Washington Port Symbiosis Study Tour: Denmark

September 2025 trip led by the Center for Sustainable Infrastructure

WPPA 2025 Environmental Seminar

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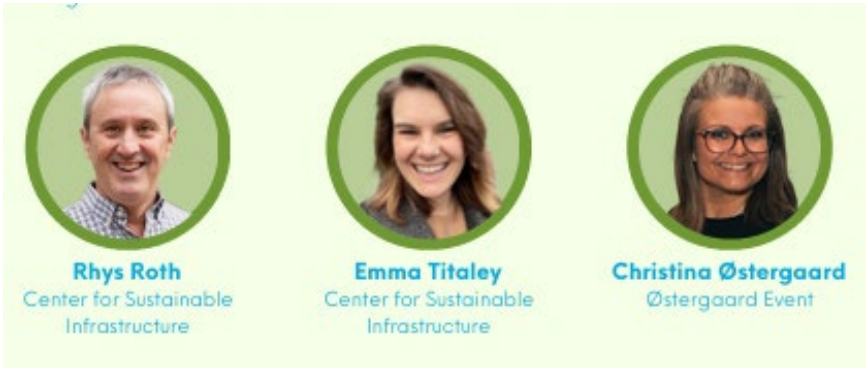
We wore a lot of yellow vests…

Erin Adams	Seattle Good
JC Baldwin	Port of Chelan Douglas
Eron Berg	Port of Port Townsend
Sen. Mike Chapman	Legisaltive District 24
Rep. Brandy Donaghy	Legisaltive District 44
Kirk Esmond	Dept of Commerce
John Flanagan	Port of Seattle
Katharine Frazier	Port of Port Angeles
Joel Hansen	Ameresco
Justin Hopkins	Burnham RNG
Sandy Kilroy	Port of Seattle
Adam Lincoln	Port of Pasco
Cassi Marshall	Port of Camas Washougal
Stephen McFadden	Port of Pasco
Carly Michiels	WPPA
Nick Rohrbach	Port of Chelan Douglas
Lisa Smith	WA Microbusiness Association
Rep. Mike Steele	Legislative District 12
Rep. David Stuebe	Legisaltive District 17
Jasmine Vasavada	Port of Olympia
John Whitchurch	Cascade Energy
Rep. Alex Ybarra	Legislative District 13
Rep. Janice Zahn	Legisaltive District 41
Kyle Gitchell	Department of Commerce

Denmark Tour Delegation & Hosts



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Washington Port Symbiosis Study Tour Agenda

Date	Activity
Sunday September 7	Welcome Orientation & Opening Dinner
Monday September 8	State of Green, DEA, & DHI
Tuesday September 9	Kalundborg Symbiosis
Wednesday September 10	Fredericia Energy Alliance & Port of Esbjerg
Thursday September 11	Esbjerg Municipality & Arla Food Products
Friday September 12	GreenLab, VCS Denmark, & Closing Dinner

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HOUSE OF GREEN

Denmark's Green Goals

- European Union and national regulations
- Aim to be among the world's first climate neutral countries by 2050 and climate negative thereafter.
    - *Phasing out fossil fuels, 100% renewable.*
    - *2027 100% renewable electricity, 2030 ending coal, and 2035 renewable heat*
- Energy efficiency is a long-standing tradition and prioritization of energy supply security.
- Water conservation: "Water efficiency first" principle ("technical water" legislative designation)

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Ambitious regulatory instruments

Normative instruments

- CO_2 audits for large energy users
- CO_2 tax on industry and agriculture
- Permitting for water reuse
- Support for EU regulations

Informative instruments

- Tools and guidance such as SparEnergi.dk
- Climate Partnerships
- International knowledge sharing

Economic instruments

- CO_2 pricing
- The Business Pool as a subsidy scheme
- The Voluntary Agreement for Excess Heat

Green Transition Strategies

- Robust financing
- Broad public-private partnerships
- Energy efficiency and preservation (tradition)
- Renewable energy development: offshore wind
- Bioenergy and agriculture
- Energy islands
- Carbon capture storage and carbon capture utilization
- Green hydrogen to replace fossil fuels
- Supporting infrastructure

Port of Esbjerg tour, loading offshore wind components.

14 Climate Partnerships

- The climate partnerships **represent sectors** in the Danish economy
- The overall purpose of the partnerships was to establish a 2030-vision for how each sector will **contribute to the 70% reduction target**
- The Ministry of Industry, Business and Financial Affairs oversees the overall process
- Specific Climate Partnerships are linked to specific ministries
- Each Climate Partnership has been assigned a Secretariat – a business organisation

Green Transition Outcomes

- Denmark is on track to meet their energy goals
- Three consistent priorities: green energy, security of supply, affordability
- New model for public-private partnerships with sector-specific recommendations
- Business lead climate action and a focus on industry: “Green business is good business.”
    - *- CO2 taxes structured by sector*
    - *- Subsidies, and schemes (The Business Pool) that drive the green transition*
    - *- Competitiveness: Support sustainable industry practices and reuse/circularity*
- Decoupling energy consumption from economic growth
    - *- Since 1990 the Danish economy has grown 80%, energy consumption has dropped 17% and GHG emissions dropped by 40% (2023).*

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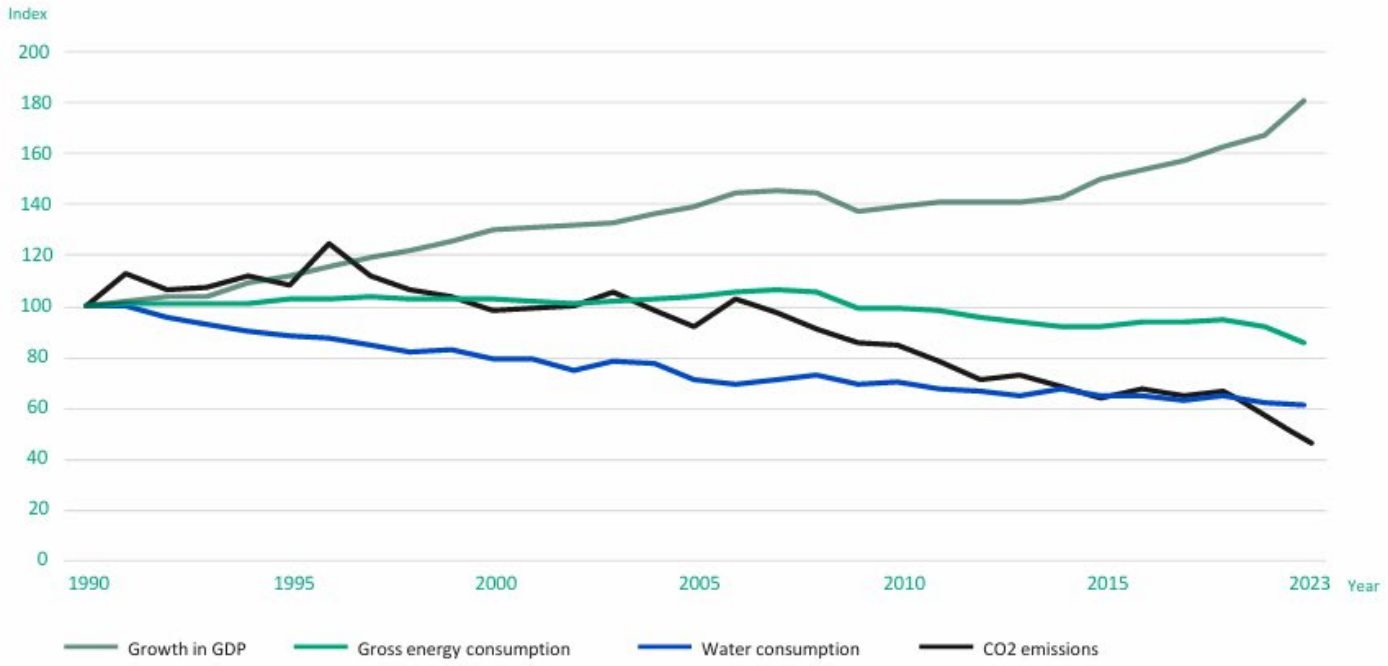
[Denmark]
We have increased GDP by 76%



76%
growth in GDP

-15%
gross energy consumption

-40%
water consumption

-48%
CO2e

State of Green

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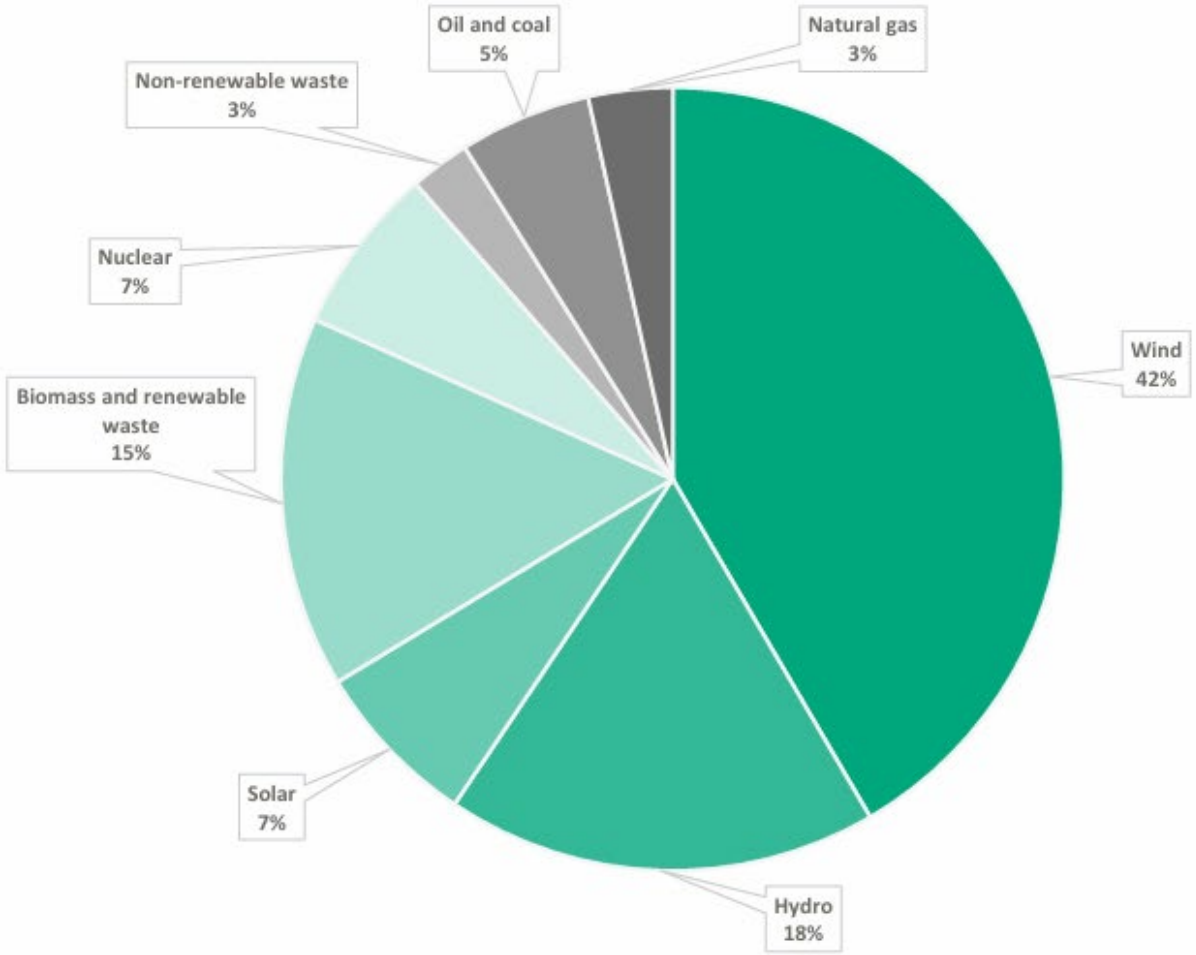
The average kilowatt hour in Denmark (2023)



Source: Danish Energy Agency, National declaration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What is Industrial Symbiosis?

Industrial symbiosis is a broad term referring to industrial operations that involve collaborations and exchanges between multiple industries, allowing for a circular transformation of materials through industrial processes. Through an exchange of resources and energy, interdependent networks are created between industries, allowing for the excess or waste materials from one industry to be used in the production process of another industry. **This process may help reduce consumption of resources production of waste as well as address environmental challenges related to energy inefficiencies.**

From the Department of Commerce,
Washington State Refinery Economic Impact Study (PDF)

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Okay, but what is it…?

1. Collaboration and interdependence among industrial processes and businesses
2. Multiple industries/businesses exchanging resources, materials, or energy
3. Identifying resources and residuals then matching demand and value
4. One’s waste becomes another’s resource
5. Reducing energy inefficiencies

By allowing for a circular transformation of materials through industrial processes, interdependent networks are created, and excess or waste materials from one can be used in the production process of another.

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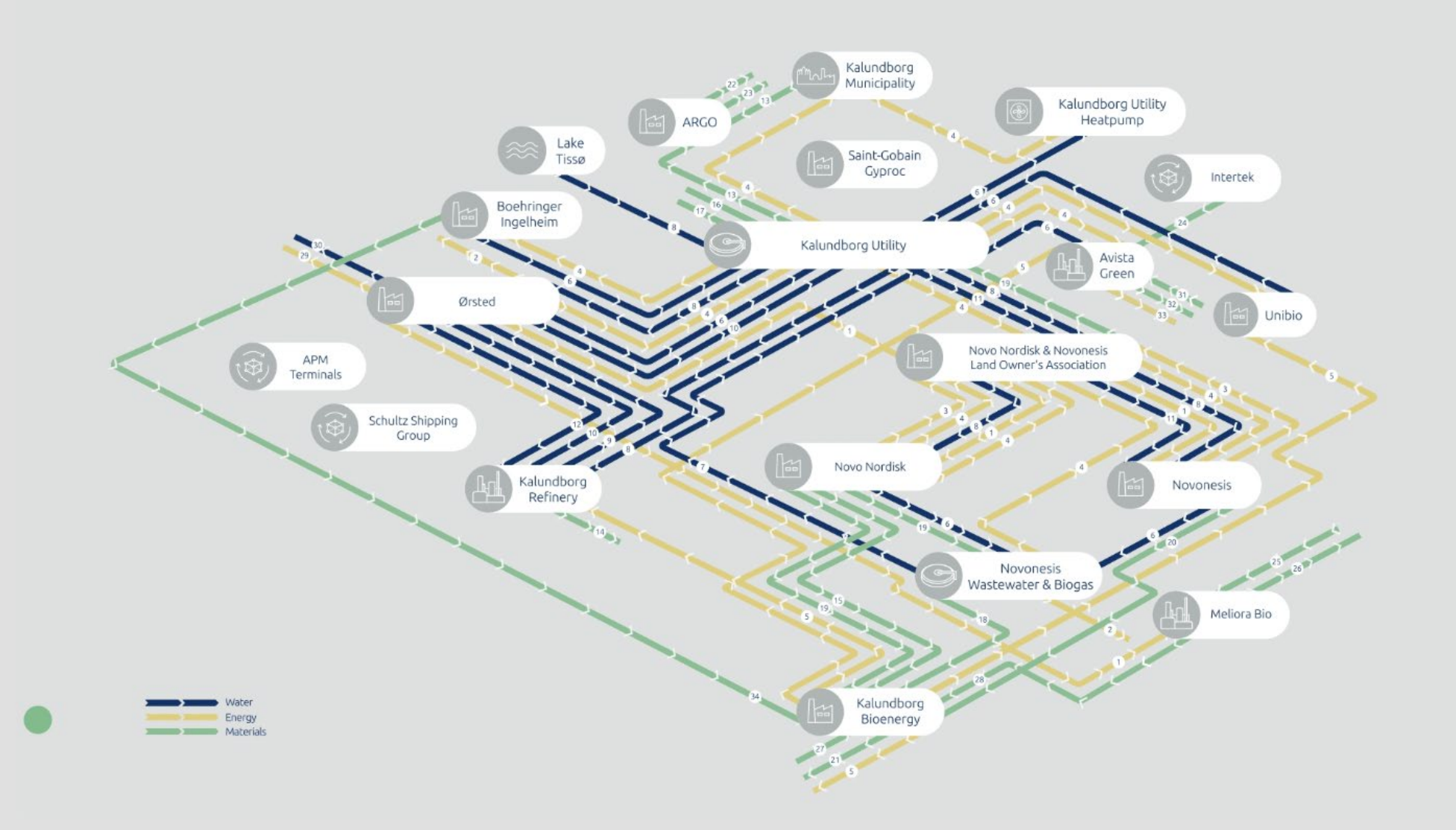
The cheesy analogy that works…
A dating app: matching resources instead of people.



The workshop... it was not easy.

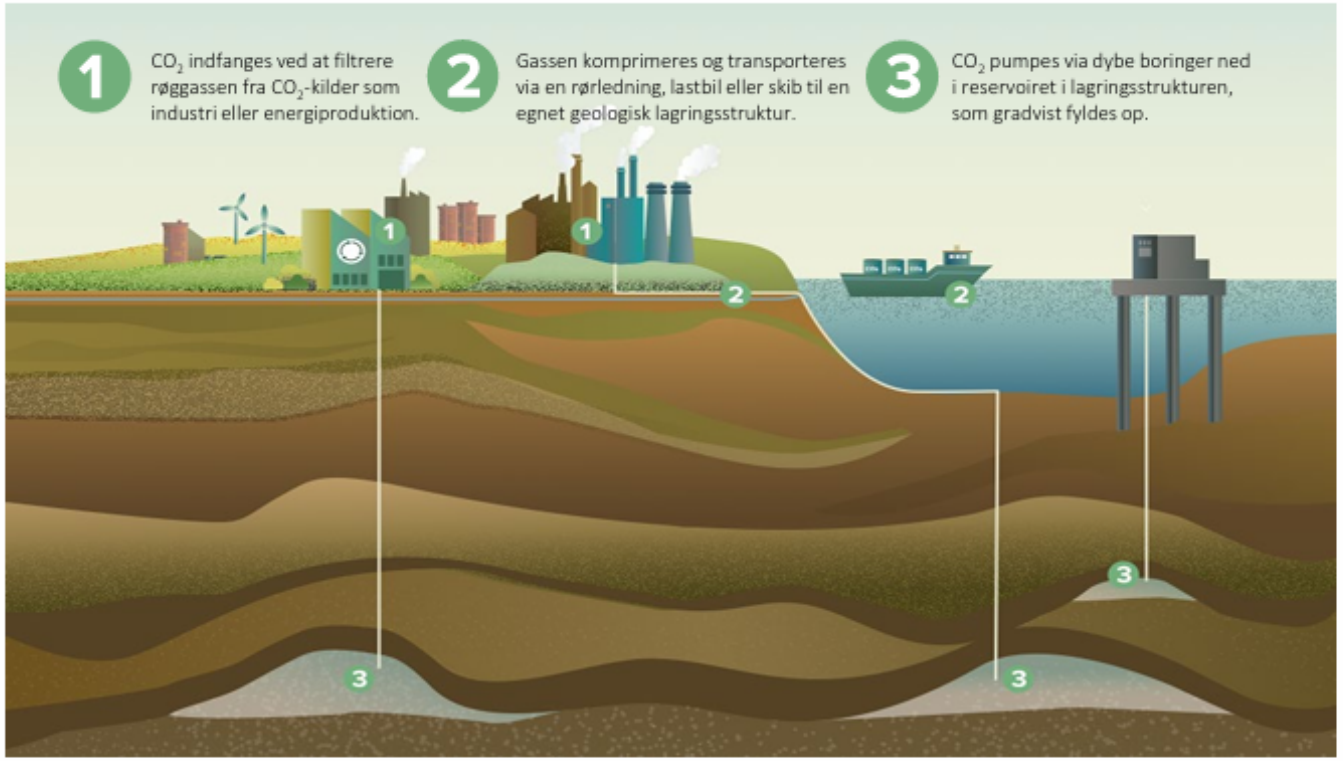
Current CO2-projects

One of the founding members of CCS Zealand and the only Port Authority among emitters, storage operators and onshore infrastructure providers.
The aim is to act as a future hub for Denmark's green transition.

2025: (10-year project)
Export of 430.000 tons of captured CO2 to the Northern Light storage site at the North Sea.
Captured from the Avedøre and Asnaes Power Plants in Copenhagen & Kalundborg.

2029: (16-year project)
New CCS fund from the Ministry of Environment of DKK 28 billion over 16 years, with a requirement for operation by 2030.
2,3 mil. tons of C02 is the expected yearly volume of CO2.

2030: (30-year project)
CO2 Storage Kalundborg (the Havnsø-structure) is expected to come into operation in early 2030's, with a high expected yearly volume, primarily through import.



CO2 – New future cargo commodity

KALUNDBORG PORT

EX: Odense Port

- Has the land space, but with larger vessels, larger roads needed for larger component parts they need to expand.

- After getting funding in 2023 for a feasibility study, the port is undergoing a massive 1 million m² expansion and will 5-fold the production for offshore wind turbines set to be completed in 2027.

- Including adding a Dry Port logistical hub and a deepening project set to be completed in 2028.

- These expansions are part of a strategy to support the rapidly growing offshore wind industry and continue to be Europe's leading production ports within offshore wind.

EX: Fredericia Port

The largest port expansion project in the history of the Port of Fredericia will increase container capacity and secure the Port of Fredericia for the increasing volumes of goods in the future, while supporting the goal of becoming CO2 neutral by 2030.

The new and modern container terminal established with possible future shore power connection of container ships.

Expansion to improve rail logistics, electric trucks and solar installation.

Seen as environmentally friendly benefit for the local community, but will also reduce heavy truck transport regionally and nationally.

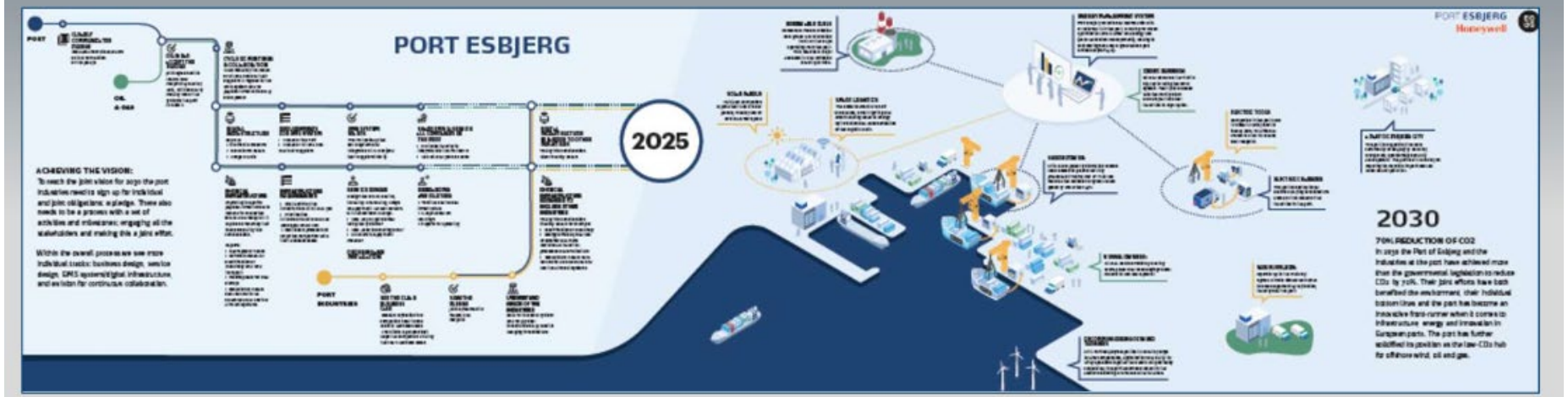
Expected to be completed and ready for commissioning in the summer of 2025.

Port of Fredericia

Medfinansieret af
Den Europæiske Union

Port of Esbjerg

WIND ENERGY – SHORE POWER – FUEL CELLS
POWER2X – EXCESS HEAT – CITY HEATING -
ALTERNATIVE VESSEL FUELS - E-VESSELS – GREEN
BUNKERING - E-CARS - BIOMASS - HEAT PUMPS –
SOLAR POWER – LNG – HYDROGEN



PORT ESBJERG

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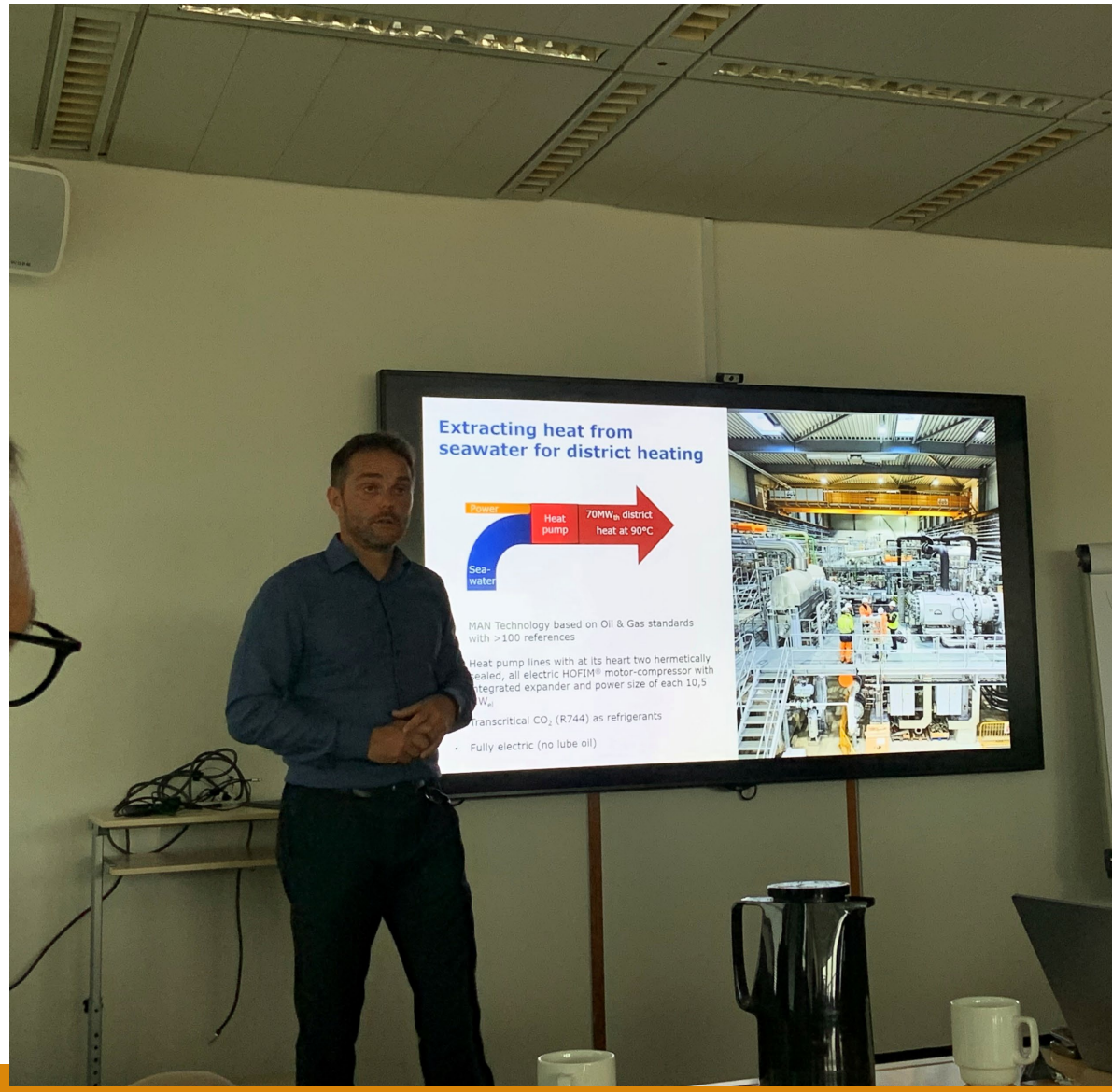
Innovation

- Energy and heat storage
- District heating strategies
- Seawater heat pumps
- Carbon capture utilization and storage
- Technical water/treated wastewater for hydrogen production



Esbjerg Municipality, DIN Forsyning

Arla Food Ingredients Site Visit

Challenges and Opportunity

- Cost competitive
- Cost of electricity
- Sector led planning
- External efficiencies and dependencies
- Ability to meet WA energy goals

- Ability to move projects quickly and expansions to support the goals

- Facilitation
- Technology, scalability
- Emission reduction goals
- Economic development tool
- Synergies around infrastructure

- This is something ports do!
- Already projects at Port of Pasco, Cowlitz Co., Vancouver

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Questions?

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