ENERGINET

WASHINGTON & OREGON STATE DELEGATION

Visit to Energinet 10th May 2022

Clement Johan Ulrichsen – Director, Gas Market
Rasmus Halfdan Sandahl Jensen – Engineer, Gas Grid Planning

AGENDA

- ABOUT ENERGINET
- OUR VISION
- THE GAS SYSTEM
- GAS QUALITY
- GUARANTEES OF ORIGIN
- HYDROGEN

ABOUT ENERGINET

ENERGINET

THE ENERGY BACKBONE

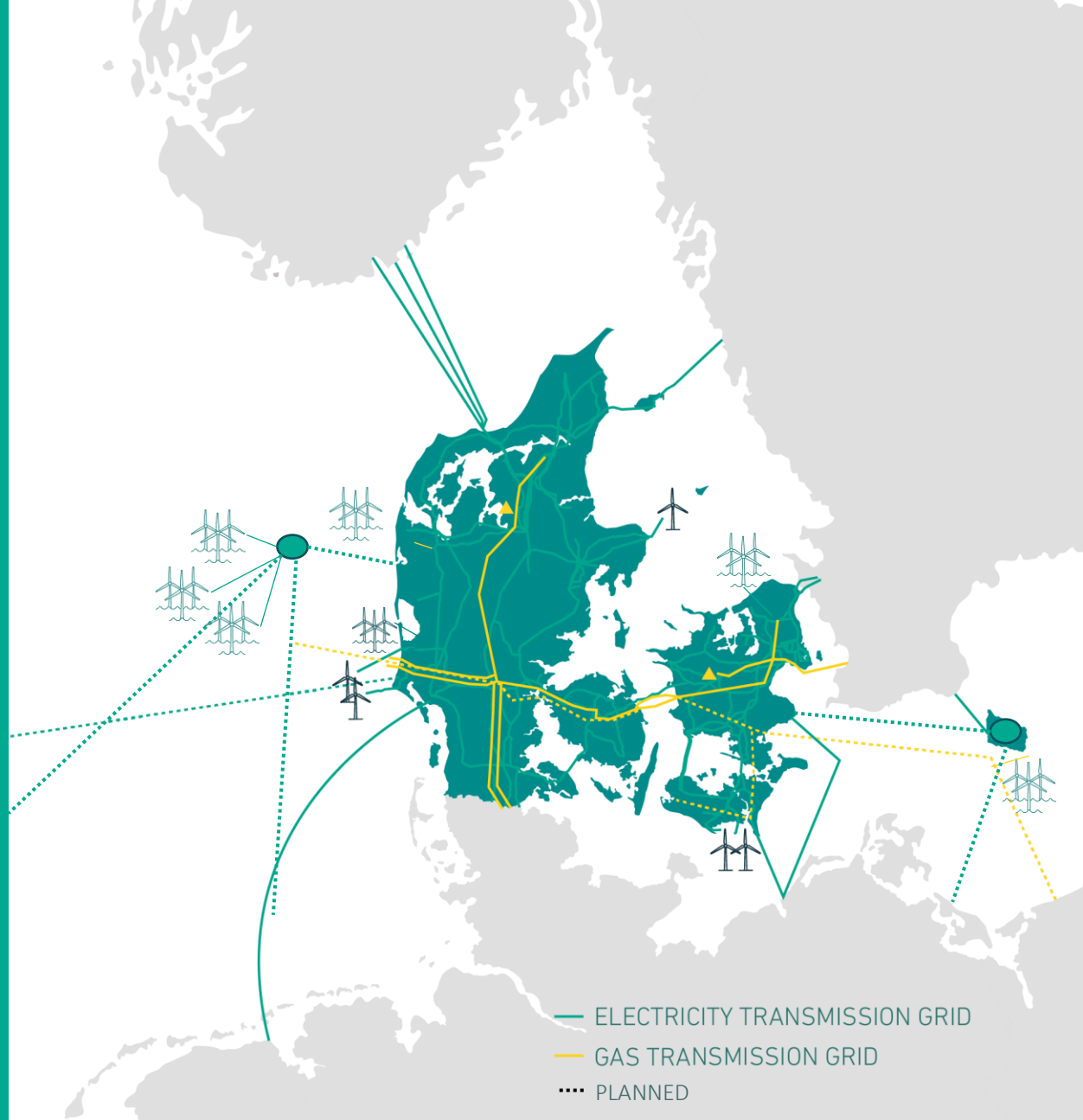
We operate and develop the transmission grids and gas pipelines in Denmark.

ENSURE BALANCE

We have the day-to-day and long-term responsibility for the overall electricity and gas system in Denmark.

WORKING FOR THE SOCIETY

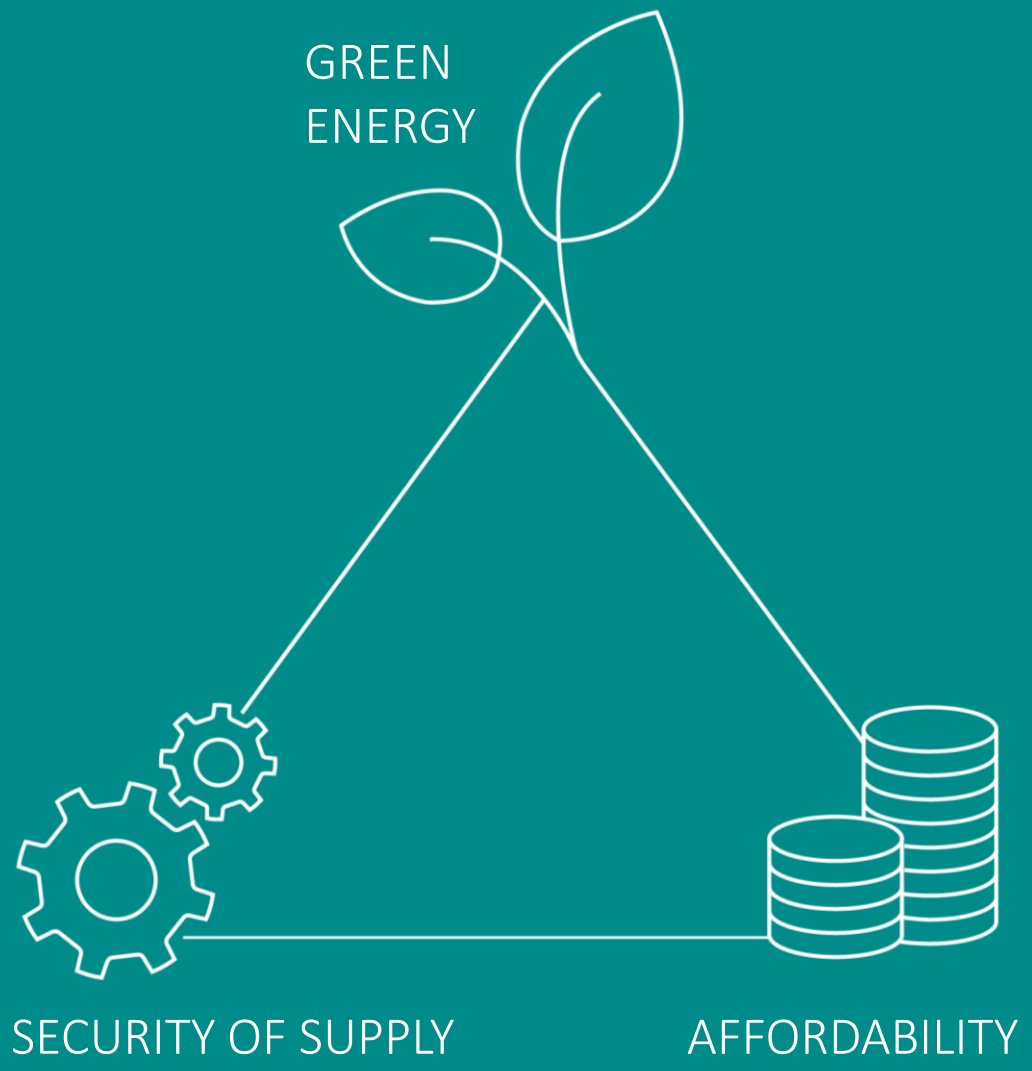
Owned by the Danish Ministry of Climate, Energy and Utilities we safeguard society's interests as we move to a 100% green energy system.



Energy island location and connections only illustrative

A BALANCING ACT

We work to make sure that the green transition is carried out in an economically responsible way without compromising on Denmark's already very high security of supply.



ENERGINET

WORLDCLASS ENERGY SYSTEM

Denmark in top 3 out of 125 countries every year since 2016

GREEN RECORDS

47.3% wind and solar power in the electricity grid in 2021

26% biogas in the gas grid in 2021

ELECTRICITY 99.99% OF THE TIME

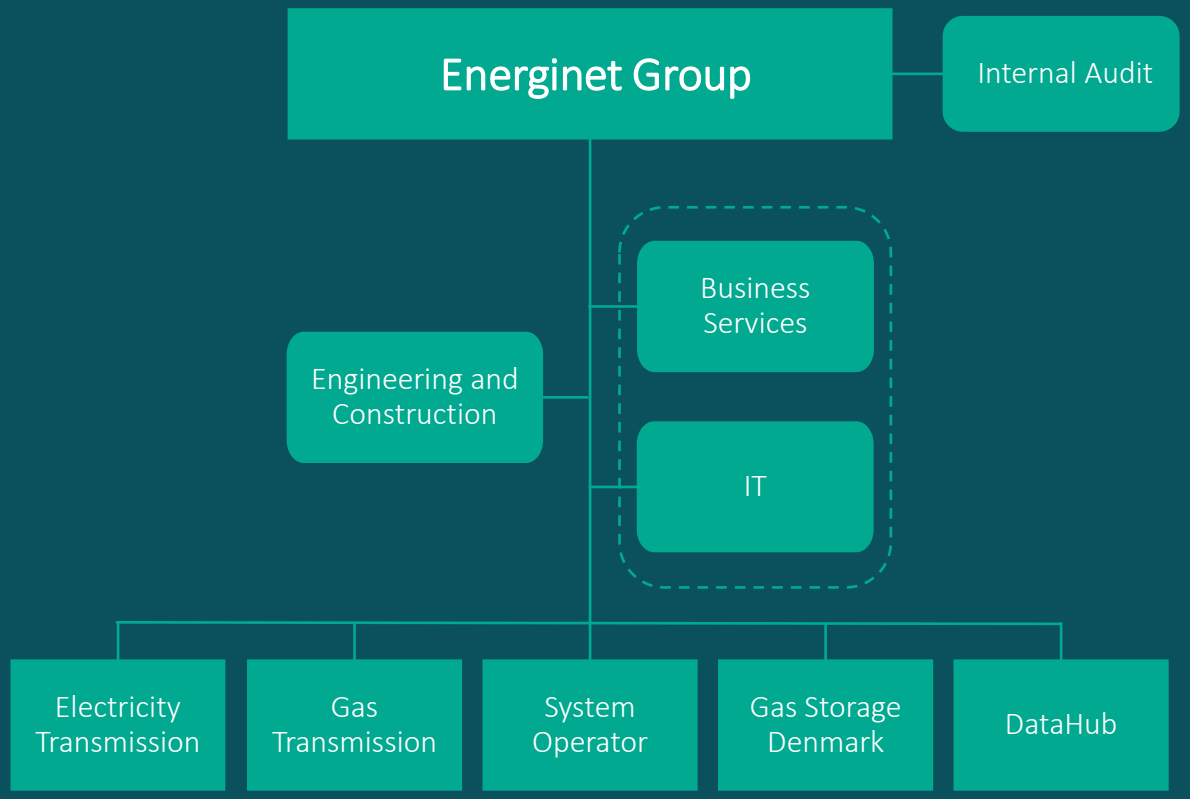
42 seconds of unserved electricity in 2021

GAS ALWAYS ON TAP

Zero gas supply failure in 2021

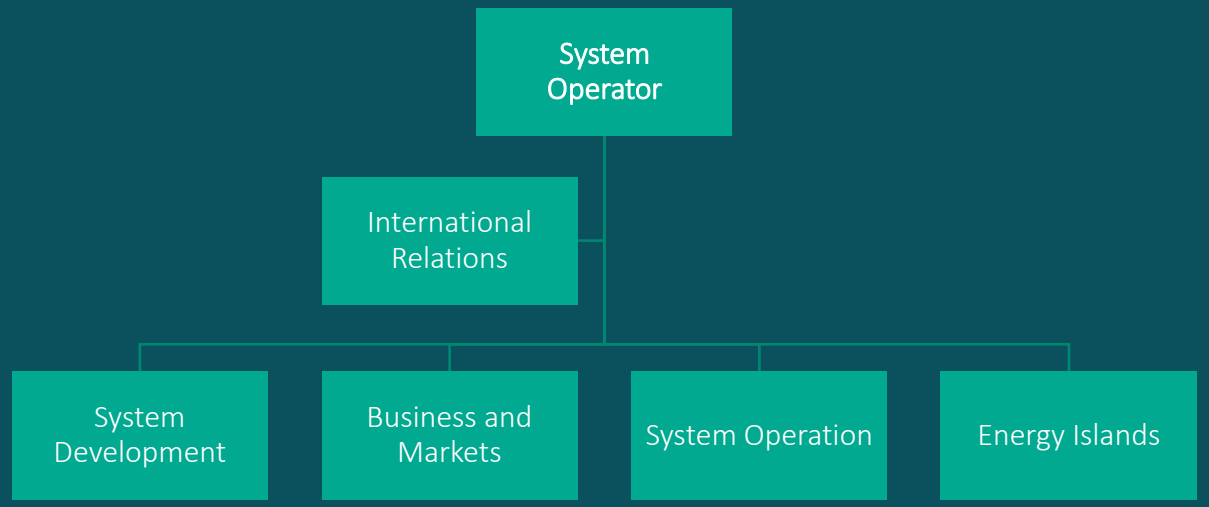
THE ORGANIZATION

Energinet Group has +1400 employees in 11 locations. The headquarter is located in Fredericia.



SYSTEM OPERATOR

The subsidiary Energinet System Operator has +330 employees and was established in 2021. The goal is to unite the system operation for electricity and gas.



ENERGINET

- **System Development**
  Strategic planning (incl. TYNDP), system perspective and grid development
- **Business and Markets**
  Markets, data, digitalization, system value and regulation (Prisma, JAO)
- **System Operation**
  Control centre, system performance, operations development, Nordic regional security coordinator (RSC)
- **Energy Islands**
  Development, construction, and operation of the world's first two energy islands
- **International relations**
  European cooperation on gas, Baltic Pipe, sector coupling and PtX, global engagement

OUR VISION

STRATEGY

WINDS OF CHANGE

The enormous offshore wind resources and the boom in renewable energy on market terms are Denmark's core strengths. These core strengths may result in extensive climate impact reductions in otherwise difficult sectors such as agriculture and transport, concurrently with the transformation to a 100% green energy system. With these new winds follow new opportunities.

WHY?

VISION

GREEN ENERGY FOR A BETTER WORLD

HOW?

WE IMPROVE THE DECISION-MAKING POWER - TO ACT IN TIME

WE GIVE THE AUTHORITY - WHEN WE DELEGATE TASKS

WE VALUE CURIOSITY AND COMMUNITY

LEADERSHIP THAT ACCELERATES THE TRANSITION

WHAT?

1 SECTOR COUPLING

2 LARGE-SCALE OFFSHORE WIND POWER

3 SOLAR AND WIND POWER ON MARKET TERMS

4 COLLABORATION WITH SOCIETY

QUESTIONS

THE DANISH GAS SYSTEM

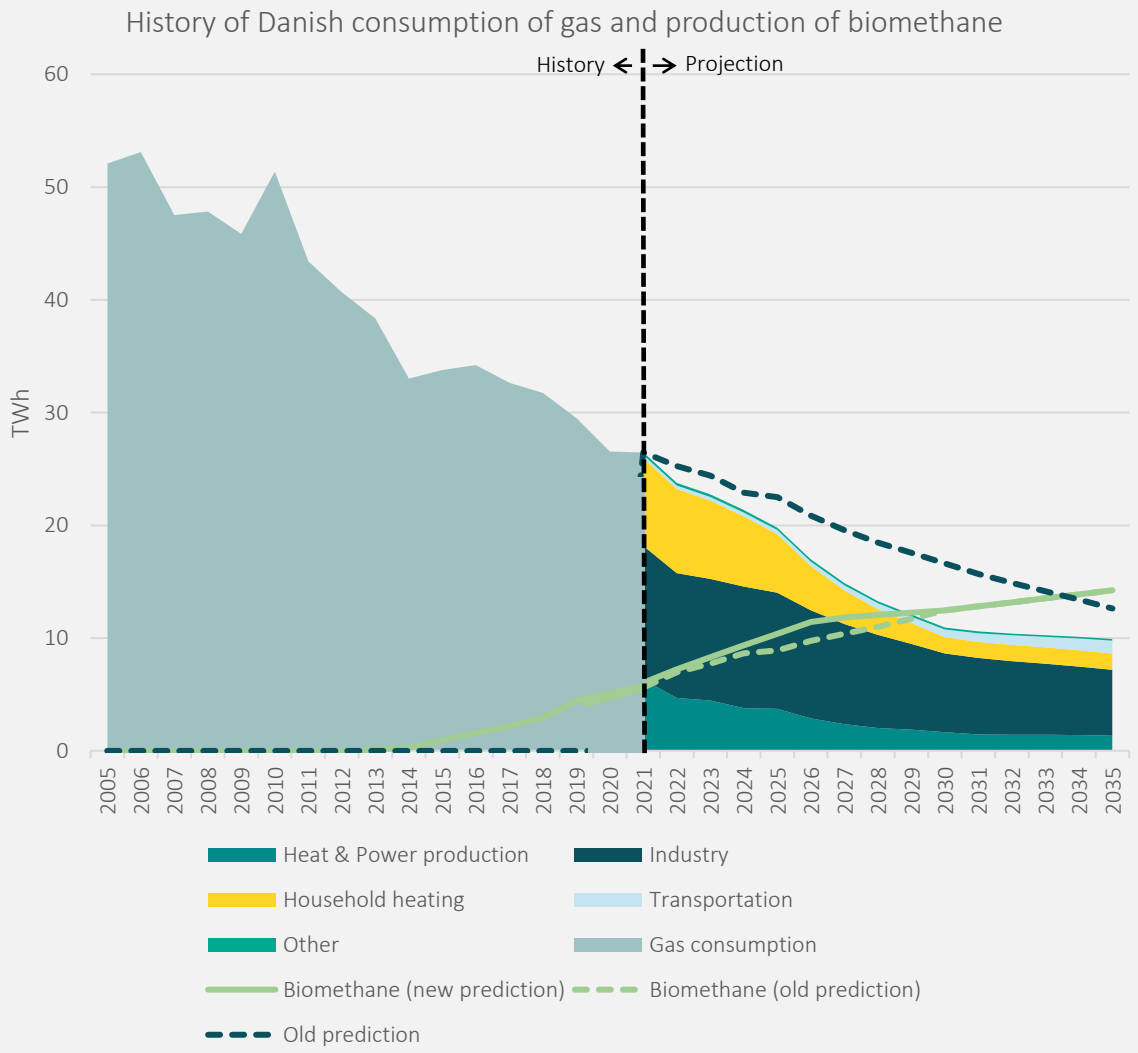
Past, present and future

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%

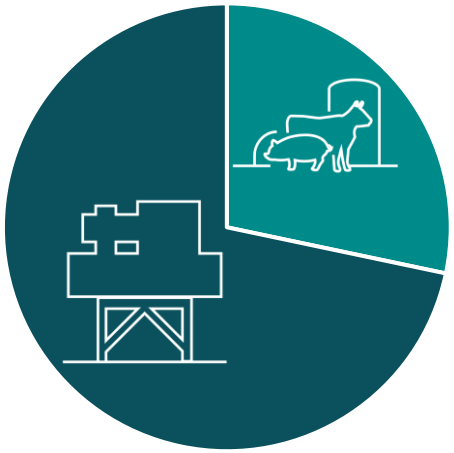


ENERGINET

A FUTURE WITH A GREEN GAS SECTOR

Development in Denmark's gas consumption

2022



23 TWh
RE: 30 pct. of domestic gas consumption

2025

20 TWh
RE: 52 pct. of domestic gas consumption

2030

11 TWh
RE: 114 pct. of domestic gas consumption

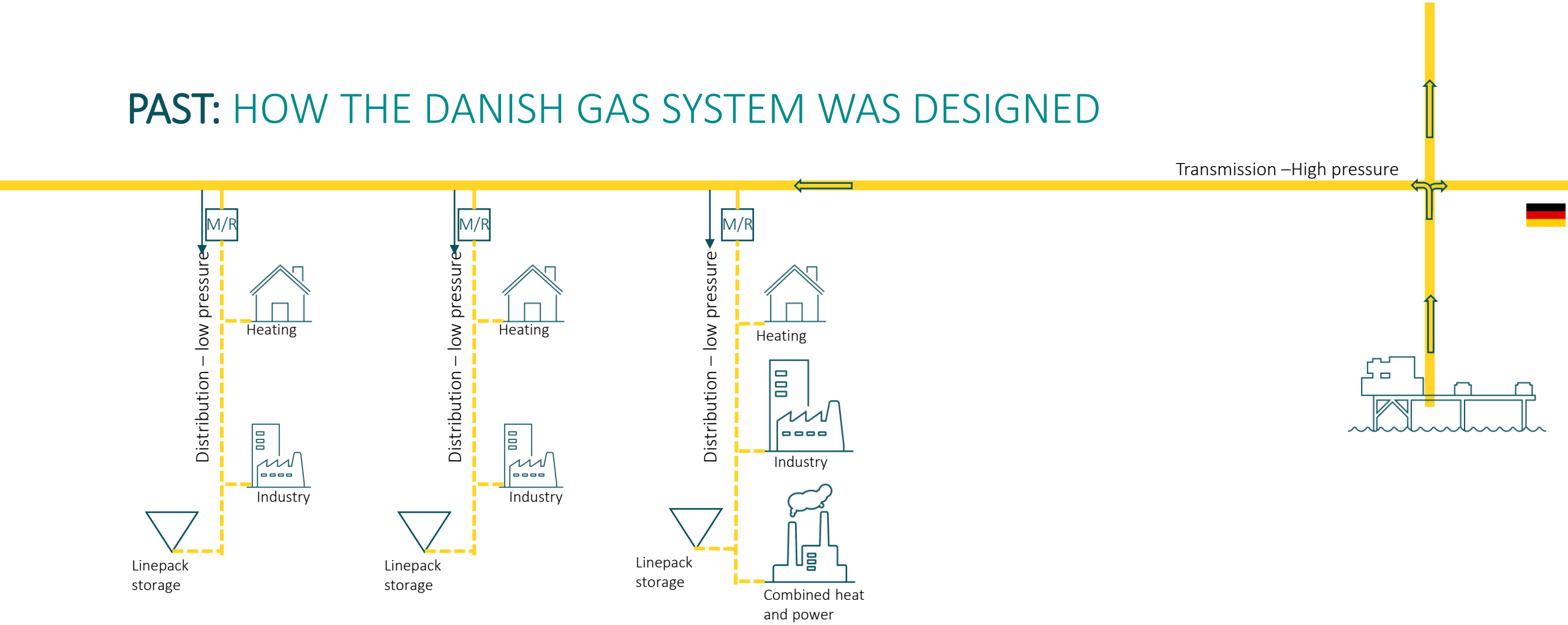
Challenges

- Natural gas is not 100 pct. green
- Decreasing gas consumption
- Local surpluses of biogas

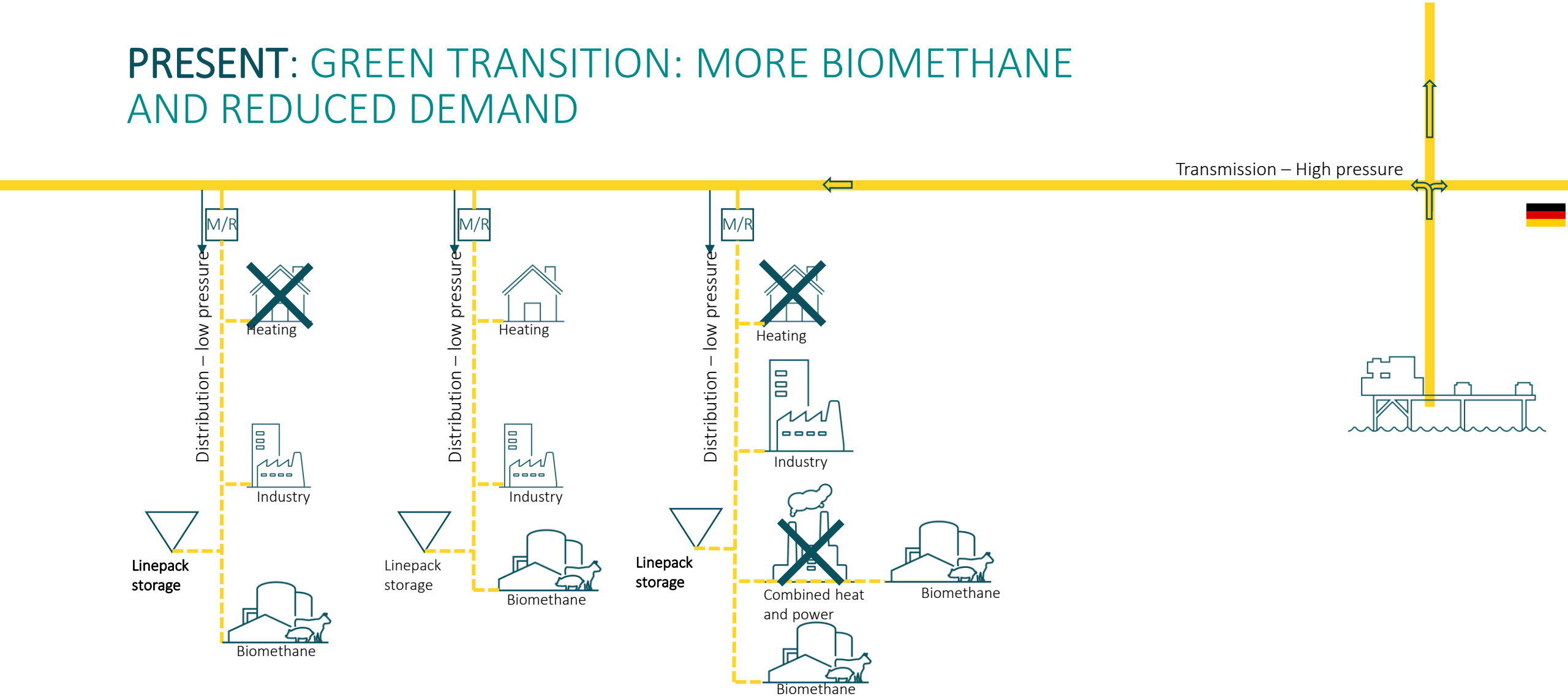
Opportunities

- Export of biomethane.
- Baltic Pipe utilize existing grid and support Polish green transition
- Heavy industry as gas consumers
- PtX and Hydrogen

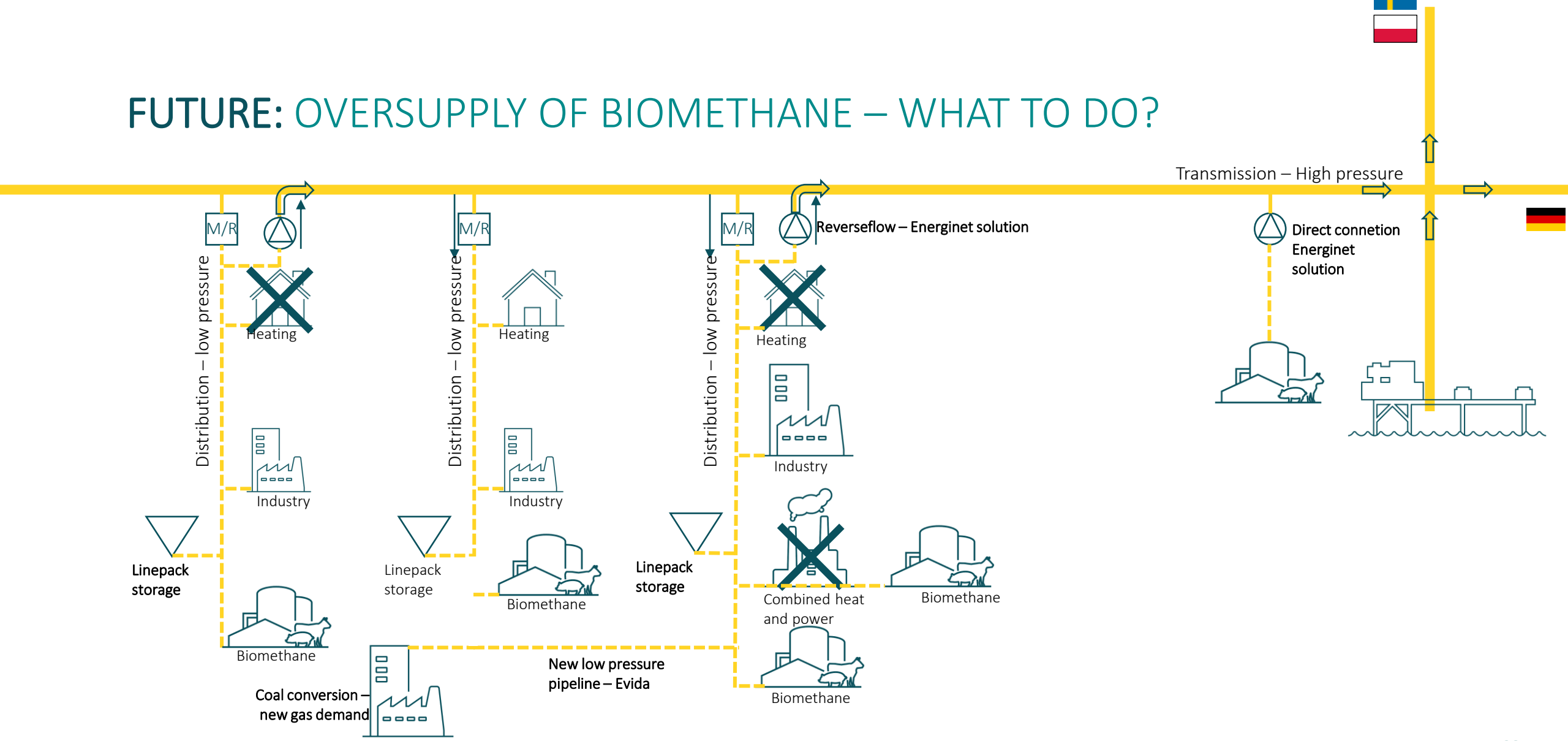
PAST: HOW THE DANISH GAS SYSTEM WAS DESIGNED



PRESENT: GREEN TRANSITION: MORE BIOMETHANE AND REDUCED DEMAND



FUTURE: OVERSUPPLY OF BIOMETHANE – WHAT TO DO?

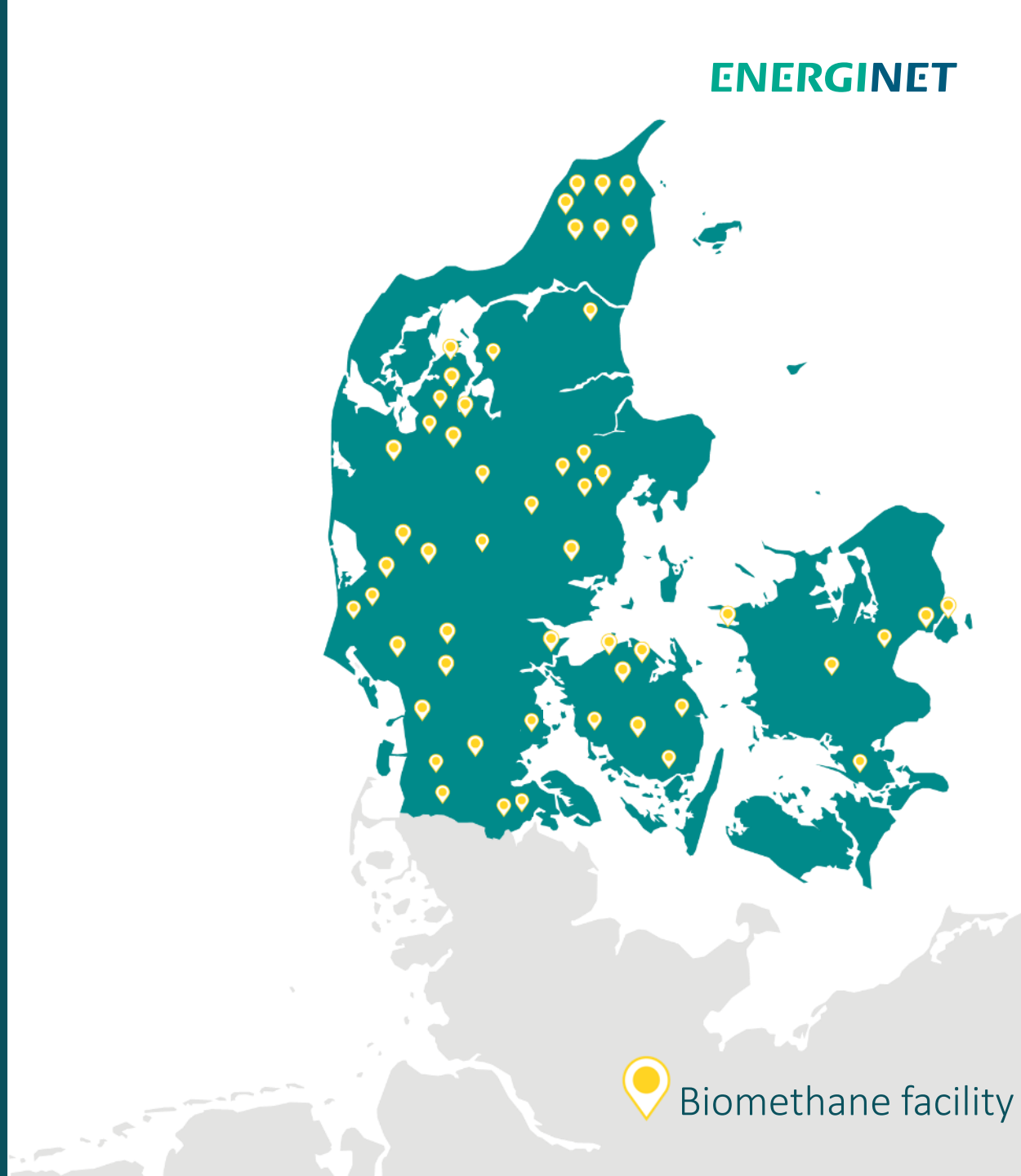


GAS GOES GREEN

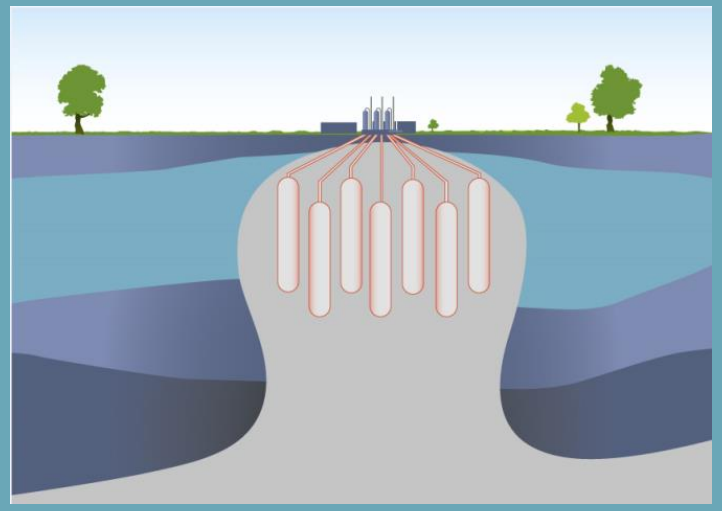
- 57 biomethane facilities
- 34 new biomethane facilities in pipeline
- Improves security of supply

A future with other types of green gas:

- Electricity to gas (methanation)
- Pyrolysis
- Thermal gasification
- New technology?

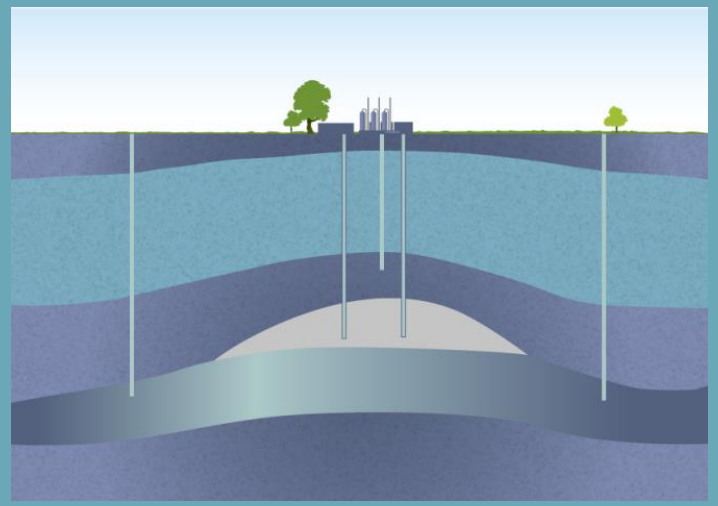


GAS STORAGE DENMARK OWNS AND OPERATES



LILLE TORUP

- SALT CAVERN FACILITY IN NORTHERN JUTLAND
- 365 mio. Nm3 working/market gas
- 572 mio. Nm3 total gas



STENLILLE

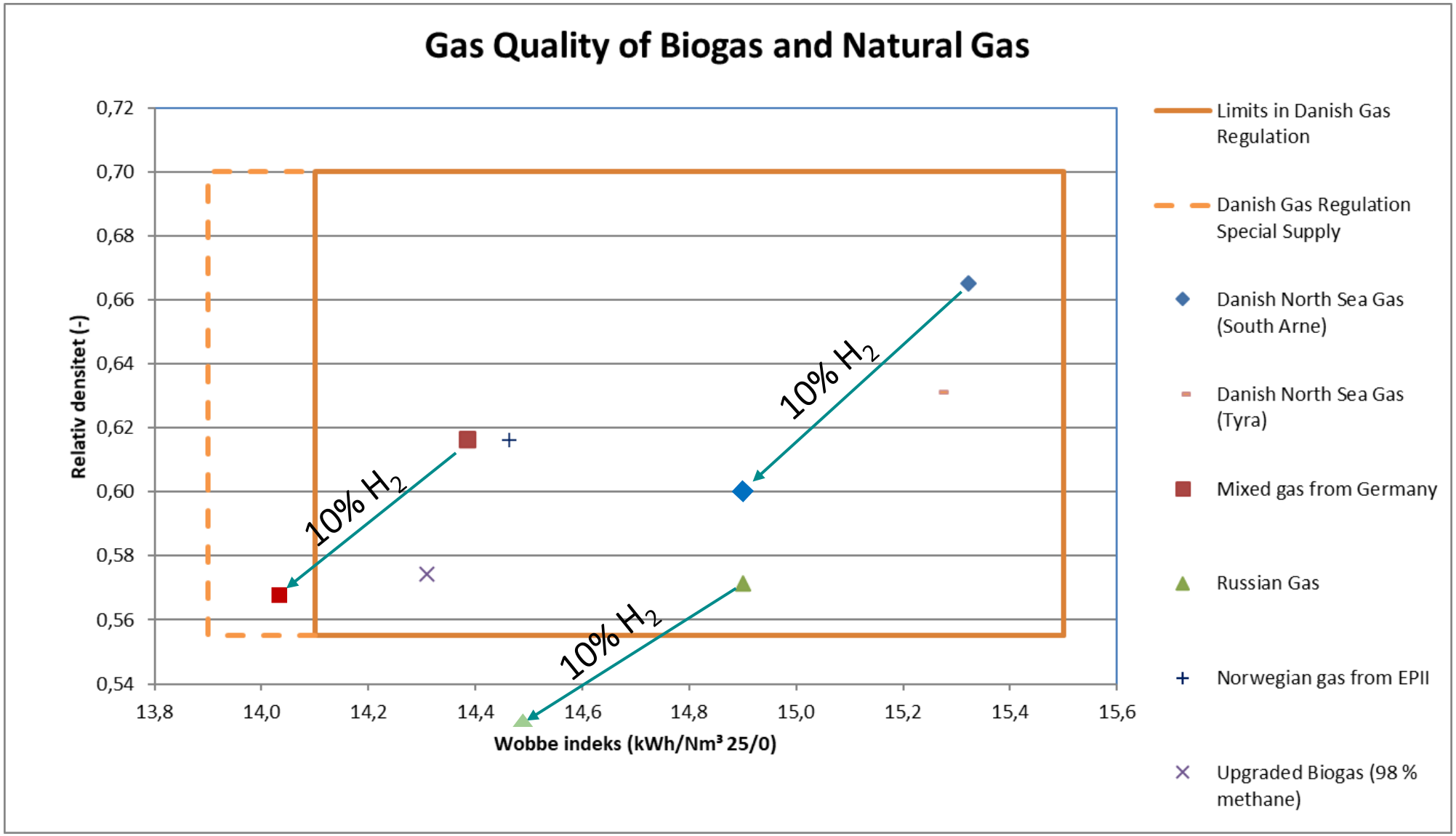
- AQUIFER PORE STORAGE FACILITY IN THE CENTRAL PART OF ZEALAND
- 534 mio. Nm3 working/market gas
- 1.607 mio. Nm3 totalgas

2/3

OF THE GAS COMES FROM GAS STORAGE FACILITIES ON A COLD DAY

GAS QUALITY

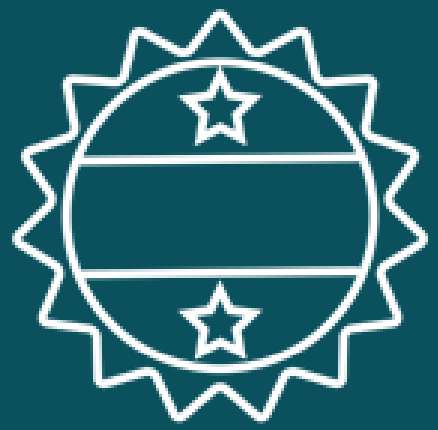
Dealing with gas quality of biomethane


Gas Quality of Biogas and Natural Gas
Relativ densitet (-)
0,72
0,70
0,68
0,66
0,64
0,62
0,60
0,58
0,56
0,54
13,8
14,0
14,2
14,4
14,6
14,8
15,0
15,2
15,4
15,6
Wobbe indeks (kWh/Nm³ 25/0)
10% H2
10% H2
10% H2
Limits in Danish Gas Regulation
Danish Gas Regulation Special Supply
Danish North Sea Gas (South Arne)
Danish North Sea Gas (Tyra)
Mixed gas from Germany
Russian Gas
Norwegian gas from EPII
Upgraded Biogas (98 % methane)

GAS QUALITY - OXYGEN

The Danish rules for biomethane allows for more oxygen-content than neighbouring countries.

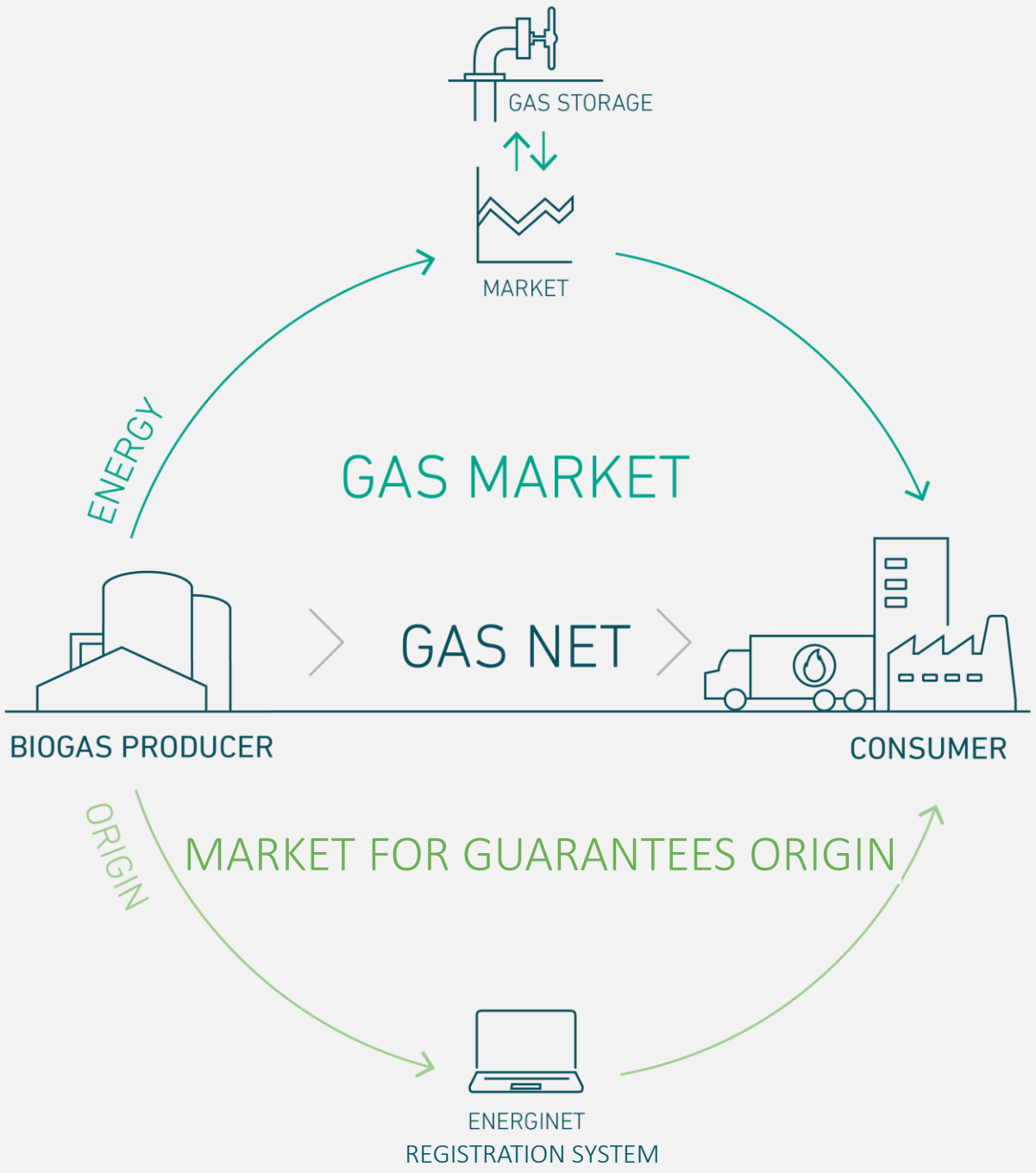
- Increased biomethane challenges the possibility for transit/export
- Current procedure for mixing of biomethane with fossil gas is adequate
- A procedure for handling operational stop related to Baltic Pipe gas flow is needed



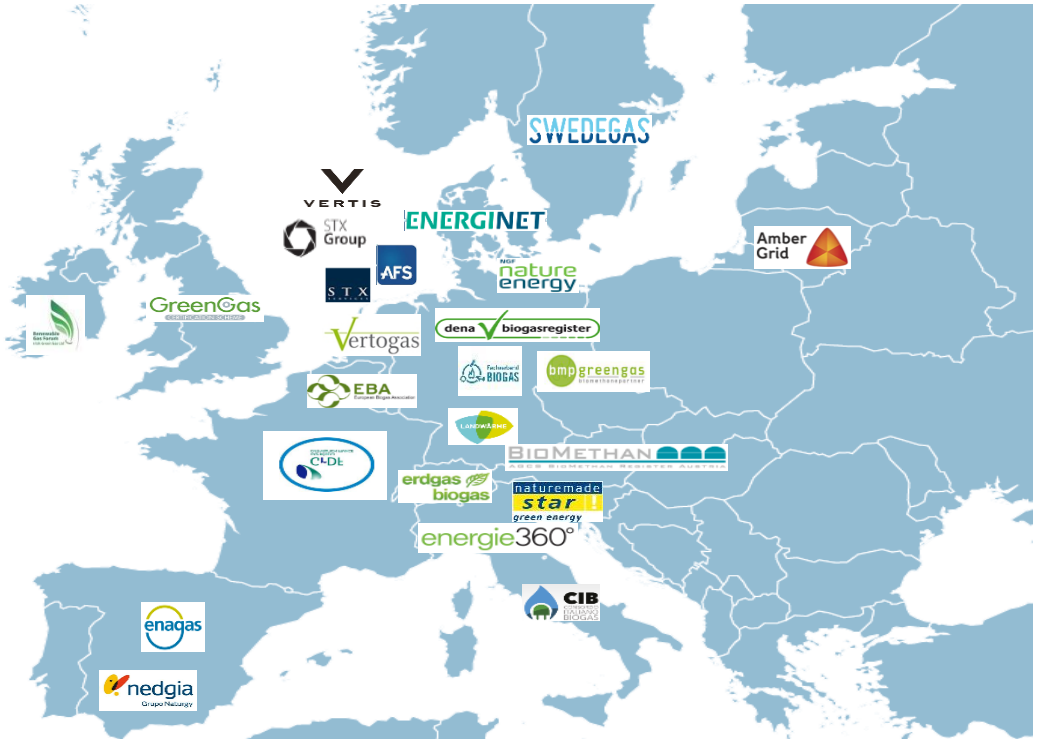
GURANNTEES OF ORIGIN (‘GO’)

GAS MARKET AND GUARANTEE OF ORIGIN ('GO') MODEL

- ✓ Renewable gas market model approved by Regulator (2010)
- ✓ Certificate model implemented (2011)
- ✓ Certificates evidence under ETS and transport fuel quota in Denmark
- ✓ Energinet appointed Issuing Body for Guarantees of Origin for renewable gases in grid (2021) – incl. biomethane and hydrogen
- ✓ Certificates for hydrogen being developed



EUROPEAN RENEWABLE GAS REGISTRY



More info: www.ergar.org

ergar
European Renewable Gas Registry

Vision:

Renewable gas will be tradable cross border in an increasingly integrated European market via the gas grid and used in all end use sectors

Mission:

Building on national renewable gas registries a trustworthy transparent and standardized documentation scheme for cross border transfers of renewable gas certificates will be established for renewable gas injected to the European gas grid. Ensuring that double sale and double counting of the green value is avoided.

Status:

- Registries handling 80-90% of renewable gas injected to European grid
- Two ERGAR schemes being developed
  - ERGAR MB: RED II compliant scheme for mass balancing European gas grid
  - ERGAR CoO: Book & Claim system for disclosure and voluntary reporting
- Transfer hub established
- First commercial transfers
- Network and knowledge sharing

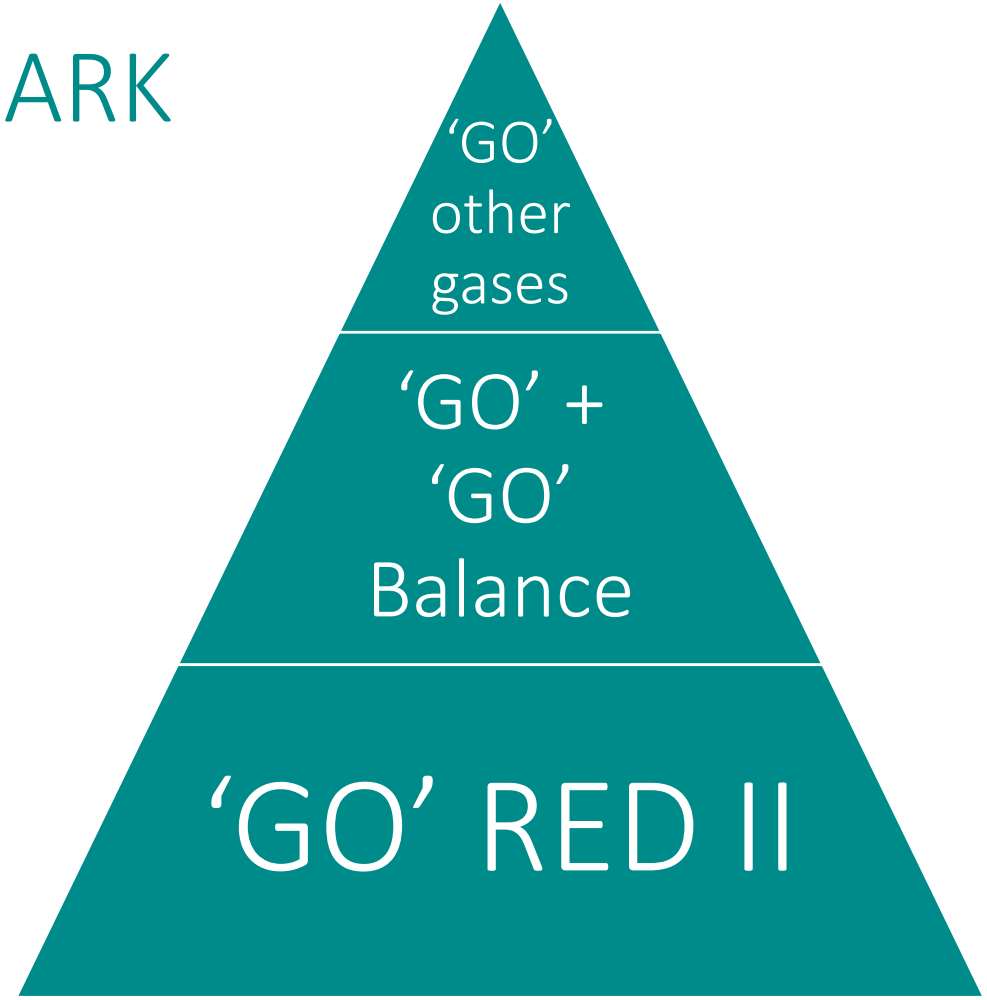
REGATRACE partner

- Energinet is associated via ERGaR collaboration

FUTURE PLANS IN DENMARK

1. Import/export European registries

2. New types of GOs being developed:
   - ✓ GO: REDII compliant
   - ✓ GO+: REDII plus additional information/requirements
   - ✓ GO Balance: balancing injection and withdrawal hourly basis
   - ✓ GO for hydrogen and methanised gas in grid



DEMAND FOR H_2 'GO' MODELS

HYDROGEN

Just the fact that hydrogen comes from electrolysis is fine. For the same reason that an electric vehicle is renewable without consideration to time and place of charging.

RENEWABLE HYDROGEN

Hydrogen must have a 'GO' and must be priced and marketed as renewable ***without contributing*** *to the EU CO_2 reduction targets.*

RENEWABLE+ HYDROGEN

Hydrogen must have a 'GO' and must be priced and marketed as renewable ***AND simultaneously contribute*** *to the EU CO_2 reduction targets.*

‘GO’-CONCEPTS FOR RENEWABLE HYDROGEN IN THE GRID

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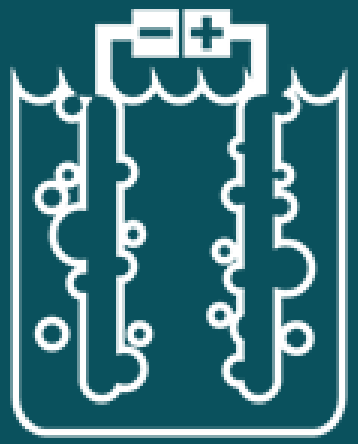
Overview

	GO	GO+ RFNBO
Documentation structure • Unit: 1MWh • Plant data • Udstedelsestidspunkt • Unikt digitalt certifikat	✓	✓
Lifetime	12 months	12 months
Co-location	DK	Bidding zone
Additionality	?	✓
Concurrency	?	✓
Price flexibility	?	✗

End purpose	Declaration of renewable hydrogen	Fuel documentation
Can be issued for direct lines and grid connections	✓	✓

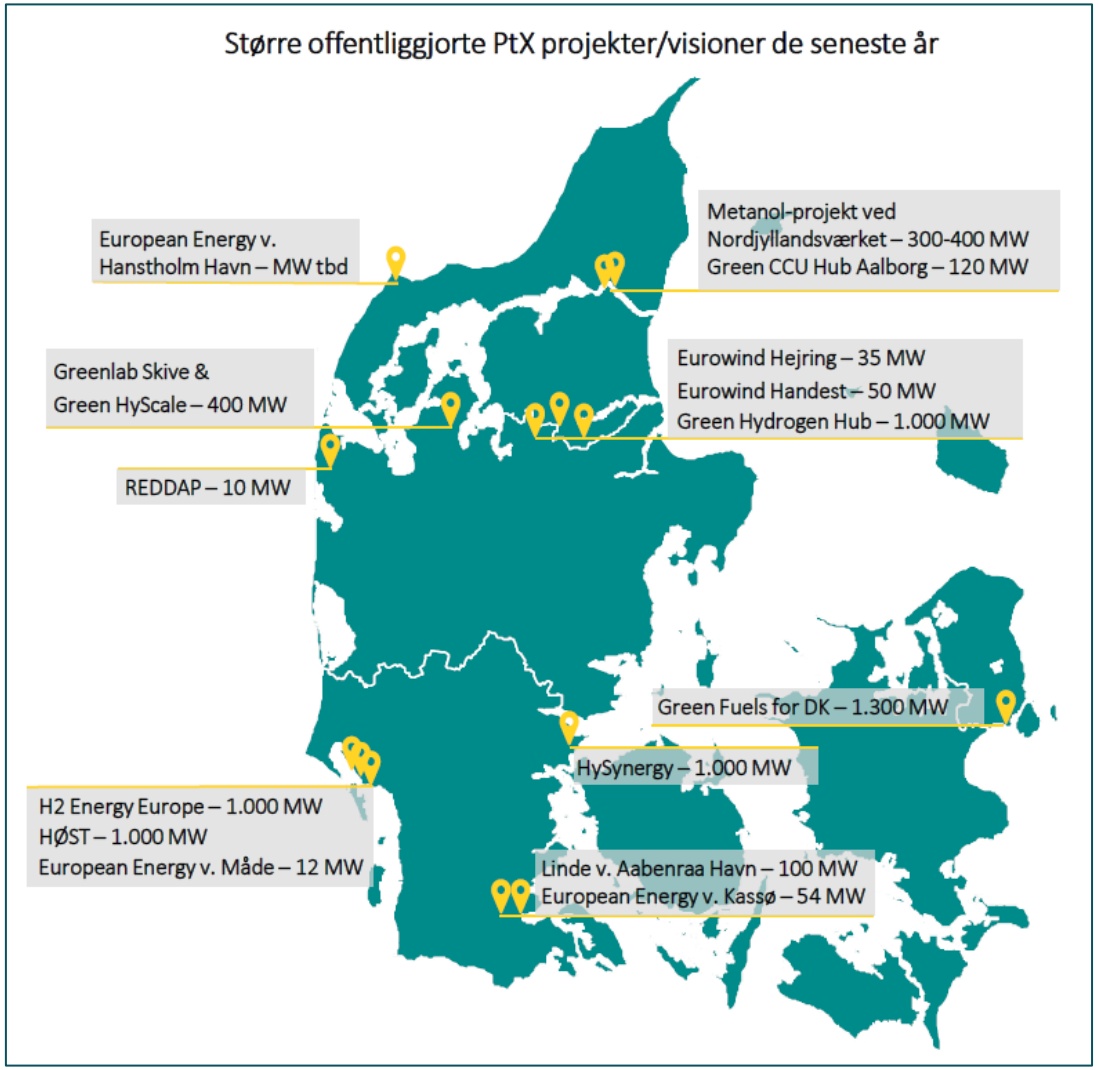


HYDROGEN

Present and future work with hydrogen infrastructure

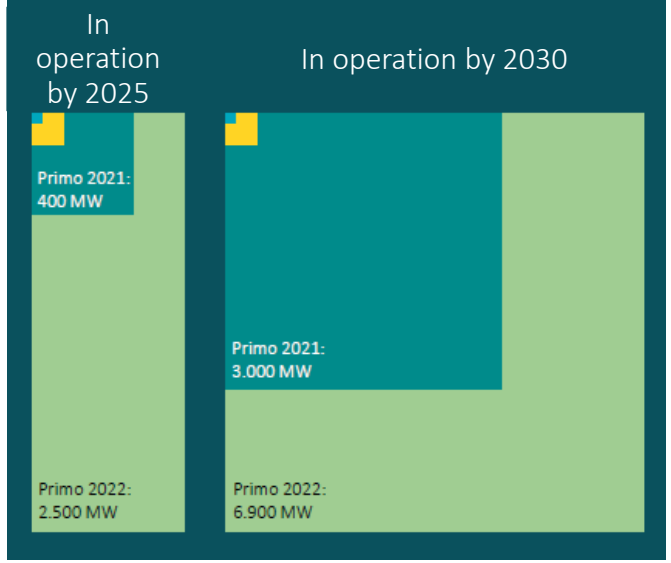
FAST UPSCALING OF PTX-PROJEKTS/VISIONS

Publicly annonced PtX projects and visions in Denmark in 2030 have gone from 40 MW to almost 7.000 MW since january 2020.



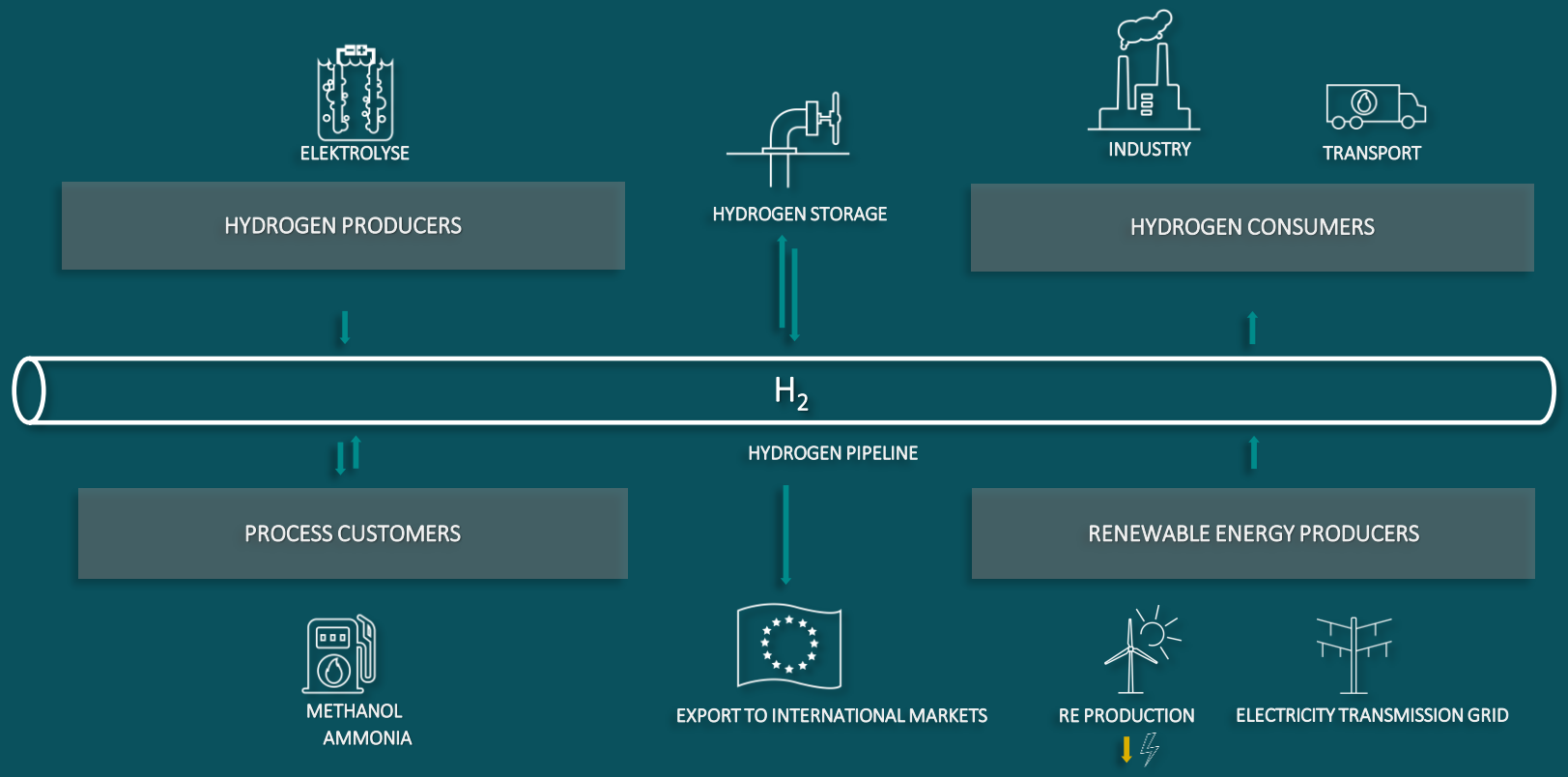
Development of announced electrolyzer capacity i 2025 and 2030 in public known projects

Udmeldt kapacitet (MW)	I drift i 2025	I drift i 2030
Primo 2019	4	4
Primo 2020	40	40
Primo 2021	400	3.000
Primo 2022	2.500	6.900



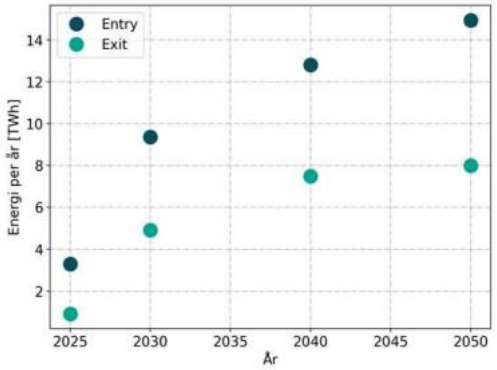
Source: https://brintbranchen.dk/danske-brintprojekter/ and publicy annonced PtX projects in Danish media.

VALUE OF DANISH HYDROGEN INFRASTRUCTURE

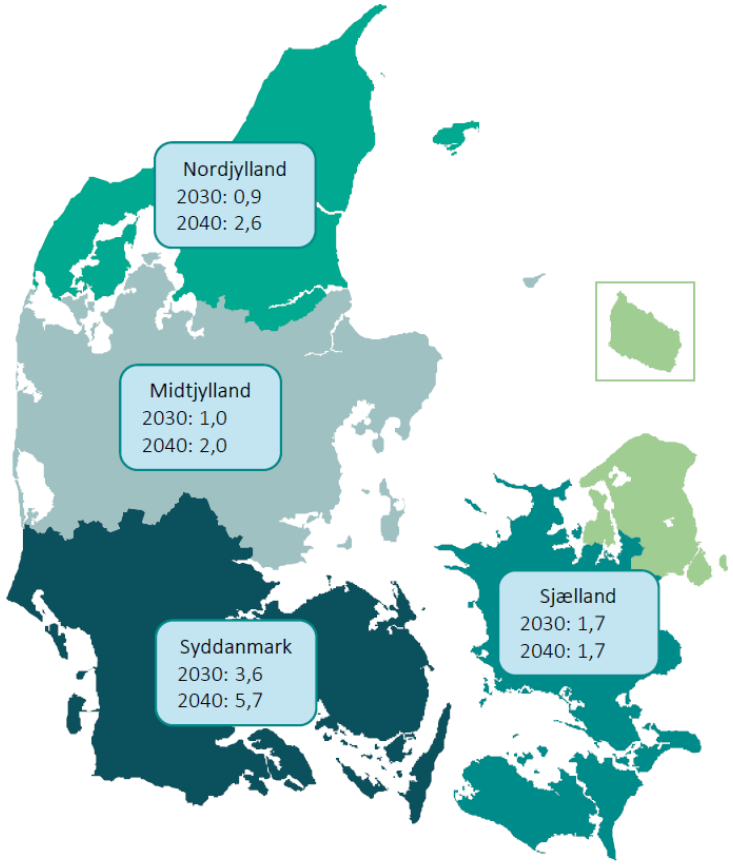


MARKET DIALOG FOR HYDROGEN INFRASTRUCTURE

Expressed need for hydrogen infrastructure before 2030 for both producers and consumers of hydrogen

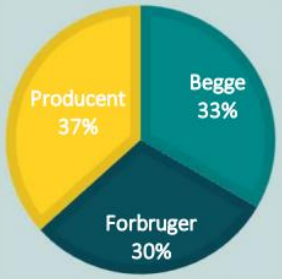


Entry (TWh) fordelt på regioner i 2030 og 2040

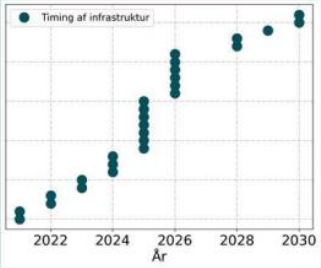


PROJECT MATURITY

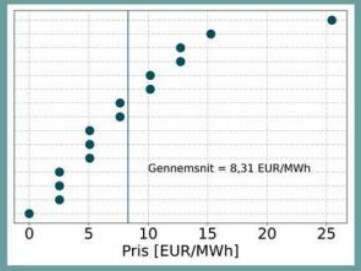
DISTRIBUTION OF PRODUCERS AND CONSUMERS



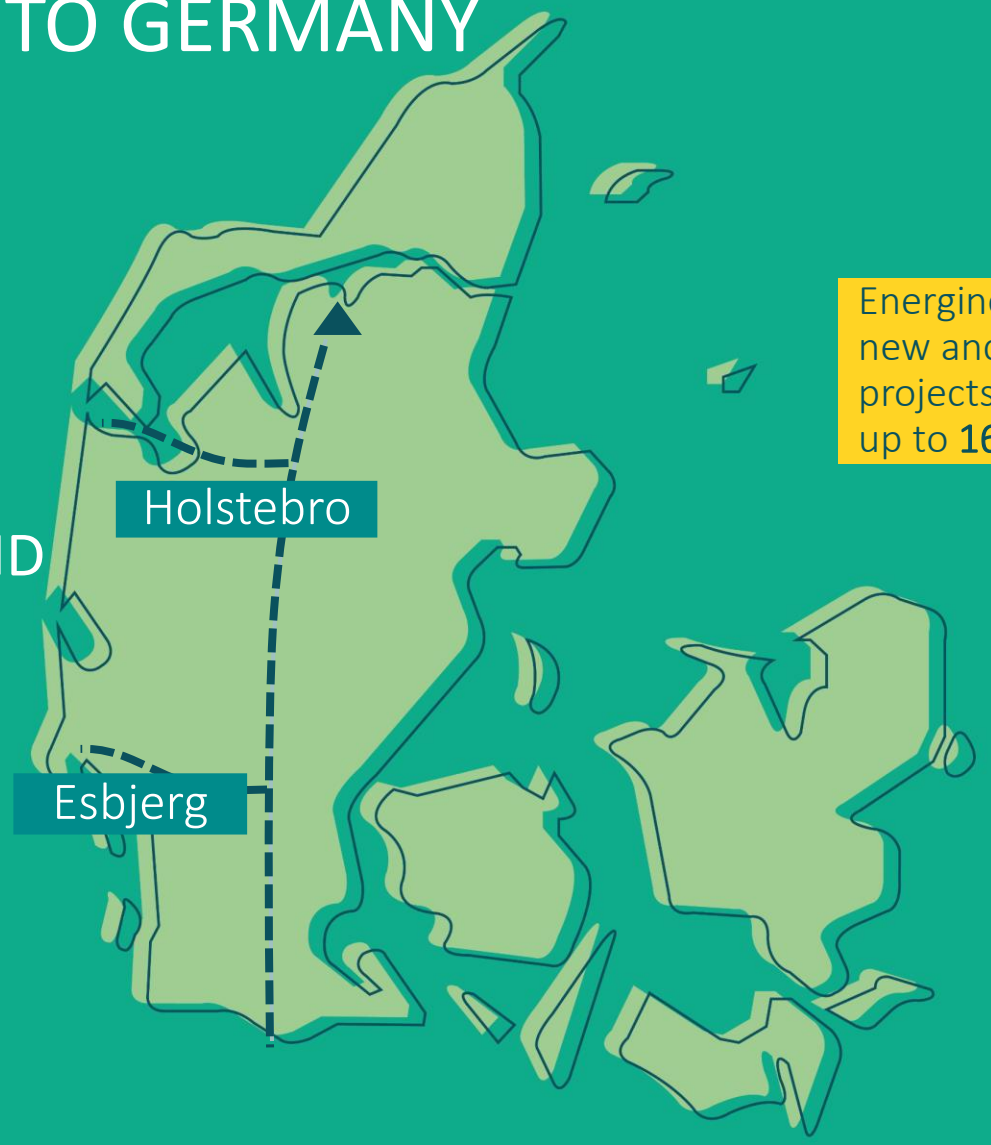
WANTED ACCESS TO INFRASTRUCTURE



ALTERNATIVE TRANSPORT COST



PRE-FEASIBILITY STUDIE OF HYDROGEN INFRASTRUCTURE FROM DENMARK TO GERMANY



Energinet has knowledge off new and possible solar power projects with at total capacity of up to **16 GW**

NORTH SEA ENERGY ISLAND

3 GW offshore wind i 2033 (*later expanded to 10 GW)

BALTIC SEA ENERGY ISLAND (BORNHOLM)

2 GW offshore wind in 2030

--- Example of hydrogen infrastructure

EXAMINED HYDROGEN SYSTEMS

Newly constructed H2 pipelines
Repurposing of natural gas pipelines
Compressor Station

MATURE INFRASTRUCTURE STRETCHING TOWARDS ALL DIRECTIONS IN 2040

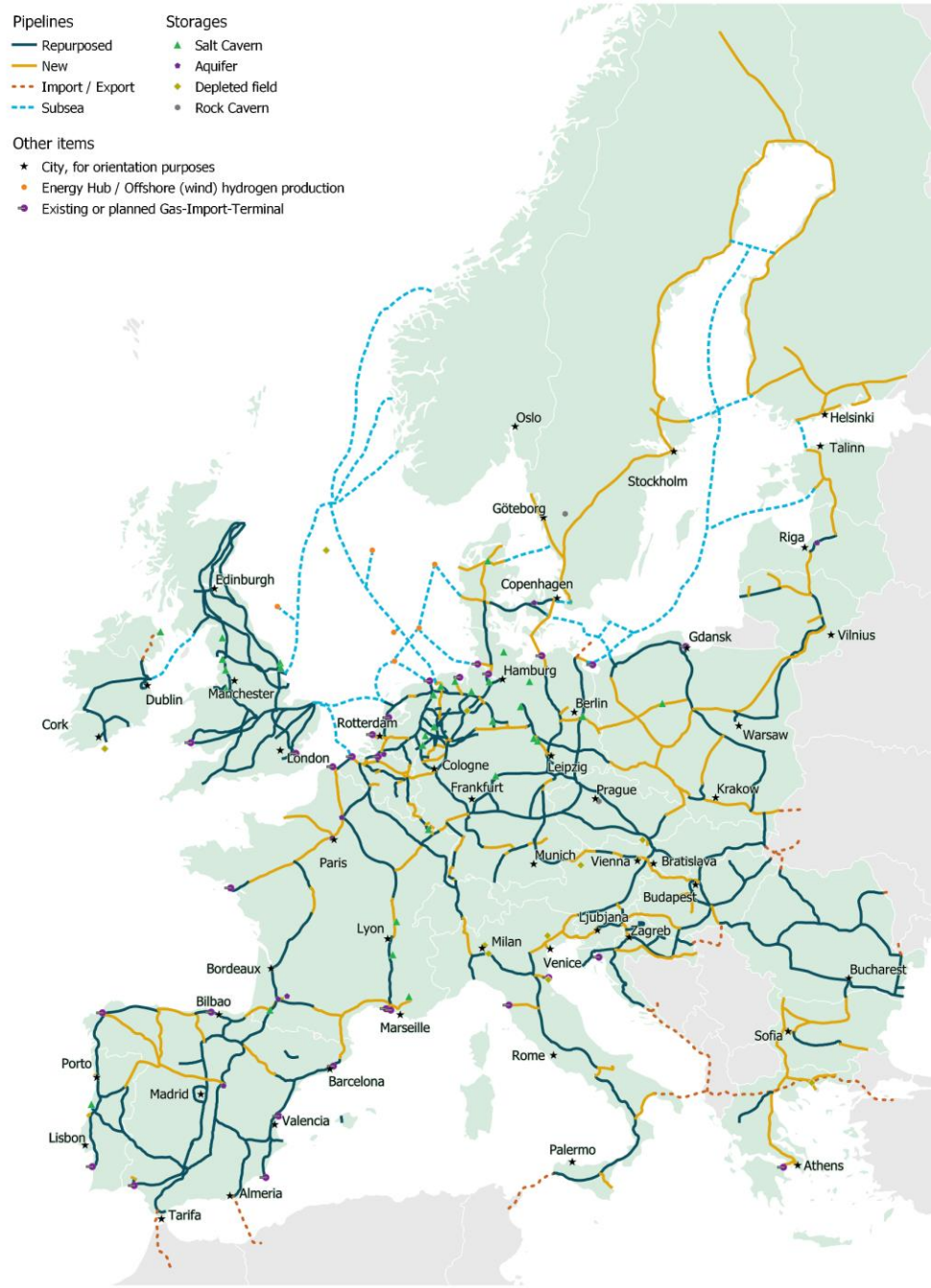
The report published shows a vision for a

~53,000 km hydrogen pipeline infrastructure

In **28** countries by 2040

over **60%** of which is based on repurposed existing natural gas pipelines

Making it possible to create the European Hydrogen Backbone at affordable costs



https://gasforclimate2050.eu/wp-content/uploads/2022/04/EHB-A-European-hydrogen-infrastructure-vision-covering-28-countries.pdf

ENERGINET ASSOCIATED ACTIVITIES

International Energy Counseling: Acellerating the green transition globally since 2010

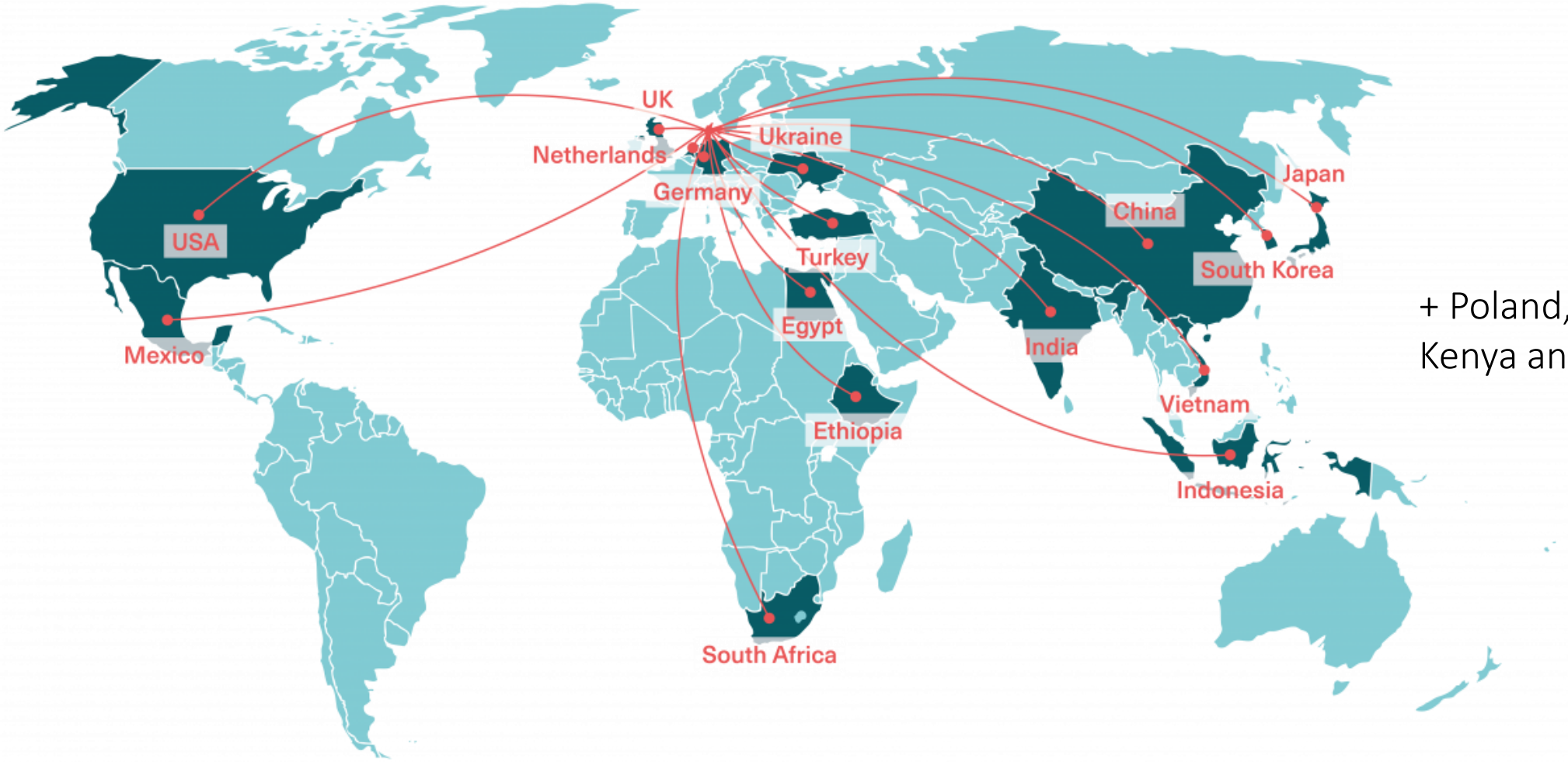
How do we work:

- Specific expertise that other consultancy businesses are unable to provide:
  - Experiences from Energinet employees
- We use long-distance capacity building and twinning
- Usually takes about 6-12 months for each project (from Terms of Reference to Evaluation)
- However, partnerships and projects can have varying durations

Our purpose is to accelerate the green transition globally via knowledge-sharing and capacity building:

- Presentations
- Workshops
- Reviews
- Training and education
- Long-term peer-to-peer partnerships

OVERVIEW OF PARTNERSHIP COUNTRIES



+ Poland,
Kenya and France

QUESTIONS

Contact: Mobile: +45 29717821 Mail: RSJ@energinet.dk