

Gas and Process Division



Smart and Clean

Capital Markets Day 2006

Dré Schmitz, President Gas and Process Division

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Smart & Clean

Natural Gas

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Driver for Smart and Clean
...is the growing demand for energy driven gas power station

Application fuel gas to the main gas turbine

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Increase in Primary Gas Demand

Year	Power generation	Industry	Residential and services	Other	GTL
1980	0.2	0.8	0.2	0.1	0.0
1990	0.5	1.0	0.3	0.2	0.0
2002	1.0	0.8	0.4	0.3	0.0
2010	1.5	0.8	0.5	0.3	0.0
2020	2.0	1.0	0.8	0.4	0.1
2030	2.5	1.2	0.8	0.5	0.2

Source: IEA World Energy Outlook 2004

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Distribution of Natural Gas

Pipeline



LNG carriers

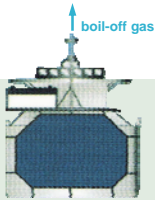


CNG carriers feasibility study short distance

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LNG – Liquefied Natural Gas



Liquid form at atmospheric pressure and temperature $-161\text{ }^{\circ}\text{C}$

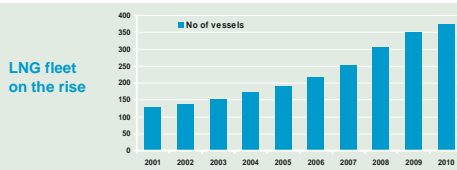
Reducing volume by a factor of 610

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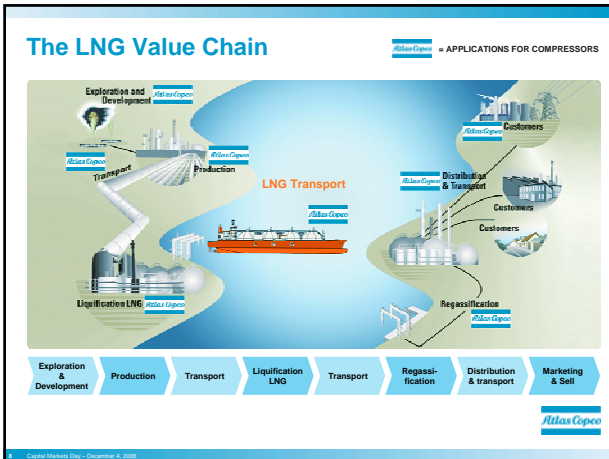
World LNG Potential

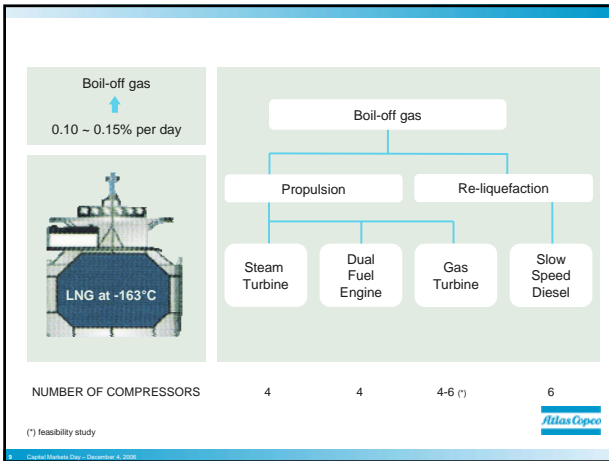
- The 12 countries that currently export LNG have approximately 28 percent of world natural gas reserves.
- Three countries with 33 percent of the world's reserves are currently building their first liquefaction facilities.
- At least seven additional countries, with 19 % of the world's reserves, are potential LNG exporters.



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Trend

- Traditional steam turbine powered LNG of 135 - 145 tm³ is virtually a thing of the past
- The majority of new ships currently being specified are
 - 210-217 tm³ with low speed diesel and on board reliquefaction
 - 150-180 tm³ with dual fuel diesel electric propulsion
- Forecast 2006 - 2011
 - Steam 19 vessels (14%) ➡ 76 compressors
 - Dual fuel 69 vessels (50%) ➡ 276 compressors
 - Reliquefaction 51 vessels (36%) ➡ 306 compressors

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LNG Equipment from Atlas Copco

SHIP'S PROPULSION SYSTEM		STEAM TURBINE	DUAL-FUEL ENGINE	GAS TURBINE	DIESEL & DIESEL ELECTRIC
GAS COMPRESSORS	L/D compressor, single-stage	✓			
	L/D compressor, two-stage		✓		
	L/D compressor, multi-stage			✓	
	H/D compressor, single-stage	✓	✓	✓	✓
RELIEF VALVES, COMB. COILS & EXPANDERS	Nitrogen compressor				✓
	Nitrogen booster expander				✓
	Nitrogen compander				✓
	BOG compressor, two-stage				✓
HEATERS, VAPORIZERS & VAPORIZERS	L/D gas heaters	✓	✓	✓	
	L/D forcing vaporizer	✓	✓	✓	
	Mist separator		✓	✓	
	L/D combined vaporizer / gas heater		✓	✓	
	H/D gas heaters	✓	✓		✓
	LNG vaporizer	✓	✓	✓	✓
	BOWU heater	✓	✓	✓	✓

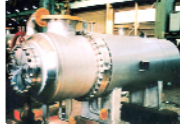
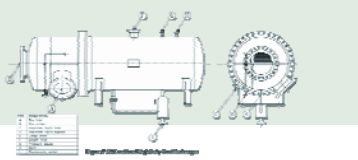
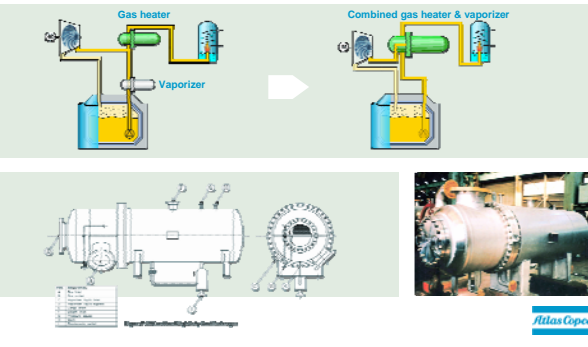


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Combined gas heater / vaporizer

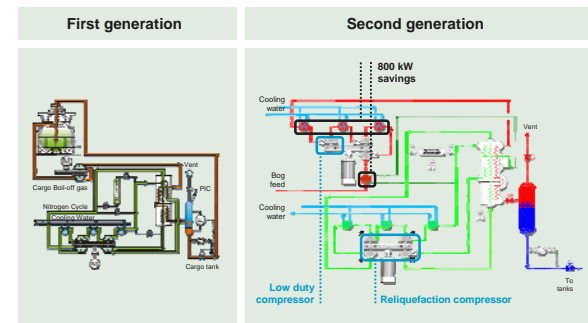
New Technology



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LNG – Reliquefaction



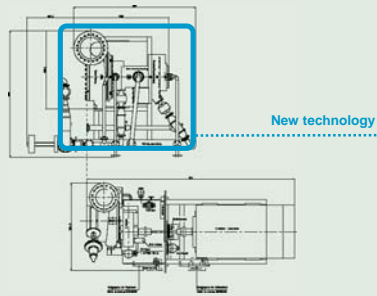
Low duty compressor

Reliquefaction compressor

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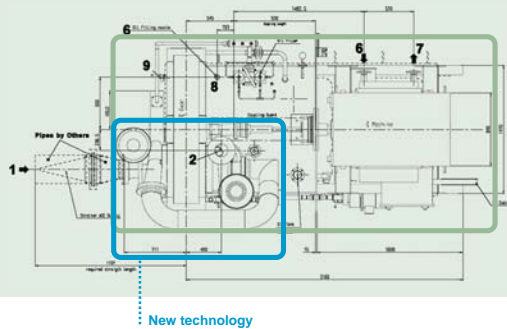
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Size Comparison – HD Compressor



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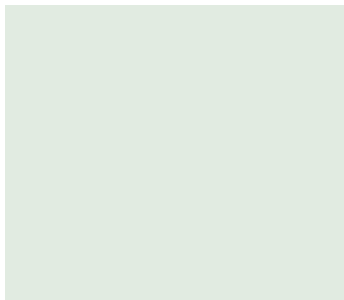
Size Comparison – LD – BOG 2 Stage



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High Speed Direct Drive Compressor

New Technology



Advantages:

- Weight and space reduction
- Efficiency improvement
- No gear box required
- No lube oil system required
- Life cycle cost reduced

play movie

continue



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Example for Energy Recovery

Not for LNG



Zandvliet – GT098 L4K1 + 2x ETI 450 NS

Process conditions GT098 L4K1

- Medium Air
- Inlet pressure 0.97 bar A
- Discharge pressure 10.75 bar A
- Flow 102.232 m³/hr
- Shaft power 12,310 kW

Process conditions Twin ETI 450 NS

- Medium N₂
- Inlet pressure 8.00 bar A
- Discharge pressure 1.35 bar A
- Flow 41,000 Nm³/hr each
- Shaft power 2,232 kW

Energy savings



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Summary

- LNG demand is growing 8% per year
- The growth is driven by gas power stations
- We have developed the products together with our customers
- Technology can also be used for other applications
- The technology used contributes to a better environment and energy savings



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We are committed to your superior productivity through interaction and innovation.



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