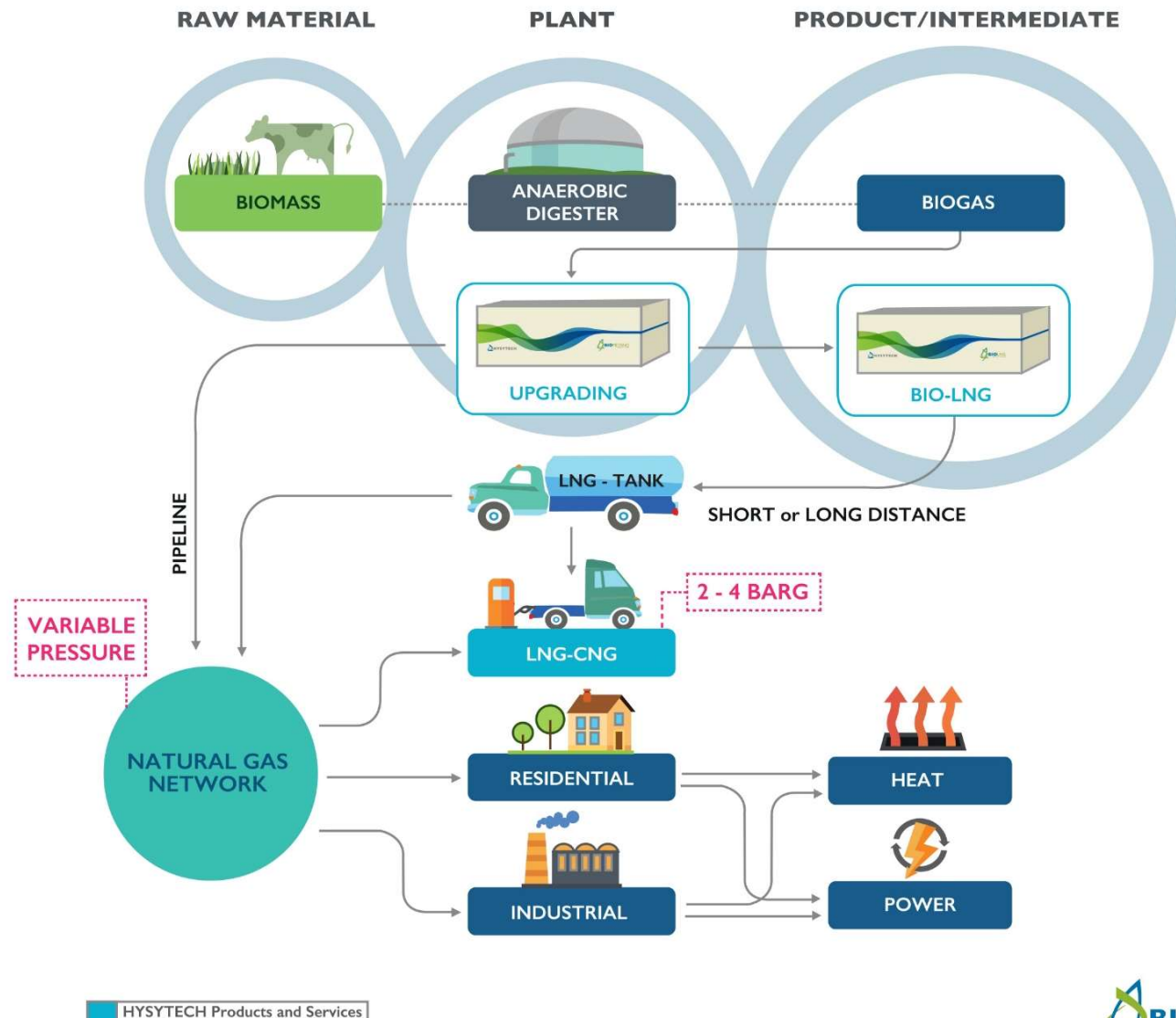


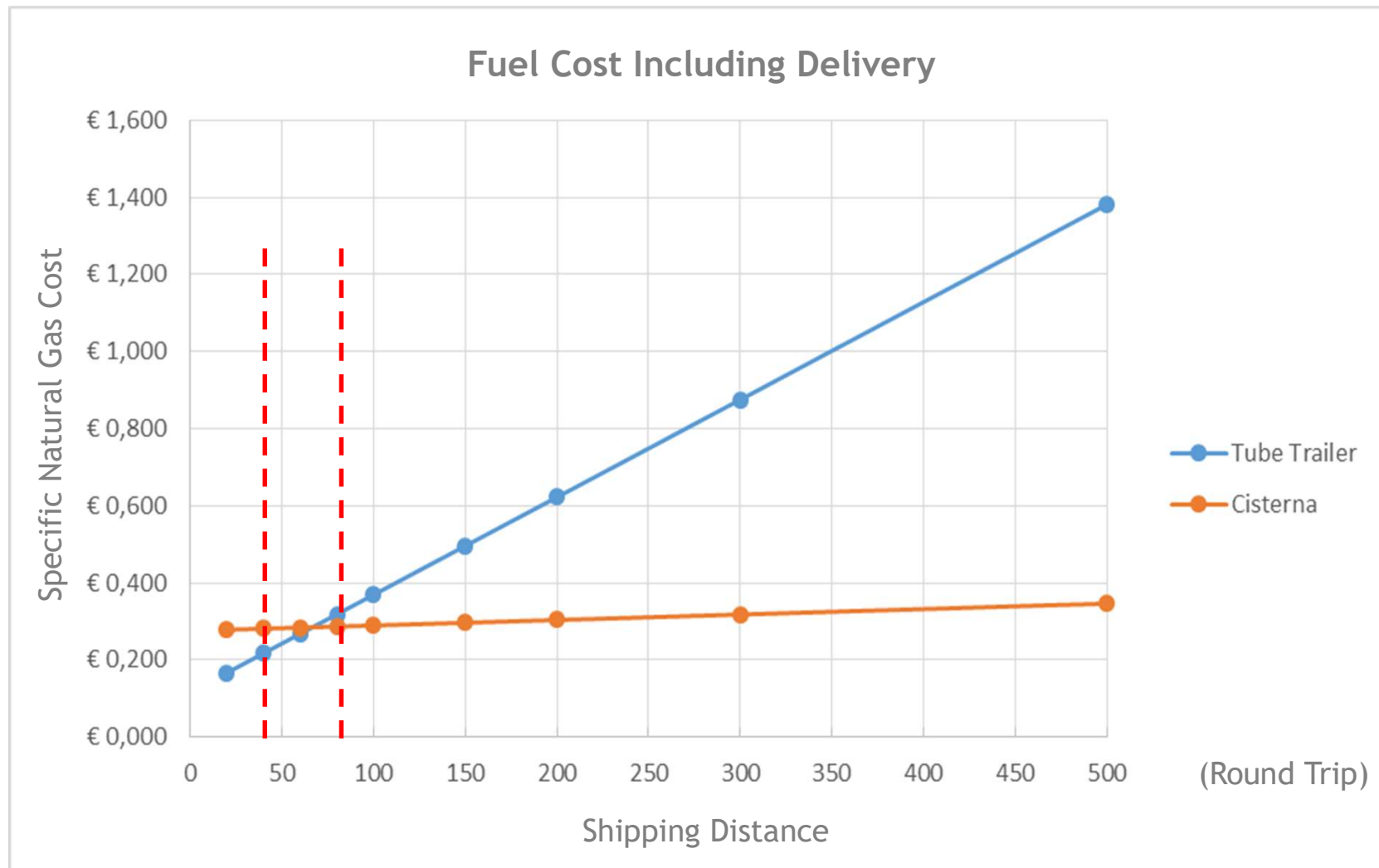
μ -LNG plants Integrated Conditioning Liquefaction Units

Issues? Opportunities?

- LNG Small Scale;
- No available LNG solutions on the market;
- 40-60% of Biogas plants does not have access to an existing Natural Gas pipeline



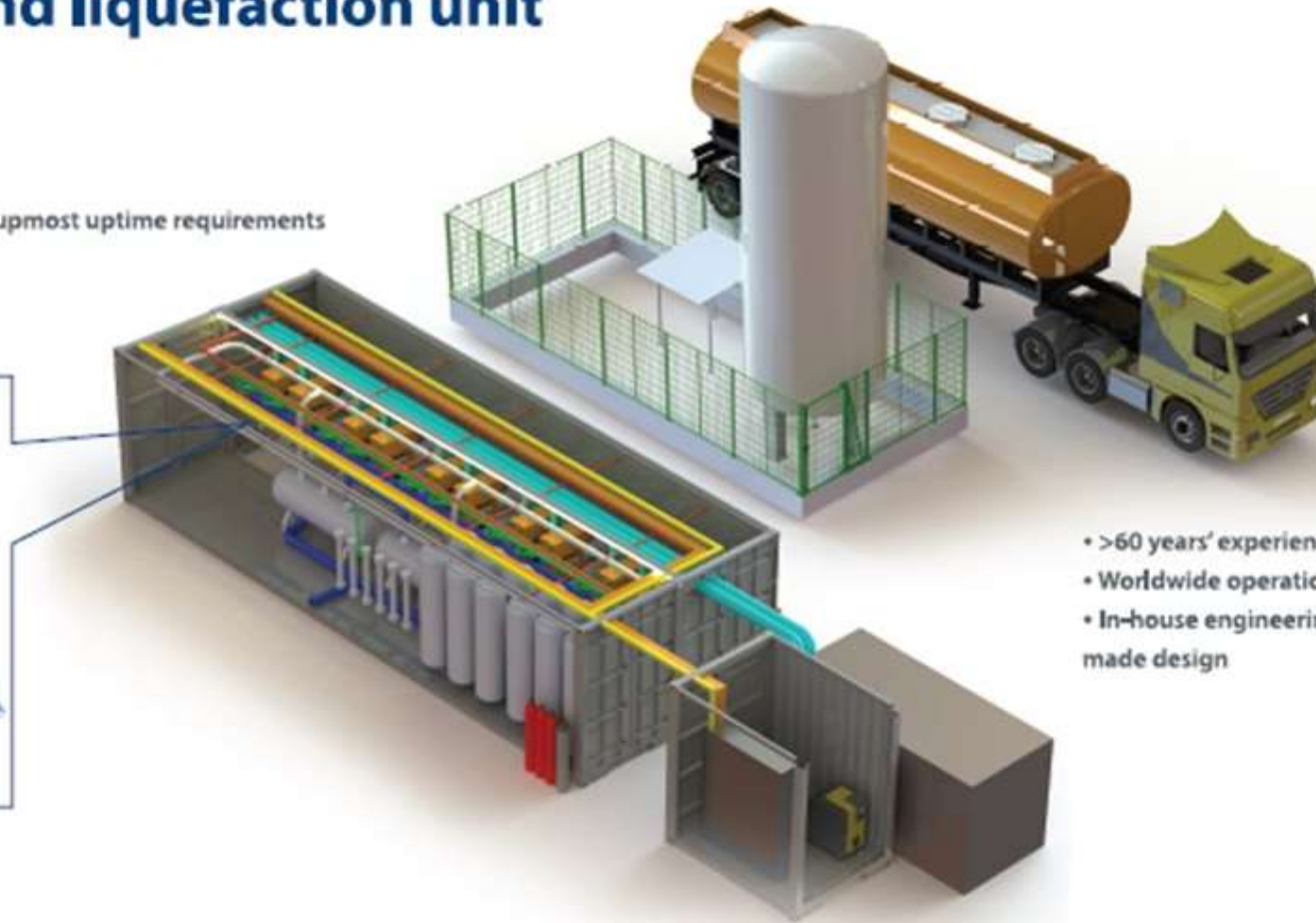
• LNG vs CNG as Natural Gas Virtual Network



Bio - LNG Integrated conditioning and liquefaction unit

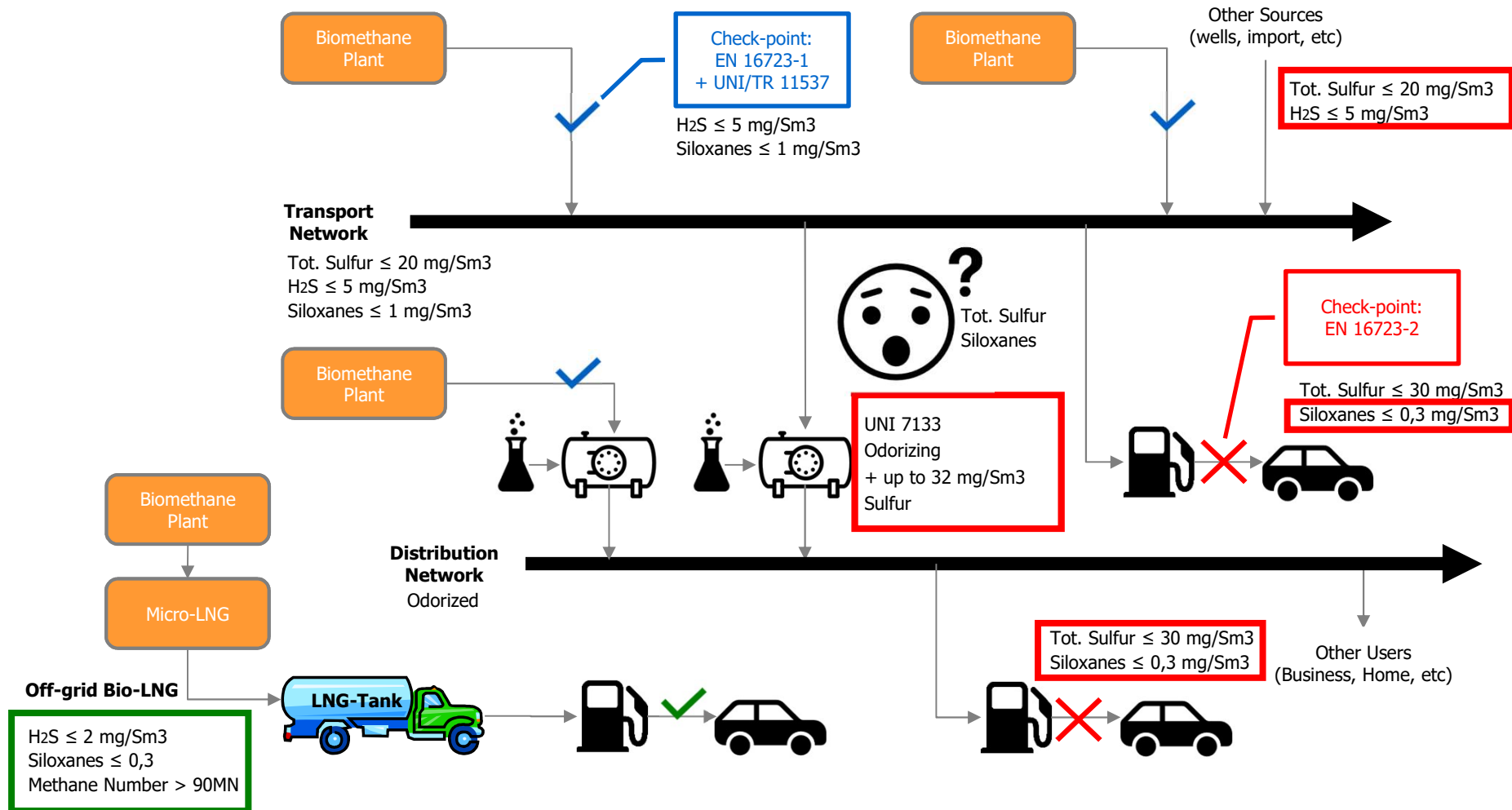
Features:

- Plug-and- Play modular design
- Turn-Key Product
- Cost efficient redundancy to meet upmost uptime requirements
- Easy to expand for future growth

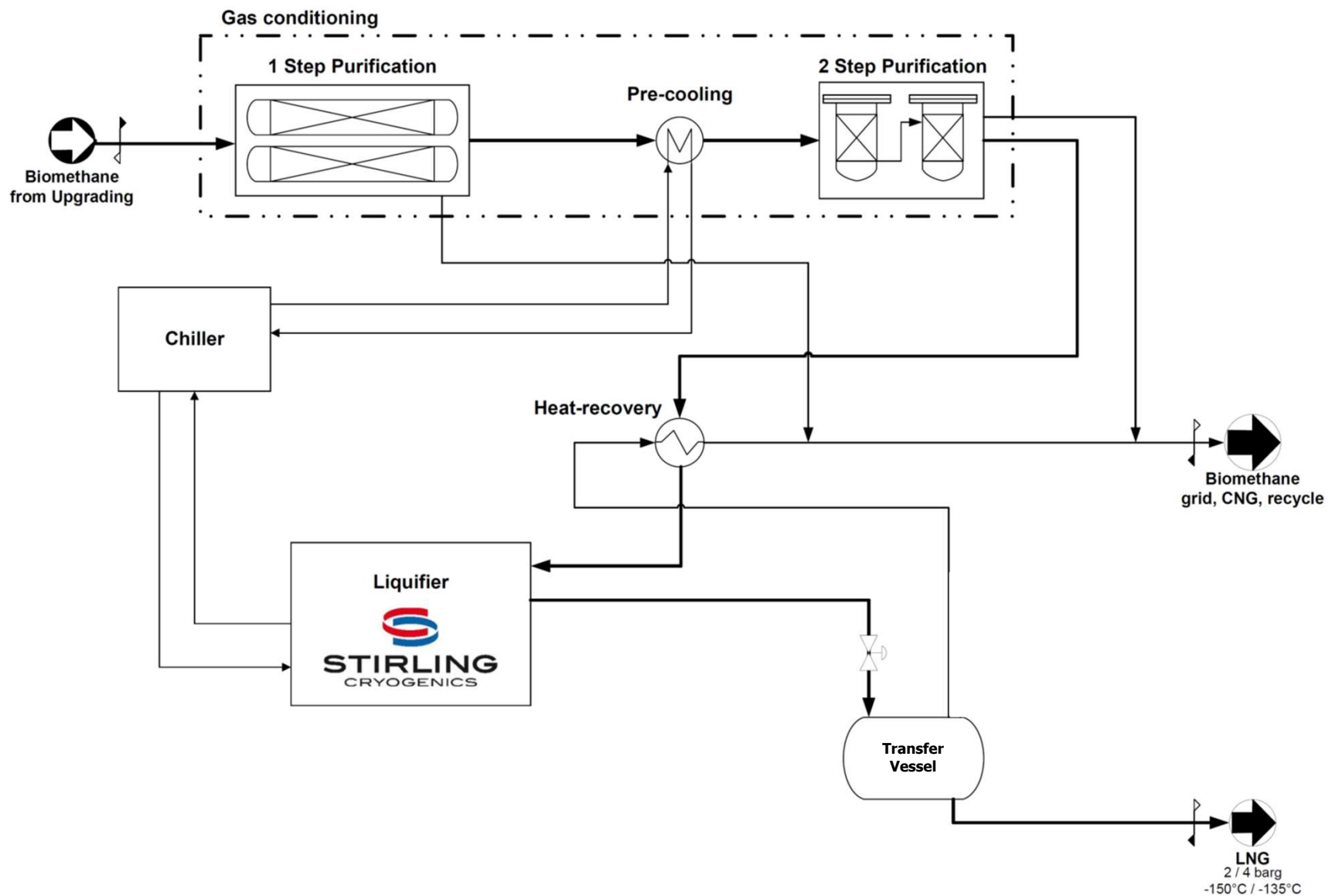


- >60 years' experience in cryogenic solutions
- Worldwide operation & service
- In-house engineering expertise for custom made design

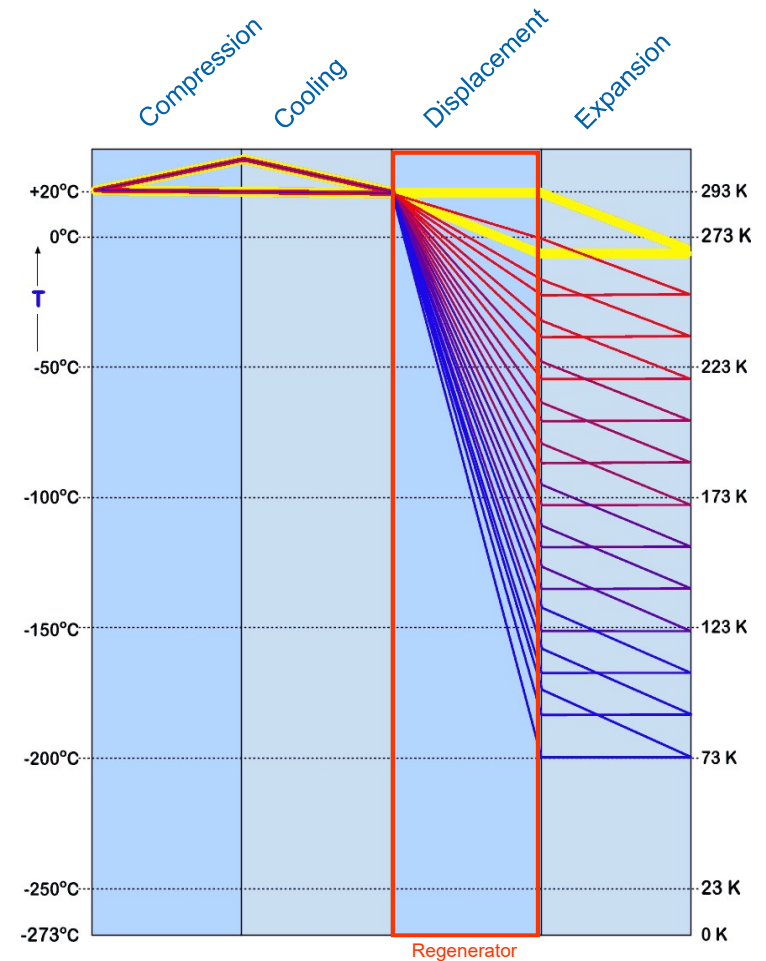
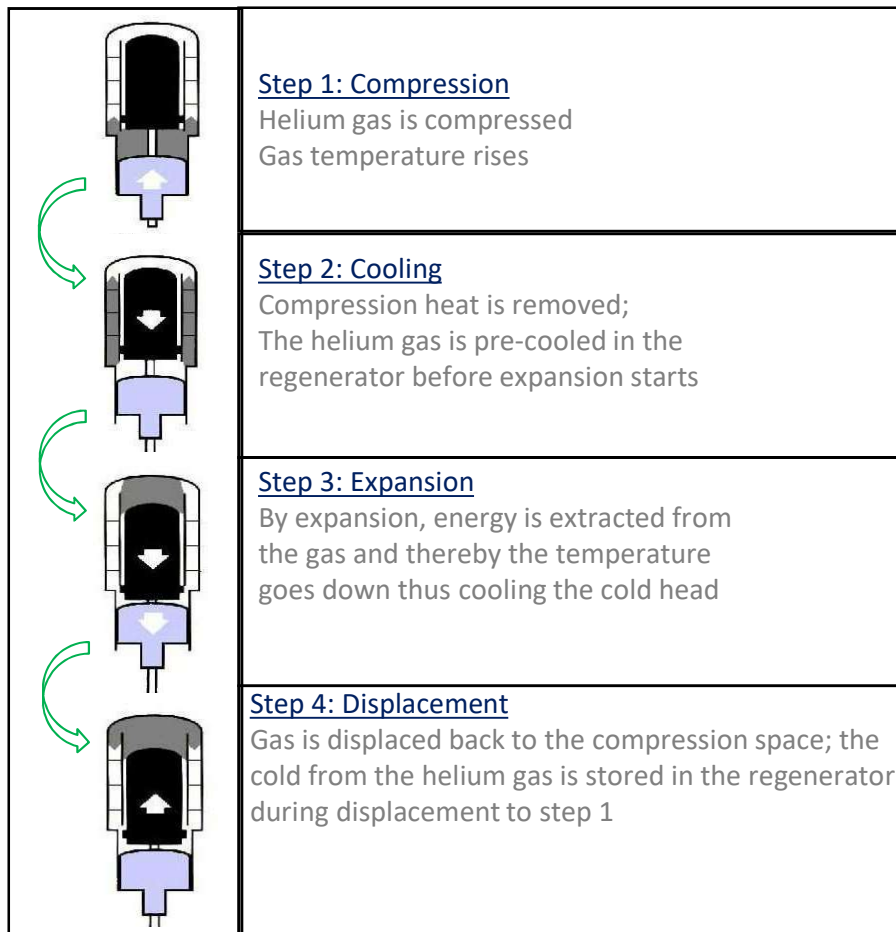
• LNG: the Best Fuel Quality



• Integrated Conditioning and Liquefaction Units



• Cryogenic Cooling: Stirling Reverse Thermodynamic Cycle



• The Stirling Cryogenerator

LNG is not in contact with the mechanical parts

He expansion space

He displacer

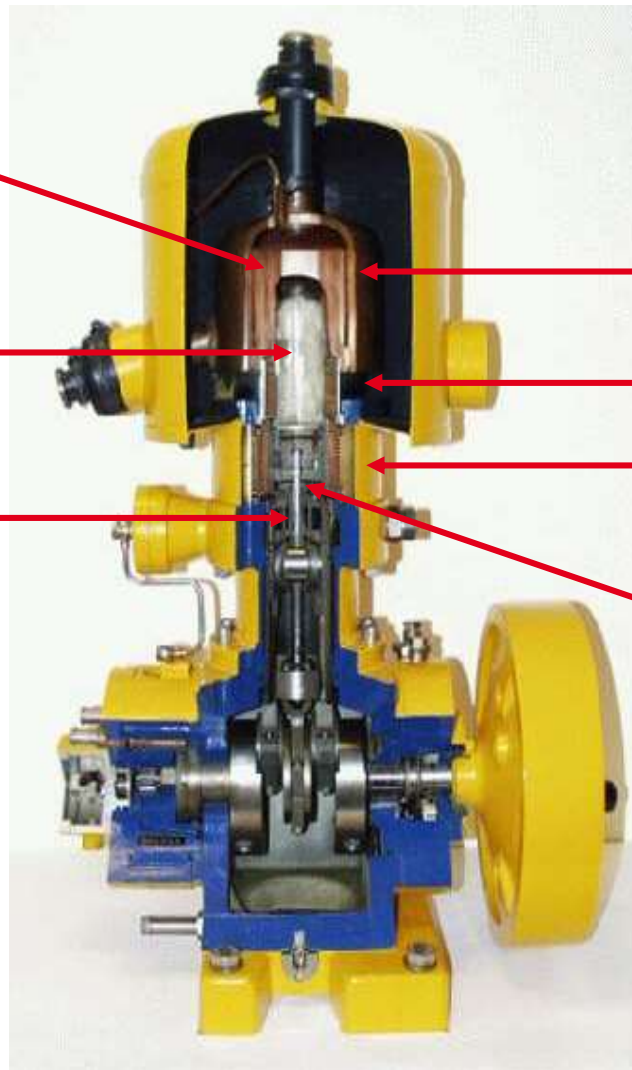
He piston

LNG condenser head
(Heat Exchanger)

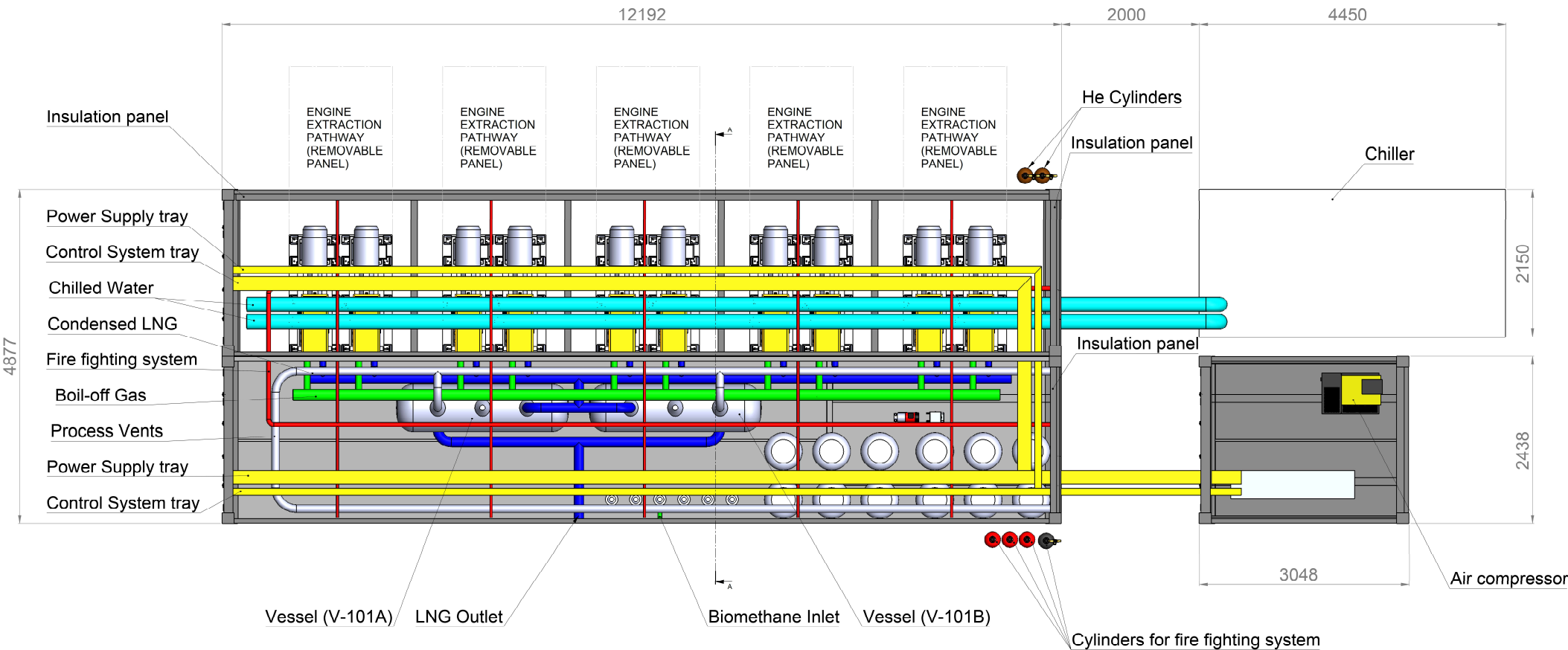
He regenerator

He cooler

He compression space



• Typical Layout for 10 tpd LNG Installation



• Our Technology Takeaways

Main Features:

- Integrated solution “Purification + Liquefaction”
- LNG Quality (Automotive: MN>80, other applications MN>90)
 - Greater vehicle efficiency +20% (less fuel consumption)
 - Lower maintenance costs (+ vehicle availability and less costs)
- Operating pressures from 6 to 20 barg while delivering LNG product at low pressures (LNG @ 2-4 barg or lower)
- “Plug and Play” and Modular design (currently we deliver modules from 1 and up to 20 tpd)
- Scalable for future growth (allows to grow/invest along with demand)
- Energy Efficiency: from 0,60 kWh/kg LNG
(0,80 kWh/kg LNG including chilled water generation)
- High Uptime (>8.400 h/y)
- Experience from the field and broad assistance network worldwide

• LNG main Process Options

- **Liquid Nitrogen cycle**

LNG produced with
2,4 kgN₂/kgLNG
(1,6 Sm³N₂/Sm³NG)
= EUR 0,34/kgLNG

- **Cryogenic Cycle for micro-scale Liquefaction**

LNG produced with
< 0,90 kWh/kg
= EUR 0,04-0,15/kgLNG

Power Cost
0,05-0,16 EUR/kWh

• References in Cryogenic Liquefaction

- >3.000 projects installed since 1955
- > 60 years of experience in liquefaction
- Tailor made design by in-house engineering
- Standardised solutions where applicable
- Worldwide operations and service network



- References in Natural Gas Liquefaction



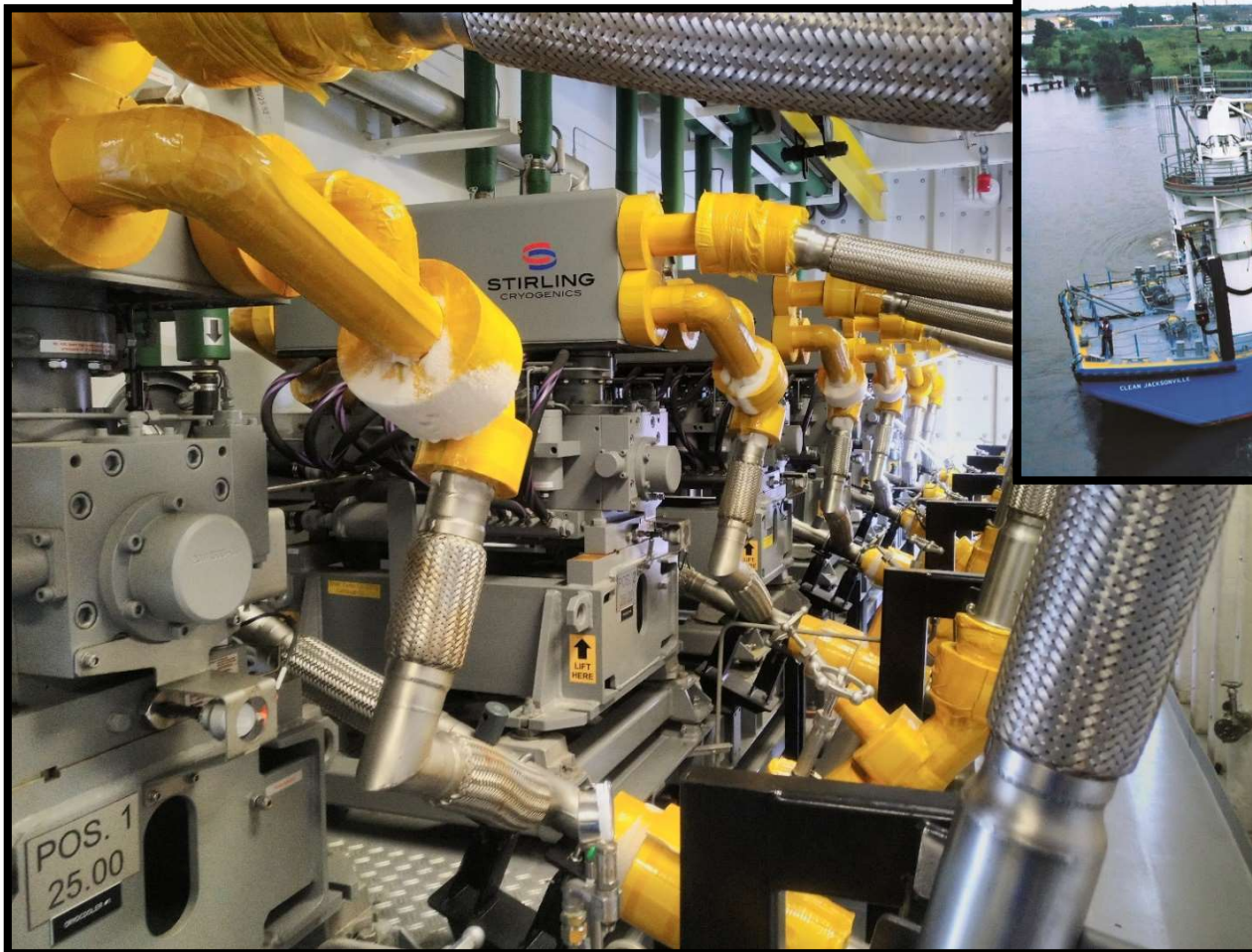
• References in Natural Gas Liquefaction

3 ton/day BOG - LNG Bunkering for Shell, Antwerp/Rotterdam (March 2019)



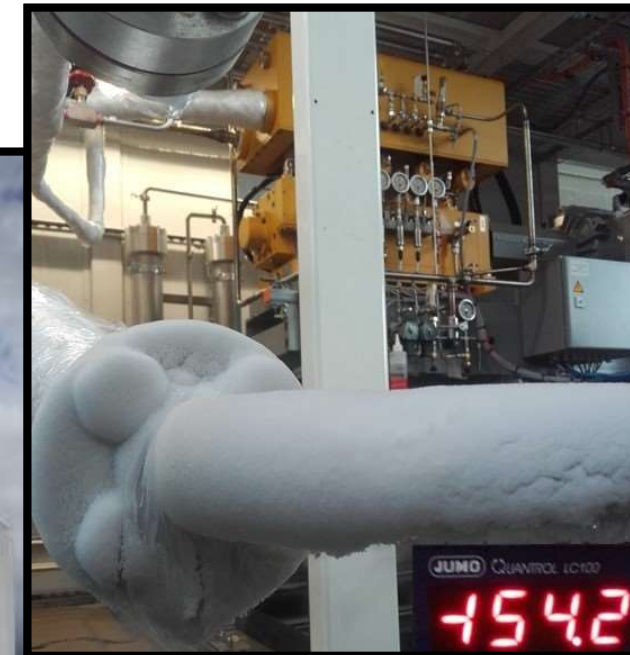
• References in Natural Gas Liquefaction

6 ton/day BOG - LNG Bunkering for TOTE, Jacksonville, USA (Sep 2018)



- References in Natural Gas Liquefaction

1 ton/day Bio-LNG plant Foggia, Italy (Sep 2018)



- References in Natural Gas Liquefaction

2 ton/day Test plant in USA



• Stirling Cryogenics

Stirling Cryogenics designs, builds and supplies cryogenic solutions based on the (reversed) Stirling thermodynamic cycle, with a long history, highly reliable record and high efficiency, with over 3,000 installations world wide.

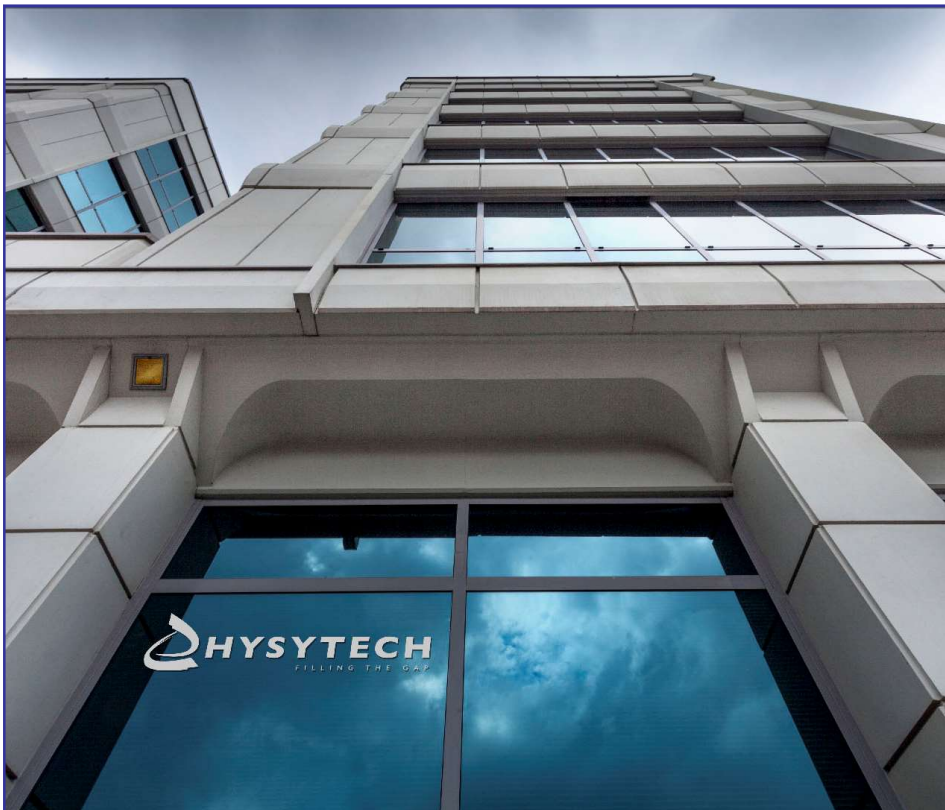
Our main products are stand-alone liquid Nitrogen production systems (StirLIN's), which produce liquid Nitrogen (LN₂) on site and custom made cryogenic cooling systems based on our Stirling Cryocoolers (Liquid Oxygen, Methane, Argon, Helium and CO₂, besides Nitrogen)



Typical applications are:

- Biotech (Cryo-storage: Cell, Tissue, insemination)
- Healthcare (on-site LOX)
- High Temperature Superconductors (HTS)
- MRI magnet cooling and Nuclear applications
- Space simulation chambers
- LNG/Bio-gas liquefaction, Boil-off recovery and Maritime
- Space Observatories

• HYSYTECH

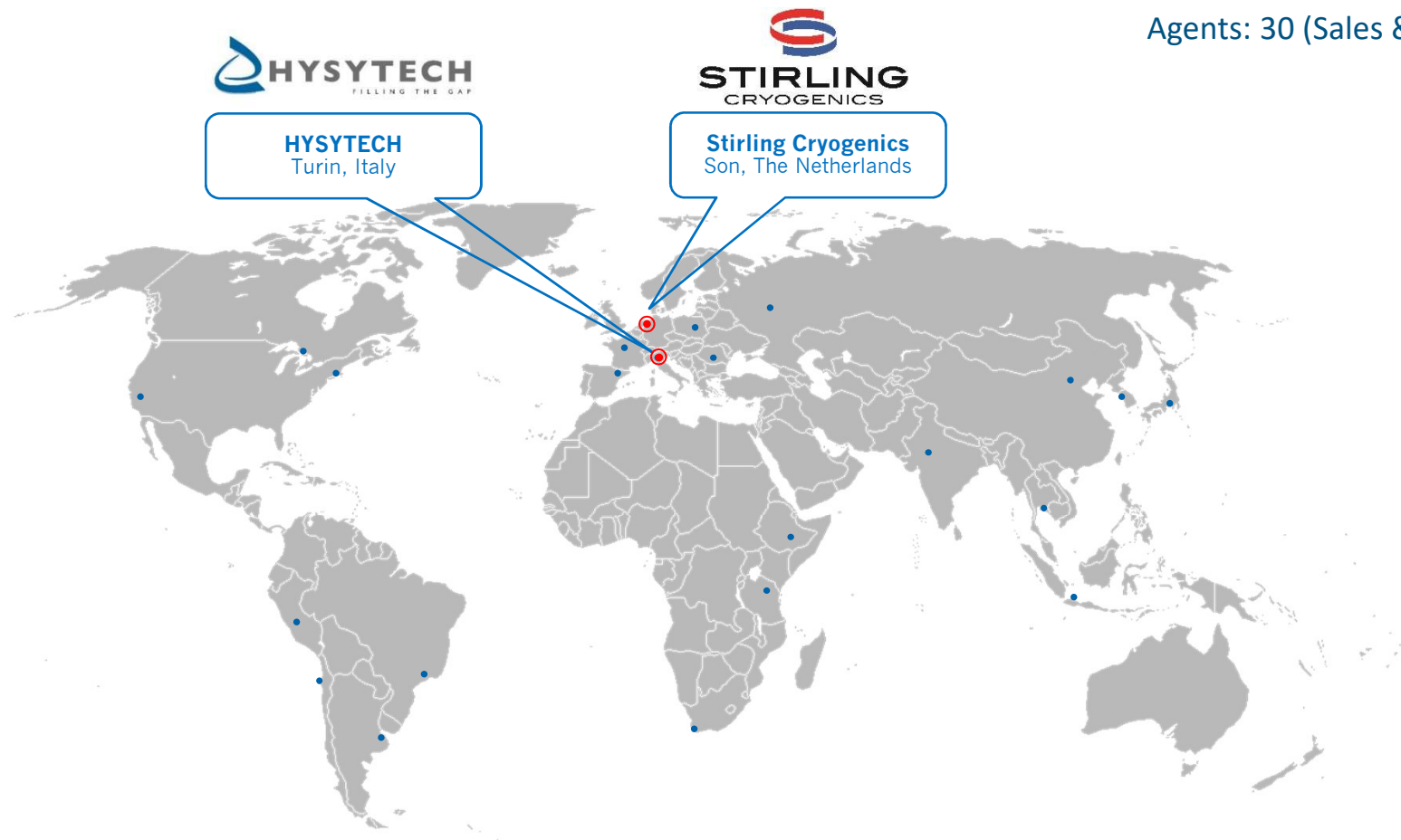


HYSYTECH is an engineering company, specialized in the design, development and industrial implementation of **new turn-key process technologies and equipment**. HYSYTECH is the owner of STIRLING CRYOGENICS.

Our skills start from the know-how in chemical and process engineering, up to commissioning, monitoring and maintenance.

We operate mainly in the field of **generation, treatment and recovery of industrial gases, organic liquids and energy**, according to the best engineering practices, also through the implementation of our technologies.

• Sales and Service Agency Network



Agents: 30 (Sales & Service)

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