

**Denmark's  
Integrated  
National Energy and Climate Plan**

**under the  
REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL  
on the Governance of the Energy Union and Climate Action**

**December 2019**



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## **SECTION A: NATIONAL PLAN**

## 1. OVERVIEW AND PROCESS FOR ESTABLISHING THE PLAN

### 1.1 Executive Summary

#### **(i) Political, economic, environmental, and social context of the plan**

On 27 June 2019 a new Danish Government was formed. The Social Democrats reached agreement with the Red-Green Alliance, the Social Liberal Party and the Socialist People's Party to form a one-party minority Government led by the Social Democrats. The parties agreed to the document titled A fair direction for Denmark.

The parties agreed that the Government will promote a sustainable policy under which Denmark resumes leadership of the green transition, significantly increases its ambitions concerning the climate, environment and nature, and ensures that Denmark is in compliance with the Paris Agreement.

The Government has the ambition of being among the world governments that do most – both domestically and abroad – to combat climate change and the deterioration of our environment and nature. In order to reach those targets, a very significant effort will be required throughout the tenure of the Government, which must take place in a socially balanced way.

On December 6, 2019 the Government reached an agreement on a new Climate Act with 8 out of the 10 parties in the Danish Parliament. The act will include a legally binding target to reduce greenhouse gases by 70% by 2030 (relative to 1990 level), to reach net zero emissions by 2050 at the latest, and to set milestone targets based on a five-year cycle.

It is stated in A fair direction for Denmark that a reduction target by 70% by 2030 is a very ambitious goal, and it will be particularly difficult to realise the last part of the goal, i.e. from 65% to 70%. This will require currently unknown methods and, therefore, also a close collaboration with the Danish Council on Climate Change and other experts.

The climate act will be followed by climate action plans, which will contribute to ensuring that national reduction targets are met. The Climate Action Plan in 2020 will include sector strategies and indicators as a minimum for central sectors as agriculture, transport, energy, construction and industry. Moreover, Denmark has already taken the first steps towards establishing a professional and efficient energy sector as the basis for the transition to a sustainable green society.

In June 2018 all Parties of the Danish Parliament at the time reached a political Energy Agreement to further build Denmark's international positions of strength with a focus on renewable energy, energy efficiency improvements, research and development and energy regulation. The measures and policies decided in the agreement are now in the process of being implemented.



## **(ii) Strategy relating to the five dimensions of the Energy Union**

### **Decarbonisation - GHG emissions and removals**

On December 6, 2019 the Government reached an agreement on a new Climate Act with 8 out of the 10 parties in the Danish Parliament. The act will include a legally binding target to reduce greenhouse gases by 70% by 2030 (relative to 1990 level), to reach net zero emissions by 2050 at the latest, and to set milestone targets based on a five-year cycle. Moreover, the Danish Government will develop Climate Action Plans that will outline concrete policies to reduce emissions in relevant sectors.

### **Decarbonisation - Renewable energy**

The Government has set a very ambitious national target of reducing greenhouse gas emissions by 70 % in 2030 compared to 1990 levels. To reach this target new initiatives will be adopted which will accelerate the transition to renewables in the energy and transport sector.

Moreover, Denmark has set an ambitious course towards at least 55 % renewables energy in gross final consumption in 2030. That will give an important contribution towards the 2030 EU-target for renewable energy. In June 2018 the Danish Parliament agreed on a policy framework for the energy policy from 2020 to 2024 that will specify the first significant steps towards that achievement. As a result, the renewable capacity and renewable shares are expected to rise steadily in all sectors throughout the period.

### **Energy efficiency**

The energy efficiency effort in Denmark has been a highly prioritised policy area since the oil crisis of the 1970s. Denmark has therefore developed a great expertise in energy efficiency, which has made it possible to keep energy consumption largely unchanged in spite of significant economic growth over the last four decades.

Due to continuing economic growth and the construction of several datacentres, the Danish energy consumption is expected to increase slightly in the period 2021-2030 by app. 1 Mtoe in primary energy consumption and 0,5 Mtoe in final energy consumption. However, Denmark is planning a number of initiatives and measures for the period 2021-2030 in order to reduce its energy consumption and fulfil its energy saving obligation. The most prominent new energy saving measure for the period, is a subsidy scheme from 2021-2024 targeting private enterprises and buildings, which is projected to save app. 1,2 Mtoe. This is supported by other measures related to energy efficiency and renovation in public and private buildings, which is projected to generate app. 0,66 Mtoe in savings.

### **Energy security**

Denmark currently has a high level of energy security. The Danish gas production will decrease during the next three years as the Tyra facility will be shut down, but the overall energy mix in Denmark is expected to keep a relatively stable trend in its transition towards a green energy system.

The continued high level of energy security is ensured through decreased dependency on import from third countries through i) Denmark's increase in its renewable energy share largely, ii) Denmark's domestic oil and gas production, and iii) Denmark's cooperation with

neighbouring countries to keep the interconnectivity level high. It is also ensured through increased flexibility in the energy system, through systematized monitoring of adequacy of the supply in different sectors, through emergency plans and the historical development of a resilient energy system.

#### Internal energy market

Denmark currently has a high level of interconnectivity and Denmark will uphold and increase interconnectivity through projects coordinated with neighbouring countries. This includes a list of PCI projects and reinvestments in existing interconnectors.

Moreover, Denmark is currently focusing on the functioning and integration of electricity markets, with a focus on developing cross-border markets for balancing products.

Regarding cross-border capacity, improvements are expected due to the DG COMP decision on the DK1-DE interconnector as well as measures from Svenska Kraftnät for the Swedish interconnectors. Denmark is also focusing on the increase of flexibility in the energy system and the development of better functioning markets in order to facilitate new actors and technologies.

#### Research, innovation and competitiveness

The new Danish Government wants to reduce greenhouse gas emissions by 70 % by 2030 compared to the 1990 level as well as reaching net-zero emissions by 2050. Denmark must be known as a nation of green entrepreneurialism. Therefore, new technologies and solutions must be developed and deployed.

Denmark has committed to spend 580 mill. DKK in 2020 and 1 billion DKK in 2024 on research, development and demonstration (R&D) of new technologies related to energy and climate. A large share will go to the EUDP programme, which funds projects in line with SET Plan objectives. Moreover, the new Danish government has proposed to increase spending to green research, development and demonstration by 1 billion DKK in 2020. It is expected that a large part of this funding will go to climate-related research and innovation, including research and innovation in clean energy. Furthermore, Denmark wants to intensify export promotion activities in the energy sector – both in scale and volume – to a total of 174 million DKK from 2019 to the end of 2024.

#### **(iii) Overview table with key objectives, policies and measures of the plan**

Table 1 presents an overview of key objectives, policies and measures of the plan.



Table 1. Overview of key objectives, policies and measures

Dimension	Key objectives	Key policies and measures
Decarbonisation - GHG emissions and removals	Denmark will reduce greenhouse gas emission by 70% in 2030 compared to 1990.	The most recent Danish Climate and Energy Outlook (2019) shows that GHG emissions in 2030 will be 46% below 1990 with the effects of implemented and adopted policies and measures, where RE- and EE- policies and measures are key policies and measures. Policies and measures contributing to the achievement of the 2030 target are expected to be decided after the submission of the NECP, in the climate action plans.
	Denmark will work towards net zero emissions in the EU and in Denmark by 2050 at the latest.	Implemented and adopted RE- and EE- policies and measures are key to the emission reductions achieved until now. Additional policies and measures to be decided after the submission of the NECP are expected to also contribute to the achievement of the long-term target in 2050.
	Limit Denmark's non-ETS greenhouse gas emissions in 2030 at least by 39% relative to Denmark's emissions in 2005	Policies and measures adopted with the 2018 Energy Agreement promoting RE and EE (see description below under RE & EE). Additional policies and measures to be decided after the submission of the NECP, including new measures to be adopted in the climate action plans.
	Transport sector transition	A Commission for Green Transition of Passenger Cars is expected to provide recommendations for policies and measures that will contribute to the green transition of the transport sector. A stop to sales of all new diesel and petrol cars as of 2030.
	Ensure that emissions do not exceed removals as accounted in the LULUCF sector	Ban on burning of straw residues on fields, public afforestation and a grant scheme for afforestation on private agricultural land and subsidy for conversion of arable land on organic soils to nature.
Decarbonisation - Renewable energy	The parties of the Energy Agreement from June 2018 have allocated funding that sets a course towards a renewable energy share of approximately 55% by 2030. The agreement will also lead to a RE share in electricity above 100% of consumption, while ensuring that at least 90% of district heating consumption is based on energy sources other than coal, oil or gas by 2030.	Technology-neutral RE tenders, three new offshore wind farms of at least 800 MW each, reduction of the electrical heating tax, reduction of the electricity tax, support of geothermal energy and an analysis of modernizing heat.
	Phase out coal in electricity production between now and 2030.	A combination of a range of policies and measures, such as incentives for producing electricity and heat with other technologies and fuels than in coal fired power stations, as well as good interconnections to neighboring counties, and market conditions (higher CO2 price in the ETS System), deployment of large scale wind power, etc.
Energy efficiency	Saving obligations according to Article 7 in the energy efficiency directive.	Competitive subsidy scheme related to private enterprises at 300 mio. DKK per year in 2021-2024 and competitive subsidy scheme related to buildings at 200 mio. DKK per year in 2021-2024. Moreover, efficiency of existing buildings by other measures is significantly increased through the requirements to the renovation of buildings in the building codes. To be updated after the adoption of the climate action plans.
	Energy savings in accordance with the requirements of art. 5 in the energy efficiency directive	To be updated after the adoption of the climate action plans.
Energy security	Stable and reliable energy supply	Laws on responsibilities regarding electricity supply, gas supply and emergency plans. A new planning target is to be set by the Minister of Climate, Energy and Utilities regarding security of electricity supply.
	The parties of the Energy Agreement from June 2018 have allocated funding that sets a course towards a renewable energy share of approximately 55% by 2030.	Policies and measures adopted with the 2018 Energy Agreement including: Tenders for new renewable energy production facilities, Market Model 3.0, a Smart Energy plan, lowered taxes on electricity, an analysis of the future tariff design, support of geothermal energy, etc. Moreover, the energy storage fund of 2019.
	Prevention of risks in the energy system	Laws on responsibilities for emergency plans and a cybersecurity strategy. Cable-laying the electricity distribution system.
	Increased international cooperation concerning energy supply	Participation in regional cooperation groups. Dialogue with neighbouring countries, such as Germany and Sweden.
	Increased interconnectivity	5 PCI projects and reinvestments in interconnectors that are about to reach the end of their expected lifetime.
	Increased flexibility in the electricity system	Policies and measures adopted with the 2018 Energy Agreement including: the Market Model 3.0, the tariff project, the Smart Energy plan etc. Moreover, the energy storage fund.





Internal energy market	Increased interconnectivity	5 PCI projects and reinvestments in interconnectors that are about to reach the end of their expected lifetime.
	Integration of renewables, interconnectivity and SoS	Investigation of a development project (NSWPH). An application has been submitted for the project to become a PCI candidate.
	Developing markets for flexibility and ancillary services	The Market Model 3.0 project. Roll-out of smart-meters. Energy storage fund. Project by the Nordic TSO to procure FFR for a sufficient level of inertia. Law on procurement of services by the TSO through market-based mechanisms.
	Having a highly competitive retail market, and protecting consumers	Smart meter rollout by 2020. Monitoring of the market development to ensure appropriate price level. Supplier centric model implementation. Creating of datahub. Online price comparison tool. Law change with stricter rules for vertically integrated companies.
Research, innovation and competitiveness	Support reduction of greenhouse gas emission by 70 % in 2030 compared to 1990 by developing new technologies and systems in energy, transportation and agriculture.	The Energy Agreement states that by 2024 Denmark has a spending target of 1 billion DKK on research, development and demonstration of new technologies related to energy and climate. Moreover, with the research reserve agreement 2020, the Government and all the political parties has agreed to increase spending to green research, development and demonstration by 1 billion DKK in 2020..
	Denmark must be known as a nation of green entrepreneurialism.	In June 2019, the Government has declared that it will further increase funding to green research and demonstration programs. With the research reserve agreement 2020, the Government and all the political parties has agreed to increase spending to green research, development and demonstration by 1 billion DKK in 2020. Denmark has decided to launch export promotion activities for at total of 174 mill. DKK from 2019 to 2024.

## 1.2 Overview of current policy situation

### (i) National and Union energy system and policy context of the national plan

Denmark has a strong tradition of broad political Energy Agreements. In 2012, a broad majority in Parliament reached an Energy Agreement defining initiatives covering crucial energy policy areas for the period 2012-2020. Also, the parties to the 2012 Energy Agreement agreed by 2018 to commence discussions on additional initiatives for the period after 2020, which was concluded with the Energy Agreement from June 2018.

Supported by all political parties of the Parliament at the time, the Energy Agreement from June 2018 sets the scene for the Danish energy policy going beyond 2020. The policies and measures decided in the agreement are now in the process of being implemented.

On December 6, 2019 the Government reached an agreement on a new Climate Act with 8 out of the 10 parties in the Danish Parliament. The act will include a legally binding target to reduce greenhouse gases by 70% by 2030 (relative to 1990 level), to reach net zero emissions by 2050 at the latest, and to set milestone targets based on a five-year cycle.

The EU's climate and energy policy constitutes a central framework for Denmark's national efforts. The overall EU targets for 2020 and 2030, and the national burden sharing that follow from some of these constitute key reference points for the Danish national policies in this area. The underlying regulations that support the achievement of those targets also constitute a central part of the national regulation and measures to achieve the overall targets. Furthermore, Denmark benefits greatly from being part of a well-functioning internal market for energy in the EU. This is one of the keys to integration of large amounts of renewable energy into the energy system, and will thus only become more important in the years to come.

### (ii) Current energy and climate policies and measures relating to the five dimensions of the Energy Union

See section 1.1 for summary of policies and measures relating to the five dimensions. For more detailed description see chapter 3.

### (iii) Key issues of cross-border relevance

As a small country taking part in the integrated Nordic electricity market, cross-border aspects of the energy system have become more and more relevant for Denmark. Especially in light of the increasing amount of fluctuating energy in the energy system, Denmark sees an increased importance of a well-functioning and integrated energy market across borders. Thus, knowledge of the energy mix and policies, as well as co-operation with our neighbouring countries is increasingly important. The North Seas region, which has a large renewable energy potential, is also a key issue of cross-border relevance. The North Seas Energy Cooperation will be explained in section 1.4.

Denmark also participates in the Baltic Energy Market Interconnection Plan (BEMIP). In this forum Denmark collaborates with Germany, Estonia, Latvia, Lithuania, Poland, Finland, and Sweden on issues of cross border relevance in regard to infrastructure, markets, gas and electricity, security of supply and integration of renewables.

Moreover, Denmark cooperates with Great Britain on the Viking Link project. Viking Link is a 760 km long electricity interconnector between Denmark and Great Britain under construction. The interconnector will enable more effective use of renewable energy, access to sustainable electricity generation, and improved security of electricity supplies. Viking Link will increase the security of electricity supplies in both Denmark and Great Britain.

In Denmark, Viking Link will increase the value of wind power. Better possibilities for cross-border electricity trading will contribute to lower wholesale prices for electricity in Great Britain. To meet international and domestic renewable and climate change targets, Great Britain and Denmark are generating more power from renewable sources, including offshore wind. By its nature, wind generation is intermittent and interconnectors provide an effective way to manage these fluctuations in supply and demand.

Viking Link will become Denmark's largest cable to a neighbouring country. The high capacity gives rise to a need for extra reserves in the western Danish power grid in order to ensure a balance in the transmission system in case of a defect in Viking Link. The reserves will be obtained via the Danish-German border and through a closer operational cooperation with German TenneT.

Moreover, Denmark cooperates with Poland and Norway on The Baltic Pipe project. Direct access of Eastern and Central Europe to gas deposits in Norway will improve the supply security by opening a permanent corridor for the delivery of gas while increasing the competitiveness and price pressure among gas suppliers. The pipeline is also embedded in the climate protection policy and the support for the Eastern and Central Europe's efforts to decarbonize their economies. Baltic Pipe will enable Poland to reduce their coal consumption. As gas emits about half the amount of CO<sub>2</sub> compared to coal, the Baltic Pipe Project can contribute to the global reduction of CO<sub>2</sub> emission by supporting the phase-out of coal. Furthermore, Baltic Pipe can support the integration of renewable energy sources such as green gas and biogas into the gas transmission system.

Denmark also participates in German-initiated "Electricity Neighbours", which is a regional cooperation that aims to ensure security of electricity supply in the framework of the internal energy market. A declaration among the participating countries was signed in 2015, and the "electricity neighbours" continue to meet regularly and exchange views on different topics of common interest.

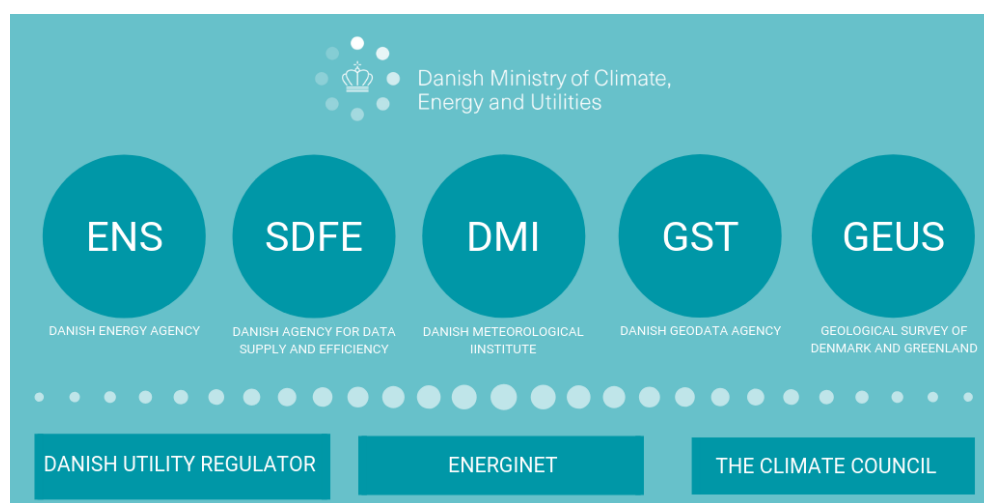
#### **(iv) Administrative structure of implementing national energy and climate policies**

To prepare the National Energy and Climate Plan, a project group has been established between the Danish Ministry of Climate, Energy and Utilities and the Danish Energy Agency. The overarching responsibility of the development of the plan is held by the Ministry of Climate, Energy and Utilities while the Danish Energy Agency is responsible for the modelling and scenario development. Moreover, Ministry of Finance, Ministry of Environment and Food, Ministry of Industry, Business and Financial Affairs, Ministry of Taxation and Ministry of Transport and Housing has contributed and been consulted on the plan.

The implementation of energy and climate policy is done in the same manner as other sector legislation and is implemented in the Ministry of Climate, Energy and Utilities.

The Danish Ministry of Climate, Energy and Utilities consists of the Department, the Geological Survey of Denmark and Greenland, the Agency for Data Supply and Efficiency, the Danish Meteorological Institute, the Danish Geodata Agency, the Danish Energy Agency and the associated independent bodies the Danish Energy Regulatory Authority, Energinet and the Danish Council on Climate Change.

**Figure 1. Organizational chart of the Danish Ministry of Climate, Energy and Utilities**



**The Danish Energy Agency** is responsible for the entire range of tasks linked to energy production, supply and consumption, as well as Danish efforts to reduce carbon emissions. The Agency supports the economical optimisation of utilities that in addition to energy includes water, waste and telecommunication. The agency is also responsible for user conditions, supply obligation and telecommunication statistics as well as water supply and waste management.

**The Agency for Data Supply and Efficiency** provides the public and private sector with high quality data. The task of the Agency is to provide the foundation for political decisions through reliable data which can be combined, and to ensure that geo and administrative data create value across the public sector. The Agency supplies the public sector, citizens and businesses with data, giving them more intelligent and accurate knowledge about society.

**DMI – The Danish Meteorological Institute** provides meteorological services in Denmark, the Faroe Islands, Greenland and the surrounding waters and airspace. Meteorological services include forecasting and warnings and the monitoring of weather, climate and related environmental conditions in the atmosphere, on land and at sea. The Institute carries out Denmark's international meteorological obligations and is the point of contact for exchanging information internationally.

**The Danish Geodata Agency** is responsible for surveying, mapping and land registering of all of Denmark, Greenland, the Faroe Islands and all waters associated with these.

**GEUS – The Geological Survey of Denmark and Greenland** is an independent Danish research and advisory institution operating in the areas of environmental geology, water resources, energy and mineral resources. GEUS collects and stores data and is responsible for research, consultancy and communication related to the exploitation and protection of the natural geological resources of Denmark and Greenland.

**The Danish Utility Regulator** regulates the Danish markets for electricity, natural gas and district heating. In the electricity market, the regulation focuses on the network companies. The Authority sets the allowed price for electricity companies with an obligation to supply. In the natural gas market, the regulation also focuses on the network companies. The Authority also sets the price for natural gas supplied by the natural gas companies with an obligation to supply.

**Energinet** is the Danish national transmission system operator (TSO). It is an independent, state-owned company that owns Denmark's electrical and natural gas grid. It also maintains a supply of natural gas. Energinet's primary responsibility is to control and maintain the national electrical transmission grid and the national gas distribution grid.

**The Council on Climate Change** is an independent body of experts. It provides recommendations on climate initiatives in the transition to a low-carbon society based on independent professional analyses centred on the overall objective for 2050.

### **1.3 Consultations and involvement of national and EU entities and their outcome**

#### **(i) Involvement of the Parliament**

The content of the National Energy and Climate Plan is among other things based on the Energy Agreement of 29 June 2018 adopted by all parties of the Danish Parliament at the time. Moreover, the signatory parties to the agreement are continuously involved and informed about the implementation of the Energy Agreement.

The Danish Parliament has also received the Danish National Energy and Climate Plan, before it was handed over to the Commission.

#### **(ii) Involvement of local and regional authorities**

There has not been a specific involvement of local or regional authorities, but the organisation representing the municipalities “Local Government Denmark” has been involved in the hearing of the plan, as well as the organisation representing the different regions in Denmark, the so-called “Danish Regions”.

The Local Government of Denmark (KL) has sent a response to the public hearing notice. In the response, KL stresses that in the agreement between the Government and Municipalities on the municipalities’ economy for 2020, it is stated that the Government will on an on-going basis involve the municipalities in the work with the green transition, with the purpose of qualifying and anchoring Denmark’s climate actions. However, KL notes that they have not yet been involved in the work with the new climate act and climate action plan.

Moreover, KL underlines strategic energy planning as an important tool in regard to the transition to a renewable energy system. The organisation stresses that strategic energy planning should be a mandatory task for the municipalities, and that the government should set clear guidelines and provide the necessary resources for this. In addition, KL highlights the need for strengthening the possibilities to set up new and bigger onshore wind turbines. KL also advocates for an external fund for multifunctional land distribution and homogeneous requirements for solar PV across state, regions and municipalities. Furthermore, KL argues that the Danish district heating system secures a stable heating system for the citizens. They argue that the commitments in the form of connection and continuation requirements should be reintroduced. Moreover, KL argues for further development of the energy and CO<sub>2</sub> account. Finally, KL argues that the government should create better incentives for the utilization of surplus heat.

#### **(iii) Consultations with stakeholders, including social partners, and engagement of civil society and the general public**

The Danish Ministry of Climate, Energy and Utilities has a structure in place where relevant stakeholders get the opportunity to take part in a hearing via the so-called EU Special Committee. The committee consists of approx. 100 stakeholders, interest groups, organisations, NGOs, companies, public institutions etc. The NECP was sent to the EU Special Committee on 22 November 2019, with the opportunity to comment on the plan on 2 December 2019 at the latest. Moreover, the NECP was published on The Danish Ministry

of Climate, Energy and Utilities' web page on 22 November and on the Danish Energy Agency's web page at the same time, to give the public the opportunity to take part in the consultation.

The Ministry has received 12 responses to the public hearing notice from the following respondents: SYNERGI, DANVA, The Danish Construction Association, Confederation of Danish Industry (DI), Danish Ministry of Defence Estate Agency, The Danish 92 group, Wind Denmark, Energinet, Finance Denmark, The Danish Forest Association, the Danish Business Authority and Local Government Denmark. The Danish Consumer Council informed that they did not have any comments.

In general, nearly all respondents explicitly welcome the Government's ambitious goal and support the target of reducing greenhouse gas emissions by 70 % in 2030. In the following, the responses will be summarised according to the main concerns and themes addressed in the responses, also bearing in mind the five dimensions in the Energy Union.

#### Energy Efficiency

Comments in regard to energy efficiency were made by a range of respondents. In general, the stakeholders express that Denmark should increase energy efficiency efforts and highlight the socio-economic potentials of focusing on energy efficiency. Moreover, stakeholders highlight that an increased Danish energy efficiency effort also will ensure Danish leadership and Danish export of energy efficient solutions. In addition, several stakeholders advocate for a national energy efficiency target and for the need for new energy efficiency measures after 2024. The key issues raised can be summarised as follows:

- *Energy saving requirements for all public sector buildings (art. 5 in EED).* The stakeholders welcome that the Government is working on a plan for energy efficiency in government buildings in 2021-2030 (EED, art. 5). The stakeholders stress that the requirements should also apply to municipalities and regions and some suggest a 3% target.
- *Energy saving obligations (art. 7 in EED).* The stakeholders stress that Denmark should live up to the energy saving obligation. Moreover, the Government is urged not to notify taxes as part of the fulfilment of the energy saving obligation.
- *The long-term renovation strategy:* The stakeholders encourage the Government to make an ambitious long-term renovation strategy. Moreover, they argue, that additional benefits, for instance better housing standards and indoor climate benefits should be included in the strategy.
- *New finance sources for energy efficiency in private buildings:* Several stakeholders argue that there is a need for better financing sources for energy efficiency in private buildings. Many private homeowners have a low knowledge of energy efficiency and there is a lack of attractive financing options in some parts of Denmark.
- *The building job scheme:* Some also mention that the building job scheme should be revised to make it possible to accumulate the yearly tax allowance over a number of years to undertake bigger and deep energy renovations. The scheme could also be extended to include demolition of buildings in poor energy conditions.

- *Energy Performance Certificates:* One respondent argue that the quality and control of the Energy Performance Certificates should be improved. Moreover, the access to the underlying data should be improved.

#### Decarbonisation, Renewable energy and internal energy market

Several stakeholders express their support for further deployment of renewable energy, in particular wind power, as a means to meeting the Governments objective of reducing GHG's by 70 pct. in 2030. One point out that two more offshore wind farms should be established before 2030, and another stakeholder encourages the Government to establish at least five more large offshore wind farms before 2030 and to establish "energy islands" with the aim of further deployment of large-scale offshore wind.

In order to maximise the use of the wind resources around Denmark, some stakeholders suggest strengthening exports of electricity to neighbouring country Germany, arguing that when green electricity is exported, this may well replace coal-powered electricity in Germany, thereby having significant benefits for the climate.

Some also mention the importance of giving priority to Power-to-X, i.e. producing liquid fuels from excess wind power electricity. In this context, a national centre for energy storage as well as further deployment of solar PV and onshore wind is also suggested.

Several mention Power-to-X as one of several building blocks in an effort to ensure *sector coupling*, which is highlighted by several stakeholders. By using green electricity to produce hydrogen, renewable energy can be used in transport, and synergy across sectors can be achieved. Sector coupling is also claimed to be able to significantly contribute to increased use of surplus heat (in the industry sector) through heat pumps, thereby contributing to a more energy efficient and green district heating system while at the same time using green electricity. Some underline that public support in Denmark as well as other EU countries are needed for the first large scale hydrogen production facilities. Moreover, some encourage the Government to promote the use of green fuels such as hydrogen based on green electricity in international sea and air transport, even if these sectors are not part of the national 70 pct. reduction objective.

On biomass, one stakeholder stresses that bioenergy accounts for a significant share of overall energy, but that this role could be further increased through the use of wood in construction of buildings, thereby contributing to storage of CO<sub>2</sub>.

Another stakeholder stresses that current conversion from coal to biomass is a bad solution for the climate, claiming that large heat pumps already today constitute an economically feasible solution to replace coal fired production in district heating.

#### Research, development and competitiveness

One respondent encourages the Government to increase the support to research and development and another respondent highlights the need for research in CO<sub>2</sub> uptake and storage, which they point to, is also already happening. Moreover, a stakeholder encourages the Government to make new initiatives to ensure the terms of competition for the industry and the green industry. In line with this, some stakeholders argue that the use



of high national CO<sub>2</sub> taxes can lead to a decrease in competitiveness and CO<sub>2</sub>-leakage. Finally, one respondent notes that the NECP will not result in administrative consequences for the business sector.

#### Compliance with Governance regulation on public consultation

One of the stakeholders argue that the public hearing is not in compliance with the Governance regulation requirements for public consultation and involvement as described in Article 10 and 11, as well as preamble 28. This criticism is particularly related to the public hearing only allowing 10 days (or six working days) to work out responses to the hearing. The same stakeholder encourages the Government to instead undertake a thorough public consultation as part of the process for working out the climate action plan.

The same stakeholder also points out that scenarios in chapter 4 of the NECP are worked out with price assumptions for gas, which are derived from the IEA New Policies Scenario in World Energy Outlook – a scenario which is not compatible with objectives in the Paris-agreement on climate change. This stakeholder notes that the Danish Parliament in 2018 has adopted a decision to, in such cases, if relevant and possible, include sensitivity analysis covering Paris agreement compatible scenarios and price assumptions.

#### Government remarks to public consultation responses

The Government welcomes all responses and will consider the points made in the future work with the climate action plan and other climate and energy initiatives.

The Government is particularly pleased to note the overwhelming support by stakeholders for the Government's target to reduce GHG's by 70% in 2030 compared to 1990 levels.

The Government has already taken concrete steps on some of the points mentioned by the stakeholders. On 2 December 2019, the Government reached agreement with the Red-Green Alliance, the Social Liberal Party, the Socialist People's Party and the Alternative on the Finance Act 2020. As an example, the parties agreed to initiate a preliminary study of "energy islands" and support power-to-X technologies.

In regard to the comments to the energy efficiency effort, the Government is aware that the current measures fall short of reaching the energy saving obligations under article 7 of EED. The Danish Government is committed to fulfill the energy saving obligations under article 7. Measures and instruments contributing to the obligation will be outlined in the upcoming climate action plan.

As regards compliance with Article 10 and 11 of the Governance Regulation, the Government acknowledges that 10 days of hearing under normal circumstances is relative short, bearing in mind the complexity of the plan. However, this also has to be seen in relation to the fact that the NECP does not introduce any new political objectives or policies and measures, as well as NECP scenarios towards 2030 are already published in the Danish Climate and Energy Outlook 2019 (DECO 2019).

Over the past year, the draft NECP has been available on the websites of the Ministry as well as the Danish Energy Agency, including a description of the Governance Regulation and the process towards a final NECP in 2019. This has not resulted in any comments or questions.

In the years to come the Government will on an on-going basis include independent experts, popular movements and interest organisations with the purpose of qualifying and anchoring Denmark's green efforts.

Moreover, the Government has taken concrete steps to ensure a close cooperation with the Danish business community on the climate agenda. On 13 November, the Danish Prime Minister presented the Government's 13 "climate partnerships". The 13 partnerships represents all branches of Danish business. The Danish business community plays a central role in the green transition and with the climate partnerships, the Government wants to work closely with the business community on how to contribute to solving the climate challenges.

The Government remains open to discussing the elements of climate and energy policy with all stakeholders in future processes towards achieving the political objectives.

#### Strategic environmental assessment

The NECP has not been subject to a strategic environmental assessment pursuant to the SEA directive. The Danish NECP is a generic and strategic plan, for which the criteria of the SEA directive does not comply. The Danish NECP reports on adopted and planned energy and climate objectives, policies and measures. Hence, the plan provides a holistic overview of Danish energy and climate politics but the reported objectives, policies and measures are founded on other agreements, e.g. the Energy Agreement from 2018 and A fair direction for Denmark from June 2019. The plan in itself does therefore not set the framework for future development, as these are set in other agreements, plans and programmes. However, future concrete plans which set the framework for future development and where land use is concerned and affected will be subject to a strategic environmental assessment.

#### **(iv) Consultations with other Member States**

Cooperation, coordination and general dialogue is taking place with the Nordic countries via the Nordic Council of Ministers. An ad hoc networking group has been established with participation of the NECP coordinators in the Nordic Countries. This networking group has met to discuss issues of common interest and to share knowledge.

Moreover, consultations with other member states have been conducted through different events and conferences. Denmark participated in the consultation of the Dutch National Energy and Climate Plan on 25 September 2019. Furthermore, the National Energy and Climate Plans were discussed at a Nordic energy seminar on 1 October 2019 in Island. Denmark also participated with a presentation and in a panel discussion on NECP's at the Nordic-Baltic Energy Conference in Tallinn on 24-25 October 2019. These events have served as a platform to exchange information and to enhance cooperation.

In addition, on 22 November 2019 Denmark's NECP was sent for consultation to the countries of The North Seas Energy Cooperation (Belgium, the Netherlands, Luxembourg, France, Germany, UK, Ireland, Norway and Sweden) and the Nordic countries. Denmark did not receive any comments.

**(v) Iterative process with the European Commission**

Dialogue with the European Commission has taken place within the structure of the Technical Working Group on the National Energy and Climate Plans. Moreover, Denmark has held bilateral meetings with the European Commission.

## 1.4 Regional cooperation in preparing the plan

### **(i) Elements subject to joint or coordinated planning with other Member States**

#### **North Seas Energy Cooperation**

Denmark is part of the wider North Seas region, which has a large renewable energy potential. The European Commission has estimated that offshore wind from the North Seas can cover up to 12 % of the electric power consumption in the EU by 2030.

Offshore wind generation and grid infrastructure projects may have cross-border effects on energy prices, security of supply and the environment, including availability of marine space as well as the pace of innovation. The North Seas countries therefore have great benefits to gain from cooperation.

The North Seas Energy Cooperation (NSEC) is a voluntary, bottom up, market-oriented, regional cooperation initiative established in 2016, which seeks to create synergies and to avoid incompatibilities between national policies and to share knowledge on international best practices and foster joint strategies where possible and beneficial. The aim is to coordinate and facilitate further cost-effective deployment of offshore renewable energy, in particular wind, ensuring a sustainable, secure and affordable energy supply in the North Seas countries through increased and better coordinated offshore wind deployment as well as potential joint projects or cluster projects. The NSEC focuses on a step-by-step approach with the perspective of further integration and increased efficiency of wholesale electricity markets in the longer term, while contributing to a reduction of greenhouse gas emissions, in average wholesale price spreads and enhancing security supply in the region.

The North Seas Energy Cooperation consists of 10 countries with participation from the European Commission: Belgium, the Netherlands, Luxembourg, France, Germany, UK, Ireland, Norway, Sweden and Denmark.

#### **Regional cooperation**

As regards to preparing this plan, Denmark made use of the NSEC, in which experts in the support groups shared information and experiences on specific aspects, for example on barriers and best practices of national offshore wind development and in particular on aggregation of national renewable energy trajectories for offshore wind until 2030 and market integration.

Denmark furthermore consulted on its National Energy and Climate Plan in the area of planned offshore wind deployment until 2030 and related grid planning aspects with the other North Seas countries.

The support groups under the cooperation focus on the following subjects:

Support group 1: Maritime Spatial Planning and environmental assessment

Support group 2: Development and regulation of offshore grids and other offshore infrastructure

Support group 3: Support framework and finance for offshore wind projects

Support group 4: Standards, technical rules and regulations in the offshore wind sector

### Maritime Spatial Planning and environmental assessment

Within the North Seas Energy Cooperation, Denmark contribute to the work on establishing common environmental impact assessment methodology. In order to reach our energy and climate targets within the EU, there is a need to better understand the possible ecological limits of large scale wind development in the North Seas. Further work is needed on maritime spatial planning and environmental assessment to be able to utilise the potential of the North Seas. To increase knowledge and support the deployment of offshore wind in the North Seas, the North Seas countries will continue to cooperate closely on maritime spatial planning, environmental research, cumulative impact assessment of wind farms between responsible authorities for energy, maritime spatial planning and environment.

### Offshore Grids and other Offshore Infrastructure

The NSEC serves as a platform to jointly work on concepts for potential joint wind offshore projects and for coordinated electricity infrastructure including transmission infrastructure.

Denmark works together with the other North Seas Energy Cooperation countries on the possibilities for concrete cooperation projects. Besides joint offshore wind projects that would be connected to and supported by several Member States, this includes the work on possible 'hybrid' solutions that would use cross-border solutions for connecting offshore wind farms to the grid and seek synergies with interconnection capacity between countries, and on the corresponding market arrangements.

Denmark is therefore contributing to the development of possibilities for cooperation on hybrid projects and identifying and addressing possible legal, regulatory and commercial barriers. By coordinating on increased interconnection among the countries in the NSEC, an increasing amount of excess production of energy could flow across borders to meet demand in a well-functioning internal energy market.

The NSEC has identified a list of potential areas and projects in the region, where joint projects could be particularly beneficial. These include: (1) IJmuiden Ver offshore wind farm to UK, (2) CGS IJmuiden Ver – Norfolk, (3) COBRA Cable, (4) DE offshore wind farm connected to NL and (5) North Seas Wind Power Hub.

The NSEC is working on developing concrete concepts for the implementation of selected projects from the above list.

The NSEC will continue to work on the actions plans for the specific hybrid projects which can also be taken further at a national and regional level. Furthermore, the cooperation will continue to work as a forum to reflect on how to deal with the uncertainties about the regulatory treatment of hybrid projects at EU and national level and as a forum to discuss options for addressing these issues.

### Support Framework and Finance of Offshore Wind Projects

As regards to measures, Denmark benefits from the NSEC in several ways. The work in the NSEC provides a platform for exchange of best practice regarding the design of support schemes and to develop and work on new concepts tackling new challenges concerning

support for offshore wind as well as to develop possible options for future joint offshore wind projects.

Denmark works in the NSEC to coordinate the timing of tenders, to exchange best practices on the design for offshore wind support schemes and to identify, where possible, common principles as well as possible options for alignment of support.

As regards to coordination of tenders, Denmark regularly shares information regarding its national tender schedule with the other NSEC countries with the aim of identifying possible overlaps in time and enabling the most continuous tender pipeline across the North Seas region to ensure that tender processes maximize competition and deliver most value for money to consumers. Denmark is ready to take into account, amongst other criteria and where possible, this overview of tender schedules in its future tender planning to avoid unnecessary bottlenecks and to provide a steady capacity pipeline to involved stakeholders without stop and go cycles.

Denmark shares and discusses in the NSEC the estimated national offshore renewable trajectory, information on its national offshore deployment plans and best practices in the design of offshore wind tenders.

At the Ministerial meeting in Esbjerg on the 20th of June 2019, North Seas countries agreed to work together to achieve an indicative aggregated installed offshore wind capacity of Member States of the NSEC of at least 70 GW by 2030 based on national planning. The indicative contribution of Denmark to this aggregate capacity in 2030 is approximately 5 GW considering only already concluded political agreements (see also section 2.1.2).

In order to reflect the dynamics of offshore wind deployment in the region, this aggregate planned capacity of at least 70 GW for 2030 can be translated into an overall trajectory with indicative milestones for the region of approximately 25 GW in 2020 and 54 GW in 2025.

In the NSEC, Denmark also contributes to the work of analysing and developing options for further mobilisation of investment capital for joint projects, for instance through EU funds such as European Fund for Strategic Investments (EFSI) and Connecting Europe Facility (CEF) as well as institutional investors. Such future joint projects could be cross-border projects for renewable energy in accordance with the CEF proposal.

#### *Harmonisation of rules, regulation and technical standards*

The North Seas Energy Cooperation is working on aligning standards and technical requirements that could contribute to further reducing costs of offshore wind deployment. The focus is on aligning rules, regulation and technical standards within five identified areas. These include: (1) Aviation, marking and lights, (2) Health and safety, (3) Certification of regulatory requirements, (4) Park layout and site investigation and (5) Approaches to research. The NSEC works to develop proposals and recommendations for implementation in close cooperation with industry. The aim of those recommendations is to achieve cost reductions whilst at the same time be achievable. The cooperation will continue to work on aligning standards and technical requirements as well as exchange of best practices to reduce unnecessary regulation and costs for the industry.

The current mandate for the North Seas Energy Cooperation will expire at the end of 2019. As presidency, Denmark is working on securing a prolongation with a new working programme, which tackles the increasing focus on reaching net-zero greenhouse gas emission by 2050 and the indispensable role that offshore renewables in the North Sea plays in reaching this goal. The new working programme will intensify the focus on maritime spatial planning, establishing the necessary transmission grids to connect offshore wind to consumers and businesses, and the need for further cooperation in identifying and developing hybrid projects. It has already been decided to establish three ad hoc working groups to intensify analytical work on how to make progress on three hybrid projects. Moreover, the cooperation will increase its level of ambition by securing a governance structure, where issues can and must quickly be raised on a political level and thereby securing the necessary progress.

### **Nordic Council of Ministers**

Denmark is a member of the Nordic Council of Ministers, which is the official body for inter-governmental co-operation in the Nordic Region. This cooperation covers both climate and energy with separate Ministerial meetings, committees, and technical working groups.

The Nordic Prime Ministers have agreed on a new vision for the Nordic cooperation, which entails an increasing focus on the green transition of the Nordic region in order to support the Nordic countries' ambitious climate targets. As a consequence of this new vision the already well established cooperation on both climate and energy matters will be intensified even more in the years to come, and a larger part of the budget in the Nordic cooperation will be allocated to these areas.

In 2020 Denmark will hold the rotating presidency for the Nordic Council of Ministers. As the first presidency to implement the new vision of the Nordic cooperation Denmark will initiate new projects in the field of energy and climate. Priority areas will be decarbonisation of the transport sector, Nordic cooperation in global fight against climate change, the Nordic electricity market, and Power-to-X.

### **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 will contribute 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.

During the Danish presidency in 2020, Denmark will launch a project that aims to contribute to the decarbonisation of the transport sector with a primary focus on more sustainable aviation.

### **Nordic energy cooperation**

The Nordic cooperation on energy focuses on the Nordic electricity market, renewable energy, energy efficiency, and many other energy related matters. At their meeting in 2019

the Nordic energy ministers decided on a new vision for the Nordic electricity market cooperation. This entails that by 2030 the Nordic countries aim to have the most competitive, innovative and consumer-oriented electricity market which contributes to reaching the ambitious Nordic climate targets.

As a new initiative, a new ad hoc working group on national energy and climate plans has been established. The mandate of the group is to provide a forum for cooperation on the NECP's, and to discuss issues of common interest and share knowledge. This group functions as a contact point for regional consultation of the Danish NECP.

The Nordic Council of Ministers cooperates closely with the Baltic countries. The Baltic countries are therefore involved with a broad range of projects and initiatives in the Nordic cooperation including e.g. a new ad hoc working group on CCS/CCUS. The Nordic and Baltic countries also organise joint events on current energy issues of common interest. A Nordic-Baltic conference in the fall of 2019 will focus on the NECP's, and thus provides a platform for exchange of views and sharing of knowledge between the Nordic and Baltic countries on their plans.

#### *Nordic energy research cooperation*

Nordic Energy Research is an institution under the Nordic Council of Ministers, which functions as a platform for cooperative energy research and policy development. As a new initiative Nordic Energy Research has undertaken a close dialogue with the Nordic countries' national research councils in order to identify new areas of interest for energy research in the Nordic region. Close cooperation between the Nordic countries on energy research will thus continue in the years to come.

#### **(ii) Explanation of how regional cooperation is considered in the plan**

As explained in the previous section Denmark benefits from regional cooperation in several ways. The NSEC provides an important forum for cooperation on offshore wind, while the Nordic Cooperation has a much broader scope.



## 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: (i) The Member State's binding national target for greenhouse gas emissions and the annual binding national limits pursuant to Regulation (EU) 2018/842<sup>1</sup>; (ii) The Member State's commitments pursuant to Regulation (EU) 2018/841<sup>2</sup>; (iii) Where applicable to meet the objectives and targets of the Energy Union and the long-term Union greenhouse gas emissions commitments consistent with the Paris Agreement, other objectives and targets, including sector targets and adaptation goals.**

In October 2014 the European Council agreed on the 2030 climate and energy framework on objectives regarding greenhouse gas emissions, energy efficiency, renewable energy and interconnections. On greenhouse gas emissions the EU endorses a binding EU target of reducing greenhouse gas emissions by at least 40 % by 2030, compared to 1990.

The agreement on the 2030 framework, specifically the EU domestic greenhouse gas reduction target of at least 40 %, formed the basis of the EU's contribution to the Paris Agreement. The EU's so-called Intended Nationally Determined Contribution (INDC) was formally approved at an Environment Council meeting in March 2015. The 40 % reduction target is sub-divided into two separate targets for the EU Emission Trade System (ETS) and non-EU ETS sectors elaborated below.

In May 2018 the European Council adopted a regulation on the EU effort sharing of greenhouse gas emission reductions in the non-ETS sectors in the period 2021-2030 – the so-called Effort Sharing Regulation (ESR). Under this regulation Denmark is committed to a 39 % reduction of greenhouse gas in non-ETS emissions in the period 2021-2030 by 2030 relative to 2005.

Under the Effort Sharing Regulation flexibilities mechanisms ensuring cost-effective reductions include borrowing, banking and transfer of annual emission allowances between years and between member states (cf. Article 5), cancellation of EU ETS Allowances instead – in practice meaning that reductions are made under EU ETS instead of under ESR (cf. Article 6) and use of credits from LULUCF (cf. Article 7). Further details on the commitments under the ESR regulation are included below.

In May 2018 the European Council also adopted a regulation of emissions by sources and removals by sinks in the land sector – the LULUCF regulation, where LULUCF is “Land-Use, Land-Use Change and Forestry”. Credits obtained under this regulation can be used to reach the target for the non-ETS sector in accordance with the ESR up to a certain limit. The limit for Denmark is 14.6 million CO<sub>2</sub>-equivalent credits from LULUCF during the period

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<sup>1</sup> Effort sharing regulation, 2018/842 <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018R0842&from=EN>

<sup>2</sup> LULUCF, 2018/841 <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018R0841&from=EN>

2021-2030. Further details on the commitments under the LULUCF regulation are included below.

The EU is committed to reducing its ETS emissions by 43 % in 2030 from 2005 to achieve the total greenhouse gas emissions reduction of 40 % below 1990 levels by 2030. The EU has also set itself the target of increasing the share of renewables in energy use to 32 % by 2030.

In June 2018 all parties of the Parliament agreed on a Danish Energy Agreement with funding that will set the path towards a 55 % renewables share in 2030 in Denmark. The Energy Agreement of June 2018 furthermore specifies that given the allocated funding renewables are to cover all final electricity consumption or more by 2030. The agreement also includes a phase out of coal in electricity production by 2030.

Consistency with Denmark's long-term low emission strategy is ensured as Denmark's targets under the ESR regulation and the LULUCF Regulation are to be seen as steps in 2021-2030 towards the objective to work towards net zero emissions in accordance with the Paris agreement and for a net-zero-emission target in the EU and Denmark by 2050 at the latest.

#### Effort Sharing Regulation (ESR)

In regards to "Decarbonisation", and with respect to greenhouse gas emissions and removals as well as contributing to the achievement of the economy wide EU greenhouse gas emissions target of 2030, Denmark's binding national target for greenhouse gas emissions and annual binding national limits pursuant to Regulation ESR are as follows:

**2030:** Limit Denmark's non-ETS greenhouse gas emissions in 2030 at least by 39 percent relative to Denmark's emissions in 2005 determined pursuant to paragraph 3 of Regulation ESR<sup>3</sup>.

**2021-2029:** Ensure that Denmark's non-ETS greenhouse gas emissions in each year between 2021 and 2029 do not exceed a specific linear trajectory.

#### LULUCF Regulation

As regards the dimension "Decarbonisation", and with respect to greenhouse gas emissions and removals and with a view to contributing to the achievement of the economy wide EU greenhouse gas emissions reduction target in 2030, Denmark's commitments pursuant to LULUCF Regulation are as follows:

**2021-2030:** Account for emissions and removals from land use, land use change and forestry ('LULUCF')<sup>4</sup> during the periods from 2021 to 2025 and from 2026 to 2030 occurring

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<sup>3</sup> Taking into account the flexibilities provided for in Articles 5, 6 and 7 of Regulation 2018/842 [ESR] cf. the regulation's Article 9 on compliance check (see footnote 5).

<sup>4</sup> MMR: Regulation(EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC (<https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:165:0013:0040:EN:PDF>)

in the following land accounting categories on the EU territory of Denmark: afforested land, deforested land, managed cropland, managed grassland and managed forest land and as of 2026 also managed wetlands.<sup>5</sup>

**2021-2025 and 2026-2030:** Denmark will ensure that emissions do not exceed removals under the accounting rules, calculated as the sum of total emissions and removals on Denmark's EU territory in the land accounting categories mentioned above combined and as accounted in accordance with the LULUCF Regulation.

**(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**

The Government's objective for 2030 is to reduce greenhouse gases by 70%, relative to 1990 levels and the long-term objective for Denmark is to obtain net-zero emissions no later than 2050.

On December 6, 2019 the Government reached an agreement on a new Climate Act with 8 out of the 10 parties in the Danish Parliament. The agreement includes the following key elements<sup>6</sup>:

- the Climate Act is legally binding,
- a target to reduce greenhouse gas emissions by 70 percent by 2030 compared to the 1990 level,
- commitment to reach net zero emissions by 2050 at the latest,
- a mechanism for setting milestone targets every five year with a ten-year perspective,
- during the Government's forthcoming Climate Action Plan in 2020, an indicative milestone target will be set for 2025,
- the milestone targets will be implemented into Danish law,
- emissions are calculated in accordance with the UN greenhouse gas inventory rules,
- the Government will develop annual Climate Programmes that will outline concrete policies to reduce emissions,
- a strengthening of the Danish Council on Climate Change (Klimarådet) with tasks such as:

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<sup>5</sup> 'Afforested land': land use reported as cropland, grassland, wetlands, settlements, and other land converted to forest land. 'Deforested land': land use reported as forest land converted to cropland, grassland, wetlands, settlements, and other land. 'Managed cropland': land use reported as: cropland remaining cropland, grassland, wetland, settlement, other land converted to cropland, and cropland converted to wetland, settlement and other land. 'Managed grassland': land use reported as: grassland remaining grassland, cropland, wetland, settlement and other land, converted to grassland, and grassland converted to wetland, settlement and other land. 'Managed forest land': land use reported as forest land remaining forest land. 'Managed wetland': land use reported as: wetland remaining wetland, settlement, other land converted to wetland, and wetland converted to settlement and other land.

<sup>6</sup> For more information on the agreement on the Climate Act see: <https://kefm.dk/media/12965/aftale-om-klimalov-af-6-december-2019.pdf>

- presentation of professional assessments of whether the initiatives in the Government's Climate Programme is sufficient to reduce emissions
  - recommendations on climate initiatives,
  - doubling of the council's annual budget<sup>7</sup>,
  - more experts are added to the council,
  - the council's political independence is strengthened as is can now elect its own chairperson and members,
- a new climate dialogue forum in relation to the Council on Climate Change with representatives from business organisations, think tanks, green organisations, worker's organisations and ministries,
  - separate report on Denmark's impact on international emissions, including those pertaining to international shipping and aviation. Furthermore, reductions from electricity produced from renewable sources and the effects of Denmark's bilateral energy cooperation can be included in the separate report. Finally, the separate report will shed light on the impacts of consumption,
  - formulation of a yearly global climate strategy to ensure that Denmark keeps on its ambitious work at the global scene.
  - a citizens' initiative in relation to the Government's forthcoming Climate Action Plan in 2020.

The Climate Act is expected to be adopted by the Parliament in spring 2020.

Moreover, on 2 December 2019 the Government reached agreement with the Red-Green Alliance, the Social Liberal Party, the Socialist People's Party and the Alternative on the Finance Act 2020. With the Finance Act the parties agreed to implement a range of initiatives which will strengthen the effort for a better environment, create more nature and which is expected to reduce greenhouse gas emissions by approximately 0.5 million ton CO<sub>2</sub>- equivalents in the year 2030 on national level <sup>8</sup>.

The Government has furthermore taken steps to ensure that climate, environment and nature will be considered across all relevant policy areas. A permanent government committee on green transition has been established to ensure that effects on climate, environment and nature is taken into account in government proposals and bills.

Moreover, Denmark has established a position among the world's elite in renewable energy through decades of committed efforts. With the Energy Agreement from June 2018 the parties have allocated funding that sets a course towards an RE (renewable energy) share of approximately 55% by 2030. The agreement will also give Denmark an RE share in

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<sup>7</sup> As part of the agreement on the Finance Act 2020, 10m in 2020 and 15m annually in the period 2021-2023 was allocated to the strengthening of the Council on Climate Change.

<sup>8</sup> See the agreement on the Finance Act here: <https://www.fm.dk/nyheder/pressemeddelelser/2019/12/finanslovsaftale-prioriteter-velfaerd-og-et-mere-groent-danmark>

electricity above 100% of consumption, while ensuring that at least 90% of district heating consumption is based on energy sources other than coal, oil or gas by 2030.

The Government (the Social Democrats) with the Red-Green Alliance, the Social Liberal Party and the Socialist People's Part have in the political understanding between the parties "A fair direction for Denmark" set the following climate and energy relevant objectives:

- **"Introduce binding targets.** During the first parliamentary year, the Government will present a proposal for a climate act with binding sub-targets and binding long-term targets, including:
  - A goal to reduce greenhouse gases by 70% by 2030, relative to 1990 levels. This is a very ambitious goal, and it will be particularly difficult to realise the last part of the goal, i.e. from 65% to 70%. This will require currently unknown methods and, therefore, also a close collaboration with the Danish Council on Climate Change and other experts.
  - That the Danish Council on Climate Change assists the Government in making decisions on reduction targets and methods which ensure that Denmark complies with the Paris Accord temperature targets.
  - That an annual follow-up target assessment is performed, and that this follow-up is linked to the national budget process.<sup>9</sup>
  
- **Transport sector transition.** As part of a green mobility plan, a wide range of initiatives are required to ensure a significant increase in the number of electric vehicles on the roads and the required transport sector transition:
  - A stop to sales of all new diesel and petrol cars as of 2030 and enhanced low emissions zones.
  - It will be investigated whether the Commission for Green Transition of passenger cars can advance its work so that the final report is available before the end of 2020. As soon as possible thereafter, a political agreement must be reached to provide a sense of security to the industry and car owners and to ensure that the green transition can be undisturbed.
  - The Government will negotiate an infrastructure agreement, which will consider climate and environmental issues to a much higher degree. This requires investments in public transportation and cycling, among other things.
  - Implementing initiatives to ensure more sustainable aviation."<sup>10</sup>
  
- **Secure climate contributions from agriculture.** Agricultural support shall be used as an active tool to provide farmers the incentive to transition to a more sustainable production and thereby supporting the green transition of the industry. The Government has decided to implement a pilot scheme for multifunctional land distribution which will contribute with experience and knowledge for a major land

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<sup>9</sup> Cf. above as a follow-up on the political understanding an agreement on the climate act was reached on 6 December 2019.

<sup>10</sup> For more information on new initiatives on transport see section 3.1.3(iii).

reform. It is important that it is designed in a way that contributes to solving multiple challenges at the same time and engages stakeholders.<sup>11</sup>

- **“Adopt a climate action plan.** The climate act will be followed by a climate action plan, which will contribute to ensuring that national reduction targets are met. In addition to describing which initiatives, cf. above, will be required for the transport industry and agriculture, the action plan will also include the following elements:
  - 1) Energy efficiency measures, including energy saving requirements for public sector buildings;
  - 2) a national strategy for sustainable construction;
  - 3) a unified strategy for electrification of the transport sector, industry and society in general;
  - 4) increased funding for green research and demonstration programmes;
  - 5) investigating the potential for Denmark to prepare a common strategy with the North Sea nations for a significant expansion and exploitation of the offshore wind potential;
  - 6) investigating the potential for Denmark to construct the first energy island by 2030, with a minimum of 10 GW connected<sup>12</sup>;
  - 7) support afforestation<sup>13</sup>;
  - 8) climate adaptation, including stronger coordination of coast protection efforts.
  
- **Assume the responsibility for more ambitious targets in the EU and enhance green diplomacy.** EU started off as a coal and steel union. The Danish Government will propose the objective that a future EU will be a climate union. This means, among other things, that Denmark will be working towards increasing the EU climate targets in 2030, that the EU will be climate neutral by 2050 and that the future EU budget will focus more on climate. Denmark will also, together with other ambitious nations, push for an expansion of sustainable energy in the EU so that the EU becomes self-reliant in terms of energy. The Government will also strengthen green diplomacy, thereby increasing Denmark’s international commitment. The Government will implement a new development policy strategy with climate assistance as a central element.<sup>14</sup>
  
- **Create greater biodiversity and more woodlands.** There is a need for more untouched woodlands and more cohesive nature areas where nature is allowed to spread out on more natural terms than is currently the case. A biodiversity package will improve conditions for biodiversity in Denmark. The plan will include clear targets for the proportion of the area of Denmark to be laid out as nature zones (including untouched woodlands and national nature parks) as well as specific initiatives to ensure that targets are reached.

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<sup>11</sup> For more information on new initiatives related to agriculture see section 3.1.1(i).

<sup>12</sup> For more information see section 3.1.2(i).

<sup>13</sup> For more information see section 3.1.1(i).

<sup>14</sup> For more information see section 3.5(i).

- **Strengthen green calculation models.** Climate and green transition considerations shall be integrated in the Ministry of Finance’s calculation models, and the effort to develop greener calculation models will be secured and enhanced. A dialogue will be entered into with Statistics Denmark about strengthening the effort to produce green national accounts and GDP.
- **Increase organic foods targets and strengthen initiatives against food waste.** The Government will increase the ambitions for more organic foods in Denmark, starting with an aim to double organic farming acreage, the export of organic foods and the consumption of organic foods by Danes by 2030, and to implement initiatives to reduce food waste.
- **Include stakeholders.** With the purpose of qualifying and anchoring Denmark’s green efforts, the Government will include stakeholders in the work on an on-going basis, including independent experts, popular movements and interest organisations. This will be the case, e.g., for areas such as promoting a strategy for circular economy, transitioning to a more energy-efficient society, smarter waste sorting and transitioning public sector procurements so that they support the green transition to a higher degree.”

*Denmark’s adaptation objectives/goals, strategies and initiatives*

As described in the previous section the climate action plan will include climate adaptation, including stronger coordination of coast protection efforts.

Moreover, updated information on adaptation in Denmark was reported to the Commission/EEA in March 2019 in accordance with the Monitoring Mechanism.

The following information on Denmark’s adaptation objectives/goals, strategies and initiatives were included:

“In Denmark, the National Adaptation Strategy (NAS) was adopted in March 2008. Following a new government in 2011, a National Adaptation Plan (NAP) was adopted in 2012. The Action Plan for a Climate-Proof Denmark was launched in December 2012 and is the first NAP in Denmark. The NAP is based on the notion that a responsible climate policy must do more than just work to address climate change in the long term, it must also ensure necessary action is taken now to adapt our society to a climate that is already changing, and that all parts of society contribute to climate adaptation.

Dealing with the climate challenge requires collaboration between authorities, organisations, private enterprises and individuals, regardless of whether the project is maintenance of existing roads, coastal protection, construction, or investments in new infrastructure. The Government itself has a responsibility as the owner of infrastructure, buildings and land. However, the principal role for the Government is to establish an appropriate framework for local climate adaptation by, for example, adapting laws and regulations, but also by ensuring coordination and providing information. The Government requested all municipalities to develop their own adaptation action plans within two years.

A solid framework for the efforts must support the specific parties involved, so that they can address the challenge in a socio-economically appropriate manner at the right time.

In the NAP, the Government commits to creating the basis for continued technological and knowledge development, so that Denmark will have a strong position on the global market for climate adaptation. The NAP presents 64 new initiatives within five general areas of initiative: an improved framework for climate adaptation; more consultation and a new knowledge base; strengthened collaboration and coordination; green transition; and international climate adaptation. A few national sectors, such as transport, roads and coastal protection, have dedicated adaptation plans. In 2017, the Danish government decided to carry out a number of initiatives to support municipalities and property owners in establishing cost-effective and holistically planned flood and erosion protection. A cross-ministerial committee was set up and 15 new initiatives were decided (Denmark's 7th NCC, p. 297).

In 2017 a new national mobile team with a focus of flooding and erosion was established by the Ministry of Environment and Food (MEF) to help share knowledge, best practices and enhance cooperation, primarily with municipalities. In 2018 an amendment to the Planning Act was adopted so that all municipalities know how to identify areas at risk of flooding and erosion and ensure remediation measures in their municipal plans. The amendment was in January 2019 followed by national guidelines and examples on how and what data to use in local-government spatial planning. The Danish Coastal Authority, under the Ministry of Environment and Food of Denmark, is responsible for the implementation of the Floods Directive in Denmark. Under this mandate, the Danish Coastal Authority has reviewed and updated the preliminary flood risk assessment together with an adjustment of identified areas of potential significant flood risks. The adjustment of identified areas of potential significant flood risk has resulted in the confirmation of the 10 areas appointed back in 2011 and the appointment of 4 new flood prone areas in 2018. Municipalities in the flood risk areas will be instructed to evaluate and prepare flood risk management plans.

Adaptation strategies have not been adopted at the subnational level but all municipalities have adopted local adaptation action plans in line with the national adaptation plan (NAP). Although not a formal responsibility or obligation, four of five regions have incorporated adaptation into their regional climate strategies: South Denmark, North Jutland, Region Zealand and the Capital Region. Central Denmark Region leads the EU funded project 'Coast to Coast Climate Challenge', which has a goal of formulating and implementing a coordinated adaptation strategy for the region between 2017 and 2022."

#### Climate Atlas

The Danish Meteorological Institute (DMI) has developed a nationwide Climate Atlas based on own data and data from IPCC. Data are free and available on DMI's website.

The Climate Atlas provides an indication of areas with particular risk of storm surge and cloudburst, and thus the risk of flooding in Denmark in the future. This tool gives the climate data so municipalities can take the necessary precautions and guard citizens, infrastructure and buildings against the expected extreme weather in the future.



In Denmark, the municipalities are responsible for climate adaptation - for example, to build dikes or secure exposed areas from cloudbursts. The Climate Atlas is therefore developed in a collaboration with the municipalities and other relevant collaborators working on climate adaptation.

Data in the Climate Atlas describe the future Danish climate in the beginning, middle and end of the century. Initially there is data about future temperature, rainfall, extreme rainfall, sea level and storm surge both at national and municipal levels - down to a 1 km grid map. Further data are added towards 2021 for other relevant climate indicators such as wind, evaporation and growth season.

#### *Towards a circular economy*

In a circular economy, the purpose is to minimize the generation of waste, while products, materials and resources are kept in circulation for as long as possible. Prevention and recycling of more waste reduces waste treatment in e.g. incinerators and can reduce the greenhouse gas emissions from heat production if heat is produced from carbon neutral sources instead. Furthermore, CO<sub>2</sub> emissions from the extraction of raw materials and production of new products will also be reduced.

In 2015, the European Commission adopted an ambitious new circular economy action plan. The action plan was followed by revisions of the waste framework directive and five related waste directives, which were adopted in 2018. The revised directives set new and more ambitious targets for recycling of waste, which will incur reductions in greenhouse gas emissions from use of recycled materials instead of virgin materials and from waste management processes. The directives include a target of 70 % recycling of packaging waste by 2030, 65 % recycling of municipal waste by 2035 and a number of material specific targets. With the revised directives the method for measuring recycling has changed from 'collected for recycling' to 'final recycling'.

Denmark has ambitious policies for waste prevention and management. In 2018 a circular economy strategy was launched focusing on supporting the transition towards more circular production. The circular economy strategy was followed by a plastics action plan later that year. The plastics action plan focused on waste prevention and increased recycling. Denmark will further implement measures to promote the transition to a circular economy and fulfillment of the new EU targets in the coming national plan for waste prevention and management, which will be released in 2020.

In March 2019 a new think tank on prevention of food loss and food waste was established in Denmark – supported by the Danish Government. The think tank brings together research institutions, public authorities, companies and organisations to ensure collaboration across the entire food product chain and to advance efforts to achieve SDG 12.3: “By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses”.

The Government is also planning on adapting a climate action plan. Furthermore, as part of the Finance Act 2020 the Government, the Red-Green Alliance, the Social Liberal Party, the

Socialist People's Party and the Alternative, agreed to increase taxes on disposable tableware and shopping bags to reduce the waste amount from these single-use products.

## 2.1.2 Renewable energy

### (i) The elements set out in point (a)(2) of Article 4<sup>15</sup>

The new Government formed in June 2019 has set a very ambitious national target of reducing greenhouse gas emissions by 70 % in 2030 compared to 1990 levels. The Government will adapt climate action plans, which will contribute to ensuring that national reduction targets are met. The climate action plans will include new measures that will further accelerate the renewable transition in the energy and transport sectors.

Moreover, Denmark has established a position among the world's elite in renewable energy through decades of committed efforts. Back in 2012 the political Energy Agreement concluded by a broad majority in Parliament defined the initiatives covering crucial energy policy areas for the period until 2020. Also, the parties to the 2012 Energy Agreement agreed by 2018 to commence discussions on additional initiatives for the period after 2020, which was done with the Energy Agreement from June 2018. The 2018 Energy Agreement sets out the policies and trajectories on renewable energies for the coming years. With the agreement, the Parliament has allocated funding that sets a path towards a renewables share of total energy consumption of approximately 55 % in 2030.

Renewable energy sources are promoted with economic measures, including e.g. taxes on use of energy, CO<sub>2</sub> taxes on fossil fuels and through the Public Service Obligation Scheme (PSO), which is a levy on electricity paid by all consumers. The PSO levy is now being phased out during a period of 5 years (2017-2021), and the financing of subsidies to renewables will gradually shift to the State Budget.

In September 2017, the government and a majority in Parliament reached a political agreement on tenders in 2018 and 2019 allowing photovoltaic panels and wind turbines to compete to deliver the largest amount of green power to the consumers. The amount of subsidized renewable energy resulting from the tenders, will depend on the size of the bids in the tenders. The 2018-tender was completed in December 2018 and will increase annual

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<sup>15</sup> With a view to achieving the Union's binding target of at least 32 % renewable energy in 2030 as referred to in Article 3 of the Renewables Directive, a contribution to that target in terms of the Member State's share of energy from renewable sources in gross final consumption of energy in 2030, with an indicative trajectory for that contribution from 2021 onwards. By 2022, the indicative trajectory shall reach a reference point of at least 18 % of the total increase in the share of energy from renewable sources between that Member State's binding 2020 national target, and its contribution to the 2030 target. By 2025, the indicative trajectory shall reach a reference point of at least 43 % of the total increase in the share of energy from renewable sources between that Member State's binding 2020 national target and its contribution to the 2030 target. By 2027, the indicative trajectory shall reach a reference point of at least 65 % of the total increase in the share of energy from renewable sources between that Member State's binding 2020 national target and its contribution to the 2030 target. By 2030, the indicative trajectory shall reach at least the Member State's planned contribution. If a Member State expects to surpass its binding 2020 national target, its indicative trajectory may start at the level it is projected to achieve. The Member States' indicative trajectories, taken together, shall add up to the Union reference points in 2022, 2025 and 2027 and to the Union's binding target of at least 32 % renewable energy in 2030. Separately from its contribution to the Union target and its indicative trajectory for the purposes of this Regulation, a Member State shall be free to indicate higher ambitions for national policy purposes.

production equivalent to about 160,000 Danish household's annual electricity consumption.

In addition, it was agreed to allocate DKK 150 million for new test wind turbines to be established inside the two national test centres for large wind turbines as well as subsidies for 35 MW of new test wind turbines outside the national test centres in 2018 and 2019.

#### Wind power

In accordance with the energy policy agreement from February 2008, the 400 MW offshore wind farm at the island of Anholt started operation in September 2013. The Energy Agreement of 2012 includes an expectation of 500 MW additional onshore wind capacity and 1350 MW of new capacity from offshore wind. In this respect the Danish Energy Agency was responsible for tendering the new offshore capacity: The Horns Rev 3 tender of 400 MW in the North Sea with commercial operation in August 2019, the Kriegers Flak-tender of 600 MW in the Baltic Sea with commercial operation in 2021 and the so-called near shore tender of 350 MW – Vesterhav Nord and Syd - with expected commercial operation in 2023. Also, as a part of the 2012 Energy Agreement, Denmark was responsible for tendering a 28 MW offshore test project at Nissum Bredning. As a result, wind energy is expected to cover about 50 % of Danish electricity consumption in 2020.

#### Biomass

In 2017, biomass accounted for approximately 64 % of renewable-energy production, mostly in the form of straw, wood pellets, wood chip and biodegradable waste for incineration. Import accounted for 45 % of the total consumption of bioenergy in Denmark in 2017, mainly in the form of wood pellets (59 PJ), liquid biofuels (10 PJ) and wood chips (7 PJ).

The energy production from biomass has more than doubled since 1990 - primarily due to the policy agreement from 1993 (the Biomass Agreement: requires power plants to use 1.4 million tonnes of straw and wood, equivalent to almost 20 PJ per year) and the policy agreement from February 2008 on the increased use of straw and chips at the large co-generation plants (up to 700,000 tonnes in 2011). The conversion from fossil fuels (primarily coal) to biomass at the large combined heat and power plants expanded after the Energy Agreement in 2012 as a result of the improved incentives (see below) At the same time, the consumption of biomass continues to rise as a source of energy for the supply of heat in district-heating plants and in smaller installations for households, enterprises and institutions. An analysis has been initiated in order to address the sustainability of the large Danish consumption of biomass for energy purposes. The outcome of the analysis will serve as input to the forthcoming climate action plan.

#### Heating and cooling

The share of renewables in the Danish heating sector including biomass and biodegradable waste is currently approximately 54 %. This has largely been achieved without direct support. The use of biomass for heat production, however, is exempted from energy and CO<sub>2</sub> taxes. A large part of the biomass utilization for heat production takes place in large scale combined heat and power generation at centralized plants converted from coal based

production. This has largely been the result of incentives for biomass conversions enacted with the Energy policy agreement from 2012. These incentives allow for a larger share of the combined operating costs to be carried by the district heating companies and consequently the consumers, along with the aforementioned support schemes for biomass-based electricity production in co-generation plants.

### Biogas

Denmark has supported the production and use of biogas through a variety of financial incentive schemes since the 1980's. Due to changes in the incentive scheme in the late 1990's and in 2004, when it was politically decided that electricity based on biogas would be granted a fixed feed-in tariff of 0.6 DKK/kWh the first 10 years, followed by 0.4 DKK/kWh the next 10 years, the production of biogas began to stagnate. As a result, the incentive scheme was modified again in 2008 in order to increase biogas production by making it financially more viable. All new and existing biogas plants would receive either a feed-in tariff of 0.745 DKK/kWh electricity or a price premium of 0.405 DKK/kWh electricity. In addition to that, it was decided to partially adjust for inflation each year. Although it was expected that the increase in direct support would boost the production of biogas, actual production remained fairly stagnant at roughly 4-5 PJ.

In 2012, the incentive scheme was adjusted once more, and two new price premiums were introduced, both of which are still in place today. The first premium consisting of 0.26 DKK/kWh is pegged to the market price of natural gas and includes a floor price. If the market price of natural gas drops below the floor price, the premium increases and vice versa. In addition to that, the second premium introduced in 2012 grants each producer another 0.10 DKK/kWh electricity, but is reduced by 0.02 DKK/kWh every year and phased out by 2020. The changes to the incentive scheme implied that biogas upgraded to biomethane and the use of biogas for industrial, transport- and heating purposes became eligible for support.

### Bioeconomy

Denmark supports the updated Bioeconomy Strategy launched by the European Commission in 2018. Moreover, The Danish Government has formed a National Bioeconomy Panel which gives advice to the Government on sustainable utilization of biomass resources to fodder, food products, materials and energy purposes. Furthermore, with the agreement on circular economy of 2018 funding has been allocated to conducting analyses of the potential of a Danish bioeconomy strategy.

### Policy frame post 2020

In 2020 Denmark expects to reach an overall renewables share of 41 %, according to Denmark's Energy and Climate Outlook 2019 (DECO19)<sup>16</sup>. The individual shares for electricity, district heating and transport are estimated to 77 %, 71 % and 9 % respectively. The share of biomethane in the natural gas grid is expected to reach 14 % in 2020.

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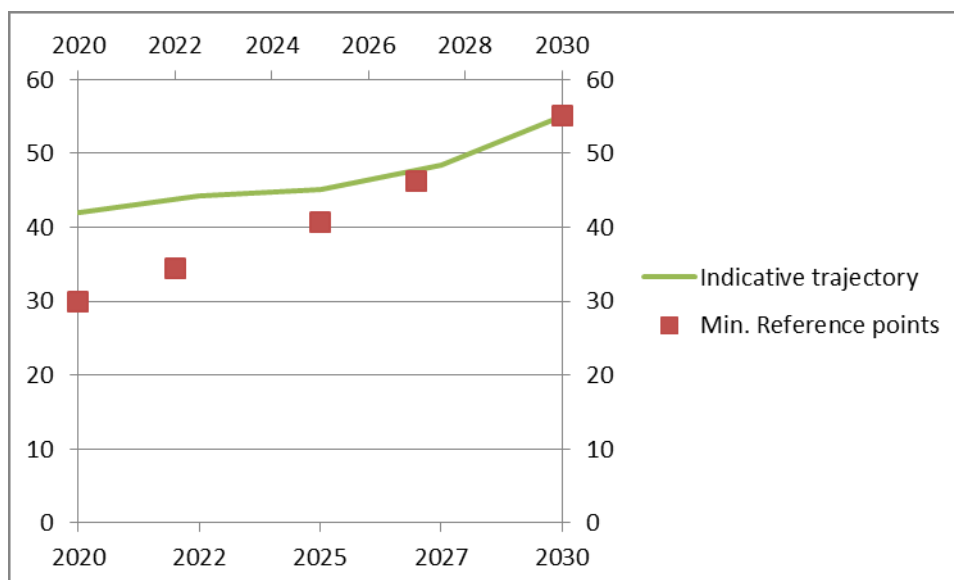
<sup>16</sup> Based on the EU methodology

In June 2018 the Danish Parliament agreed on a policy framework for the energy policy from 2020 to 2024. With the agreement, the Parliament has allocated funding that sets a path towards a renewables share of total energy consumption of approximately 55 % in 2030. The agreement from June 2018 is expected to give Denmark a renewable share in electricity above 100 % of consumption, while ensuring that at least 90 % of district heating consumption is based on energy sources other than coal, oil or gas by 2030. The agreement also includes a phase out of coal in electricity production by 2030. It is a political priority to achieve the increase in renewable energy production through market mechanisms.

The Danish binding EU target for 2020 for renewables is 30 %. Denmark plans to count the extra 11 percentage points as early effort towards the 2030 renewables target. With the Energy Agreement, the Parliament has allocated funding that sets a path towards approximately 55 % renewables share in 2030. In addition, the Government's target of reducing greenhouse gas emissions by 70 % in 2030 compared to 1990 levels will also further accelerate the renewable transition in the energy and transport sectors. The new measures that will be included in the upcoming climate action plan are described further in section 3.1.2.

The indicative trajectory for the Danish contribution from 2020 and onwards is displayed in figure Figure 2. The trajectory represents a frozen policy scenario<sup>17</sup> and entails great uncertainty. Therefore, the actual renewables share may vary from this estimation.

**Figure 2. Indicative trajectory for the share of energy from renewable sources in gross final consumption compared to the minimum reference points**



<sup>17</sup> Frozen policy scenario present the baseline projection based on existing measures as of May 2019 and under the assumption that no additional measures are implemented.

Included in the indicative trajectory are the specific initiatives described in the 2018 Danish Energy Agreement, in which funding has been allocated to renewables. Consequently, this is the Danish expected contribution to the 2030 EU target, in accordance with Article 4 (a) 2 of the Governance Regulation.

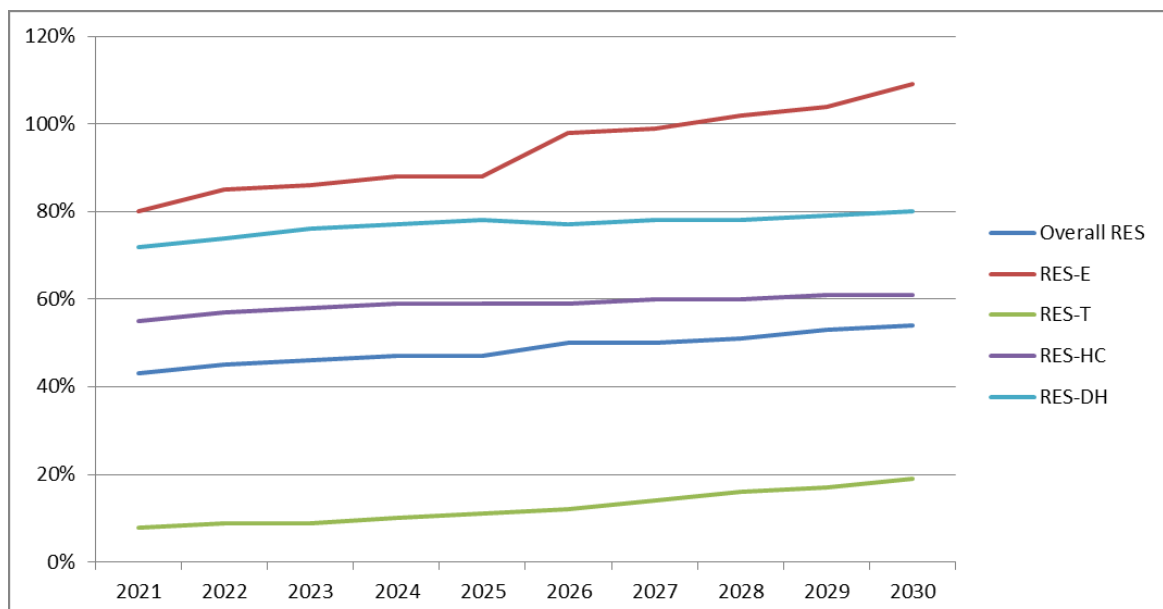
As mentioned, the trajectory represent a frozen policy, however, as shown in Figure 28, current modelling of the consequences of the Energy Agreement, leads to a renewables share of 54%, very close to the 55 % share - without further policy measures. The June 2018 Energy Agreement also include a reserve of 400 million DKK in 2025 and 500 million DKK annually for further efforts from 2026 to promote renewable energy, however it is currently not possible to quantify the effects of the implementation of the reserve for additional investments in RE from 2025.

In addition, new policy will need to be implemented to reach the 70 % CO<sub>2</sub> reduction target that may impact the pace and magnitude of the renewables penetration.

**(ii) Estimated trajectories for the sectorial share of renewable energy in final energy consumption from 2021 to 2030 in the electricity, heating and cooling, and transport sector**

Denmark has not at present set any individual objectives or targets for sectorial shares of renewable energy. Estimated trajectories for the sectorial share, based on modelling of a frozen policy scenario is presented in Figure 3.

**Figure 3. Estimated trajectories for the sectorial share of renewable energy**



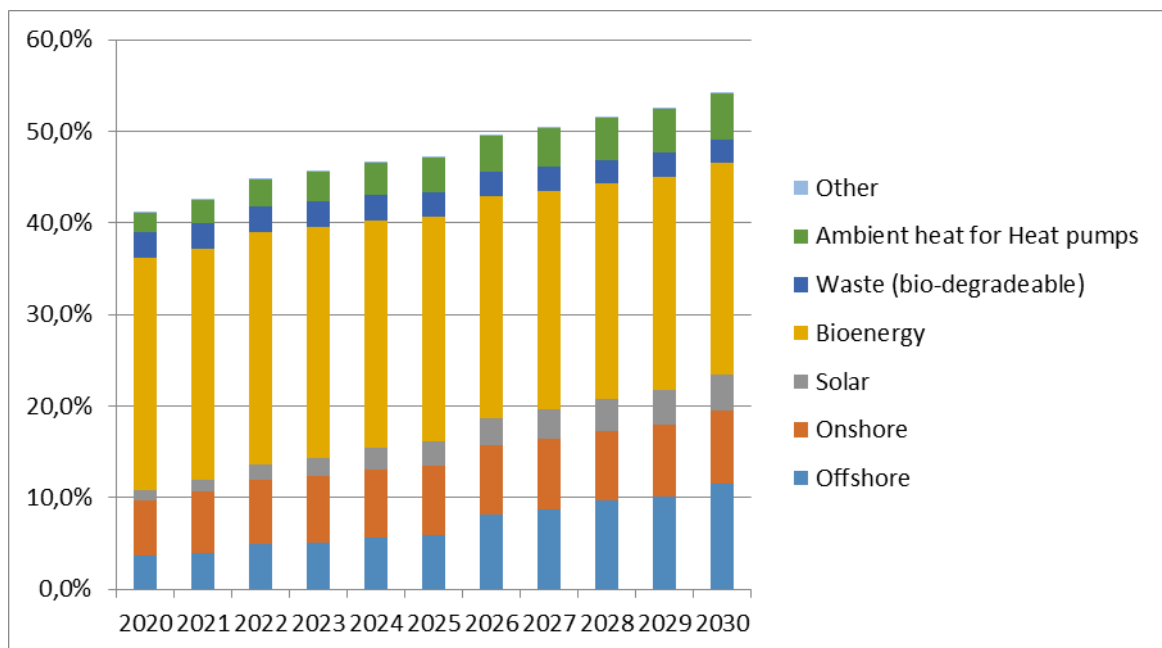
Due to new investments for renewables as well as a decision to phase out coal in the electricity production sector in 2030 – the renewables share in electricity consumption is expected to exceed 100 % of consumption in 2030. As for the district heating sector, it is the frozen policy projection that at least 80 % of the heating in the district heating sector will be based on renewables in 2030. For the heating and cooling sector as a whole the

renewables share is expected to reach 60 % in 2030. For transport the share is expected to reach 19 %, based on the calculation methodology described in the REDII.

**(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**

Denmark has not at present set any individual objectives or targets for individual technologies to use to achieve the overall and sectorial trajectories. Denmark is subsidizing renewable energy through multi-technology tenders for wind power and solar PV. New multi-technology tenders is being planned for years 2020-2024. The following trajectories are therefore based on the available model simulations.

**Figure 4. Estimated trajectory for the overall share of renewable energy, by technology**

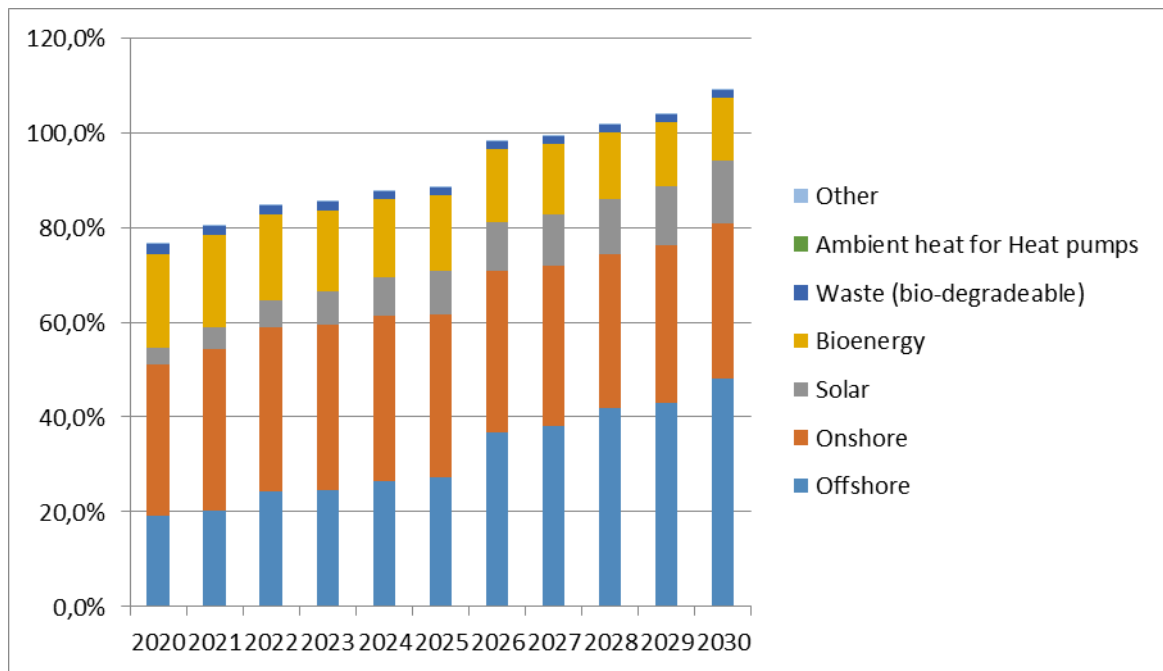


Offshore wind will continue to increase rapidly, in part due to 3 new offshore wind parks of a total of minimum 2,400 MW planned for the period, figure Figure 5. Each of the parks will be minimum 800 MW. The tender for the first park is to be finalized in 2021 and will have a capacity of 800-1000 MW– the next two tenders will take place in 2023 and 2025 respectively. The new Government of June 2019 has furthermore, in the new political agreement with supporting parties called “a fair direction for Denmark”, agreed upon undertaking an in-depth analysis of the possibility of building an energy island in the North Sea with at least 10 GW of offshore wind connected by 2030. This will also drastically increase the share of renewable energy from offshore wind turbines in the Danish energy mix.



Since the cost of offshore wind is expected to continue to decrease in the coming years, it is agreed in the Energy Agreement of 2018 to gradually reduce the number of onshore wind turbines from approx. 4,300 today to a maximum of 1,850 in 2030. At present, onshore wind is the cheapest form of renewable energy in Denmark and the production from onshore wind turbines is still expected to increase in the coming years as smaller existing turbines are replaced with newer and more effective ones.

**Figure 5. Estimated trajectory for the RES-E, by technology**

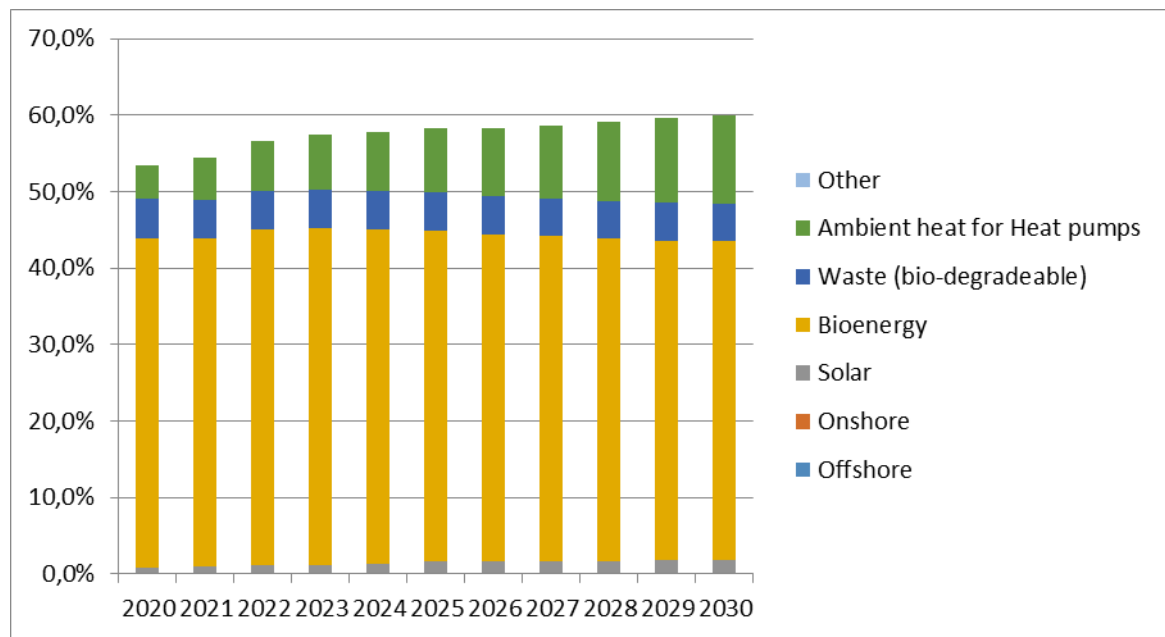


The renewable share in the heating and cooling sector and the district heating sector is expected to be achieved mainly through the use of biomass and heat pumps, cf. Figure 6 and Figure 7.

For the heating and cooling sector, the renewables share is expected to increase from 53.5 % in 2020 to 59.9 % in 2030. The estimated increase based on the frozen scenario corresponds to an average increase over the entire period of 0.64 percentage point per year and 0.94 and 0.34 percentage point for the period 2021-2025 and 2026-2030

respectively. These numbers only include renewables. Any contribution from surplus heat is not included.

**Figure 6. Estimated trajectory for the RES-HC, by technology**

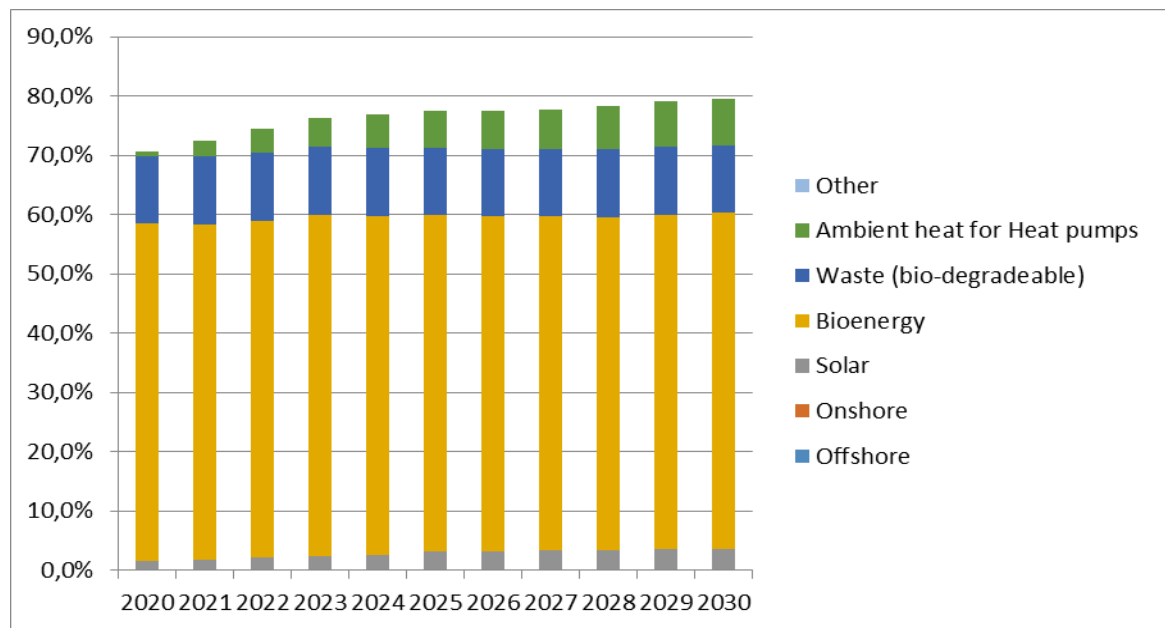


For the district heating sector, the renewables share is expected to increase from 70.7 % in 2020 to 79.6 % in 2030. The increase correspond to an average increase over the 2021-30 period of 0.88 percentage point per year and 1.37 and 0.40 percentage point for the period 2021-2025 and 2026-2030 respectively. These numbers only include renewables. Any contribution from surplus heat is not included.

The reason that the renewable share in district heating does not reach over 80 % is partly the high share of non-bio-degradable share in waste incineration that is still expected to supply large part if the district heating network in 2030. Another reason is that a final plan

for the phase out of the last remaining coal fired CHP plant on the island of Fyn remains to be agreed.

**Figure 7. Estimated trajectory for the RES-DH, by technology**

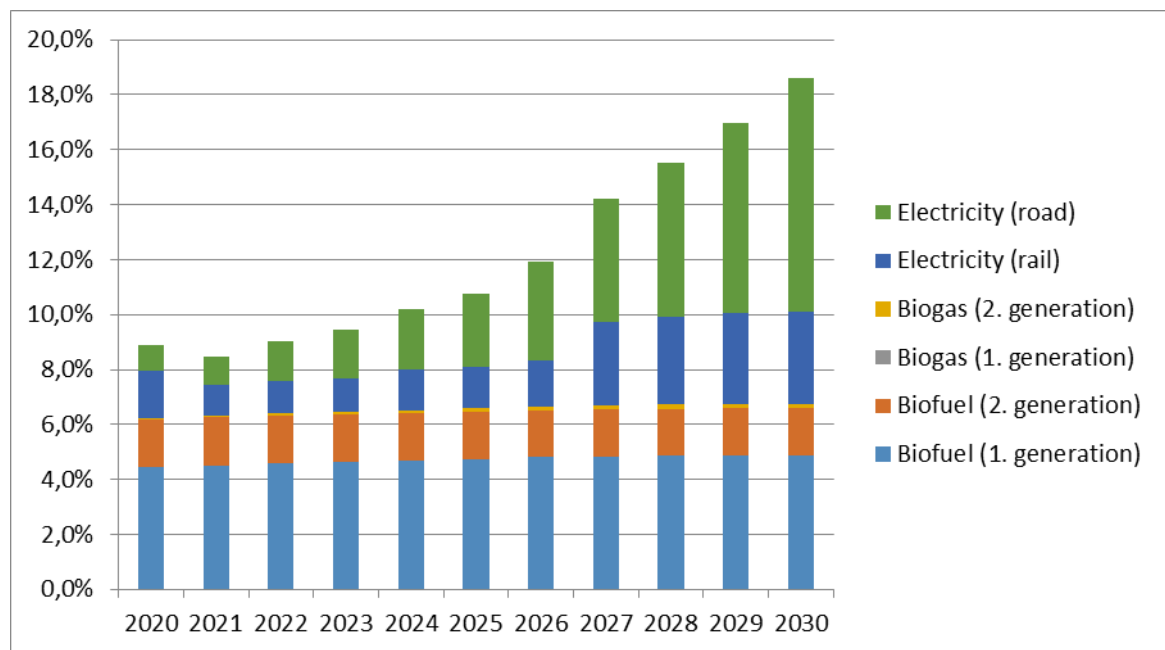


The renewables share in transport is expected to reach 19 % in 2030 (based on the REDII methodology). The increase in the period is primarily a result of increased electricity consumptions for electric vehicles combined with a higher share of renewables in the electricity mix. The increase in the electricity share for rail transport from 2027 is mainly due to new electrically powered trains and electrification of the railway line between

Frederica and Aalborg. Uncertainty regarding future technology development and other factors implies that these figures have to be interpreted with caution.

There is a specific blending obligation for advanced biofuel at 0.9 % (before double counting) in the Danish legislation. Fulfilling this obligation will be sufficient to fulfil the specific RED target for advanced biofuels in 2022 and 2025, but not in 2030.

**Figure 8. Estimated trajectory for the RES-Transport, by fuel**





**Table 2. Estimated energy consumption, by technology and sector**

	Unit	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
<b>RES in Gross Final Energy Consumption</b>		<b>7001</b>	<b>7408</b>	<b>7597</b>	<b>7795</b>	<b>7931</b>	<b>8356</b>	<b>8522</b>	<b>8720</b>	<b>8907</b>	<b>9203</b>
Offshore	ktoe	658	816	856	951	1002	1373	1472	1643	1726	1966
Onshore	ktoe	1098	1160	1211	1243	1260	1282	1298	1274	1324	1337
Solar	ktoe	222	277	333	388	456	505	549	590	632	676
Bioenergy	ktoe	4145	4210	4201	4170	4137	4080	4039	3994	3956	3923
Waste (bio-degradeable)	ktoe	453	453	453	453	441	441	441	441	441	431
Ambient heat for Heat pumps	ktoe	422	490	542	587	633	673	721	774	825	866
Other	ktoe	2	2	2	2	2	2	2	2	2	3
<b>RES-H&amp;C share</b>		<b>4164</b>	<b>4318</b>	<b>4380</b>	<b>4405</b>	<b>4431</b>	<b>4425</b>	<b>4442</b>	<b>4462</b>	<b>4490</b>	<b>4503</b>
Offshore	ktoe	0	0	0	0	0	0	0	0	0	0
Onshore	ktoe	0	0	0	0	0	0	0	0	0	0
Solar	ktoe	75	83	91	100	120	123	127	131	135	138
Bioenergy	ktoe	3281	3358	3360	3331	3301	3251	3217	3180	3153	3129
Waste (bio-degradeable)	ktoe	387	387	387	387	378	378	377	377	377	369
Ambient heat for Heat pumps	ktoe	422	490	542	587	633	673	721	774	825	866
Other	ktoe	0	0	0	0	0	0	0	0	0	0
<b>RES-E share</b>		<b>2595</b>	<b>2846</b>	<b>2970</b>	<b>3139</b>	<b>3248</b>	<b>3676</b>	<b>3823</b>	<b>4000</b>	<b>4159</b>	<b>4443</b>
Offshore	ktoe	658	816	856	951	1002	1373	1472	1643	1726	1966
Onshore	ktoe	1098	1160	1211	1243	1260	1282	1298	1274	1324	1337
Solar	ktoe	147	194	241	289	336	382	422	460	498	538
Bioenergy	ktoe	624	607	594	588	583	574	566	558	547	539
Waste (bio-degradeable)	ktoe	66	66	66	66	64	64	64	64	64	62
Ambient heat for Heat pumps	ktoe	0	0	0	0	0	0	0	0	0	0
Other	ktoe	2	2	2	2	2	2	2	2	2	2
<b>RES-DH share</b>		<b>2267</b>	<b>2315</b>	<b>2361</b>	<b>2372</b>	<b>2386</b>	<b>2363</b>	<b>2363</b>	<b>2367</b>	<b>2379</b>	<b>2376</b>
Offshore	ktoe	0	0	0	0	0	0	0	0	0	0
Onshore	ktoe	0	0	0	0	0	0	0	0	0	0
Solar	ktoe	57	64	71	78	97	99	101	103	104	106
Bioenergy	ktoe	1772	1769	1782	1764	1748	1722	1710	1697	1696	1696
Waste (bio-degradeable)	ktoe	357	356	356	356	346	346	346	346	345	337
Ambient heat for Heat pumps	ktoe	82	126	152	173	194	196	206	221	234	237
Other	ktoe	0	0	0	0	0	0	0	0	0	0

**Table 3. Estimated total capacity, by technology and sector**

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
<b>Total installed renewable capacity by sector</b>											
<b>Electricity production</b>											
Wind	MW	7590	7969	7901	8649	9010	8971	9324	9673	10626	10147
Solar	MW	2248	2671	3096	3522	3902	4237	4576	4923	6492	7842
Biomass	MW	1805	1802	1801	1796	1796	1796	1719	1719	1719	1719
Hydro	MW	7	7	7	7	7	7	7	7	7	7
Other renew ables	MW	0	0	0	0	0	0	0	0	0	0
<b>District heating</b>											
Wind	MW	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Solar	MW	1365	1478	1780	1810	1839	1868	1897	1926	1936	2479
Biomass	MW	6140	6126	6123	6074	6074	6074	6040	6038	6038	6038
Hydro	MW	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Other renew ables (incl. geothermal)	MW	32	32	32	32	32	32	32	32	32	32

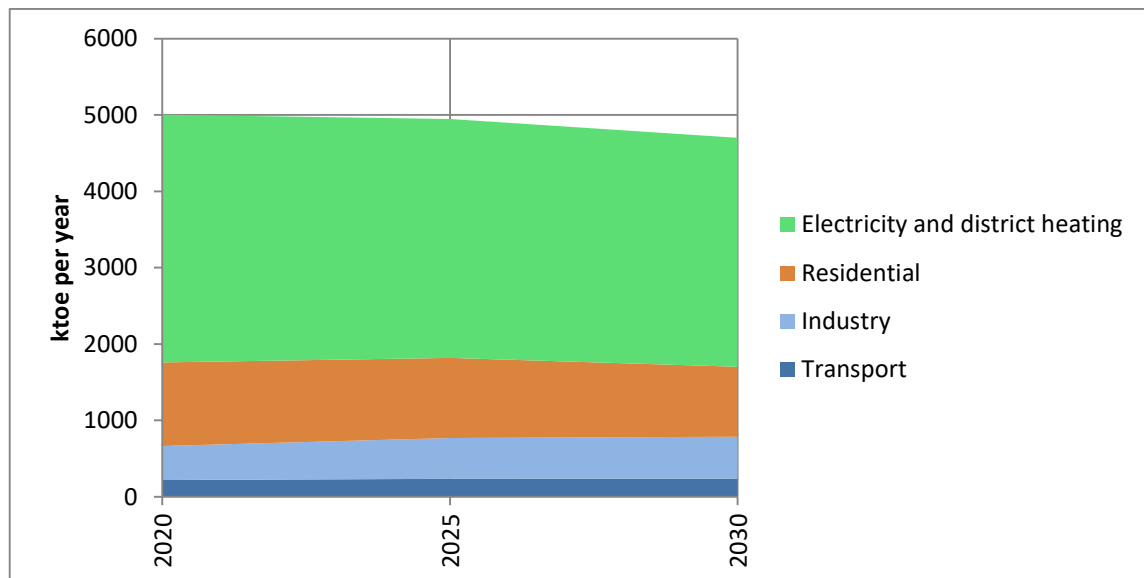
The amount of re-powering project depends on many factors, including specific market conditions and technological development. Denmark has no specific objectives regarding

re-powering projects, and the simulation for planned capacity does not distinguish explicitly between new and re-powered capacity. Therefore, regarding the split on total planned installed capacity in new capacity and repowering, there is no reliable data available regarding the amount of re-powering projects.

**(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**

The use of bioenergy in Denmark has been growing for several years, and today (2017 numbers) the bioenergy consumption constitutes approx. 75 % of the total use of renewables. Figure 9 shows the development divided upon sectors.

**Figure 9. Estimated trajectory for biomass consumption, by sector, ktoe.**



Denmark has not at present set any individual objectives or targets on bioenergy demand, aggregated or disaggregated on sectors, imports etc. Following the Denmark's Energy and Climate Outlook 2019 the use of bioenergy will continue to grow until 2020-2025. After that the consumption is expected to decrease slightly. Figure 9 shows the expected development until 2030.

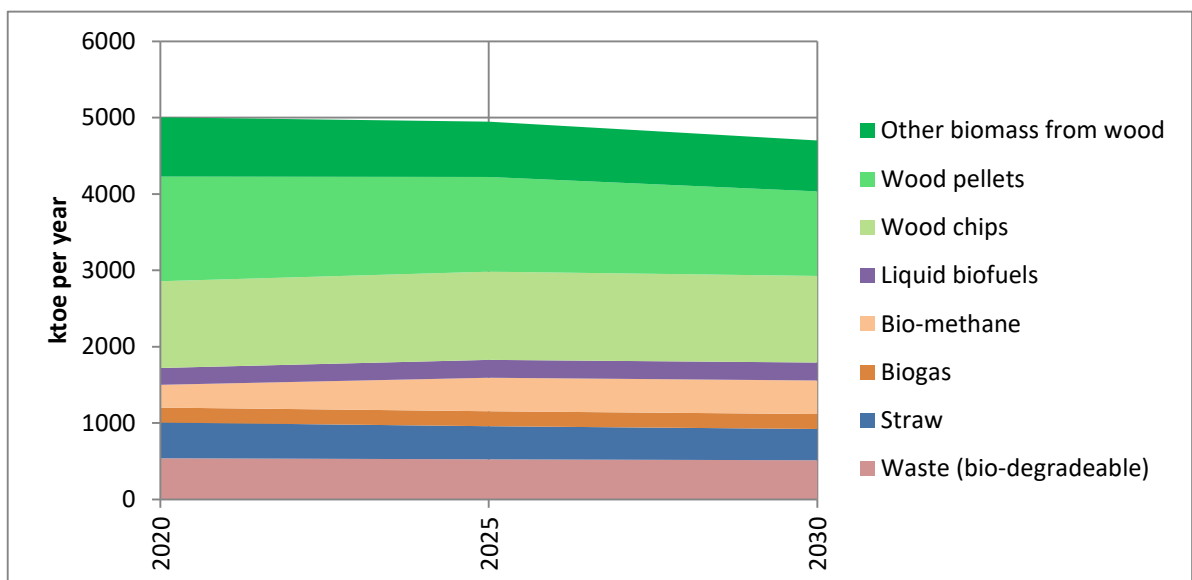
More than half of the present bioenergy consumption is used for production of district heat and electricity, and the use of bioenergy for these purposes has increased by almost a factor 4 since 2000. The main reason for this development is that nearly all of Denmark's coal fired power plants have been or are being converted to use of biomass fuels. The conversion is expected to be complete 2020-25. Hereafter the use of bioenergy will decrease slightly due to among other factors an uptake from heat-pumps and the revision of the subsidy schemes.

Use of bioenergy in households constitutes the second largest consumption. In households, bioenergy is mainly being used for heating using wood stoves (firewood) and biomass boilers (wood pellets). In Denmark, there are large energy and CO<sub>2</sub> taxes on fossil fuels for heating. For houses situated outside areas with access to district heating and natural gas, use of bioenergy for heating is therefore often the cheapest and most convenient solution.

Today, the industry and transport sectors together use approx. 15 % of the bioenergy. The consumption is expected to increase further until 2020 – 2025. The main reason for this increase is the introduction of biogas in the natural gas system.

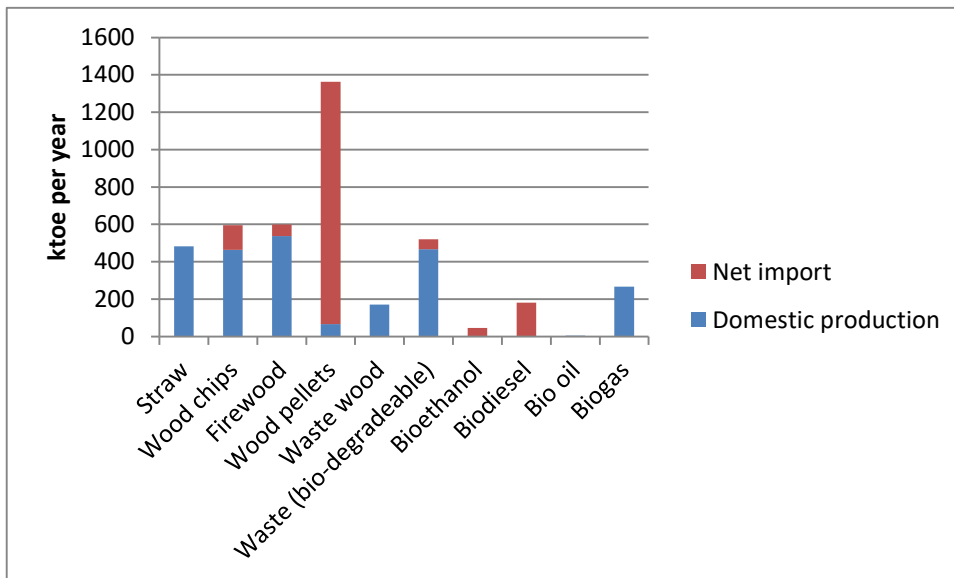
Figure 10 shows the historical and expected use of bioenergy divided upon fuel types. The figure shows that wood products constitute more than half of the total bioenergy consumption.

**Figure 10. Estimated trajectory for biomass supply, by type of fuel.**



Denmark uses both indigenous biomass fuels and imported biomass fuels. Figure 11 shows the use of different types of bioenergy divided upon indigenous sources and imports, based on 2017 data.

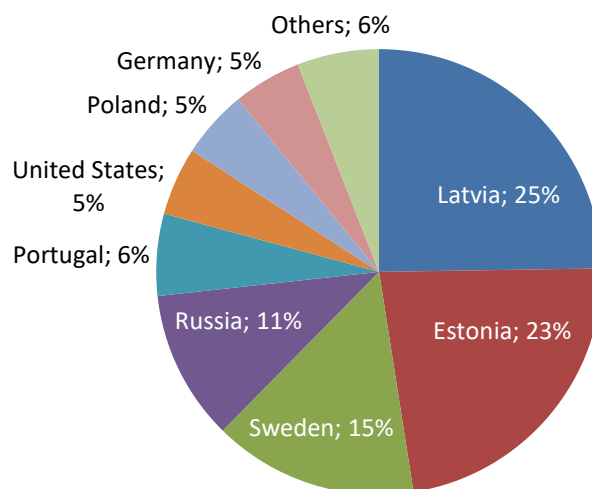
**Figure 11. Biomass origin. Domestic production and imports, 2017.**



The figure shows that the import shares differ substantially between fuel types. Wood pellets, bio ethanol and biodiesel are nearly 100 % imported, while the other types of biomass fuels are mainly from domestic sources.

Wood pellets are primarily imported from the Baltics (primarily Estonia and Latvia) and from Sweden and Russia. Smaller amounts are imported from other EU countries (primarily Portugal, Poland and Germany) and from the United States. The most important import countries regarding wood pellets are shown in Figure 12 below, based on data for 2016. "Others" include Lithuania, Belarus, Ukraine and Finland.

**Figure 12. Countries of origin for wood pellets imported to Denmark.**



Source: "Det danske træpillemarked 2016".



Data from Denmark's Energy and Climate Outlook does not include a forecast for origins of biomass fuels, but a fairly good assumption will be to say that the 2016/2017 picture is valid for the near future as well. However, for wood chips, a larger import share must be expected due to the expected conversion of the remaining coal fired CHP plants. The conversion will lead to an increase in the use of wood chips by approx. 400 ktoe, and it is expected that most of this increase will be covered by imports. The resulting use of wood chips for electricity and heat production will be around 45 PJ per year, whereof approx. 50 % will be covered by imports.

Forest biomass comprises wood chips, firewood, wood pellets and wood residues. The forecast shows that the total consumption of forest biomass will decrease slightly in the coming years from 140 PJ in 2020. Of this amount, approx. 65 % will be used for production of district heating and electricity, 25 – 30 % will be used for individual heating, and 5 – 10% will be used for other purposes.

Wood pellets used for individual heating constitute approx. 10 % of the total consumption of wood products for energy use. At present, this consumption is not subject to any Danish rules concerning sustainability. Nearly all of the forest biomass used for production of district heating and electricity is covered by a voluntary Danish industry agreement, concluded in 2014.

#### *The voluntary Danish industry agreement on sustainable biomass*

The purpose of the agreement is to ensure that biomass used in Denmark fulfils internationally recognized sustainability demands. Thus, the biomass must come from forests that are operated in a sustainable way, and the use of biomass has to lead to real CO<sub>2</sub> reductions. The sustainability of the used biomass has to be documented in annual reports verified by a third party.

The agreement comprises all plants producing district heat and electricity based on wood pellets and wood chips. Only plants with a capacity above 20 MW have to provide the documentation. The agreement covers wood from forests, but not wood from other areas such as farm land, cities etc.

According to the agreement, 90 % of the used biomass has to be sustainable, and the sustainability has to be documented. The remaining 10 % also has to be sustainable, but for this share, the documentation demands are fewer<sup>18</sup>. The sustainability criteria in the agreement are based on the guidelines regarding sustainable forestry from Forest Europe and the European Commission's recommendations regarding reduction of greenhouse gases from production, harvest, processing and transport of the biomass. Besides, the agreement contains criteria for CO<sub>2</sub> reduction compared to fossil alternatives, in order to ensure that the used biomass contributes to a positive climate effect.

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<sup>18</sup> See the agreement here: [https://www.danskenergi.dk/sites/danskenergi.dk/files/media/dokumenter/2017-09/IndustryAgreement\\_Biomass-20160623.pdf](https://www.danskenergi.dk/sites/danskenergi.dk/files/media/dokumenter/2017-09/IndustryAgreement_Biomass-20160623.pdf)

Moreover, an analysis has been initiated in order to address the sustainability of the large Danish consumption of biomass for energy purposes. The outcome of the analysis will serve as input to the forthcoming climate action plan.

*Danish forest regulation*

Danish forests are subject to a regulation with the purpose to maintain the existing forests and increase the forest area. Besides, the purpose of the regulation is to promote sustainable forestry. Thus, the regulation ensures that use of Danish produced firewood does not lead to deforestation.

Denmark will implement the sustainability criteria of the revised renewable energy directive directive. In light of this implementation, the role of the industry agreement will be considered, as well as possible new regulation covering the use of biomass in other sectors.

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

As for the district heating sector, it is the frozen policy projection that at least 80 % of the heating in the district heating sector will be based on renewable sources in 2030, see Figure 7.

## 2.2 Dimension Energy efficiency

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

*(1) The indicative national energy efficiency contribution to achieving the Union's energy efficiency target of at least 32,5 % in 2030 as referred to in Article 1(1) and Article 3(4) of Directive 2012/27/EU, based on either primary or final energy consumption, primary or final energy savings, or energy intensity; expressed in terms of absolute level of primary energy consumption and final energy consumption in 2020, and in terms of absolute level of primary energy consumption and final energy consumption in 2030, with an indicative trajectory for that contribution from 2021 onwards; including the underlying methodology and the conversion factors used)*

Reduction of energy consumption through increased energy efficiency and energy savings has been an important part of Danish energy policy since the 1970s, when the oil crisis first focused on security of supply and import dependence. In the meantime, climate change has also played a role in the desire to streamline and reduce energy consumption in Denmark.

Denmark has therefore developed a great expertise in energy efficiency, which has made it possible to keep energy consumption largely unchanged in spite of significant economic growth over the last three decades.

The indicative Danish contribution to achieving the Union's targets for primary energy and final energy in 2020 and 2030 corresponds to the energy consumption in the Danish Energy Agency's 2019 Energy and Climate Outlook published the 30th of August 2019. The primary energy contribution is the gross energy consumption excluding consumption for non-energy purposes. The consumption for non-energy purposes is also excluded in the final energy contribution.

The Danish Energy and Climate Outlook 2019 is based on a frozen policy scenario, where instruments and actions from the Energy Agreement from June 2018, from the energy policy agreement of March 2012 and subsequent adjustments are included. The Energy Agreement from June 2018 includes new energy efficiency measures in the period 2021-2024. In 2024 a stocking will take place and the need for new measures will be evaluated.

The Danish Energy Agency's Energy and Climate Outlook is based on a number of overall economic assumptions (the production of the companies, private consumption, fuel prices, etc.), a number of technology-specific assumptions (the cost of different types of installations, their efficiency, etc.) and assumptions as to what the energy market players will do when acting on market terms.

More information about the methodology and the assumption used in the Outlook are available at the Danish Energy Agency's website:

<https://ens.dk/sites/ens.dk/files/Analyser/deco19.pdf>

**Table 4: Indicative contribution 2020 and 2030.**

	2020		2030	
	PJ	Mtoe	PJ	Mtoe
Primary energy	733,5	17,52	767,4	18,33
Final energy	635,1	15,17	660,9	15,78

Note: Consumption for non-energy purposes is not included. The data will be updated after the adoption of the forthcoming climate action plan.

**Table 5: Indicative trajectory for the contribution from 2021**

PJ		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Primary	PJ	732,9	743,7	739,3	746,5	748,3	759,6	761,4	766,5	757,4	767,4
	Mtoe	17,51	17,76	17,66	17,83	17,87	18,14	18,19	18,31	18,09	18,33
Final	PJ	639,8	644,2	648,3	651,8	654,8	656,7	657,9	659,0	660,0	660,9
	Mtoe	15,28	15,39	15,48	15,57	15,64	15,68	15,71	15,74	15,76	15,78

Note: Consumption for non-energy purposes is not included. The data will be updated after the adoption of the forthcoming climate action plan.

The reasons for the increased consumption especially for final energy after 2020 are primarily:

- Increased activities (economic growth) in the different sectors
- The establishment of several new big datacentres in Denmark. In the outlook these are consuming 25 PJ (0,60 Mtoe) of electricity in 2030 equal to 15 % of the total electricity consumption in 2030. Without the increased consumption from the new datacentres, the final energy consumption would be almost stable from 2020 to 2030.
- No specific new energy efficiency measures for the period 2025-2030 exist as The Energy Agreement from June 2018 only covers the period of 2021-2024.

The Danish Government has committed itself to an ambitious climate policy, which aims to reduce Denmark's emissions of greenhouse gases by 70% in 2030, relative to 1990 levels.

The measures and instruments for reaching this goal will be outlined in the climate action plans. The upcoming climate action plan will amongst other things include energy efficiency measures, including energy saving requirements for all public sector buildings and a

national strategy for sustainable construction. Moreover, the Government is working on a plan for the implementation of article 5 in EED in the period 2021-2030. In addition, the Government will work to increase the electrification of the transport sector to ensure significantly more electric vehicles on the roads. These initiatives will thus increase Denmark's contribution to the EU's 2030 target.

*(2) Cumulative amount of end use energy savings to be achieved over the period 2021-2030 under point (b) of Article 7(i) on the energy saving obligations of Directive 2012/27/EU*

The cumulative amount of end use energy savings to be achieved over the period 2021-2030 shall be based on the final energy consumption (excluding consumption for non-energy purposes) in 2016, 2017 and 2018. The calculation is based on Eurostat-data (final energy consumption Europe 2020-2030) for 2016 and 2017 and estimated data for 2018. This data from Eurostat do not include ambient heat. The data is shown in Table 6.

**Table 6: Final energy consumption in 2016, 2017 and 2018**

		Eurostat		Estimate	Average
		2016	2017	2018	
Final energy consumption Europe 2020-2030	Mtoe	14,44	14,62	14,67	14,58
	PJ	604,6	612,1	614,2	610,3

The targets for 2021-2030 shown in Table 7 are based on the final energy consumption shown in Table 6.

**Table 7: Danish cumulative targets**

		PJ	ktoe
Annual target	0,8 % of average final energy consumption (610,3 PJ)	4,88	117
Cumulative target 2030	10 x annual target	48,8	1166
Cumulative target 2021-2030	55 x annual target	268,5	6414

*(3) the indicative milestones of the long-term strategy for the renovation of the national stock of residential and non-residential buildings, both public and private, the roadmap with domestically established measurable progress indicators, an evidence-based estimate of expected energy savings and wider benefits, and the contributions to the Union's energy efficiency targets pursuant to Directive 2012/27/EU in accordance with Article 2a of Directive 2010/31/EU;*

Denmark will submit its long-term renovation strategy separately, as soon as it is finished, but no later than the Marts 10<sup>th</sup> 2020 based on existing measures.

The existing measures to support energy renovation of existing buildings are:

- Taxes on energy use for heating of buildings
- Requirements in the building code
- Energy Performance certificate for buildings
- A new support scheme in 2021-2024 for energy renovation of existing buildings
- Subsidy scheme to replace oil burners with heat pumps in buildings outside the district heating and gas grids
- Information activities
- Data and digitalisation
- The building job scheme

The indicative milestones of the long-term strategy for the renovation of the national stock of buildings and the roadmap with domestically established indicators will be outlined in the upcoming climate action plan. The climate action plan will amongst other things include energy efficiency measures, including energy saving requirements for all public sector buildings.

*(4) The total floor area to be renovated or equivalent annual energy savings to be achieved from 2021 to 2030 under Article 5 of Directive 2012/27/EU on the exemplary role of public bodies' buildings*

Denmark is currently implementing EED, article 5 in accordance with the alternative approach. The ministries obligated under the existing Ministerial Order are bound by an energy savings target, but are at liberty to pursue the instruments which are most cost effective in their particular circumstances, including deep renovations, behavioural measures etc.

The Government is working on a plan for energy efficiency in government buildings in 2021-2030, including a model for implementing the requirements in EED, art. 5.

**(ii) The indicative milestones for 2030, 2040 and 2050, the domestically established measurable progress indicators, an evidence-based estimate of expected energy savings and wider benefits, 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**

See point 3 above.

**(iii) Where applicable, other national objectives, including long-term targets or strategies and sectorial targets and national objectives in areas such as energy efficiency in the transport sector and with regard to heating and cooling**

It requires a comprehensive green transformation of the transport sector to renewable energy in order to reach the goal of becoming a climate neutral economy. For more information on the transport sector transition see section 3.1.ii.

## 2.3 Dimension Energy security

### (i) National objectives with regard to:

- **increasing the diversification of energy sources and supply from third countries, the purpose of which may be to reduce energy import dependency,**
- **increasing the flexibility of the national energy system, and**
- **addressing constrained or interrupted supply of an energy source, for the purpose of improving the resilience of regional and national energy systems, including a timeframe for when the objectives should be met**

On December 6, 2019 the Government reached an agreement on a new Climate Act with 8 out of the 10 parties in the Danish Parliament. The act will include a legally binding target to reduce greenhouse gases by 70% by 2030 (relative to 1990 level), to reach net zero emissions by 2050 at the latest, and to set milestone targets based on a five-year cycle. The Government will moreover adapt climate action plans, which will contribute to ensuring that national reduction targets are met.

In the 2018 Energy Agreement, the parties in the Danish Parliament have agreed to work for net zero carbon dioxide emission in accordance with the Paris Agreement and net zero carbon dioxide emission in the EU and Denmark by 2050 at the latest. With the initiatives outlined in the Energy Agreement of 2018, Denmark has allocated funding that sets the course towards a renewables share of approximately 55 % by 2030.

Furthermore, the 2018 Energy Agreement states that Denmark must have the most integrated, market-based and flexible energy system in Europe, with efficient energy utilisation across the electricity, heating and gas sectors, and with a continued strong security of supply. There is also a need to further develop the electricity market and determine the potential role of the gas system in the green transition of the energy system.

Denmark does not have a legally based definition of overall energy security, but a definition of security of electricity supply is stated in the Electricity Supply Act, (LBK 840 of 15 August 2019, article 5,) requires “The probability that electricity is available when demanded by consumers”.

Stable and reliable energy supply is considered a prerequisite for the Danish society. The effectiveness and functioning of the economy, public organizations and private households depend on a reliable energy supply. The transition of the energy sectors towards increasing integration of renewable energy sources demands integration of energy systems, increased international connections and precise overview of energy production and consumption. The development of interconnection between subsectors and across borders is an objective targeting an efficient use of fluctuating energy sources.

Therefore both legislative and governance measures are being implemented in order to promote further integration internationally and intra-sectorially. The international dimension is vital to a small country like Denmark, linking Scandinavia to the continent, and the North Sea to the Baltic Sea. The geographic situation gives Denmark extraordinary conditions for import and export of energy, whether it is fossil or renewable fuels or electricity. Denmark supports further international cooperation in regard to energy supply



and further development of an open market for electricity and natural gas, as well as renewable based gasses.

Within both the natural gas sector and the electricity sector Denmark is working to further develop the international cooperation on security of supply by increasing physical interconnections and ensuring common understanding of risks to supply. The Danish electricity system is undergoing a development comprising an increasing amount of renewable energy production from mainly intermittent wind and solar power sources, together with a decreasing central and decentral power plant production capacity. This leads to an increasing dependency on interconnectors to the neighbouring countries and a need to introduce more flexibility into the electricity system. The potential security issues are being mitigated through regional cooperation in the Nordic region among authorities and at TSO level. This cooperation aims at enhancing the operational cooperation in case of crises by common exercising and knowledge sharing.

Conventional power plants are being decommissioned or transformed into biofueled plants, and diversification in both production and consumption is being improved with an impact on both the natural gas and electricity systems. This development demands further integration between subsectors in order to balance the integrated systems.

#### Cybersecurity

The energy sectors are crucial for maintaining our society as we know it. Consequently there is a need for the sectors to be protected from and resilient towards different risks and vulnerabilities. More and more of our energy security networks are digital and in some cases linked to the internet. Therefore, one of the growing threats is cyber, which is why cyber and information security in the energy sectors is highly important. In January 2019, the former Minister for Energy, Utilities and Climate published a cyber and information strategy specifically aimed at securing the energy sectors and thereby the high security of supply we have in Denmark. The strategy was developed in close collaboration with the businesses in the energy sector in recognition of the need for cooperation between businesses and authorities. The strategy entails ten initiatives which ensure that the energy sectors in the future will be resilient towards the challenges which enhanced technology creates and will continue to generate. The strategy is in the process of being implemented and towards 2021 the initiatives and thereby the strategy will improve the cyber and information security in the energy sectors and thereby the energy security.

#### Electricity supply security

With the Energy Agreement of 2018, the Parliament has allocated funding that sets a path towards a renewable energy share of total energy consumption of approximately 55 % in 2030. The agreement will also give Denmark an RE share in electricity above 100% of consumption. This ambitious development path, set for Denmark in the 2018 Energy Agreement, has two important implications for the security of electricity supply in Denmark.

Firstly, Denmark aims for an increased level of electrification in our energy system. This puts pressure on the electricity supply and challenges the security of supply, as more

appliances, especially cars and heating systems will run on electricity. The increased electricity demand from such units implies that generation and grid adequacy issues need to be addressed where constraints may arise. This issue is amplified by the plans to construct large datacentres, which will consume large amounts of electricity and will challenge the generation and grid adequacy further.

Secondly, the security of electricity supply will be affected as the renewable energy sources providing the electricity are primarily wind and solar power, which are highly fluctuating sources of energy. That will lead to periods of low electricity generation, which would previously have been covered by running the thermal power plants, but which in the future will have to be covered by other means.

Solutions and objectives for tackling the issues that arise with the increasing share of renewables in the electricity generation are presented in the following.

One of the most important solutions to the problem of fluctuating energy sources is to ensure sufficient **interconnections** with our neighbouring countries. Denmark is among the countries in Europe with the strongest interconnectors to neighbouring countries compared to the national electricity demand. Capacity in interconnectors is expected to increase in the coming years (Kriegers Flak, Cobra Cable, Viking Link etc.). That is, by becoming more interconnected, Denmark can sell electricity at times when there is a lot of wind and buy electricity at times when there is less, from countries that may have hydro power or different wind profiles, i.e. the security of supply is becoming a more shared objective in the future. The specific objectives regarding enhancements of interconnectivity can be found in section 2.4.

Secondly, it is important to connect an increasing amount of new **electricity generators** to the system. For this to have the best effect it is necessary to consider the location of the new electricity generators in order to match it with where the electricity consumption is situated. The specific objectives regarding the expansion of electricity generation from renewable energy sources are described in section 2.1.2.

Another objective for the future Danish energy system is to make sure that the demand for electricity does not rise to levels that cannot be met by the supply and to make the most efficient energy investments in line with the *energy efficiency first* principle. **Energy efficiency** objectives in terms of energy savings in buildings and households and for appliances are described in section 2.2. Reducing demand contributes to the EU's overall energy efficiency target of 32.5 % in 2030.

It is also important to make use of the existing energy sources to its full potential by integrating the different energy resources and by using data and digitalisation of the system to optimize the system. This strategy is termed **smart energy** and as prescribed by the Energy Agreement of 2018 a smart energy action plan is underway.

An additional way of ensuring sufficient electricity supply is by decreasing or shifting demand. The most important demand to limit is that which takes place in peak load, as peak load is what determines the capacity dimensioning. Thus, there is a need to shift

demand away from specific points in time and to use the possibilities of **flexible consumption and demand response**. For that to happen, favourable conditions for flexible electricity consumption must be promoted, which is a goal for Denmark.

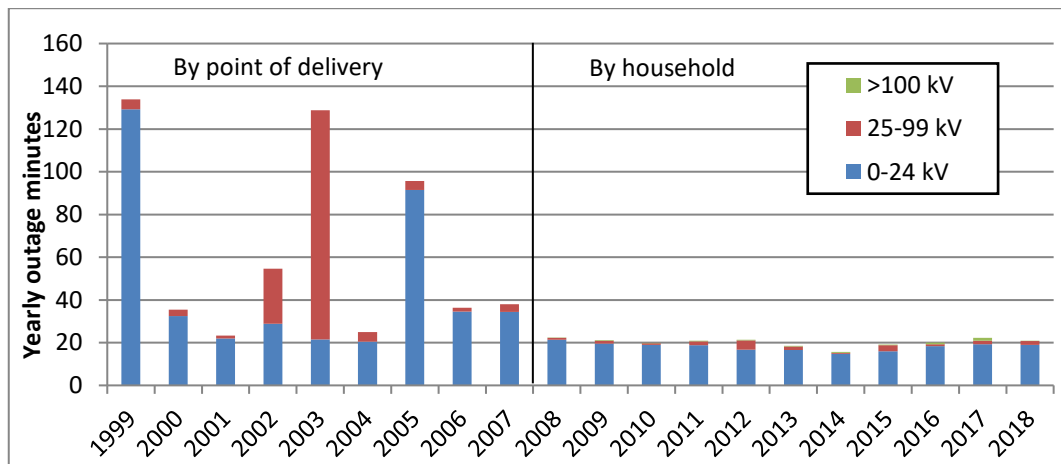
Furthermore, **energy storage** could be a useful tool to ensure sufficient supplies of energy, by levelling out demand peaks and by making use of surplus wind energy from times of high wind power generation to store for later times of shortage. Today, the technologies available for storing electricity are rather limited and expensive. Yet, the technologies will possibly continue to be developed and become profitable with time, as current trends in prices of storage technologies are indicating. This means that in the future it is not unlikely that for instance power-to-gas and the hydrogen sector could play a larger role in ensuring supply security and that batteries will become more prominent in the energy markets.

#### *Climate change risks affecting the power network and biomass resources*

With the increased level of carbon dioxide in the atmosphere, more often and more severe weather phenomena are anticipated to occur. This raises a question of whether storms will create an issue of maintaining a functioning power network, for instance with the increased risk of torn down lines and falling pylons. But in Denmark this issue has been mitigated already during the past decades, since a large part of the power network is cable-laid with the aim of avoiding such risks. To a large extent, this happened in reaction to the hurricane in December 1999, where many power lines were broken and in Denmark 440.000 households experienced a loss of electricity supply. The operation of running cables instead of overhead lines led to significantly less power disconnections when the hurricane of October 2013 came, cf. Figure 13 showing minutes of outage in the distribution grid. The objective is to continuously run cables rather than overhead lines, when possible, to minimize the risk.

On the other hand, the hurricane in 2013 was subject to a controlled shutdown of many wind turbines, necessitated by the fact that wind turbines are more likely to break under the heavy rotation that extreme weather entails. This illustrates how the shutdown of wind turbines in similar cases makes out another risk to the power supply. Yet, the wind has a tendency to travel across the country over a span of hours creating a time lag which lessens this risk. In combination with the electricity imports via the many interconnectors that Denmark has, it meant that there were no power outages due to the hurricane in 2013. Furthermore, there has been a focus on enhancing the robustness of the wind turbine technology lately in order to overcome this problem.

**Figure 13. Average number of minutes of outage over the year at a point of delivery or a household, 1999-2018**



Source: Energinet

The climate change risks with respect to biomass resources seem less applicable in a Danish context. If heavy winds overthrow trees, it will have a decreasing effect on the price of biomass, which will not cause a problem for the energy security. Furthermore, desertification of the lands that provide the biomass Denmark uses is not considered a risk.

### Responsibilities

The Minister of Climate, Energy and Utilities has the overall responsibility for the security of supply for electricity and natural gas in Denmark. The Minister also determines a planning goal for the level of security of electricity supply according to a law that entered into force in 2018. The operational and technical monitoring and maintenance of the security of supply is ensured by the national TSO (Energinet). The TSO is responsible for ensuring the presence of sufficient generation capacity or imports, grid adequacy at transmission level and balancing the system and maintaining security of supply together with the efficient utilization of the coherent electricity supply system and natural gas system. The TSO is responsible for the sector risk preparedness plans within both the electricity and natural gas sectors. The sector risk preparedness plan for electricity covers the entire connected electricity grid in west and eastern Denmark. The sector risk preparedness for electricity is developed with consideration to the cross-border effects to the neighbouring countries and the interconnectors. The sector risk preparedness plan for electricity describes how the TSO plans to handle an emergency situation in the entire Danish power grid in a coordinated fashion, which at the same time ensures a common perception of the situation at a DSO and production level. The sector risk preparedness plan for electricity also describes how the TSO plans to handle a cyber security emergency situation in the Danish electricity grid with focus on the responsibilities of the TSO, DSOs and power producers, ways of communication, requirements for situational reports, encryptions and segmentation instructions etc. The same considerations go for the sector risk preparedness plan for the natural gas sector, and are consequently not described in further detail. The sector risk preparedness plan for electricity is coordinated with the sector risk preparedness plan for

natural gas and vice versa. The risk preparedness plans for the natural gas sector are coherent with the respective EU-Regulation 2017/1938 concerning measures to safeguard security of gas supply and sector specific EU regulation.

#### Security of heat supply

While even short disruptions of electricity supply may have adverse effects on industry, service and healthcare providers etc., disruption of heat supply might last for hours before buildings cool down. Often, this allows for the deployment of auxiliary heating systems such as electric heaters. Thus, heating is considered less critical than the supply of electricity and gas as stated in the “Analysis of the security of supply in the district heating sector” published in 2016 by the Ministry for Energy, Utilities and Climate. Thus, no regulation or targets are in place concerning short-term supply security.

The Danish heating demand is covered primarily by district heating, supplying approximately 65 % of households, while the remaining are supplied by natural gas distribution systems or individual heat generation such as biomass boilers, electric heat pumps and oil burners, the latter of which are being phased out.

The large-scale deployment of the district heating system from the 1980’s was in itself a measure of tackling security of supply concerns following the oil crises in the 1970’s when oil burners supplied more than 60 % of the heating demand in Danish households. Combined heat and power plants and district heating were seen as an energy efficiency measure necessary for diminishing the dependency on imported oil, and for decreasing the amount of imported coal.

As part of the green transition, the roles in the energy system of the heating and district heating sectors are expected to change. Electrification and a higher degree of distributed generation will support the incorporation of fluctuating RE-sources in the electricity system, as an example. Moreover, the use of geothermal energy in the heating sector is expected to increase and the use of surplus heat as well. Several analyses being conducted in preparation of this transition are underway and include a strong focus on the continuance of supply in the heating sector.

#### Ending fossil fuel subsidies and risks of “stranded costumers”

Until January 2019, electricity generation on combined heat and power plants based on natural gas or waste incineration were subsidized. From 2019, the support scheme is rapidly being phased out, leaving substantial losses for some district heating companies. Due to the non-profit nature of the district heating system, these deficits are expected to translate into increased heating tariffs. Consequently, parts of the consumer base in a few areas are expected to lower consumption, partly replacing district heating with individual solutions, or leave the district heating systems entirely and deploy individual heating solutions instead. As heat sales weaken, tariffs may increase to unsustainable levels for the remaining consumers, resulting in the termination of district heating operation. The most vulnerable district heating systems are expected to be found in rural towns. In these district heating areas, in addition to stranded assets, this may result in “stranded” costumers without the economic means to successfully establish alternative heating solutions. These

risks are being analysed, and the Energy policy agreement of 2018 contains measures handling the security and cost of heat supply for these costumers.

### Oil

Oil and gas will continue to play a role in the energy mix in years to come.

In March 2017 the former government signed a new North Sea agreement with the Danish Underground Consortium (DUC) designed to ensure a future for oil production in the North Sea. The agreement supports investment in oil and gas extraction in the North Sea by, among other things, completely re-building the ageing Tyra fields. The renovation will allow the extraction of an expected 129 million barrels of oil.

The 2018 Energy Agreement confirms that, alongside the expansion of green energy, there will be a continued utilisation of oil and gas resources in the North Sea.

### **(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**

Denmark currently does not have objectives specifically focussed on diversifying energy supply from third countries. Since we are in a transition to a fossil fuel independent society and given the Government's goal of reducing greenhouse gasses by 70 % in 2030 compared to 1990, there will be less need for import of fossil energy from third countries in general.

### **(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**

Denmark does not have national objectives for reducing the energy import dependency of third countries, since these dependencies are limited due to the diversification of energy sources and the production of oil and gas within

Denmark. The dependency on import of coal is decreasing as a result of integration of more renewable energy and closure of coal fired power plants. The objective to phase out coal in electricity generation by 2030, as stated in the Energy Agreement from June 2018, is a contributing factor to this end. However, the transition towards integration of renewables leads to an increasing dependency on a well-functioning market for electricity across the Nordic region.

In regard to natural gas, Denmark has been a net exporter of natural gas since the introduction of natural gas in 1984. The importance of natural gas in the Danish energy supply has been decreasing in the last decade. This development is expected to continue in the following years as natural gas is expected to cover respectively about 12 % in 2020, 11 % in 2023 and 10 % in 2030 of the total Danish energy mix. The dependency on natural gas is decreasing as a result of a lower gas consumption altogether and the fact that there will be an increasing amount of biogas injected into the gas system.

The main gas production facility in the Danish North Sea – Tyra – will be shut down from November 2019 to July 2022 due to reconstruction of the facility. Denmark will in this period be net importer of gas. When the Tyra-facility comes on stream Denmark will return

to be a net exporter of natural gas to at least 2029. Furthermore, the Baltic Pipe-project is planned to come on stream in 2022 and will establish a new transport route for Norwegian gas to Europe which will increase the diversification of gas supplies to Denmark.

With regard to the implementation of Regulation 2017/1938 concerning measures to safeguard the security of gas supply, Denmark has participated in the regional risk groups Norway, Baltic Sea and Denmark. Denmark was lead in the risk group Denmark.

The single largest infrastructure is identified as Inter Connection Point (IP) Ellund – the single source of supply in the most critical period when the Tyra-facility is shut down. The N – 1 calculation shows that Denmark complies with the infrastructure standard in the period of reconstruction of the Tyra complex when the investment in expansion of the Lille Torup storage facility is completed in 2019 before the shut-down of the Tyra complex:  $N - 1 = 100\%$ , compared to 88 % if the Lille Torup storage facility is not expanded.

According to the Regulation the National Risk Assessment, Preventive Action Plan and Emergency Plan have been notified to the Commission in due time. In order to comply with the Regulation Member States have to lay down rules on penalties to natural gas undertakings for failing to comply with the notification obligations the Parliament has passed an amendment to the Act on Natural Gas Supply. The Act now includes sanctions for violation of rules in Regulation 2017/1938/EU.

Furthermore, Denmark will have to make agreements with Germany and Sweden in technical, legal and financial arrangements in order to ensure that gas can be supplied to solidarity protected customers in one of the Member States in case of a request. A dialog with Germany and Sweden on these arrangements is ongoing.

Historically, Denmark has imported coal from a lot of different countries. This diversification has led to a stable and secure coal supply. In recent years, the political decision to move towards an energy system with an increasing share of renewable energy and the phase out of electricity generation from coal before 2030 has made the energy system less dependent on coal.

In the heating sector, coal and natural gas are being replaced primarily by imported biomass for combined heat and power production and – to a lesser extent – electric heat pumps. While no targets exists, several measures over the past five years including the Energy Agreement of 2018 have been put in place furthering the deployment of large scale solar thermal plants and electric heat pumps including geothermal plants and utilization of surplus heat. These measures serve as a way of counteracting the dependency on biomass of the next step of the decarbonisation of the heating sector as well as enabling integration of the heating sector with the electricity sector on the demand side.

**(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 flexibility of the energy system is expected to be facilitated largely by market-based solutions. Therefore, it is an objective to support structures that favour demand response

and energy storage markets. Additionally, it is a goal to ensure a significant increase in the number of electric vehicles on the roads and the required transport sector transition. Moreover, a gas strategy, a roadmap for smart energy, as well as significant increase of heat pumps in the heating sector for both district heating and individual heat production should contribute to a more flexible energy system. Especially the integration with the district heating sector and its vast energy storage capacity is expected to provide a basis for increasing flexibility through increased demand response and energy storages.



## 2.4 Dimension Internal energy market

### 2.4.1 Electricity interconnectivity

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 2€/MWh between Member States, regions or bidding zones;
- 2) Nominal transmission capacity of interconnectors below 30% of their 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**

Denmark's current interconnectivity is at 50.6 % based on the "Energy Union Factsheet Denmark" from the European Commission. The interconnectivity level is calculated as a ratio between import interconnection and net generation capacities of the country (i.e. the 2017 value is the ratio between simultaneous import interconnection capacity and net generating capacity in the country at 11 January 2017, 19:00 pm as resulted from ENTSO-E Winter Outlook 2016/2017).

Given the high current interconnectivity level, Denmark has no specific objectives for a certain level of interconnector capacity in 2030 and consequently no strategy for reaching any targets that are way below Denmark's current interconnectivity level. However, interconnectors are now crucial for the reliability of the Danish power system so potential new interconnectors are considered and evaluated in coordination with other Member States taking into account the overall socioeconomic value and value for the security of power supply. Currently a number of interconnectors or expansions of existing connections will be completed within a near foreseeable future – see section 2.4.2 Energy transmission infrastructure for more information.

The Danish Government has an ambition to reduce the overall national CO<sub>2</sub>-emission by 70% by 2030. This target is very ambitious and it should be expected that even greater capacity on interconnectors will be feasible in this context.

So though Denmark has no official target for interconnector capacity in 2030, emphasis is definitely to make use of further integration with neighbouring countries when feasible. In the assumptions defined by Government administration to be used by the TSO for analyses on development of the electricity and gas infrastructure numbers for 2030 shows the same level of interconnectivity as today. An import capacity of 10.2 GW compared to installed capacity of 20.0 GW equals an interconnectivity of 51.2%. Denmark thus has an expectation to uphold the high level of interconnectivity.

Denmark is involved in the NSEC work on concrete concepts for joint offshore projects or cluster projects (see section 1.4 for more information).

## 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**

There are no specific projects necessary for a certain interconnectivity target. However, 5 projects are currently on the list of Projects of Common Interest, based on their positive socio-economic value and are about to be established.

- Viking Link – Interconnector between Denmark and UK. Expected completion 2023.
- Endrup – Niebüll – Interconnector between Denmark and Germany. Expected completion 2023.
- Kassø – Audorf – Upgrading of existing interconnector between Denmark and Germany. Expected completion 2020.
- Kriegers Flak Combined Grid Solution – Interconnector between Denmark and Germany which combines an interconnector with the grid connection of offshore wind farms. Expected completion end of 2019.
- Baltic Pipe – Gas interconnector between Denmark and Poland. Expected completion 2022.

Four of the listed projects are electricity interconnectors and will increase the level of interconnectivity with neighbouring countries.

With regards to gas infrastructure, the Danish TSO, Energinet, and the Polish TSO, Gaz-System, have in 2018 taken the final investment decision to establish the Baltic Pipe Project. The project will make it possible to transport up to 10 BCM Norwegian gas to Poland through the Danish gas infrastructure and connect the Danish and Polish gas markets.

Significant transit activity is expected to increase gas volume transported via the Danish gas network, which can be used to lower the tariffs for current users of the Danish transmission network.

Tariff reductions are considered to represent the main socioeconomic benefit in the Danish system, even though the degree of tariff reductions depends on the methodology of structuring tariffs in the Danish system after implementation.

In October 2013, The Baltic Pipe was granted the status of Project of Common Interest (PCI) by the European Commission under the Baltic Energy Market Interconnection Plan (BEMIP). The project was also included on the subsequent PCI lists, and the PCI status highlights the significance and regional dimension of the Baltic Pipe Project in the Baltic and CEE region and indicates the importance of its implementation. A key initiative for the implementation of the Baltic Pipe Project was a Feasibility Study concluded in 2016, which included a technical, financial and socio-economic analysis of the project. The study was partly funded by the EU under the CEF scheme.

All above electricity and gas infrastructure projects are important in terms of fulfilling the dimensions of the Energy Union such as a fully-integrated internal energy market with security, solidarity and trust. The majority of projects are based upon the need to ensure well-functioning energy markets, while the need for a number of projects is also based upon the need for security of supply.

The contribution to security of supply from biogas has historically been low, as the share in the natural gas grid has been limited, and as there are ample opportunities for natural gas supplies from the North Sea and Germany.

The contribution of biogas to security of supply is becoming more significant. Production of upgraded biogas has increased to above 11% of the gas consumption, with an expected increase to about 15% in 2020 and 30 % in 2025. In the first year during the redevelopment of the Tyra complex, biogas will make a significant contribution to security of gas supply on the Danish and Swedish gas markets.

In line with the establishment of more biogas plants connected to the distribution grid, there will be cases in which biogas production exceeds local gas consumption, for example in the summer when gas consumption is generally low. In some cases, this is handled by connecting distribution grids, while, in other cases, there is a need to be able to return gas to the transmission grid to supply a larger area. This means a completely new way of operating the gas system, as excess gas in the distribution system must be compressed into high pressure (from 40 to 80 bar) in order to be transported in the transmission system.

Today, the Danish TSO has established biogas injection points at two M/R stations. It is expected that there will be a need to inject gas back into the transmission grid at another three M/R stations in 2020.

Upgraded biogas injected into the gas system contains a higher level of oxygen relative to natural gas. Oxygen is a byproduct of sulphur removal in the biogas upgrading process. The allowed oxygen content in the gas is regulated primarily in national rules and standards, and as a consequence may vary between countries. In Denmark, the oxygen content in biogas injected into the gas grid must not exceed 0.5%. In Germany, the oxygen content depends on the gas pressure and if there is oxygen sensitive installation connected to the gas grid, such as gas storage facilities, where oxygen potentially can increase the risk of corrosion in gas installations with water.

Today, where the amount of biogas injected into the gas system is increasing, different requirements to the oxygen content is a challenge for gas exported to Germany, where the storage facilities in Northern Germany do not accept gas with an oxygen content above 0.001% (10 ppm). Due to the expected injection of biogas into the transmission system, it will be difficult to meet the German requirements for the oxygen content of the exported gas, after commissioning of the Tyra complex in 2022. The Danish TSO is working on a flexible European gas quality solution, together with European partners, which ensures the continued expansion of green gases without compromising the well-functioning internal gas markets in the EU. Concurrently, Energinet is looking into various operational solutions in a close dialogue with Danish stakeholders and the North German TSO, Gasunie Deutschland.

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

The Nordic TSOs published a Nordic Grid Development Plan in August 2019 which includes an early assessment of five cross-border investments in the Nordics. Corridors between Western Denmark and Norway as well as Eastern Denmark and Sweden are under investigation. In both cases some of the interconnectors are about to reach the end of their expected lifetime and decisions about reinvestments have to be made. Preliminary studies on reinvestment in the Skagerrak connection and the connections to Sweden (Kontiskan and Øresund) are reported in the joint Nordic Grid Development Plan 2019. Uncertainties in the business case remain and should be clarified before any final decision for reinvestment in the interconnectors can be taken.

The North Sea Wind Power Hub (NSWPH) project is currently a development project being investigated. The NSWPH project is looking into the possible benefits of a so-called “hub and spoke”-concept which could possibly connect offshore wind power production to a central offshore hub and then linking it to the European mainland using interconnectors. To this purpose the Danish Government has initiated a number of studies to explore the possibility of an energy island with a capacity of 10 GW offshore wind production before 2030. The North Sea Wind Power Hub project is a cooperation between the Danish TSO, Energinet, and the Dutch-German TSO, TenneT, along with its project partners.

The project promoters have applied for the project to become a PCI candidate.

### **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 law, market integration and coupling, aimed at increasing the tradeable capacity of existing interconnectors, smart grids, aggregation, demand response, storage, distributed generation, mechanisms for dispatching, re-dispatching and curtailment, and real-time price signals, including a timeframe for when the objectives shall be met**

Market coupling in the wholesale day-ahead and intraday timeframe is well-advanced in Denmark. Since June 2018 all bidding zone borders are also coupled through the single intraday market coupling.

There is also a common Nordic market for manual Frequency Restoration Reserves (mFRR). Denmark continuously works on developing markets for ancillary services. These markets are partly integrated with neighbouring countries or are in the process hereof, as part of the implementation of the electricity balancing guideline and the corresponding timeframe.

The Nordic TSOs are currently developing a new Nordic Balancing Model. The scope of the model is a common Nordic capacity market for aFRRs and mFRRs, and the implementation of 15 minute imbalance settlement period.<sup>19</sup>

Denmark also works on developing an improved regulatory framework for the future electricity market, based on renewable energy sources in a cost-efficient way, a new market model. This is a specific initiative in the Energy Agreement of June 2018 agreed by all political parties in Parliament. Denmark pursues a market-driven approach to utilise the most cost-efficient and innovative solutions to the challenges posed by a system based largely on variable renewable production. In this regard, the new market model should provide for a level playing field that makes it possible to achieve a least-cost solution to maintain a secure system and establish an adequate level of flexibility.

The aims of the new market model/framework (amongst others):

- Increased competition in the electricity market and clear price signals for investments
- identification and removal of possible price limits
- definition of rights and responsibilities of new players that may create value and provide flexibility in the electricity market
- an efficient market place adequately remunerating flexibility
- defining the new role of DSOs acting as neutral market facilitators, i.e. demanding flexibility
- ensuring the engagement of consumers to foster active participation in the electricity markets – for instance with local flexibility services.

Those changes to the market model related to the implementation of the electricity market directive will be implemented by the end of 2020, while recommendations beyond that are expected to be presented by 2021 and implemented at a later stage.

#### Interconnector capacities and flows

As an indicator for market integration the figures below present the weekly average available interconnection capacities and flow as a percentage of max NTC for the Danish interconnectors. Available capacity is given for all hours while the average flow is only given for hours with flow in the respective direction. The difference between flows and capacities also works as an indicator for congestion. A big difference indicates many hours without congestion, while a small difference indicates more congestion on average.

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<sup>19</sup> For more information see [https://consultations.entsoe.eu/markets/nbm-roadmap-consultation-1/supporting\\_documents/Report%20Nordic%20Balancing%20Model%20revised%20roadmap.pdf](https://consultations.entsoe.eu/markets/nbm-roadmap-consultation-1/supporting_documents/Report%20Nordic%20Balancing%20Model%20revised%20roadmap.pdf)



Figure 14. DK1-DE: Weekly day ahead capacities and flows

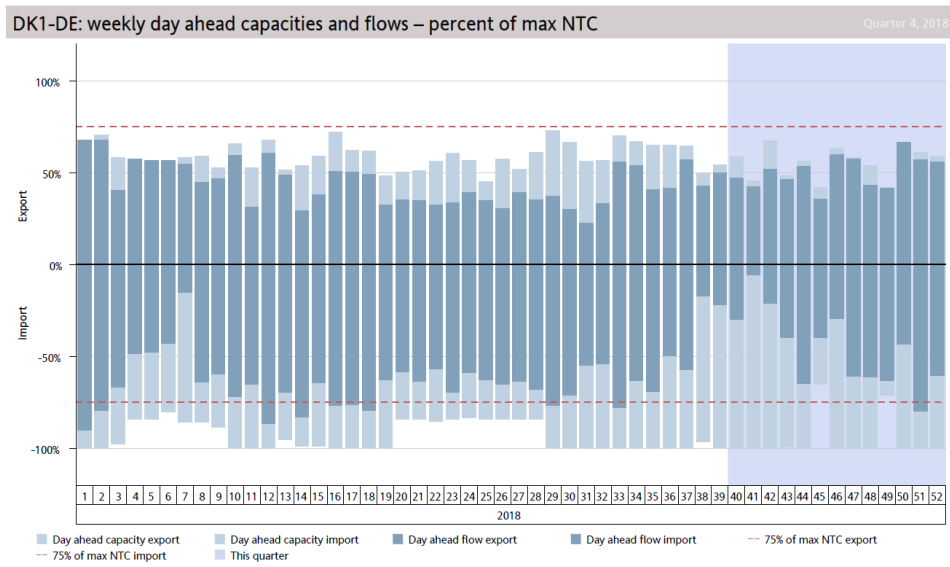


Figure 15. DK1-NO2: Weekly day ahead capacities and flows

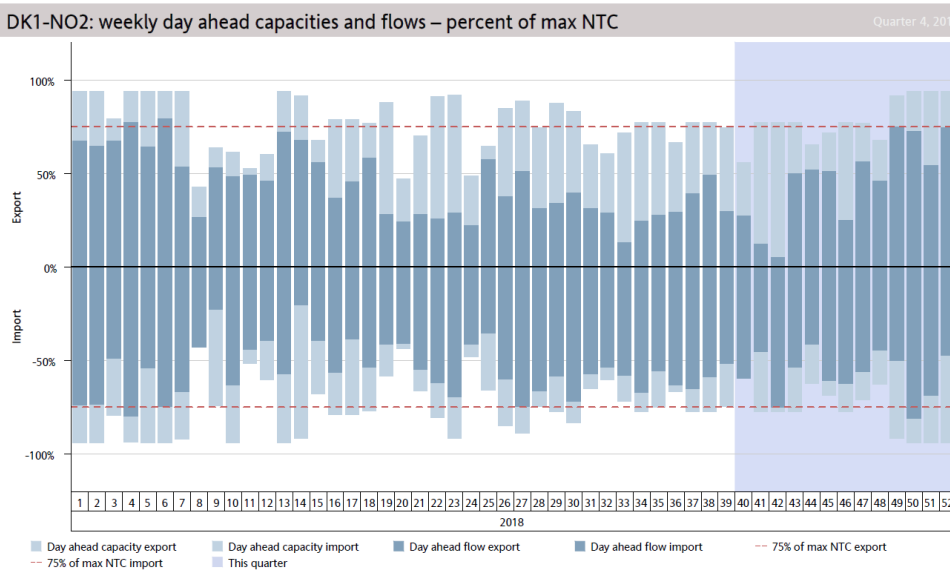




Figure 16. DK2-DE: Weekly day ahead capacities and flows

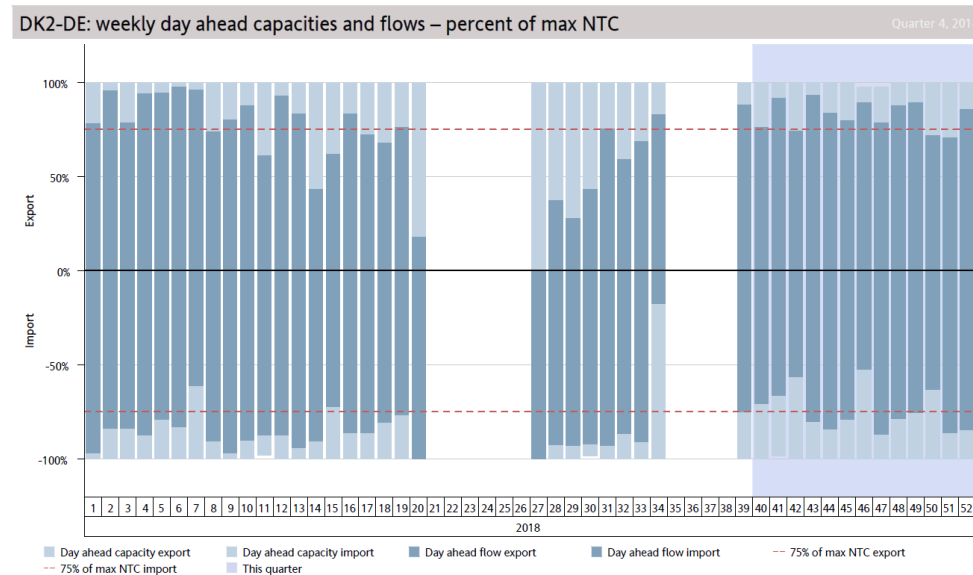
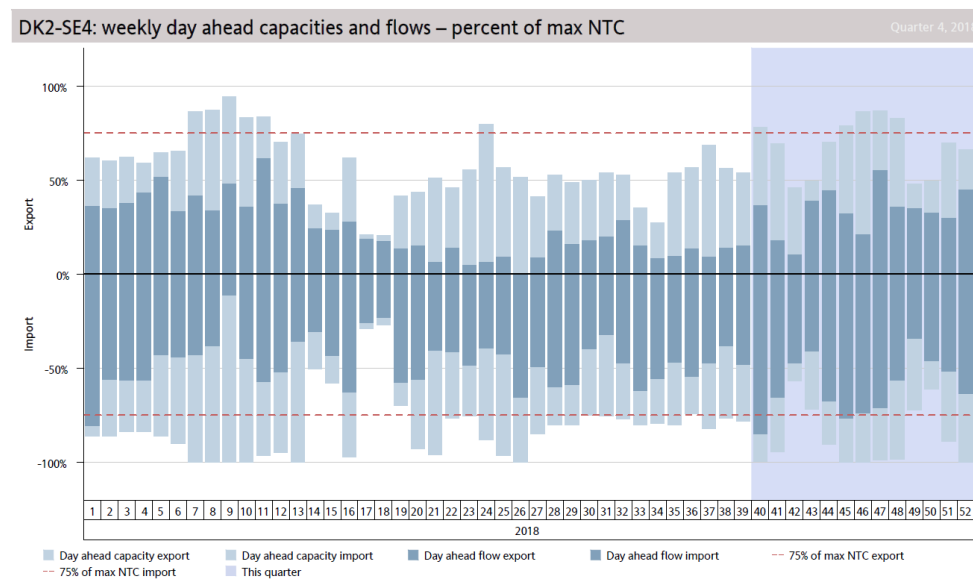


Figure 17. DK2-SE4: Weekly day ahead capacities and flows



From the above figures it can be seen that two interconnectors exhibit available transmission capacity close to or lower than the 70% threshold: DK1-DE, DK2-SE4. Denmark has been in dialogue with both neighbouring countries with the objective to increase capacities and market integration. Below is a description of their situation and outlook.

**DK1-DE:** The export available capacity from DK1 toward DE has been reduced for years due to maintenance and network constraints in the German grid. In December 2018 the European Commission published the Commission decision (Case AT.40461 – DE/DK

Interconnector) accepting Tennets proposed commitments of a minimum hourly capacity of 1300MW in the southbound direction. The commitment was to be phased in over a period of six months. Data from July 2019 shows a monthly average of available capacity of 1304 MW or 73% of max NTC.

**DK2-SE4:** export capacity from Eastern Denmark to SE4 has been reduced in recent years, mainly due to constraints at the West Coast Corridor (WCC) in Sweden. At a workshop in Copenhagen in June 2019 Svenska Kraftnät (SvK) presented background and mitigating action to address challenges with WCC.

SvK indicated that within a few years the problem with WCC will be reduced, due to decommissioning of the Ringhals power plant, flow-based capacity calculation, and infrastructure developments.

SvK will also start a countertrading pilot to possibly mitigate the problem starting from 17 June 2019.

SvK will be in discussion with the Commission on WCC commitment expiration.<sup>20</sup>

**(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 should be met**

The Danish electricity market is open for participation from renewable energy, demand response and storage, including via aggregation. The Danish TSO is by law required to contribute with its activities to the best possible conditions for competition in the electricity market.

Renewable energy producers (except for household-scale plants) are obliged to sell their production into the market via balancing responsible parties. The ancillary services markets are open to participation from renewable energy as well. Many wind power plants, for example, offer downward regulation into the market.

Denmark foresees an increasingly important role for demand-side resources in contributing to an integrated, market-based and flexible energy system. A large number of electrical boilers are already installed and may offer their service in all markets from spot to primary reserves. To encourage the participation of aggregated demand response, Denmark is constantly seeking to improve market regulations with the aim to reduce barriers for decentralised market participants. To that end Denmark is currently developing an aggregator model allowing decentralised resources to participate in energy and ancillary services markets alongside large market participants.

With increasing shares of decentralised production and new consumption due to the electrification of heating and transport the Danish grids will become challenged on a more

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<sup>20</sup> For more information see <http://www.nordicenergyregulators.org/wpcontent/uploads/2019/04/Keytakeaways.pdf>



local scale. It is goal that such local challenges shall be met primarily through market based arrangements in order to achieve the most cost-effective solutions.

In terms of the gas market, Denmark and Sweden have in 2019 merged the two national gas balancing markets to establish one common balancing market/zone for Denmark and Sweden – the so-called Joint Balancing Zone (JBZ).

JBZ means that a shipper who transports gas to Sweden no longer has to balance two systems, but shall only be in balance in one system and will no longer have to book capacity to flow gas between Denmark and Sweden.

The project details (in terms of tariff structure, market functioning, contracts etc.) were approved by the two national regulatory authorities of Denmark (DUR) and Sweden (Ei) in March 2019.

It is expected that the joint balancing between Denmark and Sweden will contribute to increased security of supply and more gas traders on the balancing market and Danish gas exchange (balancing trading platform) which could lead to increased competition to end consumers. In addition, there will be system synergies and administration that is more efficient. JBZ is in line with the thinking of the European Gas Target Model (GTM) and overall harmonization objectives.

**(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**

Denmark has an overall objective of rolling out smart meters to all consumers by 2020. In the future, this will enable consumers to participate in the energy markets through aggregation. The Energy Agreement of 2018 also underlines the objective to increase the utilisation of data and digital solutions and create a smart and flexible energy system. It is possible for consumers to self-generate electricity under defined rules for net metering. As such, however, self-generation is no particular objective for Denmark, as the goal is to provide consumers with an overall efficient and secure electricity system.

The roll-out of smart metering to all consumers including those that self-generate electricity is supposed to add to the transparency of such activities and make the impact on the electricity system visible. In this way it will be possible to identify whether a self-generator produces benefits to the system and appropriate incentives can be put in place.

**(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**

Denmark has one of the highest security of electricity supply levels in Europe. It is a clear ambition for the Government to keep a high level of security of supply also in the future when integrating more renewable energy into the Danish electricity system. As a consequence of the investments allocated to renewables in the Energy Agreement from 2018 the share of renewable energy in the electricity sector is expected to reach 100

percent in 2030. The specific targets for ensuring a high level of system adequacy while reaching the renewable energy share of 100 percent are described in section 2.3.

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

In general, Denmark aims at highly competitive retail markets. The full roll-out of smart meters is expected to change the retail business over the coming years, and Denmark will closely monitor the development. Consumer protection and competitiveness of the retail sector are addressed in many policies and measures. Future developments within the electricity sector will clearly add to the complexity. As in many other sectors digitalisation will play an important role in electricity as well. The Danish Government wants to address the challenges to consumers and issued its Consumer political strategy focusing on ‘the consumer in a digital world’ in May 2018. The strategy formulates a number of objectives that are highly relevant to electricity as well.

Objectives of particular importance to the electricity sector are that it should become easier for consumers to make decisions; they should have easy access to their data enabling them to create value in the market; and consumer information requirements shall be targeted to prevent overloading consumers.

The Danish Utility Regulator’s publishes a price survey to create more transparency in the retail electricity market and thus support consumers' active choice of an electricity product. The price survey provides an overview of the products offered in the retail and makes it possible to compare the prices of the products. Besides the price survey the Danish Utility Regulator publishes quarterly electricity price statistics providing insights into the average consumer price of electricity.

In order to ensure strong competition for the benefit of Danish citizens and businesses, Denmark is conducting an analysis of whether competition in the retail market is well-functioning. A particular focus lies on the separation between monopoly and competitive activities within the vertically integrated companies. It is investigated whether bundled grid companies challenge competition in the retail electricity market and whether appropriate measures can be identified to strengthen competition in the retail market and to enhance the separation of monopoly and competitive activities.

The level of competition in recent years has been relatively stable. The rate of customers changing to a new supplier typically lies at around 5% for small customers and 7% for large customers. At the same time, margins especially in the small customer segment lie at a low level indicating competitive pressure on retail prices.

An overall evaluation of the retail market is planned for 2022.

#### **2.4.4 Energy Poverty**

Denmark generally considers energy poverty as a social issue and consequently addresses energy poverty through social policy. Therefore, in the Danish energy policy no specific national objectives exist for the limitation of energy poverty. However, see section 3.4.3(iv) for social policy instruments related to energy consumption.

Hence, referring to Article 3.3., second subparagraph of (d) of the Governance Regulation, Denmark does not possess verifiable data supporting that a significant number of households live in energy poverty.

Eurostat, however, using data from the EU-SILC survey, assesses how many people express “inability to keep home adequately warm”. For Denmark, 3% of respondents express this (in 2018). This number is considerably lower than the EU-28 average of 7.4% and similar to numbers for neighbouring countries Sweden and Germany.

In the context of the Electricity Directive Denmark intends to consider vulnerable customers further.

## 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, if appropriate, a timeframe for when the objectives are to be met**

The new Danish government wants to reduce greenhouse gas emissions by 70% by 2030 compared to the 1990 level. To achieve this, new technologies will have to be developed and deployed before 2030.

In June 2018 the Danish Parliament made a Energy Agreement supported by all parties in the Parliament. As part of the agreement, Denmark has committed to spend 580 mill. DKK in 2020 on research, development and demonstration of new energy technologies. This matches Denmark's commitment to double its public funding to research and development under Mission Innovation. With the research reserve agreement 2020, the Government and all the political parties has agreed to increase spending to green research, development and demonstration by 1 billion DKK in 2020 in addition to the spending target in 2020 that follows from the Energy Agreement.

In 2020, 514 mill. DKK will be allocated to the Energy Technology Development and Demonstration Program (EUDP). EUDP supports development and demonstration of new energy technologies, as well as research supporting preparation for development and demonstration. The objective of EUDP is to create growth and jobs, increase the security of energy supply, and contribute to make Denmark independent of fossil fuels by 2050. 83 mill. DKK will be allocated to the energy area in Innovation Fund Denmark in 2020 (cf. the Budget proposal 2020). Furthermore, 629 mill. DKK will be allocated to green research in Innovation Fund Denmark in 2020. These funds cover different themes related to green research, including energy research. Innovation Fund Denmark primarily supports strategic research and development projects.

In addition to this the Government funds Research and Innovation in the food sector and in relation to Environmental Technologies through the Green Development and Demonstration Programme (GUDP) and the Environmental Technology Development and Demonstration Programme (MUDP). It is estimated that both programmes allocates 10 mill. DKK to energy and climate related projects.

Furthermore, the agreement states that by 2024 Denmark has a spending target of 1 billion DKK on research, development and demonstration of new technologies related to energy and climate.

The Danish parliament has already allocated 90 mill. DKK to research and development in limiting greenhouse gas emissions from the agricultural sector, which is relatively large in Denmark. The 90 mill. DKK will cover the period 2019-2021. The funds will help reach the Danish reduction target in 2030 in the non-ETS sector as well as the goal of reducing greenhouse gasses by 70% by 2030, relative to 1990 levels.

Denmark does not have any funding targets for private research and innovation relating to the energy union.

**(ii) Where available, national 2050 objectives related to the promotion of clean energy technologies and, where appropriate, national objectives including long-term targets 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**

Denmark has a long term target of net-zero emission by 2050 at the latest and independence from fossil fuels. Furthermore, Denmark has a target of 55% of energy consumption coming from renewables by 2030 and more than 100% of its electricity consumption coming from renewables by 2030.

As part of the new government's goal to reduce greenhouse gas emissions by 70% by 2030, relative to 1990 levels, it is essential that funding is in place for research, development and demonstration as well as deployment of new climate friendly technologies. New solutions will have to be developed in the energy sector, in transportation and aviation as well as in the agricultural sector. Power-to-X is one of the technologies that potentially can contribute to fully decarbonizing the energy sector, transportation and aviation as well as agricultural and industrial sectors. For this reason, research on power-to-X development and upscaling will be supported and developed.

As part of a future green mobility plan the Government wants to stop sales of all new diesel and petrol cars as of 2030 and enhance low emissions zones. This requires deployment of new green vehicles in Denmark.

As part of the Energy Agreement from 2018 three new off-shore wind farms will be deployed by 2030. Thereby Denmark will make itself increasingly independent from fossil fuels. The large ratio of green energy production will require further research, development and demonstration of technologies to fully integrate and exploit the green energy. In order to accommodate future needs, the Danish Government has established a fund supporting development and demonstration projects on energy storage. The fund's size is 128 million DKK and it was in December 2019 granted to two Power-to-X-projects. The projects will establish big scale production and storage of green hydrogen. Both projects have an ambition to demonstrate production and consumption of green hydrogen on near market based conditions.

**(iii) Where applicable, national objectives with regard to competitiveness**

The global green transition market continues to grow. In order to reach the temperature increase target limit, the international community must invest 90,000 billion DKK in green transition over the next 11 years. This represents a unique opportunity for the Danish business community, which must be exploited. The Government wants Denmark to be known as a nation of green entrepreneurialism.

It is a continuous Danish priority to deliver new green solutions to the fast-growing global market.

## 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<sup>21</sup> as referred to in point 2.1.1 and policies and measures to comply with Regulation (EU) 2018/841<sup>22</sup>, 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**  
*Existing policies and measures (implemented or adopted)*

Denmark's implemented and adopted policies and measures as of May 2019 are shown in Table 8. The policies and measures listed in Table 8 include policies and measures, which will contribute to the achievement of the target set under the ESR<sup>23</sup>, and contribute to comply with the LULUCF-regulation<sup>24</sup>.

Most of the policies and measures related to energy consumption<sup>25</sup> will have an effect on both greenhouse gas emissions under ESR<sup>26</sup> and CO<sub>2</sub> emissions under EU ETS<sup>27,28</sup>. The list covers all key emitting sectors and sectors for the enhancement of removals. Further information on Denmark's climate policy in general and the policies and measures listed in Table 8 is included in Annex 8.

The effects of the existing measures as of May 2019 are included in the "with existing measures" greenhouse gas projection scenario, the so-called WEM-projection scenario, reported in Chapter 4.

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<sup>21</sup> Effort Sharing Regulation

<sup>22</sup> LULUCF

<sup>23</sup> ESR or Effort Sharing Regulation: REGULATION (EU) 2018/842 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 30 May 2018 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013

<sup>24</sup> LULUCF-regulation: REGULATION (EU) 2018/841 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU

<sup>25</sup> Names starting with TD, EN, BU, TR or HO. TD: Taxes and Duties, EN: Energy sector (except BU, TR and HO), BU: Business sector (energy consumption), TR: Transport sector (energy consumption), HO: Household sector (energy consumption).

<sup>26</sup> In the period 2013-2020 the measures will also have an effect on greenhouse gas emission under Decision 406/2009 [ESD: Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020].

<sup>27</sup> EU ETS: Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community

<sup>28</sup> For example TR-10 (Electrification of parts of the infrastructure), which will – everything else being equal - decrease emissions from the use of diesel under ESR, but potentially increase emissions under ETS, if not counteracted by an increase in the use of renewable energy in electricity production.

**Table 8. Overview of Denmark's portfolio of existing climate relevant policies and measures (implemented and adopted)**

<b><i>Overview of Denmark's portfolio of existing climate relevant policies and measures (implemented and adopted)</i></b>			
EEA PAMs Database no.	Name of mitigation action	Single PAM or group of PAMs	PAMs included in Groups of PAMs
2	TD-1b: Mineral-oil Tax Act	Single	
3	TD-2: Gas Tax Act	Single	
4	TD-3: Coal Tax Act	Single	
5	TD-4: Electricity Tax (updated with the Energy Agreement, E3: Reduction of taxes on electricity and restructuring of surplus heat utilisation)	Single	
6	TD-5: CO2 tax on energy products	Single	
7	TD-6: Green Owner Tax - a fuel-efficiency-dependent annual tax on motor vehicles	Single	
8	TD-7: Registration Tax - a fuel-efficiency-dependant registration tax on passenger cars and vans	Single	
9	TD-8: Tax on HFCs, PFCs and SF6 - equivalent to the CO2 tax	Single	
10	TD-9: Tax on methane from natural gas fired power plants - equivalent to the CO2 tax	Single	
11	EN-1: EU-CO2-emission trading scheme for electricity and district heat production and certain industrial processes (incl. Business) and aviation from 2012	Single	
12	EN-2: Biomass Agreement (Agreement on the use of biomass in electricity production)	Single	
13	EN-3: Price supplement and subsidies for renewable energy production (updated with the Energy Agreement, E2: Renewable energy on market conditions and E10: Reserve for additional investments in RE as from 2025)	Single	
14	EN-4: Tenders for offshore wind turbines (updated with the Energy Agreement, E1: World class offshore wind)	Single	
15	EN-5(expired): Scrapping scheme for old wind turbines	Single	
16	EN-6: Energy development and demonstration (updated with the Energy Agreement, E6: Strengthened energy and climate research)	Single	
[73]	EN-7 (new): Energy Agreement, E5: Modernisation of the heating sector and mitigating impacts of eliminating the base subsidy	Single	
17	BU-1: Agreements on energy efficiency with business(updated with the Energy Agreement, E4a: Targeted energy savings)	Single	
18	BU-2: Savings activities by elec. grid, gas, oil and district heating companies (consump. of final energy excl. Transp.)	Single	
19	BU-6: Circular on energy-efficiency in state institutions	Single	



20	BU-7(expired): Campaigns and promotion of efficient appliances ( including elec. heating, conversion and efficient appliances in households)	Single	
21	BU-8(expired): Renewables for the industry	Single	
22	BU-9: Mandatory Energy Audit for large Enterprises	Single	
23	BU-10: The center for energy savings in enterprises	Single	
24	TR-1a: EU demands on vehicle manufactures to deliver fuel efficient cars and vans	Single	
25	TR-1b(expired): Information campaign on fuel consumption of new cars	Single	
26	TR-2(expired): Energy-correct driving technique	Single	
27	TR-3(expired): Initiative on enforcing speed limits	Single	
28	TR-4(expired): Establishment of intermodal installations	Single	
29	TR-5(expired): Promotion of environmentally friendly goods transport	Single	
30	TR-6(expired): Reduced travel times for public transport	Single	
31	TR-7: Spatial planning	Single	
32	TR-8: EU requirements regarding biofuels	Single	
33	TR-9(expired): Transport infrastructure projects in the fields of electric vehicles, gas and hydrogen	Single	
34	TR-10: Electrification of parts of the rail infrastructure	Single	
35	TR-11(expired): Investments in a new metro line and bicycle transport facilities.	Single	
36	TR-12: Investment in a tunnel under the Femern Belt	Single	
	TR-13 (new): Energy Agreement, E9: Funding for green transport		
37	HO-1: Energy labelling of small and large buildings (incl. public sector and business) (updated with the Energy Agreement, E4a: Targeted energy savings)	Single	
38	HO-2: Energy labelling of electric appliances	Single	
39	HO-3: Substitution of individual oil-based furnaces (updated with the Energy Agreement, E4b: Funding for scrapping oil-fired boilers )	Single	
40	HO-4: Better Houses	Single	
41	HO-5: Strategy for Energy renovation of buildings	Single	
64	HO-6 (new): Heat pumps as an energy service	Single	
42	IP-1: Regulation of use of HFCs, PFCs and SF6 (phasing out most of the uses)	Single	
43	AG-1(expired): Action Plan for the Aquatic Environment I+II and Action Plan for Sustainable Agriculture	Single	
44	AG-2(expired): Action Plan for the Aquatic Environment III	Single	
45	AG-4a/4b/4c/4d/4e: Reduced emissions of ammonia	Single	
46	AG-4f: Environmental Approval Act for Livestock Holdings	Single	
47	AG-6: Biogas plants	Single	





48	AG-9(expired): Agreement on Green Growth	Single	
65	AG-11(expired): Agreement on Green Growth 2.0	Single	
66	AG-12: Political Agreement on a Food and Agricultural Package	Single	
67	AG-13: Agreement on Nature (the Nature Package) including targeted regulation (conversion of catch crop regulation with other measures such as set-aside, energy crops etc.) and grassland and nature management.	Single	
49	LU-1: Ban on burning straw on fields	Single	
50	LU-2: Planting of windbreaks	Single	
51	LU-3: Subsidies scheme for private afforestation on agricultural land (increase the forest area in Denmark)	Single	
52	LU-4: Public afforestation (state and municipalities)	Single	
53	LU-5: Subsidy for conversion of arable land on organic soils to nature	Single	
54	WA-1: A ban of landfill of combustible waste.	Single	
55	WA-2: The waste tax	Single	
56	WA-3: Weight-and-volume-based packaging taxes	Single	
57	WA-4: Subsidy programme – Enterprise Scheme (special scheme for businesses)	Single	
58	WA-5: Increased recycling of waste plastic packaging	Single	
59	WA-6: Implementation of the EU landfill directive	Group	
60	WA-7(expired): Support for (construction of facilities for) gas recovery at landfill sites	Single	
61	WA-8(expired): Subsidy programme for cleaner products	Single	
62	WA-9: Subsidy programme for biocovers on landfills	Single	
63	G1(changed): Group of all policies and measures except in the LULUCF sector	Group	TD-b1, -2, -3, -4, -5, -6, -7, -8, -9; EN-1, -2, -3, -4, -5, -6; BU-1, -2, -6, -7, -8, -9, -10; TR-1a, -1b, -2, -3, -4, -5, -6, -7, -8, -9, -10, -11, -12; HO-1, -2, -3, -4, -5, -6; IP-1; AG-1, -2, -4a-f, -6, -9, -11, -12, -13; WA-1, -2, -3, -4, -5, -6, -7, -8, -9)
1	G2(former TD-1a): Energy taxes except on mineral oil	Group	TD-2, TD-3 and TD-4)
68	G3: All RE mitigation actions (Renewable Energy) since 1990	Group	EN-2, EN-3, EN-4, EN-5, BU-8 and TR-8
69	G4: All EE mitigation actions (Energy Efficiency) since 1990	Group	TD-b1, -2, -3, -4, -5, -6, -7; EN-1; BU-1, -2, -6, -7, -9, -10; TR-1a, -1b, -2, -3, -4, -5, -6, -7, -10, -11, -12; HO-1, -2, -3, -4, -5, -6
[70]	G5: Energy efficiency in transport by passenger cars	Group	TD-6, TR-1a, TR-1b, TR2 and TR-3
[71]	G6: F-gas taxes and regulation	Group	TD-8 and IP-1

[72]	G7: LULUCF activities	Group	LU-1, -2, -3, -4 and -5
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*Additional policies and measures*

As shown in Chapter 4 the effects of Denmark’s portfolio of existing policies and measures, as included in the WEM scenario projection from August 2019, will not be sufficient to achieve the target under the ESR.

On December 6, 2019 the Government reached an agreement on a new Climate Act with 8 out of the 10 parties in the Danish Parliament. The act will include a legally binding target to reduce greenhouse gases by 70% by 2030 (relative to 1990 level), to reach net zero emissions by 2050 at the latest, and to set milestone targets based on a five-year cycle. Moreover, the Danish Government will develop Climate Action Plans that will outline concrete policies to reduce emissions, and these will hence include further information on additional policies and measures in relevant sectors among others.

As preliminary estimates indicate that the total amount for LULUCF accounting will be above the limit for Denmark, which is 14.6 Million credits in total for the period 2021-2030, an annual average accounting quantity of 1.46 Million credits per year is shown in chapter 4 on projections for information. It should be noted that the showing of the projected accounting amount in chapter does not indicate whether Denmark will make use of the LULUCF flexibility under the ESR or not.

In addition, on 2 December 2019 the Government reached agreement with the Red-Green Alliance, the Social Liberal Party, the Socialist People’s Party and the Alternative on the Finance Act 2020. In the agreement, the parties agreed to establish a new fund called “Denmark’s Green Future Fund”, which will manage a total of 25 billion DKK. The fund will contribute to the green transition in Denmark and abroad including development and deployment of new technologies, conversion of energy systems to renewable energy, storage and efficient energy use etc. and promote global export of green technologies, particularly in regard to wind. At the same time the fund will contribute to solving the challenges that climate change and a growing world population creates in regard to food shortage and scarcity of water.

Moreover, the parties agreed to allocate a total of 2 billion DKK in the period 2020-2029 with the aim to reduce greenhouse gas emissions from agriculture as much as possible. In addition, the parties noted, that the Government is currently looking into the possibilities of establishing a Forest Fund and has allocated 100 million in the 2020 budget towards the project.

**(ii) Where relevant, regional cooperation in this area**

One fora where Denmark participates in regional cooperation is the Nordic Council of Ministers. The Nordic Council of Ministers was founded in 1971. Despite the generic name,

it consists of several councils. Regional cooperation in the area of climate change takes place through the Nordic Council of Ministers for the Environment and Climate (MR-MK)<sup>29</sup>.

The Council of Ministers for the Environment and Climate (MR-MK) is responsible for the Nordic inter-governmental co-operation on environmental issues, including on climate change. Its remit includes preserving and enhancing the quality of the environment and life in the Region and exerting influence on regional and international co-operation<sup>30</sup>. Currently, in MR-MK Denmark is represented by the Minister for Environment when environment is on the agenda and by the Minister for Climate, Energy and Utilities when climate is on the agenda.

The Nordic Council of Ministers for the Environment and Climate (MR-MK) has a Committee of Senior Officials for the Environment and Climate (EK-MK), which prepares and follows up on the work of the council and is responsible for ensuring that the Environmental Action Plan is implemented. The Nordic Committee of Senior Officials for the Environment and Climate (EK-MK) has set up a Working Committee (AU) consisting of representatives of national environment agencies, to plan and co-ordinate its activities. Currently, the Danish Environmental Protection Agency represents Denmark in MR-MK and AU.

Working Groups under MR-MK/EK-MK/AU relevant to regional cooperation on climate change and greenhouse gas emissions reduction are:

- Climate and Air Pollution Group (KoL):  
The work of the Climate and Air Pollution Group supports the Nordic objectives of reducing serious climate change and preventing the impact of air pollution on the environment, ecosystems and human health. The outcome is a series of publications<sup>31</sup>. The Nordic Council of Ministers' Environmental Co-operation funds projects whose aims are in keeping with the Nordic Environment Action Plan 2013–2018<sup>32</sup> and/or the programme of the annual Presidency. At least three Nordic countries must take part in the project, which must generate clear Nordic synergy. The Climate and Air Pollution Group (KOL) invites applications for contributions to Nordic projects that support the implementation of the Nordic Environmental Action Programme and the priorities of the Climate and Air Pollution Group. The Climate and Air Pollution Group is working to limit and prevent serious climate change and transboundary air pollution, as well as to limit and prevent air pollution from causing harm to human health<sup>33</sup>.

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<sup>29</sup> <http://www.norden.org/en/nordic-council-of-ministers/council-of-ministers/nordic-council-of-ministers-for-the-environment-and-climate-mr-mk/nordic-council-of-ministers-for-the-environment-and-climate>

<sup>30</sup> The most recent outcomes are available here: <http://www.norden.org/en/nordic-council-of-ministers/council-of-ministers/nordic-council-of-ministers-for-the-environment-and-climate-mr-mk/strategy>

<sup>31</sup> <http://www.norden.org/en/nordic-council-of-ministers/council-of-ministers/nordic-council-of-ministers-for-the-environment-and-climate-mr-mk/institutes-co-operative-bodies-and-working-groups/working-groups/climate-and-air-pollution-group-kol/publications-and-reports>

<sup>32</sup> <http://norden.diva-portal.org/smash/get/diva2:701877/FULLTEXT01.pdf>

<sup>33</sup> <http://www.norden.org/en/nordic-council-of-ministers/council-of-ministers/nordic-council-of-ministers-for-the-environment-and-climate-mr-mk/institutes-co-operative-bodies-and-working-groups/working-groups/climate-and-air-pollution-group-kol/the-climate-and-air-pollution-group2019s-project-funding-in-2018>

- The Nordic working group for global climate negotiations (NOAK):  
The group's overarching goal is to contribute to an ambitious and effective implementation of the UNFCCC and its Paris Agreement, with a Nordic perspective. The outcome is a series of publications<sup>34</sup>.

In addition there are also Working Groups under the Nordic Council of Ministers for Sustainable Growth (MR-VÆKST)<sup>35</sup> and its Committee of Senior Officials, which are relevant to regional cooperation on climate change and greenhouse gas emissions reduction.

**(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**

Renewable energy sources are promoted with economic measures, including use of energy and CO<sub>2</sub> taxes on fossil fuels and through the Public Service Obligation Schemes (PSO), which have been a supplement to the price of electricity paid by all consumers until 2017. The Danish PSO levy will be phased out during a period of 5 years (2017-2022), and the financing of support to renewables will gradually shift to the State Budget.

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<sup>34</sup> <http://www.norden.org/en/nordic-council-of-ministers/council-of-ministers/nordic-council-of-ministers-for-the-environment-and-climate-mr-mk/institutes-co-operative-bodies-and-working-groups/working-groups/the-nordic-working-group-for-global-climate-negotiations-noak/publications-and-reports>

<sup>35</sup> The Nordic countries work together on business, energy and regional policies in order to promote continued positive growth in the Region. The Nordic Council of Ministers for Sustainable Growth consists of ministers responsible for business, energy and regional policy.

### 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.**

On December 6, 2019 the Government reached an agreement on a new Climate Act with 8 out of the 10 parties in the Danish Parliament. The act will include a legally binding target to reduce greenhouse gases by 70% by 2030 (relative to 1990 level), to reach net zero emissions by 2050 at the latest, and to set milestone targets based on a five-year cycle. The Government will furthermore adapt climate action plans, which will contribute to ensuring that national reduction targets are met. The climate actions plan will amongst other things include the following initiatives in regard to renewable energy:

- A unified strategy for electrification of the transport sector, industry and society in general.
- Investigating the potential for Denmark to prepare a common strategy with the North Sea nations for a significant expansion and exploitation of the offshore wind potential.
- Investigating the potential for Denmark to construct the first energy island by 2030, with a minimum of 10 GW connected.

In addition, on 2 December 2019 the Government reached agreement with the Red-Green Alliance, the Social Liberal Party, the Socialist People's Party and the Alternative on the Finance Act 2020. The parties agreed, among other things, to initiate a screening of Danish waters that can identify locations suitable for future offshore wind, which also will include screening for potential locations for a so-called "hub-and-spoke" concept with minimum 10 GW offshore wind capacity connected. The parties further agreed to allocate funds in support of large-scale power-to-X technologies. The parties agreed to allocate 30 million DKK in 2020, 27 million DKK in 2021 and 8 million DKK in 2022.

Moreover, Denmark has already taken the first steps towards establishing a professional and efficient energy sector as the basis for the transition to a sustainable green society.

With the 2018 Energy Agreement, the parties in the Danish Parliament have agreed to work for net zero carbon dioxide emission in accordance with the Paris Agreement and net zero carbon dioxide emission in the EU and Denmark by 2050 at the latest. With the initiatives outlined in the Energy Agreement of 2018, Denmark has allocated funding that sets the course towards a renewables share of approximately 55 % by 2030.

In the coming years, the capacity of renewable energy is expected to expand significantly. In the electricity sector new capacity is primarily expected to be solar PV and wind, but also solid biomass will play an important role in the conversion of the remaining central power plants still operating on coal.

Denmark has over the last years gradually moved from fixed support for renewable energy to more competitive bidding and marked based support schemes. In the coming years Denmark will continue the path towards more marked based solutions e.g. through tendering.

Technology neutral tenders for wind and solar PV will be conducted again in 2019, and further renewable technologies are to be included in the technology neutral tenders conducted from 2020-2024.

In the case of offshore wind tenders agreed upon in previous energy agreements, contracts have been signed for 400 MW to initiate commercial operation in 2020, 600 MW to initiate commercial operation in 2021 and 350 MW expected to initiate commercial operation in 2023. Additional tenders for three offshore wind parks of a total of at least 2,400 MW have also been decided. The decision rests upon the prerequisites mentioned in section 1.1.

To support the continuant renewable capacity increase, Denmark will implement new financial support schemes for a range of technologies as described under point iii) below.

The production and consumption of renewables go hand in hand. Therefore Denmark wants to ensure better incentives for use of renewable energy over fossil alternatives. Denmark is phasing out the public service obligation originally put on the electricity bill to finance support for renewables. At the same time, the parties of the 2018 Energy Agreement agreed to reduce the electrical heating tax to approximately 0.15 DKK/kWh (2018 prices), effective from 2021. The tax reduction constitutes a follow-up on the Agreement on Business and Entrepreneur Initiatives<sup>36</sup>.

This initiative will make the tax on electrical heat slightly lower than the tax on fossil fuels for heating per GJ. Therefore it is expected an increase in the use of individual heat pumps and heat pumps in district heating systems. It also increases the incentive for utilising surplus heat.

As a result of the shift towards electrical heating, the tax reduction contributes to reducing carbon emissions in non-quota sectors. It will also make electrical heat more attractive relative to wood-burning stoves, thereby lowering particle emissions. This means that electricity produced on renewable sources will become more competitive with other energy sources.

The parties of the 2018 Energy Agreement agree to work for a modernised heating. The regulatory bindings on the choice of fuels for smaller district heating areas were terminated in January 2019. It is expected to leave way for more renewable heating as a substitute for natural gas. As well from January 2019, a stop for the connection obligations for new customers will give individual consumers freedom to choose their own renewable heating options, as these have been made more competitive.

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<sup>36</sup> <https://eng.em.dk/news/2017/november/agreement-on-business-and-entrepreneurial-initiatives/>

Increasing the renewable penetration in the heating and cooling sector further requires thorough decarbonisation of the district heating sector and especially of individual heating based on natural gas and oil fired burners. The energy policy agreement includes a support scheme of 80 million DKK for replacing oil burners with electric heat pumps to further this goal. Also a strategy for the future gas grid is being developed in order to ascertain the potential uses and required policies related to the gas system as part of the green transition.

Surplus heat has the potential to fill a small but substantial part of the district heating system with an estimated potential of 12-18 PJ. The current utilization of surplus heat is approx. 5 PJ compared to a total district heating production of around 135 PJ. The share is expected to rise to approx. 9 PJ in 2025 as a result of lowered electricity taxes and the 2019 policy agreement on increased utilization of surplus heat. This development will be monitored and the new measures evaluated in 2022.

In transport, according to present Danish legislation, suppliers must blend at least 5.75 % of biofuels in the transport fuel they put on the market. From January 1, 2020, they must blend in at least 0.9 % of advanced biofuels.

The proposal of the Government to prolong the exemption from registration tax for electric vehicles until the end of 2020 was passed in December 2018.

**(ii) Where relevant, specific measures for regional cooperation, as well 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**

Denmark has entered a cooperation agreement with Germany which will result in statistical transfers from Denmark to Germany, corresponding to the electricity production from 50 MW solar PV financially supported by Germany.

Denmark cooperates with other European and non-European countries on renewable energy in a number of fora. The European policy fora include CA-RES (RES in EU), BEMIP (RES and other topics in countries around the Baltic Sea), North Seas Energy Cooperation (Offshore wind in the North Sea), and Nordic council of ministers (RES and other topics in the Nordic countries) (see section 1.4.1). Denmark also actively collaborate with other countries in the IEA Renewable Energy Working Party.

On cooperation regarding renewable gas, the Danish TSO, Energinet, issues biomethane certificates for every MWh of biomethane injected into the natural gas grid. Upon request, certificates are issued to biogas producers serving as documentation for the amount of biogas fed into the grid. In order to receive certificates, each producer must register with a specific database operated by Energinet. Certificates can be traded across member states, but at present, the renewable share is counted towards the national Danish renewables target.

Denmark works in the North Seas Energy Cooperation (NSEC) to coordinate the timing of tenders, to exchange best practices on the design for offshore wind support schemes and

to identify, where possible, common principles as well as possible options for alignment of support. For more information see section 1.4.1.

#### *Nordic co-operation 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<sub>2</sub> 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 renewable energy sector by exchanging information and enhancing the collaboration between Nordic countries. In addition, AGFE disseminate information about relevant projects commissioned by AGFE tackling different issues on renewable energy in the Nordics. Most recently AGFE has looked at: renewable energy system support in the Nordics, how new EU sustainability criteria for biomass will affect the Nordics and finally, an assessment of 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 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 also becoming producers. The regulations and policies in the Nordic countries concerning distributed electricity production and self-consumption are discussed, and eventual barriers to a sound development identified. The study was published in June 2019 and provides useful information for policy makers and other stakeholders and will contribute to fulfil coming requirements according to the revised EU directive on renewable energy (REDII).

AGFE works for enhanced Nordic co-operation on implementing the current EU renewable energy directive (REDI) to 2020 as well as preparing for the revised directive (REDII).

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.

**(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**

Denmark has a long history of subsidizing electricity from renewable energy.

Wind power has been supported through a variety of measures since the 1970s. Later, support schemes have been established for both electricity from biomass, biogas and solar PV.

Based on the recommendations of The Energy Commission among others, Denmark has shifted from technology specific support to a higher degree of technology neutrality and a more marked based approach through e.g. multi-technology tenders.

*Electricity from wind power and solar PV*

Denmark has conducted tenders of support for offshore wind parks and signed contracts for 400 MW to start production in 2019, 350 MW is being planned to start production in 2020 and 600 MW to start production in 2021. Additional tenders for three offshore wind parks of at least 800 MW each have been decided in the policy agreement of June 2018.

Denmark has held the first technology neutral tender of support for wind power and solar PV in 2018 and will arrange the second round in 2019. The installations are expected to start production in 2020 and 2021. The policy agreement of June 2018 includes further technology neutral tenders in the period 2020-2024, which will also include wave and hydropower technologies among other things.

The June 2018 political agreement also include a reserve of 400 million DKK in 2025 and 500 million DKK annually for further efforts from 2026 to promote renewable energy.

Denmark also has specific support schemes for wind turbines with a testing purpose.

In the North Seas Energy Cooperation, Denmark contributes to analysing and developing options for further mobilisation of investment capital for joint projects, for instance through EU funds such as the European Fund for Strategic Investments (EFSI) and The Connecting Europe Facility (CEF) as well as institutional investors. Such joint projects could be cross-border projects for renewable energy in accordance with the CEF proposal.

*Promotion of the use of electricity*

Denmark has by far the highest general consumption taxes on electricity in the EU. As the renewables share in electricity steadily increases, the Danish Parliament wishes to improve incentives for the use of electricity over other types of energy, especially in the heating sector. For that purpose it is agreed gradually to reduce the electricity taxes in the period from 2019-2025.

The tax on electricity for heating purposes will be reduced to 0.15 DKK/kWh from year 2021. The general electricity tax will be reduced from 0.91 DKK/kWh (2018) to 0.77 DKK/kWh in 2025. For certain types of businesses the electricity tax will be reduced to the EU-minimum level.

A special task force has been set up with the purpose to analyse if the present tariffs and tax regime can be optimized to better support demand side management and flexible energy consumption. The report from the task force is to be finished primo 2020.

Moreover, the upcoming climate action plans will include a unified strategy for electrification of the transport sector, industry and society in general.

### Biogas

The use of biogas for certain purposes is supported financially. More specifically, end-users are eligible for different types of direct grants when biogas is used to produce electricity or heat, upgraded to biomethane, used as a fuel in the transport sector or used in industrial processes.

In the June 2018 Energy Agreement it was decided to phase out the current biogas support schemes by 2020. This implies that no new installations can enter the existing subsidy schemes from January 1, 2020 and that existing installations will continue to receive support for a fixed depreciation period.

### Electricity and heat from solid biomass

The electricity production from the use of solid biomass is supported with a fixed premium of 0.15 DKK/kWh. The scheme ran for 10 years until April 2019 and covers existing and new biomass CHP plants. The fixed premium scheme, in combination with tax exemption on biomass fuels for heat production, has been a strong driver in recent years for the fuel switch from coal and gas.

The policy agreement of June 2018 establishes the future support system after April 1, 2019.

There are in total 3 support schemes:

- 1) Existing non depreciated installations will continue with a fixed premium of 0.15 DKK /kWh in the entire depreciation period.
- 2) Depreciated installation will be supported by a fixed premium calculated on basis of the difference in operating cost in using biomass compared to an alternative fossil reference.
- 3) For new installations after April 1, 2019 a grant pool is established, which would give the possibility of aid for new capacity for the production of electricity using biomass, biogas and other green gasses after application.

The latter two new schemes are to be notified to the European Commission.

### Transport

In the Energy Agreement from June 2018 there has been made a reservation on an amount of 500 million DKK for the years 2020-2024 – 100 million DKK a year for the transport sector. The pool shall be used to support green solutions in the transport sector. The specific initiatives will be developed further.

Furthermore, as an element in the agreement on business and entrepreneurial initiatives of 12 November 2017, there has been made a reservation on 140 million DKK to support the production of advanced biofuel. It is yet to be decided how these 140 million DKK can support the production of advanced biofuel.

In addition, the Government will work for the transition of the transport sector. For more information see section 3.1.3 (iii) Policies and measures to achieve low-emission mobility (including electrification of transport).

### Heating and Cooling

Since 2015, two smaller support schemes totalling 106 million DKK have supported investments in electric heat pumps for district heating production.

Also two smaller support schemes have been enacted to support the deployment of electric heat pumps for individual households and companies by energy service providers as part of a market maturation strategy.

The Energy policy agreement from June 2018 lifts the prohibition of direct heat production based on biomass at decentralized natural gas fired combined heat and power plants.

Further, a technology neutral support scheme of 114 million DKK for investments in heat production capacity at decentralized natural gas-based district heating plants is being established from 2020. This scheme will support investments in electric heat pumps, biomass boilers and solar thermal plants.

In addition, the aforementioned support schemes for deployment of individual heat pump installations by energy service providers have been expanded by 80 million DKK for the replacement of oil boilers for individual households and 70 million DKK for electrical heat pumps in discontinued district heating areas.

These measures are expected to boost the deployment of electrical heat pumps compared to the use of biomass burners and to incentivise the phasing out of natural gas primarily in the district heating sector and oil boilers in the individual heating sector. The heat pumps are expected to utilize a variety of low-temperature heat sources such as air, ground and sea water as well as intermediate temperature sources such as geothermal energy and low grade surplus heat.

From 2020 133 million DKK/year is earmarked for promotion of use of surplus heat which is projected to increase the utilization of surplus heat by approximately 35 % by 2025. As a result of these measures combined with the lowered tax on electricity for heat production, the utilization of surplus heat is projected to increase from app. 5 PJ to approximately 9 PJ in 2025. This number is expected to rise further approaching 2030.

The Energy policy agreement also includes a series of policies amending administrative and legislative barriers to the deployment and expansion of district cooling networks from 2020. According to the *Comprehensive Assessment of the Potential for High-Efficient Cogeneration and Efficient District Heating and Cooling and in Denmark*, the total cooling potential is around 5.000 MW, of which approximately 40 % could be covered by district cooling networks. The effects of the mentioned policy measures have not yet been estimated.

**(iv) Where applicable, the assessment of the support for electricity from renewable sources that Member States have to carry out pursuant to Article 6 (4) of the Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources.**

A thorough assessment of Danish taxes and subsidies in the energy sector was published from 2016 to 2018. This analysis has informed later policymaking and does among other things form part of the background for the ongoing shift from technology specific support to a higher degree of technology neutrality and the shift from financing support for renewable electricity via a tariff on electricity consumption to financing on the state budget.

The assessment consists of six parts which can be read (in Danish) at the following links:

Part 1: Development in tax and subsidy base

<https://www.skm.dk/media/1827192/Afgifts-og-tilskudsanalysen-delanalyse-1.pdf>

Part 2: Costs of public obligations

<https://www.skm.dk/media/1827200/Afgifts-og-tilskudsanalysen-delanalyse-2.pdf>

Part 3: The extent of non-regulated externalities of energy consumption

<https://www.skm.dk/media/1827208/Afgifts-og-tilskudsanalysen-delanalyse-3.pdf>

Part 4: Effects of the tax and subsidy system on integration of green energy

[http://www.skm.dk/media/1596491/afgifts-og-tilskudsanalysens-delanalyse-4\\_19042018\\_samlet.pdf](http://www.skm.dk/media/1596491/afgifts-og-tilskudsanalysens-delanalyse-4_19042018_samlet.pdf)

Part 5: Utilisation of surplus heat

<https://www.skm.dk/media/1827224/Afgifts-og-tilskudsanalysen-delanalyse-5.pdf>

Part 6: Future support for onshore wind

<https://www.skm.dk/media/1827232/Afgifts-og-tilskudsanalysen-delanalyse-6.pdf>

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

The administrative procedures regarding permit granting for offshore wind has been simplified in recent years by the establishment of a single contact point handled by the Danish Energy Agency. The agency acts as a one stop shop and is responsible for delivering the final permission regarding feasibility studies, construction and production. The Agency is also responsible for coordinating input from other relevant authorities.

Denmark is in the preparation for the national implementation of article 15 and 16 in the revised Renewables Directive regarding streamlining administrative procedures and the set-up of national contact points for renewable energy projects.

Electricity used for self-consumption is supported by an exemption from electricity tax. At present, the tax on electricity for private consumers is 0.88 DKK/kWh plus VAT and network tariffs. This gives an economic incentive for self-consumption in buildings. As of February 2019 the pre grid connection application procedure for self-consumption through instant settlement has been removed. Instead, the self-consumer can connect the renewable installation to the grid and then afterwards notify the local distribution system operator. The new simplified rules minimize the administration and avoid long processing times.

In Denmark there is a long tradition for establishing renewable energy communities especially in the district heating sector and renewable electricity production.

Denmark is in the preparation for the national implementation of article 21 and 22 regarding an enabling framework for renewable self-consumption and renewable energy communities.

In May 2019, Nordic Energy Research published a study, initiated by the Nordic council of ministers and carried out by SWECO and Oslo Economics, on Distributed energy production and self-consumption in the Nordics. The aim was to review the current situation and future prospect of decentralized energy production and self-consumption. The report describes some *perceived* barriers identified by consumers, e.g. complex regulation, tax-rules, several different support schemes etc. The report however, does not identify administrative barriers to a sound development for self-consumption in Denmark.

An independent consultancy firm has on behalf of the Danish Energy Agency conducted an analysis of the Danish market for power purchase agreements (PPA). None of the identified barriers were due to the regulatory framework. The identified barriers were mainly driven by a lack of demand (due to the characteristics of the Danish industry with few large companies and many SME's) and transaction costs for the bilateral parties entering a PPA.

#### **(vi) Assessment of the necessity to build new infrastructure for district heating and cooling produced from renewable energy sources**

Denmark is rapidly phasing out fossil fuels for the production of heat and power. The latest Energy Agreement from June 2018 is expected to give Denmark a renewable share in electricity above 100 % of consumption, while ensuring that at least 90 % of district heating consumption is based on energy sources other than coal, oil or gas by 2030. It is a political priority to achieve the increase through market mechanisms.

An analysis of modernised heating is being conducted to assess the expected transition paths. This analysis will allow for further assessment of the possible need for new infrastructure and is expected finalized early in the second half of 2019. The analysis focuses on legislative constraints in the district heating and individual household heating sectors and is set to form the basis of new policies for the completion of the green transition for the heating sectors in Denmark driven by market mechanisms.

**(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**

Denmark currently has no specific measures that promote the production of electricity from new biomass installations after 2020. Considerations regarding the promotion of new installations (as outlined in the Energy Agreement from 2018) are currently undergoing. Biomass for heating is promoted by the absence of energy and CO<sub>2</sub> taxes on heat from renewable sources.

In 2014, the Danish energy sector laid down principles for a set of sustainability criteria for the use of solid biomass in energy production. The purpose and principles are set up as a voluntary industry agreement, to encourage the industry's members and branches to the purchase of sustainable biomass. See section 2.1.2 for a further description of this agreement. As mentioned, in the present setup the electricity production from the use of solid biomass in existing installations is supported with a fixed premium of 0.15 DKK/kWh. This fixed premium scheme has been a supplement to tax exemption on biomass fuels for heat production.

### 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**

Not applicable. Although most of Denmark's policies and measures related to energy consumption mentioned in Table 1<sup>37</sup> will have an effect on both CO<sub>2</sub> emissions under EU ETS<sup>38</sup> and greenhouse gas emissions under ESR<sup>39</sup>, as mentioned in chapter 3.1.1, assessments of the separate effect on the EU ETS sector have not been carried out.

#### **(ii) Policies and measures to achieve other national targets, where applicable**

Among Denmark's policies and measures with effect on greenhouse gas emissions reported in 2018 in Denmark's Seventh National Communication and Third Biennial Report under the UNFCCC<sup>40</sup> and under the EU Monitoring Mechanism Regulation (MMR) cf. Table 8, there are several policies and measures, which will also contribute to the achievement of the expected national share on renewable energy in 2030.<sup>41</sup>

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

It requires a comprehensive green transformation of the transport sector to renewable energy in order to reach the goal of becoming a climate neutral economy. Moreover, concrete and ambitious measures for all modes of transport are needed in order to achieve significant reductions in emissions from the transport sector.

Today, the Danish state-owned rail network is only partially electrified, though there is currently several large electrification projects being carried out on the main rail lines in the country. This electrification will enable railway sector operations to contribute to the overall target of the transport sector to reduce fossil fuel emissions. Hereto the biggest train operator in Denmark is currently in the proces of buying electrified trains to replace older diesel trains for the future train operations on main rail lines of Denmark.

In addition to the electrification af the Danish state-owned rail network we have been expanding the metrosystem in Copenhagen with the Cityring, that opened in September 2019. Further expansions of the metro system in Copenhagen will follow in 2020 and 2025. Expanding the metro system further contributes to the overall target of reducing fossil fuel emissions in the transport sector.

Furthermore, the Danish state has provided grants for the establishment of light rail transits in the country's three largest cities: Copenhagen, Aarhus and Odense. Light rail transits play a role in a future of green public transport services as well as making public transport an attractive alternative to private motoring.

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<sup>37</sup> names starting with TD, EN, BU, TR or HO.

<sup>38</sup> Directive 2003/87/EC

<sup>39</sup> Regulation 2018/842

<sup>40</sup> United Nations Framework Convention on Climate Change

<sup>41</sup> Directly this includes EN-2, EN-3, EN-4, EN-5, BU-8 and TR-8 in Table 1 and indirectly TD-1b, TD-2, TD-3, TD-4, TD-5, TD-6 and TD-7 in Table 1.

Denmark's first modern light rail transit opened in Aarhus in December 2017. The light rail transit in Odense is expected to open in 2021, and the one in the Copenhagen area is planned to open in 2025. Moreover, environmental impact declarations are underway on further lines in Aarhus and Odense, to which the Danish state has also provided grants.

Public busses are also undergoing a transformation towards greener fuel alternatives. Across the country low or zero emission busses are prioritized. By the end of 2019, it is estimated that approximately 11 percent of all public busses will use a green fuel alternative. It is expected, that these numbers will increase in the near future.

The green transition in the transport sector is also evident in the taxi industry. This is partly driven by governmental legislation which secures that all new taxis from 2025 will be zero-emission vehicles. Furthermore, the Danish state experiences a great interest towards the permission to drive in zero-emission taxis.

Passenger cars are responsible for around 60 % of the greenhousegas emissions from the transport sector in Denmark, so the Danish Government finds it essential to ensure significantly more electric vehicles on the roads. A Commission for Green Transition of passenger cars has the objective to deliver recommendations on specific policy measures to promote green cars such as electric and plug-in hybrids, recommendations on infrastructural requirements to the electrical system and charging network to support the green transition of passenger cars. The Danish Government expects to prepare a political strategy when the recommendations from the Commission are available.

The Danish Government would also like to start discussions in EU on a transition to a fleet of zero emission passenger cars as the Commissioner for Internal Market, Industry, Entrepreneurship and SMEs, Ms Bieńkowska, encouraged Denmark to do in her letter to the Danish Parliament with the aim of eventually phasing out new diesel and petrol cars in the EU. The Danish Government had therefore asked for this subject to be brought up as an AOB item at the Council meeting for ministers for environment on the 4th of October 2019, and the Danish Government will work to continue this discussion.

The Danish Government will negotiate an infrastructure agreement, which will consider climate and environmental issues to a much higher degree. This requires investments in public transportation and cycling, among other things (cf. the political understanding "A fair direction for Denmark").

At the same time, the Danish Government will work for initiatives aimed at ensuring more sustainable air transport. This can be achieved through European solutions.

Among Denmark's existing policies and measures with effect on greenhouse gas emissions included in Table 8 (for further information see Annex 8), there are policies and measures,



which will also contribute to the achievement of low-emission mobility and/or electrification of transport.<sup>42</sup>

In the Energy Agreement from June 2018 a reservation has been made in an amount of 500 million DKK for the years 2020-2024 – 100 million DKK a year for the transport sector. The pool shall be used to support green solutions in the transport sector. The specific initiatives will be developed further.

Furthermore, as an element in the agreement on business and entrepreneurial initiatives of 12 November 2017, there has been made a reservation on 140 million DKK to support the production of advanced biofuel. It is yet to be decided how these 140 million DKK can support the production of advanced biofuel.

In addition, on 2 December 2019 the Government reached agreement with the Red-Green Alliance, the Social Liberal Party, the Socialist People's Party and the Alternative on the Finance Act 2020. The parties agreed to prepare concrete initiatives in regard to how requirements can accelerate the transition to green busses and taxies towards 2030. The parties moreover agreed to allocate 75 million DKK in 2020 to a scheme to support and accelerate the transition towards greener busses.

Moreover, the parties agreed to prioritize bicycling, which supports and further develops green mobility. The parties agreed to allocate 50 million DKK in 2020 to fund half the cost of municipal bicycling projects. As such the scheme will promote investments for a total of 100 m DKK towards promotion of bicycling. Finally, the parties agreed to cancel the planned registration tax increase in 2020 on green cars. The parties also agreed to introduce a tax deduction on green company cars on 40,000 DKK from April 1 2020 to December 21 2020.

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

Denmark provides subsidies for renewable energy technologies, e.g. onshore wind, offshore wind, solar PV, biomass and biogas. Subsidies are given as production subsidy per kWh, normally for a limited number of years. The costs of renewable technologies is steadily declining, and becoming competitive with fossil fuel sources. It is a political objective to promote future electricity production from renewable energy on market conditions free of subsidies.

Subsidy systems for renewable energy will increasingly be market oriented. As of 2018 the subsidies for future onshore wind and solar PV will be offered through a tendering procedure, allowing these technologies to compete against each other and provide a

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<sup>42</sup> This includes TR-1a, TR-8, TR-10 and TR-12.

downward pressure on the subsidy level. Later more technologies will be included in the tenders and allow these to compete for support. For more information see section 4.6.iv.

In Denmark no direct subsidies to fossil fuels are given. In a report from 2019 the Commission, among other things, assessed the size of subsidies to fossil energy among the member states. In this report, Denmark is regarded to have indirect fossil subsidies especially in the form of exemptions from taxes for fuels to domestic sea- and air transport and exemption from taxes for electricity for certain types of transport. The report was written by the consultancy Trinomics, and the consultancy has identified 13 subsidies to fossil fuels in Denmark (see Table 9).

**Table 9. Overview of subsidies that are considered fossil in “Energy prices and costs in Europe (COM(2019) 1 final)”**

Subsidy	Average size, mill. EUR
Excise tax exemption on inland sea transport and fishery	72.1
Tax exemption for fuels and electricity for trains	59.6
Higher tax deductions for investment in fossil fuel extraction infrastructure	30.1
Act on energy saving obligations	23.3
Excise tax exemption for domestic aviation	19.7
Act to support power from district heating, based on e.g. natural gas	15.4
Aviation in EU ETS	3.2
Public R&D expenditures	Oil and gas: 2.2 Coal: 0.15 Other fossils: 0.8

Note: The average size is for most of the subsidies for the period 2008-16. The Green Check is excluded from the list, as it is not a fossil subsidy. It was introduced in 2010 to compensate persons with relatively low incomes for increased environmental and energy taxes etc. in relation to the so called ‘Spring Package 2.0’ from 2009. The Green Check therefore has a purpose related to distribution policy and has a neglectable effect for the energy consumption in Danish households. Source: Trinomics mentions several sources for this data, including IEA, EEA, EC, CIRCABC for R&D, ETS and tax exemptions. Moreover the Danish Energy Agency, Ministry of Taxation and Statistics Denmark are being referred to.

Some of the indirect subsidies mentioned in table 8 are already being phased out, including act on energy saving obligations and act to support power from district heating. The levels of the tax on energy used for industrial processes etc. follow EU’s minimum levels. Some uses of fossil energy have lower tax rates or are fully exempted from tax, for example energy to farms and horticultures, mineral and metallurgical processes and oil- and gas extraction in the North Sea. Typically the lower taxes on energy for industrial processes etc. are due to the fact that the relevant firms are facing fierce international competition.

Denmark has a very ambitious target of reducing greenhouse gas emissions with 70 percent in 2030 compared to 1990 level. Denmark therefore plans to further investigate the topic of fossil fuel subsidies in the coming years in order to effectively reach the target.

Denmark has for many years been working internationally for phasing out fossil fuels. Denmark has since 2010 been a member of the coalition Friends of Fossil Fuel Subsidy Reform, the F-FFSR-group, together with Sweden, Norway, Finland, Switzerland, New Zealand, Ethiopia, Costa Rica and Uruguay. The coalition works for promoting the phasing out of ineffective fossil fuel subsidies through Friends of Fossil Fuel Subsidy Reform. The group has, since the G20 countries decided to phase out ineffective subsidies for fossil fuels in 2009, been seeking to hold the G20 countries accountable to this goal. During the G20 meetings, Denmark is as a rule represented through the embassies in the respective country for the G20 meeting, and is thereby exercising direct influence. The F-FFSR-group also co-finances the Global Subsidies Initiative<sup>43</sup>. The Global Subsidies Initiative analyses the extent and the effects of subsidies to fossil fuels, including in different emerging and developing economies.

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<sup>43</sup> <https://www.iisd.org/gsi/about>

## 3.2 Dimension Energy efficiency

### **(i) Energy efficiency obligation schemes and alternative policy measures under Article 7a and 7b and article 20(6) of Directive 2012/27/EU and to be prepared in accordance with Annex III to this Regulation**

In the Energy Agreement from June 2018 it was agreed that the current Energy Savings Obligation scheme will end by 31 December 2020. The scheme will be replaced by competitive subsidy schemes related to private enterprises and buildings.

Denmark will therefore from 2021-2030 fulfil the saving obligations under Article 7(1) in the EED by alternative policy measures (article 7 b).

The main measures to fulfil the saving obligation will be:

- A competitive subsidy scheme related to private enterprises: 300 mio. DKK per year in 2021-2024
- A competitive subsidy scheme related to buildings: 200 mio. DKK per year in 2021-2024
- Efficiency of existing buildings by other measures
- Subsidy scheme to replace oil burners with heat pumps in buildings outside the district heating and gas grids: DKK 20 million per year in 2021-2024

**The subsidy scheme related to private enterprises** allocates DKK 300 million for each year in the period 2021-2024. The scheme is planned to be implemented as a subsidy scheme with a competitive bidding procedure. Subsidy is granted based on the ratio of subsidy per saved kWh in the individual projects. Subsidies are first granted to the project with the lowest costs per saved kWh, then to the one representing the second lowest costs, and so forth. The scheme is aimed at achieving energy savings in businesses, and is open to energy saving projects in all types of energy in all private sectors in Denmark and all types of activities in Denmark including:

- Industry/manufacturing
- agriculture, fisheries, forestry and horticulture
- construction and manufacturing
- energy in private service and retail

The scheme primarily targets energy savings in the delivery of services and manufacturing of products, with the main focus on so called “process energy”. Therefore, it is a prerequisite that more than 50 % of the total savings in any given project is in process energy. This means that savings in e.g. space heating and cooling are only eligible when combined with savings in process energy.

**The subsidy scheme related to buildings** allocates DKK 200 million for each year in the period 2021-2024. The scheme is planned to be implemented as a competitive based subsidy scheme aimed at achieving energy savings in buildings.

Financial aid will be given to owners of buildings who have renovated their buildings in accordance with a specific list of energy savings belonging to the subsidy scheme. In order to achieve as much savings as possible the projects will compete in relation to the amount of energy savings per square meter in the application. Furthermore the energy label for buildings is planned to be used in the scheme, and data from the label used for documentation. To help realization of energy savings in private buildings there will also be focus on campaigns aiming at support realizing the potential for energy savings.

**Efficiency of existing buildings by other measures** is significantly increased through the requirements to the renovation of buildings in the building codes, as well as through information campaigns regarding technological opportunities and financial measures available to building owners.

**Subsidy scheme to replace oil burners with heat pumps in buildings outside the district heating and gas grids** allocates DKK 20 million for each year in the period 2021-2024. The scheme is planned to be implemented as a subsidy scheme with the objective to replace oil burners with heat pumps in buildings located in areas without access to district heating or the gas grid.

Table 10 shows the calculated cumulative effect of these measures.

**Table 10: Effect of measures**

	Cumulative 2030 (PJ)	Cumulative 2021-2030 (PJ)
Subsidy scheme private enterprises	4,84	41,16
Subsidy scheme buildings	1,19	10,11
Efficiency of existing buildings by other measures	5,00	27,50
Subsidy scheme to replace oil burners with heat pumps in buildings outside the district heating and gas grids	To be updated	To be updated
Danish target <sup>44</sup>	48,8	268,5
Gap to be fulfilled	37,77	189,73

Note: The data will be updated after the adoption of the forthcoming climate action plan.

<sup>44</sup> See page 47 for more information on the obligation.

Denmark is aware, that the current measures fall short of reaching the energy saving obligations under article 7 of Directive 2012/27/EU. This is partly due to the use of a frozen policy scenario, wherein only measures from the period 2021-2024 are included.

The Danish Government has committed itself to an ambitious climate policy, which aims to reduce Denmark's emissions of greenhouse gases by 70% by 2030, relative to 1990 levels. Moreover, the Danish Government is committed to fulfill the energy saving obligations under article 7. Measures and instruments contributing to the obligation will be outlined in the upcoming climate action plans. The climate action plans will, amongst other things, include energy efficiency measures, including energy saving requirements for public sector buildings and a national strategy for sustainable construction. Moreover, the Government is working on a plan for the implementation of article 5 in EED in the period 2021-2030. In addition, the Danish Government will work towards increased electrification of the transport sector, industry and society in general, which can also result in energy savings.

**(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 block, in accordance with article 2a of EPBD**

Denmark will submit its long-term renovation strategy separately, as soon as it is finished, but no later than the 10<sup>th</sup> of Marts 2020.

**(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**

The Danish Government has implemented the following measures to promote energy services in the public sector:

The Government has developed a general concept for OPP (= Public/Private Partnerships), which encourages public authorities to enter into partnerships with private partners in order to reduce costs and increase efficiency in the public sector. OPP-projects play an important role in construction and renovation of buildings in the public sector. The core of the concept is that construction or renovation and maintenance of public buildings is carried out by private partners, while the public pays an agreed rent for the use of the buildings based on a long term contract. ESCO-projects can be considered as a special class of OPP-projects with focus on energy renovation.

ESCO-projects can be considered as a special class of OPP-projects with focus on energy renovation. In an OPP ESCO project (ESCO = energy service company) a private ESCO will take on the responsibility of financing and implementing energy savings in a public building or buildings. Sometimes the ESCO will also handle the future operation of the installed energy installations. The ESCO company and the owner of the building or buildings will usually sign an energy performance contract, where the remuneration of the ESCO company depends on the actual energy savings obtained.

It is compulsory for local authorities to consider the use of OPP whenever they decide to carry out new construction or renovation of buildings.

OPP-projects are supported by standard contracts and manuals, which have been developed by the Government for local authorities.

Furthermore, the Government is disseminating information on ESCO and how to use the ESCO-model in relation to energy performance contracting as a tool to improve the energy efficiency in buildings owned by local and regional authorities.

It is estimated that there are no regulatory barriers to the use of energy contracting. This is documented by the fact, that there has been an increase in the use of ESCOs in the public sector. Over the last years 22 % of all municipalities have chosen to carry out energy efficiency projects using energy performance contracting with private partners.

To overcome non-regulatory barriers, the Government is disseminating information on ESCOs to regional and local authorities.

**(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<sup>45</sup>, consumer information and training measures<sup>46</sup>, and other measures to promote energy efficiency<sup>47</sup>)**  
**Energy audits for large enterprises**

As regards energy audits and management systems (EED Article 8) Act No 345 of 8 April 2014 contains the overarching requirements for energy audits of large enterprises, which entails an obligation for large enterprises to carry out a mandatory energy audit every four years on their total energy consumption, including processes, buildings and transport. The enterprises can also fulfil their obligation by using and maintaining a certified energy management system or a certified environmental management system that includes an energy audit as part of the management system. The minimum requirements for energy audits are stipulated in the Executive Order 1382 of 29 November 2018 on energy audits in large enterprises, which was issued pursuant to the Act. To accommodate that non-SME companies should do energy audits which are cost-effective the opportunity to do a simplified energy audit for companies with a yearly energy consumption lower than 1.000.000 kWh/yr will be implemented in a new Executive Order. The requirements are now in the process of being updated and a new Executive Order is expected to be adopted on 1 January 2020.

#### **Consumer information and training**

In regards to consumer information and training and with a reference to Articles 12 and 17 in the EED, the Danish Energy Agency will draw up an action plan for the information

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<sup>45</sup> In accordance with Article 8 of Directive 2012/27/EU.

<sup>46</sup> In accordance with Articles 12 and 17 of Directive 2012/27/EU

<sup>47</sup> In accordance with Article 19 of Directive 2012/27/EU.

campaign on energy efficiency at end-user level. The aim is to promote energy efficient solutions and purchasing and energy efficient behaviour among end-users. The information campaign focuses on end users with home owners, the public sector, and commercial enterprises as specific focus areas.

Improving the energy efficiency of buildings and support energy efficient behaviour in connection to the use of buildings is a priority in the Danish public and consumer information campaign. This involves preparing material on energy efficient solutions, information on building regulations, and better access to information and knowledge about energy renovation. The Danish Energy Agency's website [www.spareenergi.dk](http://www.spareenergi.dk) is the backbone of The Danish Agency's communication with the end users concerning energy efficient solutions both in private households and in public and private enterprises.

BedreBolig is a scheme offering advice, which was launched in autumn 2014. There is no financial support to the building owners via the scheme. The scheme is being administered by the Danish Energy Agency. The aim of the scheme is to make it easier and clearer for building owners how to renovate their homes by offering a one-stop shop with comprehensive, expert advice throughout the energy renovation process.

Training and awareness-raising about energy efficiency are also important elements in the Danish Energy Agency's work to improve energy efficiency. The Energy Performance Certificate and BedreBolig-scheme contains a large element of training. In connection with the schemes, training courses has been set up for craftsmen, construction engineers, engineers, architects etc.

The Energy Agreement from June 2018 includes measures to improve the use of data and digitalisation to promote energy efficiency. Special emphasis is put on using data to improve the quality and use of the Energy Performance Certificates (EPC), which are produced in accordance with the Directive Energy Performance of Buildings Directive. The EPC is based on a physical review of the building where an energy consultant collects information about the building. The improved EPC scheme will use automatic digital validations in the electronic calculation programs, so that the energy consultant's registrations are assessed even before the EPC is issued to the building owner. It is expected to increase the quality of the approximately 60,000 EPCs that are issued annually, where in 2018 alone, approximately 150,000 profitable savings proposals were indicated. Also, the Danish Energy Agency is working on simplifying the access to the EPC-database and making it more searchable, so that building owners and other stakeholders can make better use of the many data behind the EPC.

Furthermore, the Energy Agreement includes measures to improve consumer information and awareness targeted at end-users and energy service companies with the view of improving energy efficiency and the market for energy services.

The Knowledge Centre for Energy Savings in Buildings is a service for craftsmen and educational institutions concerning energy efficiency improvements. The centre has worked with industry organisation within the area of mediating knowledge to its members, and



provides on regular basis courses to support the general further education of craftsmen. Furthermore, educational efforts are carried out by the labour market training centres.

#### The building job scheme

The building job scheme is a tax incentive scheme for energy efficiency in buildings. Energy efficiency is not the primary goal of the tax scheme, but it is a clear derivative effect and many parts of the scheme are directly targeted at improving the energy efficiency in buildings, for example through the installation of heat pumps, new windows etc.

The building job scheme allows for a tax deduction of ca. 26 % on up to DKK 12.200 (EUR 1.848) of the salary to craftsmen salary (expenses to materials are not included).

#### Energy-efficient public procurement

A revision of Ministerial Order regarding energy efficiency in state institutions No 9477 of 2 July 2014 will impose a requirement for energy efficient public sector procurement including the procurement of products, services and buildings where this is cost-effective, economical feasibility, in accordance with wider sustainability, technical suitability, as well as sufficient competition. Furthermore, the Government will provide general information on energy efficient procurement through the following websites:

<https://sparenergi.dk/offentlig/vaerktoejer/indkoebsanbefalinger>

<http://www.csr-indkob.dk>

<http://www.gronneindkob.dk/>

#### **(v) Where applicable, a description of policies and measures to promote the role of local renewable energy communities in contributing to the implementation of policies and measures in points i, ii and iv**

Denmark facilitates public meetings at the local level, to promote and share expertise on energy efficiency and the use of renewable energy by home owners. These meetings are organized and funded by the Danish Energy Agency with participants from SparEnergi.dk and the local municipality. The meetings especially contribute to the information campaigns described in section iv and the transition from oil boilers to heat pumps.

As part of the Danish commitment to comply with the DIRECTIVE (EU) 2018/2001 article 18 a qualification scheme is managed by the Danish Energy Agency. The qualification scheme validates the qualification of the installer to ensure energy efficient installations and is promoted at the citizen-oriented homepage SparEnergi.dk and at local energy meeting for citizens.

#### **(vi) Description of measures to utilize energy efficiency potentials of gas and electricity infrastructure<sup>48</sup>**

In 2015 The Danish Energy Agency together with the Danish TSO Energinet, The Danish Energy Association and the Danish DSO, HMN Natural Gas published the report

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<sup>48</sup> In accordance with Article 15(2) of Directive 2012/27/EU.

*“Potentiale vurdering for energieffektivitet i el- og gasinfrastruktur i Danmark” (The potential for energy efficiency in the Danish electricity and gas infrastructure).*

The report was published to meet the obligations in directive 2012/27/EU, art. 15(2). The report both addresses the energy efficiency potentials for transit and distribution in the electricity and gas sector and gas storage.

#### Electricity infrastructure

In order to increase the capacity on critical electrical transmission lines, the Danish transmission system operator Energinet has implemented a system for dynamic line rating which adapts the capacity to the current ambient conditions. Also System Integrity Protection Schemes are used to allow a higher loading without jeopardising operational security. Furthermore, Energinet is in close cooperation with other European TSOs to develop a Common Grid Model which features a harmonised approach for congestion forecasts across Europe. While some aspects of those activities result in greater grid losses, all these activities combined with improved simulation models allow a high utilisation of the transmission system which enables more renewable energy to be integrated.

Energinet is now also preparing procedures to support the use of excess heat to district heating from Energinet’s facilities on a non-profit basis, where it is socioeconomically viable. While not directly increasing the efficiency of Energinet’s electricity transmission activities, the utilization of the heat generated through electricity losses, decreases the loss of value for the Danish society as a whole.

#### Gas infrastructure

The energy loss in the Danish gas net is very low and is approximately 0,06 % of the total gas being transported. The energy loss of gas from storage is expected in the same ratio. Efficiency potentials are primarily related to the choice of components; compressors and boilers and the choice of pressure and temperature. As an example, all compressor drives in the Danish system are electrical powered.

The gas net is continuously optimized and components are renewed with more energy efficient components, when the old components are replaced.

Because of the very low net loss it is not possible to point to significant efficiency potentials, which is not being taken care of in the continuous maintenance of the grid.

#### **(vii) Regional cooperation in this area, where applicable**

##### Nordic Co-operation on Energy Efficiency

The Nordic cooperation on energy efficiency was until 2019 conducted in the networking group on energy efficiency (NGEE). The group consisted of experts from the Ministries and energy authorities in the Nordic countries. At present, much of the regional cooperation on energy efficiency is being conducted by the networking group on ecodesign and energy labeling.

The main objectives of the co-operation in this area are to promote Nordic co-operation on energy efficiency initiatives and to implement EU/EEA directives and programs.

Below are some recent examples of Nordic energy efficiency co-operation.

*“A Nordic Approach to the EU’s Heating and Cooling Strategy”*

The project had two goals: 1) to present a survey on Heating and Cooling “to generate information which will help Nordic politicians, government officials and other interest groups to further develop the market for these solutions and as a key objective to identify the common interest of Nordic countries” and 2) to arrange a workshop in Brussels to “present the good practices from the Nordic countries, further development areas, and serve as a starting point for discussions concerning the different options for regulatory approaches in the heating and cooling market”.

*Mainstreaming energy services and EPC in the Nordic countries*

The objective of the project is to strengthen the Nordic market for energy services and EPC by

- *creating networks among local authority clients and facilitators in the Nordic countries,*
- *increasing exchange of information and mutual capacity building, and by*
- *mainstreaming the way of conducting energy efficiency projects.*

*Nordic cooperation 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 cooperation among Nordic market surveillance authorities (MSAs) and policy agencies.

Ecodesign and Energy Labelling supplies nearly half the energy savings target set by the EU in 2020. Effective regulations and efficient market surveillance is essential if this is to be realized and Nordsyn aims 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 also be used to improve market surveillance in other EU countries.

*Nordsyn sub projects*

In 2018, Nordsyn focus on 1) the strategic Nordic product heat pumps with two studies on how the products work in reality in the Nordic climate; 2) an information film on the new product database and coming revised energy labelling; 3) a Nordcrawl2 project in which the previous developed Nordcrawl web crawling tool will be applied to give valuable input to market surveillance and policy work.

Earlier projects include: 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 countries 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. 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.

**Effects-project:** This study showed a prevented energy loss worth 28 million Euros for a market surveillance cost of around 2 million Euros 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.).

### **(viii) Financing measures, including Union support and the use of EU funds, in the area at national level**

The financing of energy efficiency initiatives is generally speaking not a major barrier for most projects in Denmark. This is due to a well-established practise of furnishing loans for energy efficiency projects through home equity loans. The low interest rates of the past decade have further increased the possibility for acquiring affordable loans for both private citizens and business and has made the projects more profitable by lowering interest payments. This is supplemented with flexible rules for establishing new finance measures such as green bonds and the possibility for establishing special finance facilities for energy projects.

The Danish pension funds and other parties are able to participate in energy projects by pooling project in cooperation with other actors as well as through ESCO and OPP schemes.

Most of the initiatives and policies described in Denmark's integrated energy and climate plan, including all the measures in the Energy Agreement from June 2018, are funded through the state budget.

The new energy labelling "Label2020" (2019-2022) is funded by EU through Horizon2020.

### 3.3 Dimension Energy security

#### (i) Policies and measures related to the elements set out in 2.3

On December 6, 2019 the Government reached an agreement on a new Climate Act with 8 out of the 10 parties in the Danish Parliament. The act will include a legally binding target to reduce greenhouse gases by 70% by 2030 (relative to 1990 level), to reach net zero emissions by 2050 at the latest, and to set milestone targets based on a five-year cycle. The Government will adapt climate action plans, which will contribute to ensuring that national reduction targets are met.

The climate actions plan will amongst other things include the following initiatives in regard to electricity and energy security:

- A unified strategy for electrification of the transport sector, industry and society in general
- Investigating the potential for Denmark to prepare a common strategy with the North Sea nations for a significant expansion and exploitation of the offshore wind potential
- Investigating the potential for Denmark to construct the first energy island by 2030, with a minimum of 10 GW connected

In addition, on 2 December 2019 the Government reached agreement with the Red-Green Alliance, the Social Liberal Party, the Socialist People's Party and the Alternative on the Finance Act 2020. The parties agreed, among other things, to initiate a screening of Danish waters that can identify locations suitable for future offshore wind, which also will include screening for potential locations for a so-called "hub-and-spoke" concept with minimum 10 GW offshore wind capacity connected. The parties further agreed to allocate funds in support of large-scale power-to-X technologies. The parties agreed to allocate 30 million DKK in 2020, 27 million DKK in 2021 and 8 million DKK in 2022. Additionally the Government will also, together with other ambitious nations, push for an expansion of sustainable energy in the EU so that the EU becomes self-reliant in terms of energy.

The 2018 Energy Agreement sets out the policies and trajectories on energy security for the coming years. With the agreement, the Parliament has set the path towards a renewables share of total energy consumption of approximately 55 % in 2030. A list of initiatives from the Energy Agreement of 2018 supports this objective and seeks to ensure that Denmark has the most integrated, market-based and flexible energy system in Europe, with efficient energy utilisation across sectors and with a continued strong security of supply.

The general movement of the Danish energy sectors goes towards further diversification as a result of a political ambition to increase the amount of renewables in the energy mix and the technical challenges with the fluctuation of wind and solar power. At the moment Denmark invests in a variety of energy technologies focused on increasing the variation of possibilities in production, transmission, distribution and consumption.

### Cybersecurity

The strategy for cyber and information security correlates with legislation which also pushes the energy sectors and businesses to adapt to the new cyber and information threat assessments. The legislation in connection with the strategy and the ongoing discussions and collaboration in the energy sectors between authorities, business and other relevant contributors ensure resilience towards the complexity that dominate the cyber and information security scene. Cyber and information security threats are rarely restricted to one sector only. Therefore, The Danish Energy Agency cooperates with other authorities and companies in the sector to find collective solutions to manage these threats.

### Electricity supply security

In spite of the fact that fluctuating renewable energy constitutes an increasingly larger share of the electricity generation in Denmark, currently close to 50 %, there have not yet been any incidents of lack of electricity supply due to electricity generation inadequacy.

Currently, the level of security of electricity supply in Denmark is very high, also compared to the rest of Europe. In 2018 electricity was available when demanded 99,996 % of the time, and the average number of outage minutes were 22 per consumer over a year. The outages have primarily been due to failures and planned outages in the distribution grid. They are rarely related to faults in the transmission grid and have never been due to lack of capacity.

Such statistics and the general state of the electricity security of supply are presented in the annual Security of electricity supply report, prepared by the Danish TSO, Energinet. Each year Energinet is required to report on the state of the security of electricity supply and on their forecasts for the security of supply level at least ten years ahead in time, analysing the generation adequacy for the eastern and western part of Denmark separately, in order to ensure a continuous monitoring of the developments of the capacity in the system. This was formalised in the amendment to the Electricity Supply Act, Act No 704, passed by Parliament on 8 June 2018 and further detailed in the Executive Order 1217 of 15 October 2018.

By Act No 704 of 8 June 2018 and Executive Order 1217 of 15 October 2018 it is also determined that the Minister of Climate, Energy and Utilities shall announce a planning target for the level of electricity supply security, given in outage minutes, by January each year starting in 2020, on the basis of the Security of electricity supply report prepared by Energinet.

The Danish Energy Agency is also monitoring the level of electricity security and is conducting analyses and forecasts regularly in parallel with Energinet, in order to have a good understanding of the developments and an insight into required investments in the system.

The models indicate that the eastern part of Denmark will experience some generation inadequacy, sooner than the western part of Denmark, when forecasting the decade to come. The generation inadequacy is expected to be limited to a number of outage minutes

rather than hours, for the average consumer, though. The level of inadequacy and the possible countermeasures are currently being investigated.

The Danish electricity supply security is susceptible to electricity generation inadequacy in the surrounding countries since the interconnectivity level in Denmark is very high and since the other countries will increase the share of intermittent renewable energy sources as well. This is a risk that is also being assessed in the models forecasting the security of electricity supply. An analysis of the generation adequacy in 2050 has been carried out in 2014, which is presented in the *Energy Scenarios Towards 2020, 2035 and 2050* publication made by the Danish Energy Agency. The analysis showed that given a scenario of an energy mix largely based on wind resources Denmark should be able to manage to keep up the supply security by having storages of gas to rely on when problems occur, but there are great risks of inadequacy problems when more intermittent resources are incorporated in the systems. It is therefore necessary to continuously monitor regional developments with respect to security of electricity supply.

The policies and measures aimed at increasing the **interconnectivity** to the neighbouring countries are presented in section 3.4. There is a great deal of cooperation between Denmark and neighbouring European countries, which will help support the electricity supply in Denmark.

In regard to extending the amount of **electricity generators**, it was decided with the Energy Agreement of 2018 that Denmark is going to establish three additional large offshore wind farms and that renewable energy sources in general shall be subsidized by technology neutral tenders. The specific policies and measures are described in section 3.1.2.

To further the integrating of electricity and other energy resources and by using data and digitalisation of the system to optimize the system the Ministry of Climate, Energy and Utilities is developing a **smart energy** action plan as prescribed by the Energy Agreement of 2018.

The way that Denmark is going to support the development of a **flexible and market-driven electricity system** is currently being analysed. A project mandated by the Energy Agreement of 29 June 2018 - called the Market Model 3.0 - has been initiated. The main focus of the project will be on promoting market-based solutions for the benefit of consumers, taking into account the effective integration of renewable energy and a continued high level of electricity supply security. The project includes establishing an efficient market design, localising and implementing favourable conditions for flexibility in the market and regulating the different actors and the monopolies, such that the electricity market functions in the best possible way, and in connection to the rest of Europe. This project is closely linked to the implantation of the EU's initiative 'Clean energy for all Europeans' (cf. the amended regulation and directive on electricity market design). The purpose of connecting the implementation of the Clean Energy for all Europeans to Market Model 3.0 is to ensure that implementation of the new EU market design is not detached from other initiatives and initiatives that are needed to promote a smart and flexible energy system.

The implementation of smart meters, which are being rolled out in all of Denmark as in the rest of the EU, is one of the means to create **demand response**, as more data and information can help consumers reallocate their electricity consumption more efficiently. By the end of 2020 all consumers can be settled on an hourly basis.

Another way of creating **demand response** is via economic incentives. Therefore, the Energy Agreement from 2018 encompasses a plan to look into how a new tariff system could be structured, among other things to facilitate demand response and a more flexible energy system with efficient use of the existing infrastructure. An interdepartmental working group has been established to manage the task to analyse a model for more cost effective tariffs. The goal is to identify a model for more cost driven tariffs. Work is ongoing and the working group will be assisted in the analysis process by a group of interested parties.

In addition to end user demand response, electrification of the Danish district heating system has a large potential for energy storage in the form of diurnal heat stores already operated by combined heat and power plants in addition to an increasing number of seasonal heat storage systems being deployed. Influenced by variable tariffs, deployment of electric heat pumps and electric boilers for heat production is expected to increase the demand response of the district heating system significantly.

To this end, the Energy Agreement lowered energy taxes on electricity used for heat production and included several measures supporting the deployment of heat pumps both on a household and district heating level (see section 3.2).

Solutions regarding **energy storage** will also be promoted concretely through an Energy storage fund of 128 million DKK. In December 2019 money was granted to two Power-to-X-projects. The projects will establish big scale production and storage of green hydrogen. Both projects have an ambition to demonstrate production and consumption of green hydrogen on near market based conditions.

As stated above, the Government's coming climate action plans, will amongst other things, include initiatives that contribute to the electricity supply security. The Danish Government aims to investigate the potential for Denmark to prepare a common strategy with the North Sea nations for a significant expansion and exploitation of the offshore wind potential and furthermore investigate the potential for Denmark to construct the first energy island by 2030, with a minimum of 10 GW connected.

#### The heating sector

As described in section 2.3, heating is not considered a critical energy service. Thus there are no targets or policies ensuring the overall security of heat supply.

In relation to the termination of the subsidy for decentral combined heat and power plants, however, there is a risk of "stranded costumers" being left with no alternatives as a few district heating systems might shut down.

The 2018 Energy Agreement includes a package of initiatives directed at the decentral level as combined heat and power plants no longer are benefiting from the subsidy. The



initiatives include consulting services provided by professional advisors and technology neutral tenders, both aimed at improving energy related and financial efficiency of operations. For plants terminating operations, policies are being developed to handle stranded assets in addition to a scheme for financial support for stranded customers establishing new heating solutions.

In regard to supporting the green transition of the heating sector, the Energy Agreement of 2018 also includes initiatives to this end. For instance, the use of surplus heat is supported through the abolition of the PSO system, through a reduction of the tax on electricity used for heating, and through a plan to simplify the rules regarding surplus heat and allocate 133 million DKK as of 2020 for the purpose. Geothermal energy utilization is also supported by the reduction of the tax on electricity used for heating, and by a scheme set up to limit the financial risks related to the geothermal drilling which was extended to 2024 with the Energy Agreement.

#### The natural gas sector

The producer in the North Sea has announced that the main gas production facility in the North Sea – Tyra – will be shut down from November 2019 to July 2022 in order to renovate the facility. The decision has been taken due to security reasons, as the platform has sunk since the facility came on stream in 1984, and the fact that the waves are becoming higher and more powerful. During the shut-down, gas flows on shore to Denmark will be reduced to about 10 % of the gas delivered in 2018. The oil production in the southern part of the North Sea is expected to continue during the period of renovation and the associated gas production can be evacuated to the Netherlands through the NOGAT pipe line system. However, it is expected that the export to the Netherlands will not exceed 1 BCM per year.

The Tyra shut-down period represents a new challenge for the Danish as well as the Swedish security of gas supply, as the gas markets will be almost fully relying on supplies from Germany and the two Danish storage facilities. Thanks to the former expansion of the transmission system in the Northern part of Germany and in the southern part of Jutland, the import capacity from Germany in combination with the storage capacity should be sufficient to ensure gas supply to the Danish and Swedish customers. However, the gas system will be significant less flexible and more vulnerable during the reconstruction of the Tyra gas facility.

The Tyra shut-down means that Denmark will not have any gas export during the shut-down period. Today, Denmark export more than 1 billion m<sup>3</sup> of gas to Sweden. During the Tyra shut-down Denmark will serve as transit between the European and Swedish gas markets.

The effect of the refurbishment of Tyra on the energy mix is expected to be negligible, as the energy mix rather is an effect of the energy and taxation politics than an effect of the energy supply. For instance, political goals of increasing the share of biogas can decrease the demand for natural gas, while the reduced supply from Tyra probably will be substituted by German supplies. It is possible that the natural gas will increase slightly in

price due to extra transportation cost and competition in the gas market, which can drive down the demand, but it will most likely only have a small effect on the energy mix.

When the Tyra facility comes on stream again, Denmark will return to be a net exporter of gas. It is expected that the degree of self-sufficiency of gas will be about 160-170 % and that Denmark will continue to be self-sufficient to at least 2035. The gas can either be consumed in Denmark or exported to Sweden, Germany or the Netherlands. The production from Tyra is expected to be around 8 million m<sup>3</sup>/day, that is maximum 3 billion m<sup>3</sup>/year, and the Danish and the Swedish consumption is expected to have an equivalent size after 2022.

### Oil

As part of The North Sea agreement from March 2017 the Parliament adopted new legislation amending the Danish Subsoil Act and the Pipeline Act to secure improved conditions for third-party access to infrastructure in the Danish North Sea. The amendment came into force in January 2018.

A pool of 100 million DKK for green initiatives in relation to oil and gas extraction was established alongside the North Sea agreement.

In 2019 exploration and drilling for oil, gas and shale gas on land and in coastal areas has officially ended when a bill regarding the Danish subsoils passed, entailing the discontinuation of oil and gas exploitation on land and in the coastal waters. GEUS (Geological Survey of Denmark and Greenland) and the Danish Energy Agency have made an updated assessment of the oil and gas potential on land and in the inland waters. They deem that there are no potential sources of societal significance on land in Denmark.

The decision means that all future exploration and extraction of oil and gas in Denmark will not be possible on land and in coastal areas.

### Biomass

Nearly all of the forest biomass used for production of district heating and electricity is covered by a voluntary Danish industry agreement, concluded in 2014.

The purpose of the agreement is to ensure that biomass used in Denmark fulfils internationally recognized sustainability demands. Thus, the biomass must come from forests that are operated in a sustainable way, and the use of biomass has to lead to real CO<sub>2</sub> reductions. The sustainability of the used biomass has to be documented in annual reports verified by a third party.

The agreement comprises all plants producing district heat and electricity based on wood pellets and wood chips. Only plants with a capacity above 20 MW have to provide the documentation. The agreement covers wood from forests, but not wood from other areas such as farm land, cities etc. (See section 2.1.2).

Denmark will implement the sustainability criteria of the VE II. In light of this implementation, the role of the industry agreement will be considered, as well as possible new regulation covering the use of biomass in other sectors.

**(ii) Regional cooperation in this area**

Denmark is promoting regional cooperation by participating in the Nordic risk preparedness cooperation group (NordBER) and by facilitation of the operational coordination between the Nordic Electricity TSOs in the Nordic Regional Security Coordinator (RSC) stationed in Denmark.

***The natural gas sector***

The Danish TSO (Energinet) and the Polish TSO (Gaz-System) have taken the final investment decision to establish the Baltic Pipe project. The project will make it possible to transport up to 10 BCM Norwegian gas to Poland from October 2022 through the Danish gas infrastructure. The project will connect the Danish and Polish gas markets including the possibility for Denmark to import gas from Poland.

With regard to the implementation of Regulation 2017/1938 concerning measures to safeguard the security of gas supply, Denmark participates in the risk groups Norway, Baltic Sea and Denmark. Denmark leads the risk group and a final report has been prepared and notified to the Commission. Furthermore, Denmark will have to make agreements with Germany and Sweden in technical, legal and financial arrangements in order to ensure that gas can be supplied to solidarity protected customers in one of the Member States in case of a request. A dialog with Germany and Sweden on these arrangements is ongoing.

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

Not applicable, since the objectives to diversify our energy system and become independent from energy sources from third countries has been on the agenda in Denmark since the end of the 1970'ies, which means that most of the efforts has been carried out over a long period of time as a result of the energy policy and not as a result of projects needing special financing. That said fragments of the overall energy policy on the energy security dimension are financially supported. For instance the efforts of promoting energy efficiency are supported by different schemes; see section 3.2 for more information. The implementation of wind turbines and solar photovoltaics and other renewables is also subsidized to some extent; see section 3.1.2, which contributes to the energy security and independence from other energy sources. But in general the energy security that Denmark relies on is an outcome of the historic development of the energy system.

## **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**

Denmark has no specific target regarding interconnectivity, but analysis of new feasible interconnectors remains to be a priority. In Denmark new interconnectors are approved based on their socio economic value, see section 2.3.1. It is the Danish TSO, Energinet's, responsibility to propose new interconnectors to the relevant ministry.

#### **(ii) Regional cooperation in this area**

Denmark cooperates with the other North Seas Energy Cooperation countries on the possibilities for concrete cooperation projects. Besides joint offshore wind projects that would be connected to and supported by several Member States, this includes the work on possible 'hybrid' solutions that would use cross-border solutions for connecting offshore wind farms to the grid and seek synergies with interconnection capacity between countries, and on the corresponding market arrangements (see section 1.4 for more information).

Furthermore, Nordic TSOs work closely together on Nordic grid development and have developed a Nordic Grid Development plan 2017. The report is intended to be updated every two years.

The Nordic Council of Ministers and the underlying Committee of Senior Officials for Energy and the Electricity Market Group also coordinate on energy issues and monitor for example the TSO cooperation (also on grid development).

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

According to the act on Energinet, the Minister of Finance – to the extent that it is considered as appropriate – covers the Danish TSO's financing requirements by way of state loans through the central bank of Denmark. It should be noted that in situations where such loans will be further transferred to subsidiaries of Energinet it follows from the act of electricity and the act of natural gas that Energinet's transactions with its subsidiaries have to be on market terms. Where applicable, projects apply for relevant EU funds e.g. for development of PCI projects.

### **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**

Infrastructure projects are developed by the Danish TSO and approved by the Danish Energy Agency and the Ministry for Climate, Energy and Utilities.

No specific measures have been implemented relating to the elements set out in 2.3.2. The Danish TSO, Energinet, is the sole developer of electricity and gas transmission projects and these projects are assessed in terms of the need for the project. The need is assessed in terms of whether it complies with any of the following topics

- Well-functioning energy markets
- Security of supply
- Risk preparedness
- Integration of renewable energy sources

In addition interconnectors are also assessed in terms of their socio-economic benefit.

No specific measures in addition to the TEN-E regulation have been implemented.

#### **(ii) Regional cooperation in this area**

Denmark participates in the relevant fora that are established under the TEN-E regulation, such as the North Seas Energy Cooperation and the Baltic Energy Market Interconnection Plan (see section 1.4.1).

In June 2019 the Nordic Energy ministers adopted a new vision for the Nordic electricity market, also emphasizing the need of the grid infrastructure to be smartly operated, cost-efficient, robust and without undue constraints, being optimised from a regional perspective. In the corresponding roadmap to reach the 2030 vision, the Nordic TSOs strengthen the Nordic grid planning process by taking into account Nordic welfare.

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

In general infrastructure projects are financed through tariffs. The Danish TSO, Energinet, has made use of the Connecting Europe Facility for feasibility studies and pre-lay investigation of cable routes etc. and the Baltic Pipe project.

### 3.4.3 Market integration

#### **(i) Policies and measures related to the elements set out in point 2.4.3**

To increase market integration further the Nordic TSOs are currently working on a project to procure fast frequency reserves in order to ensure a sufficient level of inertia in the Nordic synchronous area. The procurement is expected to start in 2020 or 2021.

With regards to improving real-time price signals, Denmark has updated a national law<sup>49</sup> in 2018, specifying that the Danish TSO shall, as far as possible, procure all energy and non-energy services that are necessary for security of supply through market-based mechanisms. The demand for all services has to be published annually. In cases with limited competition, the TSO shall analyse whether changes to the product definitions and procurement process could increase competition. The law aims at increasing transparency, creating price signals for all services, including non-frequency ancillary services, and thus enabling more market participants, including DER, to participate in the delivery of these services.

As a result of this, Energinet is currently working on a pilot project where voltage control is procured locally in a technology-neutral manner. The aim is to develop a product definition which gives new market actors and technologies the possibility to participate in a potential market as well as gaining overall experiences with market based procurement of voltage control.

With regard to system adequacy and the level of security of supply, new legislation implemented in 2018 prescribes how the Danish TSO is responsible for the system adequacy and that the Minister of Climate, Energy and Utilities shall determine a planning target for the level of electricity supply security by January. For more details see section 3.3 Dimension Energy security.

#### **(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**

Implicit Intra-day market coupling in the Nordic Market and between East Denmark and Germany via Kontek-interconnector has been in place for many years and from June 2018 the former explicit allocation of capacity on the interconnector between West Denmark and Germany has been replaced by implicit intra-day market coupling (also known as XBID).

Cross-border markets and products are developed in line with the electricity balancing and Capacity Allocation and Congestion Management guidelines and the corresponding timeframe.

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<sup>49</sup> LOV nr 704 af 08/06/2018

In Denmark, new renewable energy production cannot receive subsidies in hours with negative market prices. This is one measure to ensure the right incentives for market participants and reaction to price signals.

When planning network expansion at the distribution level, DSOs are obliged to consider whether energy efficiency measures through demand response or decentralised production may reduce or replace the need to expand capacity.

Demand response is generally encouraged by the roll-out of smart meters and the establishment of an hourly settlement model in the retail market. As mentioned under (v) these measure enable the use of dynamic prices and potentially near real-time price signals to a wide range of customers.

Increased flexibility in energy system is crucial for the green transition and storage can contribute to that flexibility. The Danish Government established a fund supporting development and demonstration projects on energy storage. The fund's size is 128 million DKK and it was in December 2019 granted to two Power-to-X-projects. The projects will establish big scale production and storage of green hydrogen. Both projects have an ambition to demonstrate production and consumption of green hydrogen on near market based conditions.

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

As part of the project for a new market model for the electricity market, the Danish Energy Agency is currently analysing different setups for aggregators in order to find the best suitable model in a Danish context. This will be concluded and implemented in 2020. A further task is to identify barriers for new market participants and technologies (such as storage) to participate in the market. Concrete recommendations for measures are expected in the first half of 2021.

**(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**

Denmark has phased out suppliers of last resort and replaced them with a general obligation to supply. Electricity suppliers are thus obliged to supply any household customer, upon the customer's request, in areas where the supplier offers its products. It is not allowed to enter into time-limited supply agreements with household customers. If there is particular reason to expect a lack of payment ability or willingness to pay, that is if the customer is or has been in arrears with payments, the supplier can request a guarantee from the customer. Only if the request for a guarantee is not fulfilled, the supplier is allowed to cancel the agreement. At the same time retail price formation is fully competitive. Market development is closely monitored in order to ensure an appropriate price level for all consumers.

A supplier centric model has been implemented in 2016 with the aim of ensuring that suppliers have the primary customer contact, and all costs related to electricity are

summed up in one bill sent to the customer by their supplier. In addition, a regulation on electricity companies' invoicing of costs to electricity consumers<sup>50</sup> has been passed to ensure that electricity bills are more easily understandable. The regulation sets a minimum standard on the content of electricity bills.

Denmark has also introduced a datahub that enables all transactions related to the retail and wholesale market to be managed through one central system operated and owned by the TSO. This also creates more transparency and ensures a level playing field regarding access to data.

Denmark has established an online price comparison tool, elpris.dk, operated by the Danish Utility Regulator that facilitates easier comparison between different suppliers and a trustworthy source of information on the quality and terms of different products offered in the market.

In order to improve information to customers and ease customers' activity on the retail market the Danish competition and consumer authority has launched a project aiming at an improvement of the electricity bill and the price comparison tool. The project takes into account latest findings on behavioural research and puts the consumer perspective into focus. On more general terms, the competition and consumer authority has published behavioural principles in consumer-oriented regulation that shall be applied on the electricity market as well:

1. Consumer-oriented regulation should support as simple and action-oriented consumer information as possible.
2. Consumer-oriented regulation should support that consumer-oriented information is presented at the right time in consumer decision-making.
3. Consumer-oriented regulation should be based on the best available knowledge of consumer behaviour.

A recent change in Danish law<sup>51</sup> requires stricter rules regarding the separated identity of monopoly and commercial activities in vertically integrated companies. Monopoly companies have to clearly distinguish themselves (name and logo) in public appearance, including all sorts of customer contact. The new rules are effective as of 1 July 2018.

Denmark generally addresses energy poverty through social policy, which is not specifically targeted towards energy.

The social policy guarantees all citizens fundamental rights in case they encounter social problems such as unemployment, sickness or dependency. Denmark does not have specific subsidies targeted at energy poverty, however some of the general social policy measures provide financial support to energy related purposes. Moreover, the income transfer

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<sup>50</sup> BEK nr 1400 af 03/12/2015

<sup>51</sup> LOV nr 662 af 08/06/2017



system is in general structured around costs of living, among these energy costs including taxes. Some of the social policy measures are listed below.

#### Heating supplement

Old age pensioners and persons who have taken early retirement (based on rules from before 2003) can apply for heating supplement. The supplement is given to the weakest part of the pensioners. The pensioners have to pay a part of the heating bill themselves. The heat supplement is calculated based on an average of three years documented heating costs, if it exists. The calculation of the heating supplement includes costs to the actual heating of the housing and hot water.

#### Special supplementary housing benefit

Persons who meet the requirements to receive social assistance (but who does not necessarily receive the support) and who has particular high housing costs or high costs to support large families can receive a special supplementary housing benefit. The conditions for receiving the special supplementary housing benefit are that the applicant has experienced a social incident, for instance sickness, unemployment or discontinuance of cohabitation. The incident moreover has to entail that the citizen does not have the means to fulfil the basic needs for its own support or for the support of the family. Moreover, a condition is that the need for support cannot be covered by other social benefits. Before the municipality provides special supplementary housing benefit, it has to be assessed whether a fair and cheaper housing can be found. Special supplementary housing benefit is based on the difference between what the applicant is assumed to be able to pay in housing costs and net housing costs including water, heat, gas and electricity.

#### Additional cash support

Based on a concrete assessment the municipality can provide support to reasonable expenses if a person has experienced changes in conditions (e.g. unemployment or sickness), and if the expense to a significant degree will make it difficult for the person to take care of himself in the future. The support can usually only be granted if the expense is a result of a need that has not been possible to foresee. Based on a concrete assessment the municipality can, however, make an exception even though it has been possible to foresee the expense, if the expense has a crucial importance to the person's way of life. The support can for instance be given to the payment of a particularly high heating bill.

Other measures that are relevant in regard to energy poverty are the specific subsidies targeting energy efficiency, particularly in buildings. For more information on these subsidies see section 3.2.

Finally, a green check was introduced in 2010 with the aim to compensate people with a relative low income for the higher green taxes.

#### **(v) Description of measures to enable and develop demand response including those addressing tariffs to support dynamic pricing**

By 2020 all Danish customers will have smart meters installed. Simultaneously, the TSO and distribution grid operators implement a new hourly settlement model, named

'flexafregning', for small consumers (<10ii)0.000 kWh/year). This is the basic precondition for the access to dynamic pricing products that make it possible to benefit from demand response activities.

Besides the dynamic electricity price, DSOs can choose to apply a time-differentiated tariff model, and several DSOs have chosen that model to date. Currently, the tariff is based on a static time-of-use model consisting of two different tariff levels for small consumers. DSOs and TSO are further developing their tariff models including coordination between transmission and distribution levels. The 2018 Energy Agreement also includes an initiative to address potential regulatory barriers in relation to tariffs, in particular how they affect demand response. An interdepartmental working group has been established for that purpose.

A large share of the electricity price for Danish household consumers is made up of levies and taxes. Measures have been put into force that over several years remove the levy for public service obligations from the electricity bill. Moreover, the 2018 Energy Agreement contains a substantial reduction of the electricity tax. As a result wholesale prices may be reflected onto consumers more directly and with less distortions in the future.

Just as reducing the general electricity tax rate, it is also planned to cut the tax on electricity used for heating further by almost half over the coming years. Primarily, this aims at a further electrification of the heating sector. At the same time, the new pricing- and tariff regimes shall ensure the flexible operation of such units.

The Energy Agreement also includes an initiative to explore the possibilities of a dynamic electricity tax. A dynamic electricity tax can for example increase demand in periods with low electricity prices where production of renewable electricity is high.

There are no specific barriers in Danish law that inhibit independent service providers to enter into a contract with a customer, or aggregators from offering demand flexibility. No difference is made between bids in the market coming from a single source or an aggregated source. Nonetheless, Denmark seeks to further develop its market model to facilitate demand response, including through aggregation, and support the utilisation of flexibility at the distribution level. Therefore, market models are being revised to define and accommodate aggregators as a stand-alone role in its own right.

### 3.5 Dimension Research, innovation and competitiveness

#### **(i) Policies and measures related to the elements set out in point 2.5**

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

In June 2018 the Danish Parliament made a Energy Agreement. As part of the agreement, Denmark has committed to spend 580 mill. DKK in 2020 on research, development and demonstration of new energy technology. With the research reserve agreement 2020, the Government and all the political parties has agreed to increase spending to green research, development and demonstration by 1 billion DKK in 2020 in addition to the spending target in 2020 that follows from the Energy Agreement.

Furthermore, the Energy Agreement states that by 2024 Denmark will spend at least 1 billion DKK on research, development and demonstration of new technologies related to energy and climate.

In 2020 514 mill. DKK will be allocated to the Energy Technology Development and Demonstration Program (EUDP). EUDP supports development and demonstration of new energy technology, as well as research that supports preparation for development and demonstration. The objective of EUDP is to create growth and jobs, increase the security of supply, and contribute to the green transition that will make Denmark independent of fossil energy by 2050. Demonstration projects in particular can be difficult to finance, partly because they typically demand large financial resources, and partly because they demand a high risk tolerance. By contributing to financing, the EUDP ensures results from research and development projects are brought closer to market.

EUDP supports actions under the SET-plan, IEA and Nordic Energy Research, as specified in section 3.5.(ii).

EUDP was established in 2007 to support national energy targets regarding a stable and secure energy supply, consideration for the global climate, cost efficiency and business strengths and potentials through development and demonstration of new energy technologies. EUDP has from 2011-2015 had an annual budget of approx. 400 mill. DKK. The budget decreased in 2016 to approx. 190 mill. DKK, but has since increased to approx. 430 mill. In 2019.

EUDP has a politically independent board which is responsible for allocating funds to the best projects among the applicants. EUDP funds projects in many different energy sectors. In 2018 the EUDP allocated 86% (approx. 362 mill. DKK) of its funds to four different sectors: Wind projects received approx. 180 mill. DKK, projects regarding hydrogen and fuel cells received approx. 82 mill. DKK, projects regarding system integration received approx. 55 mill. DKK, and projects regarding energy efficiency received approx. 43 mill. DKK.

In 2020 83 mill. DKK will be allocated to the energy area in Innovation Fund Denmark (cf. the Budget proposal 2020). Furthermore, 629 mill. DKK will be allocated to green research

in Innovation Fund Denmark in 2020. These funds cover different themes related to green research, including energy research. Innovation Fund Denmark primarily support projects focusing on strategic research and development. The two programs thereby cover technologies approx. from TRL 2-8. Like EUDP, Innovation Fund Denmark has an independent board which is responsible for allocating funds to concrete projects.

The Danish Parliament has already allocated 90 mill. DKK to research and development focused on limiting greenhouse gas emissions from the agricultural sector, which is relative large in Denmark. The 90 mill. DKK will cover the period 2019-2021. The funds will support the Danish reduction target in 2030 in the non-ETS sector as well as the goal of reducing greenhouse gasses by 70 % by 2030, relative to 1990 levels.

In the beginning of 2019 the Danish Parliament allocated 50 mill DKK to new test facilities at Lindoe Offshore Renewables Center (LORC). The money supplements private financing and will be spent on constructing the – by far – most powerful nacelle test facility in the world, further underlining the Danish position as world leader in offshore wind.

This is just the latest test facility constructed in Denmark. Under the former Green Labs DK program a series of test facilities were constructed, most of which are considered successful and still used by private companies to test new technologies within smart grid, green gas, heating and cooling and outdoor lighting.

As mentioned, both EUDP and Innovation Fund Denmark support a wide variety of projects. These programs are supplemented by test facilities as well as funding of climate solutions in the agricultural sector. Funding of research, development and demonstration of new energy and climate technologies and instruments is an essential part of securing national objectives on the other dimensions such as greenhouse gas reductions, further developing strengths in renewables, new technologies on energy efficiency as well as ensuring a high energy security.

Denmark does not have any funding targets for private research and innovation relating to the energy union.

*ii. Where applicable, national objectives with regard to competitiveness.*

The global green transition market continues to grow. In order to reach the temperature increase target limit, the international community must invest 90,000 billion Danish kroner in green transition over the next 11 years. This represents a unique opportunity for the Danish business community, which must be exploited. Denmark must be known as a nation of green entrepreneurialism.

With the 2018 Energy Agreement, the parties agree to significantly intensify export promotion activities in the energy sector –both in scale and volume – to a total of 174 million DKK from 2019 to the end of 2024. The current export scheme in the key export markets of Germany, the UK and the United States will be extended until the end of 2024

and expanded to include two new partner countries and the posting of four new energy advisors.

Denmark will also increase its collaborations with authorities in future growth markets through public-private partnerships with an increased focus on the promotion of Danish exports, market development and investments. To this end, 62,3 million DKK from the total of 174 million DKK have been allocated for projects and activities that serve to further the export promotion activities in the energy sector. These funds will be allocated through tenders and subsidies in accordance with the EU state aid rules (de minimis regulation).

In addition, on 2 December 2019 the Government reached agreement with the Red-Green Alliance, the Social Liberal Party, the Socialist People's Party and the Alternative on the Finance Act 2020. The parties agreed to strengthen the green diplomacy. This will happen amongst other things by strengthening the effort of posting energy advisors in growth markets with the aim to deploy Danish expertise within energy systems and green transition. The parties have allocated 5 million annually in the period 2020-2021.

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

Denmark has a long term target of net-zero emission by 2050 at the latest and independency from fossil fuels. Furthermore, 55% of its energy consumption and more than 100% of its electricity consumption must come from renewables by 2030.

As part of the new Government's goal to reduce greenhouse gas emissions by 70 % by 2030, relative to 1990 levels, it is essential that funding is in place for research, development and demonstration as well as deployment of new climate friendly technologies. New solutions will have to be developed in the energy sector, in transportation and aviation as well as in the agricultural sector.

Denmark will install three new off-shore wind farms towards 2030. Thereby Denmark will make itself increasingly independent from fossil fuels. The increasing ratio of renewable energy production will require further research, development and demonstration of technologies to fully integrate and exploit the renewable energy when production exceeds demand. As part of these efforts solutions regarding **energy storage** will also be promoted concretely through an Energy storage fund of 128 million DKK. In December 2019 money was granted to two Power-to-X-projects. The projects will establish big scale production and storage of green hydrogen. Both projects have an ambition to demonstrate production and consumption of green hydrogen on near market based conditions.

As part of a future green mobility plan the Government wants to stop sales of all new diesel and petrol cars as of 2030 and enhance low emissions zones. This requires deployment of new green vehicles in Denmark.

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

Since its establishment, the EUDP has focused on strengthening Denmark's international collaboration. International collaboration is based on participation in the European Research Area Networks (ERA-NET's) under the EU Horizon 2020 program; extensive involvement in IEA Technology Collaboration Programs (formerly Implementing Agreements); as well as international participation in a number of specific EUDP projects.

***Nordic energy research co-operation***

Nordic Energy Research (NER) is the 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. Denmark is an active member of Nordic Energy Research.

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 facilities 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, 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 transportation system; and enabling negative CO<sub>2</sub>-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. At present, the possibility of an updated report (with the working title Nordic Energy Outlook) is discussed within the Board of NER and with the IEA.

The Nordic Electric Vehicle Outlook 2018 (NEVO 2018) has been developed in co-operation 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 behavior and includes an outlook on the progress of electric mobility in the Nordic region up to 2030.

The NER Board Meeting in November 2018 decided to allocate up to 4 million NOK to each of the key areas 1-6. The proposed Nordic Exchange programs for energy researchers (key area 7) was allocated 5 million NOK for the 2019-2020 period. These funds are intended as seed money to attract additional funding from the national research councils to meet the 500 million DKK overall target. Programs meeting the following three criteria are deemed relevant; Deliver Nordic added value, agreed by all Nordic research councils and fall within the areas below. Based on this process, NER has identified seven key areas that could enhance joint Nordic research efforts:

1. Digitalisation of the Nordic Electricity Grid.
2. Further enhancing the Nordic Energy Market
3. Energy Storage
4. Energy and Transport (land-based, aviation and maritime)
5. Bioenergy and Biofuels
6. Carbon Capture Utilisation and Storage (CCUS)
7. Support Nordic Exchange programmes for energy researchers

NER is also exploring how the Nordic countries can join forces in providing input to European research programs, especially the so-called ERA-NETs under the existing Horizon 2020 and the upcoming Horizon Europe programmes. ERA-nets on; Carbon Capture Utilisation and Storage (CCUS), Energy Storage, Biomass and Digitalisation of Energy Systems seem particularly suited.

#### SET-plan

The overarching criteria of the Danish Energy Technology Development and Demonstration Program (EUDP) are applicability to global trends and challenges, and business potentials, in line with the objectives of the Strategic Energy Technology Plan (SET-plan). When it comes to specific technology areas, Denmark has taken a neutral approach, but favor areas where Denmark already has a stronghold.

The EUDP wants to further strengthen the international collaboration effort in order to attract the best international players to project consortia with Danish partners, providing that results are anchored in Denmark and create added value for Danish players. Furthermore, participation in international collaboration will also help promote Danish acquisition of knowledge about the newest trends and methodologies. The European Energy Union and the SET-Plan play an important role in this context. EUDP funds participation in large European projects and the projects must concurrently be within the scope of EUDP's objectives. In this context, EUDP funds participation in relevant ERA-NET Co-fund initiatives under Horizon 2020.

In this connection, the EUDP will prioritize participating in SET-Plan work in collaboration with the Danish Energy Agency in order to provide Danish input to the process and acquire relevant knowledge for use in implementation of the EUDP strategy and in the allocation of funding. The SET-Plan is being implemented through Horizon 2020, and through the ERA-NET Co-fund mechanism, which the EUDP is already making use of and to which the program will continue to afford priority.

The EUDP board strategy for 2017-19 was presented in early 2017 and is still valid. The strategy places special priority on ensuring that funds are granted in focus areas in which there is a particularly good match between the global demand for energy technology on the one hand, and Danish strongholds and commercial potentials on the other. This also goes for international collaboration projects.

### **Danish strongholds**

Both EUDP and an independent report on research and innovation in the Danish energy sector have identified the following Danish strongholds based on a number of indicators (i.e. patents, publications, quality of energy-related research, demonstration projects, available export statistics). Compared to other countries, Denmark is relatively strongly positioned in the following areas:

#### **Wind power**

Danish competences in wind energy are based on a network of large and small enterprises and a range of research and development centers. The wind power industry employs approx. 30,000 people. DTU Wind Energy (Technical University of Denmark) has played a key role in this development. Moreover, Denmark has a number of unique test facilities such as the Lindoe Offshore Renewables Center (LORC), the Test Center for Large Wind Turbines at Høvsøre, Østerild – National Test Centre for Large Wind Turbines and more. Denmark is also home to some of the world's largest wind turbine manufacturers, including Vestas Wind Systems and Siemens Wind Power. Furthermore, Ørsted has driven the development of offshore wind technologies through the establishment and operation of offshore wind farms.

#### **District heating**

Denmark's stronghold in district heating has been shaped over a period of 100 years. Today, Danish district-heating plants are among the most energy-efficient CHP plants in the world. The sector employs more than 7,000 people. There is strong demand abroad for Danish competences in this area. In a large number of situations, the effective Danish CHP production provides support for unique partnerships with local enterprises connected to the district heating infrastructure. Danish CHP plants have gradually been converted to a high rate of biomass use, and have therefore gone from a biomass consumption of only 8% in 1980 up to approx. 40%. This has been possible, e.g. because Danish fuel taxes have only targeted fossil fuels. However, technological developments have also been a factor. The gradual conversion of the district heating sector also contributed to the build-up of the Danish knowledge and resource base, and this was established through close collaboration between plants, authorities, consultants and suppliers. Denmark therefore has strong competencies within the design and dimensioning of CHP plants, consultancy services and specialized production.

#### **Efficient use of energy**

Efficient and intelligent energy use is crucial, e.g. in buildings, in households, in production processes, at system level and in the transport sector. Denmark is relatively well positioned within lighting, low-energy buildings, building materials and processes, as well as reduction of energy consumption in existing buildings. Comparative analyses of retrofitting of existing



buildings versus raising new buildings in a sustainability perspective, including energy consumption for production, also place Denmark in a leading position. Danish strongholds in this area have been established primarily through taxes and subsidy schemes as well as energy labelling of products; all instruments intended to reduce energy consumption. A large number of enterprises are in the markets for products within efficient use of energy and energy-efficiency improvements and optimization.

### Bioenergy

The fact that Denmark introduced energy-policy requirements for alternatives to fossil fuels at an early stage, that it envisioned a supply sector supplied from several sources, and that Denmark focused on exploiting domestic fuels, led to the establishment of a solid platform for bioenergy in the 1980s and 1990s. This development involved both research and development activities and focused on the role of agriculture as a supplier of residual products and the role of the energy sector as a recipient of energy produced at CHP plants. A large number of local and decentralized biomass-fired CHP plants were built.

Furthermore, a large number of large-scale and centralized CHP plants were converted to biomass. To this should be added the unique knowledge and technology development within biofuels and biogas. It is the expectation that biogas production will more than double and, perhaps, triple, while the use of biogas is becoming independent of local CHP plants, with distribution through the existing gas infrastructure, so that gas can be used in the CHP sector, in industry, in natural gas boilers in households, and in the transport sector. Biogas technology can also be defined as a Danish stronghold based on the number of reference projects abroad and the scope of research and development activities in Denmark.

### Smart grids and system integration

For Denmark, smart grids are a particularly interesting area because of the challenge of integrating large amounts of intermittent wind power into the existing system, which to an ever greater extent is calling for ways by which to regulate electricity consumption relative to current production efficiently and intelligently. One element in this context is activation of consumers through hourly meter pricing and smart meters. Developments in this area received a boost when it was decided that all Danish homes must have remotely-read meters and hourly pricing by 2020. Another important element is the dramatic developments in digitalization. While smart grids specifically address the problem of moving consumption to other times during the day and matching supply with demand, system integration is also a growing and very important area. In the future, many factors will be competing to supply this dynamic: electric cars, electric cartridges, heat pumps, etc. system integration also covers aspects relating to energy storage and smart energy. Smart energy is a broader concept than smart grids. Smart energy covers several energy grids, energy types and sectors in the overall energy infrastructure (electricity, heating, cooling, gas, transport). Developments within system integration are therefore to a great extent a question of creating dynamic incentive structures which can incorporate different technologies and different parts of the energy system in an integrated interplay and in a cost-efficient manner, e.g. combining solar heating and heat pumps with gas or biomass in the district heating system. The challenge with regard to storing energy is to develop

technologies and concepts that can store the energy from periods with high production and low demand (e.g. wind power) and save it for peak demand periods, or, alternatively, to convert the energy to other, high-value energy products (e.g. fuels).

#### Oil and gas

The Danish oil and gas industry is founded on Danish exploration and recovery activities in the North Sea since the 1980s. Oil from the Danish continental shelf is not easy to access, and persistent focus on increasing the recovery rate and continuously extending the service life of Danish oilfields means Danish players have become world leaders in advanced oil extraction. This applies e.g. within horizontal drilling and injection. Danish strongholds within oil and gas are primarily an industry cluster of around 250 enterprises. Furthermore, a Centre for Oil and Gas has been set up at the Technical University of Denmark (DTU). The center will provide support for research and development activities as well as highly specialized education and training in oil and gas technology and exploration.

#### Other technologies

There is a category of other technologies, for which, so far, no large export revenues have been registered, but with regard to which Denmark is also relatively strongly positioned in terms of publications and demonstration projects, for example within heat pumps, fuel cells, geothermal energy and wave power.

#### Prioritization and allocation of funds

Danish business potentials in the area of energy technologies are especially prominent in those areas which, over the next 5-10 years, will see a significant demand for specific technologies, and about which it can be said with relative certainty that there is a good match with Danish industrial strongholds and RDD activities. This assumes that Danish players in one way or another will have a head start or an advantage compared to other countries due to an extensive knowledge and resource base, patents, knowhow, test facilities.

The rationale behind the EUDP Strategy is to invest in areas in which there is a particularly good match between global demand for new energy technology, on the one hand, and Danish strongholds and business potentials on the other. First, global trends and challenges in the energy area are described, and, then, business potentials are identified by comparing the challenges and trends with the Danish strongholds. This approach forms the basis for focusing EUDP efforts. The primary focus of EUDP will be on projects which develop, demonstrate and scale-up technologies in Denmark with the aim of exporting them - in other words, primary focus is on Technology Readiness Levels 4-8 in the value chain.

On the basis of a review of global trends and Danish strongholds in the energy area, the following observations are deemed of particular interest in the context within which the EUDP is to prioritize its funds:

- Expected greater focus on unsubsidized energy production in future.
- Expectations that onshore wind will be the cheapest new electricity capacity globally in the short term.

- Expectations that solar PV will be the cheapest new electricity capacity globally in the medium term.
- Expectations that roof-top PV installations combined with battery storage will relatively quickly become widespread in many countries throughout the world.
- Offshore wind investments have seen relatively large growth in the European market so far.
- Growing focus on energy-efficiency improvements globally.
- A larger share of intermittent RE (Renewable Energy) leads to greater demand for demand-response management technologies.
- A larger share of intermittent RE leads to greater demand for energy storage solutions. In this context, battery storage, in particular, is expected to play a significant role.
- Greater focus on the use of interconnectors between countries and energy systems globally.
- Investments in biofuels have declined over the past five years, while investments in bioenergy and waste-to-energy have increased. Biomass will probably increasingly have to be used to make high-value products, e.g. in those parts of the transport sector which are not so easily electrified (heavy goods transport, ships, aircraft).

#### **International Participation and Collaboration in the IEA**

EUDP promotes international projects, knowledge-sharing, network building and knowledge acquisition, etc. through the IEA Technology Collaboration Programs, wherever this is of strategic interest to Denmark. Furthermore, the IEA is currently strengthening efforts with regard to its Technology Collaboration Programs (TCPs). By applying this, EUDP can fund Danish participation in annexes or tasks that involves:

- A technology area of particular Danish interest.
- That the applicant has a professional self-interest in participating.
- That the application has an adequate overview of relevant Danish players and stakeholders within the area of technology in question.
- That the application contains a plan for dissemination activities, which must be conducted in relation to the relevant Danish players and stakeholders within the technology area. In order to participate in tasks/annexes, a minimum requirement is to set up an electronic newsletter or similar (e.g. website), which is offered to all players and stakeholders and is disseminated at least two times a year. This can e.g. happen in relation to the applicant's participation in meetings, workshops, etc. or by the appearance of new reports, analyses or other initiatives from IEA. During the project period, there must be arranged at least one workshop/seminar addressing Danish players and stakeholders within the relevant technology area. This can take place in collaboration with other related IEA collaborations or the like.

#### **Mission Innovation**

Denmark is member of Mission Innovation, and has – besides committing to double funding in energy research by 2020 – been active in both the international secretariat, innovation challenges and the business engagement group. Denmark is active in four Innovation Challenges:

- Smart Grids,
- Carbon capture,

- Sustainable Biofuels,
- Clean energy materials,

In three out of four Innovation Challenges the engagement is rooted in research environments and contribute to knowledge sharing, as well as development of programs and projects. The work has resulted in new partnerships and strengthening of existing projects. As for smart grids and biofuels the engagements builds on Danish areas of strength, whereas materials has turned out to be a connection of different areas of expertise to create new opportunities within the fields of energy materials. Denmark has recently joined the Innovation Challenge regarding Carbon Capture, and is looking forward to contribute to the innovation challenge.

Denmark has also recently joined the leadership forum and is leading a coalition on shipping.

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

EUDP was established in 2007 to support national energy targets regarding a stable and secure energy supply, consideration for the global climate, cost efficiency and business strengths and potentials through development and demonstration of new energy technologies (TRL 4-8). EUDP has from 2011-2015 had an annual budget of approx. 400 mill. DKK. The budget was halved in 2016 to approx. 190 mill. DKK, but has since increased to approx. 430 mill. in 2019.

EUDP has a politically independent board which is responsible for allocating funds to the best projects among the applicants. EUDP funds projects in many different energy sectors. In 2018 the EUDP allocated 86% (approx. 362 mill. DKK) of its funds to four different sectors: Wind projects received approx. 180 mill. DKK, projects regarding hydrogen and fuel cells received approx. 82 mill. DKK, projects regarding system integration received approx. 55 mill. DKK, and projects regarding energy efficiency received approx. 43 mio. DKK.

Innovation Fund Denmark was established in 2014 and supports strategic research projects (TRL 2-4). The Innovation Fund has in 2018 allocated a total of 206 mill. DKK in funds to research and development in the energy sector.

Denmark has received approximately 923 mio. DKK to energy related projects under the Horizon2020-programme (from 2014 to 2019). Denmark thereby is one of the most successful countries in the EU (funding per capita) in getting access to EU funding and participating in projects in the EU. The funds are an essential part in advancing new green technologies in Denmark as well as countries working with Danish actors in these projects.

## **SECTION B: ANALYTICAL BASIS**

## **4. CURRENT SITUATION AND PROJECTIONS WITH EXISTING POLICIES AND MEASURES**

This section presents the assumptions and results from Denmark's Energy and Climate Outlook 2019 (DECO 2019) (Energistyrelsen, 2019a)<sup>52</sup>, which is a projection towards 2040 with existing policies and measures (WEM).

Technology cost projections assumptions and results are from Denmark's technology catalogues (Danish Energy Agency, 2019)

The *current situation* refers to 2017, which is the latest statistical year. Projections refer to 2018-2040.

For used parameters and variables data see Annex 1.

For detailed greenhouse gas emissions and removals data see Annex 2.

For detailed energy prices data see Annex 3 and 4.

For detailed description of existing measures and the modelling platform see Annex 5.

For carbon ETS price data used for DECO2019 see Annex 6.

For air pollutants projections data see Annex 7.

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

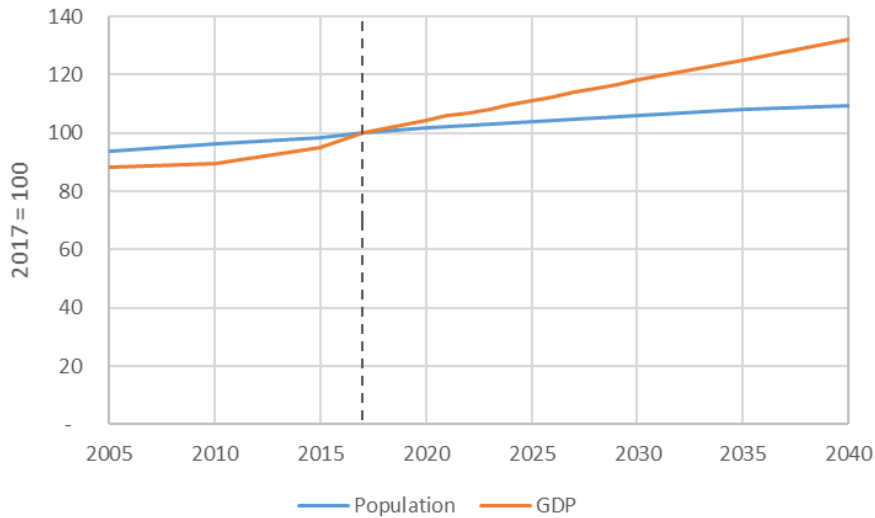
#### **(i) Macroeconomic forecasts (GDP and population growth)**

As shown in Figure 18, from 2017-2030 the population is projected to grow 6%, while GDP increases 18%. The trend is projected to continue beyond 2030, leading to a 9% population growth and a 32% GDP growth in 2040, compared to 2017.

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<sup>52</sup> <https://ens.dk/sites/ens.dk/files/Analyser/deco19.pdf>

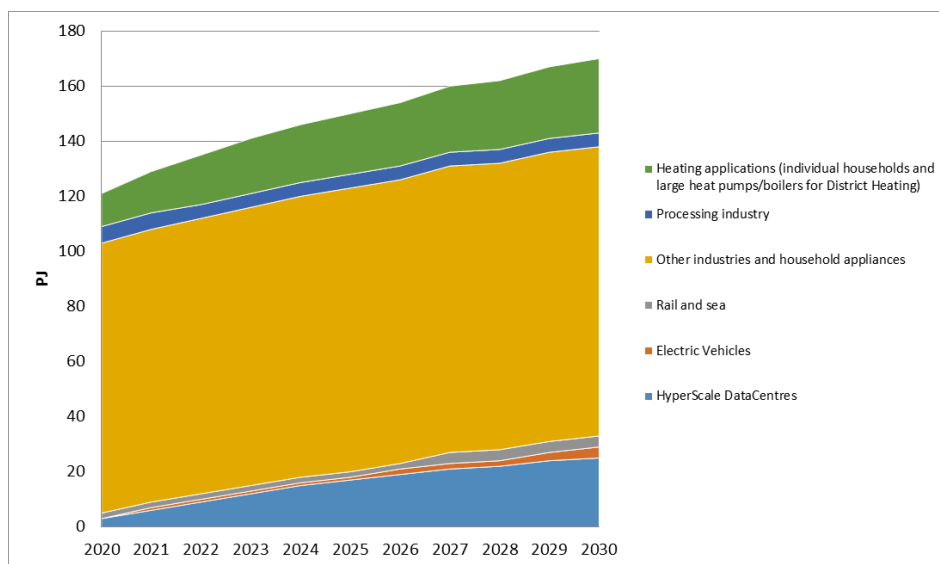
**Figure 18. Population and GDP 2005-2040 [2017=100].**



**(ii) Sectoral changes expected to impact the energy system and GHG emissions**

Figure 19 shows the electricity consumption for various sectors from 2020-2030, highlighting significant impacts, mainly due to the increase of electricity demand for hyper-scale data centers (HSDC's) and heating applications. GHG emissions will be less affected due to the increased deployment of renewable energy capacity in the same period.

**Figure 19. Electricity consumption (PJ) by sector (net loss excluded) 2020-2030.**



**(iii) Global energy trends, international fossil fuel prices, EU ETS carbon price**

Figure 20 shows the projections of fossil fuel prices used as assumptions in the NECP.

**Figure 20. Fossil fuel prices 2005-2040 [2016-EUR/GJ].**

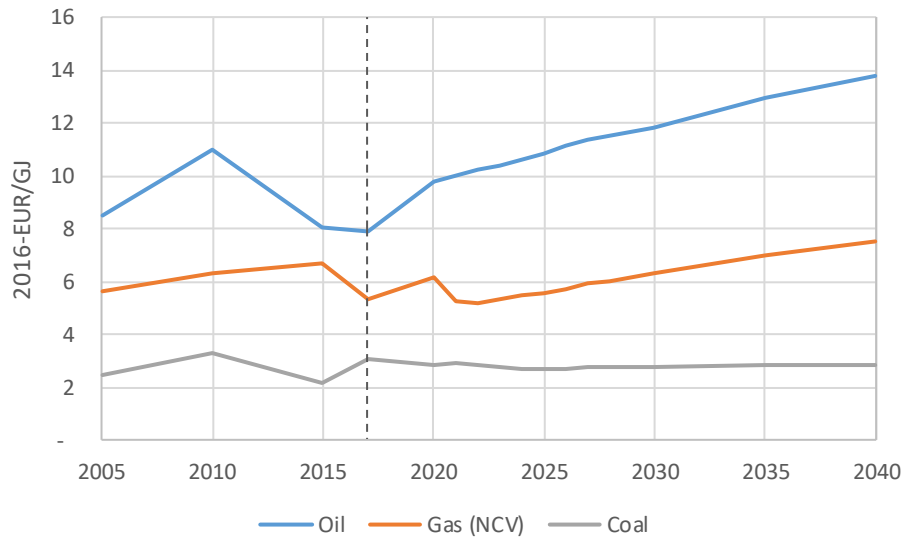
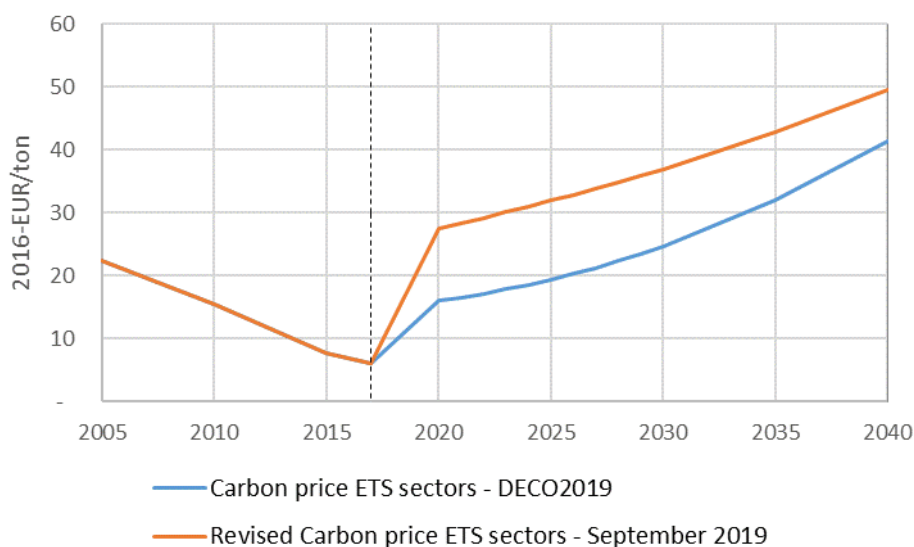


Figure 21 shows the carbon price for the ETS sectors used for DECO2019 as well as a revised carbon price projection.

**Figure 21. Carbon ETS price used for projections in DECO 2019. Carbon ETS price was revised in September 2019 [2016-EUR/ton].**

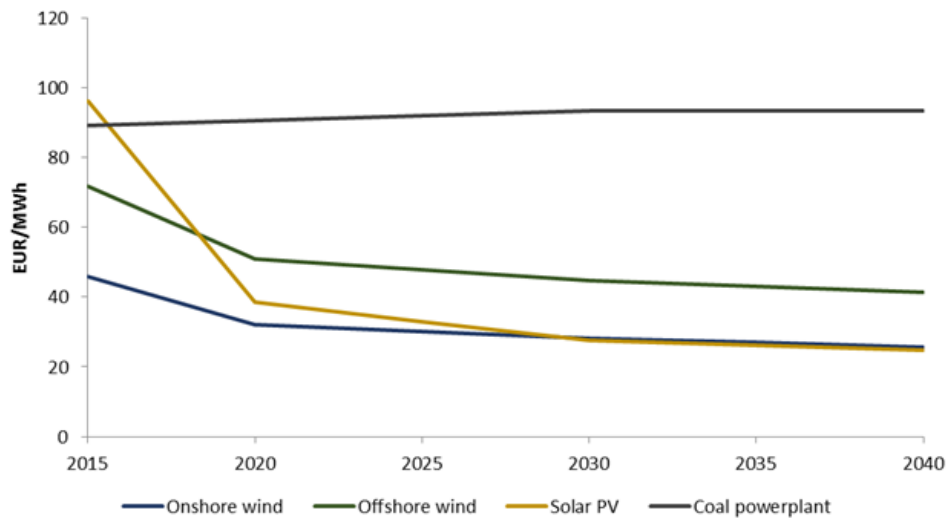




**(iv) Technology cost developments**

Figure 22 shows the levelized cost of electricity (LCoE) for wind and solar power compared to a coal-fired power plant. The projection shows that LCoE for wind and solar power is lower than for a coal-fired power plant throughout the projection period.

**Figure 22. Levelized cost of electricity generation with years of final investment decision 2015-2040 [EUR/MWh] for utility scale wind and solar and a coal-fired power plant.**



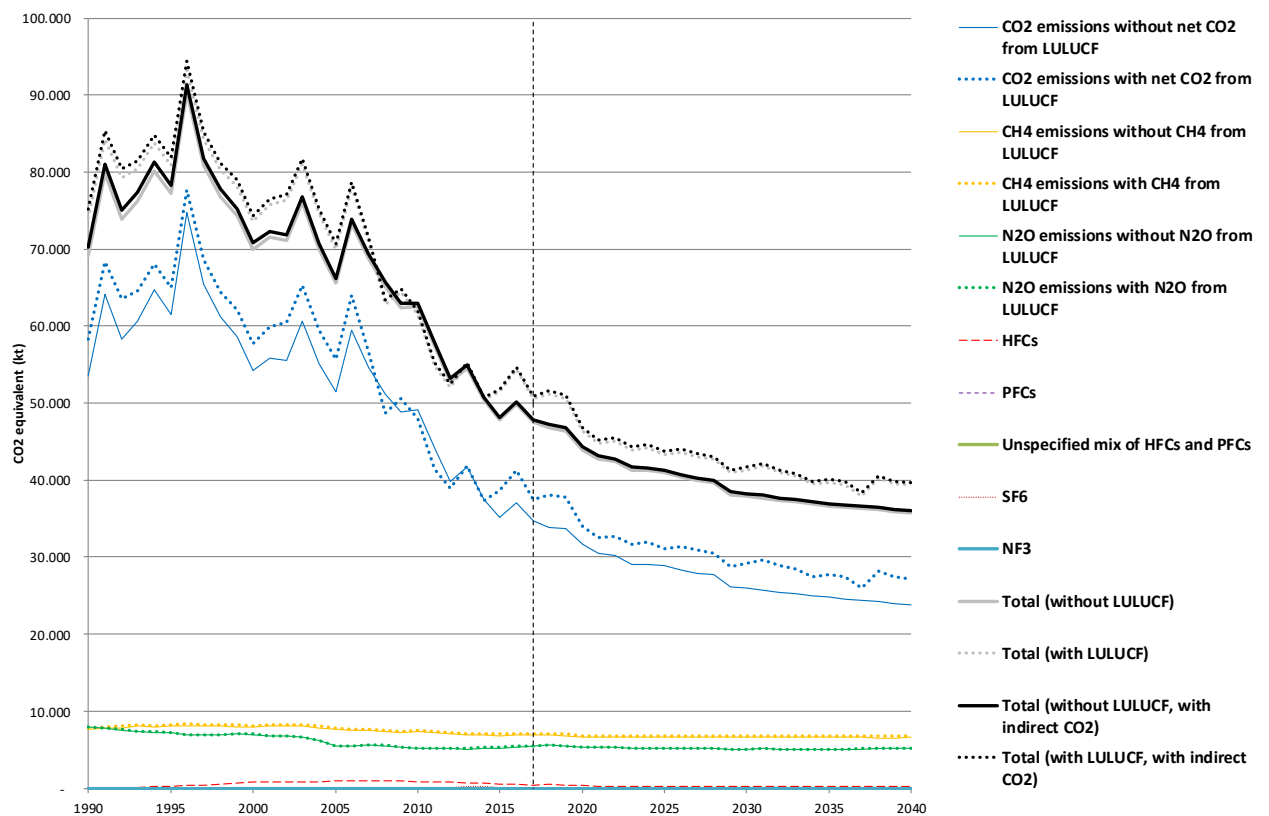
## 4.2. Dimension decarbonization

### 4.2.1. Greenhouse gas emissions and removals

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

The trends in current Danish GHG emissions and removals from 1990-2017 are shown in Figure 23 below. A key result is that total GHG emissions without LULUCF have decreased 32% since 1990.

Figure 23. GHG emissions by gas 1990-2040 [kt of CO<sub>2</sub>eq]



Other highlights are:

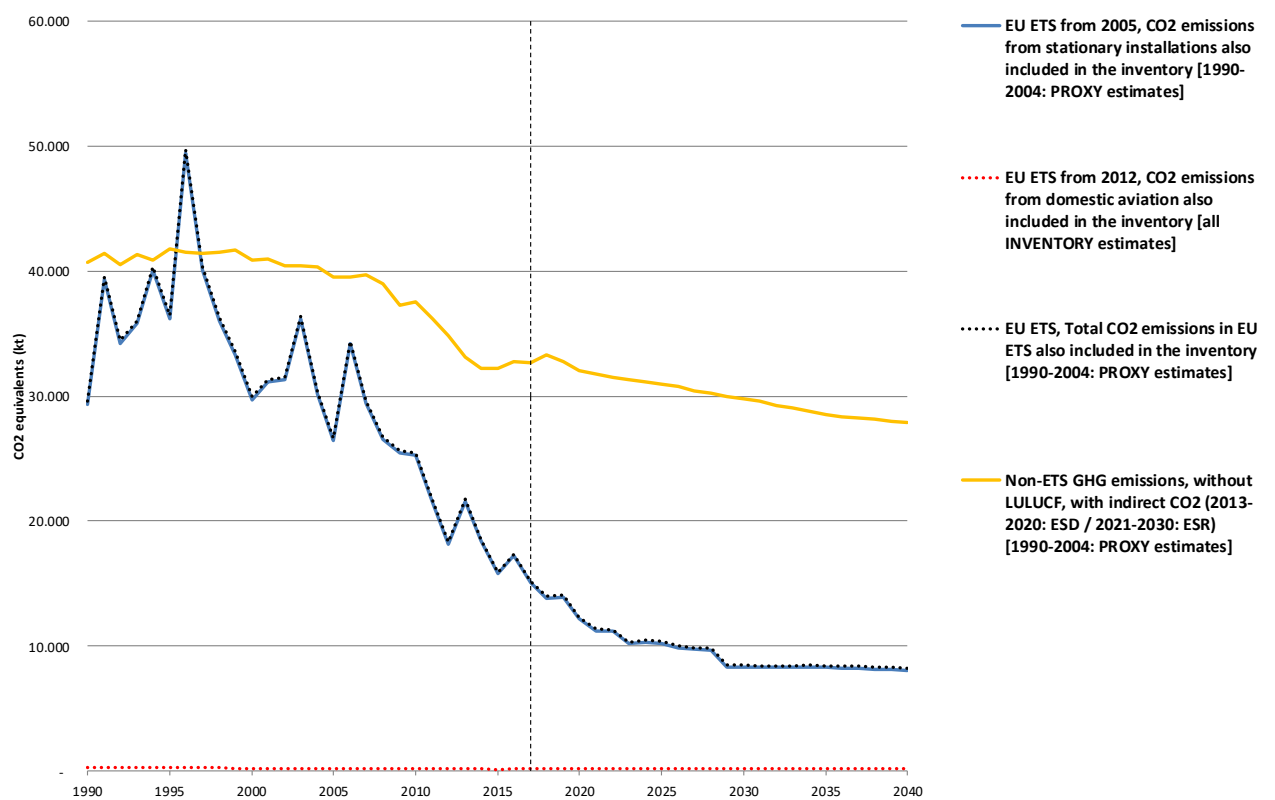
- total GHG emissions with LULUCF have decreased 32%
- CO<sub>2</sub> emissions without LULUCF have decreased 35%
- CO<sub>2</sub> emissions with LULUCF have decreased 36%
- CH<sub>4</sub> emissions without LULUCF have decreased 9%
- CH<sub>4</sub> emissions with LULUCF have decreased 9%
- N<sub>2</sub>O emissions without LULUCF have decreased 32%
- N<sub>2</sub>O emissions with LULUCF have decreased 31%

Figure 24 shows the GHG emissions reductions achieved, distributed between emissions covered by the EU ETS system and non-ETS emissions. As the EU ETS did not exist until 2005 the split of total emissions into ETS and non-ETS 1990-2004 is based on proxy estimates and not on reported ETS emissions.

From 2005, where the reporting of ETS emissions began, until 2017:

- EU ETS CO<sub>2</sub> emissions have decreased 43%
- non-ETS GHG emissions without LULUCF have decreased 17%

**Figure 24. GHG emissions in the ETS and the non-ETS (ESD, ESR) sectors 1990-2040 [ktCO<sub>2</sub>eq]**





Emissions have been particularly reduced in the energy sector and in energy industries, which is shown in Figure 25 below.

Highlights of GHG emissions reductions by IPCC energy sector from 1990-2017 are:

- energy sector emissions decreased 36%
- energy industry emissions decreased 57%
- manufacturing industry emissions and construction decreased 26%
- transport emissions increased 23%
- other sector's emissions decreased 53%

Figure 25. GHG emissions by IPCC energy sector 1990-2040 [ktCO<sub>2</sub>eq]

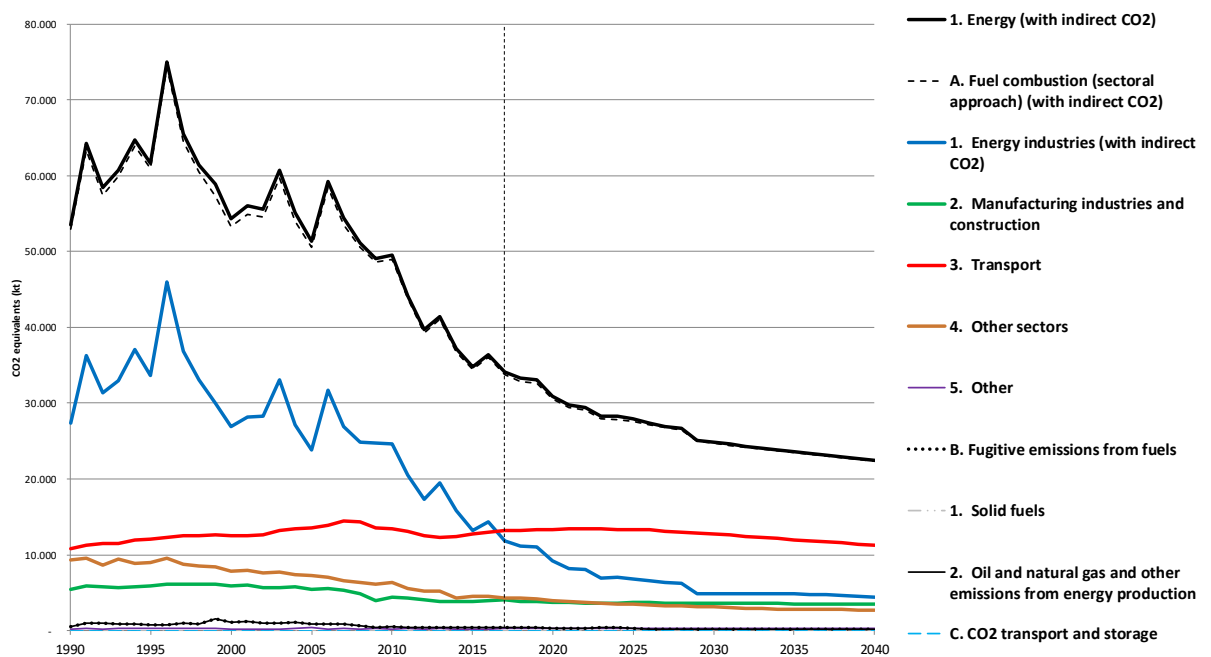




Figure 26 shows the total GHG emissions by IPCC main sector from 1990-2017:

- energy sector decreased 36%
- industrial processes and product use decreased 14%
- agriculture decreased 16%
- land use, land-use change and forestry decreased 40%
- waste decreased 36%

Figure 26. GHG emissions by IPCC main sector 1990-2040 [ktCO<sub>2</sub>eq]

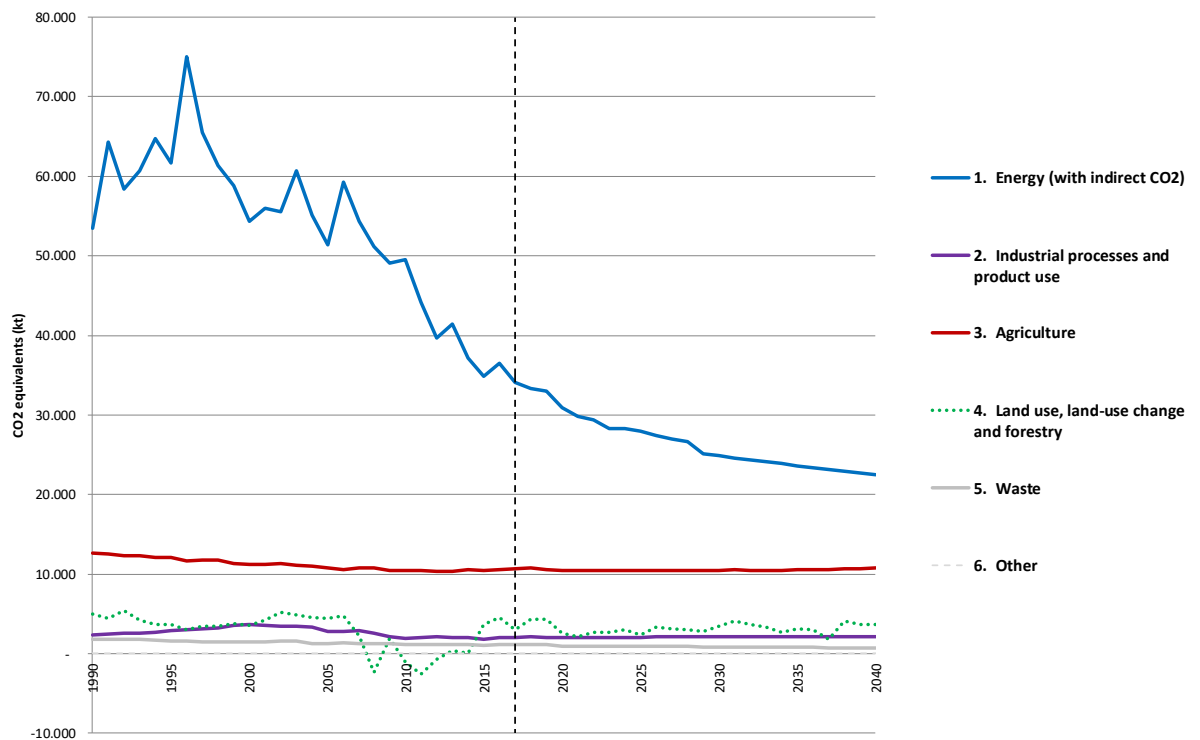
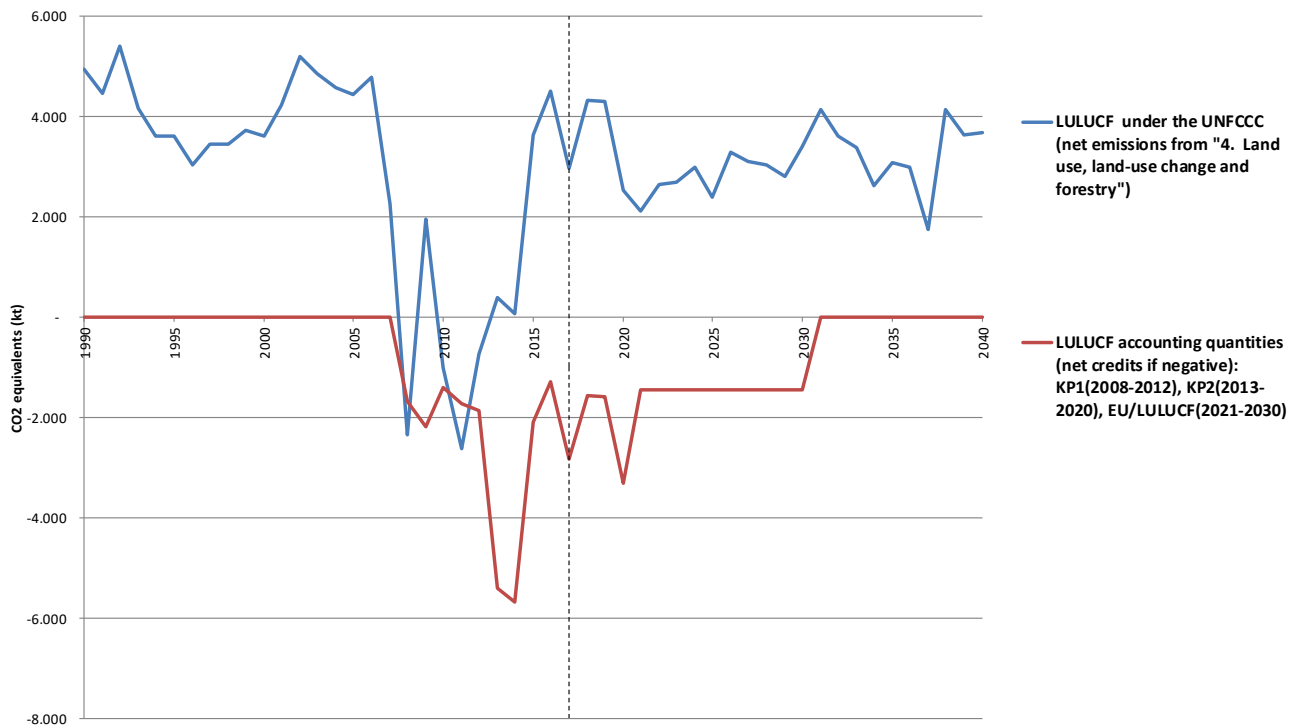


Figure 27 shows that:

- LULUCF net emissions decreased 40% from 1990-2017
- KP1 net credits accumulated to 8.865 kt CO<sub>2</sub>eq

**Figure 27. GHG emissions and accounting quantities in the LULUCF sector 1990-2040 [ktCO<sub>2</sub>eq].**



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

The previous section showed the past and current emissions, i.e. the development from 1990-2017. This section describes the projections from 2017-2040, shown in the figures presented in the previous section.

Figure 23 above shows the development of GHG emissions by gas from 1990-2040. A key result of the projection is that total GHG emissions without LULUCF are expected to decrease 46% from 1990 to 2030 and 49% from 1990 to 2040.

Other results of the projections are:

- total GHG emissions with LULUCF decrease 45% from 1990 to 2030 and 47% from 1990 to 2040
- CO<sub>2</sub> emissions without LULUCF decrease 51% from 1990 to 2030 and 56% from 1990 to 2040
- CO<sub>2</sub> emissions with LULUCF decrease 50% from 1990 to 2030 and 53% from 1990 to 2040
- CH<sub>4</sub> emissions without LULUCF decrease 13% from 1990 to 2030 and 14% from 1990 to 2040
- CH<sub>4</sub> emissions with LULUCF decrease 12% from 1990 to 2030 and 13% from 1990 to 2040
- N<sub>2</sub>O emissions without LULUCF decrease 36% from 1990 to 2030 and 35% from 1990 to 2040
- N<sub>2</sub>O emissions with LULUCF decrease 36% from 1990 to 2030 and 35% from 1990 to 2040

Figure 24 shows from 1990-2040 emissions in EU ETS and non-ETS. As the EU ETS did not exist until 2005 the split of total emissions into ETS and non-ETS 1990-2004 is based on proxy estimates and not on reported ETS emissions.

From 2005, where the reporting of ETS emissions began, the projection shows that:

- EU ETS CO<sub>2</sub> emissions decrease 68% from 2005 to 2030 and 69% from 2005 to 2040
- non-ETS GHG emissions without LULUCF decrease 25% from 2005 to 2030 and 30% from 2005 to 2040.

The non-ETS projection should be seen in context with Denmark's obligation to limit non-ETS greenhouse gas emissions in 2030 by at least 39 percent relative to emissions in 2005. Additional policies and measures to meet the objective are to be decided after the submission of the NECP, including climate action plans. For more information on this, see section 2.1.1.

Figure 25 shows from 1990-2040 the total GHG emissions by sector. The projection shows that:

- energy sector emissions decreases 53% from 1990 to 2030 and 58% from 1990 to 2040

- emissions from energy industries decrease 82% from 1990 to 2030 and 84% from 1990 to 2040
- emissions from manufacturing industries and construction decrease 33% from 1990 to 2030 and 35% from 1990 to 2040
- transport emissions increase 19% from 1990 to 2030, but will be fading from already around 2022, due to energy efficiency and increased share of renewable energy in the transport sector, reaching a level of 5% above 1990 levels in 2040
- other sectors emissions decrease 66% from 1990 to 2030 and 70% from 1990 to 2040

Figure 26 shows from 1990-2040 the total GHG emissions by IPCC sector. The projection shows that:

- energy sector emissions decreases 53% from 1990 to 2030 and 58% from 1990 to 2040
- industrial processes and product use emissions decrease 12% from 1990 to 2030 and 9% from 1990 to 2040
- agricultural emissions decrease 17% from 1990 to 2030 and 15% from 1990 to 2040
- land use, land-use change and forestry emissions decreases 31% from 1990 to 2030 and 25% from 1990 to 2040
- emissions from waste decreases 52% from 1990 to 2030 and 63% from 1990 to 2040

Figure 27 shows the LULUCF emissions and net credits from 1990-2040. The projection shows that:

- LULUCF emissions decrease 31% from 1990 to 2030 and 25% from 1990 to 2040
- KP2 net emissions accumulates to 23.806 ktCO<sub>2</sub>eq
- EU/LULUCF (2021-2030) net emissions accumulate to at least 14.600 ktCO<sub>2</sub>eq

#### Projections of air pollutants

In response to a recommendation from the Commission to the draft of this NECP, information about projections of air pollutants is included here.

Information about the projected air pollutants emissions under a “with additional measures” scenario was not available until March 2019. In accordance with the National Emission Ceiling Directive the information was reported to the EEA and the Commission on 15 March 2019 (Denmark’s 2019 submission of WEM and WAM projections of air pollutants under the National Emission Ceiling Directive (European Environmental Agency, 2019)

The main results of the “with measures” air pollutants projection and the “with additional measures” air pollutants projection are shown in Annex 7 (Tables 1 and 2).

It should be noted that the “with measures” air pollutants projection scenario from March 2019 is based on the energy WEM scenario from April 2018 and that the “with additional measures” air pollutants projection scenario only adds on the effects of the Danish energy company Ørsted’s 2017 announcement of phasing out of coal from 2023.



The next projection of air pollutants emissions will not be available until March 2021.

#### 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**

Figure 28 shows that from 2005-2017 the overall Renewable Energy Share increased from 16% to 34% and the Renewable Energy Share of Electricity increased from 27% to 64%.

**Figure 28. Overall Renewable Energy Share (RES), Renewable Energy Share in Heating/Cooling (RES-H/C), Renewable Energy Share in Electricity (RES-E), Renewable Energy Share in Transport (RES-T), 2005-2040 [%]**

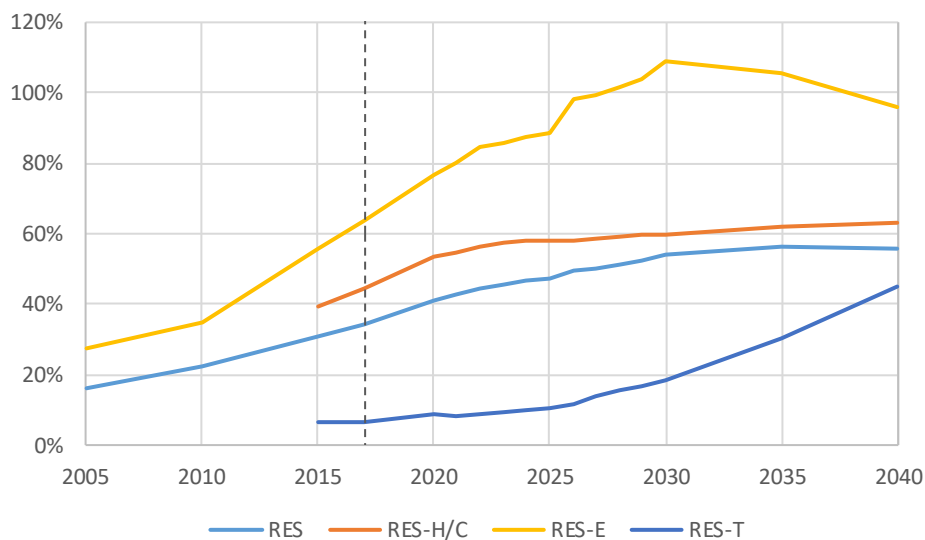
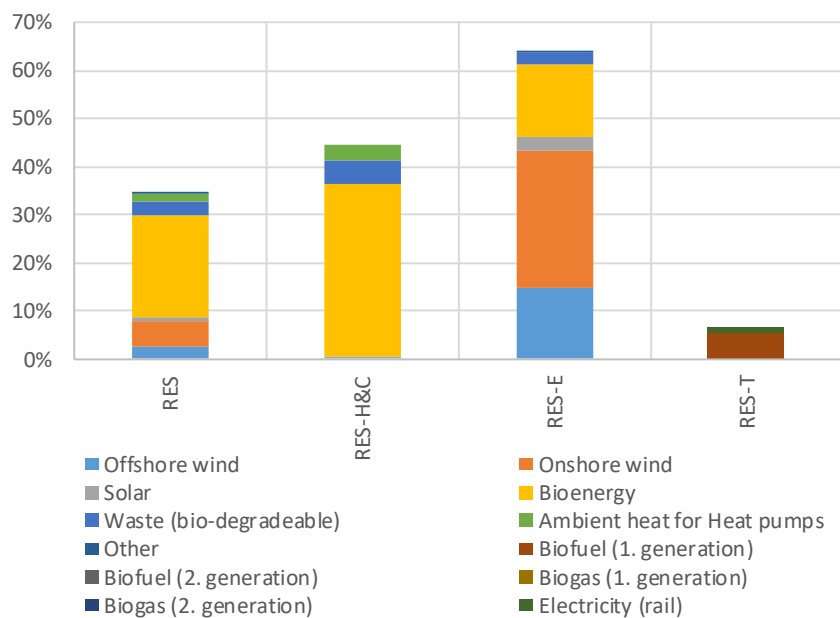


Figure 29 shows the sources of renewable energy in the respective sectors in 2017. It is worth noting that:

- bioenergy accounted for almost two thirds of overall Renewable Energy in 2017 (21 percentage points of 34 % overall RE share in energy), mainly due to its large role in heating/cooling. In electricity, bioenergy has a smaller share. onshore and offshore wind power together accounted for two thirds, i.e. 43 percentage points out of the 64% RE in electricity. The remaining part is almost entirely bioenergy.
- biofuels accounted for the 5% of the RES-T

**Figure 29. RES, RES-H/C, RES-E, RES-T year 2017 [%]**



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

This section refers to the projection part of the figures presented in the previous section.

Figure 28 on shares of Renewable Energy in various sectors shows the expected development from 2017-2040. A key result of the projections is that overall Renewable Energy Share increases from 34% in 2017 to 54% in 2030. This brings the renewable energy share very close to the 55% ambition of the Energy Agreement from June 2018, see section 1.

Another remarkable result of the projection is that the share of Renewable Energy in electricity is expected to increase from 64% in 2017 to 109% in 2030, which implies that Danish consumption of electricity from 2028, on average over a year, is projected to be covered entirely by renewable energy. This projection should also be seen in context with the Energy Agreement, in which initiatives agreed upon are expected to lead to a renewable energy share in electricity above 100% of consumption in 2030 (see section 1).

The projection also shows, however, that without new initiatives, consumption of electricity will exceed RE production by the end of the 2030's. This is largely due to two factors: 1) the assumption that electricity consumption will continue to grow, mainly from data centres (HSDC's), and 2) the projections are done on the basis of existing policies and measures, and there are currently no decisions on the establishment of new production capacity beyond 2030.

In terms of heating/cooling, the RE share is expected to increase from 44% in 2017 to 60% in 2030, whereas in transport the RE share is expected to grow from 7% in 2017 to 19% in 2030.

Figure 30 shows the share of various technologies in the overall RE mix from 2017-2040. The projection shows that while biomass continues to play a major role due to its share in heating, the increase of renewable energy in the overall mix is almost entirely due to other RE sources, notably offshore wind, ambient heat for heat pumps and solar PV:

- The share of offshore wind power increases from 3 pct.-point in 2017 to 12 pct.-point in 2030 to 10 pct.-point in 2040
- The share of onshore wind power increases from 5 pct.-point in 2017 to 8 pct.-point in 2030 to 10 pct.-point in 2040
- The share of bioenergy decreases from 21 pct.-point in 2017 to 23 pct.-point in 2030 and then falls to 21 pct.-point in 2040
- The share of solar energy increases from 1 pct.-point in 2017 to 4 pct.-point in 2030 to 6 pct.-point in 2040
- The share of waste (bio-degradable) is 3 pct.-point in 2017 and in 2030, and it decreases from 3 pct.-point in 2030 to 2 pct.-point in 2040
- The share of ambient heat for heat pumps increases from 1 pct.-point in 2017 to 5 pct.-point in 2030 to 7 pct.-point in 2040

**Figure 30. RES by technology 2017-2040 [%]**

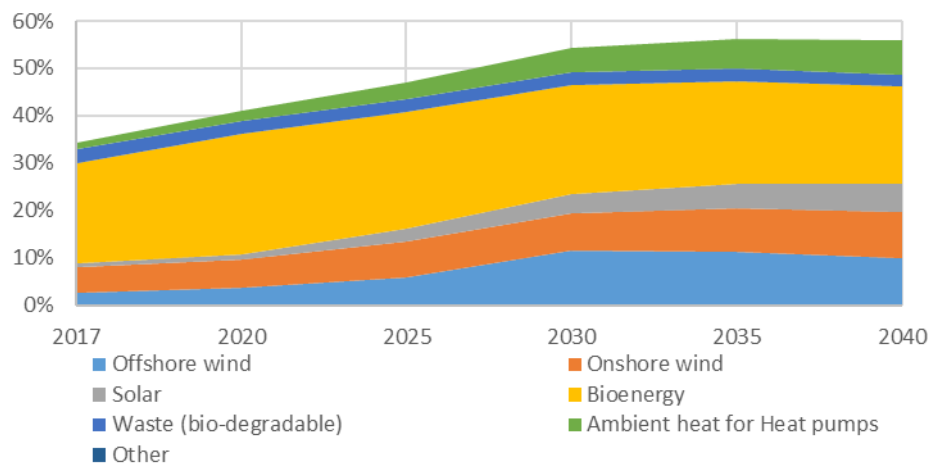


Figure 31 shows RES-H/C by technology from 2017-2040. A key result of the projection is that the share of bioenergy increases from 36 pct.-point in 2017 to 42 pct.-point in 2030, but then falls to 39 pct.-point in 2040, largely due to heat pumps penetrating the market. In the projection, the share of ambient heat for heat pumps increases from 3 pct.-point in 2017 to 12 pct.-point in 2030 to 17 pct.-point in 2040

Other results are:

- The share of solar energy increases from 1 pct.-point in 2017 to 2 pct.-point in 2030 to 3 pct.-point in 2040
- The share of waste (bio-degradable) is constant with 5 pct.-point in 2017 to 2030 and to 2040

**Figure 31. RES-H/C by technology 2017-2040 [%].**

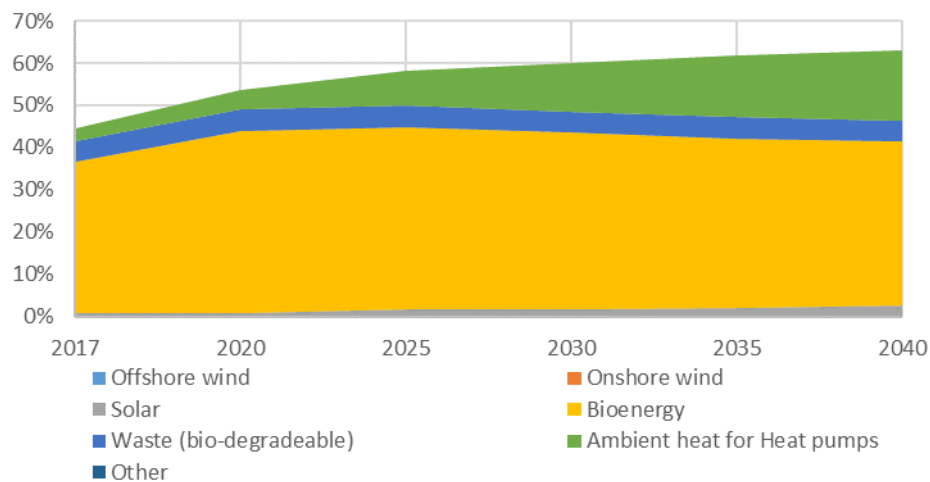


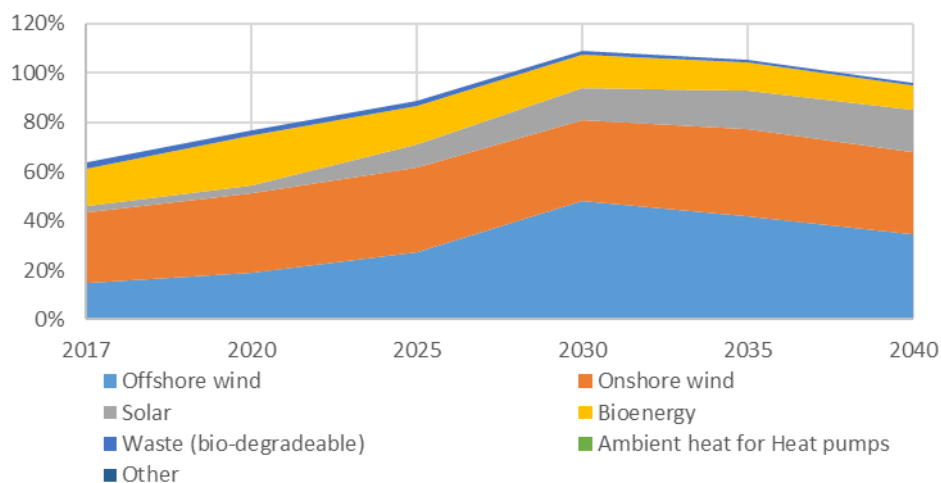
Figure 32 shows RES-E by technology from 2017-2040. Overall, it is worth noting that the increase in the RE share of electricity towards 2030 is particularly due to an increase in wind and solar. For example, the share of offshore wind power increases from 15 % in 2017 to 48 % in 2030, and the share of solar energy increases from 3 % in 2017 to 13 % in 2030.

Other results of the projection are:

- The share of onshore wind power increases from 29 pct.-point in 2017 to 33 pct.-point in 2030 to 34 pct.-point in 2040
- The share of bioenergy decreases from 15 pct.-point in 2017 to 13 pct.-point in 2030 to 9 pct.-point in 2040
- to 17 pct.-point in 2040
- The share of waste (bio-degradable) is constant with 2 pct.-point in 2017 to 2030 and decreases to 1 pct.-point in 2040

As also mentioned above, the reason why overall RE share of electricity drops below 100 % again by the end of the 2030'es, is largely due to growing electricity consumption from mainly data centres (HSDC's), and that no decisions are yet taken on the establishment of new production capacity beyond 2030.

**Figure 32. RES-E by technology 2017-2040 [%]**

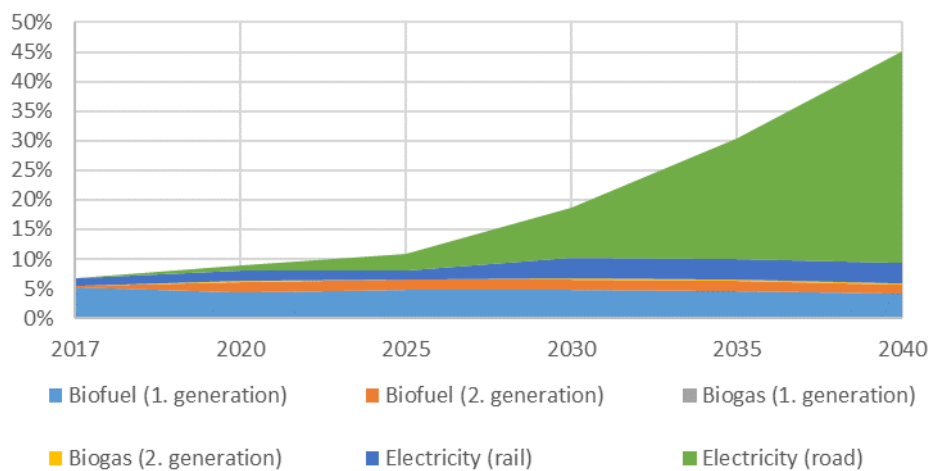


In terms of RE in transport, the development is very much dependent on how fast Electric Vehicles will penetrate the market. With the current knowledge, and the existing policies and measures, it is expected that this development takes off in the mid-2020's. With that assumption, Figure 33 shows the share of Renewable Energy in transport by technology from 2017-2040.

The projection shows that:

- The share of biofuel first generation is constant with 5 pct.-point in 2017 to 2030 and decreases to 4 pct.-point in 2040
- The share of biofuel second generation increases from 0 pct.-point in 2017 to 2 pct.-point in 2030 and in 2040
- The share of electricity rail increases from 1 pct.-point in 2017 to 3 pct.-point in 2030 to 4 pct.-point in 2040
- The share of electricity road increases from 0 pct.-point in 2017 to 8 pct.-point in 2030 to 36 pct.-point in 2040

**Figure 33. RES-T by technology 2017-2040 [%]**



### 4.3. Energy efficiency

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

The trends in primary and final energy consumption in the economy from 2005-2040 are shown in Figure 34 below.

The figure shows that in 2017:

- Primary energy consumption was 18.131 ktoe
- Final energy consumption was 14.863 ktoe
- Ratio between primary energy consumption and final energy consumption was 0,81

**Figure 34. Primary and final energy consumption 2005-2040 [ktoe]**

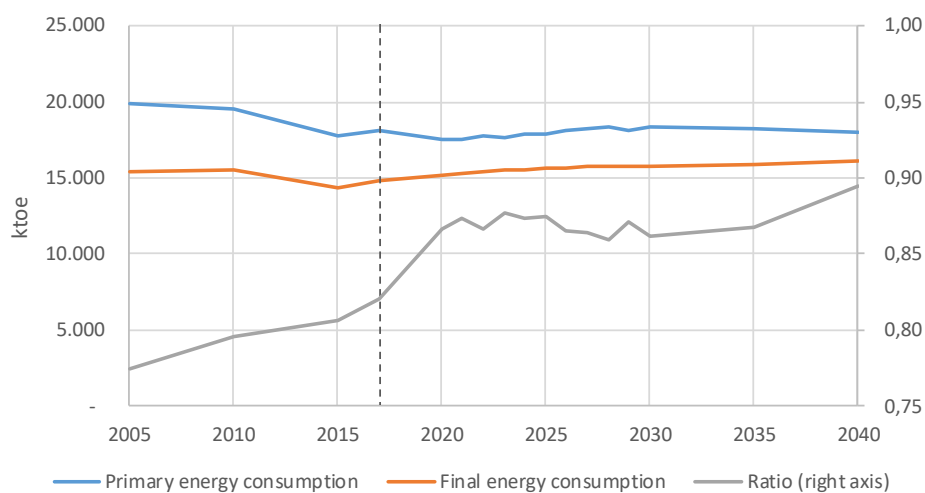


Figure 35 shows the trends in final energy consumption by sector from 2017-2040.

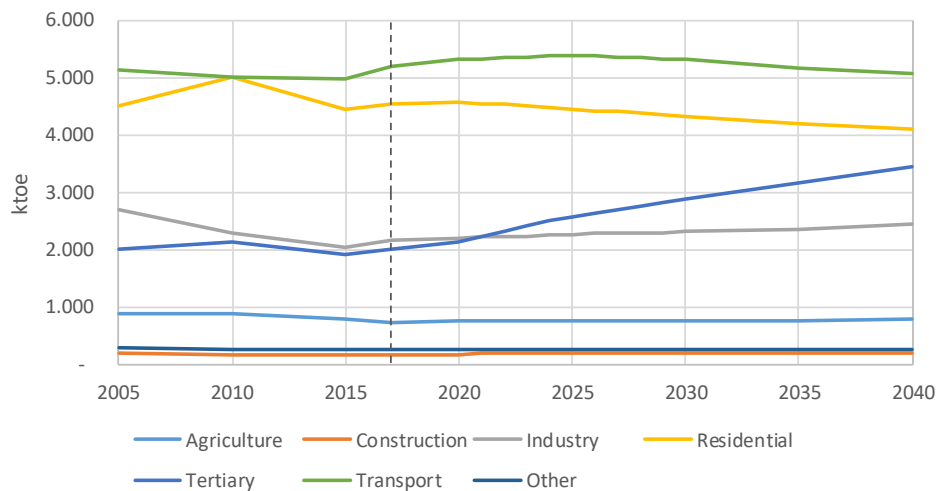
The figure shows that the transport (35 %) and the residential (31 %) sector accounted for the largest shares of the final energy consumption in 2017.

The share of final energy consumption in the other sectors in 2017 was:

- industry 15%
- tertiary 13%
- agriculture 5%
- construction 1%



**Figure 35. Final energy consumption by sector 2017-2040 [ktoe]. Tertiary sector includes HSDC.**



### **(ii) Current potential for the application of high-efficiency cogeneration and efficient district heating and cooling**

A comprehensive assessment of the potential for the application of high efficiency cogeneration and efficient district heating and cooling in Denmark was delivered to the Commission in December 2015 in accordance with article 14, 1 in Directive 2012/27/EU.

The technical potential of district heating is expected to increase by 1194 ktoe in 2035. The business economic potential is expected to reach 3583 ktoe in 2020, which is an increase by ~1433 ktoe compared to 2013 (Energi, 2015).

The socio economic potential is expected to increase from ~1911 ktoe in 2013 to 3105 ktoe in 2020. From 2020 to 2030 the analysis shows that socio economic potential district heating potential decreases to around 2388 ktoe.

The potential for combined heat and power in Denmark is expected to decrease from covering 73 % of the district heating demand in 2012 to covering 63 % in 2025 as a result of the integration of RES-electricity sources in the electricity grid.

The combined heat and power have relatively high marginal costs compared to e.g. wind and PV, and are therefore estimated to be less feasible in the future energy system in Denmark. When there is reduced market incentive to produce electricity from the combined heat and power it is more economic feasible to only invest in heat producing units. The decrease in combined heat and power is not substituted by thermal power production, but by intermittent renewable energy share and renewable energy district

heating technologies. There are no national strategies to change this development as the energy security level is high in the Danish electricity grid (99.99 %) and because there are several renewable energy share alternatives to produce heat for district heating grids.

The district cooling potential is not expected to change dramatically in the period 2006-2030 and it is expected to reach 2,866 MW. The socio economic potential is 2,211 MW and therefore it is almost corresponding to the technical potential.

**(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)**<sup>53</sup>

Section 4.3(i) showed the current primary and final energy consumption. This section describes the projections from 2017-2040, shown in the figures presented in the section 4.3(i).

Figure 34 shows the development in primary energy consumption, final energy consumption and ratio from 2017-2040. The projection shows that:

- Primary energy consumption increases 1% from 2017 to 2030 and decreases 1% from 2017 to 2040
- Final energy consumption increases 6% from 2017 to 2030 and 8% from 2017 to 2040
- ratio increases 5% from 2017 to 2030 and 9% from 2017 to 2040

Figure 35 shows final energy consumption by sector from 2017-2040. A key result of the projection is that only the residential energy consumption is expected to fall, while for the other sectors energy consumption is expected to stay at roughly the same level. The largest increase in energy consumption is expected in the tertiary sector, particularly due to expected new electricity consumption by large data centres, HSDC's, (COWI A/S for the Danish Energy Agency, 2018). However, there is still considerable uncertainty associated with projecting electricity consumption by large data centres.

The concrete results of the projections are:

- agriculture increases 2% from 2017 to 2030 and 5% from 2017 to 2040
- construction increases 6% from 2017 to 2030 and 8% from 2017 to 2040
- industry increases 6% from 2017 to 2030 and 12% from 2017 to 2040
- residential decreases 5% from 2017 to 2030 and 10% from 2017 to 2040
- tertiary increases 44% from 2017 to 2030 and 73% from 2017 to 2040
- transport increases 2% from 2017 to 2030 and to decreases 2% from 2017 to 2040

Moreover, Figure 35 shows the share by sector of final energy consumption (FEC) in 2030 and 2040. The projection shows that:

- agriculture accounts for 5% of FEC 2030 and FEC 2040

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<sup>53</sup> This reference business as usual projection shall be the basis for the 2030 final and primary energy consumption target, which is described in 2.3 and conversion factors.



- construction accounts for 1% of FEC 2030 and FEC 2040
- industry accounts for 15% of FEC 2030 and FEC 2040
- residential accounts for 27% of FEC 2030 and 26% of FEC 2040
- tertiary accounts for 18% of FEC 2030 and 22% of FEC 2040
- transport accounts for 34% of FEC 2030 and 32% of FEC 2040

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

Denmark has submitted the latest cost-optimal report to the Commission on March 23, 2018. The cost-optimal report shows the following overall conclusions:

In general, the overall level for requirements for new buildings is a little tighter than what is required by the Energy Performance of Buildings Directive (EPBD). The weighted average for new buildings shows that the Danish requirements are 21 % tighter than the cost-optimal level. However, there are variations between different types of buildings.

For building elements that are subject to a renovation, the requirements are also near the cost-optimal point. The calculations show variations for different types of constructions depending on the starting point of the insulation levels of the existing constructions.

For buildings undergoing major renovation, the building regulations include renovation classes that can be used. The levels in these classes have been evaluated in the cost-optimal report, and the report showed that the level was not sufficiently tight. The weighted average showed that the requirement in average was 30 percent from the cost-optimal point. After the cost-optimal report was published, the levels of the renovation classes have been lowered. The renovation classes, therefore, are now within the cost-optimal range.

Overall, the report shows that Denmark fulfills the requirements of cost-optimal levels in building regulations.

## 4.4. Energy security

### (i) Current energy mix, domestic energy resources, import dependency, including relevant risks

Figure 36 shows that for gross inland energy consumption in 2017 by energy source:

- solids (mainly coal) accounted for 12%
- oil accounted for 36%
- natural gas accounted for 17%
- solid biomass accounted for 19%
- other bioenergy accounted for 6%
- other renewables (wind and solar) accounted for 9%
- waste accounted for 2%

Figure 36. Gross inland energy consumption by energy source 2005-2040 [ktoe].

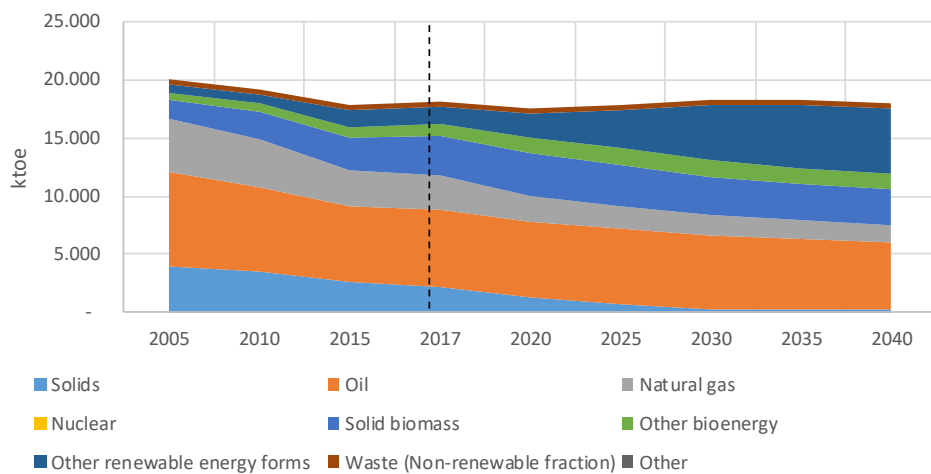


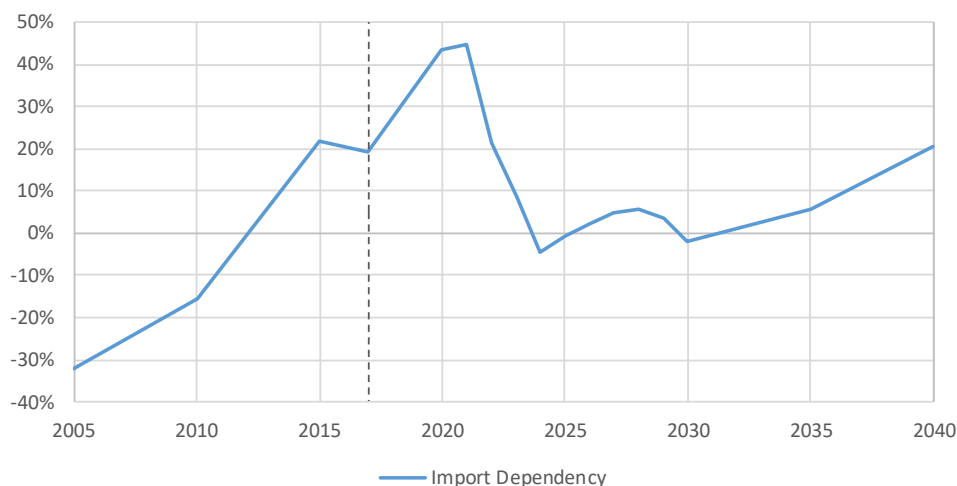
Figure 37 shows that import dependency in 2017 was 19%. However, as the figure shows, this situation has changed significantly over the past years, and is projected to change in the future.

Denmark's self-sufficiency peaked at 155 % in 2004. Since then, due to decreasing production of oil and gas, import dependency has increased and the phasing out of (imported) coal and increased renewable energy production has not yet been sufficient to cover the deficit. From early 2020's, when the Tyra gas field is expected back in operation, import dependency is expected to drop significantly, as shown in Figure 37.

The development in the mid- and second half of the 2020's reflects several developments, including on the one hand the expiration of energy efficiency measures from the Energy Agreement from June 2018 in 2024, and on the other hand three large wind farms expected to begin operations.

The projected development from 2030 to 2040 reflects the methodology used, i.e. projections done with existing policies and measures. This implies that while projections assume an expected increase of consumption of energy, mainly from data centres, HSDC's, there is currently no decisions on deployment of new production capacity beyond 2030 to offset this increase.

**Figure 37. Import dependency 2005-2040 [%]**



The most relevant risks to Danish energy security, looking ahead to 2040, is

- sufficient supply of biomass and a well-functioning market
- development in global oil supply, including a well-functioning market with balance between supply and demand
- energy system challenges related to the nature of fluctuating wind and solar power.

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

Results describe in this section refers to the projection part of Figure 36 and Figure 37 on energy mix presented in the previous section.

Figure 36 shows from 2017-2040 the gross inland energy consumption. A key result is that solids (mainly coal) decrease 86% from 2017 to 2030 and 87% from 2017 to 2040 and “other renewables” (wind and solar) increase 200% from 2017 to 2030 and 252% from 2017 to 2040.

Other results of the projections are:

- oil decreases 5% from 2017 to 2030 and 13% from 2017 to 2040
- natural gas decreases 40% from 2017 to 2030 and 49% from 2017 to 2040
- solid biomass decrease 2% from 2017 to 2030 and 12% from 2017 to 2040
- other bioenergy increases 38% from 2017 to 2030 and 32% from 2017 to 2040
- waste decreases 3% from 2017 to 2030 and 5% from 2017 to 2040
- Figure 36 shows projected energy consumption by energy sources in 2030 and 2040. A key result is that solids (mainly coal) accounts for only 2% of projected energy consumption in 2030 and 2040 and that other renewables (wind and solar) accounts for 26% in 2030 and 32% in 2040

The projection also shows that:

- oil accounts for 34% in 2030 and 32% in 2040
- natural gas accounts for 10% in 2030 and 8% in 2040
- solid biomass accounts for 18% in and 17% 2040
- other bioenergy accounts for 8% in 2030 and 7% in 2040
- waste accounts for 2% in 2030 and 2040

Figure 37 shows from 2017-2040 the import dependency. The projection shows that import dependency decreases from 19 pct.-point in 2017 to -2 pct.-point in 2030 and increases to 20 pct.-point in 2040. An explanation for this is given above under Section 4.4 (i).

## 4.5. Internal energy market

### 4.5.1 Electricity interconnectivity

#### (i) Current interconnection level and main interconnectors<sup>54</sup>

The current interconnection level<sup>55</sup> in Denmark is at 50.6%. Table 11 and Table 12 show the current interconnection level and the current interconnector's development respectively.

**Table 11: Current interconnectors**

Name	Price areas connected	Capacity [MW]
Skagerrak 1-4	DK1 <sup>56</sup> -NO1	1700
Konti-Skan 1-2	DK1-SE3	740
Kassø-Audorf <sup>57</sup>	DK1-DE	2500
Bornholm-Sweden	DK2 <sup>58</sup> -SE4	60
Storebælt	DK1-DK2	600
Øresund	DK2-SE4	1300/1700 <sup>59</sup>
Kontek	DK2-DE	585

**Table 12. Interconnectors under construction**

Name	Price areas connected	Capacity [MW]	Commissioning year
CobraCABLE	DK1-NL	700	2019
Kriegers Flak CGS	DK2-DE	400	2019
Viking Link	DK1-UK	1400	2023
Endrup-Niebuß	DK1-DE	1000	2023

#### (ii) Projections of interconnector expansion requirements (including for the year 2030)<sup>60</sup>

- Energinet is undertaking an analysis on the future level of security of supply in DK2 given that more and more thermal power plants will be closing in the near future
- In ENTSO-E's Ten-Year Network Development plan 2018 a new interconnector, Kontek 2, between DK2 and DE is mentioned

<sup>54</sup> With reference to overviews of existing transmission infrastructure by Transmission System Operators (TSOs).

<sup>55</sup> As the ratio between import interconnection and net generation capacities of the country.

<sup>56</sup> DK1 consists of Jutland and Funen.

<sup>57</sup> The present interconnector capacity is 1500 MW from Germany and 1780 MW towards Germany; however, the interconnector is currently being upgraded to a capacity 2500 MW in both directions.

<sup>58</sup> DK2 consists of Zealand, Lolland, Falster and Bornholm.

<sup>59</sup> 1700 MW export capacity to Sweden and 1300 MW import capacity from Sweden.

<sup>60</sup> With reference to national network development plans and regional investment plans of TSOs.

- Energinet and TenneT along with several other project partners launched the North Sea Energy Hub in 2017. The projects concern the construction of an island in the North Sea which will serve as a hub for offshore wind power production in the North Sea and the island could be connected to the Netherlands, Denmark and Germany and possibly other countries as well. The project is still in the initial stage where feasibility studies on a wide range of topics are being conducted to determine whether to take the project to the next stage. The project is part of ENTSO-E's Ten-Year Network Development Plan 2018. If final decision on investment is made, the project will probably be constructed in steps. Moreover, the Government is investigating the potential for Denmark to construct the first energy island by 2030, with a minimum of 10 GW connected.
- A number of other interconnectors are approaching their end-of-life, and consequently a decision whether to reinvest, build a brand new interconnector or invest in something else should be taken

#### 4.5.2 Energy transmission infrastructure

##### (i) Key characteristics of the existing transmission infrastructure for electricity and gas<sup>61</sup>

###### Electricity

Denmark is divided into two price areas, Western Denmark (DK1) and Eastern Denmark (DK2) separated by Storebælt. Western Denmark is connected and is operated in synchrony with the continental European grid and Eastern Denmark runs in synchrony with the Nordic grid. Western and Eastern Denmark are only connected through the Storebælt-interconnector. Table 13 and Table 14 show detailed information.

**Table 13. Length of overhead lines and cables by voltage level**

Line-km	Overhead lines	Cables	Sum
132 kV	753	476	1.228
150 kV	1.216	605	1.822
220 kV	40	84	124
400 kV	946	114	1.061
Sum	2.956	1.279	4.235

<sup>61</sup> With reference to overviews of existing transmission infrastructure by TSOs.



**Table 14. Number of substations and transformers**

Number	Substations	Transformers
132 kV	75	112
150 kV	78	107
220 kV	5	5
400 kV	26	30
Sum	184	254

### Gas

The Danish gas transmission system (80 bar) is owned and operated by Energinet, the Danish TSO. The gas grid is connected to natural gas fields in the North Sea and the international gas market through three entry/exit points (Nybro, Ellund and Dragør) where all natural gas enters Denmark.

Natural gas can be supplied to domestic consumers using the transmission and distribution grid. The transmission tariff varies depending on where shippers book entry and/or exit capacity.

Energinet has fully implemented the network code on harmonised transmission tariff structures for gas (TAR NC) with the approval of the methods by the Danish Utility Regulator in May 2019, and as of October 2019, the tariffs will be in accordance with the TAR NC. Henceforth, regular method approvals by the Danish Utility Regulator of the tariff structures will be carried out.

### Characteristics of the Danish gas system

- Transmission grid, length: approx. 900 km
- The transmission grid is connected to the distribution network via 42 M/R stations, which regulate the pressure down to the level of the distribution companies' pipeline systems
- 4 metering stations

### **(ii) Projections of network expansion requirements at least until 2040 (including for the year 2030)<sup>62</sup>**

Onshore wind along with solar power are constituting a more and more substantial part of the energy mix so the growing need for the integration of these energy sources is also reflected in the need for expansion of the transmission grid.

In terms of domestic heating, the expected large-scale implementation of heat pumps is also expected to have a major impact on the requirements of the future transmission grid.

<sup>62</sup> With reference to national network development plans and regional investment plans of TSOs.

The maps below show some of the possible future transmission grids as expected by Energinet, however these possible grid structures have not received approval, they only represents how the Danish TSO expects the transmission grid to develop.

**Figure 38. Possible electricity transmission grid structure by 2027 drafted by the Danish TSO, Energinet (Energinet, 2018)**

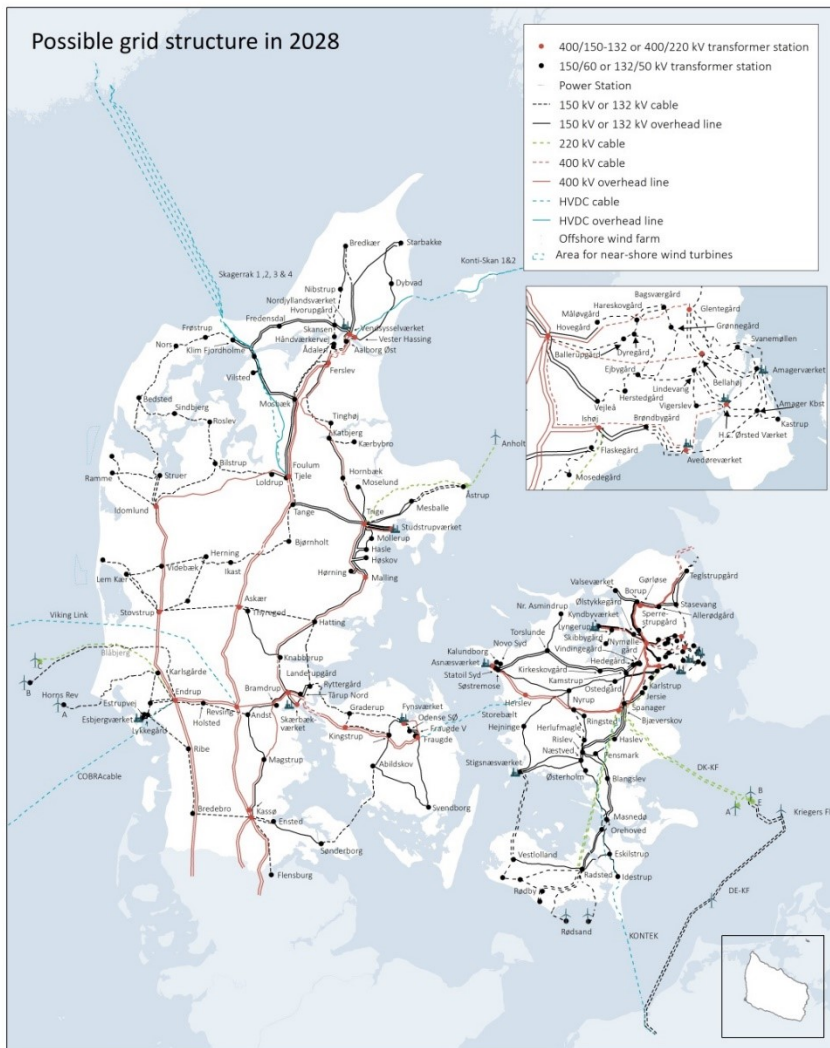




Figure 39. Electricity transmission grid structure by 2040 (Danish TSO, Energinet) (Energinet, 2018)



The Danish gas pipeline network is well developed and there are currently no plans for further network expansion besides the ongoing Baltic Pipe Project. Baltic Pipe (BP) is a project between the Polish TSO – GazSystem – and the Danish TSO – Energinet – with the objective to transport gas from Norway to Poland via Denmark. In order to ensure sufficient transport capacity, the Danish transmission system needs to be expanded as part of the project.

Baltic Pipe will include the following technical systems and installations:

- A 105-110 kilometre long, new offshore gas pipeline from Norway’s pipeline Euro-pipe II in the North Sea to a receiving terminal located on shore in Denmark.
- Expansion of the Danish transmission system with a new gas pipeline, approximately 210-230 km long.
- A compressor station in the south-east part of Zealand.

- A 260-310 km long offshore gas pipeline in the Baltic Sea between Denmark and Poland. The Polish TSO - GAZ-SYSTEM - is in charge of establishing and operate the gas pipeline across the Baltic Sea between Denmark and Poland.
- Expansions of Poland's transmission system.

The final investment decision was made in 2018, and the pipeline is scheduled to come on stream by October 2022.

#### **4.5.3 Electricity and gas markets, energy prices**

##### **(i) Current situation of electricity and gas markets, including energy prices**

Electricity in Denmark is divided into two zones, DK1 (Western DK), DK2 (Eastern DK). For the winter period 2017/2018 (October 2017 – March 2018), the average price for the whole of Denmark was 32.8 EUR/MWh

- DK1 31.4 EUR/MWh
- DK2 was 34.2 EUR/MWh (Energitilsynet, 2017)

Electricity in 2017 was:

- electricity production 29 Twh
- electricity import 5 Twh
- electricity production including grid losses 34 Twh

Gas prices in 2017 showed that:

- average gas prices for households consumers excluding taxes and levies accounted for 0,456 MEUR/ktoe
- average gas prices for industrial users excluding taxes and levies accounted for 0,278 MEUR/ktoe

Gas production in 2017 including bio natural gas was 2,65 bio Nm<sup>3</sup>

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

Figure 40 shows that DK's average price increases 7% from 2019 to 2030 and 22% from 2019 to 2040.

**Figure 40: Spot price and chosen price zones 2019-2040 [2019-EUR/MWh]**

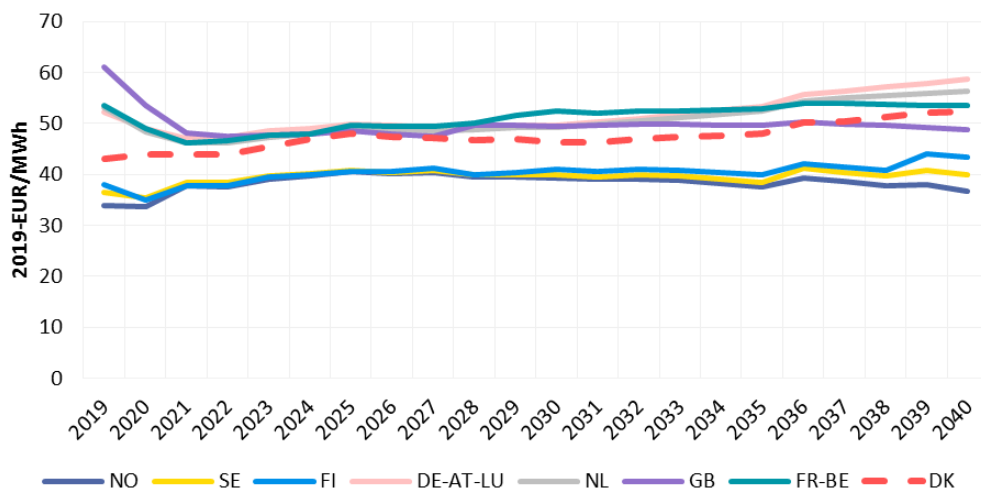


Figure 41 shows that electricity production (including grid losses) increases 33% from 2019 to 2030 and 62% from 2019 to 2040.

**Figure 41: Electricity supply and demand and net import/export 2019-2040 [TWh]**

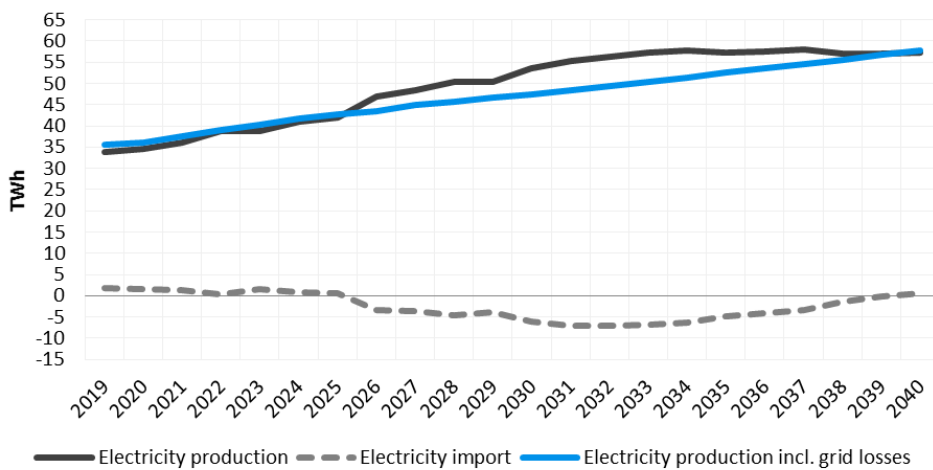


Figure 42 shows that the natural gas price for final consumers decrease 10% from 2019 to 2030 and increase 2% from 2019 to 2040.

**Figure 42: Natural gas price 2019-2040 [Meuro/ktoe].**

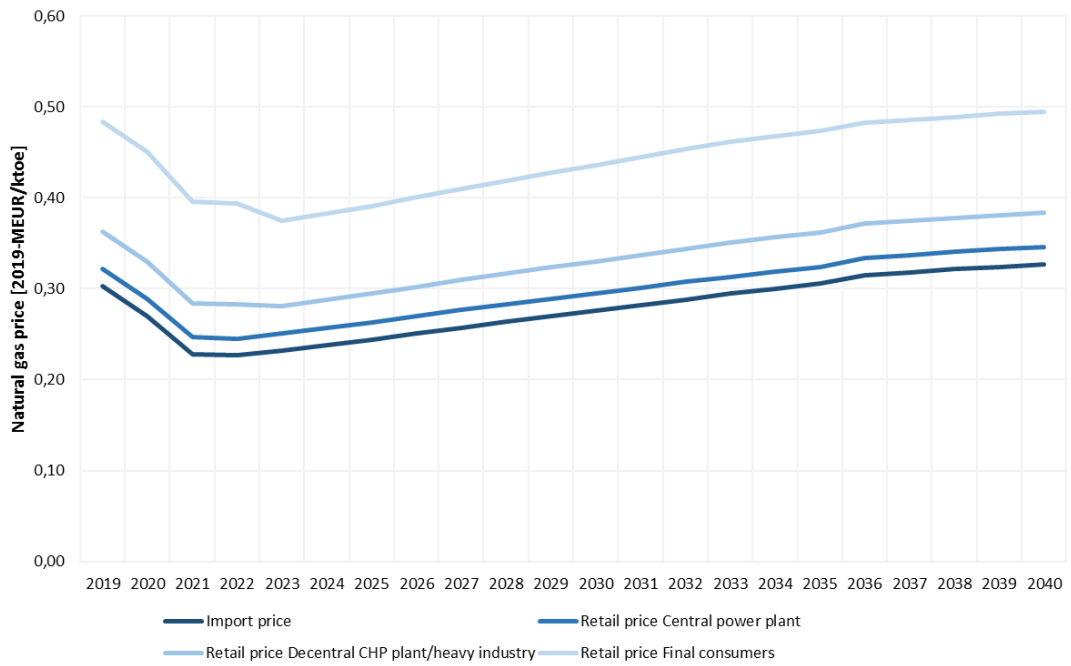


Figure 43 shows total gas consumption (incl. Denmark, exports to Sweden and to Germany) from 2019-2040. The Projection shows:

- DK's gas consumption decreases 22% from 2019 to 2030 and 35% from 2019 to 2040
- exports to Sweden decrease 13% from 2019 to 2030 and 30% from 2019 to 2040

**Figure 43. Gas consumption 2019-2040 [Mill. Nm<sup>3</sup>]**

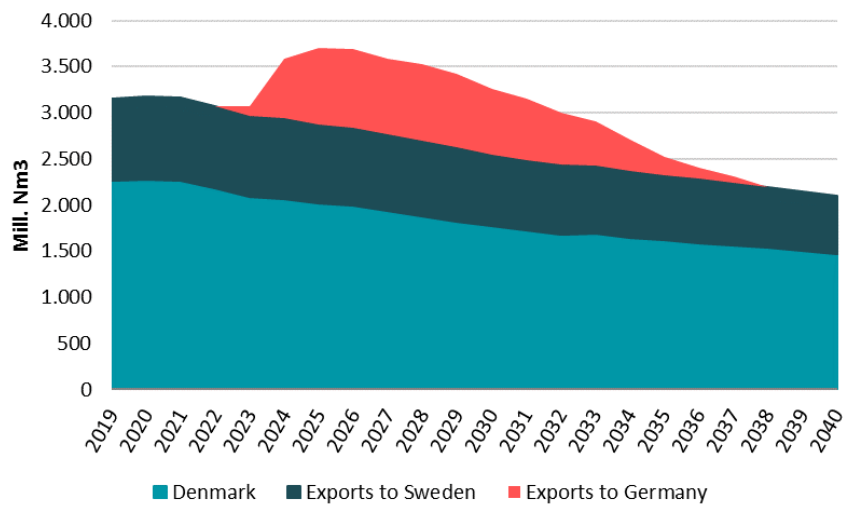
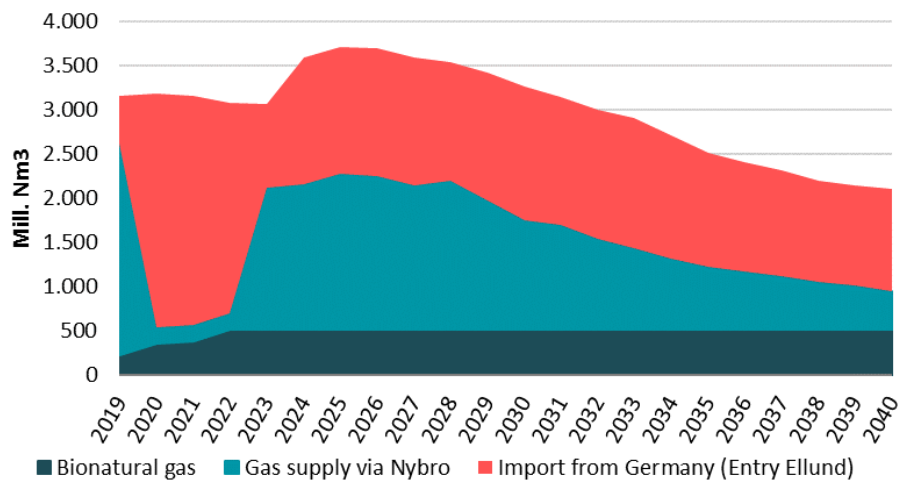


Figure 44 shows total gas production including bio natural gas and imports from Germany from 2019-2040. The projection shows that:

- bio natural gas production increases 122% from 2019 to 2030 and to 2040
- gas supply via Nybro increases 48% from 2019 to 2030 and 82% from 2019 to 2040
- imports from Germany increases 177% from 2019 to 2030 and 113% from 2019 to 2040

**Figure 44. Gas production and imports 2019-2040 [Mill. Nm<sup>3</sup>]**





## 4.6. 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)**

The low-carbon technology sector in Denmark in this chapter includes all carbon neutral technologies (wind, solar, hydro power, bio mass etc.) as well as technologies that support necessary means for the transition to a low-carbon energy system (smart grids, storage etc.). The sector employs around 31.200 full-time workers, which corresponds to 43% of the total employees in the energy sector.<sup>63</sup> The low-carbon industry is more active within research and innovation, with an average of 9 out of 100 employees working in the field of research and innovation compared to on average 5 out of 100 employees in traditional Danish companies.<sup>64</sup>

Denmark has in the years 2010-17 seen an increase in the export of energy technology of 31,5%, compared to an on average increase in EU15 of 9,9% (Energistyrelsen, 2017).

Denmark mainly exports to other EU countries, but export of energy technology to the US and China are on the rise.

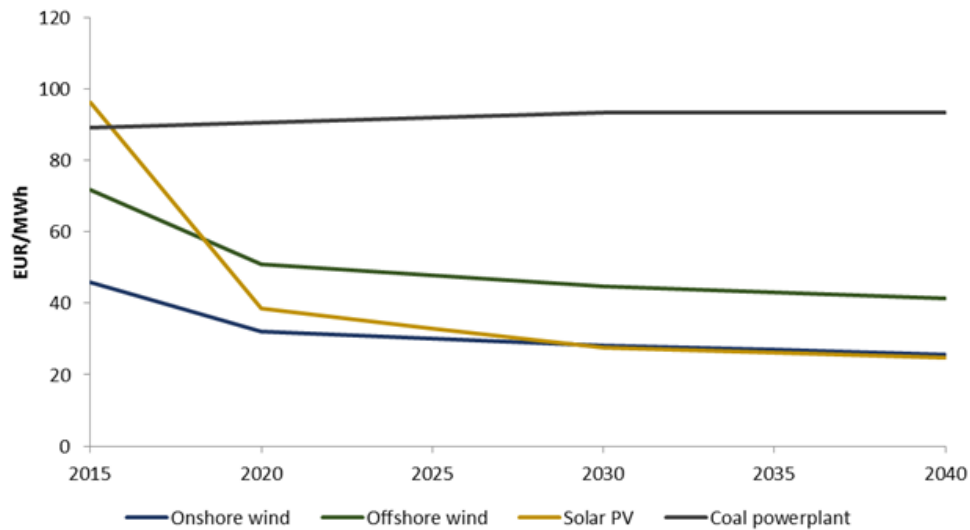
Figure 45 shows the competitiveness of onshore wind, offshore wind and solar PV by their levelized cost of electricity (LCoE). In 2017 the cost of producing electricity by wind and solar was lower than by a coal-fired power plant and their competitiveness is still increasing rapidly.

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<sup>63</sup> Damvad Analytics 2018

<sup>64</sup> Danmarks Statistik

**Figure 45. Levelized cost of electricity generation with years of final investment decision 2015-2040 [EUR/MWh] for utility scale wind and solar and a coal-fired power plant.**



For detailed information on the gross final energy consumption and the RES by technology see section 4.2.2.

**(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**

The public spending for research and innovation programmes<sup>65</sup> in renewable technologies in 2017 is listed in Table 15 (ref. Energiforskning.dk). The numbers in Table 15 include spending from three public funding programmes (Energy Technology Development and Demonstration Program, Innovation Fund Denmark and ELFORSK).

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<sup>65</sup> In addition to the specific programs for new renewable technologies, the public research institutions perform R&D within renewable energy technologies funded through unspecified funds such as the general university funds.

**Table 15. Government budget allocation for R&D and demonstration of new renewable technology programmes in 2017.**

Category	mio. EUR
Biomass and waste	0,8
Energy efficiency	17,4
Hydrogen and fuel cells	5,1
Smart grids and systems	24,6
Solar energy	1,3
Wave energy	0,2
Wind energy	7,3
Other	1,4
<b>Total</b>	<b>58,0</b>

Not all categories in the table directly supports low-carbon technologies. But they support necessary means for the transition to a low-carbon energy system.

In 2015, private companies spent approximately 536 Mill. EUR on research and development in energy research (Damvad Analytics, 2018).

Denmark has appr. 42 patents pr. mill. inhabitants in technologies related to minimizing climate changes.

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

The following tables show a breakdown of electricity and gas prices on energy, network and taxes/levies for businesses and households.

Table 16 and Table 17 show price components for businesses and households:

- for businesses, the energy price accounts for approximately 20-50% of the total price
- for households, the energy price only accounts for 10-20% of the total price

**Table 16. Price components for businesses in 2017[EUR cent/kwh]**

BUSINESSES				
	Price elements (EURcent/kwh)			
Interval (MWh)	Electricity price	Network	Taxes and tariffs	Total price
0-20	4,38	4,93	9,80	19,11
20-500	3,71	4,31	2,19	10,21
500-2.000	3,64	3,95	2,16	9,75
2.000-20.000	3,60	3,94	2,07	9,60
20.000-70.000	3,36	1,51	1,98	6,85
70.000-150.000	3,35	1,51	1,97	6,83
> 150.000	3,24	1,51	2,02	6,77



Table 17. Price components for households in 2017 [EUR cent/kwh]

HOUSEHOLDS				
Interval (MWh)	Price elements (EURcent/kwh)			
	Commercial electricity price	Network	Taxes and tariffs	Total price, Incl. VAT
0-1.000	3,91	10,94	22,24	37,09
1.000-2.500	3,91	7,17	21,30	32,37
2.500-5.000	3,91	5,29	20,83	30,02
5.000-15.000	3,91	4,39	15,10	23,40
> 15.000	3,91	4,24	13,26	21,40

Table 18 and Table 19 show gas price components for businesses and for households:

- for businesses, the energy accounts for approximately 30% of the total price before refundable taxes. However, some business consumers are eligible for a tax refund, after that, the energy price on average constitute up to approximately 60-70% of the total price for business with high gas consumption.
- for households, the energy price accounts for approximately 30-35% of the total price.

Table 18. Price components for businesses in 2017 [EUR/m3].

BUSINESSES	Inclusive taxes and levies					Refundable taxes/levies subtracted				
	Band I	Band II	Band III	Band IV	Band V	Band I	Band II	Band III	Band IV	Band V
2017H2 (EUR/m3)										
Gas price	0,26	0,26	0,23	0,22	0,21	0,26	0,26	0,23	0,22	0,21
Transmission and distribution	0,15	0,14	0,06	0,04	0,04	0,15	0,14	0,06	0,04	0,04
Taxes	0,38	0,38	0,36	0,36	0,35	0,33	0,26	0,12	0,07	0,07
<b>Total, excl. VAT</b>	<b>0,79</b>	<b>0,77</b>	<b>0,65</b>	<b>0,62</b>	<b>0,60</b>	<b>0,74</b>	<b>0,65</b>	<b>0,41</b>	<b>0,33</b>	<b>0,32</b>

Table 19. Price components for households.

HOUSEHOLDS			
2017H2 (EUR/m3)	Band I	Band II	Band III
Gas price	0,36	0,26	0,29
Transmission and distribution	0,36	0,20	0,15
Taxes	0,38	0,38	0,38
<b>Total, excl. VAT</b>	<b>1,11</b>	<b>0,84</b>	<b>0,82</b>

#### (iv) Description of energy subsidies, including for fossil fuels

Denmark provides subsidies for renewable energy technologies, e.g. onshore wind, offshore wind, solar PV, biomass and biogas. Subsidies are given as production subsidy per kWh, normally for a limited number of years. The costs of renewable technologies is steadily declining, and becoming competitive with fossil fuel sources.

It is a strong political objective to promote future electricity production from renewable energy on market conditions free of subsidies.

The current energy subsidies are described below. For fossil fuel subsidies, see section 3.1.3 (iv).

Energy subsidies for utility scale plants

- Biomass fired power plants receive a fixed premium of 2 EUR cent/kWh electricity for non-depreciated plants. Electricity generated from biomass is closely related to generation of heat. Hence, the tax exemption on heat generated from biomass has a huge impact on how much electricity is generated from biomass. Depreciated plants will receive a subsidy covering only operational costs (subject to approval from the EU commission). (Energistyrelsen, 2019b)
- Subsidies for offshore windfarms are set through tenders. Kriegers Flak is the latest settled Danish offshore tender. It resulted in a feed in tariff of 5 EUR cent/kWh for the first 30 TWh for the 605 MW windfarm, which is set to be commissioned in 2021 (Energistyrelsen, 2019e)
- As of 2018 the subsidies for future offshore wind and solar PV will be offered through a tendering procedure, allowing these technologies to compete against each other and provide a downward pressure on the subsidy level. Later more technologies will be included in the tenders and allow these to compete for support. The latest tender in 2018 resulted in a total of approximately 260 MW onshore wind turbines and approx. 280 MW solar PV installations, with a weighted average price premium of the winning bids of approximately 0.31 EUR cent/kWh (Energistyrelsen, 2019f)
- Heat produced from biomass receives an indirect subsidy by being exempted from CO<sub>2</sub> and energy tax (Energistyrelsen, 2019d)
- In Denmark, the use of biogas is supported through various aid schemes, and different types of end-use are eligible for support. The subsidy is paid to the end-user of biogas, i.e. where biogas is used to produce heat/electricity, or upgraded and injected into the gas grid. There are currently 5 recognized uses of biogas (electricity production, upgrading to biomethane and injected to grid, transport, heat production, industrial processes). The current subsidy schemes are however coming to an end and will not be granted to new producers after January 1<sup>st</sup> 2020.
- Electricity producers using biogas are eligible for a feed-in tariff which can be received in two forms. Either as a CfD where the electricity spot price is included (0,114 EUR/kWh in 2019), or a price premium (0,060 EUR/kWh) paid in addition to the electricity spot price. In addition to the tariff, the support scheme includes a variable rate which is regulated by the market price of natural gas (~0,031 EUR/kWh in 2019). If the market price of natural gas drops below a certain floor price, the subsidy increases and vice versa.
- Biogas that is upgraded to biomethane and injected into the gas grid is also eligible for aid. Biomethane producers are paid a feed in tariff (0,110 EUR/GJ in 2019) plus a variable rate which is regulated by the market price of natural gas (~0,031 EUR/GJ in 2019).

- Biogas used in industrial processes/for transportation is subsidized through a CfD (5,23 EUR/GJ) plus the variable rate tied to the market price of natural gas.
- Biogas used for heating purposes is eligible for the variable rate only.

Energy subsidies for residential scale plants:

- Residential wind turbines and solar PV systems receive an indirect subsidy by being exempted from electricity tax, public service obligation (PSO) and grid tariffs of the part of the produced electricity that is used for self-consumption behind the meter. This means that the prosumer on instant settlement has to pay tax on all electricity supplied from the collective grid – just like any other consumer of electricity. The excess production (the production that is not self-consumed) is sold to the collective grid at the SPOT price.
- Furthermore, the Danish government has agreed to lower the tax on heat produced from electricity. The tax is reduced from 4,12 Euro/kWh electricity to 2,08 Euro/kWh electricity from 2021. This is believed to increase the use of heat pumps, both in residential and collective heating. It is thereby a means to support the electrification of the heat sector and the green transition.

## **5. IMPACT ASSESSMENT OF PLANNED POLICIES AND MEASURES<sup>66</sup>**

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

The projections in this NECP, described in Chapter 4, are done on the basis of existing policies and measures, including initiatives in the most recent Energy Agreement of June 2018. These projections equal those published in the Danish Energy And Climate Outlook in September 2019. On 27 June 2019 a new Government took office, launching climate change as one of its main priorities. On December 6, 2019 the Government reached an agreement on a new Climate Act with 8 out of the 10 parties in the Danish Parliament. The act will include a legally binding target to reduce greenhouse gases by 70% by 2030 (relative to 1990 level), to reach net zero emissions by 2050 at the latest, and to set milestone targets based on a five-year cycle. The Government will, inter alia, propose climate action plans, which will launch new initiatives contributing to meeting the ambitious greenhouse gas emission reduction target.

At the time of the submission of the National Energy and Climate Plan, these initiatives, however, have not yet been proposed or developed to an extent, where they can be defined as “planned policies and measures” as defined by the Governance Regulation, i.e. being “(...) options that are under discussion and that have a realistic chance of being adopted and implemented after the date of submission of the integrated national energy and climate plan (...)”.

Consequently, no analysis has been made of the impacts of planned policies. Impact assessments of planned policies will be provided in progress reports, as appropriate, and as requested by the Governance Regulation.

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<sup>66</sup> Planned policies and measures are options under discussion and having a realistic chance of being adopted and implemented after the date of submission of the national plan. The resulting projections under section 5.1.i shall therefore include not only implemented and adopted policies and measures (projections with existing policies and measures), but also planned policies and measures.

## **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 green transition will require changes in and by the entire society, including changes that have economic and social consequences for society, companies and individuals.

Denmark is well aware of this, and it is an objective of the Danish Government to make the transition fair, just and equitable.

One result of this effort is the export of energy technology. In 2017, Danish exports of energy technology and energy services amounted to 85 billion DKK, which was 11.1 % of overall Danish exports of goods and services. Half of this export was green technologies. The green transition, hence, contributes significantly to Danish economy.

Another aspect of the green transition can be seen in the employment statistics. In 2015, 72,000 people were full-time employed within the energy sector, of which 41 % within the green energy sector. This was expected in the previous Energy Agreement from 2012. The green transition creates green jobs. Moreover, these green jobs are located in many different parts of Denmark, thereby supporting a geographically inclusive growth.

Looking ahead, the latest Energy Agreement of June 2018 likewise focuses on promoting Danish knowledge and Danish energy solutions globally, as ever more countries pursue a transition to green energy. Denmark intends to seize these opportunities through efforts such as bilateral collaborations with public authorities in other countries, thereby paving the way for other countries to benefit from Danish experiences and possibly also benefit Danish green exports (for more information see section 3.5).

Public awareness of climate change and energy issues has never been bigger. This is crucial to the choices to be made by all citizens. The Energy Agreement includes a reduction of energy taxes aimed at encouraging more people to choose green solutions such as heat pumps. This would also benefit society moving towards a flexible and integrated energy system and better utilisation of surplus heat in an energy system with a high share of fluctuating energy. The tax reductions will also reduce energy costs for Danes

Competences and skills needed for the green transition are not the same as for a society based on fossil fuels. This is reflected in the educational system on all levels from primary school to universities, where the green transition has triggered a change in study programmes unseen a decade ago.

The Danish Energy Agency has implemented different initiatives for the purpose of improving the skills and quality regarding installation of energy-related product in buildings. In 2008, the Agency established an information center for energy savings (<https://www.byggeriogenergi.dk>). The content of information in the information center is



targeted installation contractors. Furthermore, the Danish Energy Agency has a certification scheme for installing small renewable energy plants as part of the implementation of the EU-directive for renewable energy. Moreover, the agency and Danish Standards have recently developed a national standard that when published is expected to improve energy efficiency in heat pump installations.

In regard to health the projections of air pollutants shows an overall decrease in air pollutants emissions towards 2040 (for more information see section 4.2.1). This is expected to have a positive impact on the general health in society.

## 5.3 Overview of investment needs

### (i) existing investment flows and forward investment assumptions with regard to the planned policies and measures

Denmark's shift towards a greener energy system was most recently promoted with the Energy Agreement of 2018. The accumulated public and private investments flows initiated by the Energy Agreement is estimated in the range of DKK 100-180 billion DKK until 2030 – or approximately DKK 10 billion annually. The estimated investments flows can be divided into the main categories listed in Table 20 below.

**Table 20. Estimated public and private investment flows from 2018-2030 following the Danish climate and energy targets by 2030.**

<b>Estimated investment flows, by sector</b> (2018-prices, DKK billion)		
<b>Sector of investment</b>	<b>Investment description</b>	<b>Investment value</b>
Households	Energy efficiency and conversion of heat supply	20 - 30
Industry	Energy efficiency and new technology	10 - 30
Electricity	New renewable energy capacity installed	60 - 90
Gas and district heating	Biogas and new district heating capacity	10 - 30
<i>Total accumulated</i>		<i>100 - 180</i>

Note: The estimates of expected investments flows are associated with considerable uncertainties. The specified intervals do therefore not necessarily represent the entire span of possible investment outcomes. The estimation methodology of investment flows is based on expected installed volumes in the different categories and the corresponding expected unit prices. In addition to the estimated investments driven by a shift towards a greener energy supply, there will be other indirect "base load" investments associated with e.g. the conversion of power plants, as well as investments in district heating, gas and electricity transmission network which could amount to around DKK 5 billion annually.

The source of funding related to the above investments flows will in part come from both public and private capital. In particular, private capital is expected to constitute a substantial proportion of the funding as industry investments mostly are financed via capital from private financial institutions and investments funds. In terms of public sources of funding, future state budget laws will be implemented according to the agreed multi annual budget of the 2018 Energy Agreement, which is reproduced in Table 21.



**Table 21. Prioritised budgets 2018-2025 in the 2018 Energy Agreement. The agreement prioritises approximately 0.5 billion DKK in 2019, increasing to approximately 2.8 billion DKK in 2025.**

Budgetary impacts – priorities								
2018 prices, DKKm	2018	2019	2020	2021	2022	2023	2024	2025
World class offshore wind	2	10	17	16	105	117	220	376
Renewable energy on market conditions	0	0	0	6	291	346	392	429
- Technology-neutral RE subsidies	0	0	0	6	51	111	161	202
- New biogas and other green gasses	0	0	0	0	240	235	231	227
Reduction of taxes on electricity and restructuring of surplus heat utilisation	0	325	375	675	650	1,200	1,250	1,575
- of which reduction of the electrical heating tax	0	0	0	325	325	350	350	350
- of which reduction of the electricity tax	0	325	275	250	225	400	450	775
- of which abolishment of Annex 1 of the Electricity Tax Act	0	0	0	0	0	375	350	325
- of which restructuring of the regulations for surplus heat	0	0	100	100	100	100	100	100
Targeted energy saving effort	20	35	35	545	550	550	555	10
- of which subsidies for energy saving initiatives	0	0	0	500	500	500	500	0
- of which energy saving – data and information	19	33	34	44	44	44	44	0
Modernisation of the heating sector and mitigating impacts of eliminating the base subsidy	2	38	235	255	120	110	50	50
- of which modernisation of the heating sector	0	10	40	60	60	50	50	50
- of which base subsidy initiatives	2	28	195	195	60	60	0	0
Analyses, policy development and export promotion	3	53	64	52	47	44	42	0
- of which export promotion	0	20	31	31	31	31	31	0
- of which gas strategy	0	2	2	1	0	0	0	0
- of which electricity market and security of supply	3	4	5	3	3	3	3	0
- of which smart energy and storage	0	3	3	3	3	3	0	0
- bioenergy task force	0	2	2	2	0	0	0	0
- digitised public servicing of the utility sector	0	6	5	5	2	0	0	0
- task force for digitisation-ready legislation and smart energy - pilot phase	0	7	7	0	0	0	0	0
- of which analysis and model development	0	7	7	5	5	5	5	0
- Samsø Energy Academy	0	3	3	3	3	3	3	0
Funding for green transport	0	0	100	100	100	100	100	0
Funding for scrapping oil-fired boilers	0	0	0	20	20	20	20	0
Reserve for additional investments in RE as from 2025	0	0	0	0	0	0	0	400
Administrative costs	10	45	45	50	50	40	40	0
<b>Priorities, total</b>	<b>25</b>	<b>500</b>	<b>875</b>	<b>1,700</b>	<b>1,925</b>	<b>2,525</b>	<b>2,675</b>	<b>2,825</b>

Note: Due to rounding, there may be deviations between the sum of the components and the total sum. The tax reductions are listed in 2018 prices and calculated according to reversals and behavior. “Targeted energy saving effort” also includes derived lower tax revenue.

In addition, on December 2 2019 the Danish Government, its supporting parties and the Alternative reached agreement on the Finance Act 2020. The parties agreed to establish a new fund called “*Denmark’s Green Future Fund*”, which will manage a total of 25 billion DKK. The fund will contribute to the green transition in Denmark and abroad.

**(ii) Sector or market risk factors or barriers in the national or regional context**

Being a subsection of section 5.3 it is assumed the information to be reported here is information on sector or market risk factors or barriers in the national or regional context in relation to investment needs.

As mentioned in chapter 5.3(i) information both public and private investments are available for this reporting. The risk factors or barriers in the national context in relation to the investment needs relate to the budgets for achieving the objectives in the 2018 Energy Agreement. However, as announced in the 2018 Energy Agreement, progress with implementation of adopted measures will be closely monitored through frequent stock-takes and follow-ups.

The risk factors or barriers in the national context in relation to the investment needs will be minimised as any gaps in the need for additional public finance support or resources will be identified well in advance through the frequent stock-takes and follow-ups.

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

With the Energy Agreement being adopted in 2018 analyses with a view to identify gaps in the need for additional public finance support or resources have not yet been relevant.

As for financial support regarding private investment, Danish pension funds have recently announced that they plan to invest DKK 350 billion by 2030 in an effort to support the green transition.

## **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**

Nordic Energy Research, the platform for cooperative energy research and policy development reporting to the Nordic Council of Ministers and funded jointly by the Nordic governments, published *Nordic Energy Technology Perspectives 2016* together with the International Energy Agency in 2016 – a report looking at regional long-term, cost efficient, low-carbon technology pathways for the Nordic region.

This study presents a detailed scenario-based analysis of how the Nordic countries can achieve a near carbon-neutral energy system by 2050 (the Carbon Neutral Scenario, CNS) and compares this to a Nordic 4 Degrees Scenario (4DS) reflecting the Nordic contribution to the IEA's global 4-degrees scenario.

Thus, giving general information on how a Nordic cooperative approach towards near carbon neutrality could:

- i. Impacts on the energy system in neighbouring and other Member States in the region to the extent possible*
- ii. Impacts on energy prices, utilities and energy market integration*
- iii. Where relevant, impacts on regional cooperation*

The analysis in NETP 2016 is based on a scenario where Nordic energy-related CO<sub>2</sub>-emissions fall by 85% by 2050. The name –the Carbon-Neutral Scenario–reflects the wording used in official targets, although carbon neutrality requires offsets to be used for the remaining 15%. Thus, the CO<sub>2</sub> reduction pathway established in the NETP CNS scenario should be viewed as a minimum requirement. To enable the world as a whole to limit global warming to 1.5°C, as stated in the Nordic Prime Minister Declaration on Nordic Carbon Neutrality from January 2019, it is likely that additional abatement measures will be required.

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 2019*; 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. The report was launched in October 2019.

Some of the major findings of this study are that:

- For the period 2013 to 2016 the Nordic countries are on track to meet the carbon neutral pathway, even with higher GDP growth than expected, but it is likely that additional measures will be necessary to continue this trend.

- The positive development is mainly driven by the power and district heat sector which are delivering substantial CO<sub>2</sub>-emission reductions, falling from 60.7 MtCO<sub>2</sub> in 2007 to 37.4 in 2016, in line with the intermediate CNS 2030 target of 19.2 MtCO<sub>2</sub>.
- The Nordic countries have, in aggregate, seen the renewable energy share of total primary energy demand rising from 29% in 2006 to 39% in 2016 (+10 percentage points in 10 years).
- The electric vehicle share of the light-duty vehicle stock are on track to the 2020 CNS target of 4.1%.

Looking at the challenging sectors, the study finds that:

- Energy consumption and emissions in the industry sector have gone down, but hard to abate process emissions remain.
- Energy efficiency in buildings is economical, but hard to realise
- Bioenergy should be used in high-value sectors (transport), and sustainability remains a challenge.
- CCS needs to be demonstrated at scale.

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