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Ministry of Climate and Industry
Energy unit

Draft updated National Energy and Climate Plan (NECP) for Sweden

Basis for reporting pursuant to Article 14 of 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.

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OVERVIEW AND PROCEDURE FOR DRAWING UP THE PLAN

1.1 Summary

1.1.1 Political, economic, environmental and social context

The Governance Regulation1 entered into force in December 2018 and aims to ensure a coherent and coordinated implementation of the EU's energy and climate policies within the framework of the Energy Union. The Governance Regulation was introduced as part of the comprehensive "Clean Energy for All Europeans" package2 which aimed to maintain the EU's competitiveness in a context where the clean energy transition is changing global energy markets. The Governance Regulation requires Member States to communicate to the Commission by 31 December 2019, and thereafter by 1 January 2029 and every ten years thereafter, an integrated national energy and climate plan, the content and structure of which is governed by the Regulation. In January 2020, Sweden notified the Commission of its first integrated national energy and climate plan.

At one occasion during the intermediate ten-year period, the Governance Regulation also requires Member States to update the most recently notified integrated national energy and climate plan, or justify why such an update is not necessary. An updated version of the plan shall be submitted to the Commission by 30 June 2024, thereafter by 1 January 2034 and every ten years thereafter. No later than one year before those cut-off dates, Member States shall communicate to the Commission a draft update of the most recently notified plan. This document constitutes Sweden's draft update of the plan notified in 2020.

The integrated energy and climate plan builds on Sweden's existing targets and agreed policies and measures for the energy and climate area and scenarios based on them. As, in accordance with the climate policy framework, the government intends to present a new climate policy action plan during the year, some parts of the plan have not been fully updated. The Government also restores energy policy with, inter alia, a revised target of 100 % fossil-free electricity production by 2040, and is preparing an energy policy proposal.

1.1.2 Strategy on the five dimensions of the Energy Union

Overall, Swedish energy and climate policy is well in line with the ambition of the five dimensions of the Energy Union. Swedish energypolicy is based on the same three pillars as

Council Regulation (EU) 2018/1999 of the European1 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.
2IP/16/4009.

energy cooperation in 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. By 2045, Sweden shall not have any net greenhouse gas emissions into the atmosphere, and emissions from enterprises in Swedish territory shall be at least 85 % lower than those in 1990.

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

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

Targets	Target year	Base year
Sweden shall have no net emissions of greenhouse gases into the atmosphere, and then achieve negative emissions. No more than 15 % of the emission reductions shall be achieved through accompanying measures.	2045	1990
75 % reduction in emissions from sectors outside the EU ETS. Up to 2 % through accompanying measures.	2040	1990
63 % reduction in emissions from sectors outside the EU ETS. Up to 8 % through accompanying measures.	2030	1990
70 % reduction in transport emissions	2030	2010
100 % fossil-free electricity production	2040	
50 % more efficient energy use	2030	2005

For information on policies and measures see section 3.

1.2 Overview of current policy situation

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

Whereas on 18 October 2022 a coalition government, composed of ministers from the Moderates, Christian Democrats and Liberals, took office; The Government cooperates in the Riksdag with the Swedish Democrats.

1.2.1.1 Direction of the Government

The cooperation parties Moderates, Christian Democrats, Liberals and Sweden Democrats reached an agreement in October 2022 on the political direction for the 2022-2026 term of office, in the so-called Tidö Agreement.3 The agreement includes six cooperation projects under which political reforms will be developed and implemented. The cooperation project on *climate and energy* focuses, among other things, on increasing the amount of planned and fossil-free electricity generation in the energy system, not least by strengthening the conditions for new nuclear power, and on accelerating the roll-out of charging infrastructure.

3 https://www.regeringen.se/artiklar/2022/11/regeringens-politiska-prioriteringar/.

The Tidö Agreement states that the energy policy target is to be changed from 100 % ‘renewable’ to 100 % ‘fossil-free’ and that planning in the energy sector should be based on increased electricity consumption with a projected electricity demand of at least 300 terawatt-hours in 2045.

1.2.1.2 Sweden’s climate policy framework

In June 2017, the Swedish Parliament adopted a climate policy framework for Sweden.4 The framework was adopted by a large majority and consists of national climate targets, a Climate Law and a Climate Policy Council. The climate policy framework sets long-term conditions for business and society. The framework is a keycomponent of Sweden’s efforts to comply with the Paris Agreement. For details on Sweden’s national climate targets, see section 2.1.1.

1.2.1.3 Climate Law

The Climate Act (2017: 720) regulates the Government’s climate policy work, what it aims to do and how it is to be conducted. Section 3 of the Climate Act states that the Government’s climate policy work is to be based on the long-term time-bound emission target set by the Riksdag. The work shall also be carried out in accordance with the said paragraph 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 work and submit its planned measures to the Riksdag.

According to Section 4 of the Climate Act, each year the Government must present a climatereport to the Riksdag in the Budget Bill. In accordance with Section 5 of the Climate Act, the Government must present a climate policy action plan in the year following ordinary parliamentary elections. In the Action Plan, the Government sets out its policies to achieve the climate objectives during the mandate. The next climate action plan will be presented in 2023. The plan will therefore be updated accordingly in the parts related to climate policy.

1.2.1.4 Climate Policy Council

As part of the climate policy framework, the Government has established the Climate Policy Council, which 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.

1.2.1.5 Sweden’s fiscal framework

The Swedish fiscal framework consists of laws and practices aimed at ensuring that fiscal

4Government Bill. 2016/17: 146, bet. 2016/17: MJU24, rskr. 2016/17:320.

policy is sustainable and transparent in the long term. The framework governs the state budget process, which in turn sets the framework for the implementation of Swedish energy and climate policy.

1.2.1.6 The budgetary process

The budget process is mainly regulated by the Instrument of Government (1974: 152), the Riksdag Ordinance (2014: 801) and the Budget Act (2011: 203). The regulations require the Government to submit a Spring Economic Bill and a Budget Bill to the Riksdag the year before the start of the financial year. The spring bill is submitted in April and contains the government's proposal for 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 the forecast period, which is three years later. After the spring bill guidelines have been adopted 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 financial year, the Government may propose amendments to the State budget in a so-called amending budget.

1.2.1.7 Overall objectives of energy policy

Sweden's energy policy is based on the same three pillars as energy cooperation in the EU. The policy aims to reconcile environmental sustainability, security of supply and competitiveness. Energy policy must thus create the conditions for efficient and sustainable use of energy and a cost-effective Swedish energysupply with a low negative impact on health, the environment and climate and facilitate the transition to an ecologically sustainable society.

In June 2018, the Riksdag adopted the following objectives for energy policy:

- By 2 030, Sweden's energy consumption will be 50 % more energy efficient compared with 2005. The goal is expressed in terms of energy supplied relative to gross domestic product (GDP).5

In June 2023, the Riksdag adopted the following objectives:

- The objective for the composition of electricity production in 2040 is 100 % of fossil-free electricity production. This target replaces the previous target of 100 % renewable electricity generation.6

1.2.1.8 Just transition

Sweden's work towards a just transition is carried out through a general welfare policy. The Swedish *labour market policy* aims to ensure that all people who may have the opportunity

5Government Bill. 2017/18: 228, bet. 2017/18: NU22, rskr. 2017/18:411.
6Government Bill. 2022/23:99.

to participate in the labour market, as well as to provide security and facilitate transition in the labour market. Labour marketpolicies include measures to get young people into employment, job matching with job vacancies, labour market programmes, unemployment insurance and the European Social Fund. In the event of unemployment, workers have the possibility to receive compensation from the unemploymentinsurance scheme while they are looking for a job. Redeployment and skills support allows support in the form of advice and guidance to facilitate, inter alia, the transition and transition to new jobs or training both for employees and for employees whose employment is about to expire or end. In 2022, a new public outplacement grant was introduced to enable workers to study for at least 80 % of their salary for up to one year in order to strengthen their position in the labour market. *Social* security provides financial security at different stages of life and covers sickness insurance, pensions, parental insurance and parental allowances. As the ultimate safety net, there is the possibility to seek *financial assistance* for households experiencing difficulties in earning a living (see further 3.4.4).

In addition to the 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 Norrbotten steel industry, the mineral industry in Gotland and the metal industry in Västerbotten.[7] The Fund will mobilise EUR 311,5 million to invest in industries, through investment in research and innovation, as well as in reskilling and upskilling of workers. Of the total funding, EUR 155,7 million is made up of EU support.[8]

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

See section 3 for information on policies and measures.

1.2.3 Key issues of cross-border relevance

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

1.2.4 Administrative structure of implementing national energy and climate policies

1.2.4.1 The role of public authorities

In the field of energy and climate, the following authorities are in particular relevant for the

7 https://tillvaxtverket.se/tillvaxtverket/sokfinansiering/omvaraolikastod/eufinansieratstod/fondenforenrattvis - stocking.1909.html.
8 https://ec.europa.eu/commission/presscorner/detail/sv/ip_22_5316.

implementation of national policies:9

TheSwedish Energy Agency (Swedish Energy Agency) operates in various sectors of society to create the conditions for efficient and sustainable energy use and cost-effective Swedish energy supply.

TheSwedish Environmental Protection Agency plays a central role in environmental work and is to drive, support and gather 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, propose measures for the development of environmental work.

TheEnergy Market Inspectorate supervises the energy markets for electricity, natural gas and district heating.

The Swedish National Energy Administration's Swedish National Grid (Svenska kraftnät) is responsible for managing Sweden's electricity transmission network. Swedish power grids also have theresponsibility for Swedish electricity supply, which means ensuring that the electricity system is in balance in the short term and that its installations interoperate safely.

The Swedish Meteorological and Hydrological Institute (SMHI) provides planning and decision-making information for weather- and water-dependent activities. The authority acts as a community expert body in meteorology, hydrology, oceanography and climate and is a resource for environmental work.

The National Board ofHousing, Building and Planning is the national authority for town and country planning, urban development, construction and housing. The Board is the central authority for matters relating to the built environment and management of land and water areas, for spatial planning, construction and management of settlements and for housing and housing financing issues.

The Research Council for Environment, Area Industries and Community Building (Formas) supports and communicates on research in its fields. The Council promotes environmentally sustainable growth and development.

County Administrative Boards – Sweden is divided into 21 counties, all of which have a county administrative board headed by a county governor. The County Administrative Board is a state coordinating authority, a service authority and an appeal body, and has

The9 descriptions of the activities of public authorities are taken from the Government's website unless otherwise specified: www.regeringen.se.

responsibility for review and supervision. The County Administrative Board ensures that the national targets set by the government are implemented and have important roles in coordinating and leading the establishment and implementation of regional energy and climate strategies, as well as in providing certain state aid for energy and climate purposes.

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

1.2.4.2 The role of municipalities and regions

Municipalities are important in Sweden's climate action through proximity to citizens and through their responsibility for, for example, spatial planning, local transport infrastructure, construction and environmental supervision. The municipalities are large employers responsible for education and care and in many cases own real estate and energy companies. Municipalities are responsible for local development in cooperation with businesses, organisations, residents and other stakeholders, thereby helping to achieve defined national and local objectives. A number of initiatives are ongoing at local level to contribute to Sweden's national climate targets.

The regions, one for each county, are important in Sweden's climate action based on their responsibility for health, public transport, culture, transport infrastructure and regional growth. Regional growth refers to efforts to achieve sustainable regional growth and development. Regions of Stockholm, Skåne and Halland are also responsible for regional spatial planning.

The regional energy agencies work on missions and projects in cooperation with public and private stakeholders. Energy agencies shall not compete with private companies and operate as independent, non-profit and non-profit-making energy bodies. The 15 Swedish energy agencies have been an important part of the EU's energy policy since the 90s.

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 targets and instruments decided by the Riksdag and the Government.

1.3.2 Involvement of local and regional authorities

Local and regional authorities are involved in the same way as other stakeholders in section 1.3.3.

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

Consultation for the final updated plan is planned in autumn 2023, on the basis of this draft.

The policy objectives and instruments described in this plan have been subject to the usual consultation procedure, which gives interested parties and the general public the opportunity to comment. The memorandum from the Council of State entitled 'Reply for referral – If referrals of reports and other proposals from the Government Offices' (SB PM 2021: 1) describes how and why referrals are sent and how referrals are technically dealt with in the further preparation. Some of the processes in which different parties have been given the opportunity to comment on key objectives, policies and measures are described below.

1.3.3.1 Climate policy framework

The proposal for the climate policy framework and a long-term target for 2045 were drawn up on behalf of the Government in the years 2016-2014 by a party's cross-parliamentary-committee, the Environmental Target Preparatory. The preparation also developed a proposal for a long-term climate and air pollution control strategy including interim targets for 2030 and 2040.

The Environmental Target Preparatory was set up by the Government in July 2010 to reach broad political consensus on a number of environmental issues. In the preparation of the climate policy framework and the climate and air pollution control strategy, the preparation of the seven parties represented in the Riksdag at the time of the preparation and a chair was made. The preparatory work involved 30 experts representing different categories of stakeholders: public authorities, business representatives, scientists, environmental organisations and trade unions. These experts participated in a number of the monthly meetings of the preparatory work during the duration of the mission. The experts then had the opportunity to participate in discussions and to express their expertise. Key issues discussed in this context were the level of ambition and timing of the long-term objective. At these meetings, the research representatives and environmental organisations stressed the importance of the net-zero objective and the need to do so within a short timeframe in order to be in line with the conclusions of the Intergovernmental Panel on Climate Change (IPCC). Furthermore, the experts had the opportunity to react to assumptions about the potential for action made in the scenarios that formed part of the basis for developing intermediate targets for 2030 and 2040.

To raise awareness of opportunities and challenges to reduce emissions and discuss governance, around ten workshops were held during the mission on how the transition could be implemented in different sectors of society, with a wider participation of experts and stakeholders. With representatives from a number of industrial sectors (basic materials,

bioeconomy and agriculture) and the Academy, dedicated roundtables were also organised to discuss options for action and possible governance.

After reporting its mandate, the proposal for a climate policy framework and a long-term target for 2045 was sent to around 200 consultation bodies for three months.10 A corresponding consultation procedure was also carried out for the long-term climate and air pollution control strategy.11 The bodies consulted were basically all types of actors: non-governmental organisations (NGOs), industry associations, think tanks, universities and colleges, public authorities and others. The referrals showed broad support for the climate policy framework and targets.

1.3.3.2 Energy Commission

The energy policy objectives were developed in the framework of a parliamentary committee, the Energy Commission, which operated in 2015-2016. EnergyCommission Registry organised six major seminars in the Commission's focus areas; use, supply, transmission and market. The seminars were attended by representatives of industry associations, trade unions, researchers, environmental organisations, industry, ministries and authorities, as well as a number of other experts from Sweden and other countries. The seminars were open to the public, webstreamed and documented on the Energy Commission website, which also published information on the Commission's work on an ongoing basis. The Chancellery also held two expert seminars, one focusing on the electricity and heat markets and the other focusing on energy stocks. In addition, the Energy Commission, in cooperation with the Swedish Energy Companies Association, conducted a roundtable on the future of electricity market design. In July 2016, during the Almedalen Political Week, the Energy Commission organised a seminar on the Framework Agreement concluded in June 2016.

In the course of the work, 14 regular meetings were held with the Members of the Energy-Commission and the three specifically invited Directors-General of the Swedish Power Grid, the Energy Market Inspectorate and the Energy Agency. Meetings were held with external partners – Svenskt Näringsliv, Energy Companies Sweden, Swedish Association of Local Authorities and Regions (now the Swedish Association of Local Authorities and Regions) andNature Conservation Association – in order to gain a deeper understanding of the positions of various stakeholders. The Energy Commission presented its report "KraftCollection for the Energy of the Future" (SOU 2017: 2) in January 2017.

10 https://www.regeringen.se/remisser/2016/03/remiss-av-delbetankande-fran-miljomalsberedningen-med- forslag-om-one climate policy- ramverk-inclusive-langsigt-climatemal/.
11 https://www.regeringen.se/remisser/2016/06/remiss-av-delbetankande-fran-miljomalsberedningen-med- forslag-om-en-climate and air maintenancestrategies-for-sverige/.

1.3.3.3 Input to the Government's climate action plan

As described in 1.2.1, the government will present a new climate policy action plan in 2023. Ahead of this, the Government has instructed the three authorities Tillväxtanalys, Transport Analysis and the Uppsala County Administrative Board to produce documents containing analyses and proposals for policies and other measures for the climate transition of the business sector, the climate transition of the transport area and the local and regional climate transition. The assignments have been carried out in cooperation with several authorities such as the Swedish Environmental Protection Agency, the Energy Agency and the Transport Administration. In addition to these, the Swedish Environmental Protection Agency has been tasked with producing a basis for the climate action plan.

The documents have been circulated for consultation to a total of about 100 different actors in the public, private and non-profit sectors. The documentation has 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.12

In addition to the above, as part of the preparation of the climate action plan, the Government has invited both sectoral roundtables with business and civil society and a national climate meeting with Swedish businesses and trade unions, researchers, the public sector and civil society, among others. Work on a climate action plan will build on the roadmaps developed by FossilFree Sweden together with various sectors of the economy (see 3.1.1.1).

1.3.4 Consultation of other Member States

A draft of Sweden's updated integrated national energy and climate plan is planned to be sent for comments to Denmark, Finland and Norway in view of the submission of the final updated plan.

See also Section 1.4.1.

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 developing an update of their integrated energy and climate plans.

12 https://www.regeringen.se/remisser/2022/12/remiss-om-redovisning-av-underlaget-om-naringslivets- climate sequestration-day-Commission-Climate Policy/ActionPlan/.

https://www.regeringen.se/remisser/2022/12/trafikanalys-rapport-202214--forslag-som-leder-till- transport sector-climate installation/.

https://www.regeringen.se/remisser/2022/12/remiss-av-rapport-underlag-om-lokal-och-regional- climate installation-day-Commission-climate policy-action/ActionPlan/.

1.4 Regional cooperation in preparing the plan

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

On 20 August 2019, the Ministers of the Nordic countries adopted a vision for the Nordic Council of Ministers. In order to realise the vision, three policy areas were prioritised in the work of the Nordic Council of Ministers over the next four years: a green Nordic, a competitive Nordic and a socially sustainable Nordic region.

A number of joint or coordinated planning activities are under way in the Green Nordic Strategy area, which can contribute to the development and fulfilment of the Nordic countries' integrated energy and climate plans.

In order to improve the conditions for reaching the 2030 targets, a Nordic Energy Policy Cooperation Programme 24-2022 has been developed which includes a number 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 energy, 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 Annex 2 for a detailed 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 an observer). The aim of the cooperation is to interconnect the countries' gas and electricity markets. In 2020, a special group was created to develop cooperation in offshore wind energy in the Baltic Sea.

1.4.2 Explanation of 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 Reduction Dimension

2.1.1 GHG emissions and removals

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

The Member State's binding national target for greenhouse gas emissions and the annual binding national limits pursuant to Regulation (EU) 2018/842;

The non-trading sector consists of emitting sectors that are not part of the EU Emissions Trading System (EU ETS) or the Land Use, Land Use Change and Forestry (LULUCF) Regulation. Examples of sectors not included in the EU ETS or LULUCF are heating of dwellings and premises, agriculture and domestic transport (excluding domestic flights). Each Member State has a national bait under the EU13Effort Sharing Regulation (ESR). Sweden's contribution under burden-sharing is to reduce these emissions by 50 % in 2030 compared to 2005 emissions. Sweden's emission space within the ESR is estimated to be 29 592 278 CO2e for 2023. For 2024 and 2025, the estimated space is 28 452 560 and 27 312 842 CO2e respectively. The calculated values shall be confirmed in an implementing act.

Commitments by the Member State under Regulation (EU) 2018/841

In 2023, the EU decided on a revised LULUCF Regulation.14 The revision is part of achieving the objectives of the EU Climate Law.15 The revised LULUCF Regulation maintains the approach from the first commitment period 2025-2021 decided in 2018. The Regulation is divided into two periods, 2021-2025 and 2026-2030.

The starting point in the first commitment period of the LULUCF Regulation is that each Member State undertakes to ensure that the LULUCF sector does not result in accounting reductions or increases in emissions compared to the accounting rules laid down in the Regulation. With the revision of the LULUCF Regulation, all Member States have received a commitment to reduce net emissions or increase net removals by 2030 in order to enable the EU to obtain on an aggregated basis net removals of 310 million tonnes of carbon dioxide equivalent. Sweden has received a commitment to increase netremovals by 2030 by

13Council Regulation (EU) 2018/842 of 30 May 201 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) No 525/201 3.
14Council Regulation (EU) 2018/841 of 30 May 201 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.
Council Regulation (EU) 2021/111 9 of the European15 Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 20 1 8/1 999 ('European Climate Law').

almost 4 million tonnes of carbon dioxide equivalent against the average of the reference period 2016-2018.

2.1.1.2 Where applicable, other national objectives and targets consistent with the Paris Agreement and the existing long-term strategies. Where applicable for the contribution to the overall Union commitment of reducing the GHG emissions, other objectives and targets, including sector targets and adaptation goals, if available

In June 2017, the Riksdag adopted a national climate policy framework for Sweden. The framework consists of a Climate Law, national climate targets and a Climate Policy Council. For more information on the climate policy framework, see section 1.2.

Sweden's national climate target consists of four main components.

- An overarching and non-temporal environmental quality objective linked to limiting the global average temperature increase;
- A long-term emission target for Sweden by 2045.
- Interim targets for Swedish emissions outside the EU ETS by 2030 and 2040.
- A specific interim target for greenhouse gas emissions from domestic transport (excluding domestic aviation included in the EU ETS) by 2030.

Swedish environmental quality objective Restricted climate impact

In order to provide a clear structure for environmental work in Sweden, the Riksdag has adopted 16 environmental quality objectives. One of these, the mitigation *of climate change*, is the basis for action against climate change. The objective has been clarified as (see Bill. 2016/17: 146, p. 24):

> *"The global average temperature increase is limited to well below 2 degrees Celsius above pre-industrial levels and efforts are being made to keep the increase below 1,5 degrees Celsius above pre-industrial levels. Sweden shall work internationally to ensure that global efforts are geared towards this goal."*

A long-term emission target

By 2045, Sweden shall have no net emissions of greenhouse gases into the atmosphere, and then achieve negative emissions. The target is that greenhouse gas emissions from Swedish territory should be at least 85 % lower in 2045 than those in 1990. In order to reach the target, carbon capture and storage of fossil origin may also be counted as a measure where there are no reasonable alternatives. The remaining emissions to reach zero, corresponding to a maximum of 15 % of emissions in 1990, can be achieved through so-called accompanying measures. The climate target is illustrated in Figure 1.

Intermediate targets for greenhouse gas emissions by 2030 and 2040

- By 2030, greenhouse gas emissions in Sweden in the ESR sector should be at least 63 % lower than those in 1990. No more than 8 percentage points of emission reductions may be achieved through accompanying measures.
- By 2030, greenhouse gas emissions from domestic transport, excluding domestic flights included in the EU ETS, should be at least 70 % lower compared to 2010.
- By 2040, greenhouse gas emissions in Sweden in the ESR sector should be at least 75 % lower than those in 1990. No more than 2 percentage points of emission reductions may be achieved through accompanying measures.

Accompanying measures

In order to achieve the long-term objective by 2045 and the milestones, accompanying measures may be counted in accordance with internationally agreed rules. However, the way in which this is to be done has not yet been decided. Complementary measures known today include increased net removals in forests and land, verified emission reductions from investments in other countries, and bioCCS.

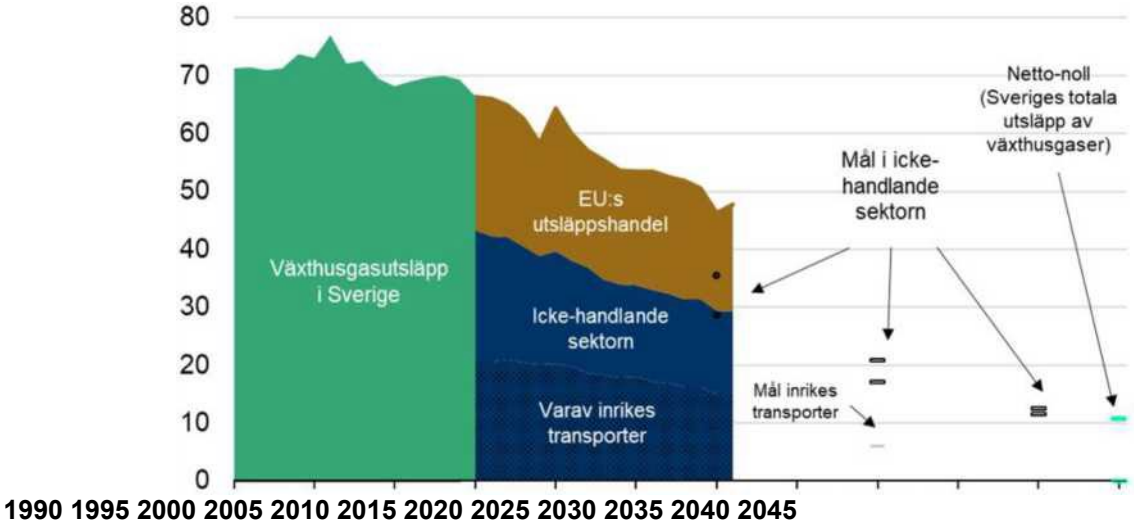

Figure 2. Sweden's climate targets (with and without the possibility of using so-called 'flanking measures') and historic emissions. The levels marked with lighter colour are the target level with maximum use of accompanying measures, while darker colours are the target level without the use of complementary measures. Historical emissions are divided into trading and non-trading sectors (ESR) from 2005 onwards, when the EU ETS started in 2005.

Adaptation to climate change

The government's goal for climate adaptation is to develop a sustainable and resilient society that actively addresses climate change by reducing vulnerabilities and seizing opportunities. In March 2018, the government decided to submit the National Strategy on Adaptation to Climate Change (Bill.
2017/18: 163) to the Riksdag. The strategy describes mechanisms for coordination, monitoring, evaluation and revision of adaptation efforts. Building on the projected societal impacts, seven particularly pressing challenges are identified for further work on adaptation to climate change. The strategy also identifies a number of guiding principles on which work on adaptation to climate change in Sweden should be pursued.

As work on adaptation to climate change covers a wide range of topics, it is largely guided by existing regulatory frameworks, frameworks and objectives, both national and international. This includes, for example, the objectives of Agenda 2030, the Paris Agreement and the Sendai Framework onDisaster Reduction. A new National Strategy on Adaptation to Climate Change and the Government's Action Plan on Adaptation to Climate Change are expected to be adopted in 2023.

The European Commission adopted a new strategy on adaptation to climate change in February 2021. The strategy aims to make Europe more resilient to climatechange and has four main objectives: making adaptation smarter; speeding up alignment; greater integration of adaptation into relevant policy areas; stepping up international action on adaptation to

climate change; The European Parliament and Council Regulation (EU) 2021/111916 (European Climate Law) provide a framework for making progress towards the global adaptation goal set out in Article 7 of the Paris Agreement. Sweden's new adaptation strategy will relate to the Regulation and the EU Adaptation Strategy.

Air transport policy

Sweden's commitments under the revised Directive on the reduction of national emissions of certain atmospheric pollutants, also known as the 'cap directive'17, set emission ceilings for sulphur dioxide (SO2), nitrogen oxides (NOx), volatile organic compounds (NMVOC), particulate matter ($PM_{2,5}$) and ammonia (NH_3). Emission ceilings are to be met by 2030 and 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 2030 are set out in Table 2 and Table 3.

Table 2. Sweden's commitment under the new ceiling directive for 2020 and 2030 in% with 2005 as the 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

Table 3 presents a comparison between the cap commitment and statistics and the latest projected scenarios (from 2023) for future air pollutant emissions.18

Table 3. Statistics and projected emissions in ktonnes for the year of the latest scenario commitment or target, the level of emissions to be/should be according to the commitment/target and the respective gap.[19].

	NOx (kton)	SO2 (kton)	NMVOC (kton)	NH3 (kton)	PM2,5 (kton)
Projected emissions in 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

Council Regulation (EU) 2021/11 19 of the European16 Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 201 8/1 999.
Directive (EU) 2016/2284 of the17 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.
18 https://cdr.eionet.europa.eu/se/eu/nec_revised/

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 emissions for ammonia by 2,6 kton and by 2030 the commitment will be exceeded by about 0,7 kton according to the gap analysis. By 2025 and 2030, ammonia emissions will need to be reduced by about 5 % and 1.5 % compared to projected emissions in the scenario in 2025 and 2030 to meet the indicative target and commitment. For NOx, the situation has improved compared to the first air pollution control programme.19 20According to the latest scenario, Sweden is now expected to reach the indicative target by 2025. However, the scenario indicates that Sweden does not reach the commitment by 2030 under current governance. NOx emissions need to be reduced by a further approximately 10 kton by 2030, equivalent to an emission reduction of around 14 % compared to projected emissions under the scenario by 2030.

2.1.2 Renewable energy

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

With a view to achieving the Union's binding target of at least 32 % of renewable energy in 2030 as referred to in Article 3 of Directive (EU) 2018/2001, 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. 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 bindingnational target of that Member State for 2020 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, expressed as the difference between the bindingnational target of that Member State for 2020 and its contribution to the 2030 target. By 2027, the indicative trajectory shall reach a reference point of at least 65 % of the total increase in the share of energy from renewable sources, expressed as the difference between the bindingnational target of that Member State for 2020 and its contribution to the 2030 target.

By 2030, the indicative trajectory shall reach at least the MemberState's planned contribution. If a Member State expects to surpass its binding 2020 national target, its

The19 inventory was reported on 9 February 2023 and the scenarios on 4 March 2023; https://cdr.eionet.europa.eu/se/eu/nec_revised

indicative trajectory may start at the level it is projected to achieve. Theindicative trajectories of Member States shall collectively reach the Union reference points in 2022, 2025 and 2027 and the Union's binding target of at least 32 % renewable energy in 2030. Separately from its contribution to the Union target and its indicative trajectory for the purposes of this Regulation, a Member State shall be free to indicate higher ambitions for national policy purposes;

In July 2019, the Commission presented a proposal to revise the Renewable Energy Directive, the Renewable Energy Directive21, as part of the Fit for 55 legislative package. A provisional political agreement was reached in March 2023 on the Directive, including a higher overall target for the share of renewable energy in an EU target. The Directive is expected to be adopted and enter into force in autumn 2023 and the Government intends to start implementation and consider how it will be taken into account in the final updated plan.

Sweden does not have a national target for the share of renewable energy by 2030. Sweden's current integrated energy and climate plan used:

The Swedish Energy Agency's long-term scenarios22 from 2018 on the basis of which instruments were adopted as a starting point for a national contribution to the Union's common objectives for 2030. 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.

Sweden will present in the final updated integrated national energy and climate plan a new national renewable contribution, which represents an increase in ambition compared to the current plan, which reports a national contribution of 65 %. Section 4.3 presents the latest scenarios for the renewable part by 2030. The reason why these are not used for the national contribution in this draft is that new policy orientations in this area have been announced in spring 2023, which could not be analysed in the scenarios, and that there is reason to wait for the revision of the Renewables Directive to come into force.

It follows that Sweden does not update the indicative target trajectory in this draft either.

The indicative target trajectory shall be based on the binding target for 2020 (which Sweden overachieved) and result in national contributions for 2030. The indicative trajectory does not set any limits on higher national ambitions and targets or on the development of national policies.

Directive (EU) 201 8/2001 of the21 European Parliament and of the Council on the promotion of the use of energy from renewable sources

22Swedish Energy Agency – Scenarios of Sweden's energy system in 2018 (ER 2019: 7).

2.1.2.2 Estimated trajectories for the sectoral share of renewable energy in final energy consumption from 2021 to 2030 in the electricity, heating and cooling and transport sector;

The latest long-term scenario, which will be updated in view of the final update of the plan, is described in detail in section 4.2.2 including trajectories for renewable share in the electricity, heating and cooling and transport sectors.

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

The Government has not taken a position on the specific types of energy to be used and the extent to which each technology is to be used to achieve the trajectory for renewable energy.

In a 2023 scenario, which does not, however, include new policies or revisions of EU directives, an estimated distribution of renewable energy by technology as well as total and sectoral energy use by 2030 has been produced. This breakdown is presented in section 4.2.2.

The expected total gross final energy consumption23 increases slightly in this scenario – from 35 Mtoe in 2021 to 38 Mtoe in 2030. In the heating and cooling sector, the corresponding energy consumption remains unchanged and 16 Mtoe in 2030. The transport sector slightly decreases from 2021 to 6,5 Mtoe in 2030 and in the electricity sector energy consumption is 16 Mtoe in 2030, an increase of 3 Mtoe from 2021.

The total installed electricity generation capacity increases from 44 GW in 2021 to 67 GW in 2030 in the scenario. The installed capacity of wind power, which increases most, increases by 13 GW between 2021 and 2030, as can be seen in Figure 4. Solar power increases in the same period by just under 5 GW. However, the scenario model lacks information on how the additional capacity will be allocated between new capacity and upgrades.

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The23 denominator of the calculation of the share of renewable energy;

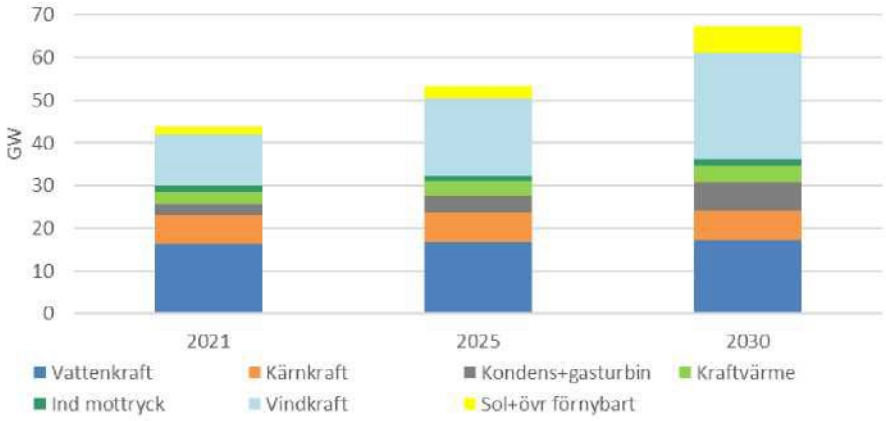

Figure 4. Installed capacity per power type in the Swedish Energy Agency's Lower electrification scenario, 2020-2030, GW. Note: The model results assume normal operation, which is likely to underestimate the need for reserve power.

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 Swedish Energy Agency's latest long-term scenario, which does not take into account new policies or new revisions of EU directives, the total use of bioenergy increases by just over 11 TWh between 2021-2025 and reaches 162 TWh.
The use of bioenergy amounts to 166 TWh in 2030.

In the heating and cooling sector, the use of bioenergy decreases by just over 3 TWh between 2021 and 2025, before falling further by just over 0.5 TWh, to 112 TWh in 2030. The reduction takes place both in the solid biofuels category and in the end (a residue in pulp production), while the category of bioliquids is slightly increasing.

Inthe transport sector, the use of biofuels increases by 14.5 TWh between 2021 and 2025. The use of bioenergy in the category increases under the scenario by a further 4.5 TWh by 2030. The increase in the scenario is mainly due to an increase in the use of HVO (around 15 TWh), which is currently mainly produced from waste and residues.24 The government and the Swedish Democrats have reached a political agreement that the reduction obligation should be set at 6 % during the current term of office (2024-2026).

24Swedish Energy Agency – Driving medium 2021 (ER 2022: 08).

In the electricity sector, the scenario shows only a marginal reduction in the use of bioenergy by just over 0.5 TWh between 2021 and 2030.

Today, there is an import into Sweden of biomass raw materials for all three user sectors, in particular biofuels for transport.

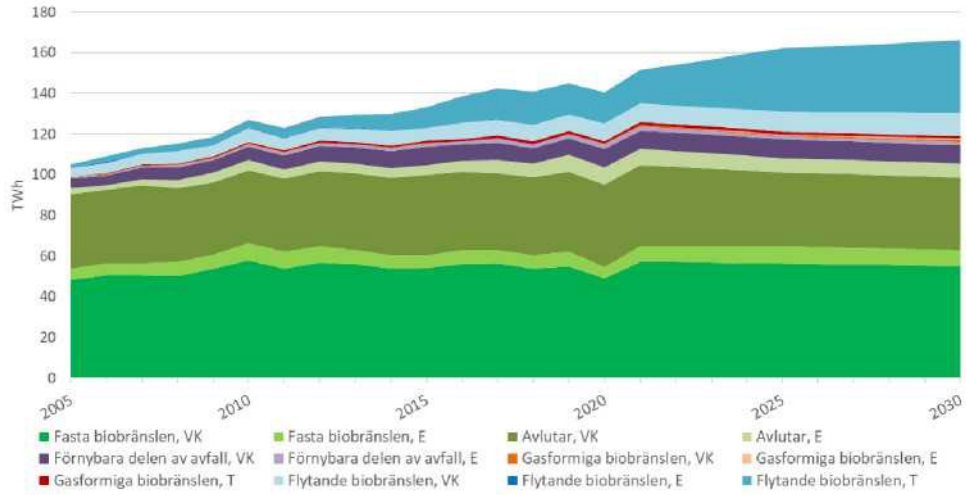

Figure 5. Use of bioenergy in the heating and cooling, electricity and transport sectors by type of biomass between 2005 and 2030 and assessment in the Swedish Energy Agency's scenario to 2030, TWh. Source: The Swedish Energy Agency.
Note: T = Transport, E = El, and VK = Heat and cold.

The use of solid biofuels decreases marginally between 2021 and 2030 by just over 2 TWh.

2.1.2.5 Where applicable, other national trajectories and objectives, including those that are long term or sectoral (e.g. share of renewable energy in district heating, renewable energy use in buildings, renewable energy produced by cities, renewable energy communities and renewables self-consumers, energy recovered from the sludge acquired through the treatment of wastewater)

2.2 Dimension energy efficiency

2.2.1 The information referred to in Article 4(b)

2.2.1.1 The indicative national energy efficiency contribution to achieving 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; Member States shall express their contribution in terms of absolute level of primary energy consumption and final energy consumption in 2020, and in terms of absolute level of primary energy consumption and final energy consumption in 2030, with an indicative trajectory for that contribution from 2021 onwards. They shall explain their underlying methodology and the conversion factors used;

Sweden has a target of 50 % more efficient energy use by 2030 than in 2005. The target is expressed as a cross-sectoral objective of reducing energy intensity, i.e. the ratio of energy input (primary) to real GDP. Figure 6 shows progress towards the target.

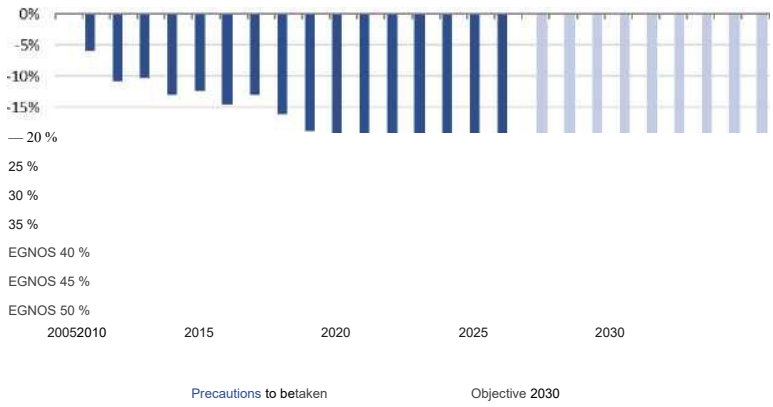

Figure 6. Energy intensity target by 2030. Statistics up to 2021, followed by an assumed linear trajectory to the target year. Source: The Swedish Energy Agency.

As the Swedish target for 2030 is an energy intensity target, there is no fixed level of input (primary) and final energy consumption when meeting the target. Assuming annual economic growth of 2 %, primary energy consumption at target achievement in 2030 is estimated to be 470 TWh. Final energy consumption at target achievement in 2030 is estimated to be 347 TWh. These levels are not target levels. Different GDP developments result in different levels of energy consumption. The calculation has been updated and now includes foreign flights in the same way as the EU's energy efficiency objectives.

In the Swedish Energy Agency's long-term scenarios, which however do not take into account the new government's energy policy and new revisions of the EU directives (see

section 4), Sweden is estimated to have a primary energy use – in practice the same as supplied energy – of 523 TWh and an end use of 392 TWh in 2030. The evolution of energy intensity depends, in addition to GDP developments, 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.

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

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

The current Energy Efficiency Directive requires Member States to achieve cumulative end-use energy savings for the whole savings obligation period 2021-2030 equivalent to new annual savings of at least 0.8 % of the average final energy consumption in 2016-2018. According to Eurostat data, the average final energy consumption in 2016-2018 was 371 TWh for Sweden, bringing the total savings requirement to 165 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;

Sweden reported its long-term renovation strategy, including the indicative milestones, to the Commission in 2020.

The *indicative milestones* are:

1) Lower energy consumption of the building stock (kWh/m^2) than at the previous milestone for 2030, 2040 and 2050.

2) Higher share of buildings with energy classes A-C and lower share of buildings with energy classes E-G for the years 2030, 2040 and 2050 than at the previous milestone with the 2020 classification.

3) The share of fossil fuels used in the building stock should be no more than 1 % in 2030 and 0 % in 2040 and 2050.

The*progress indicators* for point (1) are:

a) Temperature corrected energy consumption (kWh/m^2, year) for heating and hot water in single-family houses, multi-dwelling buildings and premises.

b) Use of electricity for buildings (kWh/m^2, year)

c) Specific energy consumption (kWh/m^2, year) for single-family houses, multi-dwelling buildings and premises

d) Share of buildings with direct-acting electricity

e) Energy use 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 each milestone compared to 2020. For point 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 simulation programme HEFTIG. Thescenarios show how the energy consumption of buildings can evolve, provided that existing or equivalent instruments continue to apply and that property owners work in the same way as today on energy efficiency and renovation of their buildings. Reference scenarios have been developed for apartment buildings, schools and offices. Scenarios for other premises and single-family houses are missing.

The scenarios estimate that purchased heat, i.e. purchased energy for heating and hot water including electricity for heat pumps but excluding property energy, could decrease by a total of 3 221 GWh between 2020 and 2030 in multi-dwelling houses, schools and offices. This represents a reduction of just over 9 % over the period. Under the same scenarios, electricity purchased, i.e. domestic electricity, real estate electricity and business electricity, but excluding electricity for heat pumps, is expected to decrease by a total of 298 GWh between 2020 and 2030 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 (both positive and negative) in addition to the more direct effect in terms of reduced energy consumption and improved net operating. These side effects are usually divided into effects of an economic, social or environmental nature (see below). However, all these effects are translatable in terms of

socio-economic added value or added costs. Positive side effects (additional values) that benefit residents, but for whom they do not have to pay (for example, an increase in the attractiveness of the area not reflected in the rent) increase the 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. As there are side effects that fall outside the real estate economic calculation basis (such as the ones mentioned above), this means that theeconomic profitability of the building with energy-efficient renovation is different from, and probably underestimates, the socio-economic benefits of this.

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

Sweden applies the alternative approach made possible by Article 5(6) of the Energy Efficiency Directive.25 The total savings obligation for the period 2021-28,6 is 2 030 GWh. The savings requirement is distributed between the Fortifikningsverket, which must save 15.8 GWh, and the National Property Board, which must save 12.8 GWh. By decision of 11 December 2019, the Government instructed:

The Fortifikationsverket and the National Property Agency to take measures that result in the abovementioned energy savings.

According to Article 5(2) (a) of the Energy Efficiency Directive, buildings officially protected as part of a designated environment or because of their particular architectural or historical value, to the extent that, after the adoption of certainminimum energy performance requirements, would entail unacceptable changes to their characteristics or appearance, do not need to be included in the building stock. Sweden makes use of this derogation, which means that these types of buildings are not included in the buildingstock.

According to Article 5(2) (b) of the Energy Efficiency Directive, buildings serving national defence purposes, with the exception of accommodation buildings for individuals or office buildings for the Armed Forces and other staff employed by the national defence authorities, do not have to be included in the building stock. Sweden makes use of this derogation. Only the open stock of the Fortifikationsverket is therefore covered.

2.2.2 The indicative milestones for 2030, 2040 and 2050, nationally

Directive 2012/27/EU of the25 European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC;

established 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 targets or strategies and sectoral targets, and national objectives in areas such as energy efficiency in the transport sector and with regard to heating and cooling

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:

— **management of limited or interrupted energy input 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;**

— **increased diversification of energy sources and supplies from third countries;**
the aim may be to reduce dependence on energy imports; and

— **increased flexibility of the national energy system;**

As regards the objectives relating to the management of limited or interrupted energy supplies, the responsibility for security of energy supply is shared among a wide range of actors. The three basic principles of Swedish crisis management are:

- The principle of accountability: The person responsible for an activity under normal conditions shall have it during a crisis situation.
- Principle of equality: During a crisis, the operations shall operate in a similar way as under normal conditions – as far as possible. The activities shall also, where possible, be carried out at the same location as under normal conditions.
- Proximity: A crisis shall be managed where it occurs and by those most closely involved and responsible.

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

Energy supply is a key component of society and disruptions can quickly have consequences in other essential activities. Security of energy supply is an integral part of the response to thesocietal crisis and civil defence. Overall defence decisions for the years 2021 to 2025 state that the starting point for planning the total defence should be to be able to cope with a security policy crisis in Europe and Sweden's neighbourhood that seriously disrupts the functioning of society and wars for part of this period for at least three months. Energy supply is one of the most important societal functions and needs to be adapted to meet total defence expectations (Govt. 2020/21: 30, p. 128).

Energy markets, which are increasingly international, need to be developed to prevent and mitigate disruptions and shortages. The public sector has an important role to play in designing the framework and controlling energy markets so that they function well and meet societal expectations.

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

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

Electricity supply

In accordance with the requirements of the Risk Preparedness Regulation for electricity26, Sweden has a risk-preparedness plan for the electricity sector.

The Electricity Market Regulation27 requires all Member States with a capacity mechanism to define a supply security target in the form of a reliability standard. Sweden has a capacity mechanism in the form of a power reserve since 2003 in order to deal with peaks in electricity supply in winter, see section 3.3 for more information. On 17 November 2022, the Government adopted a reliability standard for Sweden of one hour per year (I2022/02083). It corresponds to a target of reliability whereby the production and import of electricity will be

Council Regulation (EU) No 209/941 of the European26 Parliament and of the Council of 5 June 2019 on risk-preparedness in the electricity sector and repealing Directive 2005/89/EC
Council Regulation (EU) 2019/943 of the European27 Parliament and of the Council of 5 June 201 on the internal electricity market 9.

able to cover the full expected consumption requirement of 99.989 % of the time.

The transmission network is planned and operated according to the so-called n-1 criterion, which means that a failure of a single component should not affect the supply of electricity. If such a failure occurs, the consequences shall be remedied within 15 minutes and the electrical system shall be ready for any new failure.

This requires access to support services and remedies as well as a rapidly available active disturbance reserve.[28] If the network is damaged, the necessary repair measures must be initiated without delay.

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

Electrical energy and electrical power shortages are described in more detail in section 3.3.

Future impact adequacy analyses are described in section 4.4.

Oil supply

As far as oil supply is concerned, Sweden, through the IEP Agreement and[29] the Oil Storage Directive, is the[30] association to maintain emergency stocks equivalent to 90 days of net imports. For more information on this, see section 3.3.

Gas supply

As regards gas supply, the EU Gas Supply Regulation (EU) 2017/1938 requires protected customers to have access to gas for at least 30 days in case of supply disruption or disruption.[31] Sweden has only included households in the definition of protected customers, which represents 2 % of gas consumption on the western Swedish gas network. Work to ensure security of supply in the western Swedish gas system has continued in accordance with the requirements of EU regulations, and has taken place within the framework of the Energy Agency's role as the competent authority for gas in Sweden, and the associated

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

[29] International Energy Agency (IEA) Agreement on a Joint Energy Programme.

[30] 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;

[31] European Parliament and Council Regulation (EU) 2017/1938 of 25 October 201 7 concerning measures to safeguard the security of gas supply and repealing Regulation (EU) No 994/2010.

regulatory role.32 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.

2.3.2 National objectives with regard to increasing: the diversification of energy sources and supply from third countries for the purpose of increasing the resilience of regional and national energy systems

See Section 2.3.1.

2.3.3 Where applicable, national objectives with regard to reducing energy import dependency from third countries, for the purpose of increasing the resilience of regional and national energy systems

See Section 2.3.1.

2.3.4 National objectives with regard to increasing the flexibility of the national energy system, in particular by means of deploying domestic energy sources, demand response and energy storage

Existing oil emergency stocks are based on the objectives of minimum stocks, which are set out in the Oil33 Storage Directive and the International Energy Programme Agreement requiring members of the International Energy Agency (IEA) to hold 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 that the Member Statestriving for 2030

The Governance Regulation requires Member States to report on:

"The level of electricity interconnection pursued by the Member State for 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 the urgency of the measures:

32European Parliament and Council Regulation (EU) 2017/1938 concerning measures to safeguard the security of gas supply and the new additional Regulations (EU) 2022/1369 concerning coordinated actions to reduce gas demand, and (EU) 2022/1 032 amending Regulations (EU) 2017/1938 and (EC) No 715/2009 as regards gas storage.
33Council 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;

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 of less than 30 % of installed renewable energy generation capacity;';

Sweden has no explicit target for the level of electricity interconnection by 2030, namely installed transmission capacity abroad per installed electricity generation capacity. Sweden had an electricity interconnection level of 23 % at the end of 2021/2022. The level of Elamman linking is already higher than the EU's 2030 target. Current and expected future quotas are presented in section 4.5.

Table 4 shows the annual average prices for 2022 for Swedish and neighbouring bidding zones and the price differences between bidding zones. The difference varies from year to year and depends heavily on the weather, i.e. run-off to hydropower, wind power production and heating needs depending on temperature. In 2022, the price of electricity was pushed up as a result of Russia's invasion of Ukraine and the lack of gas supplies to Europe. Another factor affecting the price is the availability of nuclear power, where annual audits and unforeseen plant failures reduced the availability of electricity production in southern Sweden. The fact that hydropower has been dry in both Sweden and Norway is another factor which has contributed to high prices. In the rest of Europe, several factors have also influenced prices such as the low availability of French nuclear power. In 2021, North Sea Link, an HVDC connection with a capacity of 1 400 MW between Norway and the United Kingdom, was completed. This relationship has led to changes in import and export flows and the UK's higher prices have affected the Nordic region.

Table 4 indicates that virtually all area borders could benefit from increased transmission capacity. As 2022 prices have been strongly influenced by the European energy crisis, the results of the table cannot be seen as indicative of where grid expansion is required. Some projects are ongoing or planned, such as a third AC connection to Finland (SE1-FI) and Hansa Powerbridge (SE4-DE).

There is ongoing analysis of the need for new connections and reinvestment in existing links. Each new interconnector is assessed in terms of socio-economic and environmental benefits, and may only be implemented if the expected benefits outweigh the costs. The analysis shall also take into account the potential impact on profitability in a future market situation. The current price picture may provide an indication of possible needs, but the analysis should be based on the market situation 10-30 years ahead.

Table 4. Annual average prices EUR 2 022/MWh and price difference between adjacent bidding zones.

Bidding zones		Electricity price (EUR/MWh)		Difference
Area 1	Area 2	Area 1	Area 2	Difference
SE1	SE2	59,06	61,95	— 2,89
SE2	SE3	61,95	129,21	— 67,26
SE3	SE4	129,21	152,10	— 22,89
SE1	FI	59,06	154,04	— 94,98
SE3	FI	129,1	154,04	— 24,94
SE3	DK1	129,1	219,04	— 89,94
SE4	DK2	152,10	210,15	— 58,05
SE3	NO1	129,1	192,51	— 63,41
SE2	NO3	61,95	41,94	20,01
SE1	NO4	59,06	24,47	34,59
SE4	LT	152,10	230,23	— 78,13
SE4	PL	152,10	166,72	— 14,62
SE4	THEY	152,10	235,45	— 83,35

Source: Nordpool

Table 5 shows how the transmission capacity (NTC) relates to peak load. In all cases, the ratio exceeds the desired level of 30 %.

Table 5. NTC (Net Transfer Capacity) Import i Export, peak load, [MW] in 2022.

	NTC Import [MW]	NTC Export [MW]	Peak load [MW]	Import/ Peak load	Export/ Peak load
SE1	5 100	5 100	1 800	283 %	283 %
SE2	11 450	11 900	2 800	409 %	425 %
SE3	14 160	17 510	14 900	95 %	118 %
SE4	9810	6015	4 300	228 %	140 %
SEE	10 325	10 325	23 500	44 %	44 %

Source: eSett and Swedish Power Grid

Table 6 shows how the NTC relates to the amount of renewable capacity.34 In all cases, the

In34 Sweden, renewable power production consists of hydropower, wind, solar and thermal power. For cogeneration, approximately 80 % of the fuel input is renewable. The contribution of cogeneration to renewable capacity has therefore been calculated as 80 % of total installed thermal power.

ratio exceeds the desired level of 30 %.

Table 6. NTC (Net Transfer Capacity), RES (Renewable Energy Sources), [MW] In 2021.

	NTC Import [MW]	NTC Export [MW]	RES [MW]	Import/RES	Export/RES
SE1	5 100	5 100	7 505	68 %	68 %
SE2	11 450	11 900	13 755	83 %	87 %
SE3	14 160	17 510	10 669	133 %	164 %
SE4	9815	6015	4 362	225 %	138 %
SEE	10 325	10 325	36 290	28 %	28 %

Source: Swedish power grids and the Swedish Energy Agency.

2.4.2 Energy transmission infrastructure

2.4.2.1 Key electricity and gas transmission infrastructure projects, and, where relevant, modernisation projects, that are necessary for the achievement of objectives and targets under the five dimensions of the Energy Union Strategy

Transmission of electricity

Swedish Power Grid is a State Enterprise which manages the Swedish transmission network. The Swedish power grid is responsible for maintaining the instantaneous power balance and operational security in the Swedish electricity network and is certified as a system operator by the Energy Market Inspectorate (Ei). The current system development plan runs until 2031 and describes, among other things, the Swedish Power Grid's network development plan, which is fully available on the Swedish Power Grid website.35 Among the largest network development projects are:

- The West Coastal Programme, which consists of several projects to eliminate bottlenecks on the west coast.
- The North-South programme contains around 50 different projects aimed at increasing cross-zonal capacity between bidding zones 2 and 3 by 2040.36

Gas transfer

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

35Swedish Power Networks – System Development Plan 2022-2031.
36 https://www.svk.se/nordsyd.

The Liquefied Natural Gas (LNG) terminal in the Port of Gothenburg became operational in autumn 2018 and provides mainly gas for shipping, industry and heavy onshore transport. The full capacity of the terminal is about 30 000 m^3. The Government has decided to reject the application for a concession for a natural gas pipeline between the LNG terminal and the natural gas transmission network.37

2.4.2.2 Where applicable, main infrastructure projects envisaged other than Projects of Common Interest (PCIs)

A new third alternating current (AC) line is currently being designed between Sweden (SE1) and Finland. Between Sweden (SE4) and Germany, a new HVDC link of 700 MW is planned.

The latest version of the Nordic Network Development Plan was published in 2021.38 The report of the four Nordic TSOs (Energinet, Fingrid, Statnett and Swedish Grid) describes the main drivers of the major changes that the Nordic power system is undergoing as well as planned and ongoing projects 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 increasing system flexibility, in particular related to the promotion of competitively determined electricity prices in line with relevant sectoral law, market integration and coupling, aimed at increasing the tradeable capacity of existing interconnectors, smart grids, aggregation, demand response, storage, distributed generation, mechanisms for dispatching, re-dispatching and curtailment, and real-time price signals, including a timeframe for when the objectives shall be met

Sweden has no national specific objectives on market integration but is continuously working and developing measures and participates in Nordic cooperation in this area.

Within the framework of the Nordic Council of Ministers, a Nordic Electricity Market Forum has been established as a place for closer dialogue between political andnon-political stakeholders, as well as between different types of stakeholders in the Nordic electricity market. An action plan to achieve a39 2030 vision has been developed, highlighting, inter alia, development areas around flexibility, accurate price signals, sector integration, network development and resource adequacy.

37Government Decision II: 1 at the Government meeting of 10 October 2019, ref. I2019/0091 1/E.
38Stanett, Fingrid, Energinet and Swedish Power Grid – Nordic Grid Development Perspective 2021.
39 https://nordicelforum.org/wordpress/wp-content/uploads/2021/09/Vision-for-the-nordic-electricity-market- EN_2.pdf.

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

- Nordic Balancing model (NBM), gradual implementation by 2024
- Single Price Model, introduced November 2021
- 15 minutes settlement period, to be inserted
- Nordic Capacity Market for Automatic Frequency Restoration (aFRR), launched in December 2022
- Nordic Capacity Market for Manual Frequency Restoration (MFRR), planned to start Q4 2023
- Nordic energy market MFRR, to be introduced

Up to now, balancing controls have been planned and traded on an hourly basis and any changes within 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 their own balance more accurately, thereby enabling a more efficient use of power resources and the electricity grid.

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 when the objectives shall be met;

Sweden has no specific objectives in this respect. However, there is a provision in Chapter 3, Section 41 of the Electricity Act (1997: 857) that electricity network operators may not impose technical requirements or other conditions that make the provision of services in the form of changes in electricity consumption more difficult, unless the condition is justified by the safe, reliable and efficient operation of the transmission network.

There is also a further provision (Chapter 5, Section 11 of the Electricity Act) according to which, when determining the amount of electricity network charges that electricity network operators 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 provide an incentive for electricity network operators, for example, to make it easier for customers to provide services offering more demand response opportunities through new technological solutions.

2.4.3.3 Where applicable, national objectives with regard to ensuring 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 in electricity meters, measuring systems and equipment. The functional requirements under the Measurement Regulation shall be met by network undertakings by 1 January 2025 and shall include measurement systems and equipment for all electricity users who are low-voltage customers.

Functional requirements for measuring systems and equipment

- enable electricity users to easily access data such as power used, facilitating customers interested in energy savings and wishing to be active in the electricity market;
- promotes reliable and efficient grid operation and allows for an increased and cheaper integration of micro-generation, such as solar; and
- enables a developed market for various types of energy services.

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

In November 2022, the Government set the reliability standard, inter alia in the light of the provisions of the Electricity Market Ordinance40, for Sweden at one hour per year and at the same time instructed the Energy Market Inspectorate (Ei) to calculate the reliability standard annually. According to the mandate, the Energy Markets Inspectorate is to propose a new reliability standard if necessary. When carrying out the task, the Energy Market Inspectorate shall also conduct a dialogue with the Swedish National Grid System, the Swedish Energy Agency and, where relevant, with other stakeholders. The Energy Markets Inspectorate shall report on two occasions, at the latest by 1 January 2024 and by 1 January 2025 at the latest.

2.4.3.5 Where applicable, national objectives to protect energy consumers and improve the competitiveness of the retail energy sector

2.4.4 Energy poverty

2.4.4.1 Where applicable, national objectives with regard to energy poverty; including a timetable for the achievement of the objectives.

Sweden does not distinguish energy poverty from poverty in general. Thus, the term ‘energy

Council Regulation (EC) No 714/2009 of the European40 Parliament and of the Council of 13 July 2009 on ducts for access to the network for cross-border exchanges in electricity and repealing Regulation (EC) No 1228/2003, and the Agency Regulation.

poverty' is not used in Sweden and there are no specific objectives.

2.5 Dimension research, innovation and competitiveness

2.5.1 National objectives and funding targets for public and, where available, private research and innovation relating to the Energy Union including, where appropriate, a timeframe for when the objectives are to be met

See paragraph 2.5.2 below.

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

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 as described in section 2.

Energy research and innovation, according to the Government Bill on energy research and innovation for ecological sustainability, competitiveness and security of supply (Govt. 2016/17: 66 p. 57):

- build up the scientific and technical knowledge and skills needed to enable, through the application of new technologies and services, a transition to a 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 will also contribute to the general research policy objective of Sweden being one of the world's leading research and innovation countries and a leading knowledge hub, where high-quality research, higher education and innovation lead to the development and well-being of society, the competitiveness of industry and respond to the societal challenges we face, both in Sweden and globally (see Govt. 2016/17: 50 p. 34).

2.5.3 Where applicable, national objectives for competitiveness

The objective of enterprise policy is to strengthen Sweden's competitiveness and create the conditions for more jobs in more and growing companies (Government Bill.

2014/15: 1 ed. 24).

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 (see Government Bill. 2016/17: 146 p. 23).

INSTRUMENTS AND MEASURES

3.1 GHG Reduction Dimension

3.1.1 GHG emissions and removals

3.1.1.1 Policies and measures to achieve the target set under Regulation (EU) 2018/842 as referred in point 2.1.1 and policies and measures to comply with Regulation (EU) 2018/841, covering all key emitting sectors and sectors for the enhancement of removals, with an outlook to the long-term vision and goal to become a low emission economy and achieving a balance between emissions and removals in accordance with the Paris Agreement

Several policies and measures affecting the above-mentioned climate objectives stem from EU legislation, such as the Fuel Quality Directive, emission requirements for new vehicles, the F-gas Regulation, circular economy measures such as the Landfill Directive and circular economy product policy frameworks and the Common Agricultural Policy. These are not further described here.

Furthermore, policies and measures targeting renewable energy and energy efficiency have an impact on the reduction of greenhouse gas emissions in Sweden, see further sections 3.1.2 and 3.2. An overview of key policies contributing to the achievement of climate objectives is presented in Table 7.

Table 7. Overview of key policies and measures contributing to the achievement of climate objectives (EU instruments are highlighted in bold).

Cross-sectoral	Energyinput	Dwellings and services	Industry	Transport	Waste	Agriculture	Forestry
Energy and CO2 tax	Energy and CO2tax	Energy and CO2 tax	Energy and CO2 tax	Energy and CO2 tax	Ban on landfilling combustible and organic waste	Regulation on environmental concerns in agriculture	Forest Management Act
EU ETS	**EU ETS**	**Ecodesign Directive**	**EU ETS**	**Emission requirements for new vehicles**	Collection of methane from landfills	Rules of the Environmental Code on soil dewatering	Rules of the Environmental Code on soil dewatering
Climate Leap	Electricity certificate system	**Energy-Labelling Regulation**	Industrial Life	Reduction obligation	Waste tax	**Interventions in agriculture financed by the CAP**	Nature reserves and nature conservation contracts
Environmental Code	Wind energy initiative	Building regulations	Energymapping	Vehicle tax based on CO2	Producer's-responsibility	Wetland installation with LONA support	National Forest Programme
Planning and Building Act	Support for solar energy	Energy and climateadvice	Energy efficiency networks	Higher vehicle tax for high-emitting cars, known as "malus"	Municipal waste planning	Conversion of agricultural land to rewettable forest land	3 Advice and training
Communication		Energy-declarations	Environmental Code	Reduced preferential value for environmental vehicles	**EU waste package**	**CAP network**	Rewetting of drained wetlands
Fossil-free Sweden		Order groups and networks	**Regulation on F-gases and BREF**	Pumping Act	**EU product policy framework for the circular economy**	Agricultural Knowledge and Innovation System, incl. CAP support and Agricultural Environmental and Climate Competence Centres	
Energy and climateadvice		**Directive on the energy performance of buildings**		Electric bus premium and climate premium		Climate Leap	
Regional energy and climate strategies				Urban environment agreements		Support for manure based biogas	
European Regional Development-Fund				Support for charging infrastructure and hydrogen refuelling		Climate premium for vocational	
Research and Demonstration				Eco-bonus system for maritime transport			
Procurement rules				**Procurement rules**			
Government credit guarantees for green investments				Tax on air travel			
Energy Efficiency Directive				Reduction obligation for flights			
				EU ETS (aviation			
				ETS BRT (road transport)			
				Quota obligation for air and maritime transport			

3.1.1.2 Cross-sectoral policies and measures

Energy and carbon dioxide taxes

The Swedish energy taxation system is based on a combination of CO2 tax on fuels, energy tax on fuels and energy tax on electricity. The main taxes affecting greenhouse gas emissions in Sweden are CO2taxes and energy taxes on fuels. These are described in general below and in more detail for each sector.

Carbon dioxide tax, based on the fossil content of the fuel, was introduced in Sweden in 1991 and aims to reduce carbon dioxide emissions. The tax has been increased in several steps since it was first introduced. In total, the tax has increased from SEK 0,25/kg carbon dioxide (1991) to SEK 1,33/kg (2023). No CO2 tax is levied on biofuels, except those used in the context of the reduction obligation for petrol and diesel and

certain taxable bio-oils used for heating purposes.

Due to the risk of carbon leakage, i.e. the relocation of activities and their emissions beyond the borders of the country, some sectors benefit from reduced or tax exemptions.

Taxes on energy have long been applied in Sweden.[41] Energy taxes on petrol and diesel were introduced in 1924 and 1937 respectively. Fuel used for heating and electricity was subject to an energy tax in the 1950s. The purpose of the energytax was initially purely fiscal. For a long time, the aim has also been to manage energy consumption in line with Sweden's energy efficiency and renewable energy targets.[42] Theenergy tax on motor fuels also aims to internalise external costs from traffic, such as road wear and noise. The energy tax on fuel varies according to whether it is used as motor fuel or for heating purposes. The level of taxation on heating fuels also varies between households, industry and the energy supply sector, see Table 8 below for current levels of taxation.

To take account of inflation, the energy and CO2 tax on fuels is adjusted to changes in the Consumer Price Index (CPI). In order not to undermine 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).43 However, GDP indexation has been suspended from 2020 by recurring decisions.

In some cases, Sweden applies a tax reduction for sustainable biofuels. Exemptions from both energy tax and CO2 tax apply to all clean and high-blended sustainable biofuels. Sweden has state aid approval for current tax credits for liquid high blend and pure biofuels until the end of 2026.44 However, for biogas, the General Court, which is the court of first instance of the Court of Justice of the European Union, has annulled the Swedish tax exemption, but the Government is working to obtain new approvals on the spot.45 Biofuels blended into petrol or diesel are subject to the reduction obligation (see below under the Transport sector) and are therefore subject to the same tax per litre as the fossil fuel in which it is involved. The CO2 tax for the final fuel has been determined on the basis of the average fossil carbon content, taking into account the average biofuel blending, see Table 8 below for current tax levels.

Table 8. Energy and carbon dioxide taxation levels 2023 p.e.v unit of volume.

	2023
El (öre/kWh)	39,2
Eldningsolja (kr/m3)	4072
Diesel (kr/m3)	4073
Bensin (kr/l)	6,31
Kol (kr/1000 kg)	4063

41Tax on energy is a collective term for excise duties on fuel and electricity and is regulated by the Energy Tax Act (1 994: 1 776).
The42 energy efficiency target and the 2020 renewal target are set out in Government Bill. 2008/09: 162 and 163.
43The GDP indexation is designed as a flat rate mark-up of 2 percentage points, in addition to adjustments following changes in the CPI. This additional recalculation is made of both the energy tax and the CO2 tax, but is expressed as an increase in the energy tax.
44 https://ec.europa.eu/competition/state_aid/cases1/202306/SA_102347_30052786-0100-CE99-BEF2- EC95D8F4E042_64_1.pdf
45 https://www.regeringen.se/pressmeddelanden/2023/03/regeringen-kontaktar-eu-kommissionen-for-att- radda-exempt elsen-biogas/

Naturgas (kr/ 1000 m3)	3946

Fossil fuels for national and international commercial shipping and aviation are not subject to any energy or carbon tax.

For fuels consumed for heat production at installations covered by the EU ETS, 100 % energy tax is applied. Since 1 January 2023, all fossil fuels have been exempted from CO2 tax if they are used for the production of heat by heating or combined heat and power plants covered by the EU ETS. In the case of fuel use for heat production in combined heat and power plants not covered by the trading system, carbon dioxide tax and energy tax are charged at the same level as the general level of taxation, see the current levels of taxation in Table 8 above.

Fuels used for electricity production are exempt from both energy and carbon dioxide taxes, but the use of electricity is generally taxed with energy tax on electricity, see the current level of taxation in Table 8 above.

Industry has some exemptions and reductions in energy and CO2taxes, in principle due to the fact that most of the manufacturing industry is already covered by the EU ETS. The manufacturing industry covered by the EU ETS is fully exempted from the CO2 tax. Certain manufacturing processes, such as metallurgical and mineralogical processes, as well as fuel used for the production of energy products, are fully exempt from CO2 and energy taxes.

Diesel used in agricultural, forestry or aquaculture working machinery is exempt from part of the CO2 tax. The amount of the tax exemption has varied over time. In 2022 and 2023, the tax exemption for diesel used in agricultural, forestry or aquaculture working machinery has been extended to cover both carbon dioxide and energy taxes in whole or in part.

Climate Leap

All types of organisations, except activities covered by the EU ETS, can apply for funding for local climate investments since 2015.46 Candidates compete on the basis of estimated greenhouse gas savings per krona for each investment. Examples of eligible investments are charging infrastructure for electric vehicles, biogas plants, the conversion of fossil oil to biofuel or district heating, the expansion of smaller district heating networks, the destruction of nitrous gases in healthcare, and bicycle infrastructure. In 2022, the funding amounted to almost SEK 2,8 billion. In December 2022, it was decided to increase Climate Leap by SEK 400 million in 2023 and by SEK 500 million per year in 2024 and 2025.

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 limiting the climate impact (see section 2.1.1), must be indicative. The Environmental Code contains, inter alia, general rules of consideration that must be observed in all activities and measures.

46Investments in sectors covered by the EU ETS can still be eligible if they lead to an increased use of waste heat.

The Code also contains requirements to use the best available techniques. Major environmentally hazardous activities are subject to a permit requirement. The permit assessment includes assessment of direct and indirect environmental impacts as well as energy management and for installations not included in the EU ETS:

also 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 environmental and climate aspects to be taken into account in planning. Certain infrastructure projects are examined in accordance with the Environmental Code, either directly or via other legislation.

Communication on climate change

The Swedish authorities have a long experience in using communication to inform and influence 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 data on emissions that 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 climatechange. National Knowledge Centres for Adaptation to Climate Change, set up at the SMHI, have launched a Swedish ClimateChange Portal, with facts and guidance on adapting to a warmer climate.
- The Swedish Energy Agency is responsible for providing both citizens and businesses with information and advice on energy efficiency efficiency and the security and sustainability of energy supply and is responsible, inter alia, for an information dissemination website.
- The Forest Agency and the Swedish Board of Agriculture (Swedish Board of Agriculture) focus on e-services and digital information for land and forest owners, forest workers and farmers on how to reduce the climate impact of forestry, agriculture and climate impacts.
- The Transport Administration is mandated by the Government to contribute, through information and awareness-raising measures, to the achievement of the intermediate target for domestic transport and to create the conditions for Sweden to have net-zero emissions by 2045.
- The Swedish Civil Contingencies Agency (MSB) strengthens society in preventing and managing accidents, crises and consequences of war, including coordination between actors and communication to the public.
- The *crisis* information.se website 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.[47] The user can follow which parts of society are changing and how. The tool also shows what is needed for Sweden to reach the net-zero emissions target by 2045.

Fossil-free Sweden

The government initiative FossilFree Sweden, launched in 2016, aims to strengthen the state's dialogue with business, municipalities, other public actors and civil society.[48] Today, the initiative brings together more than 500 stakeholders and is open to all those who sign up for the declaration that has been produced. The declaration commits operators to present concrete measures to reduce emissions.

In cooperation with FossilFree Sweden, between 2018 and 2020, industry sectors have developed 22 so-called 'fossil-free competitiveness roadmaps'. The aim of the roadmaps is to build a stronger industry and create more jobs and export opportunities by becoming fossil-free. Roadmaps show opportunities, identify obstacles and propose solutions, both through their own commitments and policy proposals. Together, they give a picture of how a fossil-free industry will look like.

Fossil-free Sweden now focuses 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-sector and cross-industry strategies to address common problems and challenges and foster Sweden's competitiveness in the international market. To date, FossilFree Sweden has presented 5 strategies; Strategy for a Sustainable Battery Value Chain, Hydrogen Strategy, Biostrategy, Financing Strategy and a

Energy efficiency strategy. Work on a CCS/bio-CCS strategy was also launched in 2023.

Regional climate and energy strategies

The county administrative boards coordinate regional climate and energy initiatives and support regional actors, for example by collecting and disseminating information. Building 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 stakeholders to contribute to effective measures and synergies. In addition, the county administrative boards contribute to environmental assessment and monitoring, local and regional spatial planning, regional development and growth policy, crisis preparedness and civil defence, 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 phases of the procurement process. The possibilities for environmental and climate considerations in procurement are set out in procurement legislation, including the Public Procurement Act

47 https://app.climateview.global/sweden.
48 http://fossilfritt-sverige.se/.

(2016: 1145).

3.1.1.3 Transport sector

Reduction obligation – fuel switching

In order to promote the use of biofuels, the reduction obligation for petrol and diesel was introduced on 1 July 2018 by the Act (2017: 1201) on the reduction of greenhouse gas emissions from certain fossil fuels. This means that every year all fuel suppliers have to reduce life cycle greenhouse gas emissions from petrol and diesel by a certain percentage through a gradual increase in biofuel blending, see Table 9.

Table 9. Reduction levels 2018-2022 under the Act on the Reduction of Greenhouse Gas Emissions from Certain Fossil Fuels

Year	2018	2019	2020	2021	2022
Diesel	19.3 %	20 %	21 %	26 %	30 %
Petrol	2.6 %	2.6 %	4.2 %	6 %	7.8 %

In the 2023 Budget Bill, the government announced that the reduction level from 1 January 2024 would be reduced to the lowest level in the EU. What the EU minimum means can be interpreted in different ways and new reduction levels are still to be decided. Scenarios for energy and emissions reported in Chapter 4 are based on previously agreed successive increases in reduction levels.

CO2-based vehicle tax

In order to incentivise car buyers to choose cars, vans, light buses and caravans with low greenhouse gas emissions, the annual vehicletax 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. The vehicle tax also differentiates between fuels, meaning that a diesel-powered car has higher vehicle tax than a gasoline passenger car with the same CO2 value.

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. Under the current rules, the increased amount of carbon dioxide is the sum of SEK 107 per gram of carbon dioxide emitted by the vehicle per kilometre in excess of 75 grams up to and including 125 grams, and SEK 132 per gram of carbon dioxide in addition to 125 grams.

Reduced preferential value for environmental technology vehicles

The benefit of being able to use the employer's car for private travel is generally taxable and the value is calculated on a special scale. To support the introduction of green cars on the market, there is a specific reduction in the preferential value for electric cars, hydrogen cars, plug-in hybrids and gas cars.

Requirements for biofuels at refuelling stations – pumping law

In order to make renewable fuels available, section 3 of the Act (2005: 1248) on the obligation to supply renewable fuels requires service stations with a sale of more than 1 500 m^3 petrol or diesel to offer at least one type of renewable fuel.

Environmental information on fuels

Since 2020, Section 11a of the Fuel Ordinance (2011: 346) requires consumers to be informed of the climate impact and origin of fuels at the pump. This provision means that:

fuel suppliers are obliged to provide the information to consumers, based on the data they report annually to the Swedish Energy Agency under 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 the country of origin of the feedstock. More detailed information shall be available on the fuel suppliers' home pages. In order to avoid excessive administrative costs for small fuel suppliers, they are exempted from the information requirement. Therefore, for suppliers supplying less than 1 500 cubic metres of liquid or 1 000 000 cubic metres of gaseous fuel annually, it is voluntary to provide the information.

Biogase aid for the production of biogas upgraded to biomethane

In 2022, in order to accelerate the energy transition and decarbonisation, the Ordinance (2022: 225) on State aid for the production of biogas upgraded to biomethane introduced support for biogas upgraded to biomethane, i.e. with the quality required for injection into a methane distribution network. The Regulation provides additional support for biomethane wetters. According to the budget, the 2023Bill (expenditure area 21) amounted to SEK 650 million (see Bill. 2022/23: 1 ed. 21).

Electric bus premium and Climate Premium

The electric bus premium is a State aid for public transport operators purchasing electric buses, plug-in hybrid buses, fuel cell buses and trolleybuses with a transport capacity of more than 14 passengers. The premium is normally given for 20 % of the purchase price of the electric bus, but for transport undertakings the premium represents 40 % of the difference between an electric bus and the closest comparable diesel bus, where plug-in hybrid buses receive half of the premium.

The Climate Premium supports heavy goods vehicles and working machinery. For heavy goods vehicles, they may only be powered by bioethanol, vehicle gas or electricity, including combinations thereof. Electric working machines shall have a net power greater than 15 kW. For motorised machinery and tractors powered by vehicle gas, bioethanol or hybrid in combination with electricity, a net power of more than 75 kW shall apply. The allocation for the electric bus premium and the Climate premium is common and amounts in total to SEK 576 million in 2023. A maximum of SEK 260 million can be allocated to electric buses.

Urban environment agreements

In 2015, the Government introduced special support to promote sustainable urban environments, the so-called Urban Environmental Agreements (Ordinance 2015: 579). The aid is intended for municipalities and regions and amounts to SEK six billion over the period 2022-2027.49 The aid provides opportunities for

49 https://bransch.trafikverket.se/contentassets/0d04ab63a8cd489aa4f54c9bc55ef6d3/rb-i-13-i2022-01294- -installation – national-traffic impact – plan-for-transport infrastructure-for-period –

municipalities and regions to receive up to 50 % of State co-financing for publictransport infrastructure and, since 2017, also for cycling. In April 2019, the Government decided to amend the Ordinance (2015: 579) on aid to promote sustainable urban environments so that the urban environmental agreements are extended to include measures for goodstransport solutions. The amendment entered into force on 22 May 2019. Municipalities and regions that have been granted aid shall contribute by implementing counterpart measures. By means of the 2023 Budget Bill, the Government adjusted the funding to SEK 775 million for 2023. For the years 2024 and 2025, the aid is estimated to amount to approximately SEK 540 million per year.

Eco-bonus system for maritime transport

Since 2018, the government has allocated funding for an eco-bonus system to stimulate the shift of freight transport from road to sea. The aim is to test new transport arrangements and reduce greenhouse gas emissions from freight transport. The system has been extended and broadened to also include rail design by 2024 with an annual budget of SEK 100 million.

Public procurement of transport

Since 2009, the passenger cars purchased or concluded by a government authority must be green cars; see Section 5 of the 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 road transport transposes Directive (EU) 2019/1161 amending Directive 2009/33 on the promotion of clean and energy-efficient road transportvehicles. 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 percentage of green vehicles, known as minimum targets.

The contracting authority provides criteria for the calls for public procurement of passenger transport, freight transport, fuel, tyres, public transport and vehicles to[50] support how procurers can set requirements.

According to the Swedish Public Transport Environment and Vehicle Database (FRIDA), around 93 % of public transport[51] was carried out using renewable fuels in 2022.[52]

Coordination of recharging infrastructure and renewable fuels

The Energy Agency is tasked with providing information on the location of charging stations and coordinating support for charging infrastructure for charging vehicles and renewable fuels infrastructure requiring dedicated infrastructure, such as pure biodiesel, E85, vehicle gas and hydrogen. The work includes supporting the Swedish Environmental Protection Agency for aid within Climate Leap with, among other things, expert knowledge and advice on prioritisation and information on geographical coverage and evaluation of aid granted.

202220331.pdf
50 https://www.upphandlingsmyndigheten.se/hallbarhet/stall-hallbarhetskrav/fordon-och-transport/.
51 https://www.svenskkollektivtrafik.se/verktyg-och-system/frida-miljo-och-fordonsdatabas/.
52Refers to the share of vehicle kilometres with renewable fuels.

Aid for recharging and hydrogen refuelling infrastructure

Individuals wishing to install a charging box at home receive a tax reduction for the installation of green technologies (see 3.1.2.1). For other operators who wish to install charging stations for residents and employees in homes and workplaces, such as housing associations and companies, there is instead the specific aid ‘Ladda Car’. Public charging stations, i.e. where anyone can charge, can be supported through Climate Leap (see above). The Climate Leap can also support non-public charging stations for vehicles other than passenger cars, such as truck depot charging. Charging the car and Climate Leap shares the same allocation, which for 2023 was allocated SEK 2,95 billion, of which SEK 400 million is dedicated to an investment in charging infrastructure. Since 2020, the aid for charging infrastructure under this allocation has more than doubled each year with a peak in 2022, when SEK 874 million was allocated in aid to a total of 51 500 new recharging points. Of these, SEK 376 million has been granted to 3 700 public recharging points for light and heavy-duty vehicles and non-public recharging points for heavy-duty vehicles through Climate Leap.

At the same time, SEK 498 million was granted to 47 800 non-public charging points for passenger cars through the Ladda bilen aid.

In addition, for audience charging of heavy-duty vehicles and hydrogen refuelling of heavy-duty vehicles, the regional electrification pilots programme is available.
In 2022, the Energy Agency granted aid to 140 charging stations, 12 hydrogen refuelling stations and one combined charging and hydrogen refuelling station for a total amount of SEK 1,4 billion.
A further SEK 1,4 billion is allocated to the regional electrification pilots in the coming years and the Swedish Energy Agency plans to announce these funds in 2023 and 2024.

In order to ensure basic access to charging infrastructure for fast charging electric vehicles throughout the country, where such infrastructure is not otherwise developed, SEK 90 million has been allocated to the Swedish Transport Administration’s so-called White Route Support. In 2023, the aid may also be used to increase accessibility, redundancy and capacity increase along major roads and up to a maximum of SEK 30 million may be granted new commitments.

Tax on air travel

On 1 April 2018, a tax on air travel was introduced in Sweden with the aim of helping to reduce the climate impact of flights by means of the Act (2017: 1200) on tax on air travel. The tax is designed as a tax on commercial flights and is payable on passengers departing from an airport in Sweden. The operating air carrier is liable to tax. Different amounts are charged depending on the final destination of the passenger, divided into three groups (for 2023: SEK 69, SEK 288 or SEK 461).

Reduction obligation for flights

Since 1 July 2021, kerosene has been subject to a reduction obligation. The reduction obligation obliges kerosene suppliers to blend biofuels into fossil jet kerosene. The blending requirement started at 0.8 % in 2021 and is set to gradually increase to 27 % in 2030. The RefuelEU Aviation Act may require adjustments to the national reduction obligation for kerosene kerosene.

Environmentally responsible take-off and landing fees

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

Night trains abroad

On 24 July 2020, the Government instructed the Transport Administration to procure and award contracts for night train services 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 1107/70.53 An agreement was signed between the Transport Administration and SJ AB and regulated traffic between Stockholm and Hamburg Altona, which could be replaced in the future by Hamburg Hbf. The starting point for the service is that it will run 244 days per year between 1 August 2021 and 30 July 2025, with the possibility of a two-year extension.54

3.1.1.4 Waste sector and circular economy

Ban on landfilling combustible and organic matter and collection of methane

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

Law on Tax on Waste

In 2000 a tax on waste placed on landfill was introduced, see the Waste Tax Act (1999: 673). The tax has been gradually increased and since 2019 the level has been indexed by 2 percentage points of the tax in addition to the CPI increase annually. The tax in 2023 amounts to SEK 634 per tonne of waste entering a waste facility (landfill).

Producer responsibility

The producer responsibility legislation contains national recycling targets and covers a total of ten product groups under a series of regulations.[55] Producer responsibility promotes the sorting, collection and recycling of:

waste streams; The aim is also to reduce the amount of waste. Producer responsibility aims to incentivise producers to develop more resource-efficient products that are easier to recycle and do not contain substances harmful to the environment.

Collection of bio-waste

53https://regeringen.se/regeringsuppdrag/2020/07/uppdrag-att-genomfora-en-upphandling-av-nattagstrafik/.
54Swedish Transport Administration – [SI]report, Procurement of night train services to Europe [(2022]: 1 70).
55Ordinance (2018: 1462) on producer responsibility for packaging, Ordinance (2018: 1463) on producer responsibility for recycled paper, Ordinance (2007: 185) on producer responsibility for cars, Ordinance (1994: 1236) on producer responsibility for cars producer responsibility for tyres, Ordinance (2014: 1 075) on producer responsibility for electrical equipment, Ordinance (2008: 834) on producer responsibility for batteries, Ordinance (2009: (1031) on producer responsibility for pharmaceuticals and Ordinance (2007: 193) on producer responsibility for certain radioactive products and orphan sources.

From 1 January 2024, requirements for sorting and separate collection of bio-waste from households and establishments 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.56

Measures for the sustainable use of single-use plastic products

In order to reduce littering of single-use products and resource consumption, the government has introduced legislation to implement EU Directive 2019/904. According to these, anyone who supplies a beverage in a mug that is a single-use product on the Swedish market must offer the possibility of having the beverage served in a reusable mug. The same applies to fast food served in a single-use food box. The attractions are also included. The rules mainly concern plastics, but the idea is to reduce the use of single-use products, regardless of their material. Products covered by the legislation include balloons, wet wipes and fishing gear in addition to packaging.57

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 manner. The waste management plan shall include, inter alia, measures to reduce the quantity and harmfulness of the waste.58

Other circular economy measures

In addition to measures in the field of waste, further measures are described in Sweden's circular economy strategy.59 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, products and services, as well as circular economy as drivers for industry and other actors through measures promoting innovation and circular business models. Priority streams are plastics, textiles, food, renewable and bio-based raw materials, construction and real estate, 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.

Milestones for the transition to a circular economy

Circular economy measures contribute to Sweden's intermediate targets in the environmental target system, among other things, the share of reused packagingonly placed on the market in Sweden for the first time should increase by at least 20 % from 2022 to 2026 and by at least 30 % from 2022 to 2030. Food waste shall be reduced so that total food waste is reduced by at least 20 % by weight per capita from 2020 to 2025. By 2025, preparing for re-use and recycling of municipal waste shall be increased to at least 55 % by weight, in 2030 to at least 60 % by weight and in 2 035 to at least 65 % by weight. By 2023, at least 75 % of food waste

56 https://www.naturvardsverket.se/vagledning-och-stod/avfall/krav-pa-separat-insamling-av-bioavfall/.
57 https://www.naturvardsverket.se/vagledning-och-stod/plast/engangsplast.
The58 Swedish Environmental Protection Agency's regulations (2006: 6) on municipal waste management plans on the prevention and management of waste.
59 https://www.regeringen.se/contentassets/4875dd887fd34edabd8c1 d928a04f7ba /circular-economy- action plan – for installation – av-sverige.pdf

from households, mass caterers, shops and restaurants must be sorted and treated biologically so that plant nutrients and biogas are recovered. The preparation for re-use, recycling and other recovery of non-hazardous construction and demolition waste, with the exception of soil and stone, shall amount annually to at least 70 % by weight by 2025.

3.1.1.5 Agricultural sector

CAP Strategic Plan 2023-2027

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

The Strategic Plan allows investments and management measures on individual farms, such as the construction of wetlands and irrigation ponds, investment in new technologies and cover drainage, intercropping, grazing land management, precision cultivation and wetland maintenance. There are also basic conditions for receiving the aid, such as crop rotation requirements, the deposition of environmental surfaces, Vintergreen land and the protection of peatlands. The plan also includes efforts to disseminate knowledge, build knowledge through projects and innovate in the CAP target areas. One of these measures is the 'Grepp Industry' advisory service, which is implemented in cooperation between the Board of Agriculture, the advisory companies, the Swedish Federation of Swedish Farmers and the county administrative boards. The objectives are the reduction of emissions of climate gases, the reduction of eutrophication and the safe use of plant protection products.

The strategic plan also states that interventions in the agricultural sector are also carried out with national support from Climate Leap, aid for the construction of wetlands and aid for broadleaf tree plantation and the rewetting of agricultural land that can be withdrawn from production.

The Common Agricultural Policy (CAP) network is also part of Sweden's strategic plan. The network brings together actors at local, regional and central level to facilitate the implementation of the Strategic Plan and to contribute to the exchange of information and experience in the areas covered by the Plan. A dedicated network for Agricultural Knowledge and Innovation Systems (AKIS) is established within the CAP network. The network is coordinated by the Board of Agriculture.

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

A national knowledge hub for agricultural environmental issues is located at the Board of Agriculture. The hub coordinates efforts to acquire, build and disseminate knowledge in relevant areas with the aim of supporting advisory actors in processes and with skills that can be channelled to individual farms.

Manure support

Since 2015, there has been a support scheme for biogas production through anaerobic digestion of manure, which is regulated in Ordinance (2014: 1528) on State aid for the production of biogas. The aid aims to increase biogas production from manure and thus have double environmental and climate benefits through reduced methane emissions from manure and substitution of fossil energy. The increased degradation of manure brings several environmental benefits. It reduces both greenhouse gas emissions and eutrophication of fresh and marine waters and produces biogas that can be used as energy. The generated biogas can be used to generate electricity or heat or as a fuel for vehicles. The aid amounts to a maximum of SEK 0,40/kWh of biogas produced. Aid for investments in new biogas plants can also be granted through Climate Leap. Until 2022, such investment aid was also offered through the RDP. For 2023, the aid amounted to a total of SEK 72,5 million for the production of manure based biogas.

In addition, since 2022, there is a possibility of State aid for the production of biogas updated to biomethane, see section 3.1.1.3.

3.1.1.6 Land use, land use change and forestry (LULUCF)

Forest Management Act

The Forestry Act (1979: 429) has two overarching objectives on an equal footing: supporting production and protecting the environment. The production objective means that forests and woodland are used efficiently and responsibly so that they deliver a sustainable yield. The focus on forest production shall be given flexibility in the use of the forest produced. The environmental objective is to preserve the natural productive capacity of forest land. Biodiversity and genetic diversity in forests shall be ensured. Forests shall be managed in such a way as to enable naturally occurring plant and animal species to survive under natural conditions and in viable populations. Endangered species and habitats as well as cultural heritage forests and their aesthetic and societal values shall be protected.

Rules on soil dewatering

The Environmental Code contains rules on land drainage that can also be used to reduce emissions from such land. Soil dewatering is the measures carried out to remove water (drainage land) or protect against water. For the measure to be a land drainage within the meaning of the Environmental Code, the objective of the measure must be to permanently increase the suitability of the land for a given purpose, such as cultivation, building, peat extraction, road construction, gardening or golf courses.

Since 1986, a permit is required for land drainage under the Environmental Code. In most southern Sweden, where the maintenance of wetlands is particularly important, soil drainage is prohibited. This means stricter conservation protection and a two-stage assessment of soil drainage. First, an exemption from the land drainage ban is required and then authorisation for the measure is required if the exemption is granted. In the rest of the country and in places specifically protected under the Ramsar Convention,60 soil drainage is

The60 Ramsar Convention is a global wildlife convention to conserve wetlands and aquatic environments and use them sustainably: https://www.naturvardsverket.se/Miljoarbete-i-samhallet/EU-och- international/international/environmental/conventions/WatlandConvention/

prohibited.

Rewetting of drained wetlands

Wetlands play a major role in reducing greenhouse gas emissions in the LULUCF sector, but their positive characteristics are lost by drainage. The Government has invested SEK 200 million a year in rewetting suckled wetlands.

Drainage has been carried out in recent centuries to gain new land for agriculture and forestry. While this has contributed positively to production, recent attention has been drawn to the greenhouse gas emissions of suckled wetlands that have a negative impact on the climate. Many wetlands store soil carbon in the form of peat, but carbon passes into carbon, among other things, when wetlands are drained. The restoration of wetlands and the recovery of the necessary water will reduce emissions. Wetland restoration can also help reduce eutrophication, improve water management, take care of water after rainfall and benefit biodiversity.

Nature reserves, nature conservation contracts and voluntary provisions

In Sweden, forests and land are earmarked for biodiversity conservation and outdoor life. It concerns both the preservation and conservation of valuable natural environments and the protection, restoration or re-creation of valuable natural habitats.

Provisions may take the form of national parks, nature reserves, nature conservation contracts, biotope conservation and voluntary provisions. In Sweden, nature reserves are among the most common ways to protect valuable nature in the long term. Chapter 7 of the Environmental Code contains the legal framework for the establishment of nature reserves.
The Environmental Protection Agency pays compensation to landowners and the county administrative board establishes nature reserves. Municipalities can also form nature reserves.

Nature conservation contracts are civil law contracts.61 The property owner and the State or a municipality agree on a certain amount of financial compensation for the property owner in return for renouncing, for example, forestry.
The Forest Agency and the Environmental Protection Agency jointly guide how to proceed. For the owner of the land, it shall not play any role with which authority to contract.

Sweden’s national forest programme

The strategy for Sweden’s national forest programme was decided by the Government on 17 May 2018.62 The work of the National Forest Programme Strategy is guided by its vision: “Forests, the Green Gold, will provide jobs and sustainable growth throughout the country, as well as the development of a growing bioeconomy.” An action plan has been drawn up to this end, which sets out concrete actions based on the vision and objectives of the forest programme.63 The availability of sustainable biomass from Swedish

61 http://www.naturvardsverket.se/Stod-i-miljoarbetet/Vagledningar/Skyddad-natur/Naturvardsavtal/.
62 https://www.regeringen.se/49bad6/contentassets/34817820fe074cb9aeff084815bd3a9f/201 80524_hela.pdf.
63 https://www.regeringen.se/4a095b/contentassets/7cbc4c534fb3457385ff1 d7f32e3e512/handlingsplan-for- sveriges-nationella Forest Programme-2018.pdf.

forests has an important role to play in the further transition to a fossil-free society.

Advice and training on forest management

The Forest Agency provides information to forest owners on how climate change will affect their forests. The Forest Agency also provides management advice on the basis of the property's conditions and the owner's own objectives.

3.1.1.7 Energy supply sector

Policies and measures for this sector are described in section 3.1.2.

3.1.1.8 Housing and services sector

Policies and measures for this sector are described in section 3.2.

3.1.1.9 Industrial sector

Industriklivet is a government initiative that supports the development of technologies and processes to reduce process-related greenhouse gas emissions in Swedish industry. This is described in section 4.6. Other sectoral policies and measures are described in section 3.2.

3.1.1.10 Where relevant, regional cooperation in this field

In January 2019, the Nordic Ministers of State adopted a declaration committing themselves to 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 to make the Nordic region the most sustainable and integrated region in the world by 2030. Action in the field of climate change is also central here. Nordic companies and Nordic sustainability solutions have great potential to play a key role in the green transition of the global economy.

Nordic experience and know-how can help to promote increased ambition under the Paris Agreement and also promote dialogue with other countries in international negotiations. The Nordic Cooperation Programme for Environment and Climate 2019-2024, negotiated under Swedish leadership, therefore aims to ensure that Nordic countries contribute to an ambitious implementation of the Paris Agreement and remain frontrunners in the necessary climate transition. In 2022, the Nordic Council of Ministers committed to working towards a green and equal Nordic region.64

The Nordic Environmental Finance Corporation (NEFCO) plays an important role in the green transition. The NEFCO focus areas on 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 Nordic actors to implement climate action through cooperation with the Fund. The Nordic Svanen ecolabel is another example of Nordic cooperation that

64Nordic Council of Ministers – A Green and Gender-Equal Nordic Region (2022).

facilitates the promotion and demand of “green” and climate-friendly products by businesses and consumers.

3.1.1.11 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

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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 trajectories set out in Article 4(a) (2) and, where applicable or applicable, the elements referred to in point 2.1.2 of this Annex, including sector-specific and technology-specific measures

Electricity certificate scheme

The purpose of the electricity certificate scheme is to stimulate the deployment of renewable electricity. The system has been in place in Sweden since 2003 and since 2012 it is common to Norway.65 Countries had a common target that the electricity certification scheme would contribute to 28.4 TWh of renewable electricity generation 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.

The Swedish Government decided in 2017 to extend the electricity certificate system to 2045 and to introduce a target of an additional 18 TWh by 2030 which applies only to Sweden. However, the rapid deployment of renewable electricity generation has led to the target being reached already in 2021. As a result, additional electricity generation installations in late 2022 are not eligible for electricity certificates and the scheme will be abolished by the end of 2035.

Under the scheme, electricity producers whose electricity production meets the requirements of the Electricity Certificates Act (2011: 1200) receive an electricity certificate for each megawatt-hour (MWh) of electricity they produce and can then be sold on an open market. The demand for electricity certificates is created as all electricity suppliers as well as some electricity users are obliged to purchase electricity certificates corresponding to a certain proportion (quota) of their electricity sales/consumption. Until 2020, the quota gradually increased from year to year and thus the amount of electricity certificates to be purchased by electricity suppliers, leading to an increasing demand for electricity certificates.

Tax reduction for microgeneration of renewable electricity

In order to make it easier for individuals and businesses to invest in electricity production from renewable energy sources for their own use, microproducers may, since 2015, receive financial compensation for the excess electricity they feed into the grid, pursuant to Sections 33-27 of the Income Tax Act (1999: 1229). The financial compensation is provided in the form of a tax reduction.

65 http://www.energimyndigheten.se/fornybart/elcertifikatsystemet/.

The amount of the tax reduction is equal to SEK 60/kWh of renewable electricity fed into the connection point, up to a maximum of as many kilowatt-hours of electricity charged at the connection point in that year. The connection point may have a fuse of not more than 100 amperes. The ceiling for the tax reduction is SEK 18 000 per year.

Reduced energy tax on micro-production of renewable electricity for self-consumption. The exemption shall apply to electricity produced in an installation of installed generator power of less than 100 kW by a producer who has a total installed power of less than 100 kW and which has not been transferred to a collecting system, which is subject to a network concession and which has been granted on the basis of Chapter 2 of the Electricity Act.

In the case of electrical power produced from wind or wave, the installed power output of 100 kW shall correspond to 250 kW of installed generator power, solar to 500 kW of installed peak power and other energy source without generator to 100 kW installed power. Where electrical power is produced from different sources, the installed effects shall be added together.

If the producer's total power output exceeds 100 kW or equivalent, but the individual installation does not do so and the electricity is not transferred to the network subject to a concession, the energy tax may be deducted in full.

Tax reduction for installation of green technologies

Since 1 January 2021, individuals can benefit from a tax reduction for the installation of green technologies. A tax reduction of 20 % is granted for the installation of networked photovoltaic systems, while a tax reduction of 50 % is granted for the installation of systems for the storage of self-generated electricity and for the installation of recharging points for electric vehicles. The tax reduction is based on the cost of work and materials and has a ceiling of SEK 50 000.

The green technology tax reduction has replaced the previous state investment aid for the installation of photovoltaic cells, energy storage for self-generated electricity and recharging point for electric vehicles.

Energy tax rebate on electricity after battery storage

As of 1 January 2019, there is the possibility of applying for the repaymentof energy tax on electricity fed out from a network subject to a concession, stored and then fed back to the same electricity network subject to a licence. This is to avoid unintended double taxation.

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

Sweden and Norway have a common electricity certificate market since 2011, which is governed by a bilateral agreement between the countries. The objective of the joint market for electricity certificates with

Norway was to increase renewable electricity production by 28.4 TWh between 2012 and 2020. Sweden was to finance 15.2 TWh and Norway would finance 13.2 TWh, but it was up to the market to decide where and when the new production would take place. Sweden also aimed to increase renewable electricity production by an additional 18 TWh by 2030. The increase of 18 TWh would only be financed by Sweden. However, this target was already achieved in 2021.

According to the agreement between Sweden and Norway, the reporting is to be based on a distribution of electricity production of 50 % to each country until each party has credited 13.2 TWh each and then 100 % to Sweden (Article 14, paragraph 2). As production corresponding to 35.4 TWh in Sweden and 21.2 TWh in Norway became operational according to the 2022 statistics, the targets set within the electricity certification scheme have been achieved and exceeded.

3.1.2.3 Specific measures for 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 sector

See points 3.1.1.1 and 3.1.2.1. In addition, mention should be made of the Connecting Europe Facility (CEF), which aims to fill gaps, mainly in cross-border sections, in the European transport, energy and telecommunications networks. The Fund is intended to contribute to improving competitiveness within the EU and to economic, social and territorial cohesion and has over the years allocated funds to Swedish projects.

3.1.2.4 Where applicable, the assessment of the support for electricity from renewable energy sources to be carried out by Member States pursuant to Article 6(4) of Directive (EU) 2018/2001

At present, Sweden has not produced specific evaluations of the effectiveness of support schemes for renewable electricity generation and their main distributional impact on different consumer groups and on investments. Article 6(4) of the Renewable Energy Directive requires Member States to evaluate at least every five years the effectiveness of their support schemes for electricity from renewable energy sources and their main distributional impact on different consumer groups and 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.66

3.1.2.5 Specific measures to introduce one or more contact points, streamline administrative procedures, provide information and training, and facilitate the uptake of power purchase agreements 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;

Council Regulation (EU) 2018/1999 of 1 1 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 Parliament66 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 of one or more contact points

The Swedish Energy Agency has set up a contact point for permitting, exemption and notification procedures linked to renewable energy.67

National strategy for sustainable wind energy development

The Swedish Energy Agency and the Swedish Environmental Protection Agency have jointly developed a strategy for sustainable wind energy development which was presented in 2021.68 The strategy, which only covers onshore wind, breaks down national development needs for wind energy at regional level and serves as a planning tool. The initiative is an action within the framework of the Environmental Objectives Council.69 Since 2021, the focus has been on implementing the strategy. A guide has been drawn up to simplify regional analysis, in particular as regards the examination of coexistence and cooperation with municipalities. The next step of the national regional analysis strategy has started in two counties.

Maritime spatial plans

On 17 June 2015, the Government decided on a Maritime Spatial Planning Ordinance (2015: 400), which regulates how state maritime spatial planning is to be implemented in Sweden. In line with the Ordinance, the Agency for Marine and Water Management prepared draft 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 the planning and examination of claims within the MSP area.70 The aim of 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.

Offshore wind energy

On behalf of the Government, the Swedish Energy Agency has coordinated the work to identify new areas suitable for offshore wind energy, with the aim of enabling an additional 90 TWh of annual electricity production in addition to existing maritime spatial plans which allow for 20-30 TWh of annual electricity production.71 The work has been carried out in dialogue with eight other authorities with a view to promoting coexistence and cooperation solutions between energy extraction and the interests of cultural conservation, nature conservation, shipping, total defence and commercial fishing when they have claims in the same sea areas. The Mission was declared tothe Government on 31 March 2023.72 The planning documents produced will be an important starting point for the Agency for Marine and Water Management's

67 https://www.energimyndigheten.se/fornybart/tillstand/.
68Swedish Energy Agency – National Strategy for Sustainable Wind Energy (ER 2021: 2).
69The Government has set up the Swedish Environmental Objectives Council as a platform for more measures and intensified work at all levels of society to achieve Sweden's environmental objectives. On 1 March each year, the Environmental Objectives Council presents measures that the authorities undertake to implement in order to speed up progress towards the environmental objectives. The mandate of the Environmental Objectives Council will last until 6 May 2026.
70 https://www.havochvatten.se/vagledning-foreskrifter-och-lagar/vagledningar/havsplaner.html.
71 https://www.energimyndigheten.se/fornybart/vindkraft/nya-omraden-for-energiutvinning-i-havsplanerna/.
72 https://www.energimyndigheten.se/nyhetsarkiv/2023/prioritering-av-energiintresset-och-losningar-for- co-existence – avgorande-for-deployment -off-sea baseradwind turbines/

further work to draw up a proposal for new maritime spatial plans by December 2024.

The Swedish Energy Agency and the Swedish Agency for Marine and Water Management have carried out, on behalf of the Government, a knowledge compilation of the conditions and possible measures for the coexistence of offshore wind energy, professional fishing, aquaculture and nature conservation.73 The cooperation shall serve as a basis for environmental impact assessments, planning and permitting processes.

Solel portal – guidance on photovoltaic

In September 2018, the Swedish Energy Agency launched the online initiative Solelportalen.se. The portal collects factual and independent information on photovoltaic installations, from the planning phase for installation to the decommissioning of a plant, for the target groups owner-owners of small houses and owners of nearbyproperties. In this way, the Swedish Energy Agency wishes to make informed investment decisions easier for potential photovoltaic consumers.

The Solel portal was developed by the Swedish Energy Agency on behalf of the Government. The work on the portal was carried out in consultation with several authorities with relevant information in this area.

Removal of building permit requirements for solar installations

In order to facilitate the installation of photovoltaic installations, the requirements for building permits for many types of photovoltaic installations and solar collectors have been removed from the planning and construction legislation.

Since the first August 2018, as a rule, no building permit is required to assemble a photovoltaic or solar installation on a building if it follows the shape of the building. However, municipalities may impose other requirements in the development plan. The building loven exemption does not apply to buildings in residential areas that are particularly valuable from a historical, cultural, environmental or artistic point of view, nor in or adjacent to areas of national interest for the total defence.

In the past, the planning and building legislation lacked specific rules on photovoltaic and solar thermal installations and guiding case law, which meant that different conditions for solar installations prevailed in different municipalities.

Areas of national interest to optimise land use

The Swedish Energy Agency is responsible for setting out national interests in energy production and distribution and these must be particularly suitable from a national perspective.

For energy production, these include areas for large scale installations that can produce large amounts of energy or power, but also installations that can contribute to balance and regulatory requirements or are needed in areas where energy consumption is high. Today there are eight areas designated for energy

73Swedish Agency for Marine and Water Management – Samestone between offshore wind energy, professional fishing, aquaculture and nature conservation, Swedish Agency for Marine and Water Management (Report 2023: 2).

production.

For energy distribution, provisions on national interests shall apply to areas for installations which are part of wider coherent energy distribution systems of national interest.

The designation of national interest in wind farming, which has taken place since 2004 with the last update in 2013, has played an important role in assessing wind power in relation to other interests in spatial planning.74 There are currently 313 national areas of interest for wind farming, of which 284 areas on land and 29 at sea and in lakes. The total claim is 7 900 km in^2 excluding building and accounts for just over 1.5 % of Sweden's surface area including Swedish water.

Hydropower shall be provided with modern environmental conditions in a coordinated manner with maximum benefits for the aquatic environment and for efficient national access to hydropower electricity. Affärsverket Sverige kraftnät has been tasked with identifying, together with the Swedish Energy Agency and the Swedish Agency for Marine and Water Management, the consequences of the assessment of modern environmental conditions for hydropower on the electricity system. The mission must identify and describe, among other things, what negative impact on hydropower capabilities is acceptable from an electricity system perspective in order to maintain security of electricity supply within Sweden. Nine energy companies owning hydropower have set up the hydropower environmental fund Sweden 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 electricity purchase agreements

There are no specific policies or other measures to facilitate the wider uptake of renewable power purchase agreements. According to information provided by 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 is in competition 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.

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 – the availability of biomass, including sustainable biomass: both domestic potential and imports from third countries, – other uses of biomass in other sectors (agriculture and forestry sectors), and measures for the sustainable production and use of biomass

74 http://www.energimyndigheten.se/fornybart/riksintressen-for-energiandamal/.

The Government has set up a study to propose a strategy to promote the development of a sustainable and competitive bioeconomy. The inquiry shall, inter alia, describe opportunities and, where appropriate, propose measures to increase the availability of sustainably produced bio raw materials from the area-related industries. The bioeconomy strategy is to be presented by 31 October 2023 (see Dir. 2022: 77).

Climate Leap and Industriklivet (see 3.1.1.1 and 4.6 respectively) both contribute to the promotion of bioenergy use. For example, Climate Leap supports conversion from fossil fuels to biofuels. In Industriklivet, biomass is one of the main technological tracks for the transition. In 2022, SEK 557 million was granted to 32 projects.75 An example of aided projects within Industriklivet is an actor developing large-scale production of biochar as a renewable raw material in the fossil-free iron and steel value chain.76

There are several bioenergy research activities, such as the Innovation and Research Programme Bio +. The Bio +, managed by the Swedish Energy Agency, aims to develop bio-based value chains and solutions that will 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. For example, a project has been granted funding to raise awareness of how sustainable biomass extraction from different forest ecosystems can be implemented.77 Research activities related to bioenergy are further described in section 4.6.

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 instruments that have the greatest direct impact on emissions within the EU ETS are: — Energy tax on combined heat and power production (see 3.1.1). — Support for renewable electricity generation, see 3.1.2.

– Energy mapping in large companies, see 3.2.

— Energy tax for industry, see 3.1.1.

— Industrial Life, see 4.6.

These instruments complement the EU ETS mainly by promoting technological leap and energy efficiency. The instruments thus contribute to the reduction of emissions from Swedish installations within the system. This in turn means that more allowances can be allocated to the market stability reserve and eventually cancelled, thus reducing overall emissions from the EU ETS.

3.1.3.2 Policies and measures to achieve other national targets, where applicable

Air quality

In order for Sweden to meet its commitments under the cap Directive (see 2.1.1.2), efforts are needed to reduce national emissions of ammonia and nitrogen oxides. For NOx, action is needed in both domestic

75Swedish Energy Agency – Swedish Energy Agency's annual report 2022 (ER 2023: 01).
76 https://www.industriklivet.se/.
77 https://bioplusportalen.se/om-bio/.

transport and industry. Ammonia requires measures in agricultural manure management as this is the single dominant source of ammonia emissions in Sweden.

As regards environmental quality standards for outdoor air under the Air Quality Ordinance (2010: 477) and EU air quality limit values under the EU Directive 2008/50/EC on ambient air quality and cleaner air for Europe, more measures are needed to reduce nitrogen dioxide and particulate matter (PM10) concentrations in congested areas. In order to achieve also the generational objective in environmental policy in the longer term, air pollution control will also require other measures to improve air quality, in particular particulate matter, black carbon, ground-level ozone and benzo (a) pyrene, as well as reducing deposition of acidifying and eutrophicating substances in order to protect human health and the environment.

In March 2019, the Government adopted a national air pollution control programme which sets out how Sweden intends to implement measures and instruments to meet the requirements for emission reductions under the cap directive. A revised programme is expected to be adopted in 2023.

The Air Pollution Control Ordinance (2018: 740) covers the work of the Environmental Protection Agency and other relevant authorities on the development of air pollution control programmes, emission statistics, scenarios, environmental monitoring and reporting to the EU resulting from the provisions of the ceiling Directive.

Adaptation – Creating conditions for adaptation – cooperation structures, stakeholder involvement and action plans Follow-up and evaluation of adaptation is supported by the National Council of Experts on Adaptation to Climate Change and the Swedish Meteorological and Hydrological Institute (SMHI). The National Council of Experts on ClimateChange 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 Expert Council submitted its initial assessment report to the Government in February 2022.78 In accordance with the mandate of the Expert Council, the report proposes to focus national efforts on climate change adaptation, prioritising adaptation action based on risk, cost and benefit assessment, a summary analysis of the impacts of climate change on society, and a follow-up and evaluation of national efforts on adaptation. Overall, the report contains around 170 proposals to the Government on further work on adaptation to climate change in Sweden.

As a result of the National Adaptation Strategy, in June 2018 the Government instructed the National Board of Housing, Building and Planning to coordinate 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 needs for evidence and guidance for the adaptation to climate change of new and existing settlements.
- Carry out skills upgrading activities in this area.

78National Expert Council on Adaptation to Climate Change – First Report of the National Expert Council on Adaptation to Climate Change, 2022.

- Coordinate evidence provided by expert authorities and research on climate impacts and adaptation of buildings and present the evidence in a user-friendly way.
- Promote and guide the tools and processes relevant to the adaptation of the built environment to climate change.
- Monitor developments in the field of adaptation to climate change and analyse what it means for new and existing buildings.

The task is carried out in cooperation between the National Board of Housing, Building and Planning, SMHI, the Swedish Geotechnical Institute (SGI), the Swedish Civil Contingencies Agency (MSB) and the county administrative boards.

In 2012, the government mandated the SMHI to set up a National Centre of Knowledge on Climate Adaptation to assist municipalities, regions, authorities and other stakeholders in their adaptation work. 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.

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. Following the National Adaptation Strategy, the Government decided in June 2018 to adopt the Ordinance (2018: 1428) on authorities' efforts to adapt to climate change. The Ordinance covers 32 national authorities as well as the 21 county administrative boards, which have been given the task of initiating, supporting and monitoring adaptation to climate change within their respective areas of responsibility. These include carrying out climate and vulnerability assessments, developing action plans and setting targets for their work on adaptation to climate change.

One example is forestry, which is heavily affected by climate change, including an increased risk of forest fires and storm damage, as well as increased presence 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 towards achieving in its action plan:

- Damage is limited in the near future by well-functioning surveillance and emergency preparedness systems.
- Damage is prevented in the long term and cost effective by ensuring that forests are site adapted and storm safe and have a high degree of variability.
- Forestry is developed so that damage to the environment and other social values does not increase over time.

The county administrative boards are responsible for coordinating regional climate adaptation efforts and for initiating, supporting and following up the municipalities' work on climate adaptation. 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 SMHI's analysis for 2022 430, the authorities' action plans included proposed

measures. Most of the measures are of an analytical nature, followed by governance/organisational, informative and least technical/nature-based measures.

The Authority Network for Adaptation to Climate Change consists of the 21 county administrative boards, the Swedish Association of Local Authorities and Regions and 32 national authorities. The network works for coordination and knowledge sharing and the secretariat is managed by the SMHI. The Authority Network is behind the Knowledge Portal on Adaptation to Climate Adaptation, which is managed by the SMHI. There are also thematic networks for national cooperation as well as regional networks.

Significant progress has been made and awareness of the importance of climateadaptation has increased in recent years across society. In order to stimulate further progress, the Planning and Building Act has been amended in June 2018. As a result of these amendments, municipalities have now become more demanding and enabled to include climate adaptation aspects in the municipal planning process. In particular, the county administrative boards contribute to climate adaptation through support for municipalities to analyse climate risks and draw up action plans, as well as through the county administrative boards' supervision of the municipalities' work on master plans and detailed plans in accordance with the PBL.

Knowledge transfer and risk assessment

The SMHI Rossby Center is working on climate research and has developed national and regional climate scenarios up to 2100. SMHI's 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 screening service is based on observations as well as scenarios from multiple 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 events and spatial data in accordance with the Flood Risk Ordinance (2009: 956) and a database of natural disasters.

In cooperation with seven other authorities, the SGI has developed common geotechnical risk maps and tools to assess climate risks. In June 2021, SGI and MSB presented a joint government mission to identify specific risk areas for race, slides, erosion and flooding that are climate-related. The report identifies ten national risk areas which are ranked on the basis of a weighting of the probability and consequence of the occurrence of climate-related races, landslides, erosion and flooding.79

The Government Network's joint portal on adaptation to climate change, see, provides information on how society is affected by a changing climate, tools for adaptation to climate change, as well as examples of implemented climate adaptation measures and information on current activities.

Implementation

The government finances measures to improve knowledge of the effects of a changing climate and to address these effects, for example through prevention measures against race, slides and floods. For 2023, the budget

79SGI and MSB – Risk areas for race, slides, erosion and flooding, Reporting of Government mandates under Government Decision M2019/0124/K (2021).

for this is approximately SEK 620 million. This includes funding of SEK 115 million for measures to prevent race and leaching in the Götaälvdalen, which is a particularly vulnerable area in Sweden.

The Government also decides on assignments related to various measures to sectoral authorities. However, climate change adaptation is in many cases cross-sectoral, which means that the work is mostly carried out in synergy between several actors and sectors at national, regional and local level.

Sweden has a well-established and functioning framework for work 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 actors involved in land use planning, risk management, natural disasters and climate adaptation, in order to reduce risks and improve preparedness.

Several cooperation fora are currently active in Sweden, where sectoral authorities and other stakeholders can share experiences and plan important measures. These fora include the Government Network on Adaptation to Climate Change, the Government Network of Strong Destruction, the Committee on Dimensive Flows for Dams in a Climate Change Perspective, the Delegation for Race and Closing Issues 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.

In built environments where the risk of natural disasters is particularly high, municipalities can apply for state funding for prevention. The Government has allocated approximately SEK 520 million annually for 2023-2025 for measures which:

to prevent landslides and other natural disasters. The financing, administered by MSB, can be made up to 60 % of the costs, or 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

The National Adaptation Strategy has a five-year follow-up cycle. The cycle includes the implementation of the strategy and the development of an updated climate and vulnerability assessment followed by follow-up and evaluation of the work carried out. The National Council of Experts on Adaptation to Climate Change is responsible for the evaluation of the Strategy and the Council submitted its first report to the Government in February 2022. The government intends to present an updated climate adaptation strategy in 2023.

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.

3.1.3.4 Where applicable, national policies, time limits and measures envisaged to phase out energy subsidies, in particular for fossil fuels

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3.2 Dimension energy efficiency

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 7a, 7b and 20.6 of Directive 2012/27/EU to be developed in accordance with Annex III to this Regulation;

Alternative policy measures

Article 7(10) of the Energy Efficiency Directive states that80 Member States must achieve the energy savings required under point (b) of the first subparagraph of Article 7(1), either by establishing an energy efficiency obligation scheme referred to in Article 7(a) or by adopting alternative policy measures referred to in Article 7(b). Member States may combine an energy efficiency obligation scheme with alternative policy measures.

Sweden has so far opted to achieve its energy savings obligation by applying energy and CO2 taxes at levels above those laid down in the Energy Tax Directive.81 The structure of Swedish energy taxation is described in 3.1.1.1.

Swedish tax levels

The current tax rates, as set out in or resulting from the Energy Tax Act (LSE), are set out in 3.1.1.1. Instead, Table 10 shows the evolution of energy and carbon taxes on fossil fuels and electricity for the period 2012-2022 expressed as an amount per amount of energy (öre/kWh).82

Table 10. Energy and carbon dioxide tax on fuels and electricity on 1 January each year 2012-2022, öre/kWh (2021 price level).

	2012	—	2018	2019	2020	2021	2022
Electricity	31,7		34,6	35,6	36,1	35,6	36,0
Fuel oil	43,0		43,7	43,8	44,4	43,7	44,3
Diesel	52,0		63,3	58,5	49,1	48,4	49,0
Petrol	67,8		77,4	74,1	75,1	74,1	74,9
Coal	48,0		48,7	48,9	49,5	48,8	49,4
Natural gas	32,2		32,7	32,8	33,2	32,8	33,2

Directive 2012/27/EU of the80 European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC;
81Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity.
82Swedish Energy Agency – Energy Indicators 2022 (ER 2022: 10).

For households, VAT is also added at the rate of 25 %, which is calculated on the energy price inclusive of taxes. Businesses normally have a full right to deduct such input VAT.

EU minimum levels of taxation

TheEU minimum levels of taxation for motor fuels are set out in Table A of Annex I to the Energy Taxation Directive.83 Table B of that annex sets out minimum tax levels for motor fuels used for the purposes set out in Article

83Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity.

8.2 of Directive 2003/96/EC. Table C of the Annex sets out minimum rates of taxation for heating fuels and electricity. It follows from Article 15(3) of that directive that Member States may apply a level of taxation down to zero to fuels and electricity used in agriculture, horticulture orfish farming and in forestry. The EU minimum levels of taxation are presented in Table 11 and Table 12. The minimum levels of taxation have not changed since 2010.

Table 11. EU minimum rates for fuels and electricity.

	Tax rate unit	Tax rate
Motor fuels		
Leaded petrol	EUR/1000 litres	421
Unleaded petrol[j]	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 12. Minimum levels of taxation applicable under the Energy Tax Directive 2003/96/EC, converted into SEK for petrol, diesel and non-business electricity.[84]

Year	Motor fuels		Non-professional electricity
	SEK/l petrol	SEK/l diesel	öre/kWh
2018	3,10	2,85	0,86

Estimated impact of policies to achieve energy savings requirements

Article 7(9) of the Energy Efficiency Directive states that Member States are to ensure that the savings resulting from policy measures referred to in Articles 7a, 7b and 20.6 are calculated in accordance with Annex

V. Article 7(12) of the same directive requires Member States to demonstrate that energy savings are not doublecounted in cases where the impact of policy measures (instruments) or individual measures overlap.

Overall on the calculation of energy savings

Sweden applies a wide range of complementary instruments. The actual measures taken to make energyuse more efficient are the result of the interaction between these instruments.

In order to fully 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 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 effects of energy and CO2 taxes. The effects of the other complementary instruments described in section 3 will thus not be monitored and calculated in the context of Article 7(a) and (7b) of the Energy Efficiency Directive. This approach to the calculation and monitoring of energy savings applies only to the implementation of provisions of Article 7, 7a and 7b of the Directive.

Methodology for calculating energy savings from taxes

The Directive does not specify a detailed calculation method, but it follows fromthe provisions that only energy savings resulting from taxation measures exceeding the minimum levels of taxation applicable to fuels as required by the Energy Taxation Directive shall be taken into account; or

[84] conversion has been made using calorific values for different fuels according to the report Energy status in figures 2012, as well as the official ECB exchange rate for 2014 as of 1 October 2013: SEK 8,6329/EUR.

the VAT Directive. In addition, it states that up-to-date and representative official data on price elasticity are to be used for the calculation of the impact of the taxes.

The energy savings that can be credited are thus the savings resulting from the price difference resulting from Swedish taxlevels being higher than the EU minimum levels of taxation for energy and CO2 taxes and VAT respectively. Somewhat simplified, energy savings are calculated by multiplying the price difference by price elasticity and energyconsumption.

Article 7, 7a or 7b of the Energy Efficiency Directive does not require that the accumulated amount of energy savings be achieved through the use of new instruments, but that it must be achieved through new measures. These may result from new and/or existing instruments. Swedish energy and CO2 tax levels have been higher than the EU minimum tax levels for a long time. Taxes have contributed and will continue to contribute to energy savings, both by stimulating behaviouralchange and investing in energy efficient technologies. A crucial issue for the calculation of the steering effect is the starting date to be used. The energy efficiency measures taken in 2021 are a consequence of the tax levels (and other instruments) existing in 2021, but also of the tax levels and instruments that existed in 2020 and before. The taxes introduced in 2021 and later have an impact beyond 2030.

As Sweden calculated the impact of the taxes on energy savings in the period 2014-2020, 2014 should also be the starting year for the calculations 2021-2030. In order to calculate the effect of the taxes, energy savings over the period 2030-2014 should be assessed counterfactual, i.e. compared under an alternative scenario that, as of 1 January 2014, when the savings requirements of the Directive were originally introduced, the levels of taxation should be reduced to the EU minimum levels. The guiding effect of the higher levels of taxation is then that they help to keep energy consumption down, compared to the alternative scenario where taxes are reduced. The cumulative energy saving is then the difference between the scenarios, consisting of the increase in energy consumption resulting from reduced taxes (see Figure 8). If we were also to include the impact of taxes introduced before 2014 in the period 2014-2030, energysavings would have been much higher. This is because the full effect of the price difference would have been reached already in 2014 and would remain.

Figure 8. Energy savings due to differences between the Swedish tax level and the minimum level of taxation.

As mentioned above, the price-increasing effect of taxes has both a short and long term effect. In order to capture this 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 elasticities, themethod of calculation does not assume that the full effect is achieved from the first year after 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 on how long it takes to reach full effect and how the impact evolves over time. Such integration may take different shapes. More detailed information on the narrativemodels, price elasticity, etc. used to calculate energy savings of Swedish instruments in different sectors is given in the following section. Calculations are made for different fuels/energy carriers in the residential and service sectors (excluding area industries) and transport.

Econometric estimates of short- and long-term price elasticities were made in 2013 for domestic and service electricity use84 and for the use of petrol and diesel in the transport sector.85 It can be noted that these estimates result in elasticities that are lower than previous estimates from 2008 (see SOU 2008: 25 Annex 5).

84Brännlund (2013) electricity demand of *the housing sector in Sweden*, Report to the Ministry of Finance.
85Brännlund (2013) *The effects on energy saving from taxes on motor fuels: The Swedish case*, CERE Working Paper 2013: 6.

New short and long-term price elasticities have since been estimated by:

In 2019, the Swedish Energy Agency covers the period 1975-2017 for electricityuse in housing and services and 1976-2017 for the transport sector.86 TheAgency's estimates are based 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 EnergyAgency's memorandum.87

For data for calculation and subsequent follow-up, actual final energy consumption for 2014-2021 is used. The average final energy consumption for the period 2021-2017 is then used for 2022-2030. Actual energy prices, taxes and VAT are used for 2014-2021.88 2021 values are then used for 2022-2030. All these prices are expressed as constant prices at the 2021 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, minimum levels of taxation in the EU for energy tax and VAT are89 taken from the respective Directives. The EU minimum levels of taxation per fuel have been converted to öre/kWh at the official exchange rate in force, see Table 11. This level is used for the whole period 2021-2030. The EU VAT Directive states that the minimum standard tax level is 15 %, compared to the Swedish level of 25 %. The VAT amount based on the EU minimum tax level has been calculated on the basis of the Swedish energy price90 and the minimum standard tax level 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 rates in Sweden and the EU is calculated for each year. It is worth noting that the price difference resulting from the above assumptions remains unchanged from 2022 onwards, resulting in the same annual but provisional effect from that year onwards.

The description and results of calculations of energy savings in the housing and service sectors and in the transport sector are set out in *Annex 1*. Full sources and data are available at the Government Offices. 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 dioxide tax and VAT respectively in Sweden compared to the EU minimum tax levels, are shown in Table 13. The table shows that the total amount of accumulated energy savings resulting from Swedish instruments over the whole period 2030-2021 is estimated at around 165 TWh. This corresponds to the amount of accumulated energy savings to be achieved in Sweden for the same period.

86Swedish Energy Agency – PM 201 9: Calculation method of the impact of energy and CO2 taxes on energy consumption (ref. 2018-12739).
87Ibid.
88Swedish Energy Agency – Energy situation in figures 2019.
The Directive only89 allows energy savings to be counted if they result from taxation measures that exceed the minimum levels of taxation applicable within the EU.
90Excluding Swedish tax and VAT.

Table 13. Annual and cumulative energy savings resulting from Swedish instruments for the period 2021-2030.

	Dwellings and services		Transport		**Total**	
Year	*TWh/a*	TWh/ack	*TWh/a*	TWh/ack	***TWh/a***	**TWh/ack**
2021	12,8	**12,8**	4,0	**4,0**	**16,8**	**16,8**
2022	12,3	**25,2**	4,2	**8,2**	**16,5**	**33,3**
2023	12,3	**37,5**	4,2	**12,4**	**16,5**	**49,9**
2024	12,3	**49,8**	4,2	**16,5**	**16,5**	**66,4**
2025	12,3	**62,2**	4,2	**20,7**	**16,5**	**82,9**
2026	12,3	**74,5**	4,2	**24,9**	**16,5**	**99,5**
2027	12,3	**86,9**	4,2	**29,1**	**16,5**	**116,0**
2028	12,3	**99,2**	4,2	**33,3**	**16,5**	**132,5**
2029	12,3	**111,5**	4,2	**37,5**	**16,5**	**149,1**
2030	12,3	**123,9**	4,2	**41,7**	**16,5**	**165,6**

3.2.1.2 Long-term renovation strategy to support the renovation of the national stock of residential and non-residential buildings, both public and private (2), including policies, measures and actions stimulating 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 accordance with Article 2(a) of the Energy Performance of Buildings Directive (EPBD) in 2020.92

Building regulations of the National Board of Housing, Building and Planning (BBR)

The Planning and Building Act lays down requirements for buildings. The rules apply both tonew buildings and to modifications of buildings. The National Board of Housing, Building and Planning's building regulations (BBR)93 contain implementing measures to 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 limits for maximum permitted energy use in buildings. One requirement refers to limit values for the building's energy use (primary energy value) expressed as kWh per square metre of 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 primary energy requirements are currently 90100 kWh/m^2 for single-family houses depending on their size, i.e. one- and two-dwelling buildings, 75 kWh/m^2 for multi-dwelling buildings and 70 kWh/m^2 for residential buildings.

Routing

The basic deduction is a tax reduction of 30 % of the labour costs of repairs, maintenance and residential buildings. The deduction was introduced in 2008 with the aim of simulating the availability of labour and reducing undeclared work.94 Some of the measures covered also contribute to more efficient energy use.95 A natural effect of the ROT deduction is that it creates an incentive for property owners to carry out more 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 holders of tenant-ownerships.

National Renovation Centre (NRC)

The National Renovation Centre (NRC) works with industry and academia to support construction stakeholders through knowledge building and dissemination of information. This is in order to implement an efficient renovation process. The aim is to make existing buildings more environmentally, economically and socially sustainable from a life-cycle perspective, with improved or maintained functioning to meet the

Directive 2010/31/EU of the92 European Parliament and of the Council of 19 May 2010 on the energy performance of buildings.
93Boverket's Code of Statutes (BFS 2011: 6, including amendments up to and including BFS 2020: 4).
94Government Bill. 2006/07: 94, bet. 2006/07: SkU15, 2006/07: 181 and Bill. 2008/09: 97, bet. 2008/09: FiU18, rskr. 2008/09:183.
For95 house 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 at http://skatteverket.se.

demands of users and public authorities.96

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

To promote energy services, the Swedish Energy Agency acts as a contact point for customers and suppliers to provide relevant information on the web. The Promoter Group for Housing (Bebo) has developed a model agreement for housing associations in the project guided energy management.97

Energy Efficiency Council

The Energy Efficiency Council's task is to strengthen state 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.

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 (2), consumer information and training measures (3) and other measures to promote energy efficiency (4)).

In addition to the energy efficiency provisions adopted at European level and implemented in Sweden, such as the Ecodesign Directive, the98Energy Labelling Directive99, the EPBD100 and the Energy Efficiency Directive, the following policies and measures101 apply.

Municipal energy and climate advice

State funding goes to municipalities for local climate and energy advice to individuals, associations and small and medium-sized enterprises. The local climate and energy advisors, 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.[102]

Financial support is also provided to 15 regional energy agencies which coordinate energy and climate advisors. 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 companies, county administrative boards, municipalities and others, for example in

96 http://www.renoveringscentrum.lth.se/.
97 https://energiradgivningen.se/lagenhet/malstyrd-energiforvaltning.
Directive 2009/125/EC of the98 European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products.
99European Parliament and Council Regulation (EU) 2017/1369 of 4 July 2017 setting a framework for energy labelling and repealing Directive 2010/30/EU.
Directive 2010/31/EU of the100 European Parliament and of the Council of 19 May 2010 on the energy performance of buildings.
Directive 201 2/27/EU of the101 European Parliament and of the Council of 25 October 201 2 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC.
102 http://www.energimyndigheten.se/energieffektivisering/program-och-uppdrag/kommunal-energi-och- climate purposes/.

developing plans and strategies.

The focus and objectives of the energy and climate advice for the 2021-2023 programming period are as follows:

- The advice actively contributes to mobilising relevant categories or configurations of actors, generating new knowledge exchanges and awareness raising.
- The advice uses the most appropriate and up-to-date methods of energy advice, follow-up and communication for the respective target group in order to achieve the greatest exchange of the operation.
- Advice plays an active role in the decision-making process and actions of the Council by strengthening knowledge and awareness.
- Advice generates an increased amount of energy efficiency measures through targeted priority actions.

Intervention projects are part of basic energy and climate advice. The target groups of the intervention projects are the same as for basic energy and climate advice. The national action projects are based on the Swedish Energy Agency's business plan which prioritises sustainable and smart cities. There are two national intervention projects for the 2021-2023 programming period, in resource-efficient buildings and sustainable transport.

Environmental inspections and supervision guidance

The Environmental Code entered into force in 1998. The requirement for energy management and the use of renewable sources of energy then became more important because it was highlighted in a rule of consideration, which is the basic pillar of the Environmental Code. Under the Environmental Code, all operators must use energy and primarily use renewable energy sources. This means that operators must:

- acquire knowledge of energy use;
- identify possible measures; and
- carry out reasonable measures on an ongoing basis.

The supervisory authorities shall monitor compliance with the principle of household maintenance. They also have the task of providing advice. The authorities have the right to request the information necessary for supervision, such as mapping, analysis and action. It is therefore particularly important that the work on energy management is documented. Since 2011, in accordance with the Environmental Supervision Ordinance (13: 2011), the Swedish Energy Agency has been responsible for monitoring matters relating to self-monitoring by operators with regard to energy management 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, monitoring and evaluating operational supervision.

Energy mapping in large companies

The Act (2014: 266) on energy mapping in large companies aims to promote greater energy efficiency. The Act is part of meeting the requirements103 imposed on Member States by the EU Energy Efficiency Directive. The Act requires large companies to carry out energy surveys, which must include information on total energy use and proposals for cost-effective measures to improve energy efficiency. The mapping must be carried out at least every four years.

Networks to promote energy efficiency in buildings

The Swedish Energy Agency coordinates customer groups for housing (BeBo), commercial and public premises (BeLok), single-family house manufacturers (BeSmå), the public sector which rents premises (HyLok) and food distribution (ReLivs) and networks to promote new construction and conversion into low-energy buildings (flame).

The aim of the commissioners' groups and networks is to create a meeting place and platform where governments, industry and academics can work together to develop energy-efficient practices, develop good examples and carry out demonstrations. The networks are involved in testing, introducing and evaluating new technologies, models and products, creating evidence and implementing technologiesprocurements, and overcoming market barriers to knowledge. The networks also serve as a meeting platform bringing together various industry stakeholders, authorities and the Academy to create new collaborations and greater engagement.

Stakeholder cooperation in local energy efficiency nodes

In order to systematically utilise and reuse residual energy, in particular heat, local activities are encouraged to cooperate on both high and low value residual heat, not least that produced in some large industrial installations and which can be directed to the district heating network or other actors that can benefit from it. This initiative can be said to be related to the technology procurement groups 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 entered into force on 1 October 2006 and regulates the use of energy certificates in Sweden. The National Board of Housing, Building and Planning has drawn up implementing rules and supervises the declarations and the independence of energy experts. An energy certificate shall be drawn up for a building in the case of sale, rental and new construction, as well as for large buildings frequently visited by the public. The energy performance certificate is made by an independent expert on behalf of the owner and is valid for 10 years. However, owners of single-family houses do not have to re-declare the building until it is sold.

An energy certificate contains information on the building's energy use and is aimed at prospective house

Directive 201 2/27/EU of the103 European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC.

buyers or tenants. Energy certificates shall make purchasers aware of the energy consumption in order to take it into account when purchasing them. 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 2023, over 707 000 buildings were registered in the*National* Board of Housing, Building and Planning's database.104

Aid for energy efficiency in single-family houses

In the 2023 budget, the Government allocates 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 now heated with direct-acting electricity or gas.

Information campaigns

Swedish authorities, in particular the Swedish Energy Agency, have developed web-based tools to disseminate targeted information on energy use and energy efficiency.105 Information measures are targeted at households, businesses and public authorities alike. An example is Energilyft*,* a free online training on low-energy building, which is aimed at:

commissioners, architects, engineers, building project managers, managers and operational technicians.106

3.2.1.5 Where applicable, a description of policies and measures to promote the role of local renewable energy communities in contributing to the implementation of policies and measures in points i, ii, iii and iv —

3.2.1.6 Description of measures to exploit the energy efficiency potential of gas and electricity infrastructure

The Electricity Act

The Electricity Act was amended in 2014 to meet the requirements of the Energy Efficiency Directive. Chapter 3, Section 16a (now Chapter 3, Section 41) of the Electricity Act introduced a provision according to which electricity network operators may not impose technical requirements or other conditions that impede the provision of 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 the application of, for example, demand response in balancing services and the purchase of additional services.

Chapter 4, Section 26 of the Electricity Act has also included provisions requiring network tariffs to be designed in a way that is compatible with efficient use of the electricity network and efficient production and use of electricity.

Regulatory model for network operators

104 https://www.boverket.se/globalassets/publikationer/dokument/2023/boverkets-arsredovisning-2022.pdf
105 https://www.energimyndigheten.se/energieffektivisering/.
106 http://www.energimyndigheten.se/energieffektivisering/jag-arbetar-med- energy efficiency improvements/construction/energy lifes/.

In2014, the financial regulation of electricity network operators introduced incentives to encourage energy efficiency throughthe Energy HYPERLINK "https://www.ei.se/Documents/Publikationer/foreskrifter/El/EIFS_2019_4.pdf"Market Inspectorate priorto publications (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 establishing the revenue framework. These incentives mean that network operators that implement improvements in the level of network losses and capacity use and thus contribute to energy efficiency receive a bonus in the regulation.

3.2.1.7 Regional cooperation in this field, where appropriate;

3.2.1.8 Financing measures, including Union support and the use of Union funds, in the area at national level

In addition to the national funding measures described above, the following EU funding is relevant:

EU financial support for energy efficiency in buildings

The EU promotes improvements in the energy performance of buildings through a range of financial support programmes. Founded in 2011, the Energy Efficiency Instrument (EEFF) provides debt, equity and guarantee instruments, as well as technical assistance for project development assistance in a number of areas, including both private and public buildings.

European Regional Development Fund

The European Regional Development Fund (ERDF) aims to strengthen economic and social cohesion in the EU by reducing regional disparities.

The theme “Sustainable development” includes the following actions to promote energy efficiency:

- Develop support structures so that demonstration projects and support measures translateinnovation. This is done in the context of renovations and renovations being carried out in existing housing stock and in public infrastructure.

- Contribute to the promotion of energy efficiency in the renovation and renovation of housing, but also with careand attention to the environment and cultural values and to those living in and occupying a building;

- Ensure that socially sustainable urban development and regeneration of areas is promoted through a holistic approach. Physical measures are then combined with social measures.

- Contribute tocreating the conditions for energy efficiency through spatial planning of public infrastructure.

  Support measures for integrated transport of goods, supporting and strategies for urban structures that promote energy efficientsustainable mobility and reduce greenhouse gas emissions.

3.3 Dimension energy security

3.3.1 Policies and measures related to the elements set out in Section 2.3.

3.3.1.1 Electricity 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.[107] The background to the Regulation is the more interconnected electricity markets and systems, which means that the management of electricity crises can no longer be regarded as a purely national task. Article 10 of the Risk Response Regulation requires the competent authority of 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 contains, inter alia, a description of the most relevant electricity crisis scenarios for Sweden and the measures that may be in place to deal with an electricity crisis, as well as a description of the distribution of responsibilities.

Measures related to electricity cuts

The Swedish power grid is the Swedish electricity preparedness authority and is working to strengthen the electricity supply so that it can cope with severe pressures. The Swedish power grid 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 financing of preparedness measures, see section 3.3.3.

Under Chapter 4, Section 20 of the Electricity Act, there are requirements addressed to the network owner that interruptions may not exceed 24 hours; see also Section 2.3, unless it is caused by a factor beyond 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.

Furthermore, measures are being taken to raise public awareness of appropriate domestic preparedness measures in order to mitigate the consequences of blackouts.[108]

Measures to address scarcity of electricity

The Swedish Energy Agency is working on crisis management measures to prevent electricity shortages and to mitigate the consequences of shortages. The measures include, inter alia, a national information campaign to encourage electricity users to voluntarily reduce their use, thereby avoiding shortages. If this is insufficient, there is a plan for how a future ransing system could be designed. The Swedish Energy Agency is the responsible authority for measures concerning electricity shortages.

Measures related to lack of impact

The basis for avoiding power shortages is that market players act in a balanced way. Where this is not

107 https://www.energimyndigheten.se/trygg-energiforsorjning/el/riskberedskap-inom-elsektorn/.
108 https://www.energimyndigheten.se/trygg-energiforsorjning/el/elavbrott/.

sufficient, the Swedish system operator, the Swedish power grid, has a number of technical and commercial mechanisms at its disposal to maintain balance in the electricity system.

If the regular mechanisms available to the Swedish Grid are not sufficient, the power reserve is available in winter.
The power reserve is created by the Swedish Grid drawing up agreements with electricity generators to maintain a specific generation capacity. The Power Reserve Act (2003: 436) applies until 16 March 2025.

If mechanisms are not sufficient, the last resort is the unsetting of load (manual demand disconnection, MFK), which means that part of the consumption is disconnected to avoid system collapse. In order to mitigate the impact on society, a methodology for planning and prioritising essential electricity users, Styrel, has been developed.109

Responding to the 2022-2023 energy crisis

A number of interacting external factors in 2022, such as the suspension of gas supplies from Russia to Europe and the abandonment of nuclear power in France, led to a surge in electricity prices. In response to the energy crisis, an110 emergency regulation was adopted at EU level to tackle high energy prices.

The Emergency Regulation obliges Member States to reduce electricity consumption by at least 5 % during peak hours and calls on Member States to reduce overall electricity demand by at least 10 % by 31 March 2023. Member States are free to choose the appropriate measures to reduce consumption in order to achieve both targets during this period.

The Government, together with the Swedish Energy Agency and Swedish Power Grid, has communicated to society about the risk of manual disconnection of electricity users in winter 2022/2023 due to the risk of power shortages during peak hours.

Several measures implemented during the 2022/2023 energy crisis are presented below:

- The Government instructed state authorities with 10 or more employees to take possible and appropriate energy saving measures until 31 March 2023.111 The Energy Agency shall draw up the authorities' accounts and submit a final report on the assignment by 31 May 2023 at the latest.
- The Swedish Energy Agency launched an information campaign "Every kilowatt-hour count" to raise public awareness, reduce electricity consumption and reduce the price of electricity.
- The Swedish Energy Agency launched an energy112 efficiency campaign for small house owners in 2022 as part of a government mandate.

109 https://www.energimyndigheten.se/trygg-energiforsorjning/el/styrel/
110Council Regulation (EU) 2022/1854 of 6 October 2022 on a crisis intervention (the Emergency Regulation) to address high energy prices.
111 https://www.regeringen.se/regeringsuppdrag/2022/09/uppdrag-att-vidta-energibesparingsatgarder-inom- den-statliga-Forvaltenes/.
112 https://www.energimyndigheten.se/energieffektivisering/husguiden ---for-dig-som-vill-energy efficiency enhance- ditt/.

- In order to meet the requirements of the Emergency Intervention Ordinance to reduce peak power peaks during peak hours, on 10 November 2022 the Government instructed the Swedish Grid to set peak hours for electricity equivalent to at least 10 % of all hours in the period from 1 December 2022 to 31 March 2023113 and to tender for consumption flexibility during the specified peak hours. The Swedish power grid set the peak hours between 08: 00-10: 59 and 16: 00-18: 59 hours during the month.114

- On behalf of the Government, Swedish power grids have investigated the possibility of procuring consumption flexibility and plannable electricity generation in southern Sweden, with the aim of countering exceptionally high electricity costs.115 The Energy Market Inspectorate (Ei) has approved Svenska kraftnät's application to use congestion revenues for demand reduction measures.116

- In winter 2022/2023, Swedish power grids carried out tenders for moth-trading and redispatching.117

- On 9 February 2023, the Government submitted to the Riksdag an additional amending budget proposing a tax on excess revenues from electricity, in order for Sweden to be able to apply the revenue ceiling for certain electricity producers which is part of the Emergency Ordinance.118 The revenue cap limits the revenues of certain electricity generators between 1 March and 30 June 2023.

- On 18 August 2022, the Government instructed Svenska kraftnät to design a model for using revenue from capacity charges to support electricity users financially.119 On 16 November 2022, the Energy Market Inspectorate approved an application from the Swedish National Grid to use congestion revenues of up to SEK 55,6 billion to finance electricity aid to final customers.120 The first

  the electricity subsidy was paid out to approximately 4,2 million households in bidding zones 3 and 4 and the calculation of the electricity support was based on the consumption in the period October 2021 to September 2022 in southern Sweden. Payments started at the end of February and 7 March 2023, some 98 % of the beneficiaries having benefited from the electricity subsidy.

- On 22 December 2022, the Government instructed Svenska kraftnät to submit a new application to the Energy Market Inspectorate for electricity aid to traders and legal persons by 4 January 2023.121 The new application would take into account the previous decisions of the Energy Market Inspectorate as well as the EU acquis linked to the ongoing crisis. On 11 January 2023, the Energy Market Inspectorate decided to approve the Swedish Power Grid's application to use congestion

113 https://www.regeringen.se/regeringsuppdrag/2022/11/uppdrag-att-genomfora-upphandling-av- agronomic flexibility- under hogloadtimmar/.
114 https://www.svk.se/siteassets/om-oss/rapporter/2022/rapport-regeringsuppdrag-dnr-i2022-02043.pdf.
115 https://www.svk.se/siteassets/om-oss/rapporter/2022/uppdrag-att-forbereda-ytterligare-upphandling-av- agro-flexibility and planerbar-electricityproduction-i-sodra-sverige.pdf.
116 https://ei.se/om-oss/nyheter/2022/2022-12-16-ei-godkanner-svenska-kraftnats-ansokan-om-att-anvanda- bottleneck to catch-and-after-fragmentreduction.
117 https://www.svk.se/press-och-nyheter/nyheter/allmanna-nyheter/2023/mothandel-och-omdirigering-hojer- capacity/.
118 https://www.regeringen.se/rattsliga-dokument/proposition/2023/02/prop.-20222358
119 https://www.svk.se/siteassets/om-oss/vart-uppdrag/regeringsuppdrag/nodatgarder/redovisning-ru- nodator.pdf.
120 https://ei.se/om-oss/nyheter/2023/2023-01-11-ei-godkanner-svenska-kraftnats-ansokan-om-att-fa-anvanda- bottlenecks to stod-for-naringsidkare-and-legalpersons.
121 https://www.regeringen.se/regeringsuppdrag/2022/12/uppdrag-att-ansoka-om-att-anvanda-intakter-fran- overburden-for-for-for-financier-nodatgarder-for-naringsidkare-and-juriskerkers/

revenues to support electricity customers who are traders and legal entities in electricity zones 3 and 4. On 5 May 2023, the European Commission approved the Government's notification of state aid for electricity aid to undertakings and on 8 May 2023 the Government adopted the Ordinance on electricity aid to undertakings. The electricity aid to companies is administered by the Swedish Tax Agency and, as of 30 May 2023, traders and legal persons have been able to apply for the electricity aid.

- On 16 February 2023, the Government decided on targeted electricity aid to electricity-intensive businesses, see Ordinance (2023: 66) on electricity cost support for certain particularly affected companies. Under Paragraph 20 of the Ordinance, electricity-intensive undertakings could submit an application for electricity aid to the Energy Agency by 18 June 2023 at the latest.

- On 22 December 2022, the Government gave a mandate to Svenska kraftnät to investigate electricity support to households throughout the country during the period November to December 2022.122 On 3 February 2023, the Energy Market Inspectorate decided to approve the application.123 Payments started at the end of May and the plan is for the vast majority of households to benefit from the electricity support by 9 June 2023.

Measures to strengthen security of supply

On 15 December 2022, the Government gave a mandate to Svenska kraftnät and the Swedish Energy Agency to step up efforts to strengthen security of supply in the energy sector in the short and long term.124 The meaning of the assignment is briefly explained below.

With the support of the Swedish Energy Agency, Swedish National Grid shall:

- Carry out 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 sub-mandate was presented in April 2023.

- 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 after 16 March 2025 in accordance with the reliability standard for Sweden. The sub-mandate was presented in March 2023.

- Identify, as part of ensuring operational security, sufficient electricity and transmission capacity in the short and long term, how electricity generation from power sources contributes and interacts to ensure security of electricity supply. The sub-engagement shall be reported by 29 December 2023 at the latest.

The Swedish Energy Agency shall, in consultation with Svenska kraftnät:

- Identify the potential of existing and unused electricity generation and identified reasons for not

122 https://www.svk.se/stod-till-elanvandare/elstod-privatpersoner-hela-landet/.
123 https://ei.se/om-oss/nyheter/2023/2023-02-03-ei-godkanner-svenska-kraftnats-ansokan-om-att-anvanda- bottleneck takter-for-to financial-elstod-to physicalpersons.
124 https://www.regeringen.se/regeringsuppdrag/2022/12/uppdrag-att-starka-forsorjningstryggheten-i- energy sector/.

making available the electricity market. The sub-mandate was presented in March 2023.

- Propose an indicative dimensioning for security of electricity supply and supply for total defence needs and propose how the electricity supply dimensioning can be applied throughout the energy sector and refined and regularly updated. The sub-engagement shall be reported by 13 October 2023 at the latest.

Gas supply

125The Gas Supply Regulation imposes requirements on the security of gas supply. Based on the Ordinance and Swedish legislation (Act (2012: 273) on security of natural gas supply and Ordinance (2012: 275) on security of natural gas supply), a risk assessment has been carried out which forms the basis of a national preventive action plan and national emergency plan.126 In addition to these, the Swedish Energy Agency's regulations and general advice have also127 been drawn up, which impose certain requirements on natural gas undertakings and large natural gas consumers. The requirements aim to increase preparedness for possible gas supply crises. The Regulation specifies, inter alia, that the Competent Authority shall require natural gas undertakings to take measures to ensure gas supply to protected customers in the following cases:

- Extreme temperatures during a 7-day peak period occurring with a statistical probability of once in 20 years;
- During a period of 30 days of exceptionally high gas demand occurring statistically once every twenty years.
- For a period of 30 days in case of the disruption of the single largest gas infrastructure under average winter conditions.

In order to strengthen the security of gas supply, the Swedish Energy Agency has stepped up its work on solidarity under Article 13(10) of the Gas Supply Regulation, as well as cooperation work with the European Commission and several Member States, including Denmark. The Swedish Energy Agency has also increased cooperation and information exchange with industry stakeholders with a view to strengthening the Swedish gas market. Amendments to national legislation have been decided (Bill. 2022/23: 89) to enable the Swedish Energy Agency to impose requirements on natural gas undertakings to ensure that the gas storage is filled in accordance with the requirements laid down in the Gas Supply Ordinance. At the beginning of 2023, national gas consumption had decreased by around 30 % for pipeline natural gas compared to the average of the previous five years.

Oil supply

Sweden is the128 association, through the IEP129 Agreement and the Oil Storage Directive, to keep emergency stocks equivalent to 90 days of net imports. The amount of oil stocks for supply prices is determined once a year by the Swedish Energy Agency, which determines who is obliged to store and how

125European Parliament and Council Regulation (EU) 2017/1938 of 25 October 2017 concerning measures to safeguard the security of gas supply and repealing Regulation (EU) No 994/2010.
126This is in line with the requirements of Article 6(1) of Regulation (EC) No 2017/1938 to introduce a 'risk prevention plan'.
127The Swedish Energy Agency's regulations and general advice (STEMFS 2016: 1) on security of natural gas supply.
128Council 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.
129International Energy Agency (IEA) Agreement on a Joint Energy Programme.

much individual storage is to be. The amount of the storage obligation is based on what the storage debtor has sold or consumed in the previous base year. A ageing year runs from 1 July to 30 June of the following year. Emergency stocks also include biofuels if they are involved in storage fuels at the time of sale or consumption or if they are stored in Sweden and the storage party can demonstrate that they are intended to be mixed with storage fuels and are to be used as fuel.

3.3.1.2 Information security

Implementation of the NIS Directive

130The NIS Directive on network and information security has been transposed into Swedish law by the Act (2018: 1174) on information security for essential and digital services, the NIS Act, and the related ordinances and regulations.

The objective of the NIS Act is to achieve a high level of security of networks and information systems for essential services in the energy, transport, banking, financial market infrastructure, healthcare, supply and distribution of drinking water, digital infrastructure and digital services sectors. The Swedish Civil Contingencies Agency (MSB) has the coordinating role for the work on the law and the sub-sectors have specific supervisory authorities. In brief, the Act on Information Security for essential and digital services 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 appointed by the Government as the regulatory authority for the energy sector in Sweden in accordance with the NIS Act. This means that the authority must monitor 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 drawn up regulations and general advice on risk analysis and security 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 is to be transposed into Swedish law by 17 October 2024. The updated Directive extends the scope, tightened and more detailed requirements for information security work and incident reporting, increased supervisory powers and sanctions, and increased requirements for effective cooperation and information sharing.

For the energy sector, the Directive includes district heating, cooling and hydrogen. It also includes new sub-sectors in electricity and oil, such as nominated electricity market participants, central storage entities and charging operators.

National Strategy for Society Information and Cybersecurity

The Government has a national strategy on how to develop and strengthen information and cybersecurity in

Directive (EU) 2016/1148 of the130 European Parliament and of the Council of 6 July 201 concerning measures for a high common level of security of network and information systems across the Union.

Sweden.131 The strategy sets out objectives in priority areas and aims to help create long-term conditions for societal actors to work effectively on information and cybersecurity, and to raise awareness and knowledge across society. The NIS 2 Directive requires the government, among other things, 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 the oil and fuel markets, cooperation on crisis management measures takes place globally, including in the form of cooperation within the IEA. If a potential risk of oil and fuel shortage arises, such a situation is analysed both in Sweden, in the EU and in the IEA. The IEA evaluates the extent of the impact of a supply disruption on the market and analyses whether emergency stocks should be put into service. The IEA can propose measures, such as collective action, but Sweden is responsible for deciding on possible measures.

As the Swedish electricity system is linked to the other Nordic countries, cooperation on various crisis management measures takes place in the Nordic region. NordBER is a cooperation that includes electricity preparedness issues between the Nordic energy and electricity preparedness authorities and the system operators. From Sweden, two authorities, the Swedish Energy Agency and the Swedish National Grid, participate.

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 Member States into different regional risk groups with a view to developing joint regional risk assessments and thus strengthening cooperation in the event of disruptions or disruptions having a regional impact. Sweden belongs to three of these groups.132 Transmission network operators in Sweden and Denmark have entered into a common balancing zone which will enhance regional cooperation.

3.3.3 Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

Swedish power grids are allocated a budget allocation for contingency measures. A certain part of the appropriation is also used for administrative costs linked to the Swedish Power Grid's activities as a contingency authority, funding for research and tasks related to the Swedish power grid's mission to promote the country's dam safety. This appropriation is largely financed by electricity network owners' fees. For 2023, Swedish power networks were allocated SEK 425 million in electricity preparedness funds.

Crisis management measures consist of actions aimed at preventing, resisting and managing electricity supply

131 https://www.regeringen.se/49f639/contentassets/04c9e2929f474f14bb05f1 82e7054c87/faktabl ad national-strategi-for-space information and cyber objectives.pdf.
Group 1 consists of Denmark, Germany, Luxembourg and the Netherlands,132 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.

disruptions that can put severe strain on society. These measures may consist, for example, of technical reinforcement measures, strengthening physical protection of vital facilities, strengthening cyber security, as well as the acquisition of repair resources and training.

The Swedish Energy Agency has been provided with funds as part of its efforts to rebuild civil defence and strengthen robustness in the energy sector.

For 2023, the Energy Agency was allocated SEK 28 million. A new structure for society's crisis preparedness and civil defence was introduced on 1 October 2022, which includes, among other things, the establishment of civilian areas with civil area county administrative boards, preparedness authorities, preparedness sectors and sectoral authorities. The aim is to strengthen Sweden's resilience and capacity to manage both peace-time crisis situations and increased preparedness.

3.4 Dimension internal Energy market

3.4.1 Electricity infrastructure

3.4.1.1 Instruments and measures to achieve the target level of interconnection referred to in Article 4(d)

As described in section 2.4, the Swedish electricity interconnection level is:
23 % in 2021/2022, which is higher than the EU target of 15 % by 2030. Swedish power networks build connections to other countries based on societaleconomic profitability assessments.

The design of a third AC connection to Finland is currently under way and Hansa Powerbridge to Germany is included in the current network development plan. The analysis of planned and new connections takes place on an ongoing basis when the Swedish National Grid's network development plan is updated every two years.

3.4.1.2 Regional cooperation in this area

Swedish power grids cooperate with the other European transmission system operators through the*European Network of Transmission System Operators for Electricity* (ENTSO-E). Swedish power networks contribute to ENTSO-E's various products, such as the European*Ten Year Development Plan* (*TYNDP*) and also participate in various ENTSO-E working groups.

In addition, Swedish power grids together with the other Nordic transmissionsystems draw up joint Nordic network development plans every two years. The last one was published in November 2021.133 It presents planned and ongoing projects.

133
https://www.svk.se/contentassets/622252150780446d8d35e94aa55df49f/ngdp_2021_final_report_fixed2.pdf

3.4.1.3 Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

The planned AC134 connection (400 kV) between Sweden (SE1) and Finland has PCI status135 and has received EU funding through it.136

3.4.2 Energy transmission infrastructure

3.4.2.1 Policies and measures related to the elements set out in Section 2.4.2, including, where appropriate, specific measures to enable the implementation of projects of common interest and other important infrastructure projects;

There is ongoing work on the removal of structural bottlenecks in the transmission network. Similarly, the regional and local network companies are responsible for their respective networks. Structural, that is to say, regularly recurring bottlenecks, are removed if they are deemed to be economically viable.

3.4.2.2 Regional cooperation in this area

See Section 3.4.1.2.

3.4.2.3 Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

Since 1 May 2015, regional network companies have been able to apply for so-called 'grid reinforcement loans' (see Ordinance (2015: 213) on loans to network companies to facilitate connection of renewable electricity generation). The aim of the new regulatory framework is to make it easier for large projects with fossil-free production to connect 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 enhancement cost that may facilitate the continued future connection of electricity generation. Unlike the previous regulations, this means that a connecting operator only has 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 section 2.4.3.

As indicated in 2.4.3, Sweden has no national targets in terms of market integration. Actions 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 with regard to renewable energy production such as smart grids, aggregation, demand response, storage, distributed generation, mechanisms for dispatching, re-dispatching and

134 https://www.svk.se/utveckling-av-kraftsystemet/transmissionsnatet/transmissionsnatsprojekt/aurora- line/re project/.
135 https://ec.europa.eu/energy/en/topics/infrastructure/projects-common-interest.
136 https://www.svk.se/utveckling-av-kraftsystemet/transmissionsnatet/transmissionsnatsprojekt/aurora- line/study/aurora-line-granted-13-billion-i-eu-medi/.

curtailment, real-time price signals, including the roll-out of intraday market 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 helps to maintain a balance between generation and consumption. Balancing responsibility is a key element, as it is balance managers who have the 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 absorb more 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, the Energy Agency and the Swedish Board for Accreditation and Conformity Assessment, have been mandated by the Government to promote a more flexible electricity system. This mandate includes, inter alia, promoting flexibility and analysing whether further action is needed to realise the potential for flexibility and, if so, to develop an action plan for the implementation of these measures. The mission shall be reported on 15 December 2023.

Sweden cooperates within the Nordic countries on demand response issues and also participates in international cooperation in this area. The Energy Market Inspectorate is continuously following developments in the area of DSR to ensure that the regulatory frameworks are designed in a way that enables demand response.

On 1 July 2022, legislative amendments entered into force which include taking into account the extent to which flexibility services are used and improving the efficiency of operations when setting the revenue framework for a network activity.

Work is ongoing in line with the network codes with shorter settlement times and developed pricing for imbalances. These can lead to a better incentive for operators to develop so-called explicit demand response business models. Explicit demand response allows customers to sell their flexibility on established marketplaces via aggregators. The energy released in this way can be offered to different marketplaces (e.g. intraday or regulating power market) or used for other purposes (e.g. local grid benefits).

Furthermore, the Energy Market Inspectorate operates a price comparison website, www.elpriskollen.se, in order to strengthen the position of consumers in the electricity market and consumers' access to objective information. It allows consumers to compare prices and conditions on the most common contracts of all electricity supply companies. The ability to compare prices and other factors that may influence the choice of electricity supplier is a prerequisite for active customers.

In order for customers to be able to adapt their electricity consumption to hourly variations in the price of electricity themselves, so-called implicit demand response, correct price signals need to reach the customer through, for example, an hourly price agreement, but also through network tariffs. Hourly price agreements

mean that the customer is charged his electricity cost on the basis of an hourly price.).. With hourly price contracts, there is a real possibility and incentive for customers to steer their consumption so that more electricity is consumed when the price is lower and less when the price is higher. Two measures have been implemented to promote the use of hourly pricing agreements, namely the abolition of flat-rate settlement and the inclusion of hourly price agreements in the Elprise packages.

Since 1 January 2020, customers with hourly price contracts are deducted daily, that is to say, they are not set off on a flat-rate basis. This is a consequence of changes made to the Regulation on measurement, calculation and reporting of transferred electricity (Measurement Regulation). A customer who requests hourly measurement in accordance with Section 6c of the Measurement Ordinance shall also be counted daily per hour.

The 15 minutes measurement and reporting requirement will enter into force on 1 November 2023. As a result of the amendments to the Electricity Act and to the Measurement Ordinance adopted by the Government in 2022, the Energy Market Inspectorate has drawn up new regulations on the measurement, calculation and reporting of electricity transferred. The new rules follow the requirement of the EU Balancing Regulation, which states that the time period for electricity imbalance settlement shall be 15 minutes. The new electricity metering regulations will enter into force on 1 November 2023.

In addition to the abolition of the standard settlement for customers, hourly price agreements are included in the Elprise packages, which is an independent price comparison committee and is operated by the Energy Market Inspectorate. This is achieved by changing the Energy Market Inspectorate's regulations and general advice (EIFS 2013: 7) on electricity suppliers' obligation to provide information on prices and supply conditions applied to electricity users to include contracts with hourly variable prices. The display of these contracts on the Elpriskollen opens up new possibilities for Swedish consumers to choose this form of contract.

3.4.3.3 Where applicable, measures to ensure the 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.

3.4.3.4 Policies and measures to protect consumers, especially vulnerable and, where applicable, energy poor consumers, and to improve the competitiveness and contestability of the retail energy market

The Swedish definition of vulnerable customers is set out in the Ordinance (2016: 742) laying down instructions for the Energy Market Inspectorate and reads 'vulnerable customers shall mean persons who are permanently unable to pay for the electricity or natural gas transmitted or supplied to them for purposes which are outside the economic activity'. In the Swedish electricity and natural gasmarket, this category of consumers is protected by allowing the consumer to receive financial assistance to pay electricity and natural gas bills (see 3.4.4).

There are also provisions both in the Electricity Act and in the Natural Gas Act (2005: 403) that protect consumers who are at risk of being disconnected from the electricity or natural gas network due to lack of payment or other material breach of contract. The provisions require the undertaking carrying out the disconnection first to follow a certain regulatory approach. This includes, inter alia, the consumer's right to correct information from the business, the possibility for the consumer to regularise himself without disconnection and the need for the business to send a notification to the social services in the municipality where the consumer lives for a certain period of time before disconnection can occur.

In April 2022, the Government instructed the Energy Market Inspectorate to draw up legislative proposals to counter oschyst commercial practices in the electricity trade market. In its report (Oschyssta business practices: A report containing a legislative proposal, Ei R2023: 01), which was submitted to the Government in February 2023, submitted several proposals to increase the protection of electricity consumers. The proposals will also contribute to increased confidence in the market and competition on a level playing field for market players.

In the memorandum of appropriations for 2022, the Government instructed the Energy Markets Inspectorate to evaluate the regulation of assigned electricity contracts. In June 2022, the Energy Market Inspectorate submitted a report (assigned electricity contract – Evaluation of the 2017 regulations and ways forward for an improved electricity market, Ei R2022: 05) to the Government. The report describes how the indicated prices and the proportion of customers to assigned contracts have evolved since 2017. The possibility of limiting the indicated prices is analysed together with alternative ways of developing the current system of indications.

The Government has not yet taken a position on the proposals in the two reports.

3.4.3.5 Description of measures to enable and develop demand response, including those addressing tariffs to support dynamic pricing

Since 2018, Chapter 4, Sections 31-32 of the Electricity Act (1997: 857) provide for the possibility for electricity network operators to examine new tariffs as part of a pilot project. In its report "Measures for increased demand response in the Swedish electricity system" (Ei R 2016: 15), the Energy Market Inspectorate found that electricity network tariffs are a good instrument for using the demand response available to customers.

The provision of the Electricity Act allows electricity network operators to test tariffs for a smaller number of customers in a customer category that can stimulate more efficient use of the network through demand response. In this way, electricity network operators can test and develop tariffs so that they can stimulate the necessary flexibility in their own network area.

The provision constitutes an exception to the requirement for 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 generation and use of electricity.

In March 2022, the Energy Markets Inspectorate issued regulations and general advice (EIFS 2022: 1) for the

design of network tariffs for efficient use of the electricity network. The new regulations aim to contribute to a more efficient use of the electricity grid and thus help meet society's electricity needs at as low a cost as possible. In addition, the Energy Markets Inspectorate may issue regulations on how electricity network operators 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 Markets Inspectorate has continued the so-called EFFECT dialogue, which aims to raise awareness and promote dialogue between the Energy Market Inspectorate, aggregators, network companies, regions and municipalities, and operators of various market platforms. The dialogue is important to identify how regulatory frameworks and methodologies need to evolve in order to create a well-functioning market where aggregators can offer their flexibility and support services. This may concern issues linked to both the existing markets and the emerging new flexibility markets. The Dialogue Forum aims to raise issues that may need to be further addressed and to raise awareness of the value of demand response among multiple actors. The aim is also to avoid structures that hamper stakeholder participation, do not contribute to efficient pricing or are not sustainable in the long term. The EFFECT dialogue provides an opportunity to include both traditional and new players in the development of the electricity market aimed at promoting dialogue between the Energy Market Inspectorate, aggregators, grid companies, regions and municipalities, and operators of different market platforms.

3.4.4 Energy poverty

3.4.4.1 Where applicable, policies and measures to achieve the objectives set out in Section 2.4.4;

Not applicable when the issue of energy poverty as well as other types of poverty is addressed in social policy.

Households with difficulties in sustaining their livelihoods, where adults are either available for the labour market or are able to demonstrate reduced capacity for work, have the possibility to seek financial assistance from the municipal social services. Financial assistance consists of subsistence support (for regular expenditure) and assistance for the rest of life (for costs occasionally incurred, for example, in connection with relocation). The subsistence aid consists of two parts, the first of which provides support for typical costs of, inter alia, food, clothing and footwear according to a set national standard and the second of which provides support for real reasonable costs for a number of cost items outside the national standard, including housing and household electricity. This means that households that cannot afford electricity and heating have the possibility to receive support for the costs as long as they are reasonable. However, in order to be entitled to income support, households may not normally have money from the bank or other assets.137 See also section 3.4.3.4 for the protection of vulnerable consumers.

In addition to social policy, different types of support have been provided to households – whether living in poverty or not – to mitigate the effects of current energy prices. The latest electricity support will provide

137 https://www.socialstyrelsen.se/kunskapsstod-och-regler/omraden/ekonomiskt-bistand/ekonomiskt-bistand- for private persons/.

compensation for household electricity costs in the months of November and December 2022 (see further 3.3.1). Gas price support has also been introduced to support gas consumers to mitigate the effects of high gas prices, which is administered by the Swedish Energy Agency, see Ordinance (2023: 116) on gas price support.

3.5 Dimension research, innovation and competitiveness

3.5.1 Policies and measures related to the elements set out in section 2.5

3.5.1.1 Policy orientation and implementation of research and innovation The Government presents the focus for energy research and innovation in specific energy research propositions, which are normally presented to Parliament every four years, i.e. once everymandate. The funds are allocated in the annual budget proposals. The latest bill is energy research and innovation for ecological sustainability, competitiveness and security of supply (Bill. 2016/17:66). The overall research and innovation policy is presented in the specific research and innovation proposals, which are also presented every four years. The most recent was research, freedom, future – knowledge and innovation for Sweden (Bill. 2020/21:60). In the context of this bill, the government also presented major reinforcements to research and innovation in the period 2021-2024. The preparation of the forthcoming proposal for research and innovation in the field of energy is ongoing and the Government has instructed the Swedish Energy Agency to prepare the basis for the bill in 2023.

The Energy Agency is the sectoral authority for energy, where funding for research and innovation is one of several tasks linked to the development and functioning of the energy system. Section 2.5 sets out the objectives that govern the Authority's activities in the field of R & I. The Authority fulfils its mission by promoting research and innovation in the form of a strategically designed action spanning the whole innovation system, in close synergy with other energy policies and instruments.
The Swedish Energy Agency is also responsible for promoting, within its area of activity, the commercialisation of research results and the dissemination of new products, processes and services. With the different roles integrated, the Authority is well placed to analyse and understand what needs to happen for the impact of new innovations.

Research and innovation are a prerequisite for building the knowledge and skills needed for the energy transition and for developing new solutions that can bring about systemic change and accelerate the transition. The long-term sustainability of the solutions and systems developed requires consideration of issues such as security of supply, resource efficiency, robustness and sustainability based on social, environmental and economic aspects. As a result of the changing global environment, security of supply, energy security and resilience have become more important and strengthened in a wide range of research efforts.

The Swedish Energy Agency's research and innovation activities have a national and international focus and cooperation with other national research funders on neighbouring areas. In addition to energy research, since 2018, the Swedish Energy Agency has also been responsible for the 'Industriklivet' initiative to support industry's climate transition, which includes both reducing its own emissions and contributing to the climate

transition in society through its products. Industriklivet includes both research and innovation aid and investment aid.

More recently, there have been some changes in the Swedish Energy Agency's mission and environment that may have an impact on the research and innovation funded. This includes the fact that the Swedish Energy Agency has been given a coordinating sectoral responsibility in the field of energy security and that in 2022 the Government assigned several new mandates to the Swedish Energy Agency on the basis of measures in the national strategy for electrification decided upon by the Government in February 2022. In the 2023 Budget Bill, the Swedish Energy Agency received funds to implement an investment in nuclear research.

The Swedish Energy Agency's research and innovation activities are carried out in close cooperation with universities and industry. A key principle of the Authority's research funding is that the actions should be co-financed with the actors receiving the authority's support.

In addition to the Swedish Energy Agency's efforts, there are also other actors that fund research and innovation relevant to the transformation of energy systems. Examples include the Government Research Council Formas, the Swedish Agency for Innovation Systems Vinnova, the State Research Council for Basic Research, the Scientific Council and the Public Research Foundation Mistra. The private operator Energiforsk, which is owned by a number of energy sectororganisations, also funds research and innovation relevant to the transformation of the energy system. Below is a description of some of the most important research efforts relevant to climate and energy transition.

10-year research programmes on climate and sustainable community building

Formas Research Council has a particular responsibility to fund research on climate change. In 2017, the Government mandated the Research Council to implement a 10-year national research programme on climate. The aim of the programme is to contribute to achieving Sweden's objective of being a fossil-free welfare society and the ambition to be at the forefront of global efforts to achieve the objectives of the Paris Agreement. Reducing human impact on climate requires major transformation and adaptation – in Sweden, within the EU and globally. To meet the climate challenge, research is therefore needed across disciplines as well as interdisciplinary and intersectoral research and innovation. In 2018, the programme allocated approximately SEK 75 million and from 2021 the programme's budget amounts to approximately SEK 230 million per year.

In the same year, the Government instructed the Research Council to implement a 10-year national research programme for sustainable community building. The programme will develop knowledge to develop new solutions across all sectors of society to create a safe, secure, sustainable and inclusive society. The programme is based on the Sustainable Development Goals of the 2030 Agenda, the national environmental targets and relevant national targets. The programme's efforts are based on a strategic research agenda. In the coming years, the programme's funding is estimated at around SEK 125 million per year.

3.5.2 Where appropriate, cooperation with other Member States in this field, including, where appropriate, information on how SETPlan objectives and instruments are translated into a national context;

3.5.2.1 Cooperation with other Member States

International cooperation in energy research and innovation is becoming increasingly important as a complement to national efforts to achieve national objectives and is particularly important for a small country such as Sweden. Cooperation in research, innovation and development with other countries takes place to a large extent within the EU and its various instruments. This includes the EU Framework Programme for Research and Innovation (Horizon Europe) and the work of the Strategic Energy Technology Plan (SET Plan).138 Cooperation also takes place in other international fora such as the International Energy Agency (IEA) and Mission Innovation (MI).

The SET Plan sets out four core priorities and ten areas of action to accelerate the transformation of the energy system. Each action area has developed targets and implementation plans at EU level. Participation is voluntary, but Sweden participates in relevant and national priority areas of action to best link national targets with EU targets. Sweden participates to a greater or lesser extent in the work of the following working groups and corresponding implementation plans: ocean energy, smart solutions for energy consumers, smart cities, energy systems, energy efficiency in buildings, energy efficiency in industry, batteries for e-mobility, bioenergy and renewable fuels, and carbon storage anduse. The work involves linking elements 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 actions and objectives jointly developed in the relevant action areas of the SET Plan.

Swedish stakeholders also participate 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 (SNET). The platforms are industry-led 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, replacing the ERA-NET Co-fund cooperation model and involving Sweden.

The Swedish Energy Agency, together with Austria, is leading the new Clean Energy Transition Partnership (CETPartnership), which brings together around 70 research programmes from 32 countries and regions. The partnership foresees, among other things, annual research and innovation calls for proposals for the next six years. The first one, with an annual budget of just over SEK 1 billion.

Driving Urban Transitions (DUT) is another Horizon Europe partnership programme aimed at driving urban development towards a sustainable future. In DUT, the Swedish partners Vinnova, Formas, the Energy Agency and Viable Cities collaborate with the European Commission and public funders from 27 European

138 https://setis.ec.europa.eu/actions-towards-implementing-integrated-set-plan.

countries. The programme, formally launched in January 2022, builds on the work of JPI Urban Europe.

Nordic cooperation

Sweden participates in the Nordic Energy Research (NEF), which is an institution for joint energy research and analysis under the Nordic Council of Ministers. The overall 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 the potential for transnational research cooperation. The NEF funds and coordinates research and provides administrative expertise, networking and advice.

In 2023, the NEF has launched funding for the call for proposals “Hydrogen Valleys as Energy Hubs – by 2030 and 2040”, where the equivalent of NOK

170 million will be used 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 allocated by:
The Swedish Energy Agency. According to the Budget Bill for 2023 (expenditure area 21), the allocation amounted to SEK 1,4 billion (see Bill. 2022/23: 1 ed. 21).

In addition, research relevant to climate and energy is funded by universities and higher education institutions, the State Research Councils Formas and the Scientific Council and the Mistra Research Foundation.

Private entities financed by the Swedish Energy Agency also contribute a large part of their own funding to the projects carried out.

For selected societal challenges under Horizon Europe, Sweden has been granted the funds, in euro, shown in Table 14.139

Table 14. Funds granted to Swedish Horizon Europe operators [EUR].

Climate, energy and mobility	EUR 136 181 172
Food, bioeconomy resources and environment	

4 CURRENT STATE OF PLAY OF EXISTING INSTRUMENTS AND MEASURES AND PROJECTIONS BASED ON THEM

In 2022, the Swedish Environmental Protection Agency and the Swedish Energy Agency developed new climate and energy scenarios. The energy scenarios are presented in their entirety in the 2023 Scenarios of Sweden's energy system140 and are used as input for the climate scenarios, which are reported to the European Commission in the context of climate reporting.141 The 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 agreed energy and climate policy instruments in Sweden until 30 June 2022. As a result, they do not take into account political decisions and new revisions of EU directives after that date.

This chapter will therefore need to be adjusted in view of the submission of the final updated NECP in June 2024.

139Data published in the European Commission's eCorda database as of 21 March 2022.
140Swedish Energy Agency – Scenarios of Sweden's energy system in 2023 (ER 2023: 07).
141Swedish Environmental Protection Agency – Report for Sweden on climate policies and measures and on projections, March 2023.

4.1 Estimated evolution of key exogenous factors such as: affects the development of energy systems and greenhouse gas emissions

4.1.1 Macroeconomic forecasts (GDP and population growth)

The conditions for economic development are produced by the Institute of Economic Studies using the EMEC equilibrium model. These macroeconomic projections then inform the long-term climate and energy scenarios. The evolution of gross domestic product (GDP) and populationgrowth are important factors for future energy use and the impact on greenhouse gas emissions.

The evolution of GDP is modelled in the EMEC and the evolution from 2019 to 2050 is presented in Table 15.

Table 15. Average annual percentage development of GDP in theEMEC economic cono scenarios.

Year	2019 – 2035	2035 – 2050
Evolution of GDP	1,76	1,71

Demographic trends for the period 2020-2050 are prepared by Statistics Sweden (SCB) and are presented in Table 16.142

Table 16. Demographic change assumption.

Year	2020	2030	2040	2050
Population	10 379 000	10 917 000	11 365 000	11 836 000

Source: SCB

4.1.2 Sectoral changes expected to affect the energy system and greenhouse gas emissions

4.1.2.1 Transport sector

Improving the energy efficiency of vehicles, aircraft and vessels, as well as increasing the use of renewable biofuels and, in particular, electric vehicles, is a prerequisite for achieving the climate targets in the transport sector.

4.1.2.2 Industrial sector

Electricity consumption is expected to increase in the industrial sector, as more fossil energy production-processes are replaced by electricity. This does not mean a reduction in overall energy consumption, but a decrease in the use of fossil energy carriers. The creation of new electricity-intensive industries is also expected.

4.1.2.3 Housing and services sector

Developments in the housing and services sector can mainly be explained by more efficient energy use in buildings and the conversion of buildings with direct electricity to other types of energy. As the most

142SCB – The future population of Sweden 2022-2070, Demographic reports 2022: 4

profitable efficiency and conversion measures materialise, the economic potential for energy efficiency could eventually be reduced. In addition, energy consumption as a whole may increase due to new construction, although this trend is partly offset by the increased energy efficiency of new buildings. The electrification of working machinery in the sector leads to reduced energy use, while the expected development of data centres leads to an increase in the use of electricity.

4.1.3 Global energy trends, international fossil fuel prices, EU ETS carbon prices

Climate and energy scenarios use fossil fuel price developments and carbon prices under the EU ETS provided by the European Commission. These price scenarios come from the European Commission's modelling work for reference scenarios in[143] and are recommended to be used by Member States to increase comparability of results across Member States.

Fossil fuel prices and emission allowance prices used in the Lower electrification scenario are presented below in Tables 17, 18, 19 and 20.

Table 17. Assumed world market prices for crude oil, EUR/BOE (barrels oil equivalents), real (2020) prices.

År	2020	2030	2040	2050
Pris [euro/BOE]	37	88	93	112

Källa: EU-kommissionen.

Tabell 18. Antagna världsmarknadspriser för kol euro/ton, reala (2020) priser.

År	2020	2030	2040	2050
Pris [euro/ton]	40	78	83	93

Källa: EU-kommissionen

Tabell 19. Antagna världsmarknadspriser priser för naturgas, euro/MWh, reala (2020) priser.

År	2020	2030	2040	2050
Pris [euro/MWh]	11	41	41	42

Källa: EU-kommissionen

Tabell 20. Antagna priser på utsläppsrätter för koldioxid, EUR/ton CO2, reala (2020) priser.

År	2020	2030	2040	2050
Pris [euro/tCO2]	24	80	85	160

Source: Commission

4.1.4 Evolution of technological costs

In the development of the energy and climate scenarios, assumptions are made on cost developments 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 input in the scenarios is modelled in:

[143] https://energy.ec.europa.eu/data-and-analysis/energy-modelling/eu-reference-scenario-2020_en. Times-Nordic energy system model.143 More information on the assumptions made can be found in Annex B 'Potential and Methodology' to:
Swedish Energy Agency publication Scenarios on Sweden's energy system in 2023 (ER 2023: 07).

4.1.4.1 Nuclear power

The estimated costs of new nuclear power are set out in Table 22. 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 55 öre/kWh. Please note that the assumptions are subject to uncertainties. The nuclear waste levy, which finances the future repository, is a relatively small part of the total cost, around SEK 4/kWh electricity.

Table 22. Assumed costs for new nuclear power.

Investment cost (SEK/kW electricity)	Fixed D i U (SEK/kW electricity)	Variable D: U and fuel cost (SEK/MWh of electricity)	Lifespan (years)
50 000	550	100	50

Note: The costs of operation and maintenance are borne by D -U.

4.1.4.2 Water power

No expansion144 of the annual hydropower generation capacity is assumed, so the question of technology costs is not relevant for this type of power. It may be added, however, that there are several announced plans for so-called 'power expansion', which may increase the capacity of hydropower to deliver power to the grid when it is most needed.

4.1.4.3 Wind power

There are a number of ongoing deployment projects for wind power that will be completed in the coming years and in 2025 the estimate is 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. Around 70 TWh onshore and 60 TWh offshore wind are assumed to be available for deployment, see Figure 9. The model adds system – integration costs (for example, in terms of reserve capacity and some grid expansion), especially in the case of very large volumes of wind power. In addition, the model

143 http://www.profu.se/times.htm.
As a144 result of climate change, the run-off is expected to increase, which is estimated to lead to an increase in electricity production of 2 TWh, while the greening of hydropower 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.

takes some account of the fact that the earning capacity changes to the worse when the share of wind power reaches a certain limit (the more wind power in the system is reduced the electricity price received by wind turbines).

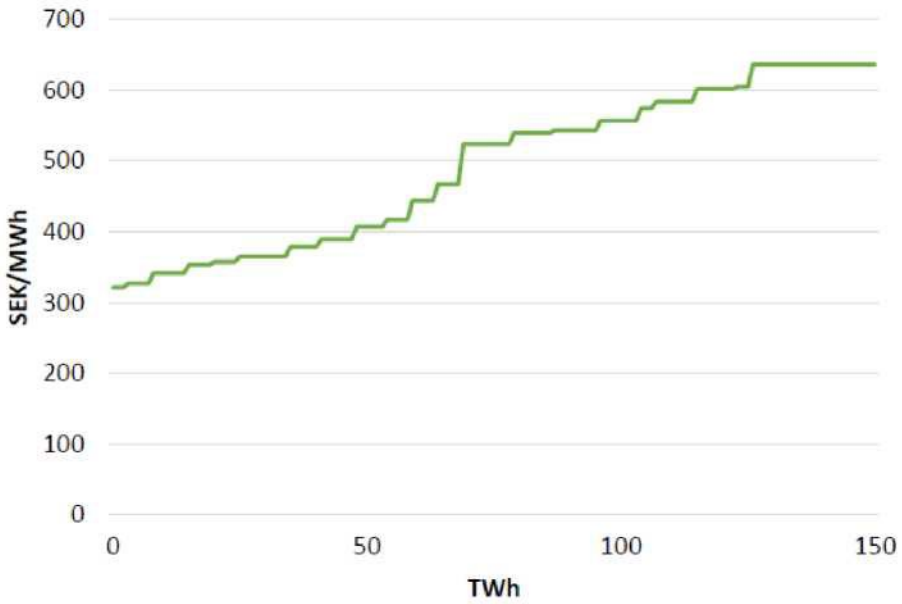

Figure 9. Estimated production cost for new wind power in Sweden, given the lifetime of 25 years and 6 % discount rate (real).
Source: The Swedish Energy Agency.

4.1.4.4 Solar power

Investments in new solar are described with several cost classes for different types of applications for sun. The evidence is based on a study carried out by145 the consultancy Profu for the Swedish Energy Agency in 2018. Since then, some updates have been made, in particular as regards costs. The different cost classes cover solar on roofs (villages, apartment buildings and premises) as well as freelance photovoltaic parks on land, see Figure 10. For all investments, a lifetime of 30 years and a discount rate of 6 % in real terms are taken into account.

145Profu – Technical economic cost assessment of photovoltaic cells in Sweden, 2018.

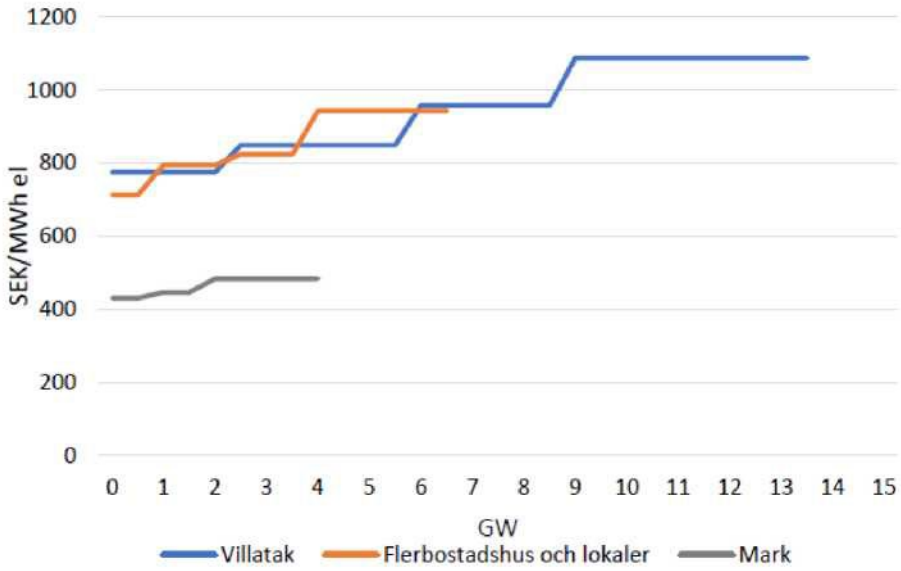

Figure 10. Estimated production costs and potential for solar energy in Sweden on villatak, apartment buildings and premises and on land (lifetime 30 years and discount rate 6 % real).
Source: The Swedish Energy Agency.

4.1.4.5 Biofuel based electricity production

The estimated data for a conventional biofuel CHP plant can be found in Table 21. With flue-gas condensation, which is assumed for these plants, the total efficiency at the lower calorific value is approximately 105 % to 110 %.

Table 21. Estimated data for a conventional biofuel CHP plant with flue-gas condensation in three sizes (some parameters such as efficiency and alfavors are assumed to evolve over time).

	Investment (SEK/kW electricity)	Fixed D i U (SEK/kW electricity)	Moving D: U (SEK/MWh of electricity)	Activity rate (%)	Alphabetical	Lifespan (years)
Large Works (approx. 80 MW of electricity)	25 500	380	80	30-32 (electricity)	0,38 – 0,41	30
Intermediate works (approx. 30 MW of electricity)	34 500	580	85	28-30 (electricity)	0,35 – 0,39	30
Small piece (approx. 10 MW of electricity)	45 000	920	85	25-27 (electricity)	0,32 – 0,34	30

Source: The Swedish Energy Agency.
Note: The costs of operation and maintenance are borne by D -U.

4.1.4.6 gas power

Only about 0.3 GW of gas power is assumed to remain in Sweden. New gas power can be built up in Sweden through new investment if the model finds them profitable. The input data for gas-based power and combined heat and power production are presented in Table 22. The efficiency evolves over time.

Table 22. Estimated data for gas-based power and combined heat and power generation.

	Investment (SEK/kW electricity)	Fixed D i U (SEK/kW electricity)	Moving D: U (SEK/MWh of electricity)	Efficiency (%)	Alphabetical	Lifespan (years)
Condensation force	7 000	40	15	55 – 62	—	30
Cogeneration, large	9 500	70	20	45-50 (electricity)	1,1	30
Combined heat and power (CHP),	12 500	120	25	45-50 (electricity)	1	30

Note: The costs of operation and maintenance are borne by D -U.

4.1.4.7 District heating – Hetwater boilers

Table 23 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 not reported in the table).

Table 23. Estimated production costs for district heating in heating plants (hot water boilers).

	Investment (SEK/kW heat)	Fixed D i U (SEK/kW heat)	Moving D i U (SEK/MWh heat)	Activityrate (%)	Lifespan (years)
Natural gas	4 000	25	15	90	30
Biofuel, peat or coal	8 000	100	20	90 – 95	30

Note: The costs of operation and maintenance are borne by D -U.

4.2 GHG emissionreduction dimension

4.2.1 GHG emissions and removals

4.2.1.1 Trends in current greenhouse gas emissions and removals in the EU ETS, Effort Sharing Regulation, LULUCF and different energy sectors

Total greenhouse gas emissions and removals

Greenhouse gas emissions (excluding LULUCF) within Sweden's borders were 47,8 million tonnes of carbon dioxide equivalent in 2021.147 This represents an increase of 3.5 % compared to 2020. However, emissions are not back at pre-COVID-19 levels, but were around 2,8 million tonnes lower than in 2019. Compared to 1990, total climate emissions have now decreased by 33 %. Emissions have varied since 1990 between a peak of 77,0 million tonnes of carbon dioxide equivalent in 1996 and a lowest level equivalent to 46,3 million tonnes of carbon dioxide equivalent in 2020. Annual variations are mainly due to temperature fluctuations, rainfall patterns and cyclical conditions, but due to emission reduction measures the trend has been a decline in emissions over time. Sweden has net carbon removals in the land use sector. The sink has varied over the period 1990-2021. Total net removals in 2021 were close to 42 million tonnes of carbon dioxide equivalent.

For total emissions and removals within Sweden, see Figure 12.

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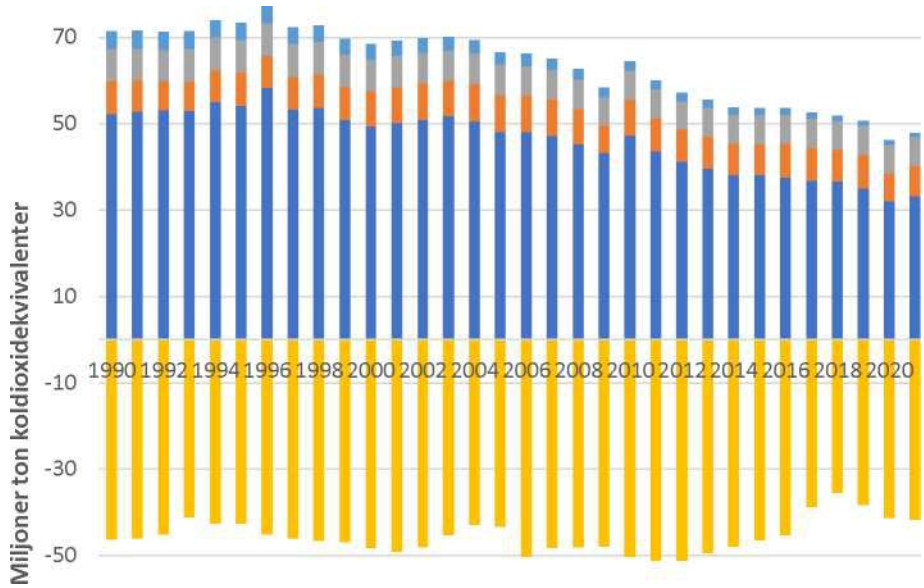


— 70

- Waste (CRF 5)
- Land use, land use change and forestry (CRF 4)
- Agriculture (CRF 3)

147All the information in this section is provided by the Swedish Environmental Protection Agency – National Inventory Report Sweden 2023, Greenhouse gas emission Inventory 1990-2021

- Industrial processes including product use (CRF 2)
- Energy (CRF 1)

Figure 12. Total emissions and removals within Sweden from 1990 to 2021.

In 2021, carbon dioxide (CO_2) emissions (excluding LULUCF) from fossil origin amounted to 35,2 million tonnes, representing approximately 80 % of total greenhouse gas emissions, calculated as carbon dioxide equivalent.

Methane (CH_4)emissions amounted to 4,5 million tonnes of carbon dioxide equivalent (equivalent to 9.5 % of total emissions), nitrogen dioxide (N_2O) 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 per cent of total emissions). The distribution of the contribution between different greenhouse gases has been similar throughout the time series from 1990 to 2021. For emissions broken down by greenhouse gas, see Figure 13.

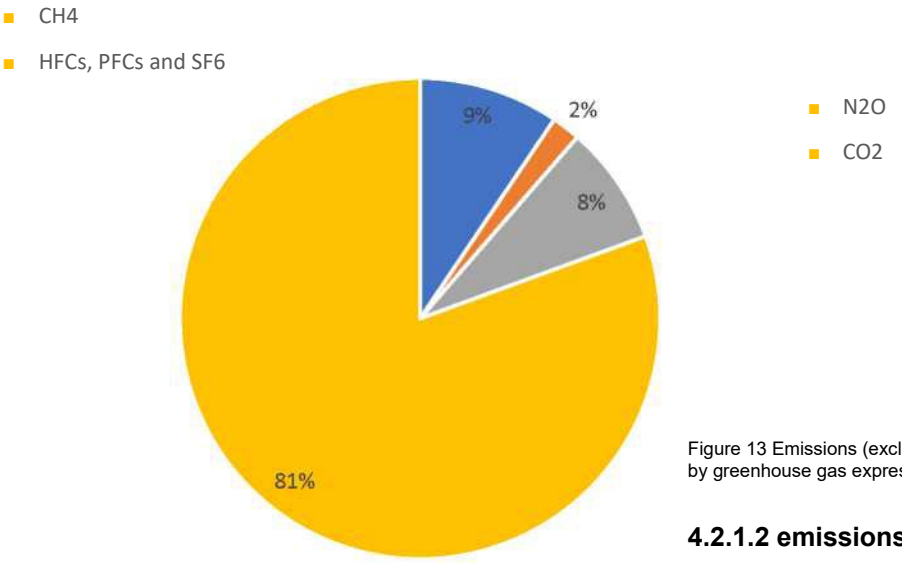


Figure 13 Emissions (excluding LULUCF) in 2021 broken down by greenhouse gas expressed in carbon dioxide equivalent.

4.2.1.2 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 broken down by sector, see Figure 14.

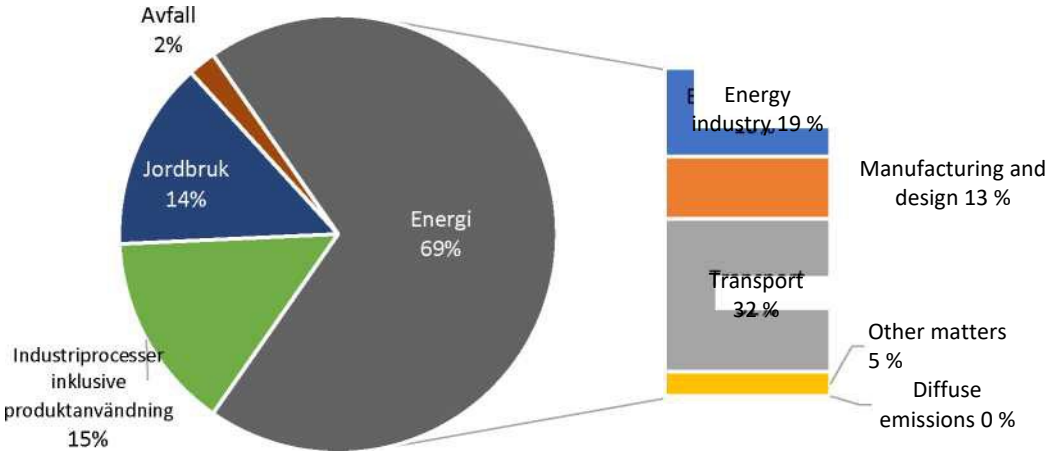


Figure 14 Emissions (excluding LULUCF) in 2021 broken down by sector.

Emissions have fallen by 33 % between 1990 and 2021. The largest contributions to emissions reductions since 1990 come from residential and residential heating. 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 affected by the economic cycle and have decreased since 2010 due to increased use of electricity and biofuels in the form of residues from the forest industry and energy efficiency. The measures that have affected the development of emissions have been implemented over a long period of time and started to some extent already before 1990.

4.2.1.3 Emissions in the non-trading sector

Greenhouse gas emissions in the non-trading sector were around 29 million tonnes of carbon dioxide equivalent in 2021. This means a reduction of 0.6 % between 2020 and 2021 and a decrease of 32 % since 1990. Emissions in the non-trading sector are mainly emissions from domestic transport (51 %), agriculture (23 %) and working machinery (11 %). Emission reductions in recent years in the non-trading sector have come mainly from the transport sector, where biofuel blending has contributed to the largest emission reductions.

4.2.1.4 Emissions from Swedish installations under 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 covered by the ETS has also decreased by 18 %. However, developments differ from one sector to another and from time to time. In electricity and district heating, emissions have decreased by around 26 % since 2005, where a reduction in the use of fossil fuels is a major cause.
Emissions in the sector may vary from year to year, mainly due to differences in temperature and precipitation.

4.2.1.5 Projections of sectoral developments based on existing Member State and Union policies and measures at least until 2040 (including for 2030)

Total greenhouse gas emissions in Sweden in 2021 were 33 % lower than the 1990 level. The scenario results indicate that overall greenhouse gas emissions will continue to decline. In 2030, emissions are estimated to be 57 % below the 1990 level, with instruments decided by 30 June 2022, see Figure 15. By 2040, emissions are projected to decrease further.

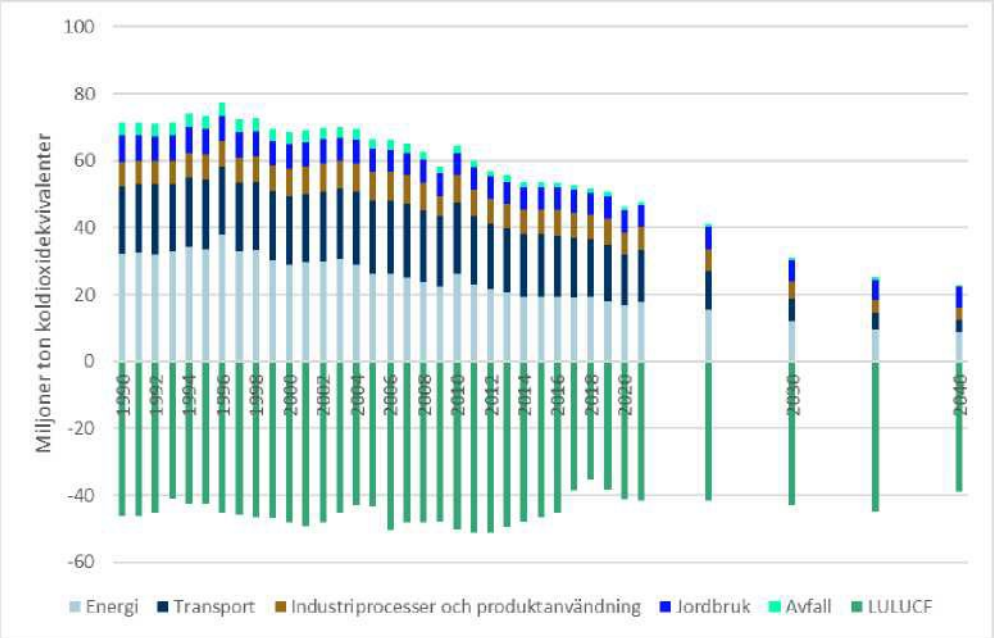
Historical greenhouse gas emissions and removals and scenarios broken down by sector are presented in Table 26.148

148Ministry of the Climate and Enterprise. 2023. Report for Sweden on climate policies and measures and on projections, March 2023. In accordance with Article 18 under Regulation (EU) 2018/1999 of the European Parliament and of the Council Decision on the Governance of the Energy Union and Climate Action

The LULUCF sector has contributed an annual net removals in Sweden throughout the period 2021-1990, but the variations are significant. For some periods, in the early 90s and for a number of years around the turn of the millennium and 2010 respectively, they were high, while they fell sharply in the context of a major storm in 2005 and in the years after the drought in 2018 when growth slowed.

However, the sector is deemed to continue to contribute to net removals during the scenario period.

Figure 15. Historical greenhouse gas emissions and removals and scenarios with instruments decided by 30 June 2022 (million tonnes of CO2 equivalent);



Note: The series “Transport” refers to domestic transport.

Table 26. Historical greenhouse gas emissions and removals by sector and scenarios with agreed policies until 30 June 2022 (million tonnes of CO2 equivalent);

	1990	2021	2025	2030	2035	2040
Energy excluding transport	32,2	17,7	15,3	12,2	9,3	8,9
Domestic transport	20,0	15,4	11,5	6,4	5,0	3,7
Industrial processes and product use	7,4	7,0	6,8	5,3	4,1	3,7
Agriculture	7,6	6,7	6,5	6,2	6,1	6,0
Waste	4,1	1,0	0,9	0,8	0,7	0,6
Total emissions	**71,5**	**47,8**	**41,0**	**30,9**	**25,2**	**22,8**
LULUCF	—46,3	—41,7	—41,6	—43,0	—44,8	—39,0

4.2.2 Renewable energy

4.2.2.1 Current share of renewable energy in final energy gross energy consumption and in different sectors (heating and cooling, electricity and transport) and by technology in each of these sectors.

Table 24 shows the evolution of the overall share of renewable energy as well as the share in the electricity, transport and heating/cooling sectors149 since 2005. The proportions shown in Table 24 are from the official reporting carried out in Shares150, the calculation tool used in the Renewable Energy Directive.

149The heating and cooling sector covers industry, housing and services, as well as district heating.
150Shares 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.

Table 24. Share of renewable energy in accordance with the calculation methodology of the Renewable Energy Directive in total and by sector between 2005-2021,%.

	Total	Heating, cooling, industry, etc.	Electricity	Transport
2005	40.0 %	49.0 %	50.9 %	6.6 %
2006	41.7 %	52.5 %	51.8 %	7.5 %
2007	43.2 %	54.5 %	53.2 %	8.4 %
2008	43.9 %	55.8 %	53.7 %	8.7 %
2009	47.0 %	59.2 %	58.3 %	9.4 %
2010	46.1 %	57.1 %	55.8 %	9.6 %
2011	47.6 %	58.5 %	59.6 %	11.9 %
2012	49.4 %	60.6 %	59.8 %	13.8 %
2013	50.2 %	61.7 %	61.7 %	15.3 %
2014	51.2 %	62.6 %	63.2 %	18.8 %
2015	52.2 %	63.2 %	65.7 %	21.5 %
2016	52.6 %	63.4 %	64.9 %	26.6 %
2017	53.4 %	63.6 %	65.9 %	26.8 %
2018	53.9 %	63.3 %	66.2 %	29.7 %
2019	55.8 %	64.4 %	71.2 %	30.3 %
2020	60.1 %	66.4 %	74.5 %	31.9 %
2021	62.6 %	68.6 %	75.7 %	30.4 %

Total share of renewable energy by technology/source

The share of renewable energy relative to gross energy consumption is 62.6 % in 2021, as shown in Figure 11. This is 2,5 percentage points higher than in 2020. Sweden has had a higher proportion of renewable renewable since 2005 than the indicative trajectory[151] for 2020 indicated.

151The indicative trajectory is a calculated trajectory for the share of renewable, the formula of which is set out in the Renewable Energy Directive (REDI). The trajectory indicates the rate at which the share should increase in each Member State.

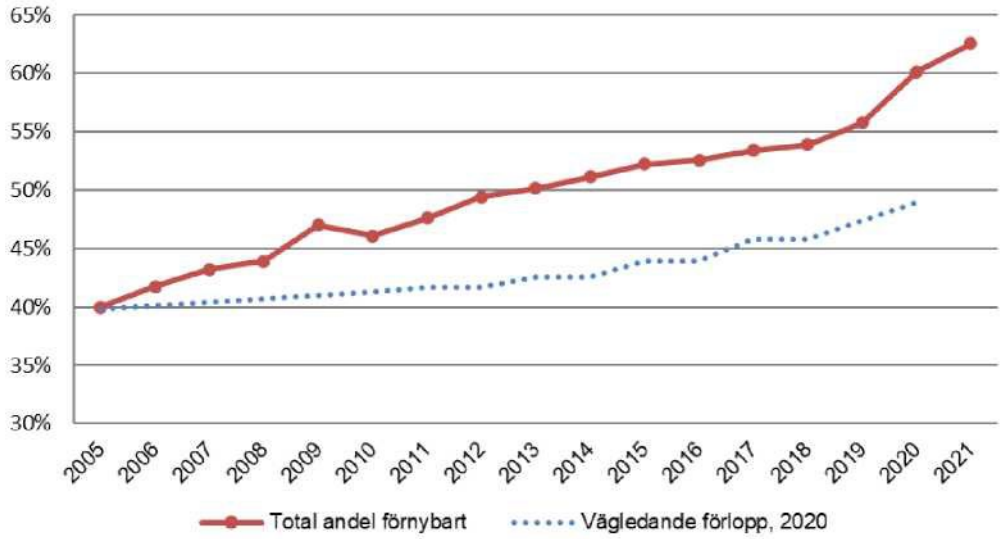


Figure 11. Development of the share of renewable energy in 2005-201 7 and indicative trajectory to 2020 %.

The share of renewable energy depends both on the overall evolution of energy use and specifically on the evolution of the use of renewable energy. In 2021, energy consumption is 409 TWh. Since 2005, energyconsumption has remained relatively stable, at around 400 TWh, despite population growth of 1,4 million or 15 % over the same period.

Theamount of renewable energy used in Sweden in 2021 was 250 TWh according to the calculation methodology of the Renewable Energy Directive. This is 12 TWh more than in 2020 and the increase is mainly due to the increased use of biofuels in the transport sector and the further development of wind energy. Since 2005, the increase is 85 TWh. It is the use of biofuels and hydropower that makes the largest contribution to the high use of renewable energy as shown in Figure 12. The contribution of heat pumps152 has increased from 7 TWh in 2005 to 19 TWh in 2021.

152Heat pumps are included here as absorbed heat with certain limitations.

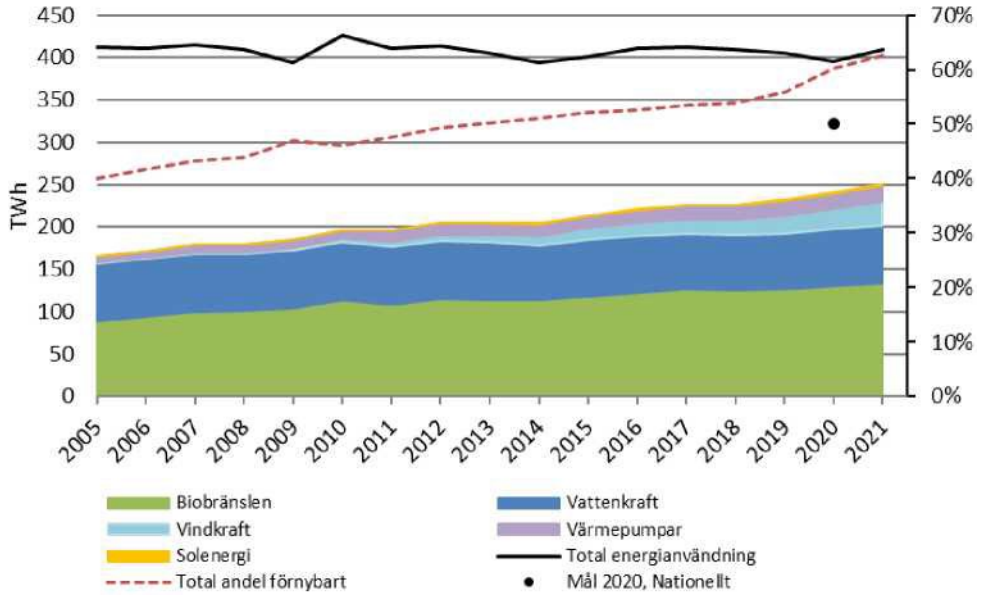


Figure 12. Renewable energy and energy use under the Renewable Energy Directive and share of renewable energy, 2005-2021, TWh and%.

Biofuels represent the largest share of renewable energy used in Sweden. In 2021, biofuels accounted for 53 % of renewable energy under the Renewable Energy Directive and have accounted for a maximum of 58 % since 2005. Biofuels are mainly used in industry and district heating. However, the largest increase in recent years is in the transport sector where biofuels have been more widely used.

The use of biofuels by sector is shown in Figure 13.

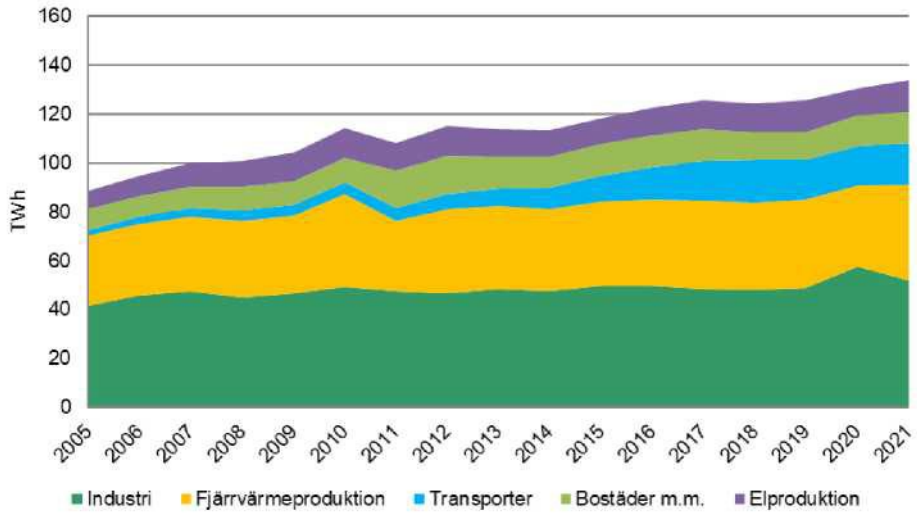


Figure 13. Use of biofuels by sector, 2005-2021, TWh.

Hydropower makes the next largest contribution to a high share of renewable energy both historically and in 2021, accounting for 27 % of renewable energy.

Wind energy is the renewable energy source that has grown most in percentage terms since

2005, accounting for 11 % of renewable energy. The contribution of heat pumps is 8 % in 2021. Solar power accounts for 0.7 % of renewable energy in 2021.

Share of renewable electricity generation by energy source/technology

The share of renewable electricity production relative to total electricity consumption was 76 % in 2021, two percentage points higher than in 2020. In 2005, the share was 51 %. The increase in the share of renewable electricity is mainly explained by an increase in wind power generation and a decrease in production from nuclear power. The share of fossil electricity production is very low at 1.8 % in 2021.

In 2021, renewable electricity production[153] amounted to 111 TWh, with hydropower accounting for 67.4 TWh[154], wind power for 28.7 TWh[155] and biofuel electricity production in combined heat and power plants and in industry for 11.2 TWh. Solar power accounts for 1.5 TWh and the remaining 1.8 TWh have been produced with the renewable part of waste and bio-oils.

Electricity consumption has decreased slightly since 2005, from 151 TWh to 146 TWh in 2021, despite a population increase of 1,4 million or 15 % over the same period. Figure 14 shows the evolution of renewable electricity production and use.

153Electricity production from hydropower and wind power is temperature corrected according to the methodology of the Renewable Energy Directive.
154Temperature corrected value, actual production was 64.6 TWh.
155Temperature corrected value, actual production was 17.6 TWh.

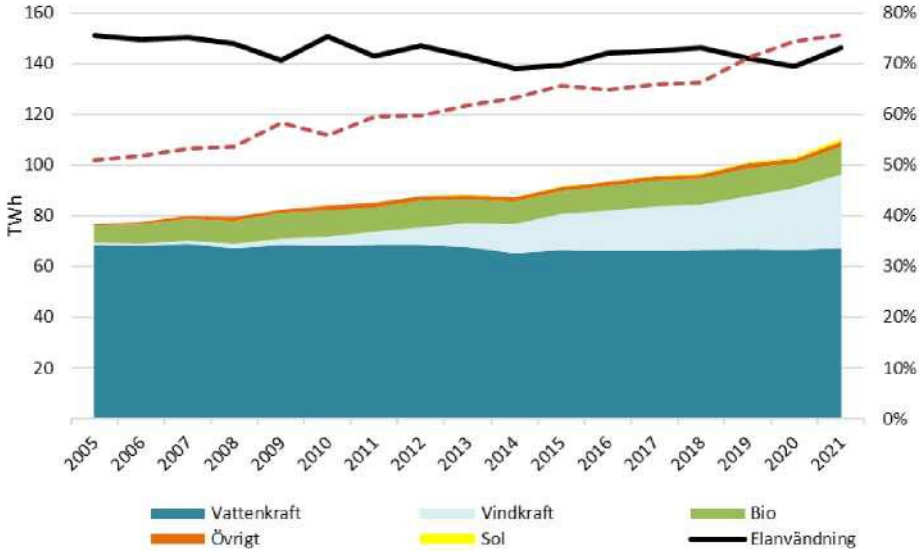


Figure 14. Renewable electricity generation, total electricity consumption and share of renewable electricity, 2005-2021, TWh and%.

Renewable share in transport by energy source

In 2021, according to the calculation methodology set out in the Renewable Energy Directive, the share of renewable energy in the transport sector was 30 %, as shown in Figure 15. The decrease from the previous year was therefore 1,4 percentage point. The reason for the decrease in the share between 2020 and 2021 is that the denominator of energy consumption increased after the pandemic year 2020 more than the increase in renewable energy in the numerator. The share of renewable energy has increased sharply in the transport sector in Sweden since 2005, when it was 6.6 %.

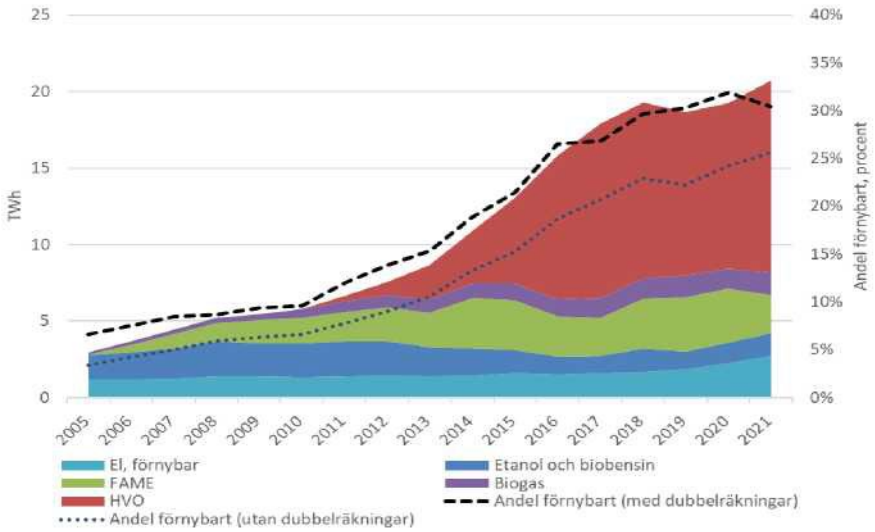


Figure 15. Actual use of renewable energy and electricity (TWh) and share of renewable energy with and without double counting (%), 2005-2021.

In particular, the use of biofuels provides the high share of renewable energy in the transport sector. It is mainly biodiesel in the form of HVO that has been used in 2021 and has increased sharply since 2010. As HVO in its chemical composition is identical to fossil diesel, it can be blended at high levels with fossil diesel, which is also used mainly. The second largest biofuel is biodiesel in the form of FAME followed by biogas and ethanol.

Biofuels produced from certain feedstocks can be double counted under the Renewable Energy Directive. The renewable part of the electricity used in transport is also rewarded in the calculation methodology of the Renewable Energy Directive. Without the calculation method of double counting set out in the Renewable Energy Directive, the actual share of renewable energy in the transport sector was 26 % in 2021.

Renewable share in the heating and cooling sector by technology/energy source

The share of renewable energy in the heating and cooling sector156 relative to energy consumption was 68.6 % in 2021 and thus

2.2 percentage points higher than in 2020, as shown in Figure 16. In 2005, the share was 49 %.

The heating and cooling sector156 includes industry, housing and services, etc., as well as district heating, but excludes the use of electricity in these sectors.

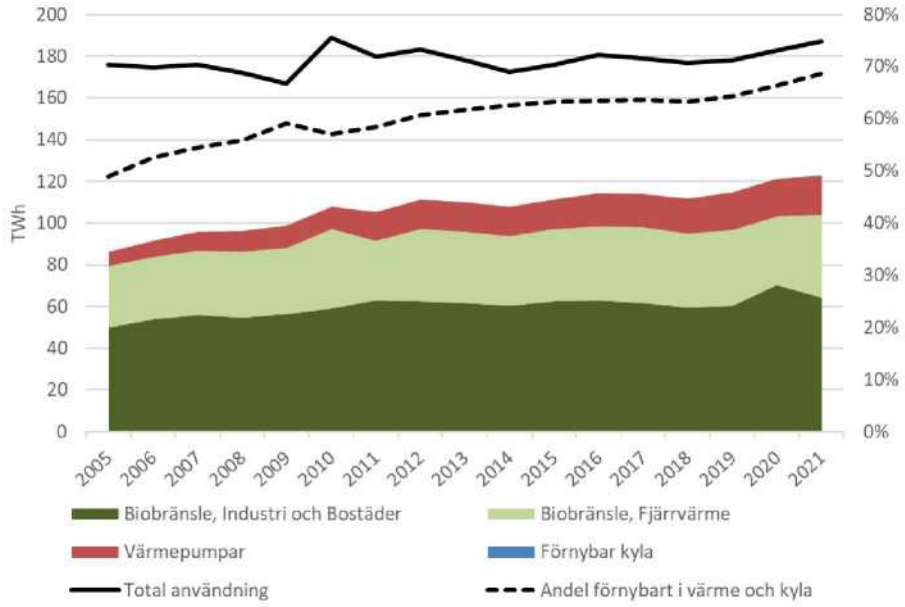


Figure 16. Renewable energy and energy use in the heating and cooling sector, 2005-2021, TWh.

The amount of renewable energy in the sector was 129 TWh in 2021, an increase compared to 2005, when it was 86 TWh. Renewable energy is mainly made up of biofuels, which account for 81 % of renewable energy, followed by heat pumps accounting for 14 %.157 During the same period, energy consumption has increased from 176 TWh to 187 TWh.

2.3 .2.2 indicative projections of developments based on existing policies for 2030 (with a perspective of 2040);

This section will be revised in view of the delivery of a final updated NECP to take into account policy decisions and new revisions of EU directives that could not be included in scenarios and analyses.

The latest long-term energy scenarios are published in the 2023 Scenarios of Sweden's energy system.158 The *Lower electrification* scenario is based on conditions given by the Commission and on the agreed energy and climate policy instruments in Sweden that existed until 30 June 2022. This means that the results do not take into account agreed and announced changes in national policies after that date, nor do they take into account the third revision of the Renewable Energy Directive, RePowerEU, Green Deal, etc. The calculations of the shares renewable below are based on the most recent calculation method adopted in accordance with the Second Renewable Energy Directive. However, pending updated scenarios, it is this scenario that is presented in this section, but for interpretation it is important to be aware that the share of renewable energy is expected to be lower than indicated in the scenario for several reasons. Those

157Also includes a small amount of solar heat.
158Swedish Energy Agency – Scenarios of Sweden's energy system in 2023 (ER 2023: 07).

include the following:

- In the scenario, biofuels are increasing under the current reduction obligation. The government has announced that these will be reduced, but no decision has yet been taken. Smaller biofuels, which are replaced by fossil fuel comparators, reduce the proportion of renewable fuels. It is unclear how the energy input changes in such an adjustment.

- The calculation includes all renewable electricity in the share of renewable electricity, regardless of how it is used. However, in the provisional agreement on the new revision of the Renewable Energy Directive, renewable electricity used for the production of, for example, hydrogen shall not be included in the calculation but shall instead include the renewable hydrogen in which it is used.

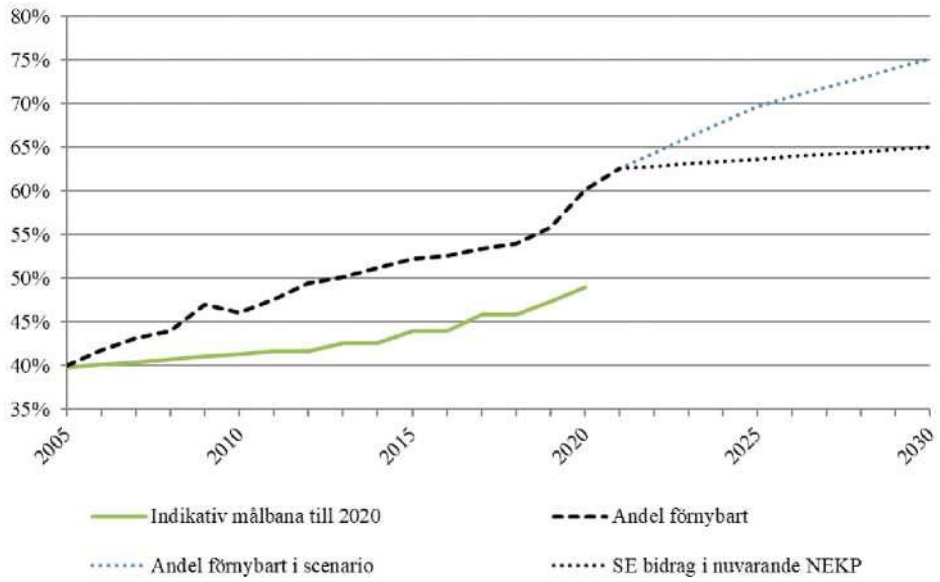


Figure 17. Share of renewable energy, actual by 2021 and in the latest scenario by 2030, as well as contributions in the current NEKP,%, 2005-2030.

Table 25 summarises the evolution of the overall share of renewable energy as well as the share in the electricity, transport and heating/cooling sectors by 2040 in the scenario.

Table 25. Share of renewable according to the calculation methodology of the Renewable Energy Directive in total and by sector, 2021 and in scenario 2025-2040,%.

	2021	2025	2030	2035	2040
Total renewable share	63 %	70 %	75 %	74 %	73 %
Electricity	76 %	91 %	88 %	81 %	78 %
Transport159	30 %	59 %	78 %	81 %	82 %
Heating and cooling	69 %	69 %	73 %	76 %	76 %

159The share of renewable energy in the transport sector includes double counting of certain fuels as calculated in the Renewable Energy Directive.

Total share of renewable energy by 2030

The share of renewable energy relative to energy consumption increases in the scenario from 63 % in 2021 to 75 % in 2030, as shown in Figure 18. The share is then estimated to fall slightly back to 73 % in 2040 in the scenario. One difference from previous scenarios that should be noted is that energyconsumption is now increasing rather than remaining stable as before. This is due, among other things, to the fact that many new establishments of industries and activities have taken place and are planned to take place in Sweden.

The increasing share of renewable energy by 2030 is due to the fact that production and use of renewable energy is estimated to increase more than overall energyconsumption. After 2030, energy consumption is growing faster than renewable energy.

The largest increase in renewable energy stands for wind power, which is estimated to increase by 49 TWh between 2021 and 2030. Biofuels also increase theiruse by 30 TWh by 2030. Half of the increase occurs in the transportsector, but is due to the fact that the current reduction levels up to 2030 are included in the scenario. Otherwise, increased use of biofuels is spread fairly evenly between industry, the residential sector and electricity generation, while there is a slight decrease in district heating production.

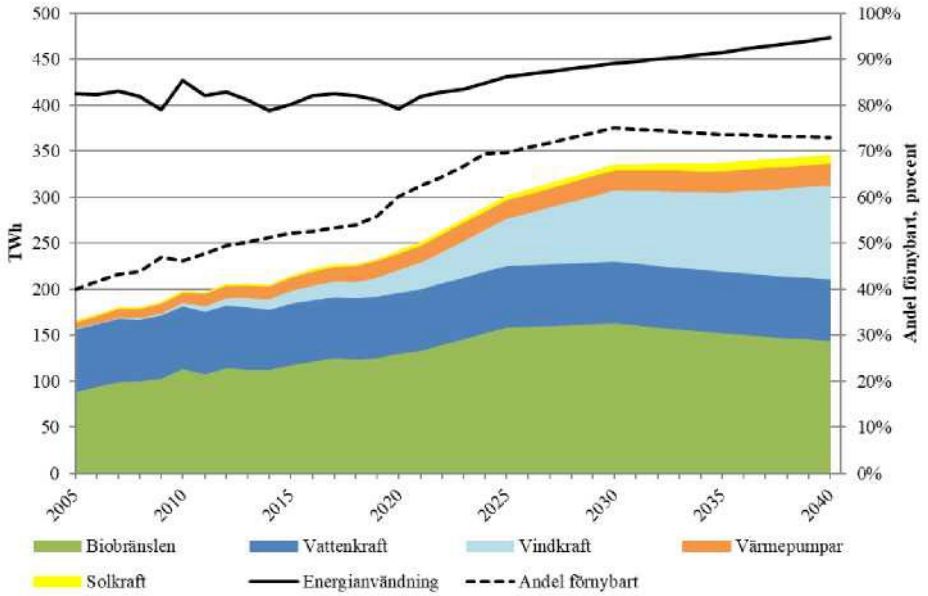


Figure 18. Renewable energy by energy source, energy use and renewable share in scenario, 2005-2040, TWh

Share of renewable electricity production by 2030

The share of renewable electricity generation under the Renewable Energy Directive in the Lower electrification scenario increases from 76 % in 2021 to 88 % in 2030, as shown in Figure 19. After 2030, the share of renewable electricity decreases as electricity consumption is increasing at a faster pace than renewable electricity generation. Increased electricity use is due to both the electrification of industry and transport, together with the construction and planning of construction of new industries in Sweden.

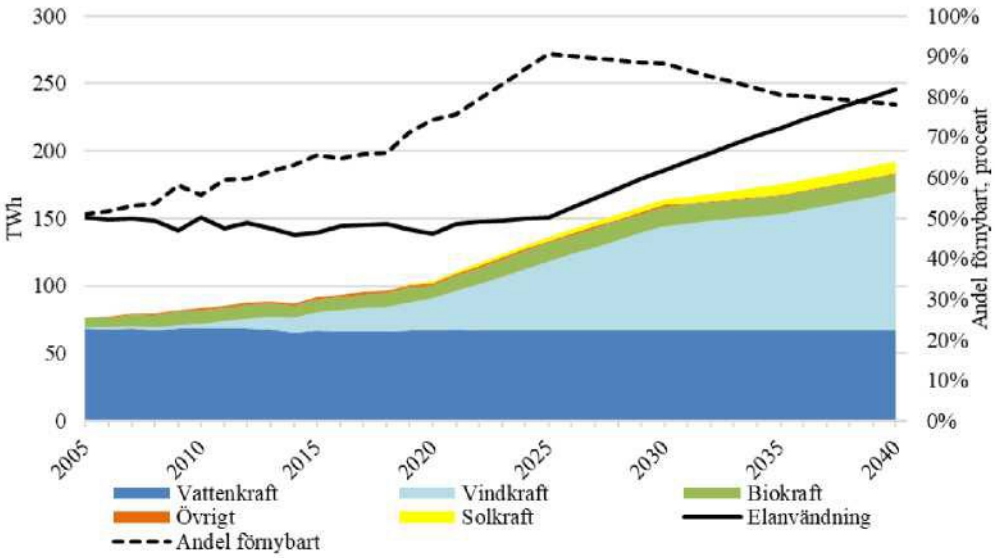


Figure 19. Renewable electricity generation, electricity use and renewable share in scenario, 2005-2040, TWh

It is the electricity production from wind power that increases most in the scenario to 2030 by 49 TWh from 2021. Solar and biopower are estimated to increase their production by 3 TWh each

over the same period. The result depends on the preconditions set out in the model, in particular in terms of prices for future technologies and electricity. The outcome could of course be different and after 2030 new nuclear power could also be built which could have an impact on deployment and the share of renewable electricity.

Renewable share in the transport sector by 2040

The renewable share according to the calculation methodology of the Renewable Energy Directive in the domestic transport sector is estimated to increase from 30 % in 2021 to 78 % in 2030, as shown in Figure 20, based on the current quota in the reduction scheme. Under the current reduction obligation, the share of biofuels that can be double-counted is also assessed to increase over the lifespan of the scheme.160

The scenario mainly increases the use of biofuels, mainly in the form of HVO, which contributes to a continued increase in the renewable share. The use of electricity is also expected to increase and, as the share of renewable electricity increases, it also contributes to an increased share of renewable electricity.

Overall energy use in the transport sector is decreasing during the scenario phase, which also contributes to a higher share of renewable energy.

160The 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 11 December 2018 on the promotion of the use of energy from renewable sources.

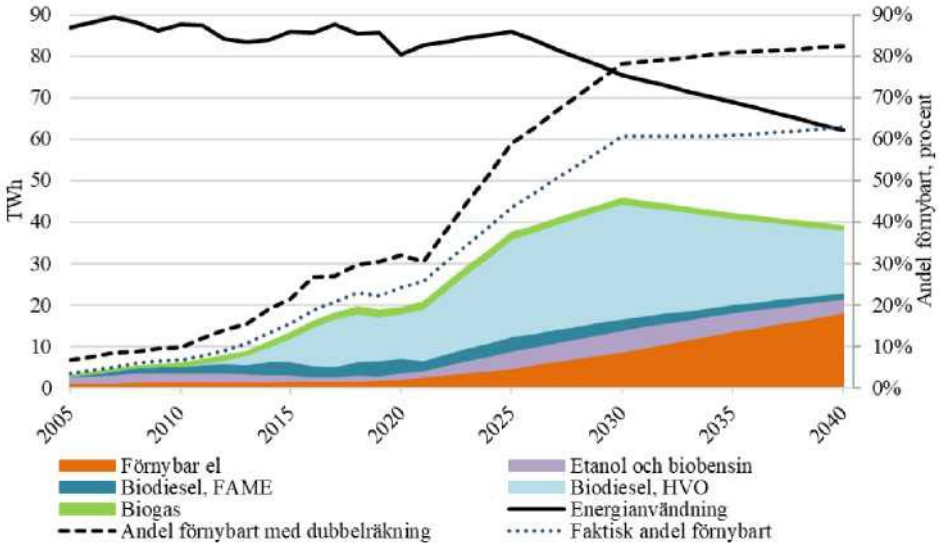


Figure 20. Use of renewable energy, energy use and share of renewable energy with double counting (according to the calculation methodology of the Renewable Energy Directive) and actual renewable share in scenario, TWh and%, 2005-2040.

Renewable share in the heating and cooling sector by 2040

The renewable share of energy consumption in the heating and cooling sector is estimated to increase from 69 % in 2021 to 73 % in 2030, as shown in Figure 21.

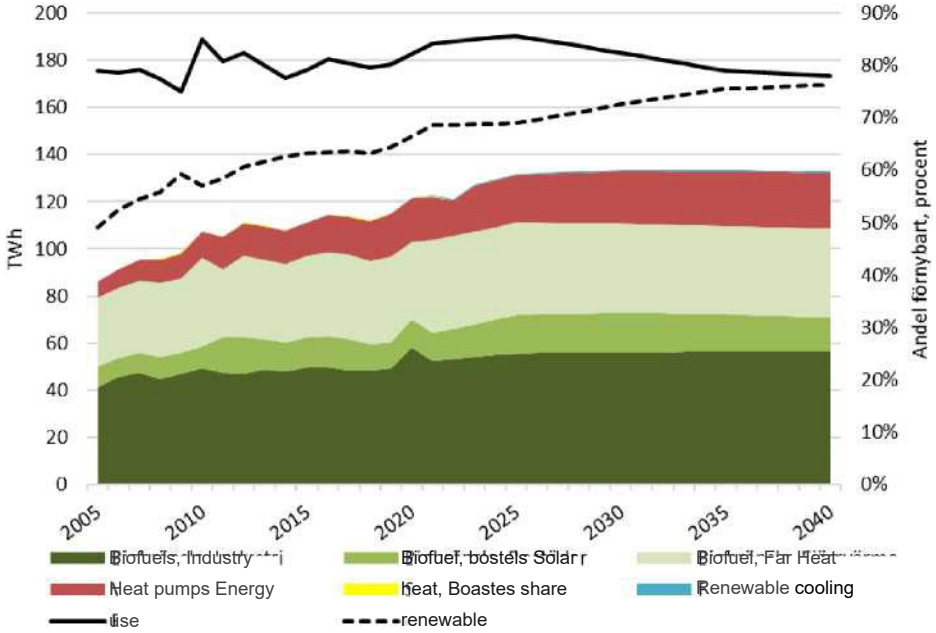


Figure 21. Renewable energy (excluding waste heat) and energy use and share of renewable energy in the heating and cooling sector in scenario, 2005-2040, TWh and%.

While the energy used in the sector is already largely renewable today, the use of renewable energy is still expected to increase by 11 TWh in 2021-2030, while energy consumption is slightly decreasing, increasing the share of renewable energy. Renewable energy is increasing both in industry and in the residentialsector through increased use of biofuels. The use of heat

pumps is also increasing in the same order of magnitude. The calculation does not include waste heat which Member States may include in the heating and cooling sector if desired. If included, countries should have a slightly higher annual rate of increase in the share of renewables in the heating and cooling sector.

4.3 Energy efficiency dimension

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 by sector is presented in Table 26.

Table 26. Energy consumption 2019-2021 [TWh];

	2019	2020	2021
Primary energy consumption	533	480	510
Final energy consumption	367	355	369
Industry	127	130	129
Household	86	84	92
Service	70	71	74
Transport	82	77	80

Source: Eurostat

4.3.2 Current potential for the application of high-efficiency cogeneration and efficient district heating and cooling

The last comprehensive Article 14 assessment was161 carried out in 2020.

According to Article 14 of the Energy Efficiency Directive, the potential for high-efficiency cogeneration must be analysed. 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 achieve 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, on the basis of 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 %. Irrespective of the reference values set by the Commission, Swedish CHP plants will therefore meet the criterion of highefficiency CHP plants. There is

161Swedish Energy Agency – Comprehensive assessment of the heating and cooling potential (ER 2020: 34).

therefore no potential in Sweden to increase the share of high-efficiency cogeneration as all cogeneration is already high-efficiency. On the other hand, there is a potential to replace hot water production with high-efficiency cogeneration.

According to the Swedish Energy Agency's long-term scenarios in 2023, the supply of district heating rises slightly to 2030, reaching 63 TWh as the heatbase increases. In reality, however, it is difficult to know how efficiency improvements, heat pumps and EU directives affect district heating and thus cogeneration. District heating is projected to increase to just under 12 TWh, while industrial backpressure is reduced to just over 5 TWh. Overall, total electricity production from cogeneration remains at today's level.

According to Article 2 of the Energy Efficiency Directive, an efficient district heating and cooling system is a 'district heating or cooling system that uses at least 50 % renewable energy, 50 % waste heat, 75 % cogenerated heat or 50 % of a combination of such energy and heat'. For all Swedish district heating,the energy supplied is about 80 % of renewable energy and waste heat. In the long-term scenarios too, this share is above 80 % by 2030 and 2040.

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 22 shows the 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 2022.

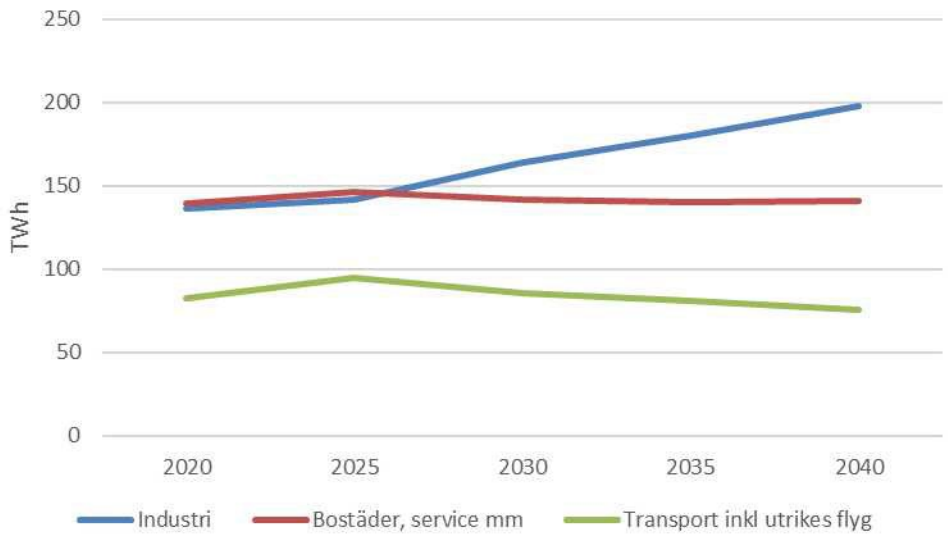


Figure 22. Energy consumption scenario 2020-2040 for industry, transport (including foreign aviation), housing and services, etc., TWh.

Energy consumption in the residential and services sector is expected to decrease slightly by

2040. This is due, among other things, to energy efficiency improvements in buildings, conversion from direct-acting electricity to heat pump and electrification of working machinery. On the other hand, increased use of electricity in data centres leads to an increase in energy consumption.

Energy consumption in the transport sector is also decreasing by 2040 due to the increased energy efficiency of vehicles, aircraft and ships and, in particular, the increased use of electric vehicles.

By contrast, energy consumption in the industrial sector is expected to increase sharply. More fossil energy production processes are replaced by electricity, leading to increased energy use. New industrial start-ups are also expected.

4.3.4 Cost-optimal levels of minimum energy performance requirements resulting from national calculations, in accordance with Article 5 of Directive 2010/31/EU

Table 26 shows the cost-optimal levels of minimum energy performance requirements as calculated by the National Board of Housing, Building and Planning.162 The results are shown as a range, depending on the form of heating, with the minimum requirements in brackets in force.

Table 26. Cost-optimal levels and minimum energy performance requirements;

	Cost-optimal level of primary energy (EPpet) kWh/m2Atemp year
Single-family house	85-88 (90)
Apartment buildings	67-70 (75)
Premises	67-70 (70)

4.4 Energy security dimension

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.163 Key indigenous energy carriers are hydropower, biofuels, wind power and absorbed heat from heat pumps. Biofuels accounted for 28 % of energy input in 2021.164 The evolution of total energy input 2005-2021 is shown in Figure 23.

However,a large proportion of energy input depends on imports such as nuclear fuel and fossil fuels such as natural gas and oil, the latter being used extensively in the transport sector. Altogether, fossil fuels accounted for 26 % of energy input in 2021. The self-sufficiency rate of

The National Board of162 Housing, Building and Planning (2023). *Control station of the rules on the energy performance of buildings* (Report 2023: 12).
163All statistics are based on the Swedish Energy Agency – Energy situation in figures 2023.
164Excluding net imports.

energy, defined as the ratio of domestic energy to total energy input, has increased in recent years, reaching 51 % in 2021.

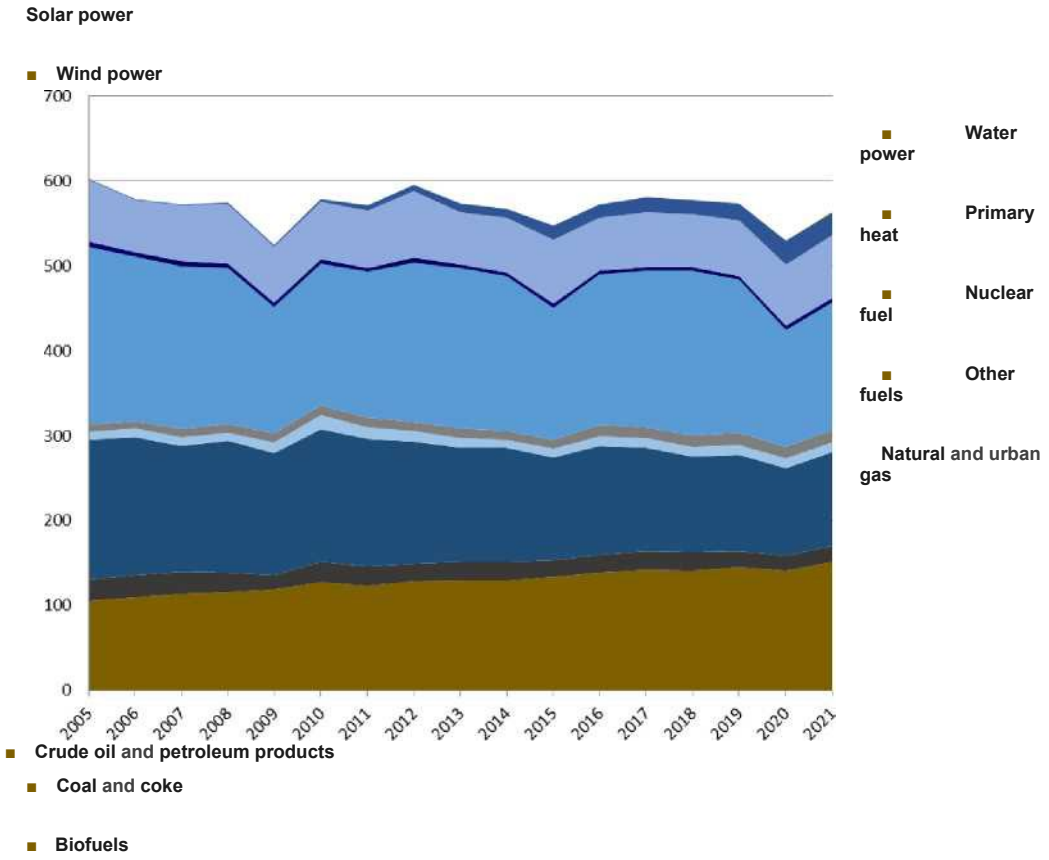


Figure 23. Total energy input per energy carrier, TWh, 2005-2021. Source: Swedish Energy Agency, Energy situation in figures 2023.

Swedish electricity production is mainly based on hydropower and nuclear power, which accounted respectively for 44 % and 30 % of total electricity production in 2021. The development of wind energy continues, accounting for 16 % of total electricity production in 2021. The use of biofuels for electricity and heat production is also increasing.

4.4.2 projections of developments based on existing policies and measures at least until 2040 (including for 2030)

Figure 24 shows the total input broken down by energy carrier in 2020 to 2040 in the long-term scenarios. The energy supplied increases over the period, mainly due to the electrification of industry.

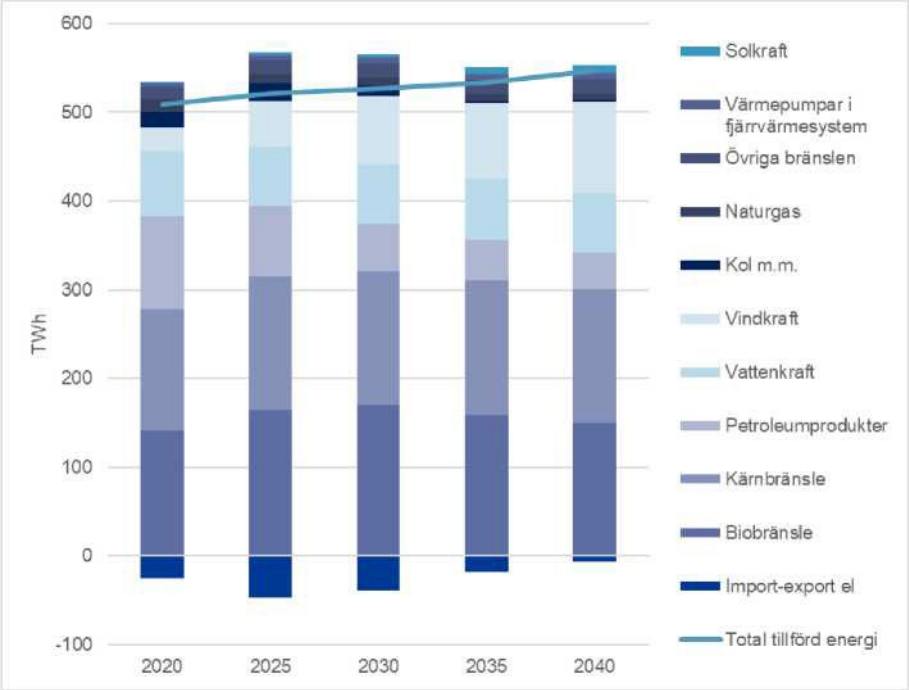


Figure 24. Total input broken down by energy carrier in the long-term scenarios, TWh, 2020 — 2040. Source: Swedish Energy Agency – Scenarios of Sweden's energy system in 2023 (ER 2023: 07).

In the scenario, renewable electricity generation is expanding while existing nuclear power is assumed to remain in place until 2040. Wind energy development is driven by higher electricity prices and amounts to 102 TWh in 2040. Solar power amounts to just over 8 TWh in 2040.

Until 2030, the use of biofuels increases, then decreases, reaching 150 TWh in 2040. The largest increase in biofuels is in the transportsector. The use of petroleum products is declining over time and is driven primarily by developments in the transport sector where increased electrification, biofuel development and efficiency reduce demand for fossil fuel-powered vehicles and vessels. Oil is also decreasing in other sectors but from lower levels. The use of coal, coke and more decreases significantly and land only 2 TWh in 2040, mainly due to the electrification of the iron and steel industry.

Sweden remains a large net exporter of electricity until around 2030 when net exports amount to 38 TWh. This is mainly due to an increase in wind power production. Thereafter, the continued increase in demand leads to a decline in net exports by 2040, with a landing of 6 TWh.

Analysis of future adequacy

Swedish power grids continuously analyse future short- and long-term power adequacy for Sweden. The assessment of the adequacy of the impact can be done using two different methods.

The static method compares the expected available domestic production with the expected electricity consumption in winter hours with the highest electricity consumption. This is called a

power balance and takes the form of a normal year, a 10-year winter (a cold winter which occurs on average once every ten years) and a 20th century.

When power adequacy is assessed in accordance with the dynamic methodology (also referred to as the probabilistic approach), the entire electricity system is simulated in an electricity market model with connections between bidding zones (and countries) 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 domestic and foreign generation resources, as well as unplanned interruptions of both generation and transmission connections.

On the basis of the static method, Svenska kraftnät estimates the power balance for winter 2023/2024 to be -1 800 MW a normal year winter and – 3 500 MW for a twenty-year winter.165 A negative power balance means that the electricity consumption during winter hours 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 the adequacy of power with the dynamic approach, in the Swedish Business Authority's short-term market analysis and in the report on Extension of the Power Reserve.166 When production and imports are insufficient to cover the load, there is a shortage of power. This is expressed as '*Loss of Load Expectation* (LOLE)' and 'Expected Energy Not Served' (*EENS*). The LOLE is measured in hours per year, while the EENS is measured in number of MWh per year. Overall, the simulations show that the risk of power shortages exceeds the reliability standard adopted by the Government from 2027 onwards. Until 2027, the risk of power deficiency

165Swedish Power Grid – Power balance in the Swedish electricity market, Report 2022.
166Swedish Power Networks – Long-term market analysis 2021, Short-term market analysis 2022 and Extension of the power reserve.

is lower than the reliability standard. Similar results are presented by ENTSO-E in their report "European Resource Adequacy Assessment 2022". The analyses form the basis for Svenska kraftnät's proposal to prolong power reserve and subsequently introduce a market-wide capacity mechanism.167

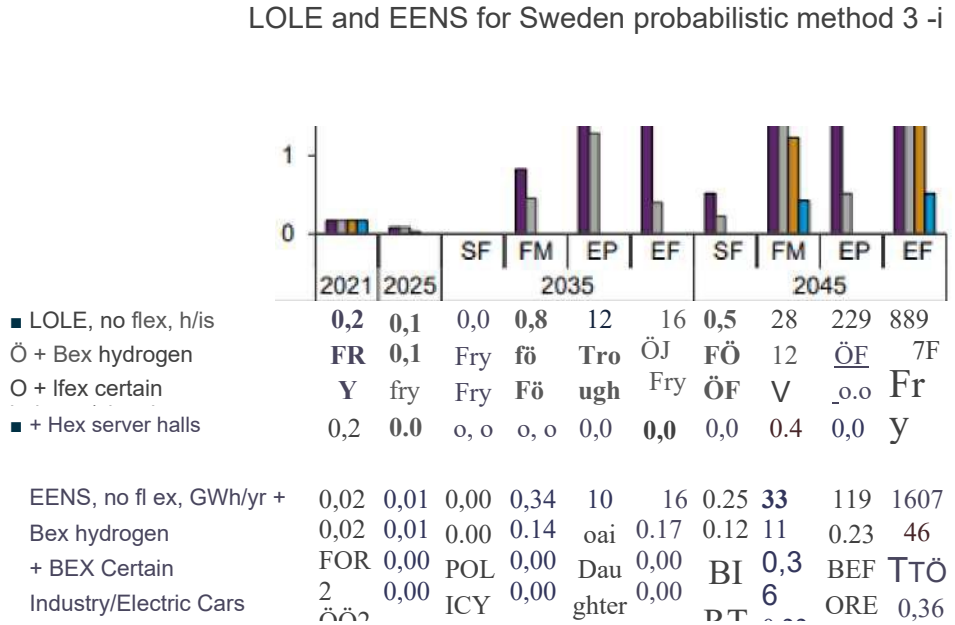


Figure 25. Modelled average power shortfall (hours per year) in case of increasing level of flexibility. Note that the vertical axis is cut at 3 h/year. Rows for the volume of power supply (GWh per year for Sweden in total) are also shown in the data table but not as stacks. Source: Swedish Power Networks – Long-term market analysis 2021.

In the Swedish power grid scenarios for 2045, LOLE amounts to between 0 and 0,5 hours per year on average, while EENS amounts to between 0 and 360 MWh per year. However, it should be pointed out that there is considerable variation. Some winters do not face any problems at all, while the risk of power shortages may be significantly higher in cold winters years and in years with exceptionally high transmission connections or generation problems. In this context, it should be noted, however, that the model has added a lot of consumption flexibility and storage to the continent. If this flexibility is not achieved, the simulated power shortage would be greater.

In the case where plannable electricity generation is phased out and replaced by weatherdependent non-plannable electricity generation such as wind and solar power, measures in the form of increased demand response, energy stocks and rapid regulatory generation capacity are needed for such an electricity system to function. Research and development and the commercial environment for these technologies play an important role in the choice of solutions. This is described more in section 4.6.

167Swedish Power Grid – Extension of the Power Reserve), and Future Capacity Mechanism to ensure resource adequacy in the electricity market

4.5 Internal dimension market

4.5.1 Electricity interconnectivity

4.5.1.1 Current level of interconnection and main interconnectors

At the end of 2021/2022, Sweden had an electricity interconnection level of:
23 %.168 Total import capacity is 10 325 MW and installed production capacity amounted to 45 000 MW. Existing connections with neighbouring countries are shown in Table 27.

Table 27. Current 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

4.5.1.2 Projections for increased interconnection requirements (including for 2030)

By 2027, the level of electricity interconnection is expected to decrease despite Sweden increasing interconnections with neighbouring countries. New planned connections are shown in Table 28. The reason for the reduction in the level of electricity interconnection is the strong expansion of domestic renewable generation that is expected and thus contributes to the reduction of the quota.

Table 28. New connections until 2027.

From	Type	Name	MW
Finland	AC	3th AC	900
Germany	HVDC	Hansa Power Bridge	700
Total			1600

After 2027, there are no further planned external connections. However, analyses show that additional connections may be profitable to build from a socio-economic perspective, especially in light of the fact that several scenario analyses show that electricity needs may double already

168Swedish Kraftnät – Power balance in the Swedish electricity market, Report 2018.

by 2035.

At present, internal reinforcement of the Swedish transmission network is ongoing to reduce cross-zonal bottlenecks and enable further connections and foreign connections. The North-South programme with about fifty different projects addresses this issue and will run until about 2040.169

4.5.2 Energy transmission infrastructure

4.5.2.1 Essential 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 transmission from north to south is not sufficient. As a result, Sweden is divided into four bidding zones, see Figure 26, based on the structural bottlenecks present in the network. Structural bottlenecks are to be removed, but it is not socio-economically justifiable to guarantee the same price throughout Sweden at all times.

169Swedish Power Grid – NordSyd Investment Package, Kraftfull reinforcements of Sweden's electricity transmission network between electricity area 2 and 3 (March 2019).

Figure 26. Bidding zones; Source: Nordpool and the Swedish Energy Agency's processing operations.

The transmission network, as shown in Figure 27, currently has as its main task the transmission of electricity from the north to the south of Sweden. However, the future is uncertain. Althoughwind power is mainly built in northern Sweden because of good project locations and better conditions for connection to the electricity grid, even though spot prices are generally lower in the north than in the south, offshore wind plans have a higher centre of gravity to the south. Nuclear power is currently located in bidding zone 3, but the Government has decided to amend the rules so that nuclear power plants can also be built in locations other than where they are currently located.170 If the announced industrial efforts in the north of Sweden are carried out, we may see in the future a northerly flow that justifies the expansion of electricity grid capacity northwards.

170 https://www.regeringen.se/contentassets/4e94b54e75114406aca6ca1 99fe4d80a/memoria-ny-karnkraft- i-sverige-ett-forsta-lad.pdf.

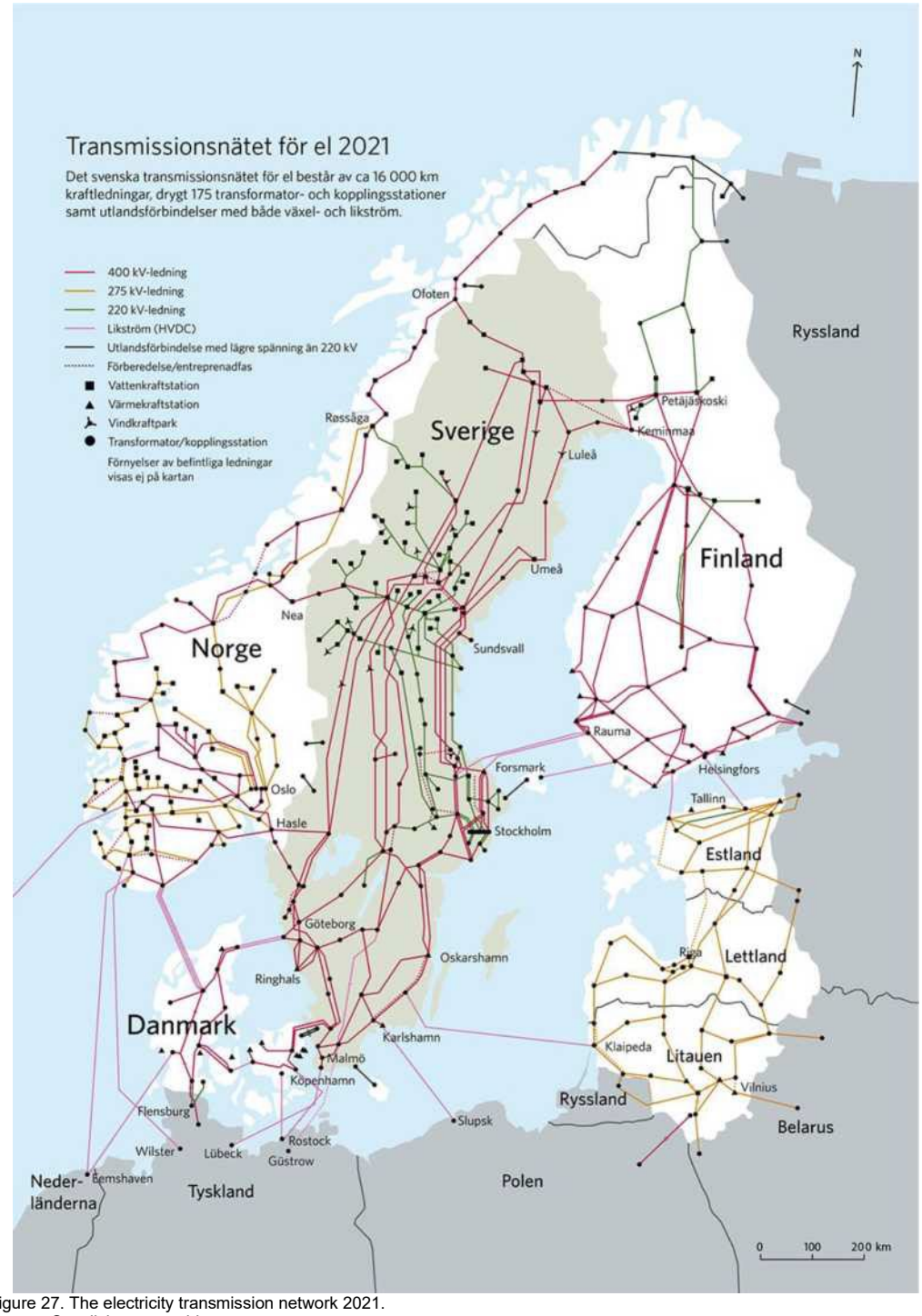


Figure 27. The electricity transmission network 2021.
Source: Swedish power grids.

Gas infrastructure

The Swedish natural gas system is small compared to most other natural gas networks in Europe. Only 30 of Sweden's 290 municipalities have access to the western Swedish natural gas network. The gas comes to Sweden via Danish-Dragning. 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 is changing with the introduction of a common

balancing zone between Sweden and Denmark, which was introduced on 1 April 2019. Imbalances will be 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 Stockholm AB gas network. The production and supply of gas to the urban gas network takes place mainly from a gas plant in Stockholm, from which both biogas and 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 dedicated to vehicles from a production site to refuelling points.

4.5.3 Projections of network deployment requirements until at least 2040 (including for 2030)

4.5.3.1 Future network deployment needs

Electricity grids

Swedish power grids have a 10-year network roll-out plan which is updated every two years.171 In addition, the realisation of maritime spatial plans may entail further network roll-out by 2035.

The basis for the development of the network deployment plan is the use of various scenarios which run until 2050.172 The main elements of the scenarios relate to power generation and use of electricity. Flexibility is becoming increasingly important in a system with a high proportion of weather-dependent variable electricity generation.

In high-electrical scenarios, it is estimated that future electricity use could double by 2035, but there are several uncertainties.
Climate transition is the overarching goal of electrification, but at the same time electrification of industrial processes provides companies with competitive advantages.
Industrial efforts are the single biggest driver of growing electricity demand. In the transport sector, there is a huge development in which the share of electric passenger cars is increasing at a rapid pace, but the whole transport sector is facing a shift towards fossil-free energy carriers, which requires access to electricity grid capacity and energy. Sweden and the Nordic countries are also an attractive region for the establishment of server halls, largely because of historic competition,strong electricity prices, cool climate and generally stable markets and political systems.

171Swedish Kraftnät – System Development Plan 2022-2031 (November 2021).
172Swedish kraftnät – Long-term market analysis 2021 (SvK 2019/3305).

Moreover, at European level, there are scenarios for future power system development and electricity market development developed by ENTSO-E, partly based on the different system operators' own scenarios.173 These scenarios are both European and regional, for Sweden within the Baltic Sea region (RGBS).

Gas networks

There are currently no forecasts for the development of the Swedish natural gas network.

4.5.4 Electricity and gas markets, energy prices

4.5.4.1 Current situation of electricity and gas markets, including energy prices

Electricity market

The electricity market consists of a wholesale market and a retail market. On the wholesale market, producers and large consumers trade electricity. Sweden's transmission system is connected to Denmark, Norway, Finland, Germany, Poland and Lithuania and indirectly to the whole of Europe. The largest wholesale market place is the spot market on the Nordic power exchange Nord Pool. On the spot market, trading takes place the day before delivery through an auction process that takes into account transmission capacity in the electricity grid between Sweden's four bidding areas and neighbouring countries. In addition, there is an intra day-market in which operators can adjust their positions if necessary, up to one hour before delivery. A number of balance responsible companies have financial responsibility for balancing at the planning stage, but during the operating hours, the Swedish power grid is responsible for keeping the electricity system in balance and carries out the necessary up- and downward controls via balancing trading in the real time market operated together with the other Nordic system operators.

Final customers' electricity costs consist of electricity trade price, electricity grid price, energy tax and VAT. In addition to the above costs, several dealers pay a fixed annual fee, which they pass on to the final customer. The annual fee usually varies between SEK 100 and SEK 500. All these costs are subject to VAT.

Suppliers are obliged to purchase electricity certificates corresponding to a certain quota of their customers' electricity consumption. The electricity certificate fee has been included in the electricity trading price since 2007.

Figure 28 shows variable prices for a typical customer of 20 000 kWh bidding zone SE3 relative to spot and system price.

173ENTSOE med Entsog – TYNDP 2018, Scenario Report.

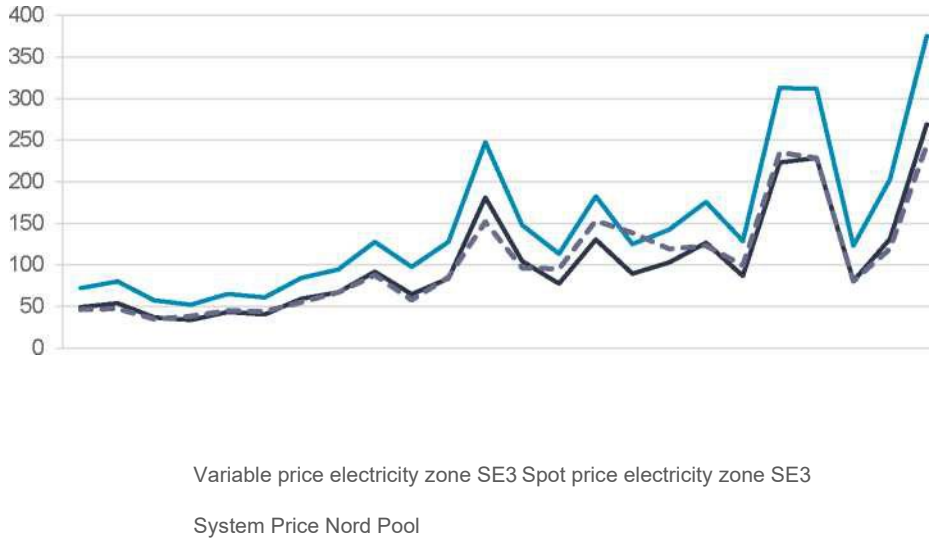
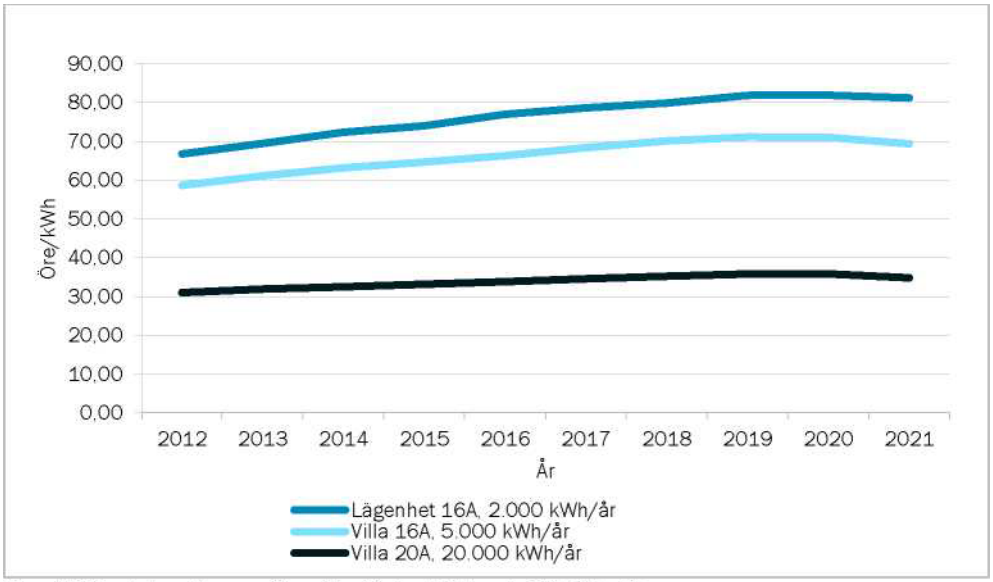


Figure 28. Variable price for a typical customer 20 000 kWh/year in SE3 relative to spot and system price, öre/kWh. Source: EI, Nord Pool

Electricity network tariffs consist of a fixed and a variable cost (transmission fee). VAT is paid on both the fixed subscription fee and the variable transmission fee.

Figure 29 shows the evolution of network charges for different types of household customers in recent years. Between 2020 and 2021, charges fell on average by 0.8 % for apartment customers, 2.4 % for residential customers with 16 A securing and 2.8 % for residential customers with a 20A securing.
In Swedish krona this corresponded to a decrease of approximately SEK 14, SEK 84 and SEK 201 over the year.



Figur 29. Real utveckling av nätavgifter för hushållskunder[174]. Källa: Ei.

Gas market

Natural gas was introduced into Sweden only in 1985 and currently accounts for around three per cent of Sweden's total energy use. Gas is mainly used as process fuel and raw material in industry, for power and district heatingproduction, as fuel for vehicles, and in households using gas for heating and cooking.

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, as well as through refuelling points and LNG terminals. Only the western Swedish gas network and the Stockholm gas network are covered by the Natural Gas Act (2005: 403) and therefore also by the Energy Market Inspectorate's supervision.

Sweden has no natural gas production of its own, but is dependent on imports via a pipeline from Denmark and on LNG transported by ship.

[174] average updated at the 2021 price level, not weighted.

However, Sweden has a certain proportion of its own biogas production that can be upgraded to blend with natural gas in the grid.

The natural gas network is divided into four different areas of activity: transmission, distribution, gasification and storage. Transmission pipelines transport the gas over long distances under high pressure. A reduction in pressure is then carried out in measurement and control stations before the local distribution network takes place for transport to customers. The western Swedish natural gas system is small compared to most other natural gas networks in Europe and consists of about 60 km of transmission line and about 300 km of distribution line. The network stretches from Trelleborg in the south to Stenungssund in the north and a small part east into Småland.

Due to the design of the Swedish network, the Swedish natural gasmarket is closely linked to the Danish market. The balancing operators in the Swedish natural gas system are also active in the Danish gas market. Since 2020, natural gas has been traded mainly on the European Energy Exchange (EEX), where the trading platform PEGAS is integrated.

Consequently, competition, price developments and transparency in the Swedish natural gas market depend to a large extent on developments in Denmark. The connection of the Swedish natural 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 Zone, started in 2017 and has been implemented in cooperation with final customers, gas suppliers, network owners and regulators in Sweden and Denmark.174 The aim of this is a larger market and even

174 https://www.swedegas.se/sv-SE/Vara%20tjanster/Systemansvar/Joint%20Balancing%20Zone.

higher security of supply

According to the Natural Gas Act, the Energy Market Inspectorate must examine theterms of contracts for balancing responsibility so that they meet the requirement of being objective and non-discriminatory. The latest Balance Liability Agreement was approved by the Energy Market Inspectorate at the end of 2021 due to changes in the terms of the contract linked to the forthcoming accession to Baltic Pipe. As of 1 April 2019, the balancing markets for Sweden and Denmark have been integrated. 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.

On EEX, an operator may trade gas on the day of delivery, the day before, ahead of the weekend and for the following month, as well as forward contracts with delivery up to 6 years ahead. All physical delivery is traded and operators must have contracts with the Danish transmission system operator Energinet.

The balancing of gas takes place within the joint balancing zone in Sweden and Denmark and is managed by the so-called 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 natural gas to Sweden, an operator needs to book capacity in Dragor. The transmission capacity is auctioned in Energinet's regular capacity auctions. In order to be able to transport gas from Denmark to Sweden, balance responsible operators 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 at present. Well in Sweden, gas can be sold on to consumers such as industries and gas distributors

4.5.4.2 projections of developments based on existing policies and measures at least until 2040 (including for 2030)

A development of the electricity price is developed in the context of the long-term energy scenarios.175 The electricity price is modelled in the Times-Nordic model and is based on fossil fuel price assumptions and emission allowance prices obtained by the Commission.

The electricity price evolution for the Lower electrification scenario is shown in Figure 30. The electricity price is calculated as an annual average for Sweden, which is treated as a price area.

The increase in the price of electricity in the scenario is due to an increase in electricity demand,

175Swedish Energy Agency – Scenarios of Sweden's energy system in 2023 (ER 2023: 07).

increased market coupling to the continent, and rising fuel and emission allowance prices.

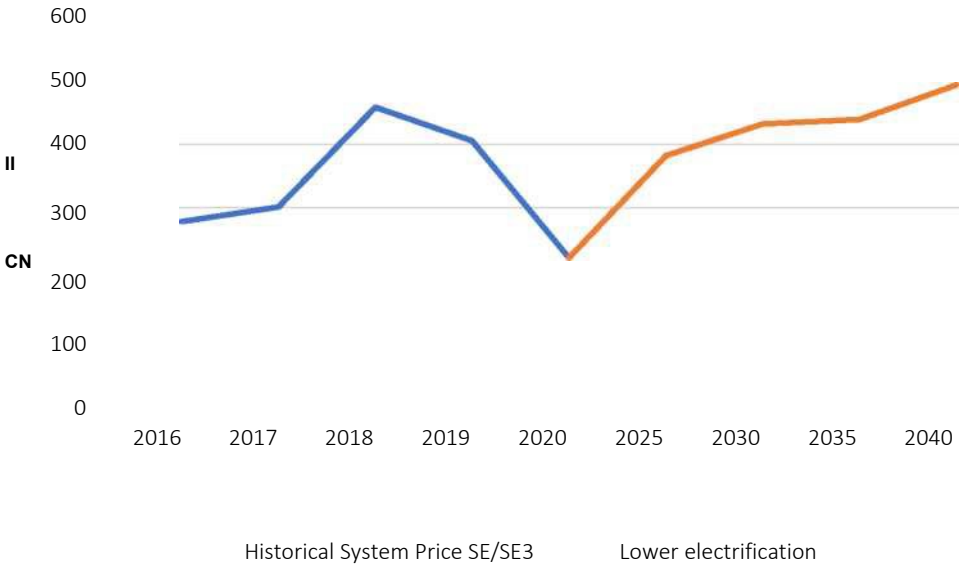


Figure 30. Electricity price development according to the Swedish Energy Agency's scenario Lower electrification, SEK/MWh.

4.6 Research, innovation and competitiveness dimension

4.6.1 State of play of the low-carbon technology sector and, to the extent possible, its position on the global market (this analysis should be carried out at Union or global level)

Sweden is prominent in several areas of research and innovation in the field of low-carbon technologies. A few examples are provided below.

4.6.1.1 Efficient biofuels for low-carbon energy transition, forestry and bioenergy

The use of forests as a carbon sink and the efficient use of bioenergy resources are a strong research area in Sweden. Actions in this area focus on:

- fuel supply: cultivation and harvesting of biofuels, logistics, processing and fuel processing, focusing on native biofuels from forests, cropland, waste and marine biomass;
- energy transformation: processes for the production of electricity and heat in combined heat and power plants and products in so-called energy combinations where other products are also produced such as pellets, biofuels or other energy carriers.

Sweden is the international leader in biofuels and waste-based cogeneration. Research has played an important role in the development of efficient and environmentally friendly biofuel and waste-based CHP plants.

4.6.1.2 Industrial Life – Resource Optimisation, Energy Efficiency and Carbon Neutrality in Industry

Sweden is at the forefront of research to make the energy-intensive industry more energy and resource efficient and ultimately free from CO2 emissions. To support the transition, the government decided in 2017 on Industriklivet, a long-term effort to reduce industry's greenhouse gas emissions. In 2019, the initial mandate was extended to allow for the financing of measures that contribute to negative greenhouse gas emissions, and in 2021 the scope was extended to include strategically important interventions such as biofuels, plastic recycling refineries, hydrogen production, recycling facilities and battery production.176 The focus of the effort 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 businesses from research and innovation projects to demonstration and full-scale facilities. Industriklivet covers a total of approximately SEK 1 354 million in 2023 and can finance projects running until 2030. The annual budget is decided in the context of the Budget Bill.

4.6.1.3 HYBRIT

Under Hybrit (Hydrogen Breakthrough Ironmaking Technology), funded by Industriklivet, research and pilot studies are ongoing in Sweden that can lead to breakthroughs in fossil-free iron ore steel production. The projects linked to Hybrit have been granted more than SEK 600 million in total and are financed in addition to the aid from Industriklivet with more than SEK 1 billion from industry.

In 2016, a preparatory study was supported and in February 2017 it was decided to support a 4-year research project under the National Energy Research and Innovation Programme. The research project explores fossil-free pellet production processes, hydrogen-based direct reduction and use of iron fungi in the electric arc furnace together with the possibility of electricity supply for hydrogen production and storage.

In 2018, aid was granted for a feasibility study aimed at clarifying the conditions for a pilot plant, its basic design, location and technology choices for further development. Later in the same year, aid was granted for the construction of two pilot plants. In one pilot plant studies for the development of fossil-free heating technology for sintering iron ore pellets shall be carried out. The studies aim to reduce emissions but also to increase knowledge about the design of a completely new pelletisation process. In the second pilot plant, studies are being carried out to develop a concept where hydrogen is used for the production of iron mushrooms from iron ore pellets and where the iron fungus is then melted in an electric arc furnace for steel production. Both the feasibility study for the pilot plant and the pilot plants have been granted in the

176 https://www.energimyndigheten.se/49b590/globalassets/forskning--innovation/industri/industriklivet/fem-ar- med-industrial klivet-2018-2022---alert report.pdf

framework of Industriklivet.

The Hybrit Consortium has also been granted aid to build a hydrogen warehouse and further develop hydrogen storage technology with pressurised clothed rock. The Hydrogen Storage is built close to the pilot of the fossil-free steel productionplant in Luleå. Joint tests will be carried out where stocks are integrated into steel production.

4.6.1.4 Transition to a sustainable electricity system

The Future electricity system research programme is one of the major R & D efforts related to the electricity system and funds research and innovation projects that highlight challenges related to electricity generation, use and the electricity grids of the future.

The Programme shall promote the transition towards a sustainable energy system by facilitating the electrification of other sectors while promoting an electricity system characterised by security of supply, competitiveness, ecological and social sustainability. The programme runs from 2022 to 2027 but may be extended if necessary. Initially, the financial framework is EUR 552 million for the entire programming period.

A well-functioning electricity transmission and production system in conjunction with a well-functioning electricity market is a prerequisite for security of electricity supply and for achieving the objective of a sustainable energy system. Electricity grids should enable the development of an increasing amount of renewable electricity generation and increased electrification in society. Variations in electricity generation and use provide a need for flexibility and storage in the electricity system. At the same time, drivers and costs of the electricity system should be distributed among the different stakeholders in a way that provides the right incentives for development that supports the vision of a sustainable energy system. In addition to technological developments, appropriate regulatory frameworks and a well-functioning electricity market are therefore needed.

4.6.1.5 Research and demonstration in the transport sector

The Swedish authorities fund several programmes and large-scale projects addressing the various challenges linked to the transition to a decarbonised transport sector. The programmes below have all government funding.

- FFI, a cooperation between the State and the automotive industry on joint funding of research, innovation and development activities across several focus areas, including zero emissions and circularity.
- Bio +, a research programme to contribute to knowledge and create the conditions for commercialising and implementing solutions by biologists such as biofuels.
- The Batteries Fund programme, a research programme focusing on battery recycling and on batteries for electrical systems and vehicle applications.

- Transport efficiency in society, a research programme aimed at developing new knowledge and upgrading the skills of academia, institutes, the public sector and industry by supporting research, development, innovation and demonstration activities that contribute to achieving an equal, accessible and resource-efficient transport efficient society;

The transport sector's transition to electrification creates new opportunities. Large-scale battery production is important for Sweden's central role in this transition and for reducing the climate impact of the transport sector in Sweden and globally. As part of this, Northvolt Labs has been granted aid of up to SEK 146 million for a pilot plant for large-scale batterymanufacturing in Sweden. The decision is a major step towards a new domestic industry and sustainable energy systems. The project involves the construction and commissioning of a pilot plant for the production of lithium-ion batteries in Västerås. The project is divided into several phases and runs from 2018 to the end of 2023. In addition to testing and validating a new production and process model enabling battery manufacturing with a lower environmental impact, the pilot plant shall also act as a centre for research and development on sustainable and flexible battery production. The establishment of a pilot plant in Västerås is an important step towards the establishment of the Northvolt Battery factory in Skellefteå and has launched the establishment of a European battery manufacturing supply chain. The aid also creates the conditions for an ecosystem of Swedish companies throughout the battery value chain – from raw materials to battery systems. The pilot plant in Västerås is planned to employ around 100 people, excluding R & D personnel. The plant in Skellefteå is expected to be fully developed by 2023, generating between 2 000 and 2 500 direct jobs.177

The Transport Administration finances the research and innovation platform, Triple F (Fossil Free Freight)178, to contribute to the transition of the freight transport system to fossil freedom. Triple F focuses on three challenges: a more transport efficient society, energy-efficient and decarbonised vehicles and craft and an increased share of renewable fuels. The expected result is cross-stakeholder interaction and knowledge building that helps to reduce greenhouse gas emissions from freight transport.

Electrically powered aircraft have the potential to contribute to reducing both direct aviation emissions and high altitude effects mainly in shorter distances, which may be interesting, inter alia, for routes procured by the State for reasons of regional policy. The State is supporting in various ways the development of new innovative solutions in this field. One example is the Elise project financed by Vinnova, which has resulted, among other things, in the development of an electrically powered aircraft at the Heart Aerospace take-off company. In the longer term, and as

177Skellefteå Municipality press release 201 9-06-12
http://www.mynewsdesk.com/se/skellefteakommun/pressreleases/klart-foer-byggstart-av-northvolts- battery factor-i-skelleftea-2885665.
178 https://triplef.lindholmen.se/.

electric flights develop, the need for charging infrastructure for aviation will increase.

4.6.1.6 Energy related construction research

As the sectoral authority, the Swedish Energy Agency has the mainresponsibility and coordination for energy-related construction research. In addition to the Energy Agency, Formas and Vinnova also fund projects in the field. In addition,

The Swedish Consumer Agency, the National Board of Housing, Building and Planning and the Environmental Protection Agency for energy-related responsibilities in the field of construction.

Research and innovation in resource-efficient building will provide the conditions for achieving social policy objectives for a good built environment and a well-functioning housing market. All people in all parts of the country should be provided with a good living environment that promotes sustainable management of natural resources and energy and facilitates housing construction and economic development. Areas addressed include:

- Energy and resource efficient building materials, products and installation technologies
- Demand perspective and coordinated construction and management process
- Functionality and good indoor environment in the building stock
- Planning for resource-efficient building together with ancillary infrastructure
- Smart settlements with holistic solutions and starting from people's habits and needs;

4.6.1.7 From Research to Market

The transition to a sustainable energy system creates a growing global demand for new technologies and services. The commercialisation and internationalisation of Swedish energy research and innovation has great potential to meet this demand. Sweden has adopted a strong strategy to be the world leader in the energy transition, thus promoting Swedish innovation and growth for the companies that are at the forefront of this development. To achieve this, Sweden supports business development, commercialisation and deployment of new energy technologies and services in companies at different stages of development. The Swedish Energy Agency has several forms of support aimed at promoting the commercialisation and business development of innovations, aimed at higher education institutions and companies of different sizes and at different stages. Sweden has supported several successful companies in bringing research and innovation to the market. Sweden was at the top of the European Innovation Scoreboard in

2022.179

4.6.1.8 Pilot and demonstration cooperation between public and private actors

Sweden has supported successful pilot and demonstration projects in cooperation with public and private stakeholders. See for example:

- Lignin Industries AB project demonstration plant for the manufacture of thermoplastic lignin materials for plastic applications.
- Demonstration of support services from Smarta Solelparks for the energy system of the future, operated by Solkompaniet Sverige AB.

4.6.2 Current level of public and, where available, private research and innovation spending on low-carbon-technologies, current number of patents, and current number of researchers

4.6.2.1 Public and private expenditure

Government funding for research and development in 2022 amounted to:
SEK 43,5 billion. Of this, the national energy research and innovation programme accounted for SEK 1,4 billion, i.e. approximately 3.8 %.180

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 2019-2022, is shown in Table 29. Other private expenditure is difficult to assess.

Table 29. Public and private funding under the National Energy Research and Innovation Programme 2019-2022.

	2019	2020	2021	2022
Swedish Energy Agency	SEK 1 295 million (43 %)	SEK 1 344 million (44 %)	1 319EIA (44 %)	SEK 1 300 million (45 %)
Companies/industry bodies	SEK 1703 million (57 %)	SEK 1 707 million (56 %)	SEK 1 713 million (56 %)	SEK 1 589 million (55 %)
Total State and Enterprise Funding	**SEK 2 898 million (100 %)**	**SEK 3 051 million (100 %)**	**SEK 3 032 million (100 %)**	**SEK 2 889 million (100 %)**

Number of patents

The number of energy-related Swedish patent applications in the period 2019-2022 was 893

179 https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation- scoreboard_en # european-innovation-scoreboard-2022.
180https://www.scb.se/hitta-statistik/statistik-efter-amne/utbildning-och-forskning/forskning/statliga-anslag-till- research and development/pong/statistic/ statement-to-research-development-2018/Reduction of R & D spending in 2022 (scb.se).

national and 1 080 international.

Number of researchers

The number of active doctoral candidates and senior researchers employed in projects funded at least 20 % by the National Energy Research and Innovation Programme is shown below. The proportion of women project managers is around 32 %.

2022: 1 240 ST (822 men, 418 women, 0 others)

2021: 1 189 ST (769 men, 420 women, 0 others)

2020: 1 167 ST (799 men, 368 women)

4.6.3 breakdown of current price components constituting the three main price components (energy, networks and taxes/levies)

4.6.3.1 electricity price components

The electricity price a final customer faces consists of three main components: electricity trade price, network charge and tax (energy tax and VAT). The energy tax is paid per kWh and VAT is paid as a surcharge on the total price of the electricity, the network charge and the energy tax. In the first half of 2022, the average price of a typical apartment customer (1 000-2 500 kWh in annual consumption) was 324 öre/kWh (see Figure 31). The cost of electricity trading accounted for the largest share (35.5 %).

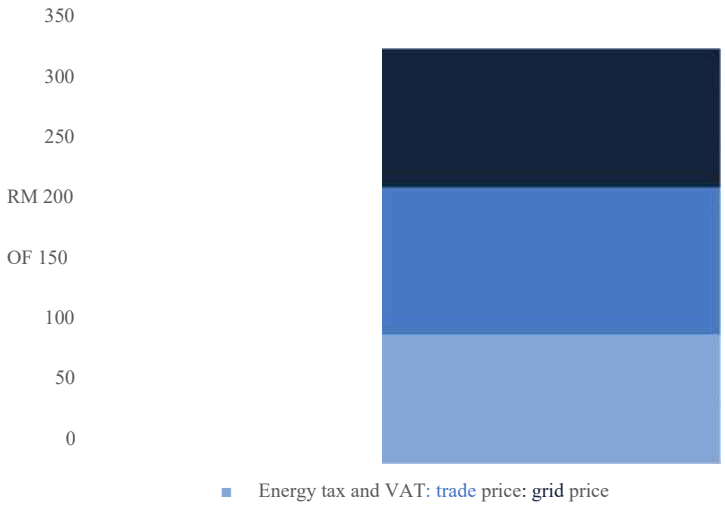


Figure 31. Distribution of electricity price components for a typical apartment customer (1 000-2 500 KWh in annual consumption) in the first half of 2022. Source: Statistical Central Bureau (SCB).

For a typical villa dog (15 000 kWh or more in annual consumption), the average cost was overall 204 öre/kWh for the first half of 2022 (see Figure 32). For this group of customers too, the cost of electricity trade accounted for the largest share (42.8 %).

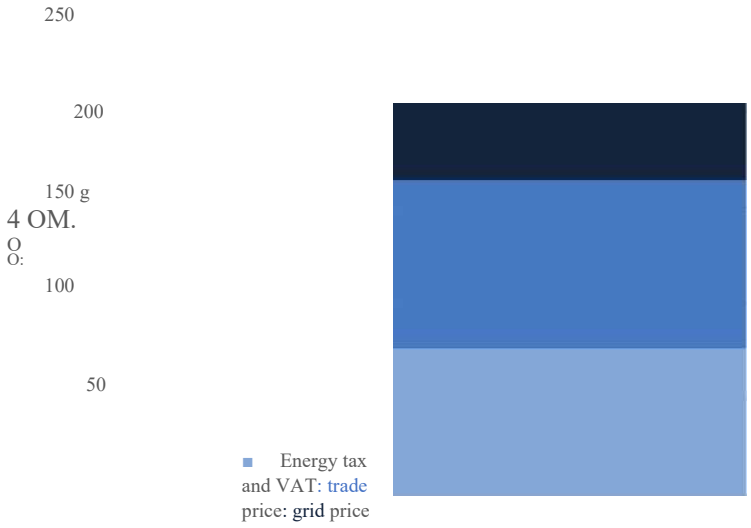


Figure 32. Distribution of electricity price components for a typical villa (15 000 kWh or more in annual consumption) in the first half of 2022. Source: Statistical Central Bureau (SCB).

4.6.4 description of energy subsidies, including for fossil fuels

In the Government's letter 'Financial statement of tax expenditure' (Sir. 2022/23: 98) reproduces the special rules contained in the tax legislation and its estimated impact on tax revenue. Tax expenditures are calculated as the tax reduction multiplied by the base (tax base) according to the tax loss method. The amount of the tax reduction is determined by the comparator applied to the respective tax expenditure. The comparator used in the calculation of tax expenditure is

essentially based on the principle of uniform taxation.

At the same time, it should be noted that tax expenditure cannot always be equated with aid on the expenditure side. For example, a tax rate lower than the comparator in the tax expenditure declaration may be high in an international context, so that a tax expense should not by definition be regarded as an aid or a subsidy.

Table 30 shows reductions in energy and carbon taxes and the estimated amount of tax expenditure for 2023.

Table 301. Tax expenditure on energy and carbon dioxide tax in 2023.

Energy tax reductions	Billion SEK
Energy tax on diesel in motorised vehicles	13,43
Energy tax on fossil petrol outside the reduction obligation	0[182]
Energy tax exemption for natural gas and LPG as propellants	0,19
Energy tax exemption for biofuels outside the reduction obligation	1,69
Energy tax exemption for electricity consumption at bandrift	1,09
Energy tax exemption for fuel consumption at bandrift	0,02
Energy tax exemption on fuel for domestic shipping	0,60
Energy tax exemption on fuel for domestic aviation	0,77
Energy tax exemption for biofuels etc. for heating	3,92
Electricity not taxed	Could not be quantified[181]
Reduced energy tax on electricity in industry	14,95

[182] energy tax is levied uniformly per litre of petrol including biofuels within the scope of the reduction obligation. The energy tax rate is calculated on the basis of the energy tax charge per unit of energy for the whole petrol blend including biofuels. Petrol environmental class 1 contains a share of biofuels in the form of ethanol and biobensin. Ethanol has a lower energy content than fossil petrol. The low-blend petrol will then have a total lower content per litre within the reduction obligation compared to pure fossil petrol outside the reduction obligation. The tax burden would then be higher than the tax charge per unit of energy for pure fossil gasoline. This gives rise to tax expenditure on fossil petrol in E85.

181According to the Energy Tax Act, under certain conditions, electricity is exempt or exempted from tax, for example electricity produced in smaller generating installations without being transferred to a network subject to a concession. The standard is the energy tax rate on electricity resulting from Chapter 1 1 of the Energy Tax Act.

Reduced energy tax on electricity in computer halls	0,36[182]
Reduced energy tax on electricity in the agricultural, forestry and aquaculture sectors	0,69
Reduced energy tax on electricity in certain municipalities	0,78
CO2 tax reductions	
Reduced CO2 tax on diesel for working machinery and vessels in the agricultural, forestry and aquaculture sectors	0,95
CO2 exemption on fuel at bandrift	0,01
CO2 tax exemption on fuel for domestic shipping	0,38
CO2 tax on fossil fuels and biofuels within the reduction obligation	0
CO2 tax on fossil fuels outside the reduction obligation	0

IMPACT ASSESSMENT OF PLANNED POLICIES AND MEASURES

5.1 Impact of planned policies and measures described in section 3 on energy systems and greenhouse gas emissions and removals and a comparison with projections based on existing policies and measures (as described in section 4).

5.1.1 Projections of the development of the energy system and GHG emissions and removals as well as, where relevant of emissions of air pollutants in accordance with Directive (EU) 2016/2284 under the planned policies and measures at least until ten years after the period covered by the plan (including for the last year of the period covered by the plan), including relevant Union policies and measures.

As stated in 1.2.1, in 2023 the government is to present a new climate policy action plan. It sets out the extent to which emission reduction measures adopted and planned can be expected to contribute to the achievement of national and global climate objectives. This section will therefore be finalised in view of the submission of the final plan, following the presentation of the Climate Action Plan.

5.1.2 Assessment of policy interactions (between existing policies and measures and planned policies and measures within a policy dimension and between existing policies and measures and planned policies and measures of different dimensions) at least until the last year of the period covered by the plan, in particular to establish a robust understanding of the impact of energy efficiency/energy savings policies on the sizing of the energy system and to reduce the risk of stranded investment in energy supply

In general, policies and measures in the energy efficiency dimension reduce the share of fossil-

182This reduction will be abolished on 1 July 2023.

free energy – and thus the instruments needed to increase this share – in order to achieve the targets set in the GHG reduction dimension. This is particularly evident as Sweden has no overall target for the share of renewable energy but quantified targets for greenhouse gas emissions. So far, efforts to electrify the transport sector have made a major contribution to reducing the need for biofuels to achieve climate objectives in the ESR sector, where transport is predominant.

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

5.1.3.1 Interaction between policies and measures for air and climate

Air pollution and climate change are closely interlinked in many ways and a complex area as they have an impact on both a local, regional and global scale. A future climate change will have an impact on concentrations, dispersion patterns, deposition and exposure of air pollutants. The magnitude and direction of this impact depend, among other things, on the evolution of climate change. In parallel, there are several air pollutants that have a climate impact.

Energy efficiency and savings in a wide range of sectors of society, such as industry, transport, space and residential heating and product performance, offer great potential for synergies between air and climate. Sweden's energy efficiency target of 50 % from 2005 to 2030 can, if properly achieved, have positive effects in several environmental areas.

Developments in the transport sector will be crucial for achieving Sweden's emission commitments for nitrogen oxides by 2030, but will also have an impact on the development of other air pollutants. The Government's decision on the NAPCP identifies measures to reach the 2030 climate target in transport as part of the air pollution control programme measures to reduce NOx emissions. The next revision of the programme is due by 2023. The share of the vehicle fleet powered by internal combustion engines by 2030, in particular diesel engines, will have a major impact on the evolution of NOx emissions. Measures that are positive for reducing emissions of both air pollutants and greenhouse gases are, for example, increased electrification of the vehicle fleet, increased transport efficiency and energy efficiency.

Future strengthening of common EU rules for CO_2requirements for light-duty vehicles and the introduction of the corresponding requirements for heavy-duty vehicles will also bring positive synergies on NOx emissions by 2025 and 2030.

Increased use of biomass contributes to the reduction of fossil greenhouse gas emissions but can have negative effects on air quality. When burning biomass, emissions of air pollutants, including particulate matter, black carbon and benzo (a) pyrene, may increase if this is not compensated by the cleaning of the waste gases.

Switching to biofuels in the vehicle fleet reduces greenhouse gasemissions but does not contribute to the reduction of NOx emissions.
NOx emissions are similar from a diesel car driven on fossil diesel as from one driven on biodiesel. Biogas powered cars generate slightly less nitrogen oxide emissions. In order to meet Sweden's commitment under the ceiling directive, it is therefore important to increase the electrification of the vehicle fleet and increase transport efficiency.

5.2 Macroeconomic and, to the extent possible, health, environment, education, skills and social impacts, including with regard to just transition (in terms of costs, 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 will be finalised in view of the submission of the final updated plan, following the presentation of the Climate Action Plan.

5.3 Overview of investment needs

5.3.1 Existing investment flows and future investment assumptions with respect to planned policies and measures.

5.3.1.1 Investment in electricity generation

The calculation results in this section are based on the scenario Reference EU from the Swedish Energy Agency's Long-Term Scenario Report 2018.183 The text is therefore not up to date from the previous plan, which will take place in view of the preparation of the final plan in 2024.

Investments in the modelling take place in a large number of electricity generation technologies (e.g. several different technology classes in wind power). The respective production technologies have been evaluated separately and then grouped into the main groups hydropower, nuclear power, combined heat and power (within district heating systems), industrial backpressure, wind power, solar power 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 compilation.

Figure 33 shows new investments in production capacity for the respective model year.184

183Swedish Energy Agency – Scenarios of Sweden's energy system in 2018 (ER 2019: 7).
In fact,184 each model year describes a period of 5 years, i.e. model year 2030 covers, for example, the years 2027,5-2032,5. The investment in the figure is therefore 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 equivalent to approximately 12 GW are made in electricity generation.

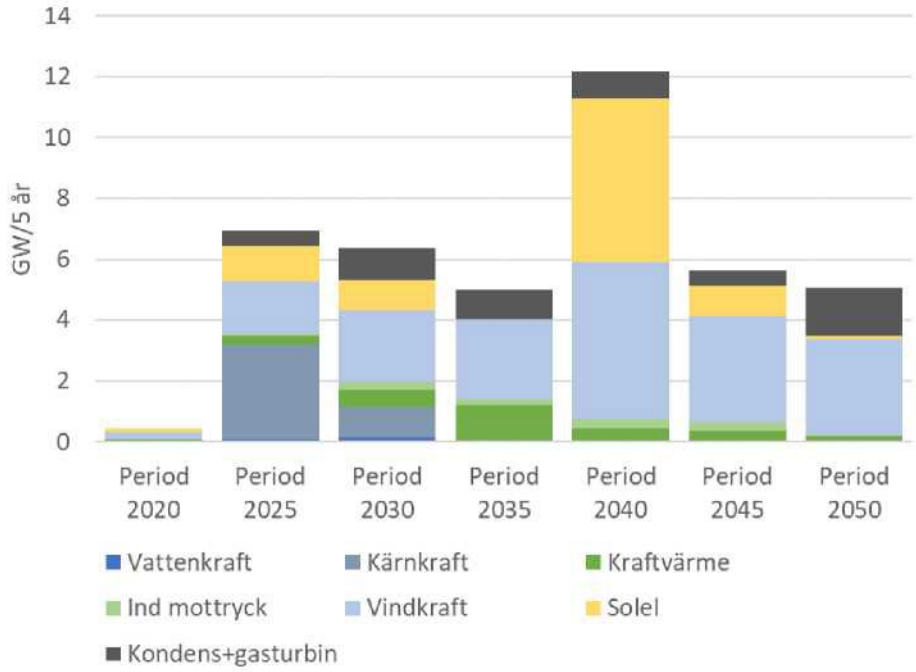


Figure 33. Investments in capacity (additional GW per five-year period); Source: The Swedish Energy Agency.

It should be mentioned that investments in capacity do not say anything about the total installed capacity. The sum of initial investments over a longer period may exceed the installed capacity. Some of the investments are made to replace earlier investments that fell for the age line (technical lifespan) and have different time to use (i.e. different energy-to-capacity conditions). Investments in nuclear power are those made for life extension purposes, from 35 years of technical lifetime to 60 years.

Figure 34 shows 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, i.e. the investment costs excluding interest costs during the construction period. As in Figure 33, each model year actually consists of a five-year period. It is during that period that the investment is charged. In order to obtain the annual investment in a given year, it is possible to divide by five in the five-year period (model year) within which the year is located.

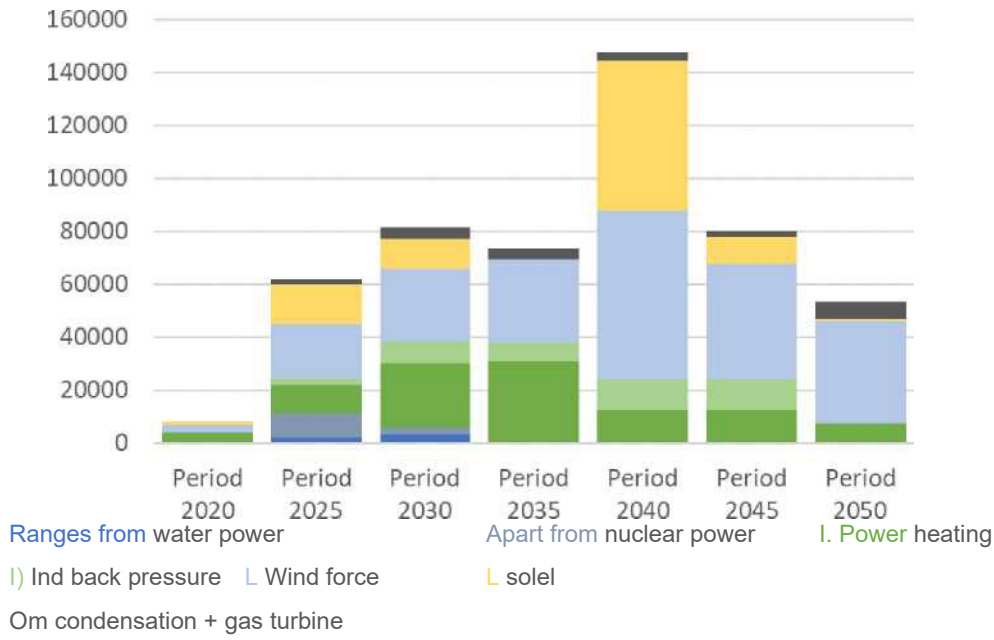


Figure 34. Investments in SEK million per five-year period, on the model years (five years) in which the investment is made (overnight cost).
Source: The Swedish Energy Agency.

Although investments in capacity, expressed in GW, in cogeneration are smaller than investments in wind power for example (see Figure 33), the difference in the amount of investment in SEK between wind and cogeneration is much smaller. This is because the entire cogeneration investment – including that related to district heating production – is allocated to electricity production. For example, for waste co-generation heat, the specific investment cost, per unit of electricity, is very high. If part of the investment cost is allocated to heat production, which may be reasonable, the cost attributed to electricity production will of course be lower. However, there is no objectively clear answer to how such allocation should be made.

An alternative way of calculating investments is to annualise185 them over the economic life of each investment and given the discount rate of each investment. This is illustrated in Figure 35, where each single investment was annualised and allocated to the respective technology group. In other words, thecost of the annualised investment is the same as the annual cost of capital. Here is the single calendar year applicable and not five-year periods as in Figure 34. Excludes the costs related to historical investments where parts of economic life still remain. It is therefore not a total cost of capital for electricity production that is shown, but only for initial investments from 2020, but not those that have already been decided today. It is therefore not possible to determine from Figure 35 whether the total capital costs linked to electricity generation increase or decrease over time.

An185 annualised cost is an annual cost (payment) which includes, on the one hand, an interest cost (based on the discount rate) and, on the other hand, an amortisation. This means that the investment is repaid in equal amounts each year (the annual cost) over the economic life of the investment.

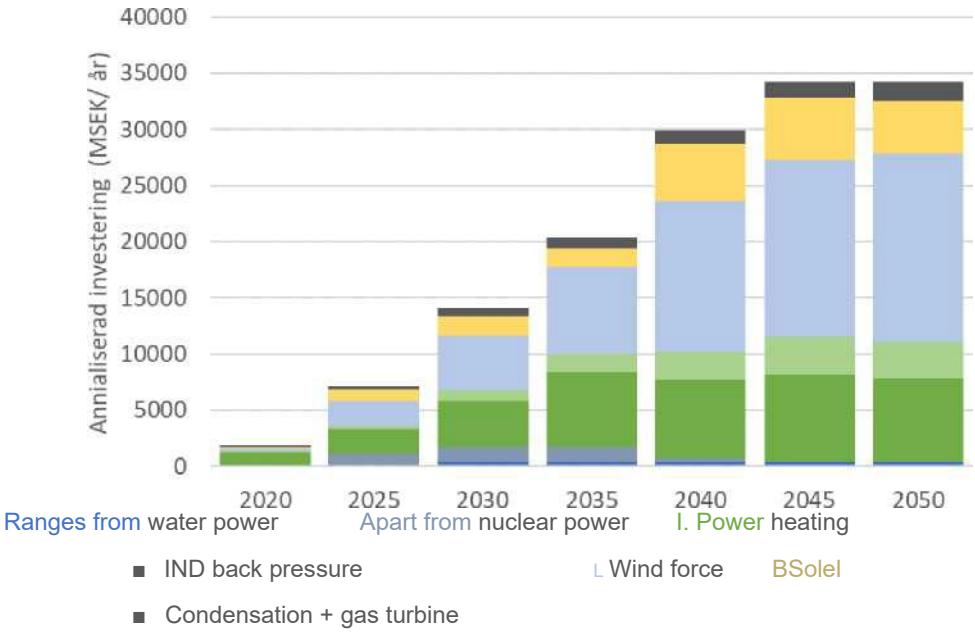


Figure 35. Investments in million SEK/year annualised over the economic life and based on the discount rate for each investment. (Excludes capital costs related to "historic" investments). Source: The Swedish Energy Agency.

Annualised investments increase over time as investments are made on an ongoing basis (but to varying degrees according to Figure 33) during the calculation 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 annualised investments. The slowdown in the growth rate of annualised investment towards the end of the calculation period for, for example, solar and wind power can be interpreted as meaning that new investment is largely offset by depreciated investments that no longer entail a cost of capital.

5.3.1.2 Investments in the transmission network

The network investments reported in the System Development Plan during the planning period for the years 2031-2022 amount to approximately SEK 170 billion, of which SEK 100 billion is estimated to fall during the planning period for the years 2022-2031.186 Of these, around SEK 46 billion represent reinvestments in existing stations and pipelines, around SEK 48 billion new investments and just under EUR 7 billion in development projects, see Figure 36 and Figure 37.

Network investments (transmission network) are carried out according to the system development plan based on four main drivers:

- Connection of new electricity generation with the majority of new wind power. The

186Swedish Power Networks – System Development Plan 2022-2031.

largest amount of wind power is expected to be connected in northern Sweden.

- Increased need for connections between the countries of the Nordic region and between the Nordic countries and the continent.
- Large increases in consumption in metropolitan regions lead to major grid investments to secure electricity supply to these areas. This, together with the assumed decommissioning of nuclear power in southern Sweden, also increases the need for transmission capacity from north to south in the transmission network.
- Network development is also driven by the need for reinvestment. The oldest parts of the Swedish transmission network will need to be renewed in the coming decades.

Figure 36. Investment levels in 2022-2031 broken down by main drivers of network investment and development projects. Source: Swedish power grids.

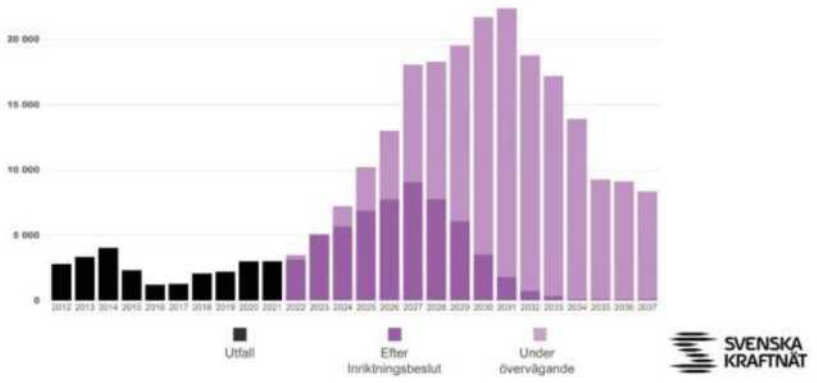


Figure 37. Investment expenditure 2022-2031 broken down by main drivers of network investment and development projects. Source: Swedish Power Networks – System Development Plan 2022-2031.

5.3.2 Sector or market risk factors or barriers in the national or regional context

No risk factors have been identified.

5.3.3 Analysis of additional public finance support or resources to fill identified gaps identified under point ii

No risk factors have been identified.

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 Impacts on the energy system in neighbouring and other Member States in the region to the extent possible

See Section 5.4.3.

5.4.2 Impacts on energy prices, utilities and energy market integration

See Section 5.4.3.

5.4.3 Where relevant, implications for regional cooperation.

Nordic Energy Research, the Nordic Energy Research and Policy Development Platform of the Nordic Council of Ministers, jointly funded by the Nordic governments, published together with the International Energy Agency the Nordic Energy Technology Perspectives 2016, which explores regional long-term, cost-effective low-carbon technologies for the Nordic region.187 The study presents a detailed scenario-based analysis of how the 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's global 4° scenario.

The analysis in Nordic Energy Technology Perspectives 2016 is based on a scenario in which Nordic energy-related carbon dioxide emissions are reduced by 85 % by 2050. The name – carbon-neutral Scenario (CNS) – reflects a formulation used in official cases, although carbon neutrality requires action for the remaining 15 %. The pathway towards CO2 reduction set in the CNS scenario should therefore be considered as a minimum requirement. Limiting global warming to 1,5 degrees, in line with the Nordic Joint Declaration on Carbon Neutrality of January 2019188, is likely to require additional measures 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 2020.189 The report

187 https://www.nordicenergy.org/project/nordic-energy-technology-perspectives/.
188 https://www.regeringen.se/48febb/contentassets/afd1e82263dc4fbba6a1 b0c15357faee/declaration-on- nordic-climate-neutrality.
189 https://www.nordicenergy.org/project/tncep/

tracks 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. Some of the main findings of this report are:

- For the period from 2013 to 2017, the Nordic countries are well on track towards carbon neutrality, even with higher than expected GDP growth, but additional measures are likely to be needed to continue this trend.

- The positive trend is mainly in the power and heat sector, which contributes significant carbon dioxide savings, from 60,7 MtCO2 2007 to 35,1 MtCO22017, 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 input has increased from 31 % in 2008 to 40 % in 2018.

- The share of electric vehicles in the light vehicle fleet is on track towards the 2020 level of 4.1 % in line with the scenario of carbon neutrality (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 used primarily in high-value sectors (transport and industry) and sustainability will continue to be of great importance.
    - CCS must be demonstrated on a large scale.

Annex 1 – Calculation of annual and cumulative energy savings in accordance with Article 7, 7a and 7b of the Energy Efficiency Directive

Energy saving in housing and services (buildings)

In the housing and services sector, only electricity savings are recorded. The reason for this is that the current direct use of oil for domestic heating and servicing purposes is very low, while available data on price elasticity are based on conditions in which oil use was significantly higher. In addition, a large proportion of heating, especially in multi-dwelling buildings, is currently carried out through district heating, where technological lock-in effects reduce the possibility of switching to other heating sources, such as geothermal heat pumps.

In order to estimate the correlation between electricity consumption and electricity prices in the residential and service sector, a dynamic model is used,192 consisting of two elements. A long-term linear relationship between electricity consumption and the independent variables on price, income and heat demand, and a more dynamic short-term relationship due to deviations in electricity consumption from the long-term relationship and/or a change in any of the underlying variables (prices or income) between the previous and the current period.

Selected elements from the model description used for estimating long-term and short-term price elasticities are set out in Annex 1 to Sweden's implementation plan for Article 7193 of the Energy Efficiency Directive for the period 2030-2021. Data, results for estimates and discussion of new elasticities for housing and services are presented in the Swedish Energy Agency's memorandum.194

The Energy Agency's estimates of price elasticity show that a higher electricity price reduces

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The192 model has been developed by Professor. Runar Brännlund at the Centre for the Economy of the Environment and Natural Resources, CERE, University of Umeå(www.cere.se). It is described in more detail in the report on the *electricity demand of the housing sector in Sweden*.

Directive 201 2/27/EU of the193 European Parliament and of the Council of 25 October 201 2 on energy efficiency, amending Directives 2009/125/EC and 201 0/30/EU and repealing Directives 2004/8/EC and 2006/32/EC.

194Swedish Energy Agency memo 2019: *Calculation method of the impact of energy and CO2 taxes on energy consumption*; Serial No: 2018-12739.

electricity consumption in the housing and services 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 falls by 1.1 % with a price increase of 10 %. It takes a long time for households and the services sector to fully adapt to changes in prices and incomes. The buildings, heating systems and other appliances you use from one year to the next mean that only minor adjustments can be made to electricity consumption from one year to thenext as a result, for example, of a change in the price of electricity. However, this does not mean that long-term changes cannot be taken into account when calculating the accumulated amount of energy savings. Some households and businesses are adapting faster than others.

These elasticities have been used to calculate the electricity savings resulting from the fact that the Swedish electricity tax in the household and service sector is higher than the EU minimum tax rates and that this, in combination with other complementary instruments, stimulates a reduction in electricity consumption compared to the absence of these instruments.

The only distinction between the reference scenario (EUMIN) and the alternative scenario (SE) is the final consumer price of electricity (including excise duties and VAT). The calculations are based on a price difference of around 50 %, which is based on 2021 prices. The calculations also include that Swedish VAT is higher than the EU minimum rate (25 % compared to 15 %). In practice, however, VAT is only paid by households and businesses which do not have the right to deduct.
The calculations are based on the latest available data and then use that year for subsequent years. After that, the difference in electricity consumption between the alternative and the baseline scenario is calculated.

Table 31 provides an estimate of the annual and cumulative amount of accumulated electricity savings in the housing and services sector over the period 2030-2021.

Table 31. Annual and cumulative electricity savings inthe dwelling sector

Change TWh	TWh/a	TWh ack
2021	— 12,8	— 12,8
2022	— 12,3	— 25,2
2023	— 12,3	— 37,5
2024	— 12,3	— 49,8
2025	— 12,3	— 62,2
2026	— 12,3	— 74,5
2027	— 12,3	— 86,9
2028	— 12,3	— 99,2
2029	— 12,3	— 111,5

2030	— 12,3	— 123,9

The results in Table 1 are based on the latest available statistics before 2022 and price elasticities for the period 1975-2017.195 The revised calculations include the impact of the VAT difference between Sweden and the EU. In addition, some simplified assumptions are made for input data.

Table 31 shows that Swedish instruments contribute to cumulative electricity savings in the housing and services sector of around 124 TWh over the period 2021-2030.

Energy saving in the transport sector

Overall, in the transport sector, the reduction in petrol and diesel consumption is recorded. Savings of pure biofuels and electricity are not accounted for.

For estimating the correlation between energy consumption and energy price of petrol and diesel in the transport sector, as well as for the construction, a dynamic model196 consisting of a long-term correlation between the total fuel use and the independent variables price and income and a dynamic, more short-term relationship due to deviations in fuel use from the long-term relationship and/or a change in any of the underlying variables between the previous and the current period (short-term dynamics) are used. A detailed description of the model, which is used to estimate 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, is set out in Annex 2 to Sweden's notification of Article 7 in 2013.197 In 2019, the Swedish Energy Agency estimated new elasticities for petrol and diesel in the transport sector. The present power calculations are based on these. Data, estimates, discussion and possible applications of the new elasticities are presented in the Swedish Energy Agency's memo 2019.198

The estimates of price elasticity in 2019 show that a higher petrol price 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. That is to say that higher petrol prices, all other things unchanged, lead to an increase in diesel

195Swedish Energy Agency memo 2019: *Calculation method of the impact of energy and CO2 taxes on energy consumption*; Serial No: 2018-12739.

The196 model has been developed by Prof. Runar Brännlund at the Centre for the Economy of the Environment and Natural Resources, CERE, Umeå University (www.cere.se), and is described in detail in the *report entitled 'The effects on energy saving from taxes on motor fuels: The Swedish case*, CERE Working Paper 2013: 6.

Ministry of197 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).

198Swedish Energy Agency memo 2019: *Calculation method of the impact of energy and CO2 taxes on energy consumption*; Serial No: 2018-12739.

consumption. The interpretation is, of course, that there is a degree of substitution from petrol cars to diesel fuelled cars. The reverse result applies to an increase in the price of diesel. For this reason, it is particularly relevant to take into account the cross-price elasticity of petrol and diesel in order to calculate the total energy savings of 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 the level of VAT 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 rate (25 % compared to 15 %).

The only difference 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 an average price difference of 44 % for petrol and 50 % for diesel, which is based on the 2021 price level. The calculations are

based on the latest available data and then use that year for subsequent years. After that, the difference in fuel and energy consumption is calculated between the alternative scenario and the baseline scenario.

Table 32 (petrol) and Table 33 (diesel) provide an estimate of the annual and cumulative fuel and energy savings in the transport sector over the period 2021-2030.

Table 32. Annual and cumulative energy savingsof petrol in the transport sector;

	Change TWh	
	TWh/a	**TWh ack**
2021	— 3,6	— 3,6
2022	— 3,8	— 7,3
2023	— 3,8	— 11,1
2024	— 3,8	— 14,9
2025	— 3,8	— 18,7
2026	— 3,8	— 22,5
2027	— 3,8	— 26,3
2028	— 3,8	— 30,0
2029	— 3,8	— 33,8
2030	— 3,8	— 37,6

Table 33. Annual and cumulative energy savingsng diesel in the transport sector.

Change TWh		
	TWh/a	**TWh ack**
2021	— 0,4	— 0,4
2022	— 0,4	— 0,8
2023	— 0,4	— 1,2
2024	— 0,4	— 1,6
2025	— 0,4	— 2,0
2026	— 0,4	— 2,5
2027	— 0,4	— 2,9
2028	— 0,4	— 3,3
2029	— 0,4	— 3,7
2030	— 0,4	— 4,1

The results in Tables 32 and 33 are based on the latest available statistics before 2021. The price elasticities used refer to the period 1976-2017.199 Some simplified assumptions are

199Swedish Energy Agency memo 2019: *Calculation method of the impact of energy and CO2 taxes on energy consumption*; Serial No: 2018-12739.

made for input data.

Summing up the results from Table 32 and Table 33, the cumulative energy savings of petrol and diesel in the transport sector from Swedish instruments can be estimated at around 48 TWh over the period 2021-2030. It should be noted that the calculations do not currently take into account the blending of biofuels into petrol and diesel through the reduction obligation. Biofuel blending increases the fuel price at pump and therefore, depending on the levels of reduction decided in the future, it may be appropriate to analyse in the future the effects of the instrument in the same way as for a tax.

On energy savings in other sectors

Sweden's notification in 2013 estimated energy savings in industry and the area industries. A simpler linear model was used, where the price difference resulting from higher Swedish tax levels was multiplied by the long-term self-price elasticity of different fuels to determine the long-term demand reduction. Assuming a linear increase in the impact over the seven years of the period up to its full effect in 2020, the annual and cumulative long-term cumulative energy savings in the period 2020-2014 were estimated to be approximately 3 TWh (cumulative 12 TWh) for the part of the industry covered by the EU ETS and for the non-ETS part of the industry at 0.34 TWh (cumulated 1.4 TWh). For area-related industries, long-term savings were estimated at 0.54 TWh (cumulative approximately 2 TWh). The impact was calculated for different industries and activities. The price elasticities used represented an average value for different industries and were based on data for the years 1990 to 2004.

Impacts on industry and surface industries have not been calculated for 2021-2030, as previous estimates produced relatively small impacts compared to the housing and services and transport sectors. Areal industries have a relatively low energy use and have both tax reductions and exemptions. In industry, tax reductions and exemptions are still relatively high, but there are industries that pay taxes and reductions and carbon tax exemptions have also decreased in recent years.

The fact that the effects of taxes in the sectors mentioned are not calculated helps to ensure that the estimation of the energy-saving effects of Swedish energy and CO2 taxes is conservative.

Annex 2 – Energy cooperation in the North Sea – Regional cooperation on offshore renewable energy

Text agreed within the North Seas Energy Coopration (NSEC) 2023, translated into Swedish.

Sweden is part of the wider North Sea region, which has a great potential for renewable energy. The deployment of offshore wind energy will play an increasingly important role in achieving Europe's energy and climate targets. The EU Strategy for Offshore Areas sets an ambitious target of 300 GW of offshore wind and 40 GW of ocean energy to be installed by 2050. On 19 January 2023, in the framework of the regional groups under the TEN-E Regulation, a non-binding agreement on offshore renewable energy production targets for 2050 with sub-targets for 2040 and 2030 concerning the prioritisation of grid corridors in the North Sea and the Baltic Sea was established. Targets for the North Sea Offshore Grid (NSOG) 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 implies a significant upscaling of the maritime sector, the deployment of renewable energy as well as more integrated offshore development strategies. High energy prices, as in 2022, and geopolitical events threatening the European energy system have underlined the need to accelerate the deployment of domestic renewable energy production capacities and regional offshore transmission networks as quickly as possible, thereby significantly improving energy security.

The*North Sea Energy Cooperation* (NSEC) is a voluntary, market-oriented and regional cooperation initiative set up in 2016 to:

- create synergies;
- avoid non-compatibility of national legislation.
- share knowledge of international best practices;
- promote common approaches where possible and beneficial.

Ministers responsible for energy meet regularly in the NSEC format. 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 with the UK on offshore renewable

energy. The establishment of this Memorandum of Understanding was made possible by the Trade and Cooperation Agreement between the European Union and the United Kingdom on 30 December 2020, and is based on the NSEC, but is nevertheless independent of the NSEC.

For the offshore wind sector, a predictable and long-term stable operating environment is crucial to facilitate investment and cost reductions. To achieve this objective, barriers need to be removed and attractive investment conditions created. NSEC members work together to help achieve these objectives by regularly exchanging expertise within four NSEC support groups:

- SG1: development of hybrid and joint projects;
- SG2: permit granting, maritime spatial planning and environmental considerations.
- SG3: funding and support framework.
- SG4: long-term network and infrastructure planning;

Interaction between and within groups is strongly encouraged in order to enable each Support Group to meet its objectives. Examples of cooperation areas are ports (SG1 and SG4), maritime spatial planning and network planning (SG2 and SG4), and criteria for innovation around key challenges for an accelerated, cost-effective and responsible deployment of offshore renewable energy (SG1, SG3 and SG4). Finally, the Support Groups also work closely with other international fora, such as the Pentalateral Energy Forum and the Clean Industrial Forum on land-based network planning, market design and stakeholder involvement.

SG1. Development of hybrid and cooperation projects

The SG1 Group serves as a platform to cooperate on concepts for potential offshore projects and a coordinated electricity infrastructure, including transmission infrastructure. The group has increased its activities as the NSEC countries have launched more joint and hybrid projects in the North Sea to facilitate technical and ministerial discussions and exchange experience throughout the projects.

In addition to joint projects on offshore renewable energy, the GPMB is also working on possible “hybrid solutions” to connect offshore wind farms to more than one electricity market and to create synergies between countries, corresponding to market design at EU and national level.

For this reason, the Group SG1 is working on developing opportunities for cooperation on

hybrid projects, as well as knowledge sharing on legal, regulatory and commercial barriers. In the future, the group will work on hybrid and joint projects, both at national and regional level. Furthermore, cooperation can feed into legislative processes at EU and national level.

SG2. Permits, MSP and environmental considerations

In order to reach the EU's energy and climate targets, there is a need to accelerate planning and permitting processes at EU and national level, while better understanding possible ecological constraints for large-scale wind energy development in the North Sea as well as impacts on other stakeholders. SG2 carried out an inventory of spatial conflicts of interest for offshore wind farms on regional sea scale. The next step is to better define ecological conflicts of interest and potential obstacles to development, as well as to define spatial strategies to avoid or reduce divisions. In order to increase the level of knowledge and support the deployment of offshore wind energy in the North Sea, the countries concerned will continue to cooperate closely on maritime spatial planning, environmental research and cumulative impact assessment of wind farms between responsible energy authorities, maritime spatial planning and the environment.

SG3. Financial and Support Frameworks

Tendering processes in offshore wind energy are a key topic for funding and support frameworks. NSEC members contribute to coordination by sharing information on the national tender plans as part of SG3. In the Task Force, countries are also exchanging experiences on tender design, zero subsidy support, design elements to promote system and sector integration, and network connection systems. Common projects are also becoming increasingly important to achieve the objectives.

Therefore, the group also addresses funding opportunities for joint offshore projects, including through EU funding instruments such as the Connecting Europe Facility and the Union renewable energy funding mechanism. Finally, PPAs play an increasingly important role in the financing of offshore projects. Countries will address problems, barriers and solutions related to the use of PPAs. Furthermore, the group exchanges knowledge on decommissioning, extending the lifespan and upgrading of wind farms.

The aim of the exchanges is also to discuss ideas on how to develop offshore energy systems in the medium term with regard to installed capacity.

SG4. Delivery 2050: long-term network and infrastructure planning

The SG4 group cooperates with ENTSO-E for electricity to provide and coordinate views on the North Sea offshore grid development plan under the EU TEN-E Regulation. In addition, SG4 aims to broaden the discussion on long-term network planning to include the early development and upscaling of green offshore hydrogen production and transport, and its

potential role in an increasingly interconnected energy system in the North Sea. Green hydrogen will be important to decarbonise our energy system. Power-to-X, and hydrogen in particular, will play an important role in providing flexibility where and when needed. Demand for hydrogen is expected to increase significantly, especially after 2030, due to both its potential for energy storage and as a fuel or raw material. Several NSEC countries have announced targets for green hydrogen onshore and offshore. In SG4, NSEC countries will share first experiences on hydrogen and offshore wind, as well as share knowledge on transport infrastructure, renewable energy development and power-to-x offshore. Countries work together to build knowledge on offshore hydrogen production, discuss the deployment of electrolysers and increase synergies between the long-term offshore grid and hydrogen grid planning. The SG4 group is working to broaden the engagement in this planning process with Member States and relevant stakeholders, including industry and NGOs, to anticipate and address supply chain bottlenecks (e.g. port development and accessibility) in the deployment and acceleration of:

the implementation of the energy system projects; This also links to protecting the security of critical infrastructure at sea and underwater, as well as the supply of critical raw materials through innovation and improved circularity.