Record Biomap Webinar
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Benjamin Berg
Business Development
+33 7 89 00 06 30, benjamin.berg@cryopur.com

TRANSFORMING BIOGAS INTO BIO-LNG AND LIQUID CO₂
About Cryo Pur

The expert in cryogenic biogas upgrading and liquefaction

- **Activity**: Supply, installation and maintenance of industrial equipment for the production of liquid biomethane (bio-LNG) and liquid CO₂.

- **History**:
  - 15 years R&D in the field of cryogenic CO₂ capture.
  - First commercial unit commissioned in Northern Ireland (01/2018).
  - 3 tenders won in France and Italy.

- **Intellectual Property**: 7 international patents.

- **Team**: 28 people, including 20 PhD, engineers and technicians.

- **Facilities**: Head Office and workshop in Palaiseau, France (Paris area).

- **Equity raised**: € 3 m in 2015, € 6 m in 2017.
Offering new solutions to the biogas sector

- **Bio-LNG** is a sustainable fuel for trucks, that reduces GHG, NOx and particle emissions vs. diesel.

- **Bio-LNG** is stored and transported easily, which enables biomethane projects even when the gas grid is remote or has a limited capacity.

- **Liquid Bio-CO₂** is an interesting by-product that can be used in various applications: greenhouses, refrigeration in transport, chemical industry…
• INTRODUCTION
• THE BIO-LNG MARKET
• CRYO PUR TECHNOLOGY
• REFERENCES
Using biogas for the transport sector
Emissions from goods transport is a national and international issue.
Bio-LNG is particularly adapted to long-range transport

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Source: All European alternative fuel strategy, EC 2013
The development is supported by the launch of new, more efficient vehicles...

...and through deployment of distribution infrastructure.

END 2017:

SCANIA:
New 410 hp

IVECO:
New 460 hp

VOLVO:
New 460 hp

LNG for long-haul trucks in development in Europe
The natural gas grid carries limitations in many countries

- In some countries, like Nordic Countries for example, the natural gas grid is limited.

- Even in countries with a denser grid, like France, it is estimated that 40% of all potential biomethane projects are precluded due to grid limitations (distance, capacity)

Source: System Development Map, Gas Infrastructure Europe, 2014
The liquid form enables efficient biomethane transport and storage

- **A - Compressed in bundles**
  - Pressure: 250 bar
  - Capacity: 2-3t per 'flak'

- **B1 - Liquefied in ISO container**
  - Pressure: up to 20 bar
  - Capacity: 10-20t per container

- **B2 - Liquefied in trailer**
  - Pressure: 2-6 bar
  - Capacity: 20t per trailer
Cryo Pur Process (1/3)

CRYOGENIC CO$_2$ SEPARATION

-120 °C

-90 °C
Cryo Pur Process (2|3)
Cryo Pur Process (3|3)
Cryo Pur facilitates bio-LNG projects
Cryo Pur technology benefits

- **Integrated technology** for biogas upgrading, bio-CO$_2$ liquefaction and biomethane liquefaction
  - Cost efficiency
  - Simplified integration and management of interfaces
  - Performance guarantees
  - Large product range
  - Liquid CO$_2$ as by-product

- **Low electric energy consumption**:
  - 0.6 kWh/Nm$^3$ raw biogas for both upgrading and liquefaction: 14 barg/-120°C
  - 0.7 kWh/Nm$^3$ raw biogas for both upgrading and liquefaction: 1 barg/-160°C

- **Heat recovery** on refrigeration systems covering up to 100% AD heating needs

- **No methane slip** or minimum methane slip for landfill biogas

- **High flexibility** of the system: from 50% to 120% of the nominal biogas flowrate

- Physical separation, **no consumables** except activated carbon
Direct heat recovery on the Cryo Pur equipment can be complemented with a heat-pump operating mode to cover up to 100% of the heating needs of the anaerobic digestion process.
Reference #1: BioGNVal Project (1|5)

*First integrated small-scale bio-LNG demo plant in the world*
Reference #1: BioGNVal Project (2/5)
First integrated small-scale bio-LNG demo plant in the world

Click here to watch the presentation video
Reference #1: BioGNVal Project (3|5)

Project profile

- **Site location:** WWTP rue Louis Armand, Valenton, France (Paris Area).
- **Biogas source:** Sewage sludge.
- **Biogas composition:** CH₄ 60%, CO₂ 39%, H₂S 100 ppm, Siloxanes, VOCs.
- **Commissioning:** October 2015.
- **Capacity:**
  - Raw biogas flow: 100 Nm³/h biogas.
  - Bio-LNG prod.: 1 tpd.
  - Liquid CO₂ prod.: 1.6 tpd.
Reference #1: BioGNVal Project (4|5)

**Partners**

- **Finance**
  - Technical expertise

- **Owner of Valenton WWTP**

- **Operator of Valenton WWTP and Project coordinator**

- **Design, manufacturing, operation of the demonstration plant for bio-LNG and bio-CO₂ production**

- **LNG/bio-LNG fueling station provider**

- **LNG/bio-LNG truck provider**

- **Liquid CO₂ refrigeration system provider**
Reference #1: BioGNVal Project (5|5)

Key achievements

Bio-LNG transfer to the mobile transport station

Use as vehicle fuel

Use as industrial fuel

Following demo plant assessment: Cryo Pur system is eligible to receiving support from ADEME as a proven technology.
Reference #2: Greenville Bio-LNG plant (1/4)

First farm-based bio-LNG plant in the world
Reference #2: Greenville Bio-LNG plant (2|4)

Upgrading and liquefaction plant layout

1. Desulfurization
2. Dehumidification and pretreatment
3. CO₂ separation and liquefaction
4. Biomethane liquefaction

Refrigeration units
Two-stage compression unit
Water cooling system
Reference #2: Greenville Bio-LNG plant (3|4)

**Plant profile**

**Site location:** Omagh, Northern Ireland (UK)

**Biogas source:** animal waste and household waste

**Commissioning:** January 2018

**Capacity:**
- Raw biogas flow: 340 Nm³/h biogas
- Bio-LNG prod.: 3.3 tpd
- Liquid CO₂ prod.: 6 tpd
Reference #2: Greenville Bio-LNG plant (4/4)

Delivering bio-LNG!

From the production site...

...to the customer site.

Mobile LNG container loading operation

LNG satellite station design / LNG container unloading
Reference #3: Confidential
France (500 Nm³/h biogas) – 2018
Conclusion

The first integrated system for biogas upgrading, biomethane liquefaction and liquid CO₂ production
- Now commercial.

Cryo Pur solutions:
- Cryo Fuel: Production of bio-LNG fuel
- Cryo Dist: Production of biomethane from landfill gas
- Cryo Haul: Production of liquid biomethane for remote injection
- Cryo CO₂: Production of gaseous biomethane and liquid bio-CO₂

Scope of supply:
- Integrated biogas transformation plant.
- Full service agreement incl. remote monitoring.
- Liquid gas storage / transfer station (option)

Product range:

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<thead>
<tr>
<th>Product</th>
<th>Nominal Biogas Flow Rate (Nm³/h)</th>
<th>Minimum Biogas Flow Rate (Nm³/h)</th>
<th>Maximum Biogas Flow Rate (Nm³/h)</th>
<th>Nominal Bio-LNG Production (t/a)</th>
<th>Nominal Production of Liquid CO₂ (t/a)</th>
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Delivery schedule:
Thank you for your attention!