The outlook for natural gas

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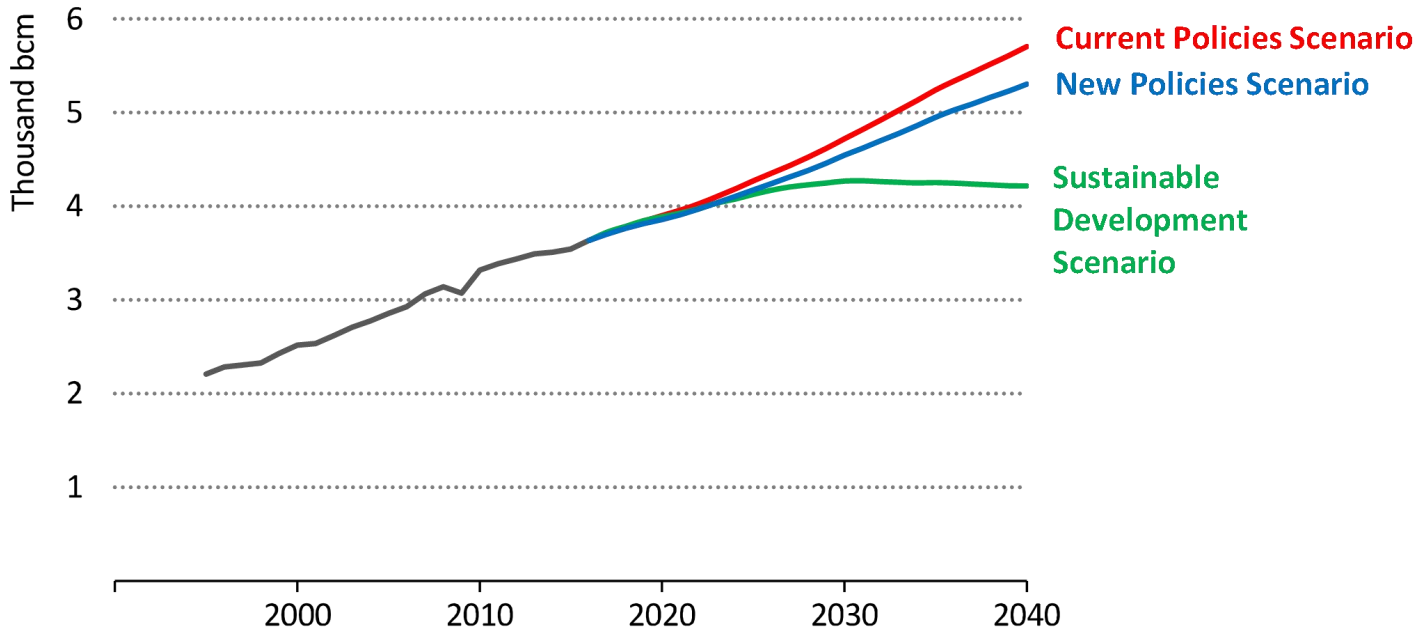
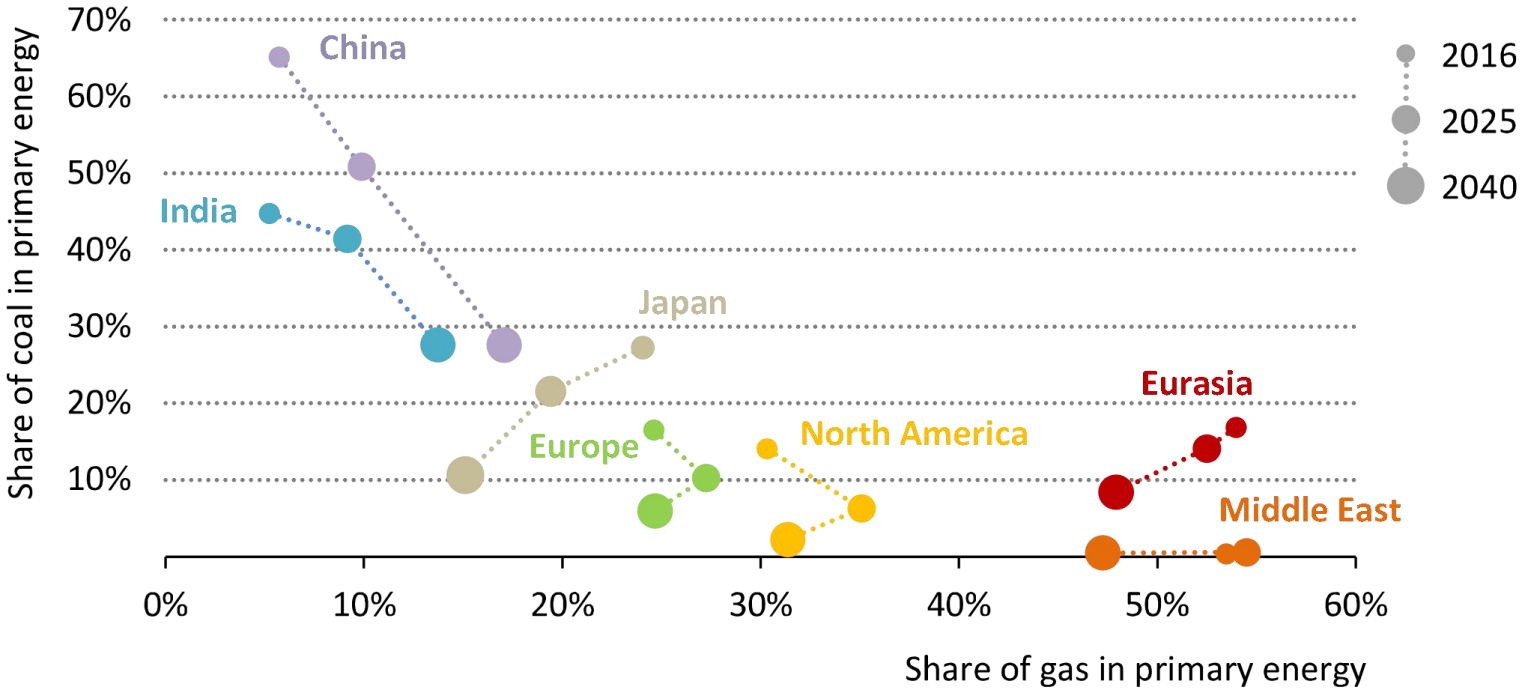
Gas demand remains robust even with a strong climate policy



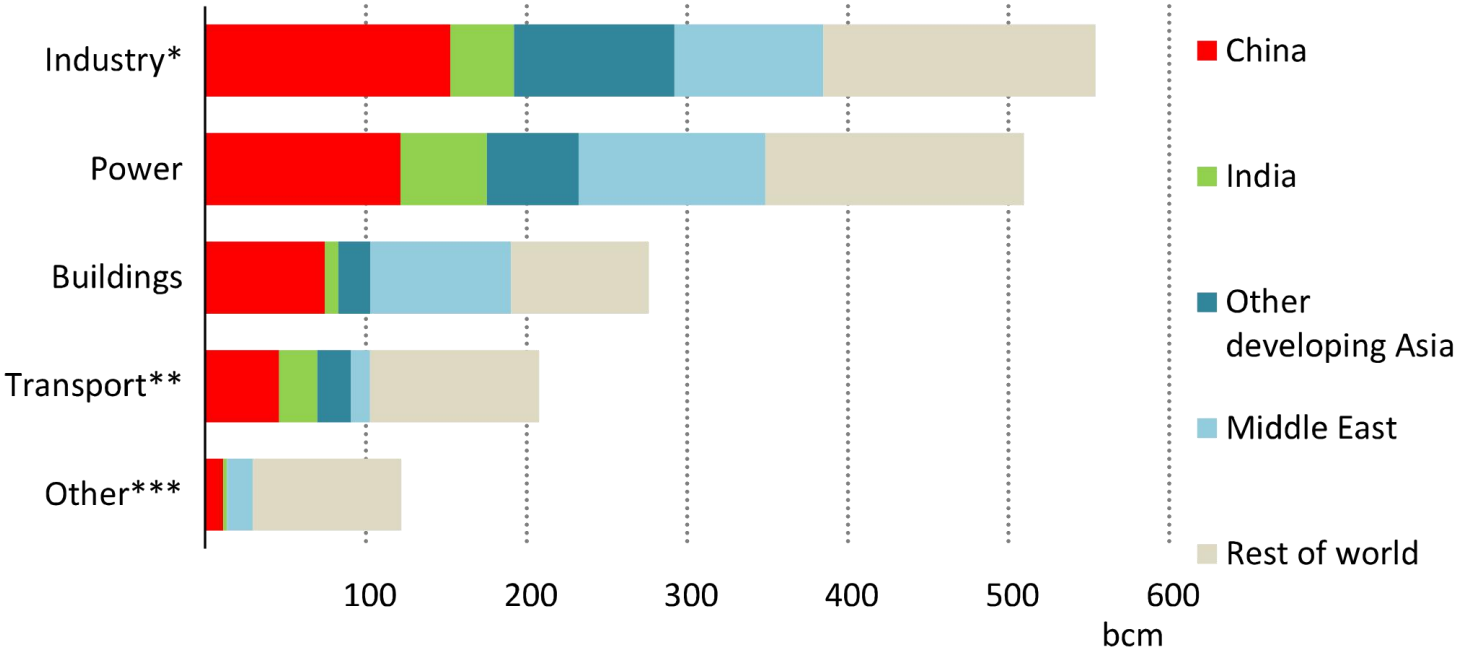
In the Sustainable Development scenario gas demand is squeezed by renewables and efficiency but gas gains market share from coal and oil

Climate policy increases the share of gas in coal heavy systems



In Europe and the US renewables squeeze gas already from 2025

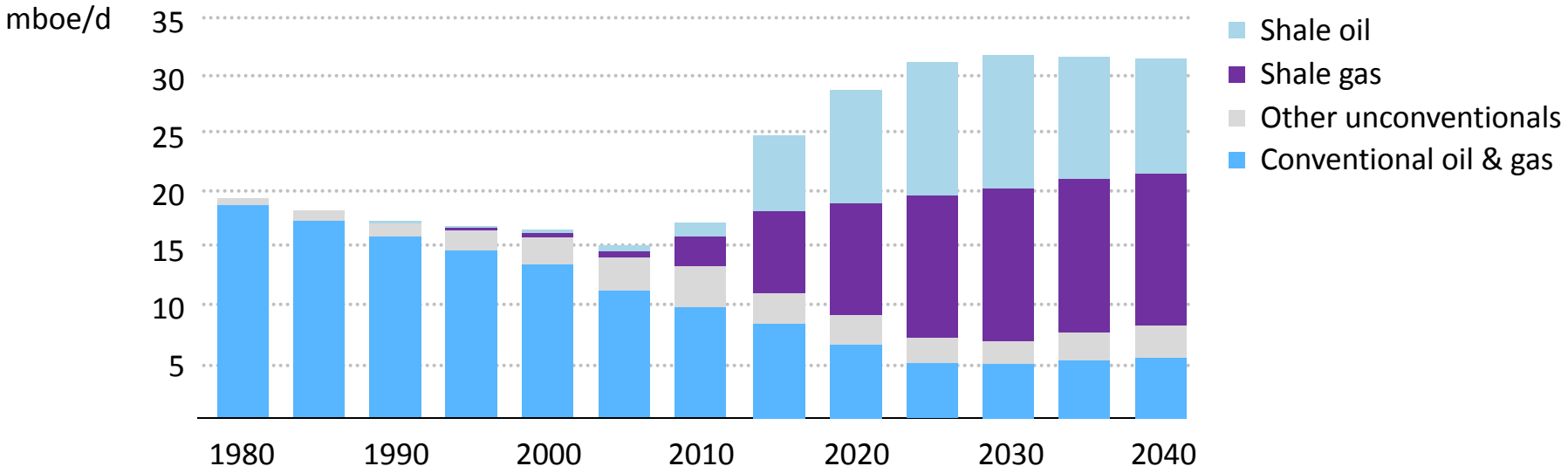
Natural gas: a jack of all trades fuel



Gas can substitute for coal and complement renewables in power generation and can replace oil in industrial energy use and even in transport

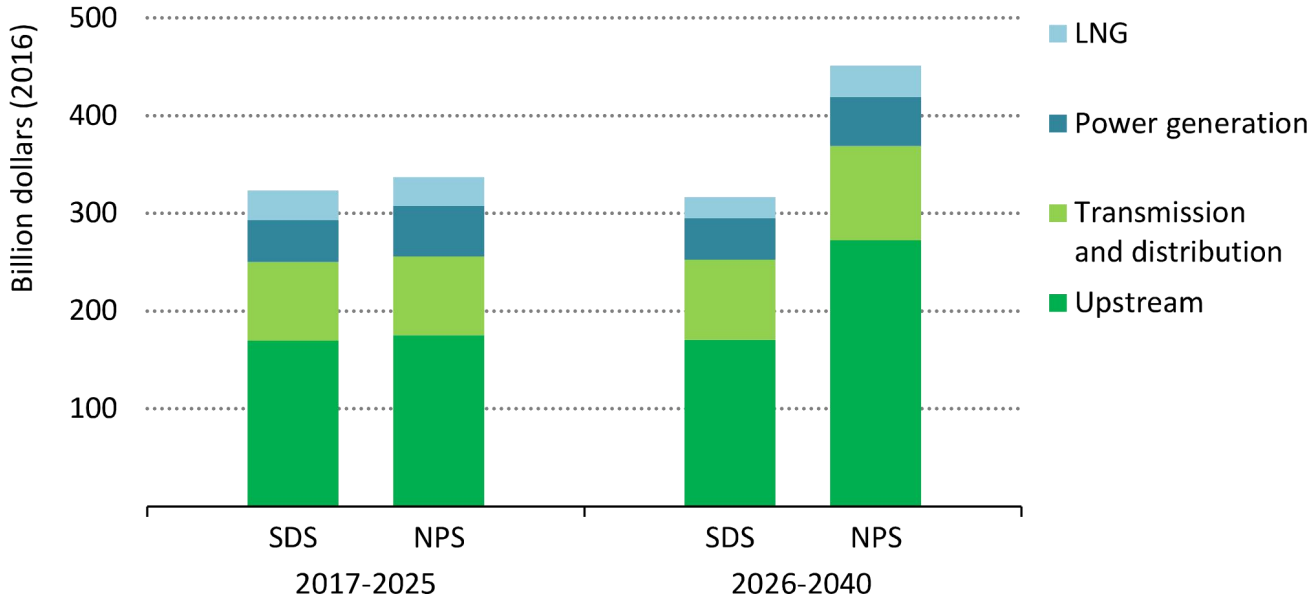
Shale 2.0, the taste of things to come

Oil and gas production in the United States



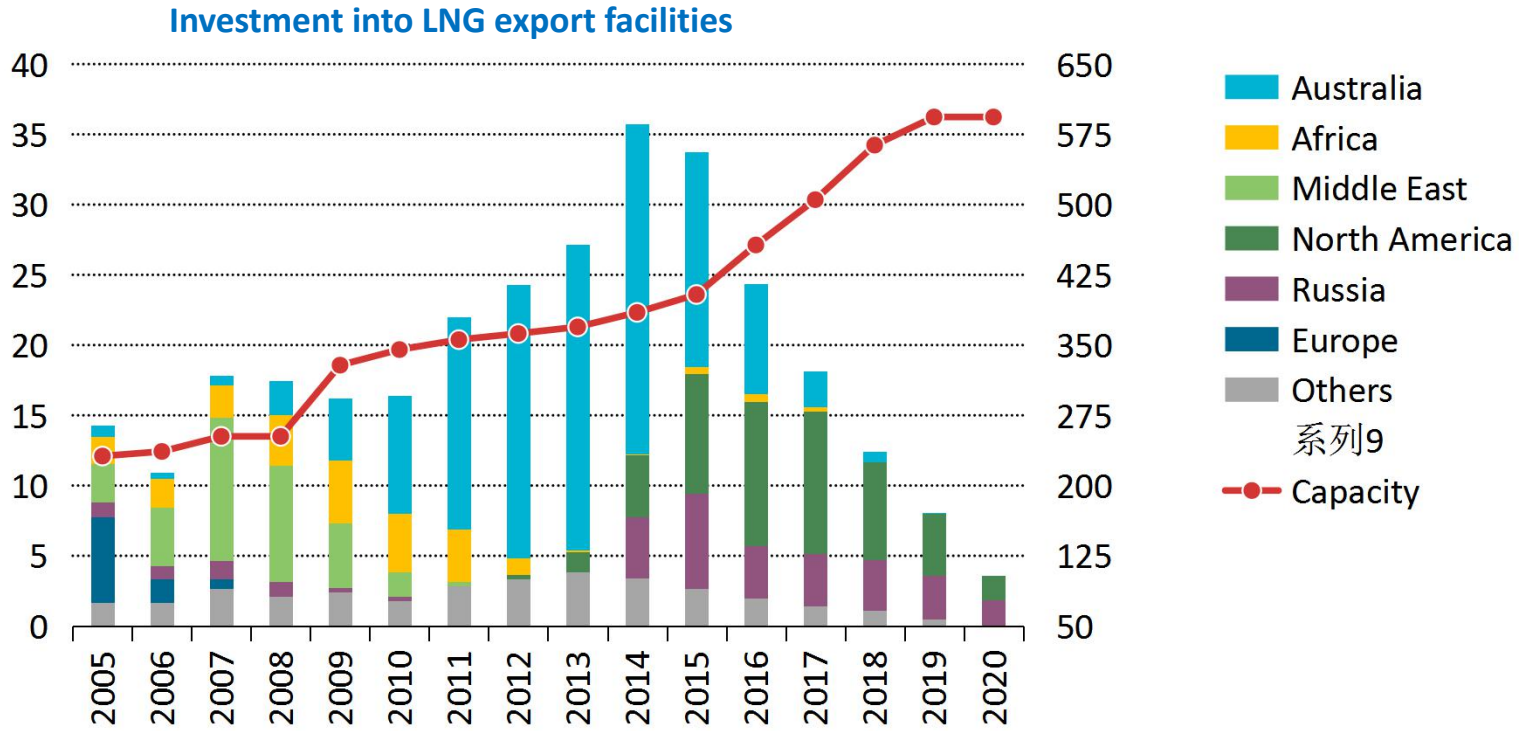
US shale production benefits from digitalisation, learining by doing and easy access to capital

A very significant investment need



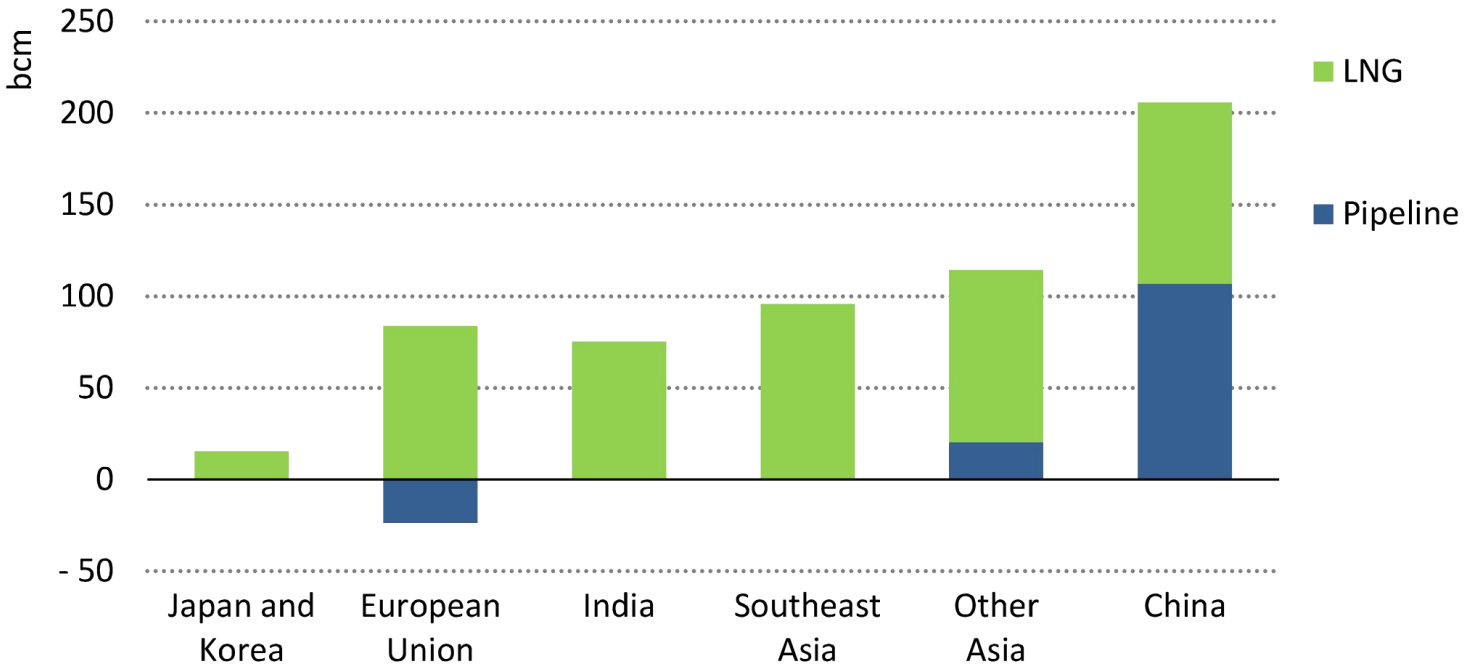
Most of the investment is in upstream, but the share of pipeline infrastructure is much higher than for oil

LNG investment: past the peak?



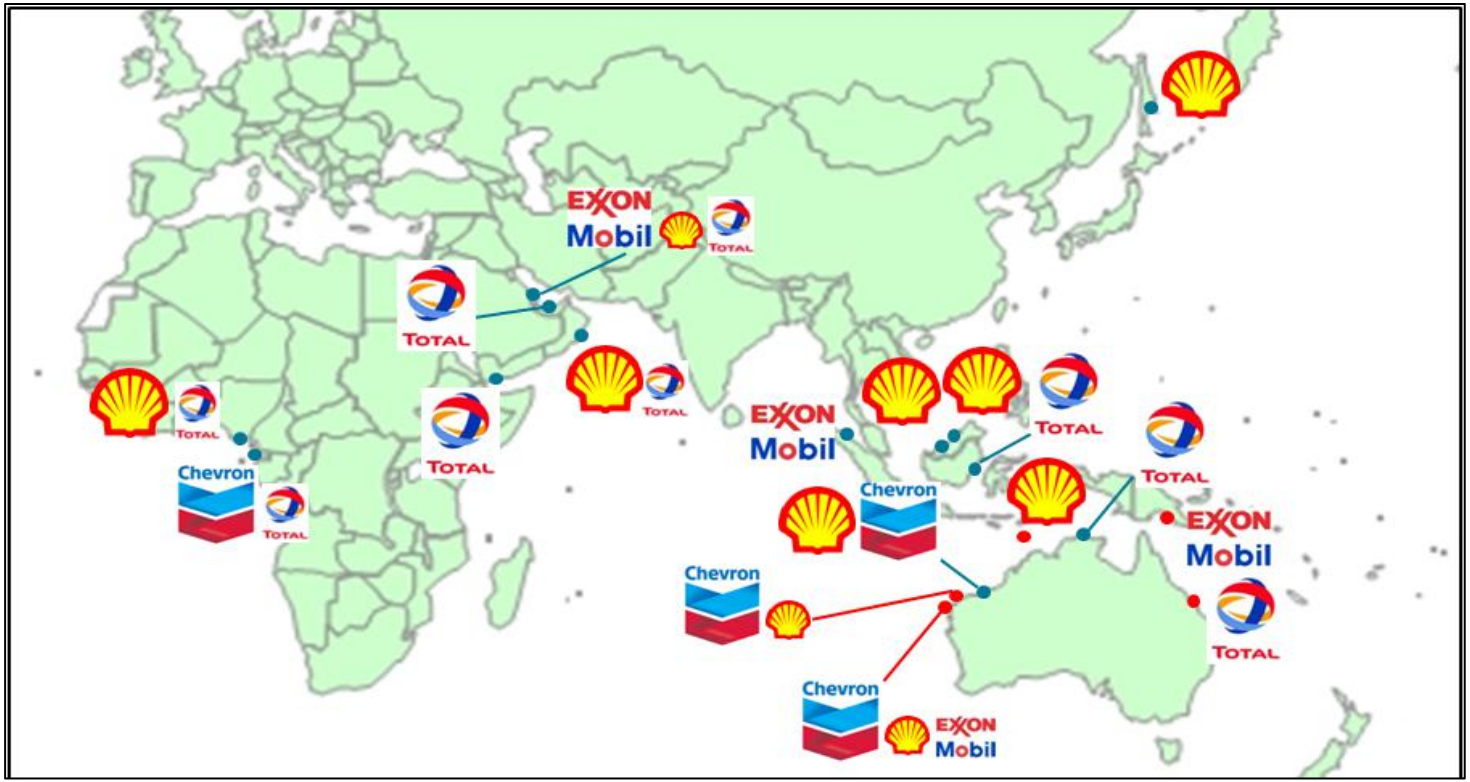
Lack of FIDs since 2015 indicate a rapid decline of investment

Global gas trade shifts towards LNG



New pipeline routes find it hard to compete with the increasing efficiency and flexibility of the LNG market

LNG in Asia: the role of the IOCs

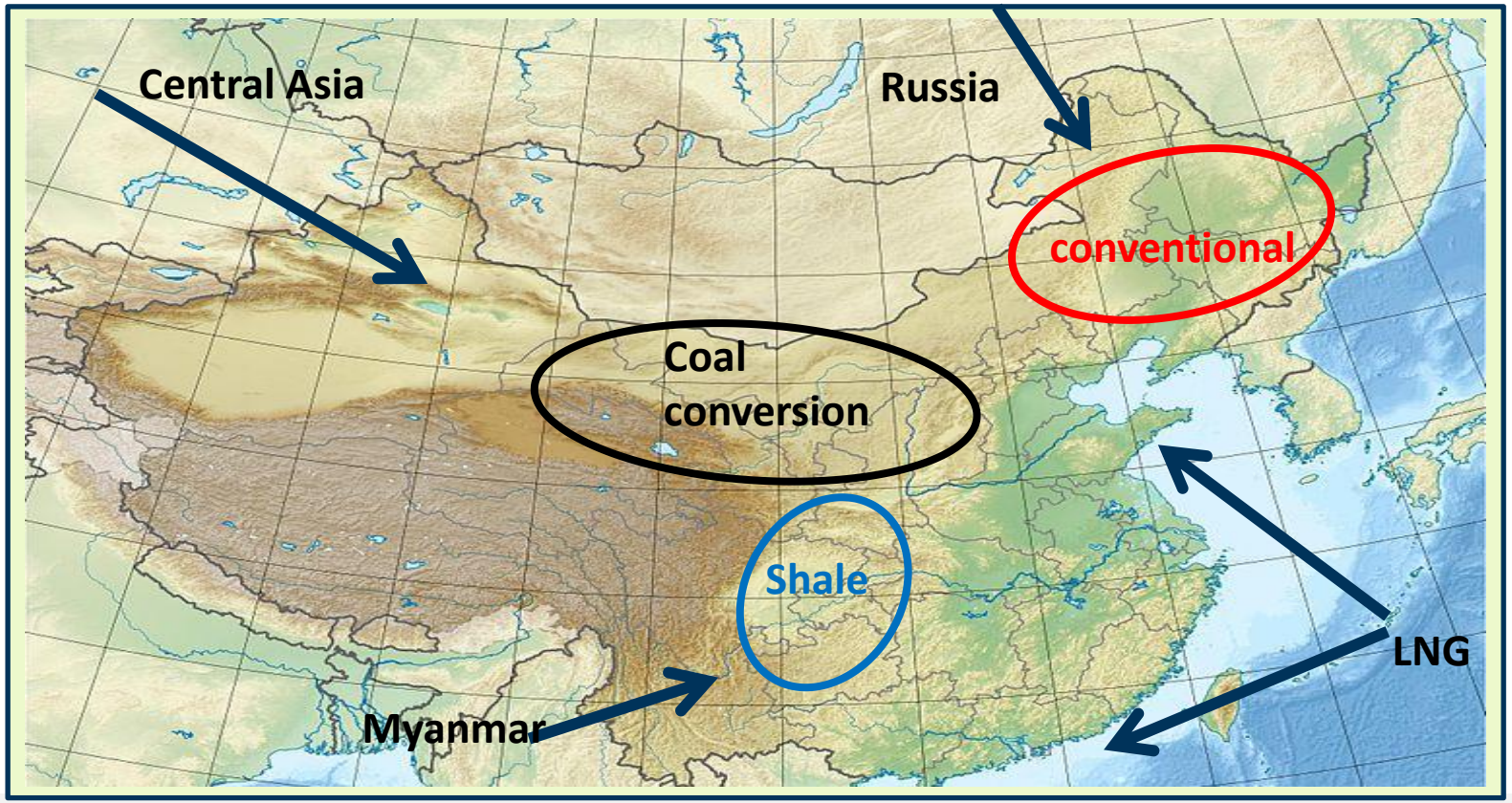


With their strong balance sheets and commodity trading expertise IOCs pioneer the development of portfolio LNG

What do you need for competition 1: competitors

A competitive upstream and a diversified import structure is a key condition for competition

China: strong foundations for an efficient, competitive gas market



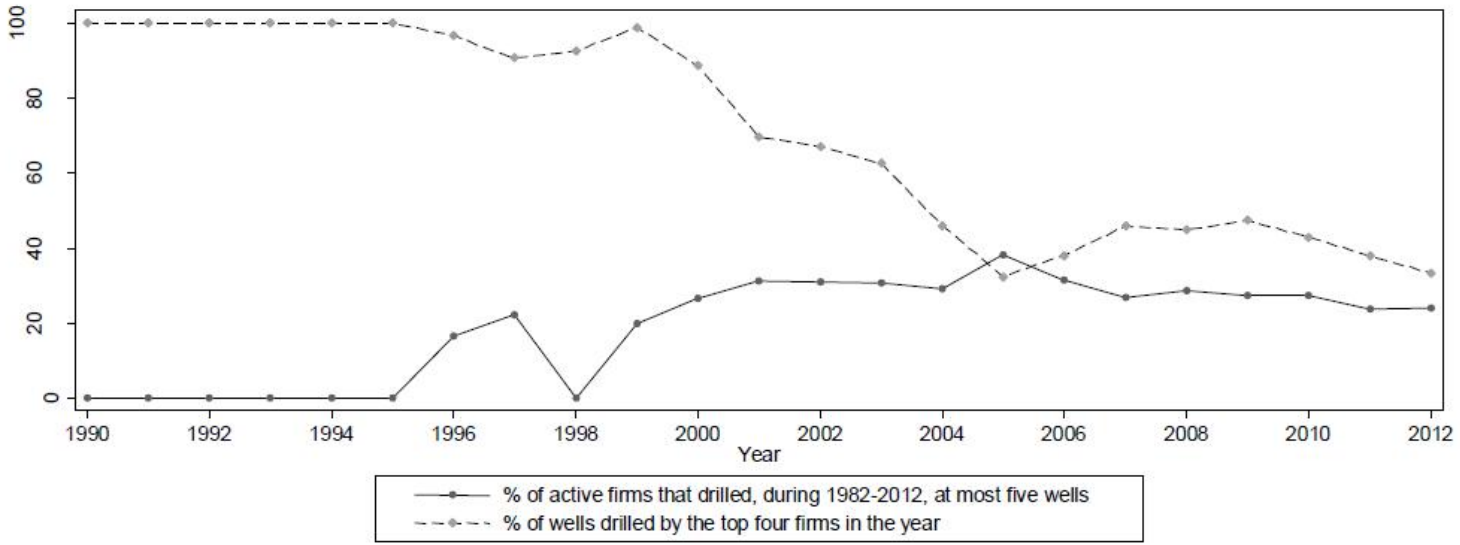
Growing domestic production with diversified players and a well diversified import structure with a strong component of LNG

What do you need for competition 2: infrastructure access

- Physical availability of infrastructure
- Allocation of capacity
- Network tariffs
- Balancing rules
- Access to data

Policymakers need either to create financially viable 'pure play" infrastructure operators or adopt intense regulatory supervision of vertically integrated entities

US shale: an intensely competitive upstream unlocks innovation



Source: Resources for the Future

The disaggregated business model of US LNG leads to lower financing costs and higher market flexibility

Technological innovation towards more flexible LNG markets

Modular LNG: standardization and factory construction with flexible scale up (Elba Island, USA)

Floating LNG: Shipyard construction mitigates project management risk, flexible deployment, smaller size at 1.2 – 5 mt/year (Malaysia, Mozambique)

While large scale land based LNG will remain essential, the industry innovating towards smaller, faster solutions

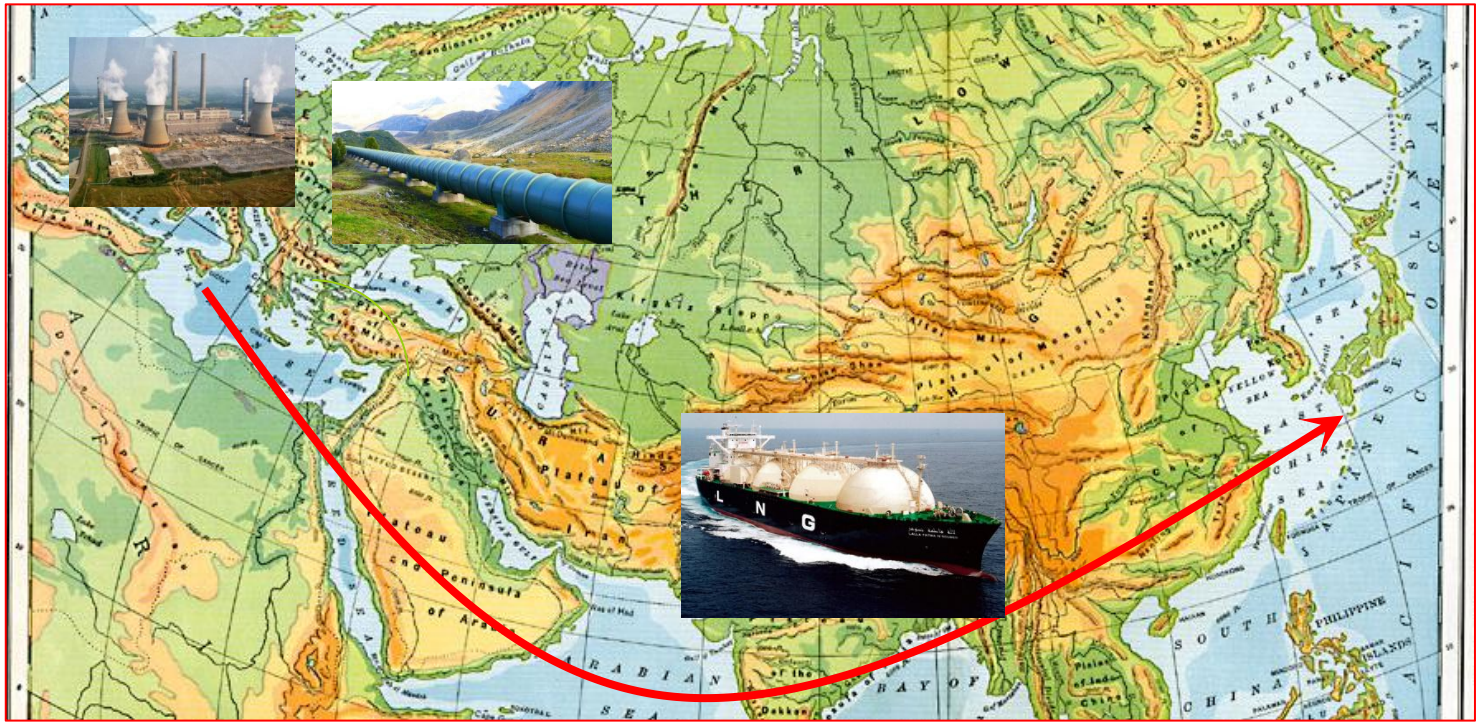
Gas supply security remained robust despite shocks

Gas production or infrastructure affected by conflict or terrorism

Conflict with potential gas supply security implications

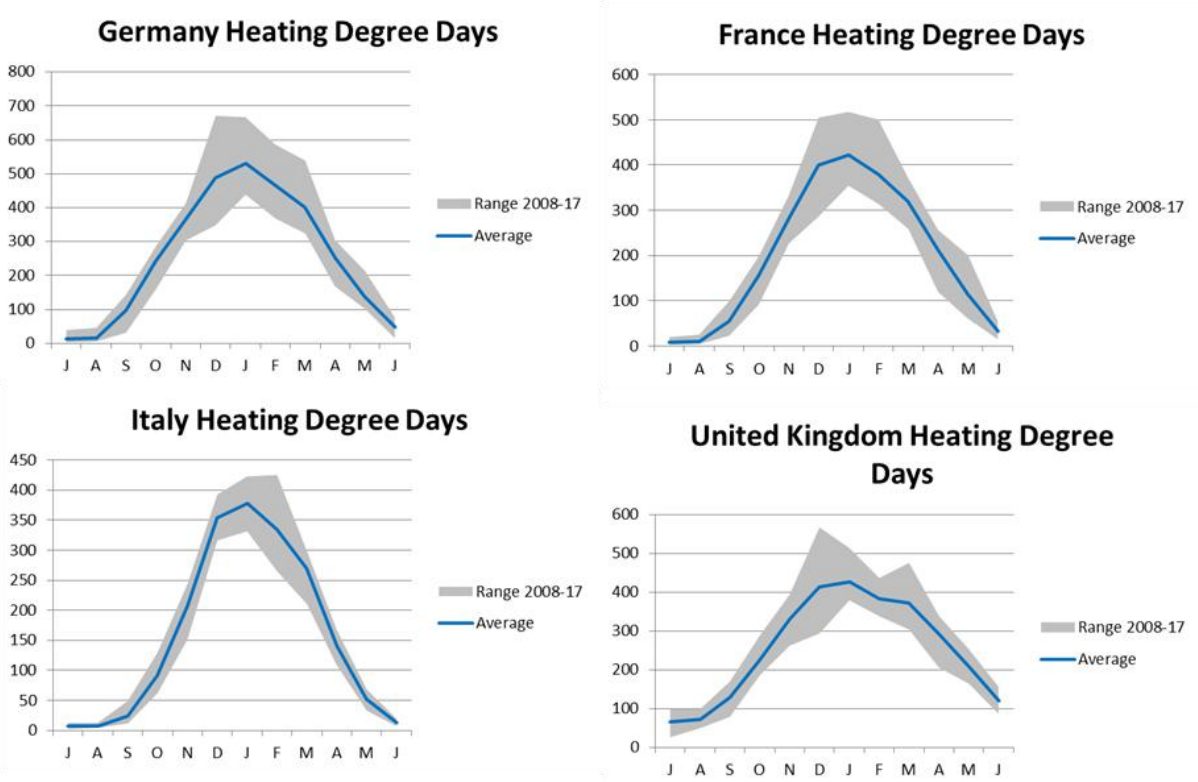
The increasing efficiency and liquidity of LNG markets was able to absorb geopolitical disruptions

Market efficiency and supply security: the post Fukushima adjustment



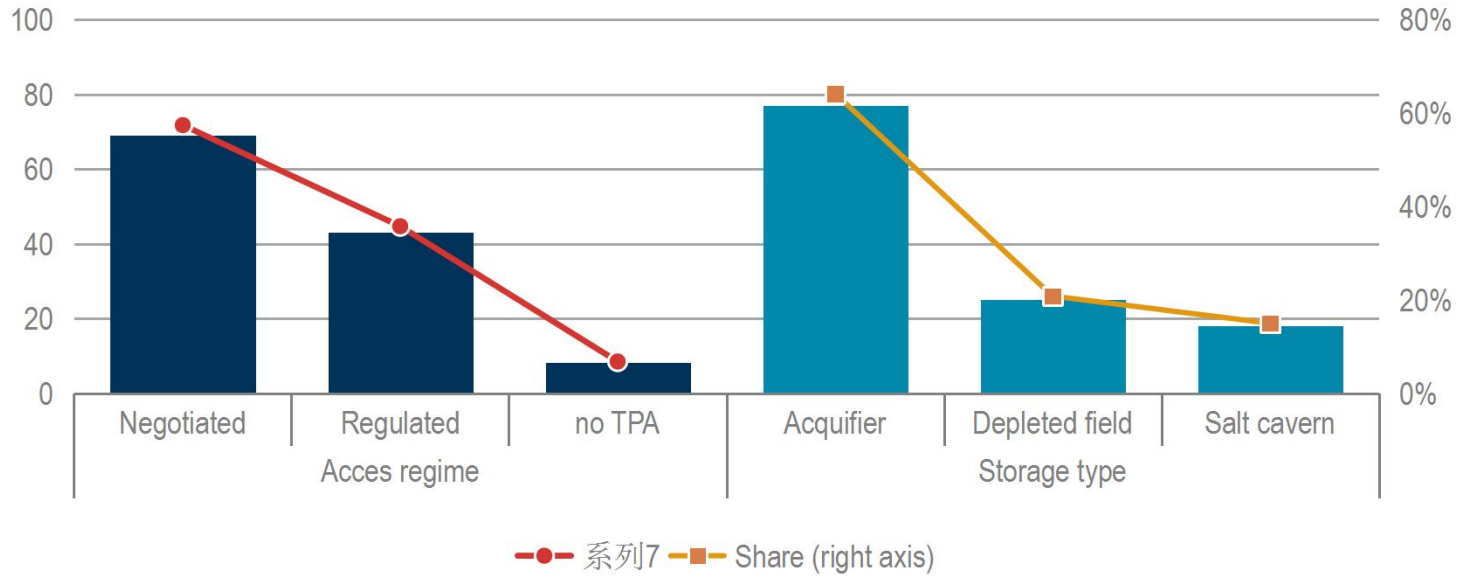
Market based fuel switching in Europe and expanded Russian pipeline flow released LNG for Japan despite stagnating global LNG production in 2011 - 2014

Large and uncertain seasonal variation necessitates storage



Heating gas demand in Northern China will soon be too big to rely on spot LNG for seasonal flexibility

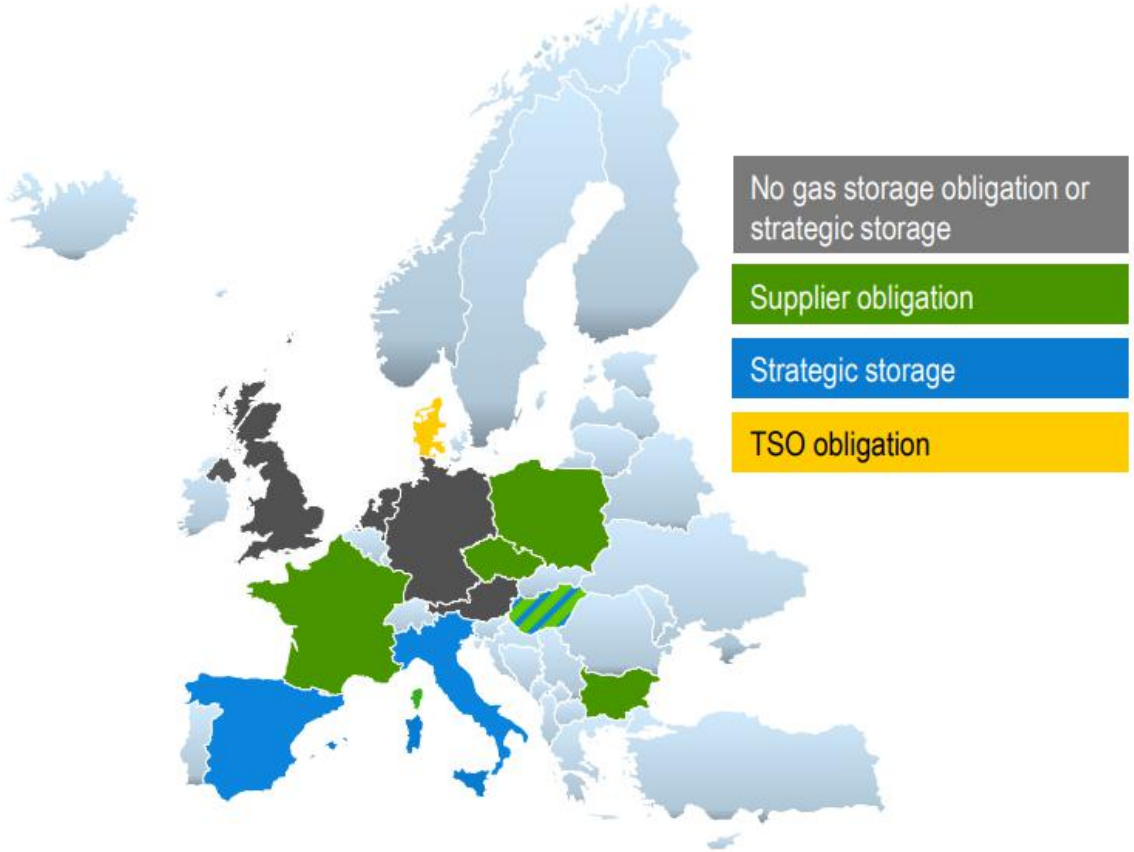
Storages in Europe



- 120 bcm gas storage capacity (~ 20% of demand)
- 70 Storage System Operators
- Mix of negotiated (57%), regulated (36%) and no TPA (7%) access

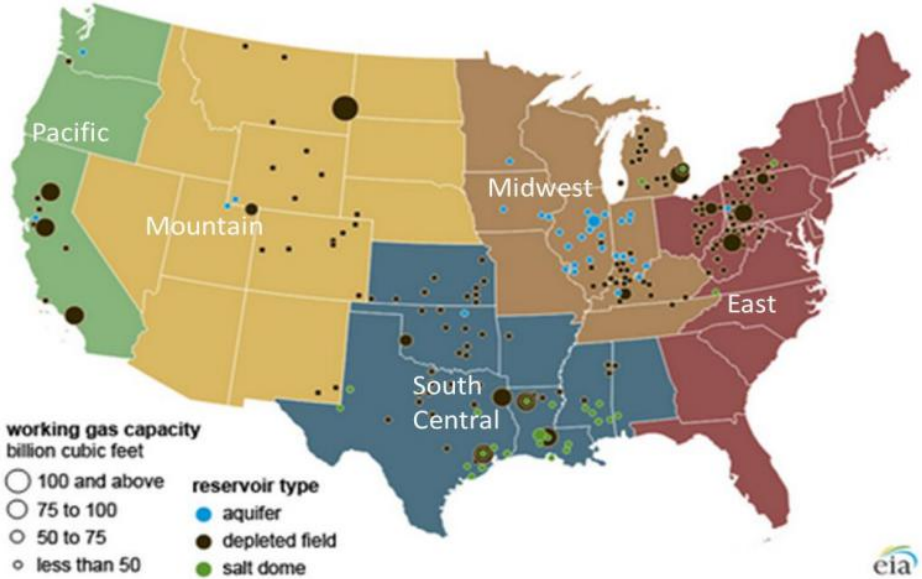
Source: GSE (2016), *GSE Storage Map 2016*

Natural gas storage obligations in selected EU countries



Source: IEA (2016), *Global Gas Security Review 2016;* EC (2015), *The role of gas storage in internal market and in ensuring security of supply.*

United States



- **Key data**
  - Storage capacity 156 bcm (~20% of annual gas consumption)
  - >120 Storage System Operators (SSO)

- **Key regulations**
  - 1992: FERC Order 636: third-party access
    - Cost of service / negotiated rates
  - 2006: FERC Order 678: market based rates (intrinsic and extrinsic value)
  - Legal obligation for local distribution companies to supply customers, therefore high reserved use of storage (~40%) but no strategic or obligatory stock fillings

Source: EIA

An efficient electricity market also enhances gas supply security

Market driven substitution provides large flexibility to the gas system in EU and USA, but this is declining due to coal decommissioning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