

GAS

Medium-Term Market Report 2013

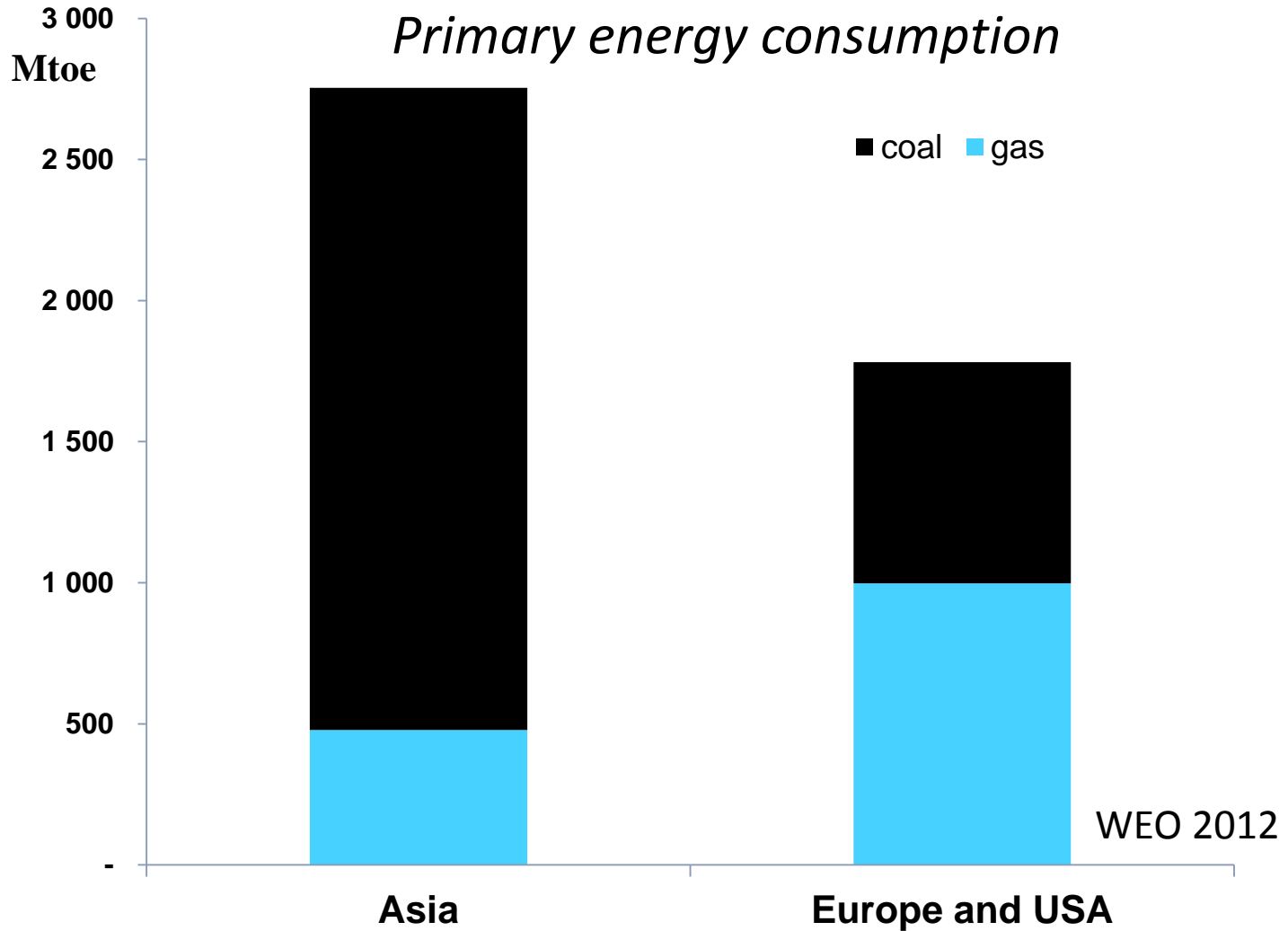
The IEA outlook for gas

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Market Trends and Projections to 2018

For gas the Asian century is just starting

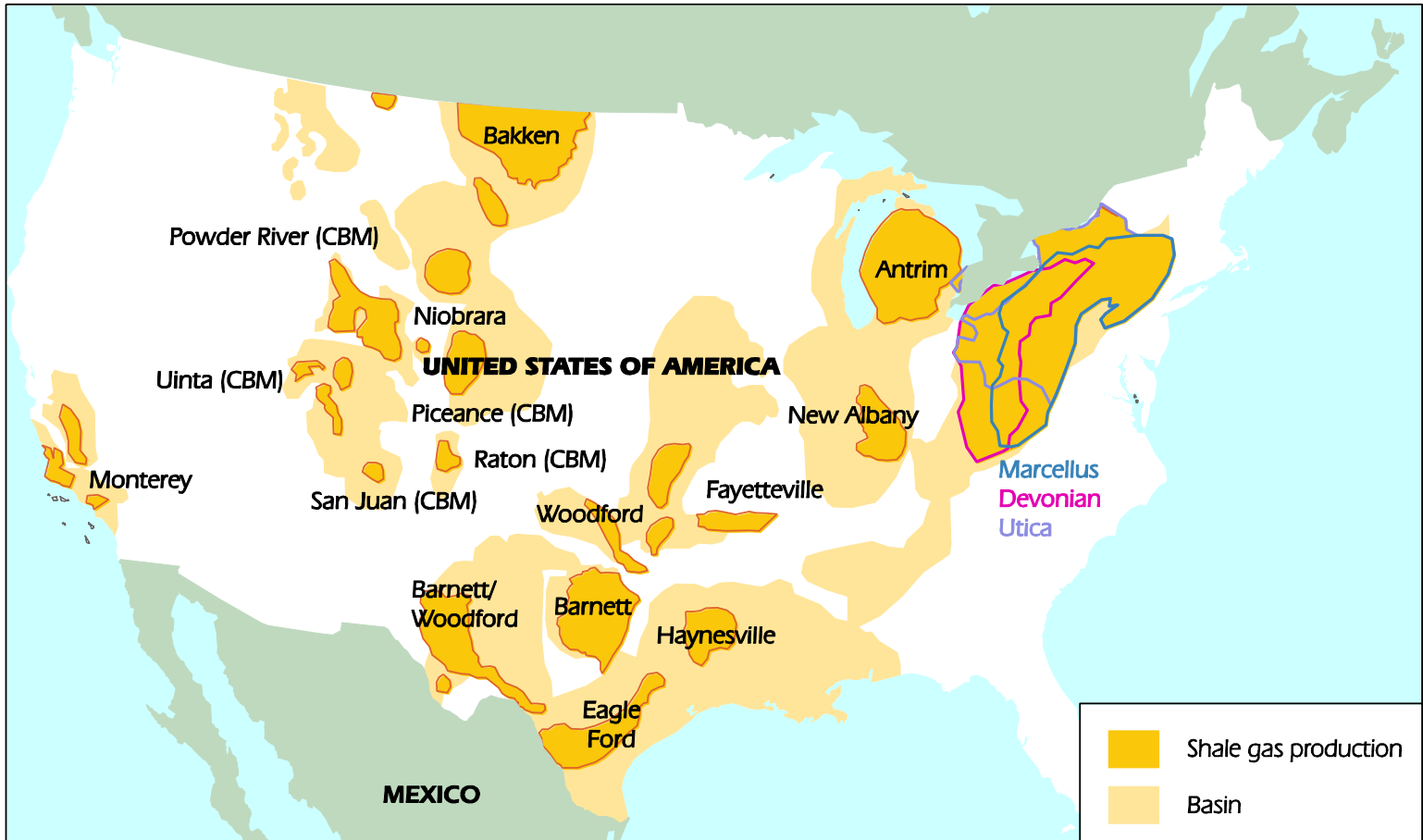


Natural gas is the key to improving air quality in Asia



Osaka 2013
Osaka 1965

With over 20% of global production growth, the US cements is leading position



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

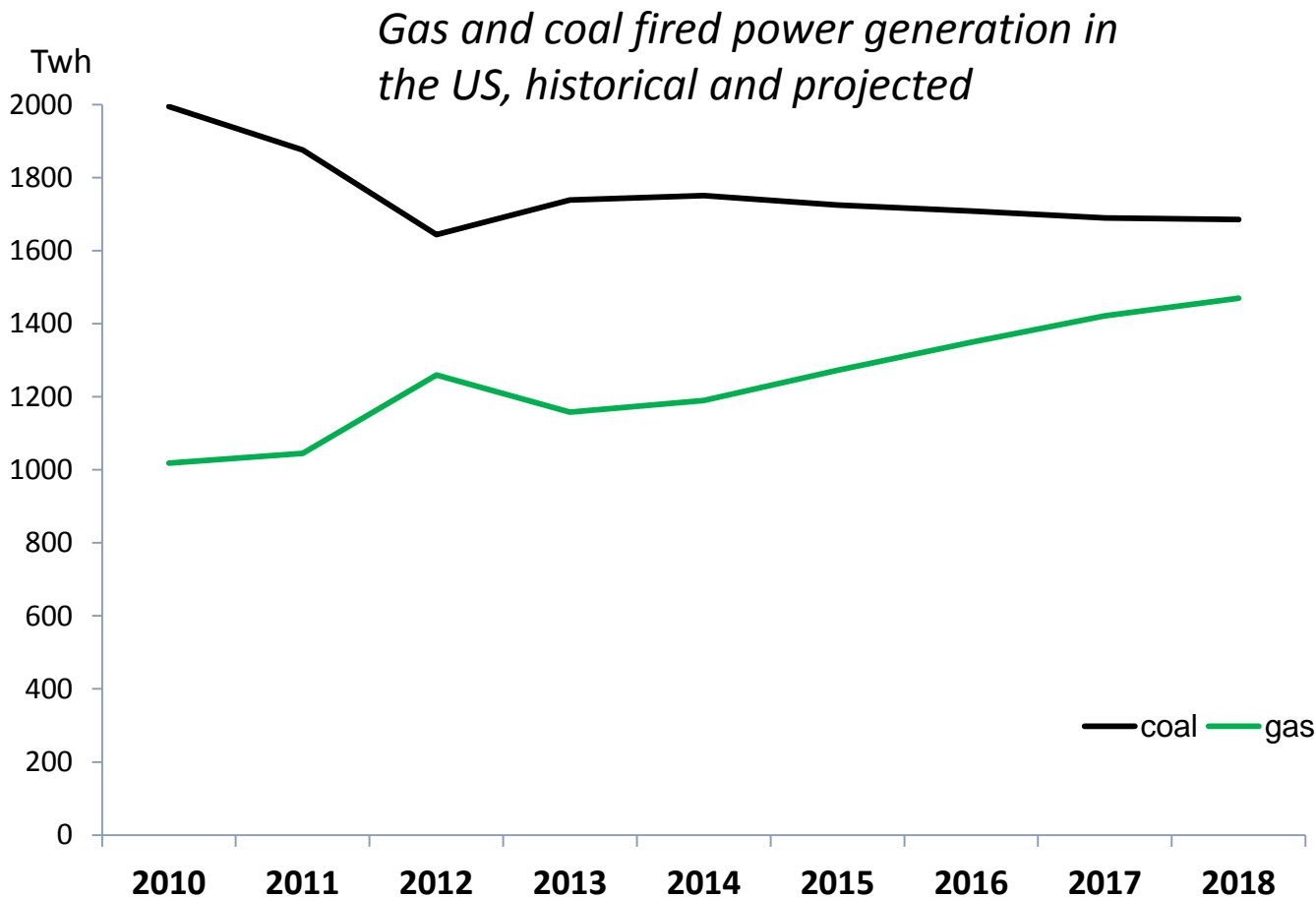
The further growth of shale gas production in the US dwarfs shale gas developments in the rest of the world

Shale production growth is sustainable at lower gas prices



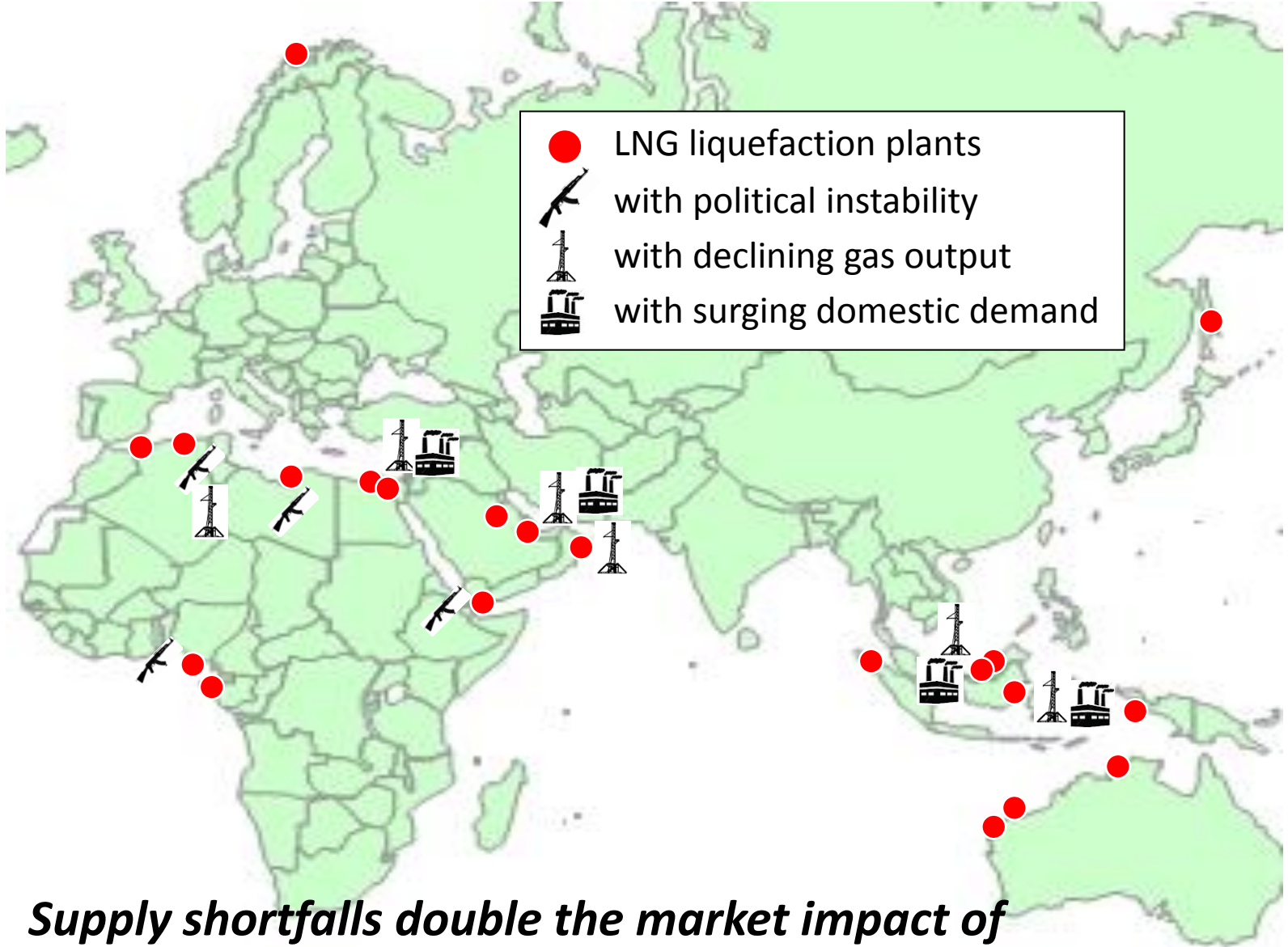
- Technological improvements in seismic, drilling and fracking
- “Mass manufacturing” methods in oil field services
- Strong financial boost from liquids

Recovery of gas prices causes a blip in the march of gas



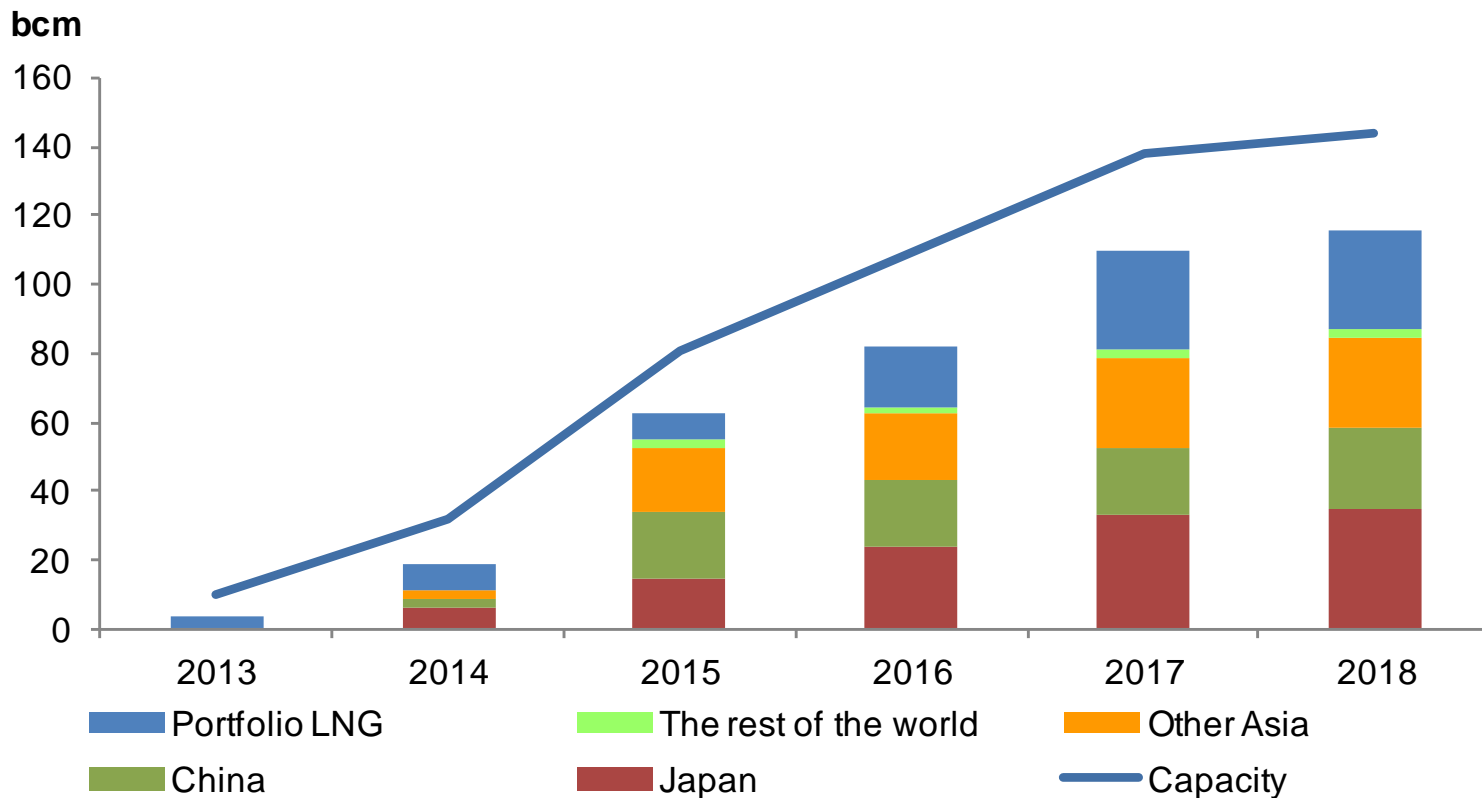
In the absence of constraints on coal-plant operation, power-sector emissions increase by 120 million tons, despite shale gas

Security issues, depletion and domestic demand growth lead to tight LNG supply



Supply shortfalls double the market impact of Japanese demand increase

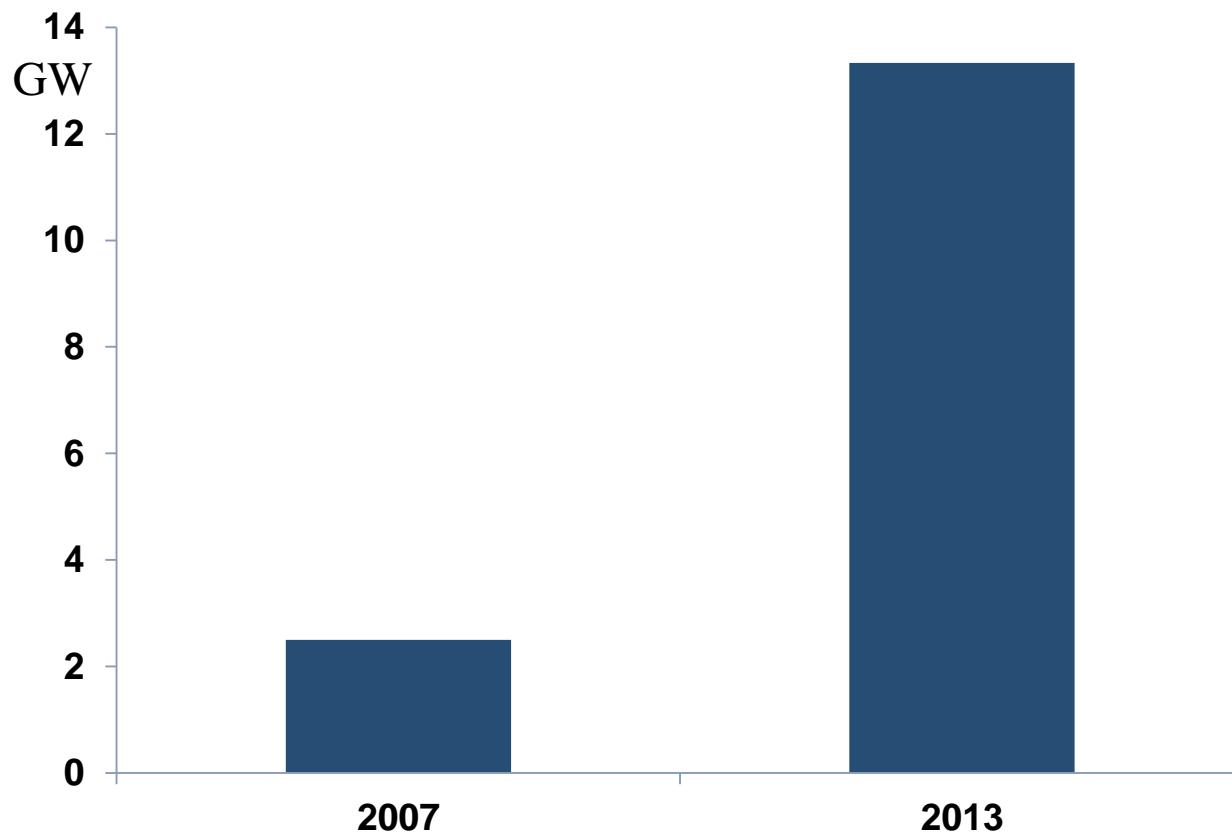
New LNG supply is predominantly backed by long-term contracts



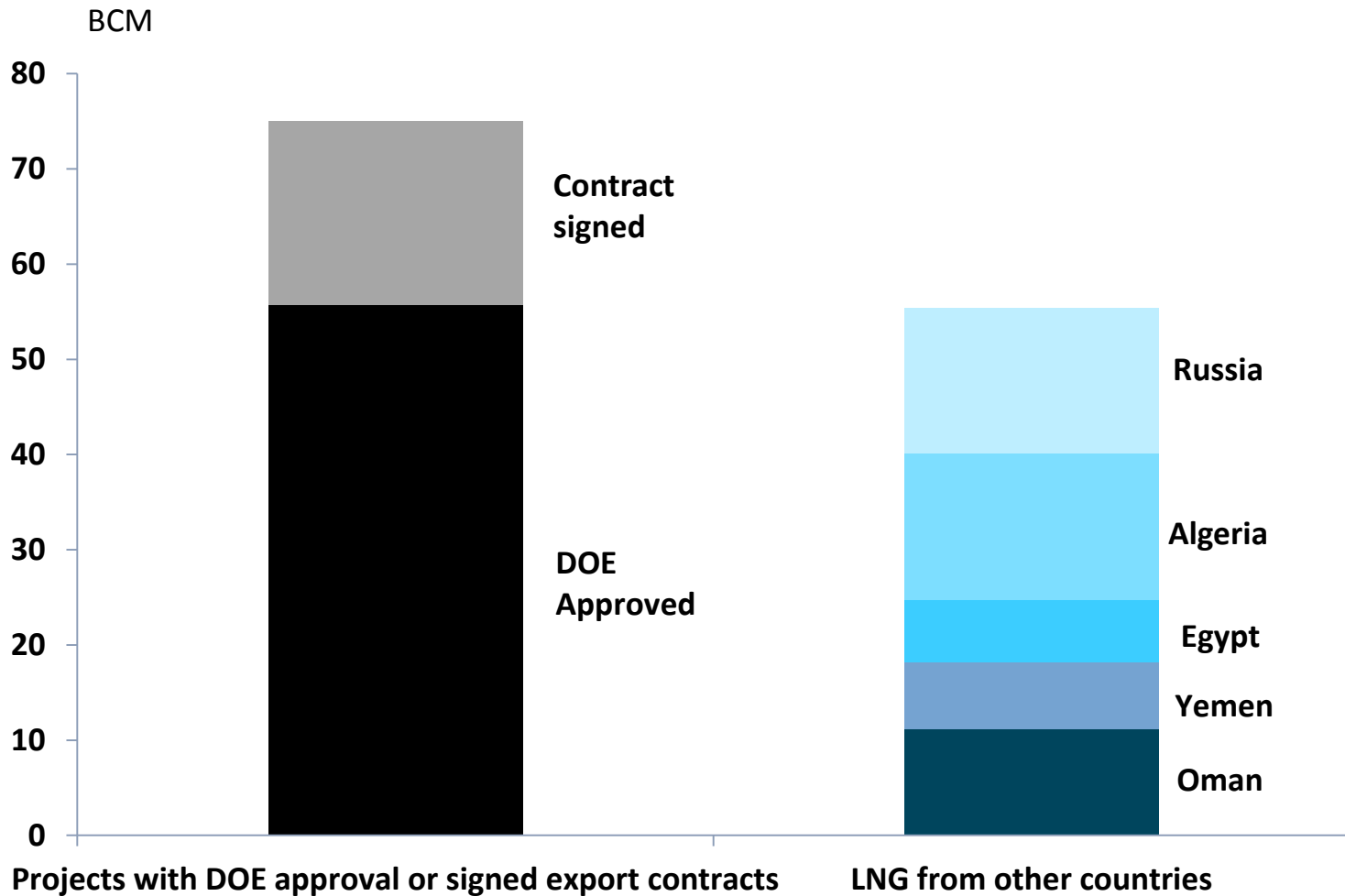
Portfolio LNG and secondary re-exports both play an increasing role

Persistent cost inflation threatens the competitiveness of LNG

How much solar panels the investment cost of a liquefaction train would buy?



North America is emerging as a major exporter



Can Henry Hub+ emerge as a price signal for Asia?

China: air quality is emerging as the key question and gas is the answer

Every year till 2018



- New gas heating in 3.5 million homes
- 7 million tons of industrial coal consumption replaced by gas
- A new CCGT in every 6 weeks (but a new coal plant every week)

China adds the combined gas demand of Germany, France and Belgium in 5 years, equivalent to 27% of global demand growth

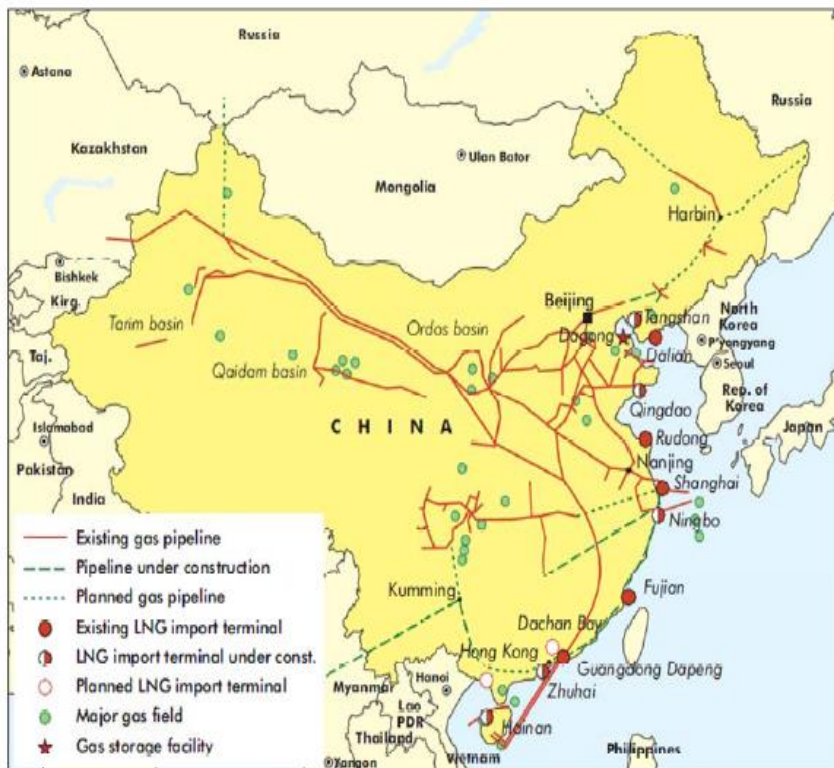
Chinese non-conventional gas developments can not keep up with demand



- Complex geology
- Population density in Sichuan, water scarcity in Tarim/Ordos
- Open regulatory issues
- Large investments in coal gasification (25 bcm by 2018)

China adds almost the gas output of the Netherlands, but with only 100 shale wells so far the shale ramp-up is beyond 2020

China adds the current German imports to its import need

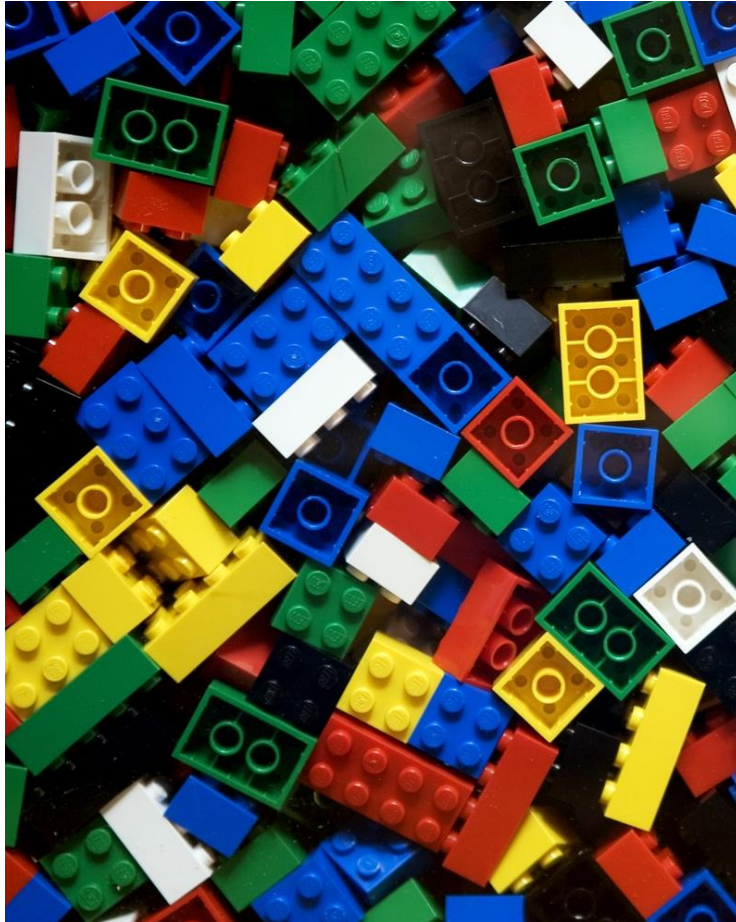


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- Myanmar imports remain upstream constrained
- Russian imports unlikely before 2020
- Central Asia: expanding infrastructure but high prices

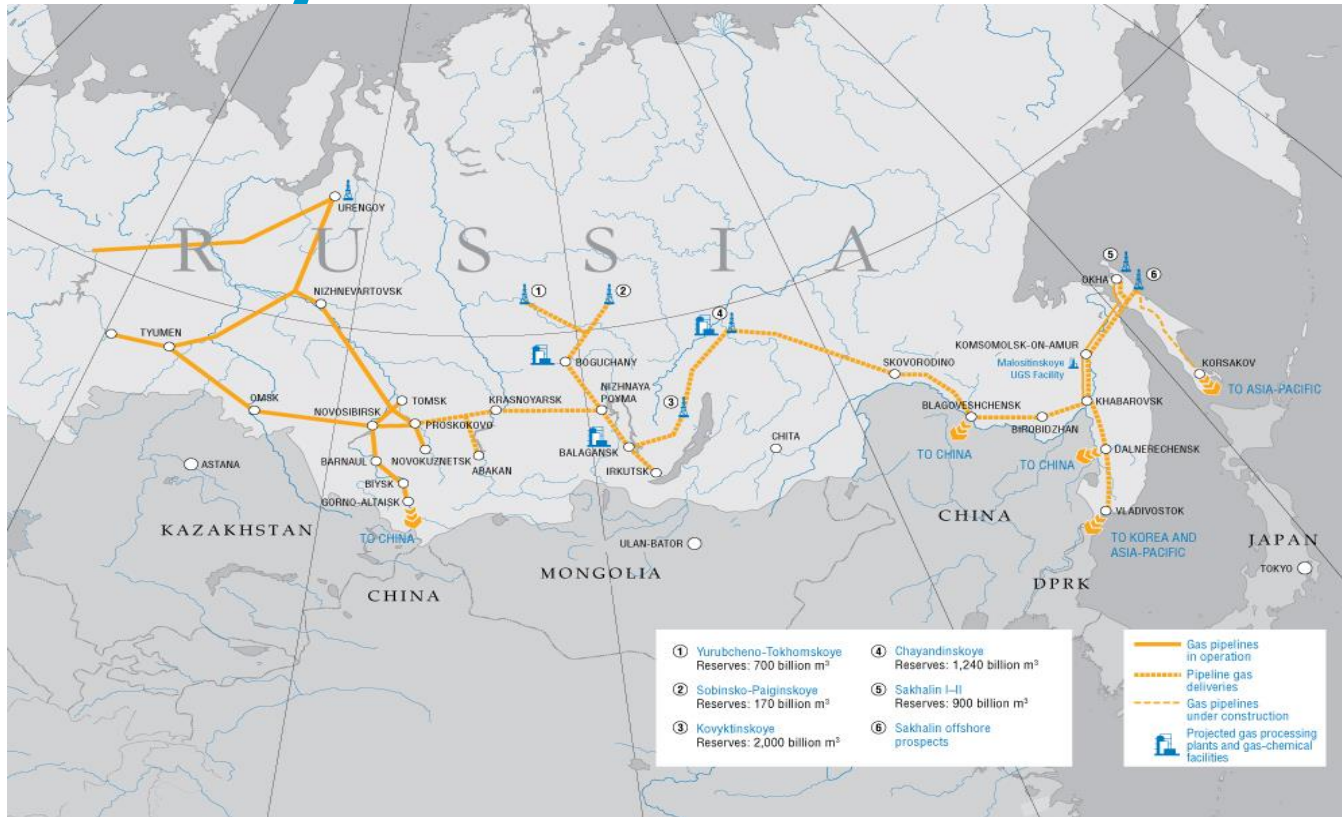
China absorbs all the production increase in Central Asia and one third of the global increase of LNG supply

China: building an efficient competitive gas market



- Non-conventionals diversify upstream
- Rapid build up of domestic pipelines
- Emergence of “City-utilities”
- LNG

Russian gas: the East is the manifest destiny?

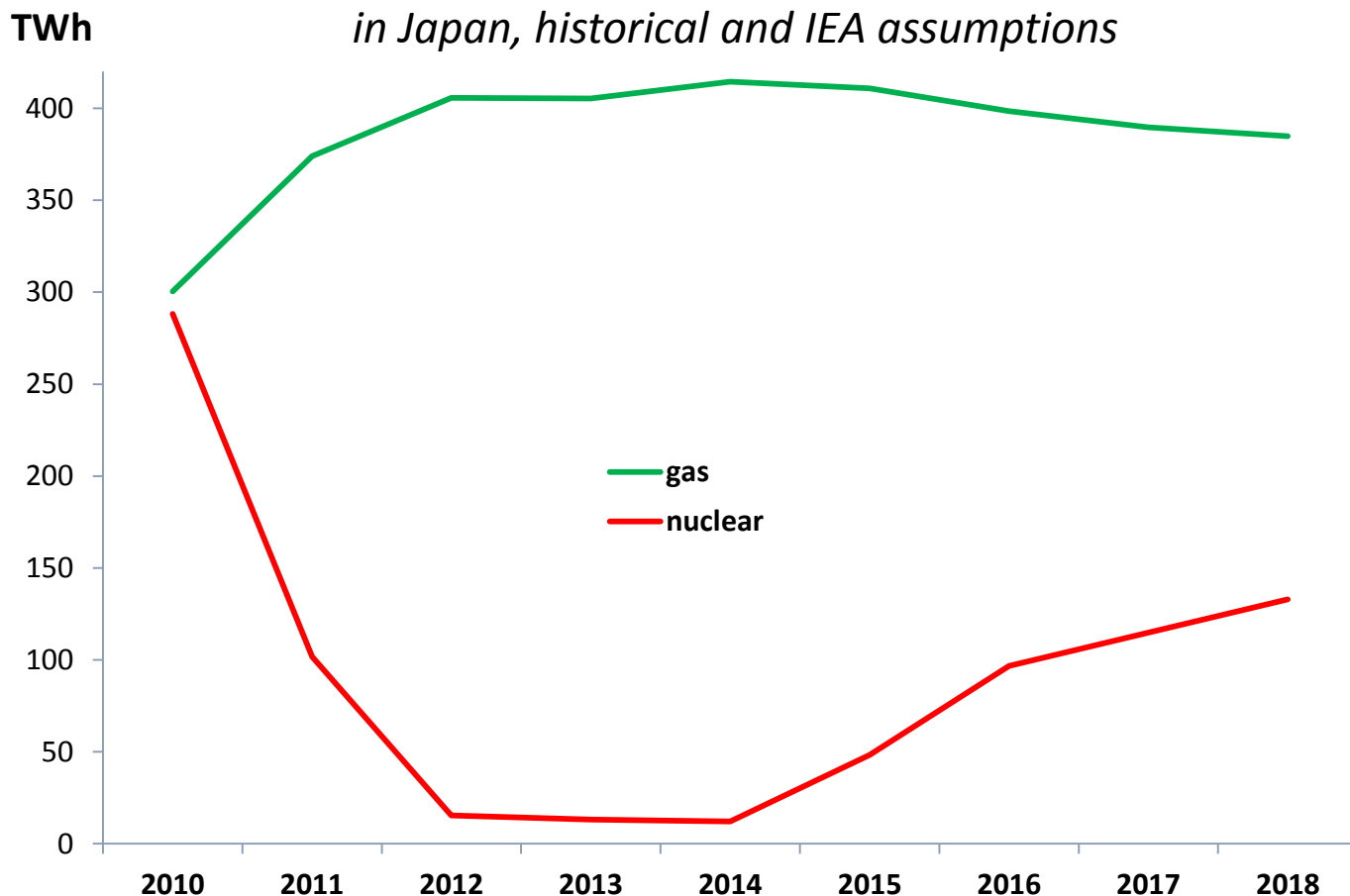


Source: Gazprom

- **Production constrained by EU and domestic demand**
- **Surging independent production backed by NGLs**
- **Asian exports depend on capital-intensive infrastructure**

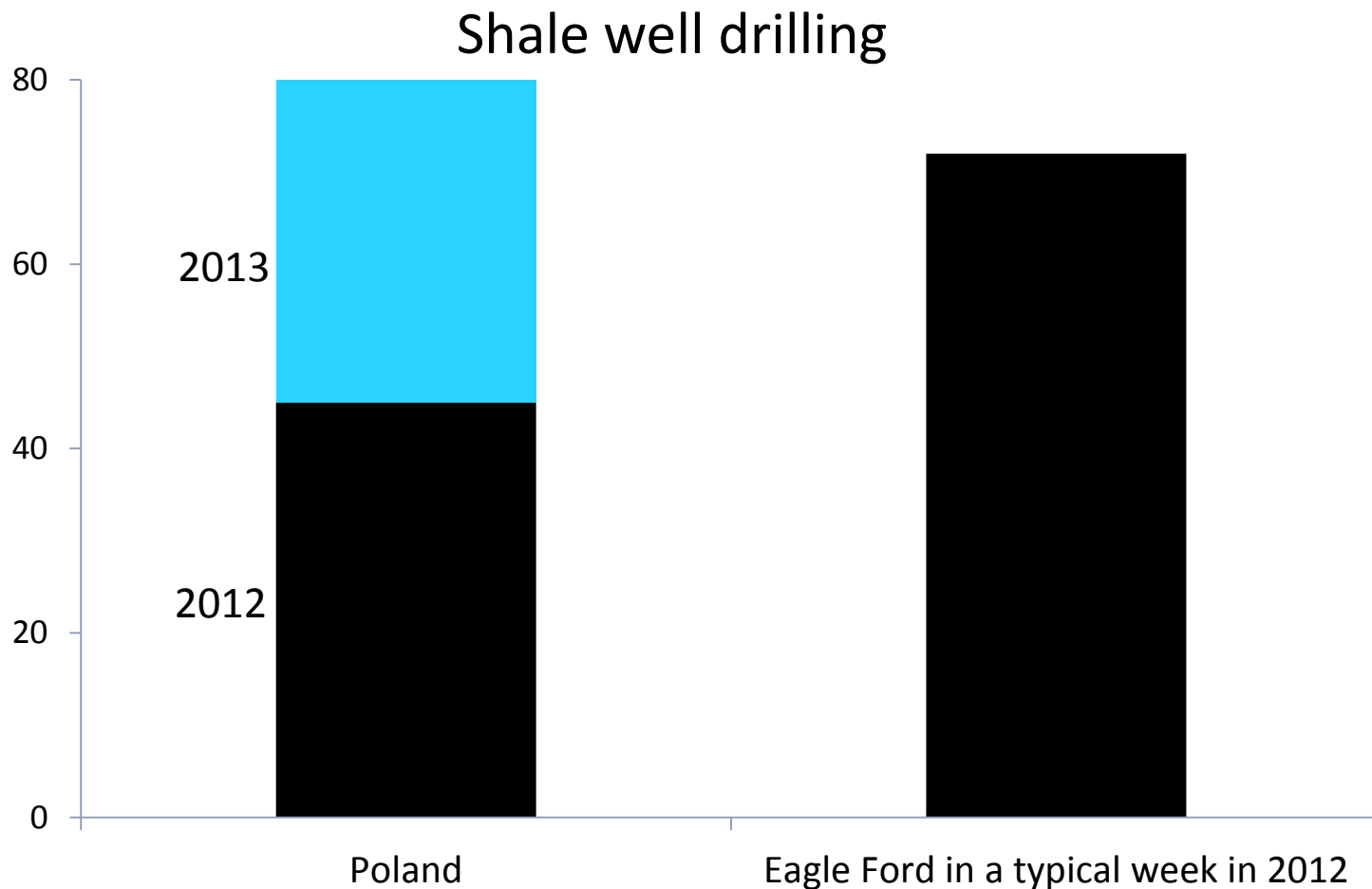
Japan: nuclear restoration stabilizes LNG demand and eliminates demand rationing

Gas fired and nuclear power generation in Japan, historical and IEA assumptions

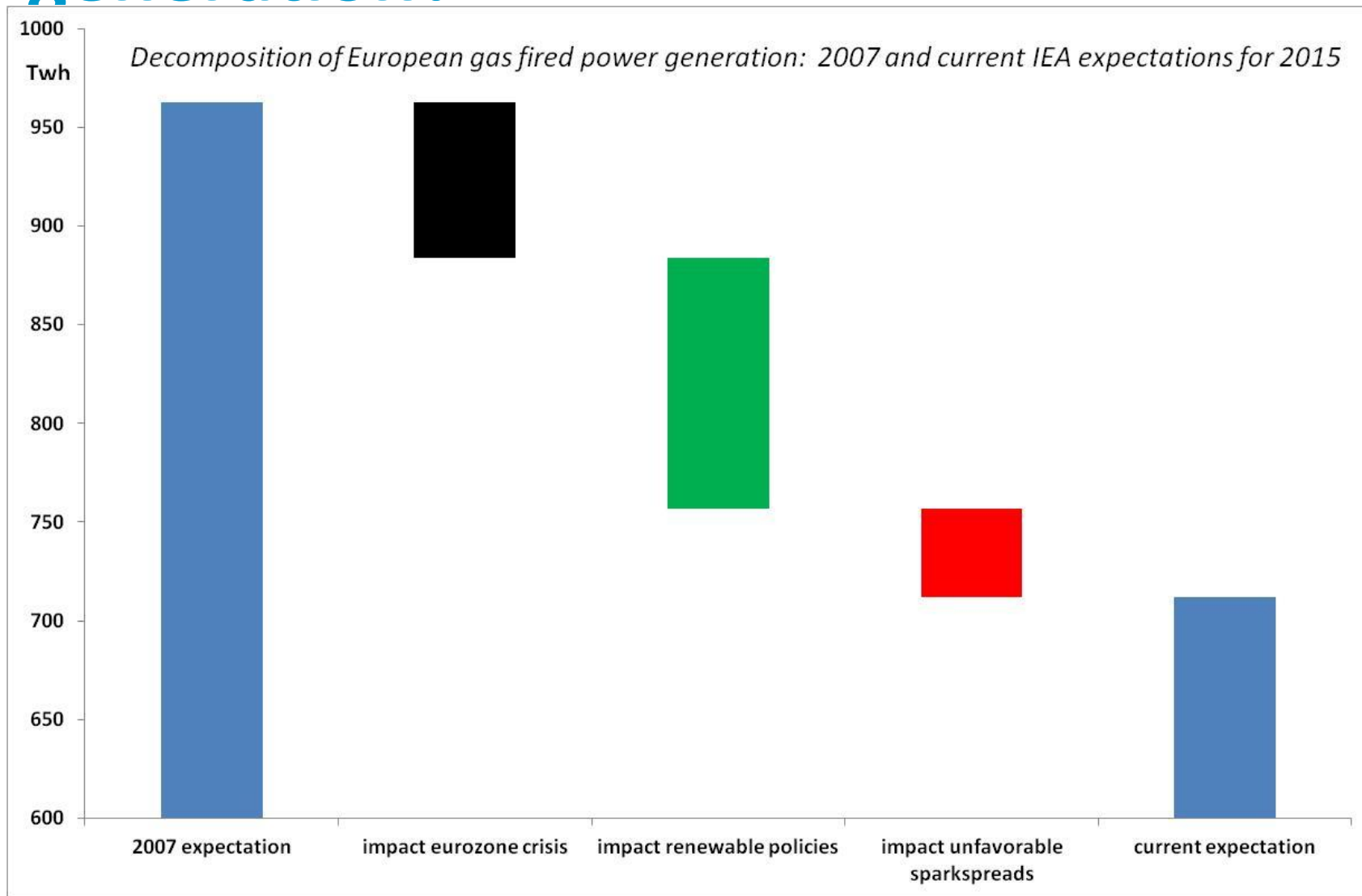


Projected nuclear restoration is equivalent to a 45 billion dollars Australian LNG project

Shale gas in Europe: ramping up by a factor of 100?

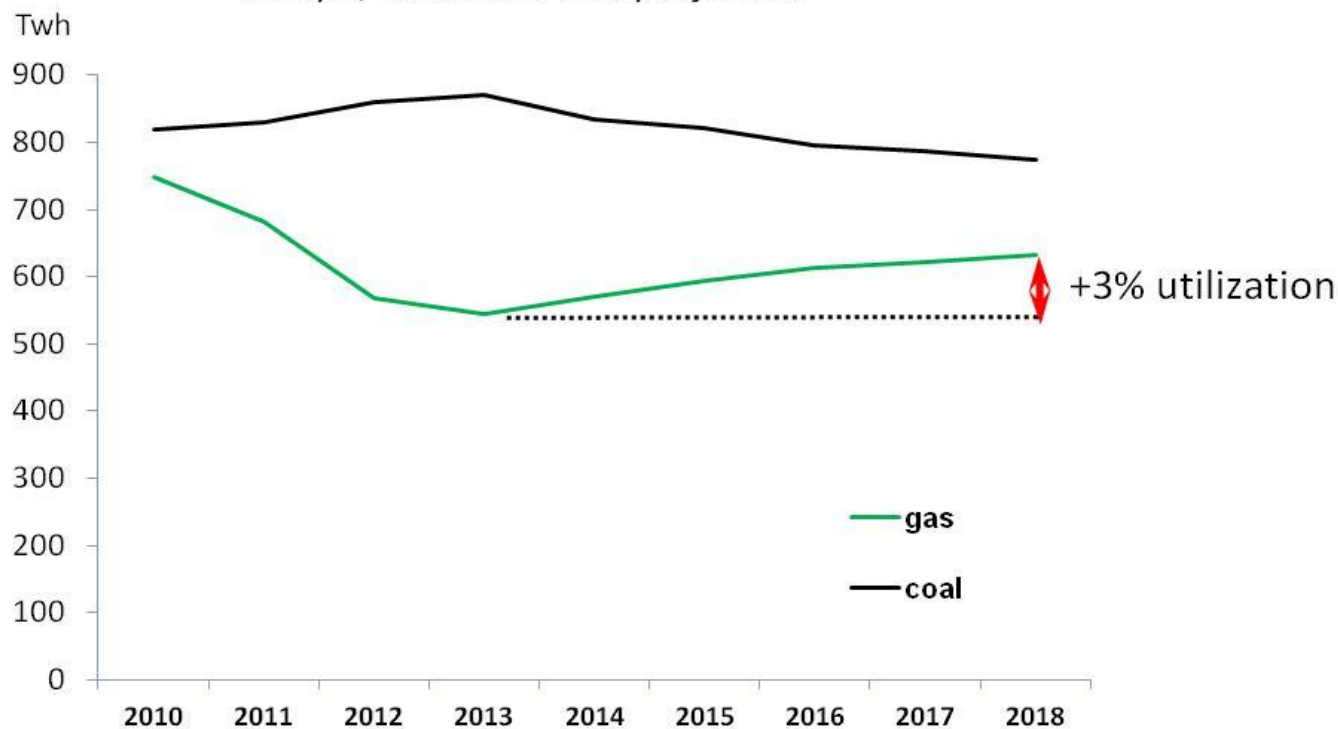


Who killed EU gas fired power generation?



Europe: Policy-driven decommissioning of old coal plants enables gas to recover

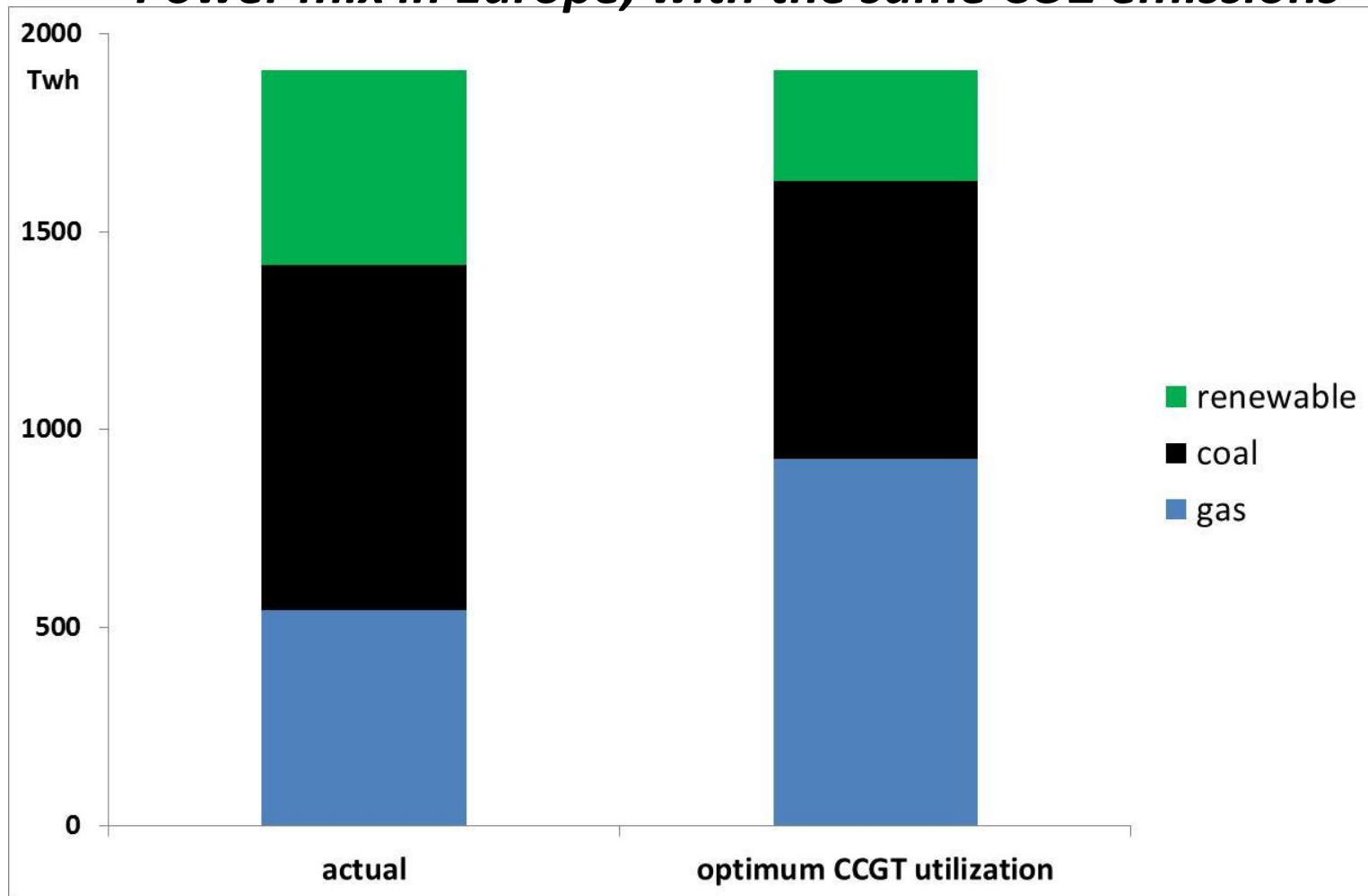
Gas and coal fired power generation in Europe, historical and projected



Gas plant utilization remains below the level expected at the time of investment

Climate policy design impacts the role of gas

Power mix in Europe, with the same CO2 emissions

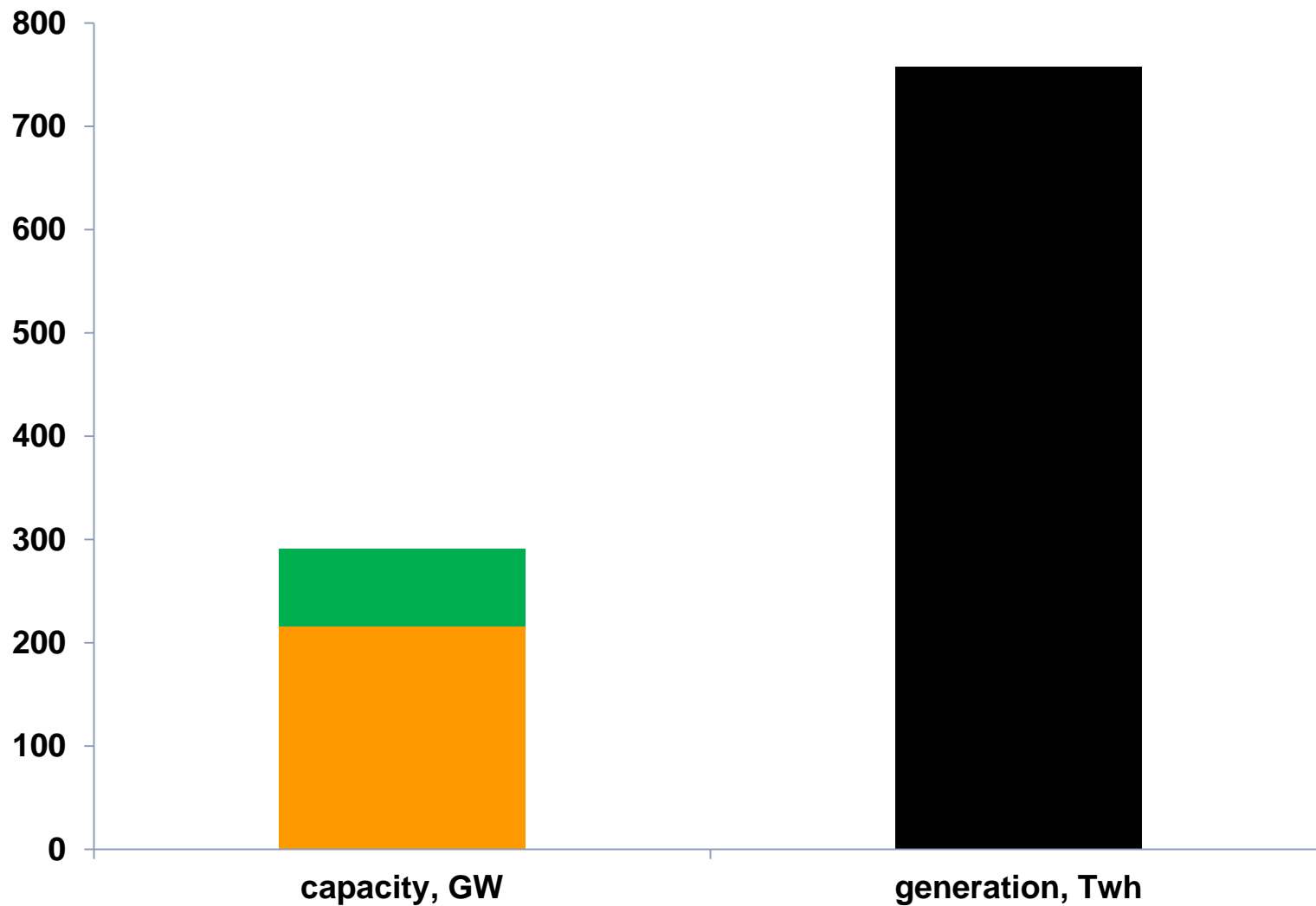


If 25% lower imports have a bigger price impact than 0.8 \$/mbtu, renewable subsidies are paid by a lower gas bill

The exporter's dilemma: premium pricing or volume?



Gas as a backup for renewables: good news and bad news



Special focus: gas as a transport fuel, this time for real?



- Traditionally concentrated in Iran, Pakistan, India, Argentina and Brazil
- Shale gas revolution in the US
- Stranded gas resources
- Oil dependency concerns
- Emission advantages

Driven by China and the US gas supplies 10% of the growth of transportation energy demand

A 100 kB/day oil replacement by gas, Plan A: Gas to Liquids

- ✓ Fuel can be used in the existing transport system without modification
- ✓ Aviation fuel possible
- ✗ 20 billion + investment
- ✗ Large project management risk
- ✗ 40% energy loss in conversion



Suitable if gas and capital both are very cheap

Plan B: 4 million CNG Cars

- ✓ Range and weight much less of an issue than with electric cars
- ✓ Easy fit with existing car models, around 4000 usd/car
- ✓ Cheap filling stations (no liquifaction)
- ✗ A wide filling station network will be needed
- ✗ Inertia of the car market, need for incentives



With the shale revolution in full swing, only 15000 CNG cars were sold in the US in 2012

Plan C: CNG in buses and delivery trucks, 300 thousand vehicles

- ✓ High utilization rates
- ✓ Predictable routes
- ✓ Cheap filling stations (no liquifaction)
- ✓ Saves urban particulate emissions
- ✗ Potential limited by the share of public transport
- ✗ Capital constrained municipalities



CNG buses play an increasing role in the US and in Asian megacities with air quality concerns

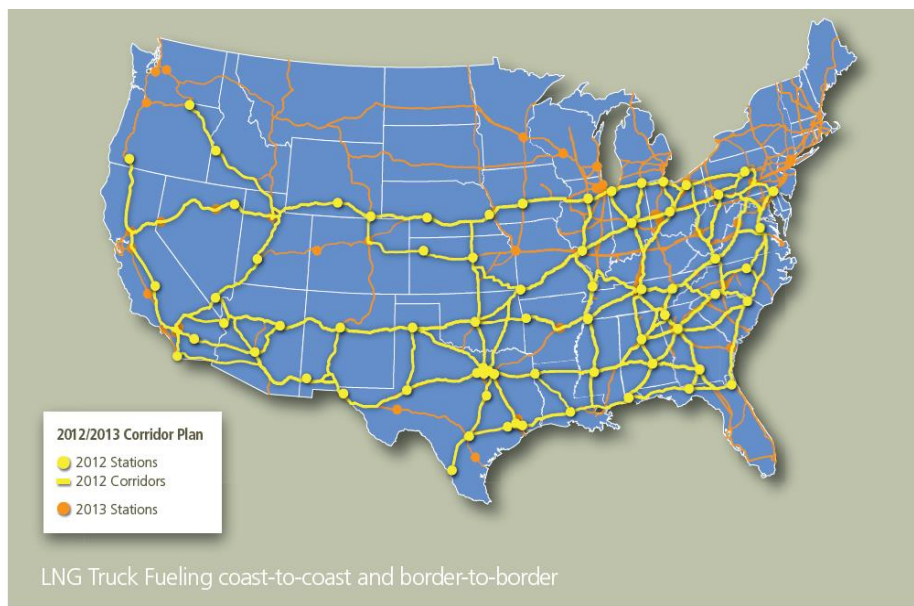
Plan D: LNG in heavy transport, 100 thousand vehicles

- ✓ High utilization rates and high energy demand
- ✓ Predictable routes
- ✓ Large corporate users – infrastructure partnerships possible
- ✓ Leveraging LNG terminals
- ✗ Expensive upgrades (80000 usd/truck)
- ✗ Expensive stations (liquefaction, LNG storage)
- ✗ Coast to coast coverage needed



Very large potential impact but serious infrastructure obstacles to overcome

US: rolling out the infrastructure



Source: Clean Energy Fuels

- Increasing market share for CNG buses
- Broad range of LNG trucks is becoming available
- Large investments in infrastructure
- Technological progress in refilling and small scale liquifaction
- Watch out for railroads

Due to infrastructure costs, after the rollout, the wholesale gas price will have little impact on competitiveness

Despite import dependency and slow ramp up of shale, China goes for gas in transport



- Concerns about particulate emissions
- Large concentrated mass transit systems
- Symultaneous rollout of pipeline and refilling infrastructure

The ramp up of gas as a transport fuel in China is 4 times the growth of the US

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