Biogas production from salmon residuals and its integration in pulp and paper industry effluent treatment
Outline

- Introduction to SBF
- Biogas in Norway
- Biogas at Skogn
- Benefits with biogas
Scandinavian Biogas in brief

• Founded in December 2005
• Former Prime Minister of Sweden Göran Persson as Chairman of the Board
• Globally leading ability to prove and optimize concepts in both laboratory, pilot- and full scale.
• Head office in Stockholm
• Waste management and Biogas production in Sweden and Korea
• R&D and Process Department at Linköping University
• 60+ employees – specialists in biogas processes and technology
## Current plants in SBF portfolio

<table>
<thead>
<tr>
<th>Projects running</th>
<th>Client / Partner</th>
<th>Substrate</th>
<th>Production GWh/y (est.)</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Henriksdal</td>
<td>Stockholm Vatten: SE</td>
<td>Sewage sludge, EOM</td>
<td>90 – (180)</td>
<td>Well functioning plant with proven technology. Extended 2015-16 with 3rd up-grading line and EOM dosing</td>
</tr>
<tr>
<td>Södertörn</td>
<td>SRV: Stockholm, SE</td>
<td>Food waste</td>
<td>70 – (85)</td>
<td>Launched in Aug 2015. Top of the line process solutions with off-the-shelf hardware. HOLD concept based</td>
</tr>
<tr>
<td>Ulsan</td>
<td>City of Ulsan: Kr</td>
<td>Sludge and food waste</td>
<td>65 (65)</td>
<td>Well functioning plant. Appointed to be the best food waste based biogas plant in Korea.</td>
</tr>
<tr>
<td>Trondheim</td>
<td>Skogn: Trondheim, NO</td>
<td>Kat2 salmon, slaughter waste, paper mill sludge</td>
<td>(125)</td>
<td><strong>Under construction.</strong> Project have CSTR for Kat2 salmon silage and ECSB for process water. Liquefied methane for sale. HOLD concept based</td>
</tr>
</tbody>
</table>

**Projects running**

- Bromma
- Henriksdal
- Södertörn
- Ulsan
- Trondheim
Outline

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Plants in Norway producing biogas for vehicle fuel

**Biokraft AS**
- Location: Levanger
- Owners: Founders and TrønderEnergi AS
- Application: Fuel for vehicles and ferries (LBG)
- Annual production: 12.5 million Nm³ (25 million Nm³ with Stage 1 extension)
- Start-up: 2016-2017

**Bergen Kommune – VA department**
- Location: Bergen
- Owners: Bergen Kommune
- Application: Heating, electricity and fuel for busses
- Annual production: 2.4 million Nm³
- Start-up: By 2015

**IVAR**
- Location: Mekjarvik (Stavanger)
- Owners: 12 municipalities in Rogaland
- Application: Fuel for cars and busses, biopellets
- Annual production: 4.5 million m³
- Start-up: June 2009

**IVAR**
- Location: Grødalnd (Hå)
- Owners: 12 municipalities in Rogaland
- Application: Fuel for car and busses, biopellets
- Annual production: 6.5 million m³
- Start-up: By 2016

**Mjøsaanlegget**
- Location: Lillehammer
- Owner: HIAS, GLT og Glør
- Application: Fuel
- Annual production: 2.5 million Nm³
- Start-up: By 2015

**Energigjenvinningsetaten**
- Location: Nes (Romerike)
- Owner: Oslo Kommune
- Application: Fuel (partly LBG) and fertilizer
- Annual production: 4.5 million Nm³
- Start-up: December 2012

**Bekkelaget Vann AS**
- Location: Oslo
- Owner: Oslo Kommune
- Application: Fuel for busses and trucks
- Annual production: 2.7 million Nm³
- Start-up: January 2010

**Fredrikstad Biogass AS**
- Location: Fredrikstad
- Owner: Frevar KF and Borg Buss AS
- Application: Fuel for busses
- Annual production: 0.43 million Nm³
- Start-up: December 2001

**Greve**
- Location: Tønsberg
- Owner: Greve
- Application: Fuel
- Annual production: 6.0 million Nm³
- Start-up: By 2016

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Scandinavianbiogas
Biogas in Norway

- Strong focus to be CO₂ neutral
- Norway have already 100% green electricity (hydropower)
- CO₂ from vehicle/shipping is major contribution
- Political drivers to phase out oil based fuels
  - Diesel free days in Oslo when air pollution is high
  - Proposal on permanent diesel free days under evaluation
  - Veibruksavgift on fossil fuels
Ruter plans, coordinates, orders and markets public transport in Oslo and Akershus.

All operative service is performed by various operating companies that work by contract for Ruter and by NSB with local trains.
Biokraft already distributes LBG to the Trondheim city busses to secure the LBG market

- Biokraft have since April 2015 been purchasing LBG from Lidkoping (Sweden) for the delivery and sales to Sorgenfri in Trondheim.
- LBG is distributed by Fordons Gas, which is owned by Air Liquide.
- The liquid biogas is distributed with truck to Trondheim.
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Skogn is the largest production unit within Norske Skog

Skogn is one of the largest newsprint mills in Europe

Skogn was founded in 1962 and have three paper machines with a total capacity of 600 000 tonnes

The plant process is Thermo Mechanical Pulp
Biogas plant at Skogn – principal lay-out

- RRS (road, rail and sea) on site
- Industrial site with possibilities for synergistic co-operation with Norske Skog and others
- Deep water dock
- Norske Skog
- E6 Train – tracks on site connected to main line
- Skogn biogas Site

Source: Management
Biogas project at Skogn

- 125 GWh LBG in first step
- Co-digesting of Kat2 salmon, sludge, and liquid EOM
- ECSB treatment of waste water from mill
- CAPEX total ca 390 MNOK (41 MEUR)
- Turn-key delivery from Purac AB
- Process concept by SBF
- Off-take agreement with AGA

Timeline:
- 2015
  - Ground works
  - Final order to Purac
- 2016
  - Purac start construction on site
  - Production start
- 2017
  - Full Production

© SBF 2016
Current treatment of process at Skogn

~ 41 ton COD/d
~ 20 000 m³/d
~ 2000 mg COD/l

Process water from mill → Pre-sedimentation → Sludge tank → Sludge dewatering → Bio sludge → Excess sludge

- Fiber sludge
- Rejected water

- Waste activated sludge → Recipient
- Sludge cake to incineration or compost

Excess sludge:
~ 8-10 ton TS/d
~ 300-500 m³/d
Pre-sedimentation

Waste activated sludge

Recipient

Fiber sludge

Sludge tank

Biosludge

Excess sludge to biogas plant:
~ 6-8 ton TS/d
~ 300-500 m³/d

Sludge dewatering

Fiber cake to incineration or compost

Process water from factory

~ 41 ton COD
~ 20 000 m³/d
~ 2000 mg COD/l

Biogas handled within low pressure gas system of CSTR: 20 – 25 GWh/year

~ 41 ton COD
~ 20 000 m³/d
~ 2000 mg COD/l
Granular sludge for digestion of dissolved organic matter

**Anaerobic Sludge Granules (SEM)**

Acetate as Substrate 
* (Methanoseta) 

Sucrose as Substrate (mixed culture)

**Anaerobic Sludge Granules (settling)**

granular  flocculent  dispersed

sakil.iubat@gmail.com

Scandinavian biogas
Biokraft Skogn – process flows
Co-location with paper and pulp mill – a win-win situation

Biogas plant
- Possibility for el and steam integration
- Good temperature of substrate stream
- Source of “dilution” water (biosludge or untreated process water)
- One source of substrate and biogas secured
  - Size is critical in industrial biogas production, thus “small streams” of biogas becomes feasible for upgrading
- Nutrient rich waters can be “transferred” to host mill

Host mill
- Decreased energy consumption in the wastewater treatment
- The excess sludge is handled by the biogas plant:
  - More efficient performance of fiber boiler
  - Reduced emissions of NOx and SOx (comes with the biosludge)
- Decreased utilization of chemicals
  - Polymers for final dewatering of biosludge is not needed
  - Ammonium from dewatering of digested sludge will be transferred to the mill wastewater treatment and replaces UREA
Two major research grants awarded in conjunction to the investment program

LIFE14 CCM/SE/000221

EnergiX – innovasjonsprosjekter
The Norwegian research council
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Gas buses in Sweden

*Source: Swedish gas association.*
Cost for gas buses?

Comparison of articulated buses in city traffic, diesel versus biogas.

The cost for service and maintenance decreased significantly between 2008 and 2012*.

Scania Euro 6 gasmotor
Kostnadseffektiv ersättare för diesel

Ottomotor med verkningsgrad som diesel
Gas 40% termisk verkningsgrad
Diesel 42% termisk verkningsgrad
Lägre bränsleförbrukning än Euro 5/EEV motorn.

Scania modul system
Mindre än 40 delar skiljer jämfört med dieselmotorn
Utmarkt tillgänglighet på service och reservdelar.

Allt från lokala till regionala ändamål
280 hk (1350 Nm) och
340 hk (1600 Nm)
Moment på dieselnivå!

Övriga funktioner
Mindre känslig för varierande gaskvalité
100% driftsduglighet på hög höjd, 2 000 m+
CNG och LNG
Endast 3-vågs katalysator behövs för att nå Euro 6.
1 TWh BIOGAS!


scandinavianbiogas.com
Thank you for your attention
Contact information

Matti Vikkula
CEO and President
matti.vikkula@scandinavianbiogas.com
+46 (0)70 597 99 38

Jörgen Ejlertsson
Director R&D
jorgen.ejlertsson@scandinavianbiogas.com
+46 (0)73 993 95 73

Håvard Wollan
Managing Director, Biokraft AS
hw@biokraft.no
+47 928 83 383

Scandinavian Biogas Fuels AB
Holländargatan 21A
111 60 Stockholm
Sweden

Switchboard: +46 (0)8 50 38 72