



ENERGINET
Systemansvar



DANISH BIOMETHANE EXPERIENCES

From 0-100 % in 5 steps

100 % BIOMETHANE BEFORE 2030

In Denmark, biomethane plays an essential role in the green transition of the gas system and for security of supply.

In 2022 the biomethane production is expected to make up 30 % of the total gas consumption, and the Danish Government aims for a 100 % green gas coverage already in 2030 – a target which might very well be achieved even before.

The current record for biomethane coverage of the total Danish gas consumption measured over 24 hours is 98,2 %.



REPOWER EU (WITH BIOMETHANE)

In the REPowerEU Plan to reduce dependence on Russian fossil fuels, the European Commission has set out a target to increase the current European biomethane production from 3 bcm (2020) up to 35 bcm by 2030. This represents more than 10x increase.

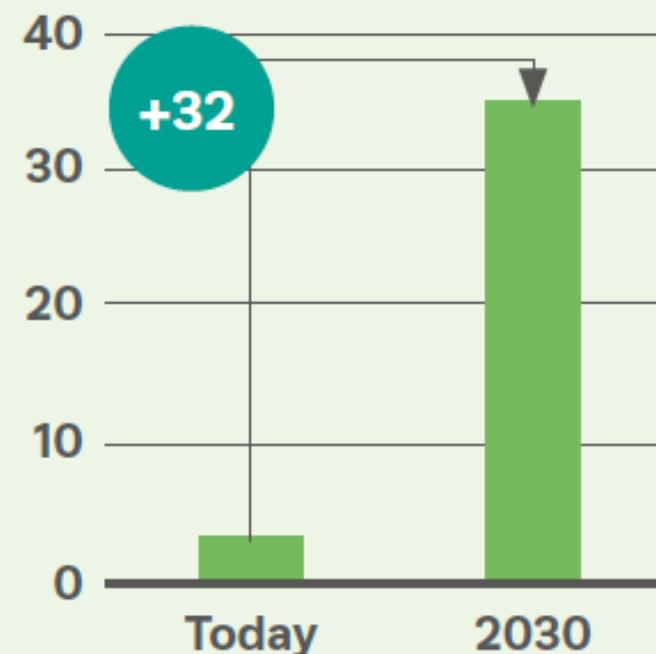
35 bcm represents 20-25 % of the European gas imports from Russia (pre Ukraine) and just under 10 % of all gas consumed in the EU.

By 2050, 30-40 % of Europe's total gas consumption can be covered by sustainable biomethane.

Facts and figures are from the European Biogas Association

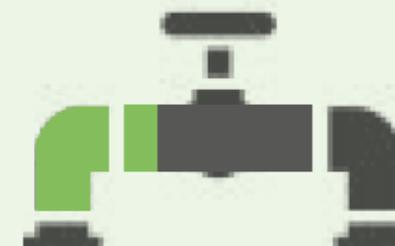
Dok. 22/04670-5 Offentlig/Public

From 3 bcm biomethane production today to 35 bcm EU-27



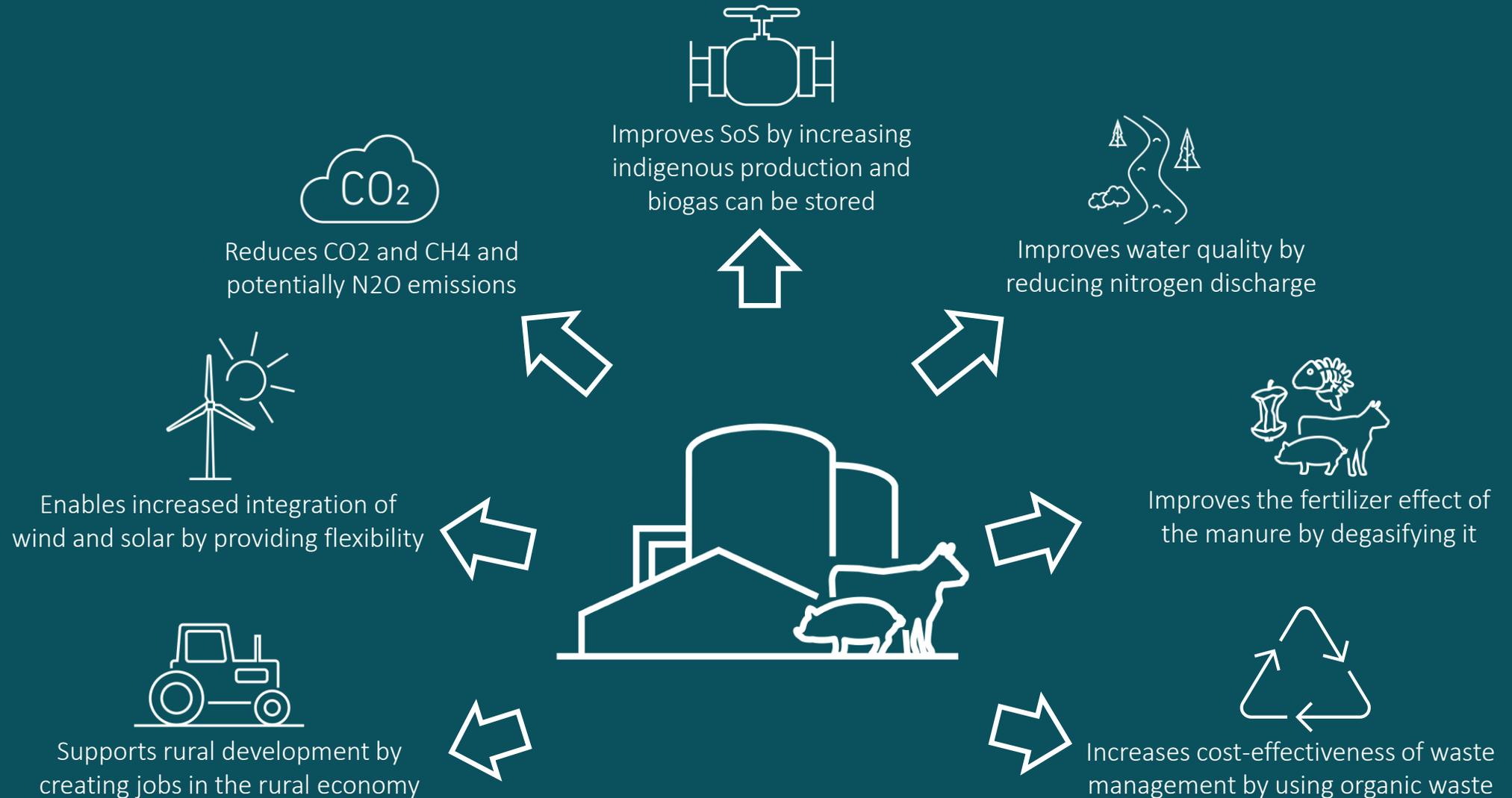
Urgent need to diversify supply and reduce dependence on external gas providers

35 bcm represent 20% of current gas imports from Russia today



21.09.2022

BIOMETHANE IS A 'SWISS ARMY KNIFE' CONTAINING SEVERAL ADVANTAGES



THE DANISH BIOMETHANE DEVELOPMENT - 5 STEPS



THE DANISH BIOMETHANE DEVELOPMENT - 5 STEPS

The Danish biomethane development can be divided into 5 steps, based on milestones in the gas infrastructure development, which have enabled the penetration of biomethane over increasingly larger and contiguous areas; Step 1 "Local", Step 2 "Upgraded", Step 3 "Transmission", Step 4 "Interconnected" and 5 "Continental".

Below you will find a condensed description of the actions taken and developments made for each step, structured according to 6 parameters, which have been essential for the Danish biomethane development: Infrastructure, market, green value, regulation, subsidy scheme and operating economy.

We have not yet taken all 5 steps in Denmark. Currently, we are on step 4 where further action is needed before progressing to the next step. It means that the actions and developments described in step 4 and 5, which we have not yet been through, are not actual experiences but rather potentials for further development, which can contribute to achieving 100 % biomethane coverage.



STEP 5 "CONTINENTAL" (FUTURE VISION)

- Connection between regional transmission networks via transmission pipelines and LBG-shipping.
- Continental GO standard and scheme.
- Continental green value exchange.
- Claiming the green value where the gas is used.
- Subsidizing biomethane is not longer necessary in certain countries.
- Scarcity of land area and large dependence on the agricultural sector.

STEP 4 "INTERCONNECTED"

- Cross-border flows of biomethane.
- Updating the quality standard for cross-border gas flows to allow for unhindered cross-border flow of biomethane.
- National green value exchange.
- Subsidies granted through technology neutral public tenders.
- Bilateral agreements on cross border trade of certificates.

STEP 3 "TRANSMISSION"

- Reverse flow from DSO to TSO network.
- Cut-off date for existing subsidy scheme.
- Coherence with "surrounding" legislation.
- Need for finding new feedstock sources.
- Demand pull - certificates and sustainability schemes enables use in fuel quota regulation – e.g ETS and biofuel quota..

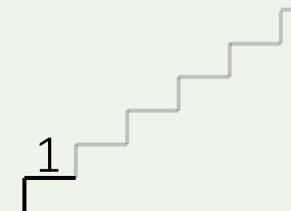
STEP 2 "UPGRADED"

- Upgrading plants connected to distribution network, as biogas is upgraded to biomethane.
- Inclusion of biomethane in natural gas market model.
- Establishment of a national certificate register.
- 'Right to inject' policy.
- Subsidizing all uses of biogas.
- Transparent cost sharing framework maximizing injection.

STEP 1 "LOCAL"

- Direct connection between production and consumption at a very small scale
- Subsidizing use of biogas in CHP generation
- Wet waste and residue resource from large agricultural sector used as feedstock. Considered a resource and not waste.

STEP 1 "LOCAL"



Infrastructure

- Direct pipeline between biogas plant and CHP plant.



Market

- No biogas market, but long-term contracts (10-15 years) between individual producers and consumers that reduce risk.



Green value

- No regulated documentation of green value.



Regulation

- Political stability around support schemes.
- Subsidies must adhere to the European Commission's guidelines for state aid.



Subsidy scheme

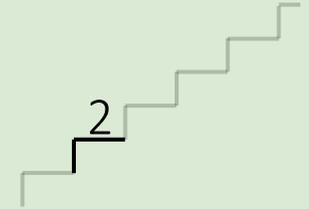
- Subsidizing use of biogas in CHP generation, as it was considered the most valuable utilization of biogas.



Operating economy

- Small production plants.
- Existing large "wet" waste and residue resource as a byproduct from an existing large agricultural sector (livestock and food production) used as feedstock. Considered a resource and not waste.
- State aid is the main driver behind the increasing biomethane production.

STEP 2 "UPGRADED"



Infrastructure

- Pipeline connecting upgrading plant to distribution network, as biogas is upgraded to biomethane.
- Introduction of 0,5 % oxygen content acceptance level to ensure a cost-effective integration of large amounts of biomethane.



Market

- Inclusion of biomethane in the natural gas market model. However, few volumes traded on short term exchange as there are still many long-term contracts between single producers and consumers.
- Biomethane producers have access to sell their upgraded biomethane on the European gas market and receive the gas market price.



Green value

- Establishment of a guarantee of origin certificate scheme enabling gas suppliers to sell renewable gas to consumers.
- Sustainability schemes ("voluntary scheme") verifying compliance with the sustainability criteria for biofuels set in the EU's Renewable Energy Directive.
- Simple monthly, manual procedure; certificate registry; internal revision.
- Negotiated price for the green value - i.e., no market clearing price.



Regulation

- 'Right to inject' policy. Upgrading plants have the right to be connected and inject into the gas grid. Standardized terms of connection.
- Political target to utilize 50 % of the manure in Denmark for green energy production in order to strengthen the agricultural sector's role as a supplier of green energy.
- EU mandatory minimum target (Renewable Energy Directive) for the share of biofuels in transport petrol and diesel consumption.



Subsidy scheme

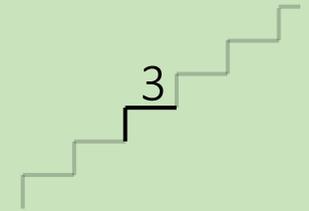
- Subsidizing all uses of biogas; Biogas used in 1) CHP generation, 2) industrial heat, 3) as a vehicle fuel in transportation, 4) and biogas upgraded to biomethane and injected into the natural gas network.
- Subsidy components: 1) basic subsidy amount (provides certainty), 2) subsidy amount adjusted in proportion to the natural gas price (the government takes the risk), 3) additional 'early bird' subsidy amount (incentive to get started quickly).



Operating economy

- Transparent cost sharing framework maximizing injection. Upgrading plants finance the cost related to upgrading the biomethane to biomethane + the cost related to connecting the upgrading facility to the gas network. DSOs and TSO finance all necessary investments in grid reinforcement (grid expansion, compression, reverse flow capacity) over the tariff.
- Larger production plants.

STEP 3 "TRANSMISSION"



Infrastructure

- Construction of reverse flow capacity from distribution to transmission network as supply of biomethane exceeds demand in distribution area on a more permanent basis.
- Sophisticated network planning incl. socio-economic analyses carried out by the system operator in close cooperation with the DSO's. A close TSO-DSO cooperation is essential – especially when the reverse flow capacity increases. Furthermore, the TSO must show willingness to handle difficulties and not see biomethane as a competitor to its natural gas investments.
- Growing concerns for sensitive consumers (related to gas quality).



Market

- *No developments.*



Green value

- Regional cooperation between national GO registers to ensure credibility, and possibility for starting cross-border trades. Development from manual to automated cooperation. NRA guidelines for accepting GO's issued in other countries.



Regulation

- Revision of "surrounding" legislation not primarily concerned with biogas to ensure coherence and make sure biogas production and use is promoted and incentivized effectively.



Subsidy scheme

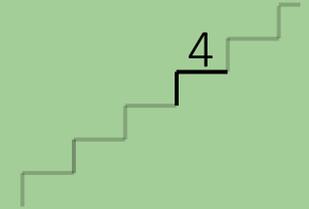
- Phase-out of the existing subsidy regime by introducing a cut-off date. New plants put into operation after that date will not be eligible for subsidies. Existing plants are still eligible for subsidies after the cut-off date.



Operating economy

- Expected gradual cost reduction (value chain; collecting feedstock, transport logistics, distribution, transmission).
- It becomes challenging to find suitable biomass to supplement the manure as the biomethane production capacity increases. Therefore, there is a need for finding new feedstock sources and maximizing the gas yield per ton processed biomass to ensure a sufficient biomass supply for the growing production. R&D efforts widens.
- Since a green value exchange has not been established, the gas market actors are dependent on their connections to the upgrading plants from whom they can buy GO's and certified sustainable gas.

STEP 4 "INTERCONNECTED"



Infrastructure

- Cross-border flows of biomethane.
- Update the quality standard for cross-border gas flows to make sure they are fit for purpose for a cost-effective green transition of the gas system. This includes increasing the oxygen content acceptance level to ensure free cross-border trade and flow of biomethane.
- Conduct risk assessment analyses when building new (expensive) infrastructure such as reverse flow capacity, considering e.g. the scenario that the biomethane will be transported via alternative means of transportation than pipelines in the future.



Market

- *No developments.*



Green value

- Establishment of a regional GO register and a regional GO scheme for documenting the green value of the biomethane. Start of ERGAR.
- National exchange for trading the green value of biomethane in the form of GO's. Thereby, setting a national market clearing price for the green value.
- Start on utilization/trade of the Carbon Dioxide (CO₂) from the biogas.



Regulation

- Increased incentives for the agricultural sector to degasify their manure in biogas production to reduce GHG emissions. E.g. by introducing a manure tax.



Subsidy scheme

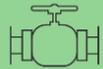
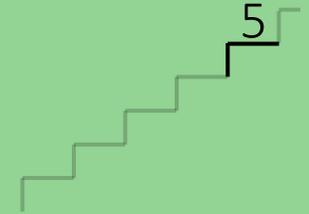
- Subsidies granted through technology neutral (across green gases) public tenders seeking to maximize CO₂ reductions.
- No longer be subsidizing CHP. It's an expensive way of generating heat and it doesn't provide system flexibility.
- Regional supervision and harmonization of national subsidy schemes to avoid 'double subsidizing'.



Operating economy

- Large untapped feedstock potential sustains significant increase in biomethane production.
- Unsubsidized biomethane has a higher value than subsidized biomethane, especially in the transport sector. GO's are used for documentation.
- Value stacking enables reduction of subsidies. The increased green value and gas market price and production optimization and value chain streamlining are to a large extent drivers behind the growing biomethane production.
- Possible introduction of a tax relief for biomethane consumers to make it price competitive (compared to natural gas).

STEP 5 "CONTINENTAL" (NEXT STEP / FUTURE VISION)



Infrastructure

- Connection between regional transmission networks via transmission pipelines and LBG-shipping. Geographically the feedstock potential is unevenly distributed meanwhile the demand is more evenly distributed.
- Import to the EU from neighboring regions (e.g. from Eastern Europe) via pipelines or ships.



Market

- The biomethane price is set on continental gas markets.



Green value

- Establishment of a continental GO standard and GO scheme for documenting the green value of the biomethane.
- Continental/global exchange for trading the green value of biomethane in the form of GO's. Thereby, setting a continental/global market clearing price for the green value.
- CO2 can be used to methanise Hydrogen (H2).



Regulation

- The green value is counted where the gas is used and not where it is produced (and subsidized). Avoiding greenwashing is necessary. Continental political agreement necessary.



Subsidy scheme

- Subsidizing biomethane is not longer necessary in certain countries. Requires that all possibilities and components of biogas be utilized. Or subsidies is given for wider energy mixture (wind, sun, gasses, etc.)
- Continental supervision and harmonization of national subsidy schemes to avoid 'double subsidizing'.



Operating economy

- Scarcity of land area is a potential barrier for increased biomethane production.
- Vulnerability: Lacking diversification of risk when up to 100 % biomethane coverage of the total gas consumption creates a large dependence on the agricultural sector and its continued operation.
- From partial to holistic cost-benefit and sustainability analysis covering the whole value chain incl. environmental life-cycle assessments.

TAKEAWAY POINTS

- ✓ Subsidies are necessary to ramp up biomethane production.
- ✓ Byproducts from the agricultural sector such as manure are considered a resource and not waste.
- ✓ A close TSO-DSO cooperation is essential.
- ✓ Gas quality standards must accommodate biomethane injection.
- ✓ Documenting the green value of biomethane via a credible certificate scheme is critical.
- ✓ Leadership from industrial gas-users on promoting biomethane – arguing for the needed regulatory/legislative development.
- ☐ Promoting the use of biogas in end-use sectors where it maximizes its socioeconomic value – e.g. in the transportation sector – could have accelerated the biomethane ramp-up even further.





THE DANISH GAS SYSTEM

Past, present and future

THE GAS SYSTEM IS CHANGING

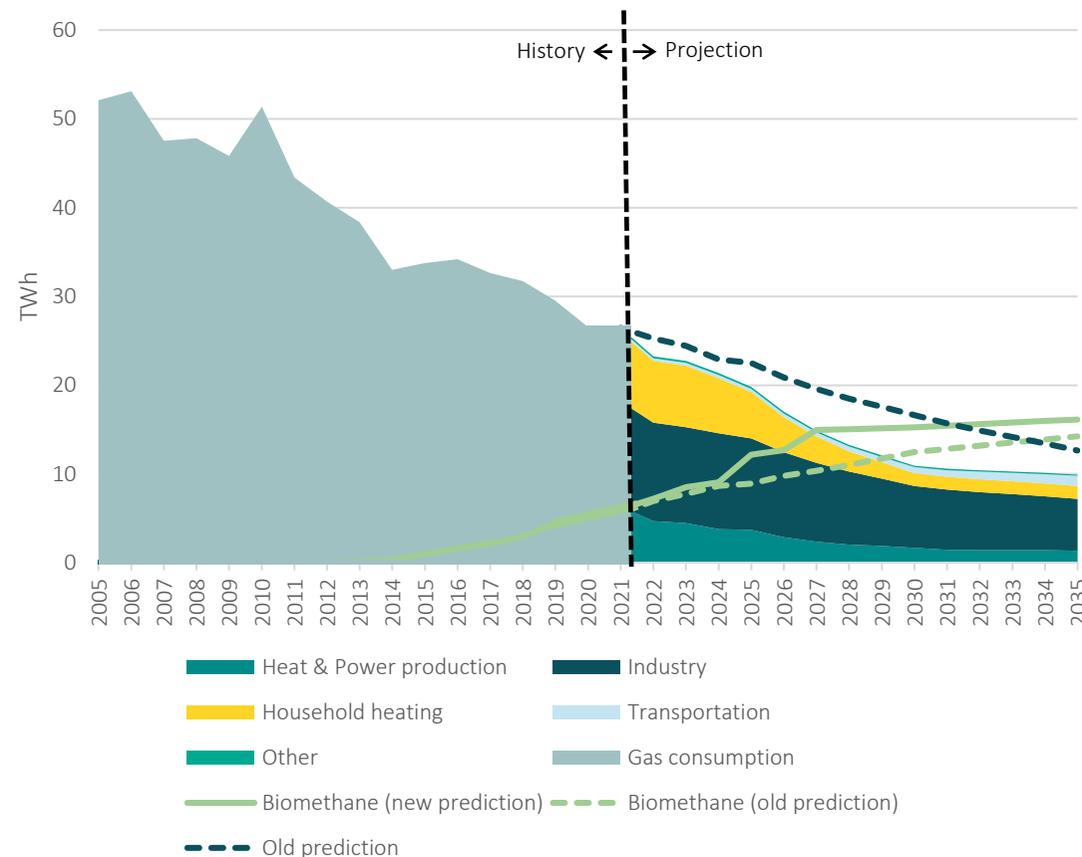
- Historically high – peak in 2005

The Danish Energy Agency project the production and consumption of gas based on political ambitions

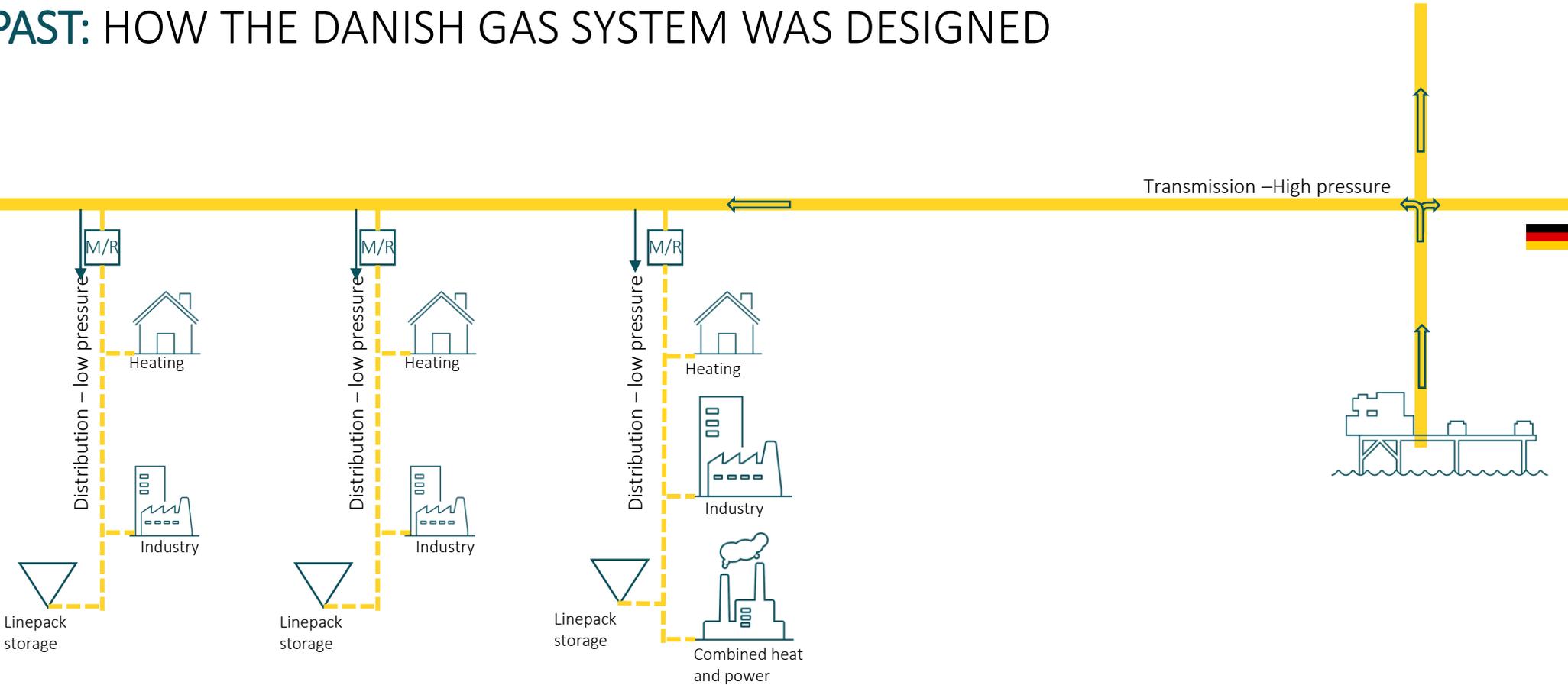
- Phasing out gas consumption for household and district heating
- Converting industry to green gas supply to reduce emissions from use of coal and oil.
- Growth in production of green gas – towards +100% around 2030

In parallel, Denmark are a big exporter on natural gas. In the same magnitude as the domestic consumption. From 2022, Denmark will transit <100 TWh gas from Norway to Poland via Baltic Pipe

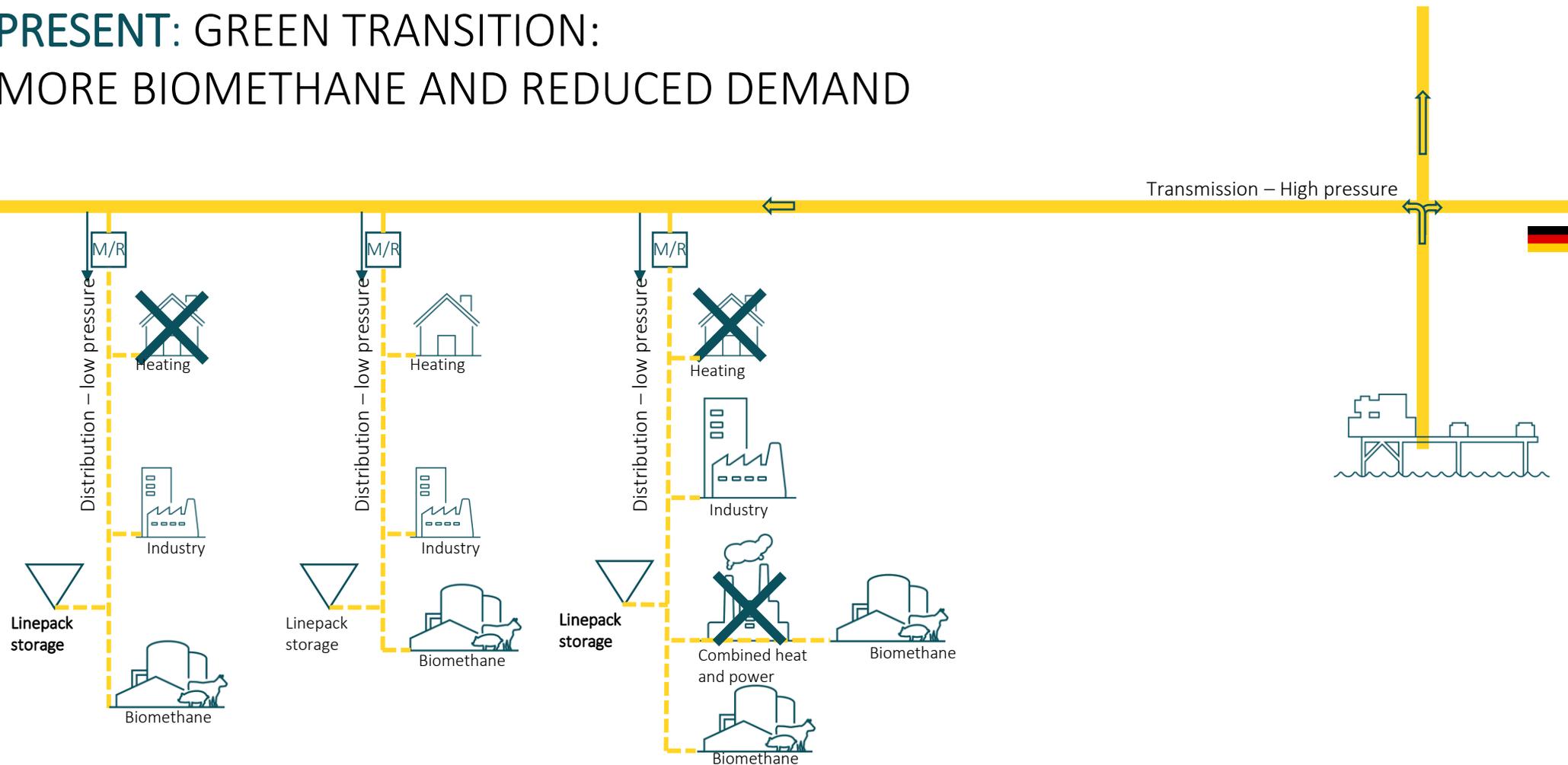
History of Danish consumption of gas and production of biomethane



PAST: HOW THE DANISH GAS SYSTEM WAS DESIGNED



PRESENT: GREEN TRANSITION: MORE BIOMETHANE AND REDUCED DEMAND



FUTURE: OVERSUPPLY OF BIOMETHANE – WHAT TO DO?

