HYDROGEN AND POWER-TO-X IN DENMARK

Henrik Skou
Senior Advisor, Green Fuels
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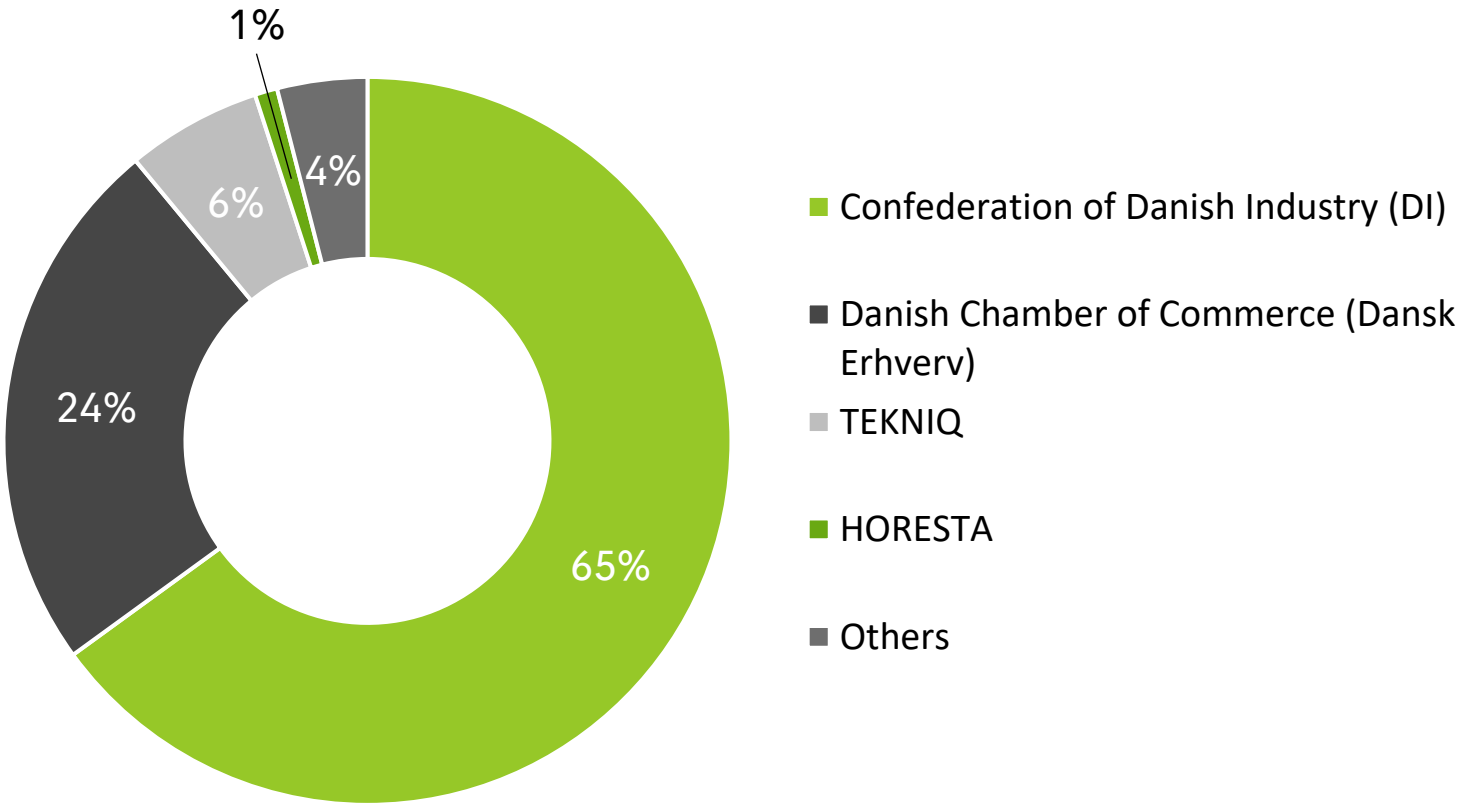
DI Energi

DI is Denmark's largest business and employers' organisation



DI's over 19,000 members represent 65 pct. of the total wages under the Confederation of Danish Employers

The diagram shows the member organisation's share of DA in terms of wages as per October 2022.
Source: DA

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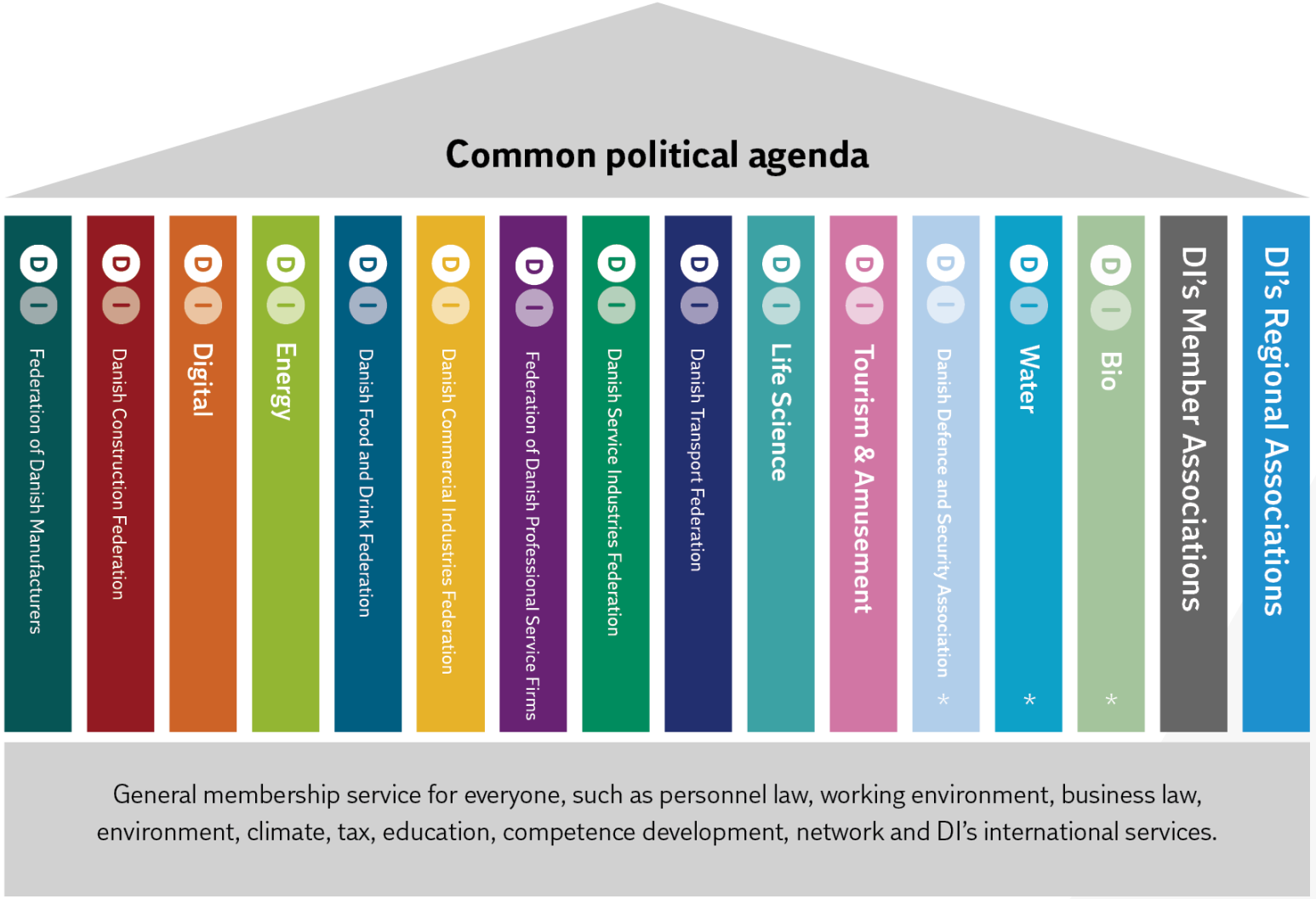
DI – The house of Industry

DI's common political agenda

Strong member pillars in branches and associations as well as regionally

A solid foundation for the entire DI



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Strong companies in a *strong* society

Denmark should be the best country in the world to live in, and the best country in the world to run a business in.

These two goals are inextricably linked.

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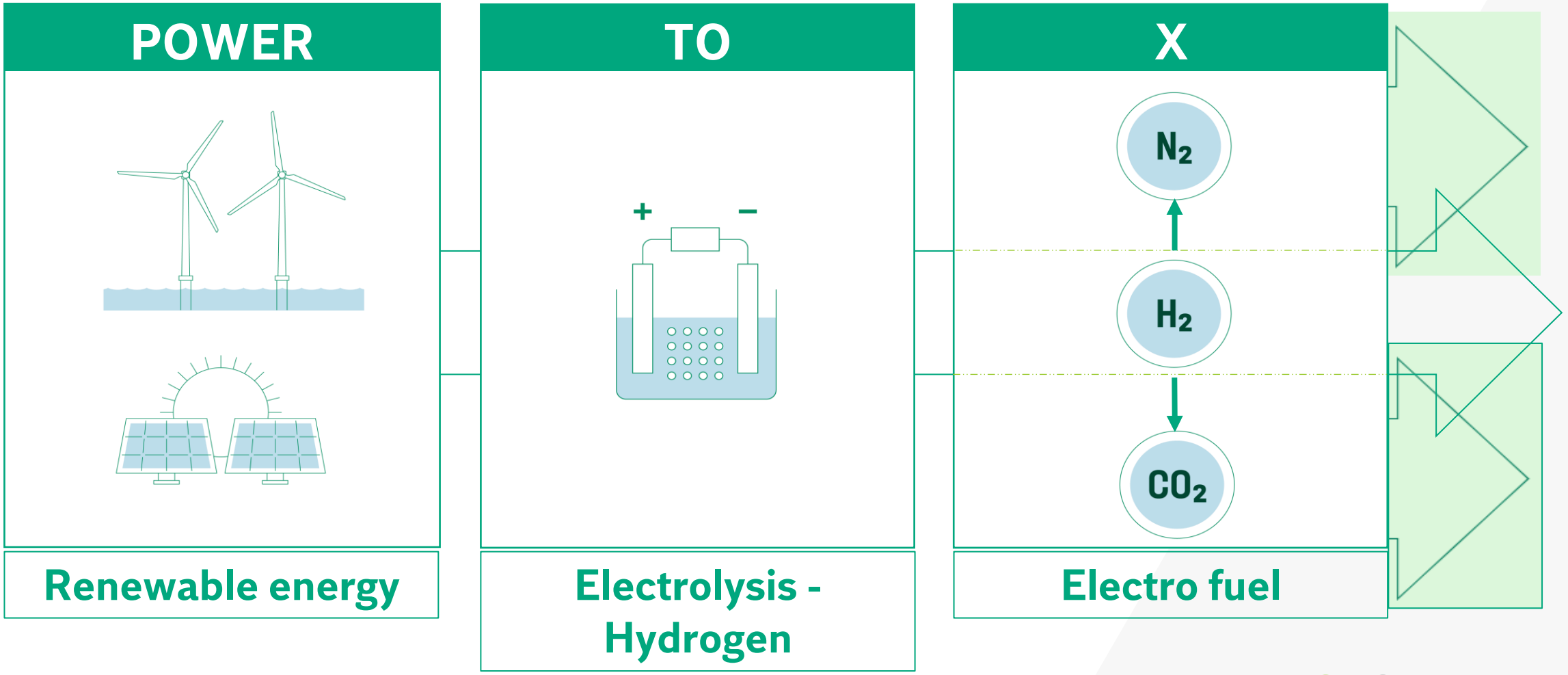
What is Power-to-X?



Credit: State of Green

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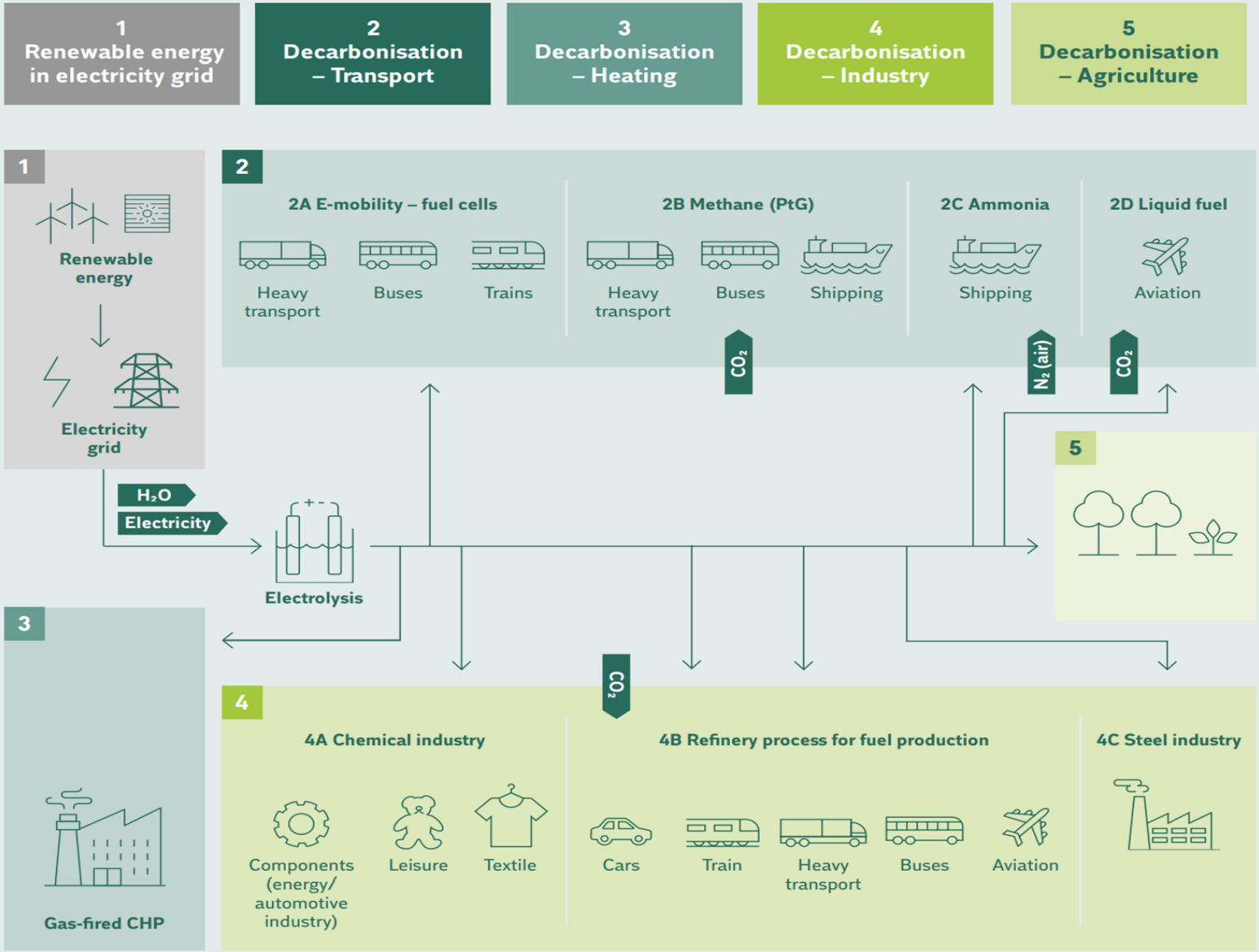
The Danish value chain



Danish prerequisites

- Leading wind industry
- Favorable geography
- World-leading companies throughout the value chain
- Well-integrated energy system
- Cooperation between producers and large purchasers of fuels, heavy transport and the proximity to German industry
- A history for public-private collaboration

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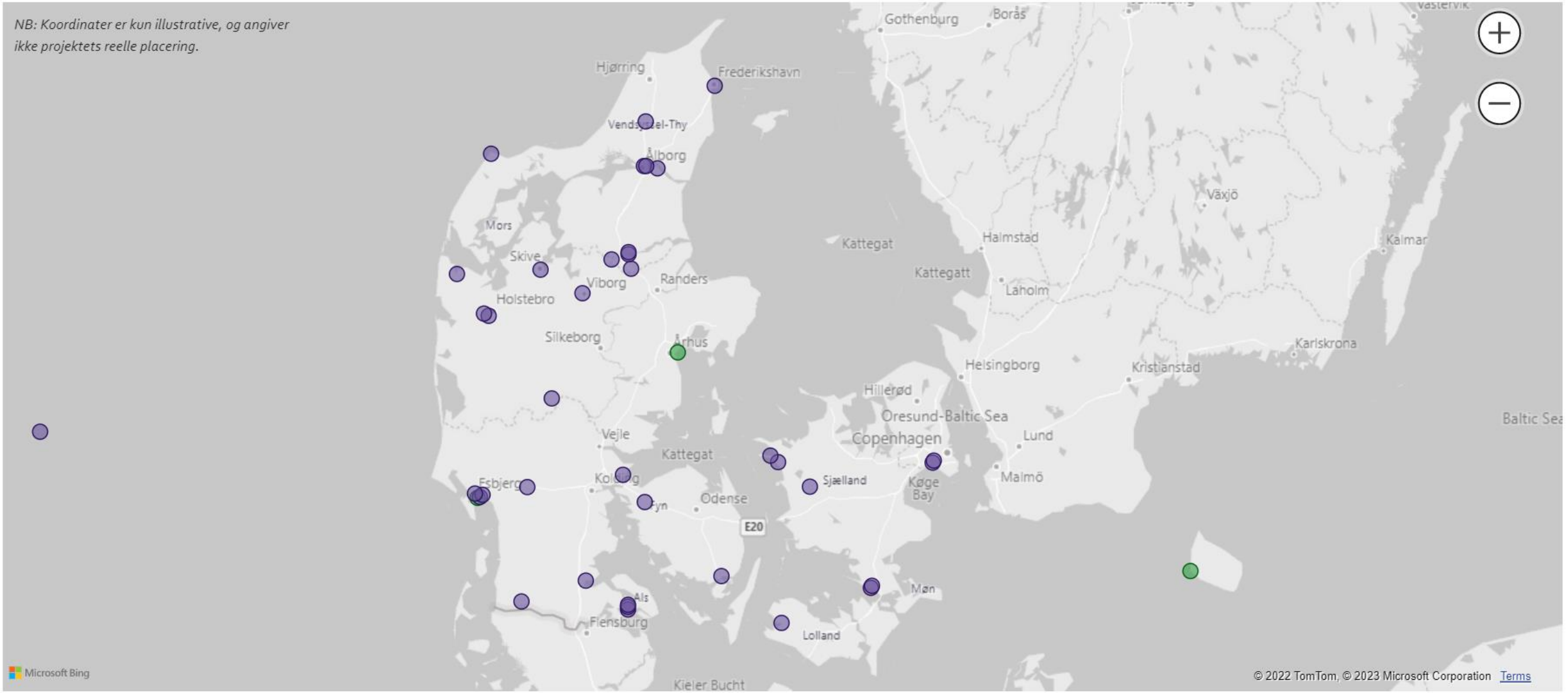
Power-to-X projekter i Danmark

Brintbranchen
Hydrogen Denmark

Projekttype Forbrug Produktion

NB: Koordinater er kun illustrative, og angiver ikke projektets reelle placering.



Power-to-X projekter i Danmark

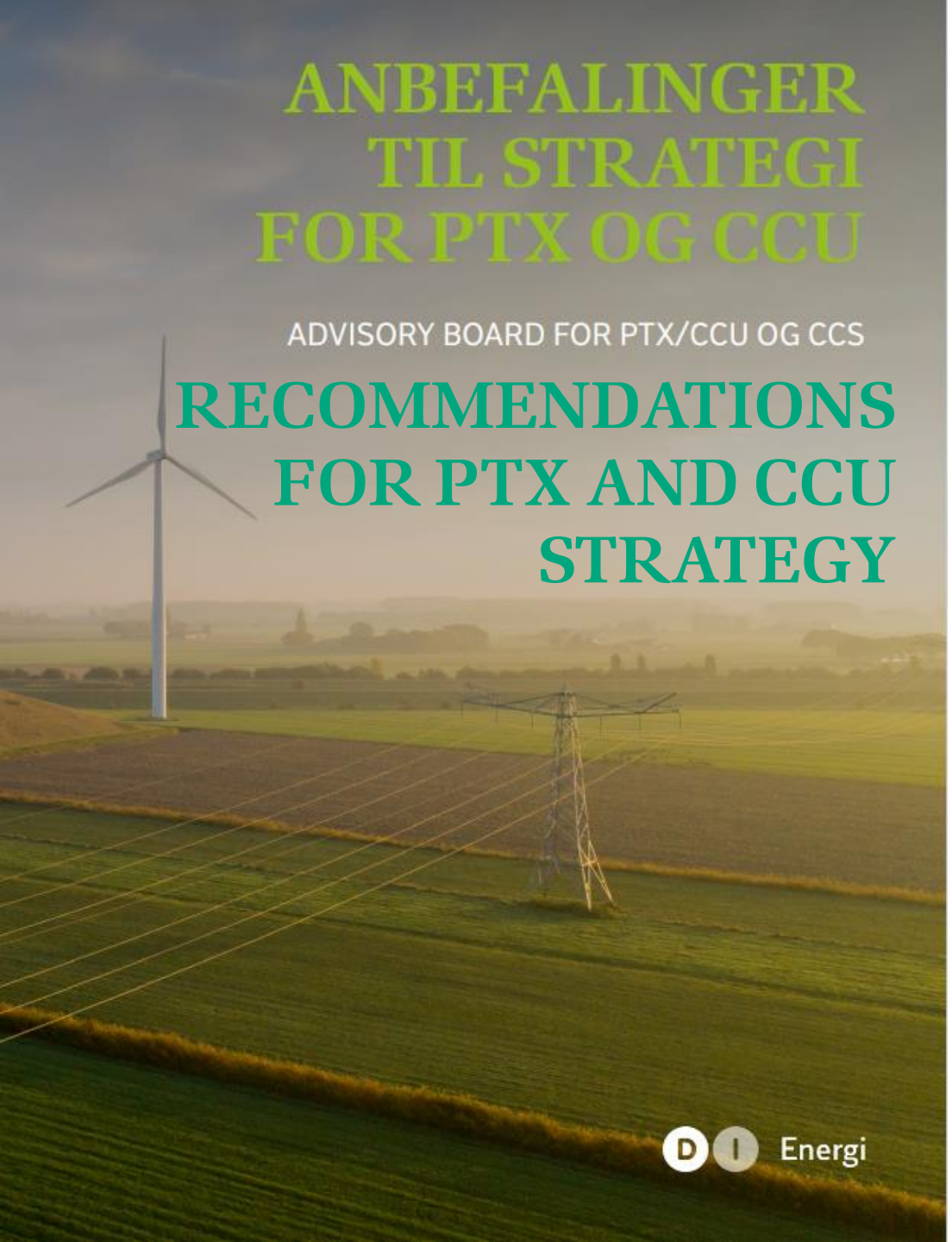
Brintbranchen
Hydrogen Denmark

Projekt	Projekttype	Forbrugskapacitet (MW)	Produktionskapacitet (MW)	Status	Partnere
HyBalance	Produktion		1.20	I drift	Air Liquide, Copenhagen Hydrogen Network, Hydrogenics, Centrica, Hydrogen Valley, LBST, Energinet, Akzo Nobel, Sintex
Arcadia Vordinborg	Produktion		254.00		Arcadia eFuels ApS, DCC & Shell Aviation Denmark A/S
GreenGuard + Esbjerg havn	Forbrug				Ballard Power Systems Europe
Aarhus Havn	Forbrug				Ballard Power Systems Europe
Blue Seal	Forbrug				Ballard Power Systems Europe, Everfuel, OSK Shiptech, Marlog, Everfuel
HFC-Marine (Ballard Test Lab)	Produktion	0.00	0.00	I drift	Ballard Power Systems Europe, Odense Maritime Technology, Hvide Sande Shipyard, Aarhus Universitet, MARLOG, Strandmøllen
HFC-Marine (Ballard Test Lab)	Produktion	0.50	0.50	Plan	Ballard Power Systems Europe, Odense Maritime Technology, Hvide Sande Shipyard, Aarhus Universitet, MARLOG, Strandmøllen
HØST	Produktion		1,000.00	Plan	CIP
BrintØ	Produktion		10,000.00	Plan	CIP, COWI
Green Hydrogen Hub	Produktion		1,000.00		corre.energy, Eurowind, Gas Storage Denmark, Everfuel
Europa Seaways	Produktion	0.00	0.00	Inaktiv	DFDS, ABB, Ballard Power Systems Europe, Hexagon Purus, Lloyd's Register, KNUD E. HANSEN, Ørsted, Danish Ship Finance
Dynelectro Kalundborg	Produktion		0.03	Udbygning	DynElectro, Rambøll
P2G BioCat	Produktion	0.00	0.00	Inaktiv	Electrochaea, Audi, NEAS Energy, HMN Naturgas, BIOFOS, Insero, Hydrogenics
European Energy (v. Kassø)	Produktion		50.00		European Energy
European Energy Brønderslev	Produktion		20.00	Plan	European Energy
European Energy Frederikshavn havn	Produktion		50.00	Plan	European Energy
European Energy Jammerland Bugt	Produktion		250.00	Plan	European Energy
European Energy Måde (Esbjerg)	Produktion		6.00	Plan	European Energy
European Energy Måde (Esbjerg)	Produktion		6.00	Udbygning	European Energy
European Energy Sønderborg	Produktion		150.00	Plan	European Energy
Hanstholms Havn	Produktion				European Energy
Nakskov Havn	Produktion			Plan	European Energy
Handest (Mariagerfjord Kommune)	Produktion		50.00		Eurowind
Hejring (Mariagerfjord Kommune)	Produktion		35.00		Eurowind

20GW Planned

400MW FID

25MW Operating



Capacity and feedstock:

1. Draw up an objective for Denmark's PtX ambitions.
2. Raise the targets for installed renewable energy capacity and advance the development of offshore wind.
3. It is recommended that future access to biogenic carbon be reserved for PtX production and there may be a need to import biogenic carbon in this connection.
4. Use of an intermediate scenario up to 2050.

Infrastructure:

5. It is recommended to establish a hydrogen storage infrastructure and to expand and retrofit the transmission infrastructure at the same time as the electrolysis capacity is developed.

Financial instruments:

6. Optimized utilization of capacity through dynamic electricity tariffs.
7. Risk minimization in connection with settlement prices at PtX.
8. Public co-financing of industrial development that is sufficient and transparent.

Transparency and collaborations:

9. The Danish government should work to establish a uniform, European certification scheme for sustainable hydrogen and other PtX products and chemicals.
10. A strengthened international collaboration around development, expansion and marketing.
11. Danish sea and air transport's international activities must be included in the Danish PtX strategy.

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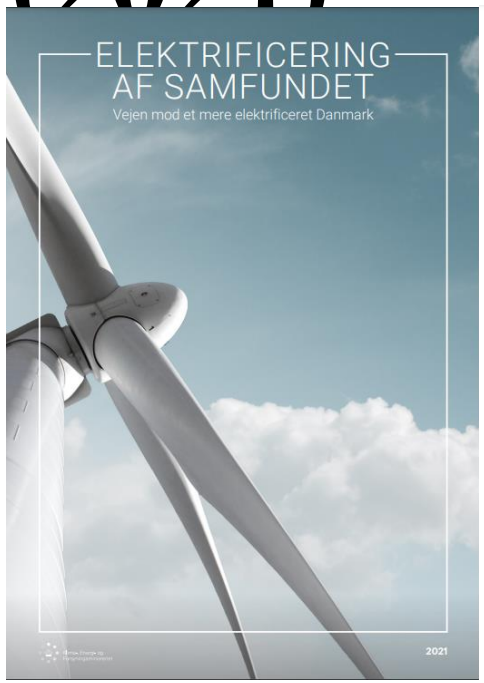
PtX – en del a le danmark (2021)



Klima-, Energi- og Forsyningsministeriet
15. marts kl. 09.34 ·

Ny bred politisk aftale om 1.25 mia. kr. til PtX – fremtidens grønne brændstoffer

- Brændstoffer til grønne fly, skibe og tung transport
- Danmark som PtX aktør i Europa

Med Danmarks store potentiale for havvind er målet 4-6 GW PtX i 2030.

https://bit.ly/3q5AkoK

Regeringen fremlægger elektrificeringsstrategien (4. juni 2021)

Aftale om fangst, lagri (14. dec

n fremlægger trategien ember 2021)

Regeringen sit udspil til fremtidens grønne brændstoffer (15. december 2021)

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The Governments objectives for Power-to-X

- Four oblectives providing a holistic approach to developing a new supply-industry with green hydrogen as the foundation

  1. The Danish Climate Act
  2. Regulatory framework and infrastructure
  3. Integrating the energy system
  4. Exports

- Initially the main aim were to target the climate crisis, now we are dealing with a European energy crisis

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Green Fuels-Agreement of 15. March, 2022 (1/6)

Political agreement on developing and promoting hydrogen and green fuels

1. Objective on 4-6GW electrolysis in 2030
2. Disbursement of 200mil EUR for public tender
3. Geographically differentiated consumption tarifs, direct lines, and investigating opportunities for open-door policy with RE facilities offshore
4. Investigating a build out of a Danish hydrogen infrastructure
5. A Green Fuels (PtX)-taskforce for supporting a Danish hydrogen market and infrastructure

1) Up to 6 GW Electrolysis in 2030

Electrolysis targets require green power

The government has a 2030 target of 4 – 6 GW of electrolysis (2.5 – 4 million tonnes of CO2).

The expansion of electrolysis capacity must, as far as possible, be based on market conditions.

The electrolysis target increases the need for green electricity. The government will present a plan for renewable energy development, which ensures that Denmark becomes a net exporter of green energy in 2030.

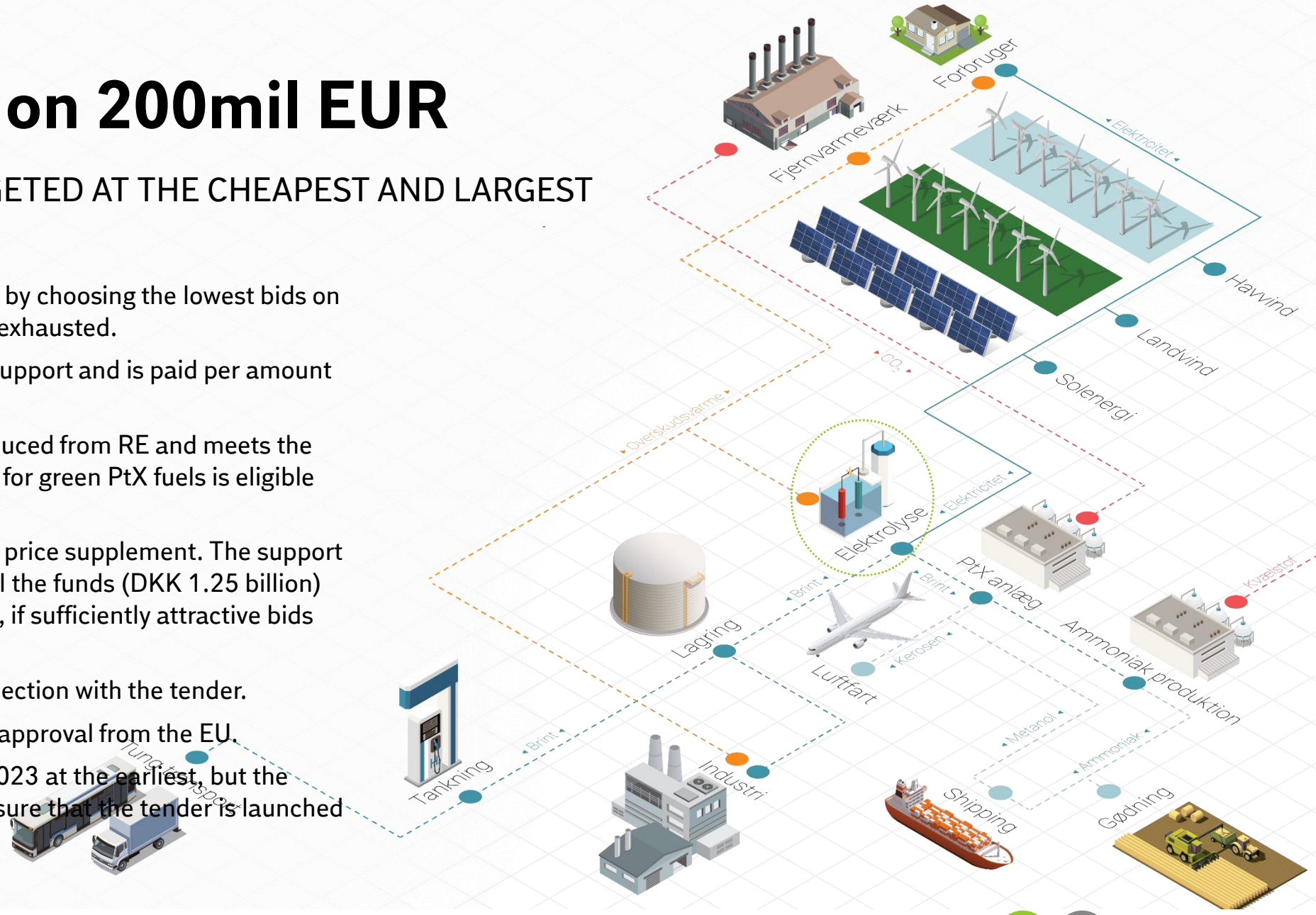
Tabel 1
Overview of goals in other countries' hydrogen strategies

Country/area	Type of hydrogen in focus	Target for hydrogen production, 2030
EU	Grøn brint	40 GW elektrolyse
Tyskland	Grøn brint	10 GW elektrolyse
Frankrig	Grøn brint	6,5 GW elektrolyse
Danmark	Grøn brint	4-6 GW elektrolyse
Storbritannien	Grøn og blå brint	5 GW brintproduktion
Sverige	Grøn brint	5 GW elektrolyse
Italien	Grøn brint	5 GW elektrolyse
Spanien	Grøn brint	4 GW elektrolyse
Holland	Grøn brint	3-4 GW elektrolyse
Polen	Grøn brint	2 GW elektrolyse
Portugal	Grøn brint	2 GW elektrolyse
Flandern (Belgien)	uklart	500 MW elektrolyse
Ungarn	uklart	240 MW elektrolyse
Norge	Primært blå brint	Ikke konkret mål

2) PtX-tender on 200mil EUR

OPERATING SUPPORT TARGETED AT THE CHEAPEST AND LARGEST HYDROGEN PRODUCTION

- Winners of the tender are determined by choosing the lowest bids on price supplements until the budget is exhausted.
- The subsidy is provided as operating support and is paid per amount of green hydrogen produced.
- Only hydrogen production that is produced from RE and meets the EU's requirements for documentation for green PtX fuels is eligible for support.
- The support model is based on a fixed price supplement. The support is provided for a 10-year period and all the funds (DKK 1.25 billion) are disbursed in a single tender round, if sufficiently attractive bids are received.
- A market dialogue will be held in connection with the tender.
- The tender scheme requires state aid approval from the EU.
- The tender is expected to be held in 2023 at the earliest, but the Danish Energy Agency will work to ensure that the tender is launched as soon as possible.



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3) Direct lines, geographic differentiated Consumption tariffs and open-door

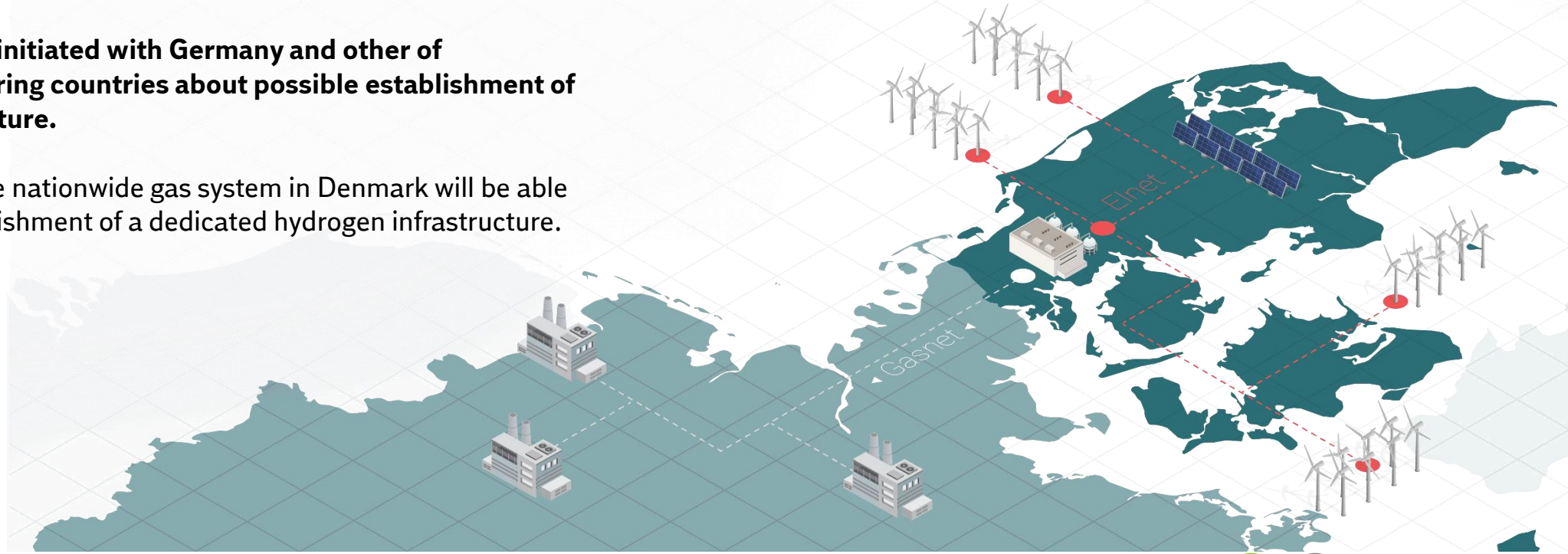
- **Direct lines**: It is possible to establish commercially owned direct lines for electricity consumers and producers at 10 kV voltage level and above upon application (Act amendment is expected to be presented in autumn 2022 - *delayed*)

- **Geographical diff. consumption tariffs**: Energinet and grid companies are given the opportunity to differentiate consumption tariffs geographically for large electricity consumers connected to the electricity grid at a voltage level of 10 kV and above (Act amendment is expected to be presented in autumn 2022 - *delayed*)

- **Open-door scheme for renewable energy plants at sea**: The government will analyze the possibilities and consequences associated with introducing an exception to the open-door scheme's distance limitation of 15 km for projects that may involve PtX plants or other electricity consumption with direct connection to large offshore wind turbine projects. The analysis will be completed as soon as possible and is expected to be presented in the first half of 2023.

4) Danish hydrogen infrastructure

- The necessary framework must be developed, making it possible to establish a hydrogen infrastructure in Denmark for the transport of hydrogen in pipes and for storage in the underground.
- Energinet (TSO) and Evida are given the opportunity to own and operate hydrogen infrastructure.
- **A dialogue must be initiated with Germany and other of Denmark's neighboring countries about possible establishment of hydrogen infrastructure.**
- Recycling parts of the nationwide gas system in Denmark will be able to support the establishment of a dedicated hydrogen infrastructure.



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5) PtX-taskforce (2022–2026)

PtX-taskforce in the Ministry of Climate, Energy, and Utilities

A PtX taskforce is set up in the Ministry of Climate, Energy and Utilities to support a Danish hydrogen market and infrastructure from 2022–2026. The purpose of the taskforce is, among other things, to:

- Contribute to coordination across government authorities and ensure ongoing dialogue with the PtX industry and the municipalities.
- Identify and deal with regulatory and legislative barriers to the development of a new Danish supply sector for PtX and strengthen the framework conditions within the production, transport and use of hydrogen and PtX products in Denmark.
- Ensure uniform rules for documentation of green hydrogen and to develop tools that promote socially appropriate placement of PtX plants and possible utilization of surplus heat.
- As part of the task force, a PtX secretariat will be set up, which will act as a contact point and assist project developers and authorities with guidance on approval procedures etc.

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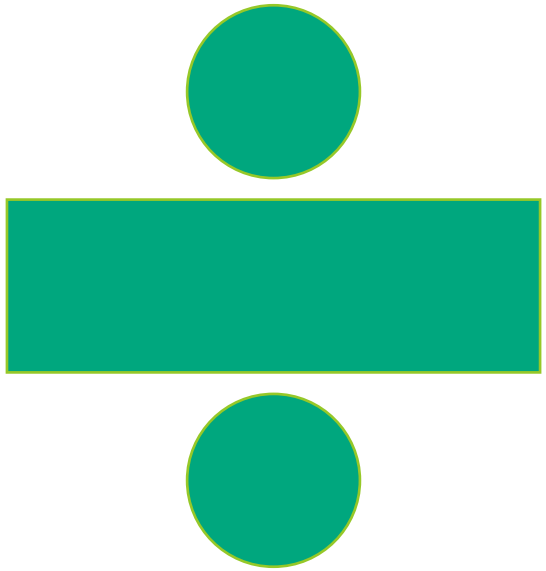
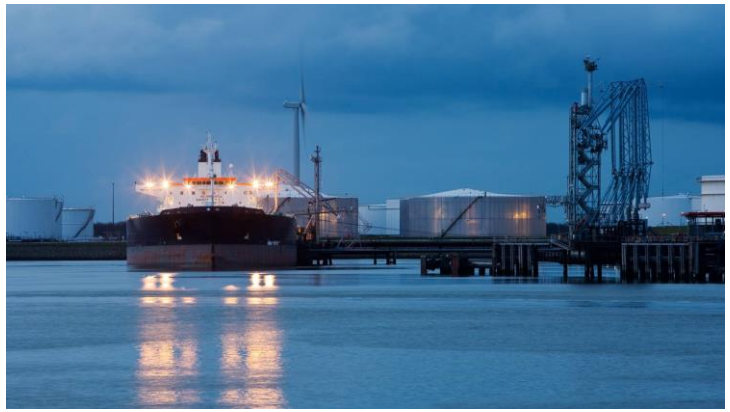
What has happened?



Main political focus areas, that needs addressing to expedite development



Scale up electrolysis capacity – offshore wind plans to be advanced

Built out of the infrastructure, nationally and to Germany

Frameworks must be defined, to promote Final Investment Decision

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Thanks for your attention

Henrik Skou
Senior Advisor, Green fuels
Confederation of Danish Industry
+45 2829 4981, hesk@di.dk

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Hydrogen and Power-to-X in Denmark