BioLNG

Liquefaction of biogas as a viable step towards emission reduction
WÄRTSILÄ PURPOSE

CLEAN ENVIRONMENT
Protection of the environment plays a bigger role than ever before. Driving sustainability contributes to reduced emissions, compliance and ensures a clean future. Integrating environmental issues to business planning creates a competitive edge.

ENERGY INTELLIGENCE
Energy intelligence is about optimizing lifecycle costs and ensuring efficiency throughout the value chain. Operations can be optimized by choosing most optimal technology and using assets in the most efficient way. Digital technologies and data intelligence enable continuous monitoring and optimization of operations and opens doors for new business models.

MARKET SHAPING & INNOVATION
Ideas, information and intelligence are needed to navigate through the digital era. Market shaping and innovation means embracing and enabling new kind of business and technology innovations and staying on the pulse of what’s new.

WÄRTSILÄ PURPOSE IS ENABLING SUSTAINABLE SOCIETIES WITH SMART TECHNOLOGY.
ENERGY
INCREASING DEMAND FOR CLEAN AND FLEXIBLE ENERGY

WÄRTSILÄ STRATEGY

INCREASED CUSTOMER VALUE

Lifecycle Optimization

WÄRTSILÄ AS A SERVICE

ENABLING SUSTAINABLE SOCIETIES WITH SMART TECHNOLOGY

ENABLERS

Energy Efficiency

High performance culture

Strong presence in growth markets

Operational Excellence

Innovative solutions

MARINE
DEMAND FOR SMART AND SAFE TRANSPORTATION
Wärtsilä Gas solutions

We are the leading provider of innovative products and integrated solutions throughout the entire gas value chain.

As a frontrunner in our field of expertise, we are enabling connections by “smart technology” in the various gas and distribution chains, to meet the highest sustainable profile and customer needs.

In a passionate and collaborative way, together with our customers we are working towards ‘Renewables in Every Tank by 2025’
Enforcing sustainability throughout the full supply chain

• UN Sustainability Goals

• RED II, IMO Resolution and Local legislations to increase the percentage of renewable fuels

• 2025, 2030 and 2050 are just around the corner and solutions are available NOW, so what is your excuse to wait?
LNG AS MARINE FUEL
>2 100 Wärtsilä DF engines | >26 000 000 running hours

REDUCED EMISSIONS
- CO2 emissions up to 21%
- TIER III compliant NOx emissions
- SOx & PM free emissions
How clean can become even cleaner...

- Recent independent studies show that LNG is reducing CO2 emissions
- But... LNG is still a fossil fuel
- Blending bioLNG/ liquid biogas into the LNG will decrease the CO2 footprint and emissions
- bioLNG, produced out of waste, enables a circular economy
- Technology for upgrading and liquefaction of biogas is available and proven
Climate agreements and directives touch all industries - not only maritime

- bioLNG is considered as an advanced biofuel (compliant with RED II)
- Blendable with LNG in different ratios to fulfill specific demands and supply
- Wärtsilä has a proven technology for biogas upgrading and liquefaction
- bioLNG as fuel is suitable for different applications:
Biogas production

Possible feedstock:
- Food waste
- Manure
- Industrial waste
- Sewage
- Crops

Gas Cleaning

Raw gas composition
- CH₄: 50 – 75%
- CO₂: 25 – 50%
- H₂O: saturated
- H₂S: 0 – 4000 ppm

Biogas Liquefaction – 160°C

Requirements to gas entering liquefaction
- CO₂ < 50 ppm
- H₂O < 1 ppm
- H₂S < 4 ppm

Liquid Biogas Storage System

bioLNG product
- -160°C
- No flash gas
- Ready for blend with LNG

Export
Wärtsilä Biogas Upgrade and Liquefaction

- Proven Technology
  - Upgrading
  - MR Liquefaction
  - Integration upgrading and liquefaction
- Lowest OPEX in the market
- Fully automated and unmanned operation
- Short delivery time
- Complete modules to site
  - Easy installation
- Weather protected
  - Service friendly
# Tekniska Verken – Amine polishing and BioLiq

## Linköping

<table>
<thead>
<tr>
<th><strong>Customer</strong></th>
<th>Tekniska Verken</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>BioLiq</td>
</tr>
<tr>
<td><strong>Tank net volume</strong></td>
<td>180 m³</td>
</tr>
<tr>
<td><strong>Capacity</strong></td>
<td>20 TPD / 7,000 TPA</td>
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<tr>
<td><strong>Gas source</strong></td>
<td>Biogas from waste</td>
</tr>
<tr>
<td><strong>Scope of supply</strong></td>
<td>Complete plant, incl. • MR liquefaction Storage tank • Electrical and control systems Excl. Civil works and installation</td>
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<tr>
<td><strong>Delivery method</strong></td>
<td>EPC</td>
</tr>
<tr>
<td><strong>Started</strong></td>
<td>Sept 2018</td>
</tr>
<tr>
<td><strong>Delivery</strong></td>
<td>2019</td>
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## BioHybrid - Hahnenest

<table>
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<tr>
<th>Owner</th>
<th>Erdgas Südwest GmbH</th>
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<tbody>
<tr>
<td>Type</td>
<td>MR liquefaction plant</td>
</tr>
<tr>
<td>Tank net volume</td>
<td>105 m³</td>
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<tr>
<td>Capacity</td>
<td>10 TPD / 3500 TPA</td>
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<tr>
<td>Size of liquefaction unit</td>
<td>30 m x 40 m</td>
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<tr>
<td>Gas source</td>
<td>Biogas from bio-waste and/or pipeline gas</td>
</tr>
<tr>
<td>Details</td>
<td>The plant will produce both bioLNG and LNG</td>
</tr>
</tbody>
</table>
| Scope of supply | Liquefaction plant, incl.  
  • Gas Cleaning  
  • MR liquefaction process  
  • Storage tank  
  • Export system  
  • Electrical and control systems  
  • Installation of plant  
  Excl. Civil works |
| Delivery method | EPC |
| Delivery | 2020 |


“Biogas and pipeline gas compositions can vary substantially, and Wärtsilä’s advanced technology can handle both.”
bioLNG as fuel

- By going for LNG as fuel today, emissions will already be reduced
- LNG as fuel today will enable the use of bioLNG in the future, without modifications
- Technology for production of bioLNG is available
- So why wait?
THANK YOU FOR YOUR ATTENTION