

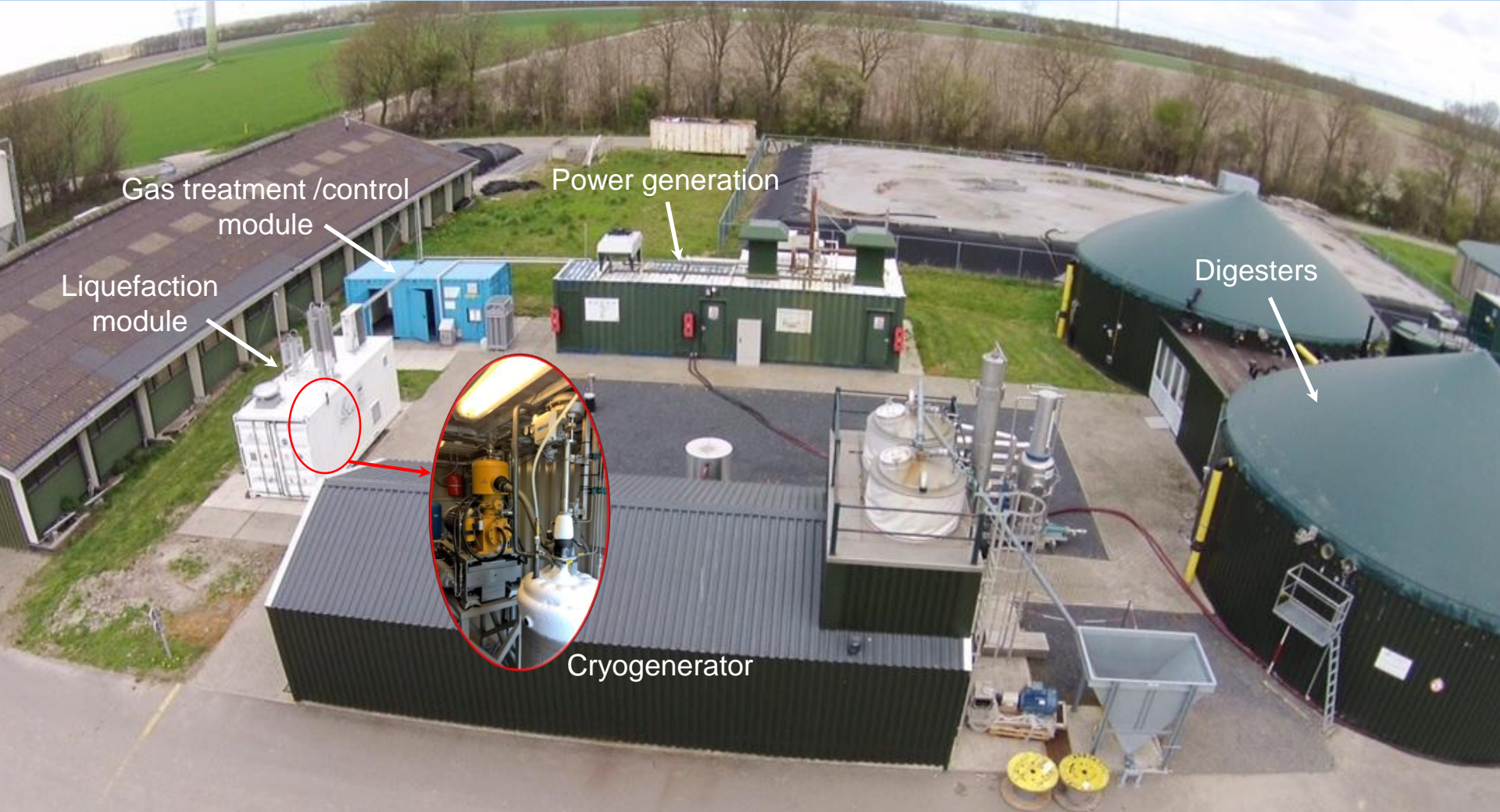
Presentation 01 maart 2016



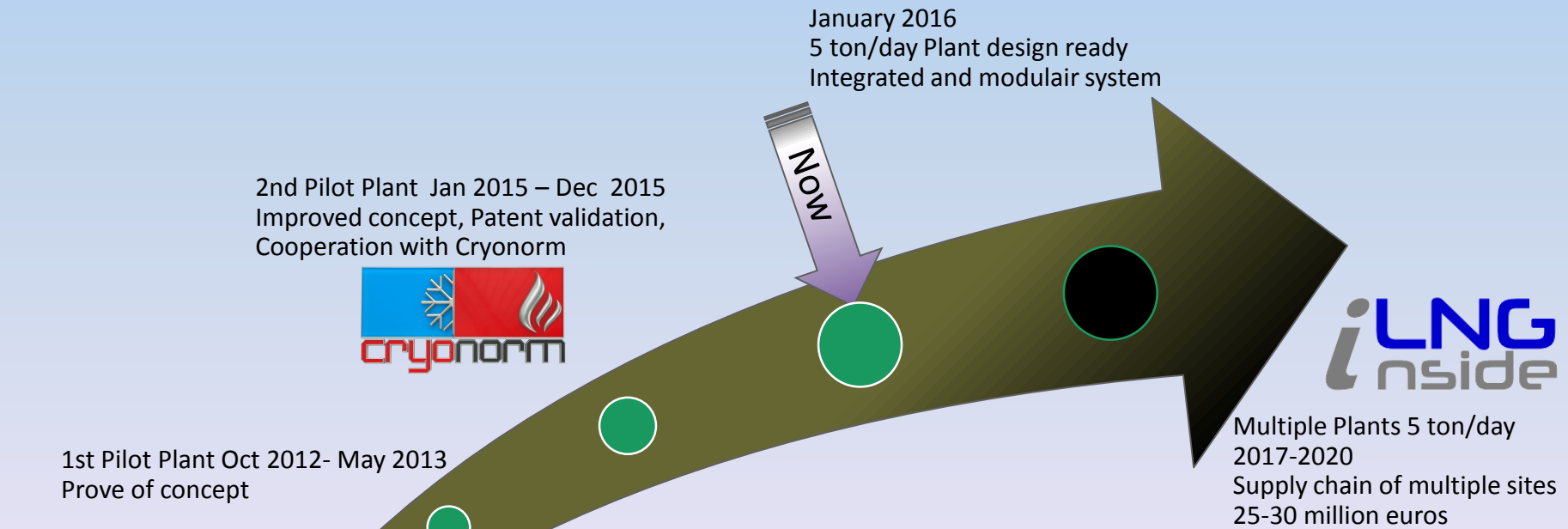
seminar

LNG, bio-LNG en bio-LPG

Liquefying biogas



Development Bio-LNG liquefaction By Osomo/Jerom van Roosmalen

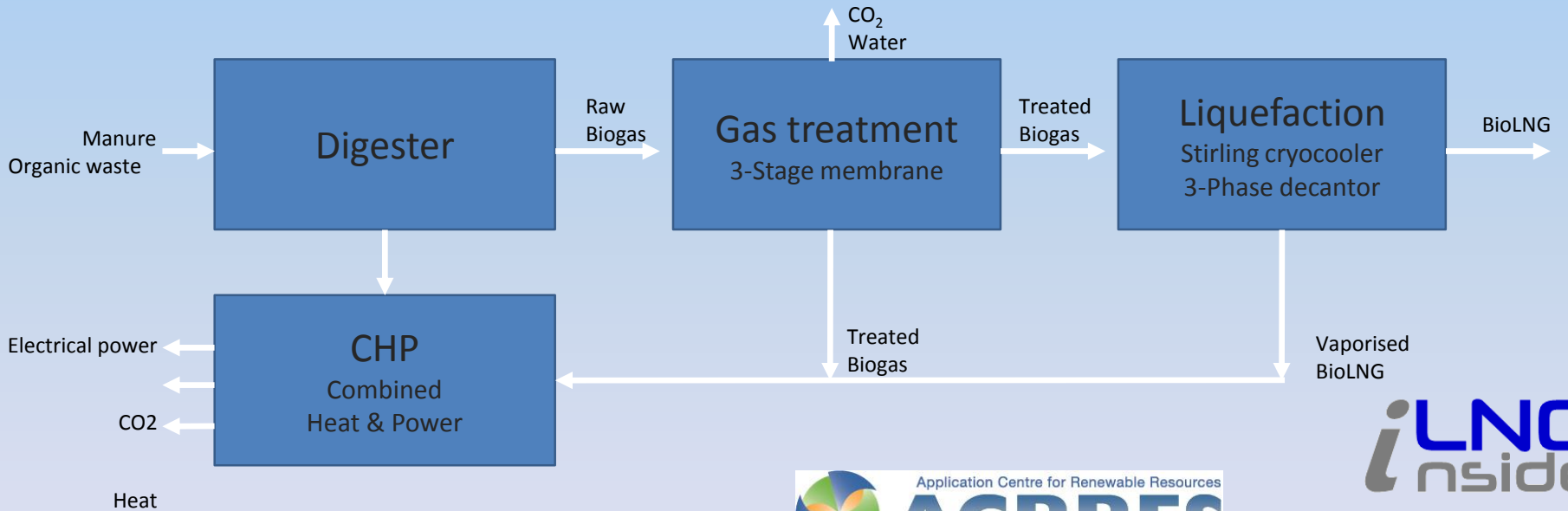


1st Demo 2011: Does it work?



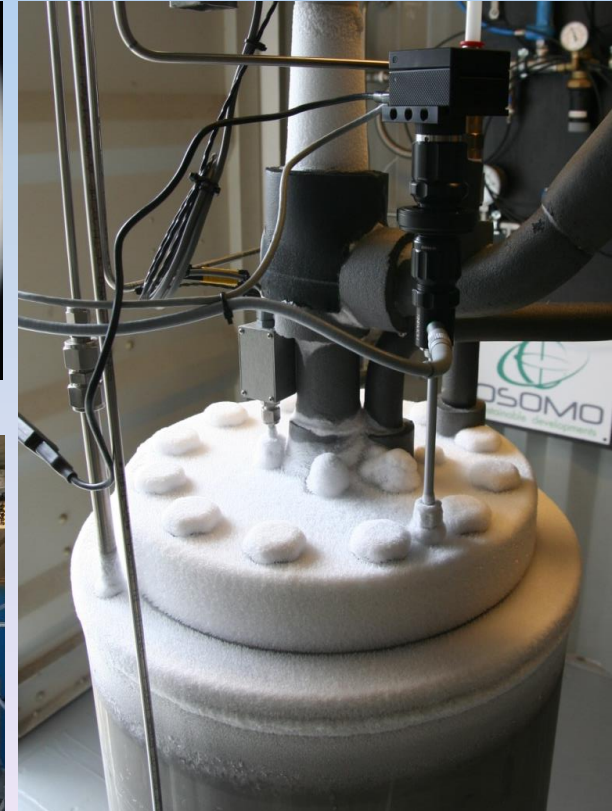
Biogas test installation Acrres

Application Centre for Renewable RESources, Lelystad



Pilot plant in Lelystad

iLNG
inside



One stage liquifaction

- Very stable
- Large variation of gas mixes
- Handles peak loads, like high concentration CO₂ or N₂
- Easy startup, recovery and process control
- Load adjustment 0-100%

3 phase separation

- Post-treatment of LNG
- Separates all crystals
- LNG at any desirable pressure or temperature
- Under saturated LNG



Design principles

- Fluctuating gas flow
- Fluctuating gas composition
- Integration of gastreatment and liquifaction
- High up-time
- Easy start-up and recovery
- Continue process flow
- (no batch processen)
- Reliable quality of LNG
- Modular setup

Challenges

- Keep Capex and Opex as low as possible
- Determine allowed bandwidth of impurities and gascomposition
- Robust process line-up
- Low energy usage
- Low loss of methane
- Re-use of CO₂
- LNG at any temperature or/and pressure

General

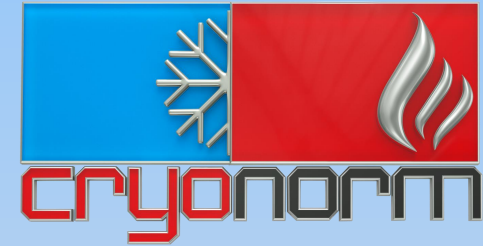
- Make small scale (Bio-)LNG economically feasible
- Design and test a robust total system from raw gas to LNG
- Patent validation
- Get insight and grip on crystallisation and separation of CO₂

Technological

- Crystallization effects
 - CO₂ crystal sizes
 - Sticky or dry
 - Nucleation
- Determine bandwidth of impurities and uncondensables, like N₂
- Push the system to the limits

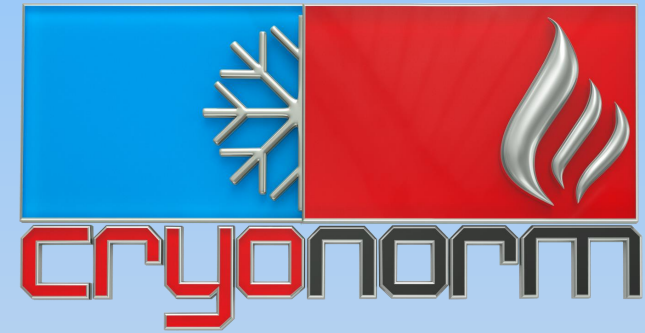
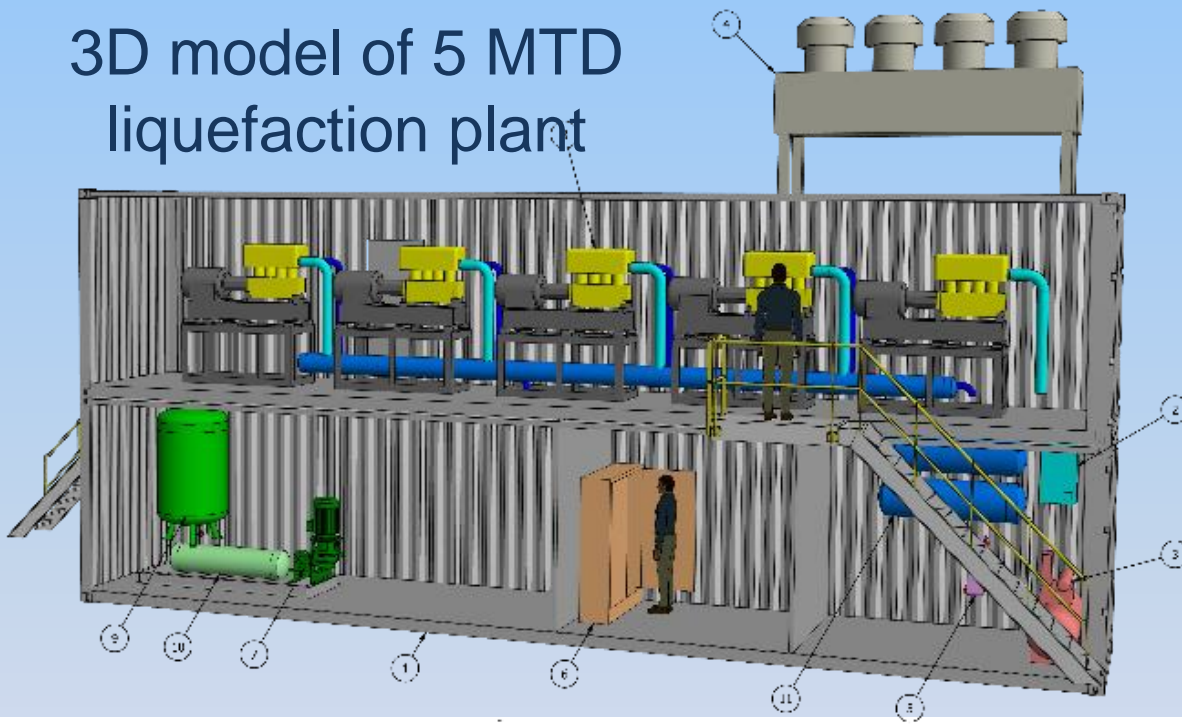


Results

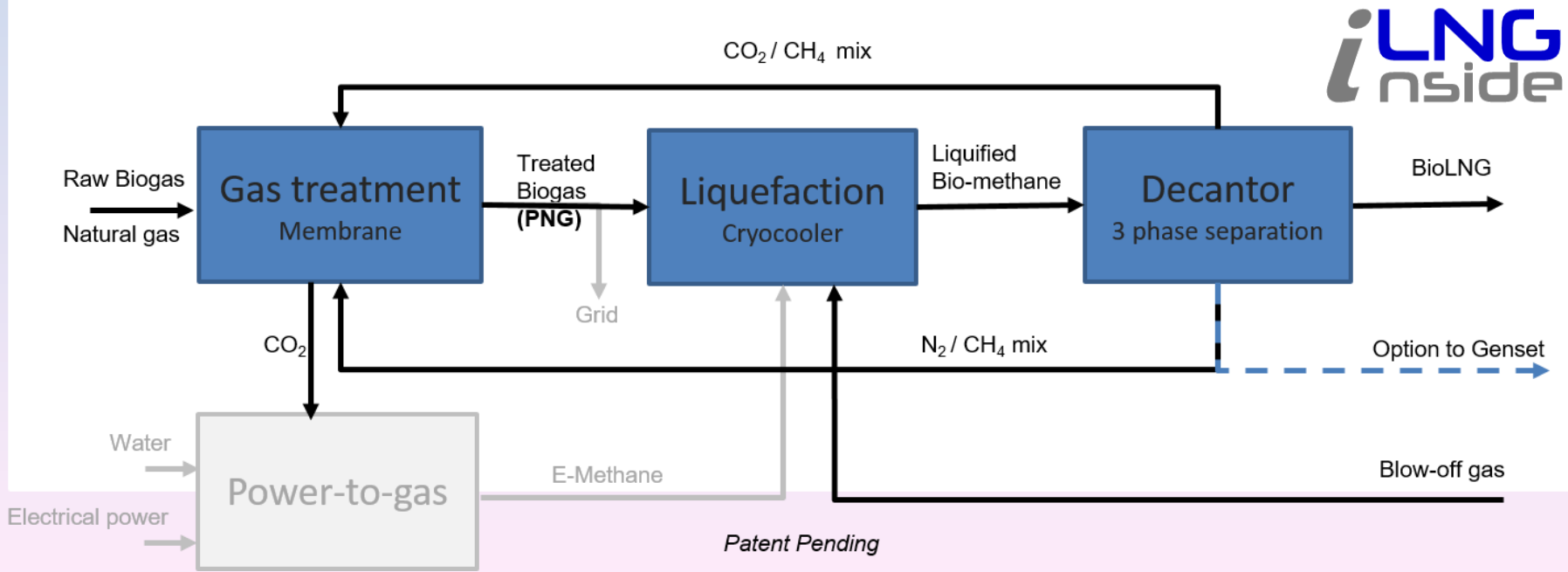


- ✓ Constant quality of LNG
- ✓ Specific energy use of 1,2 kWh/kg:
 - 0,7 liquefaction
 - 0,5 gastreatment
- ✓ Adjustable capacity 0-100%
- ✓ Start-up time <10 min, Steady state in < 1 hour
- ✓ Operational Intelligence of Osisoft
- ✓ Keeps running under extreme conditions, like temporary overshoot of CO₂, H₂O, N₂
- ✓ Patent and simulation models are validated

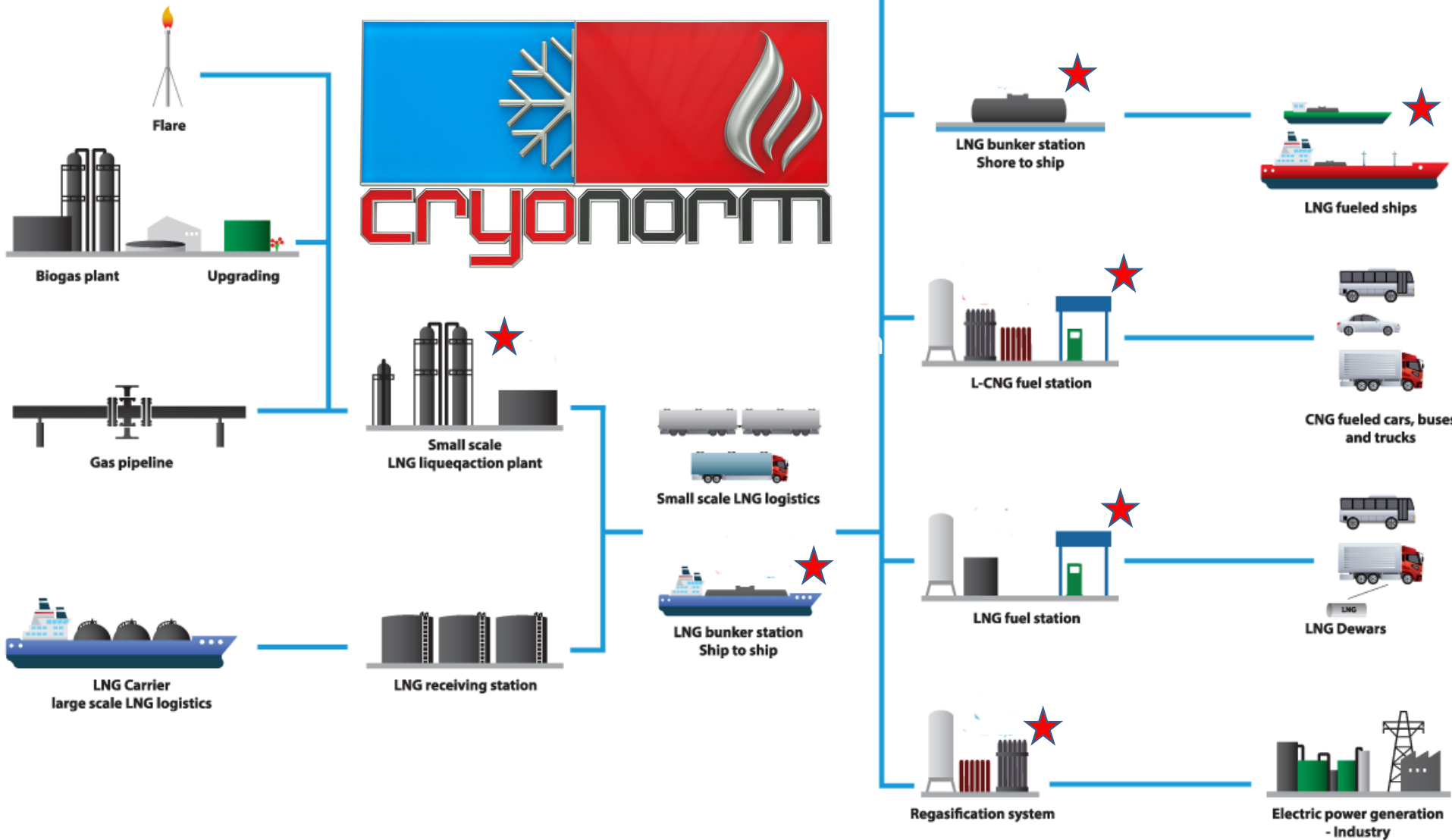
3D model of 5 MTD liquefaction plant



PFD of full plant



LNG Supply chain



1.500 Nm³/hr @ 6 barg satellite plant

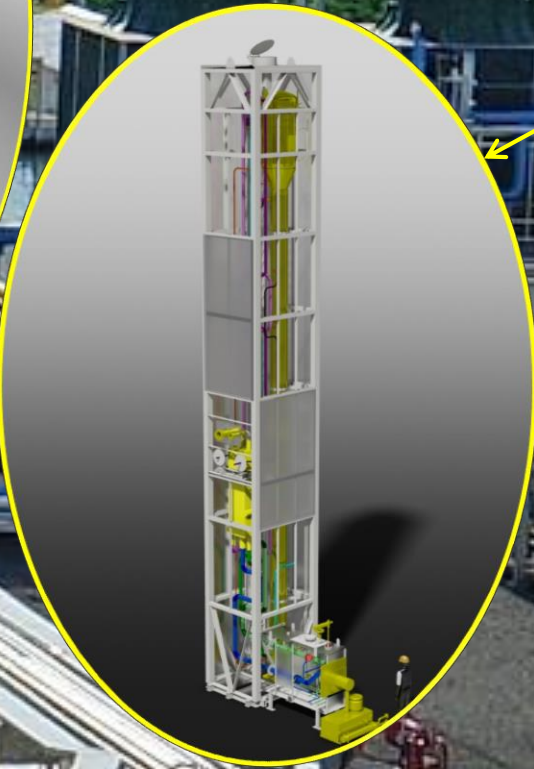
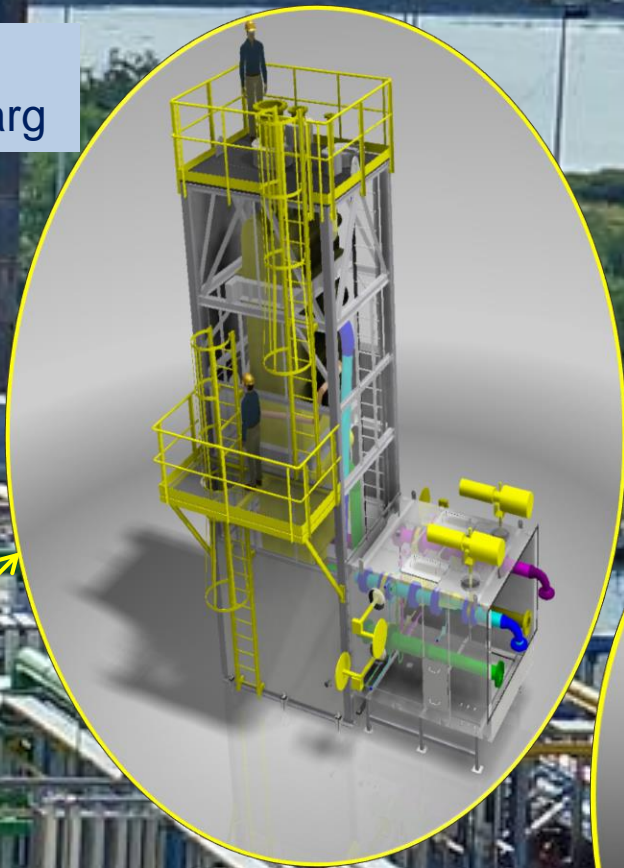
Norway



Mobile ambient air heated vaporisers for temporary gas needs or pipe line interventions



LNG Coldbox
200 MTD @ 3 barg



Coldbox for high purity Nitrogen
LIN : 148 kg/hr @ 7 barg
GAN: 1.282 kg/hr @ 7 barg



Dual LNG truck loading bay

LNG/L-CNG fueling

Public station station



Scope of supply:

- Concrete pre-fab building with LNG pump skid and control system separated
- LNG dispenser (with filling – and gas return hose)
- Credit card payment system (Tokheim)
- 60 m³ vertical LNG tank (PED certified), 12 bar MAWP
- "saturation on the fly" enabling saturated LNG supply for various filling pressures.



Submerged
pump skid



L-CNG equipment



500 Nm³ @ 200 barg
Bottle rack capacity



High pressure
Odorizer system



High pressure LNG
piston pump

LNG as shipping fuel for inland water way and short sea vessels



LNG bunkering system



LNG bunkering of dual fuel (LNG/MDO) propelled ferries

Risavika Harbor - Norway

Fiscal flow metering



450 m³/hr bunkering capacity
up to 15 barg



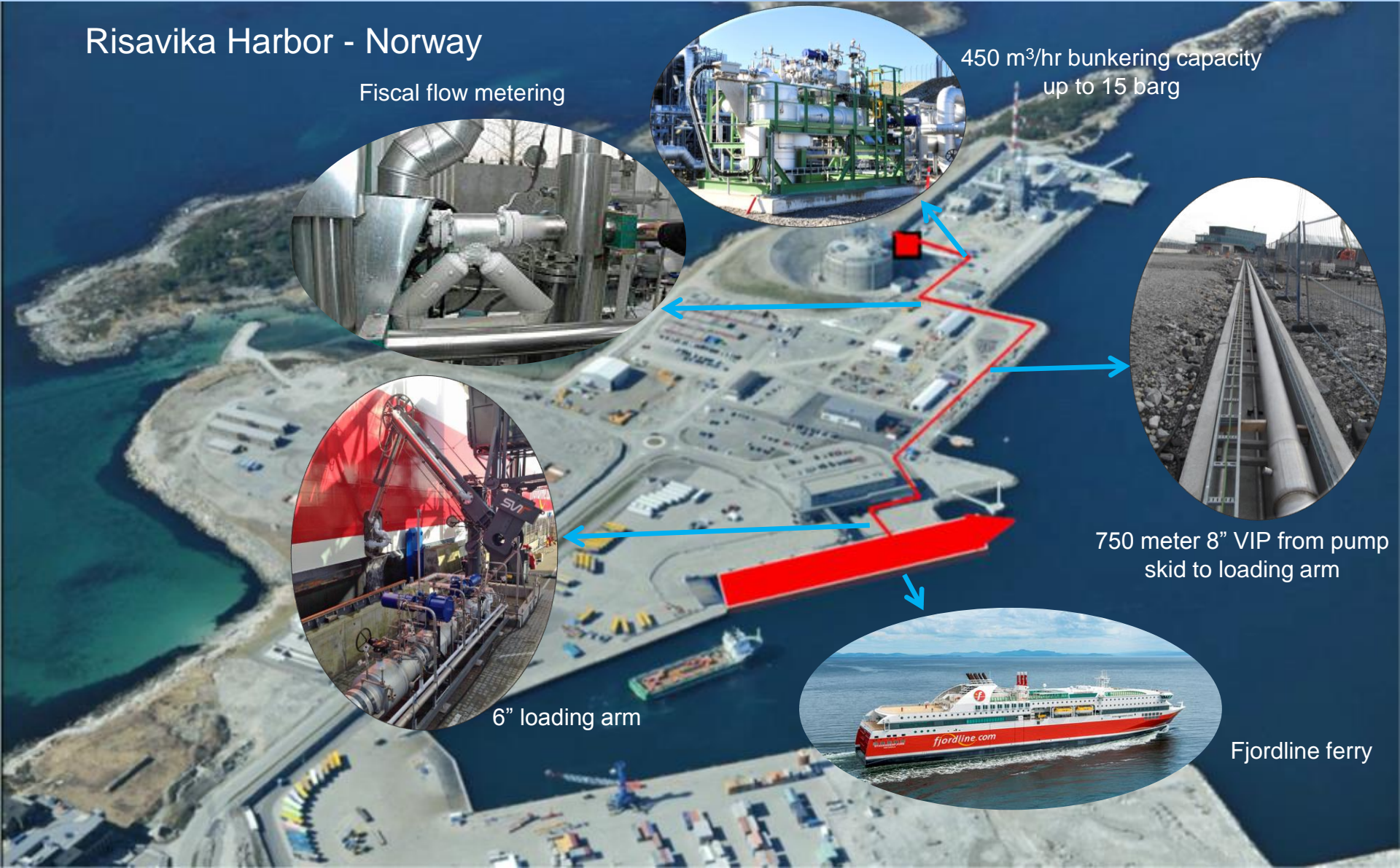
750 meter 8" VIP from pump
skid to loading arm

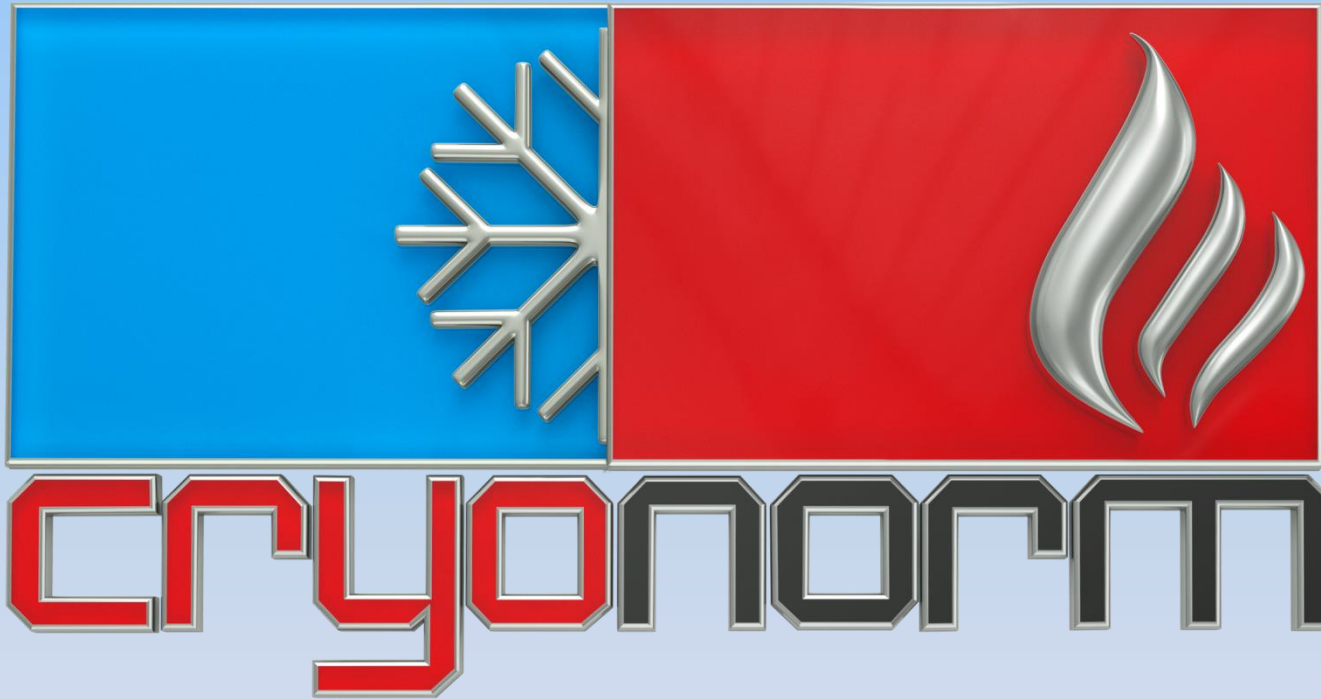


6" loading arm



Fjordline ferry





- Thank you for your attention -

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