Integrating climate and energy policies and promoting wind power

The case of Denmark

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Integrating climate and energy policies and promoting wind power

The case of Denmark

Denmark was fully dependent on fossil fuels and relied on oil from the Middle East in the 1970s but has evolved into a frontrunner in green transition, striving for climate neutrality by 2050. The key to the Danish development has been comprehensive energy policies to promote energy efficiency, energy savings and renewable energy sources which have been consistently implemented and continuously enhanced despite changing governments.

This paper will outline some of the successful elements of the climate and energy policies since the 1970s, generated in an accommodating political framework, relying on a holistic approach and including all of society. Special attention will be given to the promotion of wind power over the past four decades which has spawned the world's largest manufacturer of wind turbines, Vestas, and the largest offshore wind energy developer, Ørsted.

The paper will also address the Danish Climate Act adopted in 2020 and the 10-year plan to reduce greenhouse gas emissions by 70% in 2030 as compared to 1990. The target is ambitious since greenhouse gas emissions will need to be further reduced by 20 million tonnes CO2e by 2030. However, policy measures adopted since June 2020 are projected to reduce greenhouse gas emissions by 10 million tonnes CO2e in 2030, implying emission reductions of more than 55% by 2030. The 70% target is still challenging to reach but further measures are underway, and the systematic approach of the Climate Act applies constant pressure on the Government-in-office to act with due diligence.

This paper focuses on energy which is key to a green transition as it accounts for two thirds of total greenhouse gas emissions, according to the IEA[1].

1. Danish energy developments since the 1970s

The starting point for Denmark's energy transition was the oil crises in 1973 and 1979. Denmark was largely dependent on oil from the Middle East and the deep economic crisis led to a target of achieving energy security through self-sufficiency and independence from the Middle East. The energy self-sufficiency ratio reached 100% in 1997. Today, energy security in electricity generation is ensured by an efficient transmission grid connected to the countries surrounding Denmark.

The Danish path to energy security was primarily based on fossil fuels, substituting oil for coal in the power plants and taking advantage of domestic oil and gas supplies in the North Sea. However, it was clear from the beginning that the domestic oil and gas was challenging to extract and limited in quantity. Therefore, the endeavor to achieve energy security was accompanied by comprehensive measures to increase energy efficiency and reduce energy consumption, while also exploring alternative renewable energy sources.[2]

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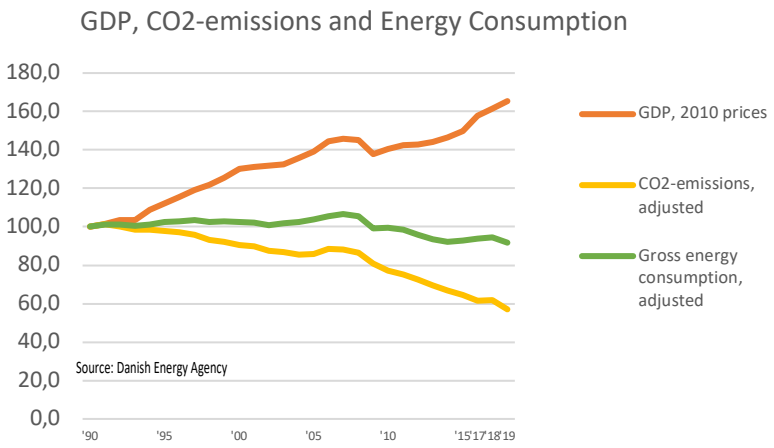
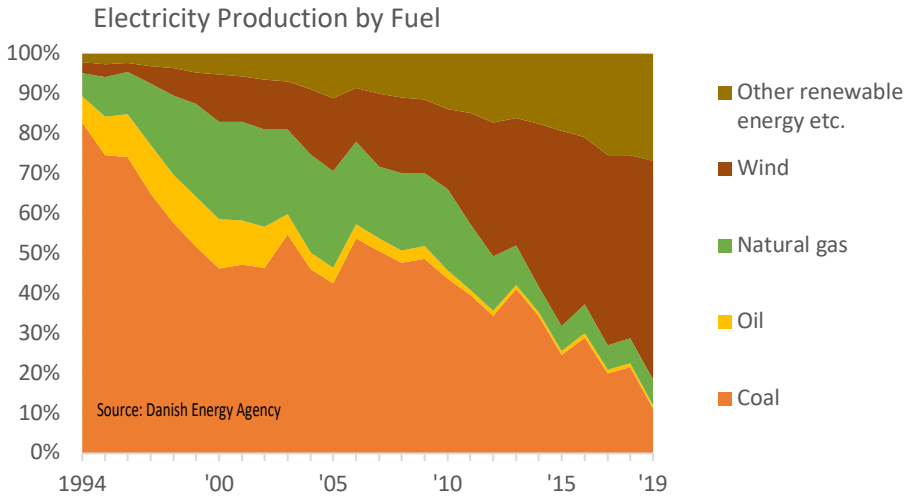
Note: This paper includes Danish climate and energy policy measures until 5 October 2021.
[1] IEA, "Climate change", https://www.iea.org/topics/climate-change.
[2] Quartz+CO, "Energiindustriens historiske omstilling og betydning for Danmark", Januar 2015, https://www.ft.dk/samling/20141/almdel/KEB/bilag/190/1502940.pdf.

In the late 2000s, the attention to climate change rose markedly and intensified the Danish efforts to exploit renewable energy sources in order to reduce the dependence on fossil fuels. The share of renewable energy in gross energy consumption[3] increased from 11% in 2000 to 38% in 2019[4]. Combined with increasing energy efficiency and energy savings, this has resulted in a stable energy consumption and lower CO2 emissions over the past three decades even though GDP has grown substantially. A policy focus on energy efficiency for energy-intensive industries helped reduce energy intensity and costs, thereby contributing to the industries' global competitiveness.

The CO2 emissions[5] were reduced by 43% from 1990 to 2019 while greenhouse gases all together were reduced by 40% in the same period. Most of the reduction took place in the generation of electricity and district heating which accounted for 30-40% of the greenhouse gases up until 2010 but only accounted for 11% of the emissions in 2019. Emissions from agriculture, forestry, horticulture & fisheries have historically been around 25% of the total emissions but made up 32% of total emissions in 2019. The transport sector accounted for 15% of total emissions in 1990 and has grown to a share of 29% in 2019[6].



In particular, the generation of electricity has evolved towards renewable energy which accounted for 82% of the production in 2019 (wind, solar, biomass, and biogas). Wind power is especially important as it accounted for 55% of the electricity production in 2019. When focusing strictly on domestic supply of electricity, renewable energy accounted for 67.5% all together which includes a wind power share of 46.8%.

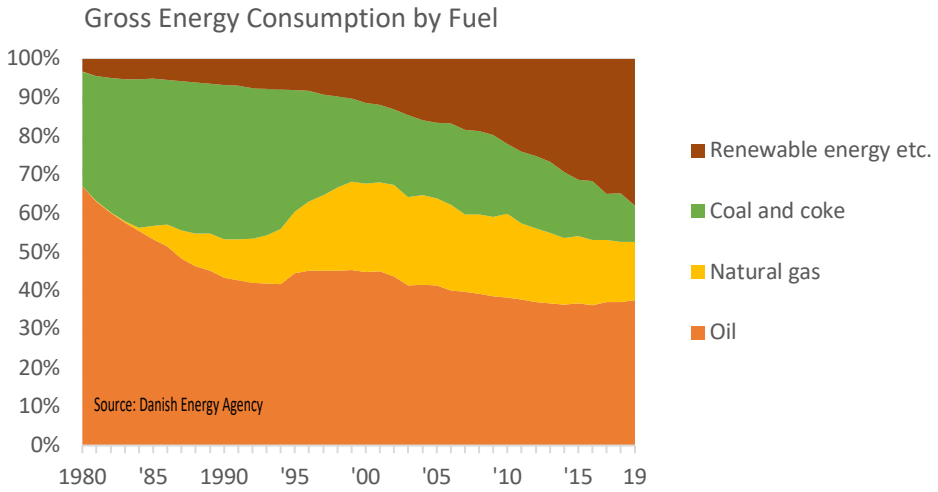


Denmark has a security of supply of 99.99% according to the Danish

[3] Adjusted for fuel consumption for net import of electricity, as well as for temperature fluctuations.
[4] Data from the Danish Energy Agency's energy statistics for 2019, https://ens.dk/service/statistik-data-noegletal-og-kort/maanedlig-og-aarlig-energistatistik.
[5] Adjusted for fuel consumption for net import of electricity, as well as for temperature fluctuations.
[6] The Danish Energy Agency, "Klimastatus og –fremskrivning 2021", April 2021, https://ens.dk/sites/ens.dk/files/Basisfremskrivning/kf21_hovedrapport.pdf.

Energy Agency. On average, Danish consumers were without electricity supply for about 20 minutes per year in the last five years. Most disruptions are due to failures in the local electricity network. There have been no disruptions in electricity supply due to lack of production capacity.[7] The national supply of electricity is supplemented by cross-border interconnectors to the neighboring countries.

Of equal importance is the total Danish energy consumption over the past four decades which clearly illustrates that renewable energy is continuously playing a larger role and that coal is almost phased out. Coal is primarily used by the powerplants, and they have announced that coal will be abolished. Ørsted announced in 2017 that coal would be phased out from their plants by 2023[8]. Two more powerplants are coal-fired, both owned by municipalities, which expect to abolish coal by 2022[9] and 2028[10], respectively. Since 1997, no new coal-fired plants have been approved.



However, the energy mix also indicates that further initiatives are necessary to reach climate neutrality by 2050 as oil and natural gas are still important energy sources with shares of 37.6% and 15.1%, respectively. Oil is primarily used by the transport sector[11]. Natural gas is primarily used for electricity and heat generation which implies that it is largely consumed by the industry and residential sector and to some degree commercial and public services[12]. A broad majority of the Danish Parliament has decided that the oil and gas extraction in the North Sea will end by 2050.

1.1 The framework for the Danish climate and energy policies

Broad political support. Danish energy policies are traditionally characterized by broad political support leading to progressing energy plans despite Government regularly changing back and forth from center-right to center-left.

For example, a Climate Act was adopted in June 2020 setting out legally binding targets to reduce greenhouse gases by 70% by 2030 and reach climate neutrality by 2050 at the latest. Currently, Denmark has a one-party minority Government but 8 of 10 parties in the Parliament agreed to the Climate Act. Also, the energy and climate policies are based on political so-called

[7] The Danish Energy Agency, "Electricity", https://ens.dk/en/our-responsibilities/electricity.
[8] Ørsted, "DONG Energy to stop all use of coal by 2023", 2 February 2017, https://orsted.com/en/media/newsroom/news/2018/06/dong-energy-to-stop-all-use-of-coal-by-2023.
[9] Fjernvarme Fyn, "Snart er det slut med kul", 26 May 2020, https://www.fjernvarmefyn.dk/snart-er-det-slut-med-kul.
[10] Aalborg Forsyning, "Det haster med en aftale om at fremskynde udfasning af kul på Nordjyllandsværket", 5 October 2021, https://aalborgforsyning.dk/privat/nyheder-og-presse/seneste-nyheder/5-oktober-2021-det-haster-med-en-aftale-om-at-fremskynde-udfasning-af-kul-pa-nordjyllandsvaerket/.
[11] IEA data, "Oil products final consumption by sector", https://www.iea.org/data-and-statistics/data-browser?country=DENMARK&fuel=Oil&indicator=OilProductsConsBySector.
[12] IEA data, "Natural gas final consumption by sector", https://www.iea.org/data-and-statistics/data-browser?country=DENMARK&fuel=Natural%20gas&indicator=NatGasConsBySector.

energy agreements which have typically been revised every 5-6 years. The most recent energy agreement was agreed by all the political parties of the Parliament in June 2018 under the previous Government, and it is a transparent pillar of the energy policies in the 2020-2030 period. It was followed up by the more ambitious Climate Agreement for Energy and Industry in 2020, agreed by 9 of 10 political parties in the Parliament.

The broad political support ensures stability and continuity which is seen as particularly important in the energy sector because investments are often large and incur long-term obligations. Since the Danish Government often constitutes a minority of the Danish Parliament, broad political support is pursued also for other far-reaching policies where stability and continuity are deemed essential, for instance defense policies.

For energy policies, even major strategic issues have been decided democratically over the years. In the 1970s, it was expected that nuclear power would be part of the solution to achieving energy independence. However, public opinion against nuclear power grew in the late 1970s and the beginning of the 1980s and a majority in the Parliament – not including the minority Government at the time – decided not to include nuclear power in the Danish energy planning in 1985. This has been respected ever since. Likewise, an explicit CO2 tax was initiated in 1991 by a majority in the Parliament – not including the minority Government at the time – and a CO2 tax has been a part of the Danish energy policies since 1992.

Ambitious targets. Denmark has been a frontrunner in setting ambitious climate targets. Already in 1990, the world's first action plan for reducing CO2 was put forward by the Danish Minister for Energy - the plan stipulated a target of 20% reduction in CO2 emissions by 2005 and 50% within 30-50 years. The primary inspiration for the Danish Minister was the so-called Brundtland report from 1987[13]. The report, "Our Common Future"[14], called for a sustainable development that meets the needs of the present without compromising the ability of future generations to meet their own needs.[15] Denmark was also a strong supporter of the Kyoto Protocol agreed in 1997 targeting emission reductions. In the late 2000s, Danish attention to climate issues accelerated while Denmark was preparing to host COP15 in 2009, and in 2011 the goal of independence from fossil fuels by 2050 was declared[16].

The ambitious target of 70% reductions in greenhouse gas emissions by 2030 compared to 1990 was included in the Climate Act of 2020. The Danish Council for Climate Change estimated in the beginning of 2020 that the reduction in the 30 years since 1990 was 38% which left only 10 years to achieve the remaining 32 percentage points. It was also estimated that even if all possible known transition elements were carried out, it would only amount to a reduction of 60% by 2030.[17] Hence, the target forces collaboration across all sectors and with multiple stakeholders, including the private sector, think tanks, NGOs, and research,

[13] Danish Energy, Jesper Tornbjerg, "Sådan fik Danmark verdens første klimamål", 6 May 2020, https://www.danskenergi.dk/nyheder/saadan-fik-danmark-verdens-foerste-klimamaal.

[14] The World Commission on Environment and Development, "Report of the World Commission on Environment and Development: Our Common Future", 20 March 1987, https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf.

[15] A sustainable development takes into account both the essential needs of the world's poor and the limitations imposed of the state of technology and social organization on the environment's ability to meet present and future needs. The background for the report was that the former prime minister of Norway, Gro Harlem Brundtland, was appointed as chair of the World Commission on Environment and Development by the UN Secretary General, Javier Pérez de Cuéllar, in 1983 to increase focus on environmental and developmental challenges globally.

[16] The Danish Government, "Energistrategi 2050 – fra kul, olie og gas til grøn energi", February 2011, https://www.regeringen.dk/media/1238/energistrategi_2050.pdf.

[17] The Danish Council for Climate Change, "Known paths and new tracks to 70 per cent reduction", March 2020, https://www.klimaraadet.dk/en/rapporter/known-paths-and-new-tracks-70-cent-reduction.

investment, and pension funds, according to the Danish Energy Agency[18]. The 2030 reduction target is seen as an important milestone to reach climate neutrality by 2050.

Holistic approach. Denmark is characterized by a holistic approach to ensuring a sustainable energy development, integrating climate into energy policies, and focusing on broader interactions and systems. Both supply and demand of energy is addressed through expansion of renewable energy on one side and increased energy efficiency and energy savings on the other side. Different sectors are included, for instance by integrating heat and power production. And a vast range of policy instruments are applied to establish synergies, for instance between taxation and policy frameworks for renewable energy. The energy sector also strives to underpin other sectors' green transition by providing the necessary renewable energy.

At the same time, Denmark has a strong tradition of inter-ministerial coordination to ensure policy implementation[19]. The Ministry of Climate, Energy and Utilities works closely with other relevant ministries when planning as well as implementing the climate and energy policies. At the political level, cross-policy measures such as Government proposals and bills affecting the green transition are discussed in the Government Committee for Green Transition, which is chaired by the Minister for Climate, Energy and Utilities. The committee normally meets every other week, and the 6 other members are the Minister for Taxation, the Minister for Food, Agriculture and Fisheries, the Minister for Transport, the Minister for Higher Education and Science, the Minister for Industry, Business and Financial Affairs, and the Minister for the Environment. The secretariat for the committee is based in the Ministry of Climate, Energy and Utilities and it is responsible for close coordination between the Ministries. If the measures entail substantial economic consequences, they are coordinated in the Government Economy Committee chaired by the Minister for Finance. The other 5 members in the Economy Committee are the Minister for Social Affairs and Senior Citizens, the Minister for Taxation, the Minister for Climate, Energy and Utilities, the Minister for Industry, Business and Financial Affairs, and the Minister for Employment.

Whole-of-society approach. The Danish energy policies have a long tradition of stakeholder engagement, involving citizens, companies, and organizations, promoting innovation, ownership, and transparency. Awareness among citizens is raised inter alia through energy saving campaigns and energy labeling. Municipalities play an important role in urban energy planning and the community is involved in the process. Public-private partnerships involving authorities, companies, and universities have been a particularly innovative factor. For instance, the Danish Energy Agency, the universities, and the wind industry collaborate to provide demonstration and test facilities for wind turbines, underpinning the development of the wind industry in Denmark and Europe as well. For the energy industry at large, requests for efficiency measures and expansion of renewable sources have been met by adaptable and innovative energy companies.

Following this approach, the Government introduced 13 climate partnerships in November 2019, covering different sectors of the Danish business community: energy & utilities; life science & biotech; finance; land transport & logistics; service, it & consultancy; aviation; building & construction; retail; manufacturing; shipping; energy-intensive industry; food

[18] The Danish Energy Agency, "Global cooperation", https://ens.dk/en/our-responsibilities/global-cooperation.
[19] The permanent Government committees are listed at the website of The Danish Prime Minister's Office, "Regeringsudvalg", https://www.stm.dk/regeringen/regeringsudvalg/.

production & agriculture; and waste, water & circular economy[20]. A 14th partnership on defense was added in 2021. Each of the partnerships is chaired by a CEO from that specific sector. For instance, the partnership on energy & utilities is chaired by the CEO for Ørsted, the partnership on life sciences & biotech is chaired by the CEO of Novo Nordisk, and the partnership on finance is chaired by the CEO of PensionDanmark.

The purpose of the partnerships is to establish a 2030-vision for how each sector will contribute to the 70% reduction target and set ambitions for:

- Reductions within the sector.
- How the sector can contribute to reductions in other sectors.
- How the sector can contribute internationally and in global value chains.

Each partnership commits to reducing emissions and to pointing to opportunities and barriers for further reductions. The Government commits to addressing these and to follow up with initiatives to support the needed transition to reach the 70% reduction target, while maintaining jobs, welfare, exports, and the international competitiveness of Danish companies.

International cooperation. Denmark is a small, open economy dependent on the surrounding world end therefore also strongly engaged in international cooperation. In particular, the Danish electricity and gas markets are integrated with the neighboring countries and Denmark has interconnectors with these to ensure the supply.

As regards climate policies, Denmark is well aware that it is responsible for only 0.1% of the global greenhouse gas emissions. From a Danish perspective, it is therefore essential that the rest of the world also strives to achieve the global climate goals. Consequently, Denmark is focused on inspiring other countries to reduce emissions through sharing successful elements of the Danish energy and climate policies, and Denmark is fostering partnerships worldwide with both developed and developing countries.

Currently, Denmark has identified 19 partner countries, representing more than 60% of global CO2 emissions: China, Egypt, Ethiopia, France, Germany, India, Indonesia, Japan[21], Kenya, Mexico, the Netherlands, South Africa, South Korea, Poland, Turkey, the USA, Vietnam, Ukraine, and the United Kingdom. The Danish Energy Agency works closely with the Danish Ministry of Foreign Affairs, as well as the Danish transmission system operator, Energinet, and other relevant organizations to promote Government-to-Government cooperation with these countries. At the Danish embassies and local partner organizations, energy advisers are posted and supported by colleagues from the Danish Energy Agency. Denmark strives to cooperate with the identified partner countries with a view to deploying a framework for a cost-efficient low-carbon transition, focusing on Danish core competencies[22]:

- Long-term energy modelling and scenarios.
- Integration of renewable energy in the energy system.
- Wind power – offshore and onshore.

[20] The Danish Ministry of Climate, Energy and Utilities, "Regeringens klimapartnerskaber", https://kefm.dk/klima-og-vejr/regeringens-klimapartnerskaber-og-groent-erhvervsforum and the Danish Ministry of Industry, Business and Financial Affairs, "Kommissorium for klimapartnerskaber", 8 November 2019, https://em.dk/media/13420/klimapartnerskaber-kommissorium.pdf.

[21] The ongoing dialogue on offshore wind energy and hydrogen infrastructure between the Japanese and Danish authorities is expected to be formalized at a later stage.

[22] The Danish Energy Agency's website, "Global Cooperation", https://ens.dk/en/our-responsibilities/global-cooperation.

- Energy efficiency – industry and buildings.
- District heating.

At the global level, Denmark is a dedicated advocate of the Paris Agreement and the UN's Sustainable Development Goals, and the global climate efforts have been supported throughout the years. As mentioned earlier, the Brundtland Report from 1987 received considerable attention in Denmark and led to a reduction target for CO2 emissions already in 1990. In 1997, the first legally binding global climate agreement, the Kyoto Protocol, was agreed which called for a reduction in emissions of an average of 5% below 1990 levels in the period 2008-2012. The EU committed to an 8% cut for the bloc as a whole while Denmark agreed to a reduction of 21%, and both Denmark and the EU as a bloc fulfilled the targets[23]. In 2009, Denmark hosted COP15 in Copenhagen with the ambition of securing a global climate agreement for the period after 2012. The Copenhagen Accord included the goal of keeping the increase in global temperature below 2 degrees Celsius and consideration of strengthening the long-term goal to temperature rises of 1.5 degrees Celsius[24]. Looking back, the major global agreement did not materialize until 2015 in Paris, but COP15 did intensify the Danish commitment to climate policies.

Denmark played a leading role in the creation of the International Renewable Energy Agency (IRENA) in 2011 as it was the result of strong efforts by Germany, supported in particular by Denmark and Spain[25]. In 2021, IRENA has 165 member countries and there are 19 states in accession[26]. Denmark is also an active member of the International Energy Agency (IEA). In January 2021, it was announced that the Danish Minister for Climate, Energy and Utilities will chair the IEA's new Commission, "Our Inclusive Energy Future", which will focus on how to enhance the success of clean energy transitions through a stronger focus on their socio-economic impacts and people's participation and inclusion in them.[27]

1.1.1 Membership of the European Union (EU)

The European Union (EU) forms a particularly important part of the policy framework for Denmark. The EU's energy and climate policies have been strengthened over the years and Europe aims to become the world's first climate-neutral continent by 2050. The EU's energy and climate policies are concentrated in the EU Energy Union[28] aimed at giving EU households and businesses secure, sustainable, competitive, and affordable energy. The Energy Union covers five interrelated dimensions:

- Reduction of greenhouse gas emissions.
- Increased energy supply security.
- Improved energy efficiency.
- A fully integrated single market of energy.

[23] The European Commission's website, "Kyoto 1st Commitment Period 2008-12", https://ec.europa.eu/clima/policies/strategies/progress/kyoto_1_en.
[24] UNFCCC, "Copenhagen Accord", 18 December 2009, https://unfccc.int/sites/default/files/resource/docs/2009/cop15/eng/11a01.pdf.
[25] IRENA's website, "Founding Conference", https://www.irena.org/history/foundingconference.
[26] IRENA's website, "Membership", https://www.irena.org/irenamembership.
[27] IEA, "Our Inclusive Energy Future: The Global Commission on People-Centered Clean Energy Transitions", 26 January 2021, https://www.iea.org/events/our-inclusive-energy-future-the-global-commission-on-people-centred-clean-energy-transitions.
[28] The European Commission's website, "The Energy Union", https://ec.europa.eu/energy/topics/energy-strategy/energy-union_en.

- Research, innovation, and competitiveness.

The current EU Regulation on the Governance of the Energy Union and Climate Action went into force in December 2018. Common targets are set at the EU level and one of the key elements of the regulation is that each Member State must prepare an integrated national energy and climate plan (NECP) for the period 2020-2030, outlining how it intends to contribute to the 2030 targets for energy efficiency, renewable energy, and greenhouse gas emissions.[29]

In July 2021, the European Climate Law entered into force, which sets a legally binding target of net zero greenhouse gas emissions by 2050. In addition, the key target for 2030 is increased from 40% to 55% reductions in greenhouse gas emissions as compared to 1990 levels. The European Climate Law also includes[30]:

- Recognition of the need to enhance the EU's carbon sink through a more ambitious LULUCF (Land-use, Land-Use Change, and Forestry) regulation,
- a process for setting a 2040 climate target, taking into account an indicative greenhouse gas budget for 2030-2050 to be published by the European Commission,
- a commitment to negative emissions after 2050,
- the establishment of the European Scientific Advisory Board on Climate Change that will provide independent scientific advice,
- stronger provisions on adaptation to climate change,
- strong coherence across Union policies with the climate neutrality objective, and
- a commitment to engage with sectors to prepare sector-specific roadmaps, charting the path to climate neutrality in different areas of the economy.

The cornerstone of the EU's policy to combat climate change is the EU emissions trading system (EU ETS)[31] which is the world's first international emissions trading system, created in 2005. EU ETS is a key tool for reducing greenhouse gas emissions cost-effectively, and emissions from installations covered by the ETS declined by about 35% between 2005 and 2019, according to the EU Commission.

The EU ETS covers emissions from the production of electricity and district heating, energy-intensive industry, and commercial aviation. A cap is set on the total amount of certain greenhouse gases that can be emitted by installations covered by the system. The cap is reduced over time so that total emissions fall. Within the cap, companies receive or buy emission allowances, which they can trade with one another as needed. After each year a company must surrender allowances to cover all its emissions; otherwise, heavy fines are imposed. If a company reduces its emissions, it can keep the spare allowances to cover its future needs or sell them to a company that is short of allowances.

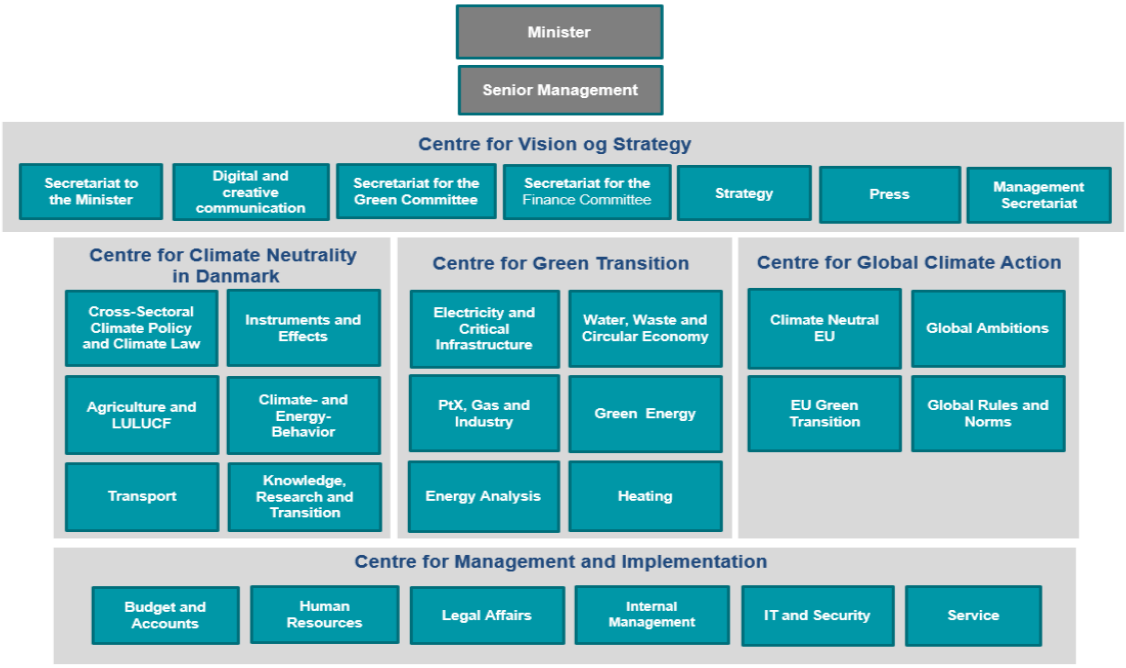
Denmark is active in evolving the EU's energy and climate policies and has pushed for the European Climate Law enshrining the target of climate neutrality by 2050 and raising the target to at least 55% reductions in greenhouse gases by 2030. Denmark supports reforms of the EU ETS which has been challenged by surplus allowances and low quota prices. The EU

[29] The Danish Ministry of Climate, Energy and Utilities, "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, https://ec.europa.eu/energy/sites/ener/files/documents/dk_final_necp_main_en.pdf.
[30] The European Commission's website, "European Climate Law", https://ec.europa.eu/clima/policies/eu-climate-action/law_en.
[31] The European Commission, "The EU Emissions Trading System (EU ETS)", https://ec.europa.eu/clima/policies/ets_en.

ETS was strengthened in 2018 and the price of EU carbon permits increased from less than 10 EUR in 2017 to around 60 EUR in the second half of 2021[32]. Further revisions of the EU ETS are underway to take into account that the EU's key target for 2030 has been increased from 40% to 55% reductions in greenhouse gas emissions.

1.1.2 The key climate and energy institutions in Denmark

The Danish Ministry of Climate, Energy and Utilities is responsible for national and international policies to promote effective and stable solutions to the areas of climate, energy, and utilities. The Department has around 200 employees and is organized in five centers:



Source: The Danish Ministry of Climate, Energy and Utilities' website, "Organisation", https://en.kefm.dk/the-ministry/organisation.

Climate and energy policies were unified in one Ministry in 2007. Before then, the Ministry of Environment (created in 1971) was responsible for climate policies. The Ministry of Energy was created in 1979 when energy policies were detached from the Ministry of Trade. However, the interconnection between climate and energy policies has been acknowledged much longer as illustrated by the first plan for CO2 reductions being presented by the Minister for Energy in 1990. Energy and environmental policies were also unified in the Ministry of Environment and Energy from 1994 to 2005.

The Danish Energy Agency (DEA)[33] is responsible for tasks linked to energy production, supply, and consumption, as well as Danish efforts to reduce carbon emissions. The DEA is also responsible for supporting the economic optimization of utilities that in addition to energy includes water, waste, and telecommunication. The DEA is organized in 4 centers: I. Utilities and Supply, Subsoil Resources & Risk Preparedness, and Global Cooperation; II. Energy Efficiency, Energy Administration, and Telecommunication; III. System Analysis, Energy Administration, and Renewable Energy; and IV. Organization. The DEA was established in 1976 under the Ministry of Trade and is today an agency under The Danish Ministry of Climate, Energy and Utilities. The head of the DEA is appointed by the Minister for Climate, Energy and Utilities and is typically a civil servant. The DEA has around 750 employees.

[32] Trading Economics, Markets, https://tradingeconomics.com/commodity/carbon.
[33] The Danish Energy Agency's website, "About us", https://ens.dk/en/about-us/about-danish-energy-agency.

Energinet[34] is the transmission system operator (TSO), an independent public enterprise owned by the Danish Ministry of Climate, Energy and Utilities. Energinet is responsible for ensuring security of supply and facilitating optimal conditions for the Danish electricity and gas markets. Energinet owns, operates, and develops the transmission systems for electricity and natural gas in Denmark. The natural gas transmission system is connected to Germany and Sweden while the electricity transmission net is connected to Germany, the Netherlands, Norway, and Sweden. The Baltic Pipe, under construction, is a gas pipeline that will provide Denmark and Poland with a direct access to Norway's gas fields by October 2022. Other plans include the Viking Link, a 760 km long electricity interconnector between Denmark and the UK.[35] The CEO of Energinet is typically a civil servant appointed by the Board of Energinet. The Board has 11 members and is primarily politically appointed. Energinet has around 1,500 employees[36].

The Danish Utility Regulator (DUR) [37] is a fully independent regulatory body which administers the regulation and supervision of the utility sectors in accordance with sectoral law and analyzes and monitors the utility sectors in order to create transparency. The DUR secures consumer interests in the utility sectors by striving for a higher level of efficiency, the lowest possible costs, a stable and secure supply, and a cost-effective development in technology and climate-friendly initiatives. The DUR's decisions can be appealed to the Danish Energy Board of Appeal. The DUR was established in 2018 and replaced the Danish Energy Regulatory Authority in order to strengthen its supervision and its organization, and to provide a clearer responsibility to analyze and monitor the utilities sector, particularly to enable the continuous assessment and development of sectoral legislation. The DUR is headed by a director appointed by the Minister for Climate, Energy and Utilities for a period of five years, which can be extended once by another five years. The DUR has around 100 employees[38].

The Danish Council on Climate Change (DCCC)[39] is an independent body of experts which advises how Denmark can most effectively and cost-effectively undertake the transition to a low-carbon economy by 2050 based on professional analyses. The Council was established by law by the first Danish Climate Act in 2014 and the mandate was strengthened in connection with the Climate Act of 2020. The Council must: 1) evaluate the status of Denmark's implementation of national climate objectives and international climate commitments; 2) analyze potential means of transitioning to a low-carbon society by 2050 and identify possible measures to achieve greenhouse gas reductions; 3) draw up recommendations to help shape climate policy, including a selection of potential mechanisms and transition scenarios; and 4) contribute to the public debate.

The Council consists of 1 chair and 8 other members. The Council elects 1 candidate for each vacant post, who is subsequently appointed by the Minister for Climate, Energy and Utilities. The Council is composed of experts with broad expertise and high level of climate-relevant academic knowledge relating to energy, buildings, transport, agriculture, environment, nature, economics, climate science research, and behavioral research of relevance to the climate field. Typically, they are university professors or other highly regarded civil servants.

[34] Energinet's website, https://en.energinet.dk/About-us.
[35] Energinet's website, "International infrastructure projects", https://en.energinet.dk/Infrastructure-Projects.
[36] Energinet's website, "Vores arbejdsplads", https://energinet.dk/Karriere/Vores-arbejdsplads.
[37] The DUR's website, https://forsyningstilsynet.dk/about-us, Retsinformation, "Lov om Forsyningstilsynet", 28 February 2018, https://www.retsinformation.dk/eli/ft/201712L00164 and The Danish Government, "Aftale om et stærkt forsyningstilsyn", 4 October 2017, https://www.regeringen.dk/media/4145/et-staerkt-forsyningstilsyn.pdf.
[38] The DUR's website, "Om at arbejde hos os", https://forsyningstilsynet.dk/job/om-at-arbejde-hos-os.
[39] The DCCC's website, https://www.klimaraadet.dk/en, and the Climate Act, 18 June 2020, https://en.kefm.dk/Media/1/B/Climate%20Act_Denmark%20-%20WEBTILGÆNGELIG-A.pdf.

They are appointed for a period of 4 years and may be reelected once. The Council is assisted by a secretariat of approximately 20 employees with expertise relating to the Council's areas of operations. The head of secretariat is appointed by the chair of the Council.

Municipalities play a key role in the implementation of energy policies through municipal plans for urban and industrial development. Municipalities are responsible for laying out overall energy plans which support sustainable development and designate areas suitable for onshore energy projects (wind power, biomass etc.) to be developed and implemented by interested parties. In 2020, municipalities´ power to reject offshore wind turbines was expanded from 8 to 15 km off the shore. Many municipalities own district heating companies.

1.2 The key elements of Danish climate and energy policies since the 1970s

The reduction of energy consumption through increased energy efficiency and energy savings has been an important part of Danish energy policies since the two oil crises led to a focus on security of supply and import independence. In the meantime, climate change has also played a role in the desire to streamline and reduce energy consumption, as mentioned earlier.

Some of the main elements of the comprehensive energy policies over the years are listed below[40][41][42] and the successful introduction of wind power is further specified in section 1.3.

Applying rules and regulations:

- In 1999, liberalization of the electricity market was decided, following up on EU regulation to create an internal market for energy. The companies generating electricity would have to be price competitive, and they were no longer allowed to be responsible for the transmission grid. By 2004, the energy sector was restructured. Energinet was established to be responsible for the transmission. Non-profit cooperatives and municipalities were in charge of distribution. A mix of publicly and privately owned companies was responsible for the generation of power.

  The Danish Energy Agency assesses[43] that the wholesale electricity market today is very dynamic, liquid and has a high degree of competition. The retail market has developed more slowly, and benefits of liberalization have been less clear. Today, all Danish consumers can choose their electricity supplier and choose between different types of contracts, e.g., a fixed electricity price for a period of time, a variable price, or combinations thereof. In 2020, there were 38 suppliers, which in total had 295 contracts to choose from. However, the households have been reluctant to change suppliers which could be due to the high taxation of electricity, see below. By the end of 2020, all customers, including households, were equipped with smart meters.

- Building requirements are aimed at energy savings. In particular, insulation has improved dramatically over the past 4 decades. The continuously strengthened building code includes minimum energy performance requirements for new buildings

[40] The Danish Energy Agency, "The Danish Energy Model", https://ens.dk/sites/ens.dk/files/contents/material/file/the_danish_energy_model.pdf.

[41] The Danish Energy Agency, "Dansk energipolitik gennem 40 år - fra energikrise i 1970'erne mod uafhængighed af fossil energi i 2050", Flemming G. Nielsen, May 2016, http://des-hjemmeside.dk/wp-content/uploads/2016/05/Dansk-energipolitik-i-40-år.pdf.

[42] Quartz+CO, "Energiindustriens historiske omstilling og betydning for Danmark", Januar 2015, https://www.ft.dk/samling/20141/almdel/KEB/bilag/190/1502940.pdf.

[43] The Danish Energy Agency, "Liberalisation of the Danish power sector 1995-2020, An international perspective on lessons learned", September 2020, https://ens.dk/sites/ens.dk/files/Globalcooperation/liberalisation_of_the_danish_power_sector_-_report_final.pdf.

and rules for upgrading energy efficiency when renovating existing buildings. Energy consumption in buildings was reduced by 45% in the period 1975-2015.

Providing economic incentives:

- Taxes on electricity and oil were introduced in 1977 to reduce energy consumption and energy imports, and they have been adjusted many times since then. The taxation of electricity supplied to households is particularly high. The Danish Energy Agency estimates that a typical Danish single-family residential house (with heating provided via district heating or natural gas) consumes electricity in the order of 4,000 kWh/year which costs roughly 1,300 USD including taxes and VAT, and that the raw electricity price is only 17% of the total.[44]
- Subsidies have been available since 1984 whenever electricity is generated from renewable energy resources.
- Taxes on CO2 and SO2 were introduced in 1992. The explicit CO2 tax rate was set at DKK 100 per tonne CO2 at the time, corresponding to JPY 1,782, and rules for compensation and subsidies were available. The CO2 tax has been amended several times, and it differs across sectors. According to the OECD[45], Denmark had the fourth highest average effective carbon taxation of non-road emissions in 2018, only surpassed by Switzerland, the Netherlands, and Norway.
- Participation in the EU ETS since 2005.
- Numerous grants for establishing renewable energy sources and introducing energy saving measures have been available over the past 4 decades.

Developing the energy infrastructure:

- The transmission grid for natural gas was developed during the 1980s. The first pipeline for natural gas produced in the North Sea was inaugurated in 1984.
- The power plants were rebuilt to generate both heating and electricity (CHP) which drastically increase energy efficiency as heat is recovered while generating electricity. Energy losses and costs were further reduced through close cooperation with innovative suppliers, optimizing the individual parts of the plants such as enabling multi-fuel, efficient pumps and valves, and well-insulated pipes.
- Expansion of district heating in order to reduce the oil consumption of industry as well as households. District heating has been one of the key drivers in reductions of gross energy consumption and CO2 emissions from the energy sector. District heating supplies more than 60% of all households in Denmark with heat and hot water.
- Introduction of biomass which is the most dominant source of renewable energy in the overall Danish energy consumption today. In the 1980s and 1990s, waste, straw, and firewood were the primary fuel. Since 2010, wood pellets have been dominant in the consumption of solid biomass. Wood pellets are used in existing coal plants for co-firing or in coal plants that have been converted to fire with wood pellets.[46]
- Securing the integration of fluctuating renewable energy such as wind power in the electricity system.

[44] The Danish Energy Agency, "Liberalisation of the Danish power sector 1995-2020, An international perspective on lessons learned", September 2020, https://ens.dk/sites/ens.dk/files/Globalcooperation/liberalisation_of_the_danish_power_sector_-_report_final.pdf.
[45] OECD, Taxing Energy Use, 2019, https://www.oecd.org/tax/tax-policy/brochure-taxing-energy-use-2019.pdf.
[46] The Danish Energy Agency's website, "Biomass", https://ens.dk/en/our-responsibilities/bioenergy/solid-biomass.

- Developing the electricity transmission grid domestically as well as expanding it to the surrounding countries.
- Joining the Nord Pool Spot in 2000, the Nordic exchange for electricity then owned by the 4 Nordic transmission system operators.

Supporting research and development:

- Providing public resources for research and development of renewable energy and energy efficiency for the past 4 decades. Further resources are available at the EU level, and private companies also spend considerable funds on research.
- For 2020, all 10 political parties of the Danish Parliament agreed to provide 1,542 million DKK for green research and development, corresponding to 0.07% of GDP or 236 million USD[47]. The largest public research and development program is the Energy Technology Development and Demonstration Program (EUDP)[48] run by the Danish Energy Agency. The program supports private companies and universities to develop and demonstrate new energy technologies such as renewable energy technologies, energy efficiency technologies, conversion technologies such as fuel cells and hydrogen, integration of energy systems including storage, more efficient methods for recovery of oil and gas, and storage of CO2.

Involving stakeholders:

- The Voluntary Agreement Scheme, launched in the 1990s, targeting large, energy-intensive companies to increase energy efficiency. The companies entering an agreement were required to, e.g., implement an ISO 50001 certified energy management system and outline an action plan of energy efficiency measures with a payback time up to 5 years. In return, they obtained a CO2 tax reduction. In the period 1990-2015, the manufacturing sector increased the gross value added by almost 30% but reduced energy consumption by more than 20%[49]. The lower energy intensity and costs have improved the industries' global competitiveness.
- Agreements with the utilities, powerplants, and distributors to implement energy savings.
- Agreements with electricity companies to include renewable energy.
- Including universities and the private sector in demonstration and test facilities for wind turbines.
- Requirement to save energy in the public sector.
- Raising awareness in the public, inter alia, through energy labeling of appliances and houses, advice on possible energy savings in everyday life, and ownership in renewable energy assets (roof-mounted solar panels, community owned wind farms etc.).

Summing-up, the foundation of the energy transition has been energy efficiency, energy savings, renewable energy, and system integration and development, including electrification, the latter enabling the use of fluctuating renewable energy without hampering the security of

[47] Ministry of Higher Education and Science's website, 6 November 2019, "Parliament agrees to provide DKK 1.5 billion to green research", https://ufm.dk/en/newsroom/press-releases/2019/parliament-agrees-to-provide-dkk-1-5-billion-to-green-research?set_language=en&cl=en.
[48] The Danish Energy Agency's website, "Energy Technology Development and Demonstration Program", https://ens.dk/en/our-responsibilities/research-development/eudp.
[49] Estimate by the Danish Energy Agency, "The Danish Energy Model", https://ens.dk/sites/ens.dk/files/contents/material/file/the_danish_energy_model.pdf.

supply. CHP and district heating have allowed the integration of large proportions of wind power into the energy system, supported by a power exchange with the neighboring countries. In addition, the promotion of renewable energy requires a secure long-term investment setting which has been induced by ambitious targets and long-term planning in predictable and stable political framework conditions, paving the way also for significant private investments.

1.3 The success of the Danish wind industry

Wind power has played a particularly important role in the green transition of the Danish energy industry as is apparent from wind power accounting for 46.8% of the domestic electricity supply in 2019. The background is that Denmark has a long tradition of wind turbines, which has been nurtured by Danish Governments since the oil crises in the 1970s led to the goal of independence from imported oil.

At the time, small wind turbines were already produced and typically run by single households or cooperatives. Cooperatives have played an important role in the development of wind power by helping create public acceptance. Communities have directly benefitted from wind power development, especially in the form of profit-sharing from electricity generation from renewable energy sources and from lower energy taxes.

Government measures were aimed at developing the sector further, supporting a commercialization of the industry. Essential measures[50] have included:

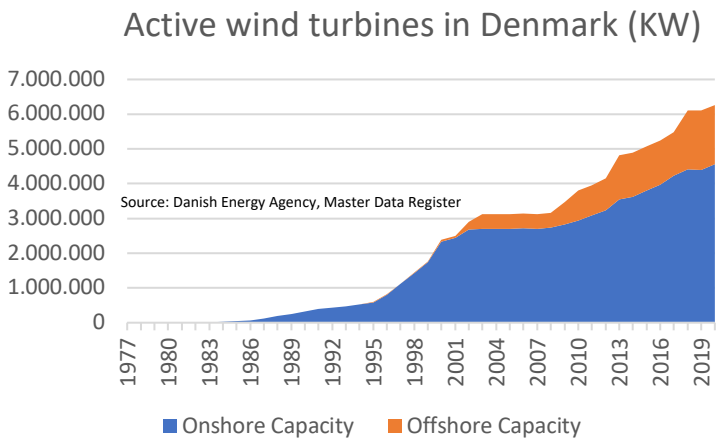
1. Providing resources for research and development since 1976, including establishing test and demonstration facilities for turbines from 1978.
2. Specific agreements with the electricity companies to include wind power since 1985. At first, the wind turbines were onshore. In 1991, the first offshore wind farm was connected to the grid.
3. Requirement since 1992 for the electricity companies to continuously develop the grid and ensure that new wind turbines can always be connected.
4. Tenders to establish offshore wind farms since 2004
5. Subsidies and grants for wind power since 1976.
    a. Construction grants in the period 1976-1989, starting out at 40% of the investment, gradually reduced over the years.
    b. Lower taxes and fees or subsidies when electricity comes from wind power. While the wind turbines were small in the 1970s and beginning of 1980s, there was no tax on electricity produced by one's own wind turbine. When the wind turbines got bigger, requiring connection to the transmission grid, a subsidy was introduced in 1984 for electricity produced by wind turbines.
    c. In 1999, the financing of the subsidies was removed from the national budget and turned into a premium to the price of electricity, a Public Service Obligations tariff (PSO), paid by the consumers to cover the expenses for new energy technologies unable to compete on normal market conditions. The Danish TSO, Energinet, charges the PSO and adjusts the level quarterly according to market prices (set at the Nord Pool exchange). The PSO tariff is mainly used for subsidies for renewable energy.

[50] The Danish Energy Agency, "Vindmølleindustrien som historisk flagskib", 24 May 2011, https://ens.dk/sites/ens.dk/files/Vindenergi/vindmoelleindustrien_historisk_flagskib.pdf.

In 2016, a broad political agreement was reached in the Danish Parliament to phase out the PSO gradually over the period 2017-2021 and instead finance support for renewables through the national budget from 2022.[51]

6. Public planning requirements.
    a. Onshore. Municipalities have been required to identify possible areas for wind farms in their planning since 1994. Citizens, associations, authorities, and other interested parties are involved in the planning.
    b. Offshore. The Danish Energy Agency is responsible for the planning of offshore wind farms and provides a "one-stop-shop". If a company wants to set up an offshore wind farm, the Danish Energy Agency will manage the necessary permissions, involve the relevant authorities, and hear the interested parties.

The result can be illustrated by the development in active wind turbines in Denmark throughout the years 1977-2020. The capacity has been gradually increasing, only onshore in the beginning until the first offshore park was built in 1991. The Government's support was temporarily reduced in the beginning of the 2000s as demonstrated by a standstill in development during these years. In 2020, the capacity reached more than 6 GW.



According to the IEA, Denmark has the highest share of wind in both total primary energy consumption and electricity of any IEA country. Also, Denmark is recognized as a global leader in integrating variable renewable energy while at the same time maintaining a highly reliable and secure electrical-power grid, supported by a flexible domestic power system and a high level of interconnection.[52] On windy days, wind turbines in Denmark produce more than the domestic demand.

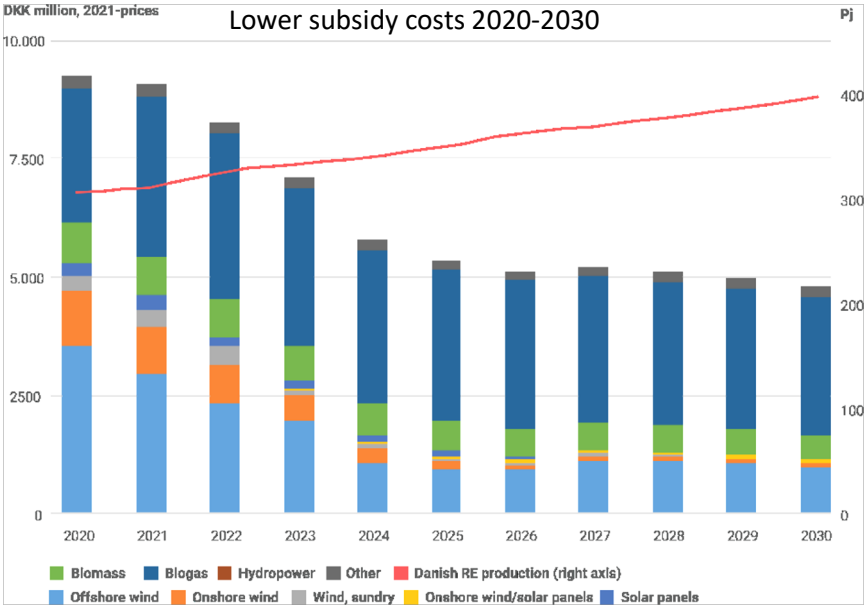
The success of the wind industry is underlined by Danish companies being among the main global manufacturers and developers of wind power today. The first Danish wind turbines were exported to the Californian market already in 1982-1983, which means that the manufacturers handled production for both the domestic market and for foreign countries very early in the development of the Danish wind industry.

In 2020, the Danish company Vestas was the world's largest supplier of wind turbines across onshore and offshore wind, according to the Global Wind Energy Council (GWEC)[53]. Vestas started producing wind turbines in 1980. In addition, the Danish company Ørsted is the largest developer of offshore wind energy[54]. Ørsted is the result of a merger between Danish energy

[51] The Danish Ministry of Climate, Energy and Utilities, "Aftale om afskaffelse af PSO-afgiften", 17 November 2016, https://kefm.dk/media/7023/elementer-i-aftale-om-pso.pdf.
[52] IEA, "Denmark 2017 Review", https://www.iea.org/reports/energy-policies-of-iea-countries-denmark-2017-review.
[53] Global Wind Energy Council, "GWEC releases Global Wind Turbine Supplier Ranking for 2020", 23 March 2021, https://gwec.net/gwec-releases-global-wind-turbine-supplier-ranking-for-2020/.
[54] Windpower Monthly, "Top 5 offshore developers", 22 March 2019, https://www.windpowermonthly.com/article/1579928/top-5-offshore-developers.

companies, one of which took part in establishing the first offshore wind farm in 1991[55]. Finally, the Danish company Bonus Energy played an important role in the commercialization of wind turbines in Denmark. Bonus Energy started producing turbines in 1981 and had an installed base of 3,321 MW in 20 countries with a market share about 9% when it was bought by Siemens in 2004[56]. Siemens merged with Gamesa in 2017, and Siemens Gamesa was the 5th largest producer of wind turbines in 2020, according to GWEC.

Government support has played a key role in stimulating demand and promoting renewable energy in Denmark. A positive investment setting has been created with priority grid access and feed-in tariffs. Feed-in tariffs for offshore wind are settled by tender and feed-in premiums with a cap are regulating the support for onshore wind power. However, gradually declining renewable energy costs and increasing prices for fossil fuels are making wind power increasingly competitive. Today, onshore wind is the cheapest power generation technology when adding new capacity in Denmark.[57] The Danish Energy Agency expects renewable energy subsidies to decrease significantly towards 2030, particularly for wind turbines and solar panels, as suggested by the chart. The first European offshore tender to attract zero-subsidy bids took place in Germany in 2017. The German offshore wind farms He Dreith, OWP West, and Borkum Riffgrund West are to be built by EnBW and Ørsted by 2024-2025.

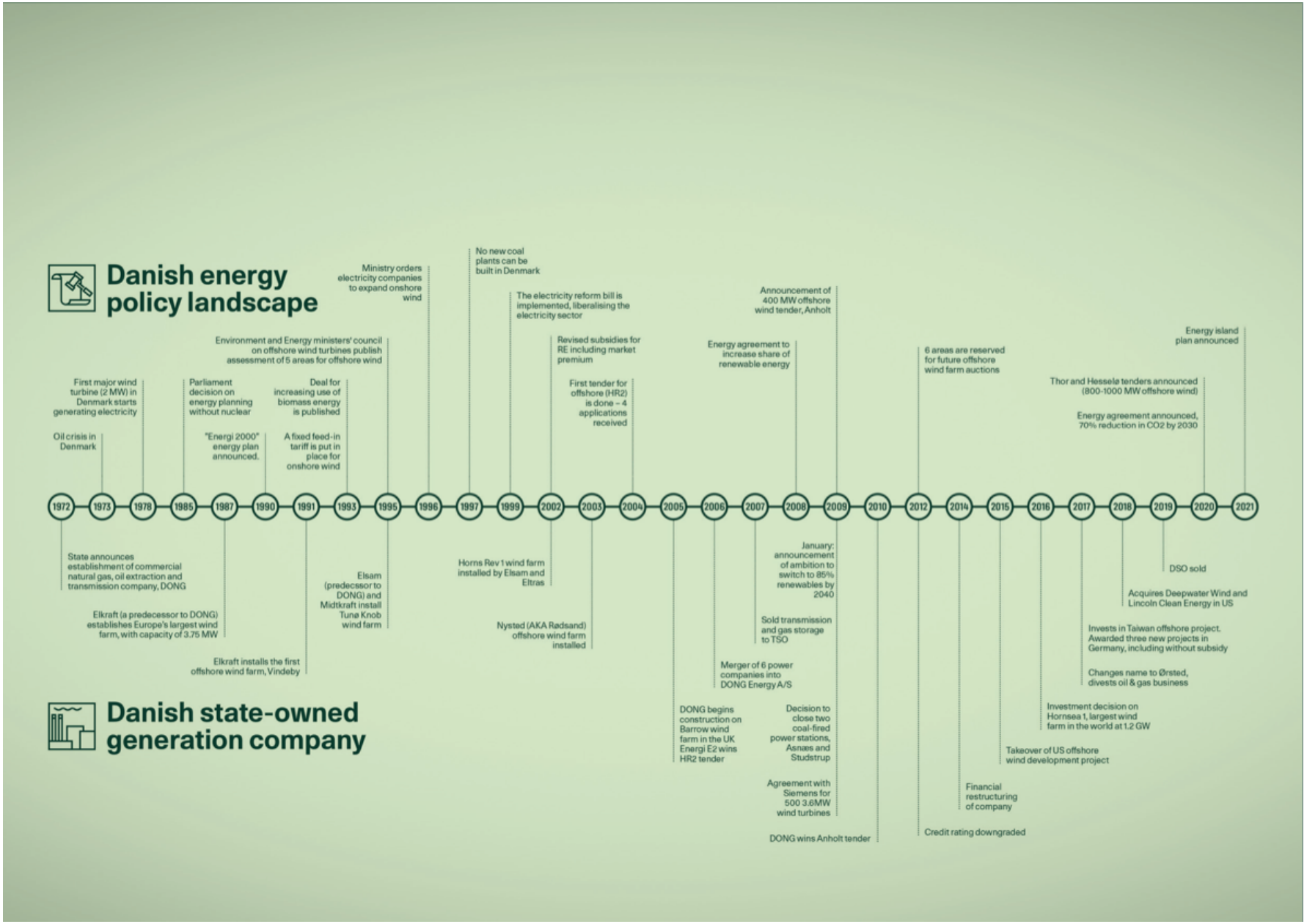


Source: The Climate Programme, chart by the Danish Energy Agency

The importance of offshore wind is rapidly increasing as the sea around Denmark offers ample space. A study of the socioeconomic impact of offshore wind suggests that the expansion of Danish wind farms will have a considerable employment effect. For each new GW offshore wind, around 4,900 jobs are estimated to be generated directly within the Danish offshore companies. Adding labor inputs from subcontractors and spending of wages and salaries means that the labor input on a 1 GW Danish offshore wind farm is estimated at a total of 14,600 jobs[58].

The chart below illustrates key milestones in the Danish energy transition over five decades.

[55] Ørsted is the result of a merger in 2006 between DONG – the state-owned company established in 1972 to provide energy to the Danish state - and 5 other Danish energy companies (Elsam, Energi E2, Nesa, Københavns Energi, and Frederiksberg Forsyning). The world's first offshore wind farm was established in 1991 by SEAS and Elkraft (the latter turned into Energi E2 which is part of Ørsted). In 2008, Ørsted (then DONG Energy) announced that it wanted to transform from being a fossil fuel-based company to a renewable energy company. The company's name was changed from Dong Energy to Ørsted in 2017.
[56] Siemens Gamesa's website, https://www.siemensgamesa.com/en-int/about-us/company-history.
[57] The Danish Energy Agency, "The Danish Energy Model", https://ens.dk/sites/ens.dk/files/contents/material/file/the_danish_energy_model.pdf.
[58] QBIS, "Socioeconomic impacts of offshore wind", 1 July 2020, https://www.danishshipping.dk/presse/nyheder/ny-rapport-havvind-sikrer-tusindvis-af-arbejdspladser.



Source: State of Green, From black to green – a Danish sustainable energy growth story, 2021, https://stateofgreen.com/en/publications/from-black-to-green-a-danish-sustainable-energy-growth-story/

2. The current Danish climate and energy policies

The current Danish climate and energy policies are based on the Climate Act of 2020 which provides legally binding climate targets. The Climate Act assigns a duty to act upon the Danish Minister for Climate, Energy and Utilities while the Danish Council for Climate Change and the Danish Parliament both assess whether the policy measures are sufficient to reach the targets.

This places the overall climate and energy strategy of the Government-in-office at the center of the process. However, the main part of the policies is still manifested in an overall agreement with broad political support, the Energy Agreement. As mentioned earlier, the overall political agreements are negotiated every 5-6 years and the most recent energy agreement covers the period up to 2030. The Energy Agreement is supplemented by more specific agreements with political support from the Parliament as well as initiatives and strategies laid out by the Government.

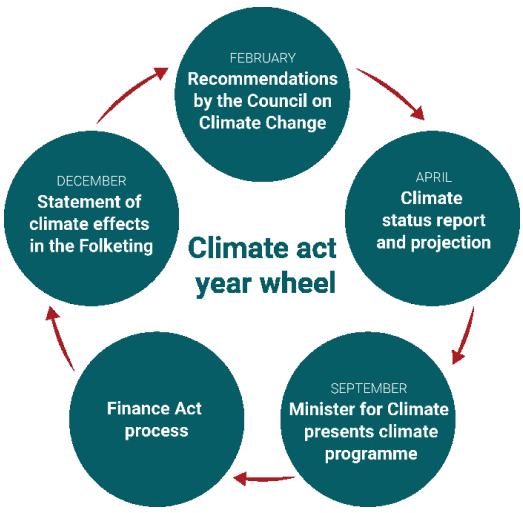
The following sections outline the Climate Act of 2020, the Government's overall strategy and the energy agreements reached with political support from the Parliament.

2.1 The Climate Act adopted in June 2020

Denmark's first climate law with legally binding climate targets was adopted in June 2020[59]. In the shorter run, the law sets out a legally binding target to reduce greenhouse gases by 70% by 2030 compared to the level of 1990. In the longer run, the law sets out a legally binding target to reach climate neutrality by 2050 at the latest.

The law also provides provisions for setting milestone targets, committing the Government-in-office to present climate sub-targets with a ten-year perspective every 5 years. The first ten-year sub-target is the 70% reduction in greenhouse gas emissions by 2030. The sub-target for 2035 is to be determined by 2025 and so forth. The updated climate target may never be less ambitious than the previous target, respecting the "no back-gliding" principle of the Paris Agreement. The Minister for Climate, Energy and Utilities is required to present a Climate Action Plan at least once every five years with a 10-year perspective.

The Danish Council on Climate Change plays a key role in an annual "wheel" set out by the Climate Act, cf. the Climate Act Year Wheel drawn up by the Ministry of Climate, Energy and Utilities[60].



In the beginning of each calendar-year, the Council provides recommendations on the Danish climate efforts. The Council assesses whether the Government's climate efforts make it probable that the climate targets will be reached and provides a status update on Denmark's international targets. The Council comments on the climate status and projection and prepares a catalogue of potential measures.

[59] The Danish Ministry of Climate, Energy and Utilities, Climate Act, 18 June 2020, https://en.kefm.dk/Media/1/B/Climate%20Act_Denmark%20-%20WEBTILGÆNGELIG-A.pdf and "Aftale om klimalov af 6. december 2019", 6 December 2019, https://kefm.dk/Media/1/D/aftale-om-klimalov-af-6-december-2019%20FINAL-a-webtilgængelig.pdf.

[60] The Danish Ministry of Climate, Energy and Utilities, "Climate Programme 2020", https://en.kefm.dk/Media/3/9/ClimateProgramme2020-Denmarks-LTS-under-the%20ParisAgreement_December2020_.pdf.

The next step is the Climate Status Report and Projection published by the Minister for Climate, Energy and Utilities (a "frozen policy" projection). This is followed up by the Government's Climate Program which includes the planned policy measures and their effectiveness, a state-of-play on reaching the climate targets, the Minister's view on the Council's recommendations, and information on the development of new climate measures world-wide. If the Danish climate targets are not projected to be within reach, the program must include new short- and long-term measures leading to the targets being met. Where appropriate, policy measures are included in the following year's Finance Act.

At the end of each year, the Minister for Climate, Energy and Utilities presents a report to the Danish Parliament on the effects of the overall climate policy. The Parliament is given the opportunity to assess whether the efforts proposed are sufficient to meet the targets of the Climate Act and a majority of the Parliament may require additional efforts. In the last resort, a majority of the Danish Parliament may move to a vote of no-confidence to the minister.

The current Climate Act supersedes the first Danish climate law adopted in 2014[61]. The first climate law aimed to establish a strategic framework for Denmark's climate policies with a view to transforming into a low emission society by 2050. The law obligated the Minister to present an annual policy report on the state-of-play of the Danish climate efforts and goals but did not include specific climate targets. The Danish Council for Climate Change was first established by the climate law of 2014 to provide a qualified and comprehensive foundation for decisions on Denmark's climate policies.

2.2 The current Government's overall strategy

Following up on the procedure set out in the Climate Act of June 2020, the Government presented its first annual Climate Program in September 2020[62]. The strategy for reaching the target of a 70% reduction in emissions by 2030 is based on two tracks: implementation and development. This approach was also promoted by the Danish Council on Climate Change since some measures are well-known while others need to be further developed.

The implementation track primarily consists of the policy measures included in the aforementioned political agreements which are described in Section 2.3.

The development track implies that the Government is initiating measures to support the development of green technologies. This track is particularly underpinned by the Government's green research strategy "Green solutions of the future - Strategy for investments in green research, technology, and innovation"[63]. Danish research efforts are focused on 4 areas where solutions are seen as most important in order to meet Denmark's climate objectives and to sustain the nature and the environment:

1) Carbon capture and storage or utilization
2) Green fuels for transportation and industry (Power-to-X etc.)
3) Climate and environment-friendly agriculture and food production
4) Recycling and reduction of plastic waste

The development track includes focus on international cooperation, particularly to ensure ambitious and cost-effective climate regulations in the EU, since common EU regulation

[61] Retsinformation, "Lov om Klimarådet, klimapolitisk redegørelse og fastsættelse af nationale klimamålsætninger", 25 June 2014, https://www.retsinformation.dk/eli/lta/2014/716.
[62] The Danish Ministry of Climate, Energy and Utilities, "Climate Programme 2020", https://en.kefm.dk/Media/3/9/ClimateProgramme2020-Denmarks-LTS-under-the%20ParisAgreement_December2020_.pdf
[63] The Danish Ministry of Higher Education and Science, "Green solutions of the future", September 2020, https://ufm.dk/en/publications/2020/filer/green-solutions-of-the-future.

implies equal conditions for Danish and other European companies as well as a stable long-term framework. The Danish Government presented its long-term strategy for global climate action in October 2020: "A Green and Sustainable World", prepared by 7 ministries.[64] The global strategy involves strengthening alliances, coalitions, and partnerships with countries as well as non-state actors to raise global climate ambitions. As mentioned earlier, Denmark is fostering bilateral partnerships with both developed and developing countries, sharing cost-efficient experiences from the Danish energy transition. Non-state actors are targeted because they are recognized as often leading the way by demonstrating the potential of green solutions, thereby inspiring and putting pressure on countries to commit to higher climate ambitions. The Government's strategy includes strengthening the financing of green transition globally through Danish as well as international investment funds and through public-private partnerships to increase private financing.

In December 2020, the Government presented its Statement of Climate Effects[65] to the Parliament, as required by the Climate Act. The political agreements and the phasing-out of coal were estimated to reduce greenhouse gas emissions by a total of approximately 7.2 million tonnes of CO2e in 2030, corresponding to roughly one third of what must be achieved by 2030 to fulfil the Climate Act.

The Government also presented its Climate Action Plan with a ten-year perspective in December 2020[66], as required by the Climate Act. Since 2020 was the first year of the Climate Act, the ten-year target had already been set at a 70% reduction in emissions by 2030.

2.2.1 Involving Danish society in the green transition

The Government's overall strategy strives to involve Danish society in the green transition. To that end, cooperation forums with the business community, civil society and private individuals have been established:

- 14 Climate Partnerships with the business community, as mentioned earlier, focused on how businesses and the Government can join forces to address climate issues.
- The Youth Climate Council aims to infuse innovative thinking into climate policy and suggest solutions to the Minister for Climate, Energy and Utilities. The members come from all over Denmark, and they have different educational backgrounds and represent different approaches to climate challenges. The Council's recommendations are wide-ranging and include the establishment of more wild nature to promote biodiversity, more focus on climate and sustainability at all levels of education from elementary school up to the universities, and recommendations on the structure and content of Danish climate policies to further encourage the green transition.[67]
- The Citizens' Assembly consists of 99 members randomly selected to represent the Danish population. The Assembly discusses dilemmas facing Danish society in view of the climate crisis based on presentations by climate experts. The Citizens' Assembly

[64] The Danish Ministry of Foreign Affairs, "A Green and Sustainable World - The Danish Government's long-term strategy for global climate action", October 2020, https://um.dk/en/foreign-policy/new-climate-action-strategy/. The 7 ministries behind the strategy were: The Danish Ministry of Foreign Affairs, Ministry of Climate, Energy and Utilities, Ministry of Finance, Ministry of Industry, Business and Financial Affairs, Ministry of Environment and Food, Ministry of Higher Education and Science, and Ministry of Transport.

[65] The Danish Ministry of Climate, Energy and Utilities, "Redegørelse for klimaeffekter 2020", December 2020, https://kefm.dk/Media/E/3/Redegørelse%20for%20klimaeffekter%202020%20(2).pdf.

[66] The Danish Ministry of Climate, Energy and Utilities, "Klima Handlingsplan", December 2020, https://kefm.dk/Media/F/5/Klimahandlingsplan%202020a.pdf.

[67] The Ministry of Climate, Energy and Utilities' website, "Ungeklimarådet", https://kefm.dk/klima-og-vejr/ungeklimaraadet.

reports to the Minister for Climate, Energy and Utilities and its recommendations are wide ranging, for instance teaching about the climate crisis in elementary schools, introducing new climate taxes, and encouraging climate-friendly eating habits.[68]

The climate partnership with the focal energy and utilities sector deserves particular attention. The sector delivered its vision for the green transition in March 2020[69]. The Danish energy and utilities sector notes that its carbon emissions have already been cut by 58% from 32 million tonnes in 1990 to 13 million tonnes in 2019. But the sector stipulates that it may be able to reduce its emissions to approximately 1 million tonnes by 2030, which is a reduction of more than 95% compared to the 1990 level. The measures would include phasing-out the remaining coal used for power stations and natural gas for district heating production, phasing-out natural gas and oil in individual heating systems, carbon capture at large point sources, reduction of the use of plastics in waste-to-energy systems, and reduction of the amount of natural gas used for energy production in the North Sea.

The emission reductions in the energy and utilities sector were estimated to account for approximately half of the total reductions required in Denmark from 2019 to 2030. The remaining 13 million tonnes would have to come from other sectors. The estimated reduction in non-energy-related emissions is 4 million tonnes while the required energy-related emission reductions amount to 9 million tonnes, in order for Denmark to reach its 70% reduction target. The energy sector takes on a holistic approach and estimates how the other sectors – mainly transport and industry - may achieve the reduction of 9 million tonnes through energy efficiency and new technologies, as well as change in fuels, to be able to accommodate future increased demand for renewable energy and infrastructure.

The total demand for renewable energy is expected to grow by 64% to 125 TWh by 2030. Meeting the increased demand for renewable energy requires a build-out of offshore wind from 1.7 to 7.6 GW, onshore wind from 4.4 to 6.1 GW, and solar energy from 1.2 to 8.8 GW. Biogas production must be increased from 4.4 TWh in 2019 to 13.3 TWh by 2030 and Power-to-X (PtX) must be increased to full-scale production. The power grid must be upgraded to be able to transport more green power. The energy and utilities sector estimates that the investments will total approximately DKK 32 billion annually towards and including 2030.

It is expected that the final consumption from the distribution grid will increase from 34 TWh in 2019 to 58 TWh in 2030, and the final consumption from the transmission grid will increase from 1 TWh to 13 TWh.[70] Demand-side response and smart solutions will reduce the necessary infrastructure upgrades. Nevertheless, the increased power generation from fluctuating renewable energy sources will require more cross-border interconnections. Furthermore, the gas and heat infrastructure will change, and infrastructure to support the development of PtX fuels will be necessary. Initiatives must be implemented to ensure security of supply during times with limited power generation from flexible energy sources.

The energy and utilities sector's strategy to reach the 70% reduction in emissions by 2030 is accompanied by a set of comprehensive requests to the Government, as outlined below.

[68] Website of the Ministry of Climate, Energy and Utilities, "Borgertinget", https://kefm.dk/klima-og-vejr/borgertinget-.
[69] Danish Energy, "Powering Denmark's Green Transition", May 2020, https://www.danskenergi.dk/sites/danskenergi.dk/files/media/dokumenter/2020-07/Powering_Denmarks_Green_Transition_Climatepartnership.pdf.
[70] The new transmission grid consumption is expected to come from large, collective heat pumps and boilers, data centers, hydrogen production, train transport and a partial electrification of the North Sea.

The energy and utilities sector request for a national climate strategy based on 5 fundamental actions, supplemented by 20 essential decisions

Action 1. Set a guiding target of reducing carbon emissions from the energy and utilities sector by at least 95%

1. Decide on a full and speedy phase-out of coal in the Danish combined heat and power generation.

2. Decide on how to phase out natural gas in individual heating systems by 2030 and prepare an action plan to allow customers time to prepare to switch to another heating option (heat pump, biogas, or district heating).

3. Decide on new regulation for the district heating sector to support the transition to 100% green energy while considering the differences in heating areas and different technological solutions and prioritizing investment in alternatives to increased biomass utilization. Also decide that all use of biomass for energy production must comply with future statutory sustainability criteria.

4. Decide to separate plastics from waste and prepare a long-term strategy to increase recycling.

5. Decide that a national climate strategy must include carbon capture (utilization and storage) and provide the regulatory and financial framework to establish carbon capture at one or more of the Danish point sources, including waste-to-energy plants.

6. Decide to prepare an action plan, in cooperation with the offshore industry, for optimization and partial electrification of the oil and natural gas production in the North Sea.

Action 2. Set a guiding target of reducing the total use of fossil fuel for buildings, transport, and industry by 50%

7. Decide on a new vehicle taxation scheme to support accelerated sales of green vehicles, eliminating the incentive to buy petrol and diesel vehicles before 2030, and supplement with a pro-active approach to planning and designation of areas for the establishment of recharging points.

8. Decide that all new public transport contracts – for the delivery of buses, ferries, taxis, and trains – must be for fossil-free solutions.

9. Decide to remove regulatory barriers to energy efficiency as identified across climate partnerships and make this an independent focus area in a national climate strategy.

10. Decide on a plan to phase out industrial use of coal, oil, and natural gas where technically feasible, and support industry in transitioning to green alternatives such as power, hydrogen-based fuels, and biogas.

Action 3. Prepare a guiding 10-year roadmap for hydrogen-based fuels, focusing on how Government and industry can work together to reduce start-up costs and costs of use

11. Decide on a strategy and roadmap for the use of hydrogen-based fuels (PtX). Allocate funds for industrial scale-up to encourage cost reductions towards commercial feasibility and appoint relevant locations for utilization of, for example, waste heat.

Action 4. Set a target for build-out of renewable energy ensuring sufficient capacity to support a complete, green transformation of Denmark

12. For annual tenders from 2021 to 2024, decide that at least 5 GW of offshore wind farms are to be installed and commissioned before 2030. A capacity of 3 GW of these 5 GW is already sanctioned in the 2018 Energy Agreement, and allowance should be made for further upward adjustment towards 2030 - also through the open-door procedure.

13. Decide on a roadmap for the total build-out of renewable energy and transmission infrastructure in the North Sea and the Baltic Sea towards 2050, also determining that one of the first public tenders of offshore wind before 2024 must include the construction of one or more energy islands, which are to be connected to other countries before 2030 and form part of a North Sea grid and/or a Baltic Sea grid after 2030.

14. Decide on an action plan allowing for an ambitious build-out of onshore wind and solar energy which caters to the overall demand for renewable energy and grid capacity. Carry through the already agreed upon technology-neutral tenders. Enter binding agreements with local authorities to secure the required land lease agreements.

15. Decide to increase the amount of biogas in the Danish energy supply by 2030 and make requirements for an increasingly cost-effective production either backed by 'fixed-volume offtake requirements' or by production subsidies.

Action 5. Define a framework for build-out of the Danish energy infrastructure to support a complete, green transformation of Denmark

16. Decide that economic regulation of distribution system operators and Energinet must enable cost-effective build-out of the distribution and transmission grids to accommodate increased power consumption.

17. Decide to implement time-differentiated tariffs and to make data available for market players to develop attractive demand-side products, energy storage, etc. for the energy customers, contributing to peak-shaving and reduction of power consumption to balance the demand.

18. Decide that the Danish security of supply target must allow for an energy system designed to support the 70% reduction target, comprising more fluctuating energy production and significantly reduced power plant capacity.

19. Decide on a plan for expanding the transmission infrastructure (on- and offshore), supported by efficient decision-making processes to ensure investments are not delayed.

20. Decide on a gas infrastructure plan, including which of the gas network to retire and when as well as how the gas infrastructure's transport and storage capacity can be used to support PtX fuels and green gases.

Source: Excerpt from Danish Energy, "Powering Denmark's Green Transition", May 2020

The work of the climate partnerships is followed up in the Green Business Forum, which was also created in November 2019[71]. The forum meets semi-annually, and participants include 10 Danish Ministers as well as chairpersons and directors from leading Danish companies and trade unions. The forum is to focus on progress in the sector roadmaps and synergies and beneficial cooperation between the different climate partnerships on issues such as technological developments and research. The forum discusses how to achieve greenhouse gas emission reductions through business-community initiatives and Government policy measures as well as the business potential for Danish companies.

Examples of independent business sector initiatives so far include[72]:

- The Government has made an agreement with Aalborg Portland, the largest emitter in Denmark, to reduce its emissions by 660,000 tonnes CO2e up to 2030. The agreement is estimated to reduce annual emissions in 2030 by 0.5 million tonnes CO2e.
- The Danish financial sector has announced that it will invest 350 billion DKK in the green transition up to 2030, corresponding to more than 10% of total Danish GDP.
- WWF and the VELUX group have launched the Lifetime Carbon Neutral initiative to ensure that VELUX covers all its historical and future greenhouse gas emissions through forest projects. This equates a total of 5.6 million tonnes of CO2 in forest projects to be developed and operated by WWF.
- 7 Danish companies - Ørsted, Mærsk, Haldor Topsøe, DSV, SAS, Copenhagen Airports and DFDS - have teamed up to establish a large-scale hydrogen plant with a capacity of up to 1.3 GW. It is set to generate sustainable hydrogen for aircraft, vessels, lorries and buses using Danish wind power. Carbon emissions are expected to be reduced by 0.85 million tonnes a year by 2030.

2.3 Key political energy agreements

The Energy Agreement of 29th June 2018[73] is the pillar of the current Danish energy policies and it was agreed by all the political parties of the Parliament. It sets the course towards a renewable energy share of approximately 55% by 2030 and a renewable energy share in electricity above 100% of consumption. At least 90% of district heating consumption is to be based on energy sources other than coal, oil, or gas by 2030.

- Three new offshore wind farms are to be established before 2030. They will supply at least 2.4 GW of green electricity to the energy system. The agreement aims to realize Denmark's offshore wind farms without state subsidies but acknowledges that subsidies may remain necessary for the installation of cables transporting electricity from offshore wind farms to consumers' outlets.
- The regulations governing the heat production will be gradually eased to promote green technologies such as heat pumps, geothermal solutions, and solar PV. Constraints on the district heating plants will be eliminated, including the requirement

[71] The Danish Ministry of Industry, Business and Financial Affairs, "Kommissorium for Grønt Erhvervsforum", 12 November 2019, https://em.dk/media/13419/kommissorium-for-groent-erhvervsforum_121119.pdf.
[72] The Danish Ministry of Climate, Energy and Utilities, "Climate Programme 2020", https://en.kefm.dk/Media/3/9/ClimateProgramme2020-Denmarks-LTS-under-the%20ParisAgreement_December2020_.pdf.
[73] The Danish Ministry of Climate, Energy and Utilities, "Energy Agreement of 29 June 2018", 29 June 2018, https://en.kefm.dk/Media/C/5/Energy%20Agreement%202018%20a-webtilgængelig.pdf and https://en.kefm.dk/Media/1/9/Handouts%20Energy%20Agreement_eng%20a-webtilgængelig.pdf.

to use natural gas. The power to obligate consumers to be connected to the collective heating system is to be abolished.

- The high taxes on electricity will be reduced since green electricity can be converted into heat and channeled through district heating systems or into large-scale heat storage facilities. In particular, the electrical heating tax will be reduced from 0.307 DKK/kWh to 0.155 DKK/kWh, effective 2021, corresponding to a reduction from 5.52 to 2.67 JPY/kWh. The general electricity tax for households will be reduced from 0.914 DKK/kWh to 0.774 DKK/kWh (phased in from 2019-2025). This corresponds to a reduction from 16.21 to 13.71 JPY/kWh.
- Energy efficiency and energy savings are focused on decarbonization and electrification and are promoted through a new tender-based scheme providing subsidies for energy efficiency improvements in businesses and buildings instead of the current energy efficiency obligation scheme set to expire in 2021. Other initiatives include grants for replacement of oil-fired boilers with heat pumps, loan funds for energy renovation of municipal and regional buildings, and information activities relating to energy savings for citizens.
- Additional state funding for energy and climate research is to be phased in to facilitate green solutions and generate new opportunities for growth, jobs, and Danish technology exports.
- The agreement is expected to provide 10-11 million tonnes reduction in Denmark's total carbon emissions by 2030.

The Climate Agreement for Energy and Industry of June 2020[74] is a strengthening of the 2018 Energy Agreement in order to reach the new target of 70% emission reductions by 2030, and it was agreed by 9 of 10 parties of the Danish Parliament.

- The earlier agreed 3 offshore wind farms will amount to a total of 6 GW (instead of only 2.4 GW) - which is a doubling of the total Danish wind capacity in 2019 - and the agreement implies the world's first energy islands. In addition to generating electricity for consumption, the energy from the islands will eventually be utilized to power PtX technologies that can store or convert green electricity into green fuels.
- The offshore wind farms are: 1. an energy island in the North Sea with a capacity of 3 GW and a potential of expanding the capacity to 10 GW; 2. the island of Bornholm is to be an energy island with a capacity of 2 GW; and 3. an offshore wind farm off the island of Hesselø with a capacity of 1 GW.
- Further financing is provided for carbon capture and storage, and there will be a tender to support the establishment of large-scale PtX plants with a total capacity of 100 MW.
- Taxes on green electricity for heating are further reduced and taxes on fossil heating are simultaneously increased. The electrical heating tax is reduced from 0.155 DKK/kWh to 0.004 DKK/kWh for businesses and 0.008 DKK/kWh for households, effective 2021. This corresponds to a reduction from 2.67 JPY/kWh to 0.09 and 0.18 JPY/kWh. The tax will be eliminated for electricity-based surplus heat, e.g., surplus heat from data centers or supermarkets.

[74] The Danish Ministry of Climate, Energy and Utilities, "Danish Climate Agreement for Energy and Industry 2020", 22 June 2020, https://en.kefm.dk/Media/C/B/faktaark-klimaaftale%20(English%20august%2014).pdf and https://kefm.dk/Media/8/8/aftaletekst-klimaaftale-energi-og-industri%20(1).pdf.

- More funds are made available to industry contributing to a green transition through energy efficiency improvements, electrification, and more biogas and other green gases. Further support is also provided for energy efficiency measures in public buildings and the phasing-out of oil and gas boilers in households. The mandatory commitments binding consumers to the use of natural gas are removed.
- Combined with the Climate Agreement for Waste Management (see below), the agreement is expected to reduce emissions by 3.4 million tonnes of CO2e in 2030.

The Climate Agreement for Waste Management of June 2020[75] aims at a climate-neutral waste sector by 2030 and it was agreed by 9 of 10 parties of the Danish Parliament. The plan for a green waste sector and circular economy includes:

- Waste sorting is streamlined and increased to ten types of waste for both households and businesses.
- A requirement for at least a 60% recycling rate for collected plastic waste is to be imposed by the municipalities which are responsible for waste management. Sector partnerships with the restaurant industry as well as the agriculture and construction sectors will be initiated to reduce and sort plastic waste.
- The waste from households and businesses are to be collected and organized more uniformly and the municipalities are required to offer tenders on management of waste for recycling. Waste plants owned by municipalities are to be separated from the municipalities' other responsibilities to ensure economic transparency and competition.
- The capacity of Danish incineration plants is to be reduced to match Denmark's decreased volume of waste as Danes begin sorting more waste for recycling. While the incineration plants have been energy efficient and displaced fossil fuels, waste is now on course to be the largest fossil source for heat and electricity.
- Further initiatives are contemplated. For instance, analysis will be initiated on how taxes may support additional CO2e-reductions in the waste sector, and work will be initiated into possibilities of increasing the share of recycled plastic in new products.

An agreement on a 2050 cut-off date for oil and gas extraction in the North Sea[76] was reached in December 2020 by 6 of 10 political parties of the Danish Parliament.

- The ongoing 8th licensing round and all future rounds to extract oil and gas in the North Sea were cancelled. This follows the advice of The Danish Council on Climate Change to establish a cut-off date consistent with the objective of climate neutrality by 2050.
- Denmark started extracting fossil fuels in the North Sea in 1972 and has made around 541 billion DKK in revenue from the North Sea, corresponding to 85.3 billion USD. In 2016, where the latest inventory was made, there were around 4,000 workers directly or indirectly employed in the extraction industry.

[75] The Danish Ministry of Climate, Energy and Utilities, "Klimaplan for en grøn affaldssektor og cirkulær økonomi", 16 June 2020, https://kefm.dk/Media/4/3/aftaletekst%20Klimaplann%20for%20en%20grøn%20affaldssektor%20og%20cirkulær%20økonomi.pdf.

[76] The Danish Ministry of Climate, Energy and Utilities, "Denmark introduces cutoff date of 2050 for oil and gas extraction in the North Sea, cancels all future licensing rounds", 4 December 2020, https://en.kefm.dk/news/news-archive/2020/dec/denmark-introduces-cutoff-date-of-2050-for-oil-and-gas-extraction-in-the-north-sea-cancels-all-future-licensing-rounds and https://kefm.dk/Media/0/3/Nordsøaftale%20(2).pdf.

An agreement on a green tax reform[77] was reached by 5 of 10 political parties of the Danish Parliament in December 2020, aiming at higher and more uniform taxes on greenhouse gas emissions by 2030.

- The reform will take place in two phases. The first phase (2020-2022) is based on the existing energy tax system and includes gradually increasing the taxes on companies' consumption of fossil fuels by 6 DKK per GJ until 2025. The second phase (from 2023) will determine the framework for a uniform CO2e tax.
- An expert group of 6 members consisting primarily of university professors has been set up to prepare proposals for the design of uniform CO2e regulation. The expert group will report in part and recommend principles for CO2e regulation by the end of 2021 which will serve as a basis for a discussion among the parties to the agreement. The expert group will finalize its report by the autumn of 2022.
- The expert group is to prepare scenarios that will make a significant contribution to the 70% target by 2030. The scenarios should reflect different tax bases and CO2e prices, and each scenario must include the effect on GDP and the business and distributional consequences.
- The first phase is expected to reduce CO2e emissions by 0.5 million tonnes by 2025.

An agreement on the road transport sector[78] was reached in December 2020 by 4 of 10 political parties of the Danish Parliament. The estimation is that there will be 775,000 million zero- and low-emission cars by 2030. The total vehicle fleet in Denmark is expected to grow from 2.7 million passenger cars today to about 3.3 million by 2030.

- The agreement includes a reform of the registration tax on cars, based on the value of the car and its CO2 emissions, to support an increase in green cars.
- The current special scheme with low electricity tax for charging zero- and low-emission cars will be extended until 2030. The tax on diesel cars will be increased.
- The toll on heavy traffic - both Danish and foreign trucks - will be converted to a kilometer-based and CO2-differentiated toll, so that truck traffic to a greater extent is taxed according to its impact on the surroundings.
- The current requirement to mix at least 7.6% biofuels into petrol, diesel and gas sold for land transport purposes will be replaced by a CO2 displacement requirement in order to promote more advanced biofuels and new fuels such as PtX.
- Under current EU law, it is not possible to introduce a ban on the registration and sale of new diesel and petrol cars in Denmark. The agreement therefore entails working at the EU level for a phasing-out of new petrol and diesel cars and opportunities for ambitious countries to take the lead and introduce a ban, as well as ambitious CO2 requirements for cars and vans in the EU and the promotion of the necessary infrastructure and alternative fuels.
- The agreement is estimated to reduce CO2 emissions by 1.0 million tonnes by 2025 and 2.1 million tonnes by 2030.

[77] The Danish Ministry of Finance, "Aftale om grøn skattereform", 8 December 2020, https://fm.dk/media/18317/aftale-om-groen-skattereform.pdf.
[78] The Danish Ministry of Finance, "Aftale om grøn omstilling af vejtransporten", 4 December 2020, https://fm.dk/media/18511/aftale-om-groen-omstilling-af-vejtransporten_a.pdf and "Faktaark - Grøn omstilling af vejtransporten", 4 December 2020, https://fm.dk/media/18512/faktaark-om-groen-omstilling-af-vejtransporten_a.pdf

An agreement on the energy island in the North Sea[79] was reached in February 2021 by 9 of 10 political parties of the Danish Parliament, following up on The Climate Agreement for Energy and Industry of June 2020.

- The island will be artificially constructed 80 kilometers from the shore of the peninsula Jutland, and it will serve as a hub for offshore wind farms gathering green electricity from hundreds of wind turbines surrounding the island and distributing the electricity to consumers in countries surrounding the North Sea. The island is expected to have a total area of at least 120,000 square meters and in its first phase it will be able to provide 3 million European households with green energy. Fully implemented, it will be able to cover the consumption of 10 million European households.
- The project will be a public-private partnership between the Danish State and private companies. The State will own the majority of the island, but private companies will be crucial for the project to fulfill its potential as regards innovation, flexibility, cost-effectiveness, and business potential. Details about the ownership of the island will be specified for a tender for private partnerships to be opened.

3. Assessment of the Danish energy policies and the ability to reach the 2030 climate target

The Danish Energy Agency annually provides a technical projection of how Denmark's greenhouse gas emissions will evolve over the period up to 2030 based on the assumption of a frozen-policy scenario. A frozen-policy scenario describes a scenario with only existing policy measures, i.e., a scenario in which no new policies are introduced.

The outlook from June 2020[80] projected that emissions would be 43.1 million tonnes CO2e in 2030, corresponding to an emission reduction of 44% compared to 1990, if no new measures were decided in the climate and energy area after 1st May 2020. Hence, a reduction effort of 26 percentage points remained if the target of a 70% reduction by 2030 were to be reached, corresponding to 20 million tonnes CO2e.

In the following, the main elements of The Danish Council for Climate Change's assessment of the current Danish energy policies' ability to reach the climate targets are presented which takes into account the political agreements reached in 2020. The focal points of the IEA's overall assessment of Danish energy and climate policies from 2017 are also presented.

3.1 The DCCC's assessment of the ability to reach the 2030 climate target

The Danish Council for Climate Change (DCCC) presented its assessment of the Government's climate measures in February 2021.[81] The conclusion was that the Government's policies do not demonstrate the likelihood that the Climate Act's 70% target for 2030 will be met.

However, the policy measures agreed in 2020 were projected to result in reductions of 7.2 million tonnes CO2e, corresponding to greenhouse gas emissions around 54% in 2030 compared to 1990. The DCCC emphasizes the importance of the political agreement regarding energy and industry and the political agreement regarding waste. The projection of 7.2 million

[79] The Danish Ministry of Climate, Energy and Utilities, "Denmark decides to construct the world's first wind energy hub as an artificial island in the North Sea", 4 February 2021, https://en.kefm.dk/news/news-archive/2021/feb/denmark-decides-to-construct-the-world's-first-windenergy-hub-as-an-artificial-island-in-the-north-sea.

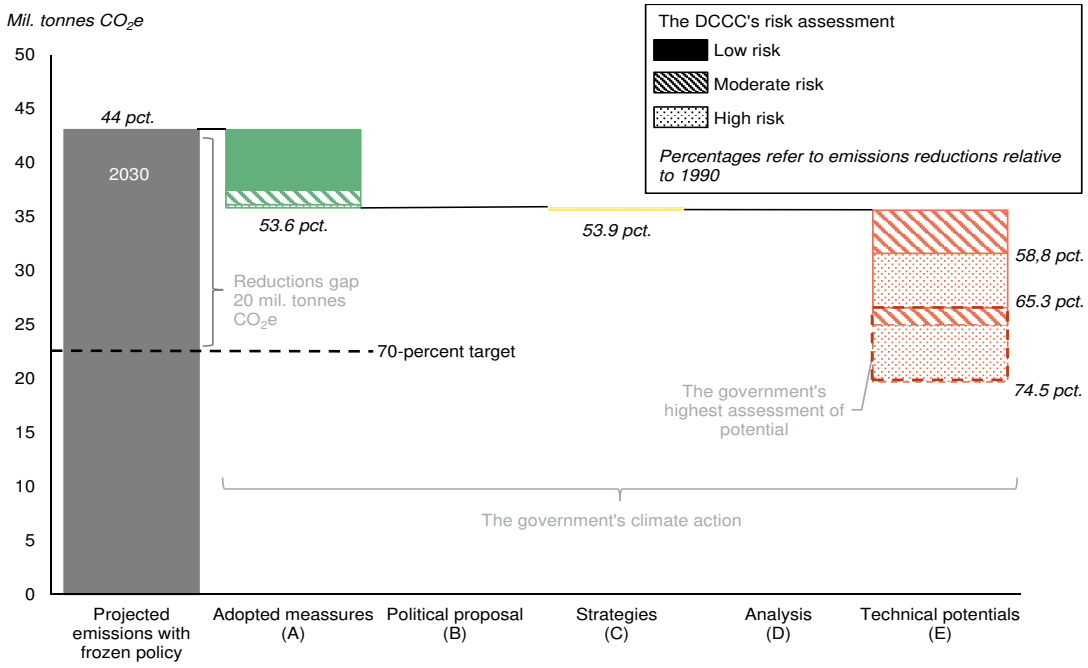
[80] The Danish Energy Agency, "Denmark's Climate and Energy Outlook 2020", https://ens.dk/sites/ens.dk/files/Basisfremskrivning/deco_2020_27082020.pdf

[81] The Danish Council on Climate Change, "Status Outlook 2021 - Denmark's national and global climate efforts", 26 February 2021, https://klimaraadet.dk/en/nyheder/new-report-assesses-governments-climate-effort-and-provides-recommendations-how-meet-70.

tonnes CO2e reductions was the same as the estimate provided by the Danish Government in its Statement of Climate Effects from December 2020.

The DCCC's survey of the Government's climate efforts is summarized in the chart below. The starting point is the Danish Energy Agency's projection from June 2020, which leaves a reduction gap of about 20 million tonnes CO2e by 2030. The chart below illustrates the expected reduction effects of the policy agreements from 2020 as well as other initiatives.

The DCCC's assessment of the Government's initiatives in relation to reduction effect, stage of concretization and risk



Source: DCCC, "Status Outlook 2021 - Denmark's national and global climate efforts", 26 February 2021

Emission reductions are grouped according to how specific the measures are at present, on a scale from A to E. The letter 'A' means that the Danish Parliament has adopted the measure; 'B' is used when the Government has presented a proposal that has not yet been adopted; 'C' indicates a Government strategy on a specific area with an indicated reduction effect; 'D' denotes an analysis, which often precedes an actual strategy; and 'E' indicates that the Government has identified technical reduction potential without indicating how to realize this potential. The reductions are illustrated with a color scale from green to yellow to red to symbolize the progress in the policy phase, with green indicating the most concrete stage.

Finally, the reduction effect of each policy initiative at each stage of concretization is categorized according to risk assessment. This reflects the DCCC's assessment of the likelihood that the indicated reduction can be realized before 2030. For example, there can be a high risk if the reduction estimates are based on immature technologies, or if it remains uncertain whether the incentives in an initiative are strong enough.

As mentioned, the DCCC estimates that the agreements reached by the parties of the Danish Parliament in 2020 - concretization level A - will reduce the emissions in 2030 by 7.2 million tonnes CO2e. However, the DCCC finds it to be unclear how the Government intends to meet the remaining gap of 12.8 million tonnes CO2e. The DCCC notes that only a few strategies are identified at concretization level C, resulting in a limited reduction effect of an estimated 0.2 million tonnes CO2e. This reduction partly stems from the Government's strategy in the

transport sector, which does not fully describe the introduction of kilometer-based taxes for trucks. Another part stems from the energy islands where many details and decisions remain.

The DCCC notes that the Government has identified technical reduction potential which can possibly bridge the remaining reduction gap. This potential is marked in red in the chart and represents the lowest concretization level E. A large share of the potential carries a high level of risk, for instance related to CO2 capture and storage or utilization (CCS/CCU). Realizing a very large reduction within a few years by employing relatively untested technologies is potentially challenging. The 70% target can only be met if the Government's high estimates on reduction potential are realized.

The DCCC calls for a reduction target for 2025 to strengthen climate action in the short term. The Government initiated political negotiations regarding the 2025 target in December 2020, proposing a 2025 target of a 46-50% reduction compared with the level in 1990. The DCCC recommends a more ambitious target of 50-54%.

The DCCC finds it crucial that a clear strategy with time schedules is quickly laid out to ensure that the expected reductions can be attained in 2030. The DCCC recommends:

- **A specific road map towards the 70% target**, including all areas of climate action until 2030, detailing specific and coherent scenarios for the target achievement. The roadmap should contain both sectoral strategies, for example in agriculture and transport, and cross-sectoral elements, that ensure a holistic approach.
- **A national strategy for CO2 capture and storage** should be an important element in the roadmap as the Government envisages CCS to fill a significant share of the reduction gap in 2030. For instance, the strategy must specify benchmarks for how much the technology is going to be used, and in relation to which CO2 sources. The placement of CO2 storage facilities and future owners and operators must be decided, and legislation must be adapted to remove legal barriers, for example to storage. Economic framework conditions must be established to create incentives to capture CO2 and store it in the ground, and the safety risks must be clarified.

The DCCC also highlights recommendations for the instruments set out below to be implemented as soon as possible:

- **A relatively high and uniform carbon tax** is a key pillar in cost-efficient achievement of the 70% target to ensure significant reductions in industry, agriculture, transport, and heating of buildings. Today, the carbon tax per tonne of carbon differs greatly across sectors, and for some it is very low and even zero. With the agreement on a green tax reform in December 2020, an expert group was set up to prepare and recommend a model. However, the DCCC recommends that the broad outlines of a tax reform are presented promptly, such as the expected tax level in 2030 and how it will be phased in. This would provide clarity for companies and citizens who are going to invest and make decisions that may be affected by the tax.
- **Accelerated rewetting of peat soils** is recommended since the CO2 emissions from carbon rich peat soils correspond to one fifth of the reduction gap in 2030 and the costs related to rewetting are low from a socio-economic perspective. The DCCC recommends a model in which rewetting is implemented in a coordinated manner, addressing practical barriers, and involving relevant stakeholders. In due time, the economic incentive may come from the general tax on greenhouse gas emissions, whereas in the shorter term it may be provided by an auction-based subsidy scheme.

- **Higher value of climate effects in socio-economic calculations** is called for. Decisions in the public sector, for instance on new construction projects, are often based on socio-economic impact assessments and often also a technical assumption of the price of greenhouse gas emissions. This price should include the cost to society of a project's potential contribution to increasing emissions in Denmark since an equivalent emissions reduction must be realized somewhere else to meet the 70% target.

The DCCC generally finds the Government's focus on the 2030 target to be reasonable at this stage since it is too soon to make detailed plans for climate action all the way to 2050. Also, Denmark is likely to be on course towards climate neutrality by 2050 if the 70% target in 2030 is reached with emphasis on long-term climate efforts. However, the DCCC warns that the last 30 percentage points towards 2050 will most likely be the most difficult to achieve.

3.1.1 Developments since the DCCCs assessment

The Danish Energy Agency provided an updated frozen-policy projection in April 2021[82] which – similarly to the DCCCs assessment - took into account the political agreements from June to December 2020[83]. The updated projection resulted in a gap of 11.8 million tonnes CO2e in 2030, i.e., 1 million tonne CO2e less than the DCCC. In addition to the positive effects of the political agreements, the Danish Energy Agency referred to a higher production of biogas and lower emissions from LULUCF than earlier expected. The gap implies a reduction of 55% in greenhouse gas emissions in 2030 compared to 1990, leaving a reduction effort of 15 percentage points if the target of 70% reductions is to be reached.

The climate partnership on energy and utilities provided an update in March 2021[84] where the political agreements are acknowledged to accommodate many of the sector's requests, cited in Section 2.2.1. In 2020, the sector emitted 10.8 million tonnes CO2 and the agreements combined with the sector's own initiatives were estimated to leave a gap of only 2.5 million tonnes CO2 to reach the target of 1 million tonnes CO2 emissions in 2030. The sector specified further requests to the Government and encouraged continued strong cooperation.

In addition, several further political agreements have been reached in 2021, including:

- In May 2021, the emission reduction target of 50-54% by 2025 suggested by the DCCC was agreed by the Government and 3 other political parties of the Danish Parliament.[85]
- In June 2021, the initial framework for CO2 storage was agreed by a broad majority of the Parliament (9 of 11[86] parties), initiating investigations of potential storage sites in the Danish subsoil, enabling import and export of CO2, and ensuring that CO2 storage will take place in a safe manner. The negotiations will continue in the autumn 2021.[87]
- In September 2021, an initial agreement on the framework for the tender on the energy island in the North Sea was reached by 9 of 11 political parties of the Danish Parliament. The island will be a public-private partnership where the State owns at least 50.1%, and the bidders on the island may suggest how to establish areas for

[82] The Danish Energy Agency, "Klimastatus og -fremskrivning 2021", https://ens.dk/sites/ens.dk/files/Basisfremskrivning/kf21_hovedrapport.pdf
[83] The impact of the energy islands is not included as further specification is required.
[84] The Danish Ministry of Climate, Energy and Utilities, "Klimapartnerskab for energi og forsyning - Sektorkøreplan", March 2021, https://kefm.dk/Media/637522788959292805/Sektorkøreplan_Energi-%20og%20forsyningssektor.pdf.
[85] The Danish Ministry of Finance, "Aftale om et indikativt drivhusgasreduktionsmål for 2025", 7 May 2021, https://fm.dk/media/18803/aftale-om-et-indikativt-drivhusgasreduktionsmaal-for-2025.pdf.
[86] The number of political parties in the Danish Parliament increased from 10 to 11 as one Member of Parliament left one of the 10 political parties and joined a political party that was not represented in the Parliament before then.
[87] The Danish Ministry of Climate, Energy and Utilities, "Bred politisk aftale om CO2-lagring", 30 June 2021, https://kefm.dk/aktuelt/nyheder/2021/jun/bred-politisk-aftale-om-co2-lagring.

innovative, green solutions such as PtX. The details will be discussed with the market participants before further specification of the framework for the tender. The preparations are expected to be finalized by summer 2022.[88]

- In October 2021, a broad majority of the Danish Parliament (10 of 11 parties) agreed that the greenhouse gas emissions of the agriculture and forestry sector must be reduced by 55-65% by 2030 as compared to 1990. The ambition is a reduction of 8 million tonnes of CO2e through removal and rewetting of climate-damaging lowland soils, investment in technologies such as pyrolysis, further development of manure handling and feed additives, as well as more focus on plant-based production and ecology. Initially, policy measures only include reductions of 1.9 million tonnes CO2e by 2030 and the agreement is to be revisited by 2023/24.[89]

In September 2021, the Minister for Climate, Energy and Utilities presented a new Climate Program[90], setting out a road map for target achievement and taking into account policy measures in 2021. The program estimated that the gap to reach 70% emission reductions by 2030 was now down to 10 million tonnes CO2e. At the same time, the Danish Government announced that all the necessary political decisions must be taken by 2025 at the latest in order to reach the 2030 climate target.[91]

3.2 The IEA's overall assessment of Danish energy policies

The IEA reviewed the Danish energy policies in 2017[92] and it was acknowledged that electricity generation in Denmark had changed fundamentally with the bulk of power generation now coming from wind and bioenergy while coal had been vastly eroded. Denmark was also recognized as a world leader in system integration of variable renewable energy; Denmark has the highest share of wind power in electricity generation, and electricity supply is stable and secure at both transmission and distribution levels. Denmark was also seen to be among global leaders in using energy efficient technologies, including combined heat and power (CHP), which provides half the electricity and two-thirds of heat sold in the country.

However, the IEA emphasized that challenges remain and need to be addressed to continue the transition towards a low-carbon society, including:

- **Achieving further decarbonization in a cost-efficient manner**. The growth in renewable energy generation and improvements in energy efficiency have been impressive, but the costs of the related support policies have increased significantly. In designing future policies, the Government should pay even greater attention to market-based, cross-cutting solutions, building upon the Danish experience with energy efficiency schemes and competitive mechanisms to reduce the costs of renewable energy projects (offshore wind and solar photovoltaic tenders).
- **Electrification and sector coupling**. Further expansion of electricity produced from renewables, particularly from wind, helps reduce or eliminate the use of fossil fuels in

[88] The Danish Ministry of Climate, Energy and Utilities, "Udbudsforberedende aftale om energiøen i Nordsøen", 1 September 2021, https://kefm.dk/Media/637661840223004382/Faktaark_energiø_udbud.pdf and https://kefm.dk/Media/637661840231461613/Udbudsforberedende%20delaftale%20om%20langsigtede%20rammer%20-%20energiø%20Nordsø.pdf.

[89] The Danish Ministry of Finance, "Aftale om grøn omstilling af dansk landbrug", 4 October 2021, https://fm.dk/media/25215/aftale-om-groen-omstilling-af-dansk-landbrug.pdf.

[90] The Danish Ministry of Climate, Energy and Utilities, "Klimaprogram 2021", 29 September 2021, https://kefm.dk/Media/637684923696666735/Klimaprogram%202021%20(DIGITAL).pdf.

[91] The Danish Ministry of Climate, Energy and Utilities, "Denmark is accelerating climate efforts with new 2025 deadline", 29 September 2021, https://en.kefm.dk/news/news-archive/2021/sep/denmark-is-accelerating-climate-efforts-with-new-2025-deadline.

[92] IEA, "Denmark 2017 Review", https://www.iea.org/reports/energy-policies-of-iea-countries-denmark-2017-review.

district heating, transport, and other sectors. In addition, electrification can reduce total energy consumption because it enables highly efficient technologies, such as heat pumps and electric cars. The next key steps include developing a sound strategy and ensuring cross-sector coordination. For example, digitalization of energy equipment, processes, data, and communications across different sectors can effectively contribute to the low-carbon transition by offering opportunities for enhanced efficiencies and performance.

- **Amending energy taxation**. Very high electricity taxation for households, while encouraging energy savings, is a barrier to the increased use of heat pumps and efficient electric boilers, as well as of electric vehicles. This limits the potentially cost-efficient sector coupling and encourages self-generation, also where this is inefficient from a socio-economic perspective. The IEA encourages the Government to reduce the electricity tax for heating and notes that heating consumption could be defined more robustly as smart meters are rolled out by separately metering electric heat.
- **Reducing emissions in the transport sector**. Denmark is encouraged to speed up the decarbonization of transport by stimulating more aggressively the penetration of electric vehicles as well as the use of sustainable liquid biofuels and biogas, increasing electrification of rail transport and, at the EU level, introducing more stringent efficiency standards for vehicles. Additionally, increasing the efficiency of the transport system could further decarbonization, e.g., through promoting public transport, digitalization, optimizing speed limits and managing flows in the road networks.
- **Effective strategy for the sectors covered by the ETS while supporting the EU ETS reforms**. Because of the surplus of emission allowances, the EU ETS was not a sufficiently effective decarbonization tool. Emissions reductions in the Danish sectors covered by the ETS have been largely the result of renewable energy and energy efficiency policies rather than the effect of the ETS itself. Therefore, the Danish Government is encouraged to continue its support for structural reforms of the ETS to reduce the amount of allowances and ensure stronger price signals. As long as the EU ETS prices are not adequate to drive a structural shift, the Danish Government will need an effective strategy for the sectors covered by the ETS, especially industry.

Since the report from 2017, Denmark has taken steps to meet many of the challenges mentioned by the IEA. The subsidies for wind and solar will be significantly reduced during the 2020s. Electricity generated from renewable energy has been further expanded and the development is set to continue during the 2020s. The electricity tax for heating has been significantly reduced (and smart meters have been fully rolled out, but there is no separate metering for electric heat). Electric vehicles have been promoted through tax rebates and further charging stations. The EU ETS was improved in 2018 and the Danish Government continues the work for further strengthening.

4. Summing-up

It is evident that the ambitious Danish climate targets for 2030 and 2050 require further comprehensive measures to be reached. However, the Climate Act of 2020 applies constant pressure, requiring an updated Climate Program from the Minister for Climate, Energy and Utilities every autumn and a follow-up assessment by the DCCC every spring. The climate policy measures in 2020 and 2021 imply emission reductions of around 10 million tonnes CO2e by 2030 as compared to 1990, now leaving a gap of less than 15 percentage points to reach the 70% target.

The past four decades illustrate how focusing energy policies on increased energy efficiency and energy savings as well as renewable energy may lead to reduced energy consumption and greenhouse gas emissions without jeopardizing economic development and even lead to a competitive global wind industry. The energy sector is no longer the largest emitter, and it expects to be able to reach 95% reductions in carbon emissions by 2030 compared to 1990.

Summing-up, 4 key features of the Danish climate and energy policies are highlighted:

A. Political framework

Setting ambitious climate targets encouraging strengthened efforts to enhance a green transition and engage in innovative solutions. This includes setting 5 and 10 year-targets since the 2050 target of climate neutrality does not allow for reliable projections and risks postponing the necessary measures.

Establishing a systematic approach through the Climate Act of 2020, imposing a duty-to-act upon the Danish Minister for Climate, Energy and Utilities, annual evaluations by the independent experts of the DCCC, and involvement of the Danish Parliament. The Climate Act enhances transparency, policy implementation, and accountability.

Establishing broad political support for forward-looking climate and energy policies to ensure regulatory stability and confidence in the green transition. Transparency and predictability are key to facilitating the long-term private investments necessary.

Integrating climate policies into overall energy policies since energy is key to emission reductions, and exercising strong coordination between the Ministry of Climate, Energy and Utilities and other relevant Ministries to ensure cross-sector policy implementation.

B. Whole-of-society approach

Engaging in public-private partnerships, promoting ownership, innovation, and investments. Government entering specific agreements with the energy sector and energy-intensive industry to increase energy efficiency, reduce energy consumption and greenhouse gas emissions, and advance the use of renewable energy.

Involving universities and other experts, including the DCCC offering knowledge and advice on an economically efficient road to climate targets. Cooperating with the universities and the wind sector on demonstration facilities for wind turbines. Engaging in international cooperation to learn from others and share Danish experiences of a cost-effective green transition as well as to strengthen international climate efforts.

Involving municipalities as responsible for identifying suitable areas for sustainable onshore energy projects while considering the opinions of citizens and organizations, thereby enabling the renewable energy infrastructure.

Raising awareness in the public through energy labeling of electrical appliances and houses and campaigns for energy savings. Mobilizing the public and inducing ownership through the establishment of a Citizens' Assembly and a Youth Climate Council.

C. Holistic approach

Addressing both supply and demand through expansion of renewable energy on one side and increased energy efficiency and energy savings on the other side.

Applying both regulatory requirements and economic incentives to promote renewable energy and energy efficiency, and to reduce greenhouse gas emissions. Internalization of the external environmental costs of emissions via direct CO2e taxation and participation in the EU emissions trading system.

Applying policy measures across different sectors (electricity generation, heating, transport, buildings etc.) as all sectors are responsible for greenhouse gas emissions.

Utilizing renewable energy and electrification to facilitate a green transition in sectors other than the energy sector.

D. Energy policy strategy

Targeting energy efficiency and energy savings, affecting the behavior of society. Regulatory requirements when renovating existing houses and building new houses, and energy-saving requirements for public buildings. Economic incentives, including taxation of energy consumption, and subsidies and grants for energy-saving measures. Entering into energy efficiency agreements with large energy-intensive businesses, powerplants and power distributers. Ensuring competitive energy markets. Raising awareness in the public.

Promoting renewable energy, in particular wind power, including subsidies and grants, low or no taxes, research and development resources, public planning requirements for onshore as well as offshore wind, tenders to establish offshore wind farms, and agreements with the electricity companies to develop the grid continuously to ensure that new wind turbines can always be connected.

The energy sector has been and continues to be key to the energy transition. Heating and electricity generation was integrated to increase energy efficiency. District heating was developed to reduce the oil consumption. Renewable energy resources have been promoted for decades, in particular biomass and wind power, and energy security and flexibility in the energy system is ensured by continuously developing the transmission grid domestically in Denmark as well as establishing interconnectors to neighboring countries. Competition is ensured by liberalized energy markets. The energy sector will continue the expansion of renewable energy and expects to facilitate the green transition in other sectors, e.g., by supplying electricity to produce hydrogen and other renewable-based fuels (PtX).

5. Conclusion

Denmark has made considerable progress reducing greenhouse gas emissions in an accommodative political framework, relying on a holistic approach and including all of society, while focusing on energy efficiency, energy savings and promotion of renewable energy.

The ambitious 2030 target of 70% emission reductions set out in the Climate Act of 2020 is still far away, but the policy measures adopted in 2020 and 2021 are projected to close approximately half of the 20 million tonnes CO2e reduction gap in 2030. Further measures are underway, including specification of the framework for the energy islands. And, the systematic approach of the Climate Act ensures regular follow-up, applying constant pressure on the Government-in-office to act with due diligence.

The main key to reaching the 2030 climate target is electrification based on renewable energy, and adequate and timely development of the energy infrastructure, underpinning a green transition in all parts of society. The energy sector has outlined that the 2030 climate target is reachable and estimated that investments of 32 billion DKK annually is required towards and including 2030. The Danish financial sector has announced that it will invest 350 billion DKK in the green transition up to 2030. The main challenge will be whether the regulatory framework is in place in due time to allow for the long-term planning required for the large investments.

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