

# The Transition of the Danish Gas System towards Net Zero and Self-Sufficiency

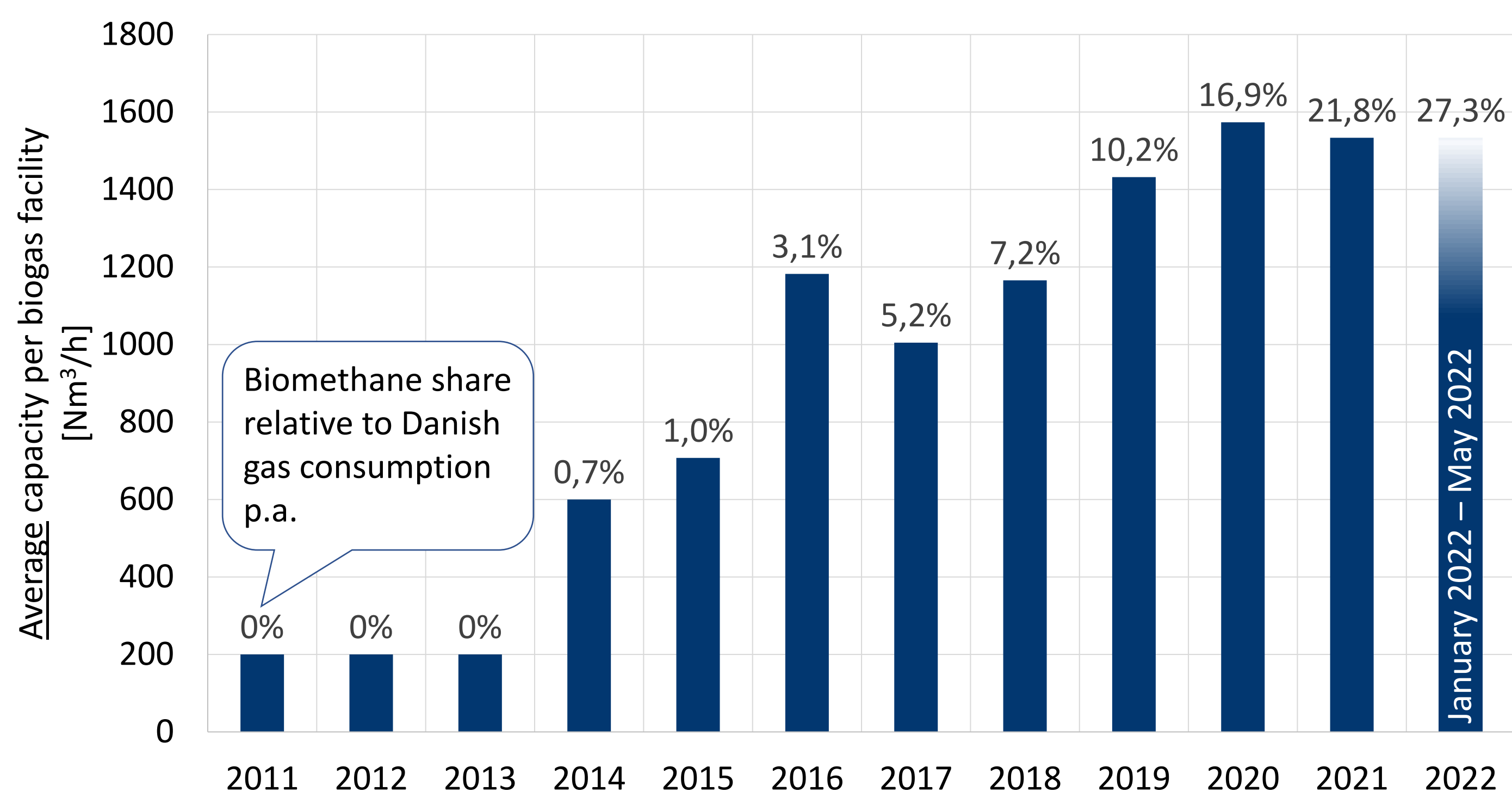
## Abstract

The Danish gas system is undergoing a transition from a centralised gas supply with hundreds of thousands of consumers towards a system supplied by several small renewable gas production sites and hundreds of consumers within the industrial and transportation sector. Already today, around 25 % of the gas consumed in Denmark is produced by biogas facilities. This number will grow over the next decade, and it is expected that the Danish gas system is CO<sub>2</sub> neutral by the mid 2030s. Besides biogas, other gasses and hydrogen are anticipated to contribute to this trend. An important role within this transition is the coupling of the electricity, gas and heat sectors to utilise most synergy effects, as electrolysers are intersecting all three sectors.

## Where Denmark is Today

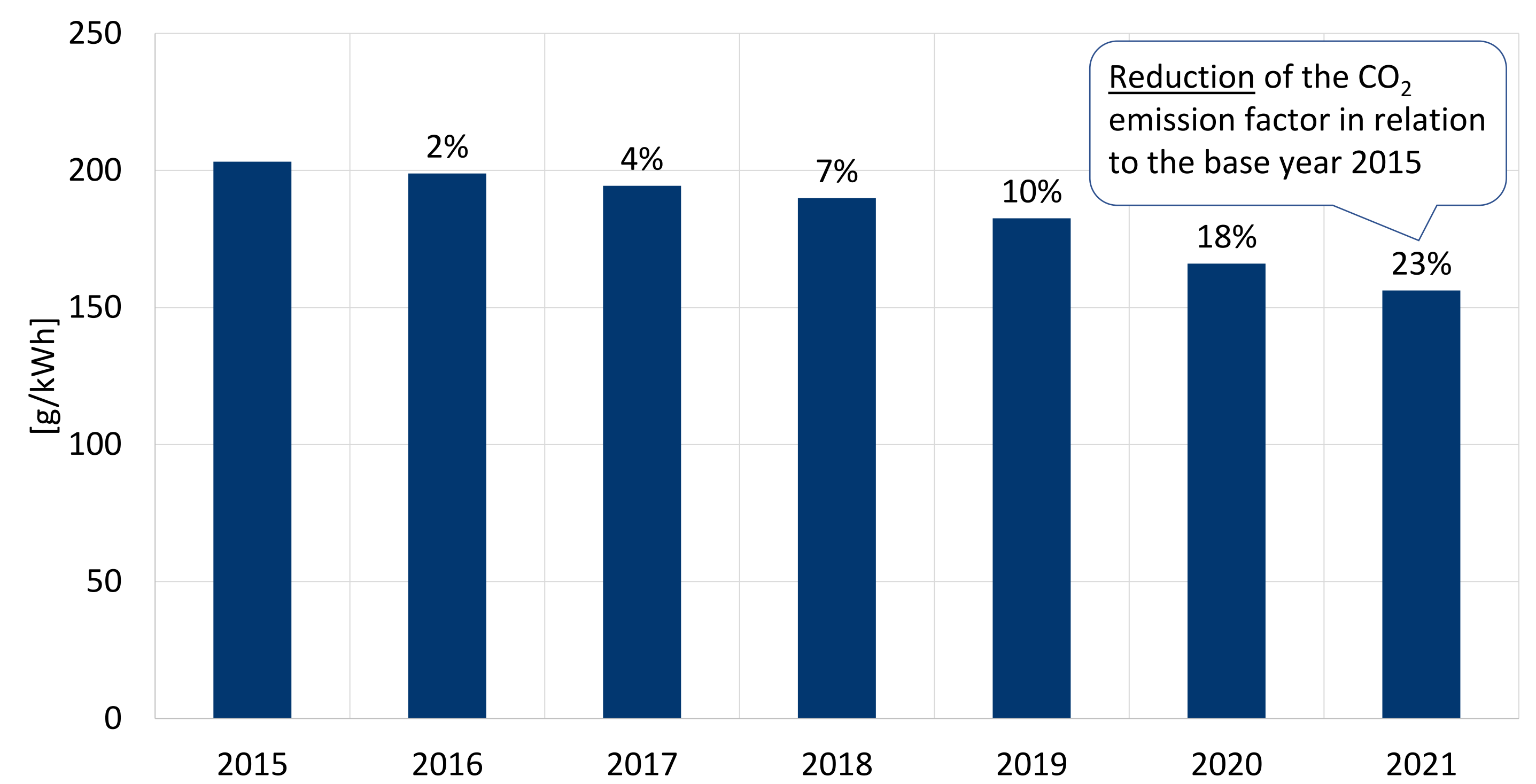
### The Development of Biogas in Denmark

The Danish government has supported the injection of upgraded biogas in the national gas grid since 2012. This led to 51 biogas plants at the end of 2021, injecting around 78.000 Nm<sup>3</sup>/h biogas. Source: (a)



### Annual CO<sub>2</sub> Emission Factor for the Gas Grid

The CO<sub>2</sub> emission factor of the gas from the gas grid decreases with the number of biogas plants injecting into the grid. By May 2022, 53 biogas facilities inject upgraded biogas into the Danish gas grid. Source: (b)



## The Plan for the Future

### The Future Support Scheme for Biogas

- In future, interested parties are to compete with their bids for funding.
- This support scheme will also apply to other green gasses.
- This support scheme is supposed to incentivise gas producers to align their production according to the demand (summer/winter).

### The Energy Islands

- The Danish parliament has agreed to establish two energy islands in the North Sea and the Baltic Sea.
- The islands will have connections to neighbouring countries.
- The artificial island in the North Sea will collect 3 GW of offshore wind power at its construction and will aim for 10 GW in the long term.
- The energy island in the Baltic Sea will at first have a capacity of 2 GW.
- An offshore production of hydrogen on those islands is planned.

### Methanation of Biogenic CO<sub>2</sub> and Hydrogen

- Electrolysers are intersection in the sector coupling: They produce with hydrogen the feedstock for P2X, balance the future electricity network fed by variable electricity production, and their excess heat can be used in the Danish district heating network.
- The large amount of biogenic CO<sub>2</sub> from biogas plants can serve as a carbon stock for synthetic methane or other renewable hydrocarbons.
- Based on today's biogenic CO<sub>2</sub> potential in Denmark, 0,6 GW of hydrogen could be methanised, this trend tending upwards.
- The first catalytical and biological ex-situ methanation plant has been tested on a small scale.
- A bigger biological plant is about to be constructed and will inject methanised hydrogen into the gas distribution network.

### Export of Renewable Gasses

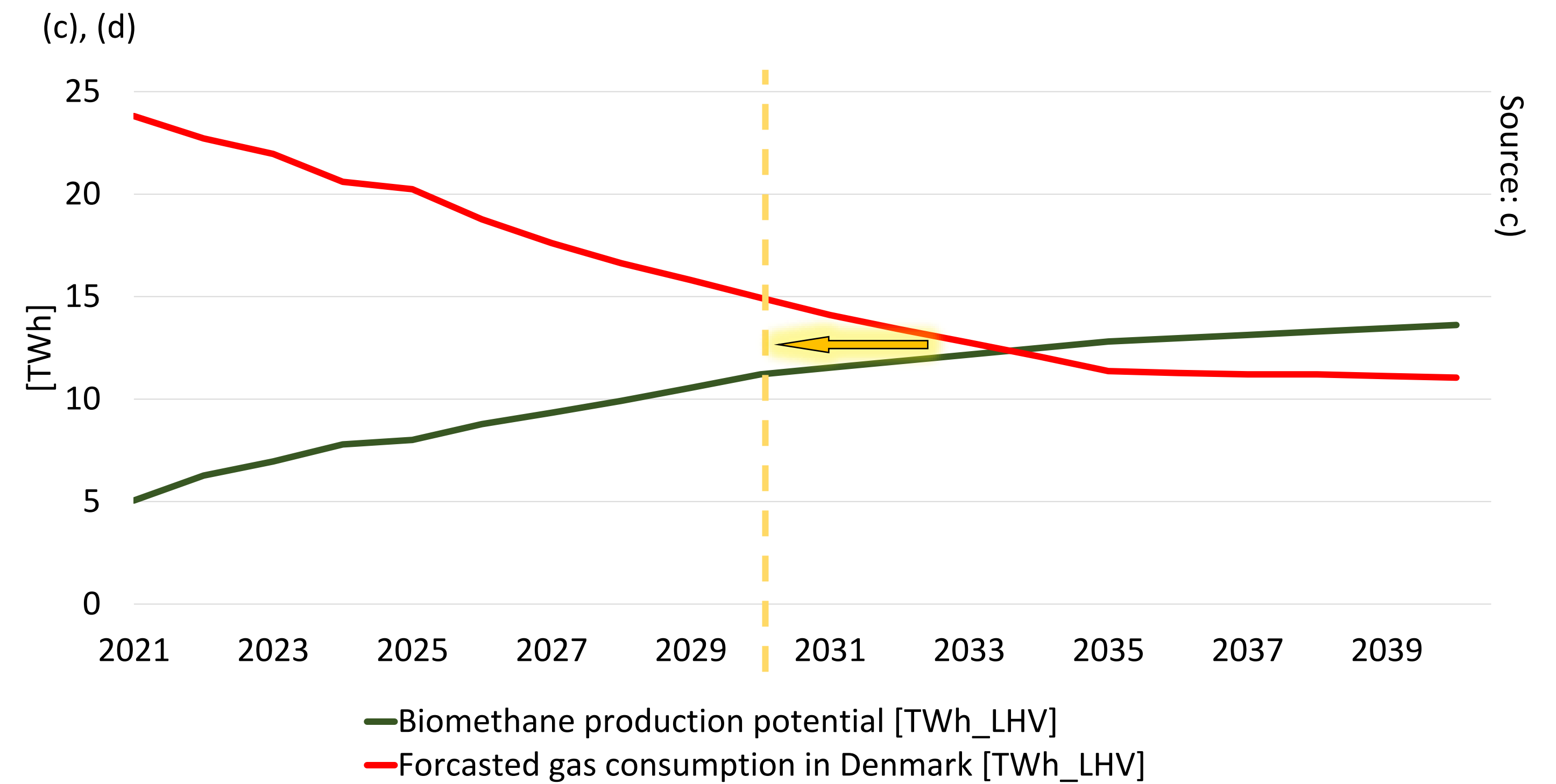
- Denmark plans to become a net exporter of green gasses like green hydrogen.
- This is made possible by the vast offshore wind potential in Denmark.
- Investigations for pipeline transport of hydrogen to Germany have already started. This includes potentially the retrofitting of one pipe to Germany.

## References

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### The Danish Gas System in Transition

- The Danish gas system in transition: From centralised gas exploration in the North Sea towards decentralised gas production in biogas plants and other green gas production sites.
- Further biogas production facilities are in the construction phase or are planned.
- At the same time, the largest customer group in numbers (private households) that accounts for approx. 25 % of the overall gas consumption will be disconnected from the gas grid in the coming years.
- The future green gas consumers will be the industry that cannot be electrified and the transportation sector.
- The Russian invasion was incentive for an acceleration of this development.
- In view of the war in Ukraine, the Danish government aims for a 100 % green gas grid, in 2030 at the latest.



### Danish Hydrogen Projects

