



BioTalks: Utilizing biogenic CO₂ from biogas plants

Gasum hackathon

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Gasum

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An aerial photograph of a serene lake scene. A paved road curves along the shoreline, bordered by lush green trees. In the lower right, a red building with a grey roof and solar panels is visible, along with a smaller red structure. The water is a deep blue, and a small boat is seen in the distance. The overall atmosphere is peaceful and natural.

Our Purpose

CLEANER ENERGY

Gasum – a nordic gas sector and energy market expert

We offer cleaner energy and services to help our customers to reduce their own carbon footprint as well as that of their customers.

Together with our partners, Gasum promotes development towards a carbon-neutral future on land and at sea.

Our services and solutions are used in maritime, road transport, industry and energy production.



Revenue
€1,571.0 million

Balance sheet total
€2,420.7 million

Personnel*
356

*in 2021

Energy products
**Biogas, LBG,
Natural gas, LNG,
Windpower, Power**

Services
**Gas filling station network,
Bunkering services for
maritime transport,
Energy Market Services,
Portfolio Management
Services,
Trading services,
Circular Economy Solutions**



Industry and
energy production



Maritime transport



Road transport



Biogas and
circular economy



Energy market services

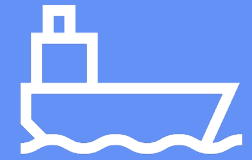
1/24/2023

BioTalks webinar

**BUSINESS
UNITS**



**INDUSTRY
& TRAFFIC**



MARITIME

A range of products and services to our customers

– We help them reduce their carbon footprint



Natural gas
Liquefied
natural gas LNG



Biogas,
Liquefied biogas LBG



Power



Solutions
for maritime
transport



Gas filling station
network
for transport



Circular economy
solutions



Energy market services

- Portfolio Management and Brokering Services
- Balance Services in the Wholesale Physical Electricity Market
- 24-h Control Room Services
- Marketing analyses and reporting services
- Guarantees of Origin Services for electricity and alternatives

We are developing the Nordic gas ecosystem and promoting the sustainable development



6 LNG terminals



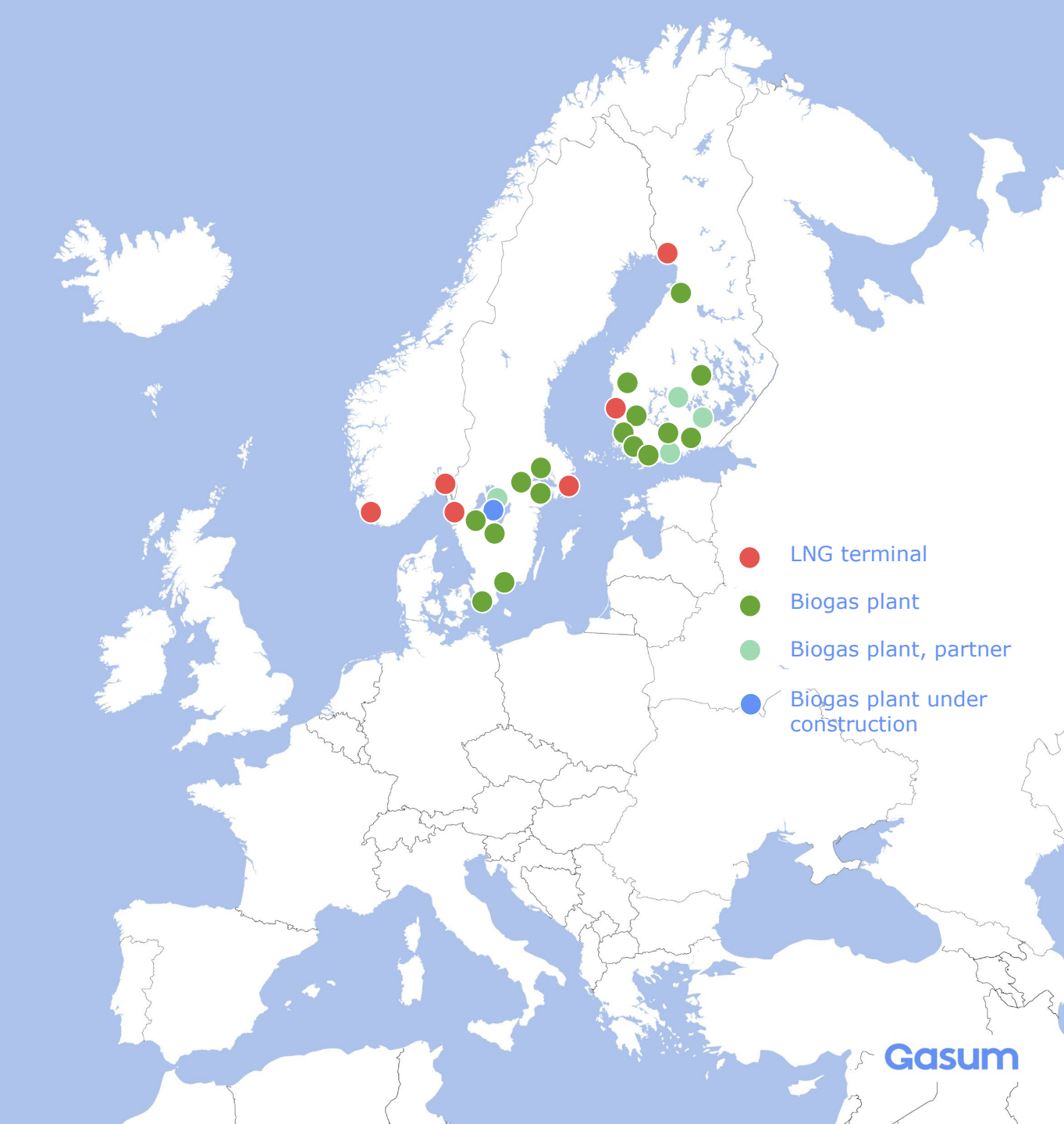
5 Bunkering vessels



17 Biogas plants
1 Under construction (Götene)
3 Partner plants
Several projects in pipeline



Over 90 gas filling stations



NETWORK OF LNG FILLING STATIONS EXPANDING IN NORDICS – GASUM NETWORK PLAN

Targeting a network of 50 filling stations in the Nordic countries by the early 2020s. Today totally 40 stations.

Key Drivers for market development:

- Significant market potential
- Requirements for fast emission reduction and low emission solutions
- Expanding filling stations network
- Availability of vehicles
- Regulatory environment and incentives for gas
- Increase awareness of gas solution

- 
- Existing LNG filling station
 - Upcoming LNG filling station
 - Planned LNG filling station

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Gasum biogas production

Biogas plants in Finland

~ over 320 GWh/a



Huittinen	Honkajoki	Kouvola	Kuopio	Lohja	Oulu	Riihimäki	Turku	Vehmaa
2010	2014	2014	2014	2021	2015	2016	2009/2020	2005
30 GWh/a	34 GWh/a	10–14 GWh/a Expansion planned	30 GWh/a Expansion planned	40 GWh/a	35 GWh/a Expansion planned	47 GWh/a	60 GWh/a	32 GWh/a
60,000 tn/a	60,000 tn/a	20,000 tn/a	60,000 tn/a	60,000 tn/a	60,000 tn/a	75,000 tn/a	110,000 tn/a	105,000 tn/a
Membrane upgrading + container filling station	CHP use	Water scrubber upgrading + connected to the main gas grid	CHP use	Membrane upgrading + connected to the main gas grid	Membrane upgrading + container filling station	Water scrubber upgrading + connected to the main gas grid	Membrane upgrading + LBG production	CHP use

- Four plants with membrane upgrading
- Two plants with water scrubber upgrading
- Three plants with no current upgrading – direct CHP use

Partners in biogas production

~ over 80 GWh/a



Espoo	Lahti	Äänekoski
From 2012	From 2014	From 2021
24 GWh/a to gas grid	50 GWh/a to gas grid	10 GWh/a
60,000 tn/a	60,000 tn/a	
Water scrubber upgrading + connected to the main gas grid	Water scrubber upgrading + connected to the main gas grid	Membrane upgrading + container filling station

Biogas production in Sweden

~ over 400 GWh/a



Jordberga

Katrineholm

Örebro

Västerås

Lidköping

Skövde

Nymölla

Vadsbo*

From 2014	From 2010	From 2009	From 2014	From 2011	From 2012	From 2021/04	From 2014
110 GWh/a	30 GWh/a	55 GWh/a	30 GWh/a	65 GWh/a	23 GWh/a	80 GWh	18 GWh
Co digestion veg origin	Manure/ABP + co digestion veg origin	Co digestion veg origin	Manure/ABP + co digestion veg origin	Co digestion veg origin	Manure and food waste	wastewater	Digestion of manure
80,000 ton biofertilizer	80,000 ton biofertilizer	65,000 ton biofertilizer	70,000 ton biofertilizer	80,000 ton biofertilizer	50,000 ton fertilizer		*Gasum has a 50% shareholding in Vadsbo Biogas

- Seven plants with water scrubber upgrading
- One plant with membrane upgrading (Nymölla)

Some of new biogas projects published

Gasum is focusing to expand biogas production

- **Götene, Sweden ~120 GWh**
 - Construction on-going, operative 2024
- Skåne, Sweden, two plants, (2 x 120 GWh)
- Borlänge, Sweden ~120 GWh
- Vormstad, Norway ~150 GWh
- Kouvola, Kuopio and Oulu, Finland expansions



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Gasum Hackathon “Utilizing biogenic CO₂ from biogas plants”

GASUM HACKATHON

- **Gasum is especially looking for a partner (a company, consortium), with near commercial solutions and interest to take the lead to create value from biogenic CO₂ produced in biogas upgrading process in Gasum biogas plants**
- Hackathon participant can select a single Gasum CO₂ source, several source locations or combine different sites as they wish
- Gasum appreciates if participant can show initial draft of business case for the idea of CO₂ use and value creation

What the winning team(s) get

- Depending on the maturity of idea and feasibility of the business case, Gasum is willing to continue with e.g., commercial negotiations and/or joint feasibility study/basic engineering to valorize CO₂ from Gasum biogas plants.



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CO₂ POTENTIAL OF GASUM BIOGAS

All CO₂ in produced biogas: 114 000 tn/a

- 40 000 tn/a at > 95 % CO₂ conc.
- 64 000 tn/a at ~15 % CO₂ conc.
- 10 000 tn/a – no current CO₂ stream (no upgrading)

*Note that potentials are indicative maximum potentials – actual production is depending on operation, own biogas use etc.

- Gasum biogas plant
- Gasum upgrading plant
- Gasum biogas plant under construction

TOTAL GASUM BIOGAS CO2 POTENTIAL

CURRENT CO₂ POTENTIAL IN GASUM PLANTS In operation + under construction (Götene)		
Sweden		Up to
>95% CO ₂ concentration (membrane and amine scrubber)	tn CO ₂ /a	22 600
~15% CO ₂ concentration - water scrubber	tn CO ₂ /a	52 900
Finland		
>95% concentration (membrane)	tn CO ₂ /a	16 900
~15% concentration - water scrubber	tn CO ₂ /a	11 600
Currently no upgrading	tn CO ₂ /a	9 500
TOTAL GASUM		
>95% CO ₂ concentration (membrane and amine scrubber)	tn CO ₂ /a	39 600
~15% CO ₂ concentration - water scrubber	tn CO ₂ /a	65 600
All Gasum CO ₂ from current upgrading	tn CO ₂ /a	104 100
All Gasum CO ₂ including raw biogas	tn CO ₂ /a	113 700

Plant specific CO₂ potential

FINLAND

Existing & FID decision made												
Plant		Kuopio	Vehmaa	Honkajoki	Turku	Riihimäki	Oulu	Lohja	Kouvola	Huittinen	Lahti upgrading	Äänekoski upgrading
Upgrading technology		Water scrubber	No upgrading	No upgrading	Membrane	Water scrubber	Membrane	Membrane	Water scrubber	Membrane	Water scrubber	Membrane
Methane	GWh/a	30	30	30	50	45	30	40	15	30	50	8
Calculative CO₂	tn/a	3 200	3 200	3 200	5 300	4 700	3 200	4 200	1 600	3 200	5 300	1 000
CO ₂ stream concentration (purity) estimate	%	~15%	No	No	>95%	~15%	>95%	>95%	~15%	>95%	~15%	>95%

SWEDEN

SWEDEN Existing & FID decision made										
Plant		Örebro	Lidköping	Jordberga	Västerås	Katrineholm	Skövde	Nymölla	Götene (2024)	
Upgrading technology		Water scrubber	Water scrubber	Water scrubber	Water scrubber	Water scrubber	Water scrubber	Membrane	Amine scrubber	
Methane	GWh/a	55	65	110	29	28	40	75	120	
Calculative CO₂	tn/a	9 969	11 318	19 153	4 296	4 147	4 046	4 909	17 775	
CO ₂ stream concentration (purity) estimate	%	~15%	~15%	~15%	~15%	~15%	~15%	>95%	>95%	

An aerial photograph of a multi-lane highway bridge crossing a large body of water. A blue semi-truck is driving on the bridge, and a dark car is visible in the opposite lane. The water reflects the sky and the bridge. In the background, a boat is docked at a pier. The sky is filled with soft, white clouds.

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