

Seminarieserie från Energiforsk
Omvärldsbevakning vätgas



Tema seminarium 2023:

Framtiden och avsättning för vätgasen
- "vad blåser det för vindar?"

Webbinariet börjar 08.00

Seminarieserie från Energiforsk Omvärldsbevakning vätgas

Praktisk information

- Tid: 08.00-09.30
- 5 minuters bensträckare ~08.45
- Panelsamtal med frågor från publiken ~09.10
- Video och mikrofoner automatiskt avstängda
- Chatt för frågor, både praktiska och till panelen
- Feedback efter seminariet via Invajo

Seminarieserie från Energiforsk

Omvärldsbevakning vätgas

- Elin Lindblad och Erik Östling, Sweco. Framtidsspaning kring vätgasmarknaden.
- Fredrik Wibling, OX2. Vätgasproduktion från vindkraft.
- Caroline Båth, Liquid Wind. Elektrobränslen från vätgas och CCS/CCU.
- Marc van Doorn, Fertiberia. Produktion av grön ammoniak och konstgödsel (eng).
- Gustav Rehnman, H2 Green Steel. Fossilfri stålproduktion.
- Sigurd Bunk Lauritsen, Sweco. Energy Island tillsammans med Danska Energimyndigheten (eng).

Seminarieserie från Energiforsk Omvärldsbevakning vätgas



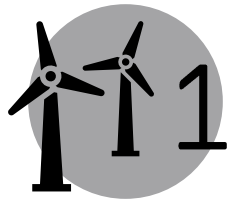
Vätgaspipelines allt närmre att realiseras i Norden?



Vätgas som intermediär och industrin går i bränschen



Policy- och styrmedelsrace mellan EU och USA. Hänger regelutvecklingen med marknadstakten?



Vätgaspipelines allt närmre att realiseras i Norden?



Pipelines betraktas som en viktig del av vätgasutvecklingen. Se Nordic Hydrogen Route, Baltic Sea Hydrogen Collector och European Hydrogen Backbone



Ambitionsnivån har höjts till följd av kriget i Ukraina



Pipelines det mest kostnadseffektiva sättet att transportera energi med ny infrastruktur. 0,11-0,21 €/kg H₂ (>1000 km)



Flera multinationella projekt, exempelvis Sverige – Finland.



Paralleller till utbyggnationen av elsystemet: kluster till regionala nät till nationella och internationella nät.



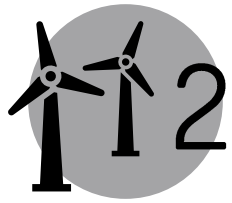
OX2 undersöker möjligheten att utveckla pipeline för vätgas i Östersjön

december 16, 2022, 12:05 Icke regulatorisk

OX2 kommer tillsammans med Gasgrid Finland och Nordion Energi, gasd och Sverige, och Copenhagen Infrastructure Partners att utforska möjlig en ny havsbaserad pipeline för vätgas för att transportera hållbar vätgas: Åland, Sverige, Danmark och Tyskland.



Gasöverföringssystemoperatörerna (TSO) i samarbete från European Hydrogen Backbone (EHB): Från vision till handling



Vätgas som intermediär och industrin går i bräschen



Förädling till andra slutprodukter än vätgas.
Konstgödsel, elektrobränslen, grönt stål, e-metanol.



Industrin går i bräschen för svensk vätgasutveckling.
H2-drivna transporter ses ofta som en synergi.



Kundintresset för grönt stål starkt. H2GS tecknat
avtal på 1,5 milj. ton/år första 5-7 åren.

Diskussion kring elproduktionen. Vissa kunder
accepterar inte kärnkraft. Landbaserad vindkraft
snabbast, havsbaserad vindkraft stor potential

Trolig utveckling att vi går mot annonserade
platser för havsbaserad vind med budgivning

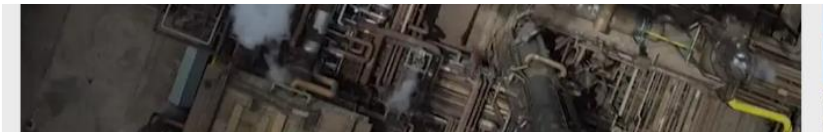
[Home](#) > [Clean fuel](#) >

Liquid Wind to set up third electrofuel facility for maritime sector

BUSINESS DEVELOPMENTS & PROJECTS

January 23, 2023, by Ajsa Habibic

H2 Green Steel tecknar avtal om framtida stålproduktion, värt flera miljarder kronor



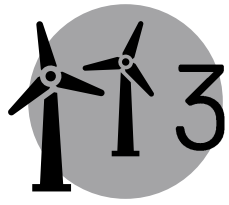
Grön el lockar spansk industrijätte till Luleå

Visa alla (2)

Spansk industrijätte bygger stor fabrik gör konstgödsel i Luleå

UPPDATERAD 13 JUNI 2022 PUBLICERAD 12 JUNI 2022

Ytterligare en internationell industrijätte ska etablera sig i Norrland, lockad av den billiga, fossilfria elen från vatten- och vindkraft. SVT Nyheter kan berätta att Grupo Fertiberia, en av Europas största



Policy- och styrmedelsrace mellan EU och USA. Hänger regelutvecklingen med marknadstakten?



IRA (USA) och EU:s policyramverk (senast exv. Net Zero Industry Act) påverkar vätgasmarknadens utbyggnadstakt men även placering



RFNBO: Bra förutsättningar för certifierad vätgas i Sverige, i synnerhet SE1 och SE2.



Tillståndsprocesser går smidigare? Ju fler vätgasprojekt desto enklare blir det.



Pågående nationellt regelverksarbete, exv.:

- Uppdaterade föreskrifter från MSB gällande brandfarliga gaser.
- Nya föreskrifter kring tankstationer

Flöde av vätgasrelaterade policynyheter

Ny rapport: IRA kan göra USA till en supermakt inom fossilfri energi

Prices of **Green steel** – made with renewable hydrogen rather than natural gas or coal – will fall below all other forms of steel manufacturing by 2024 in the United States and by 2028 in Europe, according to a study by ReTHINK Energy

'Green steel will become cheaper than grey in US as soon as hydrogen tax credits kick in': analyst

Go big or go green? The EU's massively expanding hydrogen bet

Brussels is pumping ever-increasing amounts of cash into hydrogen climate standards for the gas.

It'll be the cheapest form of steel in the EU, says Rethink Energy report

Nya EU-regler kan gynna svensk vätgasproduktion

VÄTGAS Kraven för vad som ska klassas som förnybar vätgas har sänkts i EU-kommissionens nya delegerade akt. Två undantag i regelverket underlättar för svenska företag, särskilt i norra Sverige. Nu ska förslaget granskas av EU-parlamentet och Europarådet innan det kan träda i kraft.

Commission releases Net-Zero Industry Act

Proposed regulation is a key part of the EU's response to Washington's massive green subsidies package.

Seminarieserie från Energiforsk

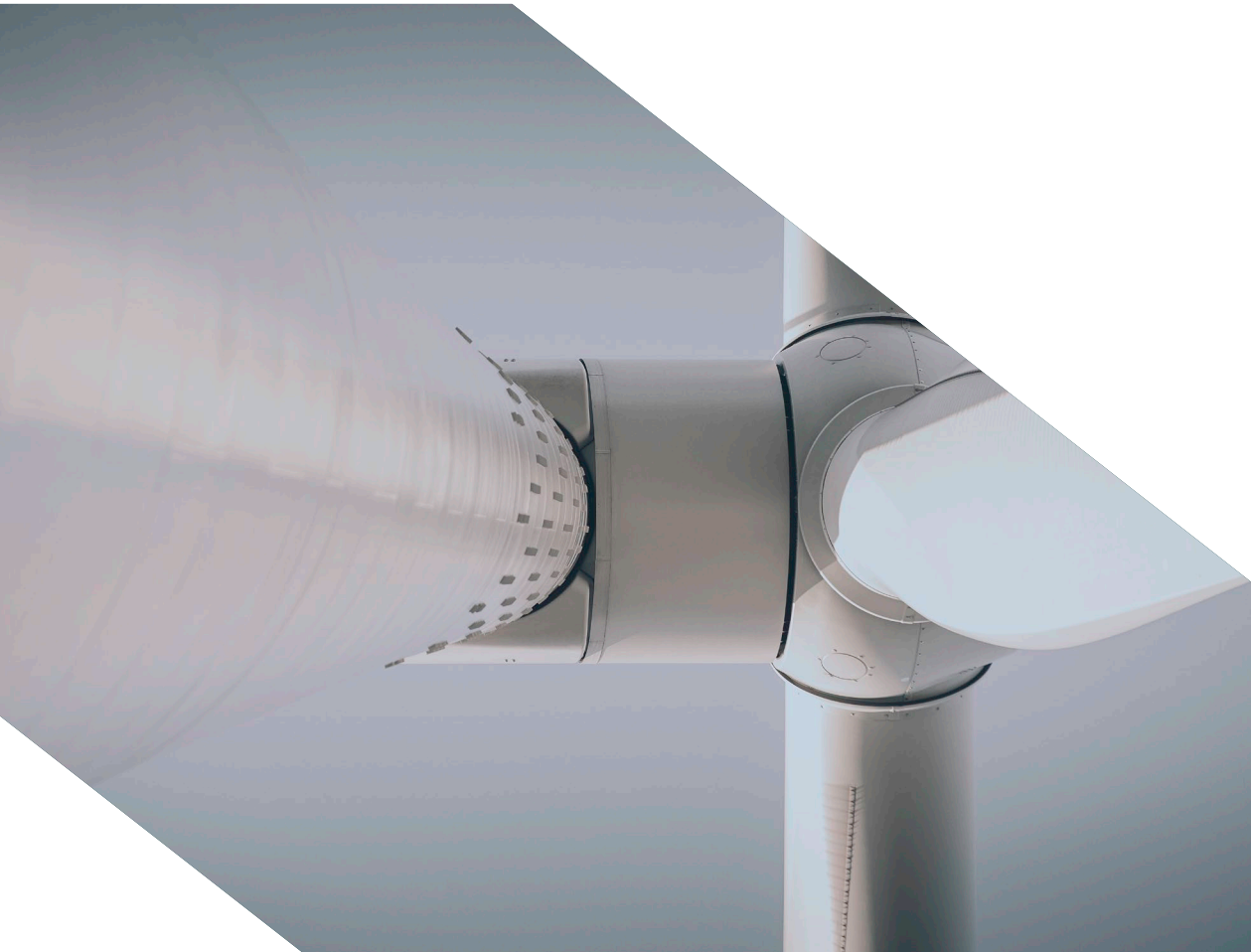
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Fredrik Wibling,
OX2



Framtiden och avsättning för vätgasen - vad blåser det för vindar?

Energiforsk och Sweco bjuder in till webinarium

Fredrik Wibling
Titel, OX2 Sweden

Who we are



Portfolio

(Q4 2022)

Development

Onshore wind

9,874 MW



Offshore wind

13,890 MW



Solar power

4,043 MW



Energy storage

456 MW



Construction

Under construction

1,343 MW



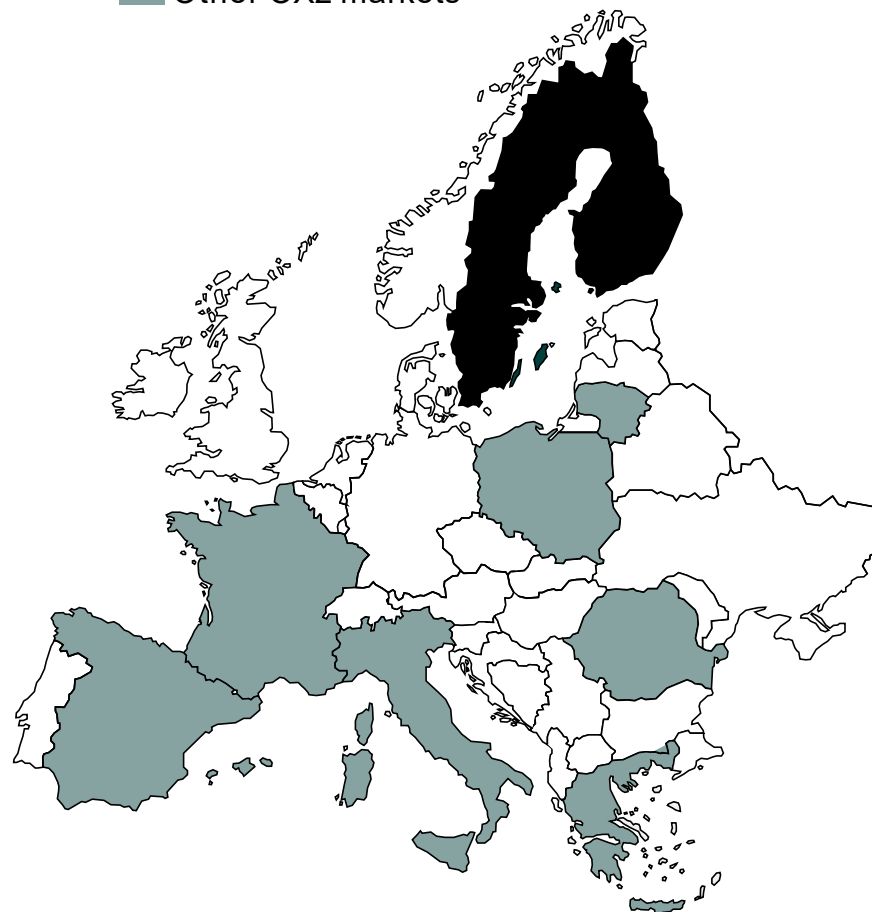
Asset management

TCM

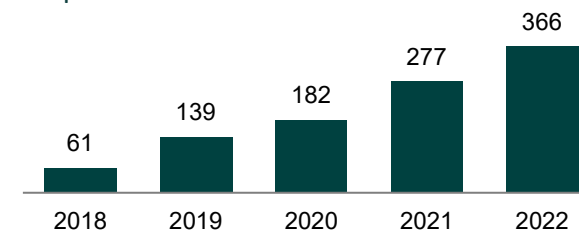
3,848 MW



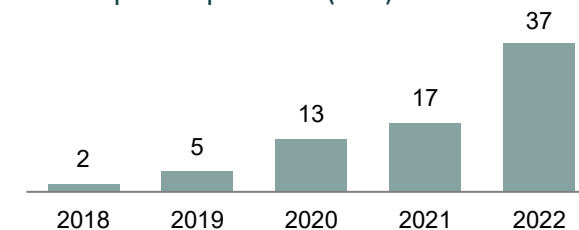
Markets with offshore wind portfolio
Other OX2 markets



People



Development portfolio (GW)



What we do

From acquisition and greenfield development to realization, construction and management of energy solutions



Expand

New markets
New technologies
New projects

Develop

Project development
Project and portfolio acquisitions
Realization

Deliver

Construction
Handover
Management

Our technologies



Offshore development

Sweden	Finland	Åland
Galatea-Galene		
Triton	Laine	Noatun
Aurora	Halla	
Pleione	Tyrsky	
Neptunus		

100GW offshore wind is in early or late development in Sweden

14GW offshore wind is under development within OX2

1GW installed wind power = 100 000 tons hydrogen/year



Why hydrogen?



Flexibility

Many national grids are not able to handle the planned amount of offshore wind power.

Intermittent power output from renewable energy.

Environmental

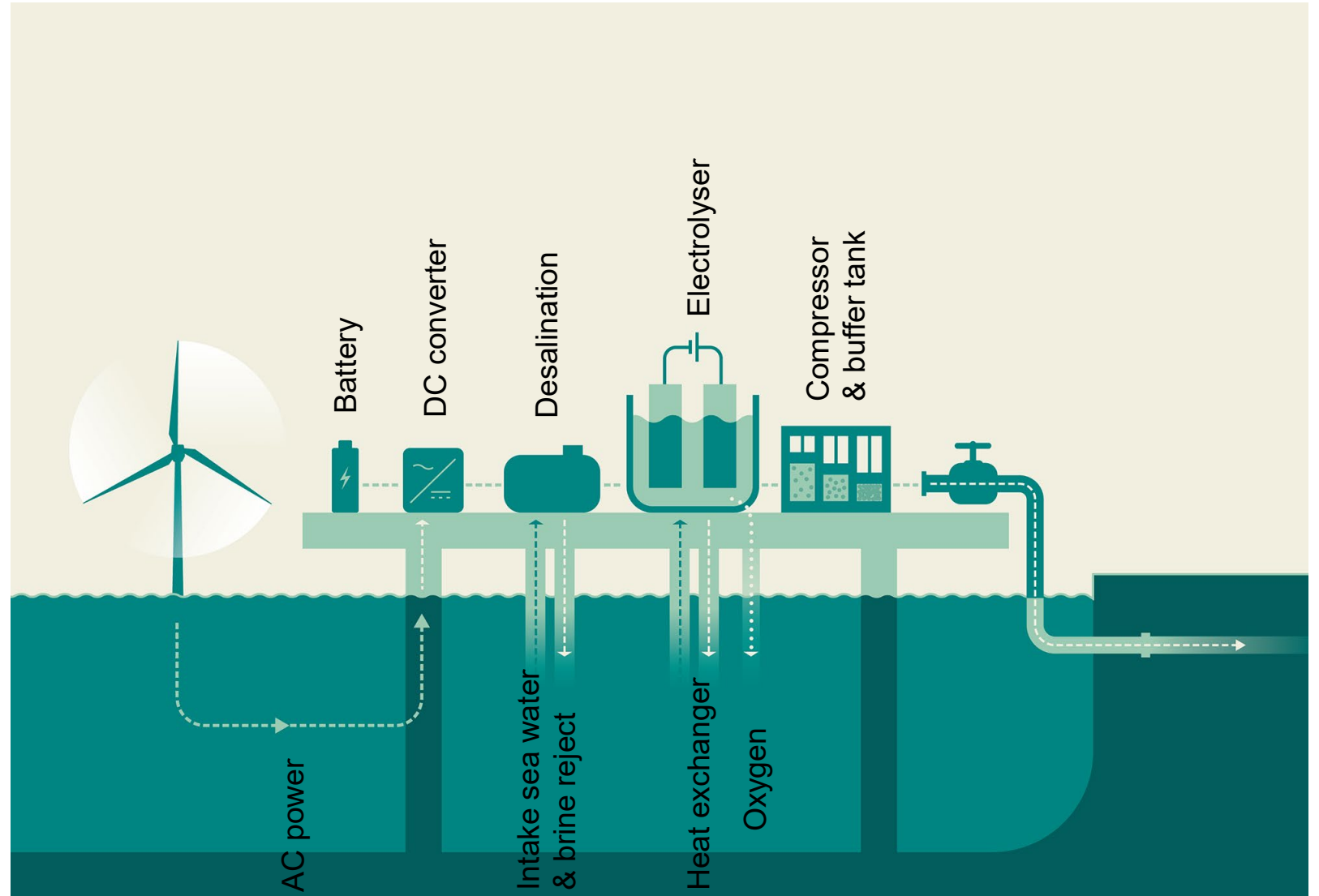
Distribute oxygen in the Baltic Sea to regenerate marine life.

Demand

Transport, industries, storage.
Baltic hydrogen collector.

Efficiency

Pipe cost lower than HV cable cost
One hydrogen pipeline can transfer +10GW of energy



Concepts for H2 production



Onshore H2 production

Electricity is distributed to shore, where the energy is converted to hydrogen through electrolysis

Centralized

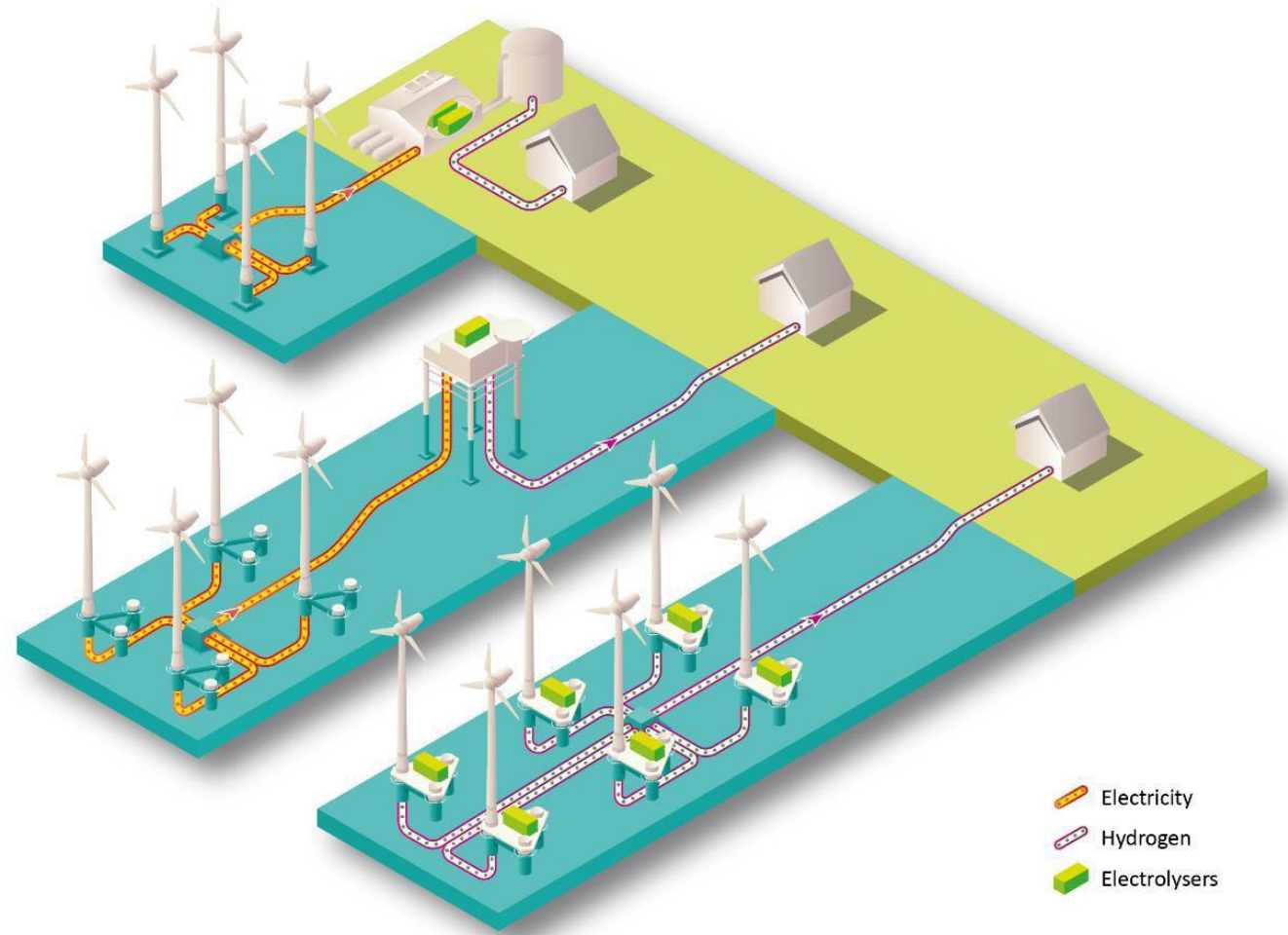
Electricity distribution from turbines to a separate H2 platform for containerized electrolyzers and balance of plant units

Pipeline with pressurized hydrogen distribution from the site

Decentralized

Electrolysis plant and balance of plant placed on each turbine platform

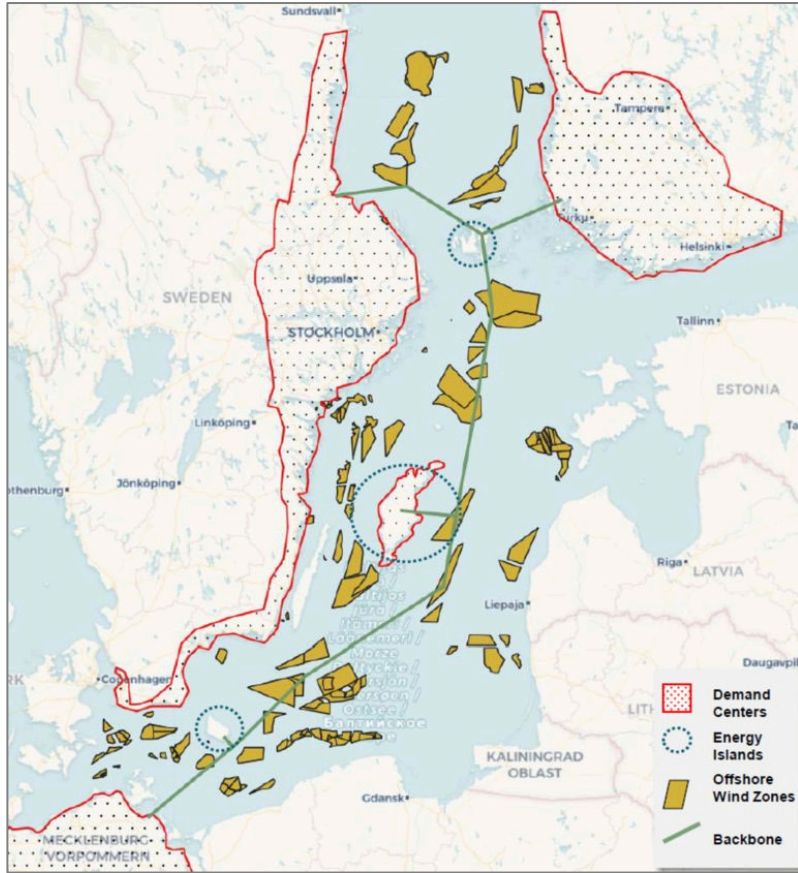
Pipelines from each turbine, collected in a larger pipeline for distribution from the site



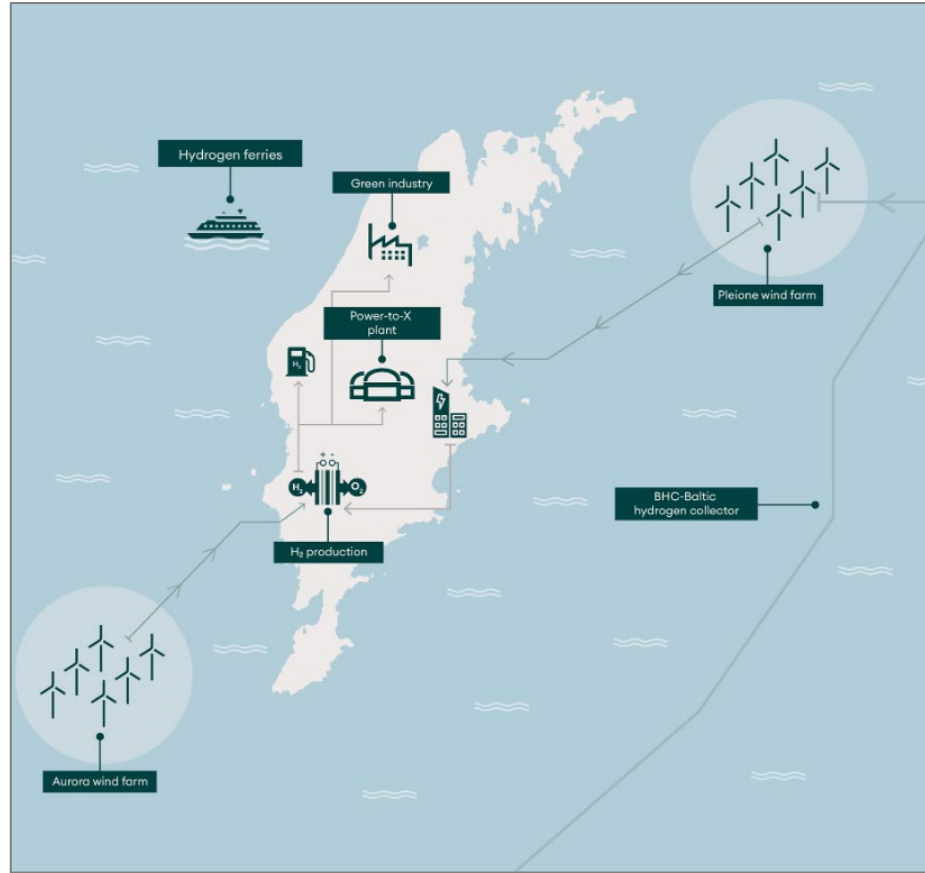
Demand and offtakers



Baltic Hydrogen Collector



Energy Hub Gotland



Offtakers

- Export pipeline (BHC)
- Gotland - energy hub for H2 and e-fuel-production
- High energy consuming industries
 - Paper and pulp
 - Steel
 - Mining
 - Cement
 - Chemical
- Transport and shipping
- Hydrogen storage

Powering the great shift

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Omvärldsbevakning vätgas



Caroline Båth, Liquid Wind

Liquid Wind

Webinarium - Framtiden och avsättning för vätgas

Caroline Båth

Public Affairs, Liquid Wind

Om Liquid Wind

Liquid Wind är ett Power-to-Fuel bolag med ambitionen att elektrifiera både svensk och internationell sjöfart genom produktion av grönt elektrobränsle.



Från fossilt till fossilfritt för att nå utsläppsmålen



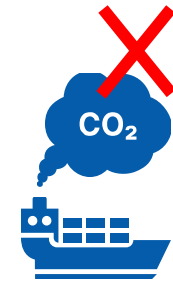
99.9% av marina bränslen är av fossilt ursprung

Källa: UNCTAD - Review of Maritime Transport 2019



Nettonoll - 2045

Sveriges långsiktiga klimatmål är att utsläppen av växthusgaser ska vara **nettonoll** år **2045** för att därefter uppnå negativa utsläpp.

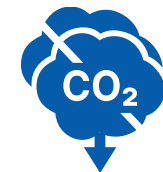


2045



Klimatneutralt - 2050

EU har målsättningen att vara klimatneutrala till 2050



2050

Vätgas och koldioxid blir ett flytande, grönt bränsle



Fossilfri el



Återanvänd biogen CO₂



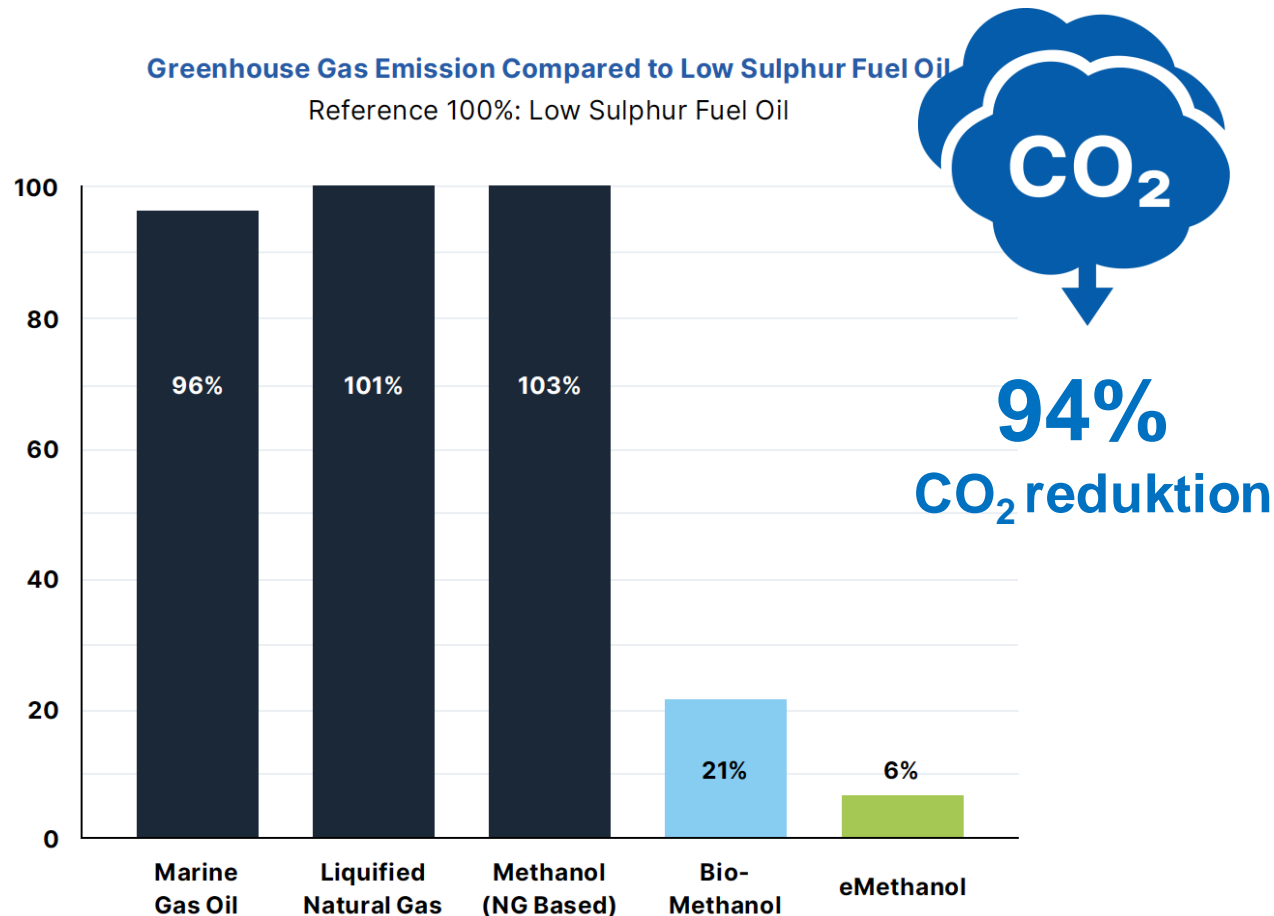
Grönt elektrobränsle



Lagringsbar energi

E-metanol är väl anpassat för sjöfarten

- ✓ Koldioxidneutralt bränsle
- ✓ Minskar CO₂ utsläppen upp till 94%
- ✓ Lätt att använda, lagra och transportera
- ✓ Kompatibel med existerande infrastruktur
- ✓ Sänker SO_x, NO_x och partikel utsläpp
- ✓ Skalbart
- ✓ Används redan idag




Source: Liquid Wind whitepaper

Ekosystem för marina elektrobränslen utvecklas

Detaljhandeln ställer krav, motorer görs tillgängliga och metanol-fartyg beställs

Amazon, Ikea and Unilever pledge zero emission shipping by 2040


Adis Ajdin · October 20, 2021 · 2,629 · 2 minutes read



19 retailers committed to zero-carbon shipping fuels by 2040

'Support for maritime decarbonization has grown swiftly in just a short time,' director of COZEV says

Alyssa Sporrer · Thursday, September 22, 2022 · 3 minutes read



Cargo Owners for Zero Emission Vessels

Wärtsilä hits methanol milestone with first newbuild engine order

Wärtsilä Corporation, Press release, 24 January 2022 at 11:00 UTC+2



COSCO Shipping eyeing methanol for new round of ship orders

September 16, 2022



MAN ES: Methanol to become available for shipowners from 2024

Waterfront Shipping orders 8 methanol dual-fuel ships from Hyundai Mipo Dockyard

VESSELS

December 1, 2020, by Jasmina Ovcina

Canada-based Waterfront Shipping Company (WFS), a wholly-owned subsidiary of Methanex Corporation, has placed an order for eight new methanol dual-fuel vessels with South Korean shipbuilder Hyundai Mipo Dockyard.

A.P. Moller - Maersk accelerates fleet decarbonisation with 8 large ocean-going vessels to operate on carbon neutral methanol

24 August 2021

Denmark Europe Decarbonisation

Share



Svensk industriell möjlighet

Rätt förutsättningar

- ✓ Kostnadseffektiv förnybar energi
- ✓ Biogen koldioxid

Svensk skogsindustri

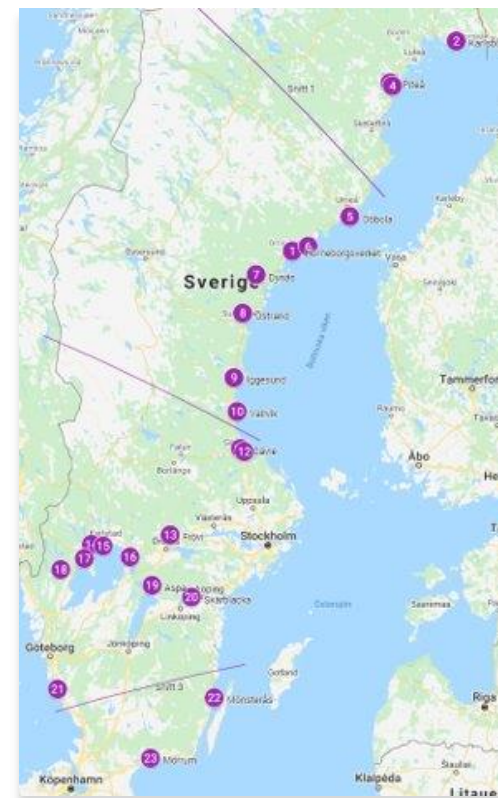
- ✓ Ökad kommersiell nytta för skogsindustrin med CCU*

Ökad försörjningstrygghet

- ✓ Lokal produktion minskar beroendet av import av fossila bränslen

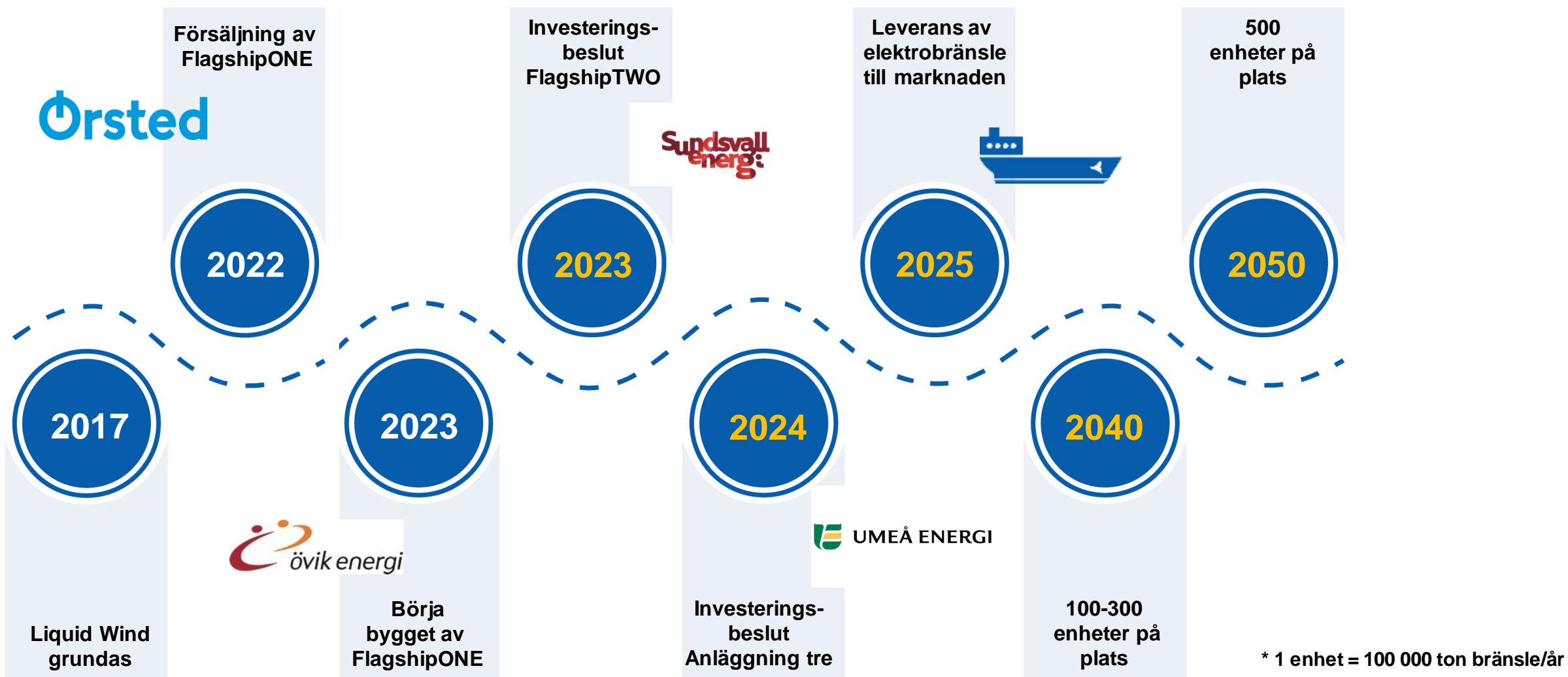
Svensk exportprodukt

- ✓ Växande internationell efterfrågan på förnybara sjöfartsbränslen



* CCU= Carbon Capture & Utilization

En skalbar lösning med grönt elektrobränsle



Tack!

liquidwind.se

Följ oss på LinkedIn och Twitter
[linked.com/company/liquid-wind](https://www.linkedin.com/company/liquid-wind)

[@liquidwind_se](https://twitter.com/liquidwind_se)



Info@LiquidWind.se

LiquidWind.se

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Marc van Doorn,
Fertiberia



Large scale Swedish production of Green Fertilizers

Marc van Doorn
Grupo Fertiberia

Towards leadership in crop nutrition and the industry of the future.

GrupoFertiberia

Grupo Fertiberia at a glance



Shareholder

Triton Partners
since February
2020

Solid balance
structure



Plants

14 production
plants

In Spain, Portugal
and France



Employees

Over 1,600
employees



Products

+520 products
A product portfolio that
is **complete,**
diversified
and **sustainable**

both for crop nutrition and
for industrial segments



Customers

+/-1 thousand in
80 countries

Distributors,
cooperatives, industrial
customers or farmers

Our roadmap



LEADER IN GREEN AMMONIA & FERTILIZERS

- First company in the world producing green ammonia at scale from May 2022.
- Developing two other world-scale green projects in Spain.
- Targeting full decarbonisation by 2035.

NETZERO
BY 2035



DISTINCTIVE EXPERIENCE IN ALL AMMONIA & FERTILIZER OPERATIONS

- One of the largest European producers, with more than 7 millions tons.
- Strong European sales and marketing platform .
- More than 50 years of experience in ammonia & fertilizer operation.



EUROPEAN LEADER IN ADVANCED CROP NUTRITION SOLUTIONS

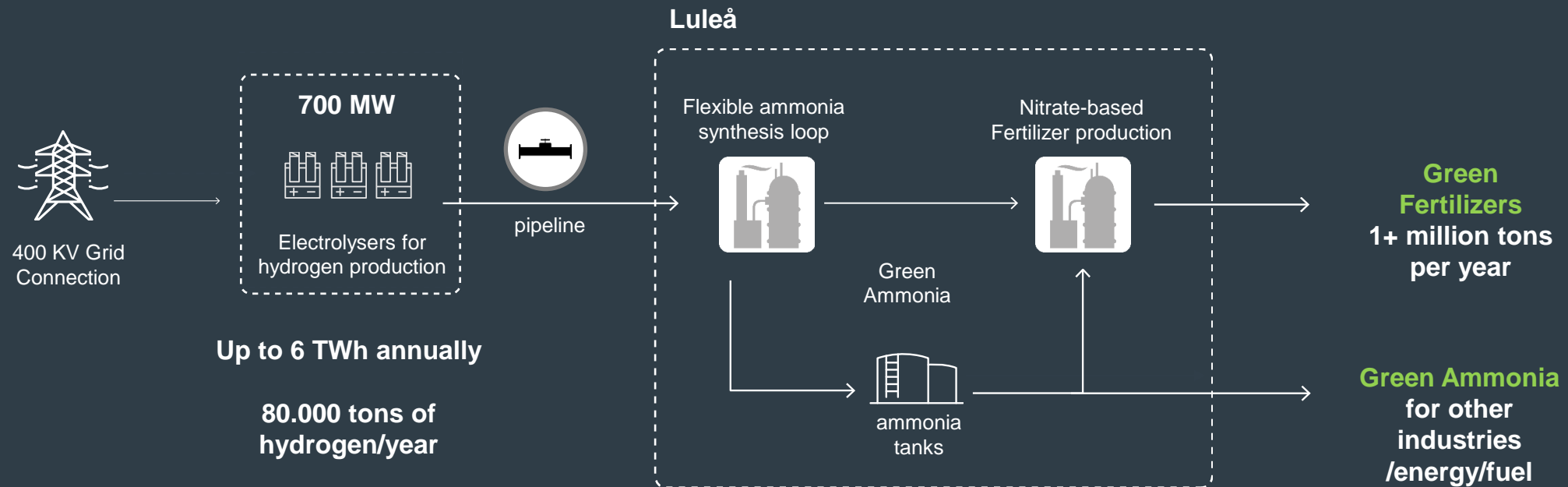
- Smart and digital crop nutrition solutions brought by Fertiberia and its partners could minimize nutrient losses to the environment and GHG emissions while maximizing nutrient uptake and carbon sequestration.

IMPACT0
Fertiberia

Puertollano, ground 0 for the future of fertilization



> Industrial configuration and main figures



➤ Project Moving from feasibility to devex/feed phase

- Fertiberia Sverige and Green Wolverine Co established in Sweden
- 40 Ha plot confirmed by Luleå community in the Hertsofjäldet area next to Luleå Port
- Concluded conceptual design of the ammonia and fertilizer complex
- Initiating the permitting application procedure for the Ammonia/Fertilizer complex in Luleå with Sweco
- Engineered the first stretch of hydrogen pipeline and corridor in Sweden
- Coordinating best power connection plot and plan with Svenska Kraftnät



Tack så mycket
för din
uppmärksamhet

Grupo**Fertiberia**

Calle Agustín de Foxá, 27 · Plantas 8-11
28036 Madrid
t. (+34) 91 586 62 00

grupofertiberia.com |  

NETZERO
BY 2035

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Bensträckare

Återstart 8.51

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Gustav Rehnman, H2 Green Steel

H₂green steel

Gustav Rehnman, Project Manager

Our purpose is to decarbonize hard-to-abate industries for the sustainable benefit of:

Customers

Employees

Investors

Society

..Our planet

...and we start with steel

We have to address steel production to fight climate change



8%



5%



12%

steel industry's share of total CO₂ emissions



1,900,000,000
tons of steel produced per year

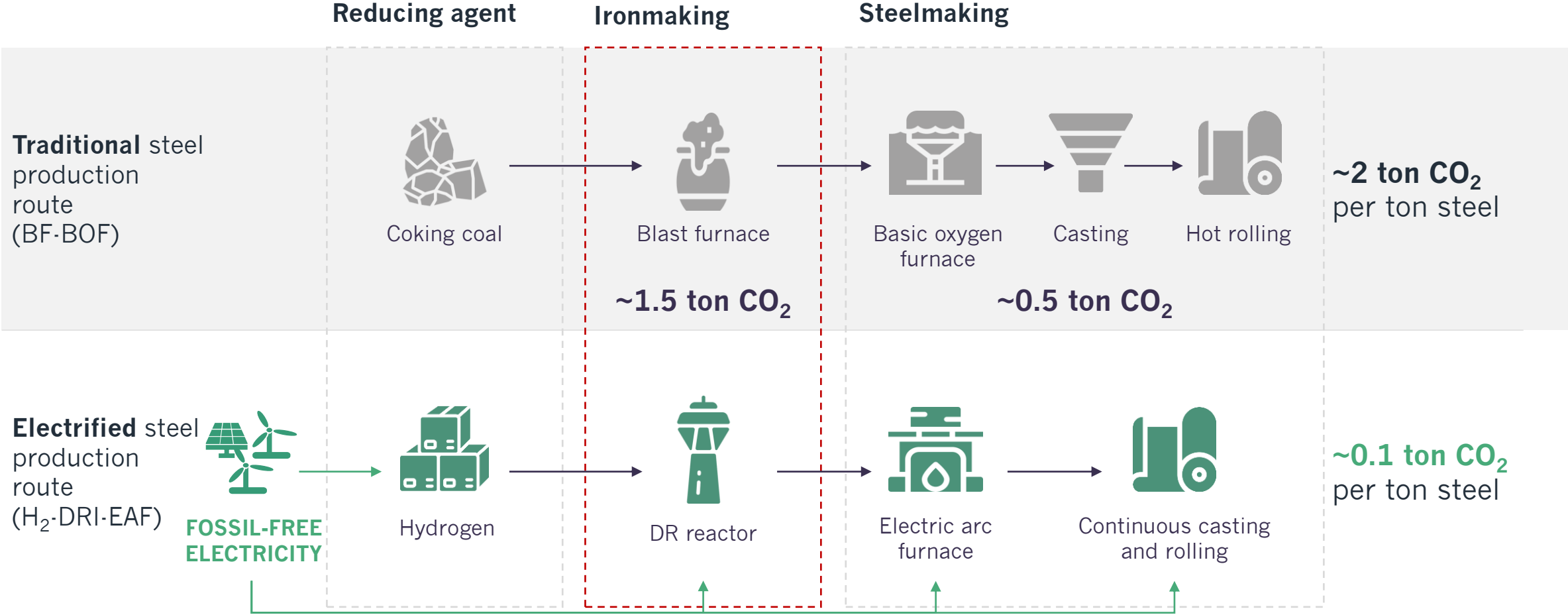


3,400,000,000
tons of CO₂ emitted every year



~28%
of global industrial CO₂ emissions

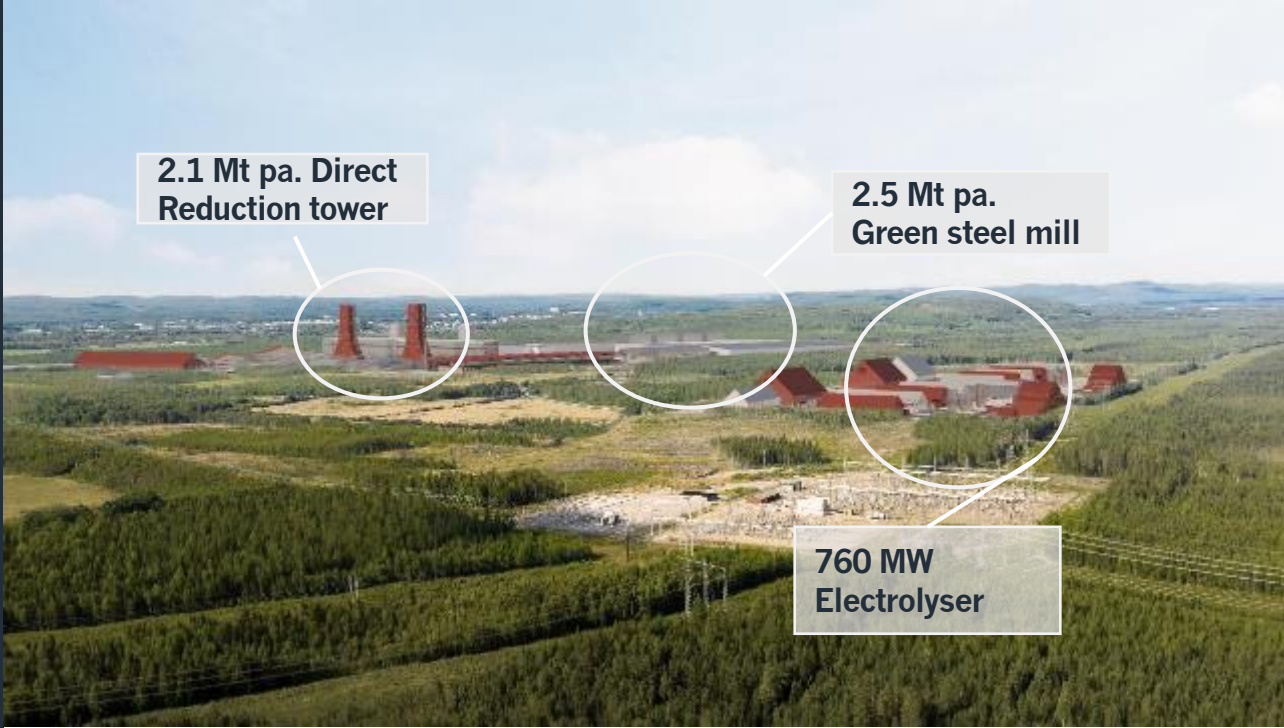
Electrification of the steel value chain – enabling >90% emission reduction



Situated in the north of Sweden...



... we are building a state of the art green steel factory



EUR ~5 billion
Phase I funding

2.5Mtpa Phase I
production

2025 start of
production

Close
partnerships





- First greenfield European steel plant for 50 years
- Swedish record in permit approval
- Started construction in July 2022
- 1.5 Mt pa. steel already pre-sold (>€10 billion)
- €3.5 billion debt financing agreed

Building on our experience from Boden, we are developing our green hydrogen projects globally



Hydrogen for steel is just the start...

-  H2 site >700 MW in feasibility or execution
-  H2 site >800 MW in early assessment

We focus on delivering hydrogen to hard-to-abate industrial verticals with direct off-take

STEEL



AMMONIA



ALUMINIUM



SHIPPING



AVIATION



Share of global CO2

~8%

~2%

~1%

~3%

~2%

Replace/New H2 application

New

Replace

New

New

New

Applications

Automotive, Construction

Fertilizer, Detergents

Automotive, Construction

Fuel as H2, NH3 or CH3OH

Fuel as H2 or e-Kerosene

Large synergies across our projects, but some differences stand out per geography



H₂green steel

Seminarieserie från Energiforsk
Omvärldsbevakning vätgas



Sigurd Bunk
Lauritsen, Sweco



ENERGY ISLAND NORTH SEA

Sigurd Bunk Lauritsen
Market Manager, Sweco

A political decision in February 2021

Denmark strikes deal on £25bn artificial wind energy island

Thanks to an inter-party agreement, the clean energy hub in the North Sea is set to be the largest construction project in Danish history



The Danish climate minister closing down the oil industry for good

[➔ Read more](#)

▲ A simulation of Denmark's clean energy island, due to be completed before 2033. Photograph: Danish government



FAQ

- Indemnified artificial island
- Construction and owned in joint public private collaboration
- Export, store and conversion of green danish energy
- Security of supply and optimized infrastructure expansion
- Modulization
- The largest development project with long perspective
- Space for Innovation
- Energinet take the traditional Danish TSO role

Two cross-European political agreements in 2022

Announcement 18 May 2022

- The government leaders of Denmark, Germany, Belgium, Netherland and the EU Commission has agreed on a 10-doubling the offshore wind power in the North Sea before 2050.
 - 150 GW new capacity in 2050
 - 65 GW to be ready by 2030
- We have 25 GW world wide to day off which 19 GW in the North Sea.
- 10.000 new 15 MW turbines
- Covering half of the European energy demand.
- To be used for electricity demand AND other forms for energy, based on Power-to-X solutions (Hydrogen, ammonia, methanol).

Announcement 30 August 2022

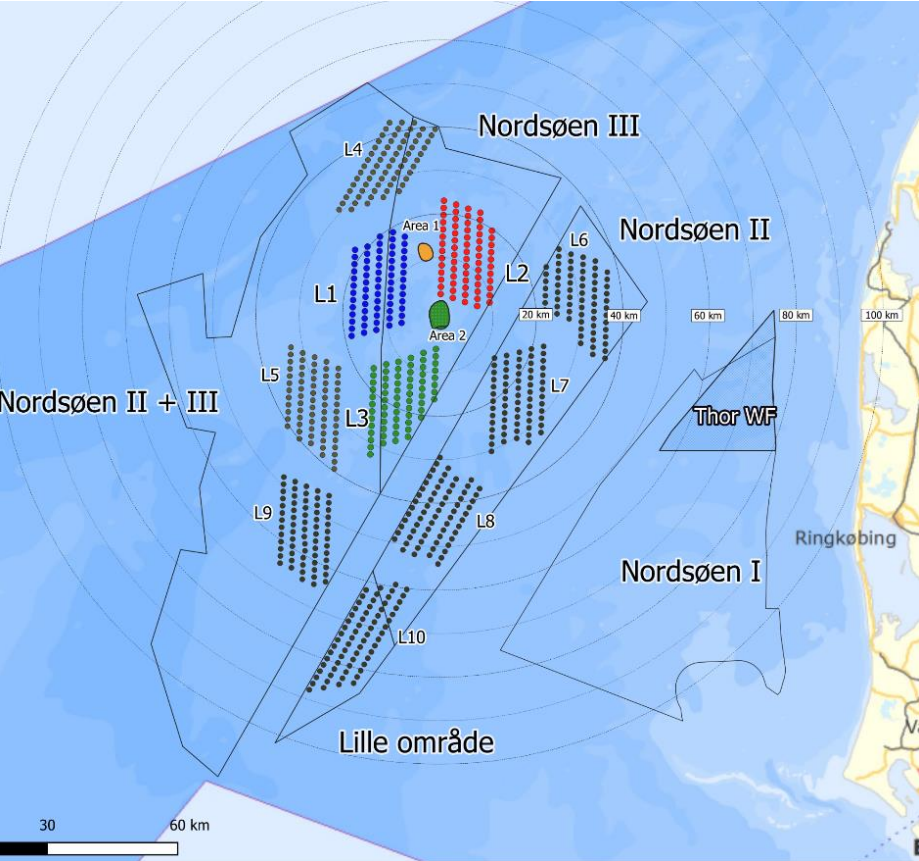
- The government leaders of Denmark, Sweden, Finland, Poland, Germany, Estonia, Latvia, Lithuania has agreed on a 7-doubling the offshore wind power in the Baltic Sea before 2050.
 - 19,7 GW new capacity in 2030 – we have 2,8 GW today.
- 1.126 new 15 MW turbines



Kilde: Statsministeriet, Grafika, Screen, Mithras, Northpark

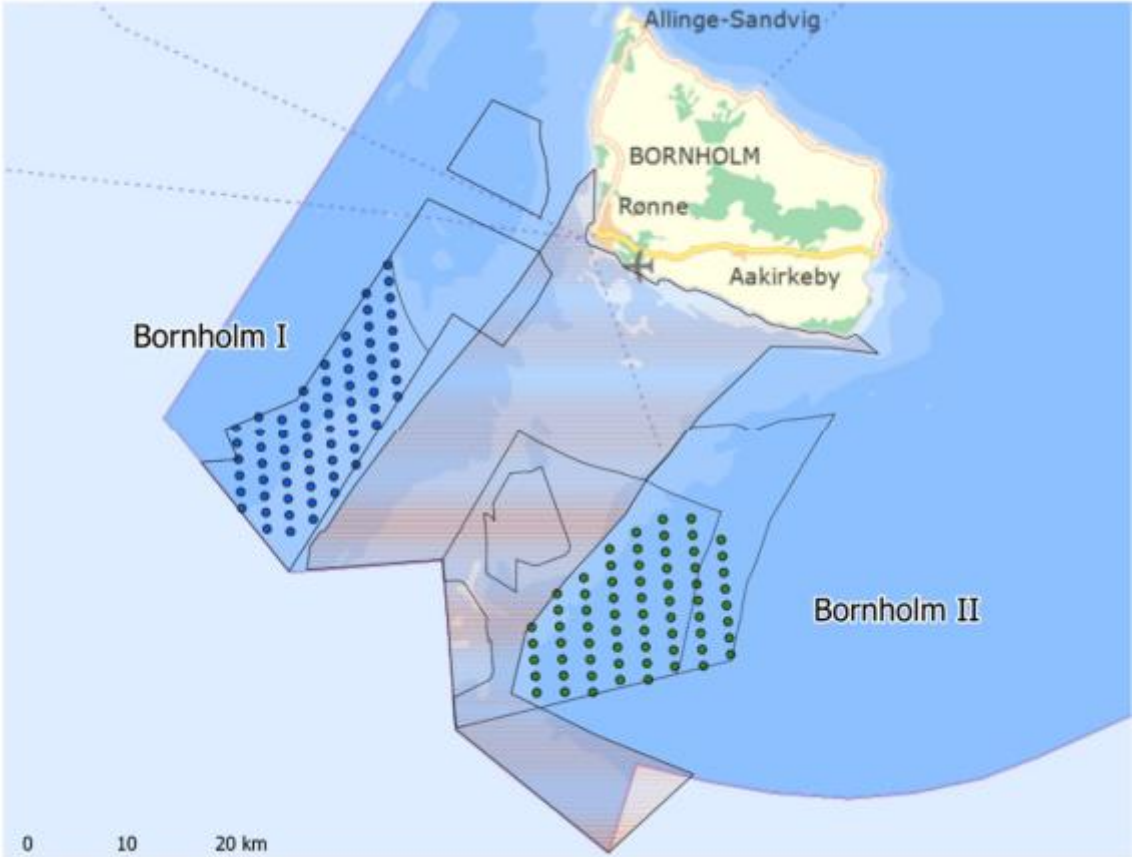
Location of the two decided energy islands

Central location in the North Sea at water depth of 30-32 m and 80 km from shore



10-12 GW

Bornholm as existing island



2-3 GW

The investment

A total investment for the North Sea island of 210 billion DKK (2020 price level)

Windfarm 10 GW



105 Bill. Dkk
~50%

Energy Island (Caisson)



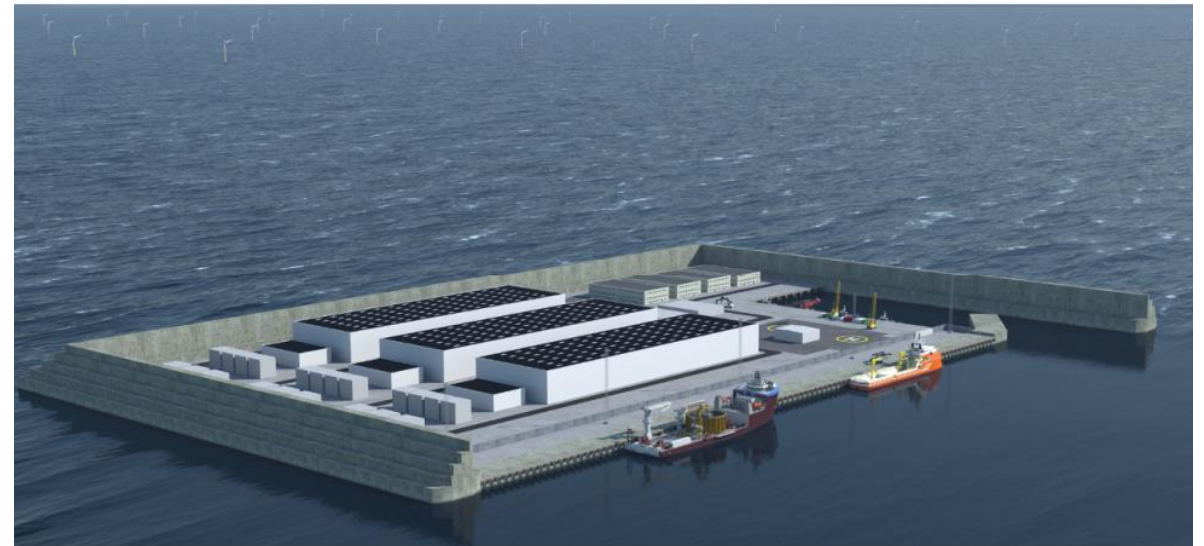
11 Bill. Dkk
~5%

Power transmission

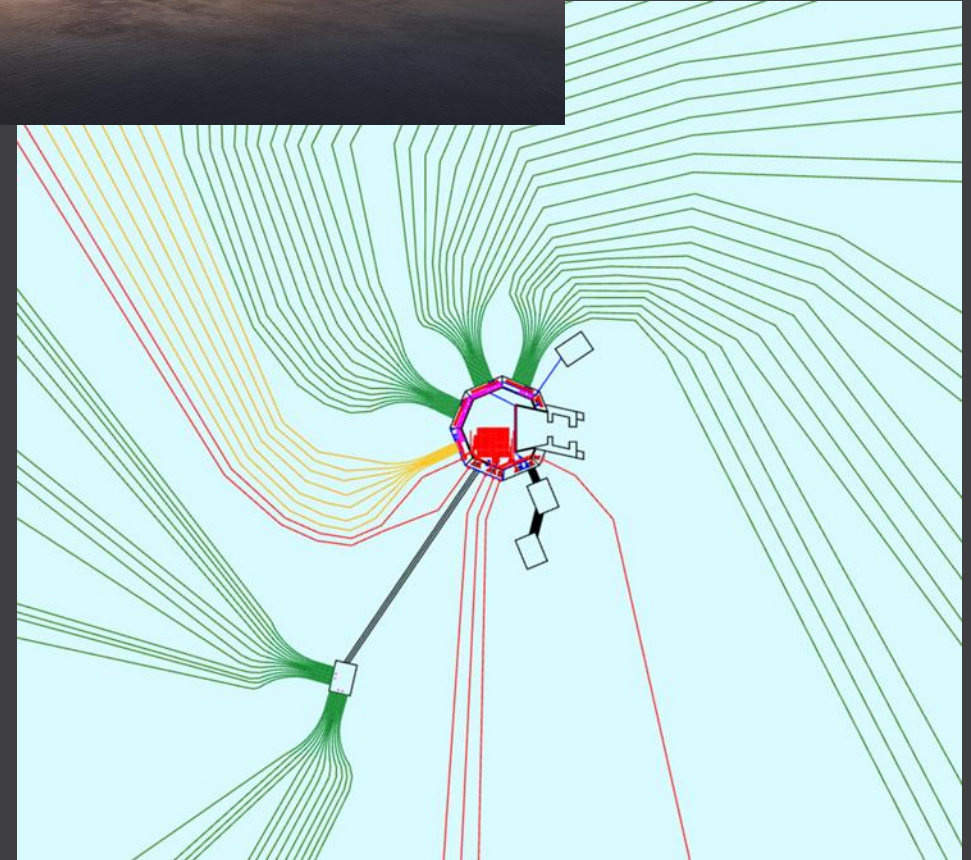


95 Bill. Dkk
~45%

Alternative concepts presented in media



The most robust concept in all analysis



Benefits of the two solutions

Caisson island demonstrates benefits when it comes to:

- > Indicative cheapest option for 10 GW.
- > Possibility of protected port, service and maintenance facility
- > Benefits of upscaling from 3 to 10 GW
- > Expandable functionality by, among other things, PtX
- > Interconnection of electrical systems via land-based connection
- > More flexible interface between foundation and top side
- > Lower costs to transmission equipment on the island as well as export cables
- > Option for having hydrogen pipeline to replace some power export cables. Reduced transmission costs.

Platform Island demonstrates benefits when it comes to:

- > Relatively mature technology in the desired dimensions
- > Central / decentralised solution option with no significant impact on CAPEX.
- > Better scope for gradual implementation
- > Less construction work at sea for platform island itself

Status as of April 2023

- > Conceptual design close to be ready (Sweco)
- > Tender documents will be ready in two months time
- > A dialogue phase will be organized over the summer period with potential bidder-consortia
- > The tender process will run from autumn 2023.

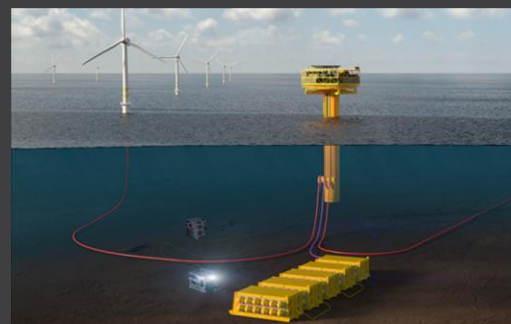
- > The construction is expected to start in 2027/2028 and be finalized by 2032

- > Energinet (Danish TSO) shall be granted access to installing their HVDC equipment by end 2030

- > The OWF tender will go out from the Danish Energy Agency later this year.
- > The OWF's to be operational by 2032.

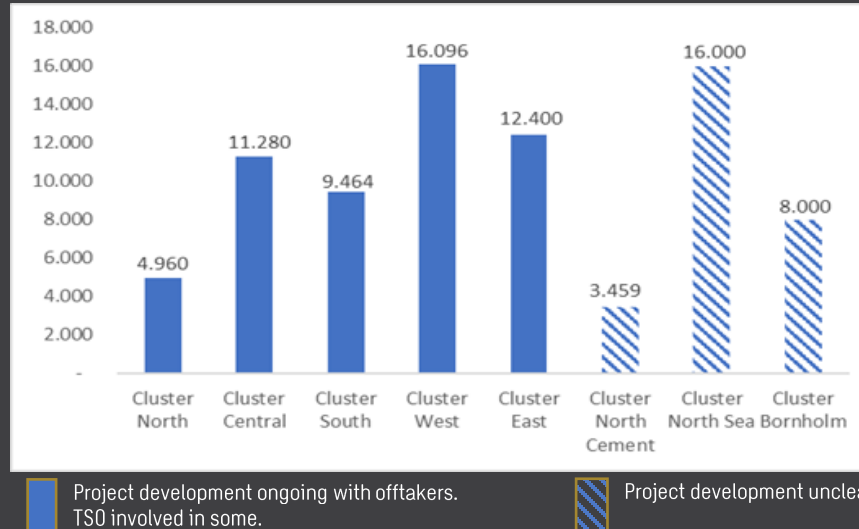
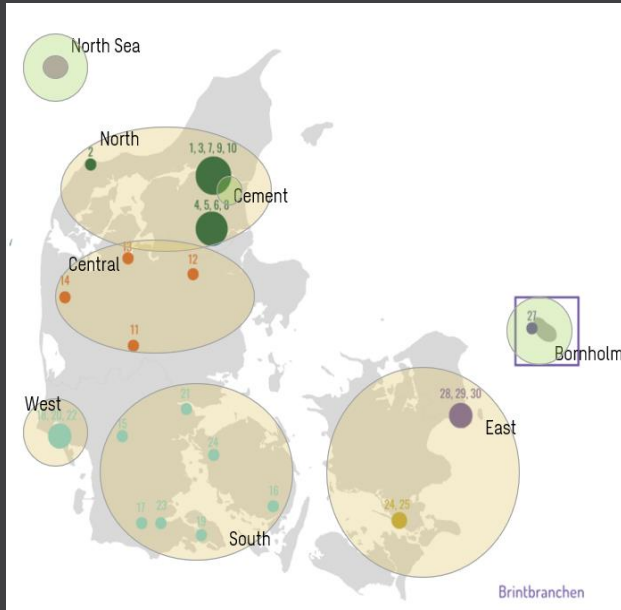
Regarding P-t-X solutions:

- > Several options are on the table. It will be up to the consortia bidders to suggest solutions
 - > On the island (HSE issues)
 - > On one or more platforms outside the island
 - > On a separate smaller island
 - > On each of the wind turbine platforms with a H2 local grid and sea bed located compressorstation
 - > On land.
 - > Marine bunkering



National Hydrogen Strategy from November 2021

Planned projects and capacities by 2030-2032 (7,5GW):



- Food and pharma industry are two dominant energy intensive industries already involved in some of the ongoing project development. The planned projects will in no way fulfil the demand from these sectors.
- Other sectors of importance in Denmark is the chemical industry, oil & refinery sector and the transport sector (maritime sector, road transport sector).
- Off-takers involved counts Mærsk, DFDS, DSV, Arla Foods, Danish Crown, Novo, ...
- Investors & operators involved counts Ørsted, European Energy, H2 Energy, CIP, Shell, Nature Energy, ...
- Export of Hydrogen, eAmmonia, eMethanol or other derivatives from Hydrogen is a focal point as well.
- The Danish gas grid will be reused
 - The planning has been initiated for converting 2 out of 3 gas caverns in Northern Jutland from natural gas to hydrogen.
 - Parts of the 80 bar gas grid will be refurbished
 - New hydrogen pipelines are already in planning phase, i.e. the 40 bar pipeline from Esbjerg to Frederica has to be ready by 2026/2027 and ammonia pipeline from Esbjerg to central Jutland.
 - Denmark and Germany agreed just two weeks ago agreed on a hydrogen pipeline down to Hamburg.

Present policy and political goals:

- By 2021 Denmark use approx. 216 GWh of blue and gray hydrogen, primarily in the refinery sector
- By 2030 it is expected that Denmark uses 82+ TWh of green hydrogen in refineries, food-production industry and agro-sector, in the pharma sector and for heavy transport.
- By 2050 the Danish demand could be 160 TWh and production 320 TWh.

Hydrogen projects in Denmark

7,5 GW by 2030-2032

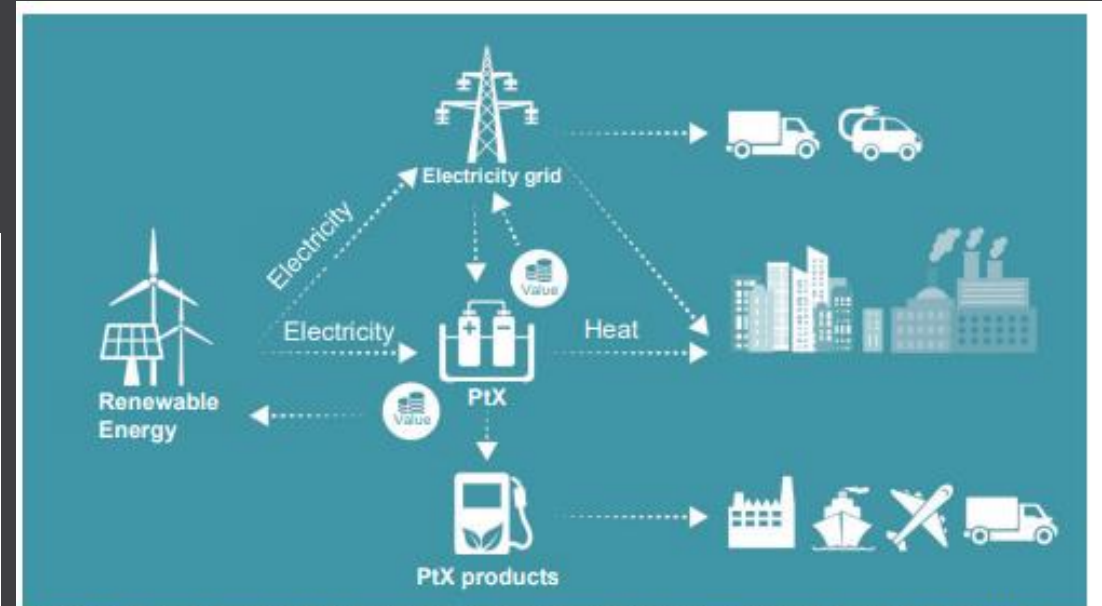
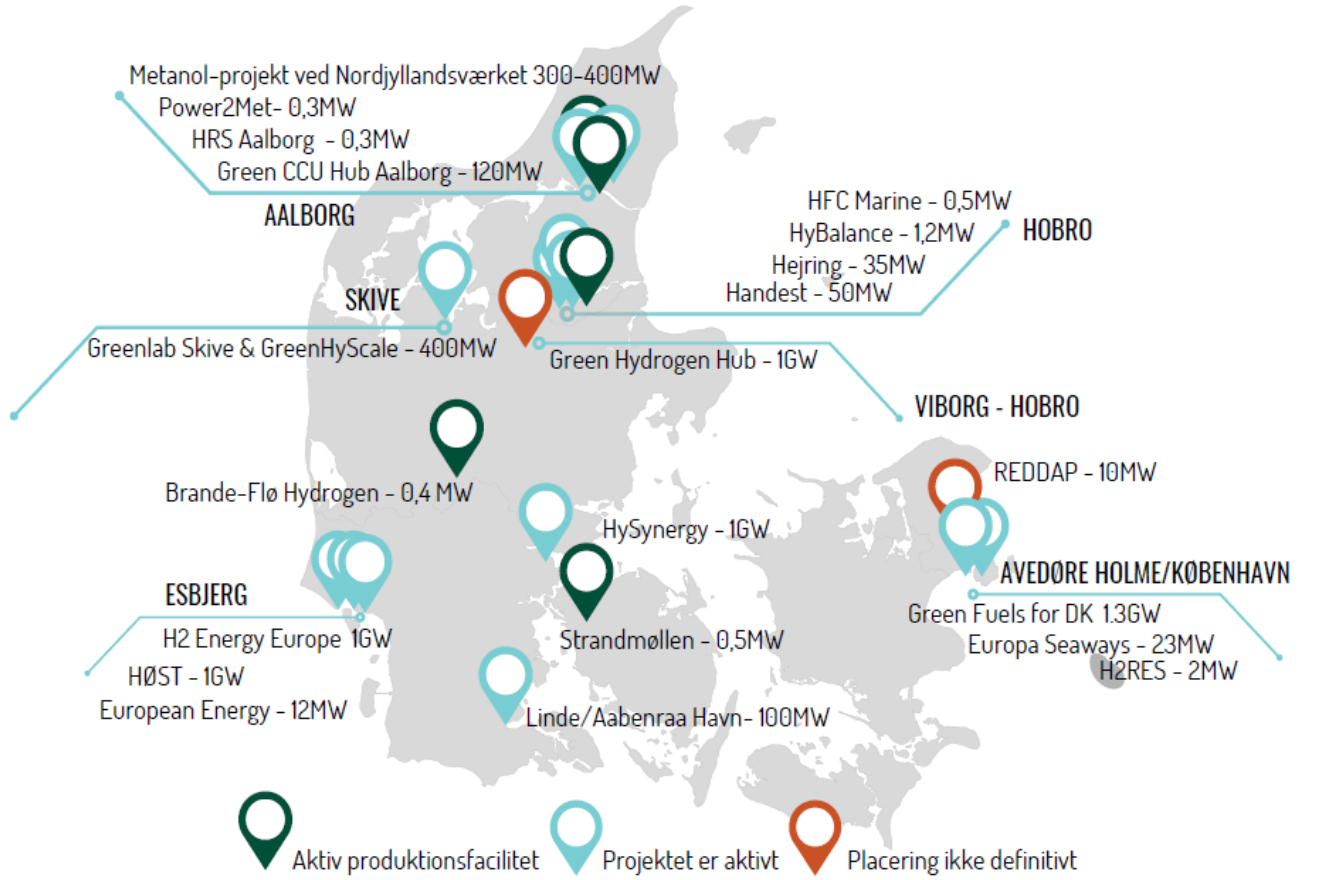


Figure 12. PtX can create value for electricity supply and the electricity grid, provide heat for district heating and produce green fuels for transport and industry. Source: The Danish Energy Agency



Figure 11. Overview of the Danish gas system and conversion possibilities over time. Red: No possibility for conversion, yellow: Some possibility for conversion, green: Good possibilities for conversion. Note the pipeline in South Jutland which can potentially be converted to hydrogen export in the medium term. Source: The Danish Energy Agency



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