

### Denmark

#### ***Drivers and Policies***

Energy Strategy 2050 represents a giant step toward realizing the Danish Government's vision of becoming independent of coal, oil, and gas.<sup>1</sup> In 2010, the Danish Commission on Climate Change Policy concluded that transition to a fossil-fuel-independent society is a real possibility. Energy Strategy 2050 builds on this work. The strategy outlines the energy policy instruments needed to transform Denmark into a green sustainable society with a stable energy supply. The strategy is fully financed and takes into account Danish competitiveness. In March 2012, Denmark reached a historic new Energy Agreement. The Energy Agreement from 2012 provides the overall framework for the Danish energy policy. According to the agreement, Denmark must reduce total energy consumption by 7% in 2020, compared to energy consumption in 2010. The long-term goal of the agreement is that the country's energy supply becomes independent of fossil fuels by 2050.

#### ***Advanced Motor Fuels Statistics***

##### **General Energy Data**

The total share of renewables (RES) is expected to be 39.8% in 2030 in the absence of any new initiatives, which results in a shortfall of 10.2 percentage points relative to the goal in the Government's Political Platform of at least 50% RES in 2030. The RES share will increase up to 2021 to 43.6%, followed by a decline due to an increase in electricity consumption and a decrease in the deployment of renewable energy. The RES share is expected to be 42.0% in 2020, whereby Denmark will have met, and exceeded, its EU obligation for a 30% RES share by 2020.

In 2020, Denmark's total greenhouse gas emissions are expected to be 38%–39% below emissions in the United Nations (UN) baseline year of 1990. Up to 2021, emissions will fall to 39% below the UN baseline year. After 2021, emissions are expected to increase in the absence of any new initiatives. This trend is contingent on the level of energy-related emissions in particular. The EU obligation for the non-EU Emissions Trading System (ETS) sector for the period 2013–2020 will be fulfilled and exceeded. Non-ETS emissions for the period 2021–2030 are expected to fall short of the EU obligation by between 32 million and 37 million tonnes carbon dioxide equivalent (CO<sub>2</sub> eq), subject to an uncertainty of ±10 million tonnes CO<sub>2</sub> eq.

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<sup>1</sup> Information is primarily from Danish Energy Agency, 2018, "Danish Energy and Climate Outlook 2018," <https://ens.dk/sites/ens.dk/files/Basisfremskrivning/deco18.pdf>; see also Energiestyrelsen, [www.ens.dk](http://www.ens.dk)

Electricity consumption (exclusive of grid losses) will increase from 31.3 terrawatt hours (TWh) in 2017 to 42.2 TWh in 2030. This increase depends in particular on increased electricity consumption by data centres, which will account for 65% of the increase. Further, these centres are expected to account for 16.7% of total electricity consumption (exclusive of grid losses) in 2030. Future demand for electricity by data centres is subject to significant uncertainty. Increasing electricity demand in combination with new electricity interconnectors to high-price areas means that domestic electricity production will increase up to 2023 and that Denmark is expected to be a net exporter of electricity from 2020 to 2024. After this time, electricity imports will increase due to declining deployment of new domestic capacity. Assuming no new initiatives are introduced, net imports are expected to amount to 8.6 TWh in 2030, corresponding to 19% of electricity consumption (including grid losses).

The share of electrified vehicles (electric cars and plug-in hybrid cars) is expected to increase steadily and will account for 7% of the total number of cars and vans on the road in 2030 as well as for 1.2% of electricity consumption (excluding grid losses). Electrified vehicles' share of sales of new cars up to 2030 is subject to significant uncertainty. The 10% renewables obligation in transport by 2020 will not be achieved in the absence of new initiatives.

Consumption of bioenergy will be constant from 2021, but, with a share of 67% in 2030, it is expected to still make up the majority of renewable energy consumption. Consumption of renewable energy in the form of ambient heat by large and small heat pumps will increase by 7.3% annually and will account for 8% of renewable energy consumption in 2030. Heat pumps will increasingly displace household use of wood pellets, natural gas, and oil. In 2030, oil for heating will account for less than 2% of household energy consumption.

In the absence of any new initiatives, energy consumption in industry and services will fall by 0.4% annually up to 2020. After 2020, it is expected to increase by 2.2% annually up to 2030 due to an increase in electricity consumed by data centres and the discontinuation in 2021 of the scheme concerning the energy-saving efforts of energy companies.

Uncertainties and assumptions subject to sensitivity affect the key results. For example, uncertainty is associated with the projection of electricity consumption by data centres, as well as with assumptions about the CO<sub>2</sub> allowance price, fossil fuel prices, transport volume, number of dairy cattle, decommissioning of coal-fired electricity production capacity, and the distribution of vehicle types in sales of new cars.

#### Details on Advanced Motor Fuels

In 2017, energy consumption in transportation accounted for 34% of Danish energy consumption. The share of fossil fuels in energy consumption will fall from 95% in 2017 to 93% in 2030. Up to the financial crisis in 2008, energy consumption in transportation had been increasing steadily. The financial crisis and greater focus on the energy efficiency of cars resulted in a fall in energy consumption up to 2013. After 2013, energy consumption by road transport has followed an upward curve again, due in particular to an increase in the number of vehicles, which reflects an increase in sales of small petrol cars and medium-sized diesel cars. This has also meant an increase in the number of kilometers driven by cars.

Figure 1 shows energy consumption by use for the period 2017–2030. Road transport will account for 75% of energy consumption, of which cars will account for 47%. Aviation will account for 19%, whereas rail transport, maritime transport, and military transport will account for the rest.

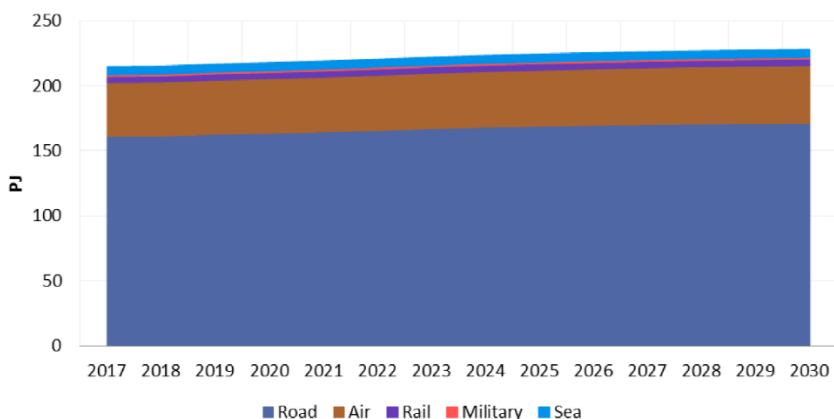


Fig. 1 Final Energy Consumption by the Transport Sector in Denmark by Use, 2017–2030 (PJ)

The increase in energy consumption will mainly come from road transport. Road transport is expected to increase by 6% in total from 2017 to 2030. Of this, the increase in energy consumption by cars will account for 80%. The reason for this increase in energy consumption is that improvements in energy efficiency will not offset the increase in the number of kilometers driven. It should be stressed that a significant improvement in efficiency is assumed up to 2030. The analysis shows that energy consumption in transportation will increase, particularly because of energy consumption by cars. Energy consumption in transportation up to 2030 will continue to be predominantly covered by fossil fuels.

Energy consumption by the aviation sector is expected to increase by 8% from 2017 to 2030 due to an increase in air traffic of 35%; however, energy efficiency will increase by 26%. The aviation sector has announced ambitious plans for biofuel blending, but these announcements are not assessed to be binding, nor are they assessed to reflect a profitable development pathway for companies in the absence of any new initiatives. Consequently, it is assumed that there will be no biofuel blending in aviation.

Sales of electrified vehicles (electric cars, plug-in hybrid cars, and hydrogen cars) will increase up to 2030 as a result of technological developments and falling technology costs and are expected to account for 22% of total sales of new cars in 2030 in the absence of any new initiatives. This central estimate means that electrified vehicles will account for 7% of the total number of cars and vans on the road in 2030. The associated electricity consumption is expected to account for 1.2% of total electricity consumption in 2030.

Figure 2 shows the development in electrified vehicles' share of total car sales. The figure shows that electric cars are expected to account for the largest share of sales of electrified vehicles. Sales of hydrogen cars are expected to be insignificant.

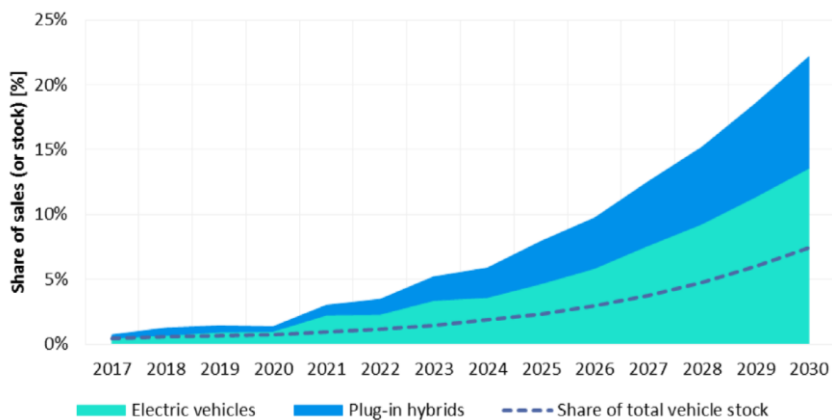


Fig. 2 Electrified Vehicles' Share of Sale of New Cars and the Share of Cars and Vans on the Road in Denmark, 2017–2030 (%)

This central estimate for sales of electrified vehicles is subject to significant uncertainty, which has been addressed in a sensitivity analysis. The analysis shows that electric cars and plug-in hybrid cars as a central estimate are expected to account for 22% of sales and 7% of the total number of cars and vans on the road in 2030. The associated electricity consumption is expected

to account for 1.2% of total electricity consumption in 2030. Sensitivity analyses examine, among other things, the effect of the significant uncertainty about the trend in sales of electrified vehicles.

The share of fossil fuels in transportation will fall from 95% to 93% from 2017 to 2030, primarily due to electrification of railways and, to a lesser extent, electrification of road transport. An increase in the use of biofuels by buses is expected, which primarily depends on municipal targets.

Consumption of biofuels (excluding biogas) is expected to increase to 10.7 petajoules (PJ) in 2030, corresponding to 5% of energy consumption in transportation. If all gas used in transportation is assumed to be biogas, biogas will contribute 0.4%. Consumption of electricity is expected to increase to 5.8 PJ in 2030, corresponding to 3% of energy consumption in transportation. Biofuel blending for road transport will not increase after 2020 in the absence of any new initiatives. The analysis shows that the share of fossil fuels in energy consumption in transportation will fall from 95% in 2017 to 93% in 2030.

#### ***Research and Demonstration Focus***

Research and demonstration in Denmark focus on electric vehicles and fuel cell vehicles for passenger cars. Several demonstration projects have been initiated. For heavy-duty vehicles, 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 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. The government's goal is that by 2050 all of the Danish energy supply will be met by renewable energy, including that required by the transportation sector. In February 2012, the Danish Energy Agency finalized a report on alternative fuels for the transportation sector, including socioeconomic aspects, energy efficiency, and environmental impact. The analysis 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.