





Biokraft AS

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Brief history of Biokraft



- Founded in 2009
- TrønderEnergi AS: lead investor i 2010
- Plant 1 (Selva), buildt and commissioned in 2011, sold in 2013
- Collected and processed Category 2 Salmon Sludge from fish farming industry





The Biokraft vision in 2013 – Skogn Biopark

SKOGN 1 – LBG PLANT



- Scandinavian Biogas Fuels AB & TrønderEnergi AS, shareholders/investors
- Financed by
 - ENOVA
 - Bank consortium consisting of Innovasjon Norge, Sparebank1 SMN, Swedish Export Credit & Export Credit Guarantee Committee
- EPC Turn Key delivery by Purac AB
- Built 2016 – 2018
- CAPEX – Ca MNOK 400



Skogn 1 – the world's largest LBG factory



- Capacity to produce 12,5 mill Nm³ Liquide Biogas - LBG (Bio LNG, Biomethane, Renewable Natural Gas)
- Equivalent to 120 GWh/year
- Equivalent to 12,5 mill liter of Diesel
- 12.5 million liters of diesel fuel represents Green House Gas emissions of 30,000 tonnes of CO₂e
- Producing ca 20 000 tons of bio-fertilizer





Dead fish to power cruise ships

Norwegian company to fuel liners with biogas made from leftovers of fish processing

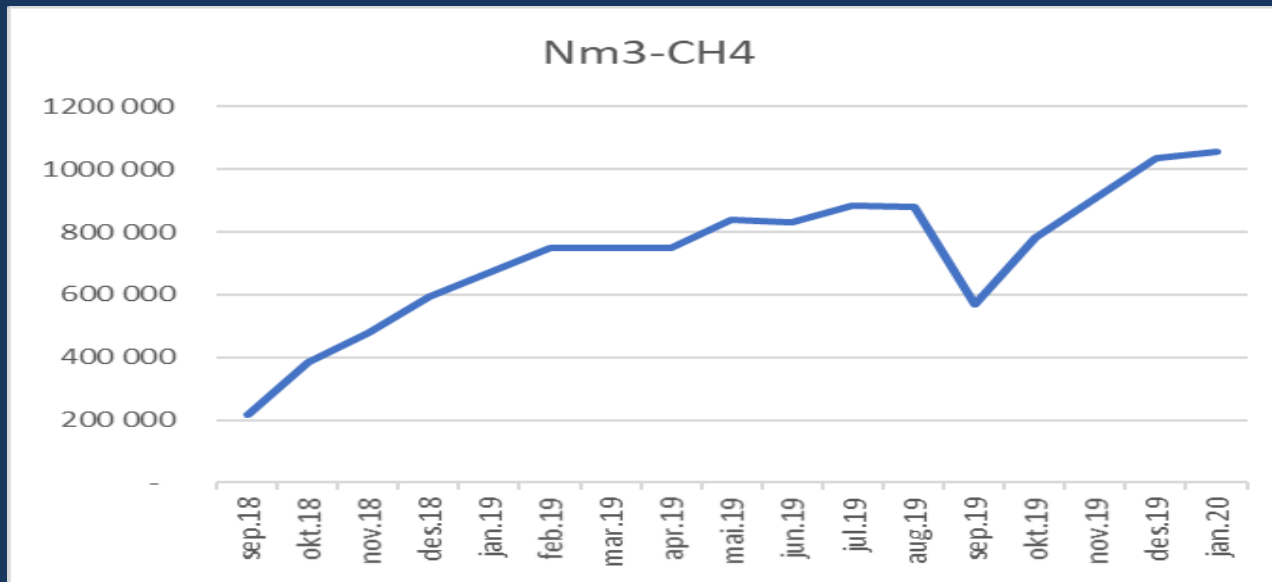


▲ Hurtigruten aims to have converted at least six of its vessels to use biogas, liquefied natural gas and large battery packs by 2021. Photograph: Franz Gingele/EPA



No “range anxiety”
1 tank with LBG fuel - 1780 km

SKOGN 1 – Start up – LBG production



LBG produced	sep.18	okt.18	nov.18	des.18	jan.19	feb.19	mar.19	apr.19	mai.19	jun.19	jul.19	aug.19	sep.19	okt.19	nov.19	des.19	jan.20
Nm3-CH4	217 778	382 389	480 055	591 555	669 194	750 527	748 250	748 250	840 611	830 444	885 492	880 305	567 757	779 472	909 638	1 036 992	1 054 387

Skogn 1 – Feedstock



Current feedstock:

- Waste from paper mill (Norske Skog Skogn)
- Waste from fish industry – silage
- Waste from fish industry – sludge
- Waste from chicken slaughter process
- Cow manure
- By-product from the food industry
- By-product from the Omega 3 industry
- By-product from Bio-diesel industry

Contributes to a more sustainable disposal of waste and by-products and supports the suppliers' brand and environmental responsibility



The International Energy Agency IEA states that biomethane for transport has a potential of up to 179% savings related to GHG emissions.

The reason for having values of more than 100% is:

- value of biomethane replacing diesel = 100 % 12,5 mill Nm3 LBG = 12,5 mill liter Diesel) = 30 000 ton CO₂e
- value of biomethane removing methane emissions from feedstock
- value if biomethane replaces other energy carriers than Diesel with other GHG effects (marine heavy oil)
- value of bio fertilizer replacing “fossil fertilizer)
- value of bio residues/nutrient used in other industries (ex. Norske Skog process effects)

Table 7: Summary of default values for GHG reductions in EU RED

Bioenergy option	No. of routes	Max. saving %	Min. saving %
Conventional biofuels	35	58	28
Advanced biofuels	14	80	78
Biomethane for transport	12	179*	17
Electricity – agricultural residues	15	90	33
Electricity – wood chips	21	90	33
Electricity – wood pellets	57	93	-2
Electricity – biogas	18	219*	14
Heat – agricultural residues	15	93	11
Heat – wood chips	21	93	57
Heat – wood pellets	57	94	32

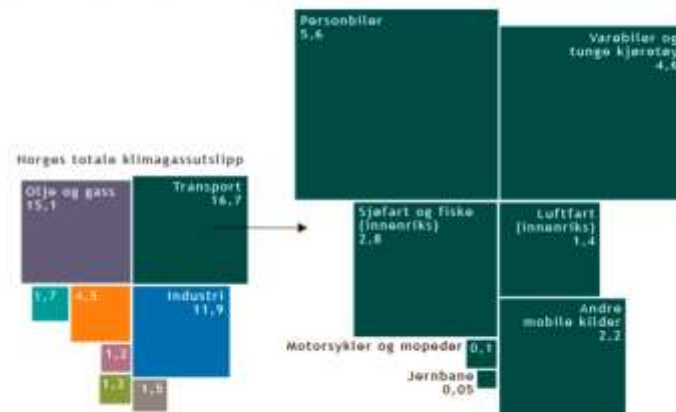
* In cases where direct methane emissions to the atmosphere are reduced, emissions savings can exceed 100% of those associated with fossil fuel use alone, as methane is a significantly more potent GHG than CO₂.

Note: These savings do not take account of emissions due to land use change.
Source: European Commission (2018), Proposal for Directive on Renewable Energy, 2016, Annex 5.

Kilde: IEA Technology Roadmap Delivering Sustainable Bioenergy, 2017

Utslipp av klimagasser fra transport i 2015

Utslipp til luft (millioner tonn CO₂-ekvivalenter)



■ Energiforsyning ■ Jordbruk ■ Bygg ■ Avfall ■ Andre utslipp

Kilde: Miljødirektoratet 2016

BIOKRAFT – Skogn biopark vision



Biokraft lead/participate in R/D projects for CCU & utilization of nutrients

CO2

- Methanation of CO2
- Industrial liquid CO2
- Jet-fuel

Nutrients

- Protein production - COMPLETE
- Streamlining of Norske Skog's biological treatment plant -Effisludge
- Biochar - Bio Sinter
- Scampi project

CO2 & Nutrients

- Greenhouse



BIOKRAFT – Extension



Skogn 2

- Investment decision Q1 2020
- Capacity of ca 3-4 mill Nm³ LBG

Skogn 3

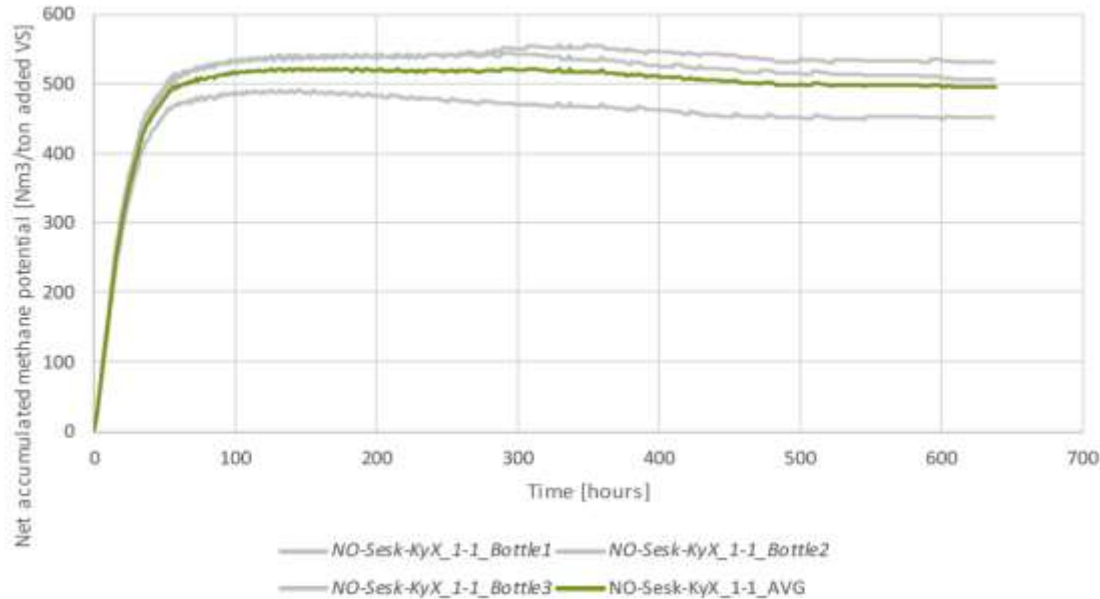
- Investment decision Q3 2020
- Capacity of ca 8-9 mill Nm³ LBG



BIOKRAFT – Hatchery Sludge



NO-Sesk-KyX_1-1



Biogas content:

$$\text{Biogas YIELD} = \text{DS} * \text{VS} * \text{YIELD}$$

- DS % 8 – 30 %
- VS % ca 70-75 %
- Digestate ca 40%
- YIELD low



Cost and sustainability of drying technology?

Wet sludge	DS = 8-10%	Pumpable	Suitable for Biokraft
Semi-wet sludge	DS = 20 – 30%	Pumpable ?	Suitable for Biokraft ?
Dry sludge	DS = + 30 %	Not pumpable	Not suitable for Biokraft