Hydrogen Valley

Bringing Power-to-X to life

HYDROGEN VALLEY®

Agenda

1. Hydrogen Valley Denmark
2. Recent achievements
3. Next steps
4. What we offer?

Hydrogen Valley Denmark

- Non-profit organization – financed partly by the Municipality of Mariagerfjord and project aids
- Based in the Northern Part of Denmark

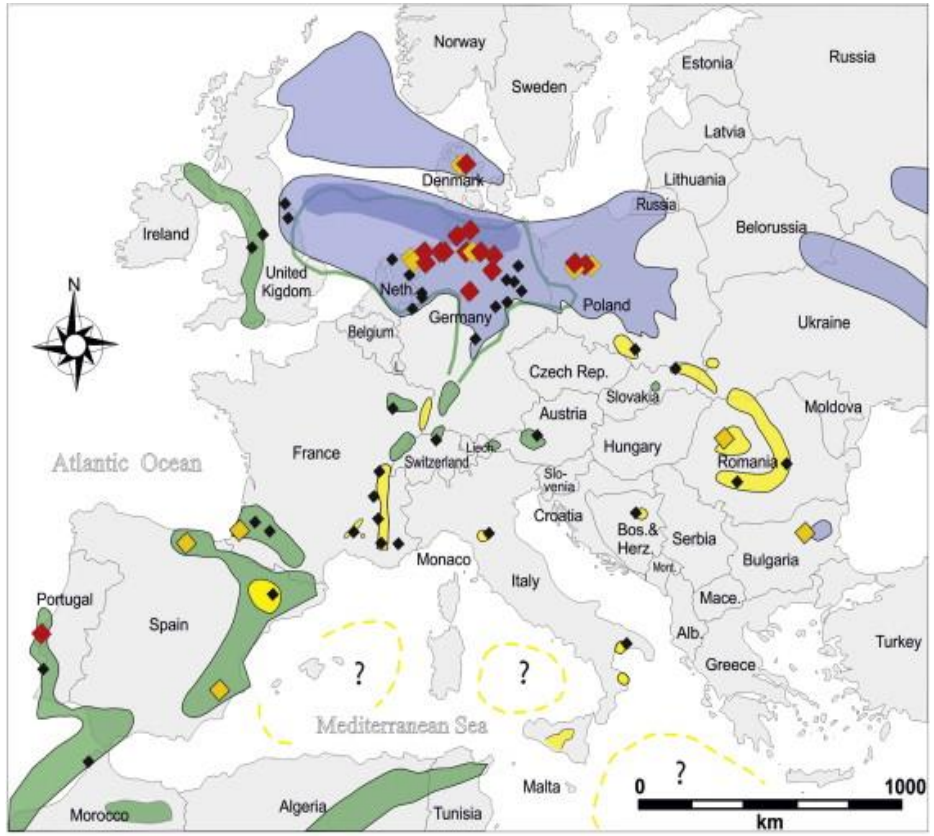
Experience and stakeholders

- 15 years of experience and already over 30 m. € invested in projects and activities within the FCH-sector
- Local stakeholders along the value chain
- Facilities and services

Resources

- Strong RE competences
- HV transmission lines
- Biogas and industry CO2 sources
- District heating network

- Geological advantages



(from Gillhaus & Horvath 2008)

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Greentech industry cluster

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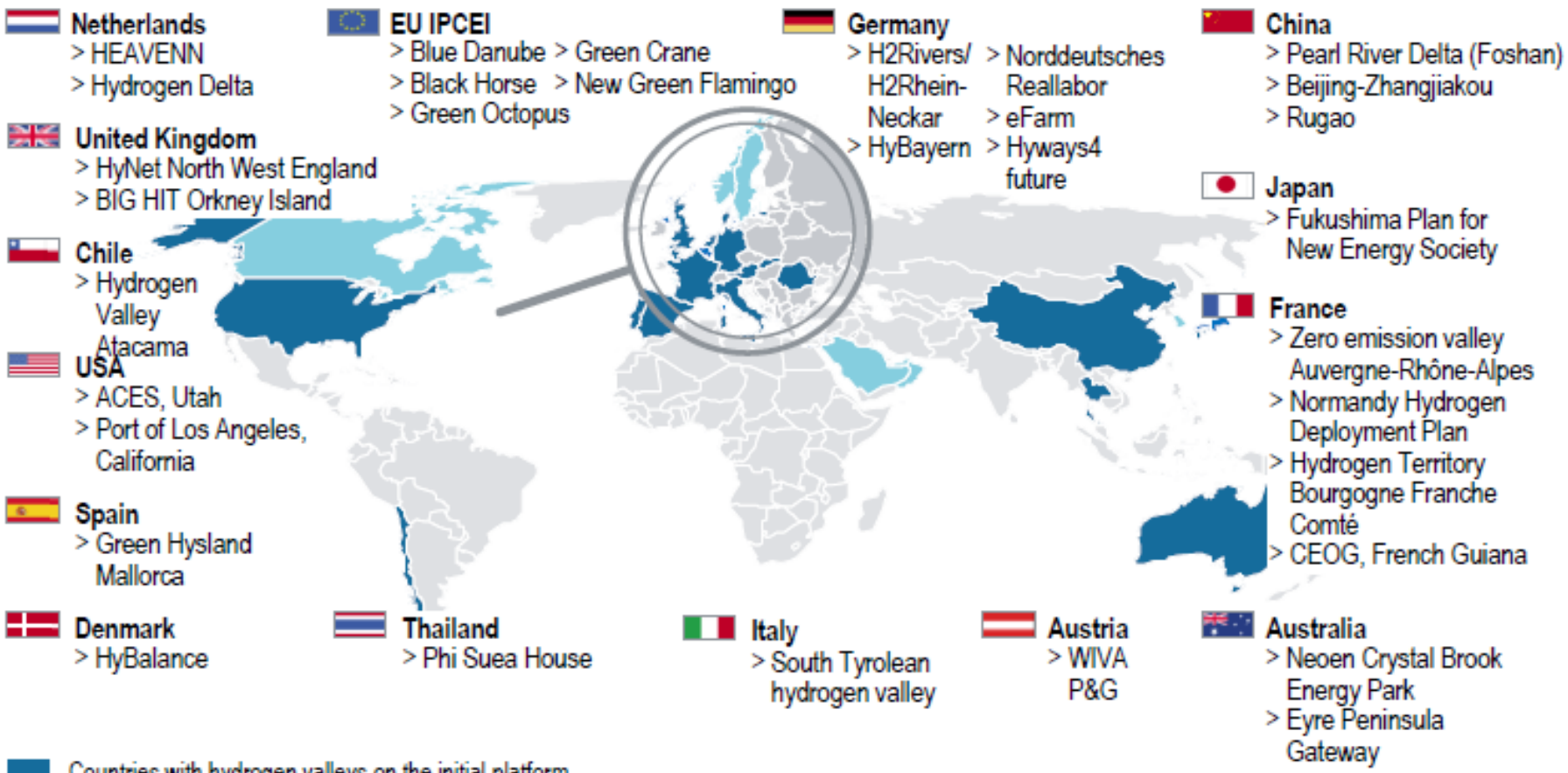
A fast-growing landscape of globally leading projects ...



Source: FCH JU, Roland Berger

... featured on a new platform

> 30 valleys from 15 countries

> 1,500 data points

10 in-depth best-practice profiles

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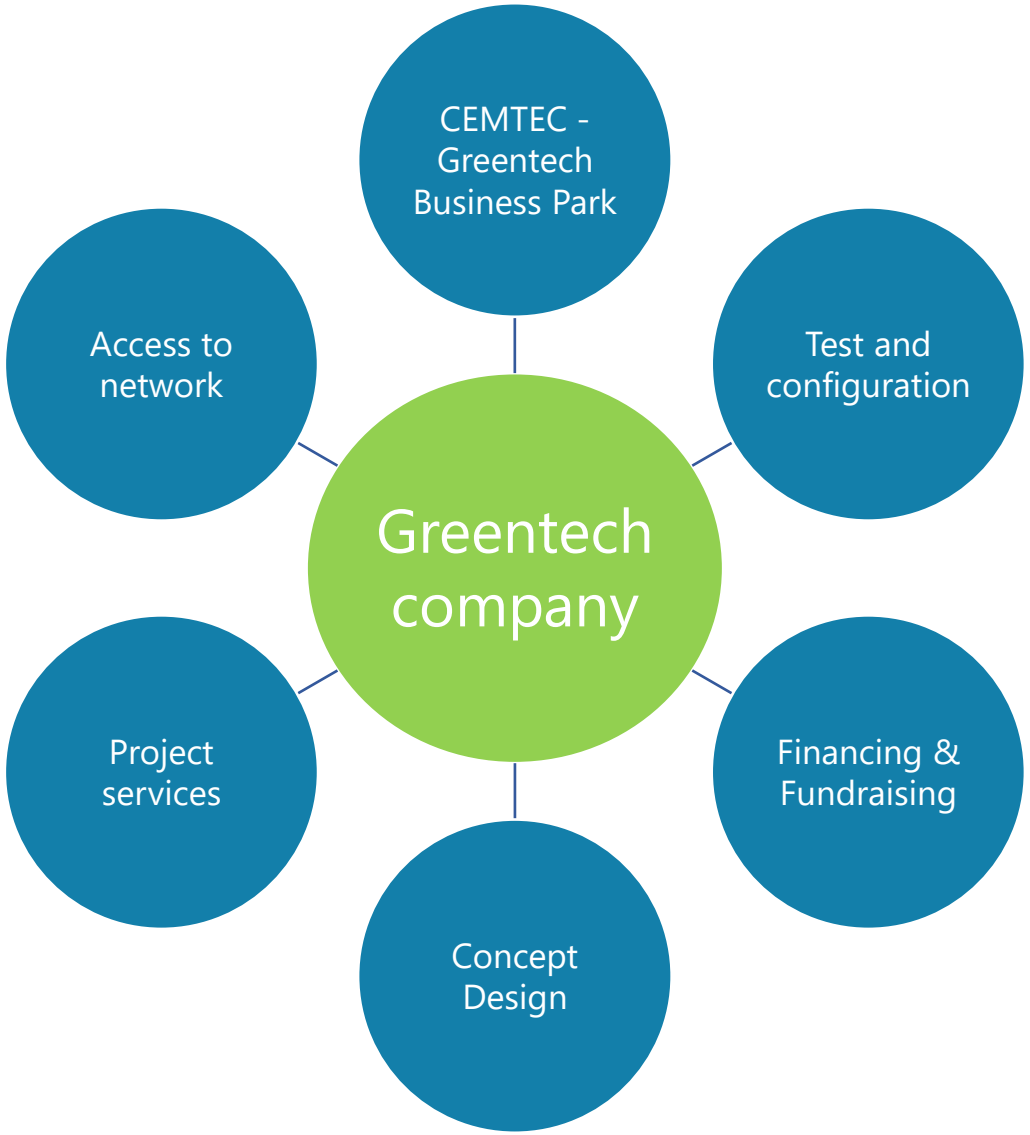
Our services

- Offices facilities
- Concept design and test
- Partnerships
- Financing & Fundraising
- Execution



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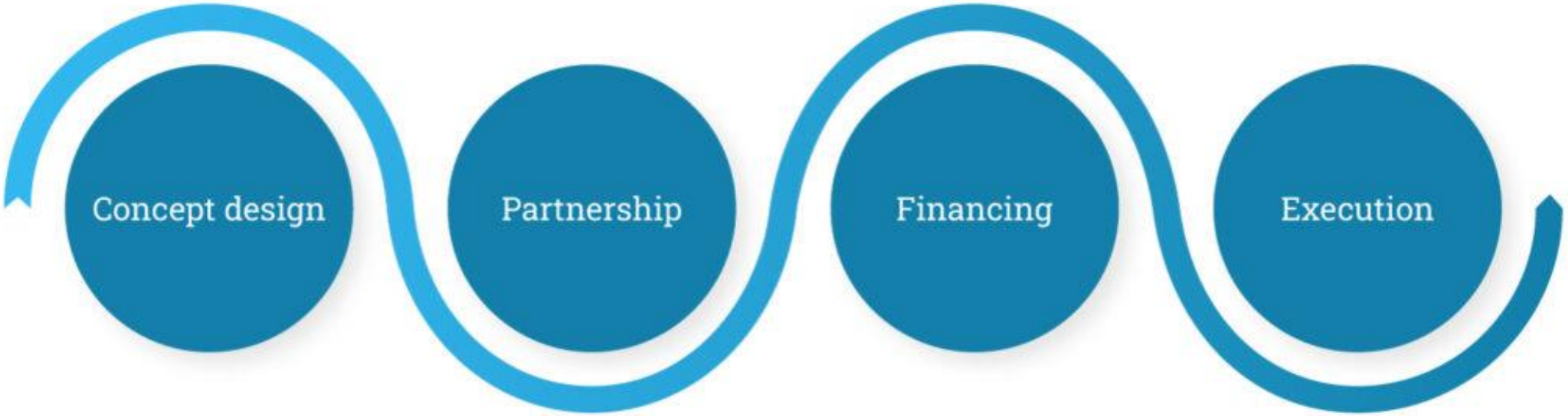
From idea



… to market

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Recent achievements

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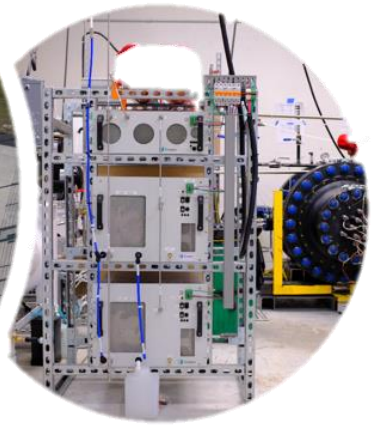
15 years of experience

Hydrogen

Methanol

Power2Met

HyBalance



Ammonia

Power2Ammonia

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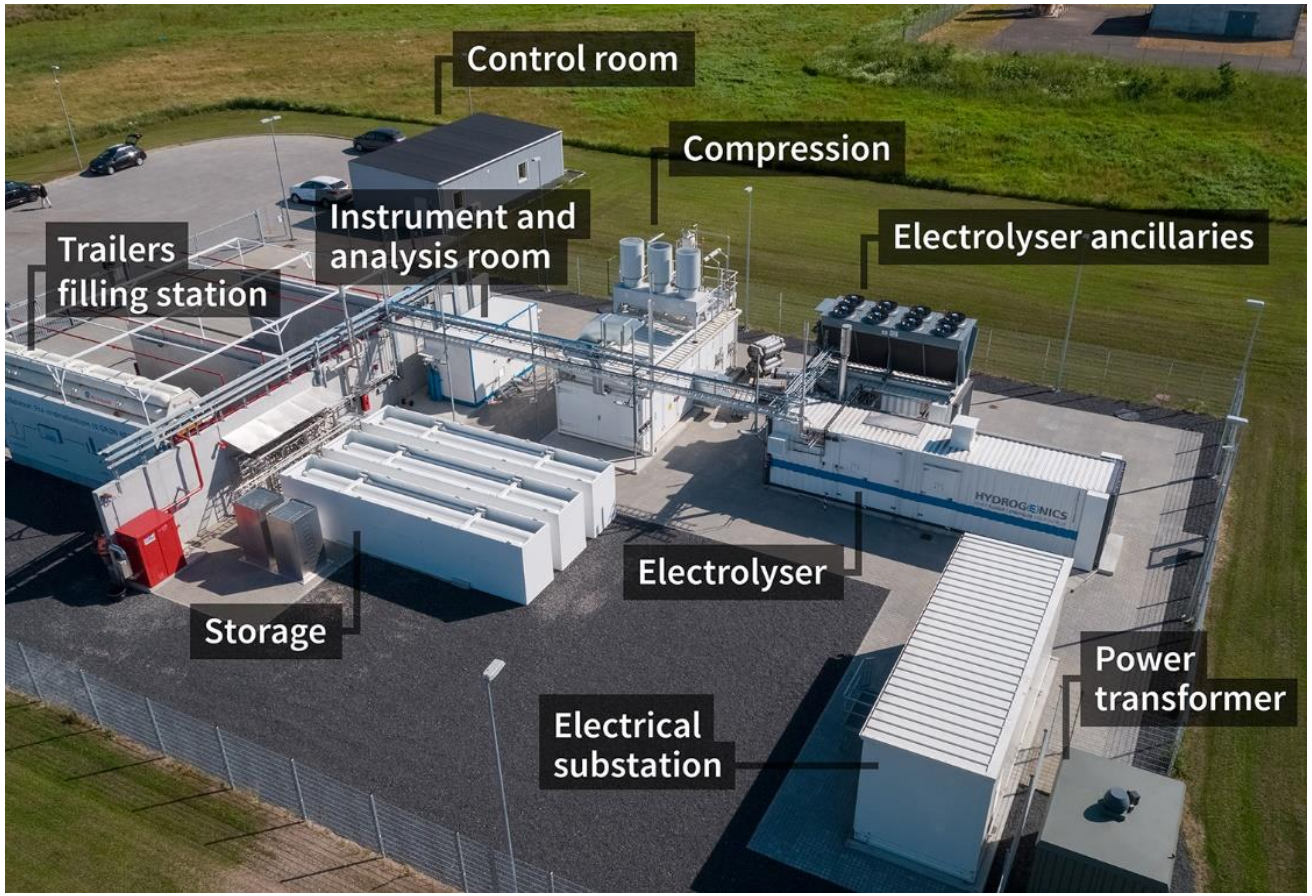
HyBalance overview



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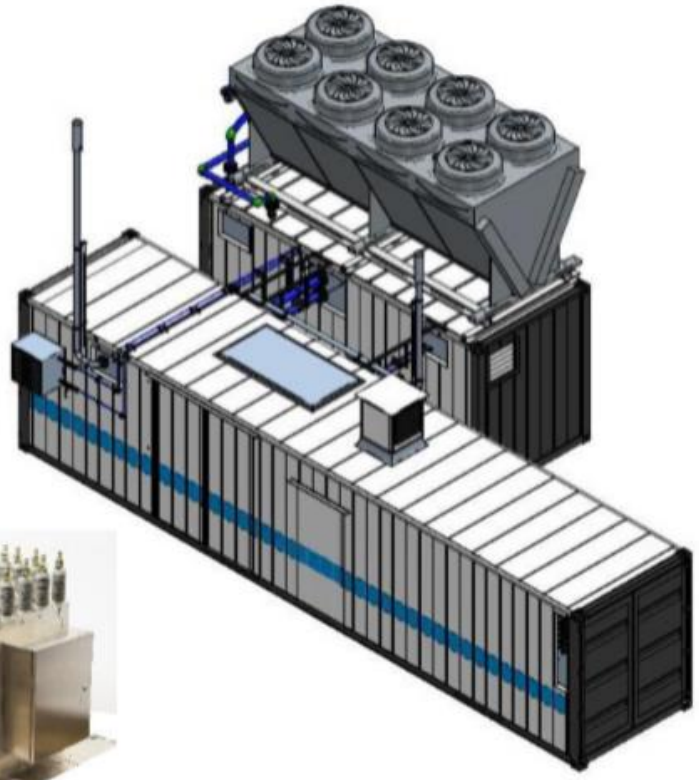
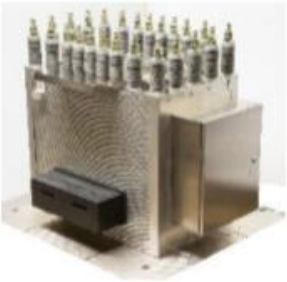
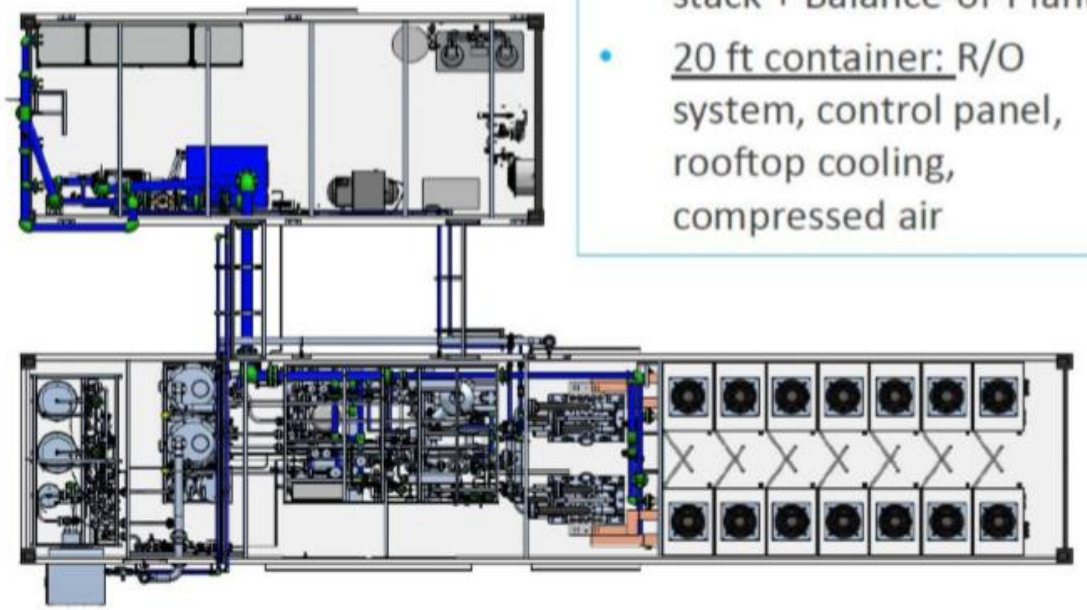
HyBalance project: PEM electrolyzer design



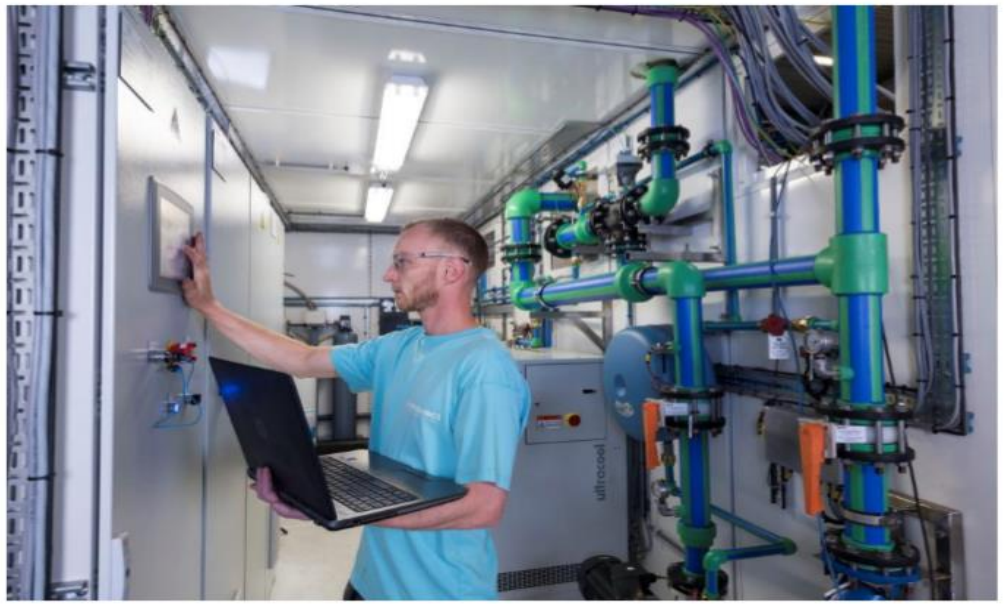




- 40 ft container: power racks (rectifiers), dual cell stack + Balance-of-Plant
- 20 ft container: R/O system, control panel, rooftop cooling, compressed air

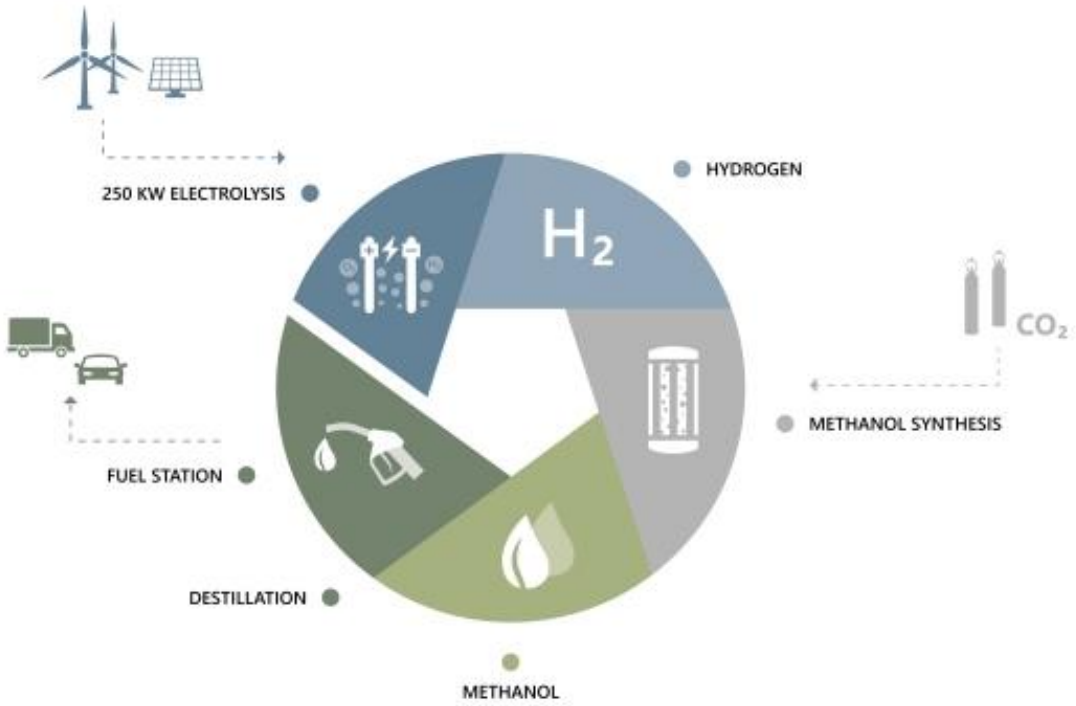
Lessons learned on the electrolyzer from HyBalance

- **>100 tons** of hydrogen produced
- **>10000 hours** of operation
- Operational availability: **>95%**
- Cell stacks can be operated asymmetrical
- Successful balancing of the grid



Power2Met

- Phase 1 – pilot scale
- Phase 2 – 10 MW methanol facility
- New spin-out formed to accelerate technology (REintegrate)
- Next phase: CO2 from Waste-to-Energy plants and Cement factories
- Video-tour: HERE



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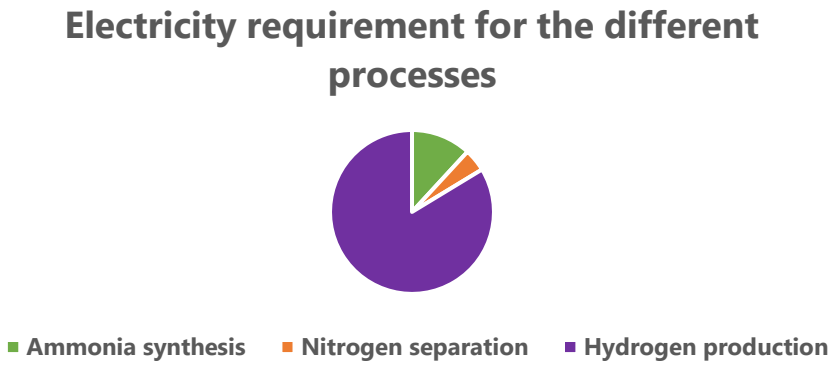
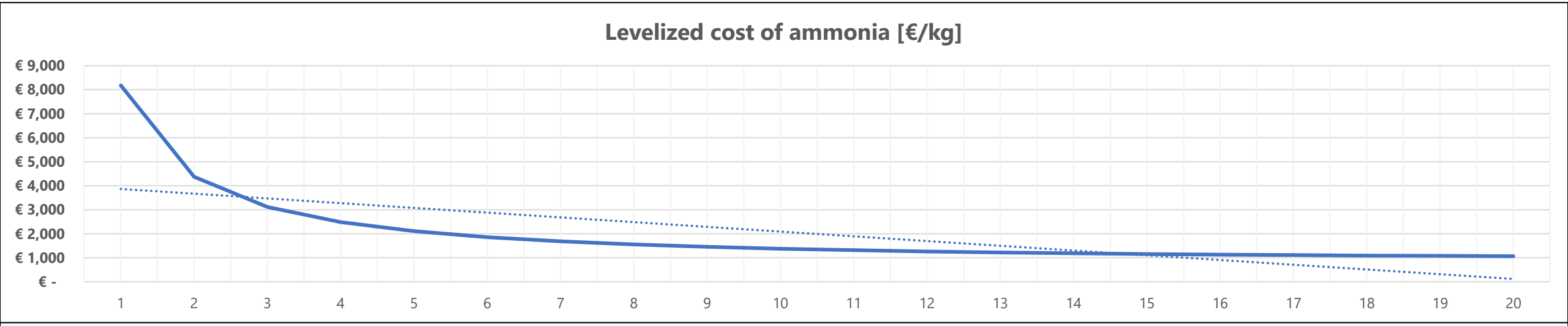
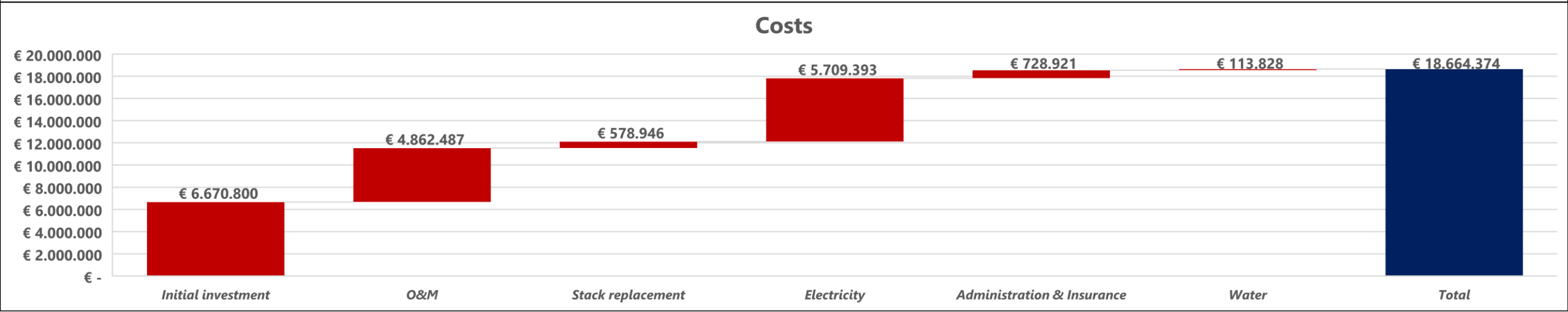
Power2Ammonia
(PTX Model concept design)







Next stop: Scale Up!

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World class test and demonstration facility for Power-to-X technology with a 1,2 MW H2 pipeline

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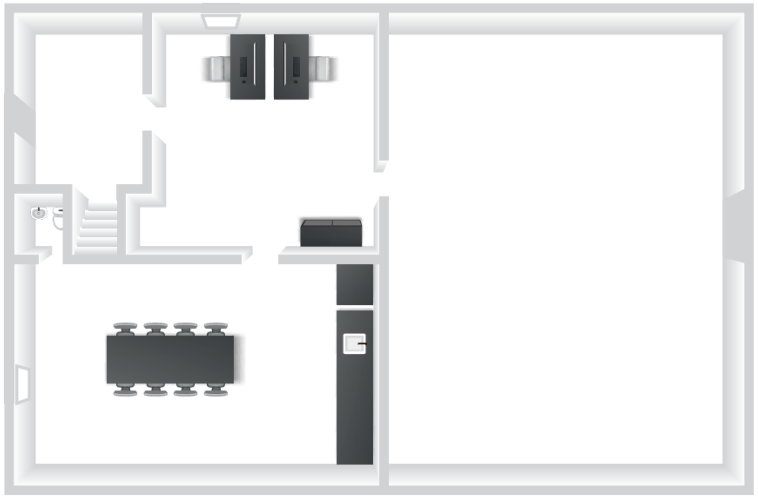
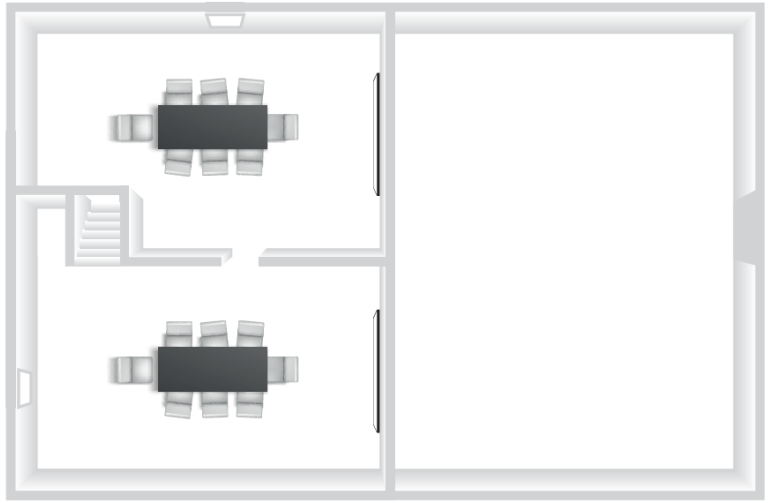
Testcenter facilities

Ground floor



1st. floor



- 1 testbed for MW scale test
- Control and project facilities
- Meeting facilities for up to 20 people
- Kitchen/Canteen facilities
- Outside area for testing and large-scale outdoor solutions
- Heat and power management for equipment

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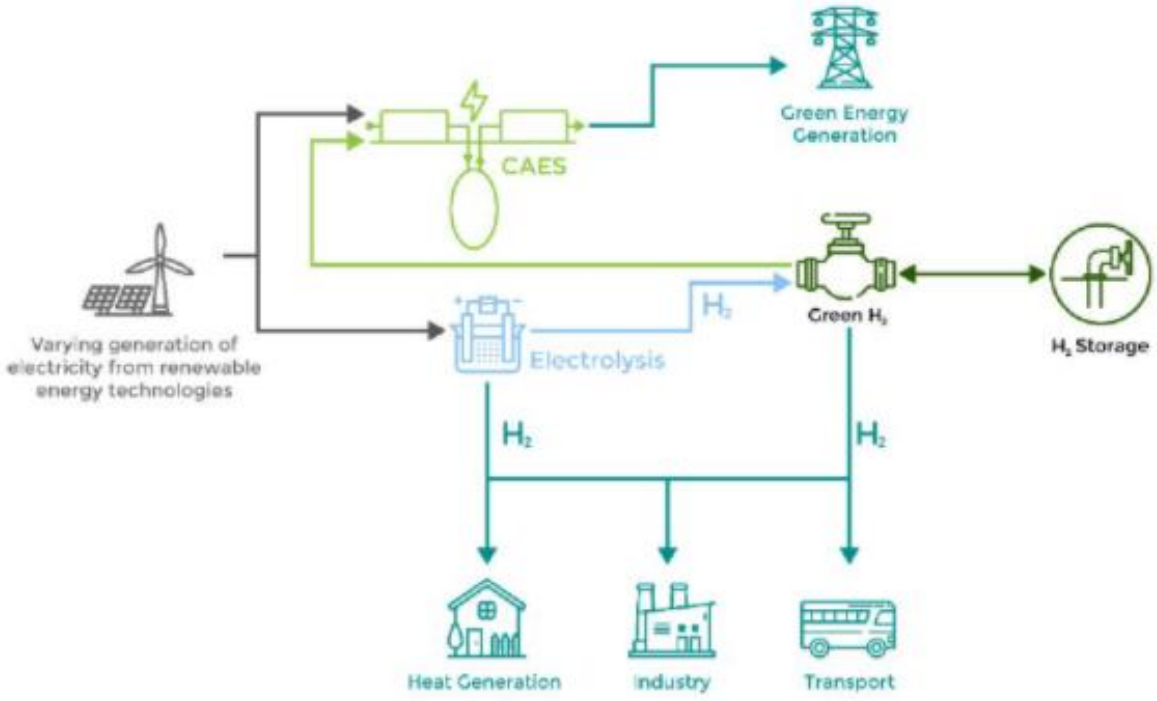
Green Hydrogen Hub

- Combined CAES/Hydrogen to provide 100% green electricity for around 280.000 Danish households
- Enables more RE in the Danish energy system by balancing the grid
- Exploiting underground caverns for gas storage



Year	Electrolysis capacity	Hydrogen storage capacity	Hydrogen CAES
2025	350 MW	200 GWh	320 MW
2030	1000 MW	400 GWh	320 MW

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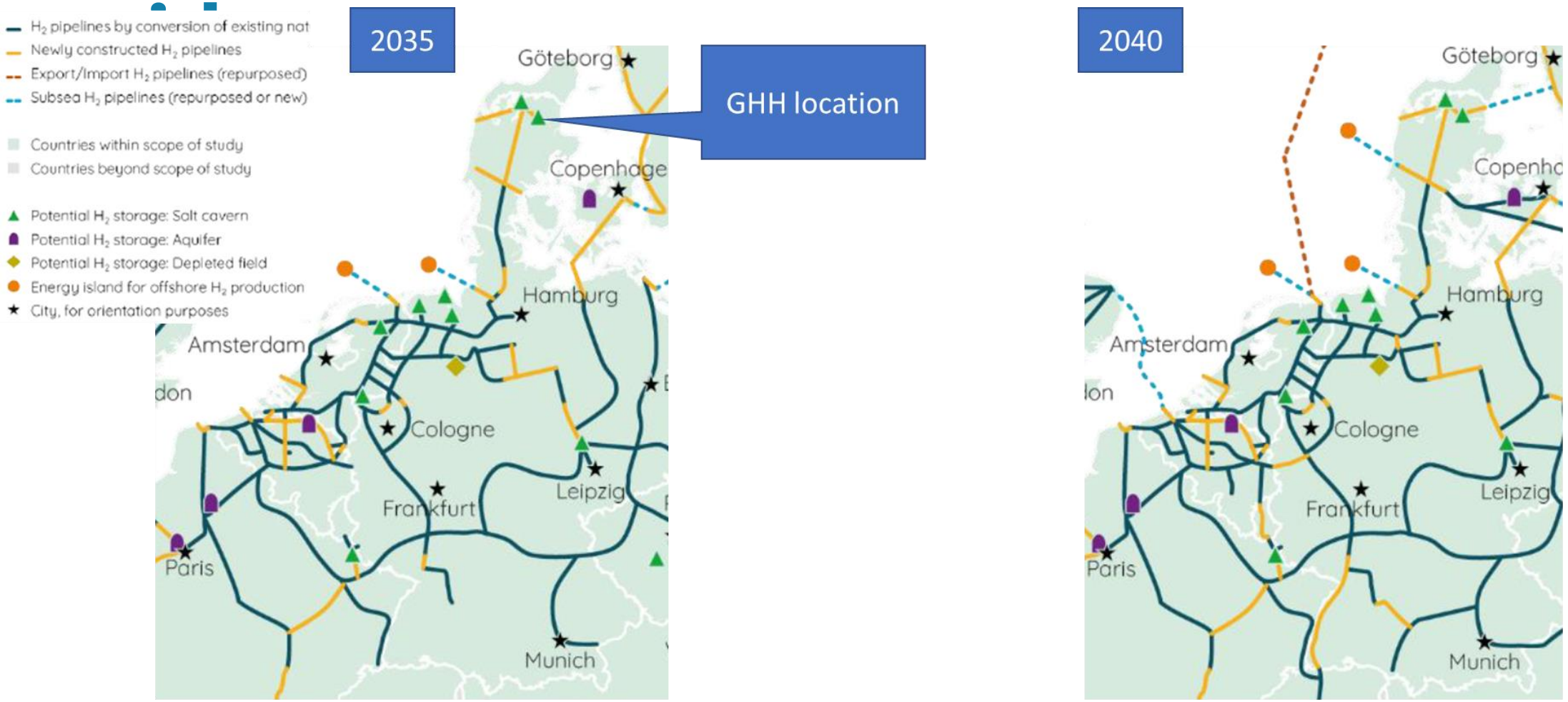
… enabling European green hydrogen



European Hydrogen Backbone - Gas for Climate 2050

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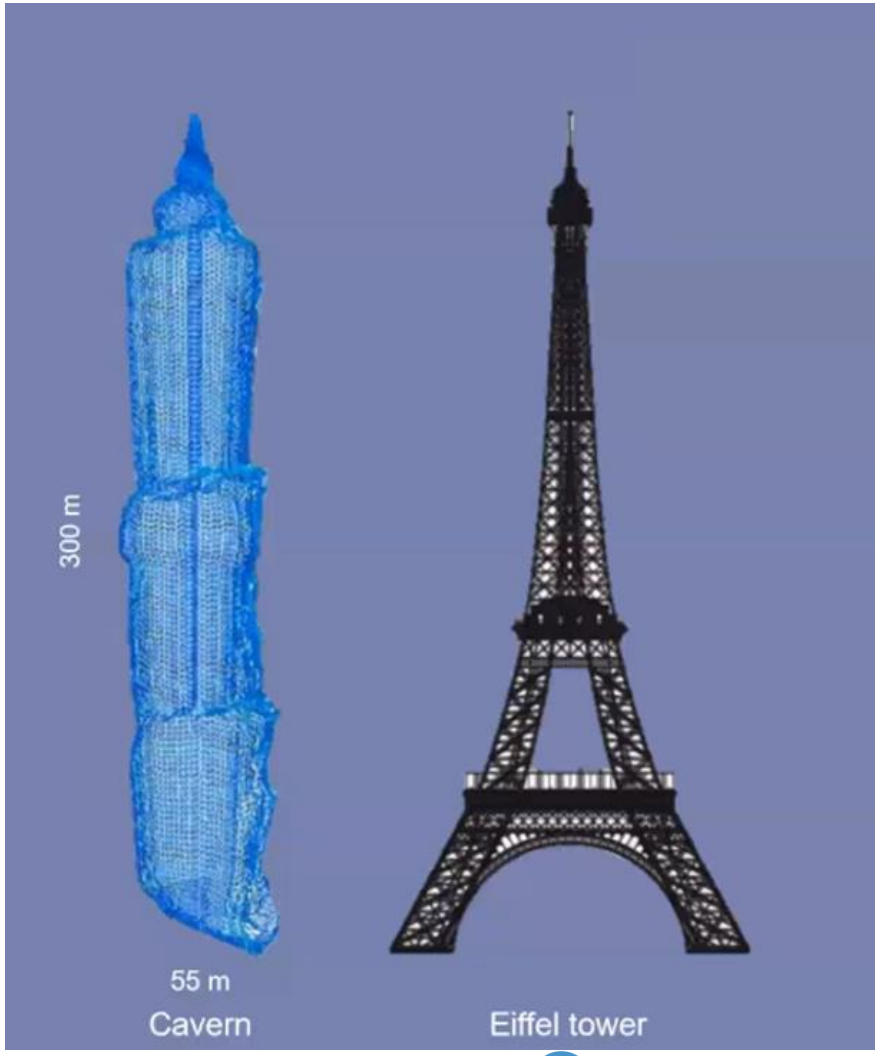
Large scale energy storage

- Caverns: the preferred hydrogen storage
- Capacity: approx. 5.000 ton / 200 GWh
- Optimization: value chains between 300-600 MW
- 7 natural gas caverns and 9 potential caverns in Lille Torup

Plant type	Effekt (GW)	Price (mio. DKK/GW/km)
HVDC (150 km incl. Converter)	2	29,1
150 kV-cable	0,26	9,6
Overhead power lines 2*400 kV	2*1,9	4,3
Hydrogen pipeline 36"	10	1,4

https://energinet.dk/Om-publikationer/Publikationer/Nye-vinde-til-brint---PtX-handlingsplan



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Danish PTX Strategy

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Hydrogen system 1.0 (2015-2020)

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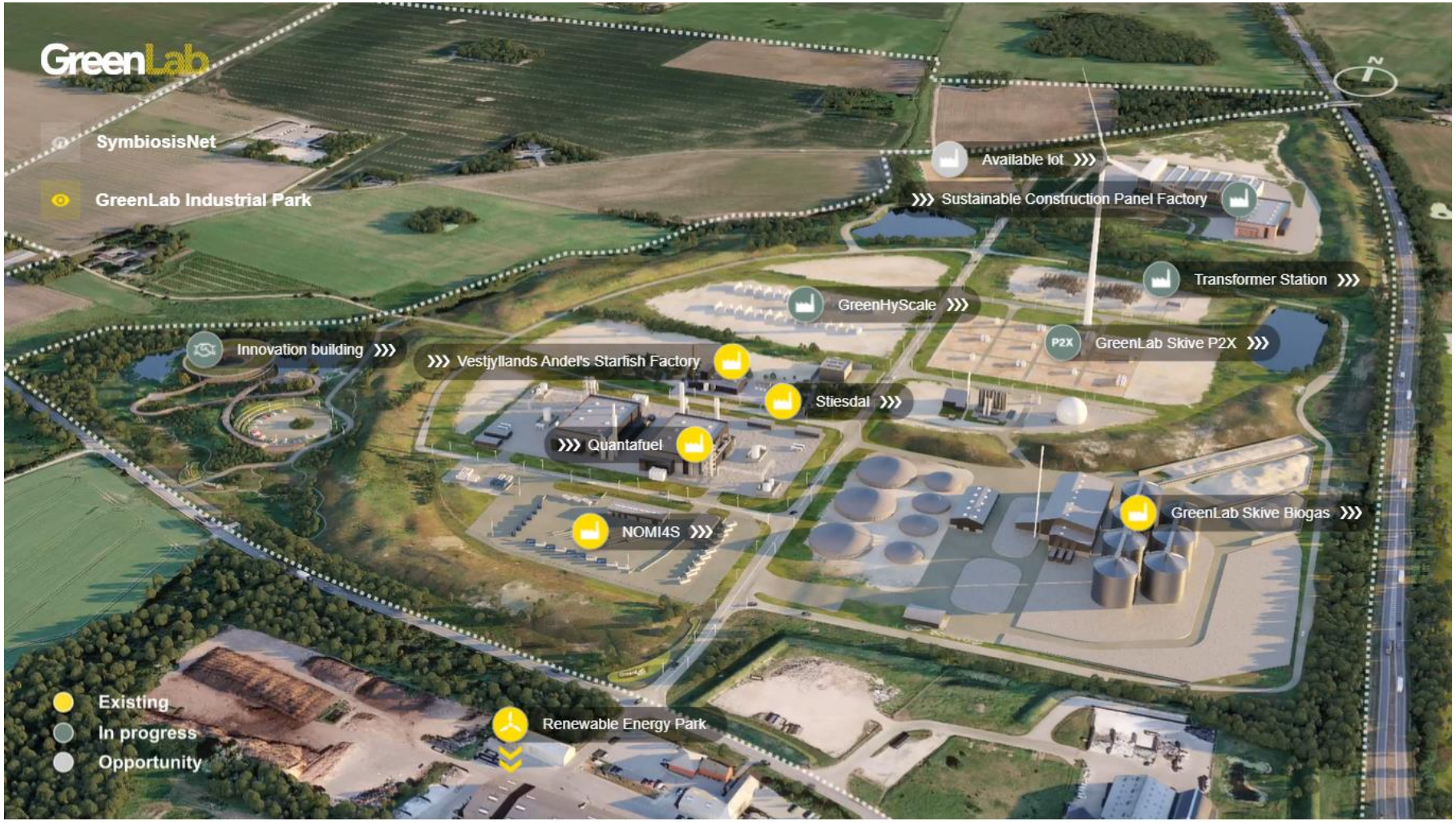
Hydrogen system 2.0 – GreenLab Skive (2020-2025)



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Hydrogen system 3.0 – 2025

- Danish DSO, Evida A/S plans to utilize 100% hydrogen DSO infrastructure in selected Danish locations in 2025
- Plans for Danish-wide network in 2030
- First deployment in Central Jutland to utilize cavern storage
- **NEXT STEP DEVELOPED AS WE SPEAK: Cross border connection (Norway/Germany/Netherlands + Use in Europe)**

— RØRFØRT INFRASTRUKTUR
A AALBORG
B EUROWIND ENERGY
C GAS STORAGE DENMARK
D GREENLAB

ClusterNorthH_2

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