



# **ON THE WAY TO CARBON NEUTRAL ECONOMIES**

## **THE ENERGY TRANSITION IN DENMARK AND GERMANY**

White Paper

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## 1. Introduction

Germany and Denmark face a **daunting challenge: reducing the CO<sub>2</sub> emissions** of their economies – in the power sector, heating, industry and mobility. Both governments currently work on **wide-ranging and ambitious climate policies and plans**. However, the countries have different starting points:

- **Denmark can bank on its large renewable electricity generation**, fueled by offshore wind, and widely established district heating plants which to a high degree have already been switched to renewables. Denmark is also much further along in phasing out coal and oil for heating and power.
- **Germany is not as far along in the transition**, and its power and heating sector has to supply roughly 20 times the energy Denmark consumes. Germany plans to **replace nuclear and coal power plants, which currently supply 50% of its power** generation – while at the same time securing the demand of its households and industry. Renewables and gas-fired power plants will need to fill the gap.
- Over **80% of German households rely on conventional home heating** systems with gas and, to a lower degree, heating oil.
- Germany at least will, for the foreseeable future, also **rely on natural gas** – for both power generation and heating – much of which will **need to be imported given Germany's relatively low production** of fuels.
- **Denmark can rely on its own gas resources** and can import gas from the German market while the large Danish gas field Tyra is being re-developed

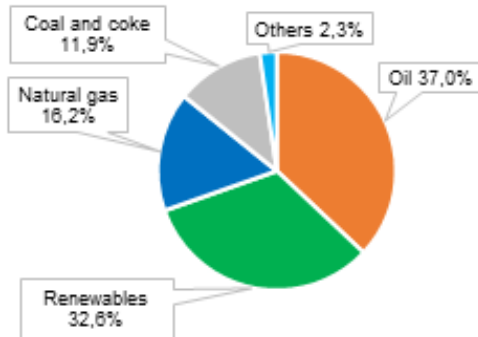
So far, **plans in both countries are not sufficient to achieve a carbon-neutral economy in 2050** – but ambitions are growing, and development of energy technology and renewable capacity will need to keep pace.

In the autumn of 2019, both governments presented their plans to cut emissions, against the **background of global climate activism** on the one hand, and growing **concerns about the cost of energy** and mobility for individual households on the other hand.

## 2. The energy systems of Denmark and Germany in comparison

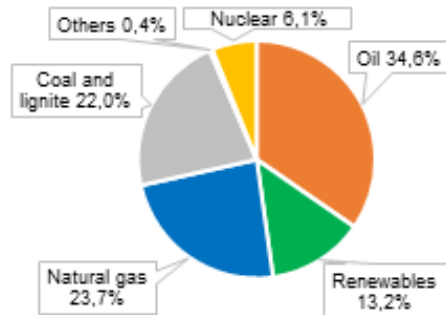
- 2.1. **Primary energy consumption is still about two thirds fossil in both countries – but Germany has to supply an energy demand 20 times the size of Denmark's.**

**Denmark primary energy consumption<sup>1</sup>**



Energy consumption in Denmark amounted to 772 petajoule (PJ) in 2017, or 134 gigajoule (GJ) per capita, with an 85% degree of self-sufficiency.<sup>3</sup>

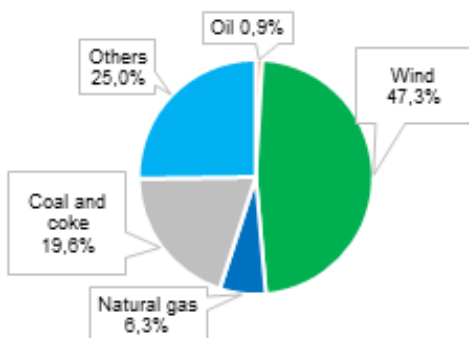
**Germany primary energy consumption<sup>2</sup>**



By comparison, in 2017, Germany's primary energy consumption totaled 13,594 PJ, or approximately 165 GJ per capita.<sup>4</sup>

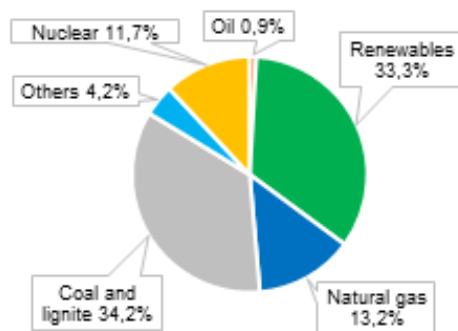
- 2.2. **Denmark outpaces Germany in decarbonising its power sector**

**Denmark power generation<sup>5</sup>**



Gross electricity production in Denmark reached approximately 31.1 terawatt hours (TWh).<sup>7</sup>

**Germany power generation<sup>6</sup>**



Gross electricity production in Germany amounted to 654.8 TWh.<sup>8</sup>

### 2.3. Germany depends on imports to a much larger extent than Denmark

- Denmark is fully dependent on imports for its oil and coal needs. However, **Denmark is self-sufficient with regard to natural gas**. Of the 4.5 bcm of gas it produces, in 2017 approximately 2.1 bcm were exported to Germany and Sweden, as well as to the Netherlands' offshore gas transport system.<sup>9</sup>
- However, over 90% of Denmark's domestic gas production originates from the Tyra field, which was shut for redevelopment in September 2019 and will not recommence production until July 2022 at the earliest. During this period, Denmark will cover its gas supply needs by tapping into its gas storage facilities as well as **importing additional volumes from Germany**.<sup>10</sup>
- **Germany's overall import dependency is 70.1%**, as an average of its 2.1% export surplus in lignite and high import share for natural gas (92.1%), oil (97.0%) and hard coal (93.7%).<sup>11</sup>
- Domestic production of oil and natural gas in Germany is continuously decreasing, with approximately 7.25 bcm of gas having been produced in 2017, compared to over 135.8 bcm of imported gas.<sup>12</sup>
- Additionally, **Germany will phase out nuclear** energy by 2022, which currently accounts for nearly 12% of its electricity production. **Coal and lignite are due to be gradually phased out by 2038**. Therefore, **Germany will need to import additional natural gas** and keep a high level of renewable power generation additions to meet demand.

### 2.4. Households still largely depend on fossil fuels for heating and mobility

- Heating
  - Germany: 18.9 million residential buildings<sup>13</sup>, 41,378,000 households<sup>14</sup>
    - 9.3 million **(49.3%) heated with natural gas**
    - 5.8 million (30.4%) heated with oil
    - 1.5 million (8.0%) heated with other systems (central/individual heating, wood/pellets, coal, etc.)
    - 1.2 million (6.6%) connected to district heating
    - 1.0 million (5.7%) heated with heat pumps/electric systems
  - Denmark: 2,688,472 households<sup>15</sup>
    - 430,000 households heated with natural gas.<sup>16</sup> It is no longer legal to build new houses using natural gas for heating, though replacement is still a possibility. Municipalities can issue a dispensation to these rules.
    - 230,000 heated with oil (to be phased out by 2030)
    - 1.7 million households use district heating of which 61% is fueled by renewable energy (biomass). Four Danish district heating plans still use coal, but ought to phase out before 2030.<sup>17</sup>
- Passenger car stock as of 1 January 2019 is still **over 99% conventional combustion engines**:
  - Denmark: 2.6 million,
    - of which 10,037 electric (0.39%) and 5,168 hybrid (0.19%)<sup>18</sup>
  - Germany: 47.1 million,
    - of which 83,175 electric (0.18%) and 341,411 hybrid (0.72%)<sup>19</sup>
- Among new registrations in 2019, the share of vehicles with alternative types of drive systems increased.
  - Denmark: 225,638 new registrations, of which 1.7 % were hybrid and 2.4 % electric vehicles.<sup>20</sup>
  - Germany: 3.6 million new registrations, of which 6.6 % were hybrid and 1.8 % electric vehicles.<sup>21</sup>

- The number of charging stations for electric cars is growing. As of 1 of January 2020 the numbers are:
  - Denmark: 3,764 (Nov. 2019). <sup>22</sup>
  - Germany: 17,859. <sup>23</sup>

### 3. Both countries have similar emission reduction goals – but face different challenges

#### 3.1. Denmark developed ambitious plans early – but an increased reliance on electricity is a challenge that needs further steps to keep pace

- Denmark has set the long-term objective of having its **entire energy supply – electricity, heating, industry, and transport – supplied by renewable energy by 2050**. As part of this plan, oil for heating purposes and coal are to be phased out by 2030.<sup>24</sup>
- Current projections for the next decade see an increasing share of renewables until 2021, followed by a decline owing to increasing energy consumption and declining energy-efficiency improvements. Emissions are projected to reach a 39% reduction by 2021 compared to 1990. <sup>25</sup>
- Denmark's ambitions to abandon fossil fuels by 2050, with 100% renewable-based district heating by 2030, means that **electrification is a cornerstone** of the country's green transition.
- One of the additional initiatives is found in the Energy Agreement from 29 June 2018, where all parties in Parliament together with the former liberal government agreed to build three new huge windfarms with a total production of 2,400 MW, which, according to the agreement will cover all energy consumption in Danish households in the foreseeable future. <sup>26</sup>
- The target of the agreement is that 55% of Danish energy consumption is renewable energy by 2030.

#### 3.2. Germany has kept its ambition ahead of European emission reduction goals – but might miss its 2020 targets and is still looking for instruments to meet 2030 and 2050 goals.

- Germany has set itself ambitious goals in climate protection. The Climate Protection Plan 2050, adopted in 2016, outlines how the country intends to implement the Paris Agreement and is based on a **largely green-house gas-neutral approach up to the year 2050**. <sup>27</sup> The Paris Agreement stipulates that global green-house gas neutrality must be achieved in the second half of this century. The objectives of the agreement also include limiting global warming to well below two degrees and even below 1.5 degrees respectively. The German governments plans call for a **40% reduction of emissions compared to 1990 by the year 2020**, and a 55% reduction by 2030.
- In 2019, emissions decreased by 35% compared to 1990 due to increased energy production through renewables and natural gas and decreasing electricity consumption overall. <sup>28</sup> However, **Germany is likely to miss its targets for 2020**. <sup>29</sup>
- A **comprehensive package** of additional climate policy instruments to ensure that Germany reaches its 2030 targets was **passed by the cabinet in October 2019** and accepted by parliament in November. The package provides for a steady increase in carbon pricing and sets out individual targets for all ministries involved that will be continuously monitored.
- Policy efforts towards climate neutrality (with e.g. **Germany aiming for 80% to 95% fewer emissions** in 2050 compared to 1990) will require significantly increased energy efficiency and the use of renewable energy sources.
- Scenarios for achieving this include the transition to largely or fully electric energy systems – a development likely associated with radical structural changes and high costs. By comparison, studies have found that **mixed-technology scenarios, e.g. involving both renewables and natural gas, as well as de-carbonised gas**, are more robust, as they build on existing infrastructure to a much larger degree and are **more likely to meet with greater social acceptance**. <sup>30</sup>
- A major challenge for Germany regarding the phase-out of coal is the ensuing **structural change in the regional economies** of areas that, today, heavily rely on coal production and coal-fired power generation.



- **40 billion euros in funding to support the further development of lignite mining regions** in Brandenburg, Saxony, Saxony-Anhalt and North Rhine-Westphalia, as well as areas with hard-coal-fired power plants are planned.<sup>31</sup>
- Sustainable mobility also remains a key objective for Berlin, but progress on this front has not been as significant as hoped. Among other things, the newest climate action plan calls for measures to achieve the **goal of 10 million electric cars on Germany's streets by 2030**.<sup>32</sup>

## 4. New energy policy developments underway in both countries

### 4.1. Coal phase-out: Germany's most significant emissions reduction step

- Germany still operates **lignite and hard coal-fired power plants with a capacity of 41 GW**. Responding to increasing public consensus, in early 2019 the **government-appointed "Growth, Structural Change and Employment" Committee (WSB) concluded that coal should be phased out by 2038** at the latest. The recommendations provide for a steady **reduction in coal-fired power generation to 30 gigawatts (GW) in 2022** (15 GW each of lignite and hard coal) and 17 GW in 2030 (9 GW of lignite and 8 GW of hard coal).
- The drafting of a Hard Coal Phase-Out Act has been delayed several times by the German government. Now it is scheduled for the end of January 2020.<sup>33</sup> Parliamentary proceedings will then begin, while talks with lignite-fired power plant operators will run in parallel. The results are to be incorporated into the Coal Phase-out Act that could be passed in early 2020.<sup>34</sup>
- Coal-fired power plants account for 235 TWh of power generation at the moment: by 2030, this will reduce to 77 TWh. Even with the phase-out of nuclear energy and the expansion of renewables, a 112-TWh gap will have to be covered by gas – **this will require another 13 bcm of gas per year**.

### 4.2. Germany's 2030 Climate Protection Program: fueling controversy

- Against the backdrop of EU targets, the German cabinet agreed on the guidelines for Germany's climate policy up to 2030 in September 2019. After strong criticism from citizens and the opposition, several amendments were made in December 2019, including higher CO<sub>2</sub> prices and reduced rail fares.<sup>35</sup>
- The key point of the comprehensive programme is additional **CO<sub>2</sub> pricing in the mobility and heating sectors, starting at EUR 25/tonne in 2022 and rising to EUR 55/tonne by 2025**. After that date, the price will be set by the market. Furthermore, the renewables levy currently imposed on electricity bills, which has been steadily rising since its introduction, will decrease as of 2021.
- While the amendments to the program were welcomed, **critics claim that the measures still fall short** of ensuring that climate goals will be reached. The new CO<sub>2</sub> prices are still seen as too low.<sup>36 37</sup> Furthermore, measures to boost electric mobility and public transport as well as the expansion of renewables are considered insufficient.

### 4.3. Danish climate policy: ambitions scaled up

- Danish climate policy efforts are underpinned by efforts to completely phase out fossil fuels by 2050, achieving a low-emission society by 2050, and by gradually reducing greenhouse gas emissions in line with the EU's 2020 and 2030 targets.
- The emission reduction targets for the EU for 2030 are to be implemented as national reduction obligations for buildings, agriculture and transportation, while Danish reduction obligations have not yet been negotiated.<sup>38</sup>
- In 2018, the Danish government agreed with parliament on the new energy policy, which will help the country meet its 2030 renewable energy, energy efficiency, and carbon emissions targets in the most cost-effective way possible.<sup>39</sup> Within this agreement the parties agreed to build 3 new windfarms, ensuring that the **Danish energy consumption will be 55 pct. green energy by 2030**. A budget of 4.2 billion DKK has been allocated for additional solar and wind installations (on land). Projects dealing with green gasses and biogas will be able to receive government funds of 240 mill. DKK yearly for a 20-year period. **By 2030 coal will be totally phased out of the Danish energy production**.<sup>40</sup>

- In 2019 a call for a legal binding Climate Act became part of the national election campaign in June 2019. The new Social Democratic government has set the **ambitious target with its supporting parties to ensure a 70% reduction of CO<sub>2</sub>-emissions by 2030** compared to the level of 1990.
- In December 2019, the majority of Danish parliamentary parties agreed on a Climate Act that is now awaiting to be formally legislated in parliament. The act will build on the previous Climate Act from 2014 but have a legally binding effect. In spring 2020, the new law will be followed up with concrete climate action plans. <sup>41</sup>
- In early October 2019, the Climate Council (created to advise the government on climate policies back in 2014) published an analysis on the prospects of the forthcoming Climate Act.<sup>42</sup> As they suggested, the Climate Act is supposed to deliver <sup>43</sup>:
  - Decisions on reduction targets
    - 70% reduction of CO<sub>2</sub>-emissions by 2030, climate neutrality by 2050.
    - 5-year climate targets with a 10-year horizon
    - Targets are compared to 1990-level.
  - Preparation of climate action plans (which are to be negotiated in spring 2020)
    - Every fifth year the government must draw up climate action plans to see through the 10-year target.
    - Should be sector specific, set the direction for each sector and indicators must be developed. Sector strategies are advised to be done in cooperation with citizens, NGOs and business.
  - Monitoring and surveillance mechanisms
    - Yearly forecasts which predict whether the climate action plan delivers
    - The forecast must be followed by policy initiatives if targets are not reached
    - An independent organisation must validate the process
    - All relevant bills must be supported by environmental impact assessment when proposed in parliament.



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