



H₂ projects in Denmark

Bird's eye view (and project examples)

REKK Energy Futures Workshop

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Who am I?

- 2011 Physicist MSc (applied physics) - Budapest University of Technology and Economics
- 2017 PhD in physics - Technical University of Denmark (DTU)
- Since 2022: Project Manager at Danish Gas Technology Centre
 - Hired for H₂ related projects and special tests/measurements in our Hydrogen Technology Test Centre



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Danish Gas Technology Centre

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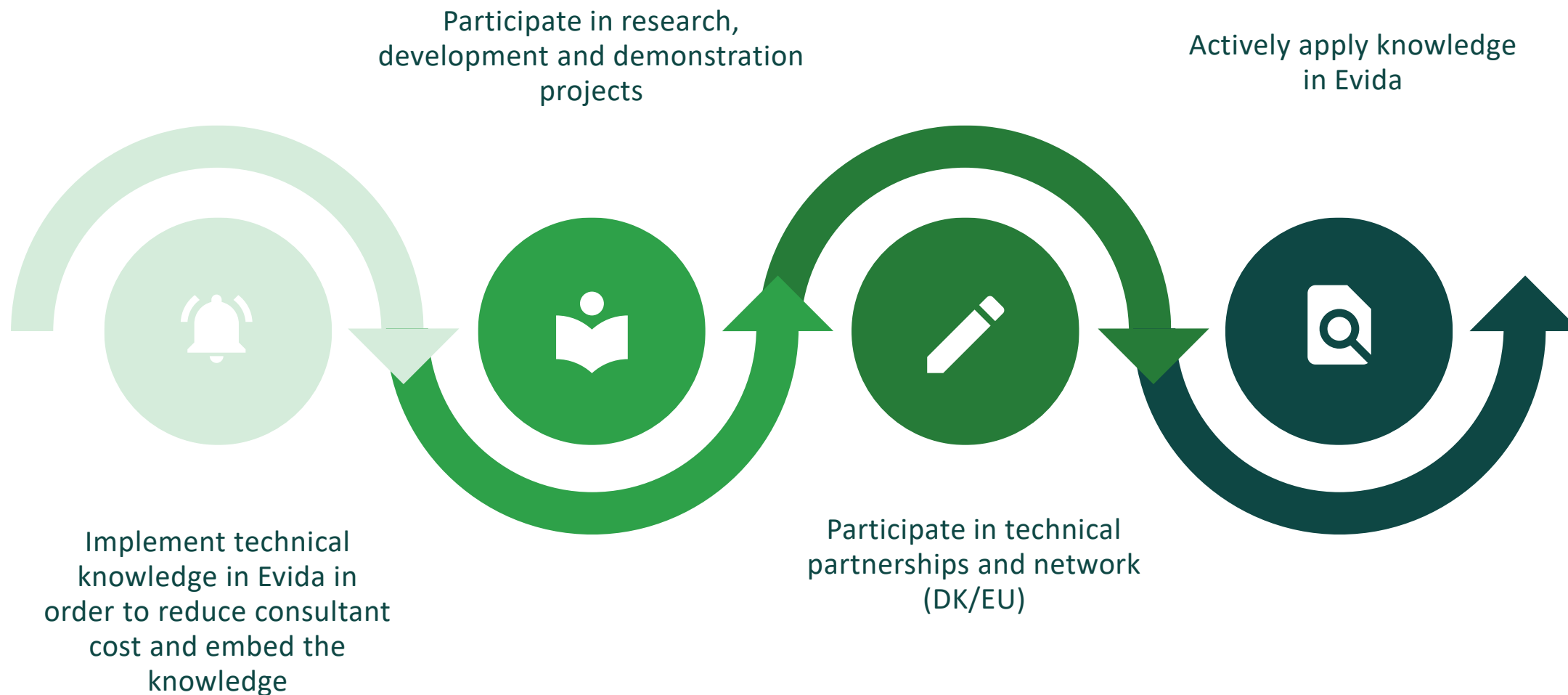
www.dgc.dk/

The Danish Gas Technology Centre (DGC)

- Started by the natural gas distribution companies
- Ca. 20 employees: engineers and technicians
- Specialised consultancy, measurements, testing, verification, development projects, etc.
- Owned by the DSO (Evida) with strong ties to TSO (Energinet) and partnerships both nationally and internationally
- Strong project portfolio within biomethane, H₂ and CO₂
- Accredited laboratory
- Methane emission measurements (EU regulation)
- Leakage testing (CH₄, H₂)



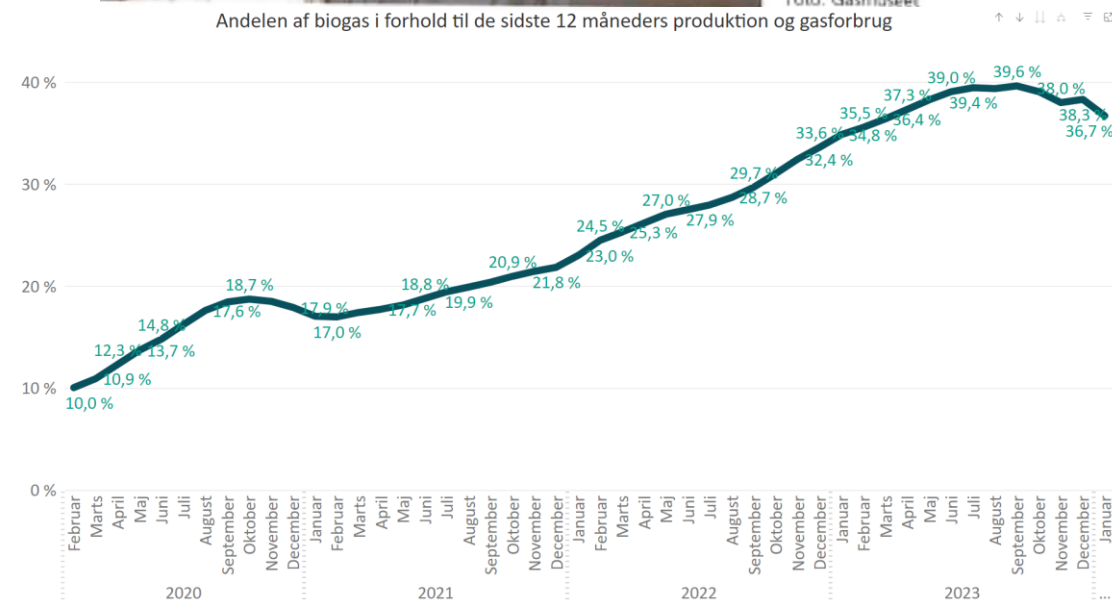
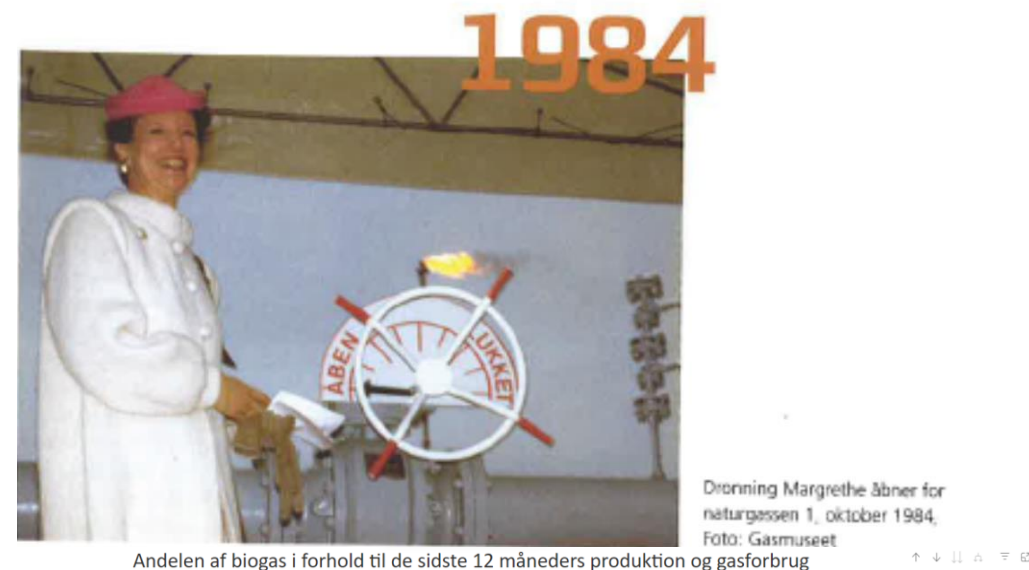
DGC's role



The (natural) gas system in Denmark

Natural gas: short history

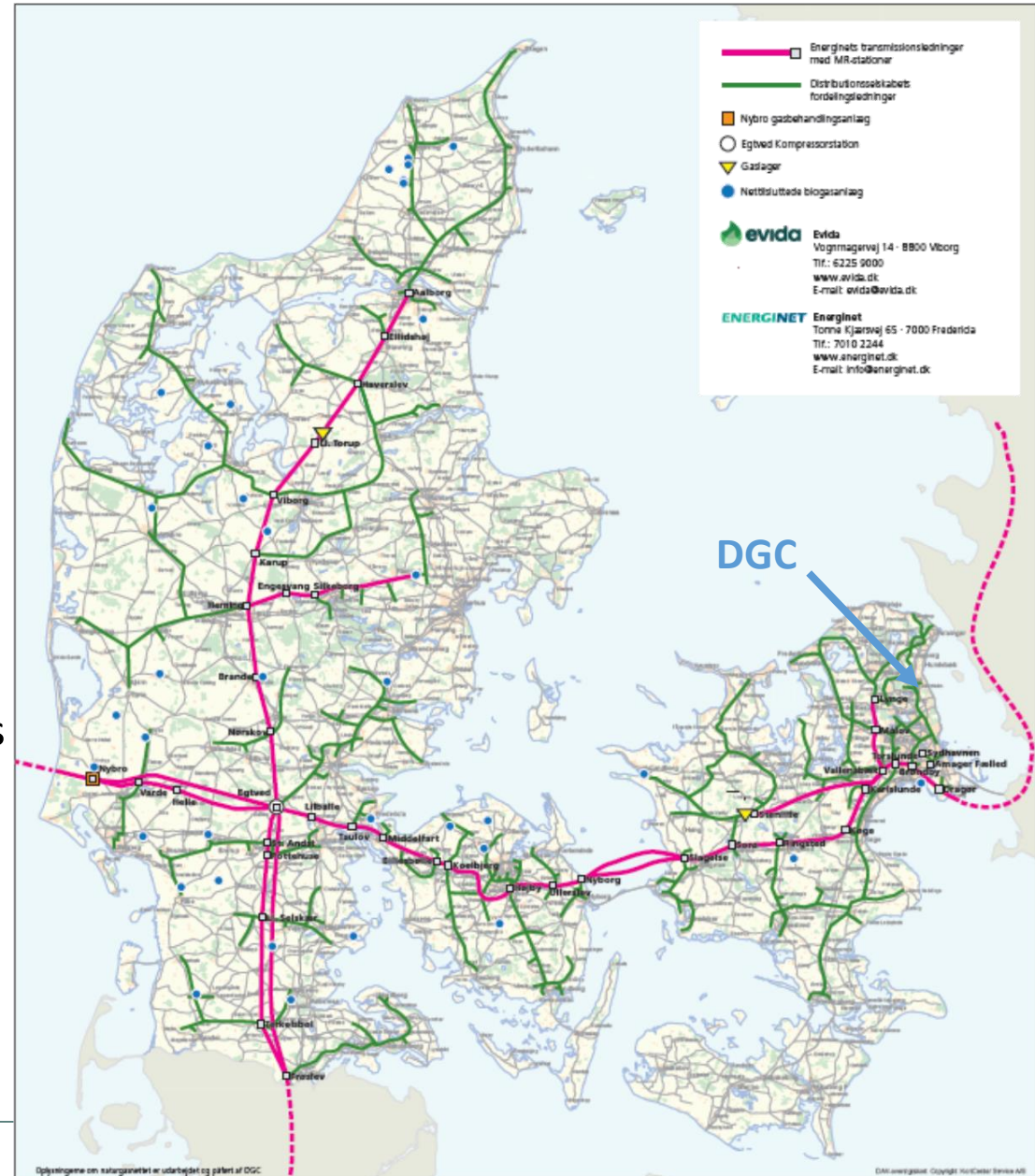
- Around 1900's widespread use of town gas
- Until the 1980's Denmark strongly dependent on oil
- Natural gas network rolled out in the end of the 1970's and during the 1980's based on large amounts of hydrocarbons under the North Sea
- Consequence: the infrastructure is young (long lifetime)



Source: Energinet, www.energinet.dk

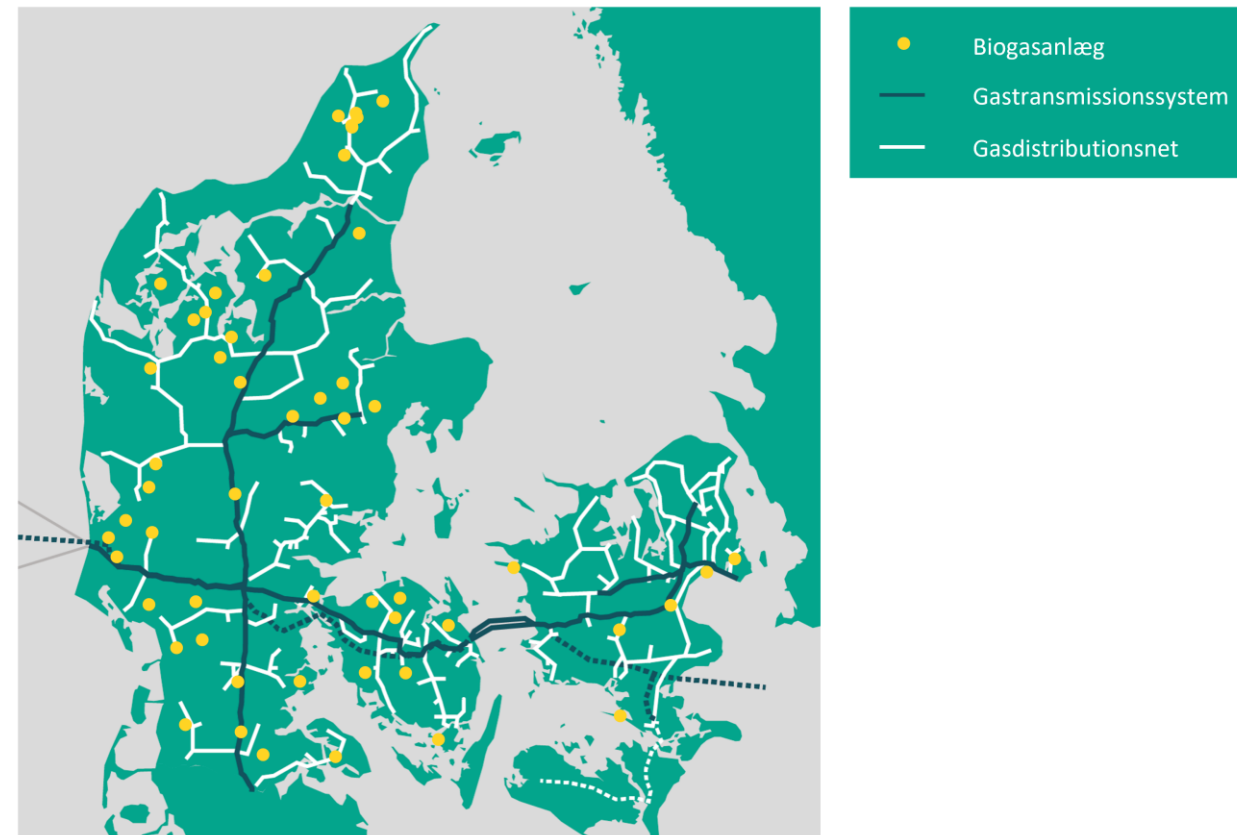
Operators

- 1 TSO (Energinet) and 1 DSO (Evida)
 - Both are independent public enterprises owned by the state, however by different entities
 - TSO: Ministry of Climate and Energy
 - DSO: Ministry of Finance
 - Political decision in 2023: H₂ system will be operated in a similar way by the same actors
- Two gas storage facilities (owned by a subsidiary of Energinet):
 - Lille Torup: salt cavern(s)
 - Stenlille: aquifer



Natural gas & Biomethane: Things to come for H₂?

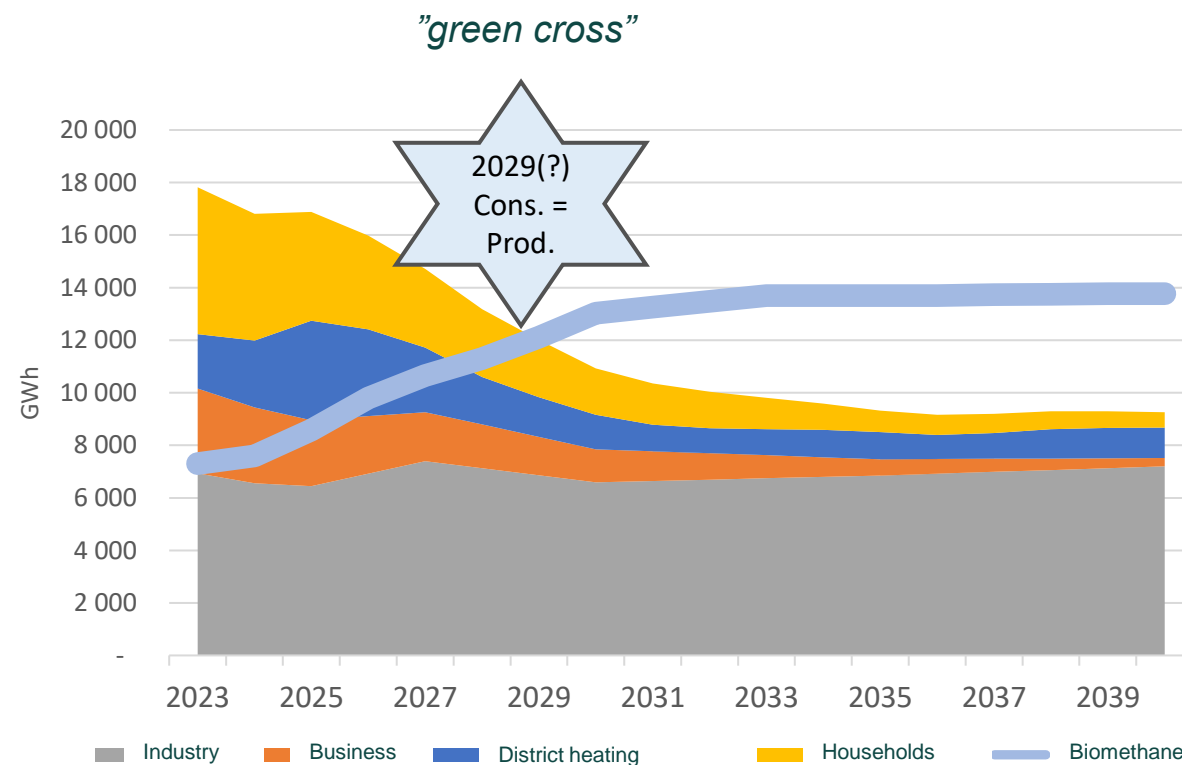
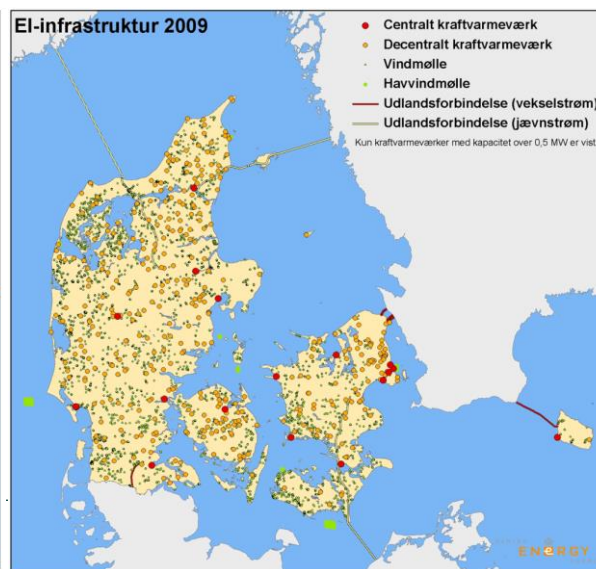
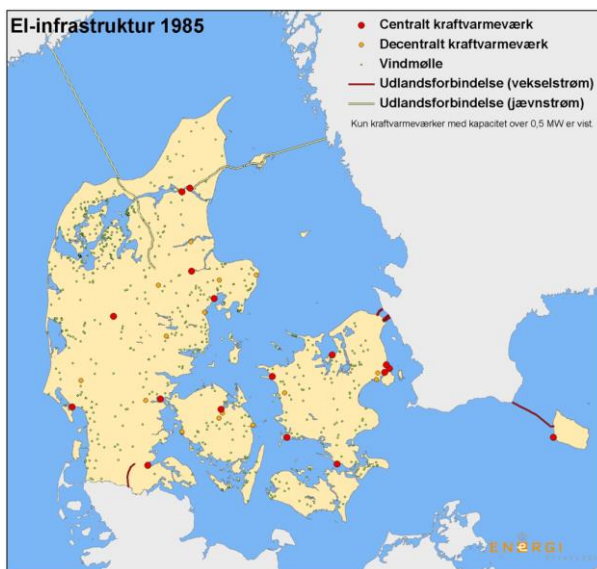
- Approx. 320,000 private households (on top of industrial users)
 - Should be decoupled (political decision)
 - Approx. 22,000 customer disconnected this year
- High (and increasing) share of biogas in the grid
 - Started in 2007, 50 m³/h
 - 57 biogas plants connected to the grid
 - 100% biogas in ca. 2030
- In the summer period, certain parts were over 100% biomethane already in 2021!



Source: Energinet, www.energinet.dk

Natural gas & Biomethane: Things to come for H₂?

- What's behind this transformation?
 - Stable rules and regulations (since 2012)
 - Support and incentives for biomethane production and injection
- This year the incentives are changing (biomethane share decreases right now)
- Has been done before (electricity)



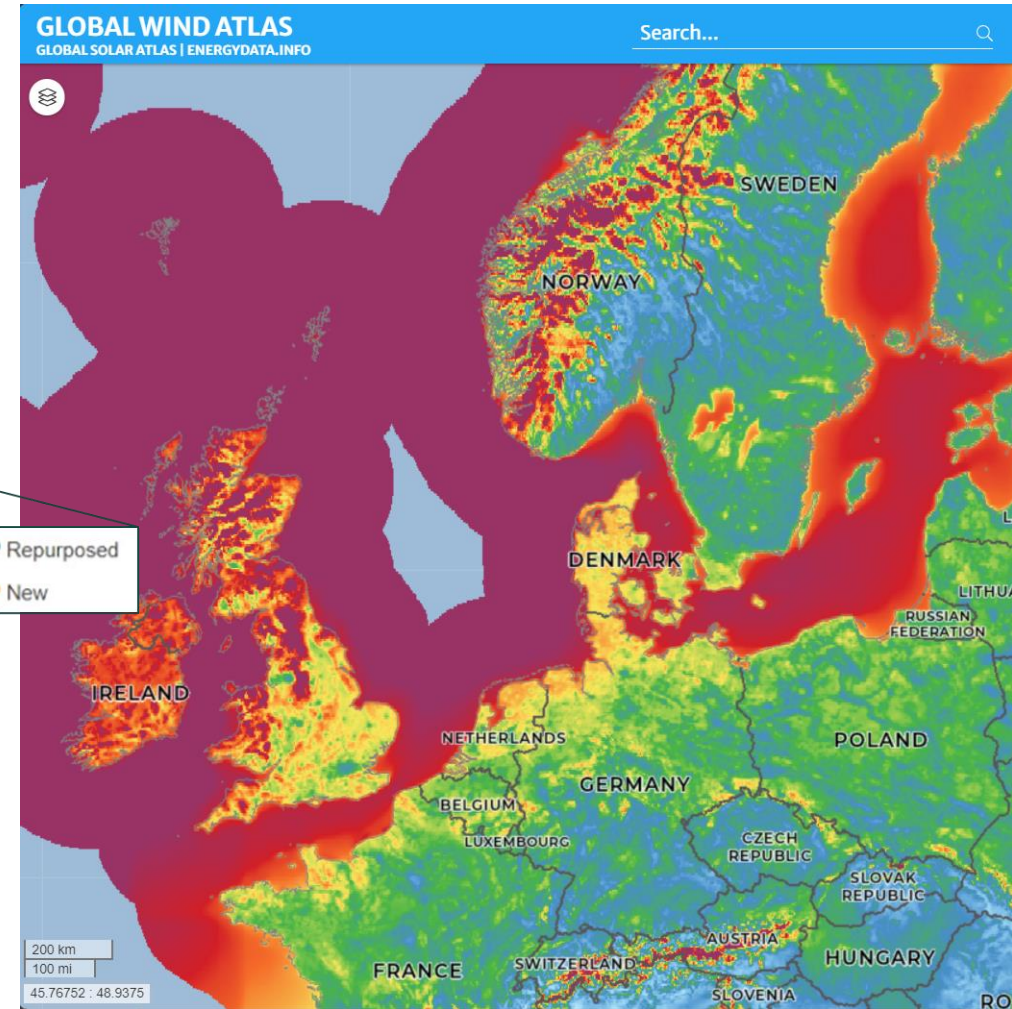
Gas consumption – Analyseforudsætninger til Energinet, 2023

H₂ in Denmark

Future Danish H₂ network

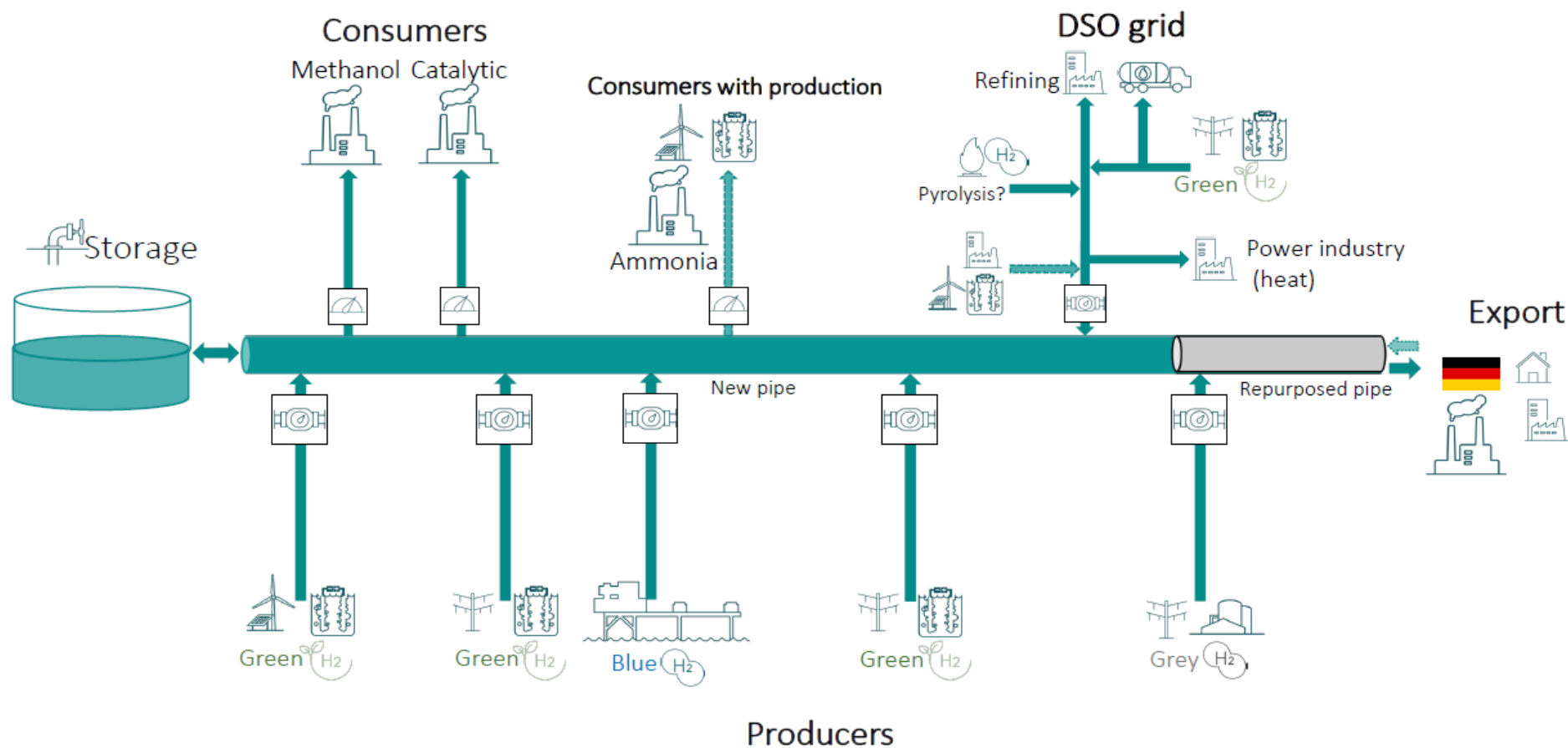


European Hydrogen Backbone Maps
<https://www.ehb.eu/page/european-hydrogen-backbone-maps>



Wind energy potential (Mean Power Density)
<https://globalwindatlas.info/en/>

Parts of the H₂ network

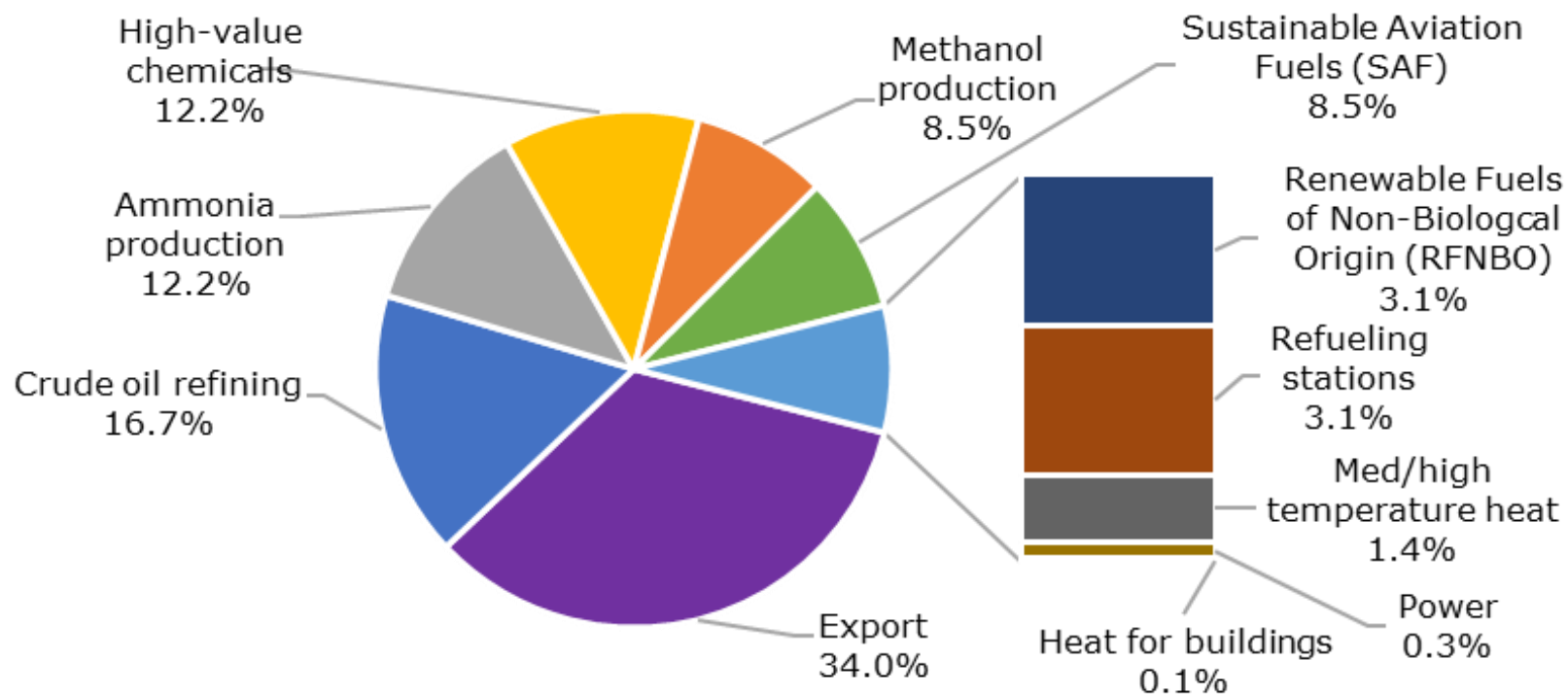


Source: Energinet market dialogue on H₂ quality

Expected H₂ utilisation in 2030

2030 H₂ demand distribution in Denmark

Total demand: 455.5 kt/a

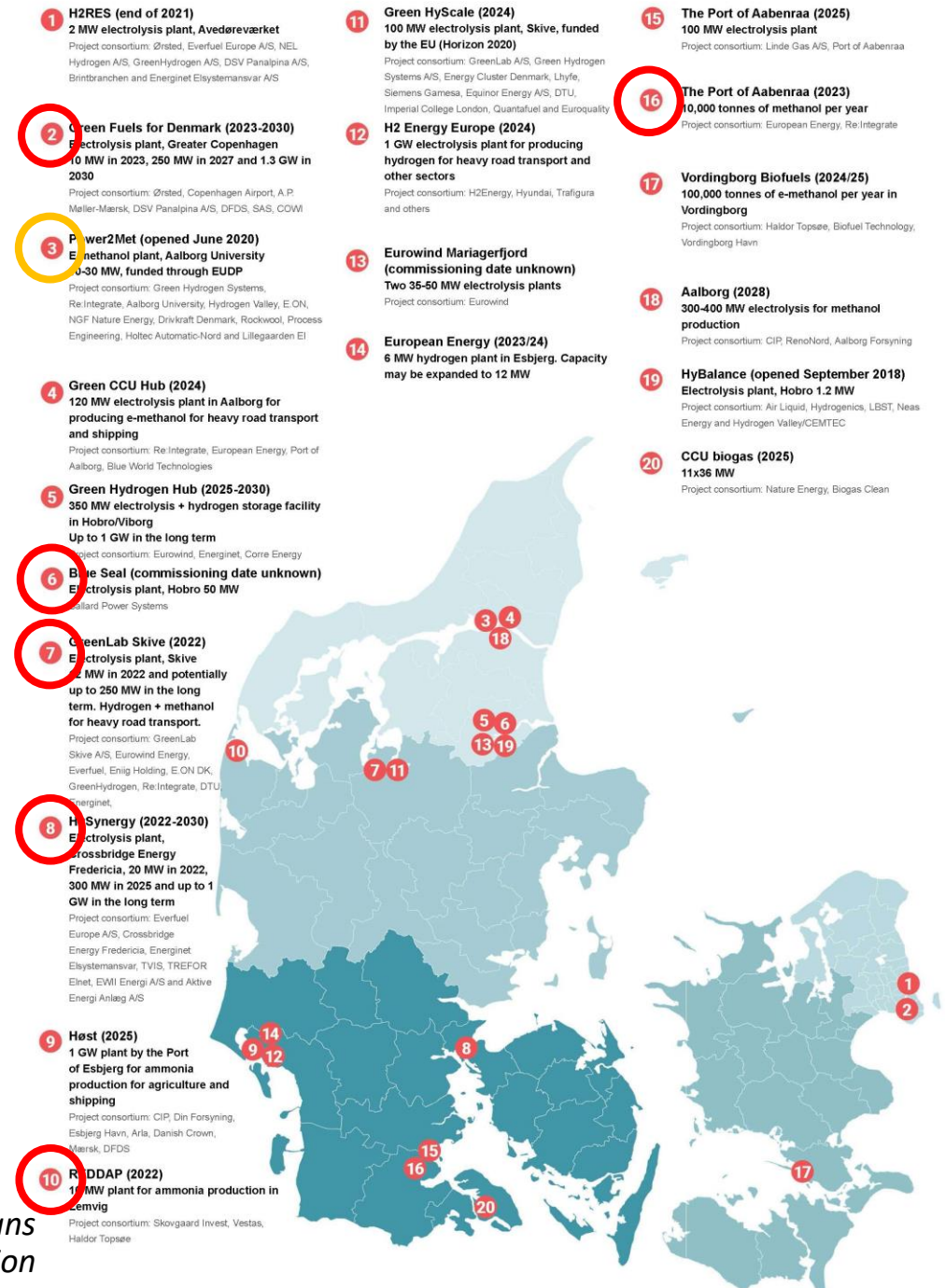


Source: DNV report for Evida, 2023

H₂/PtX projects in Denmark

- **Operating (and could be confirmed):**

- H2RES – H₂ from wind energy, 2 MW
- [ESTECH](#) – Combined carbon capture and H₂ production pilot
- Strandmøllen – Gas supplier company, 0.5 MW electrolysis for use in vehicles
- Glansager e-methane – 3 MW electrolyser
- Brande Hydrogen – 0.4 MW for vehicles
- [HyBalance](#) – wind energy to H₂, 1.2 MW PEM electrolyser since 2018
- [Power2Met](#) – 0.2 MW



Outdated map, but good summary of plans and geographical distribution

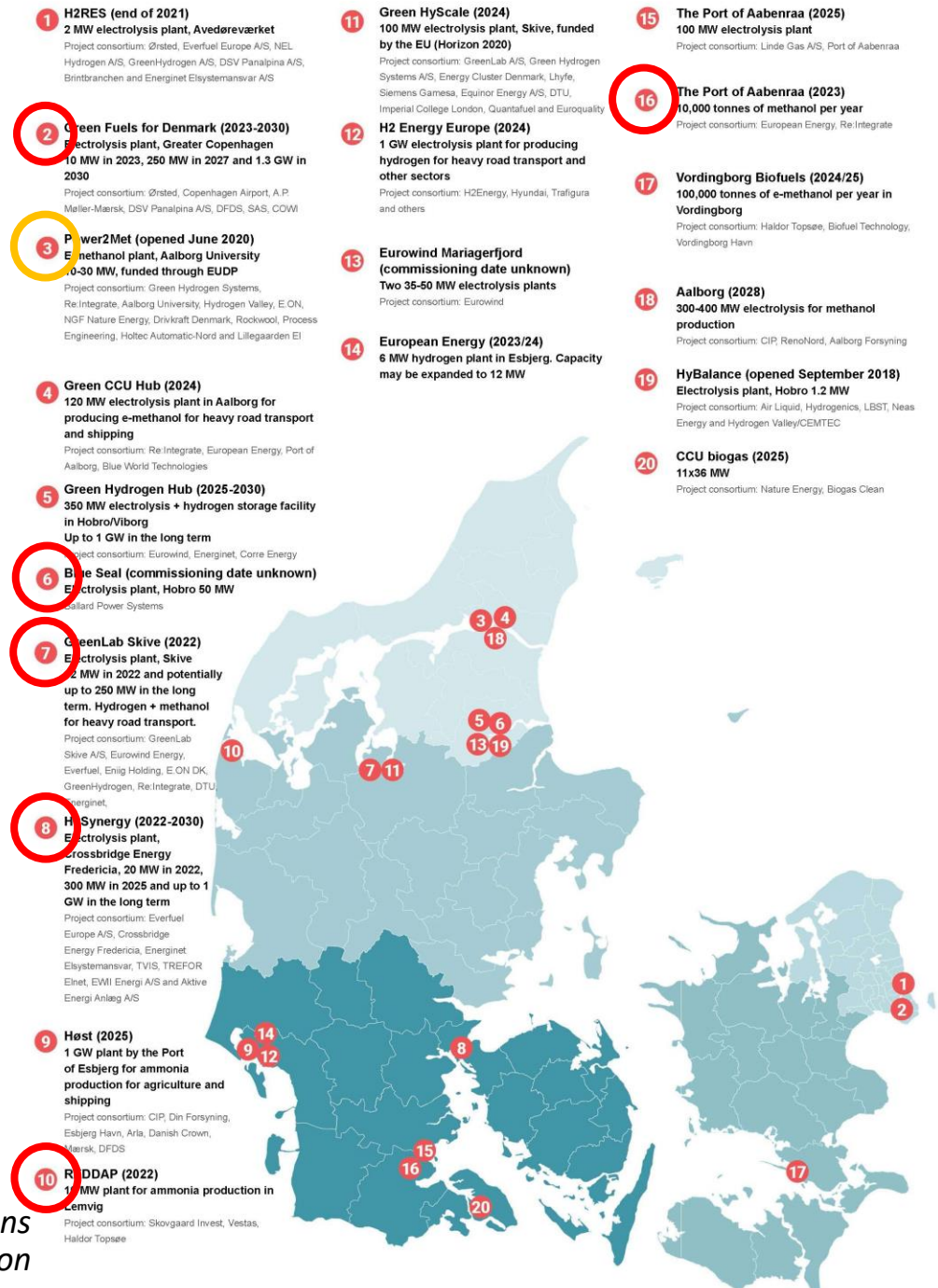
H₂/PtX projects in Denmark

124 MW capacity under construction and a lot more are planned...

2021 plans: 6+ GW by 2030 (Roll-out seems significantly slower)

Project overview (in Danish):

<https://brintbranchen.dk/brintprojekter-i-danmark/>



Outdated map, but good summary of plans and geographical distribution

Example H₂ related activities from DGC

- Recommendation of a gas quality for the future Danish H₂ network
 - Grade A (98%) or higher
 - What is technically feasible?
 - What is needed by the future customers?
 - Etc.
- Repurposing of a distribution pipeline – technical & documentation requirements and high level cost analysis
 - Analysis of requirements from ASME B31.12
 - Price estimates from internal (Evida) sources and external partners
- Repurposing of salt caverns to H₂ storage – external consultant on metering and analysis
 - Top site FEED study for TSO

Example H₂ related activities from DGC

- Leakage detection of NG/CH₄ and transfer to H₂
 - Significant activities in leakage detection connected to the natural gas grid (EU regulation!)
 - Leakage measurements of biogas plants (government requirement)
 - Transfer of experience, knowledge and methods to H₂ technologies/rid
- Field test of H₂ in a model system of the Danish natural gas grid
 - Long term test of effect of H₂ on PE and metal pipes
 - Testing of the robustness of natural gas meters
- IEA Hydrogen Technology Collaboration Program (TCP) – Task 43: Safety and RCS of Large Scale Hydrogen Energy Applications
- Standardization (among others):
 - CEN TC 234
 - ISO TC 197
 - ASME B31.12 European IWG

Thank you for your attention!
