

CONNECTING REALITY WITH CLIMATE GOALS: CASE STUDIES OF GAS DISTRIBUTION SYSTEM PLANNING AND REGULATION

Country Report Denmark

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Background and objectives

- Fossil gas consumption in the EU must decline rapidly to meet energy and climate targets, as well as in the context of energy security concerns, and gas price volatility.
- Declining gas demand will lead to higher grid fees for remaining customers as fewer people use the gas infrastructure, with potential high increases of grid fees.
- Proposals to replace fossil gas with hydrogen face technical and economic challenges, with hydrogen being less efficient and more expensive for heating compared to electrification and district heating.
- Continued investment in gas infrastructure without a decommissioning plan risks stranded assets, as the long lifespans of gas grids do not align with decreasing gas usage and climate targets.
- Regulations are beginning to address these issues, with some countries taking steps towards orderly gas grid decommissioning to manage costs and transition to alternative energy sources efficiently.
- In view of these challenges ahead, the objectives of this country sheet are to
 - provide an overview the status quo of gas consumption and gas distribution networks
 - Outline how regulations related to the gas grid embrace this challenge and identify gaps
 - Highlight opportunities for stakeholders to interact in the process

Summary of the country report for Denmark

- Denmark already has a comparable low share of gas in its energy mix, with the fuel accounting for only 12% of the country's final energy consumption.
- The gas grid is owned and operated by a single state-owned gas distribution system operator (DSO).
- Given that Denmark already relies significantly on district heating (74% of the dwellings), it is likely that the country will achieve its objective of gradually eliminating the use of gas in buildings by 2030.
- Denmark has actively promoted the use of district heating, heat pumps, and the production of biomethane. By 2030, all households will have been disconnected from the gas grid, and the remaining gas demand of the country will be met through the production of biomethane for domestic use. This will result in Denmark having a climate-neutral gas supply by that year.
- Concurrently, considerable obstacles remain to be overcome. It is imperative that network operators can disconnect households in areas where the economic viability of maintaining a gas network is no longer viable. This measure has the potential to reduce overall costs, thereby preventing the imposition of excessive increases in grid fees as the number of users declines.
- It is evident that there is potential for stakeholder involvement in two areas. Firstly, it should be noted that the regulatory authority is responsible for setting annual grid fees, thereby offering stakeholders the opportunity to exert influence through the submission of recommendations. Secondly, the Danish Energy Agency is responsible for the preparation of annual projections for gas demand and biomethane production. Similarly, stakeholders have the opportunity to exert influence through their recommendations and support.

Content and structure of the country report

1. **Development of Fossil Gas Consumption + Heating Market/Systems:** This chapter provides an overview of historical trends and current statistics regarding fossil gas usage and the evolution of heating systems.
2. **Distribution Network - Development and Current State:** This section discusses the infrastructure that supports the distribution of gas, including an assessment of its development over time and its condition today.
3. **Network Regulation, Costs vulnerable and low-income Energy Users:** Here, we analyze the regulatory framework governing the distribution network and detail the associated costs of maintaining and expanding this infrastructure.
4. **Current and Anticipated Role of Alternative Gases:** This chapter evaluates the expected role of alternative gases like biogas and hydrogen in transitioning away from fossil fuels, including current applications and future projections.
5. **Alignment with Climate Scenarios:** We explore how gas grid planning is aligned with national climate goals, examining scenarios that aim to reduce greenhouse gas emissions.
6. **Transparency of Information and Stakeholder Input:** The final section discusses transparency and highlights opportunities for stakeholder engagement.

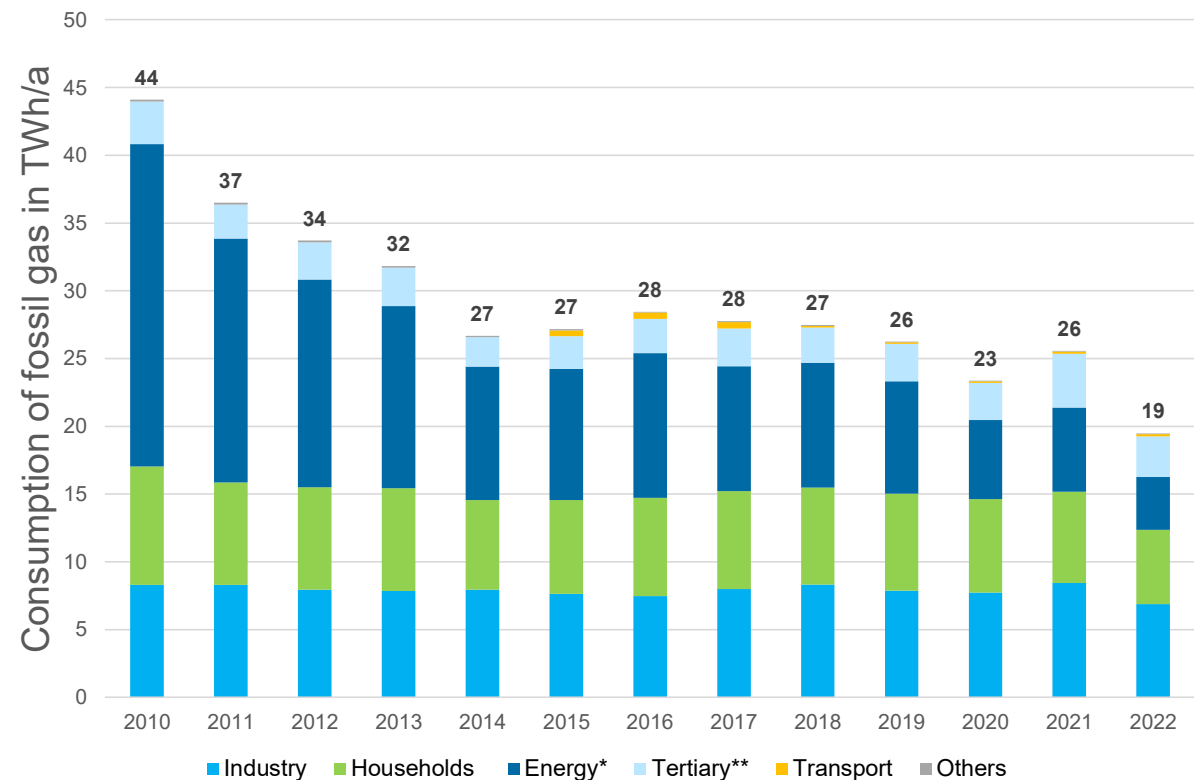
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Development of natural gas consumption – Eurostat Data

- The consumption of gas in Denmark decreased from approximately 44 TWh in 2010 to 26 TWh in 2021 and 19 TWh in 2022. Between 2014 and 2021, the consumption has remained relatively stable, ranging from 23 to 28 TWh per year.¹
- Gas plays a central role in industry, with consumption in this sector remaining constant over the last decade at around 8.5 TWh. For households, there has been a decrease from 8.7 TWh to 5.5 TWh between 2014 and 2022. Furthermore, gas consumption in the energy sector has decreased significantly, from 23.8 TWh in 2014 to 3.9 TWh in 2022.¹
- The year 2022 saw a decline in gas consumption because of the ongoing conflict in Ukraine.
- Gas accounted for 12.4% of final energy consumption in 2021 and for 9.3% in 2022.^{2, 3}

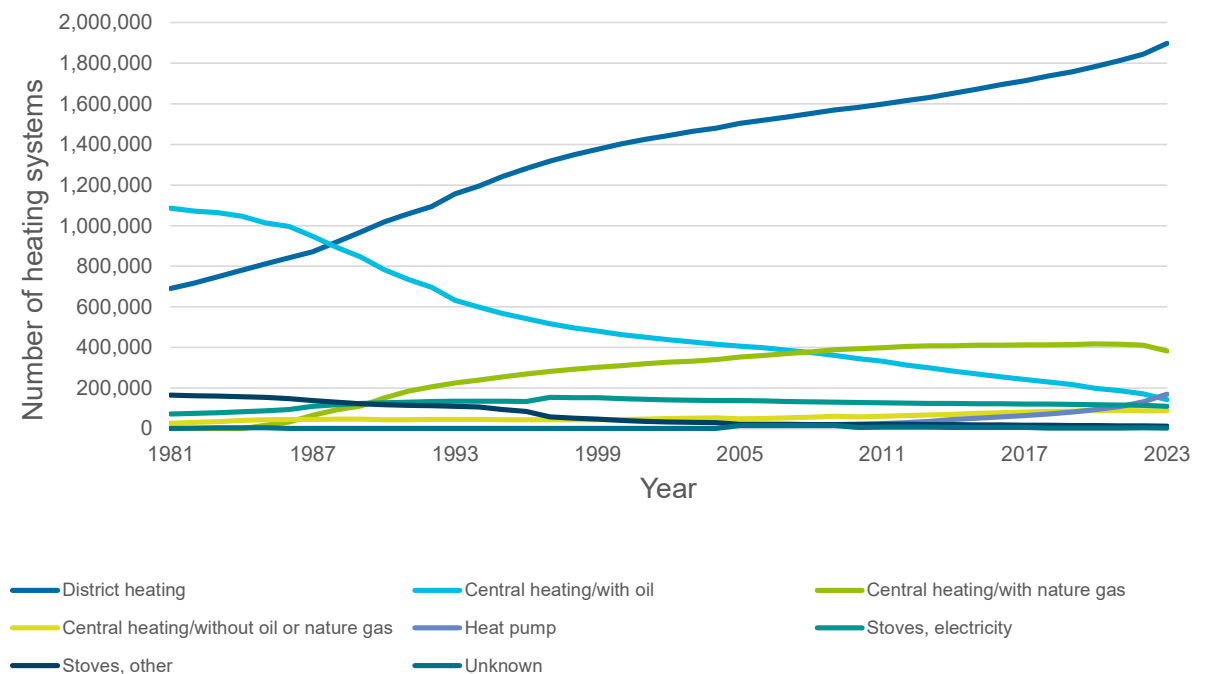
Natural gas consumption in Denmark by sector¹



Development of heating systems

- Over the past 40 years, the technologies employed in existing heating systems in Denmark have undergone a modest evolution. In 1981, oil boilers constituted the largest proportion of installed systems. However, since 1988, district heating has been the dominant technology, with this position remaining until the present day.¹
- The proportion of oil boilers and stoves has declined significantly, while the number of central heating systems using gas has increased from 1981 to 2023. In 2023, approximately 382 thousand such systems were installed, with a peak in 2022, when the number reached 411 thousand.¹
- The number of installed heat pumps has increased over time, reaching a total of approximately 170,000 installed systems in 2023.¹

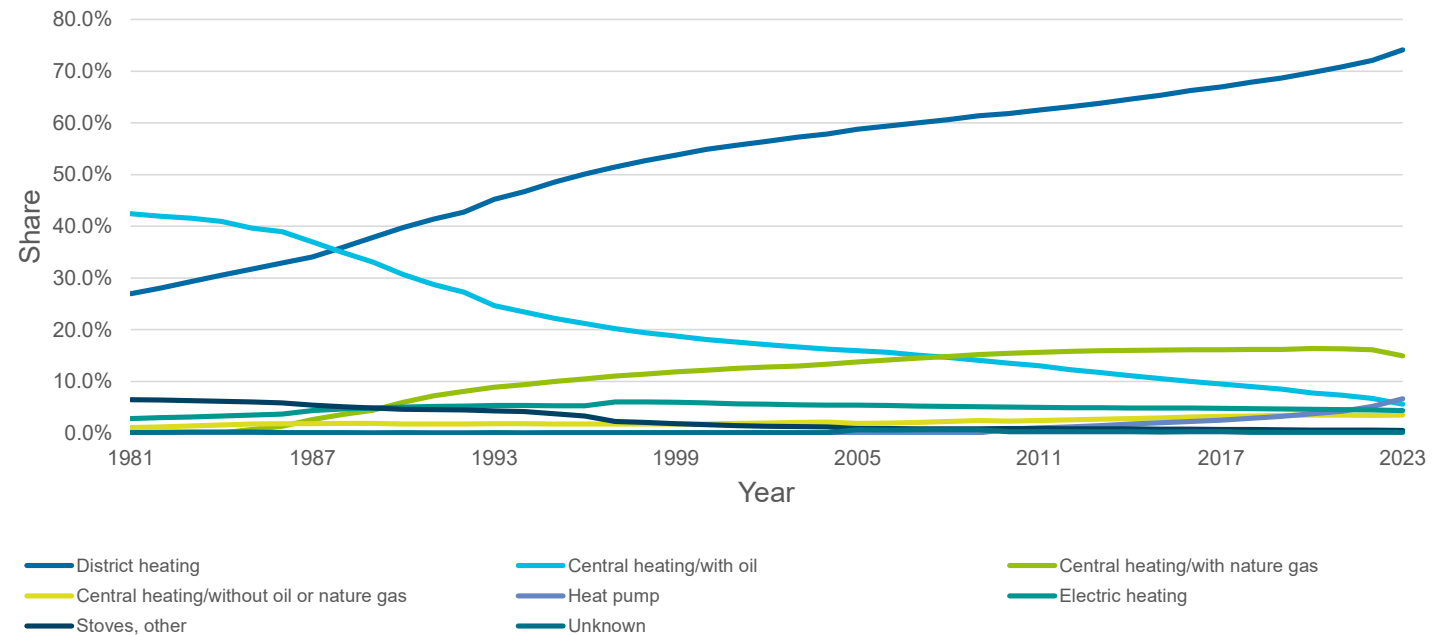
Number of heating systems installed in Danish dwellings by technology¹



Development of heating systems

- In terms of relative numbers, district heating now accounts for over 70% of the dwellings in Denmark for the heating system installed.¹
- The proportion of oil boilers in use has declined from over 40% in 1981 to approximately 5%. The current share of gas boilers is 15%, while heat pumps account for approximately 6.5%.¹

Share of heating technologies in the installed systems in Danish dwellings



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Map of the network operators (Status January 2023)

- The Danish gas transmission network is operated by the state-owned company Energinet. It comprises approximately 900 kilometres of pipelines and distributes natural gas from the North Sea throughout Denmark. It connects Denmark with Sweden and Germany and will soon also enable gas to be transported to Poland via the upcoming Baltic Pipe.²
- The Danish gas distribution network has a total length of 17,000 kilometers and supplies approximately 400,000 customers, including households, electricity and heating companies, and businesses. Originally, the network was designed to receive natural gas exclusively from the transmission network; however, today, local biogas plants also feed gas into the network.³
- In Denmark, the state-owned company Evida is also the sole network operator responsible for the distribution network. Consequently, Evida is accountable for the administration of all regional and local distribution networks, with the objective of ensuring the delivery of gas to individual consumers.^{2, 3}

Map of the Danish Gas network¹



Development of the future gas demand

- Dan Jørgensen, the Danish Minister for Climate and Energy, has announced that 50% of households currently using natural gas for heating are to switch to district heating by 2028. This initiative is designed to end the country's dependence on Russian gas. The remaining households are to be converted to electric heat pumps by 2030.¹
- Considering the global rise in energy prices and the impact of the Russian invasion of Ukraine, Danish residents have experienced a notable increase in their heating costs. The government has announced plans to provide one-off emergency assistance to those households that have been most adversely affected.¹
- Additionally, the government is allocating financial resources to assist households and building owners in disconnecting from the gas grid.²

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Gas grid regulation

- Network development: In Denmark, the responsibility for gas network planning is shared between the state-owned transmission network operator (TSO) Energinet and the state-owned distribution network operator (DSO) Evida. The planning process encompasses the operation and development of both the gas transmission network and the distribution network, with the objective of ensuring a secure and efficient supply of natural gas. For the network development Evida conducted a study to identify areas where parts of the gas network could be decommissioned in a feasible and cost-effective manner and developed a model for phasing out natural gas for residential heating. Evida would like to have the option of imposing a switch-off obligation on consumers within two years so that the connections can be used for the partial decommissioning of unprofitable parts of the grid. Additionally, Energinet's 2022 report on the long-term development needs of the Danish gas system highlights the need for improvements at the transmission level. These improvements are necessary to export biomethane and hydrogen and to transport biomethane from production areas to regions with high demand.^{1, 2}
- Network regulation: The Danish Natural Gas Supply Act is the primary regulatory instrument for ensuring an organised and efficient supply of natural gas in Denmark. The Act encompasses the transportation, distribution, supply, and storage of natural gas, including liquefied natural gas (LNG), biogas, and other suitable gases. Access to the gas system is contingent upon payment and must be objective, transparent, and non-discriminatory. The Executive Order on Gas Quality regulates the quality of gas. Furthermore, the regulations are subject to several EU regulations, including^{3, 4, 5}:
 - Regulation (EU) No. 715/2009 on conditions for access to the natural gas transmission networks,
 - Regulation (EU) No. 312/2014 on balancing of natural gas networks,
 - Regulation (EU) No. 703/2015 on interoperability and data exchange,
 - Regulation (EU) No. 2017/459 on capacity allocation procedures.
- The Danish Energy Regulatory Authority (DERA) is responsible for ensuring compliance with the regulations, with the aim of guaranteeing the efficient and transparent operation of the gas networks.

Gas grid regulation

- **Grid charges:** The charges for the gas grid in Denmark are set by Energinet and Evida and must be approved by the regulatory authority DERA. The charges are comprised of a number of distinct components, including the costs associated with the operation, maintenance, and investment of the network infrastructure, as well as the integration of renewable gases. The calculation of gas network charges is based on the authorised network costs, with the majority of the transmission system operator's (TSO) income derived from regulated tariffs. The tariffs for transport and emergency supply are established in advance for a gas year. In accordance with national legislation, the regulatory authority, the Danish Energy Authority (DERA), is responsible for approving the tariff methodology. The system operators are then tasked with determining the actual tariffs and submitting them to DERA for approval. At the present time, the tariffs are partially consumption-based; however, there are plans to introduce tariffs based primarily on capacity. Further modifications are anticipated to facilitate the adaptation of the regulatory framework to evolving market circumstances. These include the introduction of an income cap for the system operators, multi-year regulatory periods and network charges, a risk-adjusted return on capital and the macroeconomic optimisation of investments in electricity and gas networks.^{1, 2}
- **Depreciation:** The depreciation periods for gas infrastructure in Denmark are based on the applicable accounting standards and regulations. These standards determine the period of time for which the various components of the gas infrastructure, such as pipelines and compressor stations, can be depreciated. The typical depreciation period for gas pipelines and related assets is between 20 and 40 years, contingent on the specific type of asset and its anticipated useful life. The depreciation of pipelines is currently calculated on a straight-line basis over a period of 30 years.^{1, 2}

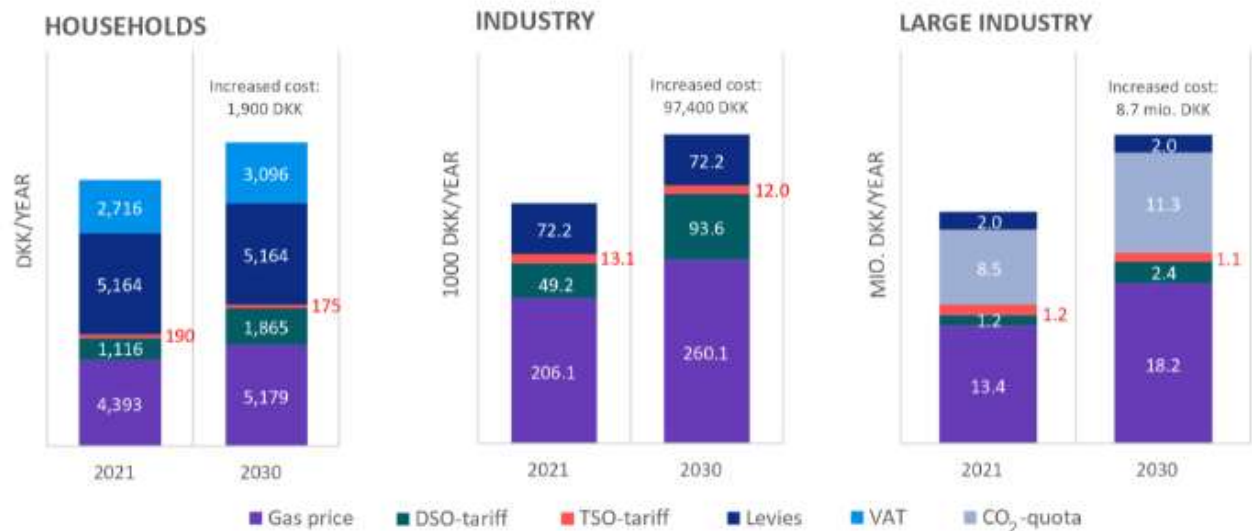
Gas grid charges

- Evida is proposing the introduction of a new tariff model, with the assumption that the regulatory authority will approve the proposal by 1 January 2025. The objective of this model is to reduce the costs associated with the gas network on a per-cubic-metre basis and to implement a fixed system tariff for each connection. At present, customers are required to pay a variable tariff per cubic metre of gas consumed, in addition to administrative fees and charges related to the installation and maintenance of gas meters. In the proposed new model, the bill will be divided into two components: a fixed portion, which will remain constant regardless of consumption, and a variable component, which will be calculated based on the cubic metres of gas consumed. The introduction of this new tariff model is intended to ensure the stability and efficiency of the gas system in the future. In the forthcoming years, there will be an increase in the amount of biogas fed into the grid, while the number of consumers will decrease. Many remaining users will continue to consume large quantities of gas. The new model ensures that all users of the gas network contribute to the costs incurred.¹

Possible future development of grid charges

- The forecast of total gas price costs indicates that the costs associated with the gas grid at the distribution grid level will increase between the years 2021 and 2030. This can probably be attributed to the reduction in the number of users. This is applicable to both domestic and industrial consumers. For households, the grid costs at the distribution level are projected to increase by approximately 67%.¹
- The costs of the transmission grid remain relatively constant or even decline slightly. The transmission grid continues to serve as a vital infrastructure for biogas producers and its utilisation, with an adequate number of customers to facilitate the distribution of gas and biogas between regions within the country and to enable exports.¹

Forecast future development of gas grid charges*¹



*It should be noted that the figure depicts a gas bill for 2021 and 2030 for three distinct consumer categories: households (annual gas consumption of 1,637 m³), small businesses (annual gas consumption of 112,500 m³), and large industry (annual gas consumption of 10 million m³). The gas bill is calculated in accordance with the tariffs set forth by Evida Nord. The overall gas prices are based on the Gas Price Guide and anticipated price developments for gas prices and emission allowance prices in the AF21 scenario of the Danish Energy Agency. Furthermore, the calculation assumes that there will be no change in levies.

Heat planning

- Since 1979, all Danish municipalities have been legally obliged to carry out heat planning in accordance with the 1979 Heat Supply Act, which was passed in response to the oil crises of the 1970s. This Act requires that heat planning encompasses both the distribution of natural gas and district heating, with the stipulation that these two systems may not coexist in the same areas. Furthermore, municipalities are permitted to impose mandatory connections to district heating.^{1, 2}
- Support framework: Technical support is provided by national and regional actors, including the Danish Energy Agency. However, there is a lack of continuous financial support for smaller municipalities.^{1, 2}
- EED-Recast and future requirements: Denmark is preparing for the recast of the Energy Efficiency Directive (EED), which will mainly complement the planning of cooling requirements. The aim is to better integrate planning for the heating, gas and electricity sectors.^{1, 2}

Gas boiler regulations

- In Denmark, a ban on the installation of fossil fuel and gas boilers in new buildings was implemented as early as 2013. This was achieved by updating the building regulation of 2010 (BR10).^{1, 2}
- Since then, Denmark has taken further steps to ensure the heating of buildings is environmentally friendly and sustainable. The current Danish building regulation of 2018 (BR18) introduced a general obligation for renewable heating connected to zoning regulations. In accordance with BR18, new and existing buildings situated within district heating (DH) areas are only permitted to be heated by DH or by renewable sources.¹
- In areas where a gas grid was established or officially approved prior to 2013, buildings may still be heated with natural gas, but not with fossil oil.¹
- In areas not encompassed by district heating and gas grids, it remains permissible to continue utilising fossil fuel boilers, provided that they have already been installed. However, new construction in these areas is required to adhere to the most recent sustainability standards, and therefore, must be heated using renewable energies.¹
- In addition, buildings with a fossil fuel heating system undergoing renovation or alteration work are required to integrate renewable energy into their heating system to the extent that it is technologically possible and financially viable. This stipulation ensures that even older buildings will gradually transition to more sustainable energy sources over time.¹

Addressing vulnerable energy consumers and broader social justice concerns

- In order to protect vulnerable energy consumers from the adverse effects of rising energy costs and network charges, a number of measures have been implemented. Furthermore, in response to the current crisis, efforts are being made to assist those consumers who have been most affected by the surge in energy prices due to the ongoing conflict in Ukraine. The overarching objective is to facilitate the transition of all approximately 400,000 homes currently connected to the gas grid to district heating or heat pumps by 2030.¹
- In Denmark, local authorities are empowered to mandate that buildings connect to the district heating supply. Once connected, buildings are typically required to remain connected to district heating systems for the duration of their operational lifespan. The objective of this policy is to optimise the efficiency and benefits of district heating infrastructure while maintaining low costs for all citizens across the country.²
- In August 2022, a series of one-time payments were enacted for disadvantaged households. These included financial support for pensioners receiving supplementary contributions, as well as a temporary deferral scheme for energy costs exceeding 2021 Q1 prices. Moreover, the employment allowance was augmented for the 2022/2023 income years, and a provisional increase in child and youth benefits was implemented in January 2023. Moreover, the government provided €13.3 million to municipalities for further distribution to low-income households.³

Addressing vulnerable energy consumers and broader social justice concerns

- The government's disconnection scheme provides financial assistance for the disconnection of gas pipes used for space heating in private residences. The scheme is applicable only to cancellations received by Evida when funds are available. Should the applicant meet the requisite criteria, disconnection will be carried out at no cost.¹
- In order to alleviate the energy crisis, Denmark increased subsidies for gas network disconnections by DKK 35 million (€4.7 million) in 2023 and expanded the district heating fund by DKK 150 million (€20.1 million) in 2022 and DKK 100 million (€13.4 million) in 2023. In addition, measures were implemented to enhance the supply of wood pellets, and grants for the transition to subscription heat pumps were augmented by DKK 10 million (€1.3 million) in 2022, extending to encompass pellet boilers as of December 2022.²
- Evida, the national gas distribution system operator in Denmark, conducted a study with the objective of identifying areas where the decommissioning of parts of the gas network would be feasible and economically beneficial. The study revealed that 28% of the subnetworks are not covering their costs, which could result in potential rate increases as customer numbers decline. Evida recommends that these subnetworks be given priority for decommissioning. Nevertheless, the current regulatory framework necessitates that gas customers must opt to transition to an alternative energy source on a voluntary basis. Evida's study emphasises the necessity for legal amendments to permit the utility to proactively decommission subnetworks, thereby ensuring that customers are duly informed and receive appropriate assistance.³
- Reasons why consumers are vulnerable:
 - Low Income: Households with limited financial resources struggle to afford high energy costs.
 - Energy Inefficiency: Older homes and inefficient heating systems result in higher energy consumption and costs.
 - The EU-Silc defines vulnerability as income below 60% of the national median income.⁴

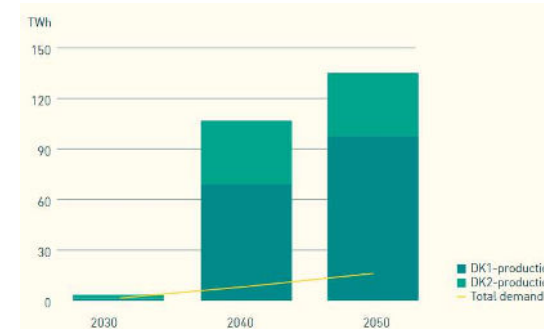
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Hydrogen

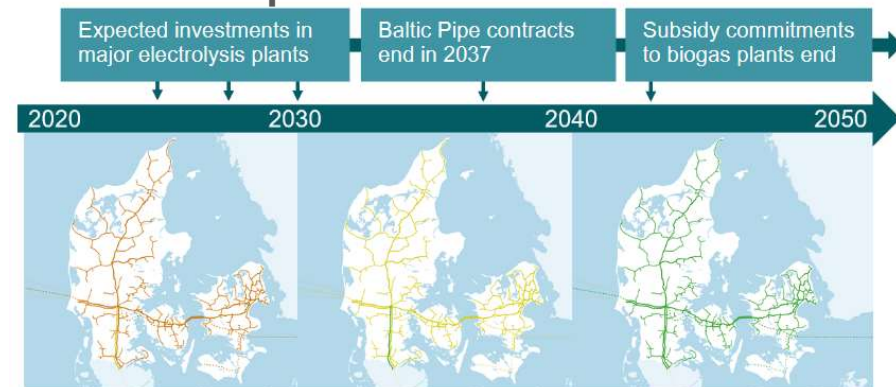
- The Danish government's plans for Power-to-X have the potential to establish Denmark as a global player in this field, as the country is set to become an exporter of hydrogen and other Power-to-X products.¹
- Around 7 GW of electrolysis projects are announced already for completion by 2030 in DK.¹
- The gas system will remain operational for at least 20 years, with the Baltic Pipe transporting gas to Poland until at least 2038. This will limit the potential for hydrogen conversion.¹
- The Danish government is establishing a framework for market-based hydrogen infrastructure. This will involve Energinet and Evida, which will be responsible for ownership and operation, including retrofitting existing methane pipelines. Gasunie and Energinet are planning a cross-border pipeline by 2028 to support hydrogen transport, which will be coordinated with national infrastructure plans in Denmark and Germany.^{2, 3, 4}

Projected Danish hydrogen demand and production*²



*DK1 = western part of DK;
DK2 = eastern part of DK

Overview of the Danish gas system and conversion possibilities over time**¹

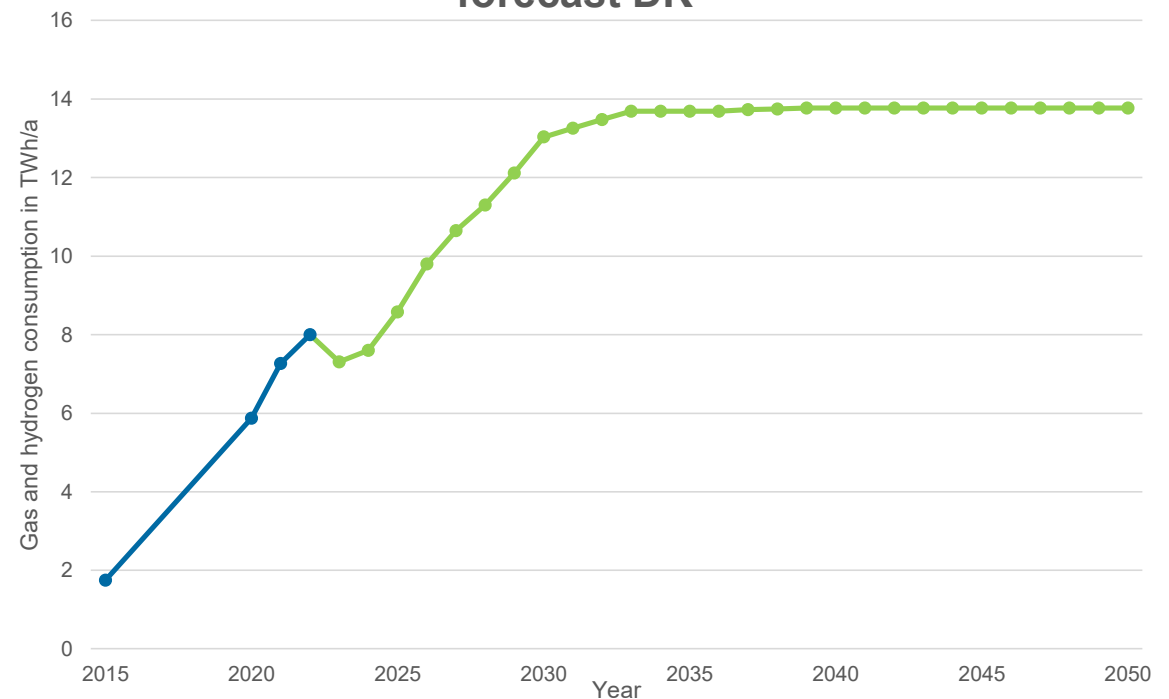


**Red: No possibility for conversion from gas to hydrogen, yellow: Some possibility for conversion, green: Good possibilities for conversion.

Biomethane

- Denmark has been promoting biogas production for several years. The Energy Agreement 2012 provided subsidies for upgraded biogas, which significantly increased production. Denmark promotes biogas through public subsidies for various uses, including electricity production, grid supply, industrial processes, transport fuel and heating. By the end of 2020, upgraded biogas accounted for 20% of the gas system, equivalent to around 4.5 TWh (16 PJ).¹ By the end of 2023, the share of biomethane had already reached approx. 38 % of gas consumption.^{2, 3}
- If there is an oversupply of biomethane in Denmark, meaning that the production exceeds the domestic demand for gas, the plan is to export the surplus to other countries, such as Poland, Sweden and Germany.⁴

Biomethane production – development and forecast DK*^{5, 6}



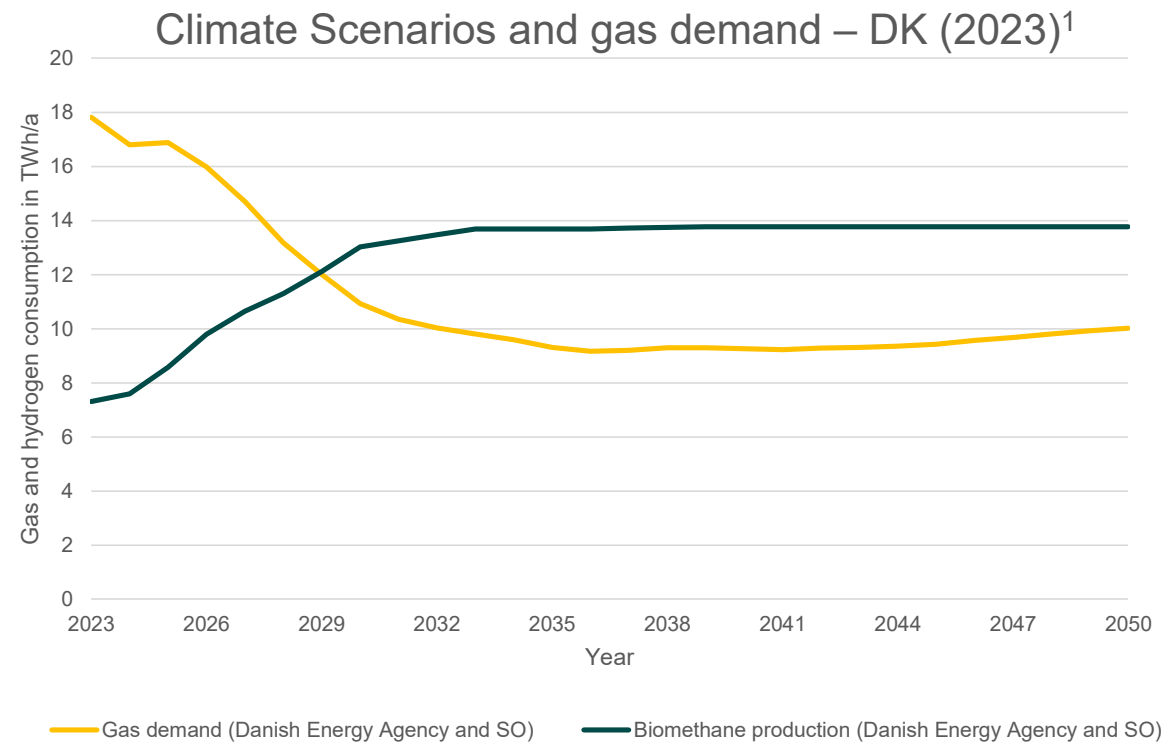
*The data presented in the figure represents the historical development of biomethane production, up until the year 2022. From the year 2023 onwards, the figure displays the forecast provided by the Danish Energy Agency.

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Climate Scenario and gas demand

- The scenario for the gas consumption is published annually, most recently in 2023 (illustrated in the accompanying figure).
- The projection is created and published by the Danish Energy Agency in accordance with the country's climate targets, with the grid operator Energinet utilising this information in its planning.
- The figure illustrates Denmark's intention to replace 100% of natural gas with biomethane by 2029. Furthermore, the country's gas demand is projected to decline from approximately 18 TWh to 10 TWh by 2050, representing a reduction of approximately 44.4%. Additionally, it is anticipated that biogas production will remain consistent at 14 TWh over the long term.



*Future gas demand in Denmark based on the Danish Energy Agency's annually updated scenario and the gas network operator's planning.

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Public information

- The two state-owned network operators, Energinet (TSO) and Evida (DSO), make public the gas prices and forecasts for the following year on their websites. Furthermore, they provide data on the current proportion of biomethane in the grid. In addition, the two state-owned network operators release reports on the long-term development needs of the Danish gas system and the future hydrogen network.^{1, 2, 3, 4}
- It is a legal obligation for gas network operators to publish a range of information. This encompasses the regular publication of metered consumption data, in addition to information pertaining to the quality and pressure conditions within the distribution system. Furthermore, any changes or notifications regarding suppliers and consumers, as well as the principles and methods of consumption billing, must also be publicly accessible.⁵
- Additionally, Evida has developed a model for the phasing out of natural gas for residential space heating and has published a report on the subject. The Danish Energy Agency and the Danish Ministry of Climate, Energy and Utilities will be granted direct access to the conversion model. Access for other stakeholders must be negotiated with Evida. Evida would like the option of imposing a switch-off obligation on consumers within two years so that the connections can be used for the partial decommissioning of unprofitable parts of the grid.⁶

Opportunities for stakeholder involvement

- The potential for stakeholder involvement is particularly apparent in two key areas: Firstly, the annual grid fees are determined by the regulatory authority. Stakeholders may exert their influence in this manner through recommendations. Secondly, the projections for gas demand and biomethane production are also prepared annually by the Danish Energy Agency. Similarly, stakeholders have the opportunity to actively exert influence through their recommendations and support.
- The planned and prepared phase-out of gas for buildings is set to occur by 2030. However, to implement this cost-effectively, it is necessary to create the possibility of disconnecting gas connections after notification. This would allow for the targeted shutdown of parts of the gas networks. The demand can be made at any time.
- Recommendations for Denmark:
 1. Enable targeted decommissioning of gas distribution networks by allowing gas connections in local network areas to be disconnected by Evida with prior notice
 2. Protecting vulnerable people from high energy costs through targeted decommissioning and prioritised support for this group of people to switch to heat pumps and district heating

List of sources

- Bygningsreglementet (BR18) (2018): Bygningsreglementet 2018 - Building regulations 2018. Available online at <https://bygningsreglementet.dk/Tekniske-bestemmelser/11/Krav>
- Danish Energy Agency (2010): Reporting obligation according to article 10(2) of directive no 2010/31/EU of the European Parliament and of the council of 19 May 2010 on the energy performance of buildings (Recast). Available online at https://energy.ec.europa.eu/document/download/b9191839-723c-40b8-8734-567ef9be017f_en?filename=dk_letter.pdf
- Danish Energy Agency (2015): Regulation and planning of district heating in Denmark. Available online at https://ens.dk/sites/ens.dk/files/contents/material/file/regulation_and_planning_of_district_heating_in_denmark.pdf
- Danish Energy Agency (2022): 2021 – Data, tables, statistics and maps – Energy in Denmark 2021. Available online at https://ens.dk/sites/ens.dk/files/Statistik/energy_in_denmark_2021.pdf
- Danish Energy Agency (2023a): Analysis assumptions for Energinet. Available online at <https://ens.dk/service/fremskrivninger-analyser-modeller/analyseforudsætninger-til-energinet>
- Danish Energy Agency (2023b): Energy statistics 2022. Available online at https://ens.dk/sites/ens.dk/files/Statistik/energistatistik_2022.pdf
- Danish Energy Agency (2023c): Natural Gas – The Danish Energy Agency is responsible for The Natural Gas Supply Act. Available online at <https://ens.dk/en/our-responsibilities/natural-gas>
- Danish Ministry of Climate, Energy and Utilities (2021a): Green Gas Strategy – The role of gas in the green transition. Available online at https://ens.dk/sites/ens.dk/files/Naturgas/groen_gasstrategi_en.pdf
- Danish Ministry of Climate, Energy and Utilities (2021b): The Government's strategy for Power-To-X. Available online at https://ens.dk/sites/ens.dk/files/ptx/strategy_ptx.pdf
- Danish Utility Regulator (2023): Rules for Gas Distribution. Evida. Available online at <https://evida.dk/media/1xshvsxi/regler-for-gasdistribution-version-51.pdf>
- Det Norske Veritas (DNV) (2022): Techno-Economic Analysis of a Danish Hydrogen Infrastructure. Evida. Available online at <https://evida.dk/media/an1dmo1k/dnv-report-energy-system-modelling-for-hydrogen-production-and-offtake.pdf>
- Directorate-General for Energy (2018): The role of trans-European gas infrastructure in the light of the 2050 decarbonisation targets. European Commission (EC). Available online at https://energy.ec.europa.eu/publications/role-trans-european-gas-infrastructure-light-2050-decarbonisation-targets_en
- Energinet (2022a): Danish Biomethane Experiences. Available online at <https://en.energinet.dk/media/bsijjbgd/danish-biomethane-experiences.pdf>
- Energinet (2022b): Long-term development needs in the Danish gas system. Available online at https://energinet.dk/media/qvfrfgd/lup22_behovsanalyse_gas_english.pdf
- Energinet (2023): General Terms and Conditions for Gas Transport - Version 23.0. Available online at https://en.energinet.dk/media/b03fk1th/general-terms-and-conditions-for-gas-transport-23-0_legally-binding-english-version.pdf
- Energinet (2024a): Biomethane – Share of Biomethane. Available online at <https://en.energinet.dk/gas/biomethane/>
- Energinet (2024b): Energinet - transmission system operator for electricity and natural gas in Denmark. Available online at <https://en.energinet.dk/about-us/organisation/>
- Energinet, Gasunie (2023): Hydrogen Market Assessment Report – For Denmark and Germany. Available online at <https://en.energinet.dk/media/pjqaedq/energinet-gasunie-rapport-2023.pdf>
- Energy Cities (2023): EU Tracker – Local heating and cooling plans in Denmark. Available online at <https://energy-cities.eu/countries/denmark/>
- Eurostat (2022): EU statistics on income and living conditions, Eurostat. Available online at <https://ec.europa.eu/eurostat/web/microdata/european-union-statistics-on-income-and-living-conditions>
- Eurostat (2023): Complete energy balances. DOI: 10.2908/nrg_bal_c. Available online at <https://ec.europa.eu/eurostat/databrowser/bookmark/64535145-5172-4804-b176-ba06dfe39e61?lang=en>

List of sources

- Evida (2023): Koverteringskortlægning - Evidas kortlægning af gasdistributionssystemet (Co-location mapping - Evida's gas distribution system mapping). Available online at <https://evida.dk/media/4w2b1xdx/evidas-kortl%C3%A6gning-af-gasdistributionssystemet.pdf>
- Evida (2024a): Afkoblingsordning - Afkobling uden gebyr (Decoupling scheme - Decoupling without fee). Available online at <https://evida.dk/frakobling/afkoblingsordning/>
- Evida (2024b): Evida - distribution system operator for natural gas in Denmark. Available online at <https://evida.dk/>
- Evida (2024c): Ny tarifmodel på vej (New tariff model on the way). Available online at <https://evida.dk/nytarifmodel/>
- Habibic, A. (2023): Energinet and Evida tasked with owning and operating Danish hydrogen infrastructure. Navigo, Team Offshore Energy. Available online at <https://www.offshore-energy.biz/energinet-and-evida-tasked-with-owning-and-operating-danish-hydrogen-infrastructure/>
- International Energy Agency (IEA) (2023): Energy system of Denmark. Available online at <https://www.iea.org/countries/denmark>
- Ministry of Climate, Energy and Utilities (2000): The Heat Supply Act. Available online at https://speed.energybrokers.co.uk/wp-content/uploads/2015/10/Danish_Heat_Law_2000EN1.pdf
- Puig Arnavat, M., Thaisen Fog, M., Sejbjerg, A. K., Stoholm, P., & Kiebach, W-R. (2020). Danish roadmap for a sustainable gas grid transition - status and potential role of thermal gasification. Technical University of Denmark. Available online at https://backend.orbit.dtu.dk/ws/files/240877731/Danish_roadmap_for_a_sustainable_gas_grid_transition_status_and_potential_role_of_thermal_gasification.pdf
- StatBank Denmark (2024): Dwellings by county, type of resident, type of dwelling, year of construction, heating, toiletfacilities, bathfacilities and kitchenfacilities. Statistics Denmark. Available online at <https://www.statbank.dk/20064>
- State of Green (2023): Green hydrogen is Danish hydrogen - How Denmark plans to speed up the fuel shift, and decarbonise global transport and energy-intensive industries. Available online at https://stateofgreen.com/en/wp-content/uploads/2023/11/soq_greenhydrogen_WP_08_DIGI.pdf
- Stöckler, M.; Harder, B.; Berman, D.; Hwan, T. Y. (2020): Biogas production – Insights and experiences from the Danish Biogas Sector. Food & Bio Cluster Denmark. Available online at <https://biogasclean.com/wp-content/uploads/2021/02/biogas-in-denmark-june-2020.pdf>
- Surwillo, I.; Slakaityte, V. (2023): Energy Without Russia: The Case of Denmark - The Consequences of the Ukraine War and the EU Sanctions on the Energy Sector in Europe. Friedrich-Ebert-Stiftung. ISBN 978-615-6289-69-8. Available online at <https://library.fes.de/pdf-files/bueros/budapest/20612.pdf>
- The Local (2022): Denmark announces major plan to replace gas heating in homes. Available online at <https://www.thelocal.dk/20220419/denmark-announces-major-plan-to-replace-gas-heating-in-homes>

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