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Developments in World-Scale LNG

Focus Russia - Linde Perspective

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Developments in World-Scale LNG

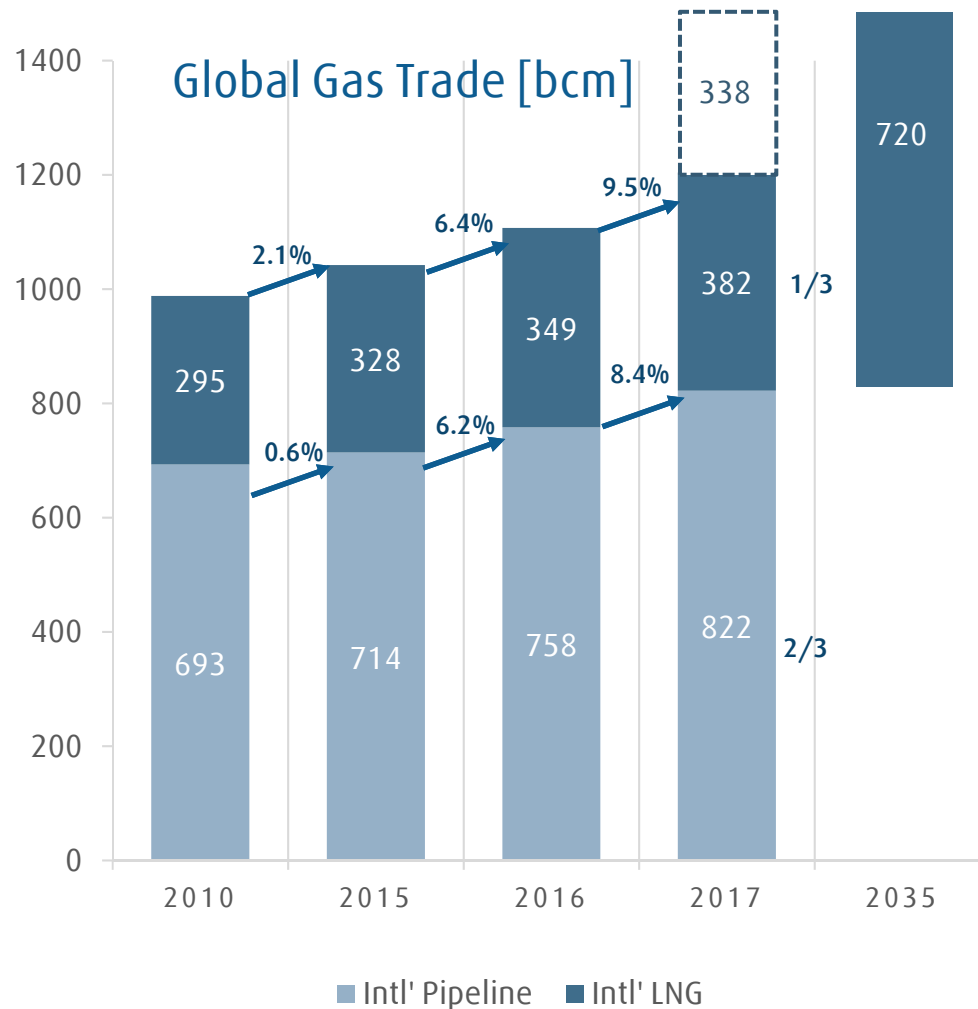
Linde Perspective – Focus Russia



1. International Natural Gas Trade - Pipeline versus LNG
2. World-Scale Natural Gas Liquefaction Technologies
3. Relevant Projects in Russia
 - Sakhalin LNG
 - Portovaya LNG
 - Amur GPP
 - Arctic LNG 2
 - Baltic LNG

Developments in World-Scale LNG

International Natural Gas Trade – Pipeline versus LNG

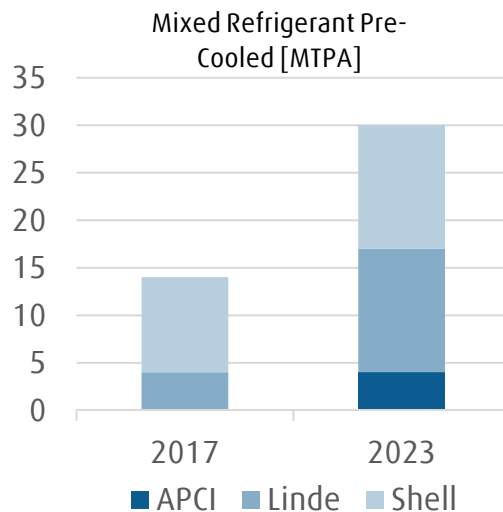
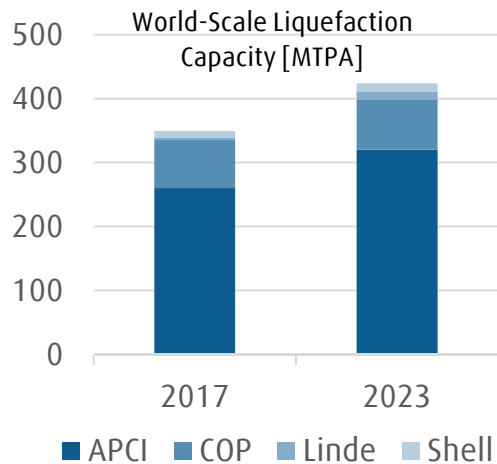


- Growing share of LNG in international natural gas trade, today app. 1/3
- LNG trade almost doubling by 2035 adding another 338 bcm (app. 270 MTPA)
- With average load of 90% this would require **300 MTPA new liquefaction nameplate capacity** until 2035 equal to 50 trains of 6 MTPA each

Sources: Global gas Report 2018, IGU, BCG, Global Gas & LNG Outlook 2035 McKinsey

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World-Scale Liquefaction Technologies



- ~ 95% of today's installed LNG capacities:
 - use C3-precooling and are installed in warm climate
 - Use APCI or ConocoPhillips technology
 - ConocoPhillips is losing competitiveness and phasing out for greenfield projects
 - C3-precooling unsafe in FLNG type projects (dense modules)
- ~ 5% of today's installed LNG capacity use mixed refrigerant pre-cooling from either Linde or Shell
- LNG developments in colder climate zones and FLNG-type projects will widely use mixed refrigerant pre-cooled technologies

Sources: Global Gas Report 2018, IGU, BCG, p. 22

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Sakhalin LNG – Supply of Coil Wound Heat Exchangers

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- Installed CWHEs in LNG Plant Sakhalin2:
 - 2 x HP-Precooler, 2 x LP-Precooler, 4 x MCHE, all in aluminum, total weight app. 550 tons
 - Endflash in stainless steel, app. 30 tons
- Total installed liquefaction capacity: > 10 MTPA



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Portovaya LNG - Stepping Stone for Russian Suppliers

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- 1.5 MTPA LNG plant with 42.000 m³ flat bottom tank
- EPSS contract award end 2016, **cooperation with main contractor Peton SRDI**
- **Ladoga 32 gas turbines** (RepHolding) as main compressor drive
- **Russian manufactured 9% Ni Steel Plates** (Severstal) qualified and first time used for LNG tank



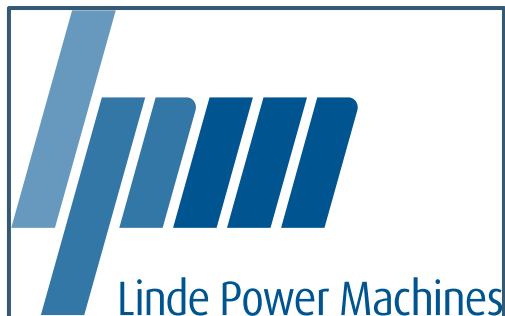
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Amur GPP – Coil Wound Heat Exchanger (CWHE)

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- 6 x 7 bln Sm³/a feed gas capacity (42 bln Sm³/a)
- Separation of He, N₂, C₂-C₅
- **Worlds largest He-plant** (3 x 20 mio. Nm³/a)
- **Deep cryogenic**, involving full condensation and vaporisation of CH₄ equivalent to app. 30 MTPA (“implicit LNG plant”)
- **Fabrication of CWHE at Linde Power Machines in St. Petersburg**

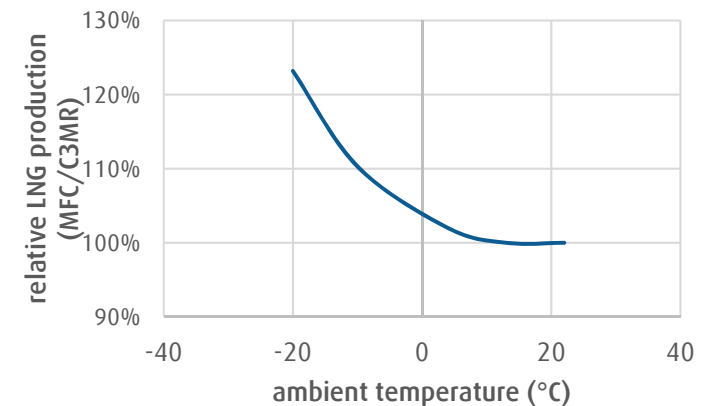
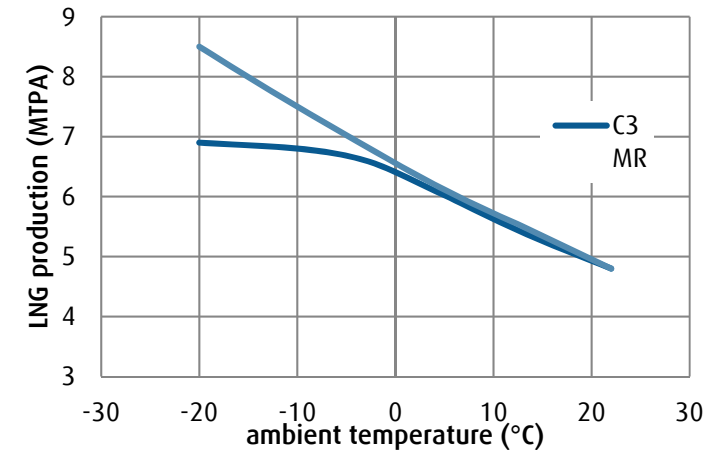


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Arctic LNG 2 – Optimised for Cold Climate & Modules



- 3 x 6.6 MTPA mixed fluid cascade (MFC)
- **Optimisation of process for dense modules and cold cyclic climate** (C3-compressor in kick-back below 0°; e.g. MFC capacity app. 10% higher at -10°)
- FEED for Liquefaction Island, process design package, supply of main cryogenic heat exchangers and site services
- **Extensive development of economic solutions compliant with Russian Codes & Standards**



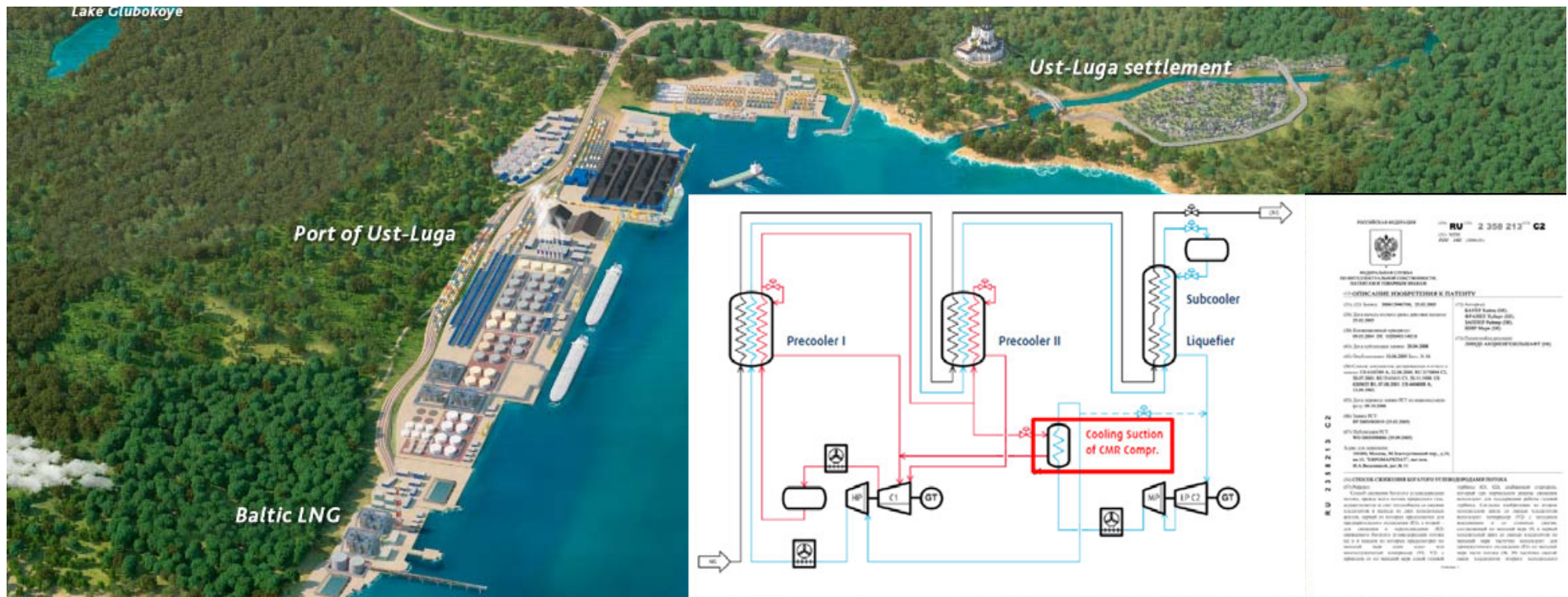
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Baltic LNG - Perspective

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- 2 x 6.5 MTPA, based on dual mixed refrigerant liquefaction process
- Linde suggests Dual Mixed Refrigerant Process (permutation of MFC), patented in Russia
- Linde prepared to maximize localisation and contribute with long-standing experience in Russia in execution, localisation and codes and standards





International
Business Congress e.V.



Announcement 2019

22nd Annual General Meeting of IBC e. V.

Thursday, May 30th, 2019

Annual General Meeting and Conference:

„Natural Gas – Paving the Way to Low Carbon Economy“

Reception and Gala Dinner

Friday, May 31st, 2019

Meeting of the IBC Working Committees



Hosting Companies

