Ammongas Solutions for Biomethane and CO2 Capture

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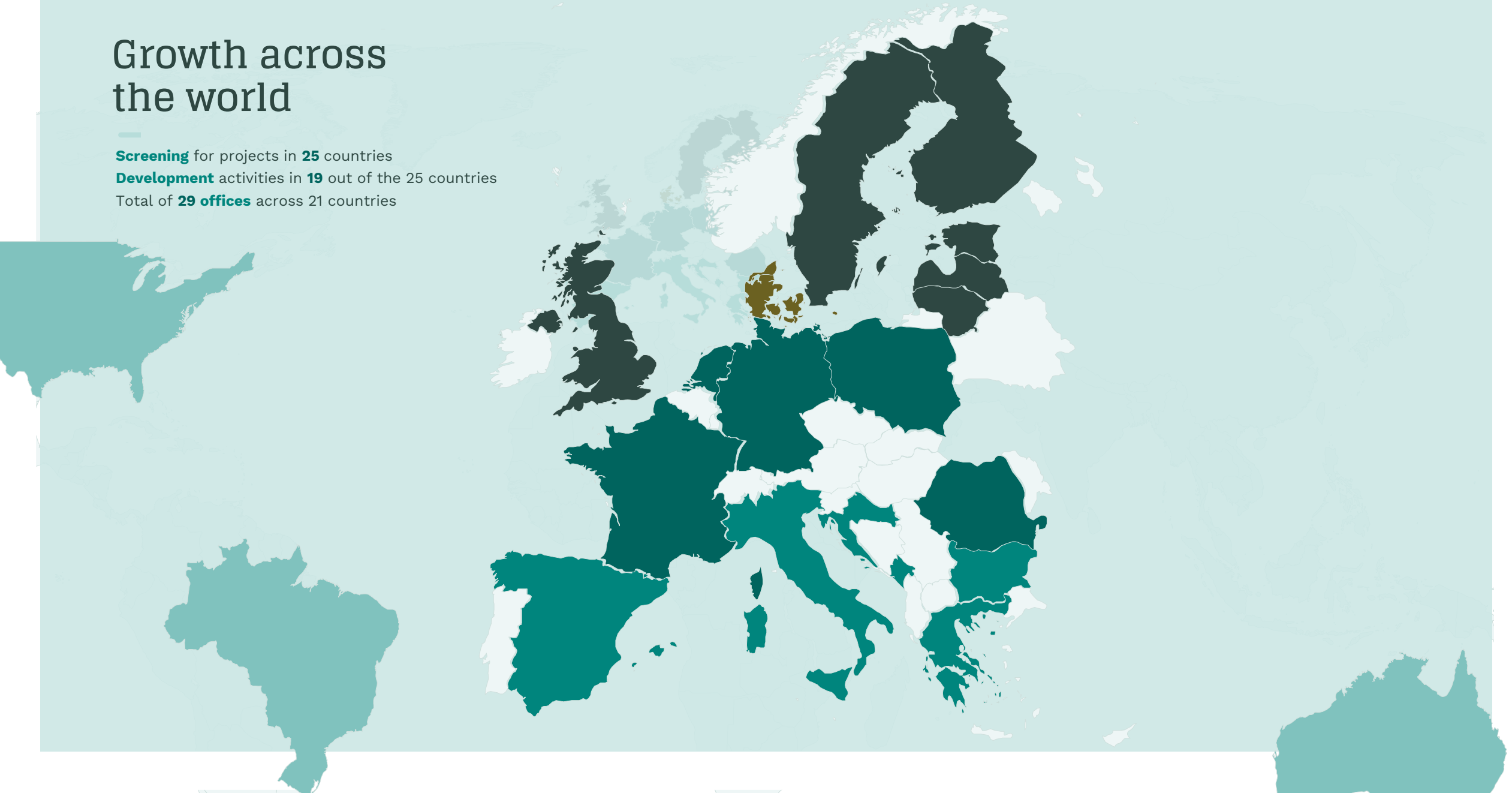
EUROPEAN ENERGY

About European Energy Group

Growth across the world

Screening for projects in **25** countries
Development activities in **19** out of the 25 countries
Total of **29 offices** across 21 countries



European Energy's 6 pillars

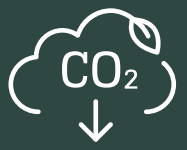
Onshore wind

Offshore wind

Solar power

Power-to-X

Carbon Capture

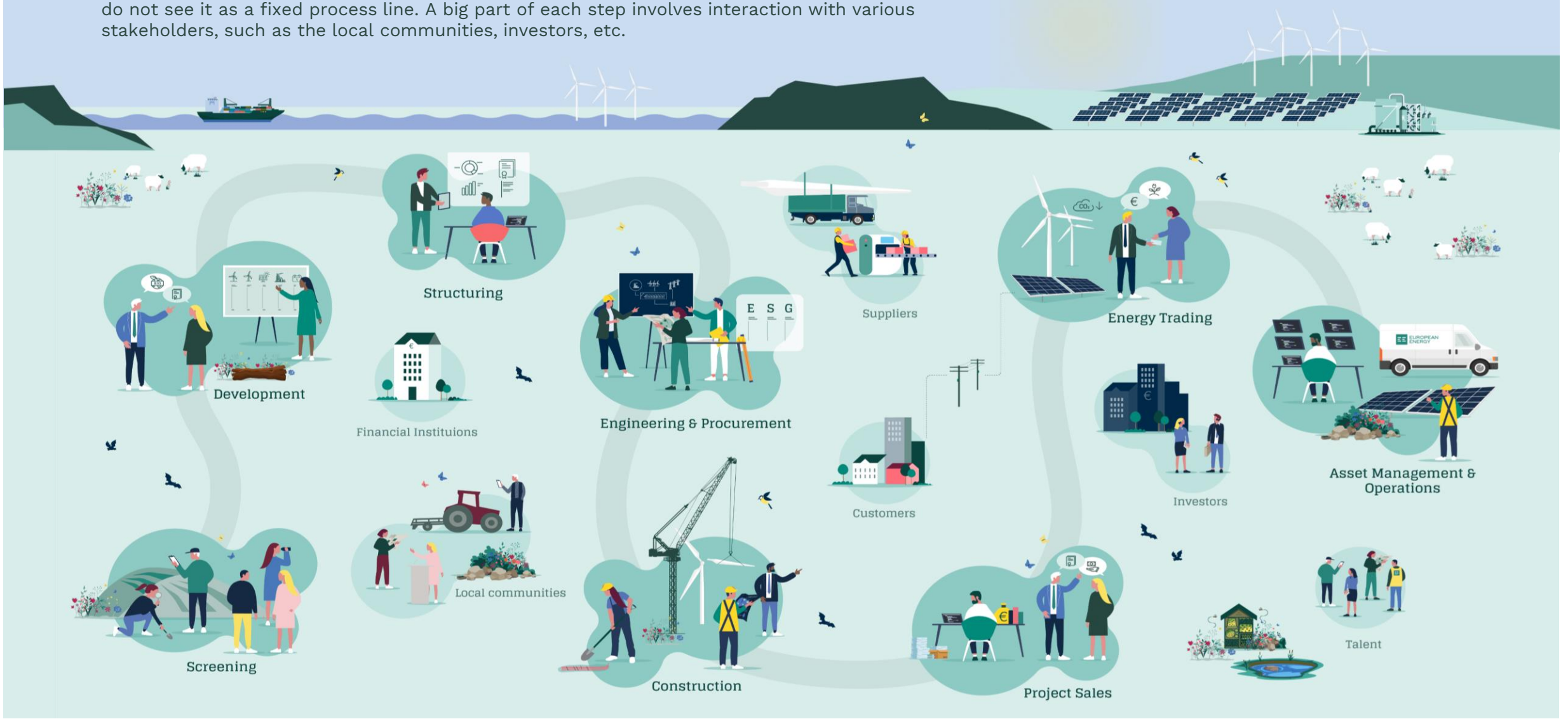


Battery Storage

EUROPEAN ENERGY

Our business model

Our business model consists of 8 steps. The flow of our business model is flexible, and we do not see it as a fixed process line. A big part of each step involves interaction with various stakeholders, such as the local communities, investors, etc.



Ammongas Company profile

In 2024 Ammongas has **35 employees**, herein **30 engineers**

Ammongas has today designed, built and commissioned **+40 biogas upgrading plants** across the globe. Including. **Scandinavia, Germany** and the **Unites States.**

From delivering small plants at **150 Nm3/h** raw biogas to **10.000 Nm3/h** raw biogas.

Today, **appr. 50 %** of the biomethane in the Danish National gas grid comes from an Ammongas biogas upgrading plant.

European Energy acquired Ammongas in 2022, and in 2023 Ammongas moved into the European Energy Headquarters in Søborg, part of greater Copenhagen.

Introduction to Main Ammongas Technologies

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Product Portfolio

Biogas Upgrading

These facilities '**upgrade**' (separate) biomethane (CH4) from Biogenic CO2

Fun fact:
*In Denmark, **50%** of the gas in the **grid is biomethane**, a significant part **upgraded** by **Ammongas***

Bio-LNG in partnerships (CO2- Polishing)

Bio-Liquified Natural Gas (**bio-LNG**) is made from **polished** biomethane after biogas has been upgraded

CO_2 Liquefaction

Biogenic CO2 is liquified, and further used to produce e-methanol like at Kassø

Tønder is the **first LCO2** facility for Ammongas, where the biogenic CO2 for **Kassø** is captured and liquified

CO_2 Carbon Capture

Capturing CO2 from other sources than biogenic such as industrial emissions

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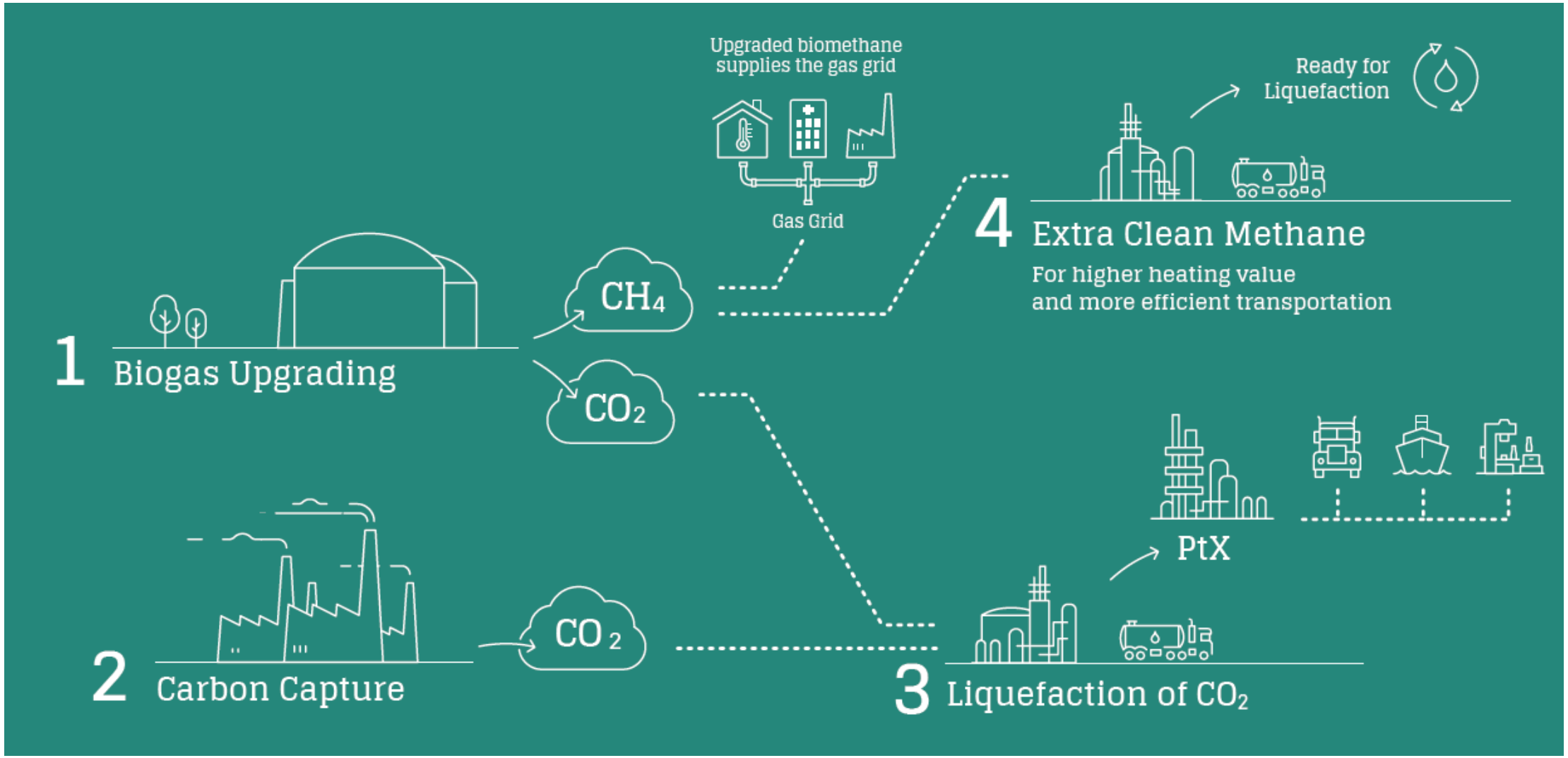
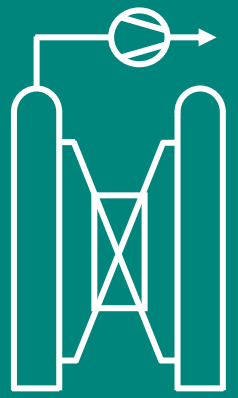


CO_2 separation with Amines

Foundation for Biogas Upgrading, Biomethane Polishing and Carbon Capture



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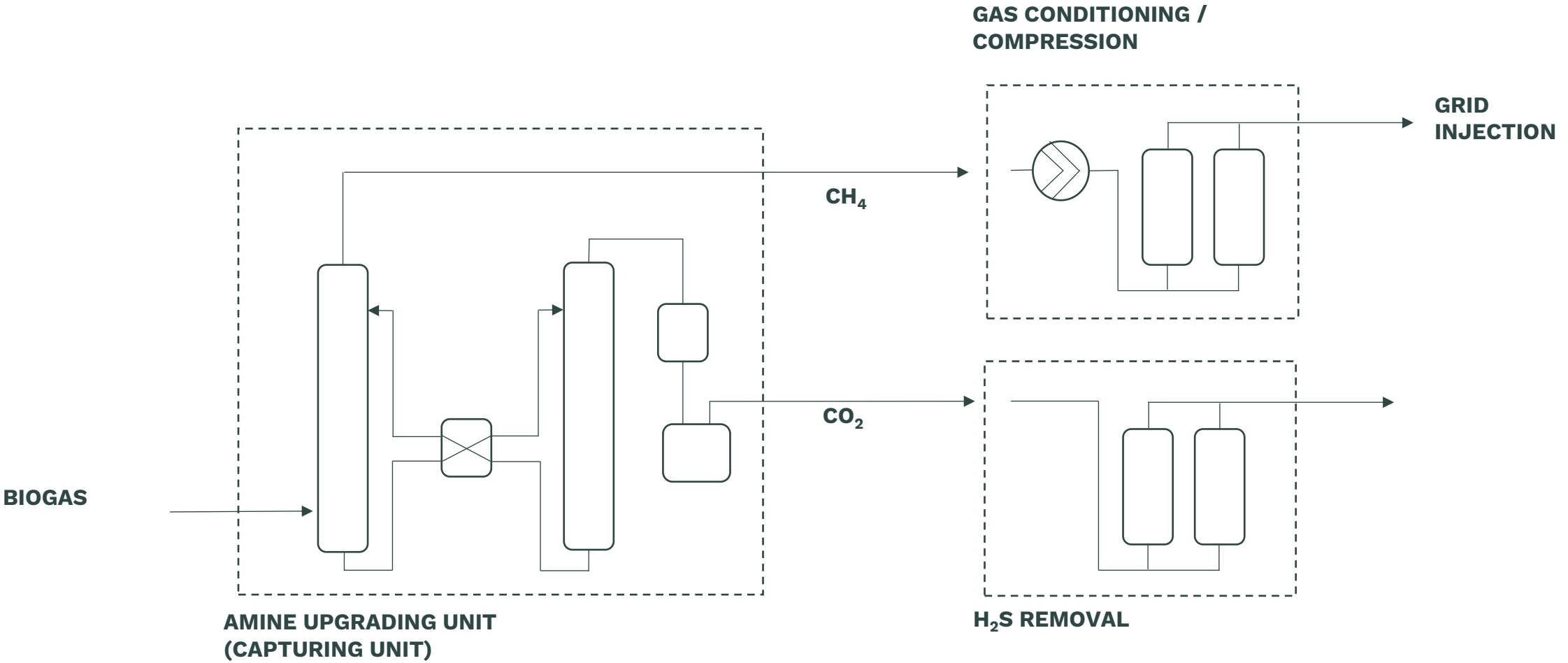
Biogas upgrading with amine scrubbing



Pressure-less system	Methane Slip Guarantee: 0.09%	Uptime Average Including service 98.7%.	Heat Recuperation 70-90 %	Typical Biomethane Purity >99%

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Why upgrading with amines is preferred for profitable projects?

Income:
↑ €/MWh

1. Maximize the price obtain from the sale of biomethane

- Maximize the generation capacity(MWh) → methane loss <0.09 %
- Favors a reduced GHG emissions (ISCC certification, price valorization)

OPEX:
↓ €/annum

2. Lower OPEX costs

- Low electrical consumption
- Integration of heat recovered with other parts of the biogas plants

Example of a Heat Utilization Layout, at 80% recovery

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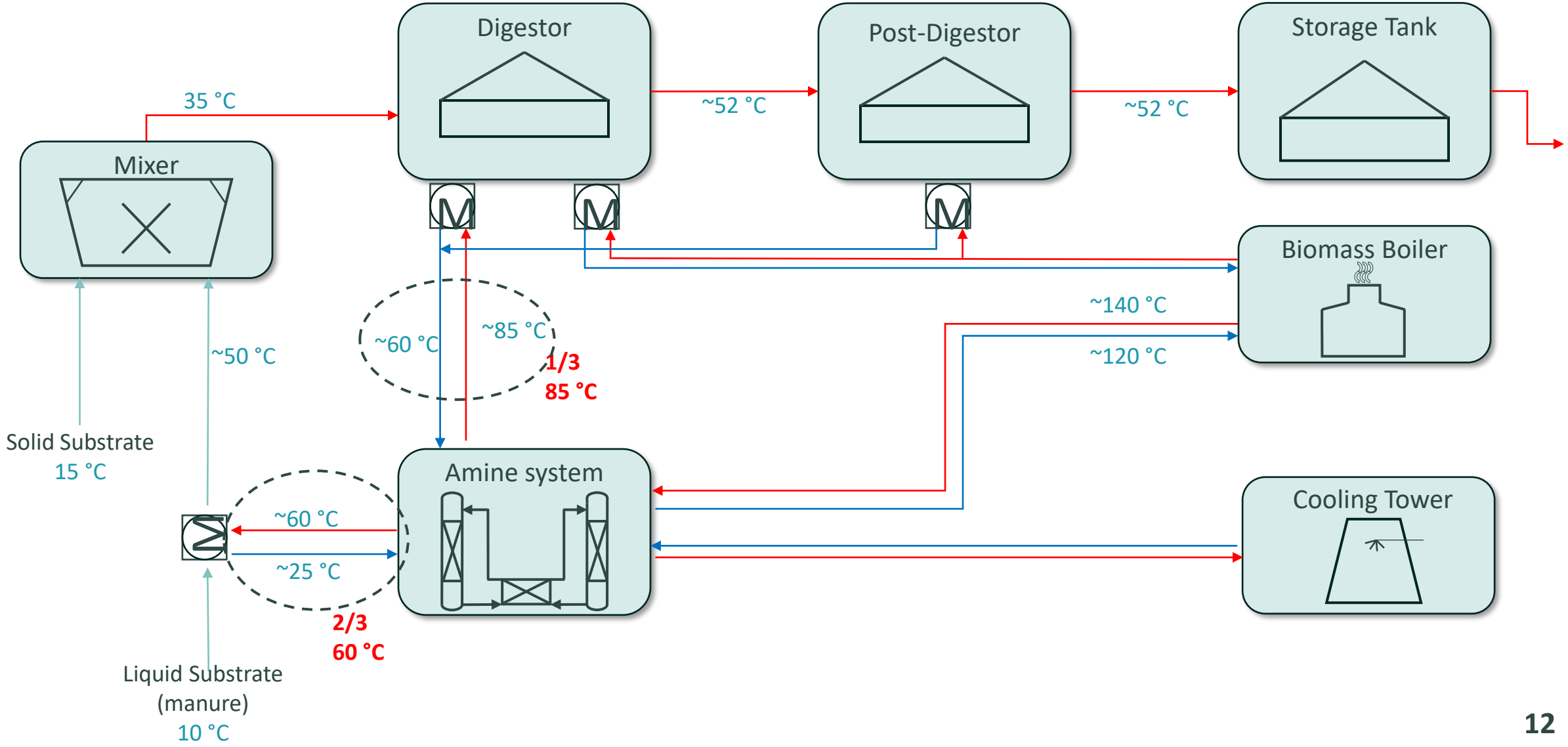
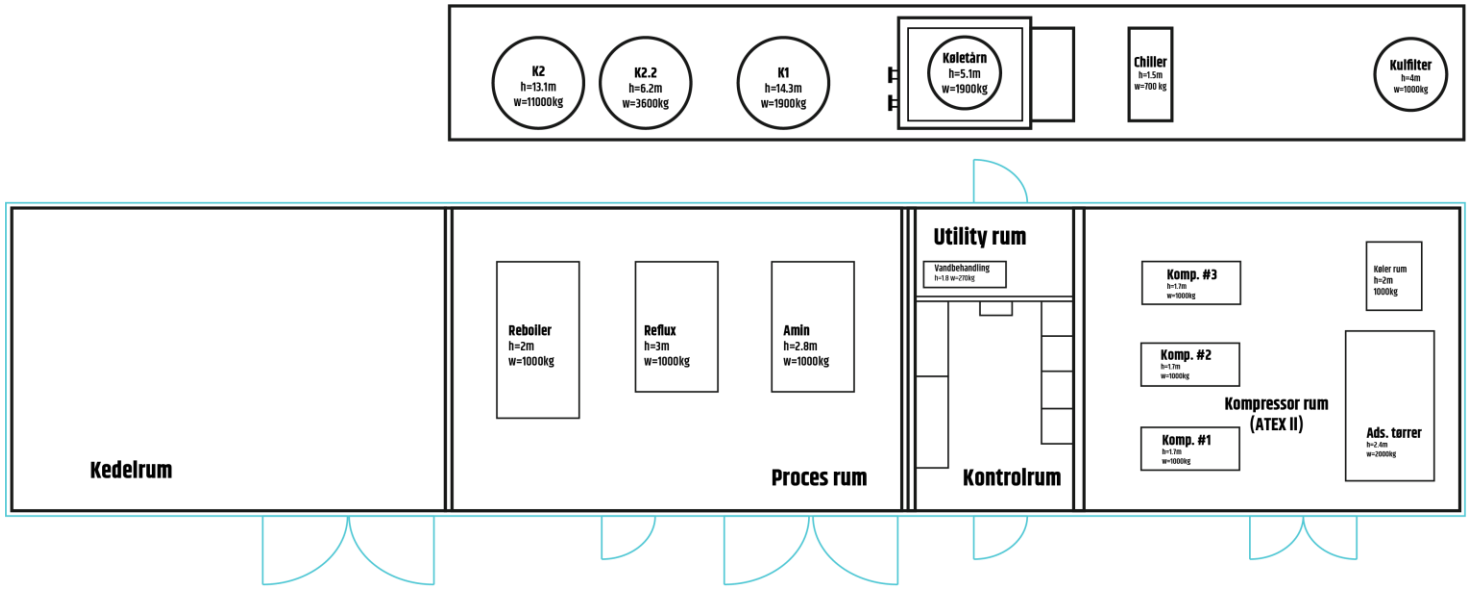


Building or Container site layout



	General arrangement		
	Drawn	IC	2017.01.02
	Checked	CK	2017.01.05
Drawing No: 1009-004	Approved	HSJ	2017.05.01

Biogas: 300 Nm3/hr
Bio-CH4: ~180~Nm3/hr
~ 17 GWh

Biogas: 1300 Nm3/hr
Bio-CH4: ~780 Nm3/hr
~ 77 GWh

Glansager
Biogas: 4.000 Nm3/hr
Bio-CH4: ~2.400 Nm3/hr
~ 237 GWh
(2020)

Biogas: 9.000+ Nm3/hr
Bio-CH4: ~6.000 Nm3/hr
~ 594 GWh/a

(This plant started at 6800 Nm3/hr in 2019 and later was expanded in 2021 to 9000+ Nm3/hr)

Containerized solution

Reduction of on-site erection work.

-Equipment are delivered w. preerected equipment

Reduction of total project cost.

-Container solution is at lower cost compared to fixed buildings.

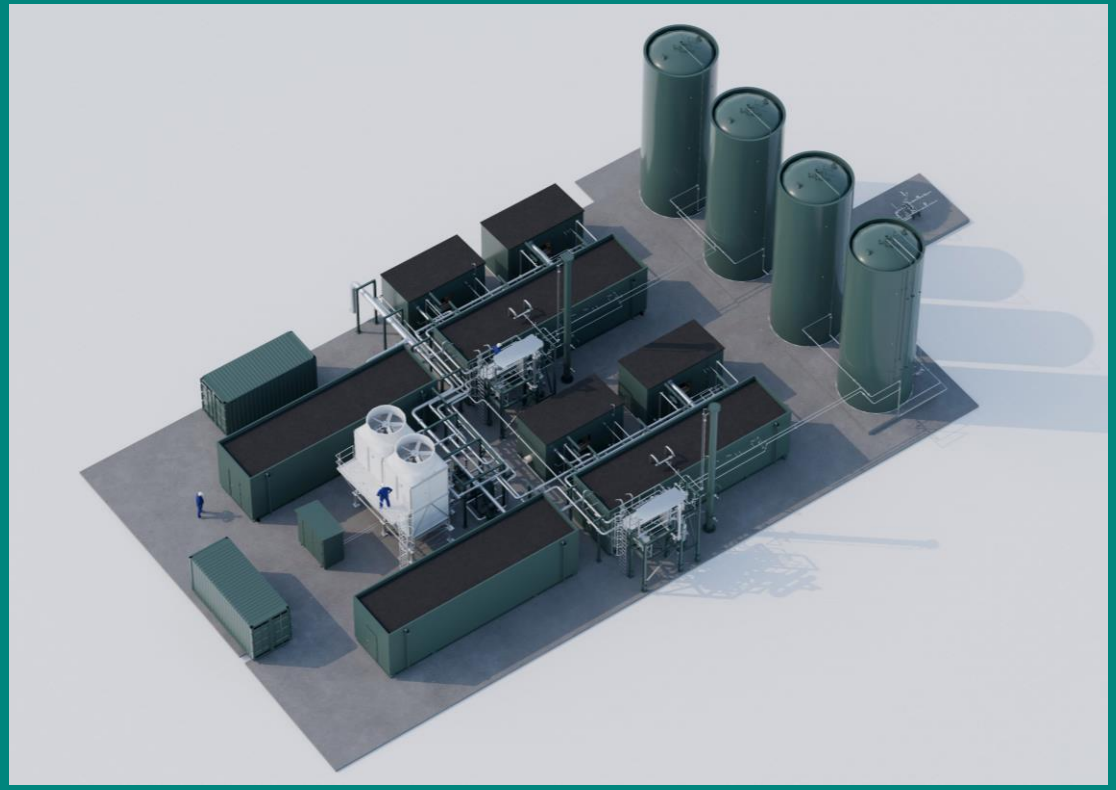
Faster installation.

-Only erection of piping between containers and erection of columns are required.

-Electrical installation pre-installed in workshop and cabling/testing on site.

Ammongas Amine Biogas Upgrading

AMMONGAS CO2 Liquefaction



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Ammongas CO2 Purification and Liquefaction

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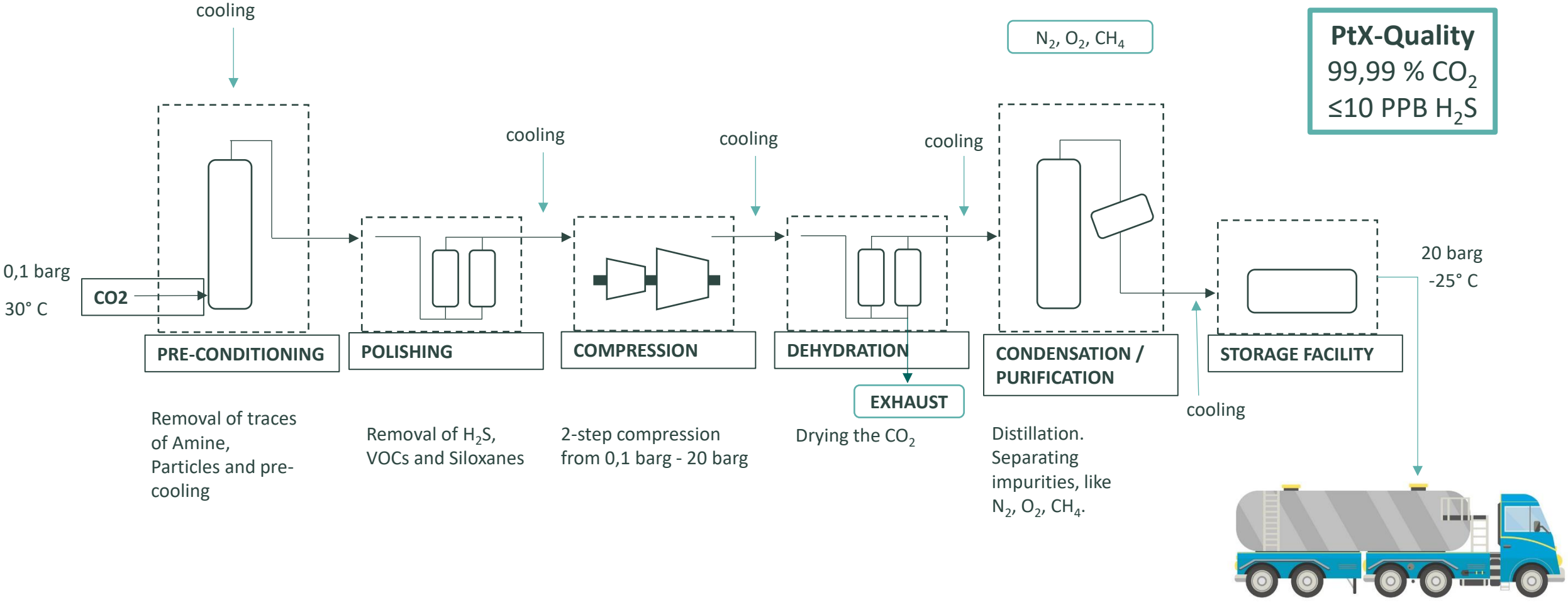
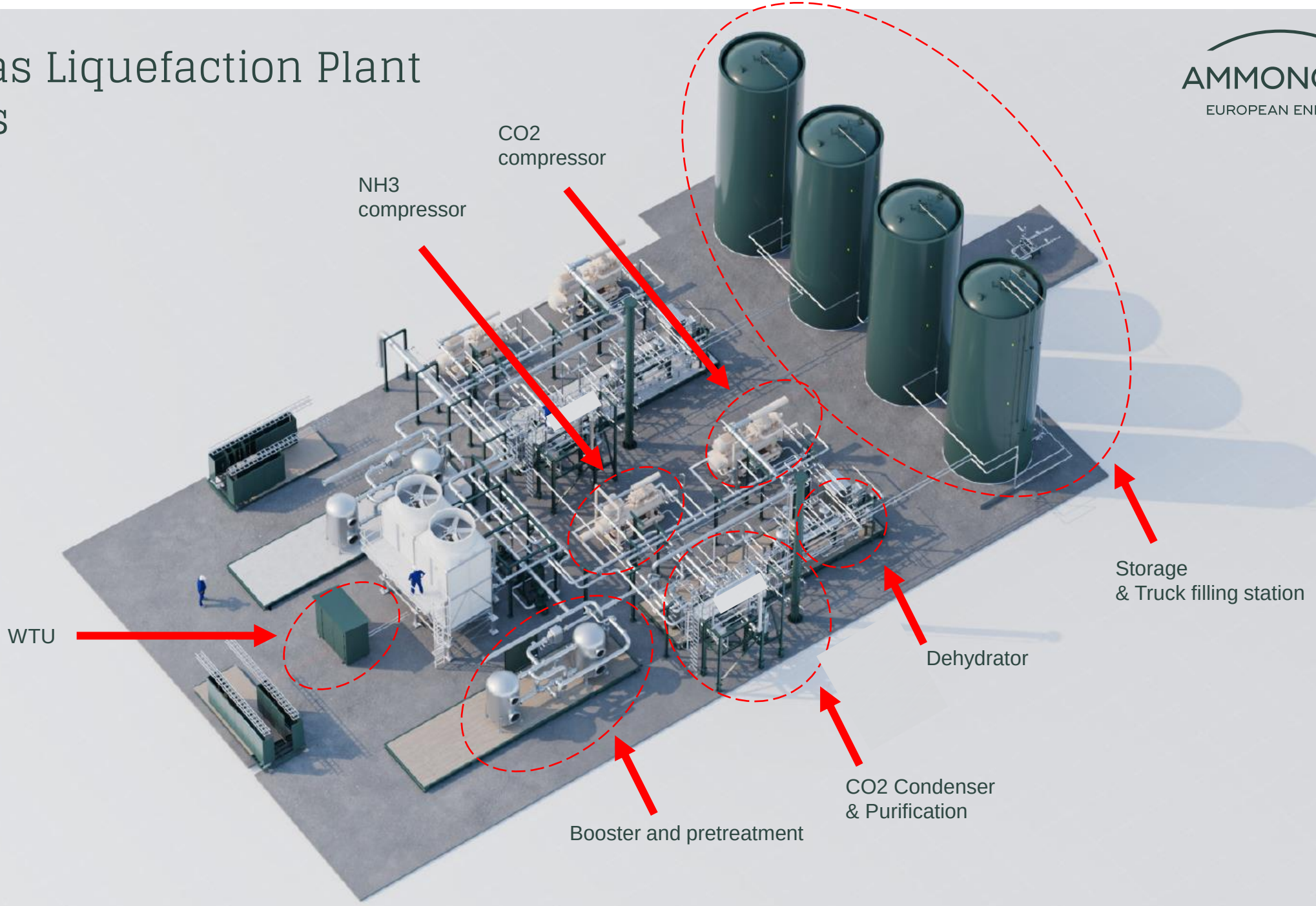


Electrical consumption: 200-250 kwh/t(CO_2)

Ammongas Liquefaction Plant
Two trains



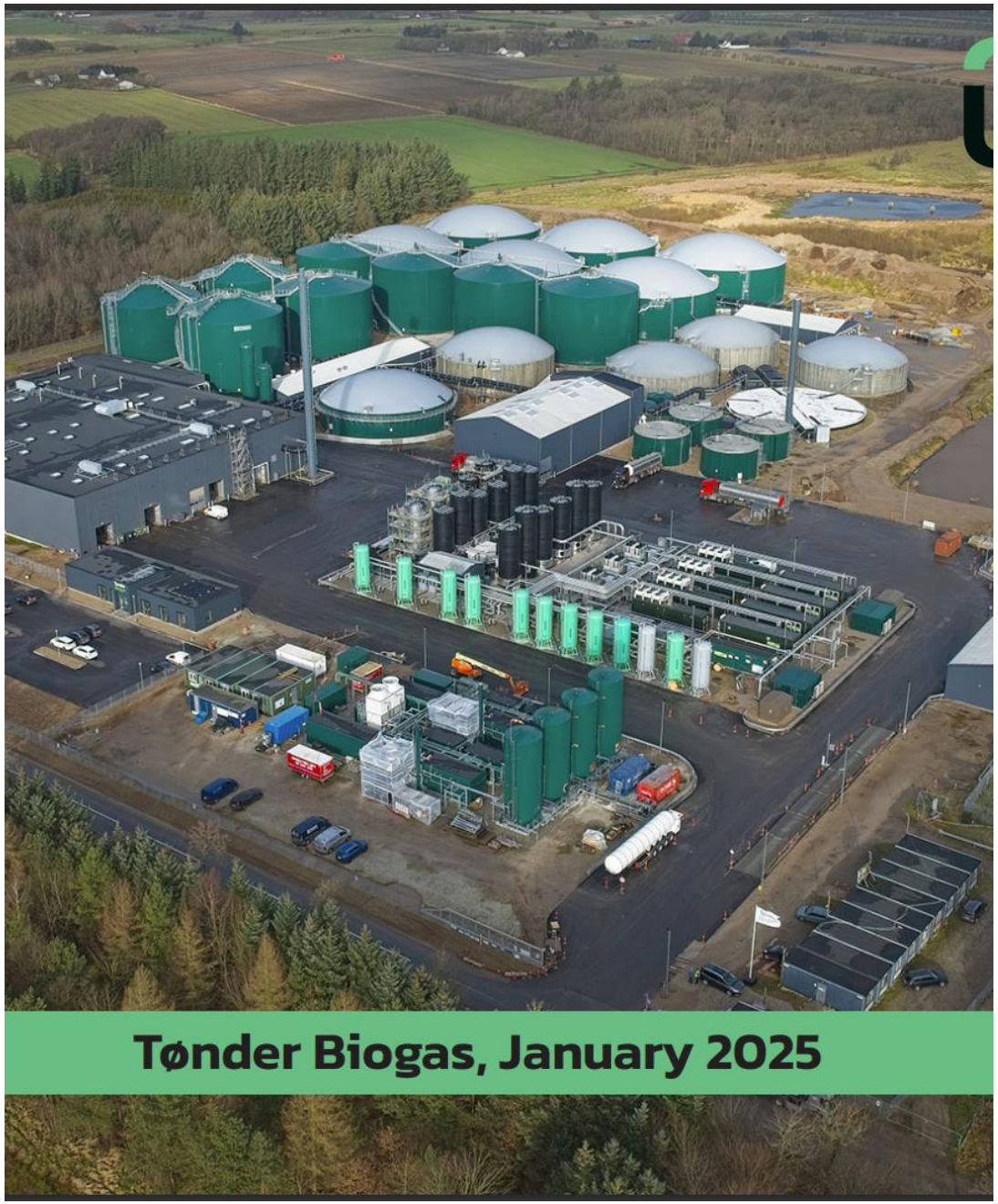
Ammongas CO2 liquefaction system – Tønder Biogas

One of the *largest biogas* plants in the world

The biogas plant will handle approximately *900,000 tonnes of green sustainable raw material* annually

Produces over *40,400,000 Nm³ of biomethane.*

48,000 tonnes of liquid CO2 will be captured and sold to Power-to-X operators



Kassø
Power-to-X

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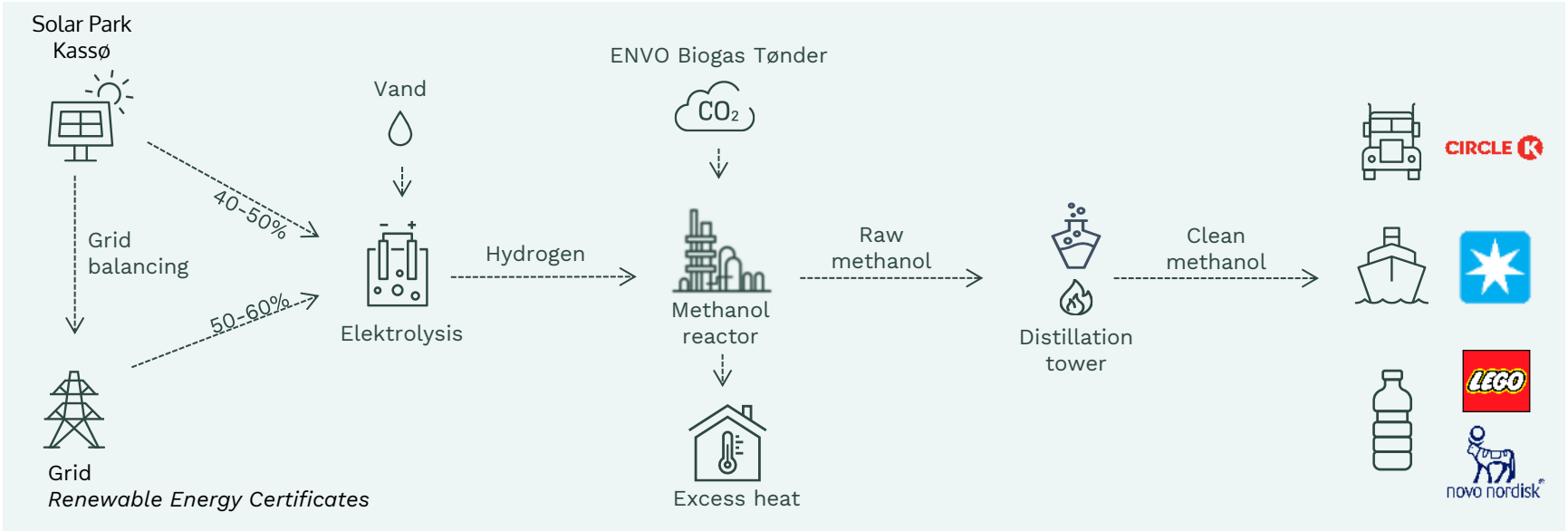
Power-to-X

Our e-methanol plant in Kassø, Denmark

Input (yearly)	
Water	~90.000 tons
Electricity	~360-380 GWh
Biogenic CO_2	~45.000 tons

Output (yearly)	
Hydrogen	~6000 tons
Raw methanol	~50.000 tons
Clean methanol	~32.000 tons (nom. cap. 42.000)
Excess heat	~50 GWh

How we produce e-methanol



Sector coupling

Power supply
Power sourced from own 304MW solar farm and from the grid robust and costoptimal power supply

Grid balancing
52 MW PEM electrolyser from Siemens Energy capable of fast ramp times flexible operation with the ability to provide grid balancing services

Excess heat
Excess heat from process of production delivered to the district heating grid to supply approx. 2500 households

Utilization
E-methanol from the plant Is shipped out from Port of Ensted to be used across three different sector for the benefit of the green transition

Milestones

- ✓ Final Investment Decision
- ✓ All permits in place
- ✓ Customer agreements in place
- ✓ The design of the methanol plant is complete
- ✓ Construction started
- ✓ First e-methanol, COD 2024

Facts about e-methanol

1. E-methanol is the same product as methanol (wood alcohol).
2. More than 100 million tons of methanol annually is produced today using natural gas and coal. Primarily this methanol is used as a raw material in the chemical industry.
3. E-methanol is chemically identical to fossil methanol, but CO2-neutral as production is based on green electricity instead of natural gas and coal.
4. Methanol burns more slowly and cleaner than gasoline. The calorific value is approx. half of e.g. petrol.
5. Production of e-methanol is safer than other PtX production. Methanol requires a much smaller safety distance than, for example, ammonia in similar quantities.
6. Production of e-methanol is odorless

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Дякую!

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