



Energy Industry in Denmark



General State of the Economy

Denmark, officially the Kingdom of Denmark, is located in Northern Europe. Its capital city is Copenhagen. Neigh-

boring countries are Norway (to the north), Germany (to the south), and Sweden (to the south-east). The country has access to the Baltic Sea and the North Sea.

Denmark/Kingdom of Denmark

Capital: Copenhagen

Density: 149/km²

Currency: Danish krone (DKK)

Official languages: Danish

Life expectancy at birth: 81.30 years

GDP (PPP): \$437.380 billion (2023)

National Day: 5 June

Land area: 40,000 km²

GDP - per capita (PPP): \$73,547 (2023)

Population: 5,977,412 (2025)

Coastline: 7,300 km

Internet country code: .dk

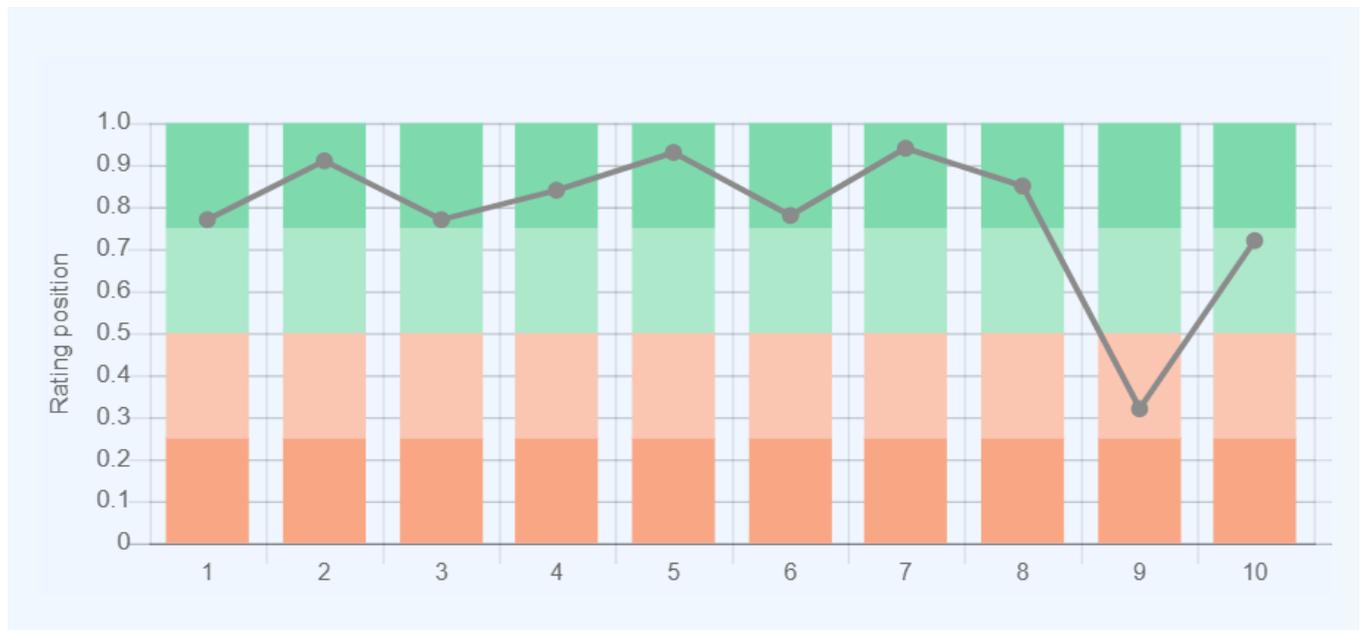
Source: [1,2,3,4,5]



Copenhagen - Denmark. Envato Elements. 9PZTAHR5NG

Denmark is the 132nd largest country in the world in terms of area and, as of 2023, is home to around 6 million people. The country ranks 85th in the world by population density [1,2,3]. The total length of the coastline is 7,300 km [3]. Denmark's political form of government is constitutional monarchy and the official language is

Danish [3]. The administrative map of Denmark is divided into 5 regions. Denmark has a balanced modern market economy, which is reflected in Figure 1. By almost every indicator in the presented diagram, Denmark places in the top 25% of the leading countries in the world included in the rating.



Sources:

1. GDP (purchasing power parity), 2020 est. / The World Factbook/Library/Central Intelligence Agency *228
 2. GDP - per capita (PPP), 2020 / The World Factbook/Library/Central Intelligence Agency *229
 3. Inflation rate (consumer prices), 2019 est. / The World Factbook/Library/Central Intelligence Agency *228
 4. Charges for the use of intellectual property, receipts (BoP, current US\$), 2020 / International Monetary Fund, Balance of Payments Statistics Yearbook, and data files. / License: CC BY-4.0 *88
 5. The Global Competitiveness Index 2019 / Rankings / Reports / World Economic Forum *141
 6. High-technology exports (current US\$) 2019-2020 / United Nations, Comtrade database through the WITS platform / License: CC BY-4.0 / Data *134
 7. 2021 Index of Economic Freedom / International Economies / The Heritage Foundation *178
 8. Reserves of foreign exchange and gold, 2017 est. / The World Factbook / Library / Central Intelligence Agency *195
 9. Annual average GDP growth in %, for the last 10 years (2011-2020) / World Bank national accounts data, and OECD National Accounts data files / License: CC BY-4.0 *206
 10. Public debt (% of GDP), 2017 est. / The World Factbook / Library / Central Intelligence Agency (from smallest to largest) *210
- * Total number of countries participating in ranking

Figure 1. Economic Indices of Denmark

From the early 1990s the country has experienced sustained GDP growth at purchasing power parity, both in general and per capita [4,5]. GDP at purchasing power parity increased from 364.63 billion in 2020 to \$456.06 billion in 2023. The dynamics of GDP at purchasing power parity per capita also positive: from \$62,529 in 2020 to 76,688 in 2023 [3]. The inflation rate changed from 0.76% in 2020 to 3.3% in 2023.

The Global Competitiveness Report reflects the effectiveness of the use of the country's own resources for sustainable development. In addition to a number of economic indicators this index also takes into account such variables as education, health, level of innovation, etc. High-technology exports in 2022 was 15.8% of manufactured exports.

According to the Index of Economic Freedom, which takes into account business freedom, freedom from government intervention, protection of property, and freedom from corruption, Denmark was 6th in 2024 out of 176 countries. Denmark's public debt as a percentage of GDP was 26.4% in 2022.

Energy resources

Denmark does not have significant reserves of fossil resources (Table 1). According to [3] in terms of oil and gas reserves the country places low on the global comparati-

ve list (46th and 77th, respectively). According to the BP Statistical Review of World Energy 2021 [6], proven oil reserves were 400 million barrels, and according to [3] at the beginning of 2021 they were estimated to be at 441 million barrels.

Table 1. Fossil energy resources of Denmark

Resource/ explanations	Crude oil*	Natural gas*	Coal	Shale Gas*	Tight Oil	Coal mine methane	Oil Shale
Value	439	1.04	No data	31.7	No data	No data	No data
Unit	million barrels	Tcf	-	Tcf	-	-	-
Year	2021	2021	-	2013	-	-	-
Source	[16]	[16]	-	[8]	-	-	-

*ongoing recovery and approved for development

**unproved technically recoverable

According to data from the Danish Energy Agency, as of January 1, 2023, total oil reserves in the country were estimated at 137 million m³ [7].

The proven reserves of natural gas in Denmark at the end of 2020 according to [6] were 1 Tcf, and about 3.964 Bcm at the beginning of 2021 [3]. According to the Danish Energy Agency, as of January 1, 2023, the coun-

try's total natural gas reserves were 76 billion Nm³ [7]. Denmark also has the second largest shale gas reserves in Western Europe – 31.7 Tcf [8]. Denmark has a variety of renewable sources for energy production, including a significant potential for wind energy. A selection of basic indicators of this type of resource is presented in Table 2.

Table 2. Renewable energy resources of Denmark

Resource/ explanations	Solar Potential (GHI)*	Wind Potential (50 m)*	Small Hydro energy Potential	Bio Potential Agricultural area	Bio Potential Forest Area	Municipal Solid Waste
Value	2.7 - 2.9	6.0 –7.0	9.75	65.6	15.8	802
Unit	kWh/m ² /day	m/s	MW	% of land area	% of land area	kg/per capita
Year	2022	2022	2022	2022	2022	2022
Source	[9]	[10]	[11]	[12]	[13]	[14]

*for most of the territory of the country

The level of global horizontal irradiation for the majority of the country is low – between 2.7-2.9 kWh/m²/day, but can reach 2.9-3.1 kWh/m²/day in the south-eastern part of the country [9]. The distribution of wind resources is as follows: for the majority of the country, the wind is 6.0 –7.0 m/s, and in the north-western part of the country and along the coastline with the North Sea, at a height of 50 m can reach over 8.7 m/s [10].

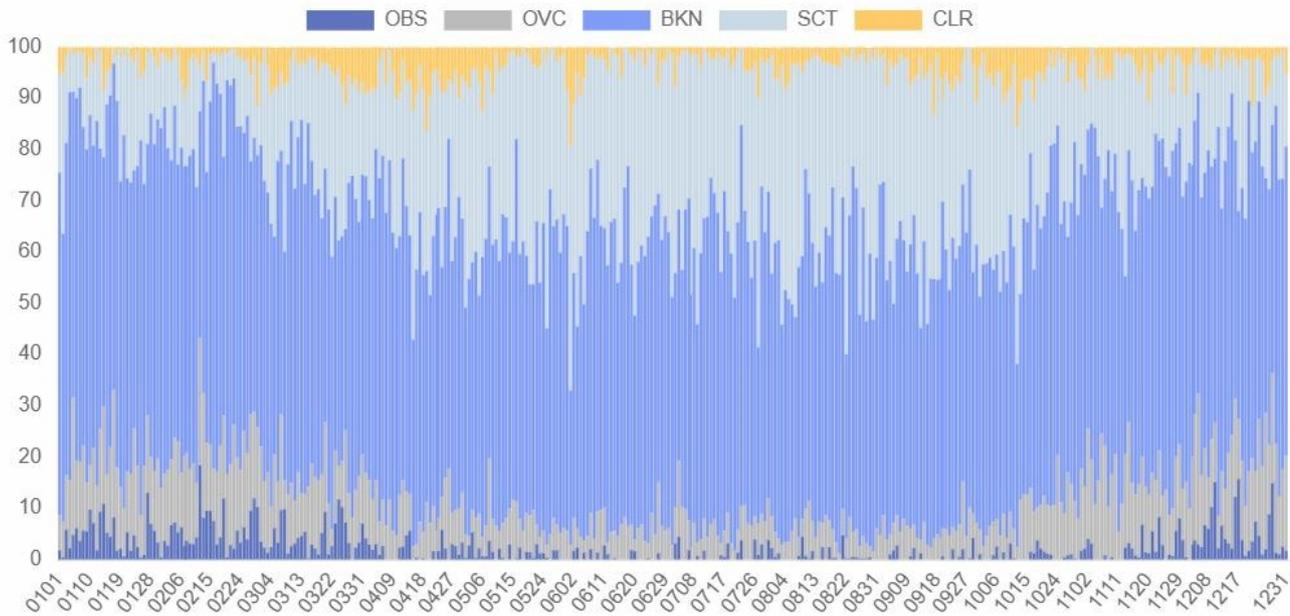
The potential of small hydropower in Denmark is 9.75 MW; the installed capacity of small hydropower is also 7.0 MW, which indicates this resource is being fully exploited for electricity production in the country [11].

65.6% of Denmark is covered by agricultural land [12], while forest area accounts for only 15.8% of the country's territory [13].

In terms of municipal waste generation (802 kg per capita in 2022), Denmark is higher than in the Netherlands (535 kg per capita), and in Sweden (431 kg per capita) [14]. Municipal waste is a valuable raw material for recycling or energy production, which is actively used in Denmark, however long-term decomposing substances can significantly pollute the environment.

DENMARK, BILLUND
 Latitude: 55.74 Longitude: 9.15

Average daily sky coverage over 10 years of observations, %



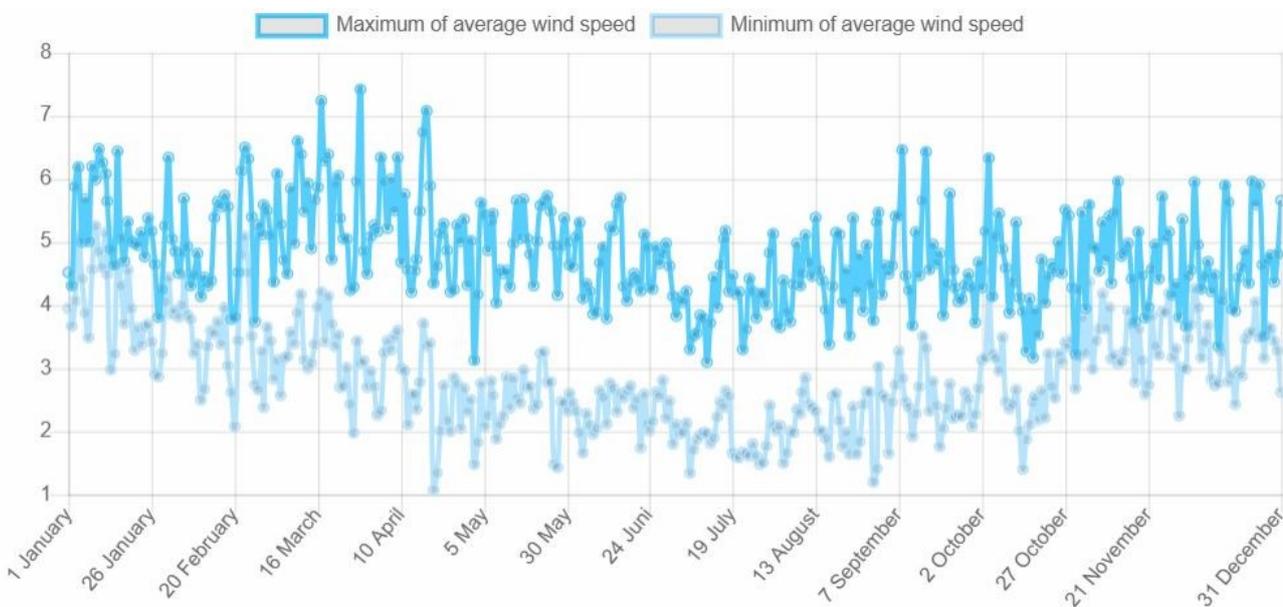
CLR - clear, SCT - scattered from 1/8 TO 4/8, BKN - broken from 5/8 TO 7/8, OVC - overcast, OBS - obscured, POB - partial obscuration

Source: based on NOAA U.S. Department of Commerce
 Detailed information: [Interactive map of solar resources](#)

DENMARK, FOULUM

Latitude: 56.5 Longitude: 9.57
 Average speed: 3.80 m/s, Operational share: 63%

Average daily wind speed for 10 years of observations, m/s, 10 m above the ground

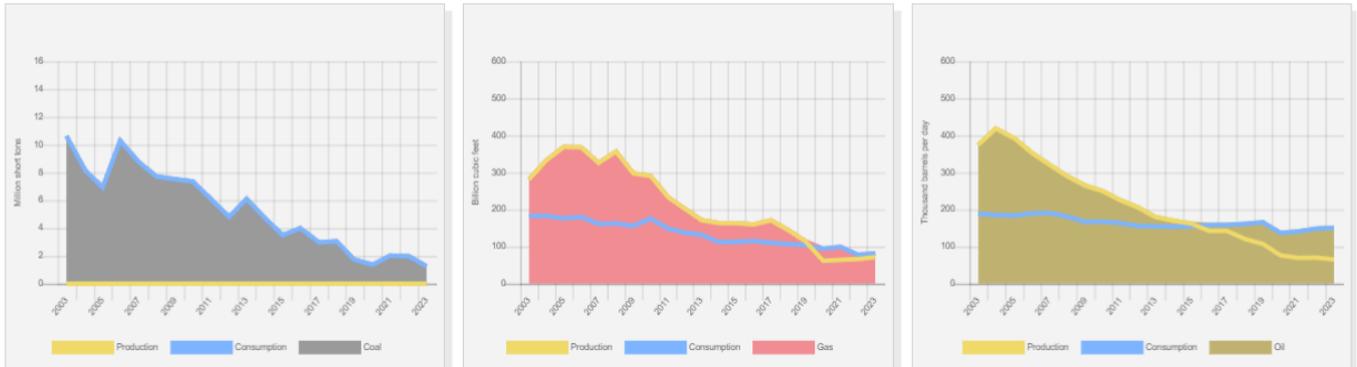


Source: based on NOAA U.S. Department of Commerce
 Detailed information: [Interactive map of wind resources](#)

Energy balance

Oil production between 2004-2023 decreased more than 6 times reaching a level of 65.03 thousand barrels/day in 2023 [16]. BP estimated oil production at 65 thousand barrels/day in 2021 [6]. According to the Danish Energy Agency, oil production in 2023 amounted to 125,647 TJ. [7]. The volume of oil consumption in the country since

2003 also showed a decline (Fig.2), but a significantly smaller one, and in 2023 amounted to 150.25 thousand barrels/day [16]. Oil imports to Denmark in 2023 amounted to 205,251TJ , and exports - 12,893 TJ [3]. Natural gas consumption in Denmark gradually declined between 2003-2023 and in 2023 reached a level of 81,55 Bcf [16].

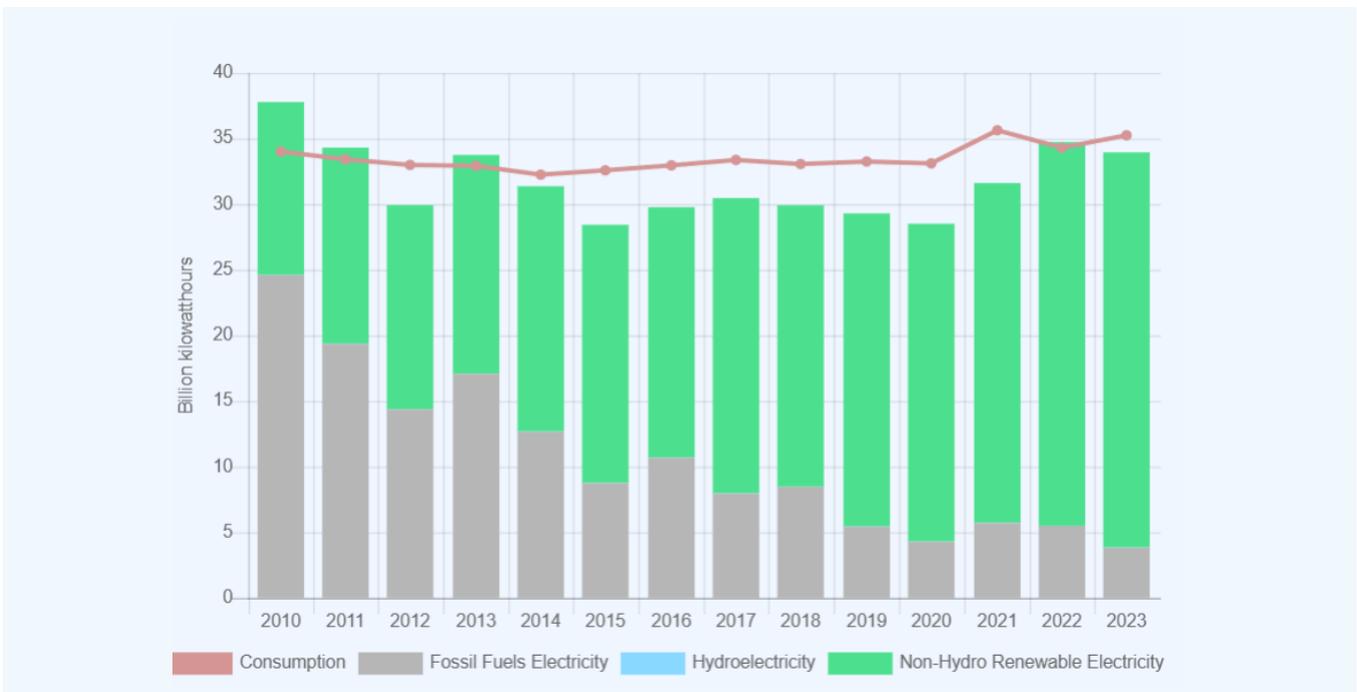


Source: U.S. Energy Information Administration (Sep 2024) / <https://www.eia.gov/>

Figure 2. Production and consumption of fossil fuels in Denmark (left– coal, in the center– gas, right–oil)

BP's Statistical Review of World Energy 2022 [6] estimated production at 1.3 billion m³. According to the Danish Energy Agency, gas production in 2023 [7] is expected to be 48,642 PJ; natural gas imports were 310,513 PJ, with exports of 303,054 PJ. The consumption of imported coal in the country has been gradually decreasing since 2006, with small fluctuations, and in 2023 it was 1.24 million short tons [16]. In

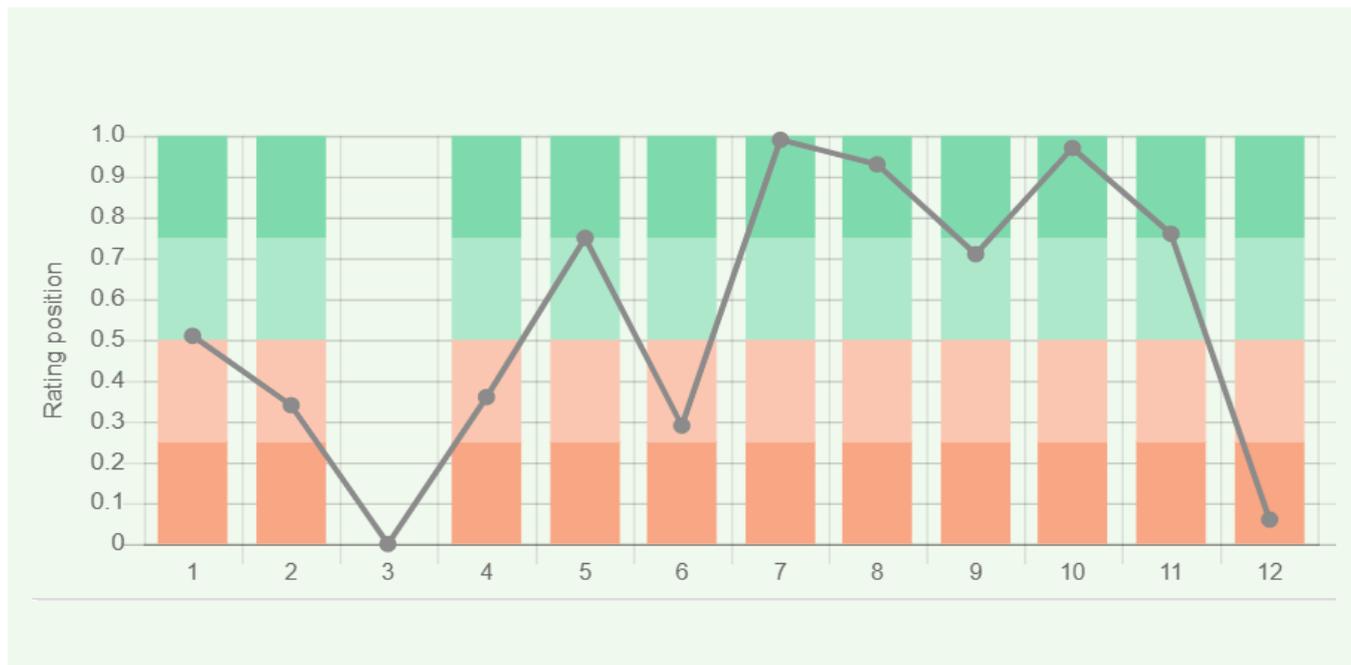
recent years, Denmark has a high share of renewable resources in electricity production (Fig. 3). According to the U.S. Energy Information Administration, electricity production reached 33.95 TWh in 2023, dominated by renewable energy – about 89%; the share of fossil fuels was about 11% (Fig.6). According to [17] the import of electricity into Denmark in 2023 amounted to 19.83 TWh.



Source: U.S. Energy Information Administration (Sep 2024) / <https://www.eia.gov/>

Figure 3. Electricity production in Denmark

Denmark's position in the comparative diagram of energy index is shown in Figure 4.



Sources:

1. Crude oil proved reserves, 2021 / International Energy Statistic/Geography / U.S. Energy Information Administration (Nov 2021)*98
 2. Natural gas proved reserves 2021 / International Energy Statistic / Geography / U.S. Energy Information Administration (Nov 2021) *99
 3. Total recoverable coal reserves 2019 / International Energy Statistic / Geography / U.S. Energy Information Administration (Nov 2021) *81
 4. Combination production-consumption for Crude oil 2018 / International Energy Statistic / Geography / U.S. Energy Information Administration (Nov 2021) *219
 5. Combination production-consumption for Natural gas 2019 / International Energy Statistic / Geography / U.S. Energy Information Administration (Nov 2021) *123
 6. Combination production-consumption for Coal 2019 / International Energy Statistic / Geography / U.S. Energy Information Administration (Nov 2021) *128
 7. Electricity – from other renewable sources (% of total installed capacity), 2017 est. / The World Factbook / Library / Central Intelligence Agency *170
 8. GDP per unit of energy use (PPP per unit of oil equivalent), 2020 *66
 - Primary energy consumption - BP Statistical Review of World Energy 2021/BP;GDP (purchasing power parity) - The World Factbook/Library/Central Intelligence Agency
 9. Energy use (primary energy use of oil equivalent per capita) 2020 *127
 - Primary energy consumption – BP Statistical Review of World Energy 2021; Population - United Nations, Department of Economic and Social Affairs, Population Division (2019). World Population Prospects 2019, custom data acquired via website. Retrieved 15 November 2021*66
 10. The Global Energy Architecture Performance Index Report (EAPI) 2017 / Rankings / Reports / World Economic Forum
 11. Electric power consumption (kWh per capita), 2016 *217
 - Electricity Consumption - The World Factbook / Library / Central Intelligence Agency; Population - United Nations, Department of Economic and Social Affairs, Population Division (2019). World Population Prospects 2019, custom data acquired via website. Retrieved 15 November 2021
 12. Combination of electricity production-consumption (kWh)/The World Factbook/Library/Central Intelligence Agency *216
- * Total number of countries participating in ranking

Figure 4. Energy indices of Denmark

Despite the relatively small amount of fossil energy resources in Denmark, the country is among the world leaders in terms of the ratio of production and consumption of oil and gas, since it fully meets its own domestic needs. In terms of the share of electricity production from renewable energy sources (excluding hydropower), Denmark is second only to Luxembourg among the 170 countries selected for consideration. Over the last 8 years the country has gained 1 position in the rating. In terms of electricity consumption per capita, the country is 48th in the world, however, for the indicator of combi-

nation of electricity production-consumption, Denmark is 205th in the ranked list of 216 countries.

Energy Infrastructure

A territorial map showing the distribution of the largest infrastructure projects of the fossil fuel sector in Denmark

is shown in Figure 5. The proven crude oil reserves account for 69.3% of the total energy potential of the country's mineral resources, with reserves of natural gas accounting for 30.7% (Fig. 5).

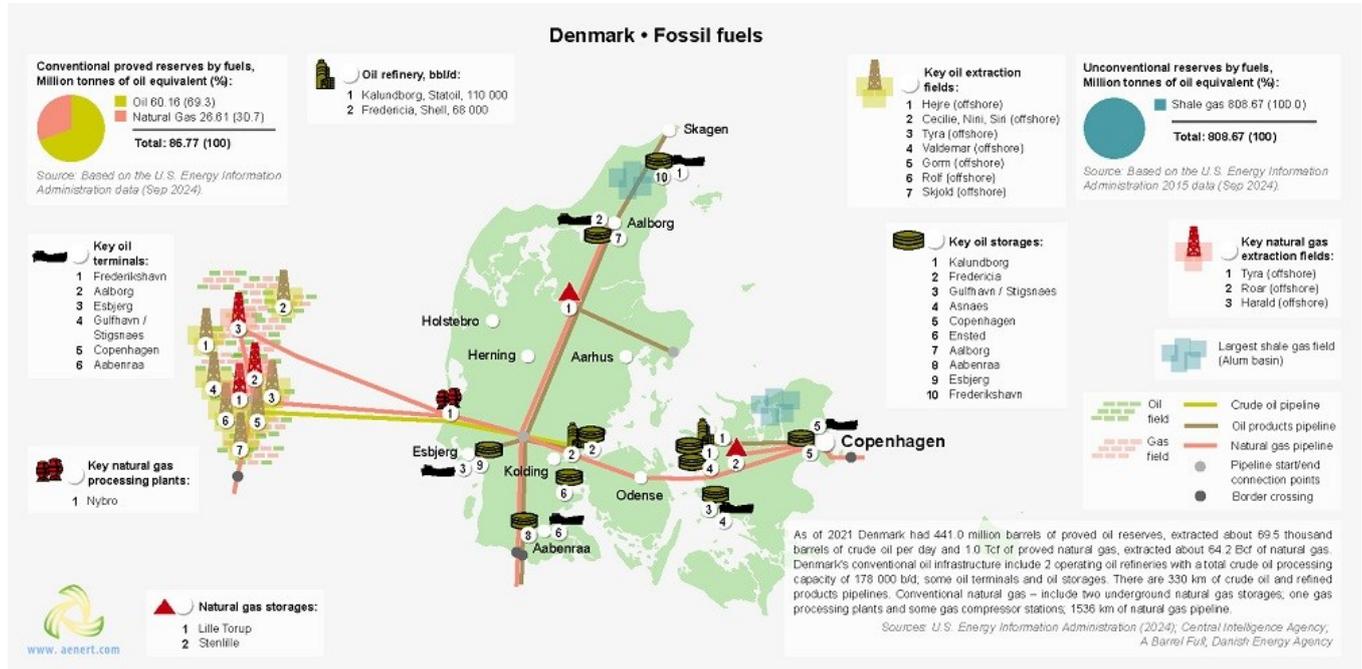


Figure 5. Basic infrastructural facilities of the fossil fuel sector in Denmark

Danish oil and gas fields are located in the North Sea and are being developed by the main operators – DONG E & P A/S, Hess Denmark ApS and MærskOlieog Gas A/S. One of these fields is Hejre, which, according to DONG has a potential production of 44,000 barrels of oil equivalent/day (boe/day) [18,19]. The largest gas-condensate field is the Tyra Field, with proven reserves of 1.250 billion cubic feet and production levels of 237.8 million cubic feet per day [20]. Two oil refineries, Kalundborg (110,000 bpd) and Fredericia (68,000 bpd), conduct oil refining in Denmark; the operators are Statoil and Shell, respectively [21] (Fig. 5).

One of the main oil terminals in Denmark is Stigsnaes (Kalundborg) with a total capacity of 406,000 m³ and a loading speed of up to 2,500 cubic metres per hour. Fredericia (800,000 m³) is the largest oil storage facility [22,23]. Transportation of crude oil and petroleum products is carried through pipelines with a total length of 330 km (Fig. 5). The Danish gas system is represented by two gas storage facilities, Lille Torup and Stenlille [24], and a gas processing plant Nybro [25]; gas is transported internally through a network of pipelines 1536 km long (Fig. 5).

As noted above, the unconventional gas fields in Denmark, according to the U.S. Energy Information Administration (EIA) may contain 31.7 Tcf of technically recoverable shale gas, as of 2013 [26].

The map of the territorial distribution of Denmark's largest infrastructure facilities for electricity generation is presented in Figure 6. According to the U.S. Energy Information Administration, in 2023 the share of fossil resources in electricity production in Denmark was 11.3% (Fig. 6).

The country has a significant number of stations for the production of electricity from fossil fuels, including power plants with a capacity of more than 100 MW, including one oil, two gas, five combined-type power plants and three coal-fired plants (Fig. 6).

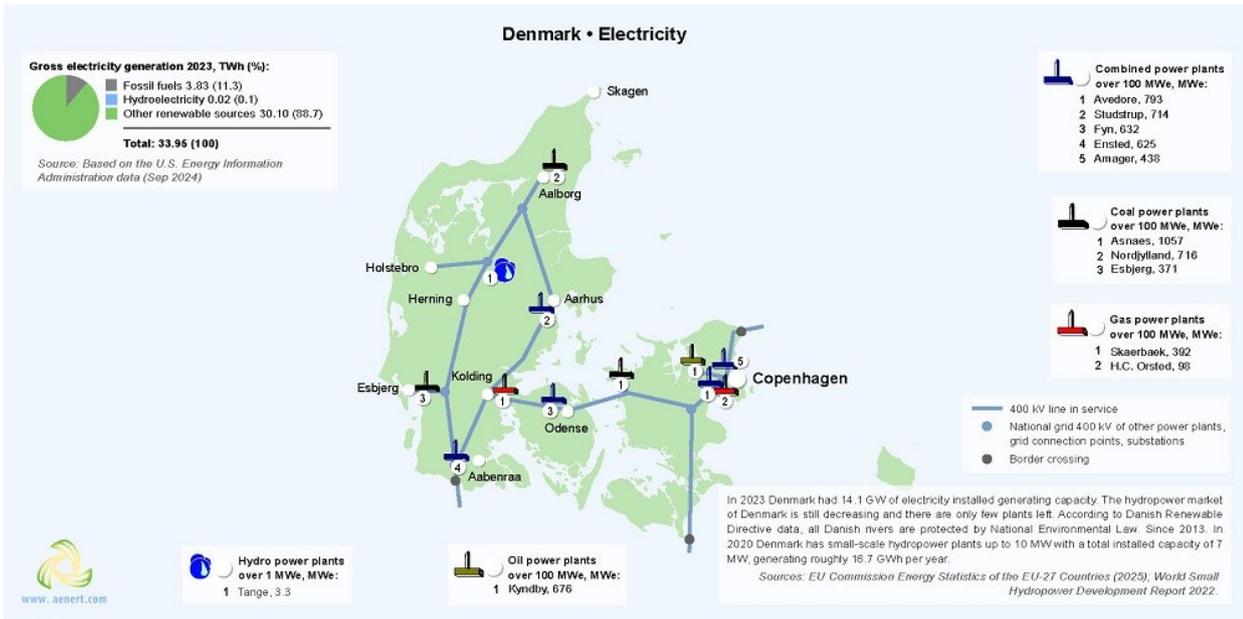


Figure 6. Electricity production in Denmark

The largest power plants in Denmark are: Skaerbaek gas power plant, with a total capacity of 392 MW [27]; Kyndby oil power plant, with installed capacity of 676 MW, Avedøre combined type power plant with installed capacity of 793 MW; and Asnaes coal power plant, with installed capacity 1,057 MW [28,29,30].



Waste incineration plant in Roskilde, Denmark

Hydropower in Denmark has a small share in electricity power plants, including Tange with installed capacity of 3.3 MW [31].

In Figure 7, you can see the main facilities of the Danish infrastructure for the production of energy from renewable sources. As noted above, renewable energy in Denmark plays an important role in electricity generation. The total production of electricity from renewable sources in 2023 was 30.12 TWh (Fig. 7). On the North Sea coast, as well as in offshore high wind activity zones, there are 10 large wind farms with a capacity of more

than 60 MW, the Horns Rev III, which is a project under construction, and a large number of smaller ones. According to [32] in 2023 Denmark generates an astonishing 56% of its electricity from wind. The largest of these is Anholt, with an installed capacity of 399.6 MW [33]. Danish Vestas is one of the ten largest manufacturers of wind turbines, and occupies more than 10% of the market. Over the first 8 months of 2017, according to the



Picturesque rural landscape with old windmill. Envato Elements. GMBFSPX39T

company's website [34], Vestas received orders for the installation of almost 1500 megawatts of wind power in the USA, about 500 megawatts in Argentina, about 600 megawatts in Germany, Mongolia, Thailand, China, Norway and many other countries. As mentioned previously, the level of solar radiation in some parts of the country can reach 3.5 kWh/m², which is low, but sufficient enough for the production of energy through photovoltaics [12]. As a result, there are a number of solar energy facilities, including five photovoltaic stations with a capacity of more than 1 MW each and 11 solar district heating plants (Fig. 7).

In 2015, Lerchenborg – the largest solar PV power plant in Scandinavia, with an installed capacity of 61 MW - was

connected to the Danish electricity grid, providing electricity to around 30,000 households [35,36]. According to [37], almost 1 million square metres of thermal solar collectors with a total installation capacity of 656 mw were installed in Denmark. Silkeborg, the largest solar district heating plant, covers about 20% of the annual heating demand of the city, the peak generation of which is around 110 MW [38].

Denmark is actively developing hydrogen energy as a source of energy for vehicles. As of August 2024, 8 hydrogen fueling stations were in operation in the country (Figure 7). Figure 8 shows the main bio-energy facilities in Denmark for energy production. In 2023, the total installed bioenergy capacity was 2.01 GW (Fig. 8).

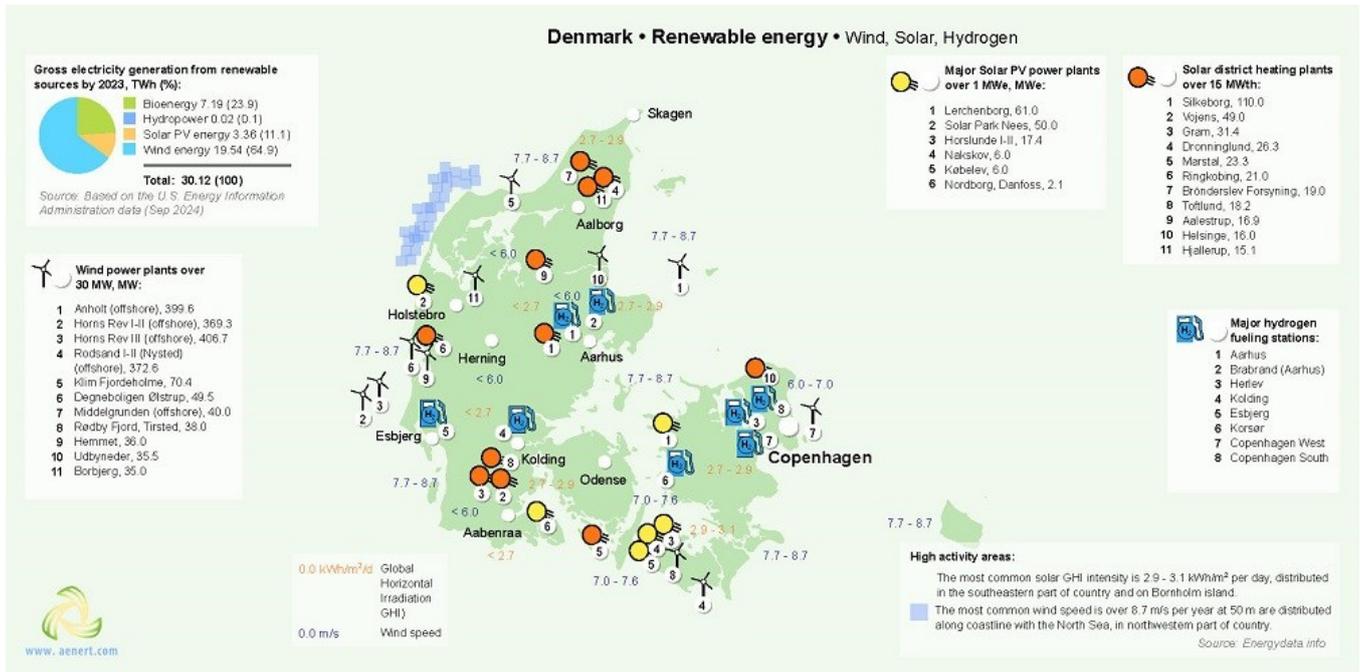


Figure 7. Renewable energy in Denmark: solar, wind and hydrogen

There are about 153 enterprises [39] in the country producing biogas, as well as enterprises for processing biomass and municipal waste and landfill gas; biodiesel, bioethanol, and pellet-producing companies (Fig. 8). Denmark is one of the top 10 world leaders in terms of the share of biofuels in the production of heat and electricity, significantly exceeding the world average, and is among the top 10 world producers of syngas from bio-

mass and municipal waste for the subsequent generation of electricity. Affald Varme Aarhus manages the largest biomass Lisbjerg, with an installed capacity of more than 153 MW [40]. StigeOe Landfill Gas Plant generates about 2.94MW of electricity from landfill gas [41]. The second-generation bioethanol production plant Kalundborg Pomacle produces 5.4 million litres of fuel per

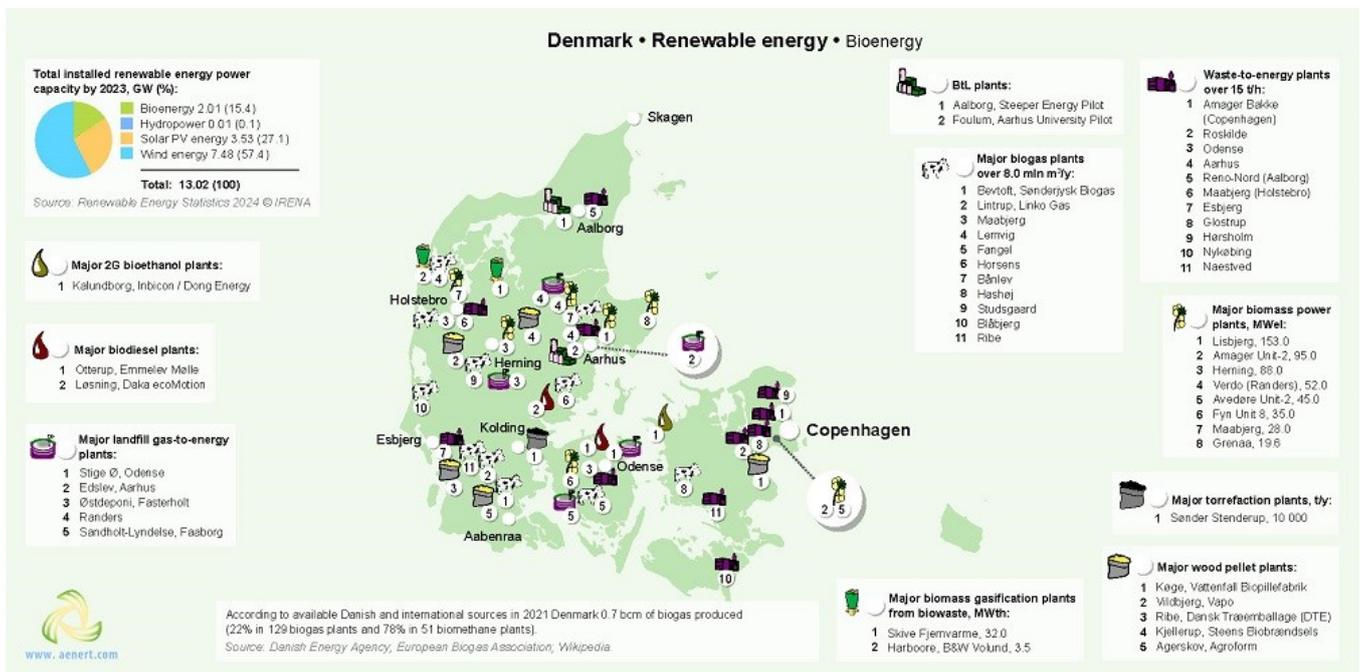


Figure 8. Renewable energy in Denmark: bioenergy

year, which can be added to traditional gasoline [42]. The main Danish facilities in the field of bio energy are: Otterup Bio Diesel Plant, which can produce around 80,000 tons annually [43]; Skive Fjernvarme biomass gasification with an installed capacity of 32 MWth [44]; Køge Vattenfall Biopillefabrik, which produces 150,000 tons of pellets annually [44]; and Sønderjysk Biogas Bevtøft biogas plant that produces about 21 million m³ of biogas annually [45].

Denmark is known to make efficient use of various types of waste. Despite the fact that in terms of the share of thermal energy production from waste relative to the total production, Denmark ranks much lower than Switzerland - around 21% and 62%, respectively (although ahead of almost all other countries); the share of electricity production from waste is around 6% - the highest figure in the world [18]. The leaders in the generation of electricity from municipal waste is Amager Bakke (Copenhagen) with an installed capacity of 81 tons per hour, 26.6 MW [46]; the Sønder Stenderup torrefication plant produces about 10,000 tons of high-energy pellets per year; and two BtL-FT plants, the largest of which at Aalborg, produces 24 tons of biofuel a year [47,48]. The main priority of Denmark's energy policy is to increase the share of renewable energy in electricity generation to 100% by 2050. The short-term energy strategy until 2020 included the following objectives: increasing the share of wind energy in electricity production to 50%; reducing total energy consumption by 7.6% in relation to 2010; and reducing greenhouse gas emissions by 34%, in relation to 1990. Since 2013, the country's new buildings are not allowed to use oil and gas for heating the premises, and in turn the use of renewable energy sources for electricity and heating is fully supported by the state. Such state initiatives include active subsidies, feed-in tariffs, tenders for the construction of new facilities, and modernization of old ones. Another priority of the country's energy policy is taxation. According to the "Green Tax Package", adopted in 1996, industrial enterprises could be reimbursed energy and CO₂ taxes if they made an agreement with the authorities on energy saving projects, as well as being able to apply for government subsidies and participate in projects for the development of renewable energy. From 2019 to 2020, consumption of bioethanol and biodiesel increased by 11.1%. In 2020, diesel oil (including biodiesel) accounted for 63.9% of total energy consumption for transport compared to 42.1% in 1990. Until 2020 electric car owners in Denmark were exempt from purchase tax and the annual owners' tax [49]. After the state abandoned tax incentives for electric vehicles, their sales fell by about 60% [50]. In June 2017, the governments of the leading offshore wind energy markets - Germany, Belgium and

Denmark, announced their intentions in their negotiations with the largest producers to increase the capacities of this energy sector to 4 GW per year by 2020. Winning bids of auctions in this field decreased by 48% compared to the price obtained in 2015 (and the target of €100/MWh planned for 2020 was reached in 2017) [51]. Notable in the field of biotechnology is Gemidan Ecogi A/S, which has developed a technology for processing source separated food wastes. In March 2017, the company received a contract for the construction of a waste treatment facility capable of processing 24,000 tons of waste per year [52]. In turn, Xergi, a Danish company specializing in the production of biogas, intends to build its largest plant, which will supply the Arla Foods milk powder production facility in Videbak in western Denmark with green energy [53]. In the town of Hobro, in northern Denmark, the HyBalance Power-to-Gas demonstration project, with a budget of €15 million, and co-managed by Hydrogenics, Air Liquide and a number of other companies, uses PEM electrolysis technology and innovative hydrogen delivery processes [54]. In August 2017, the Danish Aalborg CSP received an order for the construction of a solar power heating plant with a capacity of 8 MW, which will provide heating for more than 2.5 thousand inhabitants in the Copenhagen area [55]. The Danish city of Aarhus is to become the first city in the world to provide most of its citizens with fresh water using energy from wastewater. Marselisborg Wastewater Treatment Plant can generate enough electricity from wastewater to fuel the plant, and use the surplus for pumping drinking water throughout the city [56].



Waste incineration plant in Roskilde, Denmark

Education and Innovation

A set of indices reflecting the positioning of Denmark among other countries in the field of education and innovation is presented in Figure 9. As shown by the diagram, Denmark is a country with a very high level of intellectual culture indicators. According to the Global Innovation Index, Denmark is ranked 9th out of 132 countries in 2021



Sources:

1. The Global Innovation Index 2021, Rankings / Knowledge / World Intellectual Property Organization / Cornell University, INSEAD, and WIPO (2021): Energizing the World with Innovation. Ithaca, Fontainebleau, and Geneva *132
 2. Patent Grants 2011-2020, resident & abroad / Statistical country profiles / World Intellectual Property Organization *185
 3. Patents in Force 2020 / Statistical country profiles / World Intellectual Property Organization *109
 4. QS World University Rankings 2022 *97
 5. SCImago Country Rankings (1996-2020) / Country rankings / SCImago, (n.d.). SIR-SCImago Journal & Country Rank [Portal]. Retrieved 17 Nov 2021 *240
 6. Internet users in 2018 / The World Factbook / Central Intelligence Agency *229
 7. Internet users in 2018 (% Population) / The World Factbook / Central Intelligence Agency *229
 8. Government expenditure on education, total (% of GDP), 2019 / United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics. License: CCBY-4.0 / Data as of September 2021 *177
 9. Research and development expenditure (% of GDP), 2018 / UNESCO Institute for Statistics. License: CCBY-4.0 / Data *119
 10. Scientific and technical journal articles, 2018 / National Science Foundation, Science and Engineering Indicators. License: CCBY-4.0 / Data *197
- * Total number of countries participating in ranking

Figure 9. Indices of education and innovation in Denmark

(see diagram for links). According to the number of patents granted to Danish nationals, both domestically and abroad the country ranks 21st in the world. Similarly, by the number of valid patents, the country was 26th in the world, indicating the country's favorable conditions for innovation. In terms of government expenditure on education as a percentage of the country's GDP, the country demonstrates a result above the world average – 7th out of 177 countries selected for consideration. Five Danish universities are included in the QS University Rating. It should also be noted that the country's GDP is high, therefore, in absolute terms the costs of education and research are significant. In terms of the amount of government expenditure on research and development as a percentage of GDP, the country is 7th in the world, behind Sweden, and Finland in the region. Denmark ranks highly when considering the number of publications of specialists in scientific and technological journals and patent activities. Denmark placed 23rd out of 240 participating countries in the Scimago ranking, and in Scientific and Journal Activities is ranked 26th out of 196 countries. The country is also among the leaders in terms of its number of internet users. Danish universities, such as the Univer-

sity of Southern Denmark, the University of Copenhagen, the Technical University of Denmark, Aalborg University, and Aarhus University train specialists in various fields of energy Civil and Structural Engineering, Electrical Power Engineering, Environmental protection, Fuel Cells and Hydrogen Technology, Wind Power Systems, Oil and Gas Technology, Offshore Energy Systems, etc. In the field of synthetic fuel production inventions are actively patented by one of the world leaders in the field – Haldor Topsoe A/S, and Elsam Kraft A/S. Research and development in this field is carried out by Haldor Topsoe A/S and the Technical University of Denmark (DTU). Welltec A/S, Flsmidth A/S, SCF Technologies A/S are actively engaged in research in the field of extraction and processing of unconventional oil. The Technical University of Denmark (DTU) is the leading research institution in the field. The leading patent holders in the field of hydrocarbon production from reservoirs with low permeability are Welltec A/S, Novozymes A/S, Maersk Oil. Research and development in this field is carried out by Aarhus University and Maersk Oil. The leaders among Danish companies in the field of associated gas are Haldor Topsoe A/S, Maersk Oil and Haldor

Topsoe A/S; the Technical University of Denmark (DTU) is conducting research in this field.

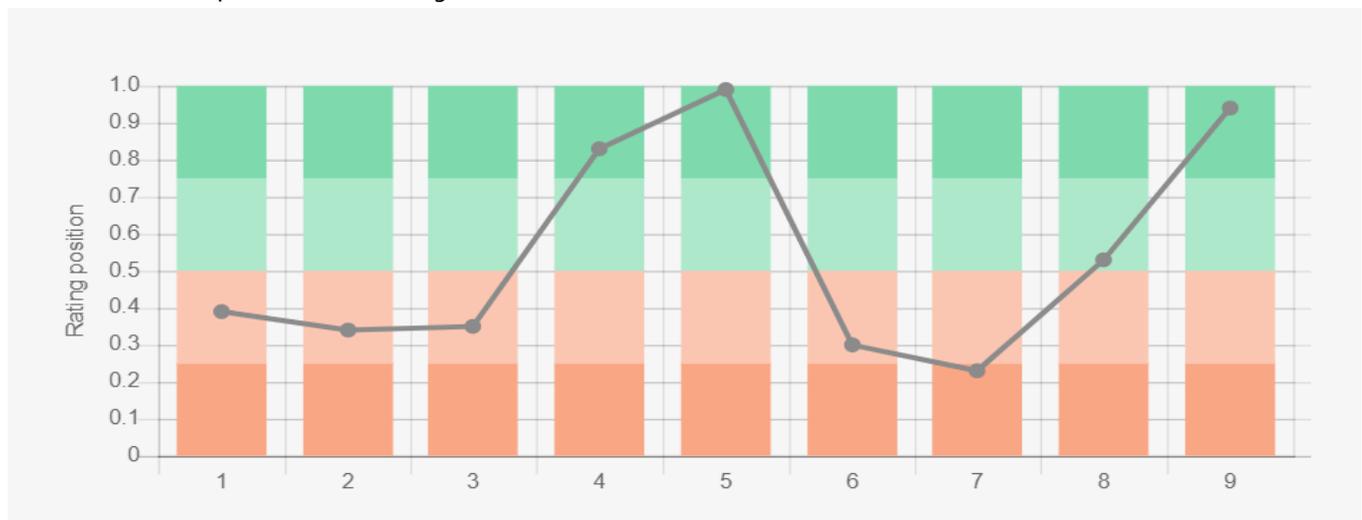
The leading patent holders in the field of bioenergy are Green Farm Energy A/S, the Technical University of Denmark, Steeper Energy Aps, Novoyzmes A/S, Haldor Topsoe A/S. Research and development in this field is being carried out by the Technical University of Denmark (DTU), the University of Copenhagen, and Aalborg University. A large number of Danish companies patent technical solutions in the field of energy production from renewable sources. In the field of solar energy are Alpha-E Aps, Innogie Aps, and Photosolar ApS. Leading research

organizations in this field are the Technical University of Denmark (DTU) and Aarhus University. Vestas Wind Systems A/S is one of the world leaders not only in the manufacturing of wind turbines, but also in patenting their technical solutions in the field of wind energy. Among other companies, we should mention LM Wind Power, LM WP Patent Holding A/S, Envision Energy (Denmark) APS, Siemens AG, MHI Vestas Offshore Wind A / S, and the research is being carried out by the Technical University of Denmark (DTU), Aalborg University, DONG Energy A/S and others.

Ecology and Environment Protection

A diagram of environmental indices shown in Figure 10, to some extent represents the ecological situation in the

country. In recent years, Denmark has done a lot to reduce emissions. Under the Paris Agreement, Denmark has pledged to reduce emissions by 70% from 1990 levels by 2030 and is aiming for climate neutrality by 2050. The



Sources:

1. CO2 total emission by countries 2020 / European Commission / Joint Research Centre (JRC) / Emission Database for Global Atmospheric Research (EDGAR)*208
 2. CO2 per capita emission 2020/European Commission/Joint Research Centre (JRC) / Emission Database for Global Atmospheric Research (EDGAR) *208
 3. Forest area 2020 (% of land area) / The Global Forest Resources Assessment 2020 / Food and Agriculture Organization of the United Nations *234
 4. Forest area change 2010-2020 (1000 ha/year) / The Global Forest Resources Assessment 2020 / Food and Agriculture Organization of the United Nations *234
 5. The Environmental Performance Index (EPI) 2020 / Rankings / Yale Center for Environmental Law & Policy / Yale University *180
 6. Annual freshwater withdrawals (m3 per capita), 2017 *179
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- * Total number of countries participating in ranking

country demonstrates a medium level of CO₂ emissions in general, and per capita, and occupies advanced positions in the renewable energy sector. Due to the fact that Denmark has a very active policy to reduce emissions, the country is the frontrunner in the list of 60 countries responsible for more than 90% of global CO₂ emissions related to energy in the Climate Change Performance Index (CCPI) 2022. In terms of forest area as a percentage of the country, Denmark is 153rd in the world, but nevertheless

demonstrates a positive trend in the forest area change – 39th in the world; the preservation of this bio resource is seemingly a priority for the Danish government. The situation is brightened by a high valuation of Denmark in the Environmental Performance Index rankings (EPI), which focuses primarily on assessing the environmental performance of national governments. Here, the country is in the first place.

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The sources of charts and curves are specified under the images.

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