Ammongas Solutions for Biomethane and CO2 Capture

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EUROPEAN ENERGY

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Technology Overview

Amine Technology –

- High CH4 recovery (>99.91%)
- Low operational cost
- Heat recuperation,
- Methane purity 99,99%

Ammongas company profile

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

Ammongas has today designed, built and commissioned 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.

About European Energy Group

Svindbæk
32 MW
Denmark

European Energy's 6 pillars

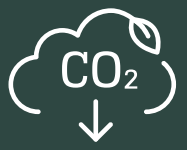
Onshore wind

Offshore wind

Solar power

Power-to-X

Carbon Capture



Battery Storage

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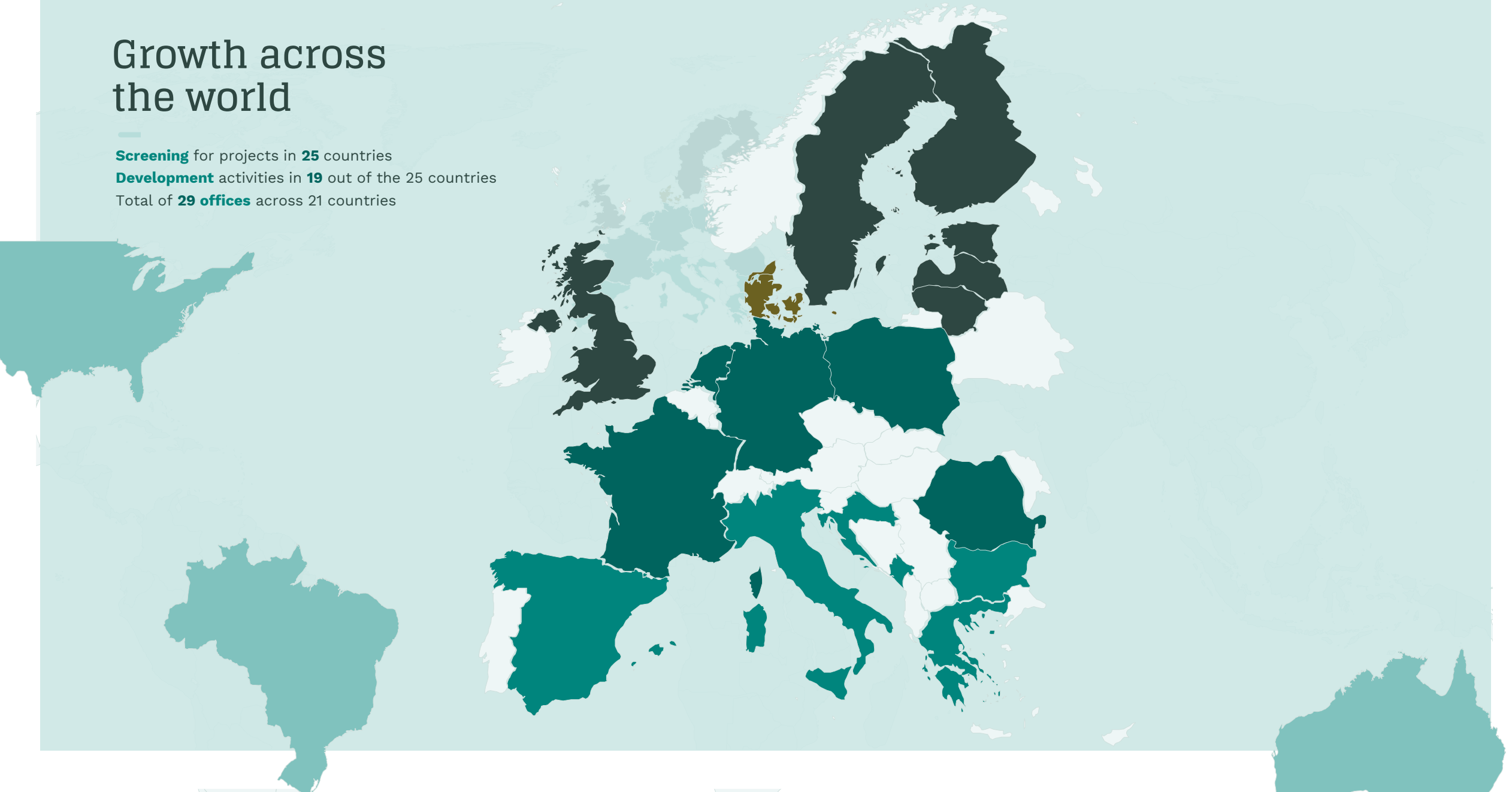
Growth across the world

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



50% of Danish biomethane comes

from

Ammongas installations

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Introduction to Main Ammongas Technologies

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Product Portfolio

Biogas Upgrading

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

Bio-LNG in partnerships (CO2- Polishing)

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

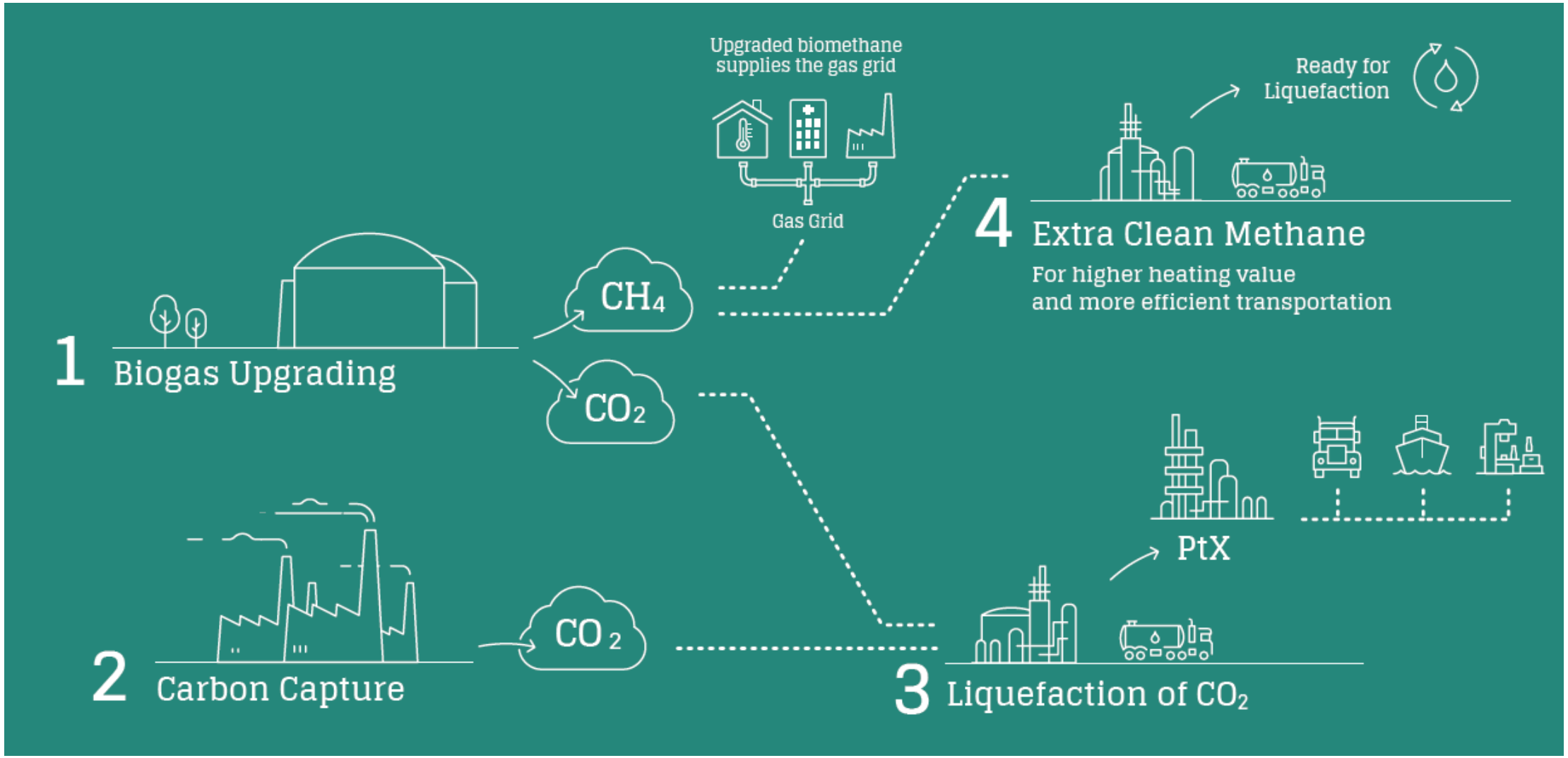
CO_2 Liquefaction

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

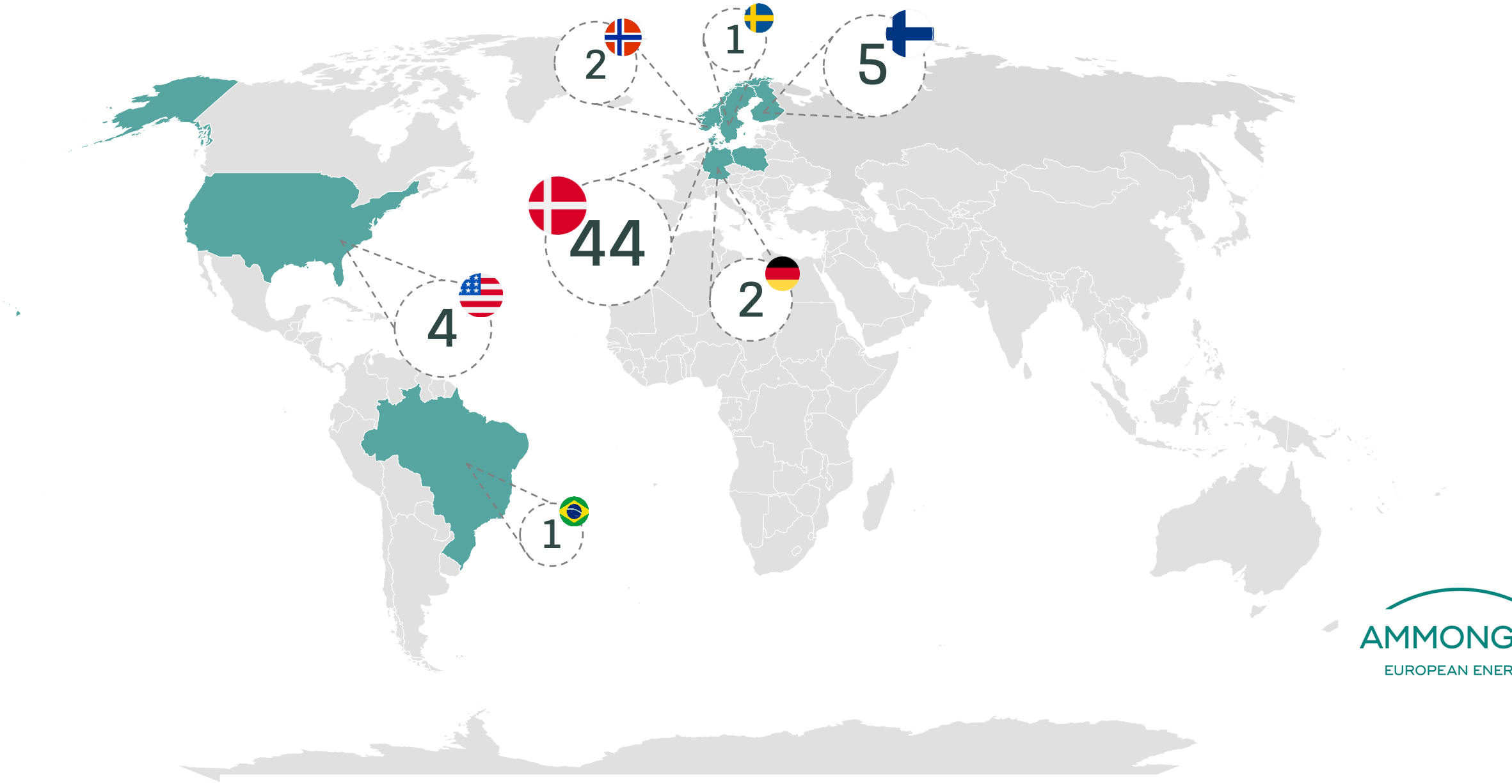
Tønder is the **first LCO2** facility for Ammongas, where the biogenic CO2 for **Kassø** is captured and liquified

CO_2 Carbon Capture

Capturing CO2 from other sources than biogenic such as industrial emissions


Upgraded biomethane supplies the gas grid
Gas Grid
Ready for Liquefaction
4
Extra Clean Methane
For higher heating value and more efficient transportation
1
Biogas Upgrading
CH4
CO2
PtX
2
Carbon Capture
CO 2
3
Liquefaction of CO2

Past Projects Executed by Ammongas



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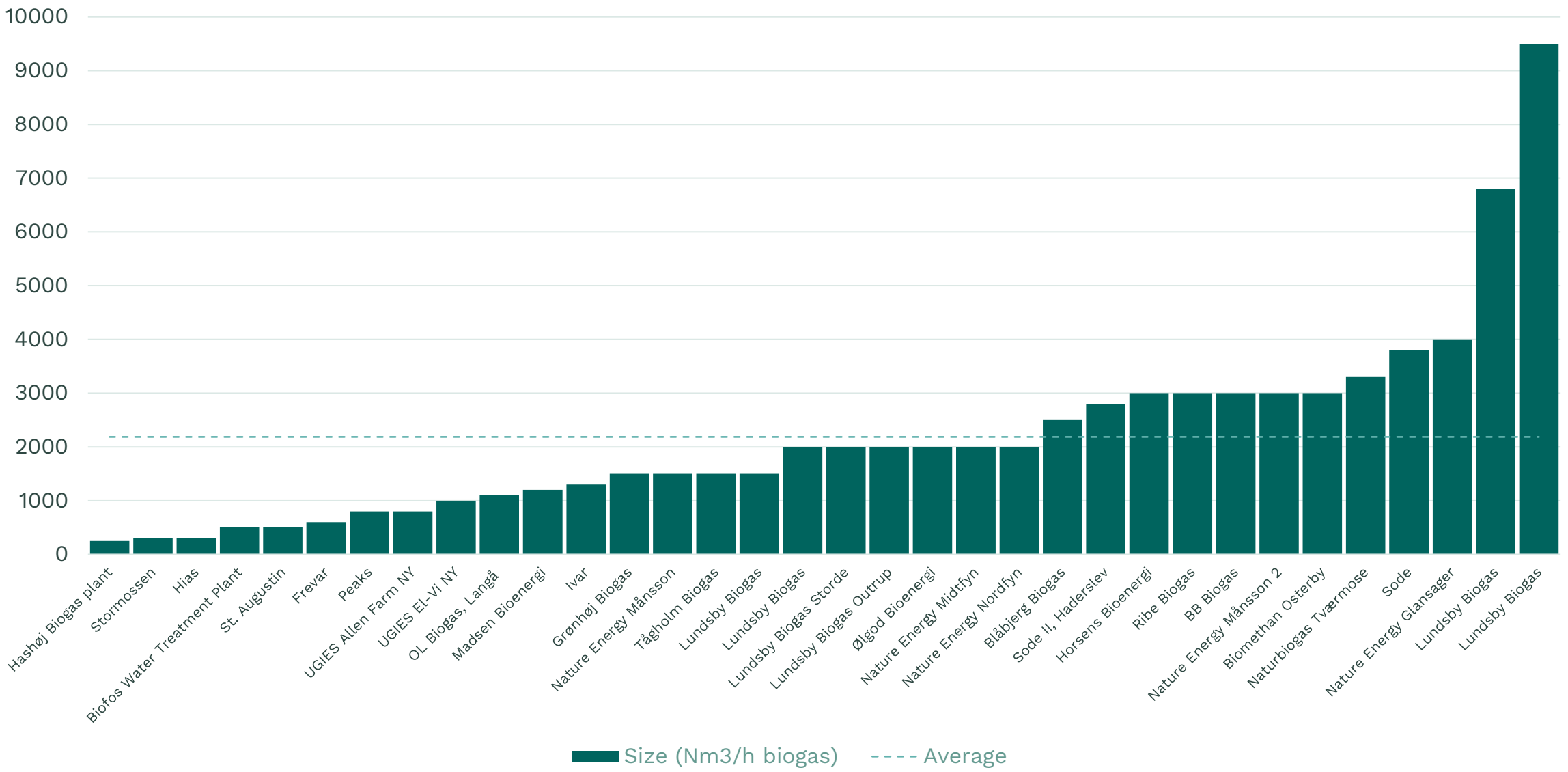
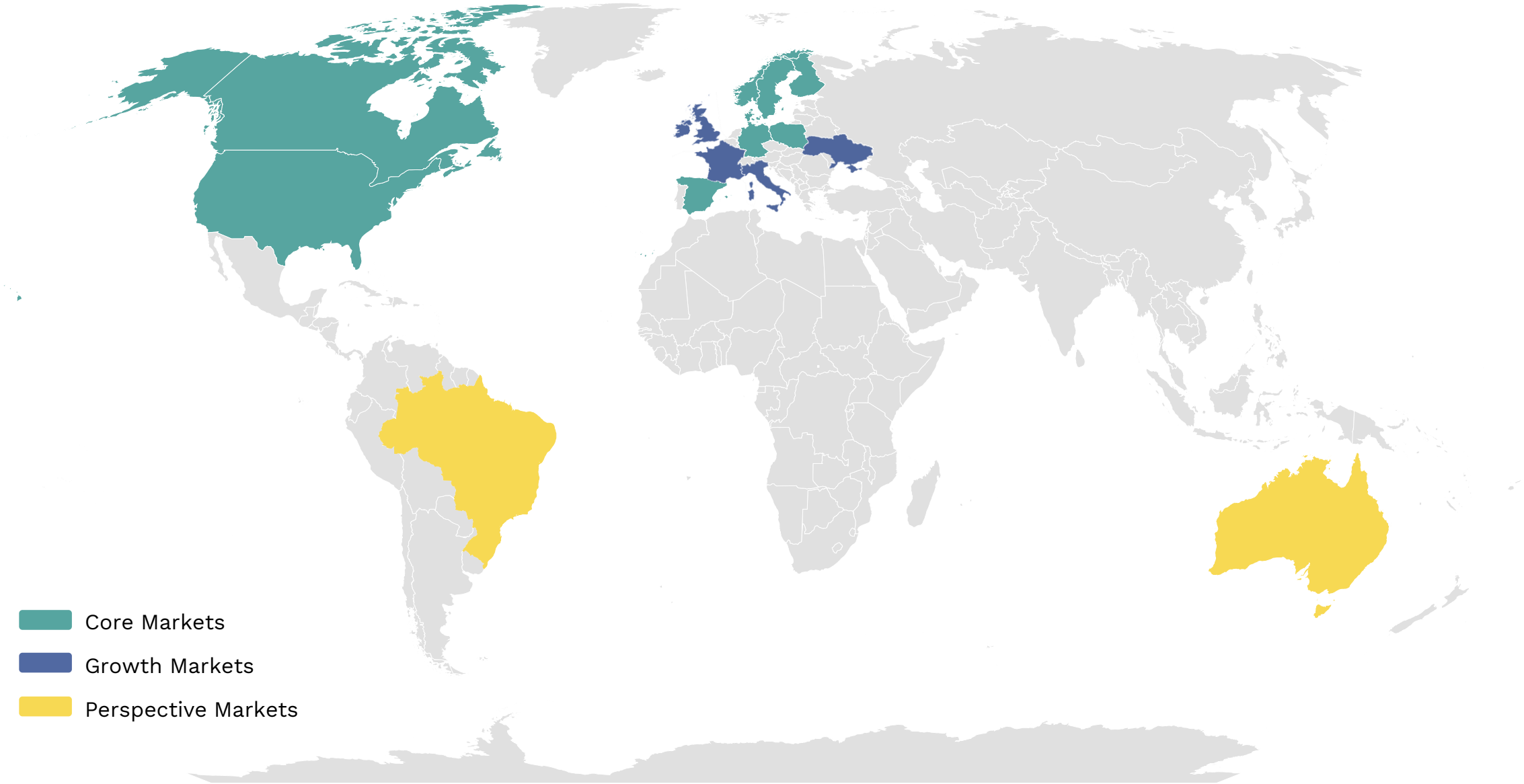
Ammongas Biogas Upgradig Projects Ordered by Capacity

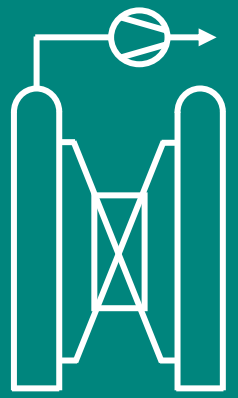


Core, Growth and Perspective Markets



CO_2 separation with Amines

Foundation for Biogas Upgrading, Biomethane Polishing and Carbon Capture



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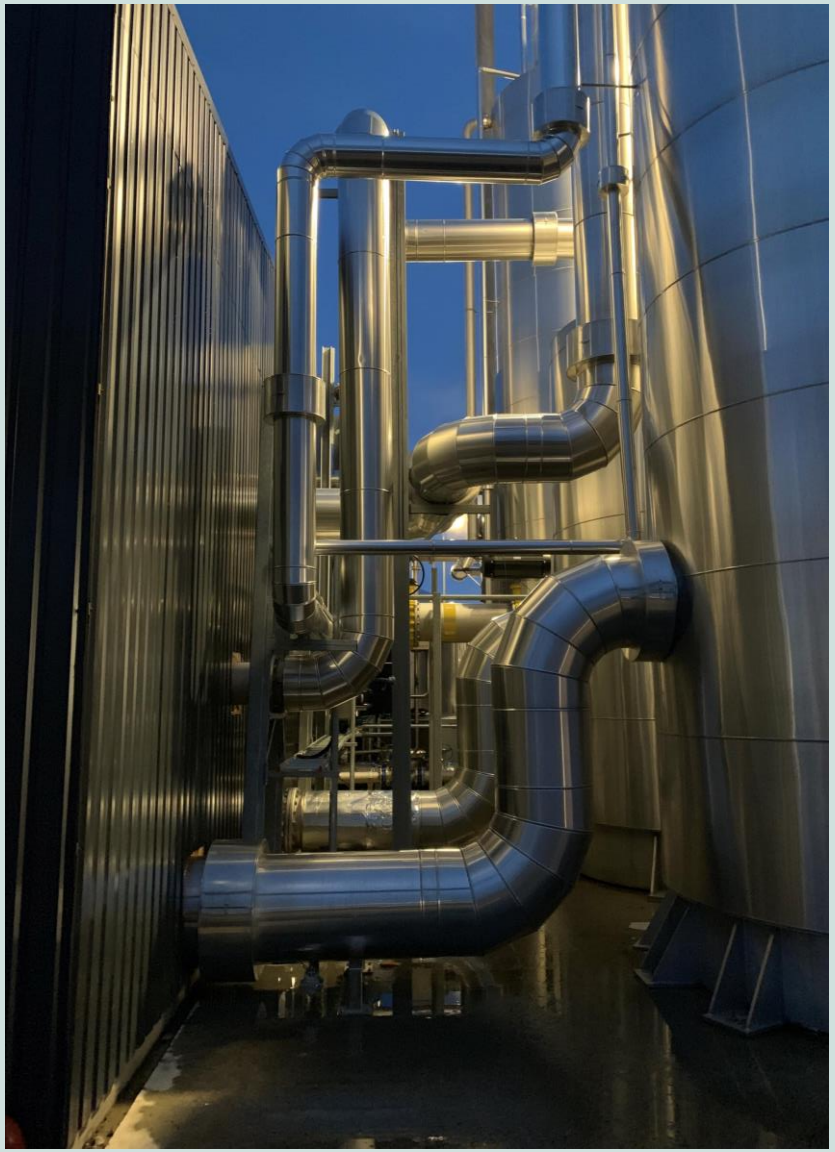

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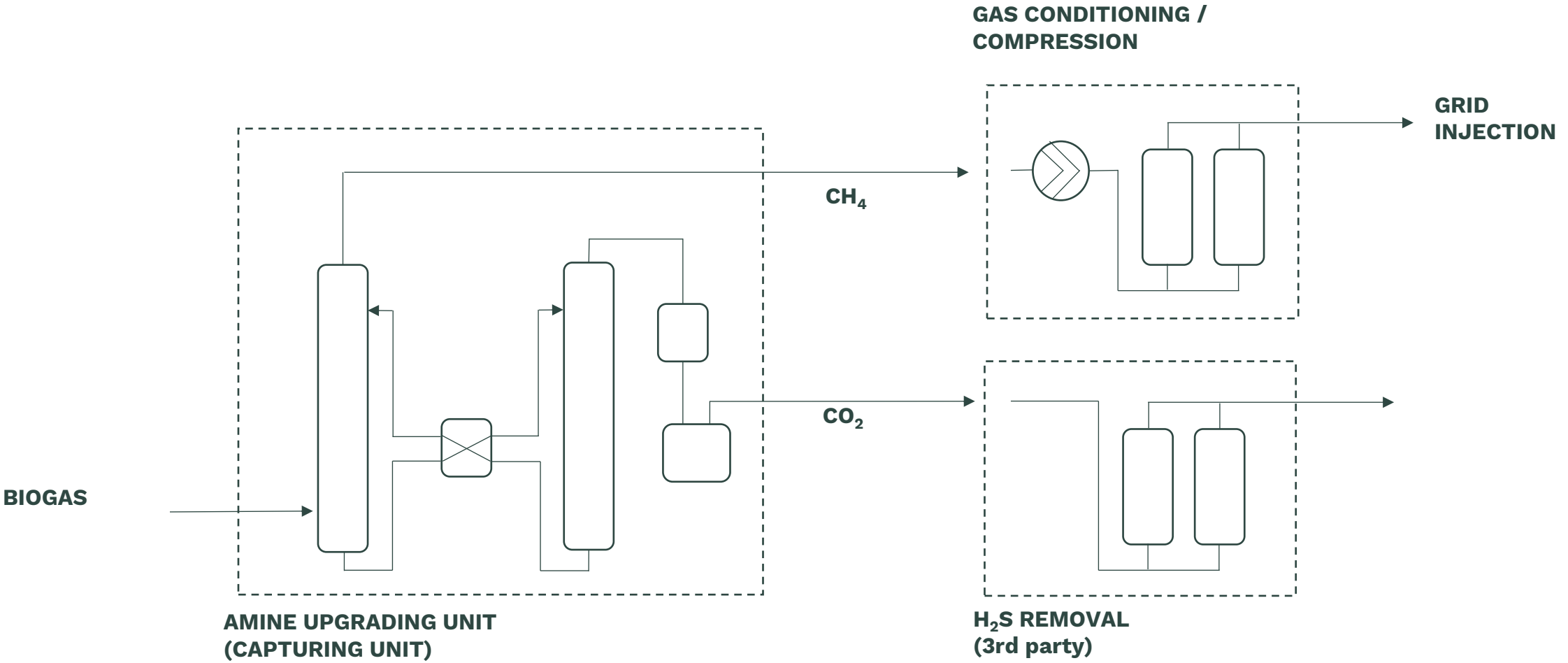
Biogas upgrading with amine scrubbing



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

Biogenic CO2 Utilization

according to European Energy

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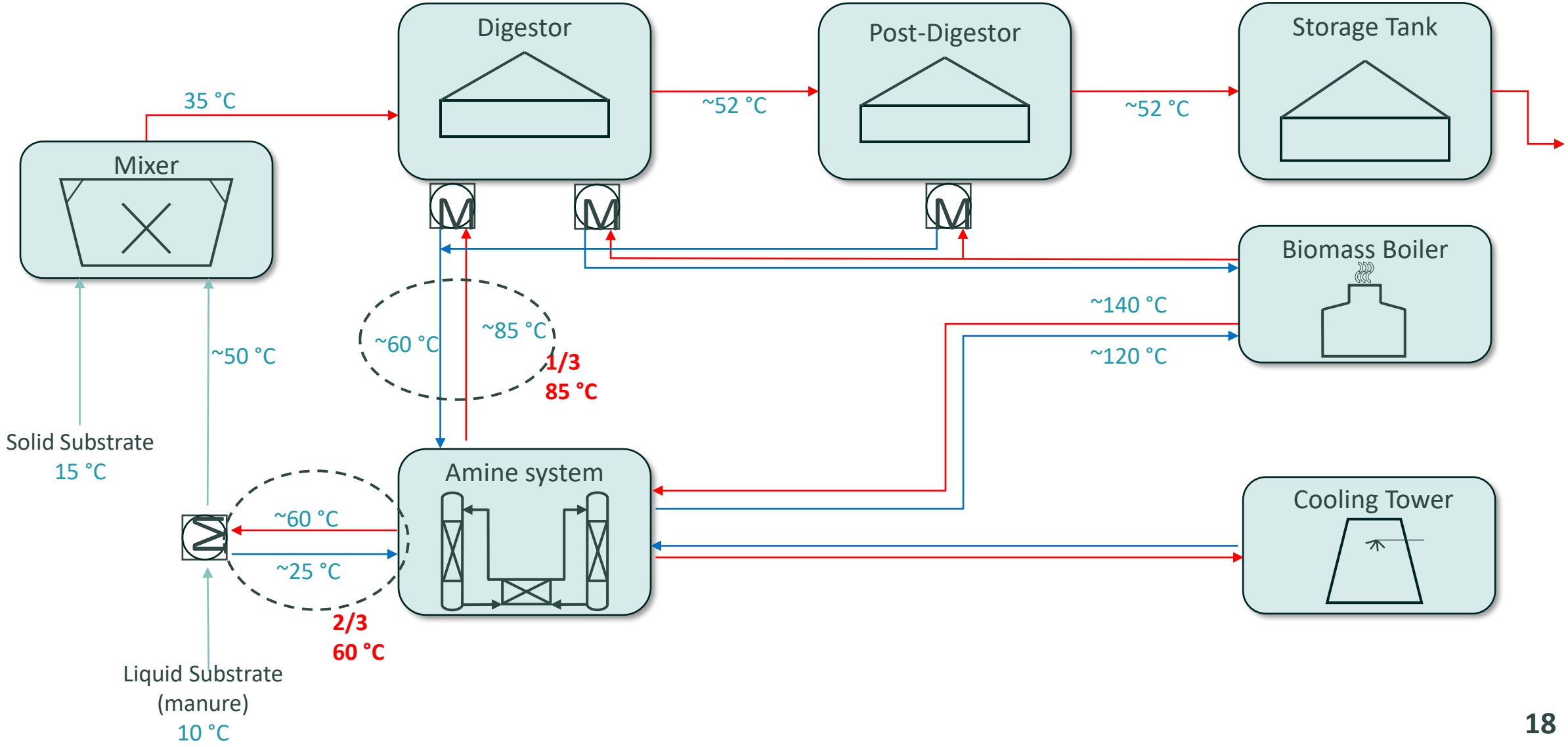
Example of a Heat Utilization Layout, at 80% recovery



Advantegies of amine technology:

- High absorption efficiency – effectively removes CO_2 **without losing methane**. Methane losses during biogas upgrading amount to only 0.09%.
- Ability to achieve high **biomethane purity (>99%).**
- **Amine is reused multiple times.** The affordability and availability of the amine make owners flexible and independent from suppliers.
- Three times lower electricity consumption compared to other technology, **lower operational costs.**
- Amine technology operates at high temperatures, but **heat recovery is 80-90%** and can be redirected to the biogas plant or other facilities requiring heat.
- **Raw biogas does not require any pre-treatment** before amine purification: pressure and H2S levels can be any (even 5000 ppm).
- Biomethane **compression occurs at the very end** of the process and is only needed **for the volume of biomethane**, not the entire biogas stream, reducing electricity costs.
- A byproduct of amine purification is **clean CO_2**, ready for liquefaction as an additional revenue source.

Guaranteed and best practice consumption figures at nominal biogas load.

Parameter	Unit	Guarantee	Best practice
Electricity consumption (1)	kW	<XXX	≤XXX
Specific electricity consumption (1)	kWh/Nm^3 $_{biogas}$	≤0,1	from 0,07
Heat consumption (2)	kW	<X.XXX	≈X.XXX
Specific heat consumption	kWh/Nm^3 CO_2	≤1,68	≤1,5
Specific heat consumption	kWh/Nm^3 $_{biogas}$		from 0,6
Heat carrier (3)	°C feed/return		ca. 140/120
Heat recovery of up to 39 % of inlet heat (kW) (4)	°C		up to 90 (95)
Heat recovery of up to 49 % of inlet heat (kW) (4)	°C		up to 60 (65)
Water consumption cooling (5)	m^3/kW		≈0.0013
Water consumption process	m^3/year	<X.XXX	0
Amine consumption	t/year	<XX,X	<XX,X
Methane upgrade efficiency	%	>99,9	>99,95
Methane slippage	%	≤0,09	≈0,04
CO2 recovery	%		>99,95
Availability	% of year	98	>99

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)

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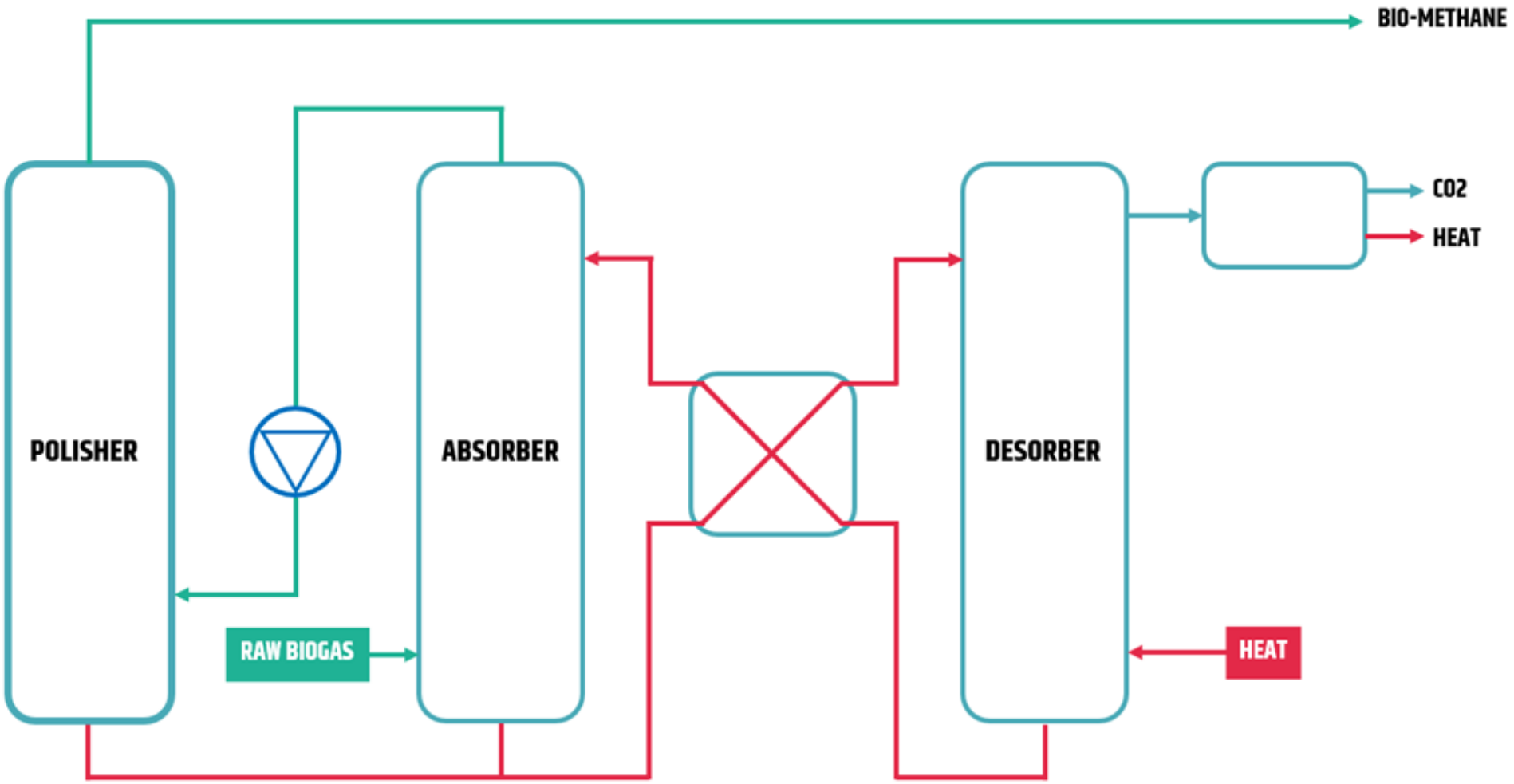
Biogas: 9.000+ Nm3/hr
Bio-CH4: ~6.000 Nm3/hr
~ 594 GWh/a

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

Biomethane Polishing



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

Service by Ammongas

Regular, planned maintenance **twice per year.**

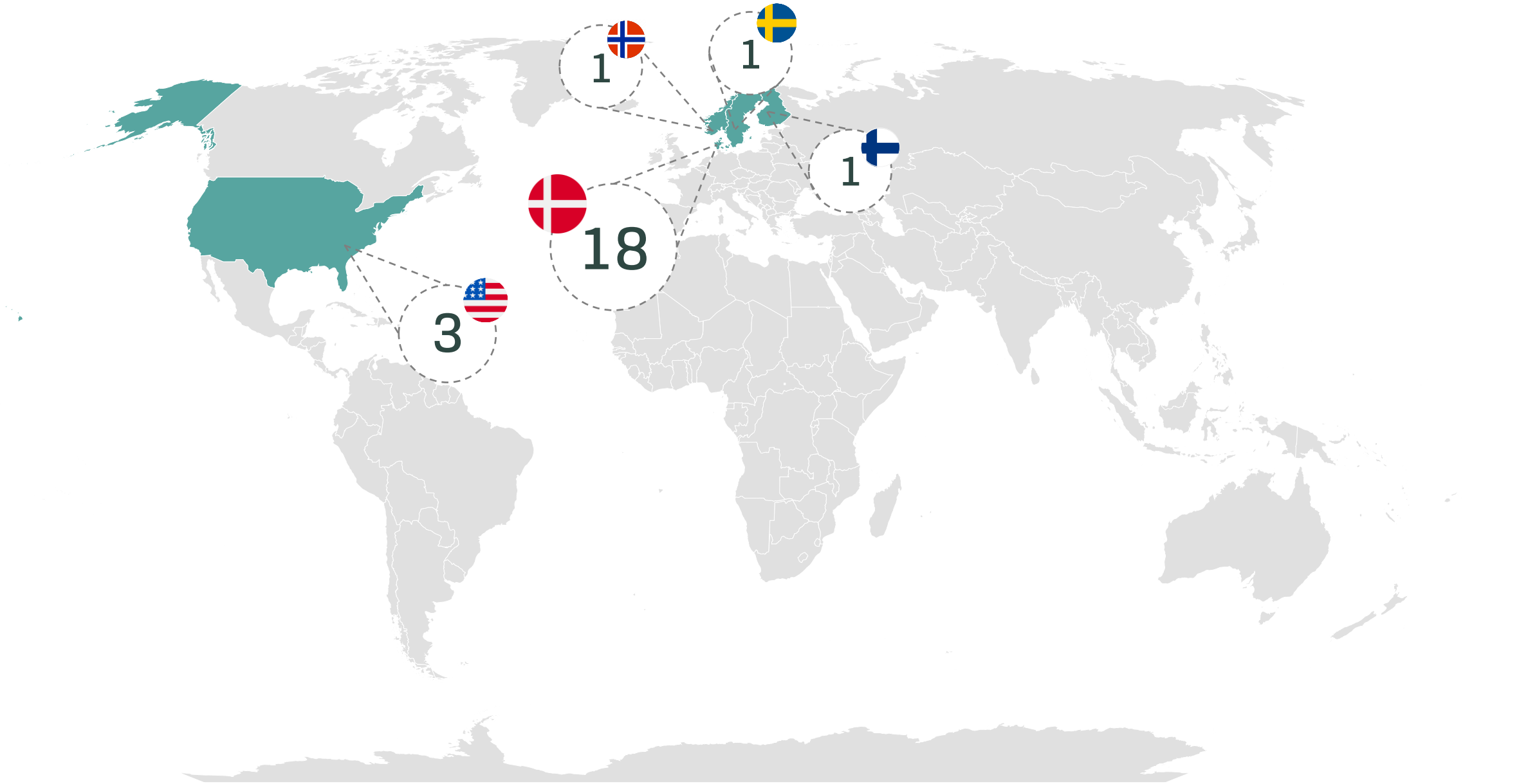
Maintenance activities include, but are not limited to, **inspection and service of key components** such as gas dryer, analyzers, pumps, chiller units, and safety systems.

Remote monitoring with the ability to intervene and assist in resolving operational issues as they arise.

Management of a local inventory of **spare parts** to ensure minimal downtime in the event of component failure.

24/7 service hotline for immediate support in case of operational irregularities.

Current Plants Being Serviced by Ammongas



Call for Expressions of Interest from EU-based businesses: leveraging private investments for Ukraine's recovery and reconstruction

European Commission

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Thank you!

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