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Why bio-LNG?

- **Volume divided by 600**
  - **600 Nm³** of biomethane
  - **1 m³** of bio-LNG
  - **0.6 m³** of diesel

Reduction of storage volumes

Energy density close to that of diesel

- **Volume divided by 600**
  - **600 Nm³** of biomethane
  - **1 m³** of bio-LNG
  - **0.6 m³** of diesel
LNG for long-haul trucks in development in Europe

END 2017:

SCANDIA:
New 410 hp

IVECO:
New 460 hp

VOLVO:
New 460 hp

• The development is supported by the launch of new, more efficient vehicles...

• ... and through deployment of distribution infrastructure.
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 25% of all potential biomethane projects are precluded due to grid limitations (distance, capacity).

Source: System Development Map, Gas Infrastructure Europe, 2014
An integrated system transforming biogas into bio-LNG and liquid CO₂

- **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...
Cryo Pur company profile

- **Activity**: Supply, installation and maintenance of equipment for the upgrading and liquefaction of gas (biogas, landfill gas, flared gas, grid gas)

- **Intellectual Property**: 6 international patents.

- **Team**: 28 people, including
  - 4 PhD-engineers
  - 8 engineers
  - 7 technicians
  - 2 PhD students-engineers

- **Creation**: 2015

- **Turnover 2017**: € 2.15 m

- **Head Office**:
  - Massy (Paris area)
  - 6 000 m² (offices & workshop)

- **Equity raised**:
  - € 11.8 m since 2015
  - € 3 m in 2018
Timeline

2001
- First laboratory pilot for cryogenic CO₂ capture (5kg of CO₂/h).

2003
- Launch of the BioGNVal project with SUEZ (120Nm³/h biogas).

2006
- Industrial demonstrator for cryogenic CO₂ capture (1t of CO₂/day).

2013

2015
- Demonstration phase of the BioGNVal project.
- Sale of the first commercial equipment in the UK (300 Nm³/h biogas).
- 2 tenders for remote injection won in France
- “Stratégies Logistiques” Sustainable Innovation Prize

2016
- € 3m funds raised.
- Pilot phase of the BioGNVal project.
- Cryo Pur wins the ExpoBiogaz 2015 Innovation Award.
- Demonstration phase of the BioGNVal project.
- € 6m funds raised.
- Manufacturing of the first commercial unit
- One tender for bio-LNG fuel project won in Italy

2018
- Commissioning of the first commercial unit
- Launch of 1 project in France and 1 project in Italy

2018
- Commissioning of the first commercial unit
- Launch of 1 project in France and 1 project in Italy
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CO$_2$ separation method
General view of the process
An integrated upgrading-liquefaction unit

1. Desulfurization

2. Pre-treatment

3. CO$_2$ separation and liquefaction

4. Biomethane liquefaction

Refrigeration units

Two-stage compression unit

Water cooling system
Cryo Pur technology benefits

- **Integrated system** for upgrading-liquefaction
- **Low electricity consumption**
- **Liquid CO₂ option**
- **Maximal recovery rate**
- **Heat recovery**
- **Physical gas separation, no consumables** (except activated carbon)
4 differentiating solutions addressing 4 market segments

**Cryo Fuel**
- Bio-LNG as vehicle fuel
- Biogas production → Bio-LNG equipment → Bio-LNG storage → Bio-LNG transport → LNG or LCNG station
- Options: Liquid or gaseous CO2

**Cryo Haul**
- Bio-LNG as logistical solution
- Biogas production → Bio-LNG equipment → Fixed Bio-LNG storage → Mobile Bio-LNG storage + Vaporisation station
- Options: Liquid or gaseous CO2

**Cryo Dist**
- Landfill
- Landfill gas → Cryo Pur equipment → Injection into the gas grid → Options: Liquid or gaseous CO2 → LNG or LCNG station

**Cryo Flare**
- Flared gas
- Flare gas → Cryo Pur equipment → Fixed LNG storage → Mobile LNG storage + Vaporisation station
- Options: LNG → Off-grid industrial site
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BioGNVal project [1|3]
A model of circular economy

THE BIOGNVAL PROJECT

1. Biogas production in water treatment plant
2. Biogas upgrading and liquefaction of biomethane and bioCO2
3. Storage of bioLNG and liquid bioCO2
4. Distribution of bioCO2 to industries & bioCNG, a fuel for cars, small trucks & busses
5. Distribution of bioLNG, a renewable fuel for long-haul trucks (& busses)

Project partners:

- Financing & technical expertise: Suez
- Project coordinator: ENGIE
- WWTP owner: SIAAP
- Biogas to bio-LNG (&LCO2) technology: Cryo Pur
- Bio-LNG filling station: IVECO
- Biog-LNG truck: IVECO

Site: Valenton (Paris area), France
Flow rate: 120 Nm3/h raw biogas
Feedstock: sewage sludge
Start date: October 2015
BioGNVal [2|3]
Using bio-LNG as vehicle and industrial fuel

Bio-LNG transfer to the mobile transport station

Use as vehicle fuel

Use as industrial fuel

Site: Valenton (Paris area), France
Flow rate: 120 Nm³/h raw biogas
Feedstock: sewage sludge
Start date: October 2015

Flow rate: 120 Nm³/h raw biogas
BioGNVal [3|3]
From pilote phase to demonstration phase

Site : Valenton (Paris area), France
Flow rate : 120 Nm3/h raw biogas
Feedstock : sewage sludge
Start date : October 2015

Click here to watch the video presentation of BioGNVal:

YouTube
Greenville Energy [1|2]
1st industrial unit in the United Kingdom

Site: Omagh (Northern Ireland), UK
Flow rate: 300 Nm3/h raw biogas
Feedstock: agricultural waste
Start date: January 2018

Click here to watch the video presentation of Greenville Energy:
Greenville Energy [2|2]
Biomethane liquefaction on a farm : a world first!

Site: Omagh (Northern Ireland), UK
Flow rate: 300 Nm³/h raw biogas
Feedstock: agricultural waste
Start date: January 2018

From the bio-LNG storage at the production site...

... to the satellite station at the customer site.

Mobile ISO container loading operation

Mobile ISO container unloading operation
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Italy - Project #1
Production of Bio-LNG vehicle fuel from biogas

Site: Confidential
Flow rate: 800 Nm3/h raw biogas
Type: Centralised biogas production
Manufacturing start date: Nov. 2018
France - Project #1
LPG and LNG production from flare gas

Flow rate: 650 Nm³/h flare gas
Type: Oil & Gas
Manufacturing start date: Dec. 2018
France - Project #2
Biomethane production from landfill gas

Site: Confidential
Flow rate: 800 Nm³/h landfill gas
Type: Landfill
Manufacturing start date: June 2019
Thank you for your attention!
Scope of supply
## Equipment range

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Nominal biogas flowrate (Nm³/h)</th>
<th>Minimal biogas flowrate (-50%) (Nm³/h)</th>
<th>Maximal biogas flowrate (+20%) (Nm³/h)</th>
<th>Nominal bio-LNG production* (TPD)</th>
<th>Nominal LCO₂ production* (TPD)</th>
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</table>

* Production is calculated for a biogas composition of 55% CH₄ and 45% CO₂.
Reference #2 : Greenville Bio-LNG plant

Pictures