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FINLAND'S INTEGRATED NATIONAL ENERGY AND CLIMATE PLAN

25 November 2019

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1 OVERVIEW AND PROCESS FOR ESTABLISHING THE PLAN

1.1 Executive summary

1.1.1 Political, economic, environmental, and social context of the plan

After submitting the draft National Energy and Climate Plan (NECP) in 2018, parliamentary elections were held in Finland in the spring 2019 and the new government of Prime Minister Antti Rinne took office on 6 June 2019.

The Programme of Prime Minister Antti Rinne's Government[1] contains several strategic themes[2] one of them being "Carbon neutral Finland that protects biodiversity". In addition, objectives and measures addressing climate change are included under several other strategic themes.

This strategic theme on carbon neutrality has i.a. the following objectives:

1) Finland will achieve carbon neutrality by 2035
2) Finland aims to be the world's first fossil-free welfare society
3) Finland will strengthen carbon sinks and stocks in the short and long term.

Related to these objectives the Government Programme states:

> *The Government will work to ensure that Finland is carbon neutral by 2035 and carbon negative soon after that. We will do this by accelerating emissions reduction measures and strengthening carbon sinks.*
>
> *The Government is committed to reforming the climate policies of the European Union and Finland so that we can do our part to limit the global mean temperature increase to 1.5 degrees Celsius. Finland aims to develop the EU's long-term climate measures so that the EU can achieve carbon neutrality before 2050. This means tightening the emissions reduction obligation for 2030 to at least 55 % below the 1990 emissions level.*
>
> *We will continue our Nordic climate and energy cooperation in order to achieve carbon neutrality and will work to strengthen the position of the Nordic countries as leaders in international climate policy.*

[1] Inclusive and competent Finland – a socially, economically and ecologically sustainable society, http://urn.fi/URN:ISBN:978-952-287-760-4
[2] Strategic themes, https://valtioneuvosto.fi/en/rinne/government-programme

In addition, the Government Programme states:

> *Electricity and heat production in Finland must be made nearly emissions-free by the end of the 2030s while also taking into account the perspectives of security of supply.*

In accordance with the Government's Programme, the existing Climate Change Act (*Ilmastolaki 609/2015*[3]*)* will be amended in a way that enables to achieve the target of carbon neutrality by 2035. The emission reduction target for 2050 will be updated.

Finland has already adopted legislation to phase out the use of coal in energy production by 2029. The Government Programme also foresees i.a. a stepwise phase-out of the use of oil for heating by the beginning of the 2030s and reducing the use of peat in energy production into half by 2030.

Some of the policy measures related to energy- and climate objectives of Antti Rinne's Government Programme are to an extent already described in the Government Programme whereas several others remain yet to be prepared and decided. Policy measures will be implemented during the current government term 2019-2023. The work has already started but it has not been possible to define all the policies and measures in line with the objectives set in the Government Programme for the timetable of the final NECP. Therefore, this NECP is mostly based on and describes the existing, previously decided, targets and policy measures[4]. In accordance with the Governance regulation a draft update of the NECP will be submitted to the Commission in 2023. The update will be based on the new Medium Term Climate Policy Plan (*Keskipitkän aikavälin ilmastopolitiikan suunnitelma*), the revised Climate and Energy Strategy (*Ilmasto- ja energiastrategia*) and the Climate Programme for land use sector, to be developed by 2021, to fully reflect the climate and energy objectives and targets in the Government Programme.

Regarding the main basis for this NECP, the National Energy and Climate Strategy from 2016 outlines concrete actions and objectives that will enable Finland to achieve the national energy and climate targets and targets adopted in the EU for 2030, and to systematically set the course for reaching the 2050 targets. The starting point of the energy and climate strategy is to look at the energy and climate policy in different sectors comprehensively from the perspectives of emissions reduction, energy policy, growth and employment. The energy and climate policies should have a long time span and be in line with the Roadmap contained in the Report of the Parliamentary Committee on

[3] Unofficial translation of the Climate Change Act 609/2015 available at https://www.finlex.fi/en/laki/kaannokset/2015/en20150609.pdf

[4] These existing policies and measures are described in the Government reports on the National Energy and Climate Strategy for 2030 (VNS 7/2016 vp) and the Medium-term Climate Change Policy Plan for 2030 (VNS 7/2017 vp). The measures in the transport sector have been specified in the final report of the working group on transport networks.

Energy and Climate Issues[5]. When formulating the National Energy and Climate Strategy, Finland's special features, including the cold climate, long transport distances, extensive energy-intensive industry and domestic raw material resources, especially forest biomass, have been taken into account.

The National Energy and Climate Strategy outlines the actions that will enable Finland to attain the targets specified in the Government Programme and adopted in the EU for 2030, and to systematically set the course for achieving an 80−95 per cent reduction in greenhouse gas emissions by 2050. With minor exceptions, Finland will phase out the use of coal for energy. The Strategy contains objectives for the share of transport biofuels to be increased to 30 %, and an obligation to blend light fuel oil used in machinery and heating with 10 % of bioliquids. The minimum aim is to have 250 000 electric and 50 000 gas-powered vehicles on the roads. The Strategy aims for developing the electricity market at the regional and the European level for the improvement ofthe flexibility of electricity demand and supply and, system-level energy efficiency in general. Cost-effective new production of renewable energy is planned on the basis of technology neutral tendering in 2018−2020.

According to the National Energy and Climate Strategy, the share of renewable energy in the end consumption is estimated to increase to approx. 50 % and the self-sufficiency in energy to 55 %. The domestic use of imported oil will be at least halved, as planned.

The other key document forming the basis for this NECP, the Medium-term Climate Change Policy Plan from 2017 defines the measures to ensure that Finland’s emission reduction target for the effort sharing sector in the EU will be achieved. The greatest non-ETS sector reductions in emissions will be achieved in the transport sector.

The Finnish target for emissions reduction in the effort sharing sector by 2030 is 39 % compared to 2005. The actions included now in the baseline scenario are not sufficient to achieve this. The current National Energy and Climate Strategy and Medium-term Climate Change Policy Plan are built on the assumption that Finland will take advantage of the 2 % one-off possibility to cancel ETS allowances towards the target in the effort sharing sector. Finland will inform about using the one-off flexibility in due time.

The National Energy and Climate Strategy (2016) and the Medium-term Climate Change Policy Plan (2017) are based on common projections and an impact assessment was carried out on both of them.

[5] Ministry of Employment and the Economy (2014) Energy and Climate Roadmap 2050. Report of the Parliamentary Committee on Energy and Climate Issues on 16 October 2014. Publications of the Ministry of Employment and the Economy. Energy and the climate 50/2014. http://tem.fi/documents/1410877/2769658/Energy+and+Climate+Roadmap+2050/9fd1b4ca-346d-4d05-914a-2e20e5d33074

1.1.2 Strategy relating to the five dimensions of the Energy Union

This integrated National Energy and Climate Plan discusses all of the five dimensions of the Energy Union on the basis of the related government reports: (i) decarbonisation, including efforts to reduce greenhouse gas emissions, the sinks and efforts to increase renewable energy, (ii) energy efficiency, (iii) energy security, (iv) internal energy market and (v) research, innovation and competitiveness.

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

Table 1 presents a summary of the main targets of this National Energy and Climate Plan, based on the targets set in 2016 and 2017 reports referred to in Chapter 1.1.1. Table 2 gives an overview of existing as well as planned energy and climate policy measures.

1.2 Overview of current policy situation

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

Finland's national energy system has been described in Chapter 2 of Finland's Seventh National Communication under the United Nations Framework Convention on Climate Change[6].

After submitting the draft National Energy and Climate Plan in December 2018, parliamentary elections were held in Finland in spring 2019 and the new government of Prime Minister Antti Rinne took office on 6 June 2019. One of the themes in the Programme of Antti Rinne's Government is "Carbon neutral Finland that protects biodiversity". In addition, objectives and measures addressing climate change are included under several other strategic themes.

This strategic theme on carbon neutrality has i.a. the following objectives:
1) Finland will achieve carbon neutrality by 2035
2) Finland aims to be the world's first fossil-free welfare society
3) Finland will strengthen carbon sinks and stocks in the short and long term.

In addition, the Government Programme states i.a. that electricity and heat production in Finland must be made nearly emissions-free by the end of the 2030s while also taking into account the perspectives of security of supply.

The policy measures related to energy and climate objectives of Antti Rinne's Government Programme are going to be prepared, decided and implemented during the current government term 2019-2023. Given the timeline set for submission of the final NECP, it has not been possible to define

[6] http://unfccc.int/files/national_reports/annex_i_natcom/submitted_natcom/application/pdf/952371_finland-nc7-1-fi_nc7_final.pdf

the policies and measures in line with the new objectives set in the Government Programme. Therefore, the following reflects the existing, previously decided, targets and policy measures.

This NECP is based on the Government reports on the National Energy and Climate Strategy for 2030 (VNS 7/2016 vp) and the Medium-term Climate Change Policy Plan for 2030 (VNS 7/2017 vp) submitted to the Parliament.

Table 1. Summary of the main targets of the National Energy and Climate Plan.

Target	Targeted year	Year of comparison
Reduce the greenhouse gas emissions in the effort sharing sector by 39 %	2030	2005
Total emissions in the LULUCF sector not to exceed the calculated sinks	Period 2021–2025 Period 2026–2030	accounted according to LULUCF regulation
Renewable energy share of final energy consumption at least 51 %	2030	
In road transport the renewable energy share of final energy consumption 30 %	2030	
Energy efficiency target: final energy consumption not more than 290 TWh (corresponds to approximately 405 TWh primary energy consumption)	2030	

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

The existing energy and climate policy measures and their effects have been listed in the reporting Finland has submitted to the European Commission in compliance with Articles 13 and 14 of the Monitoring Mechanism Regulation (EU) No 525/2013[7] and Article 10 of LULUCF decision (EU)

[7] http://cdr.eionet.europa.eu/fi/eu/mmr/art04-13-14_lcds_pams_projections/pams/envwmaa2q/ and REPORTING ON POLICIES AND MEASURES UNDER ARTICLE 13 AND ON PROJECTIONS UNDER ARTICLE 14 OF REGULATION (EU) No 525/2013 http://cdr.eionet.europa.eu/fi/eu/mmr/art04-13-14_lcds_pams_projections/pams/envwmaa2q/PAMs_Finland_Report_for_PAMs_and_Projections_2017.pdf

No 529/2013[8]. In addition, the same matters have been reported in Finland's Seventh National Communication under the United Nations Framework Convention on Climate Change[6]. An overview of the most important policy measures is presented in Table 2.

[8] https://mmm.fi/documents/1410837/4045459/update-18-1-2017-on-lulucf-actions_finland_final.pdf/dcad8afd-817f-4524-b75a-81393ab4f939/update-18-1-2017-on-lulucf-actions_finland_final.pdf.pdf

*Table 2. Overview of the existing energy and climate policy measures. Measures marked with * are additional measures included in the With Additional Measures projections but not in the With Existing Measures projections.*

Energy supply	**Industry**	**Transport**	**Residential and services**	**Waste**	**Agriculture**
Energy and carbon dioxide taxes	Energy and carbon dioxide taxes	Energy and carbon dioxide taxes	Energy and carbon dioxide taxes	Waste tax	Energy and carbon dioxide taxes
Energy Efficiency Agreements	Energy Audit Programme	Quota obligation for the use of biofuels in the transport sector, enhanced measures*	Consumer energy advice	Regulation on packaging, waste management	Energy Efficiency Agreement for Agriculture and other energy efficiency initiatives
Promoting wind power	Energy Efficiency Agreements	Promoting biogas in road transportation	Ecodesign and energy labelling	Landfill regulation limiting deposit of organic waste	Rural Development Programme for Mainland Finland
Promoting forest chips and other wood based fuels	Implementation and improved enforcement of F-gas regulations	Improving the energy-efficiency of vehicles, enhanced measures*	Information dissemination and campaigns on energy efficiency		Climate Programme for Finnish Agriculture
Promoting biogas in electricity and heat production	Public procurement criteria, information measures etc concerning F-gases *	Improving the energy-efficiency of transport system, enhanced measures *	Building regulation		Activities on organic soils *
Promoting solar power	Quota obligation for the use of bioliquids in machinery *		Energy certificates for buildings		Quota obligation for the use of bioliquids in machinery *
A premium system for renewable electricity*			Quota obligation for the use of bioliquids in space heating *		Promoting the production and use of biogas *
Phasing out coal in energy production *					

Finland has in 2019 adopted legislation (*Laki hiilen energiakäytön kieltämisestä* (416/2019)) to phase out the use of coal in energy production by 2029. The current Government Programme also foresees i.a. a stepwise phase-out of the use of oil for heating by the beginning of the 2030s and reducing the use of peat in energy production into half by 2030.

1.2.3 Key issues of cross-border relevance

Directive on the deployment of alternative fuels infrastructure

Directive 2014/94/EU of the European Parliament and of the Council on the deployment of alternative fuels infrastructure (the AFI Directive) entered into force in October 2014. The aim of this Directive was to minimise the oil dependence of transport and reduce the environmental effects of transport in the entire EU. Under the Directive, all Member States had to draft a national policy framework for the development of an alternative transport fuel market and deployment of the related infrastructure by November 2016. The national policy frameworks had to contain targets for alternative transport fuels and their distribution infrastructure for 2020 and 2030 as well as the measures necessary to ensure that these targets are reached.

The AFI Directive also has significance across the borders because measures are required to enable vehicles using alternative fuels such as electricity, natural gas or biogas to move across the Union.

Nordic cooperation

Finland is a member of the Nordic Council of Ministers and under this organisation, there are substance working groups concerning electricity markets, energy efficiency, renewable energy and climate and air. There is also cooperation in the field on eco-design and energy labelling.

Nordic cooperation on electricity market

Norway, Sweden, Finland and Denmark have long shared a single electricity market and serve as a prime example of how to harmonise and liberalise electricity markets across national borders. The design of the common Nordic electricity market aims at promoting competition on equal terms and at a socio economic efficient use of production and transmission resources, and is also key in integrating large shares of renewable energy in the system. The market price is set at the common power exchange, where the supply meets the demand at the day-ahead and the intra-day markets.

The Electricity Market Group (EMG) is a working group under the Nordic Council of Ministers, which commissions analyses and provides advice on electricity market issues to the Nordic Energy Ministers. The group consists of experts from the Ministries and energy authorities in the four Nordic countries participating in the common Nordic electricity market. Baltic countries are regularly invited to the meetings.

The goal of Nordic electricity market cooperation is to advance a harmonised and integrated Nordic electricity market where demand and production structures, flexibility measures and other relevant issues complement each other within the Nordic market area as a whole, in addition to promoting synchronised rules for all market participants, both companies and consumers. The focus is on:

- Function of the regional electrical system with particular emphasis on integration of renewable power generation, security of supply, demand flexibility and smart networks
- Network investment and network planning
- Representing Nordic interests in an EU context
- A more harmonised retail market
- Taking initiative to involving the Baltic countries in electricity market development, when appropriate
- Establishing relevant collaboration with market stakeholders
- Following trends and possible research, development and innovation (RDI) needs within the Nordic electricity market

In addition to the official cooperation among the ministries, the Nordic Transmission System Operators, the regulators, producers and other market stakeholders also have a close cooperation across country boarders, including the Baltic countries. As the electricity system is changing with influxes of large shares of renewables, the subsequent needs for system solutions on both supply and demand side, and the new European legislation, the Nordic energy ministers have decided to introduce an annual Nordic Electricity Market Forum[9] - which was held in Stockholm for the first time in autumn 2018 and the second time in Olso in November 2019. The intention is to advance communication and collaboration between different electricity market stakeholders, in addition to establishing common visions and road maps for future development of the Nordic electricity market, see Chapter 3.4.3.

The activities of the Electricity Market Group contribute to Nordic benefits through initiating Nordic collaboration on initiatives that would otherwise be undertaken at national level, but where significant positive effects are achieved through joint Nordic solutions.

As such, the Nordic electricity market cooperation is advancing the market further into an efficient and well-functioning one, high levels of security of supply, equal conditions of competition, environmental friendliness, transparency and incentives for price elasticity, in accordance with the decisions of the Nordic Council of Ministers.

Nordic cooperation on energy efficiency

The Nordic cooperation on energy efficiency is conducted in the networking group on energy efficiency (NGEE). The group consists of experts from the Ministries and energy authorities in the Nordic countries.

The main objectives of the cooperation in this area are to promote Nordic cooperation on energy efficiency initiatives and to implement EU/EEA directives and programmes.

[9] Nordic Electricity Market Forum https://nordicelforum.org/

The cooperation is conducted in a network cooperation where specific topics are discussed on an ad hoc basis within the group especially in relation to the 'Clean energy for all' package. In addition to this the group is facilitating analysis and seminars on specific issues.

Nordic cooperation on renewable energy

The Nordic countries make considerable efforts to develop and increase the use of renewable energy, aiming to diversify the energy system and to be less dependent on import of energy sources such as fossil fuels, and to reduce the CO_2 emissions. The Working Group for Renewable Energy (AGFE) – consisting of experts from the Ministries and energy authorities in the five Nordic countries – supports the Nordic countries' policy and development work in the renewable energy sector by exchanging information and enhancing the collaboration between Nordic countries. In addition, AGFE disseminates information about relevant projects commissioned by AGFE tackling different issues on renewable energy in the Nordics. Most recently AGFE has looked at the emerging trend of distributed electricity production and self-consumption.

AGFE aims to strengthen Nordic added value through projects that would usually occur nationally, but where positive effects are created through a Nordic joint effort. The group works to develop and manifest Nordic collaboration, and thereby increase Nordic competencies and competitiveness. AGFE also strives to develop Nordic perspectives on emerging policies and regulations within EU. Some of the AGFE's recent activities are listed below:

- In 2018, AGFE initiated a study on Distributed energy production and self-consumption in the Nordics. The aim of the study is to review the current situation and future prospect of decentralized energy production and the transition where consumers such as households are becoming also producers. The regulations and policies in the Nordic countries concerning distributed electricity production and self-consumption will be discussed, and barriers to a sound development will be identified. This study will provide useful information for policy makers and other stakeholders and will contribute to fulfil coming requirements according to the revised EU directive on renewable energy (RED II).
- AGFE works for enhanced Nordic cooperation on implementing the current EU renewable energy directive (RED I) to 2020 as well as preparing for the revised directive (RED II) that will take effect from 2020-2021.
- As a set of new forest biomass sustainability criteria were proposed in RED II, AGFE in 2017 commissioned a study on the emerging Bioenergy Sustainability Policy and its possible impacts entitled; "A Nordic analysis of the proposed EU policy for bioenergy sustainability". This work contributed to the process of revising the Directive and increasing the knowledge of its impact on the bioenergy sector in the Nordic region.
- In 2016 AGFE commissioned a study; "New Gameplan – RES Support in the Nordics" with the purpose to investigate the impact of the revised State Aid Guidelines on current Nordic support schemes designed to promote renewable energy. The study contributed to the discussions regarding the design of Nordic support schemes.

Nordic cooperation on ecodesign and energy labelling

The Nordic cooperation on market surveillance and policy work on ecodesign and energy labelling is conducted in the Nordsyn working group. It is a cooperation among Nordic market surveillance authorities (MSAs) and policy agencies.

Ecodesign and energy labelling can save 10 % of energy use in the EU in 2020 which is a great contribution to the EU 2020 and 2030 goals. Effective regulations and efficient market surveillance is essential if this is to be realized and Nordsyn aim to improve the efficiency of Nordic market surveillance and policy input. Nordic authorities, producers and consumers benefit from Nordsyn while green growth and energy efficiency are supported. The results and structure of Nordsyn can be used to improve market surveillance also in other EU countries.

Some of Nordsyn's projects and results are described below.

Nordsyn sub projects:
In 2018 Nordsyn focused on

1) the strategic Nordic product heat pumps with two studies on how the products work in reality in Nordic climate;
2) an information campaign for the new product database and coming revised energy labelling;
3) a Nordcrawl2 project in which the previous developed Nordcrawl web crawling tool is applied to give valuable input to market surveillance and policy work.

Earlier projects: Barriers for market surveillance cooperation (2012 and 2013-2015), Working methods (2013-2015), Information material (2013), Strategic Nordic products – Heat pumps (2014), Challenges for market surveillance – difficult products (2015-2017), Effects of market surveillance (2013-2014), Cooperation with customs (2013-2014), How small counties work with ecodesign and energy labelling (2013-2014), Energy labelling online information film (2016), Heat pump list prospect (2016), Strategic Nordic products - Windows (2017-2018), Heat pump reality studies phase 1 and 2 (2017-2018), Recycler interview study (2017-2018).

Results from Nordsyn:
The most appreciated result of Nordsyn is that the Nordic countries now regularly share questions, commission answers, discussions, test results and plans on email and skype. Even though the core of Nordsyn is continuous contact and exchange of market surveillance results, Nordsyn has also given the possibility to perform a number of projects that improve Nordic market surveillance and knowledge of legislation among producers, retailers and consumers. The Nordsyn steering group communicate on monthly skype meetings, emails and yearly physical meetings/workshops.

Effects-project: this study showed a prevented energy loss worth EUR 28 million for a market surveillance cost of around EUR 2 million in the Nordic countries, and an overall rate of 6.3 % non-

compliance. These results show that the market surveillance is cost efficient, especially when countries cooperate.

Strategic Nordic products Heat pumps-project: the project resulted in an overview of legislation, national work and recommendations. Some of these recommendations are further studied in the 2017 and 2018 heat pump projects.

Challenges-project: the project contains a number of product studies on how to perform market surveillance on complex products (ventilation units, transformers, professional refrigeration etc).

Nordic energy research cooperation

Nordic Energy Research (NER) is a platform for cooperative energy research and analysis in the Nordic region under the auspices of Nordic Council of Ministers. It funds research of joint Nordic interest that supports these ambitions by expanding knowledge on sustainable energy and contributing to the development of new, competitive energy solutions.

The governance structure of NER is closely connected to both the national political systems of the five Nordic countries as well as the intergovernmental Nordic system. Its board and other committees and project steering groups consist not only of representatives from national funding agencies, but also from national energy authorities, ministries and the Nordic Council of Ministers' secretariat. This creates a constant interaction between research strategies, results and key technical issues on the political agenda.

According to its strategy for the period 2018-2021 the vision of NER is to create the knowledge basis for the Nordic countries to become global leaders in smart energy. The mission is progressed through Nordic collaboration.

NER manages a number of projects and facilitates in various fields, ranging from compilation of results from ongoing studies, to technical research. As an illustration, in 2015 NER selected three ambitious projects to serve as "Flagships" for Nordic research cooperation in energy for the coming 4-year period. These Flagships are covering such diverse areas as flexible electricity market design to allow for more wind and solar energy; modelling how to achieve an energy-efficient and low carbon transport system; and enabling negative CO2-emissions through new combustion-related technologies.

With regard to the regional aspects linked to the national energy and climate plans, two projects are of particular significance:

- Nordic Energy Technology Perspectives (NETP) is a Nordic edition of the International Energy Agency's (IEA) global Energy Technology Perspectives. The report has been published twice (2013 and 2016) and offers a detailed scenario-based regional analysis of how the Nordic countries can achieve a near carbon-neutral energy system.

- After completing two editions of Nordic Energy Technology Perspectives (NETP), a tracking report has been made to illustrate how the Nordics progress towards a carbon neutral society. The result is Tracking Nordic Clean Energy Progress 201910; a brief, illustrative report that tracks the Nordic progress towards a carbon neutral society by highlighting the larger trends and by diving into cases where Nordic solutions could have a global impact. This study found that for the period 2013 to 2016 the Nordic countries are on track to meet the carbon neutral pathway, but it's likely that additional measures will be necessary to continue this trend.
- The Nordic Electric Vehicle Outlook 2018 (NEVO 2018) has been developed in cooperation between the International Energy Agency (IEA) and Nordic Energy Research. It aims to identify and discuss recent developments of electric mobility in the five Nordic countries: Denmark, Finland, Iceland, Norway and Sweden. The report assesses the current status of the electric car market, the deployment of charging infrastructure, and the integration with the electricity grid at country level. It analyses the role of European, national, and local policy frameworks in supporting these developments. The analysis also provides insights on consumer behaviour and includes an outlook on the progress of electric mobility in the Nordic region up to 2030.

Nordic climate cooperation

The Nordic cooperation on climate focuses on projects related to reduce greenhouse gas emissions and reaching climate neutrality in the Nordic countries. There is a Nordic working group for Climate and Air that contributes to the implementation of the Programme for Nordic Co-operation on the Environment and Climate 2019-2024. The mandate of the group is to help reduce greenhouse gas emissions and air pollution and to seek synergies between initiatives related to climate and air.

1.2.4 Administrative structure of implementing national energy and climate policies

The Climate Change Act (609/2015) lays down the general framework for the planning of climate change policy in Finland and the monitoring of its implementation. It aims to enhance and coordinate the activities of state authorities in planning measures aimed at mitigation of climate change and adaptation to it, and at the monitoring of the implementation of these measures. Furthermore, the Act aims to strengthen the opportunities of Parliament and the public to participate in and affect the planning of climate change policy in Finland.

Regarding the coordination and compilation of climate change policy plans, the Ministry of Economic Affairs and Employment is responsible for the long-term plan for climate change policy. The Ministry of Agriculture and Forestry is responsible for the national adaptation plan for climate change, and the Ministry of the Environment is responsible for the medium-term plan for climate change policy as well as for compiling the annual climate change report.

[10] https://www.nordicenergy.org/project/tncep/

The Government of Prime Minister Antti Rinne established a ministerial working group for coordinating climate and energy policy under the leadership of Minister of the Environment and Climate Change Krista Mikkonen. The ministerial working group has representatives from each party forming the Government.

The operation of the Ministerial working group on energy and climate policy issues is based on the government resolution concerning the organisation of official climate policy measures in the Government[11]. The resolution includes policy outlines for arranging the tasks and cooperation of the ministries in the preparation and implementation of domestic climate policy. A working group consisting of representatives of different ministries functions as a network for public officials and helps in the coordination and preparation of the tasks.

The Ministry of Economic Affairs and Employment is responsible for the general coordination of the work on the Energy and Climate Strategy. The Ministry convenes a network of senior officials from the Ministry of the Environment, the Ministry of Transport and Communications, the Ministry of Agriculture and Forestry, the Ministry of Finance, the Ministry for Foreign Affairs and the Prime Minister's Office for consulting on the preparation of energy policy. Each sectoral ministry is responsible for the preparation and implementation of the policy measures related to their field as follows:

- Ministry of Economic Affairs and Employment: use of energy by industry, services and households; industrial processes; production and consumption of energy; renewable energy; (including the share of bio components in transport fuels); supply of electricity and district heating
- Ministry of the Environment: F-gas emission projections, waste management sector, building volume, energy consumption of buildings and their sources of heating, energy consumption of machinery and their emissions
- Ministry of Transport and Communications: energy consumption and emissions of road, waterborne, air and rail traffic
- Ministry of Agriculture and Forestry: non-energy-related emissions in agriculture; use of energy in agriculture; biomass amounts; forestry; the land use, land-use change and forestry sector (LULUCF sector)
- Ministry of Finance: energy taxes, short-term economic development.

The preparation and implementation of energy and climate policy in central government is described in more detail as part of the reporting in compliance with Article 13(1) of the Monitoring Mechanism Regulation (MMR)[7].

Figure 1 presents a diagram of the administrative framework of drafting energy and climate policy (situation in 2019).

[11] https://www.edilex.fi/valtioneuvoston_viikko/2003_05liite.html

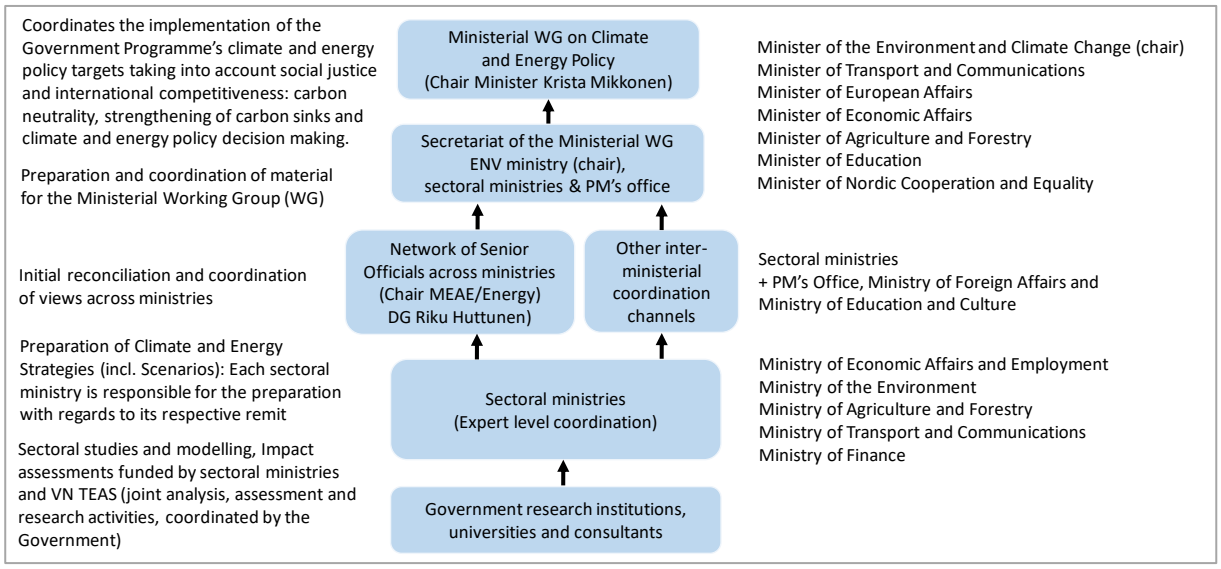


Figure 1. Administrative framework of drafting energy and climate policy.

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

1.3.1 Involvement of the national parliament

The Government reports forming the basis of this National Energy and Climate Strategy for 2030 (VNS 7/2016 vp) and the Medium-term Climate Change Policy Plan for 2030 (VNS 7/2017 vp) have been submitted to Parliament. Parliament has discussed both reports and issued related non-binding resolutions concerning them.

1.3.2 Involvement of local and regional authorities

The Association of Finnish Local and Regional Authorities has represented local and regional authorities in the consultations. Consultations are discussed in more detail in Chapter 1.3.3.

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

The targets and policy measures of this National Energy and Climate Plan have been in public consultation already when preparing the National Energy and Climate Strategy and the Medium-term Climate Change Policy Plan. In the consultations and events organised for interest groups, all relevant parties have been consulted, including other authorities, organisations representing different interest groups, non-governmental organisations, labour market parties and individual citizens. The consultations and events are listed below.

Energy and climate strategy

The following expert seminars on different topics were organised in connection with the preparation of the Energy and Climate Strategy:

- 25 November 2015: Seminar launching the strategy work.
- 27 January 2016: Expert event on the electricity market.
- 2 February 2016: Seminar on the alternatives in the implementation of the EU's policy outlines for 2030 and their effects on the Finnish electricity and heating markets and on the realisation of the objectives of the Government Programme.
- 17 February 2016: Seminar on the reform of the subsidy policy for bioenergy.
- 23 March 2016: Seminar on the supply of forest biomass and its use in the forest industry, as raw material of advanced biofuels and as fuel in energy production.
- 4 May 2016: Workshop on energy efficiency.
- 15 June 2016: Publication of the With Existing Measures (WEM) projection.
- 9 September 2016: Seminar on the increase in decentralised energy production and changing operating models in the energy markets.
- 7 October 2016: Nordic viewpoints - the role of bioenergy as part of the EU's Energy Union, a seminar.

Citizen survey

The WEM projection for the Energy and Climate Strategy was published on 15 June 2016. On the same daya website energiajailmasto.fi, a joint platform coordinated by the Ministry of Economic Affairs and Employment containing the survey, was opened. The website contributed to enabling citizens to participate in the preparation of the strategy.

On the website, citizens could learn about the possible new policy measures listed by government officials and take a stand on them. They could also propose measures of their own. The online debate for citizens was open for two months (15 June-16 August 2016). The website was viewed almost 3,500 times and a total of 466 comments and proposals were received.

Visitors to the website could also evaluate the different proposals by awarding them plusses and minuses. The three most popular proposals were:

- Current tax-exemption from electricity tax granted to small-scale production of electricity for own use will continue. (+179)
- Geothermal energy will be promoted. Investments in new energy technology may compete for aids granted to demonstration projects (+165)
- Promotion of decentralised energy production (electricity, heat, transport, storage) through sustainable and cost-effective measures. (+155).

The proposals that citizens most opposed to are below. Generally, significantly fewer opposing votes were given than votes in favour. On the other hand, it is worth noting that the proposals which received the highest number of minuses also received a relatively high level of support.

- The use of coal will be forbidden. (-78, +64)
- The creation of the preconditions for the joint Nordic retail market will be continued and equal treatment of electricity sellers in the retail market will be promoted by switching to a single invoice model for all sellers of electricity. (-76, +81)
- Finland will prepare to utilise its wind power potential extensively. (-70, +106)

The background report on the Energy and Climate Strategy[12] lists the policy measure proposals included in the online survey and the opinions expressed in the survey.

Panel discussion on strategy priorities at SuomiAreena in Pori

The WEM projection published in June was also used as the basis of the panel discussion the Ministry of Economic Affairs and Employment held at SuomiAreena organised by the television channel MTV and the City of Pori on 14 July 2016.

In the panel discussion, Minister of Economic Affairs Olli Rehn debated on the production and consumption of energy, self-sufficiency, decarbonisation, nuclear power and renewable energy with five experts of the energy sector.

The large audience present at the discussion had the opportunity to vote for the winner for each of the five discussions. The audience following the discussion online on MTV's Katsomo and on Suomi-AreenaTV could participate in the voting by sending a text message or through a smartphone application. It was also possible to watch a recording of the panel discussion on MTV Katsomo.

Medium-term Climate Change Policy Plan 2030

When the Medium-term Climate Change Policy Plan was under preparation, several consultations and workshops were organised for the interest groups. In the workshops, measures proposed by interest groups were explored, existing best practices were sought for and the acceptability of the planned measures was examined. Two open seminars were organised for the interest groups, one at the beginning of the planning in February 2016 and the other in November 2016 when the decisions concerning the range of measures had mostly been made. In addition, smaller events were organised towards the end of the summer and at the beginning of autumn 2016 for interest groups in transport and agriculture and for actors in municipalities and regions. Internal workshops were also organised in administration to obtain comments from experts on the plans made in different sectors. In February 2017, an open workshop on the gender effects of the climate change plan was organised and experts of sectors involved in the plan and experts of gender equality work were invited to participate. In addition, during summer 2016, it was possible for all citizens to comment on the measures planned by government officials on the above mentioned energiajailmasto.fi website.

[12] https://tem.fi/documents/1410877/3570111/Energia-+ja+ilmastostrategian+TAUSTARAPORTTI_1.2.+2017.pdf/d745fe78-02ad-49ab-8fb7-7251107981f7/Energia-+ja+ilmastostrategian+TAUSTARAPORTTI_1.2.+2017.pdf.pdf

It was possible to comment on the entire climate plan during the circulation for comments in May 2017. A total of 84 comments were issued during the circulation, most of which were comments on the measures in the transport sector. Other measures concerning different sectors and municipal and regional climate measures were paid attention to in the comments. All comments are public and available to read on the lausuntopalvelu.fi website. A public summary drawn up of the comments is also available on the website of the climate plan[13]. The comments were taken into account when the plan was finalised.

Other energy and climate-related events

After the drafting of the Energy and Climate Strategy and the Medium-term Climate Change Policy Plan, expert and consultation events related to the implementation of the strategy and the plan have also been organised. In addition, those involved in the drafting have participated in the events organised by other parties and have utilised the knowledge gained in the drafting of the Integrated National Energy and Climate Plan. Such events are:

- "Kuinka suuret ovat metsien ja puunkäytön ilmastovaikutukset", an event organised by the Natural Resources Institute Finland on the climate effects of forests and the use of wood, 7 March 2018.
- Consultation of interest groups related to the prohibition of the use of coal, 26 March 2018.
- Consultation of interest groups related to the generation of electricity from forest chips, 28 March 2018.
- Public debate organised by Minister of Environment, Energy and Housing Kimmo Tiilikainen. The debate also included energy issues, 23 April 2018.
- Talanoa dialogue series 2018: Päästöjään reilusti vähentävä Suomi ('Finland reduces its emissions significantly'),
    - Finnish society in 2050. Talanoa dialogue, 25 April 2018.
    - Coordination of Finland's climate choices. Talanoa dialogue, 15 June 2018.
    - Tuumasta toimeen ('Getting down to work'). Talanoa dialogue, 7 November 2018.
    - Summary of the dialogue series and a dialogue with a large number of representatives from interest groups, 26 November 2018.
- Conference on the electricity market in Norway, 22 November 2017.
- Participation in the Nordic-Baltic Energy Conference 2018 organised by the Nordic Council of Ministers in Tallinn, 27-28 September 2018.
- How to halve citizens' carbon footprint by 2030? - a workshop for interest groups in the Ministry of the Environment, 28 September 2018.

TÄHÄN PÄIVITYS kansallisesta kuulemisesta ja sen tuloksista (joulukuussa 2019)

[13] http://www.ym.fi/download/noname/%7BC4791B40-5F32-47C8-8F09-188F3D41576F%7D/129157

1.3.4 Consultations of other Member States

Finland's draft Integrated National Energy and Climate Plan was sent 9 November 2018 for consultation to Estonia, Sweden, Denmark and Norway. With Estonia, a skype meeting concerning the NECP was organised on 30 November 2018. Estonia sent written comments for Finland's draft NECP. Sweden informed that they do not have any comments on the document and from Denmark and Norway; we did not receive any response.

In the skype meeting and in their written comments Estonia explained that the policies and measures planned in Finland may have several interactions with the developments in Estonia and lifted up the following two concerns:

1) According to the information provided by Eesti Energia AS, many oil shale generation capacities will be shut down in Estonia in the coming years and this decreases significantly the dispatchable generation capacities in Estonia. The regional electricity market remains in deficit while the role of intermittent renewable electricity generation increases in Estonia. This is why the concerns on how well Estonia can ensure the generation adequacy in the power system are rising in Estonia.

   Estonia also finds it essential to develop the electricity market services on a regional scale. Increasing the level of flexibility is vital also for Estonia and the other Baltic states.

   In this situation, Estonia would like to stress the need for a closer regional cooperation to find out common solutions for the generation adequacy and the electricity market integration - issues that Estonia might face in the coming decades.

   For these concerns, Finland will conduct a risk assessment study in the future. According to the Finland's Energy and Climate Strategy for 2030, a target for the security of supply in electricity associated with the adequacy of electric power will be defined. This will happen as soon as the ENTSO-E publishes its method to define the sufficient adequacy level. As a part of the risk assessment study, Finland will also evaluate the regional electricity generation adequacy and this includes Estonia as well.

   In addition, in the Nordic fora, the regional adequacy of electricity has been in discussions. Finland finds it important that in the discussions of the adequacy also Estonia and other Baltic countries are involved.

2) Decarbonisation of the transport sector plays a significant role in achieving the long-term climate and energy targets. Finland plans to increase the number of electric and gas vehicles, Estonia puts more focus on vehicles using bio-methane. Estonia finds it important to ensure a more harmonised development of the charging and refuelling infrastructure to enable the usage of electric and gas vehicles on both sides of the Gulf of Finland.

TÄHÄN PÄIVITYS naapurimaiden kuulemisesta ja sen tuloksista (joulukuussa 2019).

1.3.5 Iterative process with the Commission

The Commission published its assessment of Member States' draft plans to implement the EU's Energy Union objectives 18 June 2019. After that, there has been several bilateral meetings between the Commission and Finland.

In 11th September 2019, a bilateral meeting on the energy efficiency in the NECP took place in Brussels. This meeting was held with Ms. Claudia Canevari, acting Head of Unit for Energy Efficiency, DG ENER C3. In addition, other Commission's experts attended the meeting. The discussions were about Finland's national energy efficiency target for 2030 and its impact on Governance Article 6 (ex Article 6 EE), which a Member State may take into account when setting its national target. Finland also informed the Commission about the possible new actions that will be presented in the National Energy Efficiency Task Force (the report was published on 6 October 2019) and their impact on strengthening Finland's national target and increasing Finland's contribution to the EU common goal.

In 7th October 2019, a bilateral meeting on the EPBD and issues related to future implementation of the amendment of the EPBD took place in Finland in Helsinki. From the Commission Policy Officer Mr. Dimitrios Athanasioun was present. The discussions were about the implementation of the Energy Performance of Buildings Directive and issues related to its future implementation.

Mr. Ville Niemi from the Commission, DG Energy has visited Finland in 6th of September to attend the meeting of several ministries responsible for drafting the NECP. Around 15 officials were present in the meeting. In this meeting, we described the current preparation state of the Finnish NECP and discussed the recommendations that Finland received from the Commission in June and the best ways forward in finalising Finland's NECP.

In addition to these bilateral meetings, Finland has attended to the following meetings to contribute the NECP preparation:

- Meetings of Commission's technical working group for the NECPs on 3rd July and 17th September in Brussels.
- Workshop on renewables and energy efficiency on Wednesday 11th September 2019 in Brussels.
- A joint meeting with members of the NECPs Technical Working Group, the SET Plan Steering Group, and the Innovation Fund Expert Group on 16th September in Brussel.
- A Nordic-Baltic Energy Conference 2019: Good governance, policy design and solutions towards 2030. This Conference was organised in Estonia in 23-24 October 2019, and a whole session of the conference was dedicated to the questions on updating the NECP's of Nordic and Baltic States and the need for regional coordination. Finland did attend this Conference and presented its NECP preparation process. European Commission was also present in the Conference.

1.4 Regional cooperation in preparing the plan

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

In 2015, the Nordic Council of Ministers for Business, Energy & Regional Policy (the Nordic Council of Ministers for Sustainable Growth as from the beginning of 2018) decided to carry out a strategic study on Nordic energy cooperation and the possibilities to develop it over the following 5 to 10 years. The study was conducted by Jorma Ollila and the final report was published in 2017. In accordance with the report's proposal concerning the operational implementation of Nordic energy cooperation, a meeting of public officials coordinating the preparation of the national plans was organised at the initiative of Sweden on 8 May 2018 in order to exchange information and to share best practices. From then on, this ad-hog group has discussed and shared best practises related to the preparation of the NECPs. A seminar on the modelling of estimated developments related to Energy and Climate Strategies was organised in Oslo on 10 and 11 October 2018.

A meeting of Nordic senior officials was organised in Stockholm on 10 October 2018 and the national plans were also discussed in the meeting. The NECPs have been in the agenda of the high-level meeting of the Nordic Council of Ministers and of Nordic Energy Seminar - The energy system of the future, both on 1st of October 2019.

1.4.2 Explanation of how regional cooperation is considered in the plan

Regional cooperation is important in the Nordic and Baltic context. The well-functioning Nordic-Baltic electricity market is expected to continue and even expand in the future. The future common gas market between Finland and Baltic countries will increase regional cooperation in that field.

The regional aspect has been taken into consideration in the modelling of the electricity market and other energy related assessments.

More text on the regional cooperation is presented in Chapter 0.

2 NATIONAL OBJECTIVES AND TARGETS

2.1 Dimension decarbonisation

2.1.1 GHG emissions and removals

i. The elements set out in point (a)(1) of Article 4

ii. 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

According to the Effort Sharing Regulation (ESR), Finland should by 2030 reduce its greenhouse gas emissions in the effort sharing sector by 39 % compared with 2005 levels. This corresponds to a permitted amount of a 20.6 Mt CO_2 equivalent in 2030. However, if flexibility measures are used, the emissions may be higher. The binding target imposed by the EU will be achieved following a linear trajectory established for cutting emissions over the period 2021–2030. The need to reduce emissions will increase towards the end of the period. The starting point of the emission reduction trajectory is determined on the basis of the average emissions between 2016 and 2018 and the calculation of the trajectory will begin from June 2019. Final certainty about the starting point will be obtained in 2020. Based on the current estimation, the starting point is at the level of about 30.2 Mt CO_2 equivalent. The annual emissions allocations in tonnes will be determined in a delegated act issued later.

Finland will take advantage of the 2 % one-off possibility to cancel ETS allowances towards the target in the effort sharing sector. The maximum annual flexibility set for Finland is 0.7 Mt CO_2 equivalent. The LULUCF flexibility mechanism included in the Commission's proposal has not been taken into account because of the uncertainty related to it. Finland will include the reporting information on utilizing LULUCF flexibility as soon as it becomes available. Finland may use the other flexibility mechanisms such as transfers between years and emissions trading between the Member States if necessary.

Under the regulation concerning the land use, land-use change and forestry (LULUCF) sector, a Member State must ensure over the periods 2021–2025 and 2026–2030 that the accounted total emissions in the sector will not exceed the accounted sinks. The accounting is applied to the following land use categories: deforestation, afforestation, managed forest land, managed cropland and grasslands. By 15 March 2027 and by 15 March 2032 Finland will submit the LULUCF compliance report including the balance of total accounted emissions and removals for the period from 2021 to 2025 and from 2026 to 2030 and where applicable, details on the intention to use or on the use of the

flexibilities and related amounts. The Commission will make an assessment of the inclusion of wetlands in the LULUCF sector for the period 2026–2030. Over the period 2021–2030, Finland will be able to use the country-specific flexibility of 10 Mt CO2 to achieve the target.

For the managed forest land category, Member States shall calculate a Forest Reference Level (FRL), against which the net removals or accounted emissions from managed forest land are accounted. The FRL consists from a projection of the managed forest land sink assuming that the forest management practices of the reference period (2000–2009) are continued on the compliance period (2021-2025). Based on the feedback from the LULUCF Expert Group and the recommendations of the Commission (COMMISSION STAFF WORKING DOCUMENT SWD(2019) 213 final) Finland recalculated its FRL and revised its National Forestry Accounting Plan (NFAP) submission, paying particular attention to the consistency of the model estimate with the data in GHG inventory. The FRL for managed forest land for the period 2021–2025, as detailed in the revised NFAP submission, is [xx Mton CO2eq without harvested wood products (HWP) and xx Mton CO2eq with HWP, tämä osa päivitetään ennen lopullista versiota].

The Natural Resources Institute Finland (Luke) has updated the long-term scenarios and greenhouse gas projections for the LULUCF sector based on new data on forest growth and revised growth model assumptions. According to the revised WEM estimate, the LULUCF net sink would be -20.1 Mton CO2eq in 2025. Retaining the LULUCF net sink on this level could enable reaching carbon neutrality by 2035.

Other national objectives and goals aimed at reducing greenhouse gas emissions include the objectives outlined in the National Energy and Climate Strategy to prohibit the use of coal in energy production by 2030 and to halve the domestic consumption of mineral oil (petrol, diesel oil, light and heavy fuel oils and aviation fuels) from 2005 levels by 2030. On 1 April 2019 an Act banning the use of coal for energy generation in 2029 was adopted. The prohibition will apply as of 1 May 2029 and incentives for energy utilities to implement the change already by 2025 are being prepared. Halving the use of oil, in turn, will support the reduction of emissions in the effort sharing sector.

The objectives and measures for promoting the use of transport biofuels and other renewable energy sources in transport have been recorded to the National Energy and Climate Strategy, to the Medium-term Climate Change Policy Plan and to Finland's plan compliant with the Directive on the deployment of alternative fuels infrastructure (2014/94/EU). The aim is to increase the share of transport biofuels in all transport fuels consumed in Finland to 30 % by 2030. Another objective is to bring the number or electricity-powered cars in Finland to at least 250,000 and the number of gas-powered cars to 50,000 by 2030.

Figure 2 shows Finland’s greenhouse gas emissions in 2000–2017 and the projected development in the With Additional Measures (WAM) projection until 2040. The WAM projection includes a set of cost-efficient additional energy and climate policy measures that are included in the Energy and Climate Strategy and in the Medium-term Climate Change Policy Plan in order to attain the targets specified in the 2015 Government Programme and adopted in the EU for 2030. The WAM projection

includes new measures in addition to the existing measures implemented by 1 January 2018. Measures implemented after the 1 January 2018 are WAM measures.

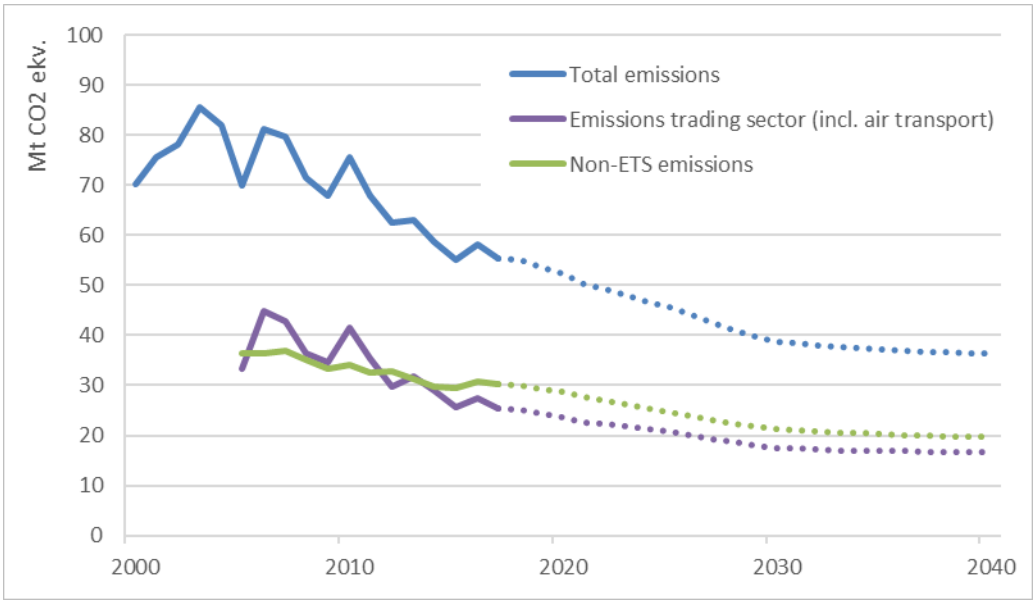


Figure 2. Actual greenhouse gas emissions 2000–2017 and the projected development in the WAM projection until 2040.

Adaptation to climate change

A key tool in preparing for climate change in Finland is the National Climate Change Adaptation Plan[14]. The government resolution on a National Climate Change Adaptation Plan 2022 was adopted in 2014. The objective of this plan is that Finnish society will have the capacity to adapt to changes in the climate and manage the associated risks. The measures introduced by the plan help to mitigate the adverse consequences of climate change, including those to human safety and living conditions, natural environment, livelihoods and functions vital to society. Climate change adaptation will be carried out cost-effectively by making adaptation part of the normal planning and decision-making processes in different sectors. The objective is that the actors will have access to the requisite methods for assessing and controlling climate risks and that society's ability to adapt can be improved, innovative solutions promoted and awareness of climate change adaptation spread by means of research and development, communications and training. The National Climate Change Adaptation Plan is part of the climate change policy planning system complying with the Climate Change Act.

Adaptation to the climate change has been taken into consideration in the energy modelling related to policy preparation. The expected consequences of the climate change is that there will be more rain and the average outdoor temperature will be higher the future. Due to the increasing precipitation, hydro power production increases. In the projections, a hydro power production increase of 5 % in

[14] https://mmm.fi/documents/1410837/5120838/MMM-_193086-v1-Finland_s_National_climate_Change_Adaptation_Plan_2022.pdf/582041ee-3518-4a63-bf60-7133aed95a9c/MMM-_193086-v1-Finland_s_National_climate_Change_Adaptation_Plan_2022.pdf

40 years due to precipitation increase is assumed. One drawback of increased rainfall in the summer time is that it can complicate peat extraction.

Due to the increasing windiness, also wind energy potential is estimated to increase in Finland. There is little information about how climate change will affect solar energy, though some estimates suggest that solar energy may be reduced as a consequence of increased cloudiness.

In relation to bioenergy production, it is essential to examine changes and risks in the availability of bioenergy caused by climate change. In Finland, biomass supply is estimated to increase due to a lengthening growing season and improved potential productivity, hence increasing e.g. the potential for forest biomass both for industry and energy production. On the other hand, climate change is expected to increase the occurrence of prevalence of heavy rain and shortening periods of snow and frost, which affect forest management. As a whole, varying weather conditions pose challenges to forest harvesting. Variable weather conditions may also affect the availability and transport of energy wood. Similarly, weather conditions might have affects, for example, the quality of forest chips used in energy production, i.e. moisture of forest chips. From the point of view of preparedness, the adequacy and availability of solid wood fuels is particularly important in winter, when the demand for heat is greatest.

The average temperature will increase in the future as winters get milder and summers get hotter. It is estimated that the amount of energy needed for heating in winter will decrease more than the increase in energy needed for cooling in summer. The consequence of the temperature rise on the heating need in buildings has been estimated by the Finnish Meteorological Institute and Finnish Environmental Institute [15] and is included in the projections. In total for the whole building stock the net heating energy need decreases in the projections 0,3–0,4 % a year being in the year 2030 3,7 % and in 2040 6,7 % less than in 2020.

In Chapter 3.3 on energy security one measure to adapt to climate change, namely making the electricity distribution network more resilient against the severe weather conditions is described.

2.1.2 Renewable energy

i. The elements set out in point (a)(2) of Article 4

The national renewable energy target set for 2030 in the National Energy and Climate Strategy (2016) is 50 % of the gross final energy consumption. However, according to the Commission recommendation this is slightly below the share of 51 % that results from the formula in Annex II of the Governance Regulation. Based on the Commission's feedback, Finland has assessed the recommendation and the market development in the energy sector. Due to recent good development in the field of

[15] Rakennusten energiankulutuksen perusskenaario Suomessa 2015-2050. Suomen ympäristökeskuksen raportteja 35/2016. Finnish Environmental Institute, 2016. http://hdl.handle.net/10138/166673

renewable energy and especially in wind power, the slightly higher target could be achieved. Therefore, Finland sets a 51 % share for Finland's national contribution to the Union's binding target of 32 % of renewable energy in compliance with the Renewable Energy Directive.

Table 3 shows the indicative minimum levels for intermediate years concerning the renewable energy target until 2030. The indicative development meets the minimum requirement for the national development of renewable energy described in point (a)(2) of Article 4 of the Regulation on the Governance of the Energy Union.

Table 3. The renewable energy targets and minimum levels for the intermediate years [share of gross final consumption of energy].

	2020	**2022**	**2025**	**2027**	**2030**
Finland's EU obligation	38 %				
Finland's RES target for 2030 and the minimum level for the intermediate years		41 %	44 %	47 %	51 %

ii. 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

Figure 3 and Table 4 present the estimated development in the WAM projection of the overall renewable energy share (RES overall) as well as sector-specific shares of final energy consumption for the electricity (RES-E), heating and cooling (RES-H&C) and transport sectors (RES-T). For the calculation of the numerator of the indicator RES-T, renewable electricity supplied to road vehicles is considered to be four times its energy content and 1.5 times when supplied to rail transport. When calculating the numerator of RES-T, the amount of biofuels for transport produced from feedstock listed in Annex IX of the Renewable Energy Directive is considered to be twice its energy content. In the WAM projection the total share of liquid biofuels in road transport increases from 18 % in 2021 to 30 % in 2030 in accordance with the quota obligation set in the national legislation[16], where double counting ends after 2020. In 2020 the total share of liquid biofuels is assumed to be 13.5 %. In the WAM projection, the amount of biofuels produced from feedstock listed in Annex IX is assumed to increase linearly from 6.5 % of all liquid road transport fuel in 2020 to 10 % in 2030. As stipulated in the Renewable Energy Directive for indicator RES-T, the average share of electricity from renewable sources of the two years before the year in question is used in the calculation of the share of renewable electricity in the electricity supplied to road and rail vehicles.

[16] Laki biopolttoaineiden käytön edistämisestä liikenteessä annetun lain muuttamisesta (419/2019) https://www.finlex.fi/fi/laki/alkup/2019/20190419https://www.finlex.fi/fi/laki/alkup/2019/20190419

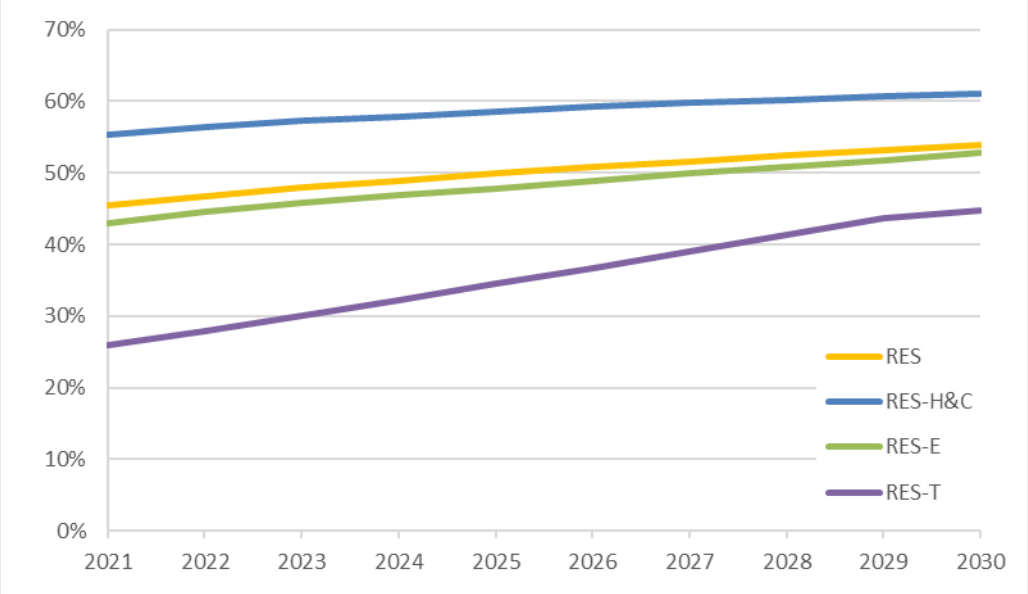


Figure 3. Estimated trajectories for the overall and sectoral shares of renewable energy in gross final energy consumption from 2021 to 2030 in the WAM projection.

Table 4. Overall and sectoral shares of renewable energy in gross final energy consumption in the WAM projection.

	2020	2022	2025	2027	2030
RES overall	44 %	47 %	50 %	52 %	54 %
RES-E	41 %	45 %	48 %	50 %	53 %
RES-H&C	54 %	56 %	58 %	60 %	61 %
RES-T	21 %	28 %	34 %	39 %	45 %

iii. Estimated trajectories by renewable energy technology that the Member State projects to use to achieve the overall and sectorial 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

iv. 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). For forest biomass, an assessment of its source and impact on the LULUCF sink

Table 5 describes the production and use of renewable energy, grouped by technology and by sector. The figures in the table represent the estimated amounts of gross final energy consumption in the WAM projection, not that of total primary energy or fuel amounts. The estimates concerning the transport sector correspond to the actual energy content of the energy source without any coefficients.

Table 5 also presents the estimated development of bioenergy in the heating, electricity and transport sectors.

The electricity and heating markets are competed industries, and the central government does not therefore have a plan for how the installed capacity of each technology will develop in the future. However, supposing 3,200 peak load hours the wind power volume in the WAM projection in the year 2030 would equal an installed capacity of 5,500 MW. This is 2.7 times the installed capacity at the end of 2018. Equally, supposing 900 peak load hours for solar power the WAM projection generation volume in 2030 would equal an installed capacity of 1,200 MW, which is tenfold the installed capacity at the end of 2018. The installed hydro power capacity is currently 3,200 MW and no significant change is expected in the coming years.

Table 5. Renewable energy per sector and technology in the WAM projection [TWh of gross final consumption].

	2020	2022	2025	2027	2030
RES					
Hydro power	14	14	15	15	15
Wind power	8	11	13	15	18
Solar energy	0.2	0.3	0.5	0.7	1.1
Bioenergy	106	113	119	122	124
Heat pumps	6	7	7	7	7
Total	135	145	154	159	165
RES-E					
Hydro power	14	14	15	15	15
Wind power	8	11	13	15	18
Solar energy	0.2	0.3	0.4	0.7	1.1
Biomass	14	14	15	16	16
Total	36	40	43	46	50
RES-H&C					
Solar energy	0.0	0.0	0.0	0.0	0.0
Biomass	87	90	94	95	97
Heat pumps	6	7	7	7	7
Total	93	97	101	102	104
RES-T (without coefficients)					
Liquid biofuels	6	9	10	10	10
Biogas	0.0	0.0	0.1	0.1	0.2
Renewable electricity	0.3	0.4	0.5	0.6	0.8
Total	6	9	10	11	11

In Finland bioenergy has a key role in the production of renewable energy. Bioenergy production is largely integrated into forestry and forest industry. In recent years, energy derived from wood fuels has accounted for around one fourth of Finland's total energy consumption. Major share of wood fuels are derived from the wastes and residues of the forest industry, including black liquor derived from the pulp-making process and bark, sawdust and other industrial wood residues. Also forest chips

– or in other words logging residues or other low value biomass from silvicultural and harvesting operations – are used for energy generation. Table 6 shows the amounts of biomass by type used as primary energy in the WAM projection.

As a result of the positive trend in the forest industries more wastes and residues (black liquor, sawdust, bark etc) are available for energy production. In recent years, the growth in the consumption of wood fuels in Finland has been based especially on an increase in burning forest industry by-products and wood residues.

Wood-based fuels are predicted to be (also in future) black liquor and other concentrated liquors, sawdust, bark and other industrial wood by-products created in connection with the forest industry and wood processing. Based on this, the share of wood-based fuels based on imports in all wood-based fuels in Finland is predicted to remain small, only a few per cent.

The energy and climate projections estimate that, at the level of the year 2030, the amount of forest chips in heat and electricity production will rise to about 24 TWh, which corresponds to about 12 million cubic meters per year. The amount is about 1.5 times the current level. We can assume that most of the forest chips will consist of small-diameter stems gathered in connection with the management of young forests. The rest is expected to consist of logging residues from regeneration fellings and to minor extent of stumps.

Table 6. Biomass by type in the WAM projection [TWh of primary energy consumption].

	2020	**2025**	**2030**
Black liquor and other concentrated liquors	44	47	49
Industrial wood residue and forest chips	41	48	50
Small-scale combustion of wood, pellets etc	19	19	20
Waste (biodegradable fraction)	4	4	4
Total	**109**	**118**	**123**

As most of the forest-based energy is based on industrial wood wastes and residues as well as harvesting and forest management residues, its impact on the LULUCF sector sink is small. The LULUCF accounting in the period of 2021–2030 in based on IPCC guidelines, respectively assuming instant oxidation of forest management residues.

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

Article 24 in the Renewable energy directive encourages Member States to increase the share of renewable energy and waste heat and cold in district heating and cooling. The historical as well as expected future development of district heat from renewable energy sources and waste heat is shown in Figure 4. Today, slightly more than half of the district heat is produced with fossil fuels.

Article 24.10 states that Member States shall not be required to apply paragraphs 2 to 9 of article 24 if its share of efficient district heating and cooling systems constitutes over 90 % of total sales of its district heating and cooling. The share of efficient district heating systems of total sales will exceed the threshold of 90 % in Finland according to current calculations, so Finland will be obliged to implement only paragraph 1 of article 24. However, Finland considers the aim of increasing the share of renewable and waste heat in district heating important and measures are addressed towards it. Also the district heating companies seek actively new opportunities to cut down their use of fossil fuels.

No sector-specific targets have been set for heating and cooling produced using renewable energy with the exception of light fuel oil used for heating.

A quota obligation has introduced for light fuel oil used for heating. The obligation for bio liquids will be 10 % share in 2028.

Prime Minister Antti Rinne's Government Programme sets the target of phasing out fossil fuel oil in heating by the beginning of the 2030s. Oil heating will no longer be used in properties owned by the central and local governments after 2024. A separate action plan is planned to be adopted to encourage properties using oil heating to switch to other forms of heating during the 2020s.

On 1 April 2019 an Act banning the use of coal in energy production as from 1 May 2029 was adopted. The prohibition will reduce the use of coal by an estimated 3 TWh compared to market-based development without the prohibition. Phasing out coal will have notable impact on district heating sector, because coal is used in Finland mainly in combined heat and power (CHP) plants. A special incentive package to support replacement investments is under preparation for those district heating companies in towns and cities that phase out the use of coal as early as 2025.

The Government Programme indicates that heat pumps generating heat for district heating networks will be transferred to the lower category of electricity tax which is mainly applied for energy intensive industries. This change should have a positive effect on the utilization of waste heat.

Together with the already existing measures and the new abovementioned plans, Finland will increase the share of renewable energy and waste heat in heating and cooling sector in line with article 23 in REDII.

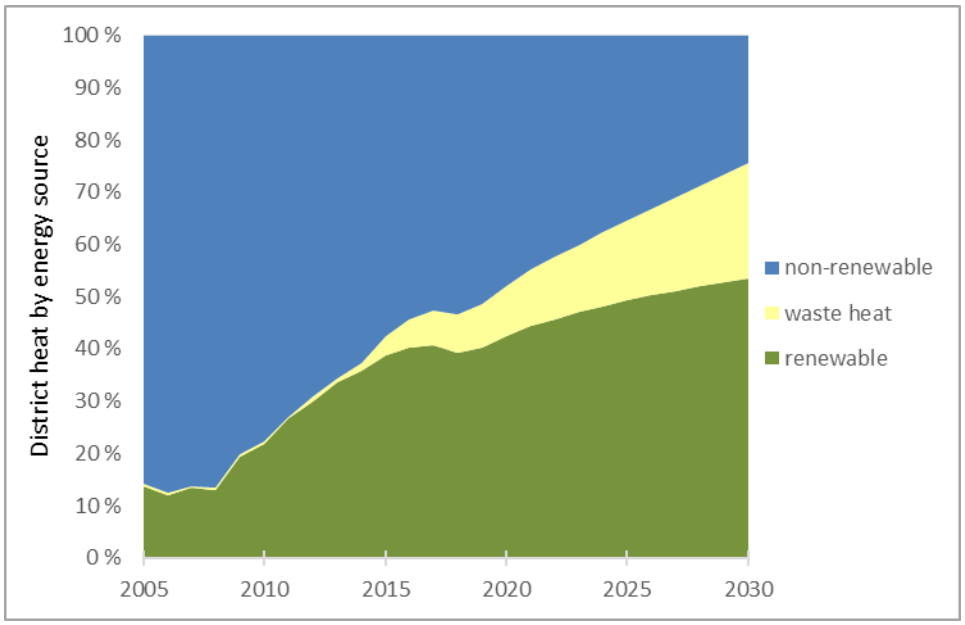


Figure 4. District heat by energy type (renewable energy, waste heat and non-renewable energy) in the WAM projection.

Energy communities are discussed in chapter 3.1.2 in more detail.

2.2 Dimension energy efficiency

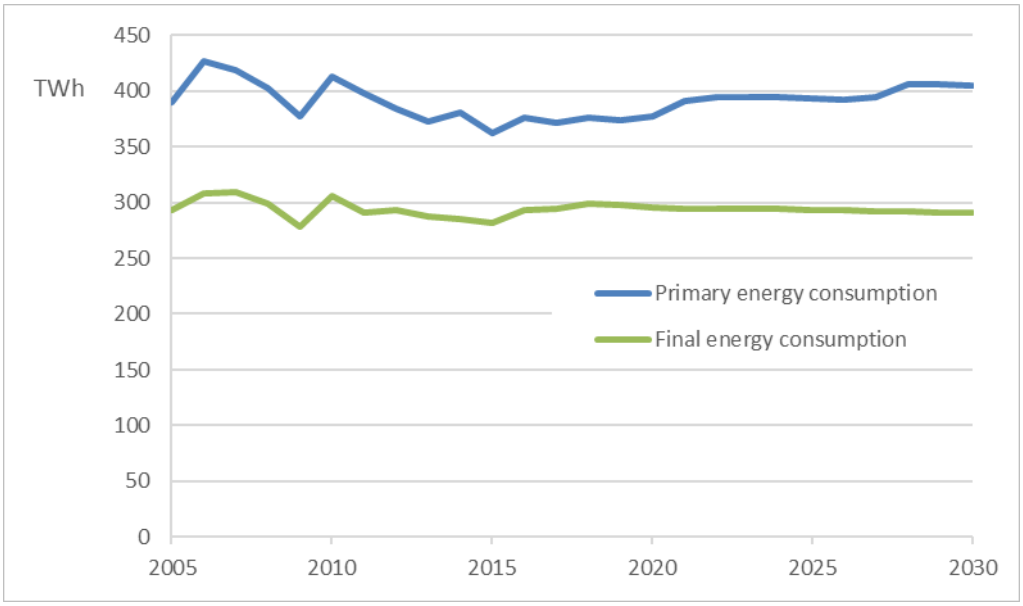
i. The elements set out in point (b) of Article 4

ii. The indicative milestones for 2030, 2040 and 2050, the domestically established measurable progress indicators and their contributions to the Union's energy efficiency targets as included 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 2a of Directive 2010/31/EU

iii. 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

Finland's indicative national energy efficiency target for 2020, in accordance with the Energy Efficiency Directive, is the absolute level of final consumption of energy at 310 TWh. The corresponding level of primary energy consumption is estimated at 417 TWh. In 2017, Finland had achieved the level of 294 TWh for final energy consumption, corresponding to 405 TWh primary energy consumption. The possibility to achieve the national energy target 2020 seems realistic but depends, however, significantly on the weather conditions. The heating demand can vary substantially - more than 5 % in final energy consumption - between the years due to significant differences in heating degree days between cold and mild winters. The competitiveness of Finnish energy intensive industry on the global market also has a big influence on final energy consumption. When running at full stretch, the final energy consumption of the industry is almost 50 % of the energy demand in Finland.

The 2030 energy efficiency target in final energy consumption is 290 TWh. Corresponding primary energy consumption is about 405 TWh. The WAM projection of primary and final energy consumption over the period 2018–2030 is presented in Figure 5.



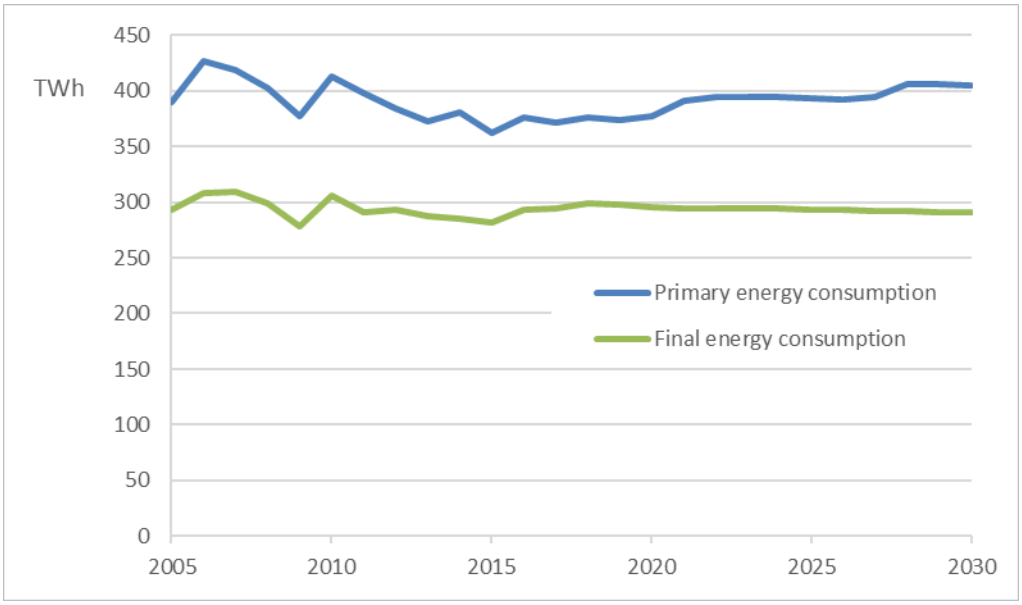


Figure 5. Historical figures and indicative development of primary and final energy consumption of 2018-2030 in the WAM projection. Data source for 2005-2017 figures: Eurostat.

As a result of Finland's long-time efforts to improve energy efficiency in all sectors, the **final energy consumption** is estimated to decrease slightly during the 2020's, although the Gross Domestic Product (GDP) is estimated to increase. Volumes of building stock continue to increase and industrial production is expected to grow particularly in the pulp and paper sector. At the same time, industry is developing its processes towards carbon neutrality, which often means electrification of the energy use and potentially an increased energy use. This transition is also driven by the Government Programme of Prime Minister Antti Rinne, where the national target of carbon neutrality by 2035 is set. It should be noted, that the industrial energy use is difficult to forecast and includes substantial uncertainties.

The **primary energy consumption** is estimated to increase comparatively much from 2020 until 2030. The main reason is the start-up of two nuclear power plant units whose production largely replace electricity import. The two units are estimated to increase the primary energy consumption by 26 TWh and 19 TWh, respectively, compared to the level with an equivalent amount of imported electricity. The effect of increased nuclear power on the primary energy consumption can be seen clearly in Figure 5. There can also be some increase of primary energy when coal based cogeneration of heat and power in big cities is converted to biomass boilers, replaced by heat pumps and other means of heat production before the year 2030.

Level of energy savings requirement – EED Article 7

Finland's national cumulative energy saving obligation in accordance with Article 7 of the Energy Efficiency Directive for the period 2014–2020 is 49 TWh_{cum}. The estimated cumulative energy saving effects of the measures implemented in the period 2014–2020, presented in the 2018 annual report of

the Energy Efficiency Directive, are 92.7 TWh_{cum} at the end of 2020. Finland notified the Commission in December 2018 of already achieving Finland´s national cumulative energy saving target for the period 2014−2020.

The annual final energy consumption as defined in the EED Article 2(3) and averaged over the years 2016−2018 (the data of the year 2018 is preliminary) is 238 TWh. Finland's cumulative energy savings target, based on this average, for the period 2021−2030 is 105 TWh_{cum}. The formulation "supplied to" in the definition of EED Article 2(3), has been taken into account by deducting auto-production of electricity, steam and heat from Eurostat FEC2020−2030 data.

Table 7 lists energy efficiency methods for the 2020's, which are estimated to result in total cumulative savings of 153 TWh.

Table 7. Main measures for the energy savings objectives of EED Article 7 and their estimated cumulative savings 2021-2030.

Energy Efficiency Measure	**Cumulative savings TWh_{cum} 2021-2030**
Energy Efficiency Agreements	82.43
Heat Pumps for Detached and Terraced Houses	20.40
Transport Fuel Taxation/Car traffic	15.35
Energy Audit Program – SMEs and Municipalities	11.43
Energy Efficiency Measures in Agriculture Sector	11.40
Energy Efficiency Agreements / Customer Advice Services	10.97
Mass and measure modifications in truck transport	1.08
Total	153.1

Finland opts to use alternative measures in the EED Article 7 implementation in the upcoming obligation period 2021−2030, further information is provided in Annex 1 to this NECP.

Renovation of public buildings owned and occupied by central government – EED art 5

The energy saving target for the central government for the period 2014–2020 is 8225 MWh. According to the 2018 annual report in compliance with the Energy Efficiency Directive, the energy savings in force in 2017, achieved with the measures implemented between 2014 and 2017, totalled 13,240 MWh. The long-term energy savings in force in 2020, achieved with the measures implemented between 2014 and 2017, total 11369 MWh.

In compliance with Article 5 of the EED Finland will continue the alternative approach for period 2021–2030. The amount of annual energy savings that would have been achieved by the default 3 % renovation rate was 1,285 MWh in 2014 and is 1,070 MWh in 2020. Respectively the annual 3 % renovation rate would deliver 1,038 MWh (1,070 x 0.97) energy savings in 2021 and 789 MWh in

2030. These values are used as the first and the last year targets for the alternative approach during period 2021–2030.

The equivalent energy savings to be reached by 2020 was notified to be 8,225 MWh. By 2030 the amount of equivalent energy savings to be reached is 17,312 MWh. The methodology and parameters for calculating the energy savings delivered by the default 3 % renovation rate has not been changed. Therefore, Finland can confirm that the condition "at least equivalent" is fully taken into account also for the new period. A detailed description of the methodology and parameters used is presented in the EU PILOT (EUP(2017)9259).

Energy efficiency in energy production

Finland exploits the Cogeneration Heat and Power (CHP) and district heating potential well. A significant part of the heated building stock in towns, cities and densely populated municipalities is connected to district heating network. Based on the Finnish district heating statistics, around 90 % of all Finnish residential apartment buildings, 30 % of industrial buildings and more than 60 % of other buildings is heated by district heating. In one family houses, district heating accounts for about 10 percent. The total market share for district heating is 46 % (2017). Almost 70 % (68 % in 2017) of district heat production is based on CHP. Similarly, CHP electricity accounts for about a third of Finland's electricity production. District heating suppliers are dominant in their operating areas with regard to the choice of the heating source, so the competition authority monitors them and can, if necessary, intervene in the abusive use of a dominant position, for example in the case of retail prices for district heating.

Energy efficiency agreements also cover energy production and energy services that serve the achievement of the indicative national energy efficiency target. The National Energy Efficiency Action Plan 2017 (NEEAP-4[17]) estimated that the energy saving effects of the measures implemented within the scope of agreement activities in the energy sector will total almost 1.7 TWh in 2020.

Energy efficiency in the transport sector

Finland has set separate sector-specific targets only in the field of transport. The objectives and measures for improving the energy efficiency of transport have been recorded in the National Energy and Climate Strategy and to the Medium-term Climate Change Policy Plan. These measures are related to improving the energy efficiency of vehicles on the one hand, and to improving the energy efficiency of the entire transport system on the other. Improving the energy efficiency of vehicles reduces vehicle-specific consumption and greenhouse gas emissions, while improving the energy efficiency of the transport system reduces the total kilometreage and, consequently, the fuel consumption and greenhouse gas emissions of the entire transport sector.

[17] https://ec.europa.eu/energy/sites/ener/files/documents/fi_neeap_2017_en.pdf

Long-term renovation strategy

Finland is in the course of establishing a long-term renovation strategy with an overview of the building stock in 2020 and indicative targets for the years 2030, 2040 and 2050. The strategy will be published in March 2020 by the Ministry of the Environment. Below is a description of the preliminary targets and other information regarding Finland's long-term renovation strategy.

The Finnish building stock will be expressed through e.g. building types, building years, locations, main heating sources and energy efficiency levels. In addition, public buildings will be handled separately from the rest of the building stock. The building stock will be divided to (1) buildings that are already highly energy efficient, (2) buildings that require renovation and (3) worst-performing buildings. Policies and actions will be planned according to the targets. The indicators will cover at least energy use of the building stock, energy efficiency levels of the buildings, GHG emissions of building use, GHG emissions of renovations, energy poverty, number and size of apartments, living conditions, smart energy systems and societal impacts.

The Finnish long-term renovation strategy aims at decarbonizing the existing building stock by 2050. This draft description of the strategy includes the 2020 building stock description as well as initial targets for the years 2030, 2040 and 2050 for the heating consumption in buildings and for the related greenhouse gas emissions. The targets take into consideration the existing policy measures as well as additional policy measures required to decarbonize the Finnish building stock (phase-out of oil heating and energy renovation subsidies). The full version of the strategy will also include e.g. the tracking of the energy efficiency levels of the Finnish building stock (the full version will be submitted in accordance with the EPBD in March 2020). Additional indicators will include e.g. energy poverty, solar panel installations and apartment sizes. The building types included in the strategy are detached buildings, terraced houses, residential blocks of flats and service buildings.

The heating energy use of the Finnish building stock in 2020 is estimated to be about 65 TWh. As a Finnish speciality, on top of the heating of buildings the saunas consume notable amounts of energy - in the year 2020 about 2.6 TWh. Another Finnish characteristic is the popularity and rapid increase of heat pumps in buildings: about 5.8 TWh of the heating energy in 2020 is estimated to come from the heat pumps.

The initial target levels for heating energy use of buildings (excluding saunas) are 52 TWh in 2030, 41 TWh in 2040 and 32 TWh in 2050, including the energy harvested by the heat pumps. This corresponds to an energy saving of 20 % in 2030, 37 % in 2040 and 51 % in 2050, when compared to the base year 2020.

The energy savings from purchased heating energy in buildings comprises of three main factors: (1) energy efficiency improvements and maintenance, (2) the installations of heat pumps and (3) removals from building stock and efficiency of space utilization. **Virhe. Viitteen lähdettä ei löytynyt.** shows the total heating energy savings compared to the base year 2020, allocated to the different sources of energy savings.

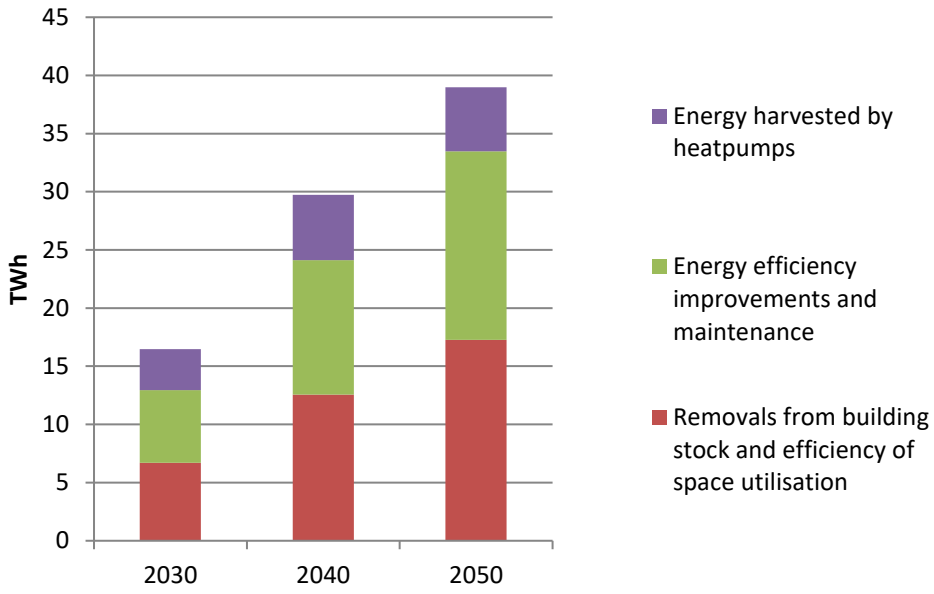


Figure 6. Total heating energy savings compared to the base year 2020, allocated to the different sources of energy savings.

The greenhouse gas emissions of the 2020 building stock are 7.7 Mt CO_2 equivalent. The corresponding emissions are 2.8 Mt CO_2 equivalent for the year 2030, 1.5 Mt CO_2 equivalent for the year 2040 and 0.6 Mt CO_2 equivalent for the year 2050. This leads to total emissions reductions of 63 % in 2030, 81 % in 2040 and 93 % in 2050, when compared to the base year 2020.

The factors behind the emissions reductions of the building energy use are (1) Energy efficiency improvements and maintenance, which include the energy efficiency improvements in renovations as well as improved building maintenance and automation practices; (2) decarbonization of heating in building level, which includes the changes in the building level heating sources (disinstallations of oil fueled heating boilers and installations of heat pumps); (3) removals from building stock and efficiency of space utilization; and finally (4) decarbonization of centralized energy production (district heating and electricity). **Virhe. Viitteen lähdettä ei löytynyt.** shows the total greenhouse gas emissions reductions compared to the base year 2020, allocated to the different sources of emissions reductions.

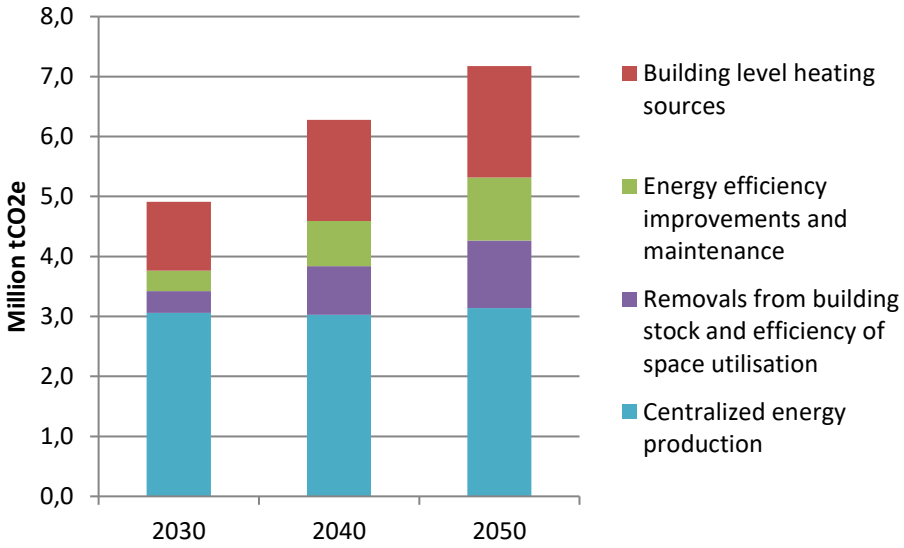


Figure 7. Total greenhouse gas emissions reductions compared to the base year 2020, allocated to the different sources of emissions reductions.

The impacts of the decarbonization policies vary in terms of energy sources. The main decrease in the heating sources is related to fossil fuel use (comprises almost fully of heating oil), and the main increase is related to the heat pump use in heating. **Virhe. Viitteen lähdettä ei löytynyt.** shows the impacts of the decarbonization policies on the use of different heat energy sources.

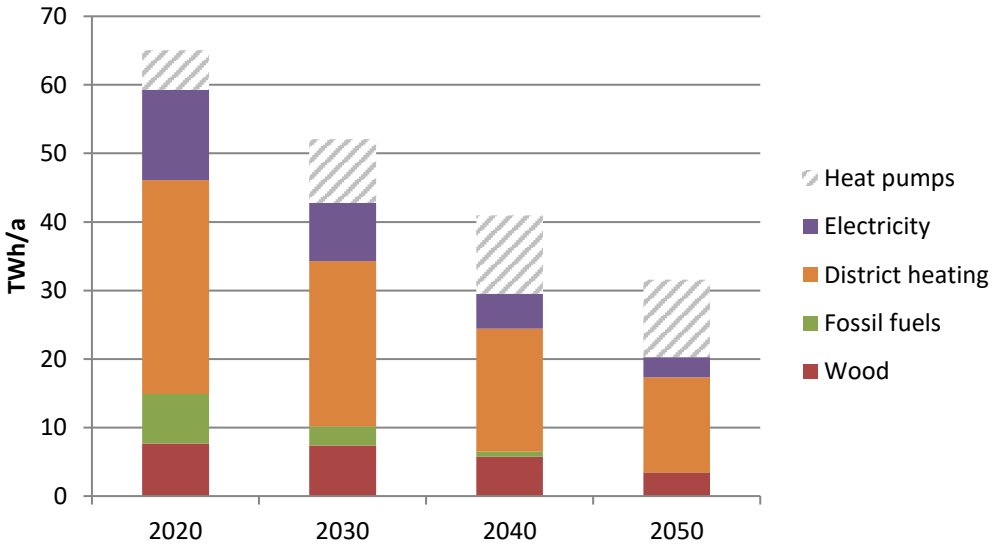


Figure 8. Heating energy sources in buildings 2020-2050.

Main Results of Recent Energy Efficiency Working Group

The Ministry of Economic Affairs and Employment appointed an energy efficiency working group in November 2018 to review the potential for improving energy efficiency during the period of 2021–2030. The working group proposed measures enabling Finland to achieve the energy savings objectives defined in Article 3 and Article 7 over the 2021–2030 period. The working group was assisted by expert working groups on industry, consumers, services and transport, consisting of the best national energy efficiency experts of each sector. The expert working groups compiled the existing and new energy efficiency measures in their respective sectors and assessed the potential for improving the efficiency of the existing ones. An impact assessment was carried out on selected measures to determine energy saving impacts and their feasibility. The estimated annual savings (in 2030) are shown in Table 8.

Table 8. Energy efficiency actions and their contributions towards the national energy efficiency target 2030[18]

Energy Efficiency Measures	**Savings 2030GWh/y**
Energy Efficiency Agreements	25,770
Energy Efficiency Agreements / Customer Advice Services	83
Energy Efficiency Agreements Increasing the coverage	1,095
Energy Efficiency Agreements: Improved reporting	1,078
Energy Audit Programme	1,420
Energy Audit Programme: Increasing volumes	1,817
Waste heat project	1,600
Energy Efficiency Measures in Agriculture Sector	3,889
Energy Efficiency Measures in Agriculture Sector: Farming land arrangement	278
Energy efficiency investments of farms	99
EU binding CO2 thresholds: Cars	8,671
EU binding CO2 thresholds: Light-duty vehicles	285
EU binding CO2 thresholds: Heavy-duty vehicles	604
Campaign of wrecking old cars (2015 and 2018)	35
State aid for full electrical vehicles (until 2021)	0.1
Fuel tax for cars	1,236
Mass and measure modifications in truck transport	20
Implementation of ecodesign directive	7,075
Heat Pumps for Detached and Terraced Houses	11,956
Building Code, energy efficiency in new buildings	9,337
Building Code, energy efficiency in renovation	3,810
Total	**80,159**

[18] Report of the energy efficiency working group, 2019. Työ- ja elinkeinoministeriön julkaisuja 2019:53. https://tem.fi/julkaisu?pubid=URN:ISBN:978-952-327-456-3

Finland continues the effective implementation of the Voluntary Energy Efficiency Agreement Scheme and other energy efficiency actions described above after 2020 and will continue many other energy efficiency policy measures based on policy decisions made before the period 2021−2030.

Link between Energy Consumption and Gross Domestic Product

The EU Energy efficiency target for the year 2030 is indicated as in terms of final energy or primary energy consumption. When considering early actions, foreseen growth of GDP, its structure − based heavily on energy intensive industries − and the changes in energy supply, it is be very ambitious for Finland to contribute to the declining projection of the energy use 2021−2030.

Finland started active energy efficiency policies and measures already after the first oil crises in 1973. The Government launched the first comprehensive Energy Efficiency Action Plan in 1993 in and established the energy efficiency agency Motiva to implement many activities of the plan, inter alia the Energy Audit Programme. This long history of energy efficiency policies and measures in Finland means, that there is no silver bullets nor low hanging fruits to improve energy efficiency.

The economic growth in the 2020's comes partly from relatively energy intensive sectors: forest industry (pulp production based merely on virgin fiber, new products, and biorefineries) and data centres. There is an increasing demand for further processed bio- and other products, which typically increases the energy intensity of the products.

Without these foreseen changes, the final energy consumption would decrease steadily with increasing energy efficiency. However, the changes described above will make the increase of the final energy use to roughly offset energy efficiency gains achieved at the same time. The progress will become even more evident in future, which is illustrated in Figure 9. It shows that the increasing GDP does not increase the final energy consumption in the same proportion. On the contrary, improved energy technology and energy efficiency actions taken have already helped and will in the future help to disconnect growth of national economy from the amount of energy use.

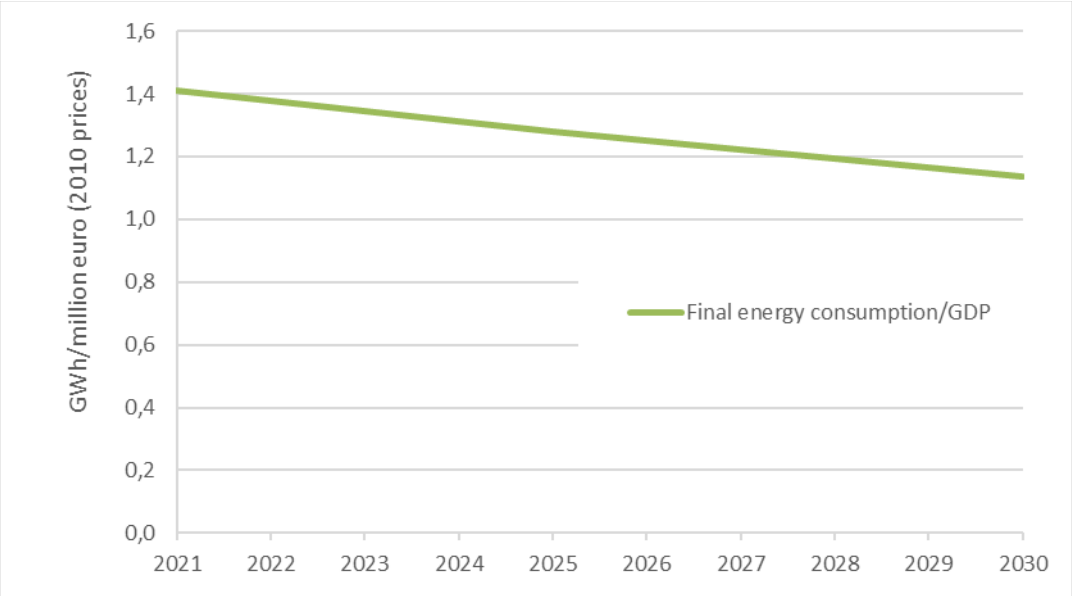


Figure 9. Final energy consumption per GDP for the WAM projection.

2.3 Dimension energy Security

i. The elements set out in point (c) of Article 4

ii. 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

The targets of the security of energy supply have been outlined in the Government Decision on the targets of security of supply (1048/2018). The security of energy supply must be based on diverse energy sources and fuels, sufficient and decentralised energy production and reliable transmission and supply systems. The security of energy supply is based on well-functioning energy markets, a clear long-term energy policy that encourages investments, and energy efficiency.[19]

According to the government decision, for Finland to be prepared for disturbances in the availability of energy and to meet the commitments under international agreements, the National Emergency Supply Agency holds imported fuels in state-owned reserves to last for the normal consumption of an average of five months. The implementation of this obligation is constantly monitored and, as necessary, the quantities, qualities and locations of export fuels are changed to correspond to the situation prevailing at the time.

[19] Government decision on the objectives of security of supply, Chapter 3.1.
https://www.finlex.fi/fi/laki/alkup/2013/20130857

The government decision on the targets of security of supply states also that the use of peat in combined power and heat generation must be secured. To ensure availability in case weather risks are realised, the target is to have peat reserve stocks covering six months' use at the beginning of the peat production season.

International cooperation develops and deepens constantly. In the past few years, there has been significant development in the cooperation with the EU, the IEA, the Nordic countries and NATO. Of the Nordic countries, Finland has agreements concerning security of supply with Sweden and Norway. Also, the relationships with the security of supply authorities of Estonia have intensified. The National Emergency Supply Agency has together with the Ministry for Foreign Affairs invested in the personnel resources of international cooperation in the field of security of supply.

According to the recent market report of the Finnish Energy Authority[20], the total installed generation capacity in Finland in the end of 2018 was about 17,600 MW. However, no more than 12,000 MW of the installed capacity (including peak load reserves) is estimated to be available during peak demand. This is due to unavailability of thermal power plants and unpredictable nature of wind power. Consumption peaks occur during winter months and they are highly affected by outdoor temperature and length of cold spell.

Table 9 below presents the highest hourly electricity demands in 2011–2018 and the realised electricity generation during the peak consumption and the highest annual generation for years 2011–2018. The table shows that the record peak consumption of 15,105 MW is from 2016. During last winter (2018-2019), the highest hourly load was 14,062 MWh/h. The consumption peak is closely related to the weather conditions.

Table 9. The peak hourly electricity consumption in Finland 2011–2018. Source: Finnish Energy Authority[21] , Fingrid[22]

	2011	2012	2013	2014	2015	2016	2017	2018
Peak demand (MWh/h)	14,804	14,304	14,034	14,228	13,494	15,105	14,273	14,062
Generation during peak demand (MWh/h)	12,063	11,916	11,843	11,632	10,992	10,874	9,963	10,602

[20] Energy Authority, National Report 2018 to the Agency for the Cooperation of Energy Regulators and to the European Commission - Finland. 11.7.2019. https://energiavirasto.fi/documents/11120570/13026619/Raportti-National-report-2019-Finland/5f0408b2-5903-11cf-29a3-3a6d0ed0d2a5/Raportti-National-report-2019-Finland.pdf

[21] Finnish Energy Authority. Kertomus sähkön toimitusvarmuudesta vuosina 2017–2018 sekä tehotase-ennuste talvikaudelle 2018–2019. 29.11.2018 https://energiavirasto.fi/documents/11120570/12722768/Raportti-s%C3%A4hk%C3%B6n-toimitusvarmuus-2018.pdf/74c52466-b53b-6927-202b-9362ff30c660/Raportti-s%C3%A4hk%C3%B6n-toimitusvarmuus-2018.pdf.pdf

[22] Fingrid, Sähköjärjestelmän toiminta talvella 2017 – 2018. 19.3.2018 https://www.fingrid.fi/globalassets/dokumentit/fi/tiedotteet/ajankohtaista/sahkojarjestelman-toiminta-talvella-2017---2018.pdf

Highest annual generation (MWh/h)	12,261	11,981	11,843	11,722	11,164	11,456	11,042	11,382

iii. 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

The National Energy and Climate Strategy sets a national target of 55 % for energy self-sufficiency. The target has been set according to the national rules for calculation and does not include electricity produced with nuclear power in Finland. National targets related to energy self-sufficiency also include the decision to prohibit the use of coal for energy by 2030 and to halve domestic use of mineral oil (petrol, diesel oil, light and heavy fuel oil, aviation fuels) from 2005 levels by 2030.

In addition, the opening of the gas market from the beginning of 2020, the construction of the Balticconnector gas pipeline and the related objective of creating a regional gas market comprising Finland and the Baltic states reduce the dependency on natural gas imported from Russia.

iv. 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.

The National Energy and Climate Strategy and the Medium-term Climate Change Policy Plan have set the objective to increase the share of biofuels to 30 % of fuels used in road transport and to replace 10 % of light fuel oil use with bio liquids. The majority of biofuels and bio liquids are estimated to be domestic and their raw materials are estimated to include biodegradable waste, side streams of the forest and other industries, and logging residues. The act concerning the quota obligation for biofuel use in transportation and in heating was passed in spring 2019 and came to force 1 April 2019.

As for the transport sector, the objective is also to increase the number of electric cars to at least 250,000 and the number of gas-powered cars to at least 50,000 by 2030. The majority of the gas used in transport is domestic biogas. The share of domestic energy sources is large also in Finland's electricity production.

The objectives of the National Energy and Climate Strategy to increase the number of renewable sources of energy described in Chapter 2.1.2 also promote the diversification of energy sources. Finland has not set specific objectives for the diversification of deliveries from third countries. National objectives are mainly related to reducing the dependency on imports from third countries (see the next section). Of imported fuels, the markets of oil and coal are global, so it is possible to change the supply sources even within a short period of time. To prepare for possible supply disruptions, compulsory stockpiles related to the security of supply of oil products and coal are held. As regards natural gas, the already completed LNG terminals, those under construction and the Balticconnector gas pipeline enable decentralised supply of gas.

Decentralised electricity and heat production based on renewable energy will be promoted. An effort will be made to increase decentralised small-scale production, mainly on market terms and through economic incentives through the electricity markets and taxation. The interest of citizens, companies and the public sector in utilizing renewable sources in the energy solutions of individual buildings will be encouraged through guidance by information and local reference sites.

Finland has been at the forefront on promoting real-time price signals for the consumers. As required by legislation, smart electricity meters were effectively installed to all customers already in 2013. All customers have the possibility of choosing an electricity contract with dynamic pricing. At the end of 2018, approximately 9 % of retail customers had a dynamic electricity price contracts[23].

Consumer protection and competitiveness in the retail sector are reflected in measures aimed to curb large one-time price increases, such as the legislation that sets restrictions on the annual price increases of the electricity transmission charges. Also other means are currently under consideration by the Ministry of Economic Affairs and Employment.

The role of flexibility and demand response was further emphasized in the National Energy and Climate Strategy. Based on the strategy, the Ministry of Economic Affairs and Employment tasked a vast working group (Smart Grid Working Group) to find ways to promote further customers' participation to the electricity markets and resource adequacy in 2016. The working group finalized its work in October 2018 and gave concrete proposals how to improve the situation[24]. The Ministry of Economic Affairs and Employment is currently implementing these proposals in parallel with the Clean Energy Package implementation.

2.4 Dimension internal energy market

2.4.1 Electricity interconnectivity

[23] https://energiavirasto.fi/documents/11120570/13026619/Raportti-National-report-2019-Finland/5f0408b2-5903-11cf-29a3-3a6d0ed0d2a5/Raportti-National-report-2019-Finland.pdf

[24] Flexible and customer-centred electricity system; Final report of the Smart Grid Working Group 2018 http://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/161147/TEM_39_2018.pdf?sequence=1&isAllowed=y

i. The level of electricity interconnectivity that the Member State aims for in 2030 in consideration of the electricity interconnection target for 2030 of at least 15 %, with a strategy with the level from 2021 onwards defined in close cooperation with affected Member States, taking into account the 2020 interconnection target of 10 % and the following indicators of the urgency of action:

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

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

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

Each new interconnector shall be subject to a socioeconomic and environmental cost-benefit analysis and implemented only if the potential benefits outweigh the costs

The level of interconnection of electric networks is defined as the ratio of commercial transmission capacity to the neighbouring EU countries, excluding connections to third countries, divided by the installed power plant capacity. Finland's electricity interconnection target for 2030 is to keep the level of interconnectivity above 15 %.

According to data for 2017, the installed power plant capacity in Finland is about 17,100 MW and commercial transmission connections, excluding connections to Russia, total 3,700 MW. The level of interconnection is thereby 22 % (3,700 MW divided by 17,100 MW). When the nuclear power plant unit OL3 in Olkiluoto is completed in 2020, the generation capacity will be 18,700 MW and, correspondingly, the commercial transmission connections, excluding connections to Russia, will decrease due to technical characteristics of the power system to total 3,400 MW. In 2020, the level of interconnectivity will thus fall to 18 %. The peak load in Finland has varied between 13,400–15,100 MW in the period 2010–2018.[25] The current total transmission capacity to the neighbouring EU countries is thus 25–28 % of the historical peak load.

Fingrid Oyj (Finnish transmission system operator) and Svenska Kraftnät (Swedish transmission system operator) have signed a letter of intent concerning the construction of an alternating current connection of 800 MW between northern Finland and northern Sweden by 2025. The transmission line project is included in the EU's Project of Common Interest list approved in spring 2018. The project

[25] https://www.fingrid.fi/globalassets/dokumentit/fi/tiedotteet/ajankohtaista/sahkojarjestelman-toiminta-talvella-2017---2018.pdf

has shown strong socioeconomic benefits in both countries, especially in Finland[26]. Commercial transmission connections to neighbouring EU countries would then be 4,200 MW and the installed power plant capacity somewhere in the order of 21,000 MW. This equals to an interconnectivity level of 20 %. The predicted peak load in 2025 is in the order of 15,700 MW[27]. Thus, the transmission capacity is predicted to be approximately 27 % in 2025, excluding the effect of connections to Russia.

The Government of Finland is fully committed in the delivery of the project between Finland and Sweden. The swift delivery of the project is a key target in the development of the regional electricity markets. The importance of the project has also been acknowledged in the National Energy and Climate Strategy for 2030.

The EU's aim is to bring the level of interconnection in the Member States to at least 10 % by 2020 and at least 15 % by 2030. Finland's interconnection capacity exceeds these targets.

The price difference of electricity between Finland and the Nordic electricity market has decreased in the latest years. While in 2015 the average difference between Finland and the Nordic System Price in day-ahead market was as high as 8.68 EUR /MWh, it was only 2.81 EUR/MWh in 2018. The price difference between Finland and Estonia has decreased rather steadily in 2012–2018 and was only 0.27 EUR/MWh in 2018. The price differences between Finland, its neighbouring bidding zones and the Nordic System price are presented in Table 10.

Table 10. Yearly average price difference between Finland (FI), Sweden (bidding areas SE1 and SE3), Estonia (EE) and Nordic System Price in EUR/MWh in 2012–2018. Source: Calculated from the market data by Nordpool.

	Price difference in EUR/MWh			
Year	**SE1-FI**	**SE3-FI**	**EE-FI**	**SYS-FI**
2018	-2.57	-2.26	0.27	-2.81
2017	-2.35	-1.95	0.01	-3.78
2016	-3.5	-3.21	0.61	-5.54
2015	-8.5	-7.66	1.42	-8.68
2014	-4.6	-4.4	1.59	-6.41
2013	-1.97	-1.71	1.98	-3.06
2012	-4.92	-4.32	2.56	-5.44

[26] For more information, see ENTSO-E ten years network development plan 2018, https://tyndp.entsoe.eu/tyndp2018/projects/projects/111#cba-results

[27] https://tem.fi/documents/1410877/2132100/S%C3%A4hk%C3%B6ntuotannon+skenaariolaskelmat+vuoteen+2050+%E2%80%93+selvitys+22.2.2019/8d83651e-9f66-07e5-4755-a2cb70585262/S%C3%A4hk%C3%B6ntuotannon+skenaariolaskelmat+vuoteen+2050+%E2%80%93+selvitys+22.2.2019.pdf

The total installed renewable generation capacity equals approximately 7,900 MW in Finland, so the share of nominal transmission capacity to the neighbouring EU countries is 47 % of the installed renewable generation.

Altogether, the additional indicators accompanying the interconnection target show that Finland is already very close to or above the targeted levels and above the target levels after 2025 when the new interconnector between Finland and Sweden and Olkiluoto 3 nuclear power plant have been commissioned.

2.4.2 Energy transmission infrastructure

i. 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

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

In addition to the 800 MW interconnection between Finland and Sweden described above in Chapter 2.4.1, the most important projects concerning the domestic electricity transmission infrastructure are listed in Table 11.

The ministry of Economic Affairs and Employment grants permits to grid owners to build cross-border electricity interconnectors based on the network operators' applications. The Finnish government has had for long time the view that the dependency on third countries in electricity imports should not be increased. Thus, in the foreseeable future there will be no increases in capacity to third countries.

Table 11. The most important electricity infrastructure projects [28]

Transmission line/corridor	Project status	Project description
Hikiä-Orimattila	Under construction Expected in operation 2019	New 400 kV AC single circuit over head line of 70 km between substations Hikiä and Orimattila.
North-South reinforcements P1 stage 2	Planned/Under consideration Seeking permission Expected in operation 2022	New 400 kV AC single circuit over head line of 300 km between Pyhänselkä and Petäjävesi. The line will be series compensated. Built to increase the north-south transmission capacity thus enabling the integration of new renewable, new connection to Sweden and conventional generation and RES in northern Finland and to compensate dismantling of obsolescent existing 220 kV lines.
Keminmaa-Pyhänselkä	Planned/Under consideration Seeking permission Expected in operation 2024	This transmission line is part of the third 400 kV AC connection between Finland and Sweden. Project will deliver 800 MW increased in transmission capacity.

In October 2016, Finnish Baltic Connector Oy and Estonian Elering AS made a decision to invest in the construction of the Balticconnector gas pipeline connection between Finland and Estonia. The construction of the Balticconnector gas pipeline is about to be completed in the coming monthsand the pipeline will be put it into commercial operation from 1 January 2020. The new gas pipeline connection is needed to open Finland's gas market and to create a joint gas market of Finland and the Baltic states.

[28] Nordic Grid Development Plan 2017, page 9
https://energinet.dk/-/media/10ACA6E691D94E0ABC600C0B07216E7E.pdf

2.4.3 Market integration

i. 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 lawn, 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

ii. Where applicable, national objectives related to the non-discriminatory participation of renewable energy, demand response and storage, including via aggregation, in all energy markets including a timeframe for when the objectives are to be met

iii. 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

Electricity

Well-functioning regional and European electricity markets and sufficiently strong cross-border connections are the most efficient and cost-effective way of guaranteeing competitive electricity prices and security of supply. The objective in accordance with the National Energy and Climate Strategy is therefore to develop Finland's electricity market as part of the regional electricity markets of the Nordic and the Baltic countries and more widely as part of the internal electricity market in Europe. A European wide electricity market with common set of rules is the best way of reaching competitive electricity prices, security of supply and given incentives for flexibility in the electricity system.

The Nordic electricity markets are characterized by the substantial share of hydro capacity accompanied by CHP and other thermal units and increased share of wind generation. The electricity generation portfolios of the Nordic countries complement each other. The dynamics of the electricity market are affected by the new transmission capacity from Norway to the Central Europe and the UK. SKM Predictor has estimated that the new connections will increase electricity exports to the Central Europe and subsequently raise the Nordic system price by 3.5 EUR/MWh in the mid-2020s[29]. The effect

[29] Sähköntuotannon skenaariolaskelmat vuoteen 2050. SKM Market Predictor AS, 2018. https://tem.fi/documents/1410877/2132100/S%C3%A4hk%C3%B6ntuotannon+skenaariolaskelmat+vuoteen+2050+%E2%80%93+selvitys+22.2.2019/8d83651e-9f66-07e5-4755-a2cb70585262/S%C3%A4hk%C3%B6ntuotannon+skenaariolaskelmat+vuoteen+2050+%E2%80%93+selvitys+22.2.2019.pdf

of price fluctuation in the Central European market will also be more strongly transmitted to the Finnish electricity market.

Regarding the wholesale market, the electricity market is already coupled to the Baltic market. The transmission capacity between Finland and Estonia (EstLink 1 & 2) equals to 1,000 MW currently. The installed net capacity of the Estonian electricity system was less than 3,000 MW in 2018[30], so the connection can be deemed very strong. The price levels in the Estonian and Finnish wholesale markets have been highly converged in recent years (see Chapter 2.4.1). The Baltic countries already represent an integral part of the Nordic electricity market.

The Nordic electricity market will be further integrated with the Central European market in the upcoming years, when the new Nordlink (NO2-DE) and North Sea Link (NO2-UK) connections will be finalized in early 2020s. Higher connection capacity with Central Europe and the increasing share of intermittent renewable energy, particularly wind energy, requires strengthening the interconnector capacity also within the Nordic market area. The increased level of market integration with Central Europe is estimated to contribute to higher price volatility during winter months in Finland, given that the prices of fuels and emissions allowances is high.

Gas

The construction of the Balticconnector gas pipeline between Finland and Estonia will enable the opening and renewal of the gas market. When this investment is completed, the derogation from the Internal Market in Article 49(1) of the Natural Gas Directive will be dropped, and the gas market will be fully open for competition from the beginning of 2020. In the new natural gas market act (maakaasumarkkinalaki 587/2017)[31], price regulation of piped gas will be dropped, and gas marketplaces and internal market rules will be introduced. On 1 January 2020 Finland will join a common regional gas market area with Estonia and Latvia (FINESTLAT-gas market area). Finland also aims at joining a regional entry-exit system with Estonia and Latvia from 1 January 2022. The final objective is to create a regional gas market comprising Finland and the three Baltic states including also Lithuania. The creation of the regional gas market is being prepared between the ministries, the national regulatory authorities and the gas network operators in Finland, Estonia, Latvia and Lithuania.

iv. 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

Finland will define the national target for the security of supply related to the adequacy of electric power when the methodology concerning the definition has been approved in the EU. At the moment,

[30] https://elering.ee/sites/default/files/public/Infokeskus/elering_vka_2018_web_trc_ENG_v4.pdf

[31] http://www.finlex.fi/fi/laki/ajantasa/2017/20170587

the target related to the adequacy of electric power has been defined indirectly through the size of power reserve described in Chapter 2.3.

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

Finland does not have quantitative objectives for the protection of energy consumers and to improve the competitiveness of the energy retail market.

The requirements related to consumer protection have been included in the electricity market act (sähkömarkkinalaki 588/2013) and the Natural Gas Market Act (587/2017) currently in force[32]. On 1 February 2019, an amendment regarding a centralized information exchange database called Datahub that will provide each party in the electricity market with all relevant information on electricity trade came into force. The Datahub will enable even more efficient and uniform transfer of data, which will be essential in the future electricity retail market. This kind of common platform is also vital to developing other opportunities, such as services for enabling significantly better demand flexibility even at an individual consumer level. The project has already started and is expected to be completed in 2022.

2.4.4 Energy poverty

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

One possible definition for Energy poverty is that it means difficulty in maintaining or satisfying basic needs due to high energy costs. In Finland there is not a significant number of households which would suffer from energy poverty. This is why, Finland does not have national objectives related to energy poverty that is mentioned in the Article 3.3 (d) of the Governance regulation. In Finland, energy poverty is in the current practice discussed as part of general social policy which secures the right of all citizens to basic necessities such as energy.

In relation to point 3.3 (d) of the Governance regulation, Finland has made three studies concerning energy poverty, in 2013, 2015 and 2018.

The first study, Selvitys energiaköyhyydestä - Kotitalouksien energiakustannukset[33], examines the importance of energy poverty in Finland. The report defines the concept of energy poverty and identifies how much and what kind of households can be affected by energy poverty. In addition, the report assesses how to respond to the challenges posed by energy poverty and how to respond to them

[32] http://www.finlex.fi/fi/laki/ajantasa/2013/20130588; http://www.finlex.fi/fi/laki/ajantasa/2017/20170587

[33] Selvitys energiaköyhyydestä - kotitalouksien energiakustannukset (Energy Poverty Survey). Ympäristöministeriön raportteja 21, 2013.
https://julkaisut.valtioneuvosto.fi/bitstream/handle/10138/41424/YMra21_2013_Selvitys_energiakoyhyydesta_FI-NAL.pdf?sequence=2&isAllowed=y

most appropriately. According to the study, energy poverty affects a small proportion of households in Finland as part of other poverty. The risk group for energy poverty mainly focuses on low-income households living in large non-energy-efficient dwellings outside urban areas. The report contains suggestions and recommendations for action to prevent and resolve the energy poverty problem.

The study in 2015, Pienituloisen omistusasujan energiaköyhyys[34], is a follow-up to the Energy Poverty Survey in 2013. This study combining energy poverty with questions on improving energy efficiency in housing, examines the relationship between changes in housing improvements and the way in which the heating system is changed to the risk of energy poverty. In this study, energy poverty means difficulty in maintaining or satisfying basic needs due to energy costs. The review of the survey is limited to owner-occupied dwellings. According to the survey, there are 60,000 to 100,000 households in Finland living in owner-occupied housing under risk groups of suffering from energy poverty (not suffering from energy poverty). In Finland, however, energy poverty is still rare, as social security mitigates its effects. The risk of energy poverty can be reduced and energy poverty can best be prevented by developing new types of financing. Particularly interesting are the financial instruments in which investment costs are paid by generating energy cost savings and state-guaranteed loans.

The latest study, ASSIST - Support Network for Household Energy Saving, in 2018 has been conducted by VaasaETT as a part of the ASSIST 2GETHER –project. [35]

According to the ASSIST-report, at present, there is already a very comprehensive social support system in Finland designed to guarantee a minimum income for all. There are no subsidies specifically targeted at energy poverty, but as an aid to mitigate energy poverty can be considered such subsidies that reduce housing expenditure or are targeted to meet basic needs such as energy costs. These subsidies include, for example, housing allowance and livelihood support. In addition to these direct subsidies, household allowance to deduct home renovation costs in taxation is also an aid for reducing energy poverty.

In Finland, the consumer is protected by the obligation imposed on the energy company to limit cut off of electricity, especially in the winter. Due to unpaid bills, electricity distribution can usually be cut off five weeks after the customer has been reminded. During the winter months (October to April), due to the negligence of a customer, electricity distribution will not be cut off in a permanent home which heating is dependent on electricity until four months have elapsed since the due date of the payment.

[34] Pienituloisen omistusasujan energiaköyhyys (Energy poverty of a resident's owner with low-income). Energiaköyhyyden jatkoselvitys liittyen asuntojen lämmitysremontteihin ja energiakuluihin. Ympäristöministeriön raportteja 6, 2015.
http://julkaisut.valtioneuvosto.fi/bitstream/handle/10138/153653/YMra_6_2015.pdf?sequence=1&isAllowed=y

[35] https://www.assist2gether.eu/

Information management aimed at improving households' energy efficiency is provided by many organisation in Finland. Consumers' energy advice is under the responsibility of the Ministry of Economic Affairs and Employment and under the auspices of the Energy Agency, a sustainable development company Motiva, which promotes and supports the work of regional energy advisers.

2.5 Dimension research, innovation and competitiveness

i. 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

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

iii. Where applicable, National objectives with regard to competitiveness

Finland makes major investments in developing new technologies and commercialising innovations. During the last years, Finland has invested in research and innovations much above EU and OECD averages measured in % per GDP. The Finnish Research and Innovation Council has set a target for Finland to be the most attractive and most competent environment for innovations and experiments by 2030. Finland has invested heavily in particular to speed up the introduction of clean and smart energy systems and the associated products and services, and also more extensively to speed up resource-wise solutions that are based on user needs and required by communities. For example, innovation funding agency Business Finland invested approximately 150 million euros to energy related projects.

In October 2016, Finland joined the Mission Innovation project published in connection with the Paris climate summit, in which 20 countries with a leading role in energy use and energy technologies undertook to double their R&D investments in clean energy over five years. The Mission Innovation cooperation will be used to promote the networking of Finnish cleantech companies and research institutes of the field and to create partnerships. For this purpose, the aim is to strengthen a clean energy ecosystem as part of the growth programme (a cooperation network for actors) based on a strong public-private partnership. In the current National Energy and Climate Strategy it is stated that Finland will continue to make major investments in developing new technologies and commercialising innovations. Full use will be made of the international Mission Innovation cooperation. Since the strategy was launched in 2016 several actions has been taken to fulfil the goals of the strategy.

The energy sector is undergoing a massive transformation, which involves a huge number of new business opportunities for companies. Constant renewal is expected in the energy sector, which is reflected especially in many system level developments. The transforming energy system will create new business opportunities while changing the existing ones. New more comprehensive service concepts will be created. RD&I funding is being allocated to the efforts to deal with this transformation and to the development of the related new business models. For experimentation and development purposes, cooperation networks (ecosystems) are to be established where the parties produce added value in the form of products, services and information in close interaction, both for each other and for customers outside the ecosystem. For the year 2030 or even longer exact programs and R&D&I funding cannot be given. The Governmental planning consist of one year budget planning and 4 years of action and economy planning.

3 POLICIES AND MEASURES

3.1 Dimension decarbonisation

3.1.1 GHG emissions and removals

i. 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

ii. Where relevant, regional cooperation in this area

iii. Without prejudice to the applicability of state aid rules, financing measures, including Union support and the use of Union funds, in this area at national level, where applicable

The 2017 Medium-term Climate Change Policy Plan defines policy measures enabling Finland to achieve the emission reduction obligation in the Effort Sharing Regulation (39 % reduction in emissions compared to 2005). The 2030 target level for Finland is going to be around 20.6 Mt CO_2eq. According to WEM projection, existing policies and measures will lead to emission level of approximately 26.4 CO_2eq in 2030, leaving a gap of about 6 Mt CO_2eq between WEM projection and the target in 2030[36]. If full advantage is taken of one-off flexibility, the gap will be about 5 Mt CO_2eq. With the measures of the Medium-term Climate Change Policy Plan, this gap can be covered (see Figure 10). A more detailed description of the measures defined in the Medium-term Climate Change Policy Plan is provided below.

[36] The climate and energy objectives of the new Programme of the Government of Prime Minister Antti Rinne in office since June 2019 are not yet implemented into national plans, or policies and measures.

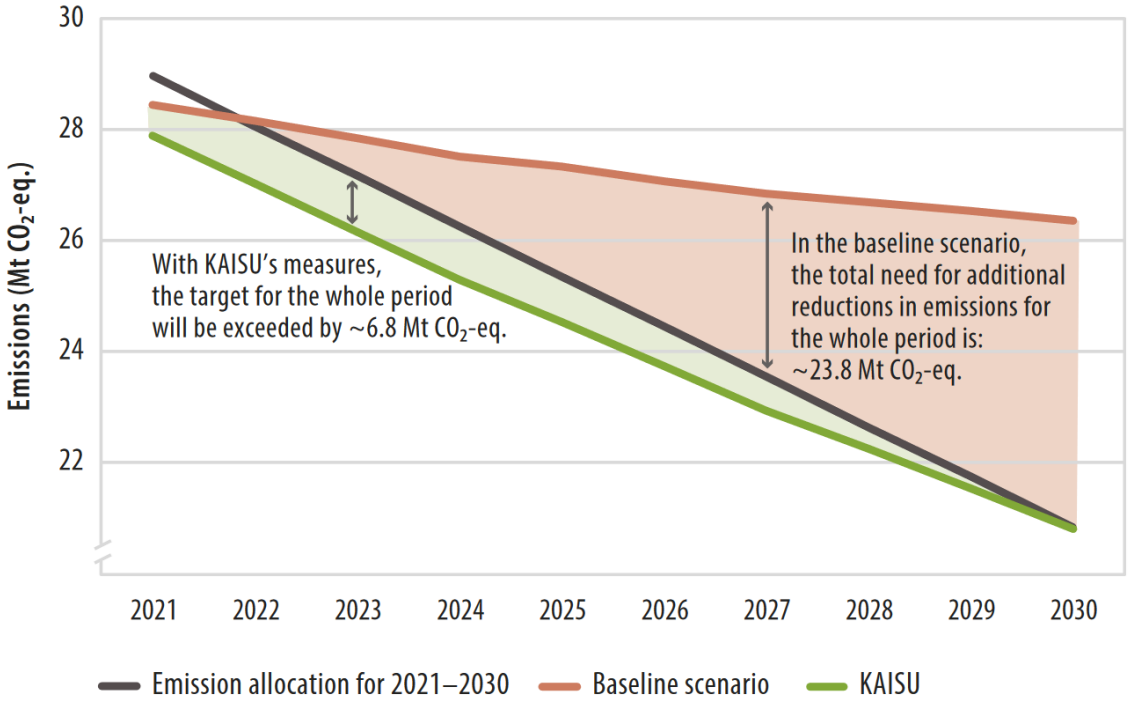


Figure 10. The emission allocation for the period 2021–2030, an estimate of emissions according to the WEM projection (baseline scenario) and with the measures of the Medium-term Climate Change Policy Plan (KAISU). One-off flexibility is not included in the figure.

Transport and spatial planning in urban areas

In the effort sharing sector, the greatest potential for reducing emissions is in the area of transport. The goal is to reduce transport emissions at least by a half by 2030 compared to 2005 levels. Measures will be focused on road transport, which presents the greatest potential for emission savings. Additional measures in the transport sector are estimated to result in a reduction of approximately 3.1 Mt CO_2 equivalent by 2030. The emission reduction measures can be grouped into three sets:

1) *Replacing fossil fuels with renewable and low-emission fuels and power sources.* The emission reduction in this set is estimated at about 1.6 Mt CO_2 equivalent. The main measure is a quota obligation of biofuels, see Chapter 3.1.2. Other measures included in this set are the promotion of the transport infrastructure and the infrastructure of biogas use in transport. An appropriation of EUR 3 million per year is reserved in the government budget for 2018-2021 for promoting the infrastructure for electric vehicles and use of biogas in transportation, and in addition an appropriation of EUR 1.5 million is reserved for promoting the infrastructure for electric vehicles in residence houses. In addition, the aim is to intensify cooperation between the Nordic countries to reduce transport emissions, for example, by developing a shared set of target indicators relating to different emissions reduction measures in transport in the Nordic countries.

2) *Improving the energy efficiency of vehicles and other means of transport.* The emission reduction in this set is estimated at about 1.1 Mt CO_2 equivalent. The main measure in this category is the binding CO_2 threshold values applicable to car manufacturers at the EU level. The main measures at the national level are the support for buying fully electric cars (EUR 2,000) and support for gas

or ethanol conversions of old cars (EUR 1,000 for gas and EUR 200 for ethanol conversions). An appropriation of EUR 6 million per year is reserved in the government budget for 2018–2021 for this purpose. In 2018 there was an eight-month scrapping premium campaign, too. In this campaign the buyer of a new car who scraps anold car was offered support from central government to the amount of EUR 1,000–2,000, depending on the power source of the new car. The introduction of a low-emission fleet in public sector will be accelerated in line with the EU requirements. Finally, a voluntary Green deal is being developed for car dealers directing them to present low-emission vehicle alternatives to customers.

3) *Improving the energy efficiency of the transport system.* The estimated reduction of emissions in this set is approximately 0.4 Mt CO_2 equivalent, including the impact that the development of land use will have on emissions. Measures included in this set are participation in the coordination of transport and land use in urban regions and in work concerning transport systems through, for example, agreements on land use, housing and transport (MAL). The aim is to ensure that projects promoting walking, cycling and public transport will be prioritised in urban transport planning and project funding. In 2018–2021, an appropriation of EUR 5.5 million per year has been reserved in the central government budget for the promotion of digitalisation and services of public transport in large urban regions and for increasing contractual rail transport services as part of the change in people's mobility habits. In addition to these, jobs and services in growing urban regions are steered towards regional centres, sub-centres and public transport nodes with a high service level, and infill construction and the creation of locations that are good for the community structure and the use of such location for new construction will be promoted in urban regions. Furthermore, a programme for promoting walking and cycling will be implemented. In 2020–2022, EUR 41 million will be reserved for the planning work and project promotion related to walking and cycling. A climate-based overall increase will be provided to public transport subsidies and purchases, annually EUR 20 million. Legislation will be introduced enabling traffic congestion charging to be introduced in city regions, with the aim of managing traffic. Finally, the amount of rail investment will be increased from the current level. Besides direct financing from the budget, separate funding will be provided for different projects (for example, Main line and its extensions, Rail line west from Helsinki (including the Espoo urban railway), Rail line east from Helsinki). However, progress in large-scale rail projects calls for agreement between the central government, municipalities and other possible beneficiaries regarding the project implementation and financing.

Drafting of a roadmap for fossil-free transport is the most important emission reduction measure in the transport sector of the Government Programme of Prime Minister Antti Rinne. The roadmap will present the measures by which the GHG emissions from national transport are halved by 2030 and transport emissions are net-zero by 2045. The Roadmap identifies both the most important measures to remove GHG in the mid- and long term as well as the costs and assessments of impacts. As part of the work, the introduction of traffic congestion charging and the development of an emissions trading system for transport will be assessed.

In addition, a reform of taxes and payments in sustainable transport will be initiated to reduce emissions. Taxation of fossil fuels will be increased by EUR 250 million over the electoral term in line

with the forecast rise in consumer prices. Changes in income taxation and benefits will be made in order to take into consideration the impact on low-income individuals.

The promotion of alternative fuels in transport will be promoted by continuing and raising the subsidy for building charging infrastructure and including sustainably produced biogas in the scope of distribution obligation. An obligation will be set for petrol station chains to provide a certain number of charging points for electric cars. In addition, the purchase subsidy for electric cars will be assessed and a national obligation will be set in accordance with the Energy Performance of Buildings Directive to build a charging infrastructure for electric cars whenever a large-scale renovation is completed in a housing company or on business premises.

In order to make the transition towards sustainable mobility, it is necessary to influence consumer mobility choices. A climate-based overall increase will be provided to public transport subsidies and purchases, annually EUR 20 million. A programme for promoting walking and cycling will be implemented. In 2020–2022, EUR 41 million will be reserved for the planning work and project promotion related to walking and cycling. In connection with the network development projects, an amount of EUR 10 million of the total funding will be allocated to meet the infrastructure needs of walking and cycling.

Building-specific heating

Green house gas emissions from building-specific heating are included in the effort sharing sector. The majority of them are caused by oil heating. Emissions from oil heating can be reduced by improving the energy performance of buildings with oil heating, increasing the use of bio fuel oil or changing the heating method. As a measure for reducing the emissions from building-specific heating, an act for an obligation to supply light fuel oil used in heating with 10 % of bio liquid was established and entered into force 1 April 2019. As an example to other actors, central government will phase out oil heating in its premises by 2024 and encourages all public actors to do the same. In addition, the energy efficiency of the existing building stock will be improved and the use of renewable energy will be promoted. Alongside these measures, clean combustion of pellets and chopped wood will be promoted to reduce soot and particle emissions. By 2030, the combined impact of these measures will be approximately 0.2 Mt CO_2 equivalent.

Machinery

Emissions from machinery can be reduced by increasing the energy efficiency of machinery or by switching to alternative fuels or power sources. An act for an obligation to supply light fuel oil with bio liquid so that the share will increase towards 10 % in 2028 has entered into force 1 April 2019. The steering instrument used to accomplish this will be the amendment to the act on promoting the use of biofuels in transport (laki biopolttoaineiden käytön edistämisestä liikenteessä 446/2007). In addition, the use of biogas in machinery will be promoted, contributions will be made at the EU level to the development of CO_2 regulation applied to machinery, energy-efficient and low-emission machinery will be promoted through public procurements, and guidance through information will be used to promote energy-efficient use of machinery.

Alongside these measures, the knowledge base related to the reduction of CO_2 emissions from machinery will be strengthened and the taxation of heating fuels has been increased; light fuel oil for heating is also used in machinery. In October 2019, a voluntary Green deal on machinery was agreed upon between the Ministry of the Environment and Association of Finnish Technical Traders. The deal promotes reduction of emissions from machinery. The emission reduction achieved with these measures by 2030 is estimated at approximately 0.5 Mt CO_2 equivalent.

Industrial oil use

The measures for reducing emissions from industrial oil use are the obligation to supply the light fuel oil with 10 % of bio liquid, promoting the replacement of fuel oil-fired boilers by boilers fired with solid fuel, enhancing the energy audit activities and increasing the taxation of heating fuels.

Energy taxes

The taxation of energy is aimed at the mitigation of climate change. In the past few years, the emphasis in the taxation of liquid fuels has moved towards the carbon dioxide tax. The heat values and carbon dioxide emissions of bio-based fuels are lower than those of fossil fuels and a tax consisting of an energy content tax and a carbon dioxide tax helps to ensure that taxation on biofuels is lower than that on fossil fuels.

The excise duty on fuels, or the fuel tax, consists of the energy content tax and the carbon dioxide tax. The energy content tax is based on the heat value of the fuel and the carbon dioxide tax on its specific carbon dioxide emission when burnt. A strategic stockpile fee is collected on both fossil and bio-based transport fuels in connection with the excise duty.

Taxation on energy is described in more detail in the IEA's In-depth-review of Finland’s energy policy[37].

Waste management

Emissions from waste management originate from landfilling, composting, digestion and the treatment of wastewater. In addition, waste incineration causes carbon dioxide emissions which have increased due to extended incineration capacity. Alternative policy measures to reduce emissions from waste incineration will be assessed. Furthermore, the implementation of the Government Decree on Landfills will be monitored and followed up.

F-gases

Fluorinated greenhouse gases, or F-gases, are emitted by various appliances that use these industrial gases that are highly harmful to the climate. Existing measures will reduce F-gas emissions efficiently but with a delay. As additional measures to speed up emissions reductions, appliances containing F-gases will be avoided in public-sector procurements, the introduction of alternative techniques will

[37] https://webstore.iea.org/energy-policies-of-iea-countries-finland-2018-review

be promoted and the recovery of F-gases will be enhanced by means of training and communication of information. In addition, alternative technologies suited to local conditions will be explored and demonstrated. By 2030, the combined impact of these measures will be approximately 0.3 Mt CO_2 equivalent.

Agriculture

The current measures in the agricultural sector are mainly related to the implementation of the EU's Common Agricultural Policy (CAP). The Rural Development Programme for Mainland Finland 2014–2020 contains several measures related to the mitigation of and adaptation to climate change: incorporation of slurry into the soil, recycling of nutrients and organic matter, environment management of grasslands, catch crops, plant cover in arable land in winter and use of organic cover for horticulture plants and potato seeds. Investment subsidy is available for controlled subsurface drainage, for more efficient storage, handling and use of manure and for investments in energy efficiency and sustainable energy, such as biogas plants. As part of the advisory services in the programme, it is possible to receive advice on energy efficiency and issues related to mitigation of climate change and adaptation to it. National funding has been provided between 2016 and 2018 for the three-year project "Making use of agricultural nutrients", which disseminates information on the funding possibilities related to the recycling of nutrients, promotes new experiments, disseminates research information and identifies and removes bottlenecks in the recycling of nutrients.

The additional measures in the agricultural sector named in the Medium-term Climate Change Plan mainly apply to the mitigation of emissions from organic soils. These measures include growing crops in organic soils for several years with zero tillage, raising the water table through controlled subsurface drainage, the afforestation of organic soils and the promotion of biogas production. Also, the sequestration and storage of carbon in soil and the implementation of the "4 per 1000" initiative will be promoted through research projects and experiments. By 2030, the reduction in greenhouse gas emissions in the agricultural sector through the above measures will be of the order of 0.5 Mt CO_2 equivalent. Moreover, the promotion of biogas production would reduce the emissions of other industries in the effort sharing sector by a total of some 0.31 Mt CO_2 equivalent by 2030. Measures to reduce greenhouse gas emissions in agriculture would also have an effect on the land use sector, in which the above-mentioned measures could reduce emissions by approximately 1.15 Mt CO_2 equivalent by 2030.

Land use, land-use change and forestry (LULUCF) sector

Measures implemented under the Rural Development Programme for Mainland Finland currently seek to slow down the breakdown of carbon in the soil of agricultural lands and replenish the carbon stock. These measures include investments in controlled subsurface drainage, perennial grassland (in other words, environment management grasslands) and plant cover on arable land in winter. Direct aid, fully funded by the EU under the Common Agricultural Policy or CAP, is now associated with agri-environmental requirements, and 30 % of direct payments have been linked to greening payments. Farmers must comply with three greening measures on their eligible hectares. Greening payment measures that affect the soil include the requirements of perennial grassland, diversification of cultivation and partly also ecological focus areas. Other measures that fall within the scope of CAP

cross-compliance conditions and impact the soil include the prohibition of burning stubble and the requirement of plant cover in fallow land. A number of research projects related to the carbon sinks of agricultural land and the impact of these measures are currently under way.

The emission reduction achieved in the LULUCF sector as a result of the additional measures taken in agriculture is estimated at 1.14 Mt CO_2 equivalent by 2030. In addition, the sequestration and storage of carbon in soil and the implementation of the "4 per 1000" initiative will be promoted through research projects and experiments. The impacts of the greening payments, cross-compliance conditions and environment payments of the EU's Common Agricultural Policy on soil carbon stocks in Finland will be examined.

The size of the managed forests sink depends mainly on the growth rate of forests and harvesting rates, resulting from the global demand for e.g. housing and packaging. The objectives of forest use have been reconciled in the National Forest Strategy 2025. Active forest management and use will maintain the forests' health and ability to grow, which is a basic precondition for their capacity to bind carbon. The National Energy and Climate Strategy emphasised the importance of enhancing the implementation of the National Forest Strategy, especially maintaining good forest health and strengthening the growth and carbon capture capacity of the forests in the long term. The projects implementing National Forest Strategy will be evaluated and updated during 2018.

A significant source of emissions in the land use sector is the clearance of forest for other land use purposes mainly as a result of civil engineering, construction and clearing land for cultivation. Finland is the most forested country in the EU, and estimates indicate that the potential for reforestation is limited.

A climate programme for land use sector will be drawn according to the Programme of Prime Minister Antti Rinne's Government. Already, the Government of Finland is preparing a wide range of additional measures in the land sector to reduce emissions and to enhance removals by sinks. This involves developing guidance instruments and incentives for maintaining and strengthening the carbon sinks and storage of forests and soil, safeguarding the management, growth capacity and health of forests, preventing land use change and maintaining and managing growth conditions in agricultural soils. The measures include, for example, promoting continuous plant cover and cultivation techniques to sequester carbon or reduce emissions, implementing a pilot for carbon sequestration and storage markets, promoting the use of diverse forestry and forest management methods, and mitigating deforestation to settlements and to cultivation through various means. Due to the early stage of the plan, the impact of such additional measures on the forest land sink cannot yet be estimated. Finland will complement information on measures and their expected impacts in the future reporting as the information becomes available.

Public financing for private forest owners, around EUR 50–60 million annually, is based on the Act on the Financing of Sustainable Forestry (34/2015). The general objectives of forestry financing are stated in the Act: increase the growth of forests, maintain road networks for forestry purposes, secure the biodiversity of forests and promote the adaptation of forests to climate change. Nature management in commercial forests is promoted through environmental support and forest nature management

projects. Private forest owners themselves invested EUR 223 million in 2015 for forest management and improvement work.

The impact of the measures on the compliance to the LULUCF regulation needs to be assessed by land use category. The net emission/sink of afforestation and deforestation are calculated in absolute values. The net emission/sink of cropland, grassland, and wetland are compared against the average emission/sink of the period 2005–2009. For the managed forest land category, Member States shall calculate a Forest Reference Level (FRL), against which the net removals or accounted emissions from managed forest land are accounted. The FRL consists from a projection of the managed forest land sink assuming that the forest management practices of the reference period (2000–2009) are continued on the compliance period (2021–2025). The FRL for managed forest land for the period 2021–2025, as detailed in the revised NFAP submission, is [Placeholder: xx Mton CO2eq without harvested wood products (HWP) and xx Mton CO2eq with HWP, tämä täydennetään lopulliseen versioon]. Due to a cap on accounted net emissions, Finland can benefit only up to 25 Mt CO_2eq during 2021–2030, if the net removals exceed the FRL. If the net removals are lower than the FRL, Finland can use forest flexibility up to 44 Mton CO_2eq during 2021–2030, but cannot compensate the emissions from other land use categories. On top of the forest flexibility, Finland is permitted to use an additional 10 Mton CO_2eq country-specific flexibility.

[Placeholder: Estimate of accounted land use emissions/removals in 2021-2025, based on the FRL and WEM scenario, tämä täydennetään lopulliseen versioon]

3.1.2 Renewable energy

i. Policies and measures to achieve the national contribution to the binding 2030 Union target for renewable energy and trajectories as referred to in point (a)(2) Article 4, and, where applicable or available, the elements referred to in point 2.1.2, including sector- and technology-specific measures

Production aid for electricity from renewable energy sources

The sliding feed-in tariff system for the production of electricity from renewable energy sources came into force in Finland on 25 March 2011. The aid scheme concerns government support for electricity production based on wind power, biogas and small scale CHP (wood fuels). The aid scheme has been phased out: It was closed for new power plants from 1 November 2017 for wind power and from 1 January 2019 for biogas and small scale CHP plants. However, the plants under the scheme will receive the aid up to 12 years from the start of production.

In May 2018, Parliament approved the act on the amendment of the act on production aid for electricity from renewable energy sources (laki uusiutuvilla energialähteillä tuotetun sähkön tuotantotuesta annetun lain muuttamisesta 441/2018), which lays down provisions on the new premium system. The premium system is based on a competitive tendering process, and investments in different renewable energy sources compete with each other so that the cost-effectiveness target will be taken into account. An auction was held in 2018 and decisions were made in March 2019. The aid

was granted for seven projects with in total of 1.36 TWh/a worth of annual electricity production. All of the projects concerned wind power. The power plants are expected to start production from 2021 onwards.

According to the Energy and Climate Strategy, no new operating aid schemes will be introduced or auctions held.

Aid for the use of forest chips

Finland promotes the use of forest chips in combined heat and power generation (CPH) with operating aid for electricity from forest chips. The aid is granted to compensate for the higher production costs of electricity from forest chips compared with fossil fuels. The maximum aid for electricity produced from forest chips has been EUR 18 per MWh. However, the aid depends on the price of the emissions allowance and has thus been in decline since the beginning of 2018. When the price of the EU ETS is above 23.7 EUR/CO_2ton, the aid is not paid which has recently been the case. At the beginning of 2019, 53 power plants were within the scope of the aid. New power plants can be approved to the scheme until 1 February 2021 and the aid is paid up to 12 years of start of production.

Energy Aid Scheme

Renewable energy is also promoted through the Energy Aid Scheme (investment subsidy). Aid is primarily targeted at the commercialisation of new technologies and to the non-ETS sector, including plants producing advanced biofuels for transport, and non-ETS electricity and heat production of companies. Aid is paid up to 30 % for mature technologies and up to 40 % for new technology projects. However, the typical aid levels are much lower especially for mature technologies. The objective is that aid for different technologies will be phased out as a technology develops, the costs are reduced and competitiveness improves. The typical annual budget has been 30–40 million EUR and this trend is expected to continue in future. However, the decisions concerning state budget is made annually. From the start of 2019 there has been a separate budget (2019: +40 MEUR) allocated for large demonstration projects. Similar additional budget has been proposed for the year 2020. In addition, in total of MEUR 90 aid scheme has been planned for early phase out of coal use in energy production. If approved, the aid scheme will be in force 2021–2023.

Promotion of the use of biofuels

The act on promoting the use of biofuels in transport (laki biopolttoaineiden käytön edistämisestä liikenteessä 446/2007) has been in force since 2008. Under the act, the share of the energy content of biofuels in the total energy content of the petrol, diesel oil and biofuels delivered by the distributors for consumption (i.e. quota obligation) will steadily increase to 20 % by 2020, taking into consideration the double counting rule. The biofuels included in the quota obligation must meet the EU sustainability criteria.

By 2030, the share of biofuels in road transport will be increased from the physical share of about 13.5 % of energy content by 2020, as required in the current legislation on the biofuels quota obligation, to 30 %. An act for increasing the quota obligation came into force 1 April 2019.

Furthermore, the quota obligation has been extended to apply to light fuel oil used in heating and machinery so that the share of bioliquids must be at least 10 % by 2028.

Energy taxes

Renewable energy is also promoted through taxation. While, renewable fuels are not taxed on heat production, fossil fuels are taxed according to their energy content as well as CO2-content.Energy taxation provides an incentive for the use of bioenergy in CHP production and building-specific heat production.

In 2015, a legislative change reducing the taxation of small-scale electricity production entered into force. Electricity production plants with a nominal output below 100 kVA and plants larger than that but with an annual production of at most 800,000 kWh were relieved of the obligation to pay electricity tax. These producers may themselves use at the site tax-free the electricity they have generated. If the produced electricity is distributed through the electricity network, the network operator distributing the electricity to consumption will collect the electricity tax on it.

Transport

The measures in transport have been listed above (Promotion of the use of biofuels) and in Chapter 3.1.1 under the heading 1) “Replacing fossil fuels with renewable and low-emission fuels and power sources”.

Energy advisory services

The funding allocated to energy advisory services is directed to regional activities (promoting energy efficiency and the use of renewable energy in counties) and communication about demand-side response to consumers. The target groups in the counties are companies, local authorities and citizens. The advisory services implemented in the counties include the promotion of energy efficiency agreements and energy audits, the promotion of municipal renewable energy audits in municipalities and companies, energy advisory services for consumers and also support for the strategic promotion of work related to energy and climate issues

ii. Where relevant, specific measures for regional cooperation, as well as, as an option, the estimated excess production of energy from renewable sources which could be transferred to other Member States in order to achieve the national contribution and trajectories referred to in point 2.1.2

Finland has not concluded any agreements on statistical transfers, joint projects or joint aid schemes with other countries for the coming years.

iii. Specific measures on financial support, where applicable including Union support and the use of Union funds, for the promotion of the production and use of energy from renewable sources in electricity, heating and cooling, and transport

See Section 3.1.2.i.

iv. Where applicable, the assessment of the support for electricity from renewable sources that Member States are to carry out pursuant to Article 6(4) of Directive (EU) 2018/...

Finland has not planned new aid schemes for electricity from renewable energy sources nor there are any plans of revising the old aid schemes. Decisions concerning the operating aid for forest chips (explained in Chapter 3.1.2) will be made in 2020.

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

According to the article 16 of the REDII, the Member States shall set up or designate one or more contact points to guide through and facilitate administrative permit application and granting process. In addition, the directive requires streamlining administrative procedures. Finland has not yet implemented the abovementioned article into national law.

The abovementioned directive includes provisions concerning information and training as well as facilitating the uptake of power purchase agreements. There is already a number of measures implemented after the REDI that are still in place. These measures are revised and if needed, new measures will be implemented. The uptake of power purchase agreements have increased recently especially concerning new wind power projects. However, during the implementation of REDII, it will be assessed whether there is a need for additional measures.

Summary of the policies and measures under the enabling framework Member States have to put in place pursuant to Article 21(6) and Article 22(5) of Directive (EU) 2018/... to promote and facilitate the development of renewable self-consumption and renewable energy communities

As described in Chapter 3.1.2. the key concepts to promote energy communities have been identified in the work of Smart grid working group in 2018 appointed by the Ministry of Economic Affairs and Employment. Key concepts include energy community within one property, typically a block of flats, energy community crossing property limits and virtual energy community.

The Government has commissioned a study on the unjustified barriers concerning self-consumption and renewable energy communities. The study is expected to be finished by the end of 2019. If unjustified barriers are found, they will be assessed, whether they can be removed.

In addition, there is a Rural Development Programme in force described in Section 3.1.2.i.

vi. Assessment of the necessity to build new infrastructure for district heating and cooling produced from renewable sources

A decision to invest in construction of new district heating or district cooling infrastructure is typically based on demand. In Finland, district heating networks have been built at almost all sites in where it is economically viable. Even very small networks have been built to connect, for example, public buildings in small built-up areas. New investments are mainly related to the establishment of entirely new areas. The fuel or energy source used to produce the energy for the district heating or district cooling does not play a key role.

vii. Where applicable, specific measures on the promotion of the use of energy from biomass, especially for new biomass mobilisation taking into account:

- biomass availability, including sustainable biomass: both domestic potential and imports from third countries

- other biomass uses by other sectors (agriculture and forest-based sectors); as well as measures for the sustainability of biomass production and use

The use of wood-based fuels in Finland is mainly based on industrial side streams and such energy fractions created in connection with forest management work and felling for which there is no demand in the forest industry processes. The aim is to direct these biomass fractions to power and heat generation and to the manufacture of transport biofuels. In Finland, the use of wood-based fuels as a whole is promoted by the emissions trading system, the operating aid for electricity from forest chips, the taxation of fossil fuels and peat and the aid schemes encouraging forest management, such as the sustainable forestry aid scheme designed for private forest owners. About one tenth of the raw materials used in the forest industry are imported, so the corresponding proportion of the generation of renewable energy based on industrial side streams is based on imported wood. Imports are not expected to account for a significant share of the total amounts of wood-based fuels in future, either.

The sustainability of the production of biomasses is regulated in the REDII. Member States shall bring into force the laws, regulations and administrative provisions by 30 June 2021 derived from the directive and Finland has started the implementation process. Finland has legislation and monitoring systems in force to minimise the risk of unsustainable forest biomass production. The most important law ensuring the sustainability of forest management in Finland is the Forest Act. The requirements concerning legality of harvesting operations (i) and forest regeneration of harvested areas (ii) are included to the Forest Act. Other relevant acts are the Forest Damages Prevention Act, The Timber Measurement Act and The Act on the Placing on the Market of Timber and Timber Products, which implements the EU Timber Regulation No 995/2010 in Finland. Concerning the objectives to minimise negative impacts to biodiversity and soil (iv) and protection of forests (iii), also the environmental legislation has a key role. 2.7 million hectares of forests are protected or under restricted use,

which is 12 % of the total forest area in Finland. The sustainability of forest management is assessed and monitored on the basis of the Pan-European Criteria and Indicators for Sustainable Forest Management. The National Forest Inventory (NFI), the monitoring system for forests and forest resources, produces diverse information on Finnish forests. NFI results are widely used in assessing the sustainability of forest management.

In agriculture, the potential in energy production lies especially in utilising biomass-based side streams of agriculture for CHP generation, as transport fuel and in solar electricity. The majority of the biogas potential is associated with farming. There has been wide interest in increasing biogas production on farms or from agricultural biomasses for some time. While farms have plenty of biomasses suitable for biogas production, they have so far only been utilised to a minor extent. The reason for this is that yield/cost analyses have been unable to identify adequate numbers of cost-effective applications. In addition, profitable concepts for costly plants have been hard to find. Achieving profitability is particularly difficult if costs are incurred for the raw material. Typically, biogas production on farms has advantages that are not directly associated with energy economy, including more efficient nutrient recycling, cutting greenhouse gas emissions, improved hygiene and reduced odour nuisances. Circular economy-related benefits are often in a key role.

The previous Government funded more than 70 research and development projects during the last four years to promote biomass nutrient recycling enhancing actions of SME's and research institutes as well as communicate and inform about the benefits of nutrient recycling and importance of bio-waste separation and food waste reduction.

3.1.3 Other elements of the dimension

i. Where applicable, national policies and measures affecting the EU ETS sector and assessment of the complementarity and impacts on the EU ETS

ii. Policies and measures to achieve other national targets, where applicable

iii. Policies and measures to achieve low-emission mobility (including electrification of transport)

iv. Where applicable, national policies, timelines and measures planned to phase out energy subsidies, in particular for fossil fuels

Activities related to technology-neutral support for electricity production and energy taxes are described above in Chapter 3.1.2. In addition, the Energy and Climate Strategy for 2030 (2016) already outlined that Finland will phase out the use of coal for energy by 2030. No new power plants burning hard or brown coal shall be built, nor shall any replacement investments based on coal be made. Once the existing plants based on pulverised fuel combustion have been decommissioned, coal will only be used as a backup fuel in exceptional situations.

On 1st April 2019, the Government adopted the act prohibiting the use of coal in energy production as from 1 May 2029. The prohibition will reduce the use of coal by an estimated 3 TWh compared to market-based development without the prohibition. A special incentive package to support replacement investments is under preparation for those district heating companies in towns and cities that undertake to give up the use of coal as early as 2025.

The measures in transport have been listed in the Chapter 3.1.1 under the headings 2) “Improving the energy efficiency of vehicles and other means of transport” and 3) “Improving the energy efficiency of the transport system”.

The main aid schemes concerning renewable energy in Finland have been operating aid scheme and energy aid scheme. The operating aid scheme consists of feed-in tariff for renewable electricity, aid for the use of forest chips and premium system, which have been explained in more detail in Chapter 3.1.2. The feed-in tariff scheme concerning wind power, biogas and small scale CHP has been phased out and no new power plants are accepted to the scheme. Aid for the use of forest chips has not been paid since December 2018 due to current level of EU ETS prices. Any decisions on continuation of aid for the use of forest chips after 2021 have not been made. In the premium system, there has only been one auction round and according to current plan, there will not be new auction rounds. All power plants within the abovementioned schemes may receive aid up to 12 years.

For energy aid scheme there is no plans for phasing out. However, according to the national energy- and climate strategy as well as Antti Rinne’s Government Programme, the focus is put more on new energy technology projects. Therefore, while budget for the scheme is estimated to stay at the same level of even increase, the aid for mature technologies will be reduced.

Energy subsidies that are considered environmentally harmful are reported in Table 12. The assessment of environmentally harmful subsidies is based on the evaluation tool developed by the OECD and previous Finnish studies on the subject. The vast majority of environmentally harmful energy subsidies are tax expenditure items targeted at lowering the cost of energy consumption at industry, transport and agriculture sectors. The benchmarks depend each time on the tax expenditure in question and are not fully comparable between each other. The two largest environmentally harmful subsidies are the reduced electricity tax rate for industry, data centres and greenhouses, which is usually considered together with the energy tax refunds for energy intensive enterprises, and the reduced energy tax rate for gas fuel used in transport mobile machinery. The figures are based on actual data or estimates for 2018, up-to-date budget data or estimates for 2019 and budget proposal data etimates for 2020.

Most of the environmentally harmful energy tax expenditure items stay almost constant over the period, because there are no tax rule changes affecting them. An exception to this general trend is the amount of energy tax refunds for agriculture, which shrinks from 2018 to 2020, because the decided tax refund increases in 2018–2019 do not continue to 2020. The compensation subsidy for indirect costs of emission trading is expected to grow somewhat markedly with the rising market price of emission allowances.

Table 12. Environmentally harmful energy subsidies 2018-2020 [mill. euro].

	2018	**Budget 2019**	**Budget proposal 2020**
Energy tax refunds for energy-intensive enterprises	222	225	235
Reduced electricity tax rate for industry, data centres and greenhouses	625	630	633
Reduced energy tax rate for peat	180	194	196
Compensation subsidy for indirect costs of emission trading	27	30	78
Reduced energy tax rate for diesel used in transport	422	419	389
Reduced energy tax rate for gas oil used in transport mobile machinery	464	456	451
Energy tax refunds for agriculture	62	55	35

There is no established view in Finland on which energy subsidies are considered as fossil fuel subsidies. One of the reasons behind this is that many of the environmentally harmful energy subsidies mentioned in Table 12 do not make any distinction per se whether the energy consumption is based on fossil energy sources or renewable sources. Many of the environmentally harmful energy subsidies in Table 12 nevertheless fall partially - or in the case of reduced electricity tax rate for peat where forementioned distinction is made, wholly - upon the consumption of energy that was produced by burning fossil fuels.

In connection to the budget negotiations of the 2020 budget, the government announced that it intends to launch preparatory work whose aim is to make cuts to environmentally harmful subsidies and redirect the vacated funds to more productive and sustainable uses. Decisions based on this preparatory work are scheduled for autumn 2020. Initially, tax expenditures will be reduced by phasing out the tax reduction for paraffinic diesel.

3.2 Dimension energy efficiency

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 financial nature) to promote the energy performance of buildings, in particular as regards the following:

i. Energy efficiency obligation schemes and alternative policy measures under Articles 7a and 7b of Directive 2012/27/EU and to be prepared in accordance with Annex II

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

iii. Description of policy and measures to promote energy services in the public sector and measures to remove regulatory and non-regulatory barriers that impede the uptake of energy performance contracting and other energy efficiency service models

iv. Other 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 (for example measures to promote the exemplary role of public buildings and energy-efficient public procurement, measures to promote energy audits and energy management systems, consumer information and training measures, and other measures to promote energy efficiency)

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

vi. Description of measures to utilise energy efficiency potentials of gas and electricity infrastructure

vii. Regional cooperation in this area, where applicable

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

The policies and measures for the period 2021–2030 required in the updated Energy Efficiency Directive has been outlined by the extensive energy efficiency working group appointed by the Ministry of Economic Affairs and Employment. The working group started its work in November 2018. .

For the implementation of Article 7 of the Energy Efficiency Directive over the period of 2014–2020, Finland has chosen the alternative policy measures described in Section 3.3.2 of National Energy Efficiency Action Plan (NEEAP) IV[17]. Finland will continue with alternative policy measures also over the period of 2021–2030. Planned measures for the implementation of Article 7 are defined in the Chapter 2.2.

Voluntary Energy Efficiency Agreements

Energy savings and energy efficiency have been improved through Voluntary Energy Efficiency Agreements drawn between the Government and industrial/municipal associations already since the 1990s. The current period of the agreement for the years 2017–2025 plays an important role in the achievement of Finland's cumulative energy saving targets set for the periods 2014–2020 and 2021–2030 in Article 7 of the Energy Efficiency Directive. Finland will continue the Voluntary Energy Effiency Agreement also after the current period (of 2017–2025).

The agreements are planned to guide companies and municipalities towards continuous improvement in energy efficiency. The participants set a quantitative target to improve their energy efficiency and they implement actions, in order to achieve their targets.

The Government grants energy subsidies to support the implementation of new energy-efficient technology and, case-dependently, the conventional energy efficiency investments and energy audits of the participant municipalities and small companies.

The agreement scheme also supports the implementation of the obligations set in other articles of the directive and also supports the implementation of the Energy Performance of Buildings Directive (EPBD). Voluntary Energy Efficiency Agreements covers Industries (Industry, Energy sector and Private Service sector), Property Sector, Municipal Sector, and Oil Sector (Distribution of liquid heating fuels).

The municipalities and companies joining the agreement undertake to

- promote energy efficiency in a goal-oriented and systematic manner, for example, through the deployment of an energy management system,
- explore the possibilities to save energy by carrying out energy audits,
- explore the financing solutions (e.g. PPP, EPC and ESCO) and use them as necessary when financing is an obstacle to investing in energy efficiency,
- train their personnel and inform the personnel about promoting energy efficiency, and
- monitor their energy consumption and report their consumption and energy savings on an annual basis.

Transport fuel taxation

Energy savings are created as a result of Finland's higher transport fuel taxation (including excise duty, carbon dioxide-based taxes, strategic stockpile fee and value added tax) compared with the EU's minimum requirements for the level of fuels taxes and value added tax.

Road transport

The measures in transport have been listed in Chapter 3.1.1 under the headings 2) “Improving the energy efficiency of vehicles and other means of transport” and 3) “Improving the energy efficiency of the transport system”.

Energy audits

Along with the energy efficiency act (energiatehokkuuslaki 1429/2014), which entered into force at the beginning of 2015, energy audits have been divided into a voluntary side involving support and into compulsory four-yearly energy audits carried out in large companies. Energy aid for energy audit activities is granted to voluntary audits. These include four audit models for service properties, three audit models for industry, two audit models for the energy sector, a municipal renewable energy audit, energy planning for farms, and an energy audit model for transport chains that with minor adjustments can be used also as an energy audit model for transport companies (NEEAP IV[17], KETO-3-TEM).

Energy performance of buildings

Finland will adopt an energy subsidy scheme designed especially for housing companies with the goal of supporting improvements in energy efficiency and measures aiming toward smart, flexible energy consumption. The principle of the subsidy scheme is that the assistance will be paid in proportion to the energy efficiency benefits achieved. The projects must be cost-effective and appropriately designed.

Finland will phase out the use of fossil fuel oil in heating by the start of the 2030s. Oil heating will no longer be used in properties owned by the central and local governments by 2024. Finland will adopt a separate action plan to encourage properties using oil heating to switch to other forms of heating during the 2020s.

The Land Use and Building Act (132/1999) was amended in 2017, in order to transpose the nearly zero-energy (NZEB) provisions of the Energy Performance of Buildings Directive. The amendment came into force on 1 January 2017.

Minimum requirements for all new buildings are issued in the National Building Code of Finland. The requirements are set in the Decree of the Ministry of the Environment on the Energy Performance of New Buildings (1010/2017). The requirements came into force on 1 January 2018. Same requirements are applied for both private and public buildings. These regulations set the level for NZEB in Finland. The same requirements will apply if an existing building would like to be renovated as a nearly zero-energy building.

According to the Decree, the overall energy consumption (E-value) of a building shall not exceed the given limits. The overall energy consumption (E-value) includes energy consumption of the heating, ventilation, domestic hot water, cooling, as well as system auxiliary units, consumer equipment and lighting. The Decree of the Ministry of the Environment on the Energy Performance of New Buildings sets also requirements for heat losses, summertime temperatures, specific fan power of ventilation and AC as well as for energy consumption metering.

Minimum requirements for existing buildings are set in the Decree of the Ministry of the Environment on improving the energy efficiency of buildings in conjunction with repair and modification works (4/2013). The requirements came into force on 1 June 2013. The decree has been supplemented with Decree of the Ministry of the Environment on Amending the Decree of the Ministry of the Environment on Improving the Energy Performance of Buildings Undergoing Renovation or Alteration (2/2017). The requirements must always be fulfilled in the case of repairs and modifications where the improvement of energy efficiency is technically, functionally and financially feasible.

According to Decree 4/2013 of the Ministry of the Environment, compliance with the requirements set for the energy efficiency of renovation projects can be done using three alternative ways. A party engaging in a building project subject to a permit must select one of following alternatives: 1) energy efficiency requirements for each building element, 2) E-value requirements of a building or 3) Energy consumption requirements for a building. In addition to the three previous alternatives, the Decree sets requirements for the technical systems.

According to the Cost-optimal reports of Finland submitted to the Commission in 2018 the minimum requirements for new buildings and for existing buildings are on a cost-optimal level. Next review will take place in 2022–2023. As regards buildings, the most important current energy efficiency measures are promoting the installation/use of heat pumps in terraced and single-family houses (RA-04-TEM), the energy efficiency agreement on the distribution of heating fuel oil, and the energy efficiency regulations on new buildings, which set the minimum level of building requirements. See NEEAP IV[17], Section 3.6.1 and RA-no-YM measures.

Promotion of energy efficiency at system level

Energy efficiency has been taken into consideration in the planning of networks and in tariffs and regulations (electricity market act 588/2013).

Maintaining the preconditions for combined power and heat generation

Efficient cogeneration works in an open energy market and competes with other generation methods. The energy efficiency measures in efficient cogeneration are related to improving the overall efficiency of primary energy use and the overall efficiency of energy production within the scope of energy efficiency agreement activities.

District heating and cooling

Energy efficiency measures in the field of district heating and cooling are related to improving the efficiency of primary energy use, more efficient utilisation of waste heat and the overall efficiency of energy production within the scope of Voluntary Energy Efficiency Agreement activities.

Communication and training to promote energy efficiency

The communication, advisory and training activities related to energy efficiency cover all sectors from consumers to industry. The nationally coordinated Energy advice for consumers and the guidance implemented by energy companies cover all aspects of consumer communications and guidance related to the promotion of energy efficiency and use of renewable energy. Guidance for transport, renovation and partly also for farms is included in the nationally coordinated Energy advice for consumers service.

Energy efficiency in awarding public contracts

In compliance with the Directive, the energy efficiency act (energiatehokkuuslaki 1429/2014) lays down provisions on the energy efficiency requirements concerning central government authorities with regard to public procurements. Guidelines on the energy efficiency of public procurements, updated by the Ministry of Economic Affairs and Employment in January 2016, have been drawn up for central government authorities and other public administration.

In addition, Motiva Oy continues to organise annual training events focusing on the energy efficiency requirements of public procurements. The energy efficiency of procurements is also promoted by the Competence Centre for Sustainable and Innovative Public Procurement, established in 2017. The aim of the Competence Centre is to increase procurements that promote the sustainable development goals from both the social and the environmental perspective.

Energy Aid Scheme

Energy aid (explained in more detail in Chapter 3.1.2.) may be granted also to investments for companies that have signed energy efficiency agreements. For new energy technology projects, aid may be granted also for companies outside the energy efficiency agreements. In addition, energy aid is granted for voluntary energy audits. The total budget for energy efficiency investments has traditionally been EUR 10-20 million of the total Energy aid scheme budget.

In addition, energy aid will be used to promote and to non-ETS investments related to decentralised energy production and renewable fuels in transport.

Regional cooperation

Regional cooperation is carried out with Sweden, Denmark, Norway and Iceland in the networking group on energy efficiency The group has also worked in cooperation with the Baltic States.

Funding

A comprehensive report on financial solutions related to energy efficiency was compiled in 2017 and 2018. It was aimed at identifying financial instruments that could be used to improve energy efficiency in Finland. Obtaining financing for good projects is generally not a problem in Finland although the preconditions for granting financing are today examined more closely. It is essential to provide information on energy efficiency and its benefits so that the macroeconomic aspects can be considered when investments are made. Information must also be available at the right time. The work will be continued in 2019 and onward with the aim of bringing together actors both from the financial sector and from organisations that implement energy efficiency measures and finding concrete procedures to promote the implementation of energy efficiency measures.

Energy efficiency first -principle

Improved energy efficiency throughout the whole energy system, from production and transmission to distribution and end-use, makes a major contribution to the national goals of a competitive low-carbon economy and security of energy supply.

The future energy system will be flexible and intelligent. In addition to directing energy production, may energy consumption also be managed and coordinated as indicated by the current production situation. Hybrid systems that combine different forms of production will become more widespread. Flexibility of demand will change the role of the consumer. An active consumer will simultaneously consume, produce, save and store energy. Digitalization and the Industrial Internet will help improve the efficiency of energy use everywhere. Energy efficiency is a cost-effective way of reducing greenhouse gas emissions and the mentality of circular economy will further increase the efficiency of resources use.

Finland aims to benefit the “smart and efficient integrated energy system” approach to implement the idea of “energy efficiency first” principle: Combined generation of heat and power, and related district heating and cooling with smart demand response mechanisms improves energy efficiency, help to increase the share of renewables and link heating with electricity for flexibility.

For decades has Finland used the potential for aligning energy efficiency and renewable energy policies, linking heating with electricity for flexibility and integrating more renewables in both heating and electricity and utilise waste heat and waste cold. Having in mind the benefits from greater sector coupling through electrification as the energy system decarbonises, the heating/cooling sector is critical and the use of more renewable sources will be encouraged. Taking the cost-efficiency into account comprehensively at the whole energy system level from supply to end use of energy will help to facilitate the Energy efficiency first -principle also in practice.

Energy communities

See Section 3.1.2.i.

Circular economy

In 2016, the Finnish Innovation Fund Sitra published for a first time the Finnish road map to a circular economy[38] and updated it in 2019. The target of the Finnish Government and the road map is to make Finland a global leader in the circular economy by 2025. The road map describes the concrete actions that can accelerate the transfer to a competitive circular economy in Finland. The road map highlights best practices and pilots that can be easily replicated. It was constructed in close cooperation with government ministries, as well as almost 50 other representatives from the public, private and third sectors.

Finland has recognized that moving towards circular economy has many synergies with greenhouse gas emission reduction measures and the potential to make a significant contribution to the achieving of Finland's energy and climate goals. There is an ongoing research project by the Finnish Environment Instituteto better understand the potential quantifiable greenhouse gas emission effects of the circular economy and the most cost-efficient policy measures moving towards the circular economy.

A state owned company Motiva Ltd, which promotes the efficient and sustainable use of energy and materials, has developed external material efficiency audits to provide support to businesses to help them identify and make resource efficiency improvements. Material efficiency is a subsidised programme in which authorised auditors perform the auditing using the audit model. The Government is offering economic incentives for these audits. Motiva has also developed a Finnish Industrial Symbiosis System (FISS), which is a systematic way to help companies and other organisations to create partnerships and new business opportunities through more efficient use of raw materials, technology, services and energy. At the moment, around 650 companies from different sectors and around 5000 resources are involved all over the country.

Antti Rinne's Government Programme aims to strengthen the role of Finland as a forerunner of the circular economy. There are several key measures outlined in the Programme to promote transition towards the circular economy. These measures include the implementation of the strategic circular economy programme and the related indicators. To prepare and implement the programme, 7,2 million euros has been allocated for the years 2020–2023. Also, additional funding of 48 million euros has been granted for the years 2020–2021 to support innovation and ecosystems in circular economy.

As a key measure, Finland will also implement the Plastics Roadmap to improve the efficiency of plastics recovery, recycling and product design, creating conditions for investments and innovations in the circular economy, and reducing the dependency on fossil raw ingredients by increasing bio-based and biodegradable solutions.

[38] Leading the cycle - Finnish road map to a circular economy 2016–2025
https://media.sitra.fi/2017/02/28142644/Selvityksia121.pdf

3.3 Dimension energy security

i. Policies and measures related to the elements set out in point 2.3

In point 2.3 not only the national objectives with regard the energy security are described. Point 2.3 includes also some of the measures that are applied for energy security. In the area of energy security, it is not always easy to separate the objectives form the respective measures.

The measures that are mentioned and described in point 2.3 are for example:

- The National Emergency Supply Agency holds imported fuels in state-owned reserves to last for the normal consumption of an average of five months.
- Of the Nordic countries, Finland has agreements concerning security of supply with Sweden and Norway.

In addition to the measures described in point 2.3 some further measures are listed below.

Electricity

Finnish generation adequacy is affected by the development of regional electricity markets. According to the SKM Market Predictor's report[29], the Nordic power balance will strengthen in the 2020s due to the increases in generation of wind and nuclear energy. Overall, the supply of electricity is predicted to increase by 70 TWh, while the demand of electricity is estimated to grow only by 45 TWh in the Nordics by 2030. Thus, the electricity exports from the Nordics will increase by 2030, particularly to the UK and Germany.

As for ensuring the generation adequacy in light of the renewable energy contribution, including demand response and storage, the Finnish strategic reserve system plays a significant role. The strategic reserve system is open to participation from demand response facilities, as well. The power reserve system39 (strategic reserve) secures the security of electricity supply in Finland in situations in which the market-driven production of electricity does not cover consumption. The system has been in use since the beginning of 2007. Both power plants and facilities capable of demand-side flexibility can participate in the power reserve. The Energy Authority defines the size of the power reserve required in Finland, organises the competitive tendering process for plants to be included in the reserve, confirms the terms of the reserve and monitors the operation of the system and compliance with the law. The total power reserve capacity over the period 1 July 2017 – 30 June 2020 is 729 MW. Thus, the national target for the security of supply related to the adequacy of electric power has been defined indirectly through the size of the power reserve. The National Energy and Climate

[39] The act on the power reserve ensuring balance between generation and consumption of electricity (117/2011). http://finlex.fi/fi/laki/ajantasa/2011/20110117

Strategy outlines that the Government will define the target for the security of electricity supply associated with the adequacy of electric power according to Electricity regulation. The target will be defined once the Commission has approved the methodology compliant with the EU's regulation.

Demand response and storage are further promoted by applying the proposals by Smart grid working group, as discussed in Chapter 3.4.3. These initiatives include inter alia the definition of the improved functionalities of next generation smart meters and discontinuation of the flexibility implemented by distribution network operators to encourage market-based initiatives. Overall, the proposals by the Smart grid working group highlight the significance of market-based solutions for demand response and storage.

Finland has set binding reliability standards to the distribution system operators to ensure resilience in electricity distribution networks especially in severe weather conditions. The Electricity Market Act (588/2013) sets limits for power outages following extreme weather conditions. According to the Electricity Market Act, the distribution networks must be designed and built in a way that the longest allowed interruptions in electricity delivery are maximum 6 hours in urban areas and maximum 36 hours in rural areas. The electricity distribution companies are free to choose the measures with which they are going to fulfil these obligations. One possible measure is to change the overhead power lines into the electric cables. These requirements have to be fulfilled stepwise by 2028. By the end of 2019, 50 % of the distribution network has to be within the time limits. Already now significant decrease in outage durations and number of customers affected by the outages has been observed.

Concerning the electricity transmission power lines, they are already built in a way that storms or snow does not cause interruptions in power transmission.

An integral part of the energy security dimension is also the regulation on risk-preparedness in the electricity sector. The regulation sets the rules governing the cooperation between Member States to prevent, prepare for and manage electricity crisis situations. Cooperation is carried out in the spirit of solidarity and transparency, taking fully into account the requirements of the competitive market for electricity. The regulation includes provisions related to the assessment of risks in the security of electricity supply, drawing up risk-preparedness plans in case the risks are realised, the management of electricity crisis situations, ex-post evaluation of the crisis situations and different types of monitoring.

According to the regulation (Regulation (EU) 2019/941 of the European Parliament and of the Council of 5 June 2019 on risk-preparedness in the electricity sector and repealing Directive 2005/89/EC), the competent authority in each Member State, including Finland, should publish a preparedness plan based on national electricity crisis scenarios. The preparedness plan should include all planned or introduced measures to prevent, prepare for or mitigate an electricity crisis situation. The preparedness plan should also include regional and bilateral measures to ensure that electricity crises with cross-border effects are appropriately prevented and managed.

Finland will prepare and publish its own preparedness plan according to the timetable defined in the regulation.

The National Emergency Supply Agency has been actively promoting cybersecurity in the energy sector by carrying out sector-specific cybersecurity exercises, programs and sharing best practices. One example is KYBER-ENE project[40] which was carried out together with energy sector companies and VTT research center.

Gas

In 2017, the National Emergency Supply Agency as a competent authority prepared plans for the prevention of risks in the security of supply of natural gas (prevention plan) and for measures to be taken in disruptions of supply (emergency plan). The natural gas section of the Oil pool, a part of Finland's security of supply organisation, has also been engaged in the work. The plans are based on the repealed regulation of the European Parliament and of the Council concerning measures to safeguard security of gas supply (994/2010). Concerning the implementation of the Risk Preparedness Regulation and the preventive action and emergency plans for gas, Finland is part of the risk group which includes also Estonia, Latvia and Lithuania. The preventive action and emergency plans have been actively prepared by the group.

The prevention plans and emergency plans complying with the Regulation of the European Parliament and of the Council EU No 2017/1938 concerning measures to safeguard security of gas supply and repealing Regulation (EU) No 994/2010 (Security of Gas Supply Regulation) must be published and the Commission must be informed of them at the latest on 1 March 2019. The Commission informs the Gas Coordination Group (GCG) of notifications concerning the plans and publishes them on the Commission's website. The plans were published[41] and Commission was informed on 30 October 2019. Plans were made in close cooperation with the Baltic countries.

The security of natural gas supply in Finland has been good, and there have been no significant disruptions in the supply over the past twenty years. In the event of a disruption in Finland's largest individual gas infrastructure, the remaining infrastructure will be able to satisfy the total demand for gas for 24 hours during peak consumption.

In Finland, the most challenging situation in terms of the supply norm set in the Regulation would be a situation in which the procurement of gas from Russia to Finland is interrupted entirely for a longer period of time. During a long-term disruption in the gas supply, biogas or LNG fed into the network would be supplied to protected gas customers, i.e. households that have joined the distribution network.

[40] https://www.huoltovarmuuskeskus.fi/energia-ala-kehitti-yhteiset-toimintatavat-kyberuhkia-vastaan/
[41] https://cdn.huoltovarmuuskeskus.fi/app/uploads/2019/10/31111328/Finland-gas-preventive-action-plan-and-emergency-plan.pdfhttps://cdn.huoltovarmuuskeskus.fi/app/uploads/2019/10/31111328/Finland-gas-preventive-action-plan-and-emergency-plan.pdf

Balticconnector, the gas pipeline connecting the gas networks of Finland and Estonia, will be introduced into use towards the end of 2019.

Finland has implemented projects to build import terminals for liquefied natural gas: the first terminal was completed in Pori in autumn 2016 and the second one was completed in Tornio in 2019. There are no plans to connect these terminals to the gas transmission network. The LNG terminal to be constructed in Hamina will be connected to the local supply network and is estimated to be in use in 2020.

Most of the natural gas consumption can quickly be replaced by alternative forms of energy or by shifting to an alternative fuel. Fuels that can replace natural gas primarily include light and heavy fuel oil and, for gas-specific use, liquefied petroleum gas, LNG and biogas that is injected into the natural gas network. One alternative in disruptions in the availability of natural gas may also be to adapt production or to interrupt it.

The users of natural gas, except from consumer-clients, are primarily responsible for their own preparedness plans and the operability of the reserve fuel systems possibly related to them, the buffer stocks of reserve fuel and the organisation of the required transports.

To prepare for any disruptions in the availability of imported energy and to meet its commitments under international obligations, Finland keeps reserves of imported fuel covering on average the normal consumption of five months. This amount does not include the natural gas consumption by industry. As regards natural gas, the reserves comprise compulsory stockpiles of companies and state-owned reserves.

ii. Regional cooperation in this area

Regional cooperation in the field of energy security is carried out in the Electricity Market Group operating under the Nordic Council of Ministers. Among other things, the working group monitors the estimations ENTSO-E and the Nordic transmission system operators make of the adequacy of electric power.

Cooperation related to the security of gas supply is carried out between the authorities in Finland and the Baltic States. The authorities have drawn up contingency plans for gas supply.

General cooperation related to the security of energy supply is carried out between the Nordic emergency supply organisations (NordBER, Nordisk Beredskapsforum).

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

The emergency stockpiling of imported fuels is financed through a strategic stockpile fee. No specific requirements regarding the security of supply are related to biofuels. However, a strategic stockpile fee is also levied on biofuels.

3.4 Dimension internal energy market

3.4.1 Electricity infrastructure

i. Policies and measures to achieve the targeted level of interconnectivity as set out in point (d) of Article 4

The National Energy and Climate Strategy outlines that well-functioning regional and European electricity markets and sufficiently strong cross-border connections are the most efficient and cost-effective ways of guaranteeing competitive electricity prices and security of supply. The electricity market act (sähkömarkkinalaki 588/2013) requires the transmission system operator Fingrid to improve its grid according to the reasonable needs of its users and also requires Fingrid to develop the transmission grid in a way that Finland remains as one bidding zone.

ii. Regional cooperation in this area

The Nordic transmission system operators work in close cooperation for the development of the electricity infrastructure. They publish a common Nordic Grid Development Plan every other year. The latest joint plan was launched in August 2019[42]. Also, the ministries in the Nordic countries cooperate in the electricity market field through the Electricity Market Group operating under the Nordic Council of Ministers and the national regulatory authorities through NordREG[43]. Cooperation between the Nordic countries in the electricity market has been intensified by establishing a cooperation forum, Nordic Electricity Market Forum[9] for the ministries, regulatory authorities, transmission system operators and market participants.

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

The transmission system operator Fingrid has announced it will apply for CEF funding for the new cross-border connection between Finland and Sweden on the Project of Common Interest list. Fingrid and Svenska Kraftnät will finance the rest of the investment. The Finnish Government fully support this project.

[42] Nordic Grid Development Plan 2019, https://www.fingrid.fi/en/pages/news/news/2019/nordic-grid-development-plan-2019/
[43] NordREG, http://www.nordicenergyregulators.org/

3.4.2 Energy transmission infrastructure

i. Policies and measures related to the elements set out in point 2.4.2, including, where applicable, specific measures to enable the delivery of Projects of Common Interest (PCIs) and other key infrastructure projects

The electricity market act (sähkömarkkinalaki 588/2013) requires the transmission system operator Fingrid to improve its grid according to the reasonable needs of its users. The investments made in the projects described in Chapter 2.4.2 are based on this obligation.

The natural gas market act (maakaasumarkkinalaki 587/2017) sets an obligation for the natural gas system operators to develop the network. The system operator must maintain, use and develop its natural gas network and connections to other networks in accordance with customers' reasonable needs and for its part secure the supply of natural gas to customers. The transmission system operator must also build sufficient cross-border transmission capacity for the integration of the European transmission system if building it is required from the financial point of view to satisfy reasonable and technically feasible demand for natural gas and to pay attention to the security of supply of natural gas.

The Finnish Government has established a separate company, Baltic Connector Oy, to lead the construction of the Balticconnector gas pipe connection between Finland and Estonia. The unbundled Gas Transmission System Operator (Gasgrid Finland), which will start it operations on 1 January 2020, will operate the Balticconnector pipeline as part of the Finnish transmission system.

ii. Regional cooperation in this area

The regional cooperation in the electricity market has been described above in Chapter 3.4.1.

In 2015, the ministries, the national regulatory authorities and the gas transmission system operators in Finland and the three Baltic states established a regional group for the coordination of the regional gas market and will work in close cooperation within this coordination group to create a regional gas market from the beginning of 2020.

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

The Balticconnector gas pipeline project on the Project of Common Interest list received EUR 187.5 million through the EU's CEF funding instrument. Finnish Baltic Connector Oy and Estonian Elering As will finance the rest of the project's costs.

3.4.3 Market integration

i. Policies and measures related to the elements set out in point 2.4.3

The regional electricity market formed by the Nordic and the Baltic states is promoted through cooperation of the ministries, regulatory authorities, transmission system operators and market participants.

The Nordic cooperation has been further strengthened by the Nordic Council of Ministers' decision to establish a Nordic Electricity Market Forum. The first Nordic Electricity Market Forum was held in Stockholm in November 2018 and resulted in a new and ambitious vision for the Nordic electricity market[44]. The vision states that

> *In 2030, the Nordics should have the world's most competitive, innovative and consumer-oriented electricity market, that contributes to reaching the Nordic climate goals.*

In the first forum the forum participants agreed that there are grounds for annual Nordic Electricity Market Forums as a venue for:

- Communication, collaboration and creating synergies among the different types of stakeholders related to the electricity market (e.g., producers, consumers, TSOs, regulators, etc.)
- Interactions between electricity market policy makers and non-policy stakeholders
- Input on joint Nordic standpoints on electricity market issues e.g. in relation to new EU regulations on electricity markets
- Discussions on forward-looking themes, such as visions and long-term strategies specific to the Nordic electricity market, as well as preparation of relevant action plans

This work was further strengthened by the Nordic Prime Ministers Declaration on Nordic Carbon Neutrality[45], adopted in January 2019. The vision was also further discussed and endorsed by the Nordic Energy Ministerial meeting in June 2019.

The 2019 Nordic Electricity Market Forum continued to address the vision and the action points formulated in the roadmap[46]. Different stakeholders presented news and priorities for the electricity

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[44] 2030 Vision for the Nordic Electricity Market
https://nordicelforum.org/wordpress/wp-content/uploads/2019/06/Vision-for-the-nordic-electricity-market-EN_2.pdf

[45] https://www.ym.fi/download/noname/%7B5CF4258D-8264-4F5C-8527-081CCBBF2AE2%7D/143425

[46] ROADMAP FOR REACHING THE NORDIC ELECTRICITY MARKET VISION
https://nordicelforum.org/wordpress/wp-content/uploads/2019/06/Handlingsplan-for-at-opn%C3%A5-2030-visionen-FINAL.pdf

market – giving an overview of status quo in the Nordic region. The forum is also a place for discussion – and together the participants can contribute to setting the scene and making the Nordic countries achieve the 2030 electricity market vision.

The construction of the Balticconnector gas pipeline between Finland and Estonia will enable the opening and renewal of the gas market. When this investment is completed, the derogation from the Internal Market in Article 49(1) of the Natural Gas Directive will be dropped, and the gas market will be fully open for competition from the beginning of 2020. In the new natural gas market act (maakaasumarkkinalaki 587/2017)[47], price regulation of piped gas will be dropped, and gas marketplaces and internal market rules will be introduced. In 1 January 2020 Finland will join a common regional gas market area with Estonia and Latvia (FINESTLAT-gas market area). Finland also aims at joining a regional entry-exit system with Estonia and Latvia from 1 January 2022. The final objective is to create a regional gas market comprising Finland and the three Baltic states including also Lithuania. The creation of the regional gas market is being prepared between the ministries, the national regulatory authorities and the gas network operators in Finland, Estonia, Latvia and Lithuania.

ii. 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 curtailment, real-time price signals, including the roll-out of intraday market coupling and cross-border balancing markets

Increasing the level of flexibility is part of the regional cooperation described above. As regards the electricity markets, the countries already have a single day-ahead market and an intra-day market[48]. On 9 March 2018, five Nordic transmission system operators concluded a cooperation agreement on the development of a new Nordic balance service model[49].

See also sub-point v below.

[47] http://www.finlex.fi/fi/laki/ajantasa/2017/20170587
[48] www.fingrid.fi/en/pages/news/news/2018/nord-pool-restructures-for-the-future/
[49] www.fingrid.fi/sivut/ajankohtaista/tiedotteet/2018/pohjoismaisen-tasehallintasopimus-julki-ja-tasehallintarakenne-ehdotus-toimitettu-energiavirastolle/#

iii. Where applicable, measures to ensure the non-discriminatory participation of renewable energy, demand response and storage, including via aggregation, in all energy markets

iv. 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 requirements related to consumer protection have been included in the electricity market act (sähkömarkkinalaki 588/2013) currently in force[32]. On 1 February 2019, an amendment regarding a centralized information exchange database called Datahub that will provide each party in the electricity market with all relevant information on electricity trade came into force. The Datahub will enable more efficient and consistent data communications, which will be essential for future electricity retail market. This kind of common platform is also vital to developing other opportunities, such as services for enabling significantly better demand flexibility even at an individual consumer level. The project has already started and is expected to be completed at the beginning of 2022.

To improve the competitiveness of the retail market, the Energy Authority publishes on its website an independent electricity price service, www.sahkonhinta.fi, in which users of electricity can compare the electricity offers of different sellers. The service is free of charge and available to all users and sellers of electricity.

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

In terms of the adequacy of electric power, it is also important that the preconditions for combined power and heat generation remain as part of an energy-efficient and low-emission energy system with a high degree of security of supply.

In October 2018, the Smart grid working group appointed by the Ministry of Economic Affairs and Employment proposed an extensive operational programme for increasing the demand-side response of electricity and the opportunities for customers to participate. The working group's key proposals [50] were:

- Clarifying the roles of actors in the market-based implementation of demand-side response (e.g. principles for the storage of electricity, discontinuation of the flexibility implemented by distribution networks)
- Improving of the operating preconditions for different energy communities and aggregation models
- Defining the functionalities of next generation smart meters
- Enabling flexibility in the operation of grid companies

[50] http://urn.fi/URN:ISBN:978-952-327-346-7

- Enabling joint invoicing for all sellers

The Ministry of Economic Affairs and Employment is currently implementing these proposals along with the Clean Energy Package implementation. The implementation is well under way in Finland. Many elements of the flexibility requirements already exist in the Finnish electricity market legislation, such as fully liberalised retail markets, balancing responsibility, customers' ability to choose dynamic tariffs, 100 % roll-out of smart meters etc.

The objective set in the Government's Energy and Climate Strategy is to create a regional gas market for Finland and the Baltic states. The ministries, the national regulatory authorities and the gas transmission system operators in Finland and the Baltic states work in close cooperation within the group for the coordination of the gas market to create a regional gas market for the beginning of 2020. Finland's aim is to join the regional gas market step by step. In the first stage, the aim is to join the regional agreement between the transmission system operators on the removal of capacity payments at interconnection points, harmonisation of feed-in charges and the compensation mechanism for transmission charges. In the second stage, the aim is to form a regional balance area.

3.4.4 Energy poverty

i. Where applicable, policies and measures to achieve the objectives set out in point 2.4.4

Finland does not have national indicative objectives to reduce energy poverty as indicated already in Chapter 2.4.4. The prevention of energy poverty is part of general social policy. Non-energy specific measures to mitigate energy poverty are presented in Chapter 2.4.4.

Ministry of Environment has conducted two studies regarding energy poverty in Finland[33, 34], Problems relating to energy poverty are mainly targeted in Finland through social aid schemes to guarantee sufficient indoors temperature and supply of electricity for households. In addition, the Social Insurance Institution of Finland (Kansaneläkelaitos) provides security deposits to the energy companies. If the energy company requires a deposit from its customer, the customer may apply for the security deposit from Kansaneläkelaitos in connection with income support (toimeentulotuki). This so-called "electricity security deposit" relieves energy poverty concerns of people in the most vulnerable situations.

Energy advisory services and support for energy efficiency improvements are used to reduce household energy costs. Changes in consumption habits may reduce the energy costs 5–35 %. Sustainable development company owned by the State of Finland (Motiva) provides energy advice for consumers related to living, building and redecorating, heating options and mobility.

National electricity and gas market regulation include detailed restrictions for energy companies' right to stop the service in case of unpaid bills. For example, according to the Electricity Market Act (588/2013), electricity service to eletrically-heated building cannot be cut between beginning of October and end of April before four months have passed from the date of non-payment.

3.5 Dimension research, innovation and competitiveness

i. Policies and measures related to the elements set out in point 2.5

ii. Where applicable, cooperation with other Member States in this area, including, where appropriate, information on how the SETPlan objectives and policies are being translated to a national context

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

Finland supports research, innovation and competitiveness in energy technology with a number of measures, of which energy aids are crucial. Based on project assessments, the Ministry Economic Affairs and Employment and Business Finland may grant energy aid to companies, municipalities and other organisations for investment and research projects that promote the use of renewable energy or energy efficiency.

The purpose of energy aid is particularly to promote the introduction and placing on the market of new energy technology. Energy aid plays an important role in the innovation chain when the development of the technologies is already advanced and the first commercial targets are sought. This way, the competitiveness of companies operating in Finland and the creation of new jobs can be supported. Energy aid can be granted to companies, municipalities and other communities. The aid is not granted, for example, to housing companies, residential properties or farms.

The primary purpose of the aid is to enhance the profitability of early-stage investment and minimise the risks associated with the introduction of new technology.

In the 2018 central government budget, the grant authority for energy aid was EUR 55 million. The budget authority for energy aid is established annually in the central government budget. In the past few years, aid has also been granted for certain specific purposes through separate budget reserves. In total, the Government has allocated EUR 100 million to investments in renewable energy and new technology for the period 2016–2018.

At the beginning of this decade, Finnish Funding Agency for Innovation Tekes made large investments in SHOK programmes (Strategic Centres for Science, Technology and Innovation). Of the energy and environmental sector programmes, SGEM (Smart Grid and Energy Markets) has produced significant competence that can be utilised in the development of intelligent electricity networks and smart control. The FLEXe programme (Flexible Energy Systems) initiated an examination of the requirements for a flexible energy system. Companies have taken the lead in utilising the programme's research findings. The project completed in 2016 investigated the building of an intelligent and flexible energy system in the Åland Islands.

The Smart Energy programme of Business Finland was launched in 2018. It develops test platforms and innovation ecosystems that boost the competitiveness of Finnish companies and exports of Finnish expertise in the growing international markets and also attracts investments to Finland. The ecosystems will open up opportunities also for SMEs to enter energy markets, in which large investments are necessary.

The development of new business and new solutions requires opportunities for experimentation. Test platforms offer the opportunity to conducts experiments and pilots and to implement research and development projects in the programme focus areas. These include smart networks, renewable energy, energy efficiency, sustainable and smart energy solutions and systems, their related products and services, and resources-wise solutions based on user needs. Instead of developing an individual technology, the intentions is to develop ecosystems and integrate technology into a smart system. The aim is to create to Finland several test platforms that are internationally attractive and will also bring investments to Finland.

The importance of the Mission Innovation cooperation is growing. Finland was accepted to the Mission Innovation initiative in October 2016. When joining, Finland made a promise to double the public innovation funding for clean energy by 2020. The starting level was the average of the funding granted by TEKES to projects on renewable energy sources, storage of energy, energy systems and energy networks between 2013 and 2015 plus the average of the energy aid allocated to new energy technologies in the same theme areas over the same time period by the Ministry of Economic Affairs and Employment. Calculated in this manner, the starting level of public funding for RD&I in clean energy settled at EUR 54.7 million, which would be EUR 109.4 million when doubled in accordance with the objective. When doubling, also the demonstration aid for new technologies allocated to the key projects in the field of energy are taken into account. This was EUR 20 million in 2016 and EUR 40 million in 2017 and 2018. Finland is quite well on the track of the Mission Innovation cooperation doubling target towards EUR 109.4 million in 2021, since the contribution in 2018 was EUR 92.9 million and the increase from the baseline almost 70 %.

Finland also participates in the Clean Energy Ministerial (CEM) cooperation, the first meeting of which was held in Washington in 2010. The participating countries account for about 80 % of global energy use. A central part of CEM's operation consists of initiatives covering the following themes: bioenergy, CCS, energy and women, Clean Energy Solutions Centre, electric cars, energy efficiency, smart electricity network, solar and wind energy, solar energy and LED, hydropower and sustainable development. Finland participates in the Electric Vehicles and Smart Grids initiatives. Finland has also joined the 21st Century Power Partnership initiative, the Women in Energy (C3E) initiative and the until 30 campaign related to it, and the campaign promoting the more flexible use of power plants and electric transport between cities (Pilot City Programme).

Finland – China (Business Finland – MoST) joint call related clean energy collaboration was opened in the end of 2018. Joint Call in Smart Energy theme with Germany was launched and 10 joint projects were funded.

Finland has also been actively involved in the operation of the SET-Plan. The SET-Plan combines the promotion and better coordination of energy technology in the EU and the EEC countries. A total

of 14 implementation plans have been prepared in the SET-Plan between 2016 and 2018. Finland has participated actively in the preparation and introduction of these implementation plans. Finland has been chairing and co-chairing preparation of two implementation plans (Action 6 and Action 8) and continues chairing the related Implementation Working Groups. A good example of the flexibility of the SET-Plan is the eBattery plan. Finland participates in the implementation of the plan and has also strengthened its own activities, for example, through Business Finland's ”Batteries from Finland” 2018–2020 activation programme. Finland has launched ecosystem type of consortium named BatCircle, where over 30 companies, universities and research institutes are involved. Finland also is active in Set Plan key action no 7. “Batteries for e-Mobility and Stationary Storage” where Finland is leading working group related battery recycling. This is a good example how SET-Plan objectives and policies are translated into national use.

Business Finland, the Finnish funding organization for innovation, is actively advancing ecosystems promoting low-carbon business. For example so called Growth Engines are being funded. The name Growth Engine describes cooperation networks − ecosystems − aimed at new business activities amounting to more than one billion euros. Growth Engines are implemented through an enterprise-driven partnership model between companies, research organizations and public actors, which strives to find solutions to global market disruption and create new growth sectors in Finland.

Growth Engine funding enables collaboration between companies of different sizes, research organizations and public actors to achieve a common concrete business goal, launching a new operator, a platform company to achieve a business goal and the construction of the platform company's business.

The Government has directed EUR 60 million of capital funding for Growth Engines in 2018 (EUR 30 million) and 2019 (EUR 30 million). In addition, Business Finland directs its normal funding (about EUR 200 million 2018–19) and services to projects that meet the ambitious and funding criteria of companies, research organizations and communities operating in Growth Engines, aiming at achieving a Growth Engine’s business objective.

Growth Engines operate currently in the fields of Carbon compensation, smart port and marine services, artificial intelligence and new solutions for a societal scale model of renewable energy production.

SECTION B: ANALYTICAL BASIS

4 CURRENT SITUATION AND PROJECTIONS WITH EXISTING POLICIES AND MEASURES

4.1 Projected evolution of main exogenous factors influencing energy system and GHG emission developments

i. Macroeconomic forecasts (GDP and population growth)

ii. Sectoral changes expected to impact the energy system and GHG emissions

iii. Global energy trends, international fossil fuel prices, EU ETS carbon price

iv. Technology cost developments

Economic growth and the change in the structure of the economy play a key role in the estimation of energy consumption and emissions. The economic outlook provided by the Ministry of Finance forms the basis for the estimate regarding the development of the Finnish economy in the near future, whereas longer-term development assumptions are based on the *Uutta, vanhaa ja sinivalkoista – Suomi 2040* -report of VTT Technical Research Centre of Finland Ltd [51] and the modelling related to the report. Table 13 shows the GDP and the average annual increase of the national economic output during the period 2016–2040. In the case of forest industry, the growth assumptions are based on the expertise of Pöyry Management Consulting and published in the report Suomen metsäteollisuus 2015–2035[52].

Table 13. GDP and the average annual increase of the national economic output in the projections.

	2016	**2020**	**2030**	**2040**
GDP, million EUR in 2016 prices	216,111	231,000	285,000	354,000
		2016–2020	**2020–2030**	**2030–2040**
Annual growth		1.6 %	2.1 %	2.2 %

The Finnish economy has experienced a structural change in the 2010's, where the role of services has increased and traditional industries have been forced to adapt to changes in global demand and competition. The Government is carrying out major reforms in order to cut expenditures of the public sector and to bring the Finnish economy onto a path of sustainable growth and higher employment.

[51] https://www.vtt.fi/inf/pdf/technology/2018/T327.pdf
[52] Suomen metsäteollisuus 2015 – 2035. Loppuraportti X304203, 19.1.2016, Pöyry Management Consulting, https://tem.fi/taustaselvitykset

The impact of the reforms is included in the economic growth assumptions of the WEM and WAM projections.

With these fairly high economic growth assumptions the industrial activity, and hence also the energy demand, increases steadily during the projected period. If the assumed economic growth level, however, is not reached, one can expect the greenhouse gas emissions to be lower than the projections indicate.

The population growth in the projections is based on the population forecast drawn up by Statistics Finland. The development of the population is presented in Table 14.

Table 14. Population [mill. inhabitants].

2016	2020	2025	2030	2035	2040
5.50	5.60	5.69	5.77	5.83	5.86

Assumed fossil fuel prices in the world market and the assumed prices of emissions allowances in the EU's emissions trading system correspond to the values recommended or suggested by the Commission for greenhouse gas emission projections. The default values are presented in Table 15.

Table 15. The prices of the EU ETS emission allowances and fossil fuels [euros in 2016 prices].

	2020	2025	2030	2035	2040
EU ETS, EUR/t CO_2	15.5	23.3	34.7	43.5	51.7
Crude oil, EUR/GJ	13.86	15.73	17.33	18.08	19.14
Coal, EUR/GJ	2.64	3.16	3.79	4.01	4.18
Natural gas, EUR/GJ	8.91	9.64	10.49	11.20	11.58

The assumptions for technology cost development that are used in the electricity market modelling work are presented in Table 16. The figures represent levelized cost of energy (LCOE) in 2016 prices for given technologies.

Table 16. Technology cost development [euros in 2016 prices].

Levelized Cost of Energy (LCOE)	2020	2025	2030	2035	2040
Combined Cycle Gas Turbine (new)	65.5	64.0	68.3	71.4	73.8
Hard Coal (new)	78.8	82.6	87.2	92.2	94.3
Bio-CHP	47.2	50.1	53.1	55.1	57.0
Wind Power - onshore	33.7	33.1	32.1	30.9	30.0
Wind Power - offshore	66.9	60.6	53.9	48.1	42.9
Solar Power - large scale	70.0	64.3	59.2	54.6	50.5
Solar Power - small scale	81.9	76.8	71.8	66.8	61.8

4.2 Dimension Decarbonisation

4.2.1 GHG emissions and removals

i. Trends in current GHG emissions and removals in the EU ETS, effort sharing and LULUCF sectors and different energy sectors

ii. Projections of sectoral developments with existing national and Union policies and measures at least until 2040 (including for the year 2030)

Transport

The greenhouse gas emissions from domestic transport totalled 11.3 Mt CO_2 equivalent in 2017. Transport emissions account for approximately a fifth of Finland's total greenhouse gas emissions and some 40 % of emissions in the effort sharing sector. Greenhouse gas emissions from domestic transport increased from the economic depression in the early 1990s until 2007. Since 2008, they have mainly been decreasing. From 2005 to 2017, greenhouse gas emissions from transport dropped by some 1.3 million tonnes in total, or by 10 %.

The WEM projection for transport is based on the traffic performance projected until 2030 by the Ministry of Transport and Communications and VTT. According to the projection, road transport performance will increase in 2016–2020 by approximately 0.9 % a year and in 2021–2030 by approximately 0.8 % a year. This rate would result in a total increase of 12 % in road transport performance by 2030. Another key assumption in the WEM projection is the replacement rate of cars and the average CO_2 emissions of new vehicles. In the WEM projection, the annual replacement rate of cars is estimated at approximately 5 %. In 2020, the specific emissions of new cars would be close to the limit of 95 g/km that the EU has established for car manufacturers, but they would no longer decrease after 2020 without new (EU-level) measures. The third factor with a substantial impact on transport greenhouse gas emissions in the WEM projection is the share of biofuels in the total consumption of fuel in transport. In the WEM projection, the actual share of biofuels is estimated at 13.5 % in 2020 and onwards. The estimate is based on the act on promoting the use of biofuels in transport (laki biopolttoaineiden käytön edistämisestä liikenteessä 446/2007), which stipulates that biofuels must account for a calculated share of 20 % of all transport fuels sold in 2020. The quota obligation allows 'double counting', in which certain biofuels that do not compete with food production count double for compliance with the target. The WEM projection is based on the assumption that starting from 2020 the share of non-double counted biofuels will be 7 % and the share of double counted biofuels 6.5 %. Thus, the calculated share of biofuels would be 20 % while their actual share would be 13.5 % in 2020–2030.

Agricultural sector

The emissions reported by Finland in the agricultural sector in 2017 totalled about 6.5 Mt CO_2 equivalent. The agricultural sector accounts for approximately 12 % of Finland's total emissions and some 22 % of emissions from the effort sharing sector. Emissions from the agricultural sector have remained at the same level between 2005 and 2017. According to the WEM projection, total emissions from agriculture are estimated to slightly increase from 2005 to 2020, but in 2030 they will be below the 2005 level.

Building-specific heating

Emissions from heating buildings are divided between the EU ETS sector and the effort sharing sector. In the effort sharing sector, the main source of emissions was building-specific oil heating. Emissions from certain small heating plants are also included in statistics concerning the effort sharing sector. In 2017, the emissions from building-specific heating amounted to 2.6 Mt CO_2 equivalent in the effort sharing sector, which is about 9 % of the sector's total emissions. The majority of these emissions were generated by oil heating. Emissions from building-specific heating have declined in recent years, but there has been some fluctuation because of year-to-year variation in temperatures. The majority of emissions from building-specific heating are produced in the heating of residential buildings followed by the heating of commercial and public buildings.

Waste management

Greenhouse gas emissions from waste management totalled 1.9 Mt CO_2 equivalent in 2017, or 6 % of Finnish emissions in the effort sharing sector. The most significant greenhouse gas produced in waste management is the methane emitted from landfills. Waste management emissions in the effort sharing sector also include the greenhouse gases produced in the biological treatment of waste and in the disposal and treatment of waste water: CO_2, methane and nitrous oxide. These emission sources are of a limited importance, and their emission volumes are stable. Greenhouse gas emissions from waste management have reduced by approximately a third from 2005 to 2017. Greatest reductions have been achieved in methane emissions from landfills as landfilling of organic waste has decreased. The increased use of digestion in the biological treatment of waste has slightly reduced the CO_2 emissions of biological treatment. However, CO_2 is still being emitted from the digestion residue that will be composted and the remaining compost windrows. According to the WEM projection, emissions from the waste management sector will decrease by around 60 % by 2030 compared to 2005 levels.

Emissions from waste used as energy are included in the energy sector. They are covered by the EU ETS when waste is being burned together with other fuels as 'co-incineration' for example in power plants at industrial facilities. In 2030, total emissions from waste incineration will amount to approximately 0.8 Mt CO_2 equivalent, of which some 0.6 Mt CO_2 equivalent will be emissions from waste incineration plants included in the effort sharing sector.

F-gases

In 2017, F-gas emissions totalled 1.3 Mt CO_2 equivalent, which currently equals to approximately 2 % of all greenhouse gas emissions and approximately 4 % of emissions in the effort sharing sector.

The emissions peaked in 2014 at approximately 1.46 Mt CO_2 equivalent. Fluorinated greenhouse gases (F-gases) are used for example as refrigerants and extinguishing agents and in plastic foaming.

Measures under the original F-gas Regulation, applied between 2007 and 2014, and the new F-gas Regulation and the Mobile Air Conditioning Directive (MAC Directive) are estimated to reduce F-gas emissions to 0.59 Mt CO_2 equivalent by 2030 and further to 0.24 Mt CO_2 equivalent by 2040.

Machinery

In total, various types of machinery currently account for 8 % of emissions in the effort sharing sector. In 2017, total emissions from machinery were 2.4 Mt CO_2 equivalent per year.

Machinery is used in industry and construction, trade, services, the public sector, households, agriculture and forestry. Machinery is usually equipped with combustion engines. Quantitatively, the most common fuel is gasoil but petrol is also used. Among machinery emissions, CO_2 is the most significant greenhouse gas, but machinery also emits small quantities of methane and nitrous oxide.

Industry

The energy-related emissions from industry total 10.3 Mt CO_2 equivalent, of which 0.9 Mt CO_2 equivalent originated from non-ETS activities in 2016. Energy related emissions are mainly CO_2 emissions and they originate from all branches of industry. These days, the EU ETS also covers more than 90 % of the industrial process emissions. According to the WEM projection, industrial activities continue to grow. As a result, the energy-based and process emissions will also slightly increase, amounting to approximately 11 Mt CO_2 equivalent in 2030. Industry is becoming more energy efficient and produce fewer emissions, which will offset the increase in emissions due to growth in industrial activities. Thus, in the WEM projection, energy-related emissions from industry will remain at their current level throughout the 2020's.

Energy industry

The greenhouse gas emissions from the energy industry were 18.7 Mt CO_2 eq. in 2016. Although the emissions vary considerably from year to year, the trend is a steady decline. District heating emissions vary according to the heating demand (cold or warm winters) whereas the emissions from condensing power vary depending on the hydro situation in the Nordic-Baltic electricity market. Future years are in the projections assumed to be standard years with respect to heating demand and hydro levels (i.e. long-term average plus impact of climate change).

The emissions from the energy industry mainly fall in the scope of the EU emissions trading system (EU ETS). In addition to the EU ETS, the energy industry is strongly affected by other policy measures to reduce the emissions, to enhance energy efficiency and to increase the share of renewable energy sources.

In the WEM projection, the most significant future changes in electricity and heat production are the startup in 2020 of a 1600 MW nuclear power plant unit currently under construction, one additional

nuclear power plant unit in the late 2020's and the increase in the use of renewable energy sources, mainly wind power and biomass in CHP plants. All these changes reduce emissions.

Small power plants and boilers are not included in the EU ETS. The total emissions of these plants excluding waste incineration plants amount to 0.2–0.3 Mt CO_2 equivalent. In the WEM projection, the emissions from these plants are expected to slightly decrease in the future.

Other fuel consumption

Emissions from the greenhouse gas inventory category *1.A.5 Other non-specified emissions of fuels* amount to 1.1 Mt CO_2 equivalent. The unknown consumption of light and heavy fuel oil, LPG and natural gas account for the largest share of consumption in this subcategory. In practice, the consumed amounts are determined as the difference between total sales and known consumption. The subcategory also includes the fuels consumed by the Finnish Defence Forces, statistical adjustments and smaller emission sources, such as helicopters. According to the greenhouse gas inventory report, uncertainty regarding emissions in this subcategory may be up to ±10–50 %, depending on the fuel, which is substantially higher than in other energy subcategories. In the WEM projection, emissions from this subcategory are expected to increase marginally to approximately 1.2 Mt CO_2 equivalent by 2030 due to growing economic activity.

LULUCF sector

The annual net sink of the LULUCF sector reported by Finland to the United Nations Framework Convention on Climate Change between 1990 and 2017 varied between -14 and (-33.7) Mt CO_2. In 2017, the LULUCF sector was a sink sized -20.4 Mt CO_2 equivalents. As a whole, the LULUCF sector is expected to remain as a sink during the obligation period 2021–2030.

Agricultural land, or arable land and grassland, are a net source of greenhouse gas emissions in Finland, sized approximately 5.4–7.7 Mt CO_2 equivalent per year in the reporting period 1990–2017. Of these, the emissions from arable land account for approximately 90 %. After 2020, the emissions from agricultural lands are expected to increase. The development of the surface area of grasslands and the emissions from these grasslands is expected to continue stable until 2030. The trend of emissions from grasslands has been declining since 1990.

The reported sink of managed forest land has varied between -18.4 and -47.4 Mt CO_2 equivalent between 1990 and 2016. The size of the sinks varies from year to year, mainly as a result of the volume of commercial fellings. In 2017, managed forest lands were a sink sized -27.0 Mt CO_2 equivalents. According to the estimation of the Natural Resources Institute Finland, forests will continue to act as a sink in Finland also in future.

With the exception of 2009, wood products in Finland have mainly been a sink over the period 1990–2017. In 2017, wood products were a reported net sink sized -4.0 Mt CO_2 equivalent. Wood products are estimated to remain sinks during the period 2021–2030.

About 72 % of the land area of Finland is forests. The shift of forests to other land use purposes is estimated to continue for such reasons as the structural change in agriculture and urbanisation. The

emissions from deforestation over the second period of the Kyoto Protocol have been approximately 3.3–3.9 Mt CO_2. The emissions from deforestation during the period 2021–2030 are expected to decline slightly. The most significant factor reducing the emissions from deforestation in the reduction of emissions from the clearing of fields when the oldest cleared sites become managed agricultural lands. During the second period of the Kyoto Protocol, afforestation has in Finland been both a small sink (about -0.2 – -0.4 Mt CO_2 and a small emission in 2015 (0.3 Mt CO_2). According to the estimation of the Natural Resources Institute Finland, afforestation will be a sink until 2030, but the sink gained from afforestation is estimated to continue to decline mainly because of emissions caused by the afforestation of wetlands and agricultural lands.

The decision on including wetlands in the calculations in accordance with the LULUCF regulation for the period 2026–2030 will be made later. The annual emissions from reported wetlands have been approximately 1.3–2.4 Mt CO_2 equivalent during the period 1990–2017. The land area of the areas used in peat production and consequently also emissions from managed wetlands are expected to decline until 2030. However, the current estimations are very uncertain and do not include, for example, the emissions or removals caused by the restoration of mires.

Natural Resources Institute Finland (Luke) is updating long term scenarios and greenhouse gas projections respectively for LULUCF sector based on new data. Their results will be available in 2019.

Figure 11 shows the historical development of greenhouse gas emissions and removals and the estimated development based on the current national and EU policies and measures until 2040.

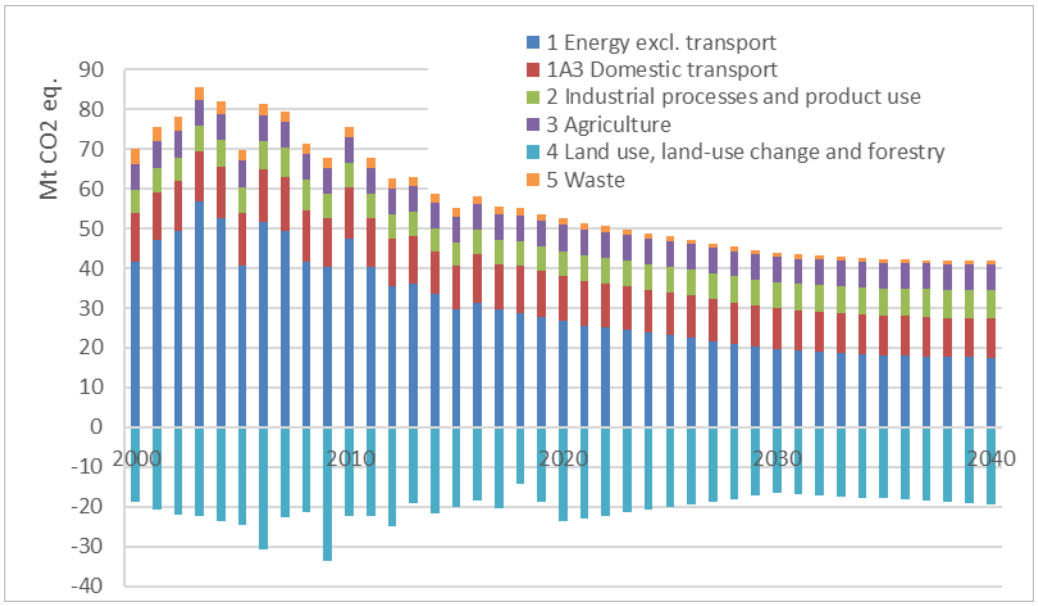

Figure 11. The historical development of greenhouse gas emissions and removals and the estimated development until 2040 based on current national and EU policies and measures.

4.2.2 Renewable energy

i. Current share of renewable energy in gross final energy consumption and in different sectors (heating and cooling, electricity and transport) as well as per technology in each of these sectors

ii. Indicative projections of development with existing policies for the year 2030 (with an outlook to the year 2040)

Finland is one of the world's leading users of renewable energy sources. The most important renewable energy sources are bioenergy wood and wood-based fuels in particular. In addition to that, also hydropower, wind power, air and ground heat pumps and solar energy is used. Renewable energy is one of the most significant means by which Finland's energy and climate targets can be achieved. The current high level of wood utilization in forest industry forms a backbone in meeting renewable energy targets.

The share of renewable energy in the gross final consumption of energy was 41 % in 2017. The EU target for the share of renewable energy in Finland in 2020 is 38 % of the gross final energy consumption and this was reached for the first time in 2014. The share of renewable energy in the gross final consumption in Finland is the second highest among the EU countries.

The share of renewable energy in gross final consumption of energy in 2005, 2010, 2015 and 2017 is presented in Table 17. The shares have been calculated using coefficients and normalisations compliant with the ILUC Directive.

Table 17. Overall and sector-specific share of renewable energy in gross final consumption of energy. Source: Eurostat ShaRES.

	2005	**2010**	**2015**	**2017**
RES	28.8 %	32.4 %	39.3 %	41.0 %
RES-E	26.9 %	27.7 %	32.5 %	35.2 %
RES-H&C	39.1 %	44.2 %	52.6 %	54.8 %
RES-T (with coefficients)	0.9 %	4.4 %	24.8 %	18.8 %

Table 18 shows the amounts of energy from renewable sources in 2005, 2010, 2015 and 2017. The amounts of hydro power and wind power have been normalised using the utilisation periods of maximum load over 15 and 5 years, respectively. The energy quantities in the transport sector correspond to actual quantities without coefficients.

Table 18. Amount of renewable energy as final consumption by energy source in different sectors [TWh]. Source: Eurostat ShaRES.

	2005	2010	2015	2017
RES Overall				
Hydro power	13.9	13.9	14.1	14.5
Wind power	0.2	0.3	2.0	4.5
Solar energy	0.0	0.0	0.0	0.1
Bioenergy	72.6	86.3	94.6	101.5
Heat pump energy	0.6	2.7	4.7	5.1
Total	87.2	103.3	115.6	125.7
RES-E				
Hydro power	13.9	13.9	14.1	14.5
Wind power	0.2	0.3	2.0	4.5
Solar energy	0.0	0.0	0.0	0.0
Biomass	9.5	11.0	11.4	11.9
RES-H&C				
Solar energy	0.0	0.0	0.0	0.0
Biomass	63.1	73.7	77.4	85.1
Heat pump energy	0.6	2.7	4.7	5.1
RES-T (actual contribution without coefficients)				
Liquid biofuels	0.0	1.7	5.7	4.5
Biogas	0.0	0.0	0.0	0.0
Renewable electricity	0.2	0.2	0.2	0.3

Figure 12 presents the historical development of renewable energy between 2000 and 2017 and the projected development based on existing policies until 2030 and an outlook until 2040.

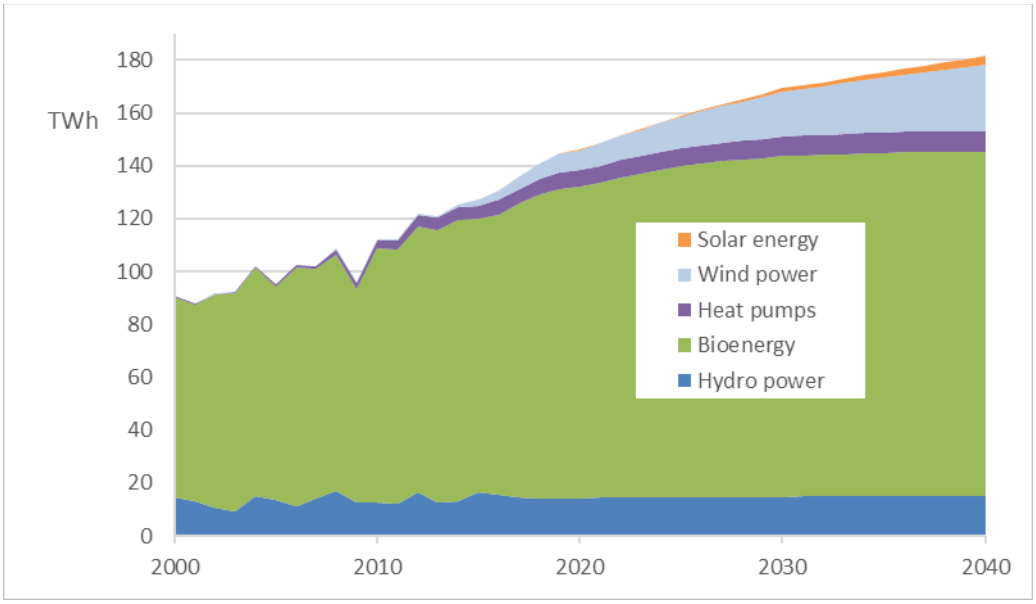

Figure 12. Historical development of renewable energy between 2000 and 2017 and the projected development based on current policies until 2030 and an outlook until 2040.

4.3 Dimension energy efficiency

i. Current primary and final energy consumption in the economy and per sector (including industry, residential, service and transport)

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

iii. Projections considering existing energy efficiency policies, measures and programmes as described in point 1.2.(ii) for primary and final energy consumption for each sector at least until 2040 (including for the year 2030)

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

In the WEM projection, the primary energy consumption in 2030 is 411 TWh and the final consumption of energy 297 TWh. According to sector-specific examination of the WEM projection the final energy consumption in 2030 of the industry would be about 147 TWh, households 59 TWh, the service sector 37 TWh, transport 45 TWh, and other sectors together 8 TWh. Distribution losses and power plants' own use is not included in the final energy consumption figures. There is no estimation of primary energy consumption by sector. Historical development 2005–2017 and projections until 2040 for total primary energy consumption and final energy consumption for each sector are shown in Figure 13.

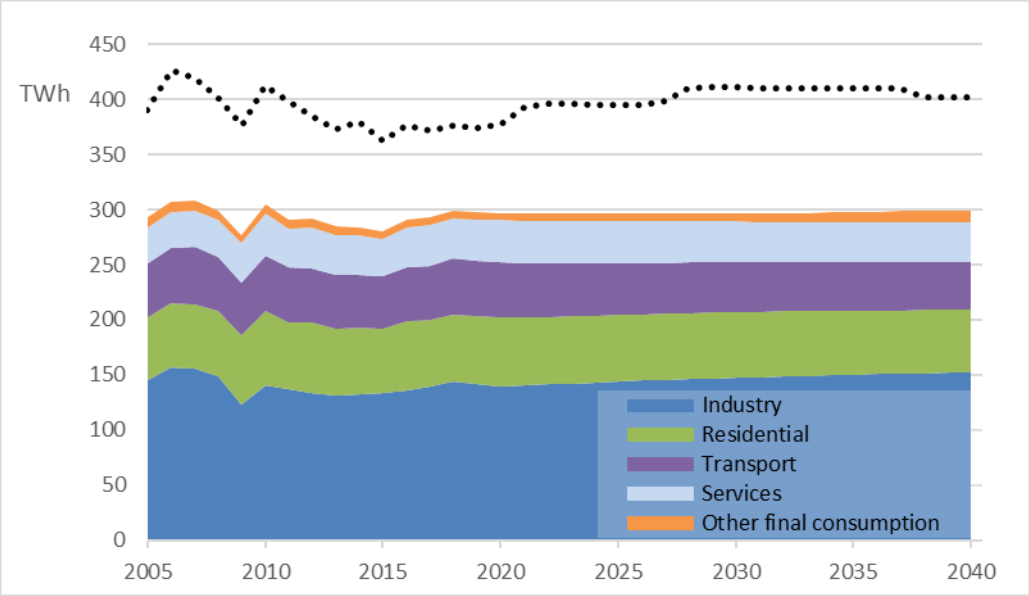

Figure 13. Historical development of primary energy and final energy consumption by sector between 2005 and 2017 and the projected development based on current policies until 2030 and an outlook until 2040.

Finland's energy saving target in accordance with Article 7 for the period 2021–2030 will be estimated. After the period 2014–2020, the intention is to continue the ongoing national energy efficiency measures for the period from 2021 to 2030. These include: energy efficiency agreements, energy advice for consumers, promotion of deployment of heat pumps in detached and terraced houses, energy audit activities (in addition to the compulsory audit in the EED) and promotion of investments in heating plants.

Efficient cogeneration and efficient district heating and cooling operate in open energy markets and compete with other generation, heating or cooling methods. District heating and cooling are built especially in towns, cities and densely inhabited municipalities. In these areas, a significant part of the heated building stock has been connected to district heating. Based on statistics 90 % of blocks of flats, 30 % of industrial buildings and more than 60 % of other buildings use district heating. The share in single-family houses is about 10 %. The total market share of district heating is 38 %. In 2017, the sales of district heating were 33.2 TWh. With temperature correction, the consumption equals 35.7 TWh. The consumption of district heating is projected to be 34 TWh in 2025 and just over 33 TWh in 2030.

In 2017, district cooling was sold by nine companies and the sales of district cooling amounted to 220 GWh. In 2030, the sales of district cooling are projected to be 490 GWh.[53]

[53] Report by Finnish Energy in 2015:
https://energia.fi/ajankohtaista_ja_materiaalipankki/materiaalipankki/rakennusten_jaahdytysmarkkinat_-_tutkimushanke.html#material-view

4.4 Dimension energy security

i. Current energy mix, domestic energy resources, import dependency, including relevant risks

Finland is dependent on imported fuels. Accordingly, the cornerstones of Finnish energy policy are a diversified and reliable supply of energy and improved self-sufficiency. The energy-intensive basic industries, cold climate and long distances underline the significance of energy for the wellbeing of its inhabitants and the country's competitiveness.

Until the 1960s, Finland's energy policy relied on the electricity produced by hydropower stations and the extensive use of wood. Due to the limited hydro resources, the use of coal and oil started to increase rapidly, and the need to find new energy sources became clear. A gas pipeline from Russia to eastern Finland was completed in 1973 and later extended to the capital area and to some other cities. The first nuclear power plant unit was taken into use in 1977, followed by three other units in the years 1979 to 1982. A fifth unit is currently under construction and is expected to be completed in 2020 and sixth toward the end of 2020s. The 1970s also brought peat into the Finnish energy mix.

In 2017, the total energy supply was 378 TWh. Finland's domestic energy sources are wood-based fuels, hydropower, wind power, waste and peat. Its energy dependence, calculated as the proportion of imported net energy in the total primary energy supply (TPES), was 47 % in 2015. The current distribution of the different energy sources in the total energy supply is presented in Figure 14.

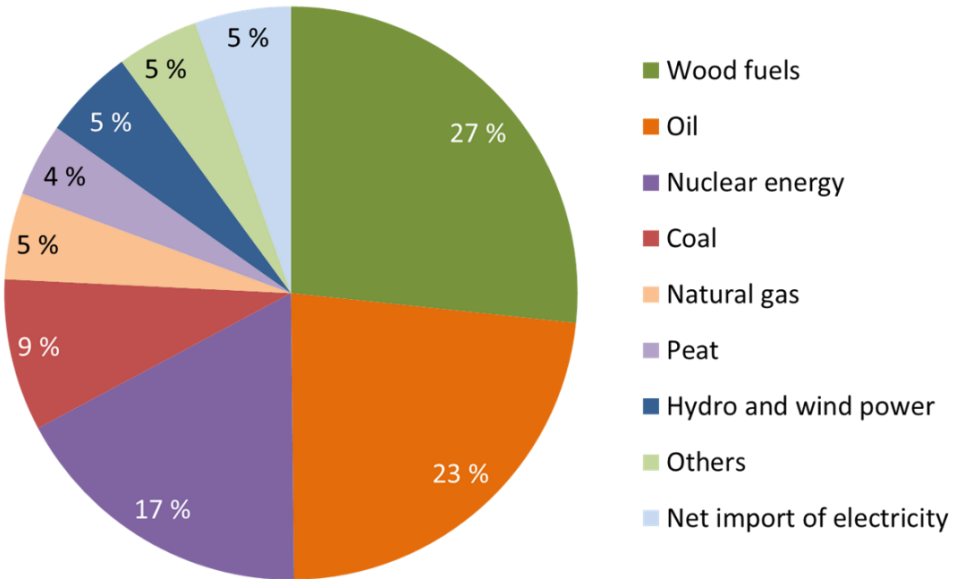

Figure 14. The distribution of different energy sources in the total energy supply in 2017. Source: Statistics Finland.

The domestic electricity generation was 65.1 TWh in 2017. This consisted of combined heat and power production (32 %), both in connection with district heat production and by industry for its own

use, nuclear power (33 %), hydro power (2 2%), conventional condensing power (5 %) and wind power (7.3 %). The total electricity consumption was 85.5 TWh.

The power system is interconnected with the power systems in Russia, Sweden, Norway and Estonia. Net imports from the Nordic and Baltic countries and Russia vary considerably from year to year, mainly due to variations in hydropower production in the Nordic countries. Between 1990 and 2017, maximum net imports were 20.1 TWh (2017) while minimum net imports were 3.7 TWh (1996).

The share of net imports of electricity has grown during the last years and about 2,000 MW of generation capacity has been shut down since 2010. High share of net imports is not a problem in itself. Well-functioning regional and European electricity markets and sufficiently strong cross-border connections are the most efficient and cost-effective way of guaranteeing competitive electricity prices and security of supply. However, generation adequacy during winter peak hours is a concern before the commercial operation of Olkiluoto 3 nuclear power unit starts in 2020. Two simultaneous large failures over 1,200 MW (e.g. largest generation unit and significant interconnector) in an especially cold winter day would create a situation where curtailment of demand could be needed[54].

In Finland, renewables accounted consistently around 30 % of the gross final energy consumption for the period 2000 to 2007, but it has increased over the last years, reaching 41 % in 2017. In 2010, an extensive package of specific targets concerning different renewable energy sources was launched in order to reach the EU 2020 renewable energy target set for Finland, i.e. 38 % of its gross final energy consumption. The package promotes the use of forest chips and other wood-based energy in particular, alongside wind power, the use of transport biofuels, and increased utilisation of heat pumps. Since 2010, measures have been strengthened and adjusted when needed. Wood energy and wooden pellets are exported and imported to some extent, the net amount depending on the year is typically between -1 and +1 TWh.

Combined heat and power production (CHP) provides opportunities for the cost-effective use of renewables both by industrial producers and at district heating plants. The amount of energy Finland saves annually through CHP approximately corresponds to one-tenth of all primary energy used in the country. CHP accounts for more than one third of all electricity production compared with the EU average of 12 %. Installed wind power capacity has increased steadily in Finland since 1990 as a result of the Government's support measures. The capacity was only about one MW in 1992, whereas it climbed to 82 MW in 2005 and reached 630 MW at the end of 2015. By the beginning of 2019, the installed wind power capacity had increased to 2,041 MW.

[54] Suomen sähkötehon riittävyys ja kapasiteettirakenteen kehitys vuoteen 2030, Pöyry Management Consulting Oy, 23.1.2015. https://tem.fi/documents/1410877/2717655/Suomen_sahkotehon_riittavyys_ja_kapasiteettirakenteen_kehitys_vuoteen_2030_2015.pdf/56b3f402-31fa-48a7-a6ef-d750e4665f78/Suomen_sahkotehon_riittavyys_ja_kapasiteettirakenteen_kehitys_vuoteen_2030_2015.pdf.pdf

For several decades the use of primary energy, as well as electricity were increasing and they reached their peak values in 2006 to 2007. Demand rose more rapidly than GDP until 1994. Thereafter, both the energy intensity and the electricity intensity of the economy have decreased. The decrease reflects the structural change within the economy from basic industry towards services and less energy-intensive industry. Furthermore, increased energy efficiency has contributed to the positive development of energy intensity. Figure 15 shows the historical development of the different energy sources in the period 2000 to 2017.

ii. Projections of development with existing policies and measures at least until 2040 (including for the year 2030)

As described in Chapter 4.2 the most significant future changes in the WEM projection in electricity and heat production are the two nuclear power plant units currently under construction and in planning phase, respectively, and the increase of renewable energy sources, mainly wind power and biomass. District heat production from heat-only plants is expected slightly to increase its share at the expense of combined heat and power production, which is struggling with the feasibility due to low electricity prices. The primary energy supply by energy source in the WEM projection until 2040 is outlined in Figure 15.

The projected development of self-sufficiency in total energy supply is shown in Figure 16. The self-sufficiency is 55 % today and is expected to exceed 70 % by the end of the 2020's. The positive development is mainly achieved due to an increased use of domestic renewable energy and new nuclear power that reduce the need for imported fossil fuels and electricity import.

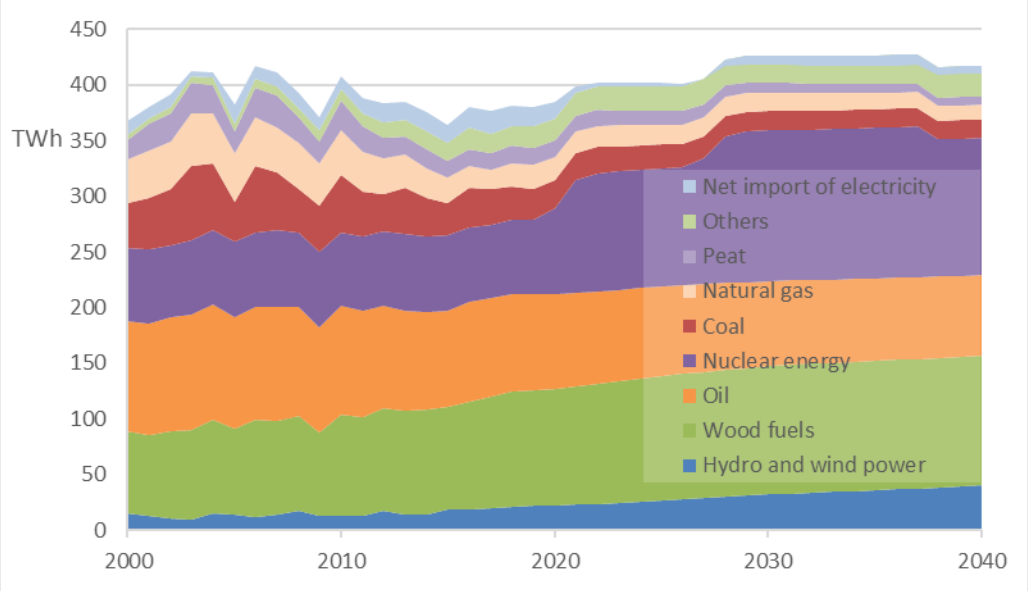

Figure 15. Historical development (2000 – 2017) and WEM projection of the primary energy supply until 2040.

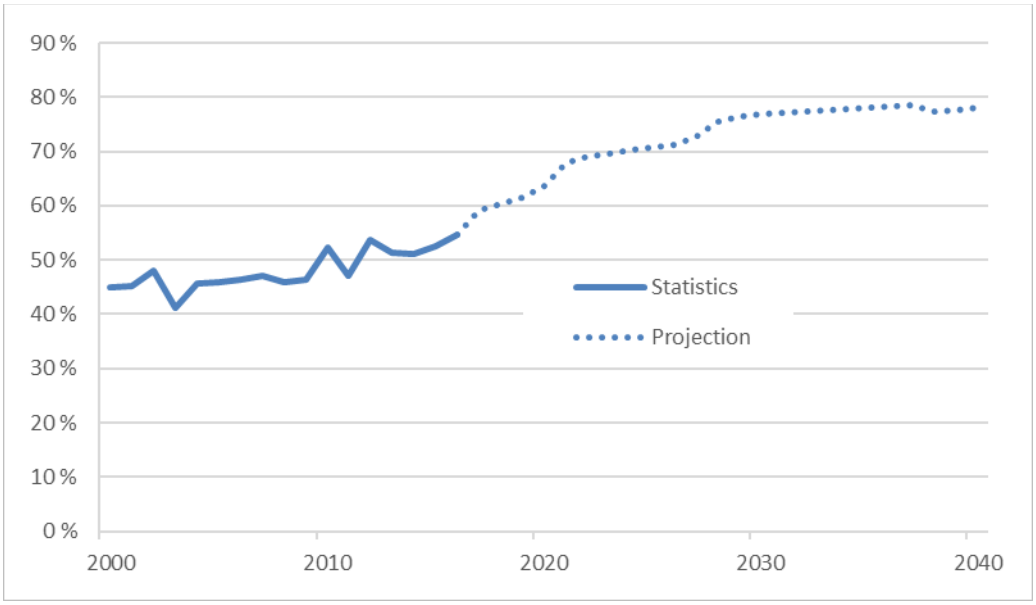

Figure 16. Historical self-sufficiency in energy supply 2000 - 2016 and the projected development in the WEM projection until 2040.

SKM Market Predictor estimates in its study[29] that the projected electricity demand at peak load increases from 15,300 MW in 2020 to 16,200 MW in 2030. After the start of Olkiluoto 3 nuclear power plant unit the margin between electricity supply and demand in terms of capacity decreases being only about 1,620 MW in 2020. In mid-2020's the generation adequacy may decline temporarily when some conventional condensing and CHP plants are likely to shut-down. The investment of Fennovoima Hanhikivi nuclear power plant is expected to increase the generation adequacy again in the end of the 2020's despite a constantly growing electricity consumption and peak demand. The operation permits of Loviisa 1 and 2 nuclear power units are in force until 2027 and 2030 respectively. Unless the operation permits of Loviisa nuclear power units are prolonged, generation adequacy margin decreases clearly again. In the projections, these two units are dismantled in the late 2030's. Table 19 presents the projected development of peak load demand and available generation and interconnector capacity in peak load situations for the years 2020, 2030 and 2040.

Table 19. Projection of demand, generation capacity and interconnector capacity in peak load situations [MW]. **Virhe. Kirjanmerkkiä ei ole määritetty.**

	2020	2030	2040
Peak demand	15,300	16,200	17,000
Generation capacity *	13,680	13,920	12,960
Deficit	1,620	2,280	4,040
Interconnector capacity	4,850	6,050	6,050

**including strategic reserves in 2020, wind power equalling 6 % of installed capacity, PV capacity not included.*

4.5 Dimension internal energy market

4.5.1 Electricity interconnectivity

i. Current interconnection level and main interconnectors

Chapter 2.4.1 describes current status of the interconnection level and its development in the near future. The main interconnectors are listed in Table 20.

Table 20. List of main interconnectors.

To country	Type	Export	Import	Name of interconnector
Sweden SE1	AC	1100 MW	1500 MW	
Sweden SE3	HVDC	1200 MW	1200 MW	FennoSkan 1 & 2
Estonia EE	HVDC	1000 MW	1000 MW	EstLink 1 & 2
Norway	AC	100 MW	120 MW	
Russia	AC	350 MW	1400 MW	
Total		**3750 MW**	**5220 MW**	

ii. Projections of interconnector expansion requirements (including for the year 2030)

Table 21 presents planned interconnector investments and decommissionings.

Table 21. Planned interconnector investments and decommissionings.

To country	Type	Export	Import	Information
Sweden SE1	AC	+900 MW	+800 MW	Completion 2025
Sweden SE3	HVDC	+800 MW	+800 MW	FennoSkan 1 replacement late 2020's
Sweden SE3	HVDC	-400 MW	-400 MW	FennoSkan 1 decomissioning
Total		**+1300 MW**	**+1200 MW**	**Net increase of capacity**

4.5.2 Energy transmission infrastructure

i. Key characteristics of the existing transmission infrastructure for electricity and gas

Electricity

The Finnish electricity system is part of the Nordic synchronous power system along with the Swedish, Norwegian and Eastern Denmark systems. Finland is also connected to the Russian and Estonian power systems by direct current connections. The Nordic synchronous system is connected to the Central European power system and the Baltic power systems through direct current connections.

The main grid is the primary electricity transmission network and includes the 400, 220 and 110 kV lines that are most important for power transmission, and substations. The size of the main grid operated by Fingrid is presented in Table 22. Local transmission to small users takes place in the distribution grids.

The main grid serves electricity producers and consumers by enabling a functional electricity market throughout the country as well as cross-border trade. The majority of electricity consumed in Finland is transmitted via the main grid. Fingrid is responsible for main grid operation, planning and supervision.

Table 22. Current size of the main grid operated by Fingrid (2017).

Component	length/number
400 kV transmission lines	5,100 km
220 kV transmission lines	1,600 km
110 kV transmission lines	7,600 km
total transmission lines	14,300 km
submarine cables	320 km
substations	119

Gas

At the moment, Finland's gas pipeline network is isolated from the networks of the other Member States. The gas pipeline network has been connected to the Russian network with two transfer pipes. The maximum import capacity is 24.1 million cubic metres per day (in 20 degrees Celsius). Finland's

gas pipeline network is located in the southeast and southern Finland and its length is 1,300 kilometres. The transmission system operator is the state-owned company Gasum Oy.

ii. Projections of network expansion requirements at least until 2040 (including for the year 2030)

Electricity

Fingrid has a EUR 1.2 billion investment program for the years 2015–2025. In the latter half of the present decade and start of the 2020's, grid investments will focus mainly on renewing aging transmission lines and substations. The most significant new cross-border interconnector will be the third AC interconnector between Finland and Sweden. This project is scheduled to be completed in 2025.

Existing subsea DC cables to Sweden and Estonia will be renewed in this timeframe (2040). When these interconnectors are replaced also their capacity will be reviewed. Also the DC interconnectors to Russia will be renewed but the capacity will remain the same.

Gas

In October 2016, Finnish Baltic Connector Oy and Estonian Elering AS made a decision to invest in the construction of the Balticconnector gas pipeline connection between Finland and Estonia. The Balticconnector gas pipeline will be put it into commercial operation on 1 January 2020. The capacity of the Balticconnector pipeline will be 7.2 million cubic metres per day.

In 2020 a new LNG terminal in city Hamina that is under construction at the moment will be connected to the gas transmission network. The storage capacity of the Hamina LNG terminal will be at the first stage 30000 cubic metres. The entry capacity into the transmission system as well as into the local distribution system will be 0.5 million cubic metres per day.

4.5.3 Electricity and gas markets, energy prices

i. Current situation of electricity and gas markets, including energy prices

Electricity

Finland forms an integrated wholesale electricity market with Denmark, Norway, Sweden, Estonia, Lithuania and Latvia. The Nordic-Baltic market has been price coupled with the North Western European electricity market since 2013. There is currently one power exchange (Nord Pool AS) active in the Nordic market and another (EPEX SPOT) entering the market. In 2018 72 % of the electricity supply in Finland was traded through Nord Pool day-ahead market. Historical time series of monthly and hourly average day-ahead spot prices are shown in Figure 17 and Figure 18.

Finland is heavily dependent on integrated European electricity markets as there is a significant deficit in generation capacity compared to peak load. Finland is importing over 20 % of its annual electricity supply and around 30 % of the power consumption during the winter peaks.

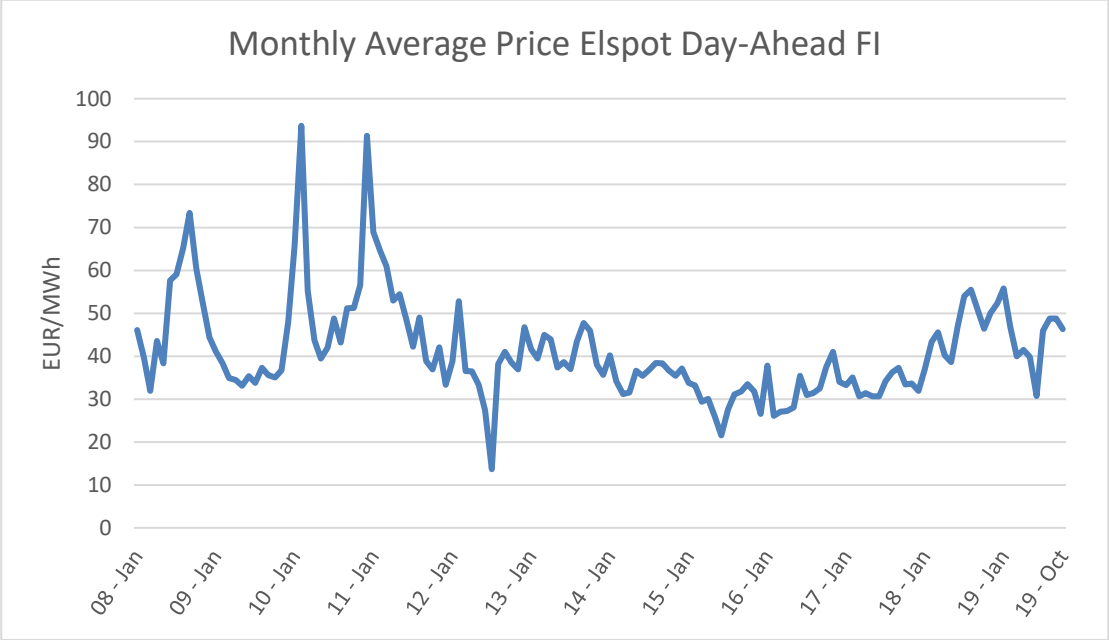

Figure 17. Monthly average prices in Finland's price area in 2003-2018.

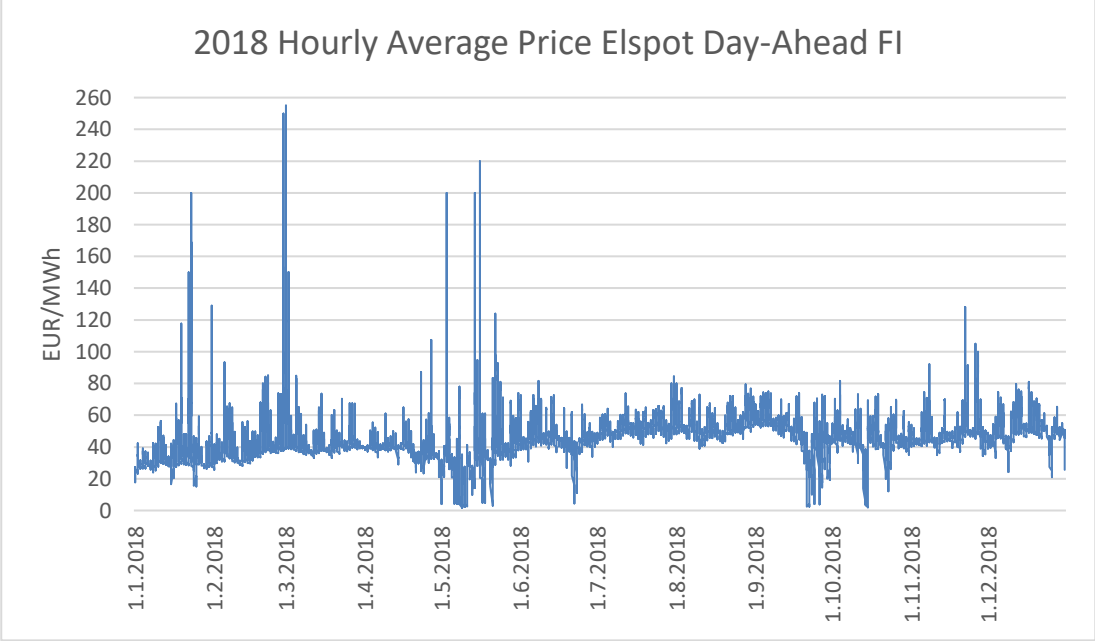

Figure 18. Hourly prices in Finland's price area in 2017.

Gas

Until 31 December 2019, Finland applies a derogation for isolated markets in accordance with Article 49(1) of Directive 2009/37/EC. As regards natural gas, there has been no third party access to a pipeline network, so the buyers of natural gas have not been able to organise a tendering process for their

natural gas supply. Wholesale and retail sellers have bought their natural gas from Gasum Oy, the owner of the transmission network. Gas produced from renewable energy sources has had limited access to the pipeline network, however. In addition, the buyers of natural gas can between themselves trade in the secondary market the natural gas they have bought from Gasum.

Because of the monopoly situation in the natural gas supply, both the wholesale and the retail market prices have been regulated.

Figure 19 and Figure 20 show the time series starting form 2001 of as well energy price as total price of natural gas for different type (T1 – T8) industrial size natural gas consumers. All the prices are without taxes, calculated with gross calorific value and in EUR per MWh. The total price of natural gas includes both the price for transmission and energy.

For the different type of natural gas consumers (three examples T1, T4 and T8 are given here), the detailed information of annual consumption, peak load time and contracted capacity are as follows.

Table 23. Description of natural gas consumer types T1, T4 and T8.

Type of consumer	**T1**	**T4**	**T8**
Annual consumption (GWh)	50	150	1,000
Peak load time (h)	4,000	6,000	6,000
Contracted capacity (MW)	12.5	25	166.7

Complete price statistics are presented on the Energy Authority's web pages[55].

[55] https://www.energiavirasto.fi/maakaasun-hintatilastot

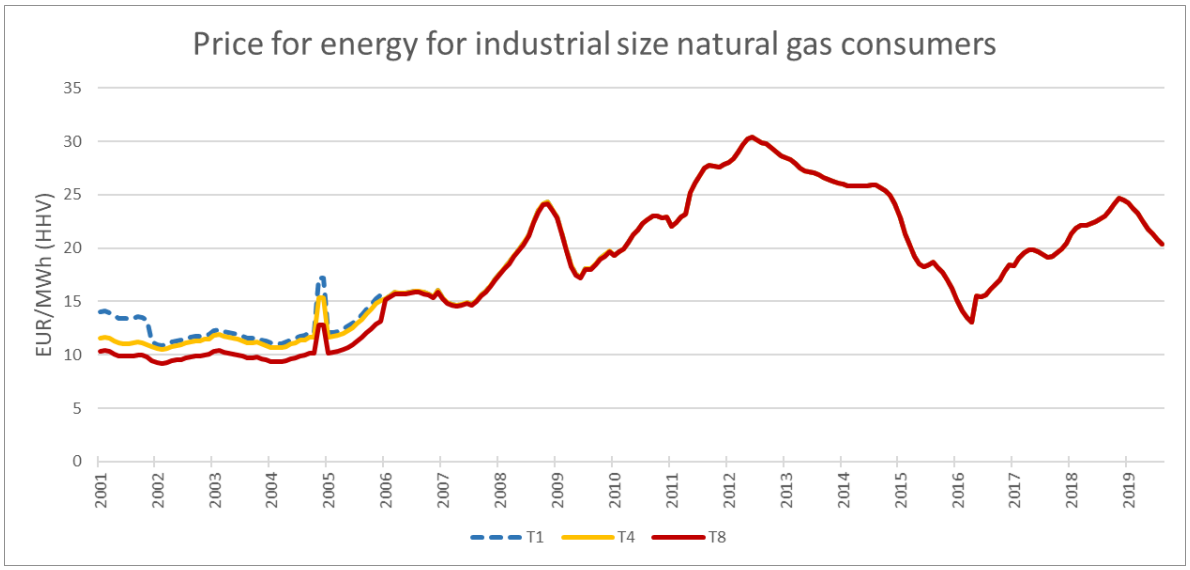

Figure 19. Price for energy for industrial size natural gas consumers.

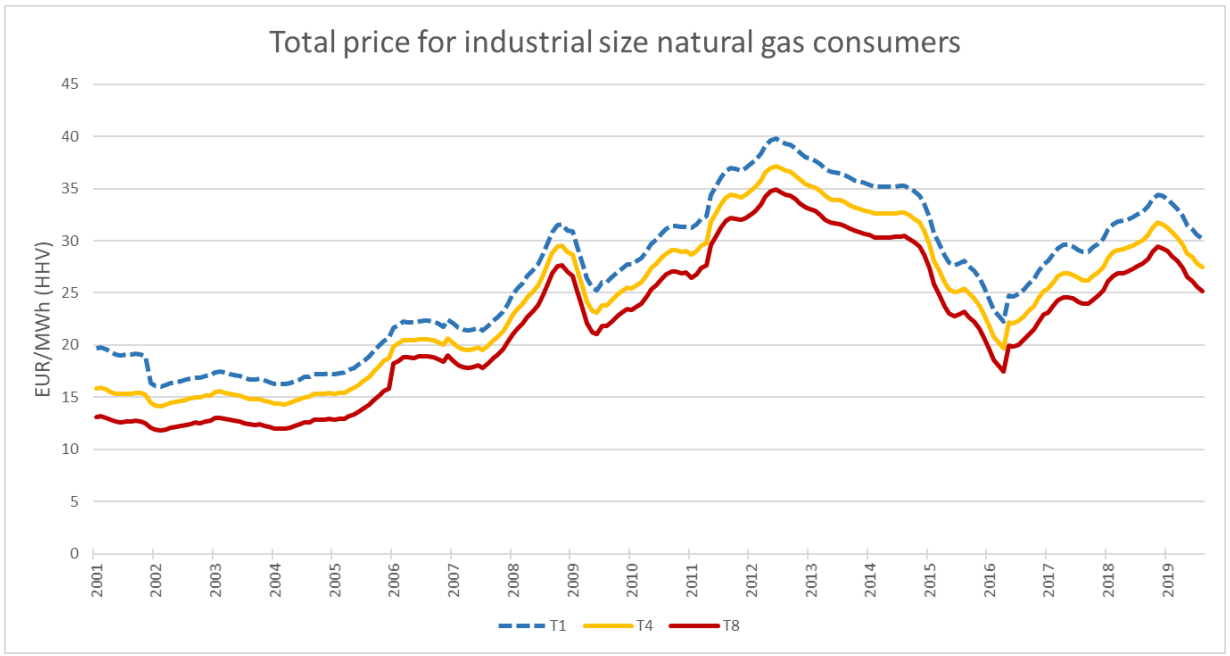

Figure 20. Total price for industrial size natural gas consumers.

ii. Projections of development with existing policies and measures at least until 2040 (including for the year 2030)

Electricity

According to the SMK Market Predictor's study[29] the Nordic countries will increasingly integrate into the Central European electricity market, and thus the importance of the Central European region as a price-driver for the Nordic electricity market is emphasized. Although the share of wind and solar power in the European electricity balance will significantly rise over the coming decades, fuel prices and emission allowance prices will remain important price-drivers for the Central European electricity market for a long time. Another important price-driver for the Central Europe is the abandonment of nuclear and coal-fired power capacity because of aging or political decisions.

Despite the growth in wind and nuclear power, the rising central European price level keeps also the Nordic price level rising. The regional price of Finland follows the Nordic system price until the end of the 2020s, when the introduction of Hanhikivi 1 nuclear power plant and the new interconnection between Northern Sweden and Finland will lower Finland's regional price to the price level in northern Sweden. The regional price of Finland follows the regional price of northern Sweden until the exit of Loviisa 1 and 2 nuclear power plant units increases the regional price of Finland closer to the Nordic system price after the mid-2030s (Figure 21).

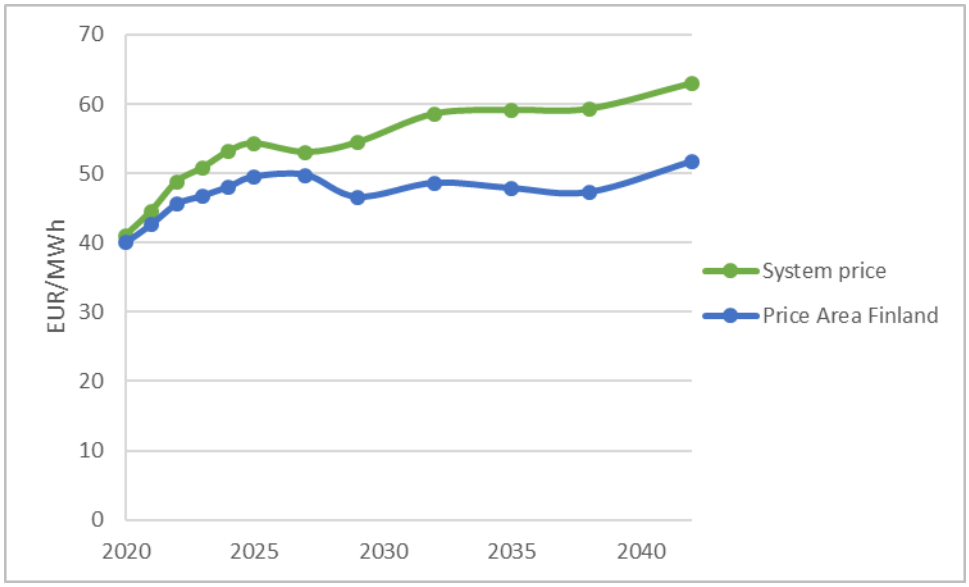

Figure 21. Projection of the electricity wholesale price in the WEM projection (EUR per MWh in 2016 prices) [29].

Gas

It is expected that as from 2020, the gas supply conditions in Finland will comply with the conditions determined for agreements with Gazprom by the Commission's investigation concerning competition. The price of gas energy will thus be determined on the basis of the reference price of the liquid gas hubs in Central Europe.

4.6 Dimension research, innovation and competitiveness

i. Current situation of the low-carbon-technologies sector and, to the extent possible, its position on the global market (that analysis is to be carried out at Union or global level)

ii. 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

iii. Breakdown of current price elements that make up the main three price components (energy, network, taxes/levies)

iv. Description of energy subsidies, including for fossil fuels

The competitiveness of low-carbon technologies compared with the alternatives has improved considerably over the past few years. The competitiveness of renewable forms of energy with particularly great variation (solar and wind power) has improved. According to monitoring of energy technology exports carried out in Denmark, energy technology exports accounted for just under 10 % of Finland's goods exports in 2016, which is among the highest percentages in Europe. Finland's traditional strengths include bioenergy solutions. Finland is also a significant importer of energy technology. Finland imports solar energy systems, among others.

According to the estimation made by the Ministry of Economic Affairs and Employment of Finland, Finnish energy technology exports in 2018 grew to EUR 5.1 billion euros. The estimation excludes energy technology related services. The share of energy technology in total exports for the year was 7.9%. Finland's trade balance in energy technology has been clearly positive in 2016-2018. In 2018, the energy technology trade balance was around one billion euros, meaning that Finland exported energy technologies more than it imported. Finnish energy technology cluster is globally competitive. The analysis included energy technologies related to energy production, distribution, storage as well as certain materials and components.

Public research and development funding targeted at the energy sector has declined over the past few years. In 2015, EUR 177.5 million of public R&D funding was allocated to the energy sector, EUR 69.7 million in 2016, EUR 61.7 million in 2017 and the estimate for 2018 is EUR 42.4 million. In 2015, the financing provided to innovations in the energy sector by Finland was highest of the IEA countries in relation to the GDP.

The consumer price of electricity for households in Finland is below the EU average, which improves Finland's competitiveness. In 2017, Finnish households paid on average 16 cents per kWh for electricity (EU average 20 cents per kWh) The price of electricity for others than households in Finland was about 7 cents per kWh (EU average 11 cents per kWh). Finland taxes fossil fuels fairly heavily and the difference is considerable when compared with countries outside the EU, in particular. The competitiveness of an individual industry in terms of the price of energy also partly depends on the granted electricity tax reliefs and refunds.

5 IMPACT ASSESSMENT OF PLANNED POLICIES AND MEASURES

5.1 Impacts of planned policies and measures described in section 3 on energy system and GHG emissions and removals including comparison to projections with existing policies and measures (as described in section 4)

i. 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.

The development of greenhouse gas emissions and removals in the WEM and WAM projections are shown in Figure 2 and Figure 11. The WEM projection estimates that the total greenhouse gas emissions (without LULUCF) in 2020 and in 2030 will be 53 and 44 Mt CO_2 equivalent respectively, whereas the WAM projection assesses that they will be 52 and 39 Mt CO_2 equivalent, respectively.

Finland is in the course of fulfilling its EU 2020 emission reduction goal and its corresponding emission reduction obligation under the second commitment period of the Kyoto Protocol with the existing policy measures. The effect of the additional measures is aimed at the 2020's and in full at the year 2030 at the latest. With the measures of the WAM projection the renewable energy share will rise to above 50 % of gross final energy consumption and the use of imported oil for domestic needs will be cut by half by 2030 compared to the level of 2005. The use of coal in energy production will end by 2029.

Ban of coal in energy production will have an impact on the energy system. Coal CHP plants will mainly be replaced by heat only boilers using biomass. The use of forest chips is expected to increase by 2.0–2.8 TWh. Market based development of coal use would lead to 200 MW decrease in coal CHP generation capacity during years 2025–2030. Ban of coal based on legislation further decreases the CHP generation capacity with 300 MW. This reduces the flexibility of the electricity system and the generation adequacy between supply and demand will be tighter. Ban of coal by 2029 will also have a marginal impact on power prices, EUR 0.1–0.3 per MWh depending on the fuel price scenarios.

Even though the electricity demand increases steadily in the WAM projection the electricity generation from district heating CHP plants is likely to decrease. In the 2020's wind and solar power are expected to be competitive and grow their share of generation. The development of the electricity supply in the WAM projection until 2030 is shown in Figure 22.

The dependency of electricity import in particular at peak load situations remains a challenge in the 2020's despite investments in smart grid solutions and system flexibility. Further measures will be considered the coming years.

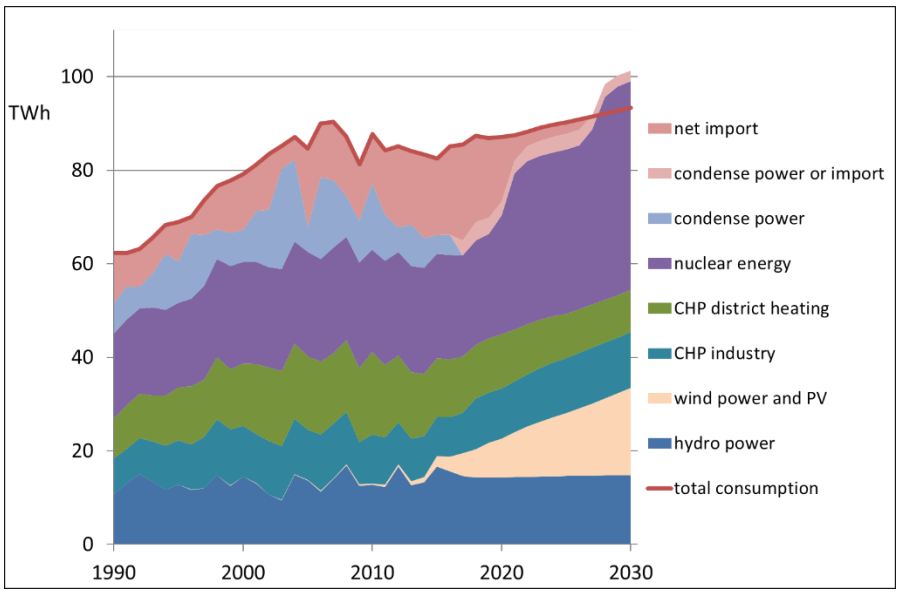

Figure 22. Development of electricity demand and supply in the WAM projection.

The planned transport sector policy to increase the number of electric vehicles to 250,000 by 2030 increases significantly the amount of electricity used by the sector (Figure 23). At the end of the 2020's electricity demand of road transport equals that of railways. Thereafter the road transport electricity is expected to double by 2040. The electricity use in the transport sector in total is not more than 1–2% of the total electricity demand during the assessed period. Its impact on electricity generation is on a yearly level small, but charging batteries and an active use of them as two-way electricity storage can affect both the short-term electricity market and local grid. Thus, electric vehicles can with clear rules and developed market solutions contribute to an over-all efficient and advanced energy system.

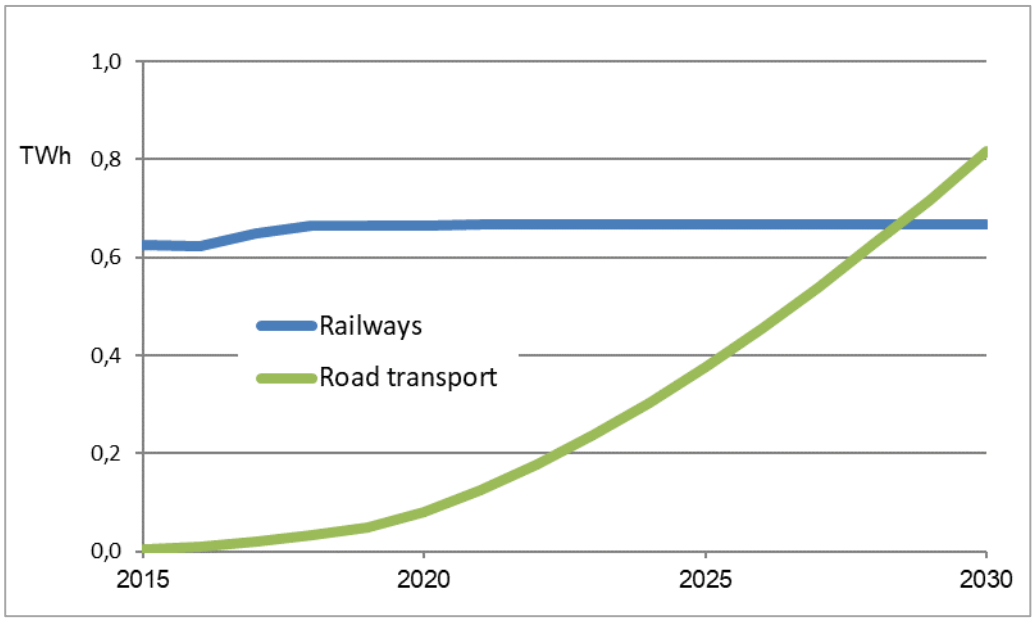

Figure 23. Development of the electricity use in the transport sector in the WAM projection.

ii. 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.

The new premium system for renewable electricity increases annual electricity generation with (only) 1.4 TWh, which can well be integrated in the existing power system. The premium system plays an important role in contributing to market-based deployment of wind power in the future. Large-scale integration of variable renewable energy into the electrical system requires greater flexibility in the system. There is a need for a variety of service providers and for more diversified markets, for which a number of proposals have been presented in the report of the Smart Grid Working Group[56].

Installation of large wind farms requires the electricity grid to be strengthened at both the local and national grid level. Electricity companies must develop the network according to the customers' reasonable needs. In addition, as the use of energy in society as a whole moves more into electricity the electricity demand increases and there is a continuous need to invest in network infrastructure. Therefore, in relation to the network infrastructure, there is no risk of stranded costs, rather the opposite.

[56] https://tem.fi/documents/1410877/2132296/%C3%84lyverkkoty%C3%B6ryhm%C3%A4n_keskeiset_ehdotukset_241018/3800ce98-68bc-da20-52e9-494722cfc2bd/%C3%84lyverkkoty%C3%B6ryhm%C3%A4n_keskeiset_ehdotukset_241018.pdf
https://tem.fi/alyverkot

The 1.4 TWh subsidized production slightly weakens the profitability of existing power plants as they cannot sell just as much electricity as before. In addition, the spot price drops slightly, which reduces the returns of all electricity producers. This renewable energy measure is not considered to be of any importance to the energy security dimension, and the direct impact on the internal market dimension is also marginal, see also Chapter 4.5.

Finland has set binding reliability standards to the distribution system operators to ensure resilience in electricity distribution networks especially in severe weather conditions. One possible measure for the DSOs is to change the overhead power lines into the electric cables. Finnish Energy (association representing energy industry, including DSOs) has estimated that this measure will release an area of 40 000 hectares for aforestation. Thus, replacing medium-voltage overhead power lines with underground electric cables could have a policy interaction with carbon sinks in longer term.

The planned Datahub facilitates the development of services that are related to small-scale electricity production, the creation of energy communities, etc. This is expected to speed up the deployment of small-scale electricity production and thus supports the low-carbon dimension. An increase in small-scale electricity production that is used on site results in lesser billing for network companies and vendors. Consequently, it is likely that network companies change the structure of distribution tariffs over time so that they emphasize less the energy component and introduce capacity based components.

The ban on the use of coal is good for the low carbon dimension but not necessarily favorable for the energy security dimension, at least with regard to the security of electricity supply. Ban of coal based on legislation in 2029 decrease the CHP generation capacity by 300 MW. This will decrease the flexibility of the electricity system and the generation adequacy between supply and demand will be tighter. The policy measure increases slightly the market price of electricity, see Chapter 5.4.

Policies and measures for the dimension of decarbonisation, such as biofuels/bioliquids quota obligations for the transport and heating sectors, requires development of new technology. Thus, the dimension of decarbonisation has policy interactions with the dimension of research, innovation and competitiveness

As an additional consideration, building sector projections show that improvement of the energy efficiency of buildings reduces the use of district heat. This development is likely to happen even if the total building volume increases. As the district heating network has already been fully built out, there a risk that the number of paying customers is not sufficient for maintaining the district heat infrastructure. The problem is even accelerated if district heat customers chose to disconnect and switch to decentralized heating such as f.ex. heat pumps. Consequently, it is important to ensure the competitiveness of district heating and CHP.

iii. Assessment of interactions between existing policies and measures and planned policies and measures, and Union climate and energy policy measures.

All the implemented and planned measures in all the five dimensions that Finland has indicated in this report are either related to implementation of the EU legislation or contribution to achieving the EU energy and climate targets. The policy measures will ensure that Finland takes care of its own share and contributes adequately to the EU's common energy and climate goals. The policy measures also ensure that Finland is also on the path to achieving long-term goals by 2050.

5.2 Macroeconomic and, to the extent feasible, the health, environmental, employment and education, skills and social impacts including just transition aspects (in terms of costs and benefits as well as cost-effectiveness) of the planned policies and measures described in section 3 at least until the last year of the period covered by the plan, including comparison to projections with existing policies and measures.

The impact assessment of NECP is based on two separate impact assessments reports, one prepared for the Finland's National Energy and Climate Strategy[57] from 2016 and the other prepared for the Medium-term Climate Change Policy Plan (KAISU)[58] from 2017. In addition, Finland's National Energy and Climate Strategy and Medium-term Climate Change Policy Plan both include one chapter for impact assessments. In Energy and Climate Strategy it is Chapter 4 including also impacts on national economy (Chapter 4.5) and environmental impacts including also for example quantity of air impurities (Chapter 4.6). In Medium-term Climate Change Policy Plan Chapter 13 is about the impacts of the policy plan including economic impacts and also impact on national economy (Chapter 13.2), impacts on human health and the environment (Chapter 13.3) and impacts on security (Chapter 13.4). These documents are available also in English **Virhe. Kirjanmerkkiä ei ole määritetty.** and **Virhe. Kirjanmerkkiä ei ole määritetty.**.

The conclusion of the impact assessments of the National Energy and Climate Strategy is that the proposed actions and measures allows Finland to reach the targets of the EU Effort Sharing Decision and national targets to increase renewable energy, to reduce fossil fuel consumption, and to increase self-sufficiency of energy consumption. The largest share of additional emission reductions would be achieved in the transport sector followed by reduction of emissions from oil heating of buildings, work machinery, waste management, F-gases and agriculture.

The realization of the targets of the Energy and Climate Strategy affects economic steering and the national economy. According to the impact assessments, the gross domestic product would be 0.6 %-points lower than the baseline in 2030. The employment would grow over 3% by 2030 compared to 2015, but would remain 0.15 %-points lower than in the baseline.

[57] https://tietokayttoon.fi/julkaisu?pubid=16902 (in Finnish).
[58] https://tietokayttoon.fi/julkaisu?pubid=21004 (in Finnish).

By 2030, investments will fall by less than 1% compared to the WEM projection. Private consumption will fall by about 0.4% compared to the WEM projection, mainly due to the rise in the average price of transport fuels and cars, which will weaken purchasing power. Rising domestic prices will weaken export competitiveness and reduce exports by more than 1% compared to the WEM projection, but compared to 2015, growth will still be over 40%. The measures in the WAM projection change the structure of both demand and production compared to the WEM projection. However, the changes are not very dramatic.

Forest biomass is the largest growing renewable energy source from 2015 to 2030. The impact assessment of Finland's National Energy and Climate Strategy from 2016 concludes that the existing felling potential in the Finnish forests will be large enough to supply the estimated needs of both forest and energy industries, and major share of wood fuels are derived from the by-products of the forest industry Finnish forests will remain a carbon sink. Natural Resources Institute Finland (Luke) has updated scenarios for carbon sinks based on new data on forest growth.[59] The study was published in February 2019 and partly updated in autumn 2019.

According to the impact assessments of the Energy and Climate strategy and Medium-term Climate Change Policy Plan, they will affect climate change, nature's biodiversity and water basins, air pollution, health and living conditions. The details of the practical implementation are essential. They will influence how the increased harvesting affects biodiversity and what welfare impacts different population groups will experience. According to the impact assessments, increased wood use may potentially have negative impacts on biodiversity but this depends on for example how additional felling is carried out and on what measures are taken to prevent adverse effects. The effects of an increase in biofuel production will highly dependent on the raw materials used for production. The impacts on biodiversity can be alleviated by introducing new incentives to uphold the biodiversity of forests. This can be done by several means such as leaving dead trees to a higher extent on regeneration areas and avoid fellings on valuable nature areas.

In the impact assessment of the Medium-term Climate Change Policy Plan the assessments of the measures of the non-ETS sector under the effort sharing regulation have been updated and extended. According to the results of the energy system model TIMES, a realistic overall emission reduction potential compared to baseline (WEM projection) sums up to 5.1–6.8 Mt CO_2-eq. in year 2030. The largest potentials are identified in transportation, but there are also substantial uncertainty regarding these emission reductions and associated costs. Additional emission reductions are achievable especially through decreasing the use of mineral oil in heating of buildings and in fuel use of work machines. An increased share of biofuels in transport, heating and machinery is the most significant individual measure. In total, the measures of KAISU have only a minimal impact on the growth of gross domestic product. In combination with other policy measures, the measures of KAISU affect environment, people's health and living conditions in many ways. The level of impacts depends on

[59] Development of emissions and sinks in the agricultural and LULUCF sectors until 2050 (in Finnish) http://julka-isut.valtioneuvosto.fi/bitstream/handle/10024/161408/20-2019-MALULU_.pdf

many factors, making the anticipation of impacts uncertain. Careful monitoring is therefore needed to verify the reaching of targets and other impacts.

Economic impacts of policies and measures have also been reported in Chapter 5.5. of the Finland's Seventh National Communication under the United Nations Framework Convention on Climate Change[6]. The information in the Seventh National Communication is based on the situation at the end of 2017 and the impacts of the policy measures of Finland's National Energy and Climate Strategy. The results related to the Medium-term Climate Change Policy Plan on macroeconomic level are very similar to those of the National Energy and Climate Strategy.

For the economic impact assessment, a dynamic applied general equilibrium model that describes the economy from the perspective of decisions made by households, companies and the public sector is used.

The impact of the WAM measures on the national economy in 2030 in comparison to the WEM projection is shown in Table 24.

Table 24. Impact of the WAM measures on the national economy in 2030.

	Change compared to the WEM projection [percent]	**Impact on the domestic product compared to the WEM projection** [percentage point]
Domestic product	-0.59	
Private consumption	-0.40	-0.23
Investments	-0.85	-0.10
Public consumption	0.00	0.00
Exports	-1.75	-0.76
Imports	-1.33	0.49

Water impacts resulting from climate change mitigation measures are closely related to the development of wood use. When forestry is intensified, the effects will be in the same direction as with the more severe climate. Both increase the load on the water. Nitrogen and phosphorus loads cause eutrophication of waterways and solids loads cause turbidity, silting and overgrowth. Increasing logging in line with the objectives of the Energy and Climate Strategy will increase the load on the water.

Most of the serious health hazards associated with air pollution are caused by small particles. The largest domestic sources of small particles are small scale wood combustion, road traffic, including both exhaust and street dust, and machinery. Burning wood in fireplaces and stoves reduces air quality, especially in densely built areas of small houses. The small particles emissions from wood burning cause premature deaths and increase the incidence of illness just as the small particles in traffic. Small-scale wood combustion is also an important source of black carbon emissions. The relative

share from wood burning is growing as the other sources such as transport are becoming less important. No significant reduction of small particulate emissions from small-scale wood burning can be foreseen without noticeable technological changes in the equipment used.

Exposure to particles from small-scale combustion will decrease slightly in the future, but there is only minor difference between the WEM and WAM projections. In the transport sector the shift towards increased use of electricity and gas is reflected in an improved air quality in urban areas. In the current situation, the biggest air quality related mortality effects in Finland is caused by long-term exposure to small particles of small-scale combustion and street dust, each causing about 200 premature deaths per year.

All of the air pollutants considered will be significantly reduced from 2015 to 2030, although overall energy use will increase. Emissions reductions for combustion installations and the transport sector are largely the result of EU legislation coming into force or already in force. The major impact of the fuel changes is the reduction in the use of coal, which significantly reduces sulfur and nitrogen oxide emissions, and the increased use of wood in combustion plants, which, despite tightening emission limits, may slightly increase nitrous oxide emissions.

For air pollutants, the differences between the WEM and WAM projections are small. The most significant changes are the partial replacement of coal by renewable energy sources and the declining fuel consumption of road transport as a result of more efficient transport and modal shift as well as the increasing number of electric and gas vehicles.

According to Prime Minister Antti Rinne's Government Programme, a fair transition is a guiding theme in the Government's climate policy. Emissions reduction measures will be carried out in a way that is fair from a social and regional perspective and that involves all sectors of society. The Government will establish a ministerial working group on climate and energy issues, which will be in charge of preparing climate policy as a whole. Assessing climate impacts will become a part of the normal process of drafting legislation.

Work to combat climate change requires contributions from all sectors of society. The Government will establish a round table on climate policy in connection with the sustainable development committee. By bringing together a variety of operators in society, it can be ensured that climate actions are in the best interests of society and have broad approval from the public.

For example, the Government will establish a broad-based peat industry working group to explore how the use of peat can be directed away from energy use and increase its use in innovative, high added value products. The working group will present means to ensure that the change occurs in a way that is fair at the regional and social levels and that does not jeopardise the security of electricity and heat supply in Finland.

5.3 Overview of investment needs

i. Existing investment flows and forward investment assumptions with regards to the planned policies and measures

General policies on investments and RDI

Securing the necessary funding is the key to meet targets of the energy and climate policy. In the context of the European Semester the Council Recommendation on the 2019 National Reform Programme of Finland and delivering a Council opinion on the 2019 Stability Programme of Finland recommended that Finland take action in 2019 and 2020 to:

> *Focus investment-related economic policy on research and innovation, low carbon and energy transition and sustainable transport, taking into account regional disparities.*

According to Prime Minister Antti Rinne's Government Programme Finland will see significant improvements in its research and innovation environment, and rising level of investments. The Government's goal is to raise RDI investments to 4 % of GDP and to make Finland the world's best environment for innovation and experiments.

The transition to a low-carbon economy will require additional investments, particularly in bioeconomy, circular economy, clean energy solutions, energy efficiency, emissions-free forms of energy production, energy storage solutions, carbon recovery and energy utilisation, along with research, development and innovation activities and measures to bring these solutions to the market.

In the industrial sectors, the Government is preparing, in cooperation with industry operators, sector-specific low-carbon roadmaps. The aim is to find technological pathways, which still need RDI investments in order to meet the ambitious climate targets. The sector-specific low-carbon roadmaps will be included in the Government's international growth programme.

In the transport sector, the Government's goal is to reduce transport emissions by at least 50 % compared to the 2005 level by 2030. This is a step towards carbon-free transport. In order to reduce transport emissions, measures will be taken to reduce transport performances, to promote the transition towards more sustainable mobility and to phase out fossil fuels.

Investment needs for the ban of coal

Economic impact of the premature investment costs in cities Helsinki and Vaasa are EUR 34 million. In addition to this EUR 2–4 million has to be invested in additional equipment in other cities with multi-fuel boilers.

Investment generated by the tender process for renewable electricity production

Energy Authority has carried out the tendering process and the deadline for tenders was 31 December 2018. It received over 20 tenders for new wind capacity of which seven were accepted in the rising

price order. According to the SKM report, investment cost for wind power is 1,500 MEUR/MW. Based on this the overall investment cost would be EUR 600–750 million.

Investment needs for the centralized data exchange solution

The total cost of the centralized data exchange solution, the Datahub, is approximately EUR 36 million, of which the transmission system operator accounts for EUR 19.6 million and the electricity companies EUR 16.6 million. The average investment of electricity companies per customer is EUR 0.5 per year during 10 years. Investments are almost equally distributed between retailers and distribution system operators.

Investment needs for the production of biofuels

According to the research study ”Biopolttoaineiden kustannustehokkaat toteutuspolut vuoteen 2030”[60], the development of the WAM projection presented in the Energy and Climate Strategy is estimated to amount to a total of 800 000 oil equivalent tonnes (toe) of biofuels in 2030. The amount of bioliquids needed to replace light fuel oil is estimated at 34,000 toe/a in heating and 69 000 toe/a in machinery, i.e. a total of 103 000 toe/a and the rest 700 000 toe/a in domestic traffic. Biofuels production capacity in Finland is currently more than 500,000 toe, so the additional requirement by 2030 would be around 400,000 toe, if the obligations presented are to be fully met with domestic production.

Based on the estimates made earlier, the cost of investing 400 ktoe in production capacity would be up to EUR 1.300 million by 2030. However, there are significant uncertainties about the estimation of the amount of biofuel needed. If, for example, the energy efficiency did not improve and the number of electric cars would be half of the 250,000 vehicles expected in 2030, the required amount of biofuels would be raised annually by about 600 ktoe in 2030 situation.

Investment needs for the public recharging points for electric vehicles

Finland´s national plan for distribution network for alternative transport fuels [61] estimates that in 2030 at least 25 000 public recharging points should be provided for a minimum of 250 000 electric vehicles. The amount is based on the Alternative Fuels Infrastructure directive (2014/94/EU), which indicates that the appropriate average number of recharging points should be equivalent to at least one recharging point per 10 cars.

[60] Cost effective pathways of biofuels until 2030 (in Finnish but abstract in English). http://urn.fi/URN:ISBN:978-952-287-614-0

[61] Distribution network for alternative transport fuels. Finland´s national plan. Ministry of Transport and Communications, Reports 44/2017 http://urn.fi/URN:ISBN:978-952-243-501-9

If we assume that the average investment cost of one fast charger is approximately EUR 40,000 and the average investment cost of one medium speed charger is approximately EUR 14,000 [62], the estimated investments of building the public charging infrastructure are EUR 415 million by 2030. This is based on an assumption that ten percent of the public recharging points are fast chargers.

Investment needs for the security of supply of electricity networks

For the security of supply of electricity networks, the investments needs are estimated in the report of the electricity transmission pricing and security of supply[63].

Based on the report, according to the Electricity Market Act, grid companies must develop their grids and operations so that after 2028 a single disruption may not last more than 6 hours in areas covered by local detailed plans and 36 hours in other areas.

Since the 2017 legislative amendments, the Energy Authority has been able to grant companies extension until 2036 at the most where there are very serious grounds. Total investments by grid companies amounted to EUR 9.5 billion in 2016–2018, of which about EUR 3 billion is related to security of supply requirements.

The investments exceed significantly the required amount of straight-line deprecations under the Energy Authority control scheme, resulting in considerable needs for equity capital or non-equity capital. The domestic content of the security of supply investments is 70–90%. The effect of significant and accelerated investments on grid companies' turnovers is estimated at +10–40% in 2018–2028, depending on regional circumstances.

Investment needs in electricity interconnector capacity

The estimated costs of the construction of an alternating current connection of 800 MW between northern Finland and northern Sweden are just under EUR 200 million. The transmission line is planned from Messaure in Sweden via Keminmaa to Pyhänselkä in Finland, spanning a distance of around 370 kilometres. [64]

[62] The average costs are estimated based on research report of VTT Technical Research Centre of Finland: Tieliikenteen 40 %:n hiilidioksidipäästöjen vähentäminen vuoteen 2030: Käyttövoimavaihtoehdot ja niiden kansantaloudelliset vaikutukset (in Finnish). http://www.doria.fi/bitstream/handle/10024/162111/Tieliikenteen%2040%20hiilidioksidip%C3%A4%C3%A4st%C3%B6jen%20v%C3%A4hent%C3%A4minen%20vuoteen%202030%20K%C3%A4ytt%C3%B6voimavaihtoehdot%20ja%20niiden%20kansantaloudelliset%20vaikutukset%20(VTT%20Oy).pdf

[63] Jarmo Partanen. Electricity transmission pricing and security of supply. Publications of the Ministry of Economic Affairs and Employment 43 – 2018.
http://urn.fi/URN:ISBN:978-952-327-356-6

[64] Fingrid Oyj, Press Release 16.12.2016. https://www.fingrid.fi/

ii. Sector or market risk factors or barriers in the national or regional context

No significant sector or market risk factors are recognised.

iii. Analysis of additional public finance support or resources to fill identified gaps identified under point (ii)

5.4 Impacts of planned policies and measures described in section 3 on other Member States and regional cooperation at least until the last year of the period covered by the plan, including comparison to projections with existing policies and measures

i. Impacts on the energy system in neighbouring and other Member States in the region to the extent possible

Ban of coal in energy production and the new premium system for 1.4 TWh renewable electricity will have marginal impacts on the Nordic power system. By 2030, CHP generation capacity is expected to decrease by 300 MW compared to market based development. This will decrease marginally the flexibility of the Nordic power system. The inertia of the power system will decrease marginally when conventional power plants are shut down and variable renewable energy production increases.

ii. Impacts on energy prices, utilities and energy market integration

The impact of Finnish subsidized renewable electricity generation on neighbouring countries, energy market integration and electricity prices has been examined in SKM Market Predictor's study[29].

On an annual basis, Finland is a net importer of electricity and is expected to remain a net importer at least until the mid-2020s, despite of an increase in domestic production capacity. Consequently, subsidized renewable energy production primarily reduces the need for imports from neighbouring countries. According to SKM Market Predictor's analysis, the increase in renewable energy output of 1.4 TWh to be built as a result of a tendering process, reduces electricity imports from Sweden by about 0.9 TWh annually, which is equivalent to about one-twentieth of Sweden's estimated total export at the beginning of the 2020's. Similarly, imports from Russia would decline by about 0.2 TWh on an annual basis whereas exports to Estonia would increase by about 0.2 TWh.

The increase of renewable electricity generation by 1.4 TWh reduces, according to SKM Market Predictor's estimates, the Nordic-Baltic system price by about EUR 0.25 per MWh at the beginning of the 2020's. As Nordic renewable electricity production at the same time continues to grow, the price effect of Finnish subsidized production will be smaller later on. As a conclusion, SKM Market Predictor notes that the impact of Finnish subsidized renewable electricity generation on neighbouring countries, electricity prices and the integration of energy markets is small.

Ban of coal by 2029 will have a marginal impact on power prices, depending on the fuel price scenarios an increase of EUR 0.1–0.3 per MWh can be expected.

Finland, Sweden and Norway all have ambitious goals to reduce emissions in the transport sector. Quota obligation of biofuel in the transport sector has an important role in the beginning. This will create a joint Nordic market for biofuels in transport.

iii. Where relevant, impacts on regional cooperation

The renewable energy target in transport sector increases the activities of private companies and research institutes especially in biofuels and electric vehicles. This offers an excellent opportunity for regional cooperation in the dimension of research, innovation and competitiveness.

In the dimension of internal energy markets, the quota obligation of biofuels is expected to foster the joint Nordic biofuel market.

Annex 1

Level of energy savings requirement – Period 2021–2030 of the EED Article 7

The annual final energy consumption, as defined in the EED Article 2(3), and averaged over the years 2016−2018 is 238 TWh. Consumption for the year 2018 is preliminary. Finland's cumulative energy savings target for the period 2021−2030 is 105 TWhcum (= 238 x 0,008 x 55).

The formulation "supplied to" in the definition of EED Article 2(3), has been taken into account by deducting auto-production of electricity, steam and heat from Eurostat FEC2020−2030 data.

Energy Efficiency Measures – Period 2021–2030 of the EED Article 7

Finland opts to take alternative measures in the EED Article 7 implementation in the upcoming obligation period 2021–2030.

Planned seven energy efficiency measures for the implementation of revised EED Article 7 are listed in the table below. Most of them are also used in the ongoing EED Article 7 obligation period 2014–2020. However, some of these will be strengthened with some new amendments and features. Detailed descriptions of these measures and the method of calculating the cumulative energy savings to be achieved from each measure will be presented in the final EED notification June 2020.

The monitoring of the achievement of the energy savings target referred to in Article 7 of the Energy Efficiency Directive may take account energy savings resulting from the individual energy efficiency measures implemented in 2021–2030. In accordance to the Governance Regulation Annex III requirements, an estimation of the expected cumulative energy savings impact under the Directive during the two intermediate periods and the entire period 2021−2030 are presented in Table 25. Estimated cumulative savings impact pursuant to Article 7 is presented for the periods 2021–2025, 2026–2030 and the entire period 2021–2030. Cumulative savings presented for measures 1−7 are not overlapping.

Table 25. Planned Energy Efficiency Measures under the Art. 7 during the obligation period 2021–2030 and their cumulative energy saving impacts (TWh_{cum}).

	Energy Efficiency Measure	Period 1 2021–2025		Period 2 2026–2030		Period 1&2 2021–2030	
		TWh_{cum}	$ktoe_{cum}$	TWh_{cum}	$ktoe_{cum}$	TWh_{cum}	$ktoe_{cum}$
1	Energy Efficiency Agreements	59.95	5 155	22.48	1 933	82.43	7 088
2	Heat Pumps for Detached and Terraced Houses	16.00	1 376	4.40	378	20.40	1 754
3	Transport Fuel Taxation/Car traffic	8.55	735	6.80	585	15.35	1 320
4	Energy Audit Programme - SMEs and Municipalities	8.31	715	3.12	268	11.43	983
5	Energy Efficiency Measures in Agriculture Sector	8.44	726	2.96	255	11.40	980
6	Energy Efficiency Agreements/ Customer Advice Services	5.54	476	5.43	467	10.97	943
7	Mass and measure modifications in truck transport	1.08	93	0.00	0	1.08	93
	Total	**107.9**	**9 275**	**45.2**	**3 885**	**153.1**	**13 161**

As for the ongoing obligation period, Finland has planned also to calculate during spring 2020 the option to notify only taxation measures instead of the separate energy efficiency measure presented in the table.