IEA-Advanced Motor Fuels
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Denmark

Technology Collaboration Programme
by iea

Denmark

Drivers and Policies

In December 2019, Denmark approved a new Climate Act that includes a legally binding target to reduce GHGs by 70% by 2030 (relative to the 1990 level), to reach net zero emissions by 2050 at the latest, and to set milestone targets based on a five-year cycle. In the political understanding, "A fair direction for Denmark" states that a reduction target of 70% by 2030 is a very ambitious goal, and that it will be particularly difficult to realize the last part of the goal (i.e., from 65% to 70%). Meeting the target will require currently unknown methods and, therefore, a close collaboration with the Danish Council on Climate Change and other experts. The Climate Act will be followed by climate action plans, which will contribute to ensuring that national reduction targets are met. The Climate Action Plan in 2020 will include sector strategies and indicators, at a minimum, for central sectors such as agriculture, transport, energy, construction, and industry. Moreover, Denmark has already taken the first steps toward establishing a professional and efficient energy sector as the basis for the transition to a sustainable green society. In June 2018, all parties of the Danish Parliament reached a political Energy Agreement to further build Denmark's international positions of strength with a focus on renewable energy, energy efficiency improvements, research and development, and energy regulation. The measures and policies decided in the agreement are now in the process of being implemented.

Advanced Motor Fuels Statistics

General Energy Data Gross energy consumption has been relatively constant since 1990, with falling consumption of coal and increasing consumption of renewable energy (see Figure 1). Gross energy consumption peaked in 2007 at 873 petajoules (PJ) and has since followed a downward trend. Gross energy consumption is expected to drop annually by 1.2% until 2020, after which it will rise slightly to 778 PJ in 2030, corresponding to amounts in 2017. Coal consumption will fall considerably by 14% annually until 2030, due in particular to the expected stop in the use of coal in large-scale combined heat and power (CHP) production. In 2030, only the Fynsværket power station and the cement industry will consume large amounts of coal. However, some plants will retain the option for coal operation, although actual use is assumed to be limited.

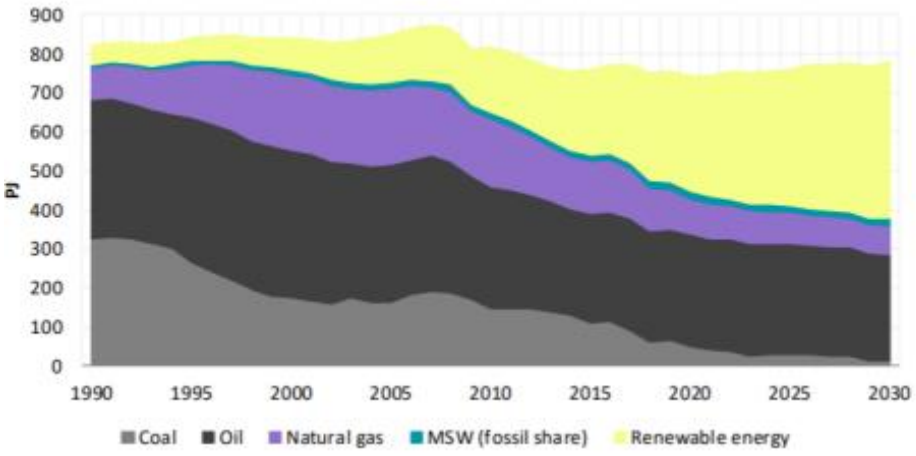

Fig. 1. Gross Energy Consumption by Type of Energy, 1990–2030 [in petajoules (PJ)].
The calculation for 1990-2017 has been adjusted for outdoor temperature/degree days relative to normal years (climate-adjusted) and electricity trade with other countries.

Figure 2 shows the total share of renewables (RES) as well as renewables shares for transport (RES-T), electricity consumption (RES-E), heating and cooling (RES-H&C), and district heating (RES-DH), respectively, calculated on the basis of the method described in the EU Renewable Energy (RE) Directive (EU, 2009; Eurostat 2018).

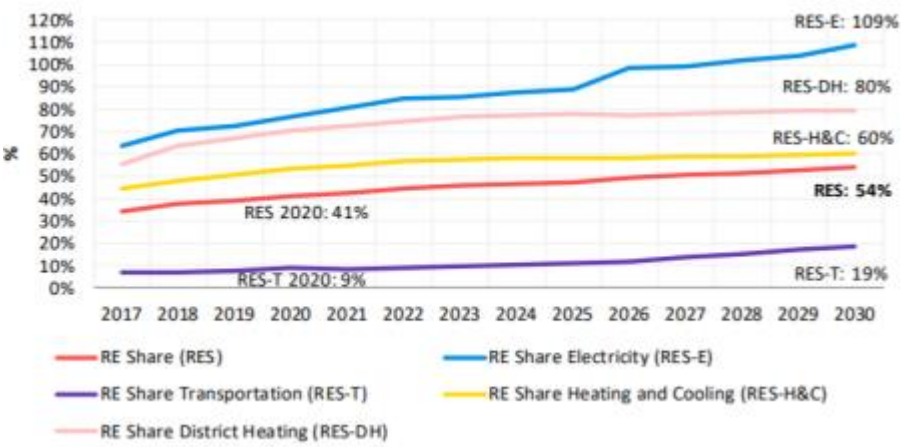

Fig. 2. Renewables Shares, 2017–2030 [%].
The renewables shares is calculated as defined in the RE Directive (Eurostat, 2018).

The RES and RES-T are subject to binding national EU targets in 2020. The EU RE Directive also sets out a 2030 target for 27% renewables for EU countries together, but this target has not been implemented as national obligations. Instead, EU Member States are obligated to account for their contributions to reaching the common EU target in their National Energy and Climate Plans.

Projections show that the RES is expected to be 41% in 2020, whereby Denmark will have met and exceeded its EU obligation for a 30% renewables share by 2020. The RES-T will reach 9% in 2020 – that is, a 1% shortfall compared to the 2020 RE Directive obligation of 10%. The overall RES will increase, reaching 54% by 2030. The trend depends on the deployment of offshore wind, onshore wind, and solar PV, and on the conversion of CHP plants to biomass, while energy-efficiency improvements in transport, industry, services, and households will contribute to a lesser extent. The rate of renewables deployment in electricity supply is expected to exceed the rate of increase in electricity consumption, and Denmark's production of electricity from renewables is expected to exceed its electricity consumption from 2028.

The RES-E is expected to increase to 109% in 2030. This trend is particularly contingent on the offshore wind farms included in the 2018 Energy Agreement being commissioned by 2030. Updated expectations also exist regarding the deployment of commercial solar PV (ground mounted solar farms) and expectations regarding the replacement of older onshore wind turbines with fewer, more efficient turbines. The projection of onshore wind and solar PV deployment depends on the development in electricity prices; maintenance of the level for tender prices achieved in the 2018 technology neutral tendering round; voluntary renewable energy targets from large consumers; and the market for PPA/guarantees of origin. A high percentage of RES-E affects the calculation of the RES-T because the RE Directive uses a multiplication factor of 4 for the renewables share of electric road transport and a multiplication factor of 1.5 for the renewables share of electric rail transport.

With this background, RES-T increases to 19% in 2030, contingent on the number of electrified passenger cars and vans increasing to around 9% of the total number in 2030, and an increased use of electricity in rail transport. Greater use of bio-natural gas in transport will contribute to only a very limited extent. The blending ratio of biofuels in petrol and diesel is expected to be maintained at the current level in the absence of new measures. Fuel consumption for domestic air traffic is included in the calculation of the renewables share. The aviation sector has announced ambitious plans for biofuel blending, but as these announcements are neither binding nor reflect a profitable development pathway for companies in the absence of new measures, the plans this sector. Measured in relation to final energy consumption, the share of fossil fuels in the transport sector will fall from 95% in 2017 to 92% in 2030. This is due to a combination of electrification of the rail and road transport sectors as well as improved energy efficiency for conventional vehicles. Fossil fuel consumption by road transport is expected to amount to 73% of total fossil fuel consumption by the transport sector in the absence of any new measures.

Details on Advanced Motor Fuels

Renewables share increasingly consists of electricity produced from renewable energy sources (see Figure 3). In 2030, the RES-E by the transport sector will correspond to the consumption of first generation biofuels; consumption of second generation biofuels will constitute a smaller share.

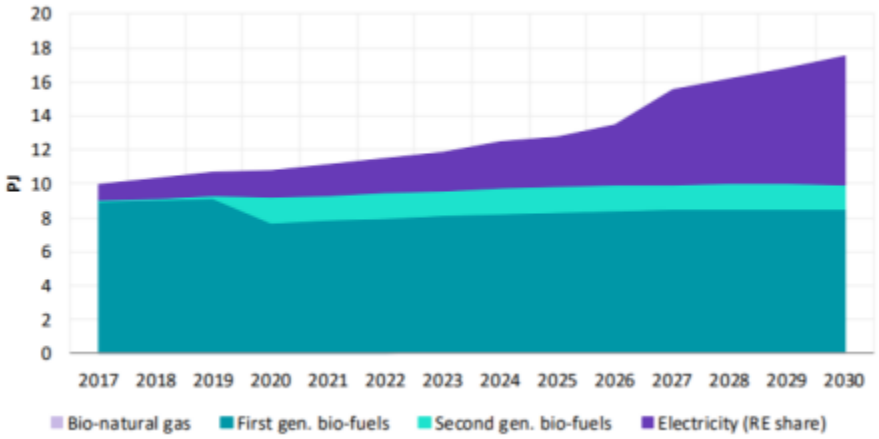

Fig. 3. Renewable Energy Consumption by the Transport Sector, 2017–2030 (in petajoules)

Sales of electric cars in particular are therefore likely to increase considerably, and by 2030 electric and plug-in hybrid cars are expected to amount to about 48% of all new car registrations. This trend is expected to increase the percentage of zero- and low-emission cars on the road to about 22% in 2030, corresponding to around 730,000 electric and plug-in hybrid cars, of which purely electric vehicles will amount to about 75%, as shown in Figure 4. A beginning transition is also expected for vans, so that the number of electric cars and vans in 2030 will total around 800,000.

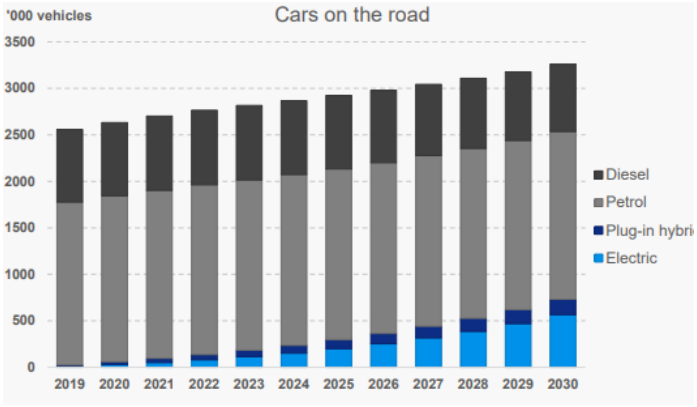

Fig. 4. Number of Cars by Technology, 2019–2030

Although sales of electric and plug-in hybrid cars are expected to increase, petrol and diesel cars are still expected to amount to around 78% of cars on the road in 2030. This is due to inertia in the transition because of the relatively long lifetime of vehicles.

CO_2 Emissions from Road Transport

As shown in Figure 5, passenger cars contribute the most to road-transport emissions, followed by vans and lorries. Passenger cars account for around 60% of total road-transport emissions.

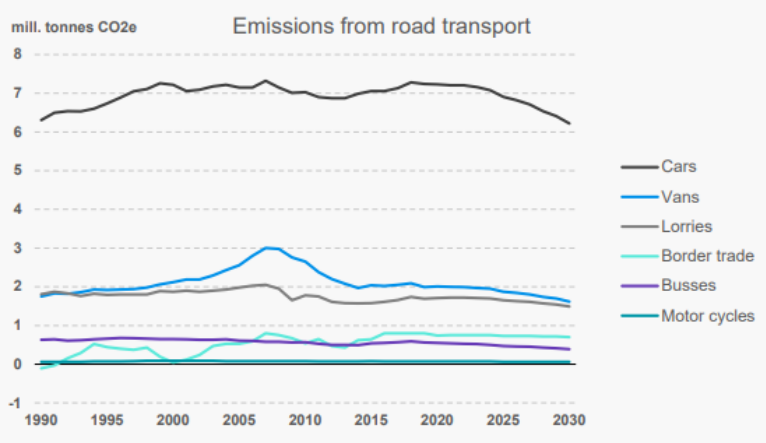

Fig. 5. Emissions from Road Transport, by Vehicle

Traffic work is expected to continue to rise for all types of vehicles. From 2019 to 2030, overall traffic for road transport is expected to increase by approximately 21%. Nevertheless, a reduction in GHG emissions is expected for all vehicle types during that time period, due primarily to continued energy-efficiency improvements for conventional vehicles, increased biofuel blending in petrol and diesel, and more transition to alternative fuels, especially electric cars. Blending with biofuels and other renewable fuels is assessed to provide a direct CO_2 reduction in 2030 of about 1.2 million tonnes compared to a development with no blending. Similarly, the replacement of conventional passenger cars with electric and plug-in hybrid cars is expected to reduce emissions by about 1.4 million tonnes of CO_2.

Research and Demonstration Focus

Research and Demonstration in Denmark are focused on electric vehicles and fuel cell vehicles for passenger cars. Several demonstration projects have been initiated. For HDVs, biofuels are the most obvious solution. However, liquid and gaseous electrofuels, which can store a surplus of wind turbine electricity, appear to be gaining attention. Research supporting the analysis of common energy and transport fuels production systems also has high priority.

Outlook

In Denmark, the transportation sector is still almost entirely dependent on oil. By 2050, however, the government aims to meet all Danish energy supply by renewable energy, including that required by the transportation sector. In 2012, a broad majority in Parliament reached an energy agreement defining initiatives covering crucial energy policy areas for the period 2012–2020, and agreed to discuss additional initiatives for the period after 2020. The analysis from 2012 indicates that by 2020 and beyond, electricity, biogas, and natural gas could become especially attractive as alternatives to petrol and diesel in the transportation sector. Electricity is the most energy-efficient alternative because of high efficiency in the engine and an increase in the share of wind-generated electricity supply.

Energy Islands

The world's first energy islands will be constructed in Denmark, exploiting our immense wind resources in the North and Baltic seas. The energy islands will serve as hubs that can create better connections between energy generated from offshore wind and the energy systems in the region around the two seas.

In the North Sea, an artificial island will be established, which will be a hub for 3 GW offshore wind farms and with the possibility of 10 GW in the long term, and will thus be able to cover the consumption of 10 million households. The wind turbines that will supply power to the island are expected to be larger than they are today, and will go further out to sea than before. The technical equipment for energy distribution will be located on the island. It will not be possible to see the turbines from land. The energy islands are part of the development of the energy systems of the future, and it is part of the political agreements that electricity from the energy islands should be converted

into new forms of energy (e.g., Power-to-X). This means that green power will contribute to the phasing-out of fossil fuels in both Denmark and Europe.

In the Baltic Sea, the technical equipment for energy distribution will be located on Bornholm, where electricity from offshore wind farms will be transported to the electricity grid on Zealand and neighboring countries. The offshore wind farms will stand approximately 20 km south-southwest of the coast and will be visible but not dominant on the horizon.

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Additional Information Sources

- Danish Energy Agency, 2019, Danish Energy and Climate Outlook 2019, https://ens.dk/sites/ens.dk/files/Analyser/deco19.pdf
- Energistyrelsen, www.ens.dk