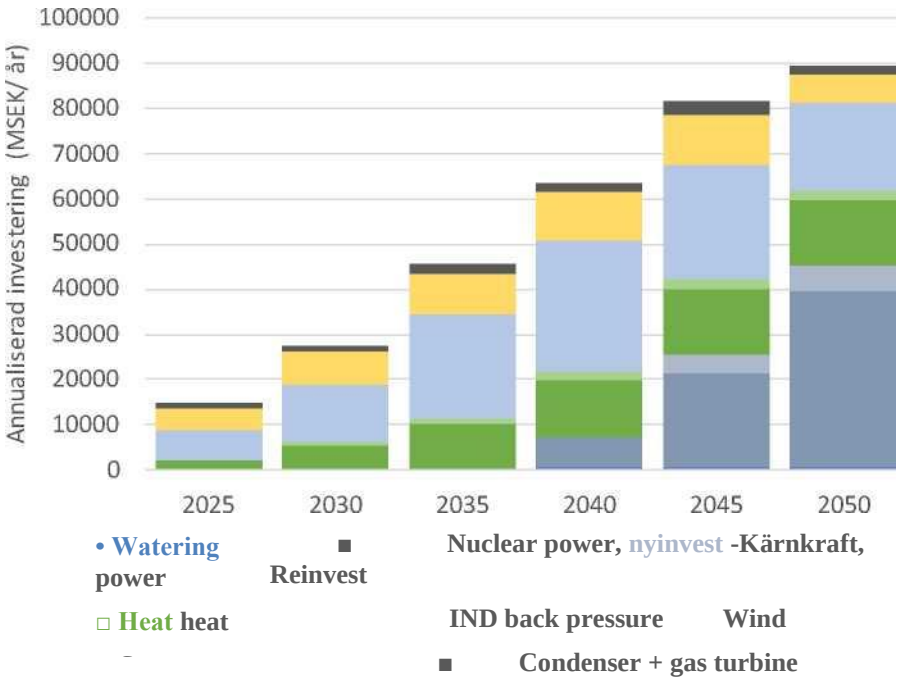

Figure 52 Investments in million SEK/year annualised over the economic lifetime and based on the discount rate for each investment. (Excludes capital costs related to “historical” investments). Source: The Swedish Energy Agency.

The annualised investments increase over time as investments are made on an ongoing basis (but to varying degrees as shown in Figure 50) during the reference period. This means that annualisations are added to each other, i.e. the annualisation of new investments in model year x is added to the annualisations resulting from the investments made in the previous model year (x-1, x-2, etc.). What discourages an increase over time is depreciated investments that no longer contribute to the sum of the annualised investments. The slowdown in the growth rate of annualised investments towards the end of the calculation period for, for example, solar and wind energy can be interpreted as meaning that new investments are largely offset by depreciated investments that no longer involve a capital cost.

Investments in the transmission network

The network investments reported in the Swedish kraftnät
The438 system development plan during the planning period for the years 2031-2022 amounts to approximately SEK 170 billion, of which SEK 100 billion is expected to fall during the planning period for the years 2022-2031. Of these, approximately SEK 46 billion represent reinvestments in existing stations and lines, approximately SEK 48 billion new investments and just under EUR 7 billion in development projects, see Figur 53 and Figure 54.

438 Swedish National Grid, *System Development Plan 2022-2031 – The road to double electricity use,* https://www.svk.se/siteassets/om-oss/rapporter/2021/svk_systemutvecklingsplan_2022-2031 .pdf (2021).

Figure 53 Investment levels for the years 2022-2031 broken down by main drivers of network investment and development projects.
Source: Swedish National Grid.

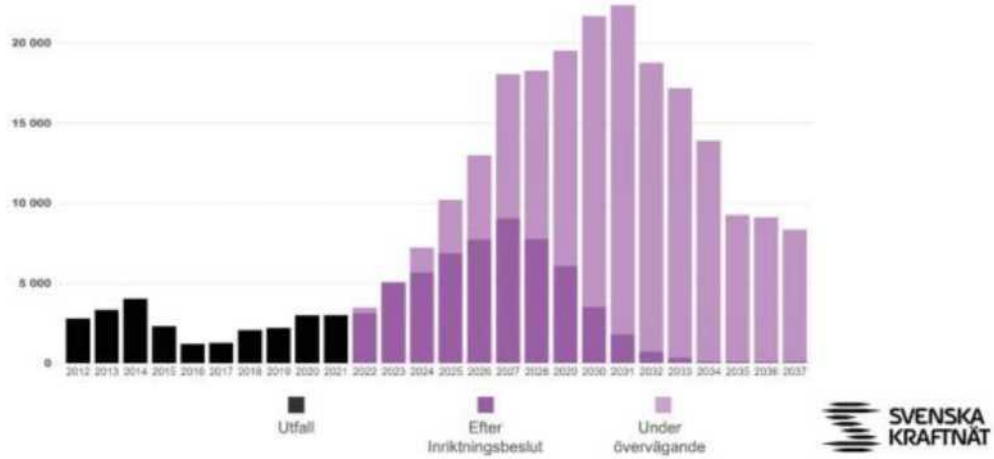

Figure 54 Investment expenditure 2022-2031 broken down by main drivers of network investment and development projects.
Source: Swedish National Grid – System Development Plan 2022-2031.

5.3.2 Sector-specific or market risk factors or barriers in the national or regional context

No risk factors have been identified.

5.3.3 Analysis of complementary public funding support or resources capable of bridging gaps identified in point (ii)

Investment in nuclear energy involves significant financial risks and, in order for such investments to be made, it may be crucial that the State bears part of the risk. A credit guarantee means that, up to a certain amount, the State guarantees someone else's payment obligation and the guarantee thus serves as a cover against credit losses. The credit guarantees for nuclear energy shall be designed in accordance with the provisions of the Budget Law, the Regulation on Loans and Guarantees and that the design of the guarantees should take into account how any approval process in the European Commission under the State Aid Framework can be managed. Moreover, these credit guarantees should be designed on more generous terms than the current system of credit guarantees for green investments, but within the limits of what is compatible with EU State aid rules.

In November 2023, the Government instructed the National Debt Office to take preparatory measures to provide state credit guarantees for investments in new nuclear energy.439

In order to strengthen the conditions for investment in new nuclear power, an investigator

439 Government, *Mission to take preparatory steps to provide state credit guarantees for investment in new nuclear power,* https://www.regeringen.se/contentassets/5bf1e1b788074276a39d92461a325589/uppdrag-att-vidta-forPreparation-atgarder-for-att-kunna-stalla-ut-statliga-credit-for-investar-i-ny-karnkraft.pdf (2023).

was set up in December 2023 to develop and propose financing and risk-sharing models for new nuclear reactors to enable competitive electricity market players to build new nuclear power. The aim is to create economic conditions that lay the foundations for investment in new nuclear energy.440

In the 2024 Budget Bill, the Government proposed that the Riksdag authorise the Government to issue credit guarantees for loans for investments in new nuclear energy amounting to a maximum of SEK 400 billion in 2024.

5.4 The impact of planned policies and measures described in: section 3 on other Member States and on regional cooperation at least until the last year of the period covered by the plan, including comparison with projections based on existing policies and measures

5.4.1 Impact on the energy system of neighbouring countries and other Member States of the region, insofar as they can be identified

See Section 5.4.3.

5.4.2 Impact on energy prices, utilities and energy market integration

See Section 5.4.3

5.4.3 Where relevant, impact on regional cooperation

Nordic Energy Research, the platform for joint energy research and policy development under the Nordic Council of Ministers and jointly funded by the Nordic governments, published together with the International Energy Agency the Nordic Energy Technology report

Perspectives 2016 exploring regional long-term, cost-effective low carbon technology pathways for the Nordic region.441 The study presents a detailed scenario-based analysis of how Nordic countries can achieve a near-carbon-neutral energy system by 2050 (Carbon Neutral Scenario, CNS) and compares this to a Nordic 4 degree scenario (4DS) reflecting the Nordic contribution to the IEA global 4° scenario.

The analysis in Nordic Energy Technology Perspectives 2016 is based on a scenario where Nordic energy-related carbon emissions are reduced by 85 % by 2050. The name – carbon-neutral Scenario (CNS) – reflects a formulation used in official targets, although carbon

440 Government, *Financing and risk-sharing for investments in new nuclear power reactors, https://www.regeringen.se/contentassets/6eb5486c07cb4730b450a4c986b43afd/uppdragsbeskrivning- mission-om-finance* and risk-sharing – av-karnkraft.pdf (2023).
441https://www.nordicenergy.org/project/nordic-energy-technology-perspectives/

neutrality requires action for the remaining 15 %. The pathway towards CO2 reduction identified in the CNS scenario should therefore be seen as a minimum requirement. Limiting global warming to 1.5 degrees, in line with the Nordic Joint Declaration on Carbon Neutrality of January 2019,442 is likely to require further action to reduce emissions.

Nordic Energy Research has also produced a follow-up report on the progress towards carbon neutrality in the Nordic region: Tracking Nordic Clean Energy Progress 2020.443 The report follows the Nordic progress towards a carbon-neutral society by highlighting the major trends and examples where Nordic solutions can have a global impact. The report was launched in April 2020. Among the main findings of this report are:

- For the period 2013 to 2017, the Nordic countries are on track to carbon neutrality, even with higher-than-expected GDP growth, but it is likely that further measures will be needed to continue this trend.
- The positive developments are mainly in the power and heat sector, which contributes significant carbon dioxide emission reductions, from 60,7 MtCO in 2 to 35,1 MtCO in2in 2017, in line with the intermediate CNS 2030 target of 19,2 MtCO2.
- Overall, for the Nordic countries, the share of renewable energy in total energy supply has increased from 31 % in 2008 to 40 % in 2018.
- The share of electric vehicles in the light-duty fleet is moving towards the 2020 level of 4.1 % in line with the carbon neutrality scenario (CNS).
- For particularly challenging sectors, it is noted that:
    - Energy consumption and emissions in the industrial sector have decreased, but process emissions are difficult to reduce.
    - Bioenergy should be primarily used in “high value” sectors (transport and industry) and sustainability will continue to be of great importance.
    - CCS must be demonstrated on a large scale.

5.4.4 Contribution of planned policies and measures to the achievement of the Union’s climate-neutrality objective set out in Article 2(1) of Regulation (EU) 2021/1119

Sweden has a long-term target of achieving net zero emissions by 2045, which means that

442https://www.regeringen.se/48febb/contentassets/afd1e82263dc4fbba6a1 b0c15357faee/declaration-on- nordic-climate-neutrality
443https://www.nordicenergy.org/project/tncep/

emissions excluding LULUCF should be reduced by at least 85 % compared to 1990, and Sweden should thereafter achieve net zero emissions. This is 5 years ahead of the EU's climate neutrality objective. Additional instruments are needed to ensure that Sweden reaches net zero. There is also a need for enabling measures such as increased fossil-free electricity generation, efficient permitting processes and skills supply.

The existing governance and the upcoming ETS 2 are not considered sufficient to reach the ESC commitments and our national targets. According to the Climate Action Plan, see section 1.2.1.7, the Government will set up an inquiry for the period 2030-2027 to analyse and provide evidence on whether and, if so, what instruments can be designed to ensure that Sweden's commitments in the EU are achieved in a cost-effective and socio-economically efficient manner. Furthermore, it must be ensured that excessive costs for households and businesses are not incurred with the risk of serious impact on the competitiveness of Swedish companies. Regulatory flexibility should be used to achieve cost-efficient compliance.

In 2022 additional directives (Dir. 2022: 126) were asked to propose a strategy with intermediate targets, policies and measures that contribute to Sweden's EU commitments on biodiversity and net greenhouse gas removals from the land use sector (LULUCF). The additional mission will be presented in December 2024.

Annex 1 to Sweden's updated National Energy and Climate Plan 2021-2030

Calculation of annual and cumulative energy savings in accordance with Article 8 and 10 of the recast EED

Energy saving in housing and services (buildings)

In the housing and services sector, savings in electricity, heating oil and district heating use are reported.

In order to estimate the relationship between electricity consumption and electricity price in the residential housing and service sector, a dynamic model444 consisting of two parts is used. On the one hand, a long-term linear relationship between electricity use and the independent variables price, income and heat demand; and, on the other hand, a dynamic, more short-term relationship due to deviations in electricity use from the long-term relationship and/or due to changes in any of the underlying variables (prices or income) between the previous and the current time period. Selected elements from the model description used for estimating long-term and short-term price elasticity are presented in Annex 1 to Sweden's plan for the implementation of the Energy Efficiency Directive Article 7 for the period 2030-2021. Data, results for estimates and discussion of new elasticities for dwellings and services are presented in the Swedish Energy Agency's memorandum.445

The Swedish Energy Agency's estimates of price elasticity show that a higher electricity price reduces electricity use in the residential and service sector. A price increase of 10 % indicates a reduction in electricity consumption of around 5.2 % in the long term. In the short term, electricity consumption decreases by 1.1 % in the event of a price increase of 10 %. Households and the services sector take a long time to fully adapt to changes in prices and incomes. Investments in buildings, heating systems and other appliances are often long-term, meaning that only minor adjustments to electricity consumption from one year to the next can be made as a result of, for example, a change in the price of electricity. However, this does not mean that long-term changes cannot be taken into account when calculating the cumulative amount of energy savings. Some households and businesses are adapting faster than others.

Estimated elasticities have been used to calculate the fuel savings resulting from the fact that

The444 model has been developed by Professor Runar Brännlund at the Centre for the Environment and Natural Resources Economy, CERE, University of Umeå (www.cere.se). It is described in more detail in the report on *the housing sector's demand in Sweden*.
445Swedish Energy Agency memo 2019: *Calculation methodology for the impact of energy and CO2 taxes on energy consumption*. Event No: 2018-12739.

the Swedish tax in the household and service sector is higher than the EU minimum tax rates and that, in combination with other complementary instruments, this stimulates a reduction in fuel use compared to the absence of these instruments. The only distinguishing between the reference scenario (EUMIN) and the alternative scenario (SE) is the final consumer price of fuel (including excise duties and VAT).

The calculations for savings from electricity use are based on a price difference of around 50 %, which is based on 2022 prices. This price difference also includes VAT as Swedish VAT is higher than the EU minimum rate (25 % compared to 15 %). However, VAT is in practice paid only by households and businesses that do not have a right to deduct. The calculations are based on the latest available data and use the average values for subsequent years since the last five years. After that, the difference in electricity consumption between the alternative and the baseline is calculated.

The fuel oil is subject to both energy and CO2 taxes and VAT. The calculations for savings from the use of fuel oil are based on a price difference of around 50 %, based on 2022 prices. The calculations are based on the latest available data and use the average values for subsequent years since the last five years. After that, the difference in the use of fuel oil between the alternative and the baseline is calculated.

The calculations for savings from district heating use are based on a price difference of around 50 %, based on 2022 prices.
Consumers pay 25 % VAT on their district heating use, but no energy and carbon tax. On the other hand, fossil fuel use is taxed at the production stage. In order to determine whether the tax burden is ultimately borne by producers or consumers, further investigation is needed. In Sweden, the sector consists of a collection of local markets which are to be regarded as individual monopolies. According to basic economics theory, monopolistic activities pass on all costs to consumers. It is therefore correct to argue that fuel taxes are ultimately paid by consumers through higher prices. Not least in multi-dwelling buildings where district heating is the clearly predominant mode of heating.

When we include the effects of energy and CO2 taxes on electricity use, we count effects including VAT. Similarly, the impact of VAT on the use of district heating can be calculated. The calculations are based on the latest available data and use the average values for subsequent years since the last five years. After that, the difference in district heating consumption between the alternative and the baseline is calculated.

The immediate short-term effect of a price change can be seen in the first year, while the impact is greater in the longer term, as can be seen in the last year. These results can also be compared to if the effect were to be estimated solely on the basis of the long-term elasticity.

Table 45 provides an estimate of the annual and cumulative amount of electricity, heating oil and district heating savings in the residential and service sector over the period 2021-2030.

Table 45. Annual and cumulative energy savings from electricity, heating oil and district heating in the residential and service sector, from current energy and CO2 taxes and value added tax.

Year	—Energy TWh/year	Δ Energy ack. TWh
2021	**15,8**	**15,8**
2022	**8,6**	**24,4**
2023	**12,7**	**37,1**
2024	**12,7**	**49,8**
2025	**12,7**	**62,6**
2026	**12,7**	**75,3**
2027	**12,7**	**88,0**
2028	**12,7**	**100,7**
2029	**12,7**	**113,4**
2030	**12,7**	**126,1**

The results in Table 45 above are based on the latest available statistics before 2023 and price elasticities for the period 1975-2017.446 The revised calculations include the impact of taxes as well as the VAT difference between Sweden and the EU.

Energy saving in the transport sector

Overall, the transport sector reports a reduction in the use of petrol and diesel. Savings of pure biofuels and electricity are not accounted for.

For estimating the relationship between energy consumption and the energy price of petrol and diesel in the transport sector, as well as for the building, a dynamic model447 consisting of a long-term correlation between the total fuel use and the independent price and income variables, as well as a dynamic, more short-term relationship due to deviations in fuel use from the long-term link and/or to change any of the underlying variables between the previous and the current time period (short-term dynamics). A detailed description of the model, which is used for estimating both long-term and short-term price elasticity and the simulations made of energy savings due to higher levels of taxation in Sweden compared to the EU minimum levels of taxation, are set out in Annex 2 to Sweden's notification of Article 7 in 2013.448 In 2019, the Swedish Energy Agency estimated new elasticities for petrol and

446Swedish Energy Agency memo 2019: *Calculation methodology for the impact of energy and CO2 taxes on energy consumption*. Event No: 2018-12739.
The447 model has been developed by Prof. Runar Brännlund at the Centre for the Environment and Natural Resources Economy, CERE, University of Umeå (www.cere.se), and is described in detail in *the report "The effects on energy saving from taxes on motor fuels: The Swedish case*, CERE Working Paper 2013: 6.
Ministry of448 Enterprise, Energy and Communications, *Plan for the implementation of Article 7 of the Energy Efficiency* Directive, 5 December 2013, Dnr. N2013/5035/E (in part).

diesel in the transport sector. The current power calculations are based on these. Data, estimation results, discussion and possible applications of the new elasticity are presented in the Swedish Energy Agency's memo 2019.449

The estimates of price elasticity in 2019 show that a higher price of petrol reduces petrol consumption and that a higher price of diesel reduces diesel consumption. Furthermore, as expected, the results show that petrol and diesel are substitutes in the long term. In other words, higher petrol prices, all other things being the same, lead to an increase in the consumption of diesel. Of course, the interpretation is that there is some substitution from petrol cars to diesel. The opposite result applies to the increase in the price of diesel. In view of this, it is particularly relevant to take into account the cross-price elasticity of petrol and diesel in order to calculate the overall energy savings resulting from increases in petrol and diesel prices.

The estimated and processed elasticities from 2019 have been used to calculate the energy savings resulting from the fact that the Swedish energy and carbon tax levels and VAT levels are higher than the EU minimum levels of taxation and that, in combination with other complementary instruments, this stimulates a reduction in energy consumption compared to the absence of these instruments. The calculations also include that Swedish VAT is higher than the EU minimum tax rate (25 % compared to 15 %).

The only distinguishing between the baseline (EU) and the alternative scenario (SE) for the energy savings simulations is the final consumer price of petrol and diesel (including excise duties and VAT). The calculations are based on a price difference of 46 % on average for petrol and 26 % for diesel, based on the 2022 price level. The calculations are based on the most recent data available at the time of the analysis (2023) and use the average values for the last five years to subsequent years. After that, the difference in fuel and energy consumption between the alternative and the baseline is calculated.

Table 46 provides an estimate of the annual and cumulative fuel and energy savings in the transport sector over the period 2021-2030.

Table 46 Annual and cumulative energy savings of petrol and diesel in the transport sector.

Year	—Bensin TWh/year	—Diesel TWh/year	Δ Energy TWh/year	Δ Energy ack. TWh
2021	5,8	— 2,1	3,7	3,7
2022	3,7	— 1,2	2,5	6,2
2023	5,8	— 2,0	3,7	9,9
2024	5,8	— 2,0	3,7	13,7

449Swedish Energy Agency memo 2019: *Calculation methodology for the impact of energy and CO2 taxes on energy consumption*. Event No: 2018-12739.

2025	5,8	— 2,0	3,7	17,4
2026	5,8	— 2,0	3,7	21,1
2027	5,8	— 2,0	3,7	24,8
2028	5,8	— 2,0	3,7	28,6
2029	5,8	— 2,0	3,7	32,3
2030	5,8	— 2,0	3,7	36,0

The results in Table 46 are based on the latest available statistics before 2023. Price elasticities used refer to the period 1976-2017.450 Some simplified assumptions are made with regard to input data.

Summing up the results from the table, the cumulative energy savings of petrol and diesel in the transport sector from Swedish instruments can be estimated at around 36 TWh over the period 2021-2030. It should be noted that, at this stage, the calculations do not take account of the reduction obligation. This increases the price of fuel at pump and it may therefore be necessary, depending on the future decision on the reduction obligation, to analyse the effects of the instrument in the same way as for a tax.

Energy saving in the industrial sector

The effects of the energy and carbon tax from industry are included in the calculations in the same way as applied for the 2020-2014 obligation period.451 For industry, a simpler linear model is applied, where the price difference resulting from higher Swedish tax levels is multiplied by the long-term self-price elasticity of different fuels in order to determine the long-term reduction in demand. Assuming a linear increase in effect, the annual and cumulative cumulative energy savings over the period 2030-2021 can be determined. The same price elasticity as applied when calculating industry savings for the 2020-2014 obligation period is also applied here.

In terms of industry's cumulative savings, the impact of energy tax alone on certain fuels in the industrial sector was counted. Tax on electricity use is reduced to the EU minimum and no tax is paid for biofuel use not subject to tax under the Energy Taxation Directive. Therefore, the tax method does not apply to electricity and the use of biofuels. Industry covered by the EU Emissions Trading System (EU ETS) pays the emission allowance price and energy tax and the non-ETS industry pays both energy and CO2 taxes. For the energy tax, there are exemptions depending on the purpose of the fuel use. In order to avoid the risk of double counting of energy savings, the sample has been limited. This means that the estimation of the energy-saving effects in industry is conservative. Cumulative energy savings from the energy tax from the use of fossil fuels in industry amount to approximately

450Swedish Energy Agency memo 2019: *Calculation methodology for the impact of energy and CO2 taxes on energy consumption*. Event No: 2018-12739.
451Government, *Notification of Sweden's plan for the implementation of Article 7 of the Energy Efficiency* Directive (N2013/5053/E (in part)).

4.5 TWh.

Annex 2 to Sweden's updated National Energy and Climate Plan 2021-2030

North Sea energy cooperation – regional cooperation on offshore renewable energy

Text agreed in the North Seas Energy Coopration (NSEC) 2024.

North Sea Energy Cooperation – Regional Energy Cooperation on ORE

Sweden is part of the wider North Sea region, which has a great potential for renewable energy. The deployment of offshore wind will play an increasingly important role in achieving Europe's energy and climate goals. The EU Offshore Wind Strategy has set the ambitious target of 300 GW of offshore wind power and 40 GW installed capacity for offshore wind by 2050. On 19 January 2023, the North Seas Energy Cooperation (NSEC) has facilitated the development of the non-binding agreement on offshore renewable energy targets for 2050 with intermediate steps 2040 and 2030 for priority offshore grid corridors in the North Sea under the TEN-E Regulation. The objectives of the Northern Seas Offshore Grids (NSOG) maritime network corridor are 60.3 GW in 2030, between 134,9 and 158 GW in 2040 and between 171,6 and 218 GW in 2050. This represents a significant change in scale for the offshore wind sector, the integrated offshore wind sector and strategic deployment of renewable energy. High energy prices, for example in 2022, and geopolitical events threatening the European energy system have underlined the need to accelerate the deployment of domestic renewable energy generation capacity and regional offshore transmission networks as quickly as possible, significantly improving energy security.

Sweden is working with the other NSEC countries to identify, analyse and realise opportunities for concrete cooperation projects. The NSEC is a voluntary, bottom-up, market-oriented regional cooperation initiative established in 2016, which aims to:

- Create synergies;
- Avoid incompatibilities between national policies;
- Knowledge sharing on international best practices;
- Join strategies where possible and beneficial.

Ministers responsible for energy meet regularly within the NSEC. In 2023, the NSEC consists of Belgium, Denmark, France, Germany, Ireland, Luxembourg, the Netherlands, Norway and Sweden, with the participation of the European Commission. On 18 December 2022, the NSEC Energy Ministers and the EU Energy Commissioner signed a Memorandum

of Understanding on cooperation on offshore renewable energy with the UK. The establishment of this Memorandum of Understanding was provided by the Trade and Cooperation Agreement between the European Union and the United Kingdom of 30 December 2020. This builds on cooperation within the NSEC and is distinct but complementary to the NSEC framework.

For the offshore wind sector, it is important to offer a predictable and stable long-term operating environment to facilitate long-term investments and further cost reductions. To this end, existing barriers need to be removed and attractive investment conditions created. NSEC members work together to make an important contribution to achieving these objectives through a regular exchange of expertise focused on several topics within the four NSEC Support Groups (SGS):

- SG1: development of hybrid and joint projects;
- SG2: permits, maritime space planning and environmental considerations;
- SG3: financial and Support Frameworks;
- SG4: long-term network and infrastructure planning;

In order for each support group to achieve its objectives, exchanges between and within the support groups at NSEC coordinator level are encouraged and monitored. Examples include SG1 and SG4 ports, maritime spatial and network planning within SG2 and SG4, and how non-price criteria can boost innovation to challenges for an accelerated, cost-effective and responsible expansion of sea pigs within SG1 SG3 and SG4. Finally, the Support Groups are also in close contact with other international fora, such as the Pentalateral Energy Forum and the Clean Industrial Forum on land network planning, market arrangements and stakeholder engagement.

Development of hybrid and joint projects

The NSEC SG1 serves as a platform to work together on concepts for potential offshore wind projects and coordinated electricity infrastructure, including transmission infrastructure. The Group has increased its activity as NSEC countries have launched more joint and hybrid projects in the North Sea to facilitate technical and political discussions and the exchange of best practices as the projects advance.

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

Therefore, SG1 members develop opportunities for cooperation on hybrid projects on possible legal, regulatory and commercial barriers. SG1 will continue to work on the barriers and steps for hybrid and joint projects, which can be addressed at national and regional level. Furthermore, cooperation will continue to serve as a forum to reflect on working arrangements on issues of co-legislative processes at EU and national level.

Permits, maritime spatial planning and environmental considerations

In order to reach our energy and climate goals within the EU, there is a need to speed up planning and permitting procedures at EU and national level, while better understanding the possible ecological boundaries of large-scale wind energy development in the North Sea and the impact on other users of the sea. SG2 carried out an inventory of spatial tensions for 2030 offshore wind farms at regional sea scale. The next step is to better define ecological tensions and potential threats to development and define spatial strategies to avoid or mitigate such threats. In order to increase knowledge and support the deployment of offshore wind power in the North Sea, North Sea countries will continue to work closely together on maritime spatial planning, environmental research, cumulative impact assessment of wind farms between the authorities responsible for energy, maritime spatial planning and the environment.

Funding and support frameworks

Tenders for offshore wind are a key topic for funding and support frameworks. NSEC members coordinate bids by sharing information on the national tender plans as part of SG3. In the Working Group, countries also exchange best practices on tender design, zero subsidy support, design elements to promote system and sector integration and grid connection systems. Joint projects are also becoming increasingly important to achieve the ambitious objectives.

For this reason, the Group also addresses funding opportunities for joint cross-border offshore wind projects, including through EU financial instruments such as the Connecting Europe Facility and the Union Renewable Energy Financing Mechanism. Finally, Power Purchase Agreements (PPAs) play an increasingly important role in financing offshore wind projects. Countries will address the issues, barriers and solutions for a wider uptake of PPAs. It also discusses the decommissioning, lifetime extension and renewal of wind farms.

The purpose of the exchanges is also to jointly develop and discuss ideas for the medium-term future of the ocean energy system in terms of installed capacity, for example through the coordinated bidding plans.

Deliver to 2050: long-term network and infrastructure planning

The NSEC SG4 cooperates with ENTSO-E to provide and coordinate input to the North Sea offshore network development plan under the EU TEN-E Regulation. Furthermore, SG4 aims to broaden the discussion on long-term network planning to also include early development and scale-up of green hydrogen production and maritime transport, and its potential role in an increasingly interconnected North Sea energy system. Green hydrogen will be important to decarbonise our energy system. Power-to-X, and in particular hydrogen, will play a key role in providing flexibility where and when needed. Hydrogen demand is expected to grow significantly, especially after 2030 due to both its potential as a storage energy carrier and as a fuel and feedstock for hard-to-electrify activities. Several NSEC countries have announced production targets for green hydrogen on land and at sea. In SG4, the NSEC countries will exchange first experiences on hydrogen production in offshore wind, sharing knowledge on transport infrastructure, renewable energy development and offshore Power-to-x production. They will work together to provide insights on offshore hydrogen production, to discuss the deployment of electrolysis and to increase synergies between the offshore grid and hydrogen network planning. In all aspects of medium- and long-term infrastructure planning, SG4 underlines the importance of broad engagement in this planning process with Member States and relevant stakeholders, including industry and NGOs, to anticipate and address supply chain bottlenecks (such as port development) and accessibility) in the deployment and acceleration of the supply of our North Sea energy system. This is closely linked to the importance of securing critical infrastructure at sea, and the availability of critical raw materials, through innovation and increased circularity.

Annex 3 to Sweden's updated National Energy and Climate Plan 2021-2030

Compilation of national consultation

To ensure that the draft updated NECP was made available to the public, it was published on the websites of the Government and Energy Agency.452 In autumn 2023, it was possible to comment on the draft sent to the European Commission in summer 2023 via the Swedish Energy Agency's website. The Swedish Energy Agency informed on its website that input was requested for the national energy and climate plan (NECP) by 24 November 2023. Through the Energy Agency's subscription service, the same information was sent to all subscribers of the Energy Agency's news. Comments were to be submitted in writing to the e-mail address set up for that purpose. Seven written inputs were received from various organisations and individuals.

In order to make the final updated national energy and climate plan available to the Swedish Government Offices on 17 April 2024, this was published on the Swedish Energy Agency's website.453

The Swedish Energy Agency, in cooperation with the Government Offices, organised a hearing on 7 May 2024 at which stakeholders were given the opportunity to comment on the Swedish Energy Agency's dossier. The invitation was closed on 22 April to a hundred trade associations and associations, together with a call for written input by 13 May 2024 to the email address established for that purpose. The hearing was attended by around 25 interest and industry associations, representatives of the Swedish Energy Agency, the Environmental Protection Agency and the Ministry of Climate and Enterprise. Thirteen written inputs were received from various organisations and private individuals.

A summary of comments received on both the draft and the Swedish Energy Agency's dossier for a final updated national energy and climate plan is presented below.

Overall

In general, stakeholders are in favour of having been consulted on the NECP and consider that it provides a good overview of Swedish energy and climate policies. However, many

452 Government Offices, *Draft updated National Energy and Climate Plan for Sweden, https://www.regeringen.se/artiklar/2023/09/utkast-pa-uppdaterad-nationell-energi--och-klimatplan-for-sverige/* (2023) and Energy Agency, *Please provide comments: Draft updated National Energy and Climate Plan,* https://www.energimyndigheten.se/nyhetsarkiv/2023/utkast-pa-uppdaterad-nationell-energi--och-klimatplan-- oppet-for-synpunk/ (2023).
453 Swedish Energy Agency, *RemisResponse and Mission*, https://www.energimyndigheten.se/remissvar-och-uppdrag/ (2024).

stakeholders call for better opportunities to influence the content of the plan. Several stakeholders argue that there are no concrete proposals for policies and measures to achieve the objectives for Sweden, and note that the Energy and Climate Plan is more of a descriptive product. Many stakeholders consider that the measures in the plan are not sufficient to achieve a high degree of sustainability.

Comments from hearing and written consultation

One individual highlighted the need for new, strengthened policies to meet EU requirements and refers to John Hassler's inquiry "Sweden's climate strategy", whose estimates suggest that Sweden will release more than the EU ESR Regulation allows by 2030.

The*Climate Policy Council* reiterates its concern that the targets do not seem to be met and considers that the government needs to explain how Sweden will achieve the targets. The Climate Policy Council refers to the recommendations of the March report (2024), "comprehensive recommendations on how to achieve the RSA and LULUCF targets".

The 2030 Secretariat considers that the ESR objective, which in principle covers the climate impact of transport, agriculture and forestry, means that Sweden's climate impact should be halved between 2005 and 2030. The target is cumulative, meaning that any delay in emission reductions means that even greater reductions need to be made later. This requirement continues even after the EU introduces in 2027 the complementary ETS EU ETS 2 covering almost all carbon emissions in the ESR sector.

Furthermore, the 2030 Secretariat considers that the Government's reasoning in the Climate Policy Action Plan on the relationship between transport and other sectors is wise ("The 2030 domestic transport objective is designed in such a way that other sectors in practice hardly need to reduce their emissions by 2 030 in order to meet the target for the ESR sector. This reduces the transition pressure for these sectors ") but that the continuation of increasing the pressure of change in agriculture and forestry is less well conceived, as with the short time left until 2030, this would mean a reduction in food production precisely when we need to increase self-sufficiency. By rapidly reducing emissions from the transport sector, Sweden can reach the ESR target without draconically reducing production in agriculture and forestry. Technological neutrality should prevail instead of rewarding a particular technology, which should characterise the support put in place, but for example for light vans, the premium applies only to electric operation, not for example biogas, and the same applies to the premium for scrappers – the premium is given only when switching to electric cars, not when switching to other climate-smart transport choices.

As regards LULUCF, the 2030 Secretariat states that the requirement for Sweden to increase carbon storage in forests and land can mainly be done by increasing forest growth or by

reducing logging.

Surpluses from the existing EU ETS can be used to reach the ESR target, but only up to 3 % of the target. In addition, Sweden can purchase ESR rights from other EU countries without restrictions, but both the asset and the price picture are unknown because there is no organised trading with the ESR. If it is not clear in the very near future that Sweden can purchase large amounts of ESF entitlements from other Member States at a reasonable price, the Fiscal Policy Council considers that there is a need for swift decisions on additional domestic instruments to reduce ESR emissions by 2030. The 2030 Secretariat shares this picture and believes that it should inform the government's response to the EU.

The 2030 Secretariat considers that, in order to meet the objective of the Energy Efficiency Directive, accelerated electrification of the transport sector is key, as is a shift towards more energy-efficient modes of transport than private cars. It also shares the view of the Fiscal Policy Council that it may be prudent to ensure that accelerated electrification of heavy industry and the vehicle fleet is not counted as a reduction in efficiency.

The 2030 Secretariat also proposes more domestic production of cinema, more efficiency, electrification and behavioural shift for all transport modes and fuels. It also notes that given that there are five million vehicles in Sweden, Sweden needs to do otherwise around infrastructure and purchases and that Sweden will not reach its 2030 target of the Renewables Directive without increasing renewable and reducing fossil fuels, not least through the blending of renewable fuels in the transport sector. Accelerating the electrification of the transport sector is also key, as is a shift towards more energy-efficient modes of transport than private cars.

Svebio considers that the Swedish energy and climate targets should be based on the EU targets adopted and will be adopted in the framework of the common EU policy, most recently under Fit for 55. This concerns in particular the target adopted for greenhouse gas emissions (ESR target), as well as a Swedish national target for energy efficiency, and the targets adopted for the share of renewable energy. In addition, there are the targets adopted by the Riksdag for 2030.

Svebio wishes to emphasise the potential of forests as a feedstock for renewable energy and renewable materials over its potential for increased natural carbon removals and considers that, on the contrary, the policy decided leads to a significant reduction in the use of biofuels in Sweden in favour of fossil fuels in the transport sector. Despite clear ambitions for a growing bioeconomy, Svebio lacks political action in this key area. In addition, there is a call for more focus on policies towards more biofuel production and bio-electricity, arguing that a combination of electrification and renewable fuels for industrial processes, electricity, heat and transport provides the most cost-effective transition.

In conclusion, Svebio would like to stress that bioenergy is of great importance for Sweden's energy supply, in particular at local level, both for fossil freedom and for a high level of security of supply. A sustainable, competitive and growing bioeconomy, including bioenergy in various forms, should continue to be developed. In addition, heat production helps to relieve the burden on the electricity market and it is important for the State to define the various system benefits needed for the proper functioning of the electricity network and to properly price them, leading to investment in new generation and better use of existing capacity. The potential for achieving negative CO2 emissions from the use of bioenergy should therefore be effectively exploited.

The*Climate* Municipalities state the following: "The ESR states that Sweden will reduce emissions from 31.3 million tonnes CO_2e to 21.6 million tonnes CO_2e by 2030. According to the Swedish Energy Agency's calculations, we reach only 25.3 million tonnes of CO_2e by 2030. In addition, the EU target is based on cumulative emissions, leading to a surplus of around 9 million tonnes of CO in$_2$ by 2030. Under the LULUCF Regulation, Sweden's forests and land must take up 49 million tonnes of CO_2e/year by 2030. Under the medium growth scenario for forest land, total net removals from the LULUCF sector are estimated at around 42 million tonnes of carbon dioxide equivalent in 2030. Climate municipalities want incentives to increase the willingness and opportunity for agriculture and forestry to create carbon sinks, as well as incentives for the restoration and conservation of wetlands."

Swedish wind energy is of the opinion that the impact assessment should include an account of alternative solutions and costs, since it is not clear what the cost of ESR and LULUCF will be for 2030, but that an estimate should be made of what the cost could be for Sweden if our commitments under EU law are not met. The consequences of the unavailability of emission allowances and Sweden's failure to meet its commitments should also be reported. It is also of the opinion that a comparison should be made with what emission reductions could be achieved in Sweden for the corresponding amounts. In addition, the plan should describe the effects of a delayed transition in Sweden.

Furthermore, according to Svensk vindenergi, a comprehensive electrification based on renewable energy is key for the EU to reach its 2030 climate targets, and therefore a comprehensive expansion of renewable electricity production is needed. According to Svensk vindenergi, wind power is the only power that can be deployed as quickly and on the scale needed to achieve the electrification announced by industry, adding that there is also a need for massive and rapid investments in grid infrastructure, smart solutions and renewable energy projects to strengthen Europe's green workforce. Swedish wind energy considers that the plan can and should describe possible policies and measures needed, for example, to cope with electrification with renewable electricity and that Swedish companies can play a key role.

One individual considers that there is no credible and updated national contribution in renewable energy and that it is worrying that the 100 % renewable electricity target has been replaced by a target of 100 % fossil-free electricity generation, as it opens up for non-renewable nuclear power. Without biofuels from forests and other forest products, there is a risk of a return to fossil fuels, cement becoming more common as a building material, and plastics gaining ground in a number of areas. Attention should be paid to measures that stimulate growth.

Greenpeace submitted the following observations: "The draft updated Energy and Climate Plan sets out the government's ambitions in the framework of the so-called Time Agreement. It is made clear that the policy pursued in the framework of the government's cooperation with the Swedish Democrats is aimed at "increasing the amount of programmable and fossil-free electricity generation in the energy system, not least by strengthening the conditions for new nuclear energy". We can note that this approach hardly, and especially in the near future, leads Sweden to meet the EU targets set for example in terms of reducing emissions, share of renewable energy and improving energy efficiency. On the contrary, it seems increasingly clear that the government's focus is a side-path which in fact makes it more difficult to achieve the objectives."

Greenpeace further notes that the Swedish Energy and Climate Plan is largely descriptive, and that this is certainly of some value, but that it is even more urgent to analyse the policies pursued and where they lead, in particular section 5, which would require a thorough impact assessment. It notes that the plan does not include a national target for the share of renewable energy by 2030, which is an obvious shortcoming, but that it is pleased that Sweden is announcing a forthcoming new national renewable energy contribution, which represents an increase in ambition compared to the current plan, which reports a national contribution of 65 %. Finally, Greenpeace argues that it is a shortcoming in Swedish policy, and in this draft updated National Energy and Climate Plan, that there is no clear roadmap for renewable energy growth in Sweden. Finally, Greenpeace would like to highlight the evaluation carried out in the framework of CAN Europe, of which Greenpeace is part.

Swedisol notes that Sweden will not achieve the 2030 targets with current instruments, neither for energy efficiency nor for renewable energy, and proposes that the basis be supplemented by a concrete action plan. It is pointed out that several studies, for example from the Swedish Energy Agency and FossilFree Sverige's energy efficiency strategy, show the potential as cost-effective instruments from a socio-economic perspective.

Swedisol also welcomes the introduction of stable and long-term economic instruments targeting key stakeholders such as property owners and industry (in particular energy efficiency measures in the Climate and Industry Leap).

At the hearing on 7 May Swedisol expressed its wish that energy efficiency and cost efficiency be increased in plans and policies. It also calls for a broader perspective than the individual dwelling, pointing to the existence of analyses showing that energy efficiency is more cost-effective than increased energy production. It also identifies a major risk for Sweden, with such a strong focus on production of only one type of power.

The*County Administrative Boards' Energy and Climate Coordination (LEKS)* considers that uncertainties remain as to how Sweden should achieve EU objectives such as renewable energy, energy efficiency and emissions of climate gases. LEKS shares the assessment that current policies do not achieve climate objectives and therefore calls for instruments that allow for a transition in line with the EU's and Sweden's climate targets.

According to LEKS, the term 'the western Swedish natural gas network' is somewhat misleading, as a significant proportion of the gas is made up of biogas. There is also good potential to increase the proportion even more, either by injecting Swedish-produced biogas or danish-produced biogas. LEKS would also like to point out that industry has an interest in establishing large-scale biogas production facilities along the western Swedish gas network. However, the uncertainty surrounding future instruments and the annulment by the General Court of the tax exemption for biogas have led some operators to wait for investments. However, LEKS would like to stress that there is good potential to expand the Swedish biogas system and that biogas can be used as a fuel in the transport sector and industry as well as as an input to the chemical industry.

LEKS also considers that the wording needs to be updated on the basis of the county administrative boards' mandate on energy planning: The second paragraph on the County Administrative Board on page 27 is based on wording from older memorandum of appropriations. The county administrative boards' memorandum of appropriations for 2024 states that the county administrative boards are to lead and coordinate the regional implementation of energy and climate policy by, inter alia, developing regional energy planning and promoting climate action. It also states that the County Administrative Boards will, among other things, revise regional energy and climate strategies and start developing regional electrification action plans. This also relates to the wording on energy planning on pages 28-29.

The Climate Municipalities consider that urgent measures are needed to facilitate the expansion of wind and solar energy and that the government needs to put in place a system whereby municipalities are incentivised for wind power start-ups within the municipality's borders and bring forward the "municipal wheat". In the case of solar energy, the state should take steps to create more predictable and efficient review processes for the construction of solar parks.

The Climate Municipalities also believe that Sweden should set stronger energy efficiency targets, linked to total energy consumption per capita rather than linked to GDP, and would like to see a reintroduction of the tax exemption for biogas that disappeared in 2023.

Climate municipalities do not have national investment in transport efficiency and want to see targets for reduced car traffic, stronger rail investment and cycling measures. The phasing out of the urban environment agreements has reduced municipalities' ability to work on transport efficiency and the Climate municipalities would like them to be reinstated or similar. Finally, the Climate Municipalities argue that the electrification of the vehicle fleet is too slow and call for measures that, in particular, enable those most dependent on the car to be better able to buy/lease electric cars.

The installer companies consider that Sweden needs to supplement the plan with concrete policy measures. In order to strengthen energy efficiency and renewable energy targets and increase energy security, the installer companies propose that the plan should include:

- Energy efficiency measures and economic instruments that accelerate the pace. Bets can usefully be combined with FossilFree Sverige's and Installator's proposals for a market-based auction system to reduce the use of energy and power.

- Measures to achieve a well-functioning flexibility market for both fossil-free electricity and heat. This could mean establishing a national action plan for the digitalisation of energy that supports the integration of decentralised and fossil-free energy into the energy system.

Eneff – Energy Efficiency Association notes that there are no plans in the basis for HUR's energy efficiency objectives to be achieved, but only a finding that Sweden does not do so, which is serious and a major shortcoming that will delay Sweden's work on energy efficiency.

ENEF wants Sweden's energy efficiency plan to realise the existing potential and demonstrate cost-effective and long-term instruments, to be complemented by the "power" and "user flexibility" components, and to show how the policies interact with each other and with other activities in society.

According to the Swedish Environmental Protection Association, there is a significant confusion in terms of the basis, which, among other things, creates a conflict of objectives between electrification and energy efficiency. The opposite applies in practice to the contrary: When a process is electrified, efficiency is generally achieved. The significant increase in the use of electricity in Sweden is therefore not due, as the basis seeks to demonstrate, solely to a shift in the Swedish transport sector and industry, but to a significant new establishment of heavy industry. However, the addition of the new electro-intensive

industry should not be an argument against energy efficiency but in favour. Energy efficiency is the fastest and cheapest way of reducing emissions, freeing up capacity in the electricity system and lowering the electricity price, the last two reasons being crucial for both electrification and the establishment of new electrified industries.

With regard to the consultation, the Swedish Environmental Protection Association notes that there has been a lack of opportunity for civil society to comment on the plan, which is more than one plan, and that it is under any criticism that Sweden is not reaching targets.

The Swedish Ventilation proposes that the plan should contain:

- Instruments capable of accelerating energy efficiency renovations of the entire building stock. Policies must also be long-term and sustainable over time. The right design of incentives for investments and renovations in the sector can have major energy-saving effects.

- How different instruments can interact to increase the potential of each instrument when put into context with other instruments.

Energigas Sverige wants the development of all sectors in the street to be clearer and that the strength of biogas and hydrogen (for which Sweden is well positioned) should also be more emphasised from a security of supply perspective.

Lhyfe points out that food preparedness states that we need more bioenergy and that the Climate Policy Council recognises the use, but not the production of bioenergy, which is particularly important for cogeneration.

Lhyfe also lacks guidance on how to obtain green hydrogen for shipping and aviation and believes that the plan should mention the green hydrogen tax (within the combustion engine) that is equated with a tax on fossil fuels.

The Norr Energy Agency wonders whether there are current objectives for the Energy and Climate Plan relating to urban planning, to minimise car use and to increase investment in rail? The Climate Action Plan (2019) mentioned economic instruments as particularly effective in guiding consumers from fossil fuels to fossil-free ones.

The Norr Energy Agency does not have a description of the municipalities' requirements for energy plans or targets for the robustness of the national energy system through the development of elements other than oil. The Swedish Energy Agency also wishes to see how Sweden plans for a scenario in which the north needs all and probably more than the electricity produced in SE1. the need for capacity is predicted to change and how would it affect the flow and creation of new electricity generation?

Technology companies are awaiting with interest the study on instruments for 2030 announced by the Tiers parties in the Climate Action Plan. In parallel, the Technology Companies carry out their own shadow investigation, which will be presented after the summer of 2024, analysing a whole policy package consisting of three key elements: (1) policies that make it more expensive to burn fossil fuels (in particular diesel and petrol), (2) instruments that can support the electrification of the transport sector and (3) redistribution schemes that increase the acceptance of those most affected by climate policy.

According to the Technical Companies, industry in Sweden urgently needs clear signals from the policy on where Sweden is moving on this important issue for Swedish competitiveness. If we do not get the right signals from politics to the market, we risk losing billion-class investments to other countries that are currently in open arms and welcome investments in fossil-free technology.

The*association Svenskt Landskapskydd (FSL)* points out that the countryside and the sea appear to be forgotten parts of Sweden when it comes to how climate measures are to be implemented and considers that all problems remain even if compensation may be introduced in the future.

The FSL urges the Government to quickly and significantly reduce the importance of wind power and to carry out a proper analysis/investigation of how it has worked and may work or the right to fail.

The Riksförening motvind Sverige (network against the expropriation of wind power) notes that, although the draft provides information on the Tige Agreement and its implications, the draft does not contain any concrete traces of the intentions of the Tiö agreement. It is also stated that knowledge of the negative effects of wind energy is low among national politicians.

The Swedish National Association is also of the opinion that its views are ignored despite the fact that on several occasions it submitted a request for participation in the adoption of national energy and climate plans (NEKP), in accordance with the Aarhus Convention and the Governance Regulation. It is also of the opinion that the Government Offices keep important information for the Swedish people who have little knowledge of the NECP and that consultation bodies are regularly selected from among the representatives of the wind energy industry, while the Government Offices, the authorities and the Environment Court officials are infiltrated by wind power advocates and that there is abuse of power and corruption. The Swedish National Association is calling for a moratorium on wind energy.

Sweden is of the opinion that the plan contains good analyses, but that more detailed descriptions are needed on how the targets are to be met and how more biofuels can be

produced.

Green mobilists do not propose measures to enable Sweden to reach the targets and do not have any basis on how much it will cost Sweden not to meet its commitments to the EU.