

# IEA-Advanced Motor Fuels ANNUAL REPORT 2025

## DENMARK



## Denmark

### Drivers and Policies

The adoption of the Climate Act in 2020 set an ambitious direction for Danish climate policy and Denmark's diplomatic role in the world around climate change. Central to the goal is to reduce Danish greenhouse gas (GHG) emissions by 70% by 2030 (compared with 1990 levels) and achieve climate neutrality by 2050 at the latest. The new government — consisting of the Social Democrats, the Liberal Party, and the Moderates — has moved up the climate neutrality goal to 2045 and has set a goal of a 110% reduction in GHGs by 2050 (compared with 1990 levels). Since the 2020 Climate Act, more than 75 green agreements have been concluded and more than 129 billion DKK have been prioritized for the major climate agreements. For example, agreements have been made to implement a high (and more uniform) carbon dioxide equivalent (CO<sub>2</sub>e) tax for industry, significantly expand Denmark's renewable energy production, and establish a binding reduction target for the agricultural and forestry sector, all of which will contribute significantly to the achievement of the 70% GHG emissions reduction target.

### 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). Since its peak in 2007 at 873 petajoule (PJ), gross energy consumption has followed a downward trend. It was expected to drop annually by 1.2% until 2020, after which it will rise slightly to 778 PJ in 2030, corresponding to consumption in 2017. Coal consumption will decrease considerably (by 14% annually) by 2030 as a result of Denmark's expected decision to stop using 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 expected to be limited.

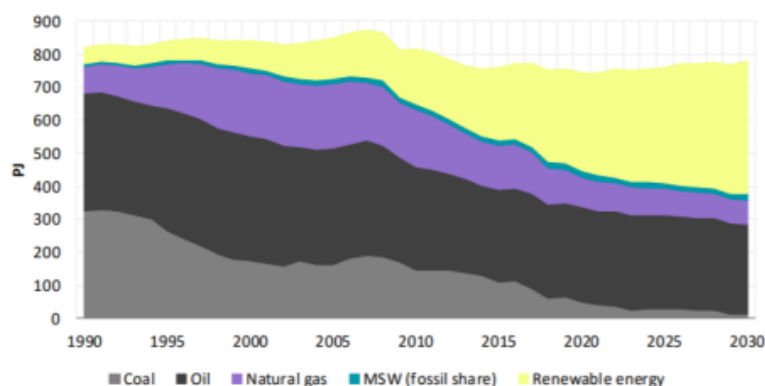


Figure 1. Gross energy consumption by type of energy 1990–2030 (in PJ). (The calculation for 1990–2017 has been adjusted for outdoor temperature/degree days relative to normal years [climate-adjusted] and electricity trade with other countries).

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

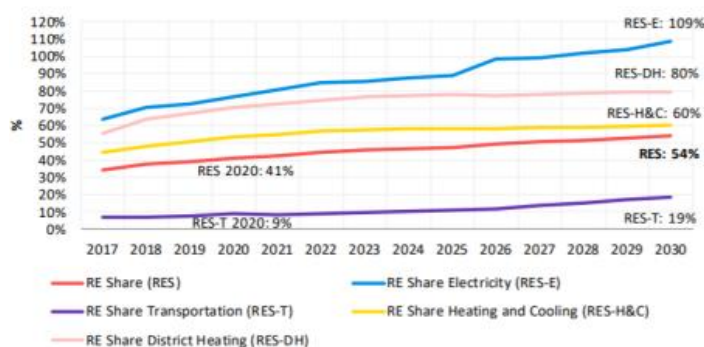


Figure 2. Renewables shares 2017–2030 [%].

The RES and RES-T are subject to binding national EU targets established in 2020. The EU RE Directive also establishes a 2030 target of 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.

The projections (from the Danish Energy Agency [2019, 2023] and Energistyrelsen) show that the RES is expected to be 41% in 2020, in which case Denmark will have met, and exceeded, its EU obligation for a 30% renewables share by 2020. The RES-T will reach 9% in 2020, revealing a shortfall of 1 percentage point compared with the RE Directive obligation of 10% in 2020. The overall RES will increase to 54% in 2030. The projection depends on the deployment of offshore wind, onshore wind, and solar photovoltaic (PV) energy and on the conversion of CHP plants to biomass; 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 beginning in 2028. The country's RES-E is expected to increase to 109% in 2030, but the increase is particularly contingent on the offshore wind farms included in the 2018 Energy Agreement being commissioned by 2030.

There are also updated expectations regarding deployment of commercial solar PV (ground-mounted solar farms) and replacement of older onshore wind turbines with fewer, more efficient turbines. The projection of onshore wind and solar PV deployment depends on developments that affect 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 power purchase agreements (PPAs)/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 four for the renewables share of electric road transport and a multiplication factor of 1.5 for the renewables share of electric rail transport. Considering these factors, 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 RES only to 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 because these announcements are neither binding nor reflect a profitable development pathway for aviation-related companies (in the absence of new measures), the plans have not been included in a renewables contribution from 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 decrease 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 in 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

RES 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.

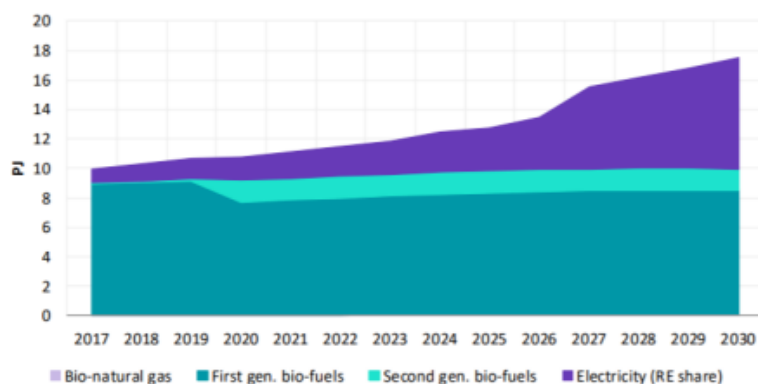


Figure 3. Renewable energy consumption by the transport sector 2017–2030 (in PJ).

The energy consumption for the transport sector can be split up into subsectors until 2023, as shown in Figure 4. In Figure 5, the energy consumption is split into fuel types applied.

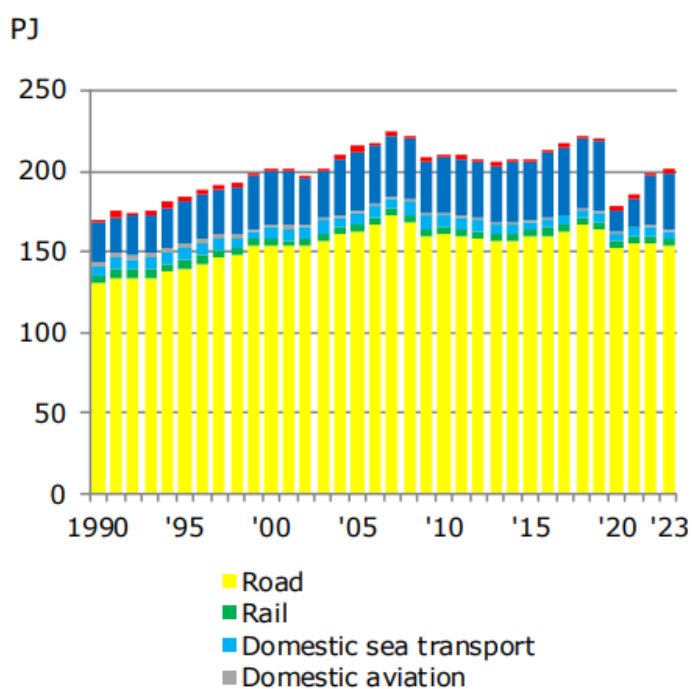


Figure 4. Energy consumption for different sectors of transport.

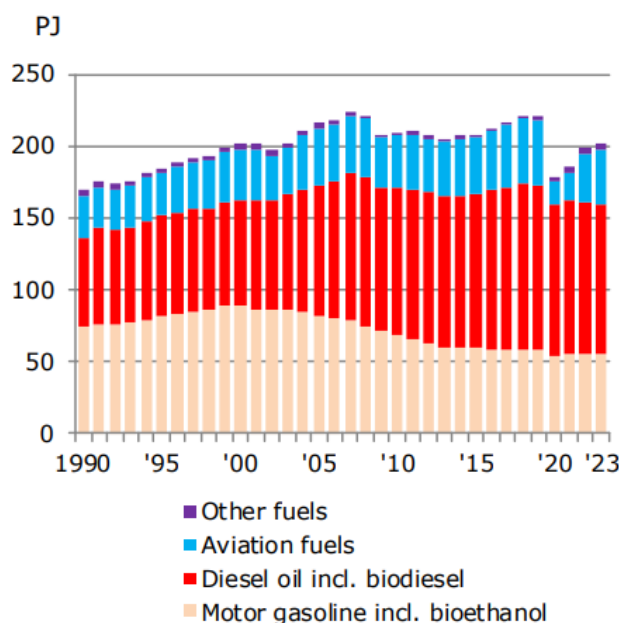


Figure 5. Energy consumption for different fuel types.

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 lower-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 6. A beginning transition is also expected for vans, so that the number of electric cars and vans in 2030 will total around 800,000.

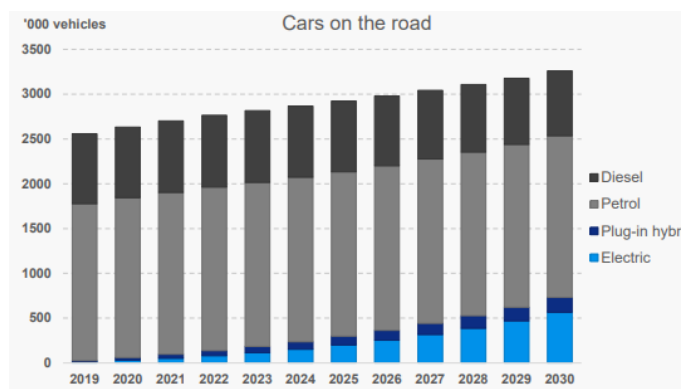


Figure 6. Number of cars by technology, 2019–2030

### Emissions from road transport

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 lag in the transition is because of the relatively long lifetime of vehicles.

Road transport is responsible for, by far, the majority of emissions from the transport sector. In 2019, road transport produced 12.4 million tonnes of CO<sub>2</sub>e, corresponding to 92% of total emissions by the transport sector. Emissions fell during the Covid-19 pandemic to 11.4 million tonnes CO<sub>2</sub>e in 2020 and 11.6 million tonnes CO<sub>2</sub>e in 2021. The projection shows an increase in emissions in the wake of the pandemic, but after this, emissions are projected to decrease significantly in spite of continuous growth in demand for road transport. By 2025, emissions will have fallen to 11.2 million tonnes CO<sub>2</sub>e, and by 2030 and 2035, they will have fallen to 9.6 million tonnes CO<sub>2</sub>e and 7.3 million tonnes CO<sub>2</sub>e, respectively.

Cars account for the largest share of emissions from road transport, at 57% in 2021, followed by vans and lorries. Figure 7 shows GHG emissions from road transport, broken down by type of vehicle and cross-border trade. The projected decrease in emissions is also greatest for cars (in absolute figures). Despite a continued increase in traffic, the projection shows a reduction in emissions of GHGs from all vehicle types. This decrease is attributable to vehicle electrification, higher blending ratios for renewable fuels, and continued energy-efficiency improvements in conventional vehicles.

### Emissions from rail transport

In 2019, rail transport emitted 0.2 million tonnes of CO<sub>2</sub>e, corresponding to around 2% of emissions by the transport sector. Despite an expected expansion in train operations, a considerable reduction in emissions is projected after 2025, corresponding to the electrification of inter-city and regional trains, which are responsible for most emissions. In 2030, emissions from rail transport are projected to be 0.02 million tonnes CO<sub>2</sub>e — a mere tenth of today's emissions — and in 2035, there will be no emissions at all. The last diesel trains are expected to be phased out just after 2030.

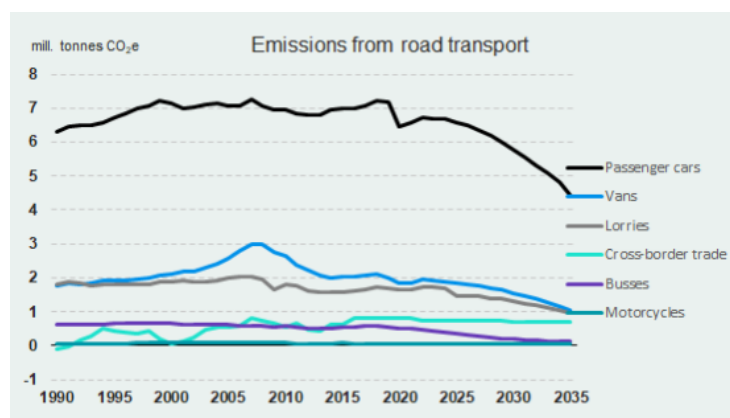


Figure 7. Emissions from road transport by vehicle

### Emissions from domestic aviation

Emissions from domestic aviation were 0.15 million tonnes CO<sub>2</sub>e in 2019, corresponding to around 1% of total transport sector emissions. As a result of the Covid-19 pandemic, emissions from domestic aviation were 0.08 million tonnes CO<sub>2</sub>e in 2020 and 0.09 million tonnes CO<sub>2</sub>e in 2021. The projection that activity in the sector will increase gradually as a result of increased demand for domestic flights includes a caveat that it may not return to the pre-pandemic level until 2025.

The projection includes an expectation that the incrementally increasing CO<sub>2</sub> tax on fuels for domestic aviation under the 2022 Green Tax Reform for Industry Etc. agreement, which will take effect in 2025, will put a damper on developments in aviation activity. The projection also assumes general energy efficiency improvements.

Emissions from domestic aviation are expected to increase to 0.13 million tonnes CO<sub>2</sub>e in 2025 and 0.14 million tonnes CO<sub>2</sub>e in 2030, after which emissions will remain unchanged. Renewable fuels blending is not assessed to be financially feasible without further regulation of the sector, and use of renewable fuels in domestic aviation has therefore not been included in the projection.

### Emissions from domestic shipping

Emissions from domestic shipping accounted for 3.9% of total emissions by the transport sector in 2019. The projection shows that emissions will remain more or less constant at around 0.5 million tonnes CO<sub>2</sub>e until 2035. However, the projection predicts a slight reduction in emissions as a result of electrification of a number of short ferry services, partly resulting from deployment of the funding pool to promote green transition of domestic ferries in 2021 (11 ferries received a funding commitment) and in 2022 (three ferries received a funding commitment); the program replaced 15 existing ferries with 14 green electric-powered ferries, either through refurbishment or new purchase.

Further, the introduction of a CO<sub>2</sub> tax as part of the 2022 Green Tax Reform for Industry Etc. agreement will likely increase the incentive to opt for electric ferries when buying new ferries. The projection does not include use of renewable fuels (e.g., ammonia or methanol) in domestic shipping,

because such fuels are not financially feasible without further regulation of the sector. Even with the introduction of the agreed CO<sub>2</sub> tax, renewable fuels are associated with a considerable additional cost, including the cost of having to invest in infrastructure, etc.

## Outlook

In Denmark, the transportation sector is still almost entirely dependent on oil. By 2050, the government aims to meet all Danish energy demand with renewable energy, including that required by the transportation sector. In 2012, a broad majority in Parliament reached an energy agreement defining initiatives directed at crucial energy policy areas for 2012–2020 and agreed to discuss additional initiatives beyond 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 its high efficiency in the engine and an increase in the 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 constructed, which will be a hub for 3-gigawatt (GW) offshore wind farms, with the possibility of 10 GW in the long term — enough to power 10 million households. The wind turbines that will supply power to the island are expected to be larger than they are today, and they will extend 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. Political agreements state that electricity from the energy islands should be converted into new forms of energy (e.g., Power-to-X), creating green power that 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 in 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.

The parks at Bornholm must have a capacity of 2 GW, corresponding to the electricity consumption of two million households. Like the island in the North Sea, the ambition is for electricity from the offshore wind farms to be converted into other forms of energy (Power-to-X).

## 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](http://www.ens.dk).
- Danish Energy Agency, 2023, *Denmark's Climate Status and Outlook 2023*, [https://ens.dk/sites/ens.dk/files/Basisfremskrivning/kf23\\_hovedrapport\\_v3\\_eng.pdf](https://ens.dk/sites/ens.dk/files/Basisfremskrivning/kf23_hovedrapport_v3_eng.pdf).