



## Kingdom of Denmark

# Transformational Change: Danish 100% Renewable Energy Policy

Activity	Adopting and implementing an integrated energy model with ambitious renewable energy targets.
Country	Kingdom of Denmark
Sector(s) involved	Energy sector (electricity supply, district heating, transport, industry)
Time frame	2012-2050

**Case summary**

Danish energy policy mandates the complete phase-out of fossil fuels in the energy supply by 2050. In the long term, electricity, heating, industry and transport energy are to be provided entirely by renewable sources. In the medium term, the 2012 Energy Agreement sets targets of 35% renewable energy in final energy consumption, approximately 50% of electricity consumption supplied by wind power, and a 7,6% reduction in gross energy consumption (in relation to 2010) by 2020. (Danish Ministry of Energy, Utilities and Climate – EFKM, 2012).

Denmark's energy model offers lessons on how an energy system can be radically changed through sectoral planning, private sector involvement and wide-reaching reforms. Denmark's highly ambitious energy strategy is supported by a large majority in the Danish Parliament and sets an integrated framework for a transition to a society independent of fossil fuels, providing both long and medium term targets based on technical analysis and a participatory stakeholder process. The energy model provides a diverse set of instruments and mechanisms to achieve system-wide change that is aligned with national climate and economic growth strategies, and leverages public and private investment.



Windmills on the coast – Denmark ©iStock.com/Calin\_Strajescu

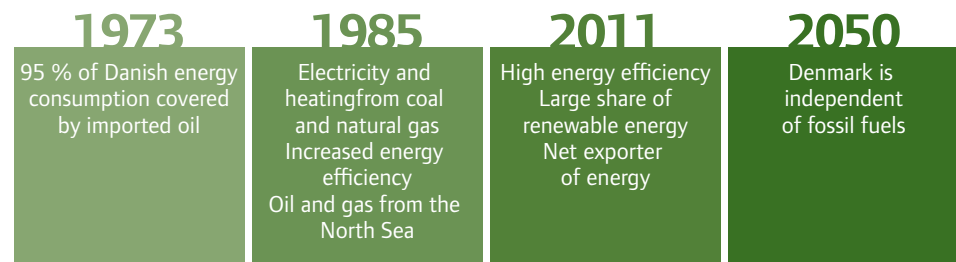
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## Background

Danish energy policy is rooted in the country's long-standing support of renewable energy sources, and wind power in particular. In the 1970s, the oil crisis created public demand for greater security in energy supply and independence from oil and coal-producing countries (Pedersen, 2015). The following decades saw the development of energy strategies, the exploration of renewable energy sources and the establishment of a natural gas grid. Alongside a growing environmental awareness within society, public investment in research technology and development, subsidies for wind turbines, and community-led wind cooperatives facilitated the development of an industry and supply of renewable energy and green tech yielding a diversified energy mix. Ambitious national targets and incentivising support schemes in the 1990s led to a boom in wind power development. Today, exports of green energy technology by Danish businesses are growing steadily (Danish Energy Agency – ENS, 2015a) and the green sector is a large employer in Denmark (ENS, 2015b).

### Phases in the Transition of the Danish Energy System



Source: (EFKM, 2011: 11) (author's illustration)

Over past decades, a mix of objectives has guided Danish energy policy-making: to ensure the security of energy supply, support economic growth and reduce greenhouse gas (GHG) emissions. Both the Energy Strategy 2050 (EFKM, 2011) and the 2012 Energy Agreement (EFKM, 2012) received vast support in Parliament, and are aligned with the Climate Change Act of 2014 (EFKM, 2013).

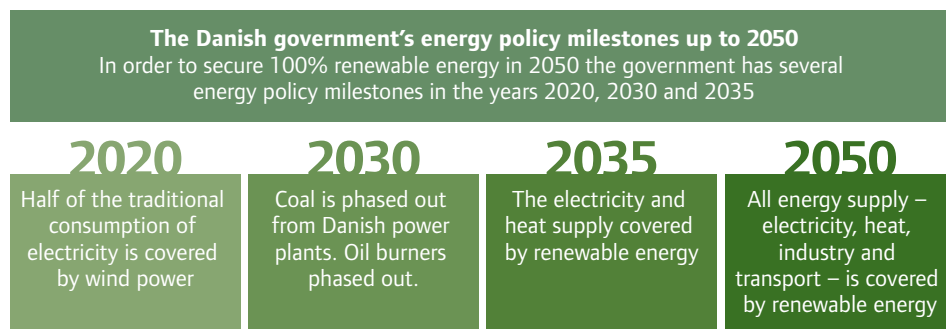
## Activities

Danish energy policy mandates the following long-term and sub-targets:

- » More than 35% renewable energy in final energy consumption by 2020;
- » Approximately 50% of electricity consumption to be supplied by wind power by 2020;
- » 7,6% reduction in gross energy consumption (vs. 2010) by 2020;
- » 34-40% reduction in GHG emissions (vs. 1990) by 2020;
- » Eliminating coal and oil completely from power generation by 2030;
- » Covering electricity and heat supply by renewable energy by 2035;
- » Transitioning to a society independent of fossil fuels by 2050.

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Figure 2: Danish energy policy milestones



Source: ENS, 2015b: 5 (author's illustration)

The low-carbon transition is based on 1) expanding renewable energy, 2) increasing energy efficiency, and 3) advancing system integration and electrification (ENS, 2015b), hence providing a diverse set of instruments to achieve system-wide change (EFKM, 2011, 2012; ENS, 2015b):

- » **Expand renewable energy**
  - » Initiatives to expand wind power: large offshore wind parks, offshore wind turbines in coastal areas, new planning tools to encourage continued onshore wind power;
  - » Continued public investment in the research and development of new technical solutions including solar and wave power, large heat pumps and geothermal energy for district heating;
  - » Renewable energy in industry and buildings: promotion of biomass-based combined heat and power production (CHP) in industry, conversion of oil and gas-fired boilers to renewables in buildings (solar, heat pumps), tax incentives to switch from coal to wood chips and pellets for energy production and heating.
- » **Increase energy efficiency**
  - » Energy labelling of buildings, building codes on energy consumption, energy labelling of appliances;
  - » Green business scheme to promote efficiency in enterprises.
- » **Advance system integration and electrification**
  - » Electrification of passenger transport: use of biofuels in the short term (minimum 10% of fuel content in 2020), expansion of infrastructure for electric and hydrogen cars, pilot scheme for the promotion of electric cars;
  - » A strategy for smart grids: improved metering, continued cooperation through NordPool electricity market to optimise energy use and storage, new electricity transmission lines to Germany.

### Institutions involved

Energy Agreements are negotiated between the Danish Ministry of Energy, Utilities and Climate (EFKM), the Ministry of Finance, the Ministry of Taxation and the Ministry of Environment and Food (for instance regarding the planning perspective of offshore wind).

### Cooperation with

The Danish Energy Agency (ENS) undertakes research and technical analysis. Interested organisations such as energy associations, the confederation of industry, civil society actors, consumer groups and cooperatives are involved in policy dialogues.

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## Finance

EFKM estimates that the initiatives of the Energy Agreement will require financing of roughly EUR 470m in 2020. Denmark provides a mix of financial support schemes to create a positive investment environment that stimulates demand and promotes the expansion of renewable energy (EFKM, 2012: 10; ENS, 2015b):

- » Finance mechanisms to cover high initial investment costs of renewable energy - such as wind turbines - include priority access and resource-based feed-in tariffs. Feed-in tariffs for offshore wind are settled by tender and feed-in premiums with a cap to regulate onshore wind support;
- » The expansion of renewable electricity production is financed through Public Service Obligation schemes (PSO) that supplement the price of electricity paid by consumers. A similar PSO scheme exists to finance subsidies for renewable energy in the gas grid;
- » Energy saving initiatives by energy companies are financed through tariffs and the consumers' energy bills;
- » Regulation ensures that local communities have the opportunity to invest in new onshore wind turbines (20% of a commercial project must be tendered to local people);
- » Research, development and demonstration of new green energy technologies receive funding through a number of public-private cooperation channels, e.g. the Danish Transmission System Operator Energinet.dk (ForskEl/VE), the Danish Energy Association for energy companies (ELforsk), and the Energy Technology Development and Demonstration Program (EUDP).

## People

- » On the individual level, the Minister for Energy and Climate played a big role in negotiating the energy strategy (especially in the 1990s) and Danish energy targets receive broad political support in Parliament. Stakeholders from industry and, to some extent, local cooperatives play an important role in reaching ambitious energy agreements.

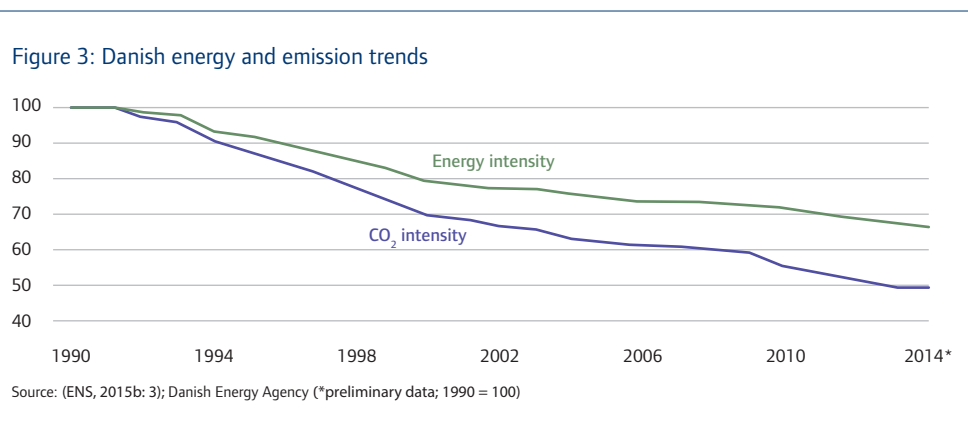
## Impact of activities

Denmark's energy strategy has system-wide, long-term impacts, including emission reductions, increased energy independence and security of supply, and socio-economic benefits associated with the growth of the green tech industry.

The Danish Energy Agency's Baseline Projection 2014 shows that the transition to a decarbonised energy system is accelerating (EFKM, 2015):

- » By 2020, fossil fuel consumption will be reduced by an estimated 20% and the contribution from coal will fall by 57%;
- » The expansion of wind power and conversion of CHP plants to biomass will lead to a share of renewable energy sources in electricity consumption of 71% in 2020 (compared to 43% in 2012). The use of fossil fuels in electricity will be reduced from 84% in 2000 to 29% in 2020;
- » By 2020, gross energy consumption will decrease by 4% due to efficiency improvements in electricity and district heating, buildings and appliances. Energy consumption and CO<sub>2</sub> emissions in the road transport sector will decrease due to lower growth and the promotion of less energy-intensive technologies;
- » The consumption of renewable energy will rise by 47% by 2020 as a result of growing offshore wind farms and increased use of biomass, biogas and liquid biofuels for transport. The renewable energy share will rise from 26% in 2012 to 38% in 2020;
- » With the initiatives already taken, GHG emissions will be reduced significantly by 37%, falling slightly short of Denmark's target of 40% in 2020 (vs. 1990 level), but exceeding EU targets.

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Denmark's investment in efficiency and renewable energy may reduce the cost of energy, exposure to fluctuations in fuel prices and to the development of new products and industries, benefitting the Danish economy. In 2013, Denmark produced green products and services for EUR 22bn, mainly related to renewable energy and energy efficiency. The green sector employs approximately 58,000 people and export of wind energy technology accounted for more than EUR 6.5bn in 2013. (ENS, 2015b: 3)

### Why is it good practice

There are several interrelated good practice elements that make Danish energy policy so effective:

- » **Ambitious and holistic:** the renewable energy and energy efficiency targets are highly ambitious and target the country's key sectors.<sup>1</sup> The various policy elements lead to a significant GHG reduction impact and the transition to a low-carbon society in a manner that benefits Denmark economically, socially and environmentally. The foundation of the energy model is threefold: to increase energy independence and security of supply, to contribute to green economic growth, and to reduce GHG emissions in a manner that is sustainable and socially accepted (EFKM, 2011, 2012, 2013). Denmark is well on its way to reaching these goals and currently has the highest contribution of non-hydro renewables in any electricity system worldwide (46% in 2013) – roughly 40% of electricity consumption is based on wind power (ENS, 2015). Energy policy is clearly aligned with the national climate strategy.
- » **Long-term system-wide approach:** Danish energy policy has a broad system-wide scope that mandates an integrated mix of interventions to expand renewable energy, increase energy efficiency and increase electrification across sectors ranging from energy supply, industry, transport and heating to agriculture. The combination of long-term targets (Energy Strategy 2050) and sub-targets (Energy Agreement 2012–2020) provide policy-makers and enterprises with a clear mandate, guideline and implementation and finance plan beyond individual legislative periods.
- » **Based on detailed technical analysis:** Danish energy policy and the respective set of initiatives and regulations are based on technical analysis of (mitigation) options, costs and benefits. The Danish Ministry of Energy, Utilities and Climate mandates the Danish Energy Agency and consultants to provide research on the feasibility of options, associated system and market effects and cost assessments. These regular reports are shared with a variety of stakeholders and policymakers and, to a large extent, inform the policymaking process. This foundation in scientific facts ensures that policy measures are achievable and widely accepted.

<sup>1</sup> It should be noted, however, that this is a country-specific approach and that targets and respective actions need to be tailored to the country context. In developing countries in particular a detailed feasibility study and a stronger emphasis on bottom-up approaches may prove more effective and appropriate.

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- » **High-level political ownership:** The Energy Agreement 2012 reached the largest and broadest majority in Danish Parliament to date (EFKM, 2012). One important element of consensus on energy matters is the foundation of policy on the aforementioned three pillars of supply security, economic growth and mitigation that is rooted in Denmark's historical approach toward renewable energy (see above). This framing and investment logic appeals to the interests not only of parliament, but also to the prominent green tech and renewable energy enterprises and industry, as well as civil society actors. A second element to consensus is the institutionalised process of setting targets based on analysis. This factual basis allows politicians to engage more comfortably in a more objective debate and allows the forming of broad coalitions on energy matters beyond political parties. Consensus on long-term energy targets, independent of changes in government, creates stability and predictability that lead to lower risk premiums and create a solid framework for public and private investment (EFKM, 2012).
- » **Participatory stakeholder process:** The Danish energy policy-making process is characterised by a high degree of institutionalised involvement of a variety of stakeholders. Energy policy measures are developed in a dialogue process between ministry representatives and policymakers, as well as a number of interest groups from the energy industry (such as associations and confederations), non-governmental organisations (NGOs), and consumer groups. All stakeholders are invited to voice their interests and contribute to the development of energy solutions based on the analysis provided. Danish agencies and ministries work closely with industry representatives to find common solutions to developing a smart grid and continue supply security (e.g. to develop a catalogue that calculates energy security and develop an appropriate measuring tool). This participatory process ensures stability and widespread acceptance of measures and stimulates public-private cooperation and investment.

### Success factors

- » Promoting renewable energy and the transition to a decarbonised society requires **ambitious targets, long-term planning and a stable political framework** that foster a favourable investment climate (ENS, 2015b: 8). Setting long-term targets and sub-targets allows for long-term planning and private investment beyond legislative periods.
- » A **rational approach aligned with economic targets** that allows for an informed debate and the development of implementable solutions. By providing regular research to inform the policy debate and institutionalising a stakeholder process, the risks of system-wide change can be reduced and consensus can be achieved among politicians and civil society at large. Integrating economic growth strategies creates incentives for enterprises, private investors and communities to support energy measures. This long-standing approach has become the backbone of Danish energy policy.
- » In Denmark's case, the **historical importance of energy security** created a window of opportunity to develop renewable energy solutions that play an important economic role and are supported by the majority of the population. Raising awareness for policy changes and generating public support is a process that has spanned several decades in Denmark (cf. Pedersen, 2015).
- » **Cross-border cooperation and a regional process to align markets** can broaden and deepen the renewable energy market and help overcome energy supply and storage issues. The shared NordPool electricity market enables a balancing of energy production e.g. from Danish Wind and Nordic hydropower depending on peak loads and demand. Denmark is currently improving cooperation with Germany, the Netherlands and the UK.
- » By taking an **integrated approach** that aims to increase renewables, efficiency and electrification, Denmark can balance fluctuations in electricity prices. By also strengthening energy efficiency schemes, Denmark can limit the amount of energy that needs to be produced. This holistic approach across sectors enables system-wide transformational change.



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“The Danish Energy Model has shown that through persistent and active energy policy with ambitious renewable energy goals, enhanced energy efficiency and support for technical innovation and industrial development, it is possible to sustain significant economic growth and a high standard of living, while reducing fossil fuel dependency and mitigating climate change.” (ENS, 2015b: 2)

### Overcoming barriers/ challenges

#### Financial

**What were the main barriers/challenges to delivery?**  
How were these barriers/challenges overcome?

**Need to keep energy prices at a reasonable level to ensure industry and society support.**

Use of a mix of financial incentives, including tax structures, subsidies and levies to facilitate change to a smart system that distributes costs across consumers, companies, and industries. Tender regulations leverage a mix of commercial and local investment in wind turbines. Growing PSO has been subject of debate and is currently being adjusted to relieve burden on consumers.

#### Capacity

**Complex bureaucratic process with many actors involved.**

The Danish Energy Agency functions as a ‘one stop shop’ for permits, where all relevant information is gathered. This makes necessary processes more streamlined and effective. (ENS, 2015b: 8)

#### Socio-cultural

**Not in my back yard phenomenon (NIMBY).**

Increase public acceptance e.g. of wind farms and support through stakeholder involvement of consumer groups and NGOs. Regulation ensures the compensation of loss of property due to wind projects and ensures a minimum involvement of local investors in the development of onshore turbines.

#### Informational

**Some elements of the energy policy and measures are highly technical and complex and difficult to explain to the public. A lack of understanding can lead to a lack of acceptance of transition agenda.**

Appeal to economic interests of Danish population by highlighting monetary returns to be gained by increasing household energy efficiency and employment opportunities in green sector. Launch programmes to inform population about short-term costs and long-term gains and share best practices on energy savings. Schemes to encourage energy providers to make energy efficiency changes that will reduce household energy bills.

### Lessons learned

- » **Research is key:** Preparing the background of every initiative based on research and economic analysis of implications is a good tool to finding solutions (facts are hard to dispel).
- » **A participatory process goes a long way:** Including society in the process, both in stakeholder consultations with industry, and through widespread public information schemes, is crucial to building consensus.
- » **A common vision creates stability:** Long-term planning based on technical analysis can build political coalitions and create a favourable investment climate for renewable energy solutions.

### How to replicate this practice

- » **Institutionalise scientific input:** Provide the institutional and political framework to enable the design of energy agreements and setting of targets based on robust technical analysis. Task consultants and/or a ministerial research agency with the provision of cost and benefits and options analysis.
- » **Enable stakeholder involvement:** Identify community and industry interest groups and support the organisation of associations to represent various stakeholders. Institutionalise a participatory stakeholder process that allows the exchange of interests and the joint development of energy solutions. Ensure that all relevant groups are represented in the policymaking process.
- » **Aim for a long-term system-wide change:** Establish long-term targets and steps along the way to create predictability and stability.
- » **Reach out to society:** Raise awareness and provide public with information that appeals to their interest and ensures societal support over time.

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- » **Take a holistic approach:** Takes into account historical and market developments and integrate energy strategy with social, environmental and economic objectives to appeal to a variety of stakeholder interests.

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