



# **NYNÄSHAMN LNG TERMINAL THE FIRST LNG HUB IN THE BALTIC SEA**

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THE LINDE GROUP

*Linde*

# Agenda



- 1) The Linde Group
- 2) Clean Energy initiatives
- 3) LNG and safety
- 4) Key drivers for LNG terminal project
- 5) Key facts LNG terminal
- 6) Baltic Sea emission
- 7) Retrofits and new buildings
- 8) LNG unit onboard
- 9) Bunkering marine clients
- 10) Some stakeholder's views
- 11) Commercial considerations

# The Linde Group

45.000 employees, turnover 13 bill EURO



## No. 1 industrial gas company world wide

- Oxygen, nitrogen, argon
- Acetylene, fuel gases
- Welding process shielding gases
- Carbon monoxide, hydrogen
- Medical gases
- Rare gases, ultra-high purity gases
- Gas application processes and services
- Propane and LNG

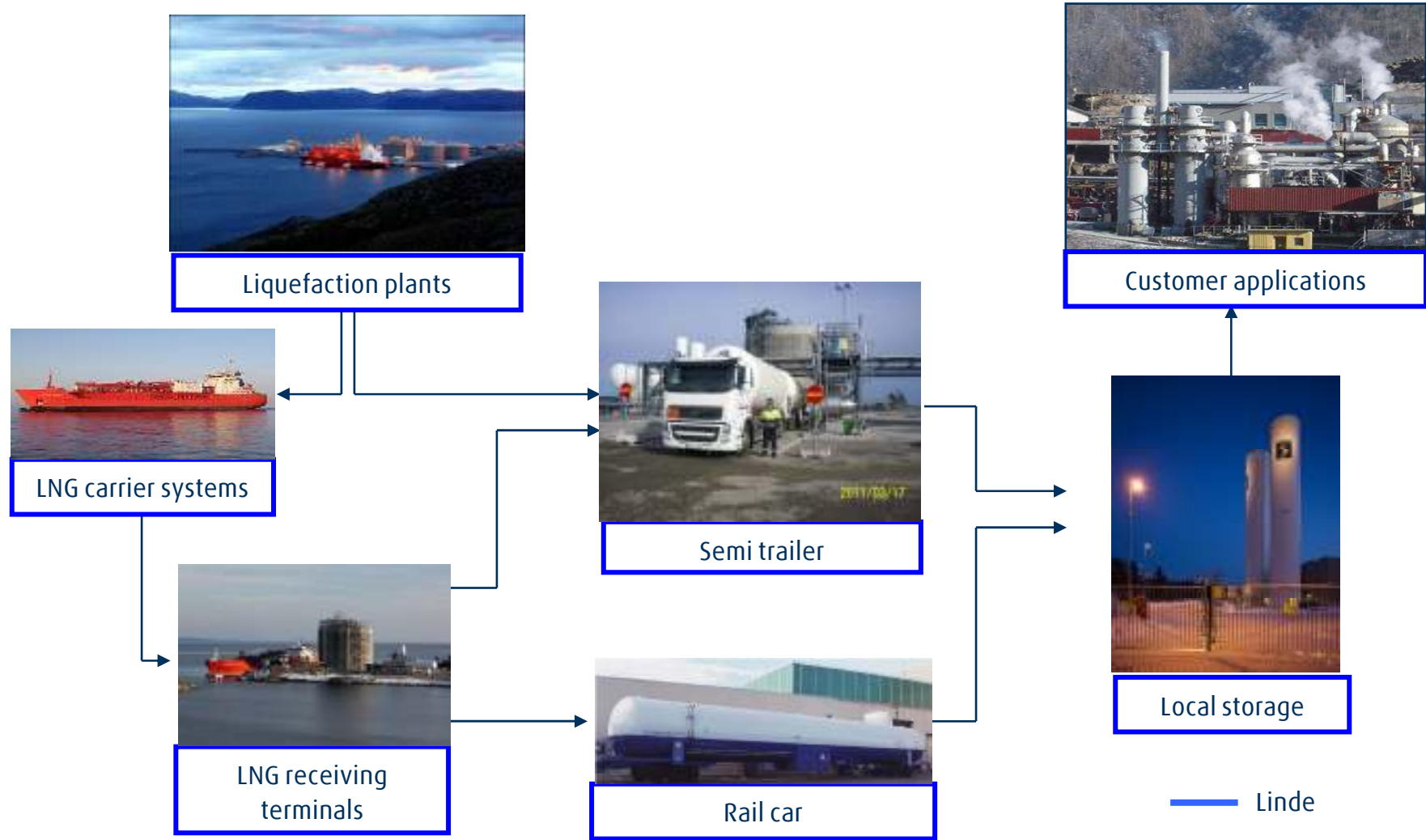


## Leading global engineering company

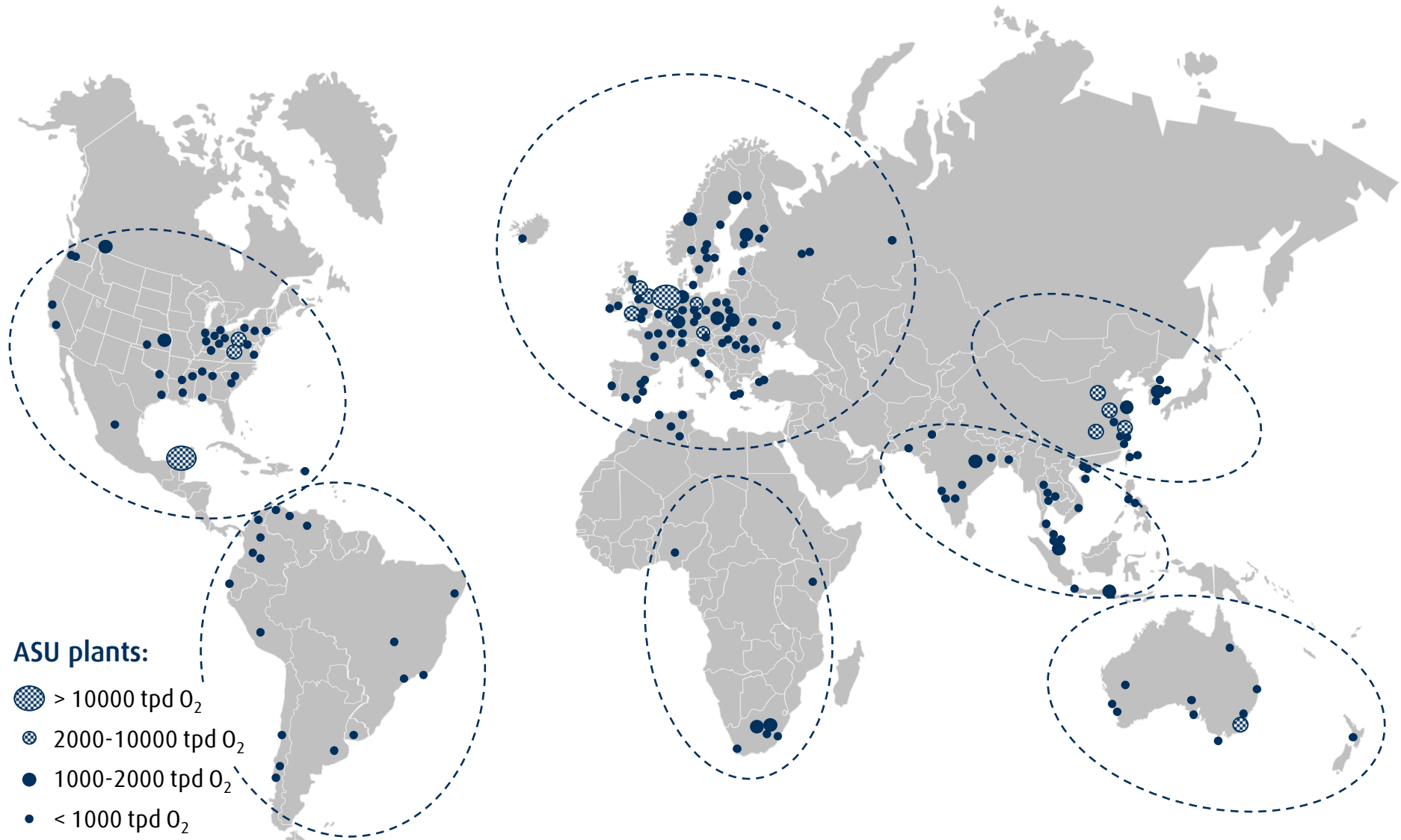
- Petrochemical, polyolefin plants
- Hydrogen, synthesis plants
- LNG, natural gas processing- and gas processing plants



# Engineering capacity within the LNG value chain



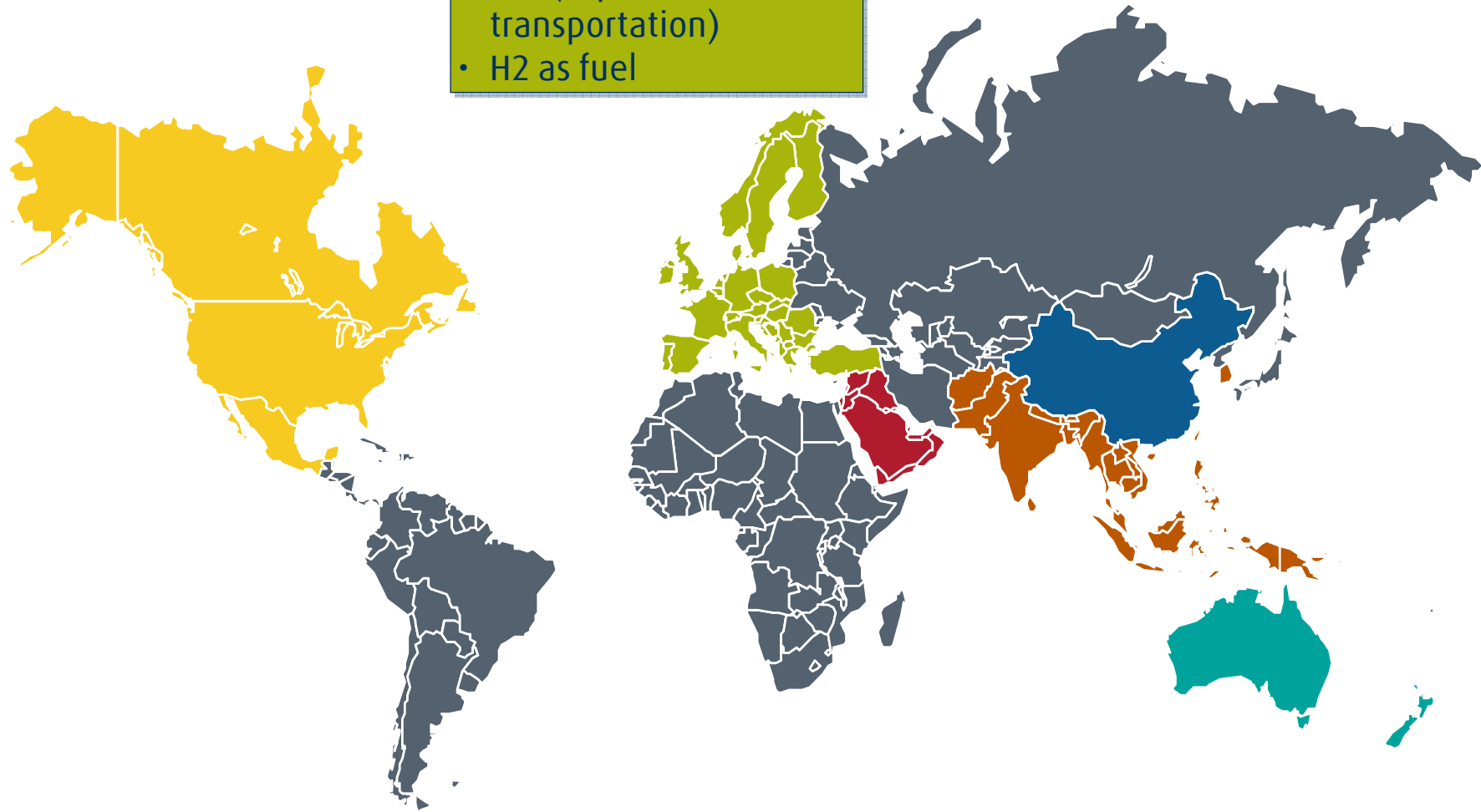
> 320 ASU/hydrogen/LNG/specialty gases plants  
Example: 4th largest energy consumer in the UK



# Linde Clean Energy initiatives



- Europe
- Merchant LNG
- CCS (capture & CO2 transportation)
- H2 as fuel



## Marine incidents

Gibraltar, May 2011 (newspapers stated fire in gas tank)

Ålesund, Norway September 2011 (Hurtigruten MS Nordlys)



# LNG # marine fuels

- Cryogenic liquid
- Use protection clothes, gloves, boots
- Colorless, odorless, tasteless, non-toxic
- Density abt 0,43 kg/ltr
- LCV 13,7 kWh/kg vs diesel 12 kWh/kg
- Methane content 80 % up to 99 %
- Boiling point – 162 deg C
- Freezing point – 182 deg C
- 1 m<sup>3</sup> liquid = 600 Nm<sup>3</sup> gas
- Ignites in a 5-15 % concentration in air
- Ignition temperature 542 deg C
- Burns slowly
- Use fire extinguisher or foam, not water





# Key drivers for AGA's LNG terminal in Nynashamn (2008)



- Supplier of and part owner in Norwegian LNG plant (Tjeldbergodden, Norway)
- AGA REN focusing on innovation and growth
- No expansion of gas grid in Sweden
- Initiatives to build LNG terminals had failed
- Fortum Gas to replace naphtha for Stockholm grid
- Nynas refinery to replace naphtha steam reformer
- Nordic LNG, Norway able to supply LNG
- Shipping capacity available (IM Skaugen)
- IMO's proposal for SECA area
- LNG accepted as back up for growing biogas market
- No sign of the European financial crisis
- Linde able to combine Skangass LNG plant (advanced single flow process) with the Nynashamn terminal



# Skangass LNG plant (Linde EPC contract)



# AGA sole owner of the Nynäshamn LNG terminal

Adjacent to Nynäs refinery, Gotland traffic and Norvikudden



- Specialty products
- Bitumen
- Substantial upgrading
- LNG replacing naphtha

- Traffic owned by the Swedish state
- 1,4 mill passengers, 640 km goods
- Summer season 16 departures/day
- Operated by Destination Gotland
- Aim to introduce LNG/biogas

- Harbour of the future
- 2 jetties, 1800 length, 60 acres
- 300.000 TEU/year
- Logistical centre 40 acres
- 300.000 trailers/year
- Railroad to the terminal

# Nynäshamn LNG terminal – 3D layout



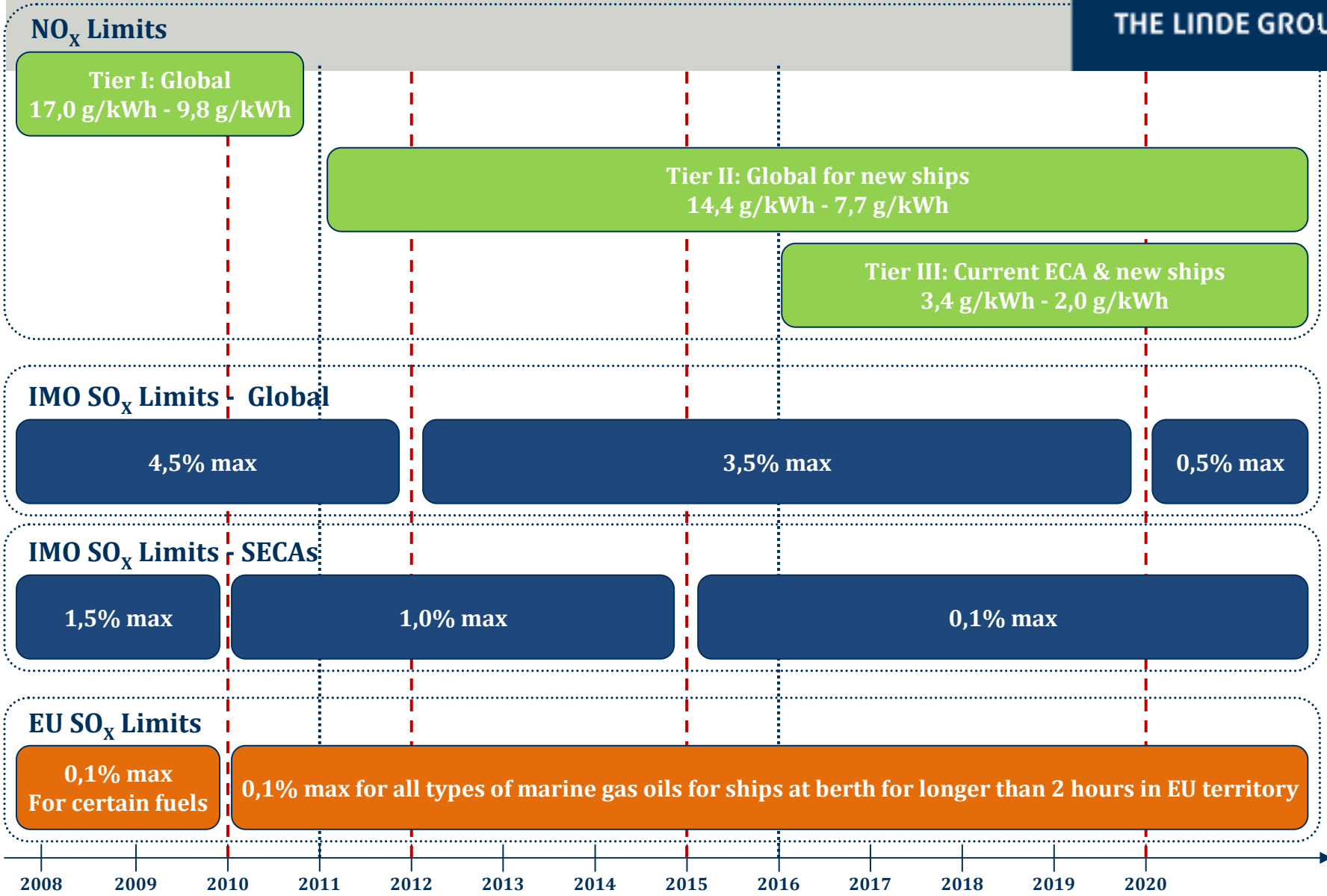
# Key data LNG terminal



- 5 year from kick off to start up
- Time from LOI to mechanical completion abt 25 months
- Full containment LNG tank (EN 1473)
- Total weight abt 21.000 tons, including LNG
- Storage volume 20.000 m<sup>3</sup> (9000 ton)
- 65.000 engineering and mgt hours
- > 850 documents delivered
- Dedicated jetty – up to 15.000 m<sup>3</sup>
- Separate unit to liquefy boil off gas
- Dedicated pipeline to Nynas refinery
- 2 truck loading units (> 20 trucks per day)
- Prepared for second tank
- Prepared for export
- 15 hours from first LNG received to operations
- New LNG trailer design – 80 m<sup>3</sup>



# Timeline of Emissions Regulations



Source: DNV's MARPOL Annex VI Brochure, Wärtsila, IMO <http://www.imo.org>

## Norwegian NOx funding – a success story

- ~ 28 % of the Baltic Sea is today defined as dead ocean
- ~2000 ships moving in/out at any time
- SOx emissions from Baltic shipping twice the Swedish and Danish land based emissions
- Low sulphur diesel, scrubber technology (LSFO) or LNG ship owner's alternatives
  
- Norway signed the 1990 Gothenburg Convention related to NOx emissions (~ 40 kton)
  - NOx emissions from Baltic shipping equal to Swedish and Danish land based emissions
  - Norwegian NOx Fund has been a success – acc. 18.000 ton NOx saved year end 2010
  - Oil and gas industry major financial contributor – cost effective solutions onboard ships/ferries
  - Abt 75 % of LNG investment can be refunded under the new regime



# CRYO AB LNG reference list – today more than 25 ships

It started with Glutra in 1999/2000





# Retrofits and new buildings in Norway/Sweden

**Tresfjord** undergoes retrofit by STX from diesel electric into gas electric operations

- New gas engine
- New generator
- LNG tank
- Automatic systems
- Water systems
- Foam
- Bback up systems etc



**Bit Viking** undergoes retrofit 2010/2011 by Wärtsilä installing “LNG Pack”

- NOx funded

New **Romsdalsfjord** ferries

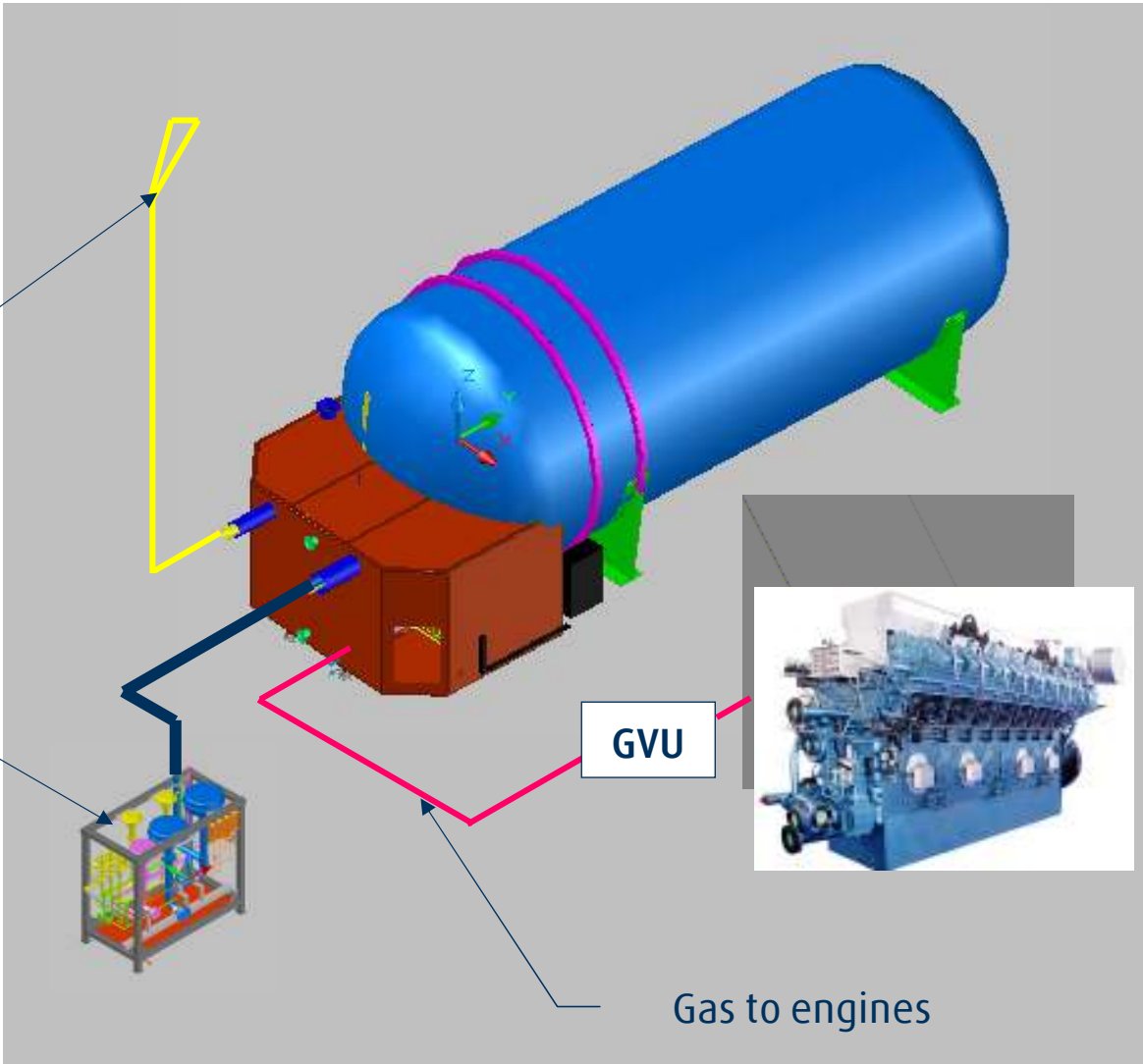
- Mitsubishi GS16R-MPTK LNG generator
- Azimut thrusters STP 1010 each 1000 kW.
- Mitsubishi S12R-MPTA diesel back-up 1000 kW.
- Cryo AB LNG tank 125 m<sup>3</sup>



# LNG unit – main components



- Tank
- Cold-box
- Cold-flare
- Bunker station
- Piping
- Nitrogen supply



### Dual fuel

- ✓ Double fuel systems = high safety
- ✓ Independent of LNG availability
- ✓ Second hand value

- ✓ More space
- ✓ More complex
- ✓ Higher investments

### Single fuel

- ✓ Single system = less space
- ✓ Lower investment , less complex
- ✓ Lower consumption and emissions
- ✓ More energy efficient

- ✓ Need 100 % LNG supplies
- ✓ Second hand value?

## Cold box unit delivered by Cryo AB

- ✓ Water heated vaporizer
- ✓ Valves pneumatically operated
- ✓ All piping to safety relief valves
- ✓ No pumps needed



## Materials used in the LNG facility

- ✓ Vessel – piping – coldbox in stainless steel
- ✓ Mild steel will cause brittle fracture in contact with LNG



# Archipelago Stockholm and LNG

Viking Line first mover in the Baltic Sea

New Stockholm- Åbo ferry 2013

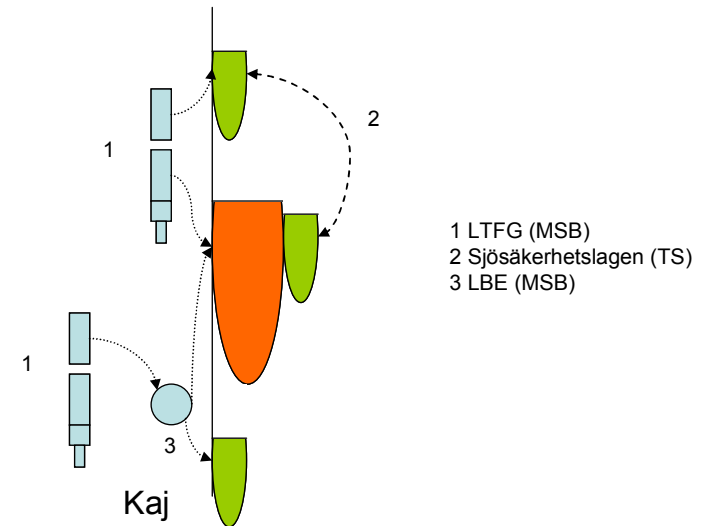
55.000 ton RoPax ferry

3 engines: HFO, MGO and LNG

2\*200 m<sup>3</sup>LNG tanks on rear deck

LNG consumption > 20.000 ton/year per ferry

Safety and bunkering procedures are key issues



# Supplying a marine client with LNG



1. By LNG semi trailer



2. From a permanent storage facility



3. By bunker barge/ferry solution



4. From terminal via loading arms

## Shell energy scenarios to 2050

### (2008 report)

Never before has humanity faced such challenging outlook for energy demand on the planet. This can be summed up summed up in five words:

“more energy, less carbon dioxide”

CEO Jeroen van der Veer

## IMO Annex VI legislation

NOx emission reduction (TIER III - 2 gr/kWh 2016)

Sulphur content globally (max 0,5% 2020)

Sulphur content SECA/ECA areas (0,1 % 2015)

+ Energy efficiency index

## New EU sulphur legislation

## Tony Öhman, Viking Line (Stockholm Feb 2011)

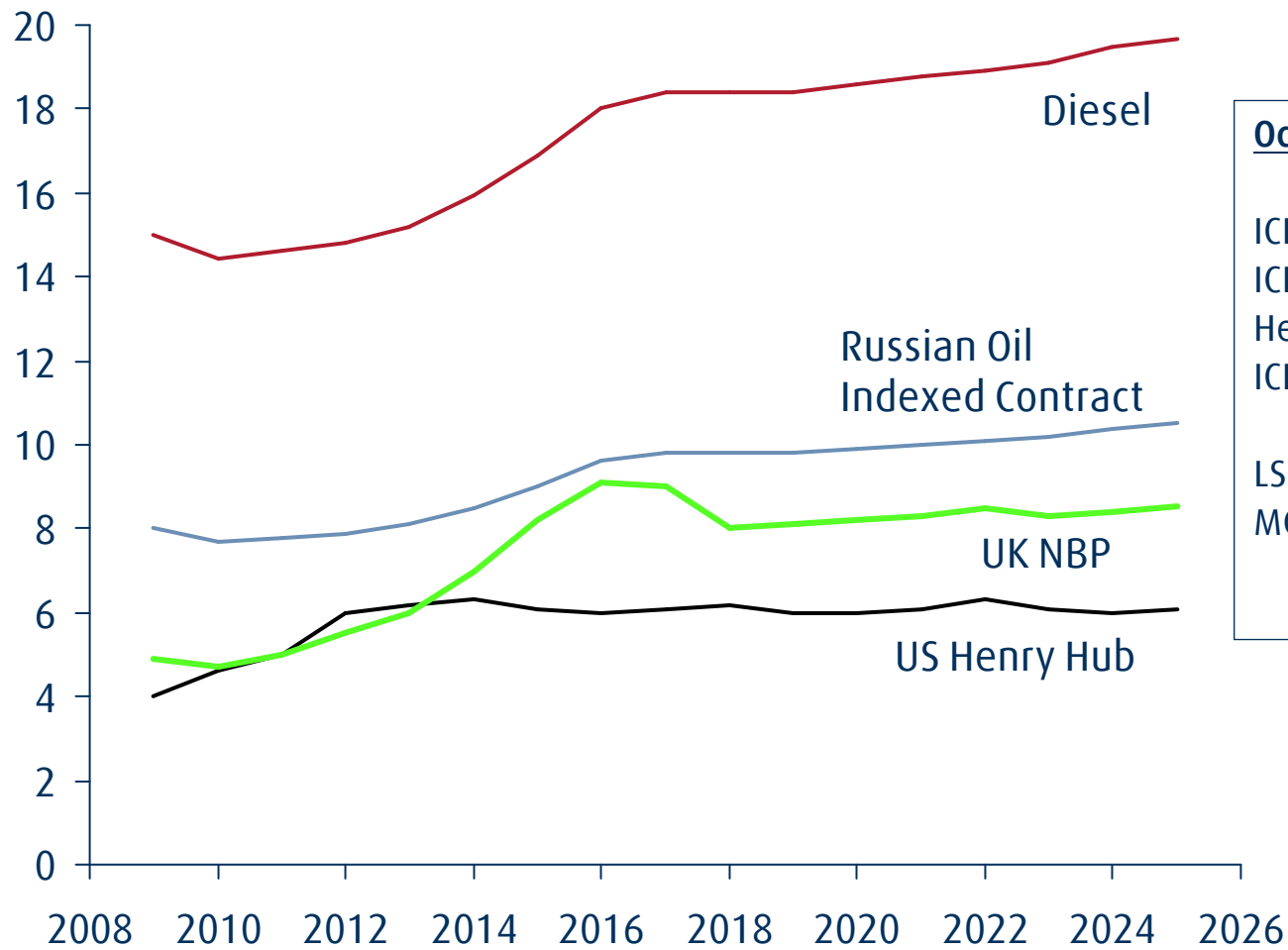
- Support from harbour authorities
- Governmental funding
- Support from class societies
- Support from approval agencies
- Industry focus
- Global interest
- Technology in place
- Regulation in place
- Simple fuel system
- No treatment of emission gases
- Strong interest from ship yards
- Suppliers in place
- Cleaner working environment
- Cleaner engines
- Less cleaning needed
- Competitive price conditions



# Fuel price will influence speed of introduction



USD/MMbtu



October 2011 (\$/MMbtu)	
ICIS NBP:	9,7
ICIS Japan:	15,6
Henry Hub:	3,6
ICIS Brent:	19,9
LSFO 1 %:	~16,0
MGO 0,1 %:	~23,0



Quality in = quality out

Thank you for your attention