# Washington delegation

## Introduction to the PtX-partnership in the Triangle area

September 10th 2025

TRIANGLE ENERGY ALLIANCE

**Triangle Energy Alliance – Sector coupling and infrastructures**

**Fredericia Municipality**

**Fredericia College of Marine and Technical Engineering**

**Associated Danish Ports**

Short stroll to the harbour – show and tell

11.30 – departure from FMS – ”På gensyn”

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ENERGY
ALLIANCE

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# Vision

**A unique cooperation will make the Triangle area a North European centre for green energy and fuels.**

# Purpose

- **Support the development of large scale PtX plants in the Triangle area**
- **Raise knowledge on PtX and required skill sets for further advancement**
- **Exchange knowledge and experiences with PtX and supporting technologies**

**TEA was established in June 2021 with 17 partners in the beginning. We are now 34 public and private partners**

# Our board

KNUD ERIK LANGHOFF, Vicechairman, Mayor, Kolding

Keld R. Demant, CEO, Bunker Holding (alternate)

JENS EJNER CHRISTENSEN, Mayor, Vejle

FINN SCHOUSBOE, CEO, Crossbridge Energy Fredericia

FRANK SCHMIDT-HANSEN, Mayor, Vejen

ANDERS FRANDSEN, Chairman, CEO, Danish Forestry Association

JØRGEN NIELSEN, CEO, TVIS

JACOB KROGSGAARD, CEO, Everfuel

OLE THOMSEN, Senior Vice President and Head of Bioenergy, Ørsted

Christian Bro, Mayor, Fredericia

TRIANGLE ENERGY ALLIANCE

# A strong partnership

ABB
ADPC
AIRCO PROCESS TECHNOLOGY
Billund kommune
Billund Airport
BLACKBIRD AIR
Bunker Holding Group
COWI
Crossbridge ENERGY FREDERICIA
energnist USE OF USED
EUC Lillebælt
Everfuel
Fredericia Kommune
FREDERICIA MASKINMESTERSKOLE
FREDERICIA Spildevand og Energi A/S
Haderslev Kommune
JOIN JET
Kolding Kommune
Middelfart KOMMUNE
morgen
nature energy
Nordea
Ørsted
PROCESS ENGINEERING A/S
Region Syddanmark
ROCKWOOL
TOWII Renewables
trekantområdet
TVIS sammen om varmen
VATTENFALL
Vejen KOMMUNE
VEJLE KOMMUNE


# The Triangle Area
# Energy infrastructure

- Highway
- Rail
- High voltage grid
- Gas pipeline
- Gas – Baltic pipe
- Oil pipe line
- District heating
- Potential hydrogen
- Potential $CO_2$

OGSI ikke stabiliseret endnu

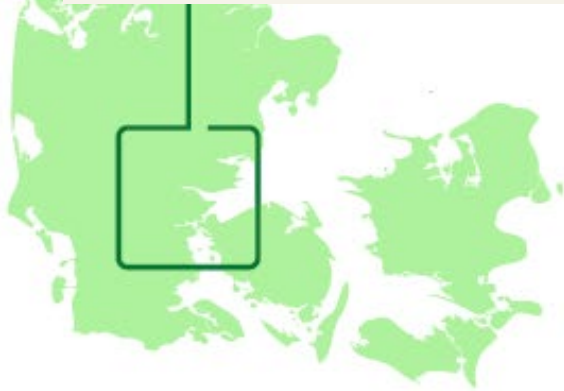
**ENERGINET**

Energinet anbefaler at tilslutte strøm fra Energiø Nordsøen til højspændingsnettet ved Revsing i Vejen Kommune

12.4.2022 06:30:00 CEST | Energinet

Del

Grøn strøm fra vindmøllerne ved den kommende energiø i Nordsøen skal føres i kabler på havbunden og under jorden ind til et sted på land, hvor strømmen kan kobles til det danske højspændingsnet. Energinet peger nu på Revsing i Vejen Kommune som det mest velegnede sted.



# **Power to X value chain** in the Triangle Area

Renewable power

be better energy · TOWII Renewables

Infrastructure

VATTENFALL

Water

FREDERICIA Spildevand og Energi A/S

$H_2O$

Electrolysis

Everfuel · GREEN HYDROGEN SYSTEMS · morgen

$H_2$

$O_2$

ROCKWOOL

$H_2$

Hydrogen fueling stations

$CO_2$

Refining

Crossbridge ENERGY FREDERICIA

Surplus heat

TVIS

Carbon capture

AIRCO · energinet · Ørsted

$CO_2$

Biomass

nature energy

Biomass

System-integration

ABB

Financing

Nordea

$CO_2$

Aviation

Billund Airport · JOIN JET · BLACKBIRD AIR

Road transport

Harbors

ADPC

Shipping

Bunker Holding Group

Education

EUC Lillebælt · FREDERICIA MASKINMESTERSKOLE

Counseling

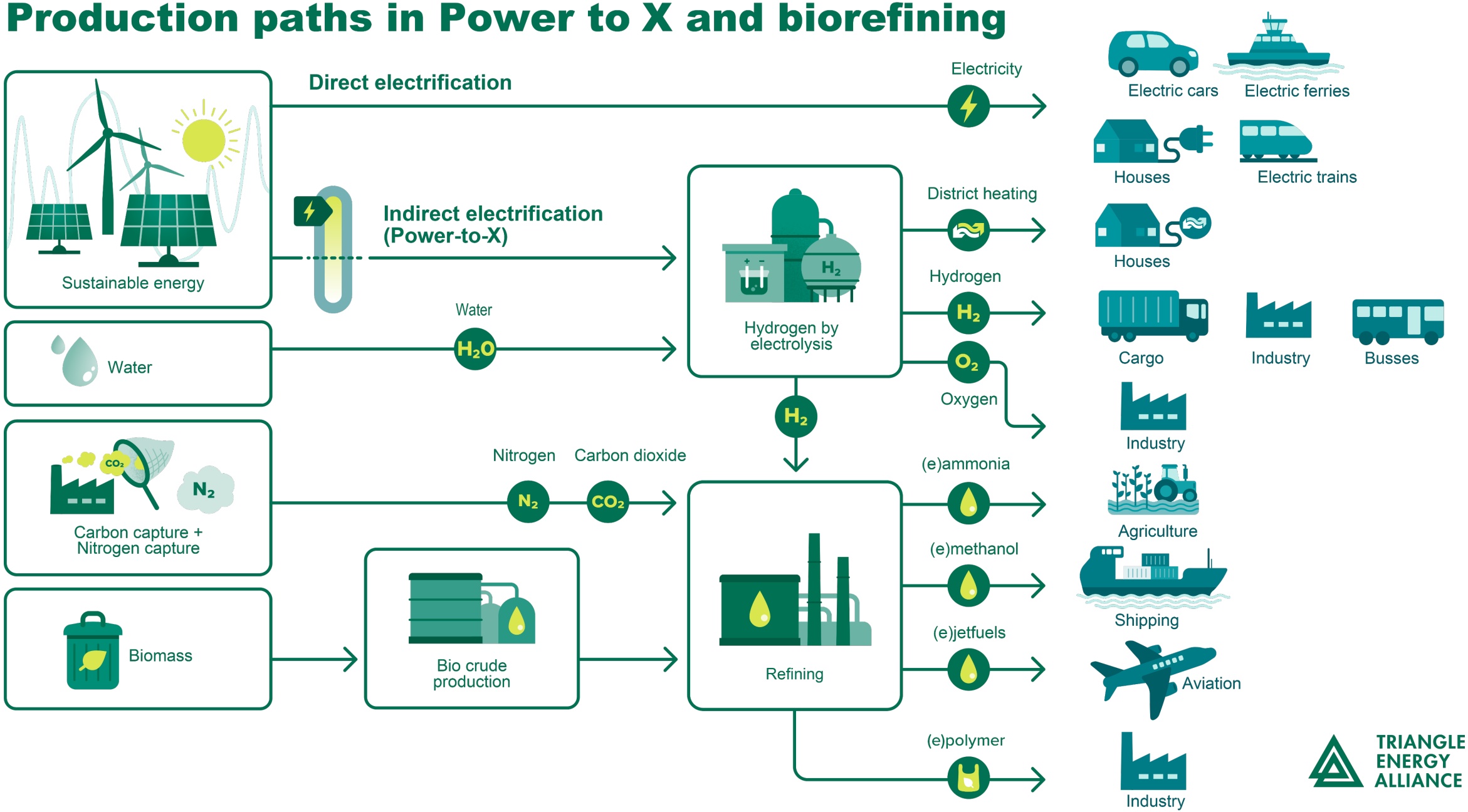
COWI · PROCESS ENGINEERING A/S

Municipalities and regions

BILLUND KOMMUNE · Fredericia Kommune · Haderslev Kommune · Kolding Kommune · Middelfart KOMMUNE · Vejen KOMMUNE · VEJLE KOMMUNE · trekantområdet · Region Syddanmark

TRIANGLE ENERGY ALLIANCE

# Production paths in Power to X and biorefining

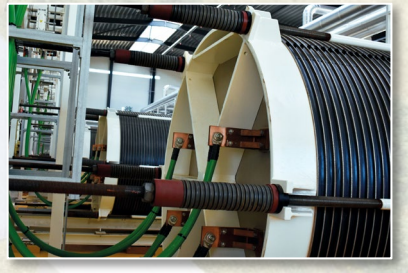


# HySynergy – Everfuel's flagship hydrogen production project

## Phase 1

- **20 MW green hydrogen** production facility next to Crossbridge Energy refinery fully operational in Q1 2025
- Surplus heat used for district heating to **~1,800 households**
- H2 delivery by pipeline and Distribution Centre

**Pictures August 2023**



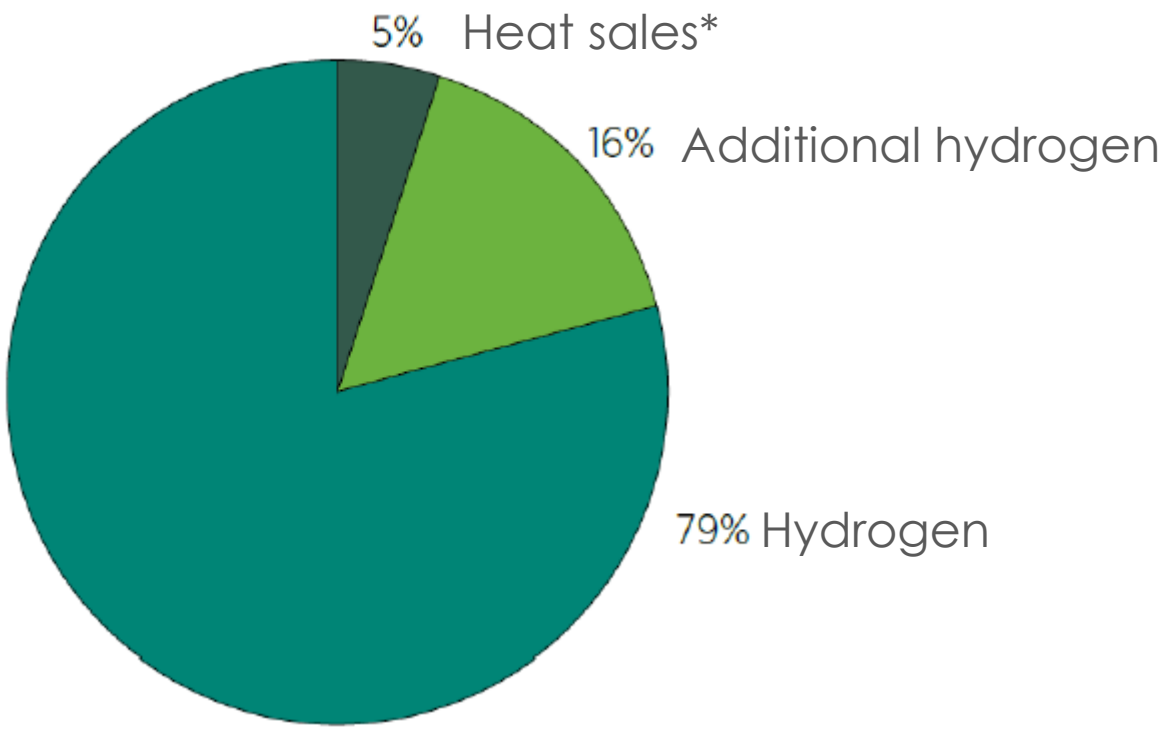
Everfuel

# Everfuel, Crossbridge Energy and TVIS 20 MW electrolyser

Operational hours per year: 6000
Hydrogen: 3.880 Nm3/h (ca. 350 kg/h)
Surplus heat - Direct: 10.000 MWh per year
Surplus heat – Heatpump: 18.000 MWh per year.

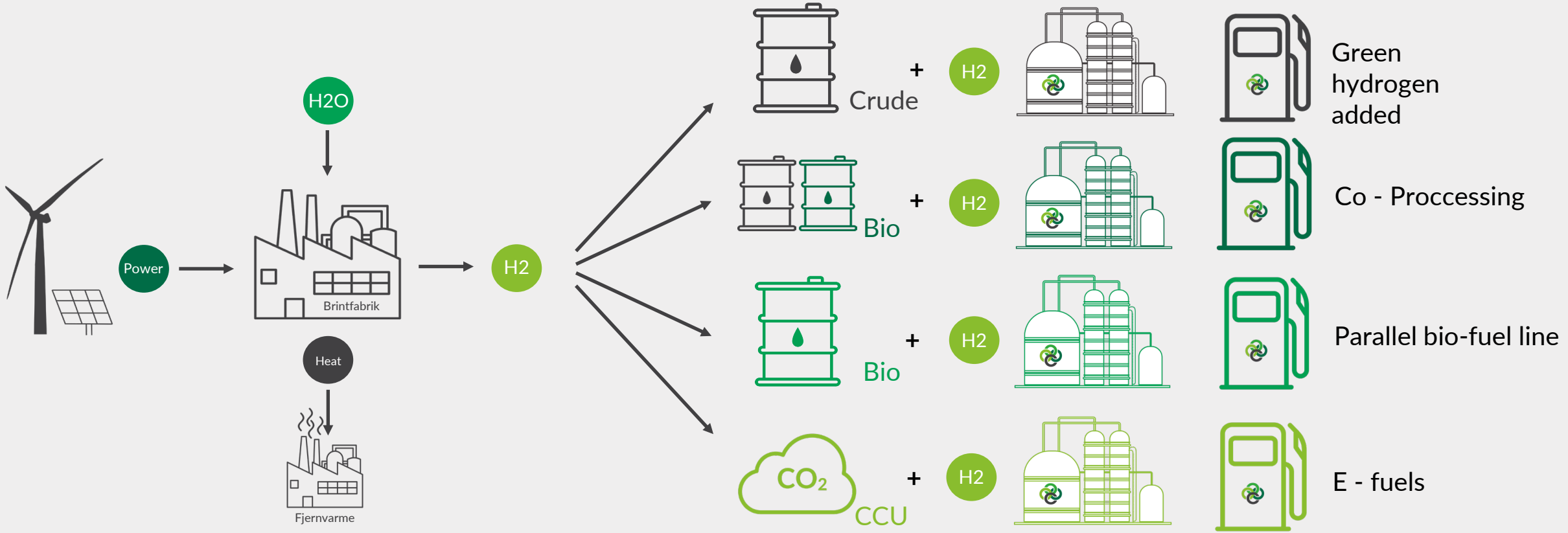
* **1 ton green hydrogen will reduce CO2 emissions with 10 ton at the refinery.**


# Surplus heat and cooling – Hydrogen production




* Not including reduced investment in cooling and operational costs for cooling

# Green transition of Crossbridge Energy refinery



# Hydrogen and infrastructure binds east and west together in Southern Jutland, West Denmark and towards Germany

### Njordkraft - Esbjerg

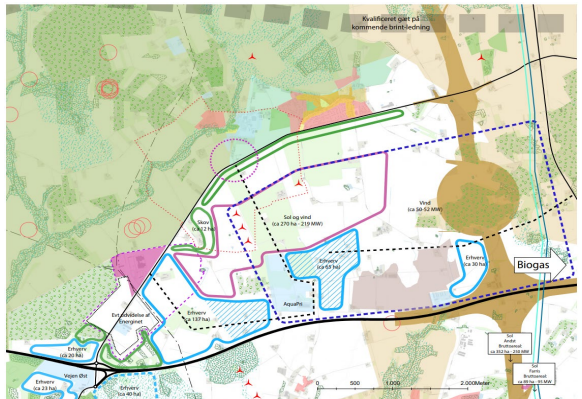
MorgenEnergy – owned by Trafigura
1 GW PEM Electrolysis
120.000 tons of H2/year
District heating
Pipeline via Egtved/Revsing to Taulov/Fredericia: Assessing potential for hydrogen production.

### Frigg - Vejen

**Phase 1:** 500 MW electrolysis, blocks of 100 MW
**Phase 2:** +500 MW electrolysis,
**Phase 3 vision:** Up to 2 GW electrolysis

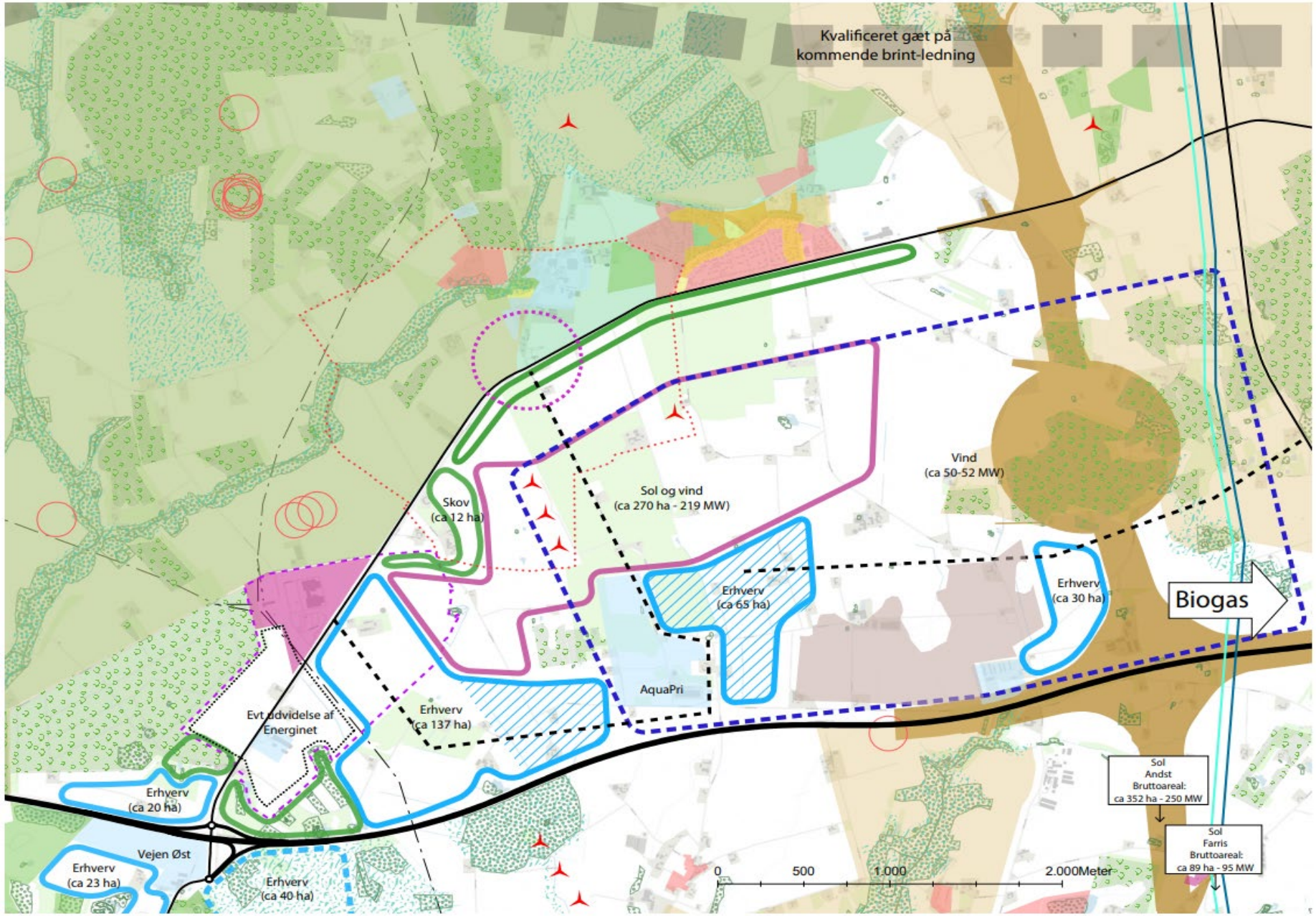
### HySynergy - Fredericia

**Phase 1:** 20 MW electrolysis, comm. now (8 t/day)
**Phase 2:** 100-300 MW electrolysis, (IPCEI supported, app. 40 t/day expected PEM electrolysers)
**Phase 3 vision:** App. 1 GW electrolysis





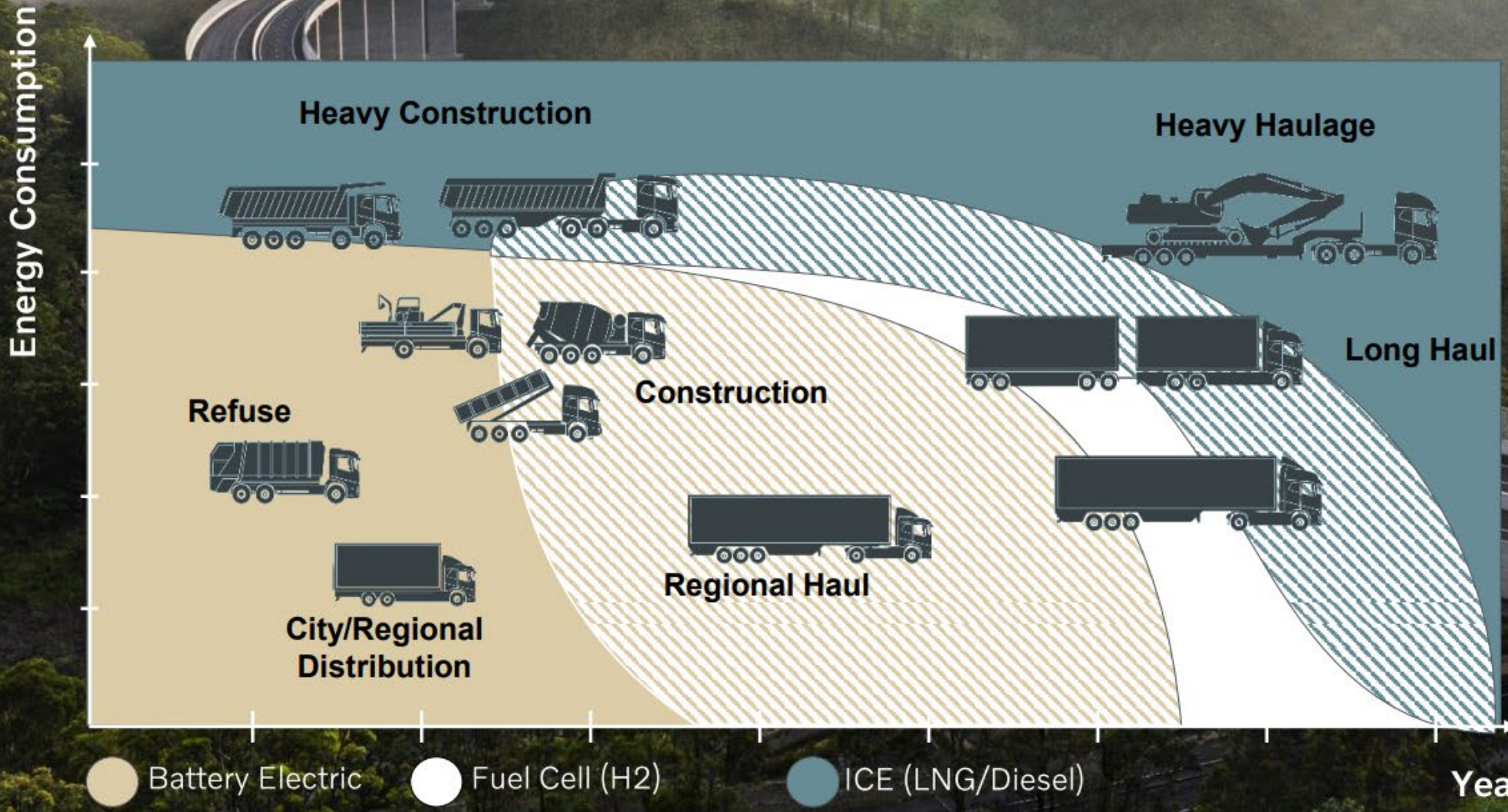
# Energypark Revsing

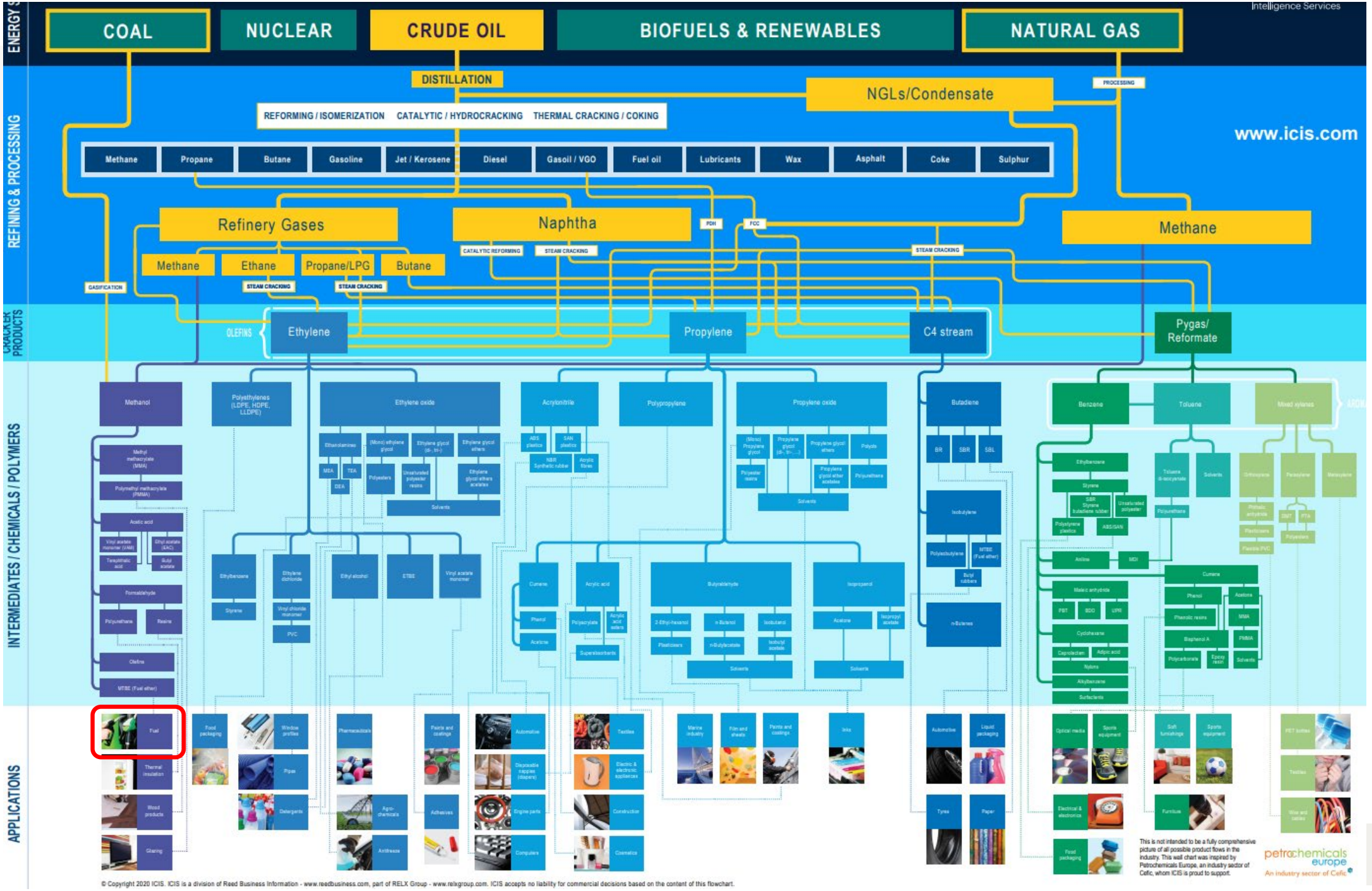



| Energipark Revsing | Hybrid with wind turbines |
|---|---|
| Installed effect [MW] | 268 |
| Energy production [GWh ] | 475 |
| ”Grøn pulje” (up to) [mio. DKK] | 43 |
| House holds | 106.000 |

Vejen KOMMUNE

# SEGMENTERNE I TUNG TRANSPORT





# Danmarks forbrug af fossile ressourcer 2021

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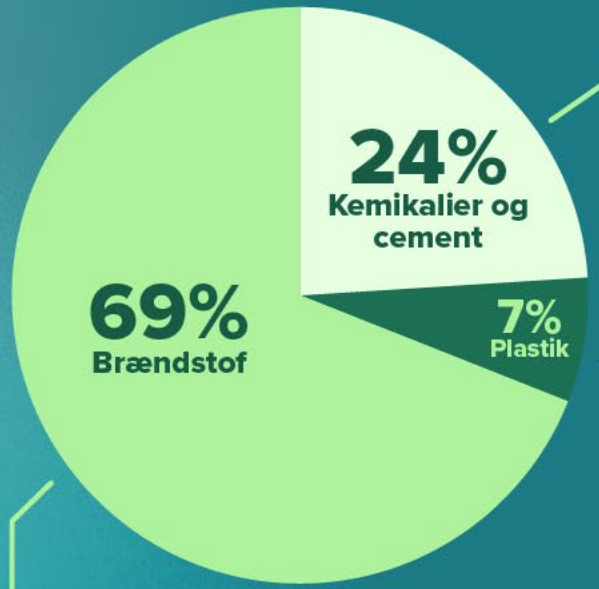
## 13.700.000 tons samlet

Heraf: 8.986.000 tons kulstof / 1.594.000 tons brint

Potentielt $CO_2$: 32.949.000 tons




### Kemikalier og cement

**3.300.00 tons – heraf:**
925.000 tons kulstof
140.000 tons brint

**Potentielt $CO_2$**
**3.400.000 tons**

### Brændstof

**9.400.000 tons – heraf:**
7.200.000 tons kulstof
1.300.000 tons brint

**Potentielt $CO_2$**
**26.500.000 tons**

### Plastik

**1.000.000 tons – heraf:**
850.000 tons kulstof
150.000 tons brint

**Potentielt $CO_2$**
**3.100.000 tons**

Kilde: COWI, september 2023, Nettoforbrug af brint og kulstof i Danmark. Baggrundsnotat udarbejdet for Triangle Energy Alliance.

$CO_2e$

# Future demand and availability of carbon in Denmark

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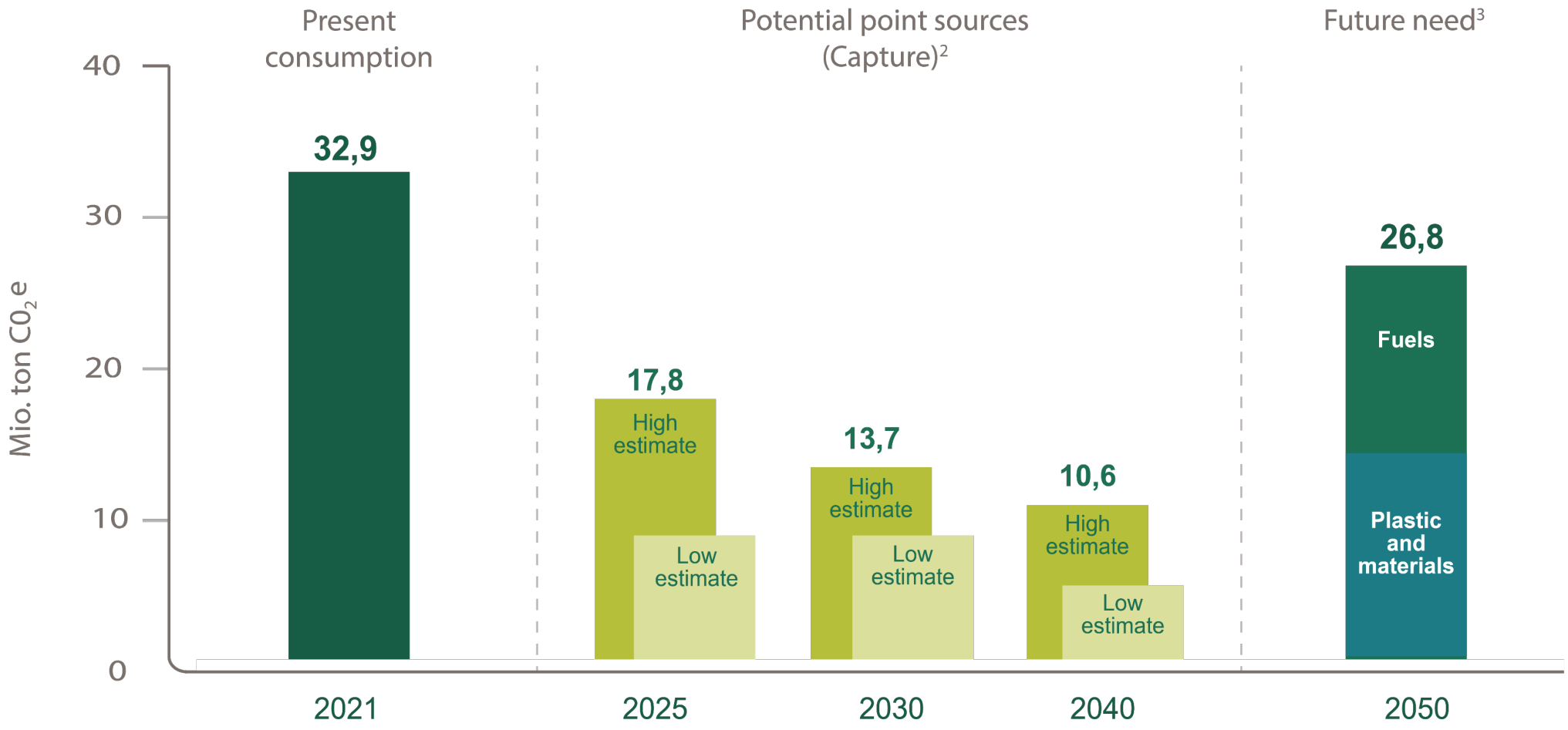



Sources:
1) NETTOFORBRUG AF BRINT OG KULSTOF I DANMARK I 2021 - BAGGRUNDSNOTAT for Triangle Energy Alliance, COWI, 2023
2) Punktkilder til CO2 – potentialer for CCS og CCU 2022-opdatering, Energistyrelsen, februar 2023
3) Scenarier for anvendelse af biomasseressourcer i fremtidens produktionssystemer for fødevarer, energi og materialer inden for rammerne af gældende politik for landbrug, miljø, klima, natur og energi. DCA - Nationalt Center for Fødevarer og Jordbrug, 2022. (Rådgivningsrapport fra DCA - Nationalt Center for Fødevarer og Jordbrug).

# Issue: Where to find sustainable carbon in the future?

## Photosynthesis – wasteproducts from primary production

## Or Direct Air Capture (DAC)/Direct Ocean Capture (DOC)

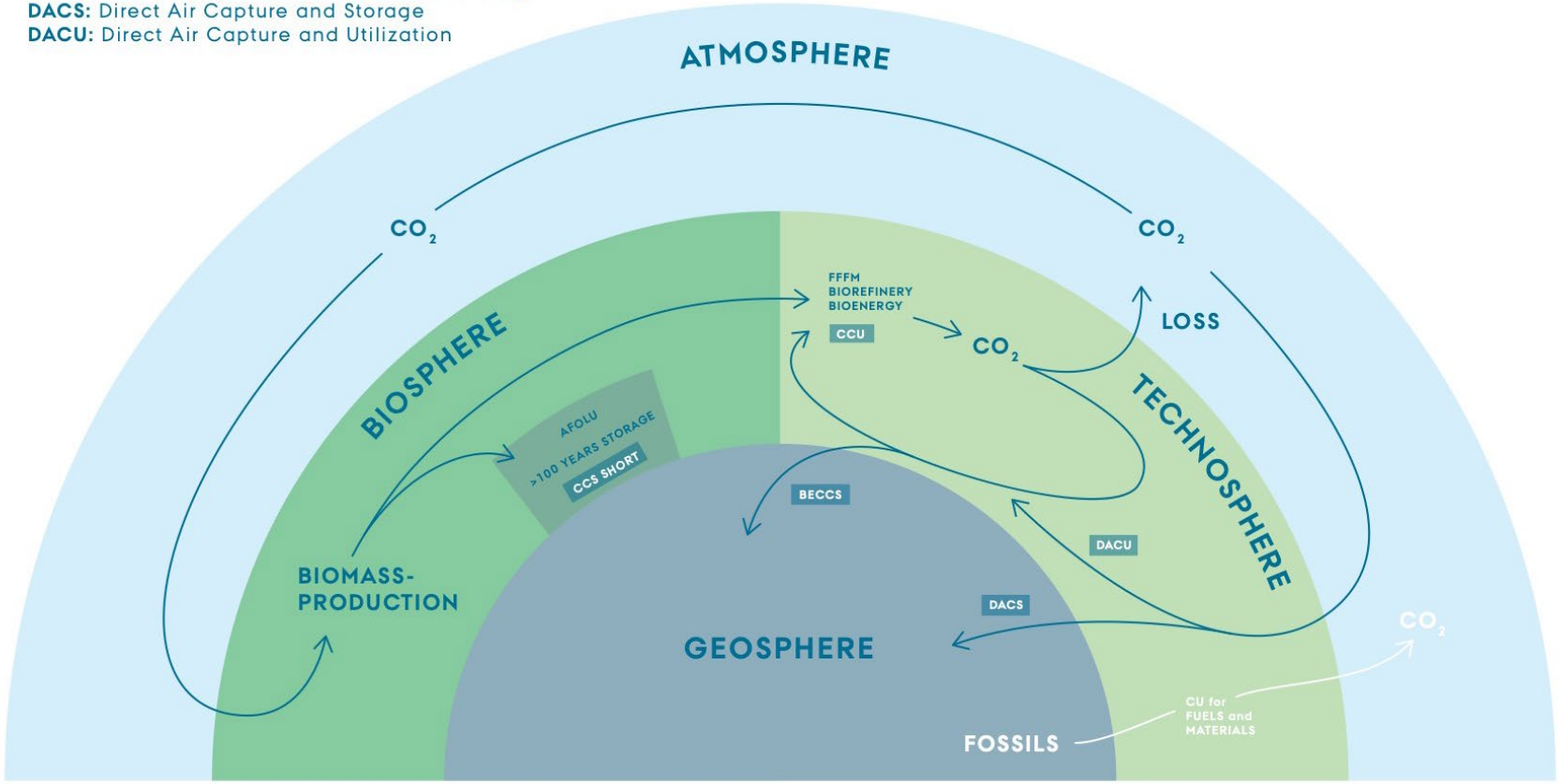
2017: 900 t/y (Schwitzerland)

2021: 4.000 t/y (Iceland)

20??: 1.000.000 t/y (?! Texas)

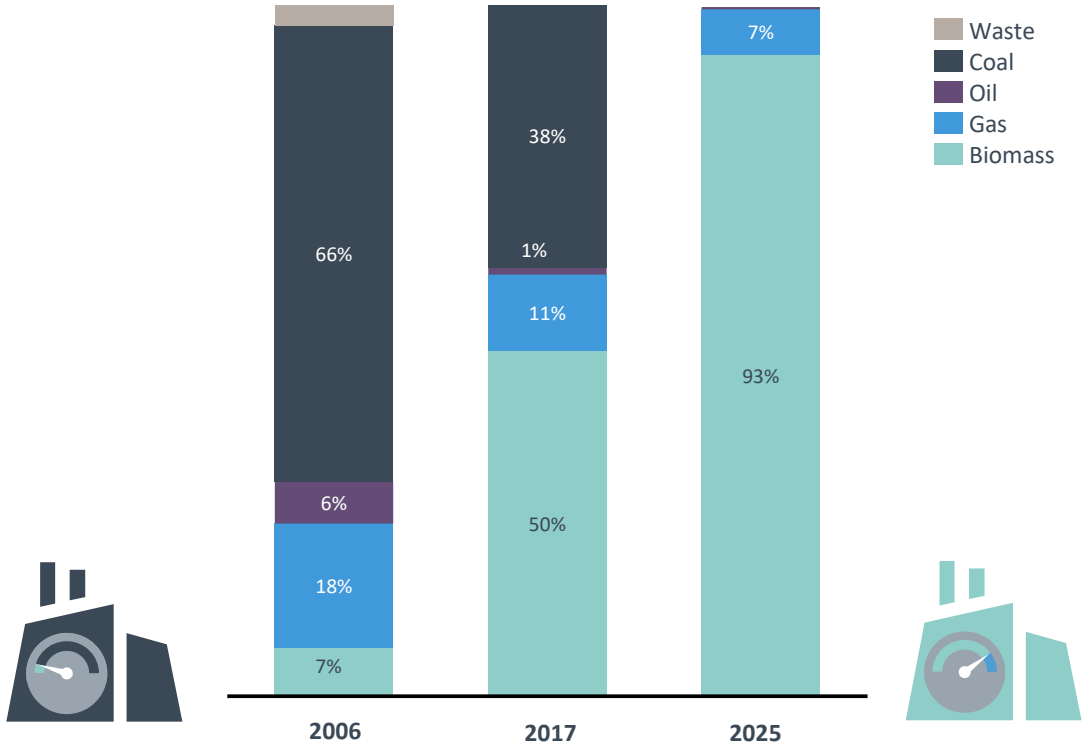
# GLOBAL CARBON CYCLE

**FFFM:** Food, Feed, Fuels and Materials
**AFOLU:** Agriculture, Forestry, Other Land Use
**BECCS:** Bio Energy Carbon Capture and Storage
**DACS:** Direct Air Capture and Storage
**DACU:** Direct Air Capture and Utilization



# Sustainable biomass played an important role in reducing Ørsted's $CO_2$ emissions

## Fuels used in Ørsted's electricity and heat production




5bn DKK[1] were invested in this transition from 2011-2016



Source 1: Energistyrelsens basisfremskrivning, 2019

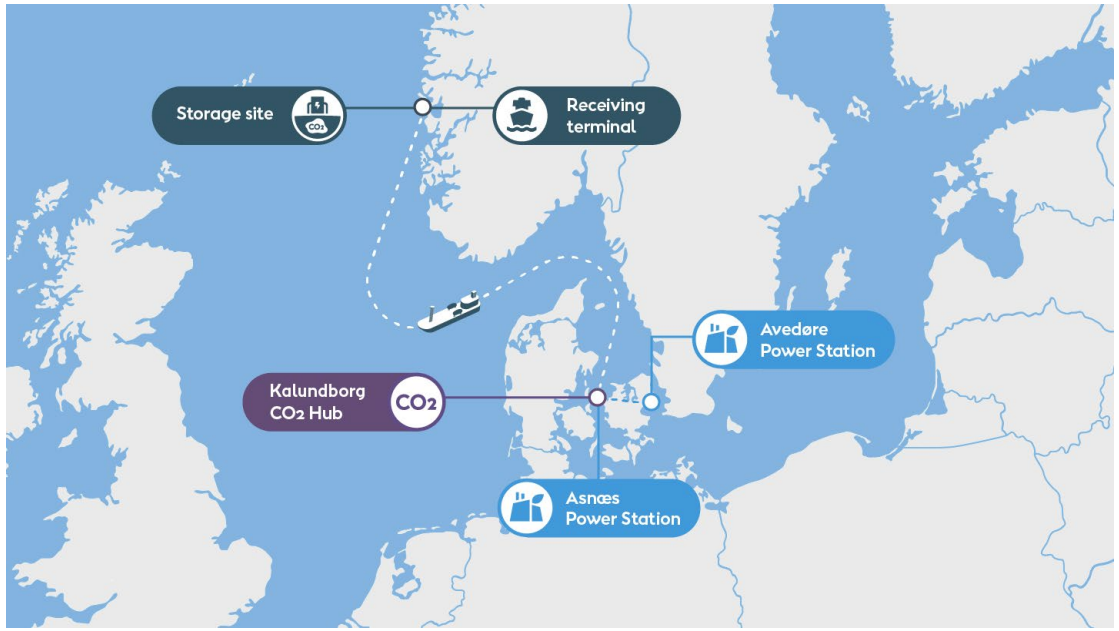
# The Ørsted Kalundborg $CO_2$ Hub establishes a key starting point for $CO_2$ infrastructure in Denmark, capturing & storing 430,000 tonnes $CO_2$ annually

## Key facts on Ørsted Kalundborg CO2 Hub

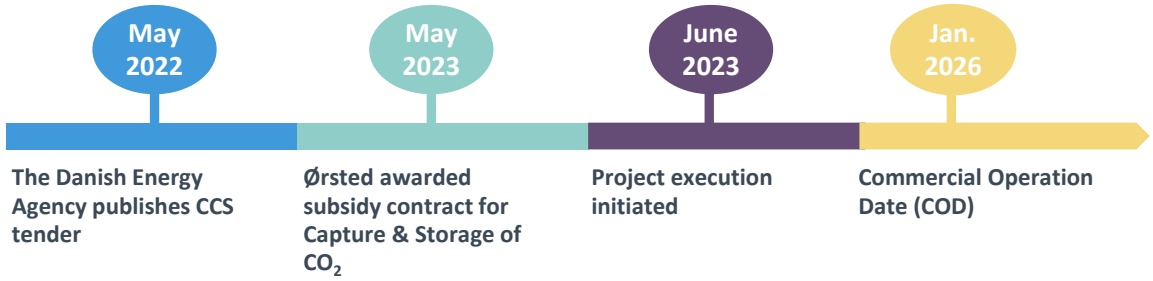
**Project Scope**

- Ørsted Kalundborg CO2 Hub will have a central role in the import and export biogenic $CO_2$
- Project is based on a portfolio of two-point sources to deliver the contracted $CO_2$ quantity of 430,000 tonnes annually:
  1. Asnæs Power Station with ~280,000 tonnes/annually
  2. Avedøre Power Station with ~150,000 tonnes/annually
- The project establishes first-of-kind, large scale agreement with Microsoft for the offtake of carbon removal credits
- Subsidy contract with the Danish Energy Agency is for a 20-year period.

## Location of assets




## Timeline






Ørsted

# FREDERICIA $CO_2$-HUB


ADPEI
ENERGY INFRASTRUCTURE

ADPEI

# Scenario Development

## Scenario 2a: “Build and they will join”

**Scenario 2 – “Build and they will join”**

In both scenarios called “build and they will join”, the infrastructure with the development of storage sites and backbone pipeline grid, will be planned, built and set in operation simultaneously in a rough 2030 timeline. The pipeline infrastructure will be designed to facilitate the expected storage capacity and take into account domestic and foreign volumes of CO2. In order for this to be feasible and for the infrastructure to facilitate CCS market development sticking to the 2030 timeline is key. These scenarios assumes a degree of public participation and coordination in order to facilitate simultaneous developments and resulting societal benefits

**Scenario 2a – Current pathway**

In scenario 2a – Current Pathway, the infrastructure development is coordinated, hence more national CO2 will be captured due to the supporting infrastructure. The CO2 ports in Aalborg, Esbjerg and Kalundborg are included as it is expected that these ports will be developed because of timing as presented in Scenario 1. The CO2 port in Copenhagen will however not be built as the CO2 will be transported by pipeline to Havnsø. Instead, a port in the Fredericia area will be developed to increase import capacity by vessel.

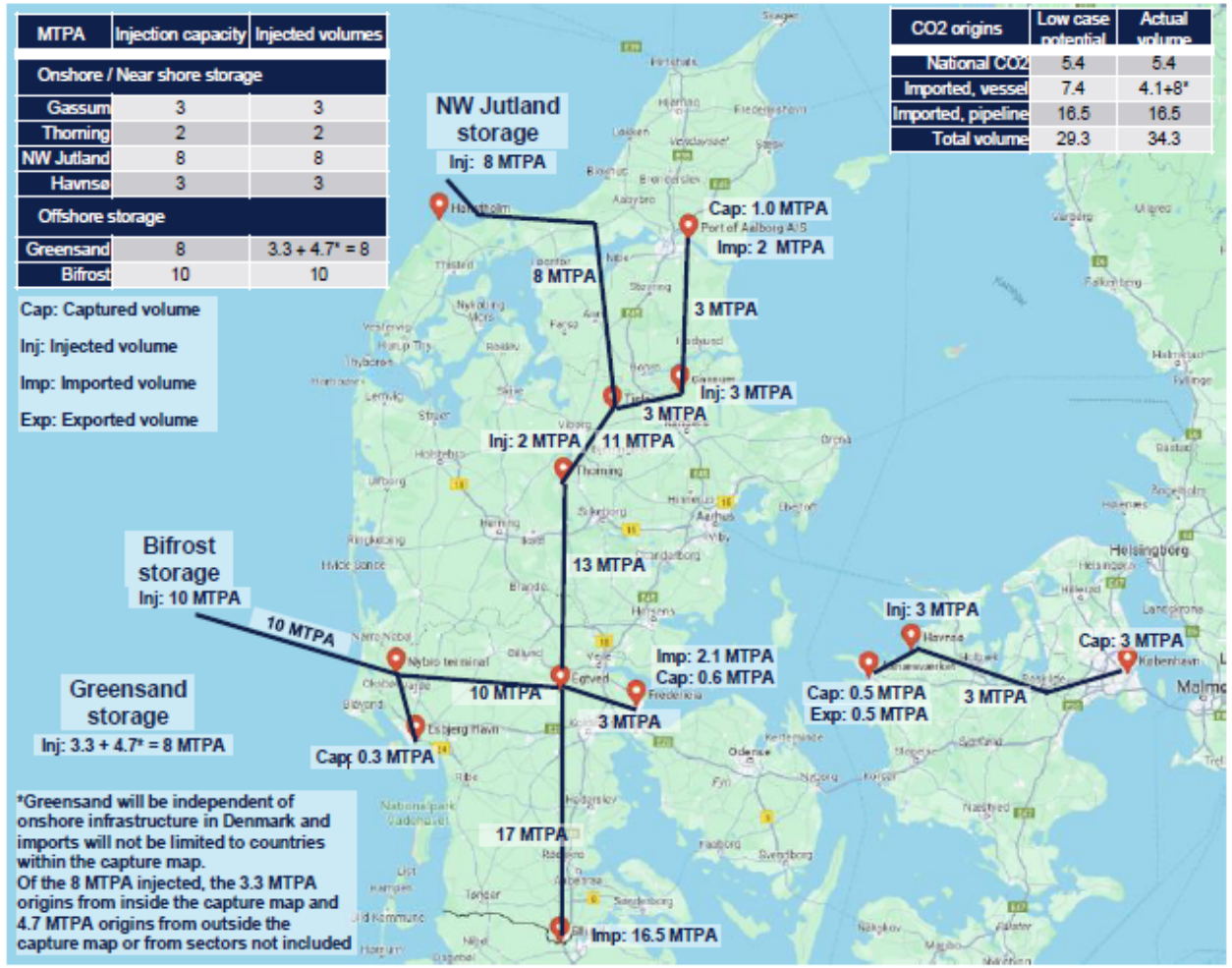
The CO2 from the Copenhagen area will be transported by pipeline to Havnsø storage site with a further connection to Kalundborg. It is expected that a total of 3.5 MTPA CO2 will be captured on Zealand and the surplus of 0.5 MTPA CO2 will be exported to Fredericia.

The CO2 backbone pipeline in Southern Jutland is designed to facilitate import of 16.5 MTPA CO2 from Germany. From the intersection at Egtved, it connects to the pipeline to Bifrost storage site and Fredericia which are designed based on the storage capacity and imported and captured volumes. The pipelines running north from Egtved are designed based on the available storage capacity further north. The pipeline between Egtved and Thorning is thus designed for the capacity equivalent to the total storage capacity of NW Jutland, Gassum and Thorning.

The volumes stored in this scenario will partly utilize the Greensand storage site which still relies on offshore offloading of CO2 volumes.

| MTPA | Injection capacity | Injected volumes |
|---|---|---|
| **Onshore / Near shore storage** | | |
| Gassum | 3 | 3 |
| Thorning | 2 | 2 |
| NW Jutland | 8 | 8 |
| Havnsø | 3 | 3 |
| **Offshore storage** | | |
| Greensand | 8 | 3.3 + 4.7* = 8 |
| Bifrost | 10 | 10 |

| CO2 origins | Low case potential | Actual volume |
|---|---|---|
| National CO2 | 5.4 | 5.4 |
| Imported, vessel | 7.4 | 4.1+8* |
| Imported, pipeline | 16.5 | 16.5 |
| Total volume | 29.3 | 34.3 |




Source: Google Maps. Location of storage sites has been applied manually.

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