Agenda

• COMPANY

• REFERENCES

• TECHNOLOGY

• SOLUTION FOR SAMSØ PROJECT
CRYO PUR COMPANY
An integrated system directly transforming biogas into bio-LNG and liquid CO₂
About Cryo Pur (1|2)

**Company profile**

- **Activity**: Supply, installation and maintenance of industrial equipment for the production of liquid biomethane and liquid CO₂

- **Intellectual Property**: 7 international patents

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

- **Facilities**:
  - Palaiseau, France (Paris Area)
  - 2 400 m² (office & workshop)

- **Equity raised**:
  - € 3 m in 2015
  - € 6 m in 2017
About Cryo Pur (2|2)

15 years of experience in cryogenic gas separation

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

Dr. Denis Clodic files the first patent on cryogenic CO₂ capture.

Cryo Pur system selected for the BioGNVal project with SUEZ.

Cryo Pur wins the « Biogaz d’Argent » at Biogaz Europe 2016.

2001

2003

2006

2013

2015

2016

2017

First €3m fundraise with investment fund XERYS.

Cryo Pur wins the ExpoBiogaz 2015 Innovation Award.

Cryo Pur selected as FrenchTech Ambassador for COP 21 in Paris.

€6m fundraise with investment fund XERYS.

3 tenders won for bio-LNG projects in France and Italy.

Opening ceremony of the BioGNVal project.

Sale of the first commercial equipment in the UK.

Demonstrator for cryogenic CO₂ capture on an industrial scale (1T of CO₂/day).
Reference #1: BioGNVal Project
Valenton WWTP, France (120 Nm³/h biogas) (1|3)

Click here to watch the presentation video
Reference #1: BioGNVal Project
Valenton WWTP, France (120 Nm$^3$/h biogas) (2/3)

- **Finance**
  - Technical expertise

- **Owner of Valenton WWTP**
- **Operator of Valenton WWTP and Project coordinator**
  - Design, manufacturing, installation and commissioning of bio-LNG and bioCO$_2$ demo plant

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

- **SIAAP**
  - Service public de l’assainissement francilien

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

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Reference #1: BioGNVal Project
Valenton WWTP, France (120 Nm³/h biogas) (3|3)

Bio-LNG transfer to the mobile transport station

Use as vehicle fuel

Use as industrial fuel
Reference #2: Greenville Project
N. Ireland (300 Nm³/h biogas) – Summer 2017
Reference #3: Doué Métha Project
Angers, France (500 Nm³/h biogas) – 2018
Cryogenic gas separation

-90 °C → -120 °C
Cryo Pur Process (1|2)

CRYO PUR SYSTEM

1. PRETREATMENT
   -75°C
   - H₂S
   - H₂O
   - VOC
   - Siloxanes

2. CO₂ CAPTURE
   -120°C
   - CH₄
   - H₂O
   - VOC
   - Siloxanes

3. LIQUEFACTION
   -120°C / -160°C
   - Flash N₂
   - Flash O₂
   - BioLNG
   - BioCO₂

Biogas

CH₄

CO₂

H₂O

N₂

O₂

H₂S

VOC

Siloxanes
Cryo Pur facilitates your bio-LNG project
# Equipment Range

<table>
<thead>
<tr>
<th>Product</th>
<th>Nominal biogas flowrate (Nm&lt;sup&gt;3&lt;/sup&gt;/h)</th>
<th>Minimal biogas flowrate (-50%) (Nm&lt;sup&gt;3&lt;/sup&gt;/h)</th>
<th>Maximal biogas flowrate (+20%) (Nm&lt;sup&gt;3&lt;/sup&gt;/h)</th>
<th>Nominal bio-LNG production* (TPD)</th>
<th>Nominal LCO₂ production* (TPD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP 70</td>
<td>70</td>
<td>35</td>
<td>85</td>
<td>0.6</td>
<td>1.3</td>
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<tr>
<td>CP 150</td>
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<td>75</td>
<td>180</td>
<td>1.3</td>
<td>2.8</td>
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<tr>
<td>CP 250</td>
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<td>125</td>
<td>300</td>
<td>2.3</td>
<td>4.7</td>
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<tr>
<td>CP 500</td>
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<td>CP 800</td>
<td>800</td>
<td>400</td>
<td>960</td>
<td>7.4</td>
<td>15.1</td>
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<tr>
<td>CP 1000</td>
<td>1 000</td>
<td>500</td>
<td>1 200</td>
<td>9.2</td>
<td>18.9</td>
</tr>
<tr>
<td>CP 1500</td>
<td>1 500</td>
<td>750</td>
<td>1 800</td>
<td>13.8</td>
<td>28.4</td>
</tr>
<tr>
<td>CP 2000</td>
<td>2 000</td>
<td>1 000</td>
<td>2 400</td>
<td>18.5</td>
<td>37.9</td>
</tr>
</tbody>
</table>

* Production is calculated for a biogas composition of 55% CH₄ and 45% CO₂.
Scope of supply

Biogas feeding line → Civil engineering works → Electricity and connections → Water and connections → Internet and connections → Flare and connections → Bio-LNG pipe and cryogenic tank → Bio-CO₂ pipe and cryogenic tank

Measuring

Cryogenic biogas Upgrading, bio-CO₂ liquefaction & Biomethane Liquefaction

Liquid bio-CO₂ Storage

Measuring

Liquid bio-CO₂ Offtake

Bio-LNG Offtake

Bio-LNG Storage

Bio-LNG
SOLUTION FOR SAMSØ PROJECT
Assumptions

- **Unit dimensioned for phase 1 & phase 2** (+10%)

- Methane content: 60%
- H₂S content: 100 ppm

- **Bio-LNG product pressure**: 4 bara (ferry working pressure: 6 bara)

- Heat requirements: 1,8 GWh and then 2,4 GWh/y on 40/60°C loop
- Equivalent to using ~10% of biogas production.

- Electricity cost: 85 €/MWh

- Business Plan duration: 20 years

- Interest rate: 4%
## Performance

<table>
<thead>
<tr>
<th>Performance Guarantee</th>
<th>Expected Value</th>
<th>Guaranteed Value</th>
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<tbody>
<tr>
<td>Average electric energy consumption (in kWhe/Nm(^3) of raw biogas)</td>
<td>0.58</td>
<td>0.63</td>
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<tr>
<td>Biomethane recovery rate</td>
<td>100%</td>
<td>99.5%</td>
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<tr>
<td>(\text{BioCO}_2) Quality</td>
<td>(\text{CO}_2 &gt; 99.99)%</td>
<td>(\text{CO}_2: 99.9)%</td>
</tr>
<tr>
<td>(\text{BioCO}_2) recovery rate</td>
<td>95%</td>
<td>90%</td>
</tr>
<tr>
<td>Heat recovery</td>
<td>Up to entire AD heating needs</td>
<td></td>
</tr>
<tr>
<td>Equipment availability under maintenance agreement</td>
<td>98%</td>
<td>95%</td>
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</tbody>
</table>
Cryo Pur benefits

- Integrated system
- Energy efficiency
- Only consumable: activated carbon
- Reliability and performance guarantees
- Heat recovery: up to 10% more bio-LNG production
- Possible sales of liquid CO$_2$ as a by-product
- No methane slip
- High flexibility: from 50% to 120% of the nominal biogas flowrate
## Project execution schedule

<table>
<thead>
<tr>
<th>Task</th>
<th>Duration</th>
<th>Milestone</th>
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<tbody>
<tr>
<td>Entry into force of the contract</td>
<td>Month 0</td>
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<tr>
<td>Week 1</td>
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<td>Week 8</td>
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<td>End of Manufacturing</td>
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<td>End of Installation</td>
<td>Month 11</td>
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<tr>
<td>Site Delivery</td>
<td>Month 10</td>
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<tr>
<td>End of Project</td>
<td>Month 12</td>
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</tbody>
</table>

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THANK YOU FOR YOUR ATTENTION!

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