Cryo Pur

From waste to fuel

AN EFFICIENT SOLUTION FOR LBG PRODUCTION

VAASA GAS EXCHANGE

March 21st, 2019

Agenda

1. Introduction & Company Presentation
2. Technology and solutions
3. References
4. Projects

Why producing LBG?

FEEDSTOCK

BIOGAS

- **Renewable**
  - non fossil
- **Circular**
  - waste management
- **Local**
  - economy & environment

- **On-site use**
- **Clean power & heat**

BIOMETHANE

- **Biogas benefits**

+

- **Upgraded**
  - -> Higher energy content

- **Grid or off-grid logistics**
- **Clean fuel for transport**
  - -> Higher value

LIQUID BIOMETHANE (LBG)

- **Biomethane benefits**

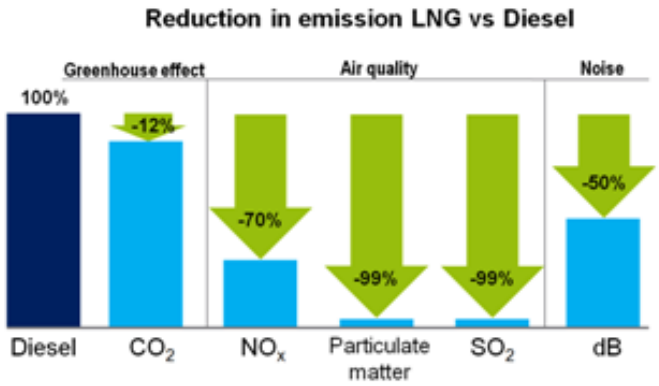
+

- **Liquefied**
  - -> Higher density

- **Off-grid logistics**
- **Clean fuel for *heavy* transport**
  - -> Higher value
  - -> Long-term value

LNG / LBG as a fuel for long-haul trucks

- LNG is a **clean fuel** for long-range heavy vehicles.



LBG:

GHG emissions reduced by >80%.

Liquid form:

Energy density enabling high autonomy & fast refueling

- Its development is supported by the launch of new, more **efficient vehicles**...

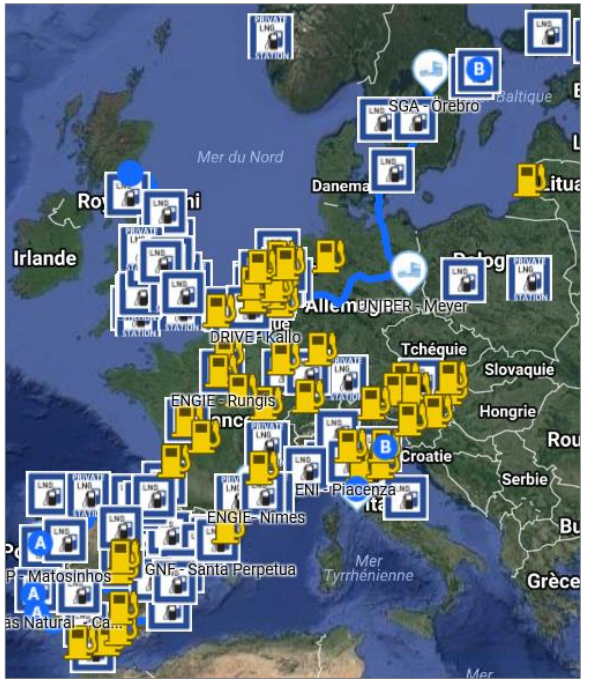
2017/2018 :

SCANIA:
New 410 hp

IVECO:
New 460 hp

VOLVO:
New 460 hp

- … and through deployment of **distribution infrastructure**.



Source: LNG BLUE CORRIDORS

LBG as a logistics solution

The natural gas grid carries limitations in many countries

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

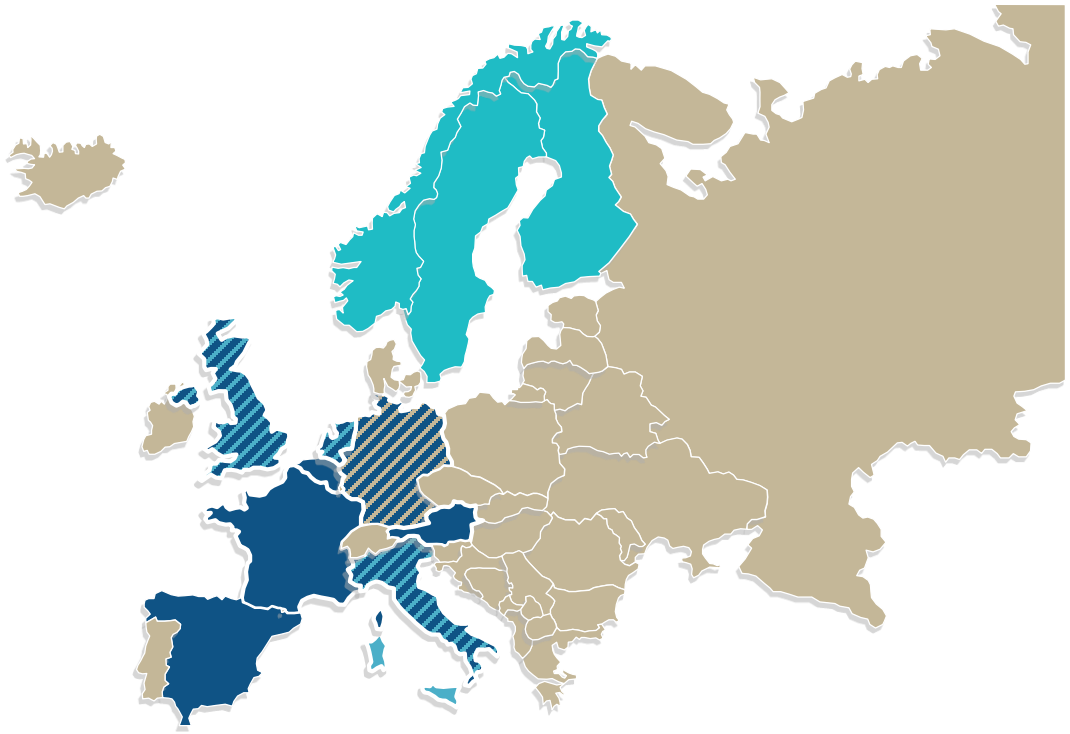
Source: System Development Map, Gas Infrastructure Europe, 2014

- Even in countries with a denser grid, like France, its is estimated that **1/4 of all potential biomethane projects** are precluded due to **grid limitations** (distance, capacity).

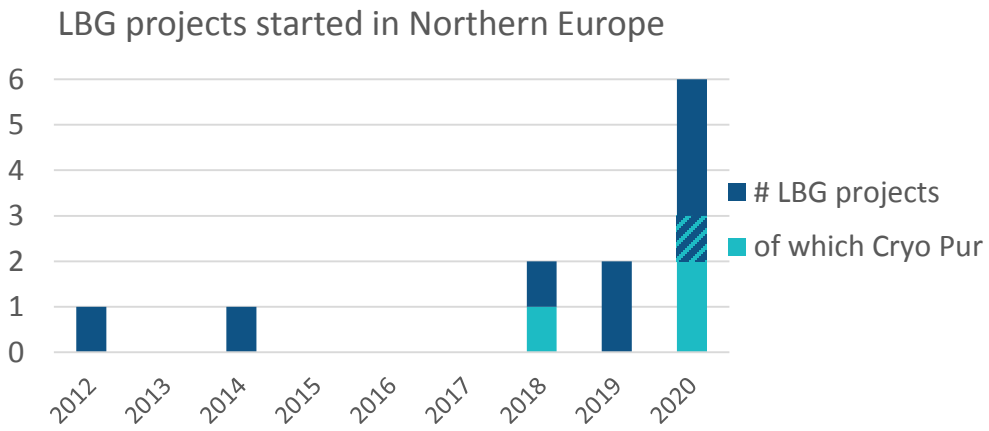
LNG / LBG fuel development in Europe

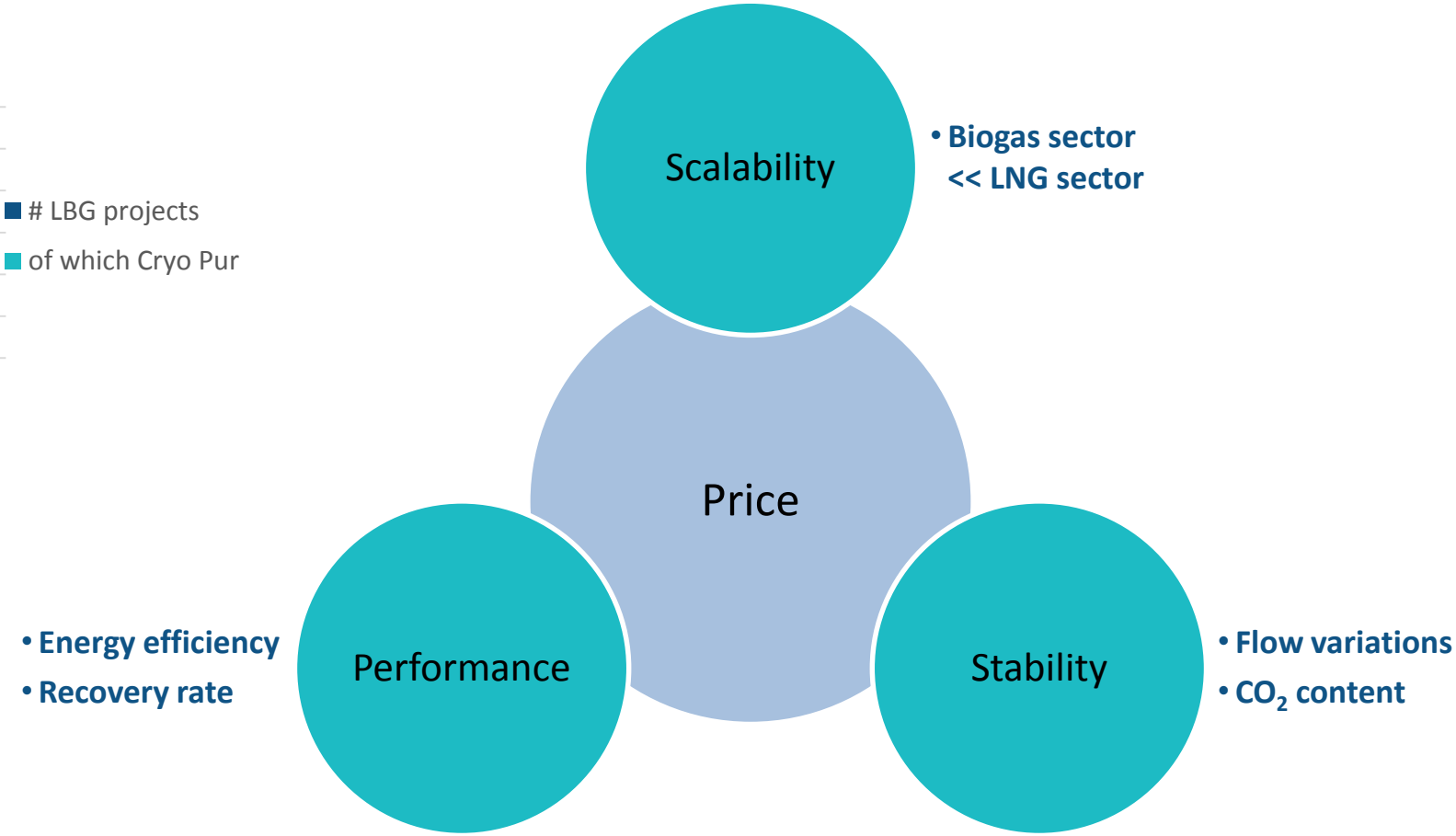
Development of LNG as vehicle fuel

Support for LBG



LBG production technology: the challenges

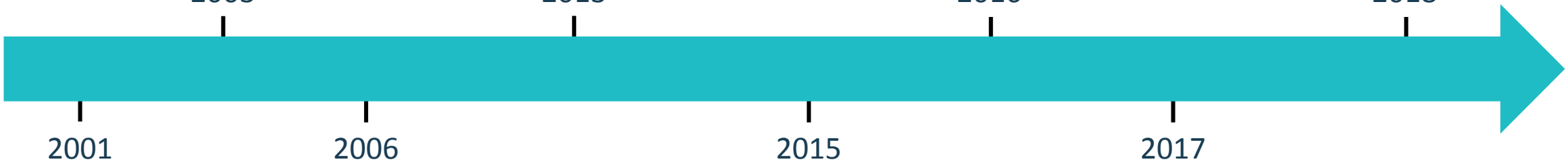




Cryo Pur company profile

- **Activity :** Supply, installation and maintenance of **equipment for the upgrading and liquefaction of gas** (biogas, landfill gas, flare gas, grid gas)
- **Intellectual Property :** 6 international patents.
- **Team :** 26 people, including
  - 4 PhD-engineers
  - 7 engineers
  - 7 technicans
  - 2 PhD students-engineers
- **Head Office :**
  - Massy (Paris area)
  - 6 000 m^2 (offices & workshop)

Timeline



2001

First patent on cryogenic capture of CO_2.

2003

First **laboratory pilot** for cryogenic CO_2 capture (5kg of CO_2/h).

2006

Industrial demonstrator for cryogenic CO_2 capture (1t of CO_2/day).

2013

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

2015

- **€ 3m funds raised**.
- **Pilot phase** of the BioGNVal project.
- Cryo Pur wins the ExpoBiogaz 2015 **Innovation Award**.
- Cryo Pur selected **as FrenchTech Ambassador for COP 21** in Paris.

2016

- **Demonstration phase** of the BioGNVal project.
- « **Biogaz d'Argent** » **prize** at Biogaz Europe 2016.
- **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**

2017

- **€ 6m funds raised**.
- **Manufacturing** of the first commercial unit
- **One tender for bio-LNG fuel project** won in Italy

2018

- **Operation** of the first commercial unit

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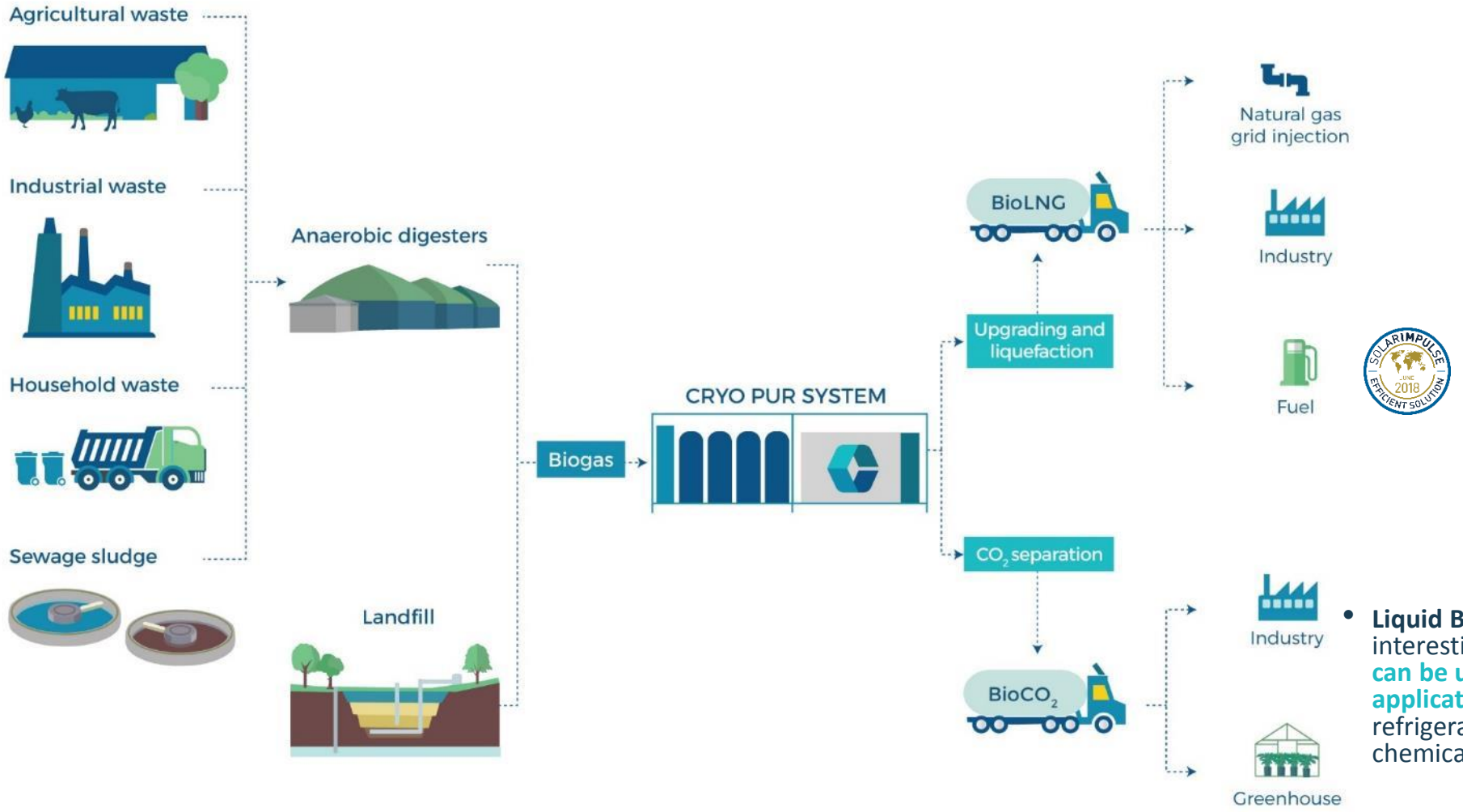
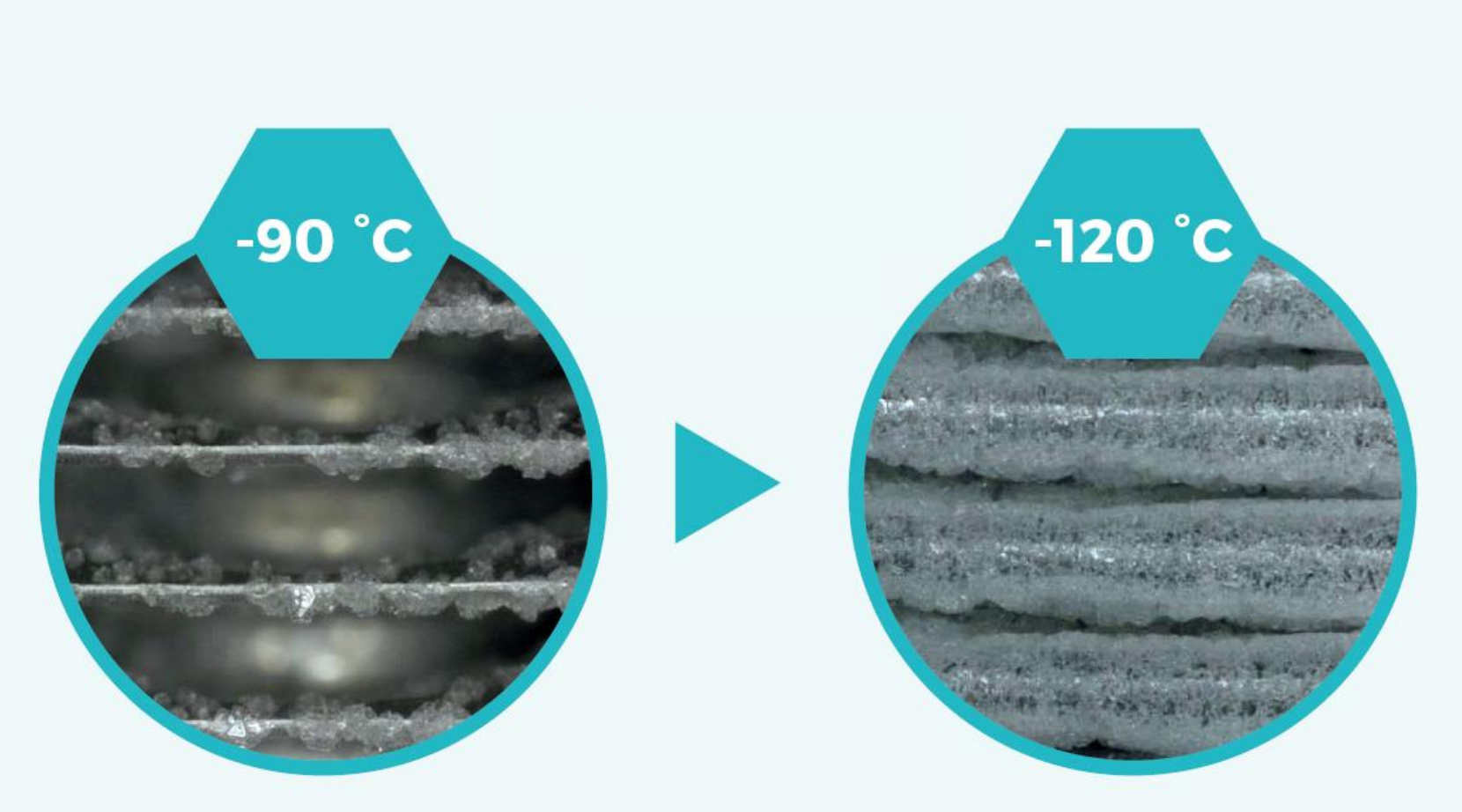
An upgrading and liquefaction solution for the biogas sector

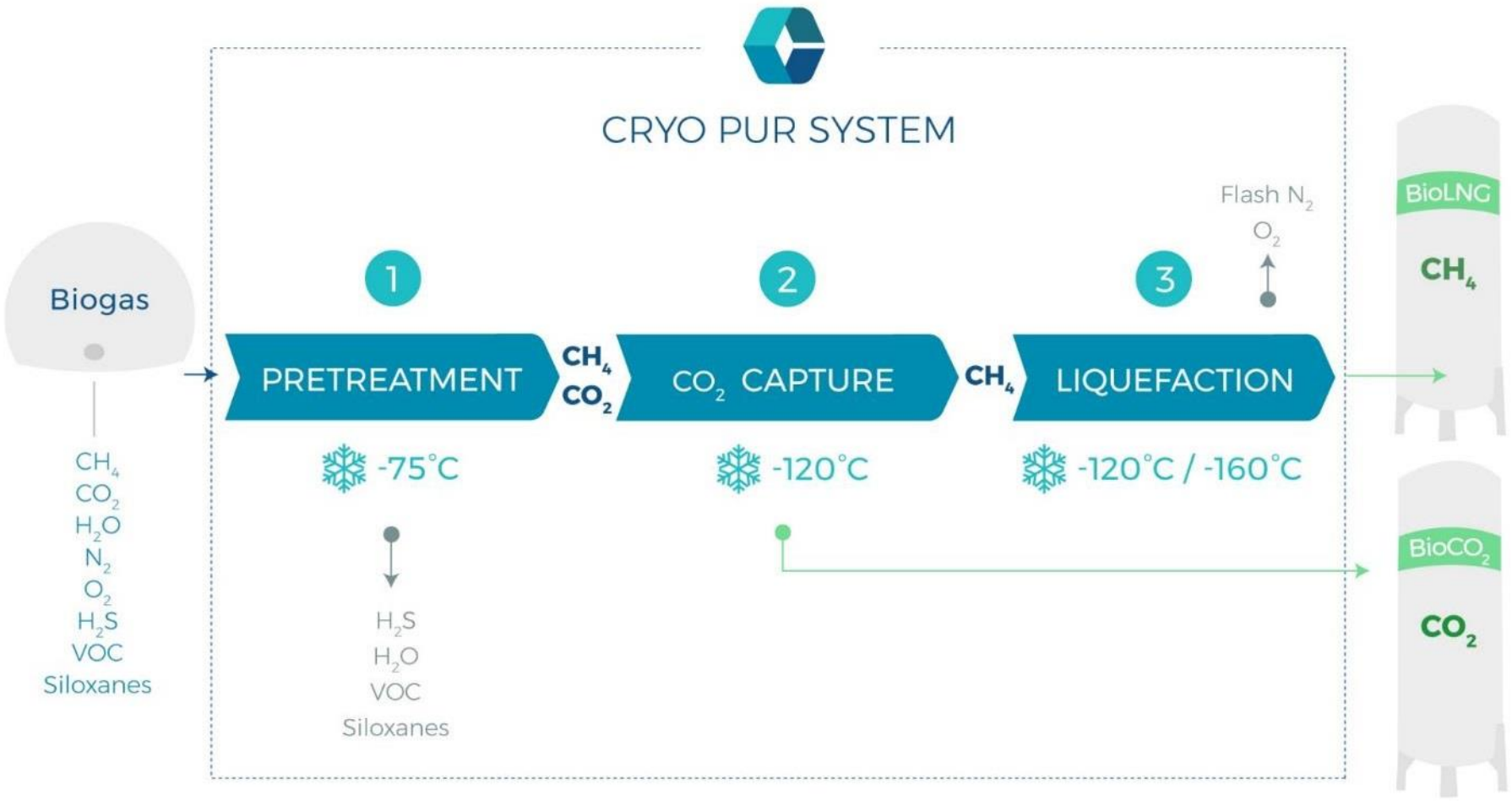


- **Liquid Bio-CO_2** is an interesting by-product **that can be used in various applications**: greenhouses, refrigeration in transport, chemical industry…

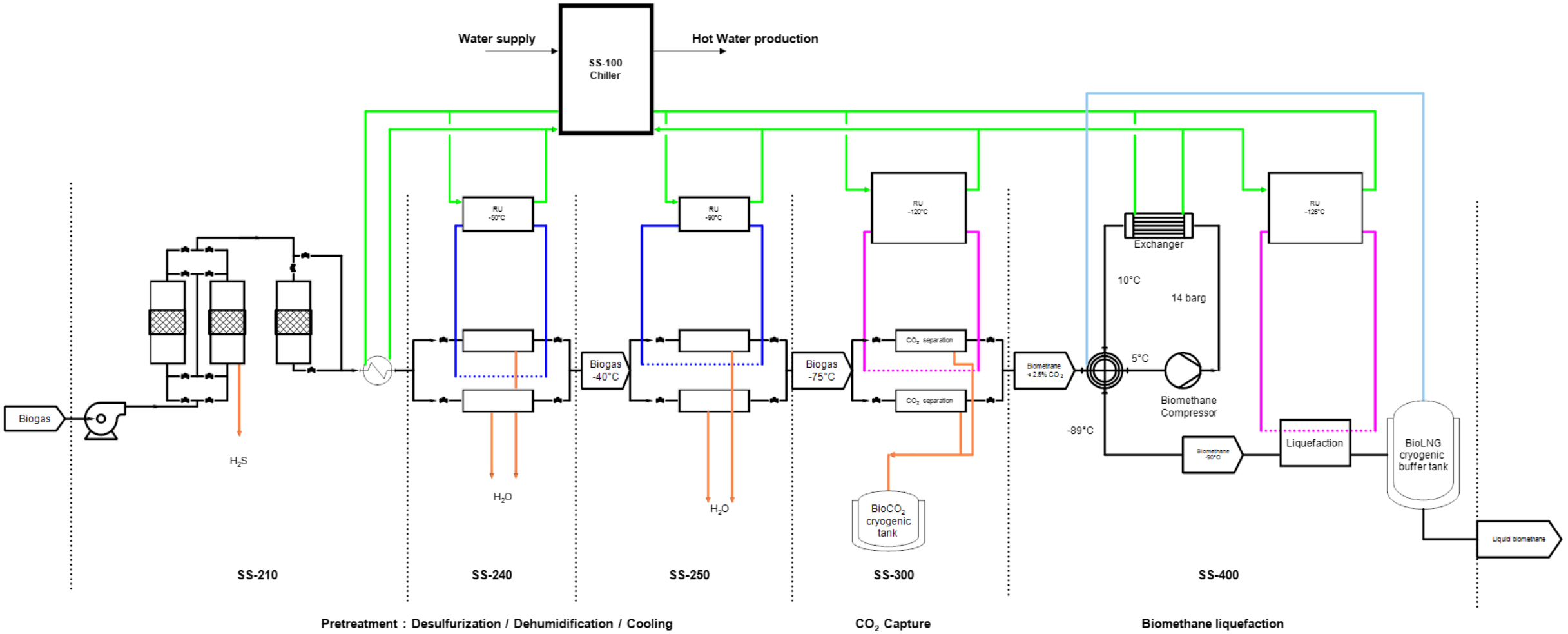
CO_2 separation method



General view of the process [1|2]

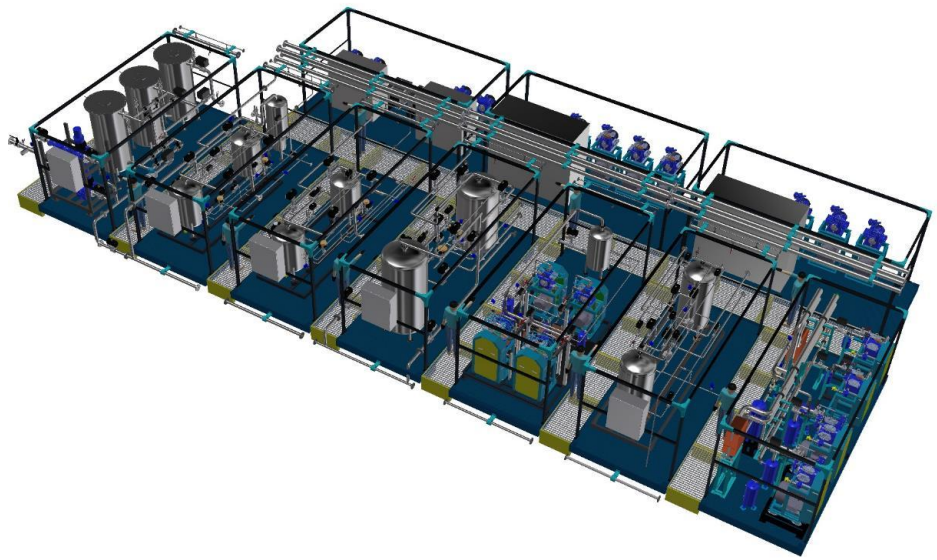


General view of the process [2|2]

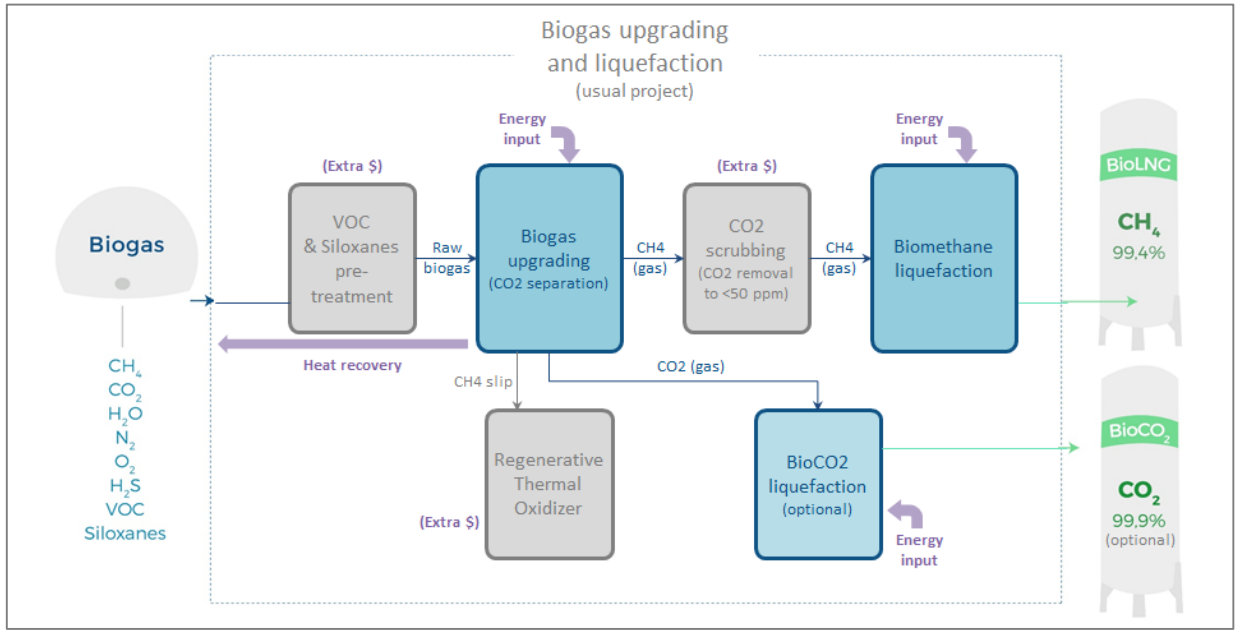


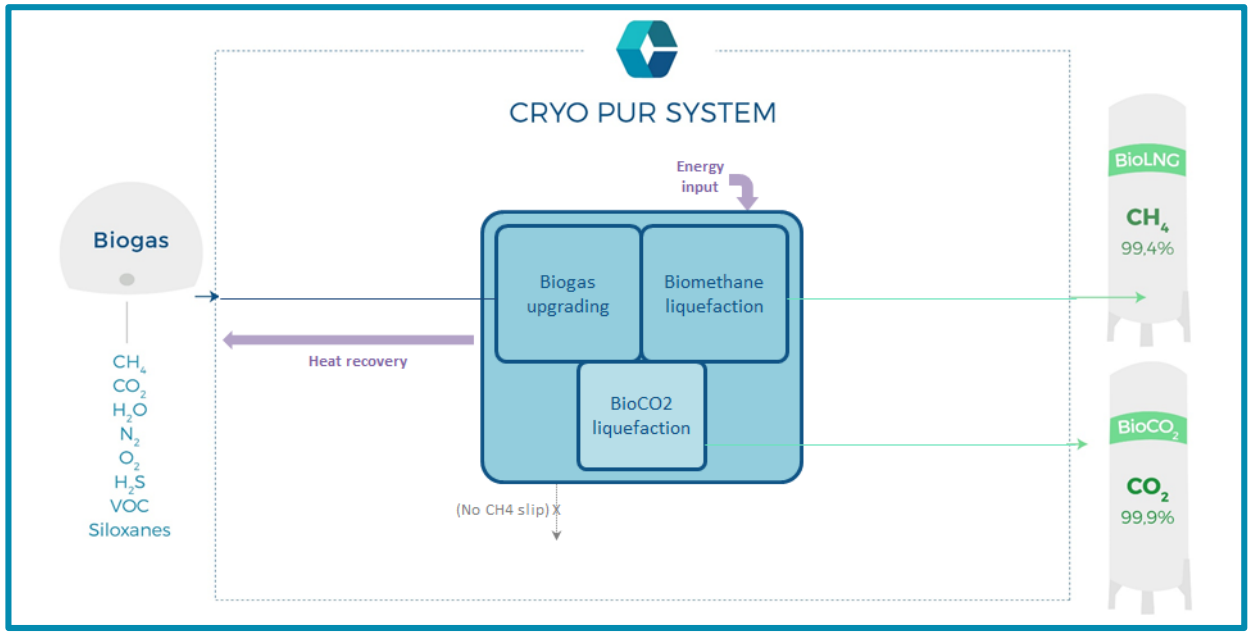
Cryo Pur technology benefits [1|2]

- **Integrated system for upgrading-liquefaction**
- **Low electricity consumption**
- **Liquid CO_2 recovery**
- **High recovery rate**
- **Flexible operation range**
- **Physical gas separation, no consumables (except activated carbon)**



Cryo Pur technology benefits [2|2]





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BioGNVal Project [1|3]

First integrated small-scale bio-LNG demonstration plant

Site : Valenton Waste Water Treatment Plant, France (Paris Area)

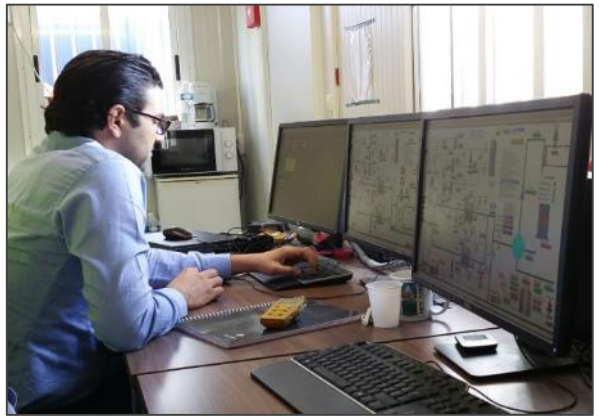
Flow rate : 120 Nm3/h raw biogas

Feedstock : Sewage sludge

Start date : October 2015

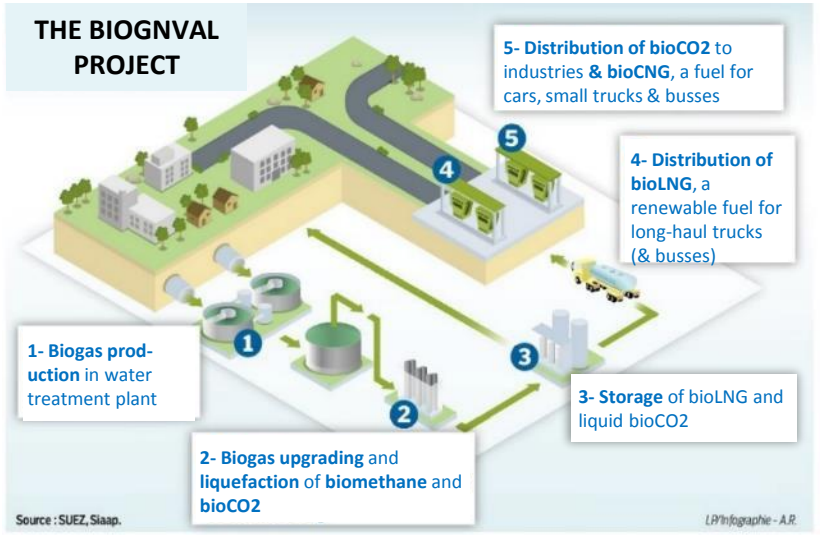
Click here to watch the video presentation of BioGNVal :

YouTube



BioGNVal Project [2|3]

Demonstrating a circular economy value chain



Project partners :

Financing & technical expertise	Project coordinator	Bio-LNG filling station
WWTP owner	Biogas to bio-LNG (&LCO_2) technology	Bio-LNG truck

BioGNVal Project [3|3]

Key achievements

Bio-LNG transfer to the mobile transport station

Use as vehicle fuel

Use as industrial fuel

Greenville Bio-LNG plant [1|3]

First farm-scale bio-LNG plant in the world

Site : Omagh,
Northern Ireland (UK)

Flow rate : 300 Nm3/h raw biogas

Feedstock : Agricultural waste

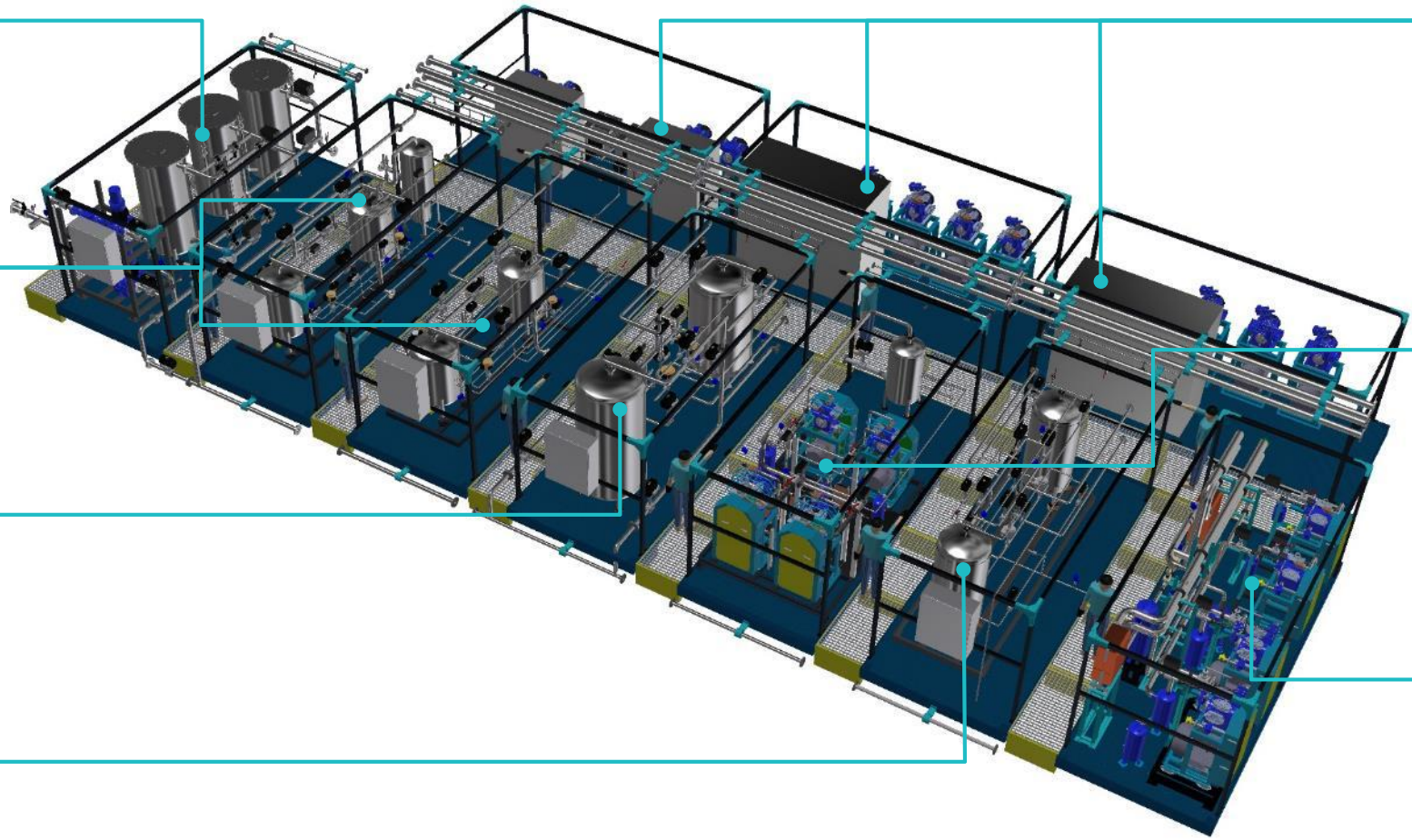
Start date : January 2018

Click here to watch the video presentation of Greenville Energy :

YouTube

Greenville Bio-LNG plant [2|3]

Upgrading and liquefaction plant layout



Greenville Bio-LNG plant [3|3]

Biomethane liquefaction on a farm, a world first

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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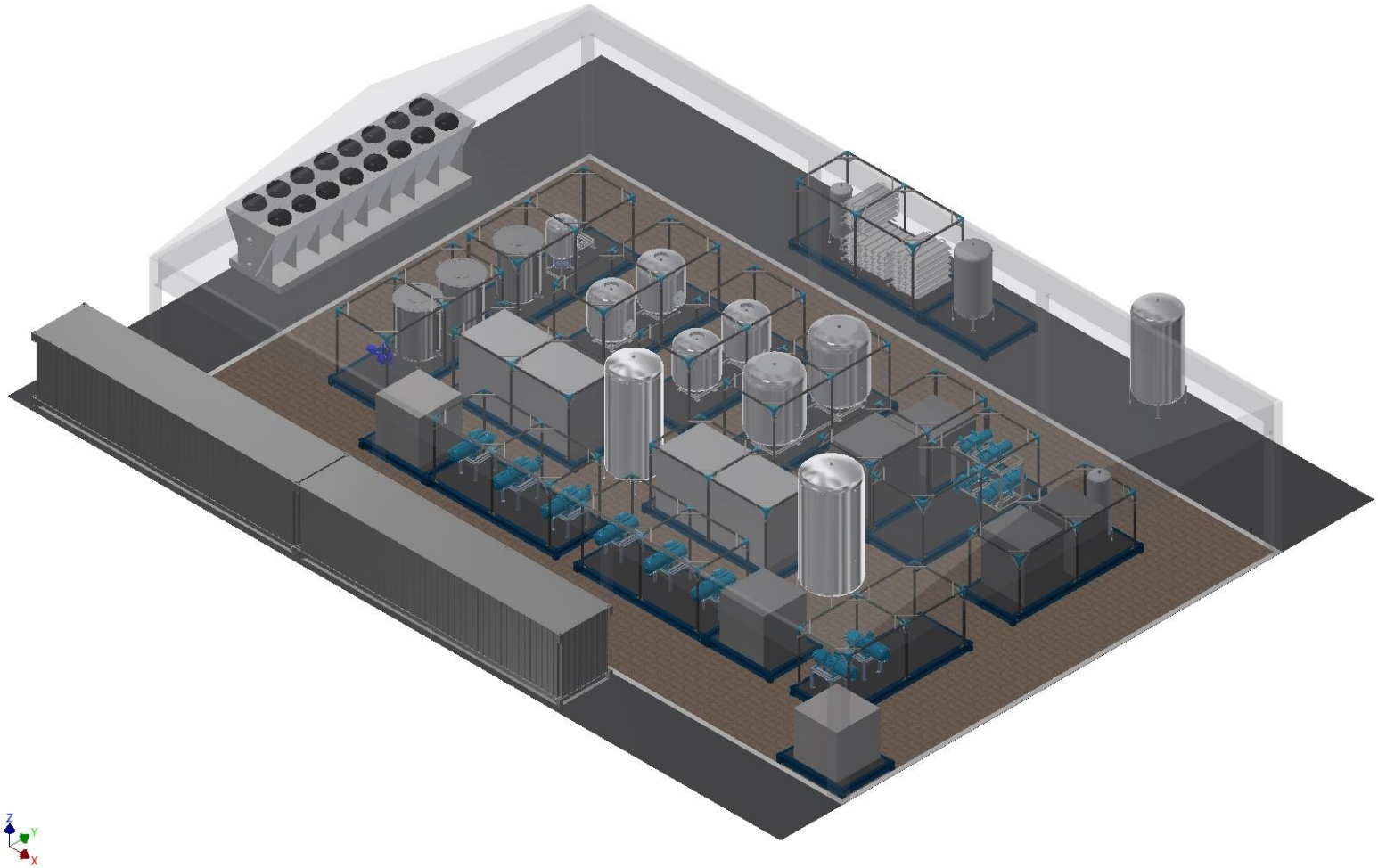
Norway - Project #1

Production of Bio-LNG vehicle fuel from biogas

Site : Confidential
Flow rate : 650 Nm3/h raw biogas
Type : Local biogas production

Cryo Fuel

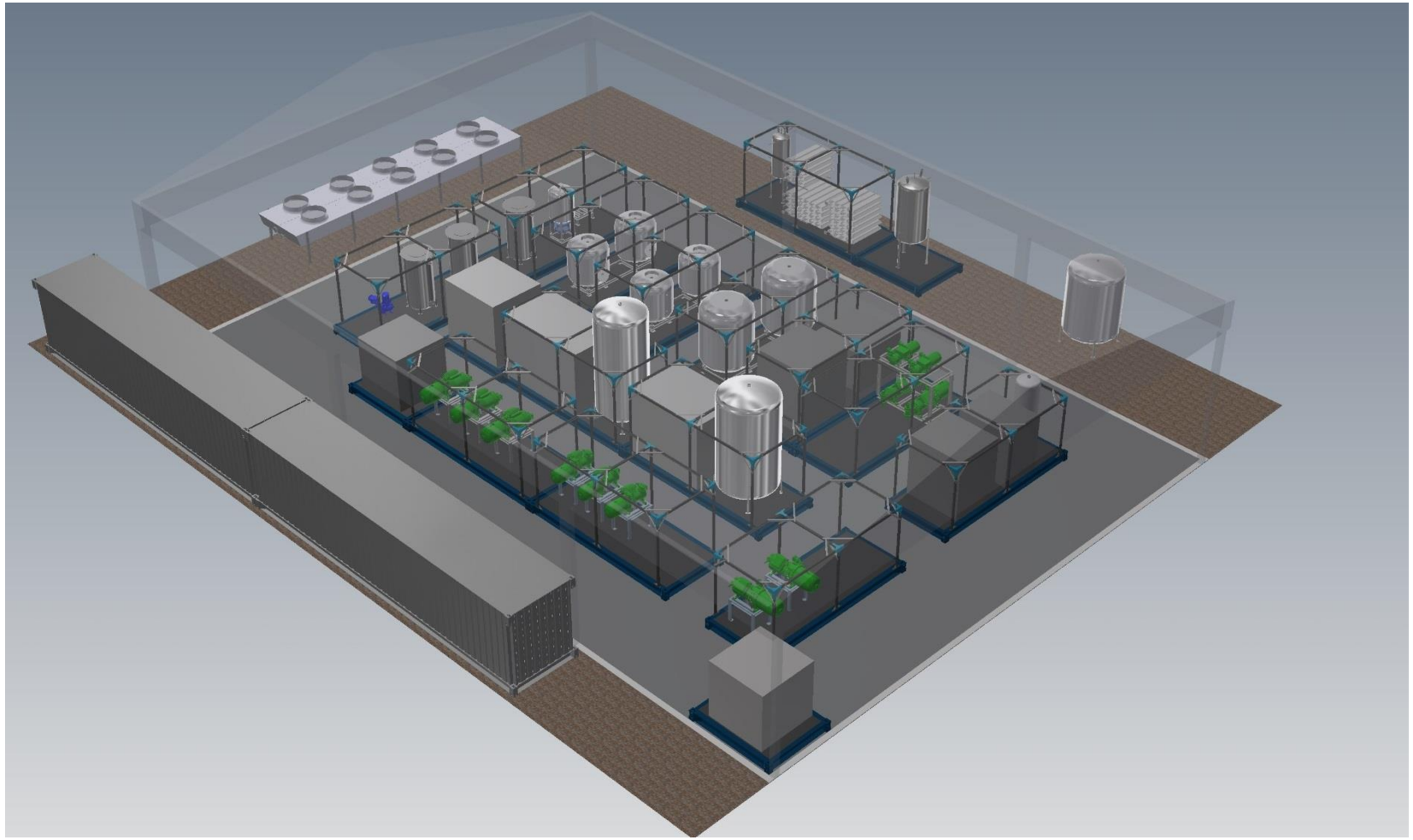


Italy - Project #1

Production of Bio-LNG vehicle fuel from biogas

Site : Confidential
Flow rate : 800 Nm3/h raw biogas
Type : Centralised biogas production

Cryo Fuel



France - Project #1

LNG and LPG production from flare gas

Site : Confidential
Flow rate : 650 Nm3/h flare gas
Type : Oil & Gas

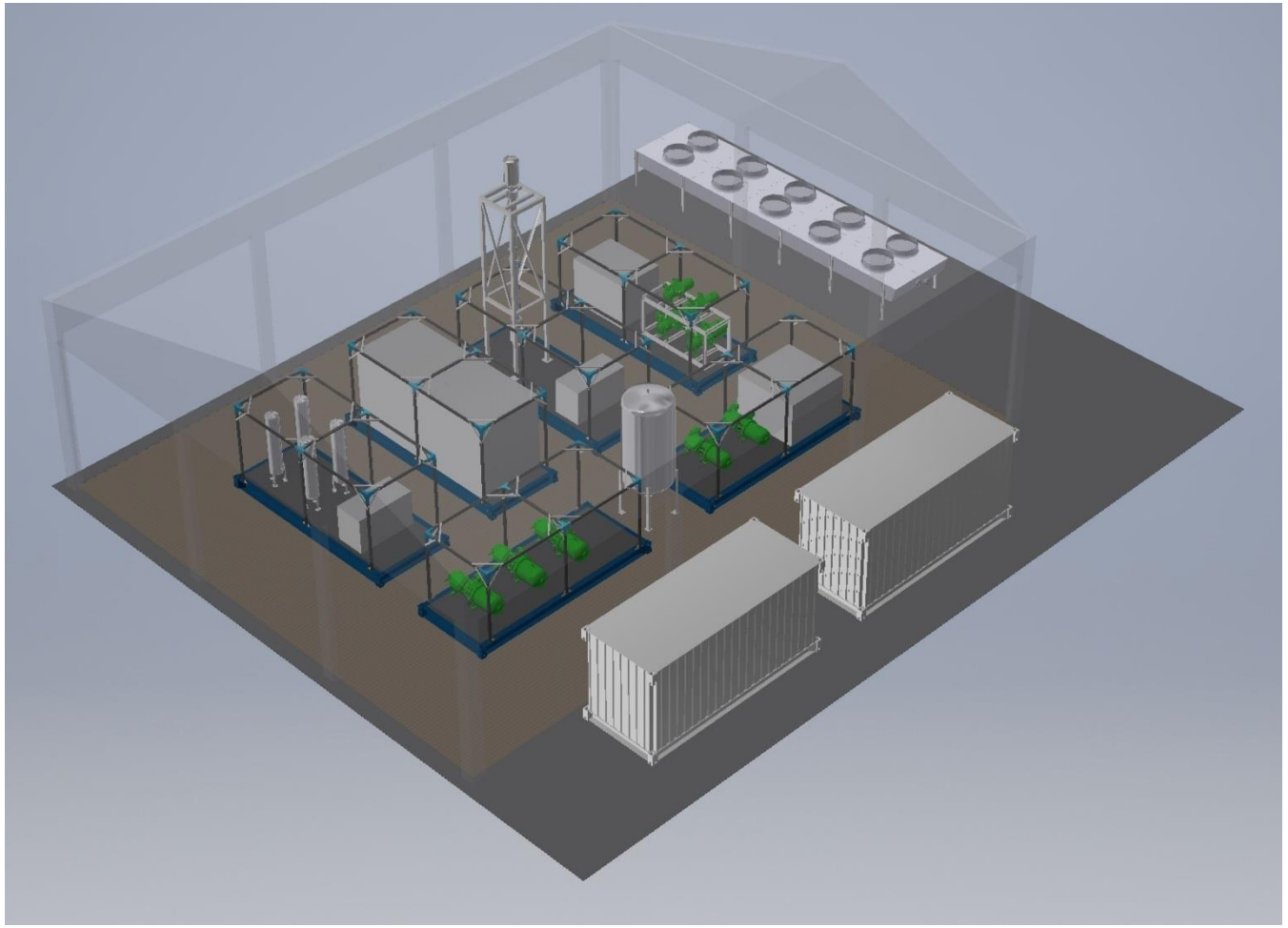
Cryo Flare

France - Project #2

Biomethane production from landfill gas

Site : Confidential
Flow rate : 800 Nm3/h landfill gas
Type : Landfill

Cryo Dist



Conclusion

Cryo Pur :

Bringing to market new solutions
for biogas upgrading, methane liquefaction & liquid CO_2 production

…contributing to more distributed, more efficient LBG production.

- **Range of solutions :**
  - Cryo Fuel / Cryo Dist / Cryo Haul / MicroLNG
- **Range of sizes :**
  - 200 to 2 000 Nm3/h raw biogas
- **Scope of supply :**
  - Upgrading / Liquefaction units
  - Full service agreement
  - LBG storage & transfer in option
- **Delivery schedule :**
  - 15 months

- **LBG solution for smaller projects :**
  - From 200 to 2000 Nm3/h
- **Improved economics for LBG production :**
  - Cost efficient integrated system
  - CO_2 sales
- **Further improvement of footprint :**
  - Liquid CO_2 recovery

Thank you for your attention !

Cryo Pur
From waste to fuel

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