LNG supply in the Baltic Sea

LNG in Baltic Sea Ports II – Final Conference
3rd of December 2015

BOMIN LINDE LNG

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Agenda

BOMIN LINDE LNG

1. Introduction

2. Bomin Linde LNG projects & operations

3. LNG pricing & summary

Bomin Linde LNG is a joint venture between The Linde Group and Marquard & Bahls to supply marine LNG

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The Joint Venture

Comments

The Linde Group

- Founded in 1879 in Munich
- Leading supplier of industrial, health care and specialty gases
- Leading supplier of cryogenic equipment and facilities

Marquard & Bahls

- Founded in 1947 in Hamburg
- Largest privately owned natural resource trader in Europe
- Global bunkering, fuel storage and handling

Agenda

BOMIN LINDE LNG

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BLLNG is a front runner in development of the complete marine LNG value chain in North West Europe

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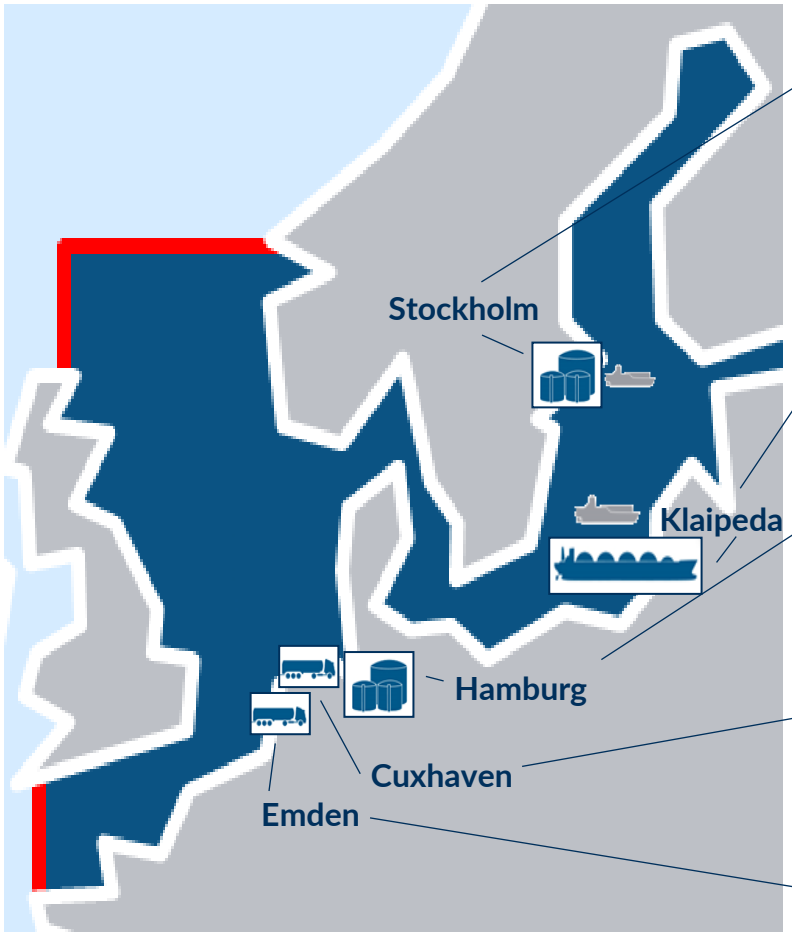
Bomin Linde LNG in Europe



Projects / Operations

Stockholm
- 20,000 cbm LNG terminal
- World's first LNG Supply Vessel: SEAGAS[1)]
- Long-term supply of Viking Grace

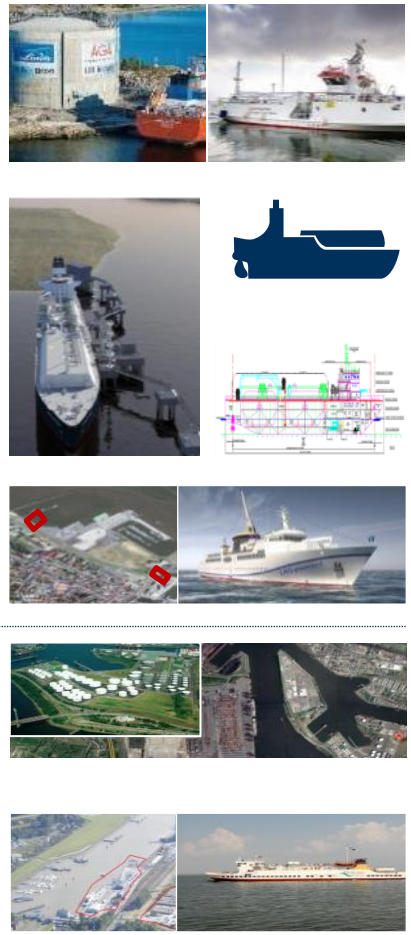
Baltics: large-scale LNG capacity & Bunker Supply Vessel (from 2017)
- Partnership with Klaipedos Nafta
- LNG Bunker Supply Vessel (under development)

Hamburg
- Flagship small-scale LNG terminal (under development)

Cuxhaven
- Long-term supply of LNG-fuelled newbuildt "Helgoland" from Q3/2015

Emden
- Long-term supply of first seagoing LNG-fuelled vessel in GER "MS Ostfriesland"

Impressions



1) Bomin Linde LNG has full access to both the LNG terminal as well as the SEAGAS fueling vessel

07/12/2015 Source: AGA, AG EMS, Klaipedos Nafta, Bomin Linde LNG

20,000 cbm LNG terminal in Nynashamn, Sweden

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The world's first LNG bunker vessel "SEAGAS"

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Bunkering operations in Stockholm

Comments

- Experience: 800+ safely completed ship-to-ship bunkering operations
- Fast fuelling operation to Viking Grace; finished in ca. 45 minutes
- "State of the art" cryogenic technology manufactured by The Linde Group

Hamburg small-scale LNG terminal: Permit request is currently being processed

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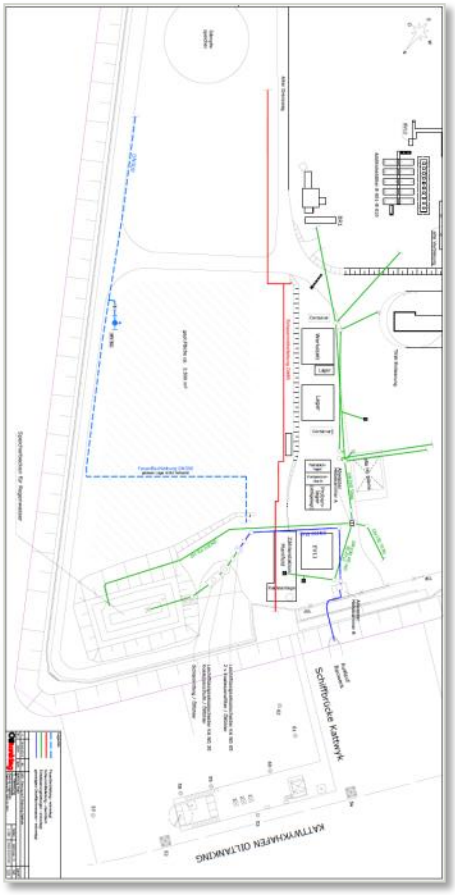
Premises: Blumensandhafen, Hamburg









Comments

- Functions of terminal include:
  - Receiving LNG from bunker supply vessels and trucks
  - Filling of LNG containers, trucks, bunker supply vessels as well as LNG-fueled vessels
- Modular construction, capacity expandable
- Basic engineering finalized
- authority approval in process (BImSchG)
- Planned to be operational by end 2017

Bomin Linde LNG has secured the first two marine LNG supply contracts in Germany

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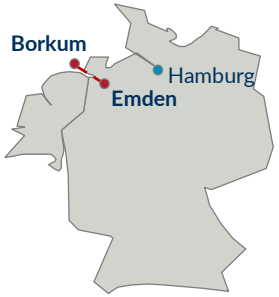
MS Ostfriesland



Co-financed by the European Union
Trans-European Transport Network (TEN-T)

MS Helgoland

Co-financed by the European Union
Trans-European Transport Network (TEN-T)

Comments

- 2014: Development of LNG fuelling procedures in cooperation with AG Ems and DNV GL
- 2015: Start of Truck-to-ship LNG supply
- Port of Emden was the first port in Germany to grant permits for regular LNG fuelling operations

BLLNG and Klaipedos Nafta jointly developing the LNG market in the Baltic Sea

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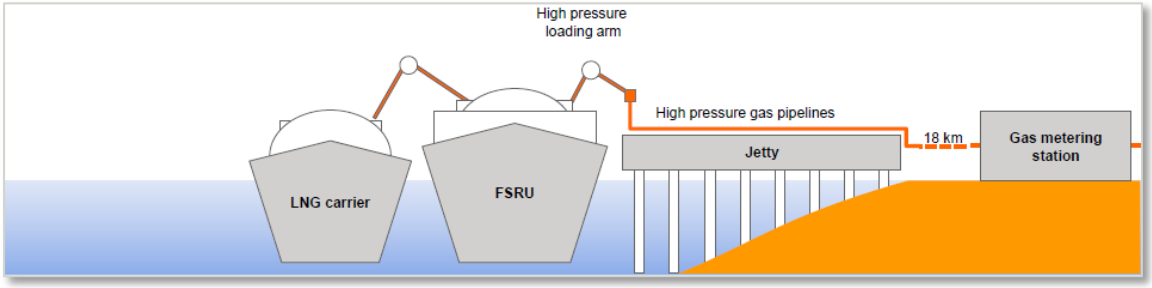
FSRU "Independence"

KLAIPĖDOS NAFTA



Comments

- Q1/2015:
  Memorandum of Understanding between Klaipedos Nafta & Bomin Linde LNG signed
- Q4/2015:
  Bomin Linde LNG & Klaipedos Nafta established joint-venture for LNG Bunker Supply Vessel

Next steps:

- Signing charter contract / placing order for the LNG BSV
- Bomin Linde LNG to become capacity holder in the FSRU "Independence", Klaipeda
- LNG Bunker Supply Vessel will be operational in 2017

12/7/2015 Source: Klaipedos Nafta, Bomin Linde LNG

LNG Bunker Supply Vessel combines highest safety standards & superior performance

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Vessel

- LOA: 110 m
- Breadth: 18 m
- Draught: 5.3 m
- Crew: max. 20
- Ice class: 1A

LNG

- Capacity: 7,500 cbm (LNG)
  170 cbm (MGO)
- Tank type: Type C
- Pressure: 3.75 bar(g)
- Hose diameter: 6 inch (4+8 opt.)
- Flow rate: 60 -1,250 cbm /h
- Delivery height: 1 – 20 m

Set-up

- Speed: 13 knots
- Generator: 3 DF gensets
- Propulsion: 2 x azimuth thrusters
  2 x pump jets

Re-liquifaction unit onboard, (no „aging“)

No Gas-Combustion Unit (zero-emission)

Dynamic Positioning 2 (DP2) ready

LNG quality: state-of-the-art equipment onboard ensures accurate measurement of LNG quality & mass

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Gas Chromatograph & Coriolis Flow Meter

Comments

Gas Chromatograph:

- LNG quality will be constantly analyzed by a gas chromatograph
- Gas chromatograph will regularly re-calibrate via reference gas

Coriolis Flow Meter:

- Flow (mass) will be measured by a coriolis mass flow meter

Official LNG Bunker Delivery Note

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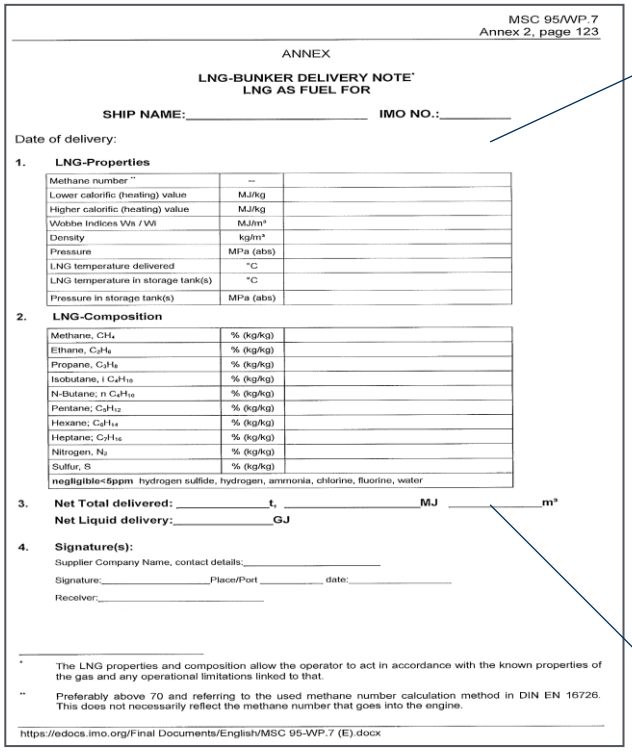
Issued by the International Maritime Organization (IMO)



MSC 95/WP.7
Annex 2, page 123

ANNEX

LNG-BUNKER DELIVERY NOTE*
LNG AS FUEL FOR

SHIP NAME:_____ **IMO NO.:**_____

Date of delivery:

1. LNG-Properties

Methane number **	--	
Lower calorific (heating) value	MJ/kg	
Higher calorific (heating) value	MJ/kg	
Wobbe Indices Ws / Wi	MJ/m³	
Density	kg/m³	
Pressure	MPa (abs)	
LNG temperature delivered	°C	
LNG temperature in storage tank(s)	°C	
Pressure in storage tank(s)	MPa (abs)	

2. LNG-Composition

Methane, CH_4	% (kg/kg)	
Ethane, C_2H_6	% (kg/kg)	
Propane, C_3H_8	% (kg/kg)	
Isobutane, i C_4H_{10}	% (kg/kg)	
N-Butane; n C_4H_{10}	% (kg/kg)	
Pentane; C_5H_{12}	% (kg/kg)	
Hexane; C_6H_{14}	% (kg/kg)	
Heptane; C_7H_{16}	% (kg/kg)	
Nitrogen, N_2	% (kg/kg)	
Sulfur, S	% (kg/kg)	
negligible<5ppm hydrogen sulfide, hydrogen, ammonia, chlorine, fluorine, water		

3. Net Total delivered: _____t, _____MJ _____m³
Net Liquid delivery:_____GJ

4. Signature(s):
Supplier Company Name, contact details:_____
Signature:_____Place/Port _____ date:_____
Receiver:_____

* The LNG properties and composition allow the operator to act in accordance with the known properties of the gas and any operational limitations linked to that.

** Preferably above 70 and referring to the used methane number calculation method in DIN EN 16726. This does not necessarily reflect the methane number that goes into the engine.

https://edocs.imo.org/Final Documents/English/MSC 95-WP.7 (E).docx

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negligible<5ppm hydrogen sulfide, hydrogen, ammonia, chlorine, fluorine, water		

Flexible LNG Ship-to-Ship bunkering solution

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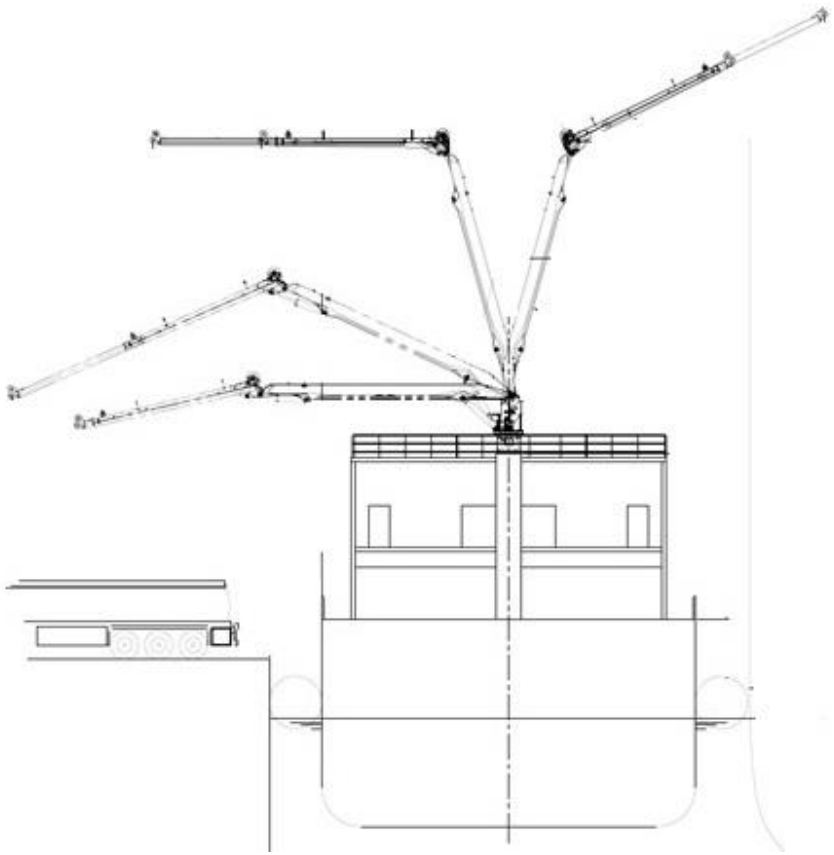
Two knuckle-boom crane



Comments

- Two knuckle-boom crane with telescopic extension using flexible hoses
- Operating radius: +1 - +20m above water level
- Fibre-optical and hard wired ESD interfaces
- Quick release coupling with integrated automatic release (ESD2) & break-away coupling
- Vapor return (high pressure compressor)
- Flow: 60 – 1,250 cbm/h
- Compliant with SIGGTO & SGMF regulations as well as ISO 20519 (specification for bunkering of gas-fuelled ships)

Bomin Linde LNG ensures availability of LNG for various customer segments

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Break-bulk hub in the Baltic Sea

Comments

1. LNG bunkering of maritime customers
2. LNG supply to small scale terminals
3. LNG supply via truck

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A wide variety of LNG price indexations and flexible contract durations are being offered

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Contract Durations	Availability
Short-term contract (<3 years)	Offered by Bomin Linde LNG including specific conditions
Mid-term contract (3-5 years)	Offered by Bomin Linde LNG
Long-term contract (5 – 10 years)	Offered by Bomin Linde LNG

LNG Indexations	Type	Hub/Index Location	Status	Comments
Title Transfer Facility (TTF)	Gas	The Netherlands	Default	▪ Customised LNG pricing formulas will be offered indexed to the preferred product.
National Balancing Point (NBP)	Gas	United Kingdom	Default	
Henry Hub (HH)	Gas	U.S.A.	Default	
Marine Gas Oil Futures (ICE)	Oil	Europe/USA/Canada	Default	
Brent Futures (ICE)	Oil	Europe/USA/Canada	Default	

Commercial feasibility:
Consider main drivers of LNG pricing at early stage

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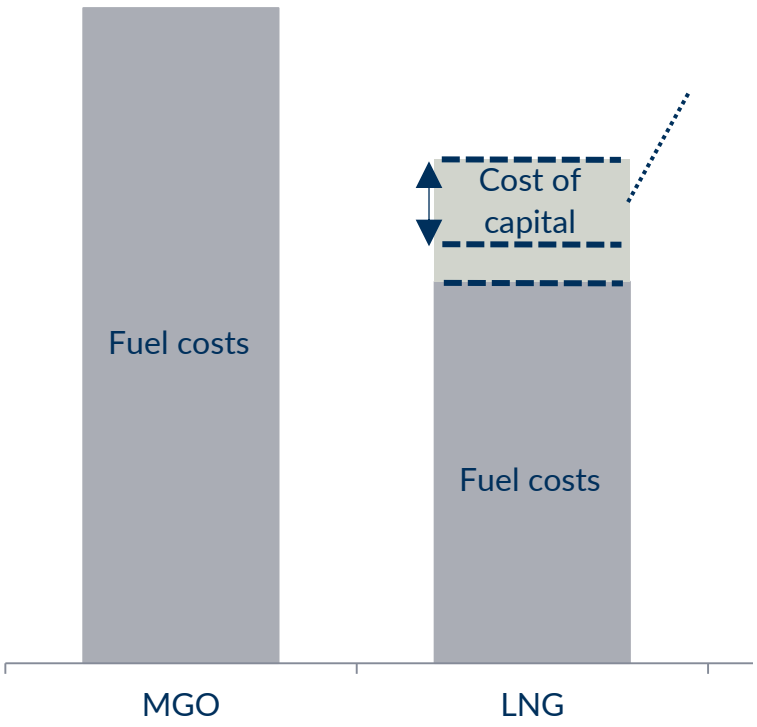
Fuel: Cost perspective in shipping (MWh)



Comments

Most important drivers for competitive LNG price for maritime customers:

- Bunker location
- Bunker frequency
- Small-scale supply chain
- LNG volume (economies of scale)
- Long term partnership

LNG can be offered at an attractive discount to MGO, ensuring payback for additional investments in LNG Equipment

07/12/2015 Source: Bomin Linde LNG

LNG market outlook:
Additional supply in the global LNG market expected

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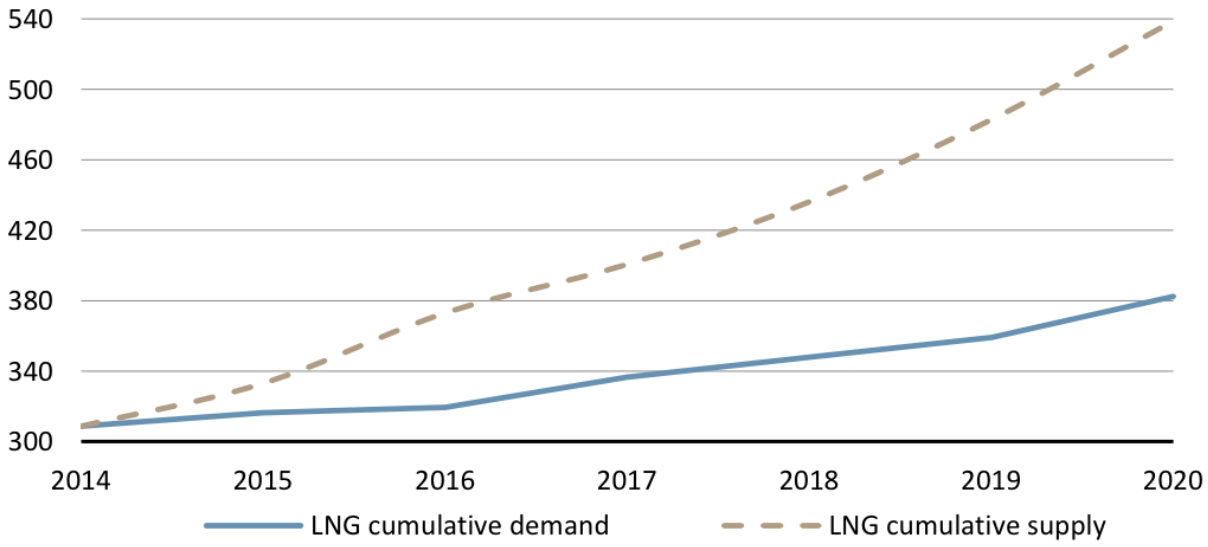
LNG supplies +75% by 2020 (bcm)



Bomin Linde LNG as an independent LNG supplier and its customers will participate from a "buyer friendly" global market

Comments

Main driver for increasing LNG volume in the market:

- U.S. LNG exports:
  - Sabine Pass (start 2015)
  - Cameron LNG (FID)
  - 5+ other US terminals have applied for export licenses
- Australian LNG export
  - Additional volumes expected from 2016

Analysts see strong growth of LNG bunkering

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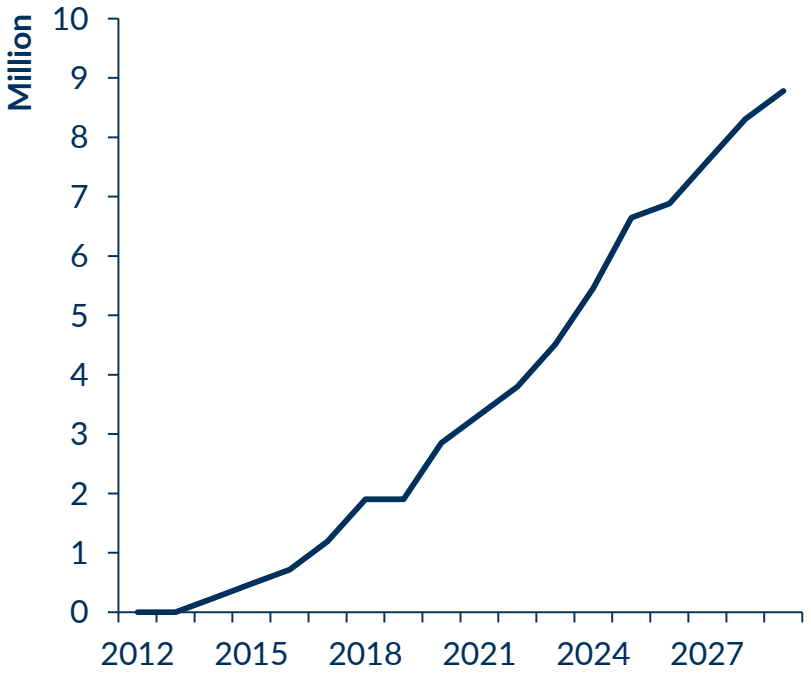
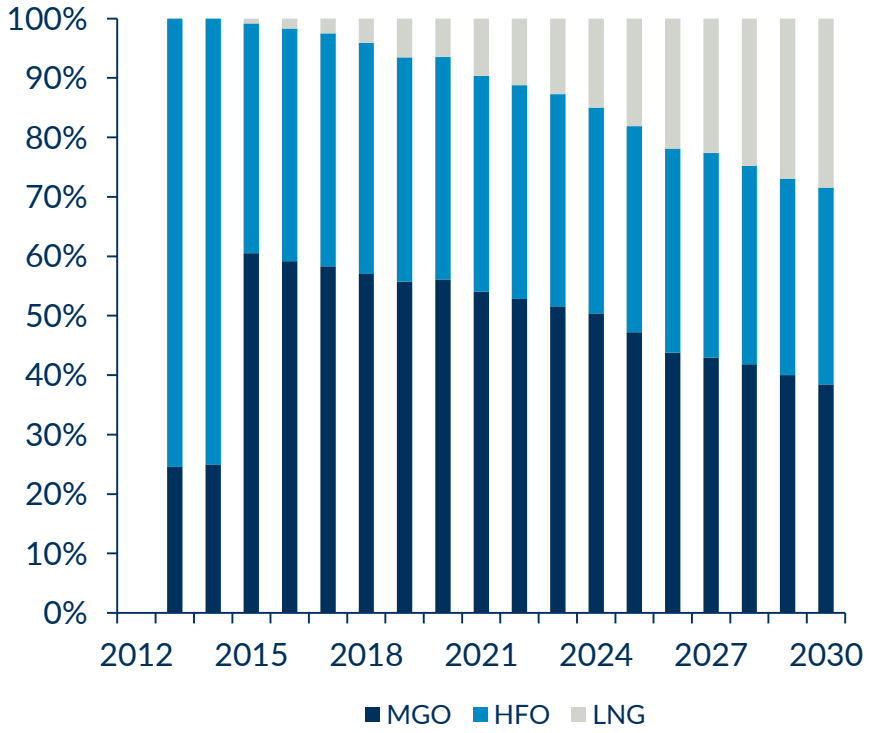
Market forecast (WoodMacKenzie 2014)

Volume LNG bunker market North Western Europe [tpa]



Share LNG in total bunker market North Western Europe



LNG is predicted to play an important role in the future's maritime fuel mix, even if HFO/MGO remain dominating fuels

12/7/2015 Source: WoodMacKenzie, Bomin Linde LNG

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Bomin Linde LNG – Profile Summary (1/2)

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Independent and flexible LNG supplier

- ✓ Partnership approach with tailor-made supply chain solutions
- ✓ Leading LNG bunker supplier in North-West Europe

MARQUARD & BAHLS

THE LINDE GROUP

Experienced and committed shareholders

- ✓ Linde Group: Engineering, industrial gases & cryogenic experience. Worlds' first LNG barge "SEAGAS" operating in Stockholm conducted over 800 safe ship-to-ship fueling operations (AGA)
- ✓ Marquard & Bahls: International bunkering & trading expertise
- ✓ Oiltanking/Bomin: Worldwide storage and bunkering solutions for traditional maritime fuels

HPA Hamburg Port Authority

Niedersachsen Ports

Ports of Stockholm

Strong port network and operational experience in approval process

- ✓ Port of Stockholm: Mid-scale terminal, bunker supply vessel
- ✓ Port of Hamburg: Small-scale terminal
- ✓ Port of Emden & Cuxhaven: Truck-to-ship bunkering
- ✓ Port of Klaipeda: FSRU and bunker supply vessel

Bomin Linde LNG – Profile Summary (2/2)

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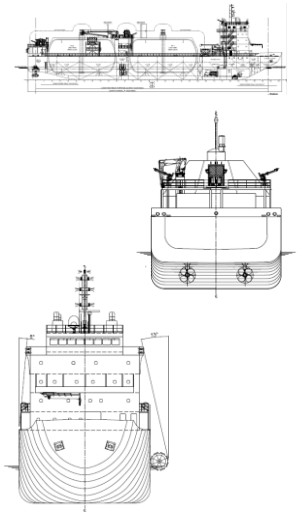

State-of-the-art LNG bunker supply vessel with proprietary technology

- ✓ DP 2 equipment allows for flexible offshore bunkering operations
- ✓ Re-liquefaction equipment onboard utilizing Brayton cycle technology
- ✓ Able to supply LNG at constant temperatures via sub cooling unit
- ✓ Fast LNG transer with rates of up to 1.250 cbm per hour
- ✓ Highly maneuverable with 2 x azimuth thrusters and 2 pump jets
- ✓ Compliant with all SIMPOS regulations
- ✓ Environmentally friendly operations – no gas combustion unit

Closely involved in developing uniform international bunkering standards

- ✓ Committee member at the Society for Gas as Marine Fuel (SGMF)
- ✓ Committee member of DIN & ISO for LNG application in maritime industry
- ✓ Committee member of European Sustainable Shipping Forum (ESSF)

Unique access to global LNG markets

- ✓ Multiple locations of supply with attractive commercial terms
- ✓ Large network of reputable multinational LNG suppliers