Cryo Pur

From waste to fuel

GREENVILLE BIO-LNG PLANT

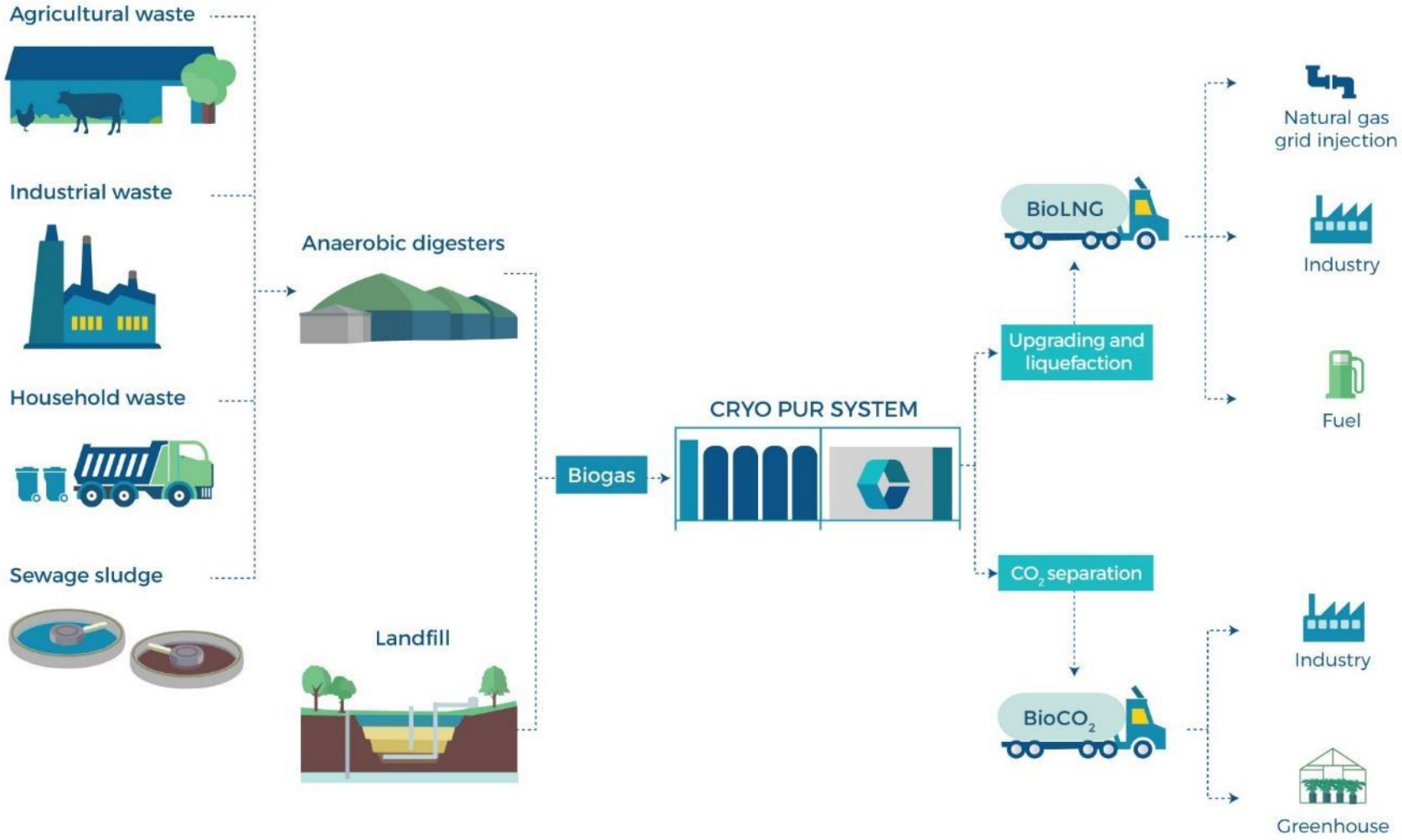
THE 1ST INTEGRATED BIOGAS UPGRADING & BIOMETHANE LIQUEFACTION PLANT

World Biogas eFestival 18-21 May 2020 A VIRTUAL TOUR OF THE GLOBAL BIOGAS INDUSTRY HOSTED BY WORLD BIOGAS ASSOCIATION

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 :** 22 people, including
  - 4 PhD-engineers
  - 7 engineers
  - 7 technicans
  - 2 PhD students-engineers
- **Head Office :**
  - Massy (Paris area)
  - 6 000 m^2 (offices & workshop)

An upgrading and liquefaction solution for the biogas sector



Why producing bio-LNG? [1|2]
A logistical solution

The natural gas grid carries limitations in many countries

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

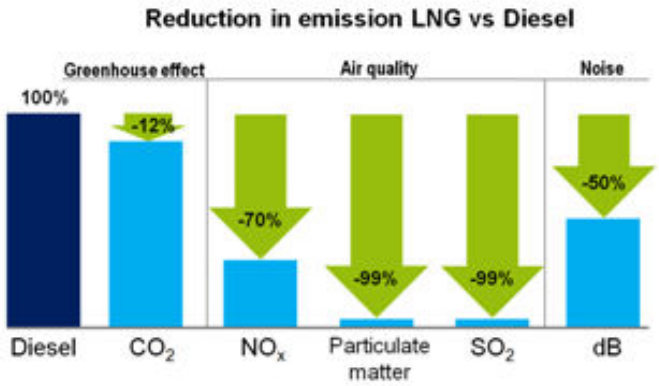
Source: System Development Map, Gas Infrastructure Europe, 2014

- 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).

THANKS TO ITS DENSITY, BIO-LNG CAN BE EASILY TRANSPORTED OFF-GRID

Why producing bio-LNG? [2|2]
A renewable fuel for long-haul trucks

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



Bio-LNG:

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**...

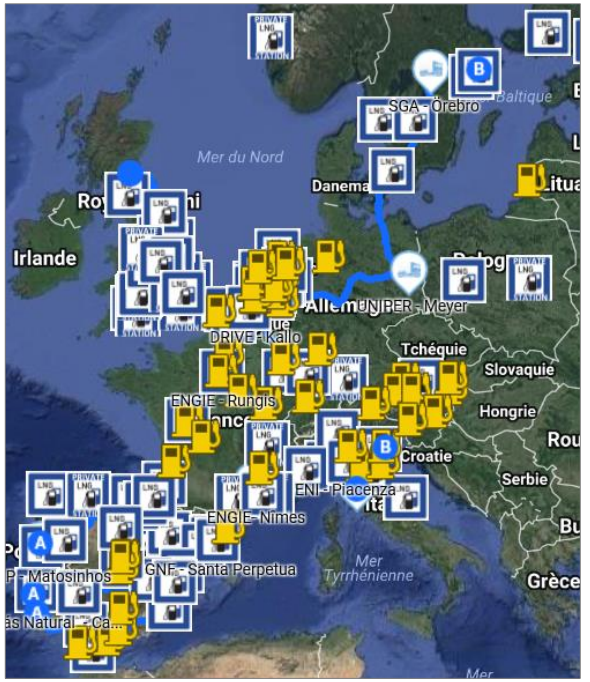
2017/2018 :

SCANIA:
New 410 hp

IVECO:
New 460 hp

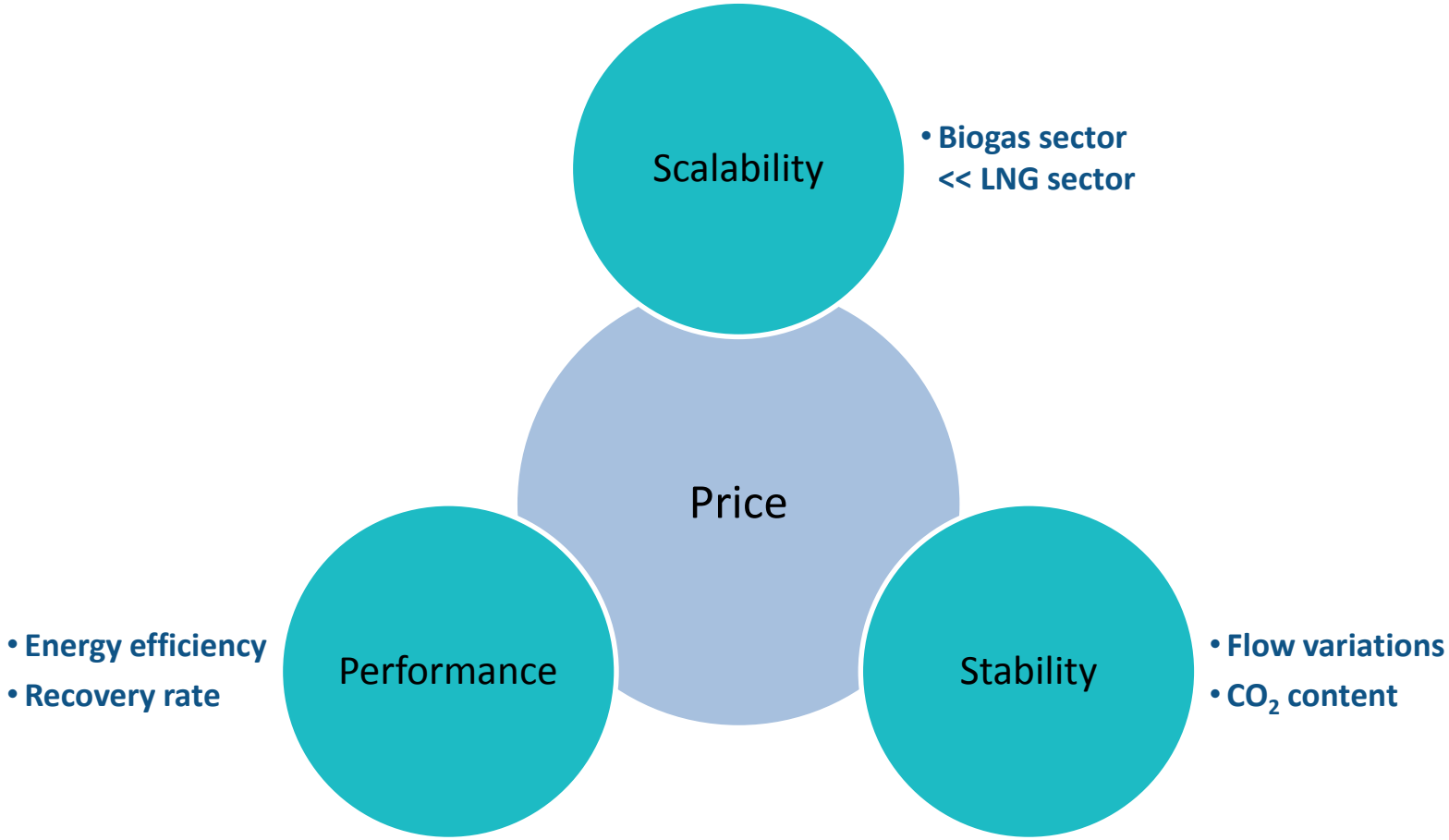
VOLVO:
New 460 hp

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

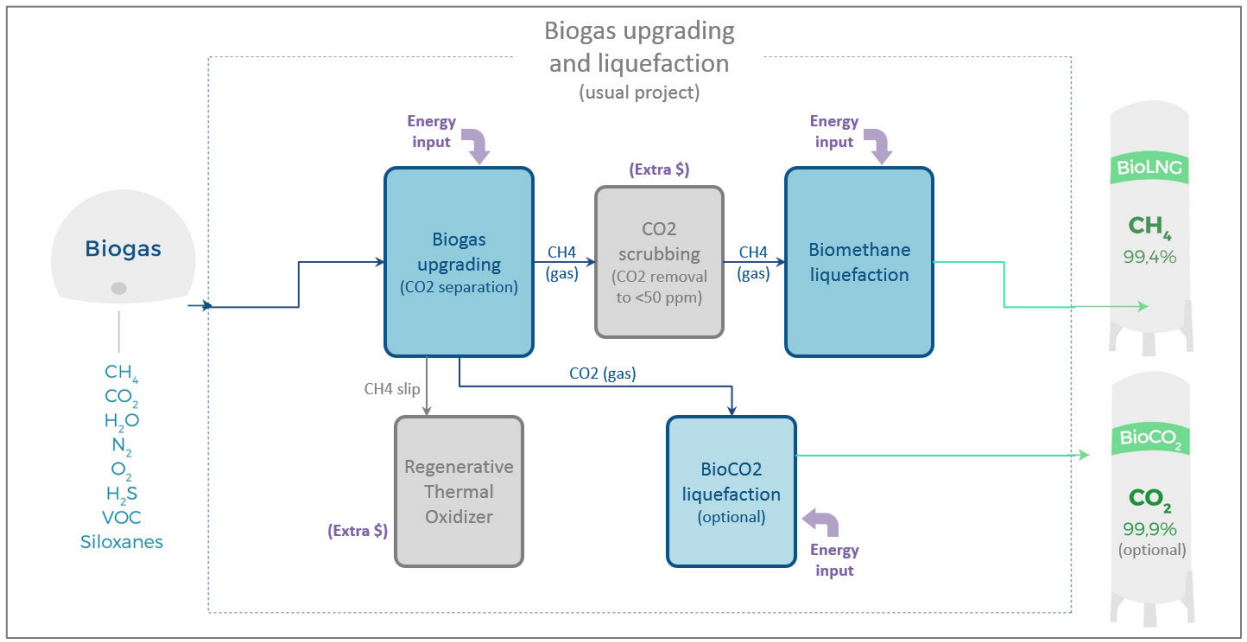


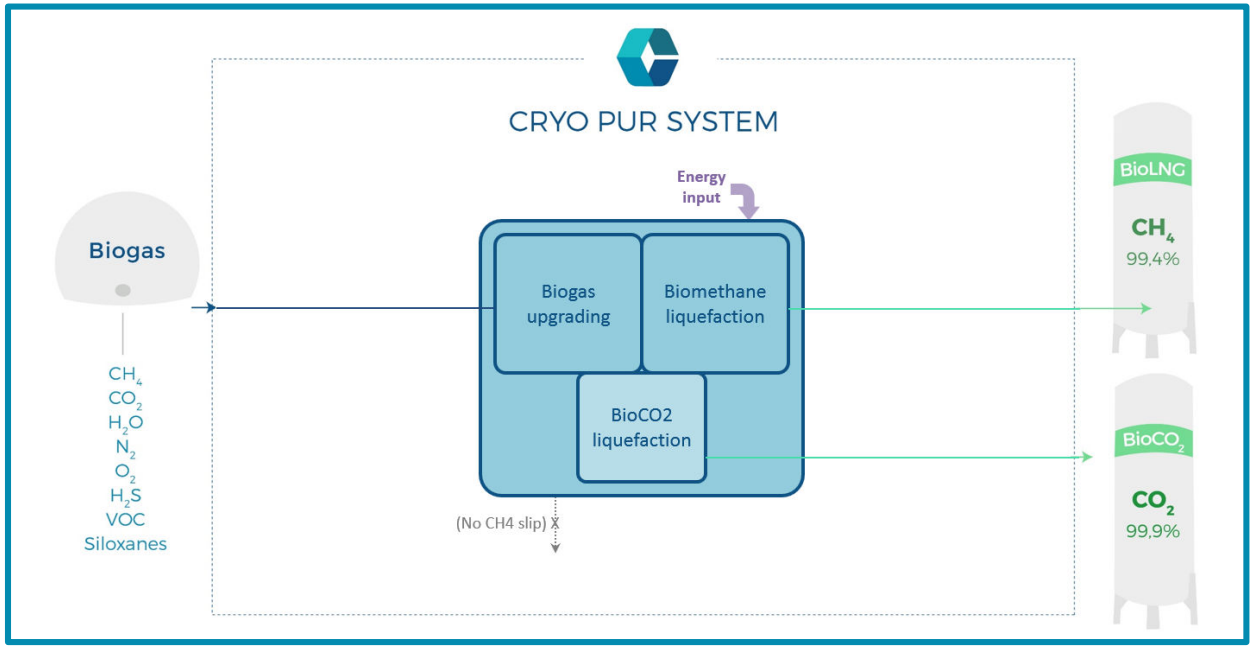
Source: LNG BLUE CORRIDORS

Bio-LNG production technology: the challenges

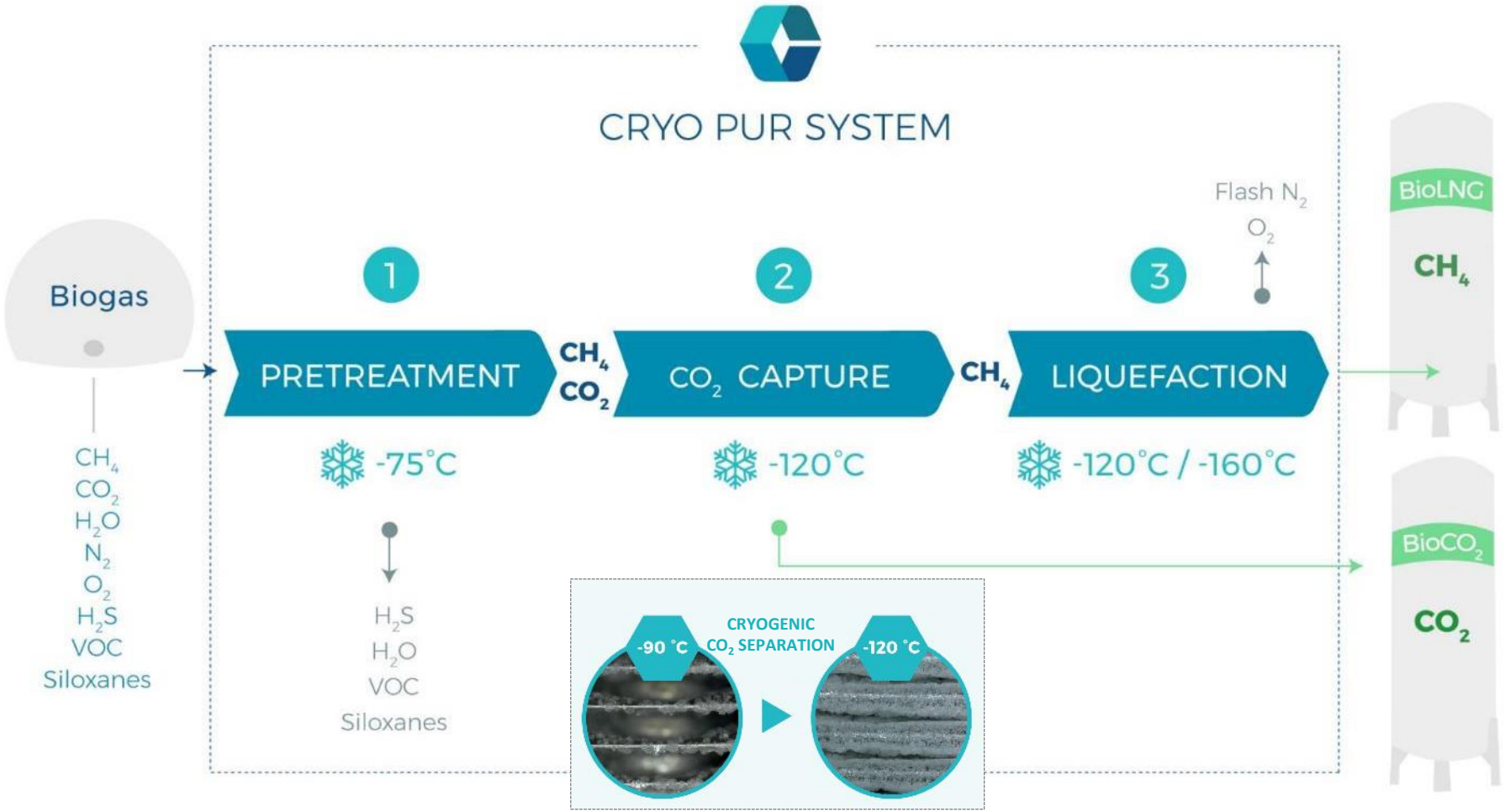


Cryo Pur technology: the integrated approach



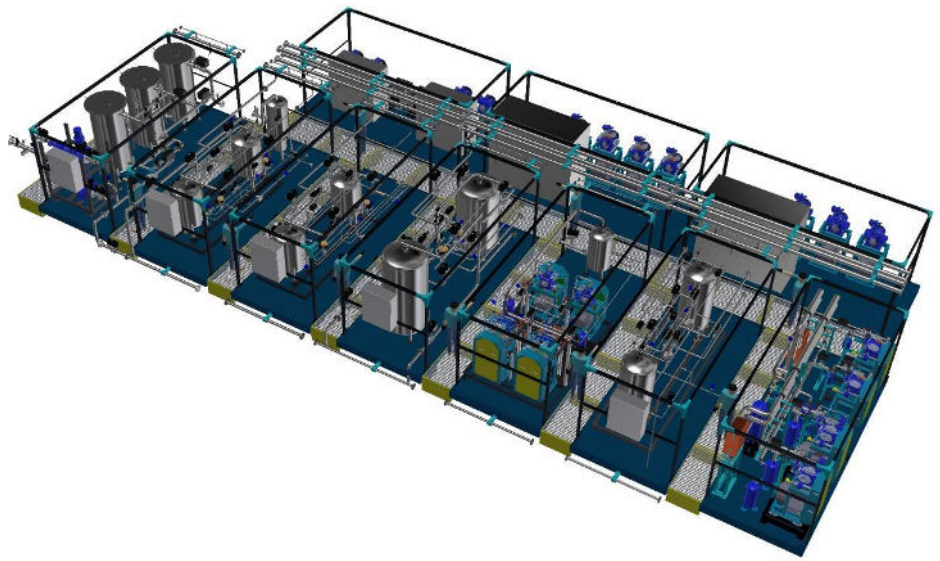


Cryo Pur technology: key principle



Cryo Pur technology benefits

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



BioGNVal Project

First integrated small-scale bio-LNG demonstration plant

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

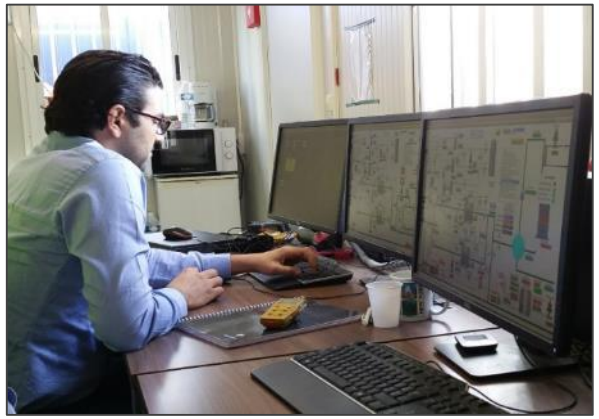
Flow rate : 120 Nm3/h raw biogas

Feedstock : Sewage sludge

Start date : October 2015

Click here to watch the video presentation of BioGNVal :

YouTube



Greenville Bio-LNG plant [1|6]

First farm-scale bio-LNG plant in the world

Site : Omagh,
Northern Ireland (UK)

Flow rate : 300 Nm3/h raw biogas

Feedstock : Agricultural waste

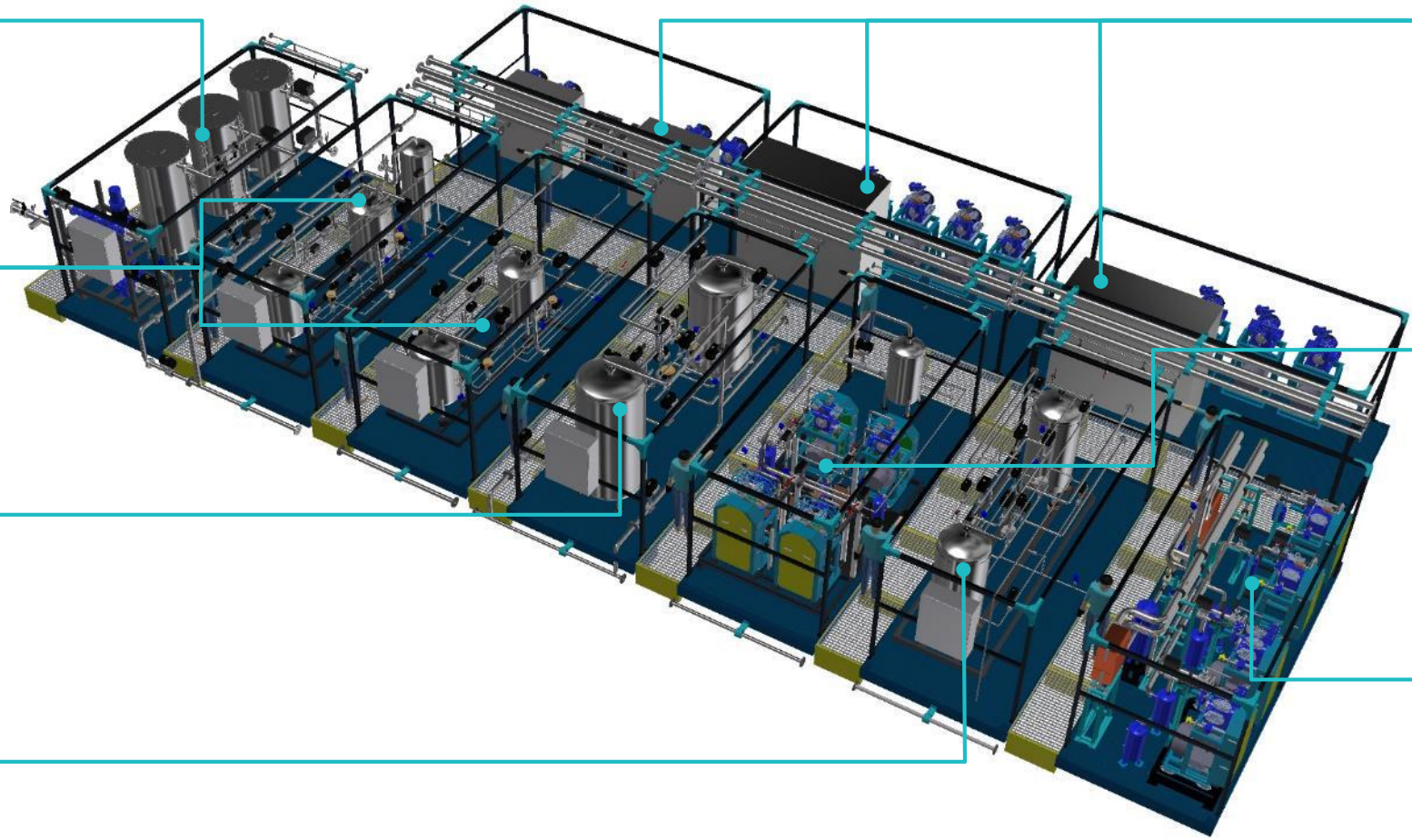
Start date : January 2018

Click here to watch the video presentation of Greenville Energy :

YouTube

Greenville Bio-LNG plant [2|6]

Upgrading and liquefaction plant layout



Greenville Bio-LNG plant [3|6]

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

Greenville Bio-LNG plant [4|6]

Project & operation timing

- **Context :** Since 2012 Greenville Energy, located in Newtownstewart, Northern Ireland, had been producing biogas from cattle manure, agricultural waste, and collected food waste, for on-site CHP production. From 2016/2017, they planned to expand their biogas production capacity by an additional 300 Nm3/h raw biogas.

- **H2 2016:** Contract with Cryo Pur for Supply of Equipment and maintenance
- **Sept 2017:** Delivery of the equipment skids
- **Oct 2017:** On-site installation of the skids and electrical system
- **Nov-Dec 2017:** Installation of the satellite bio-LNG reception stations
- **Dec-Jan 2018:** Commissioning
- **Since Jan 2018:** Operation of bio-LNG production and distribution

Greenville Bio-LNG plant [5|6]

Commercial operations, challenges and solutions

- **Bio-LNG:**
  - Production of 3 tpd bio-LNG at 14 barg
  - Delivery to industrial customers with ISO-containers
  - Production of renewable power at customer sites
- **Bio-CO_2:**
  - Production of liquid CO_2 first, and then dry-ice at production site
  - Expansion plans for the dry-ice blasting market
- **Main challenges:**
  - Original compression systems > impact on capacity and availability
  - Management of inlet H_2S level in raw gas > impact on availability
- **Key success factors:**
  - Cryo Pur performance commitment > compressor replacement plan carried out
  - Cryo Pur monitoring and customer training > activated carbon replacement routine
  - In general : strong customer-supplier cooperation in the ramp-up period

Greenville Bio-LNG plant [6|6]
Key achievements

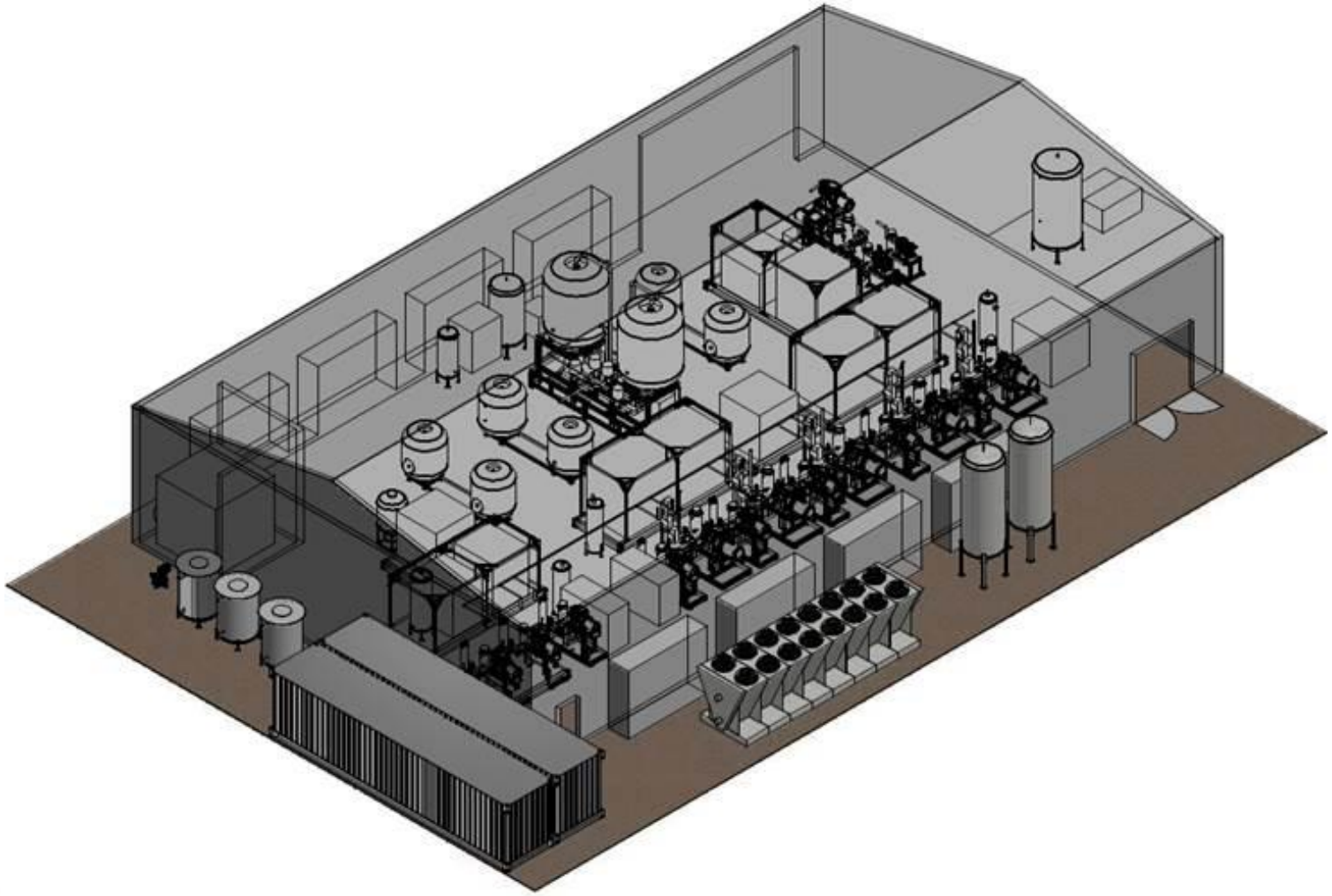
- **3rd** commercial bio-LNG plant started in Europe.
- **1st** integrated solution for upgrading of biogas, liquefaction of biomethane, and liquefaction of CO2, using cryogenic technology for biogas upgrading (CO2 frosting/defrosting).
- **1st** commercial bio-LNG plant with a capacity lower than 10 tpd.
- Record ramp-up performance vs. previous bio-LNG plants

Next project : Norway

Production of Bio-LNG vehicle fuel from biogas

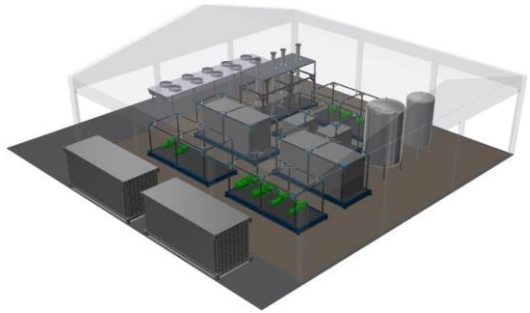
Site : Confidential
Flow rate : 710 Nm3/h raw biogas
Type : Local biogas production

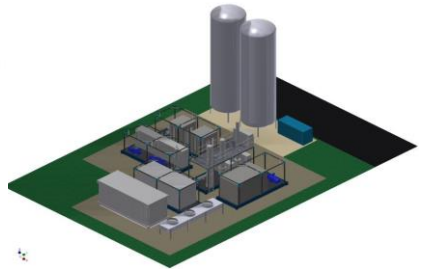
Cryo Fuel



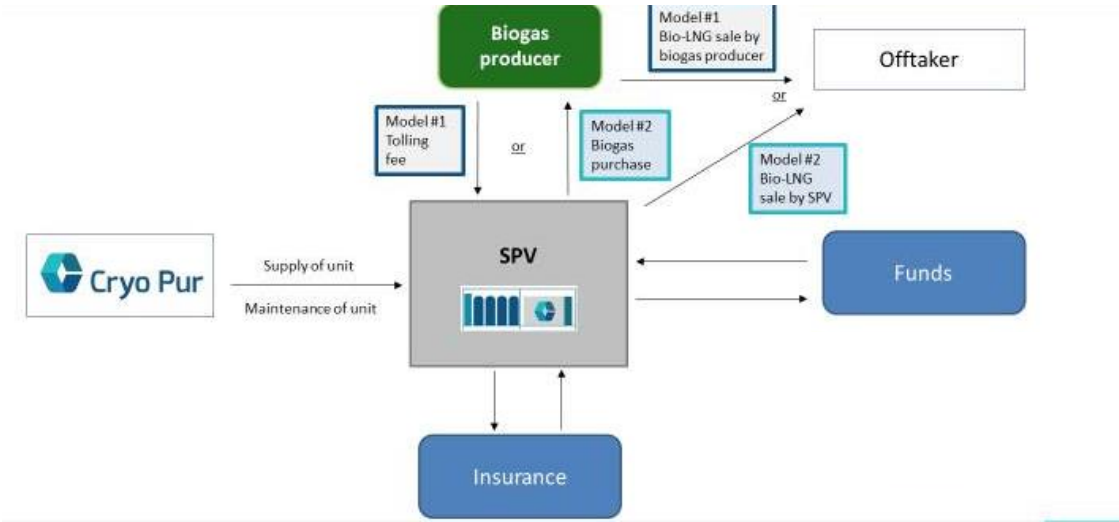
Next projects : a range of solutions

- **Technical solutions:**
  - **Biogas upgrading & liquefaction**
  - Biomethane or grid gas liquefaction
  - CO_2 upgrading & liquefaction
  - Landfill gas upgrading
  - Flare gas recovery





- **Sales model / Financing options:**
  - Sales of Equipment
  - Investment through SPV
    - Upgrading & liquefaction as a service
    - Purchase of raw gas / Sales of Bio-LNG



Thank you for your attention !

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