Liquefied Natural Gas and Regasification

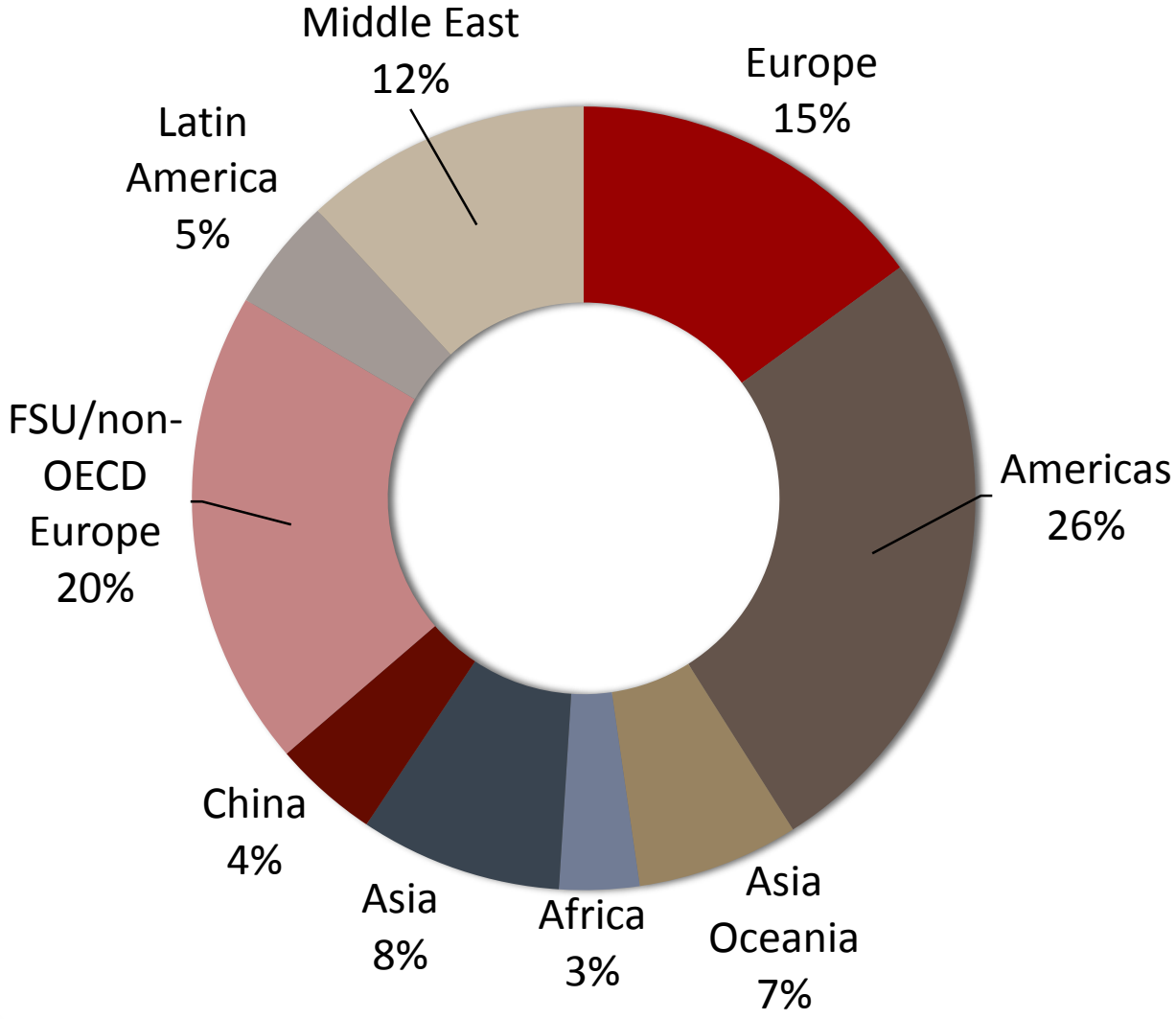
Harvard Energy Journal Club

April, 2015

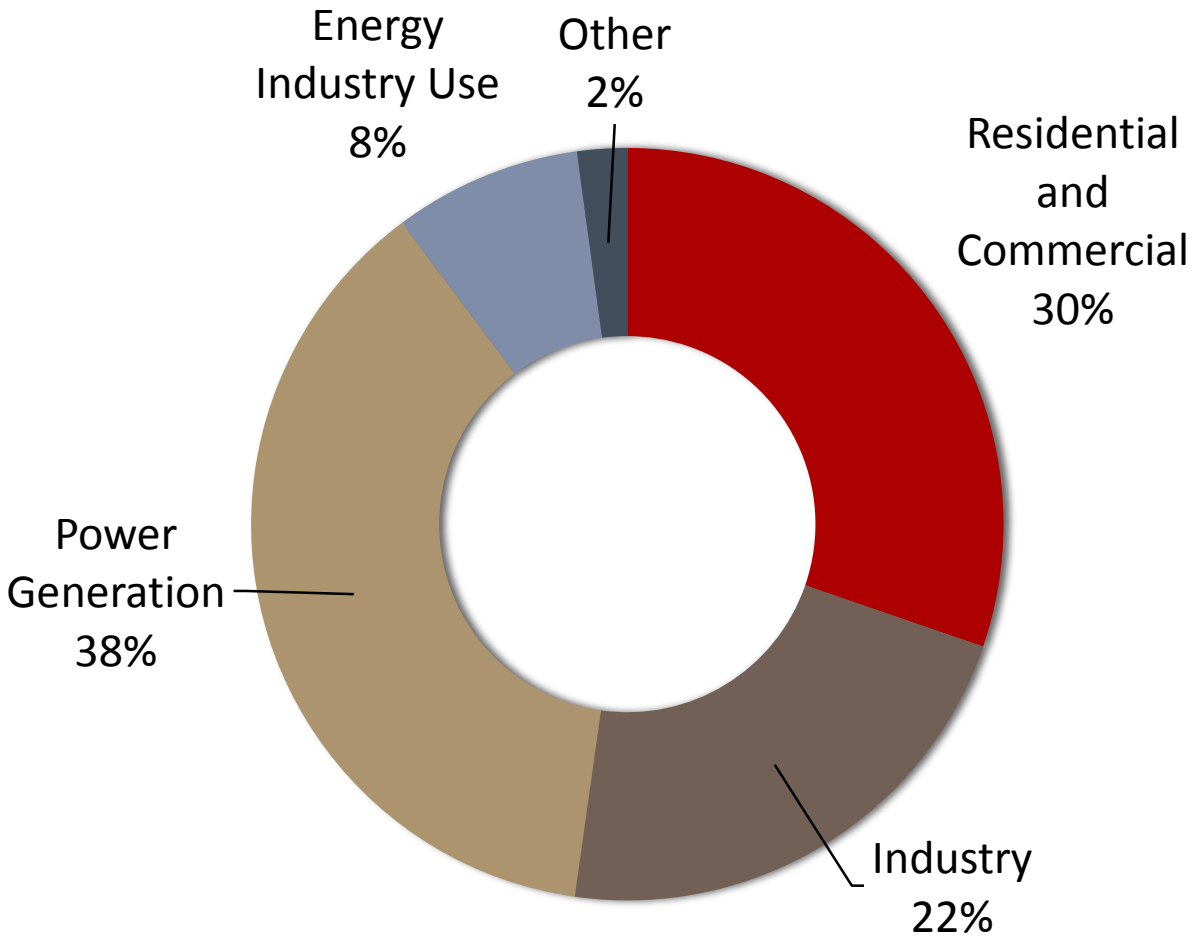
Talk outline

- Natural Gas Market Overview
- What is LNG?
- Market Outlook

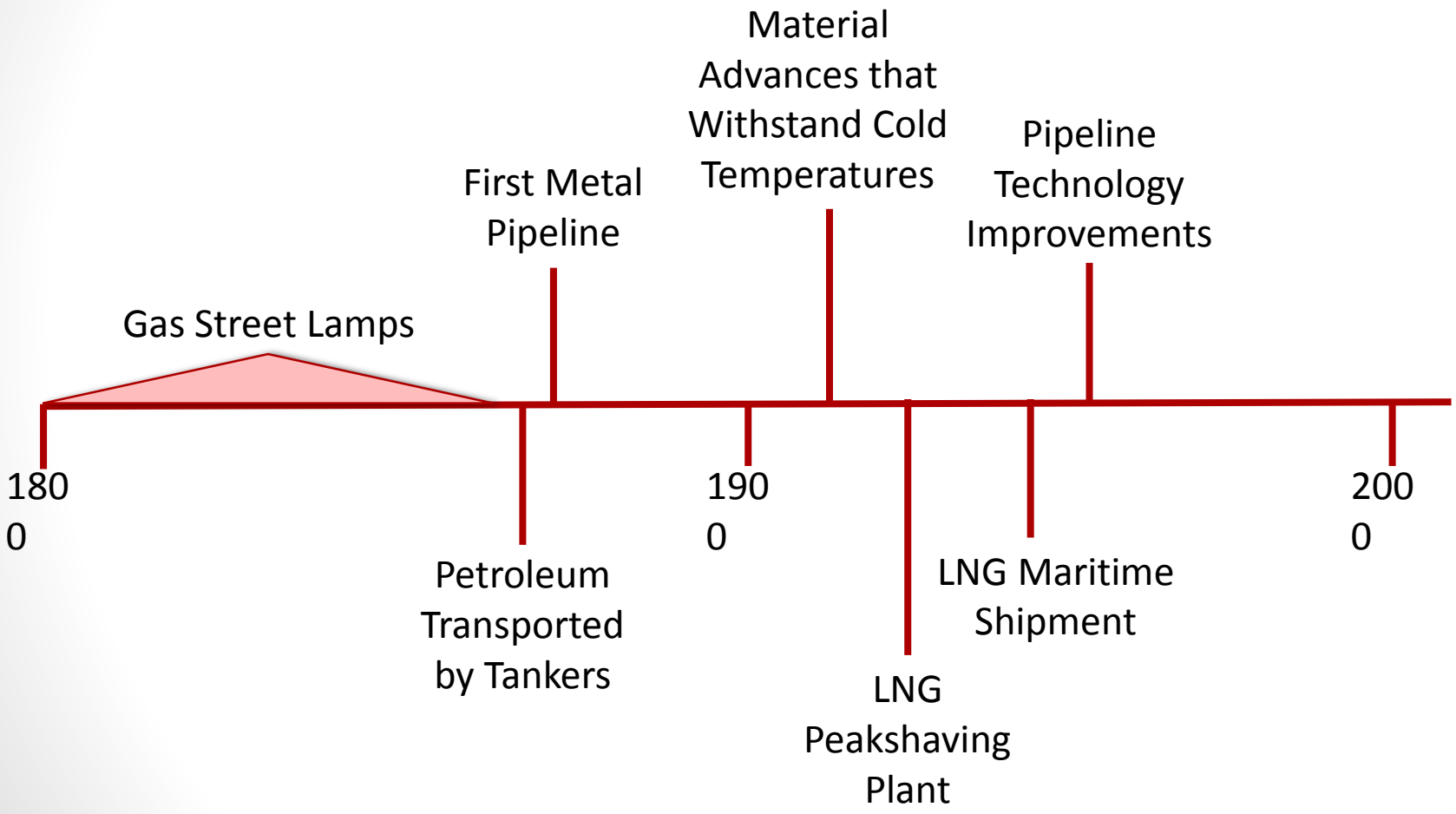
Global Natural Gas Demand 3,427 BCM



Natural Gas Sector Use



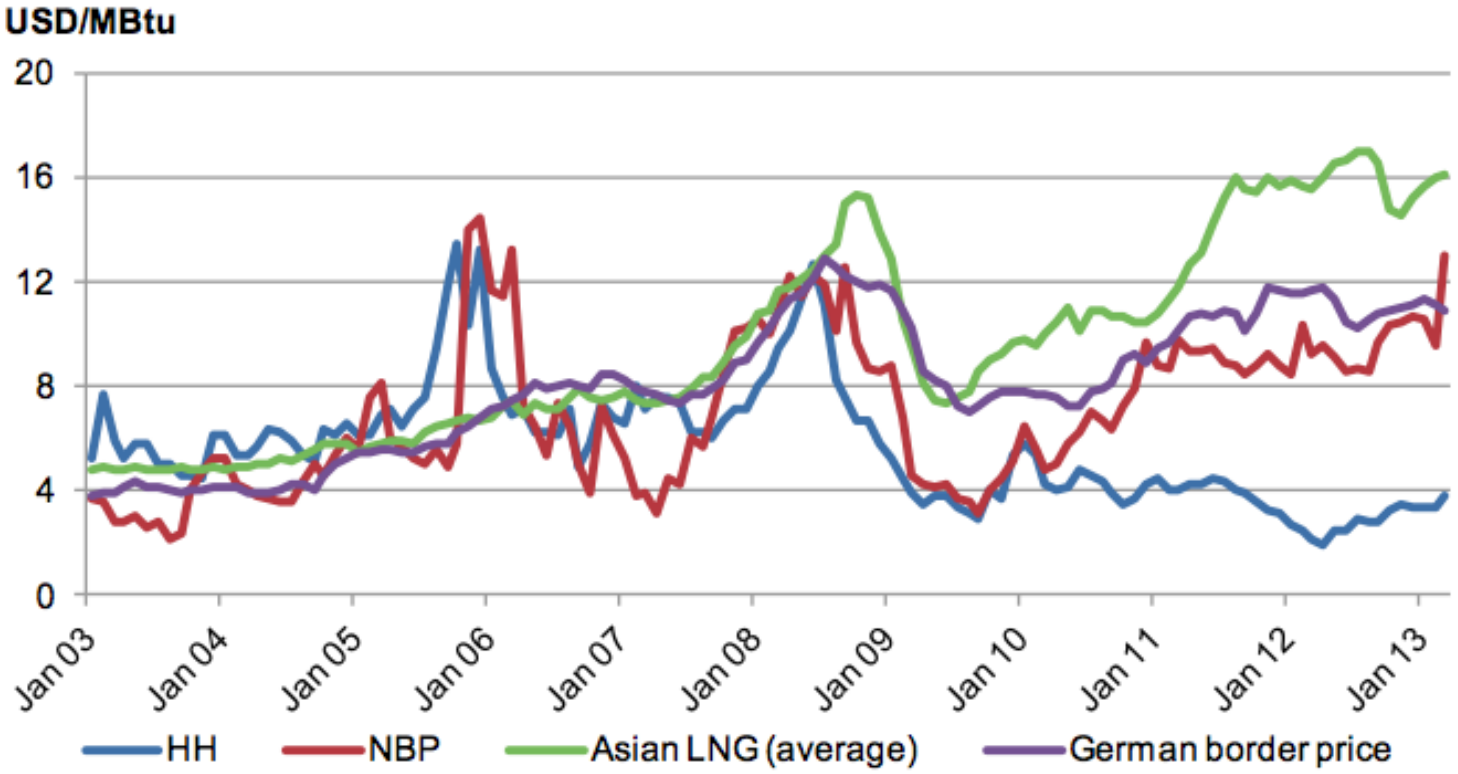
Natural Gas Timeline



Tusiani, MD and Shearer, G (2007)

Natural Gas Pricing

Figure 54 Gas price developments in the three main regional markets, Jan 2003-Jan 2013



IEA (2013)

LNG

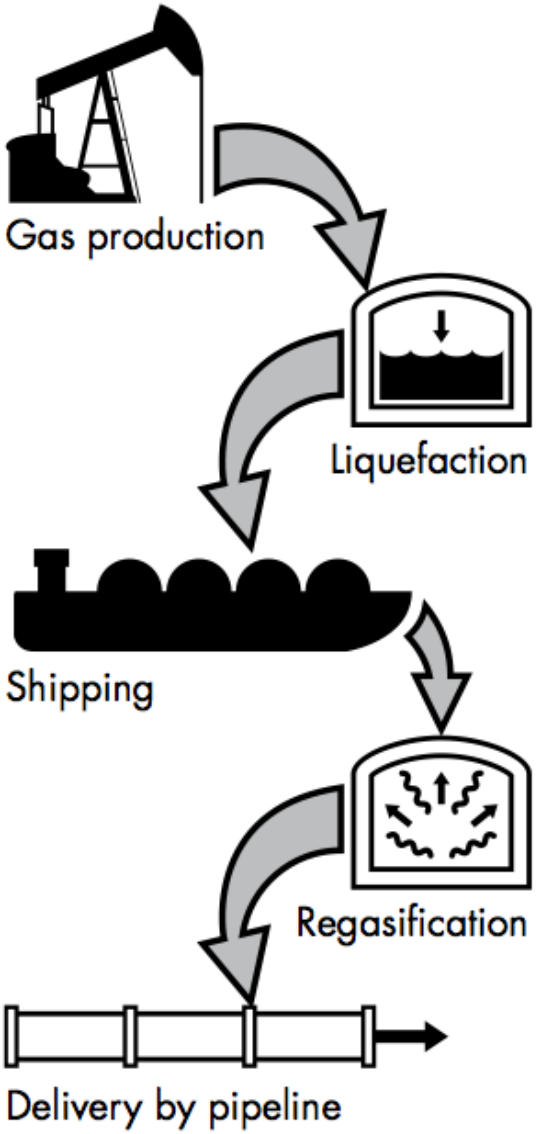
- Reduce volume via cooling the gas to a liquid
  - Boiling Point: -163^{o}C
  - Volume reduction > 600 fold
- Auto-refrigeration sustains liquid form
- Either use as LNG, or reheat to return to gas state

When liquefied, natural gas that would fill a beach ball...

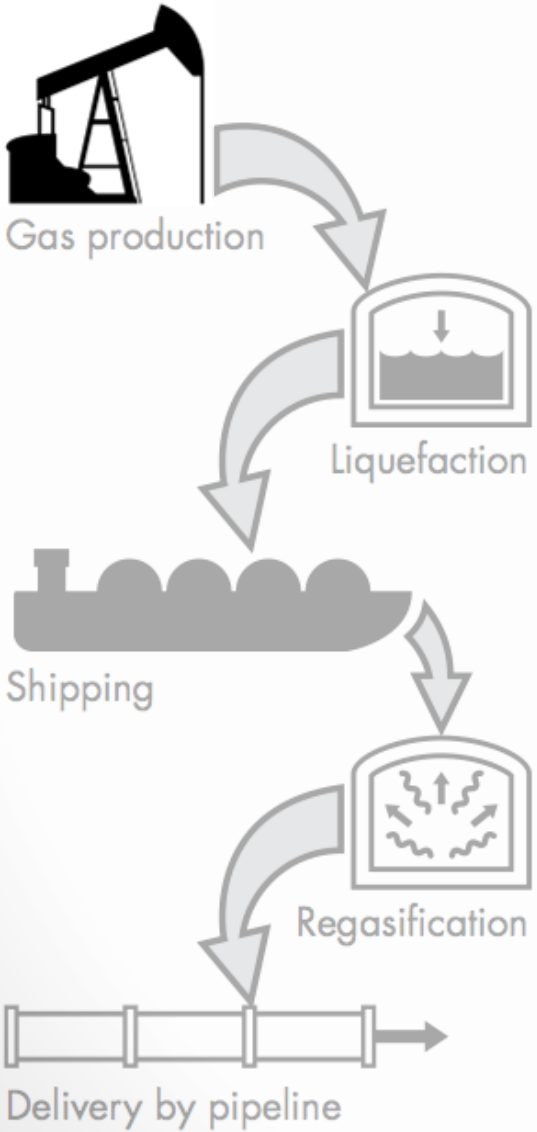
...becomes LNG that can fit inside a ping-pong ball.

DOE (2005)

LNG Value Chain

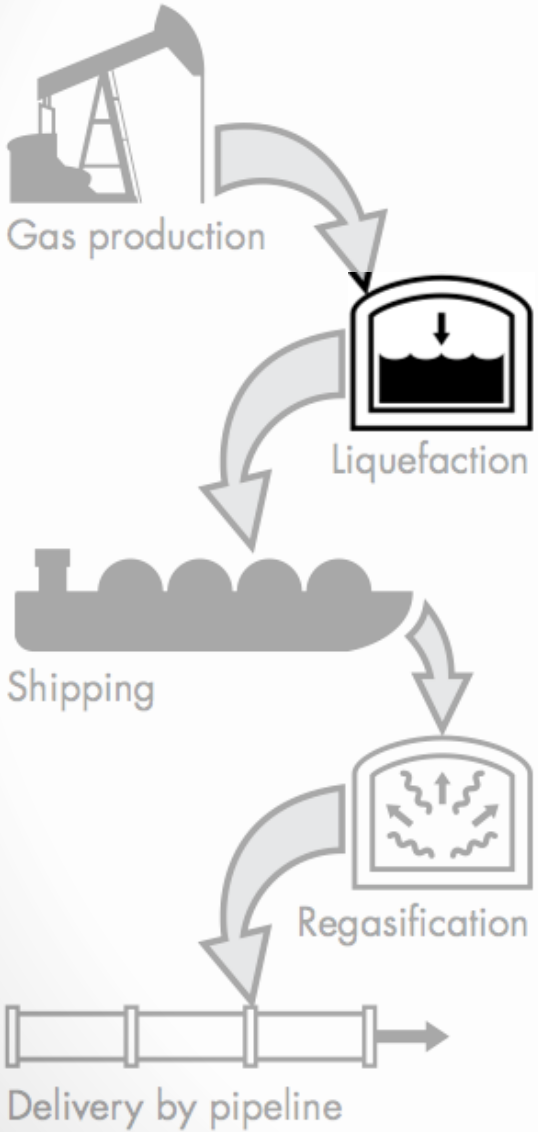


LNG Value Chain – Gas Production



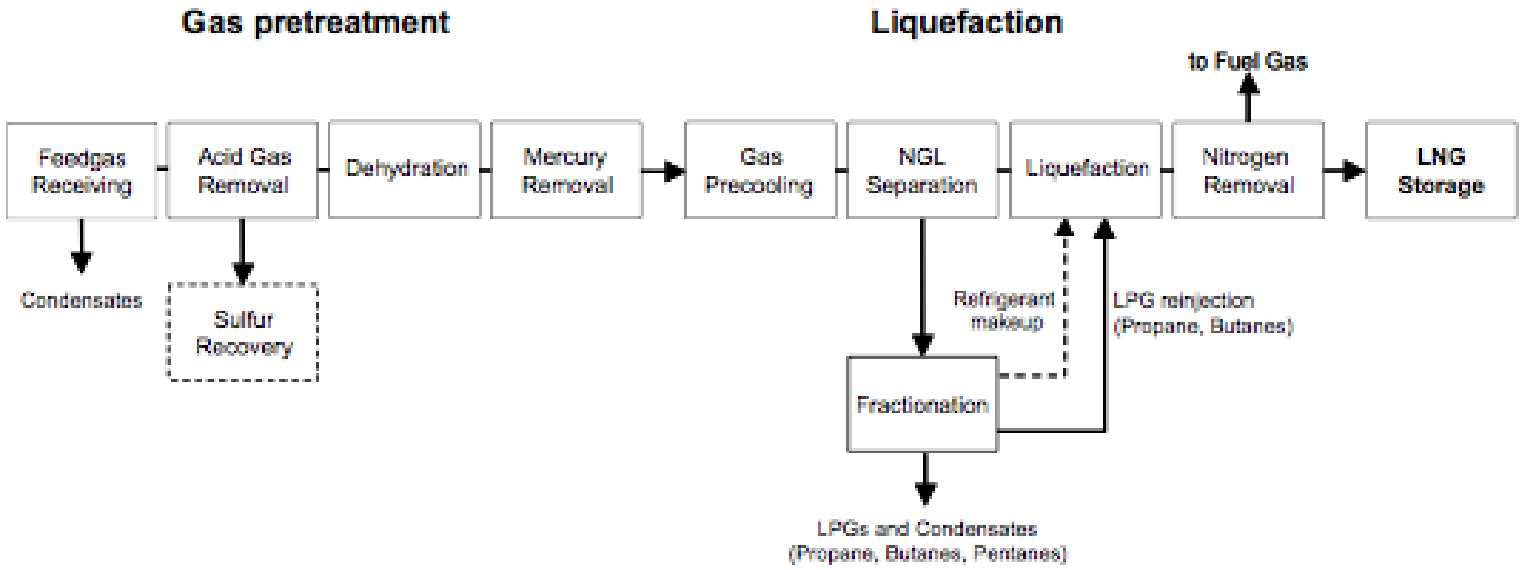
- Expands viability of various gas production sites
- 15-20% of capital cost

LNG Value Chain – Liquefaction



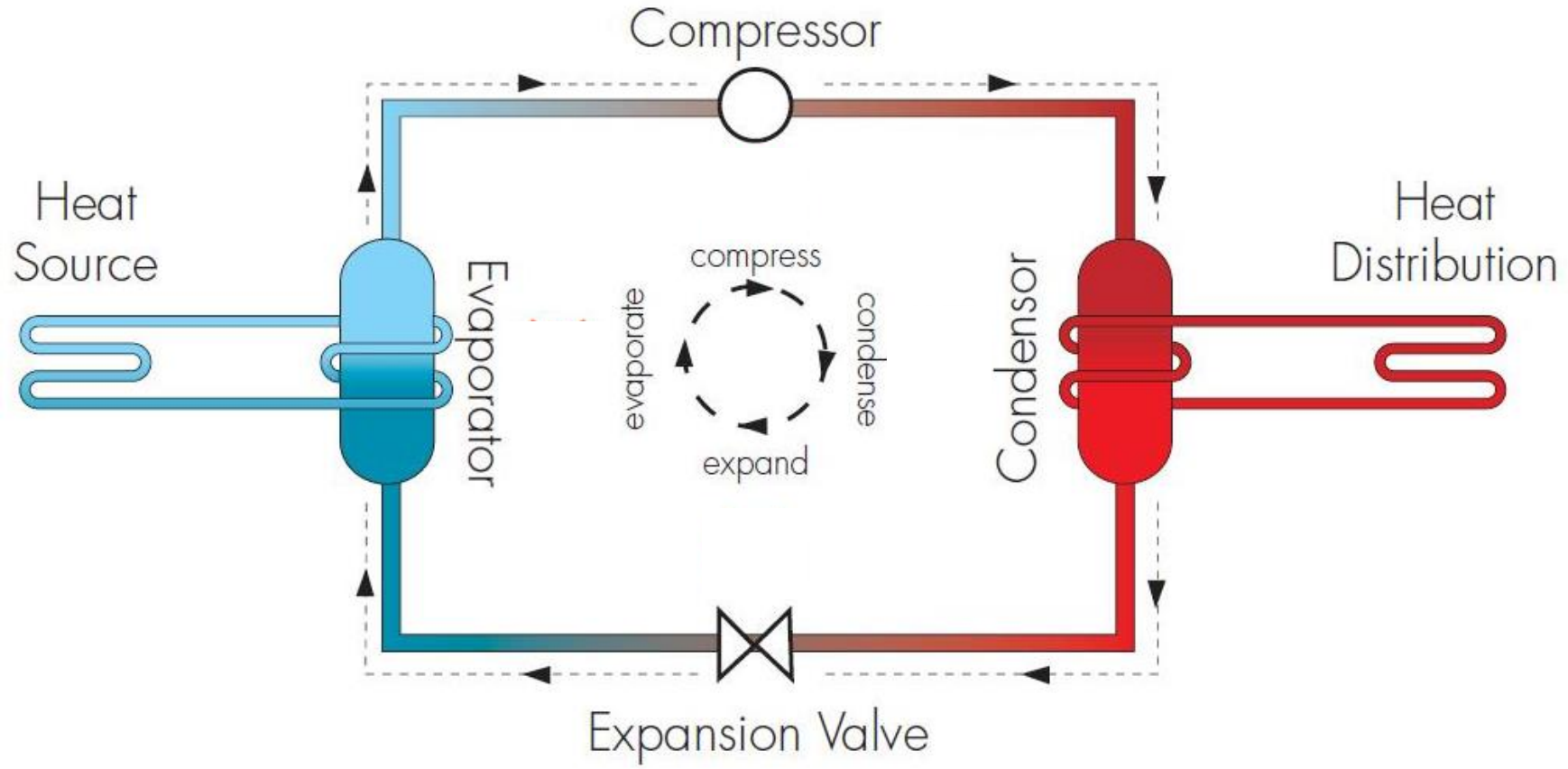
- Essentially just a giant refrigerator
- (Plus some pretreatment for impurities)
- 30-45% of capital cost

Liquefaction Process

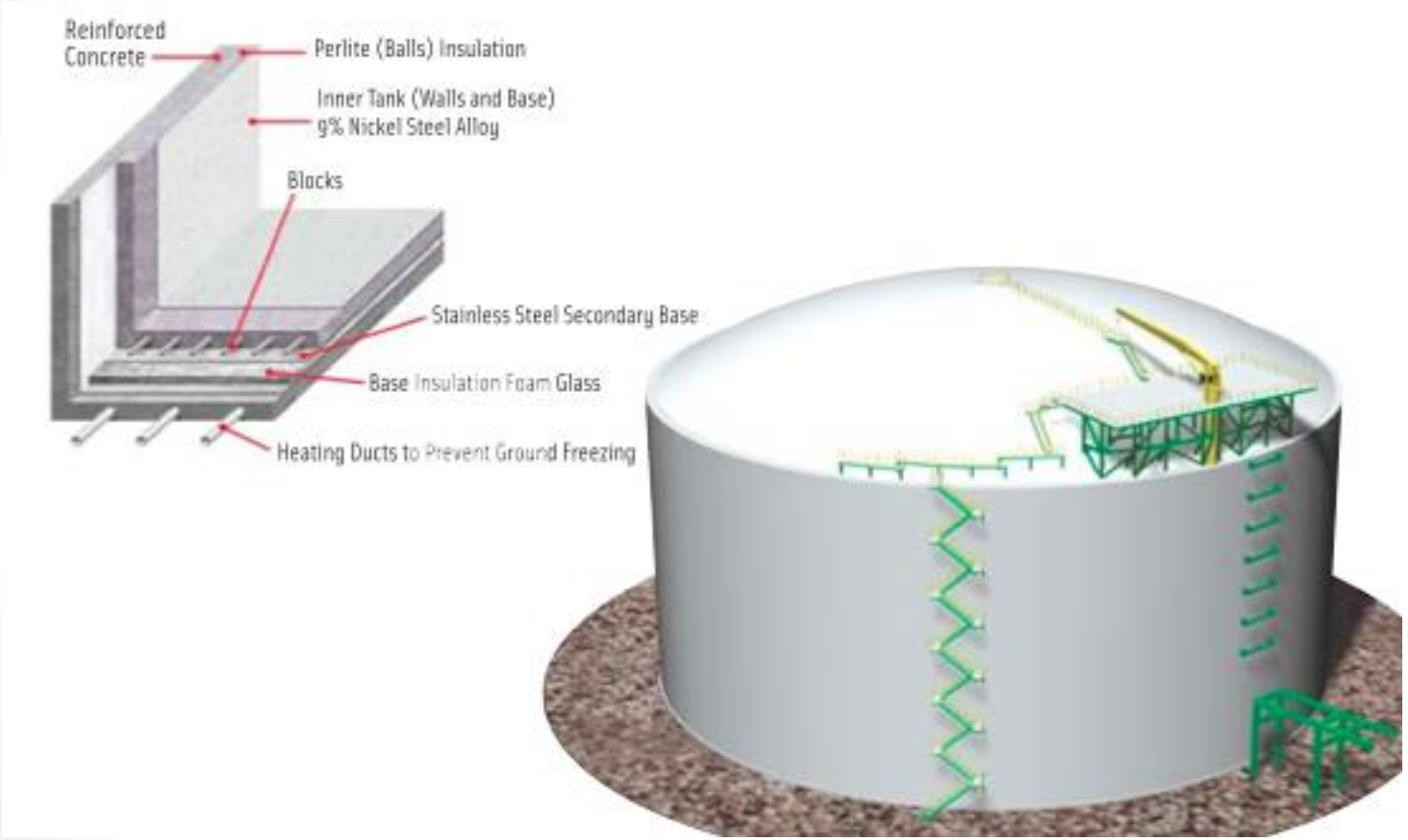


Tusiani, MD and Shearer, G (2007)

Simple Refrigeration Schematic

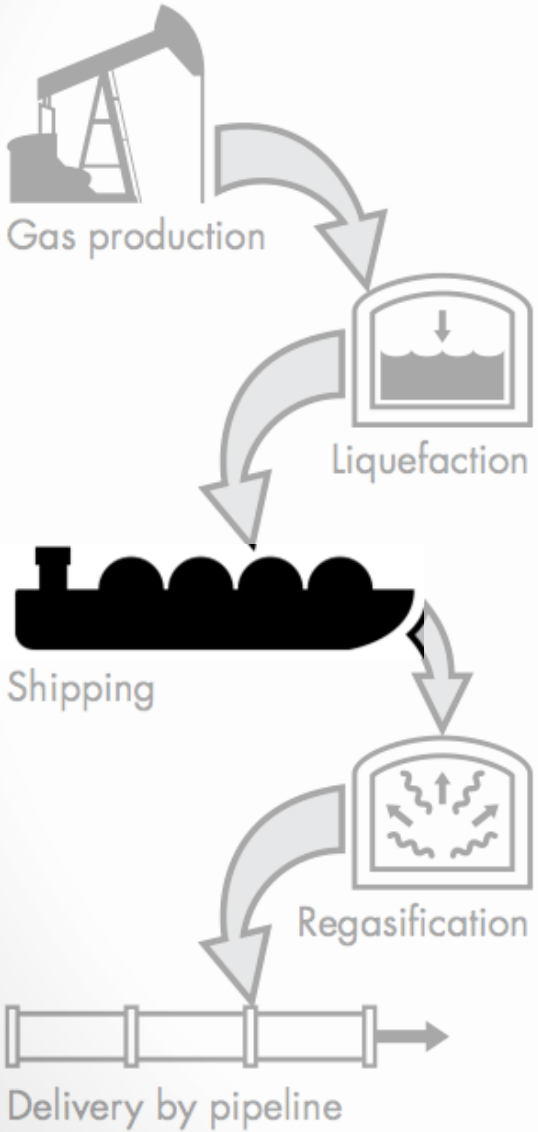


Storage Tanks



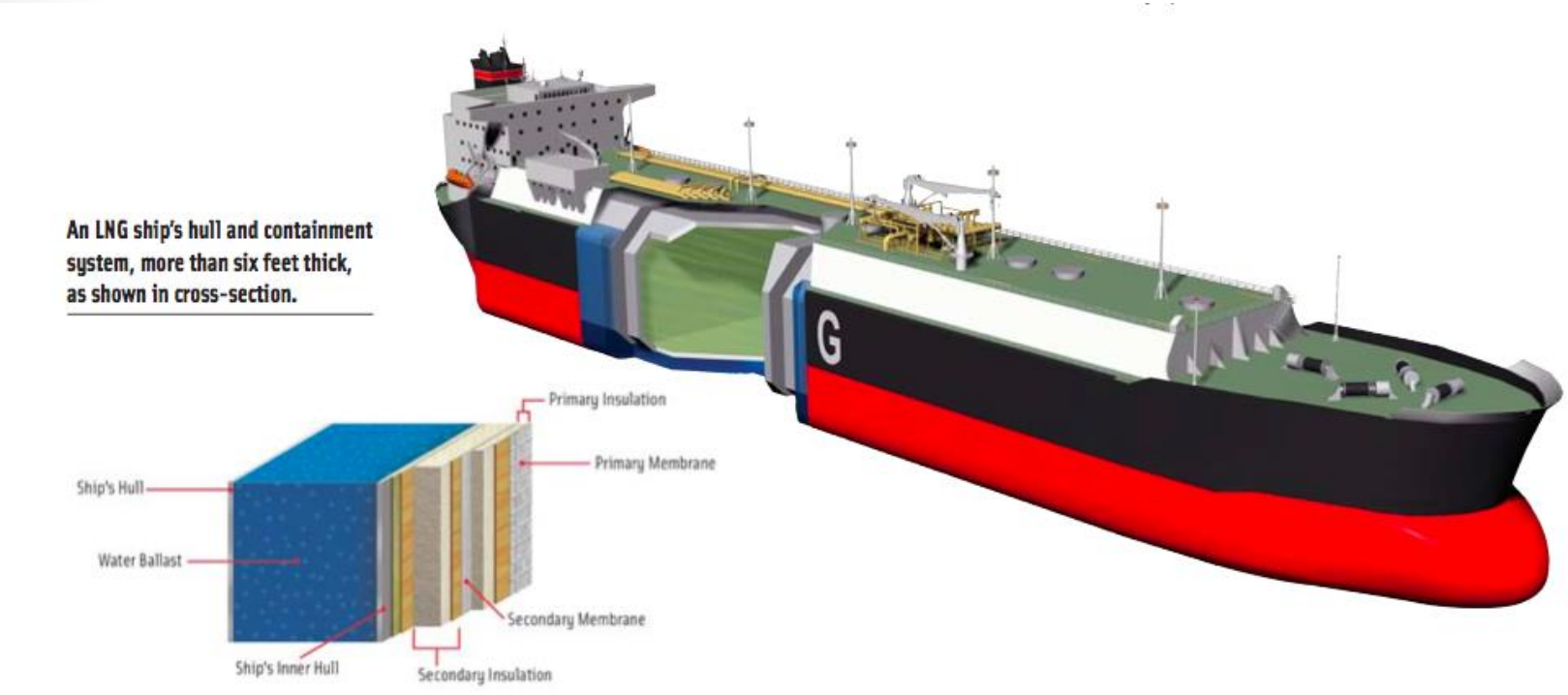
DOE (2005)

LNG Value Chain – Shipping



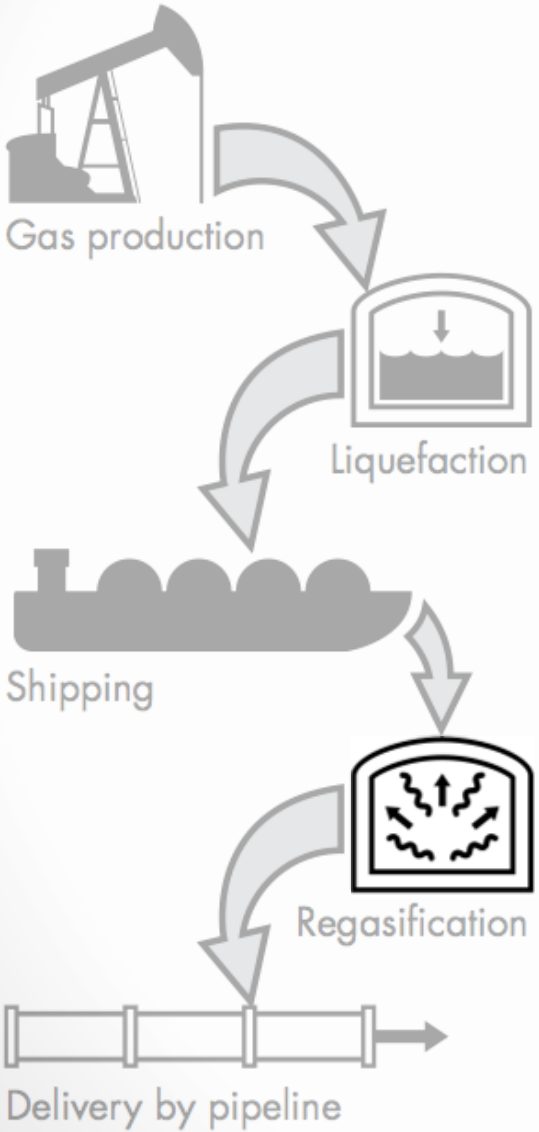
- 10-30% of capital cost
- Substantial component of operational costs
- Tanker must be cooled before loading

LNG Shipping



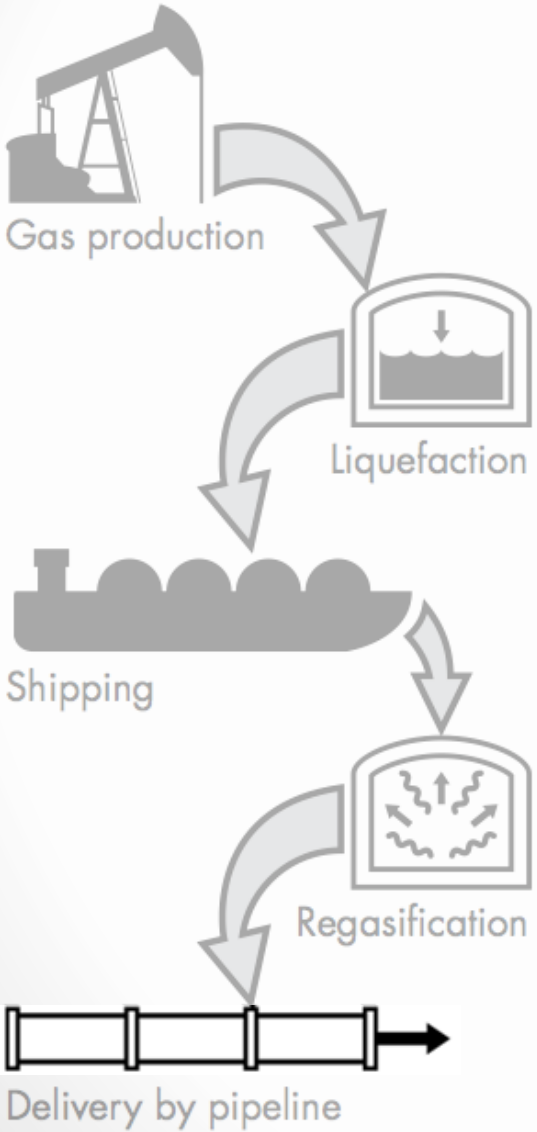
DOE (2005)

LNG Value Chain – Regasification

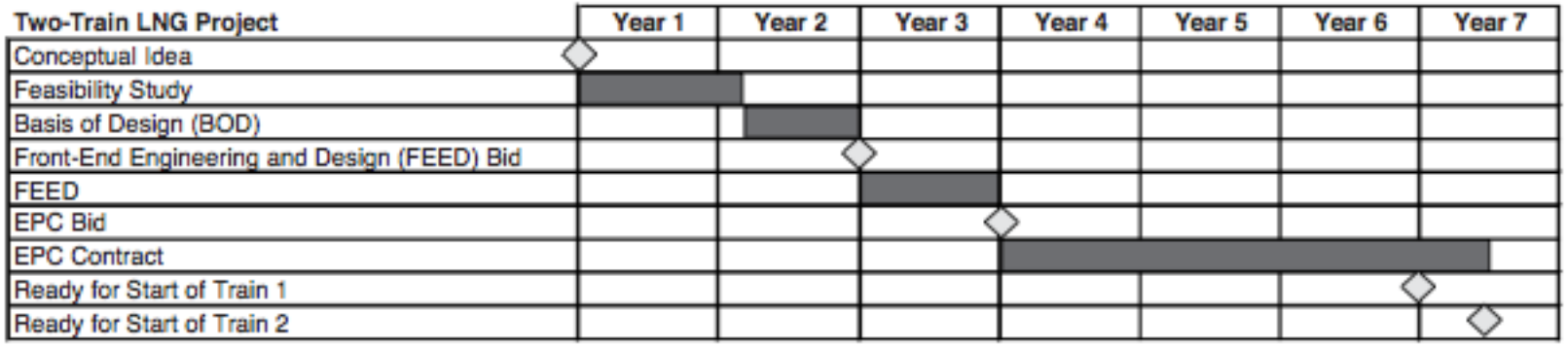


- 15-25% of capital cost
- Unloading arms, storage tanks, and vaporization equipment

LNG Value Chain – End Use

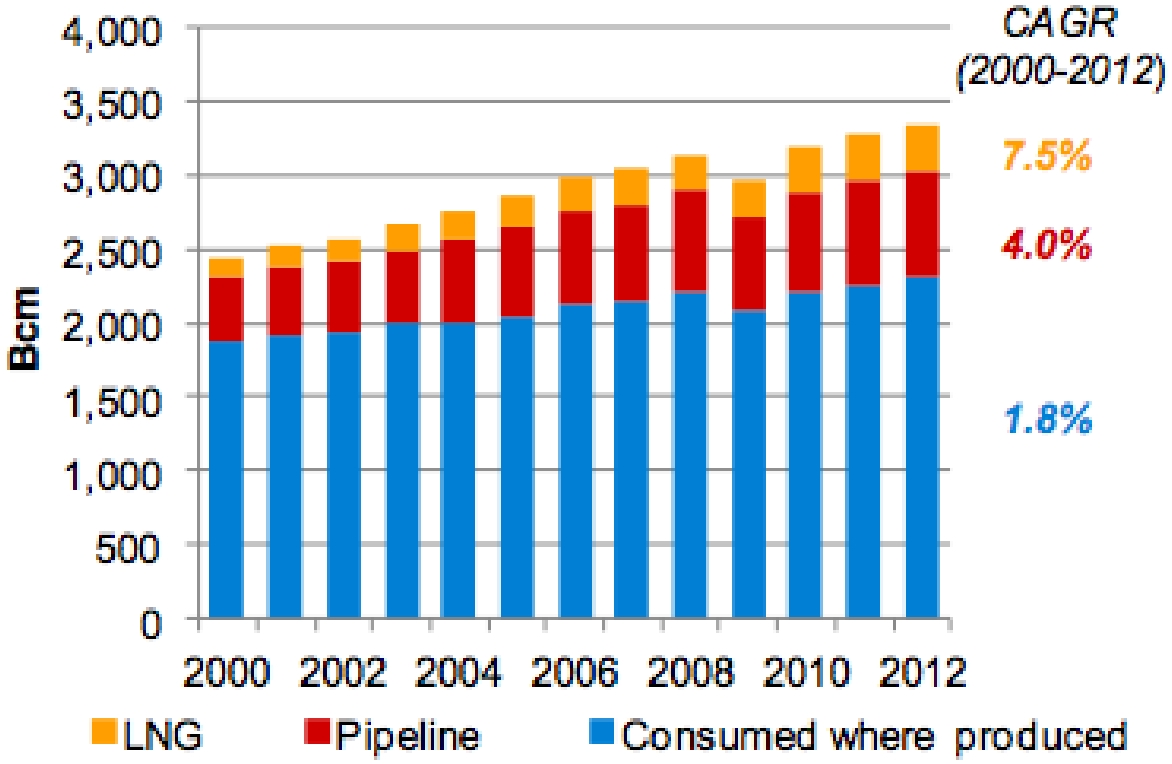


Project Timeline



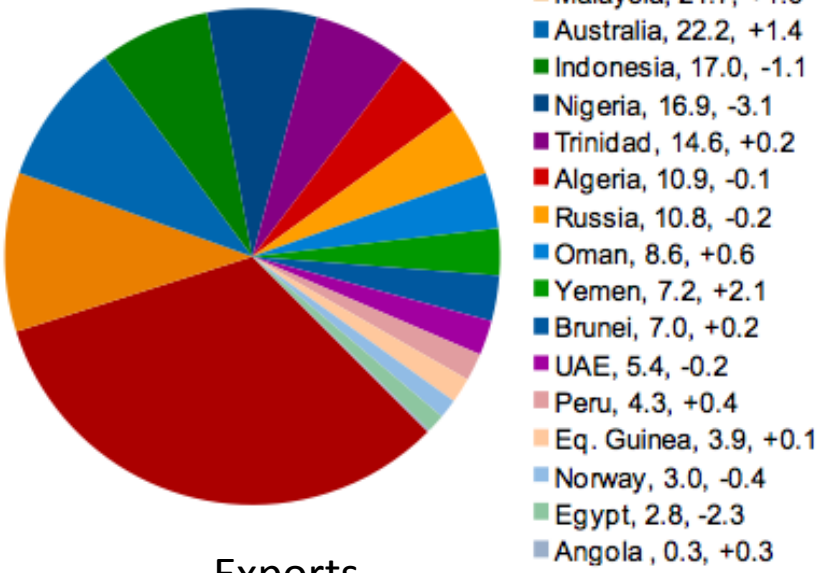
Tusiani, MD and Shearer, G (2007)

Current State of LNG

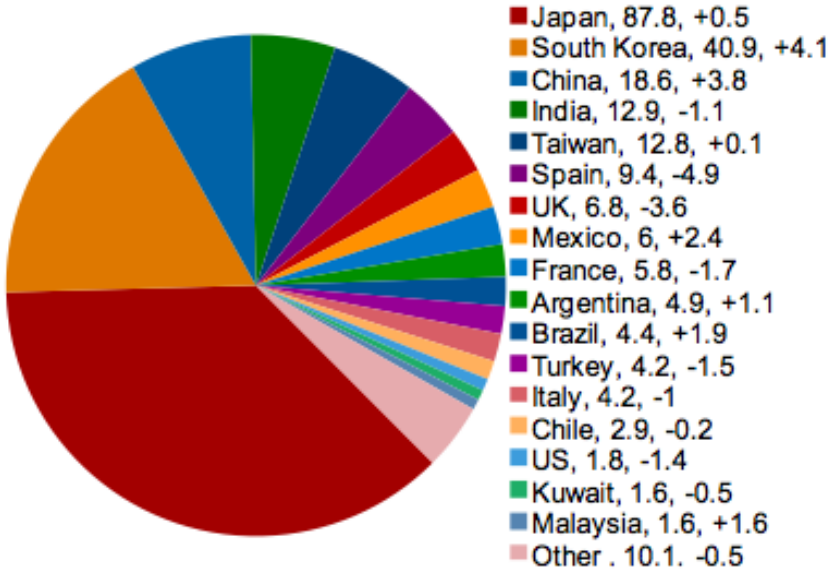


IGU (2014)

Current State of LNG



Exports



Imports

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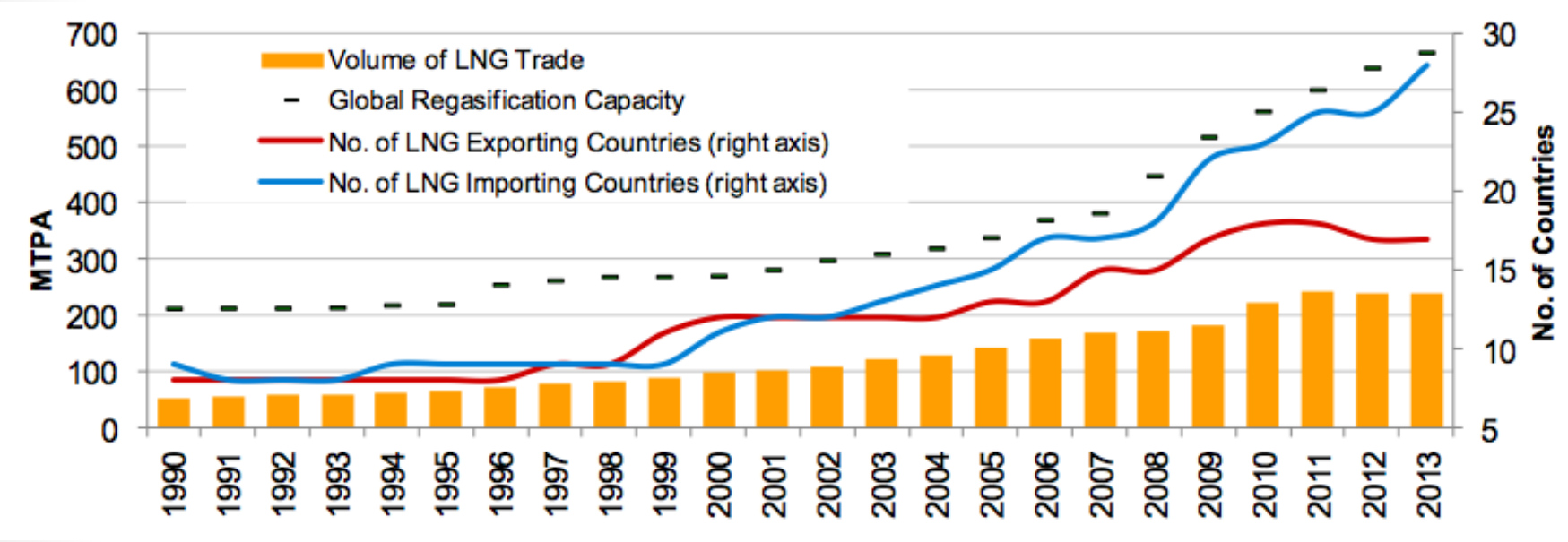
Current State of LNG



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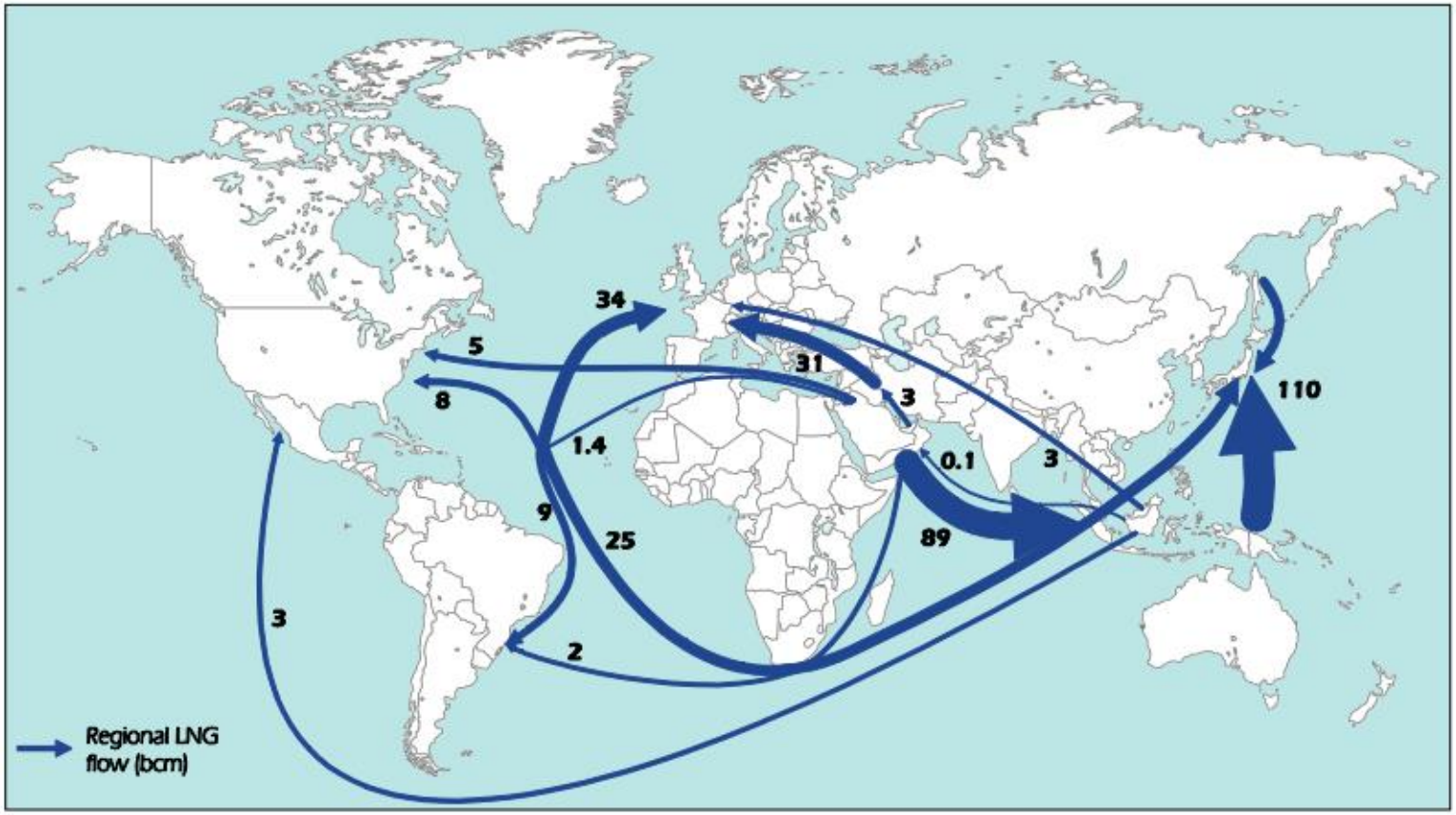
LNG Flows



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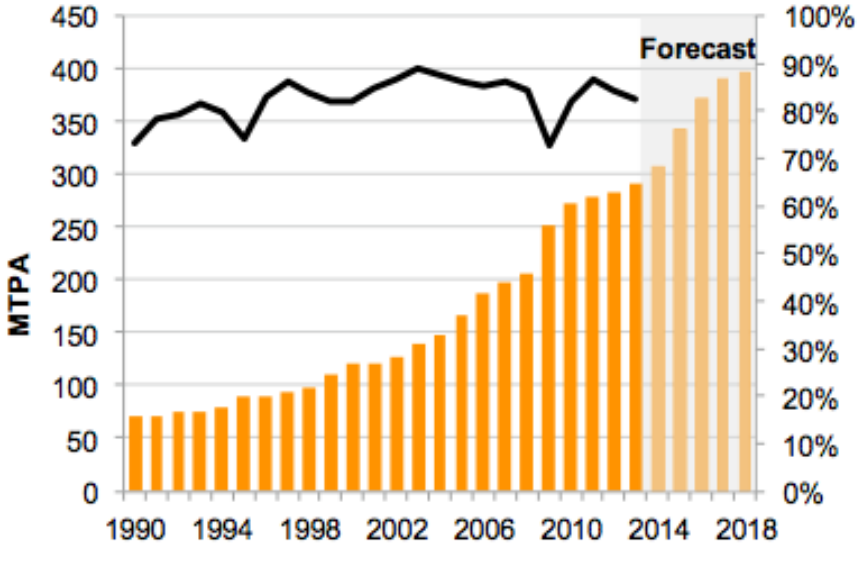
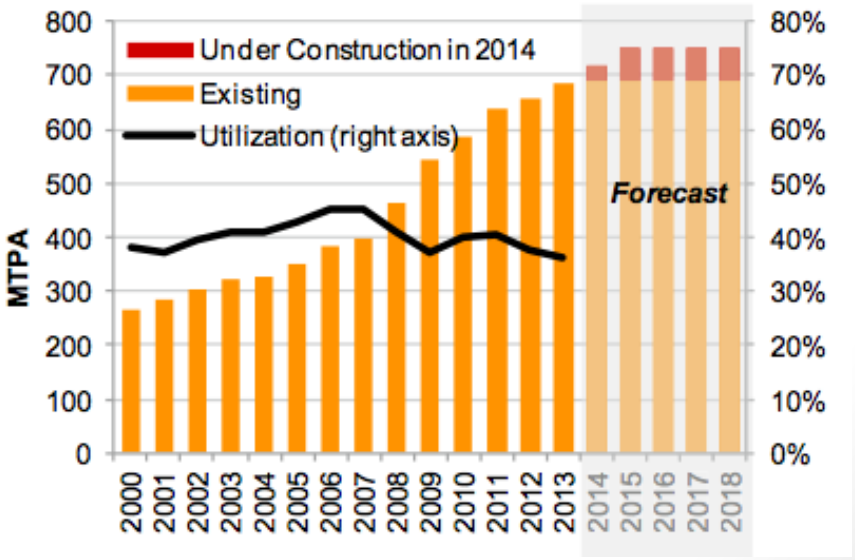
LNG – A Tight Market

Liquefaction Capacity



Import Capacity



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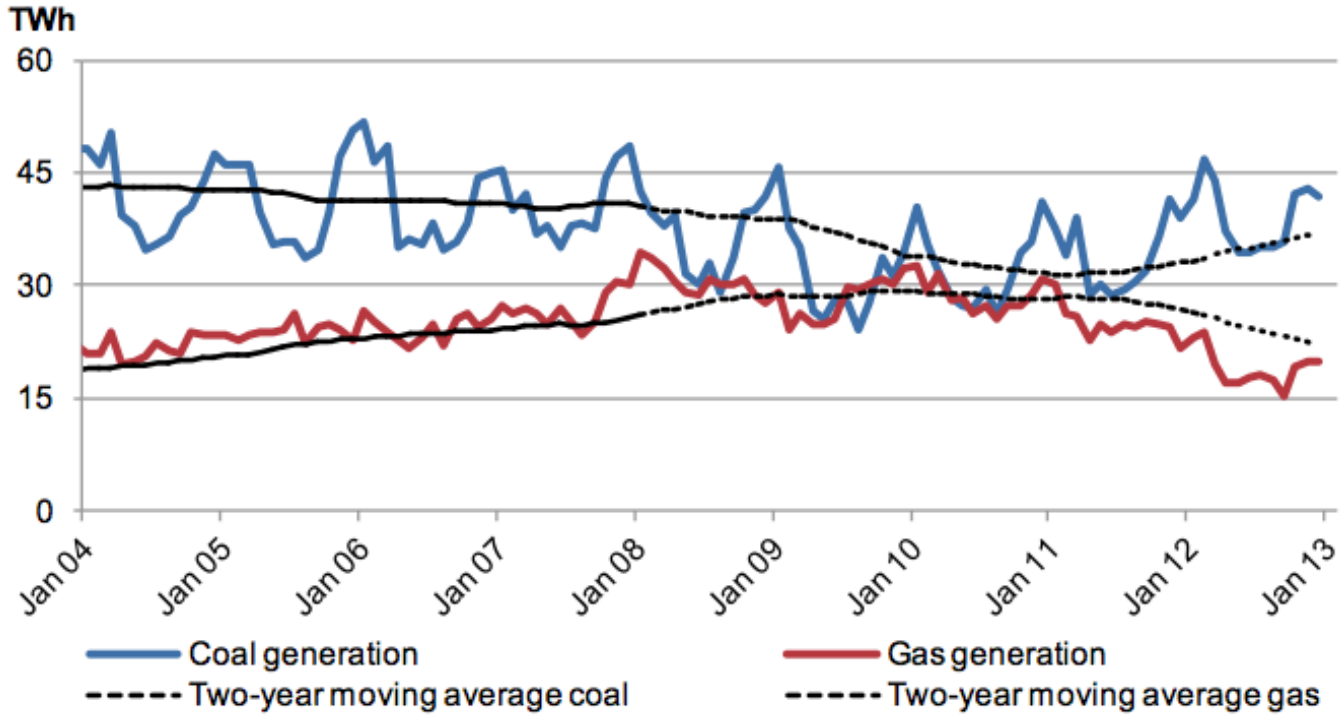
Future Trends in Europe

Figure 12 Monthly quantity of power produced by coal and gas in Germany, Spain, United Kingdom, Jan 2004-Jan 2013



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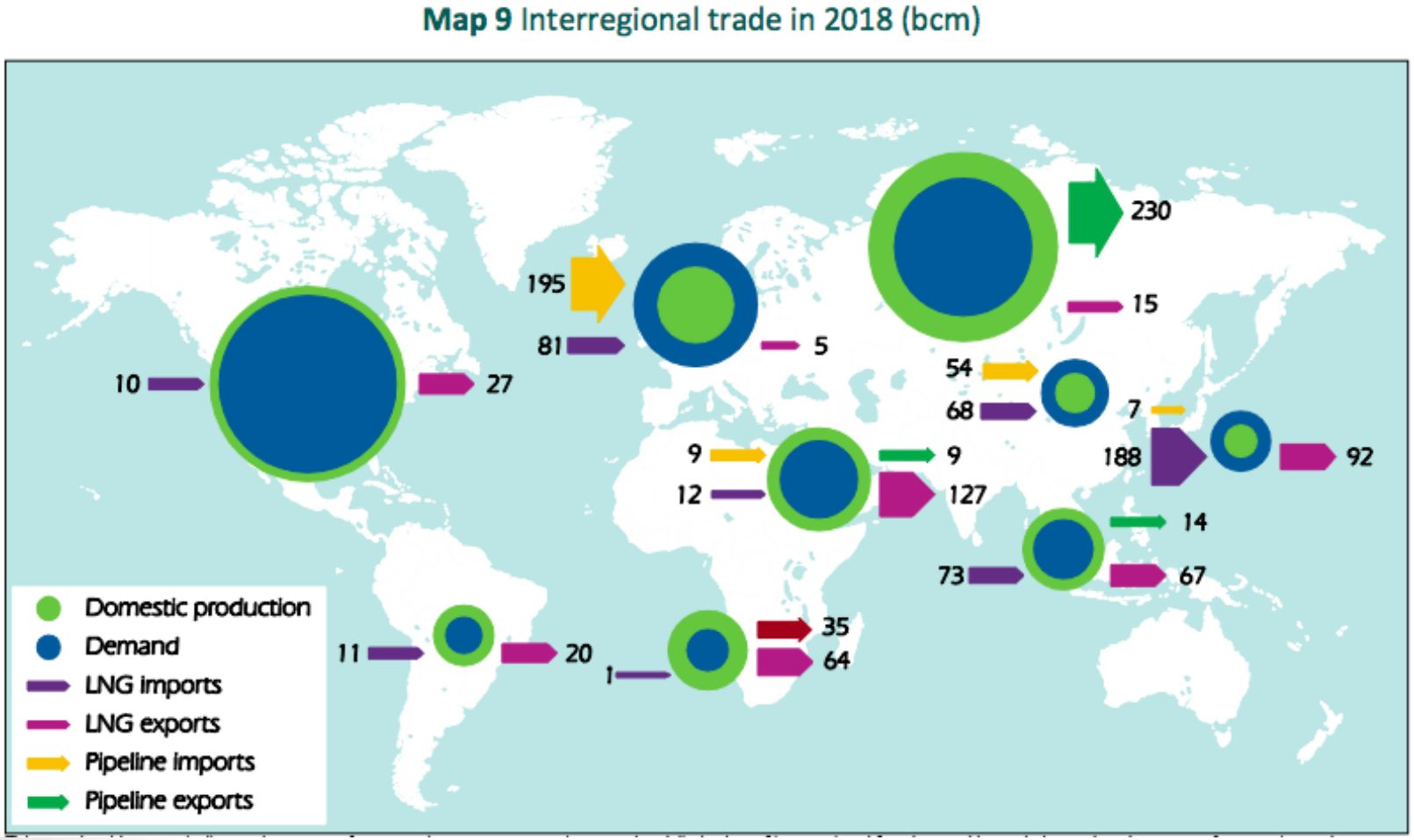
Natural Gas Interregional Trade



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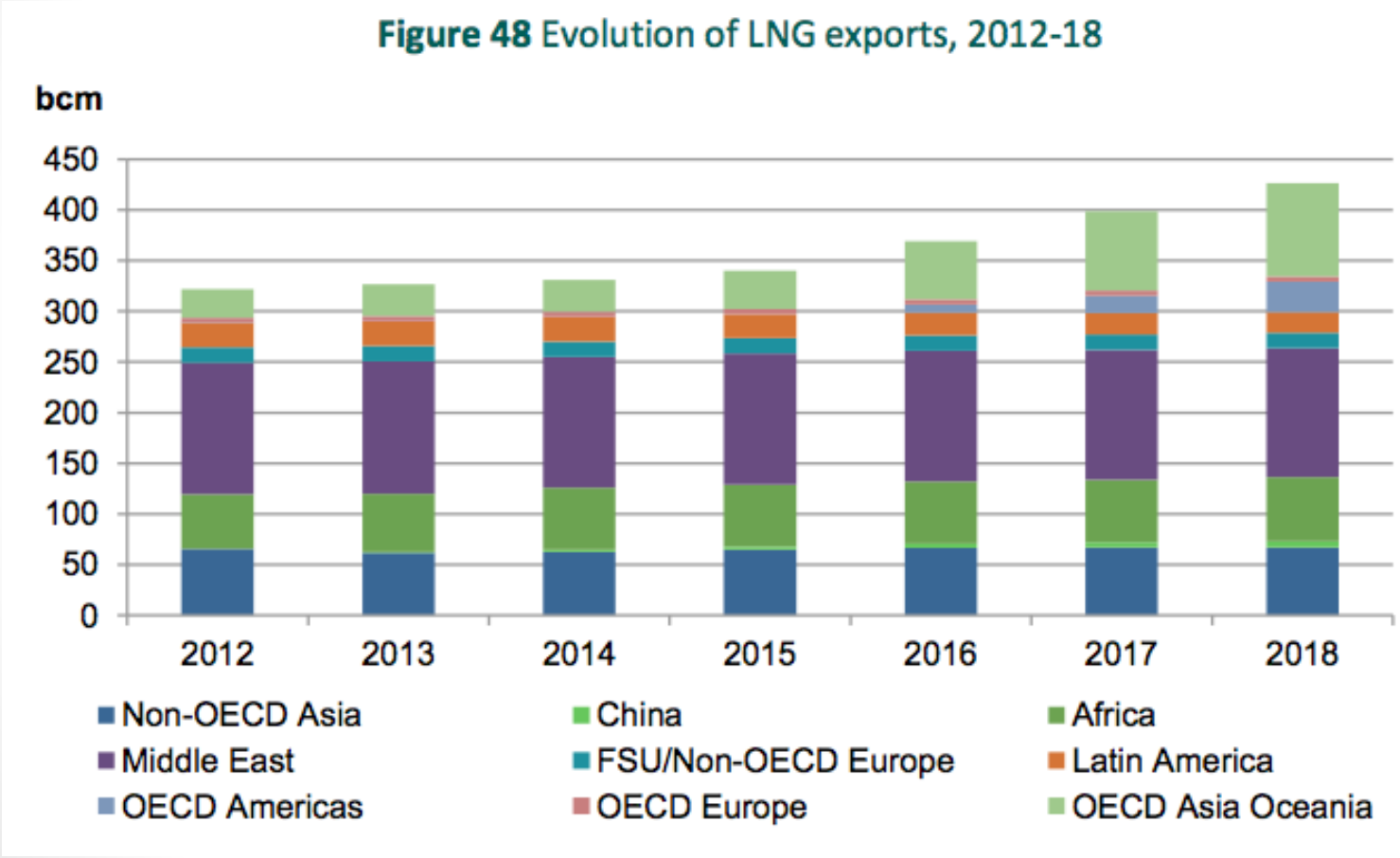
LNG Exports



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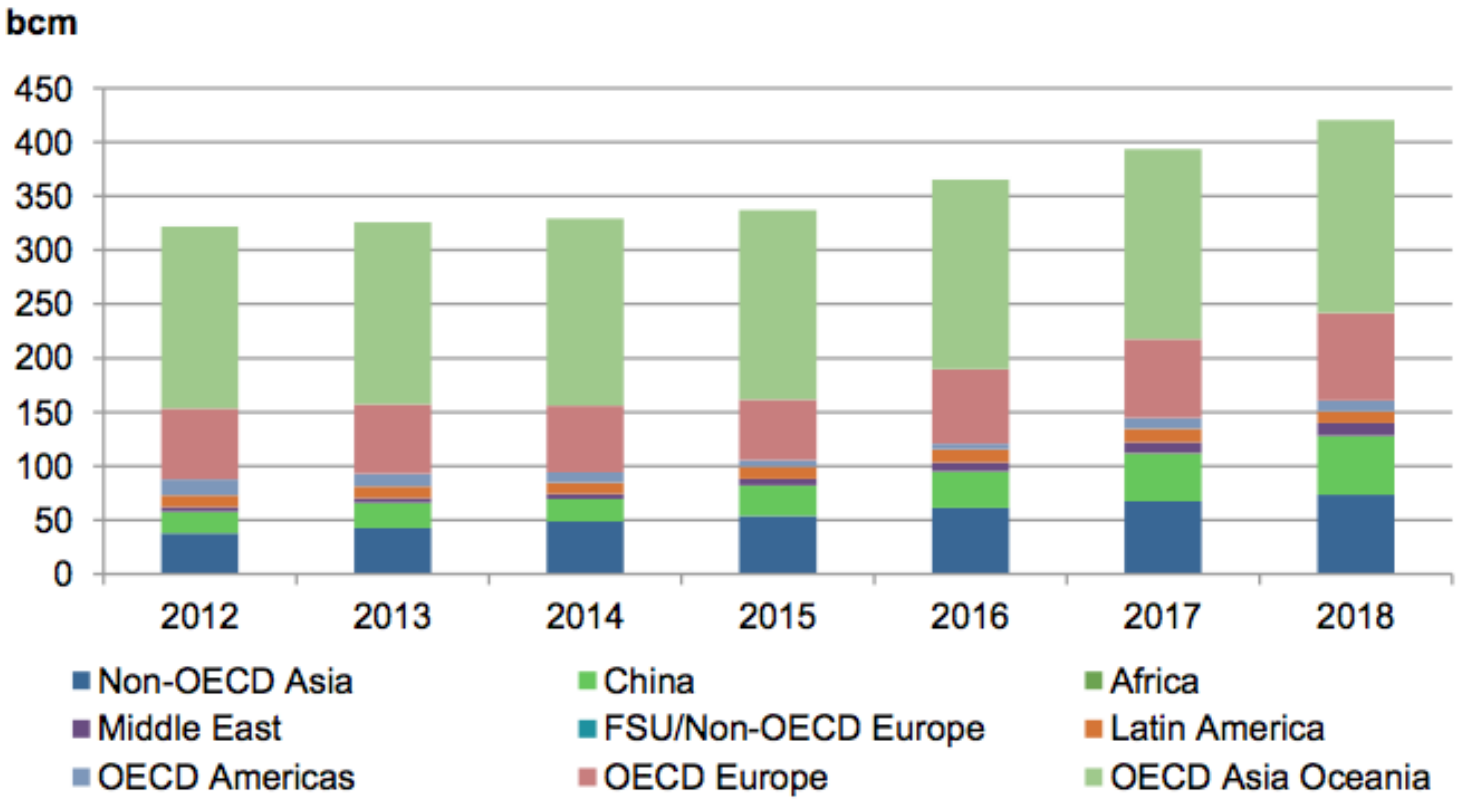
LNG Imports

Figure 49 Evolution of LNG imports, 2012-18



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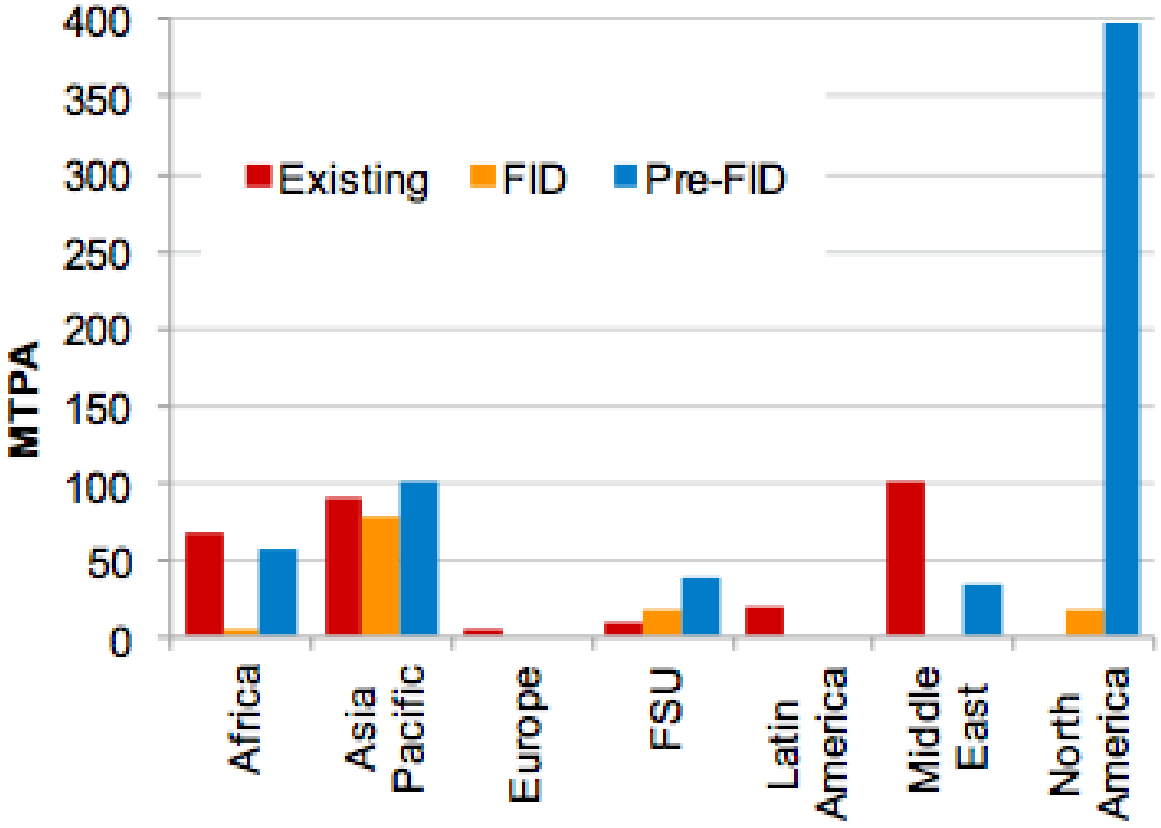
LNG plants under construction



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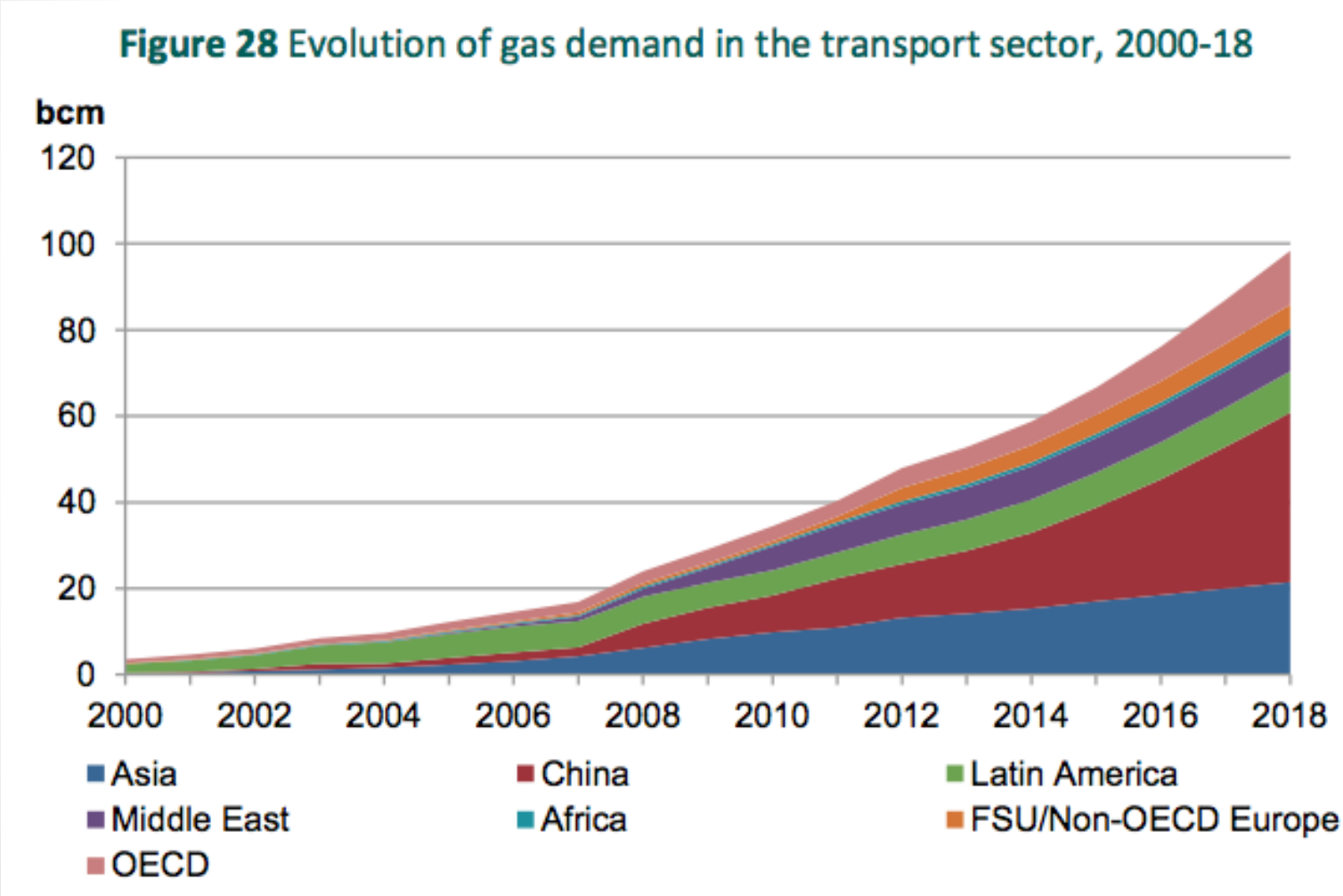
Natural Gas for Transportation



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