

LNG Markets in Transition The Great reconfiguration

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The authors

- OIES and KAPSARC brought together 12 international experts from the industry and academia to create this book



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Looking back at the past 2 years

- Mid 2014: we started thinking about the LNG book
 - ‘Only’ 100 mtpa under construction, including 1 US project
 - Asia still considered as the bottomless premium market for LNG
 - Oil prices at ~\$100/bbl
 - Many planned projects ready to take FID

How is the LNG business going to be affected by these changes?

- May 2016: we finalize the book
 - 150 mtpa to come over 2015-20 (64 mtpa in the US)
 - Asian LNG demand growth uncertain (additional volumes) (down by 2 percent in 2015), buyers in search of flexibility
 - Sellers looking at new markets
 - Oil prices at around \$40-50/bbl, gas spot prices at ~\$4-6/MMBtu
 - Who will take FID?

Towards a reconfiguration?



Moving away from the “cosy” club



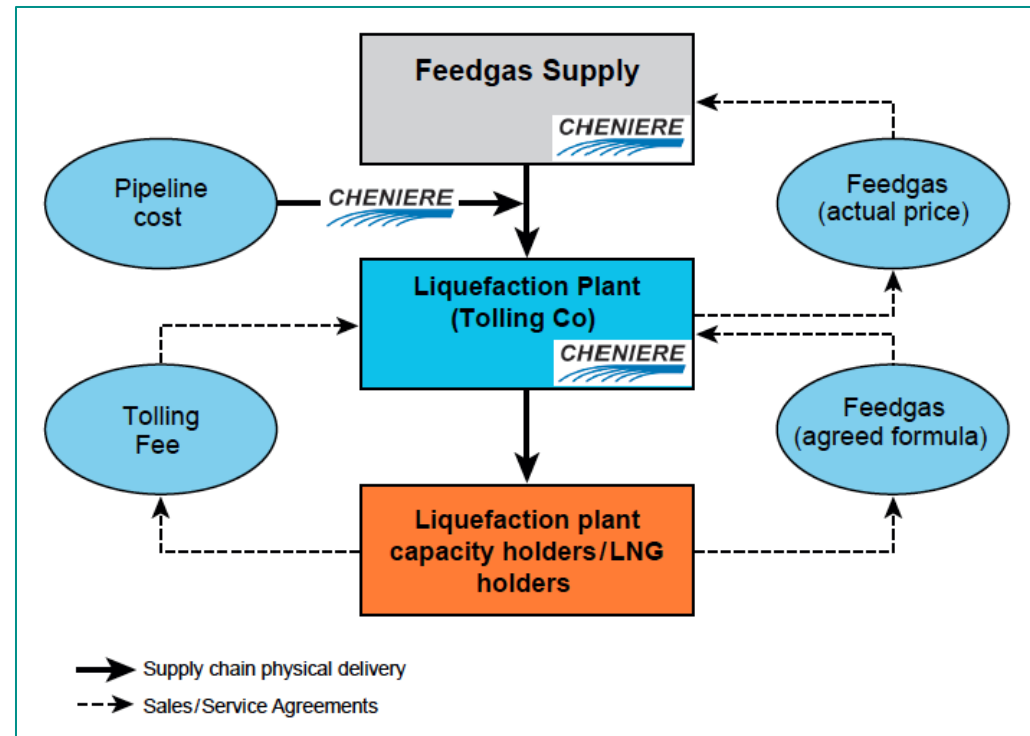
- Multiplication and diversification of players in the liquefaction, shipping and regasification businesses
- Aggregators are increasing their role, buyers are going upstream, traders want to participate, and new entrants to take market shares (even in Asia)
- More companies alliances on the buyer side



Developments in the chain

- New companies are coming into the LNG business, throughout the whole value chain
- These companies bring new ideas and ways of doing business that have challenged the norms of the LNG sector
- Changing market structures are driving changes in LNG contracts
- US projects have adapted the LNG tolling structure and LNG business models
- FSRUs give fast access to market
- FLNG gives options for liquefaction

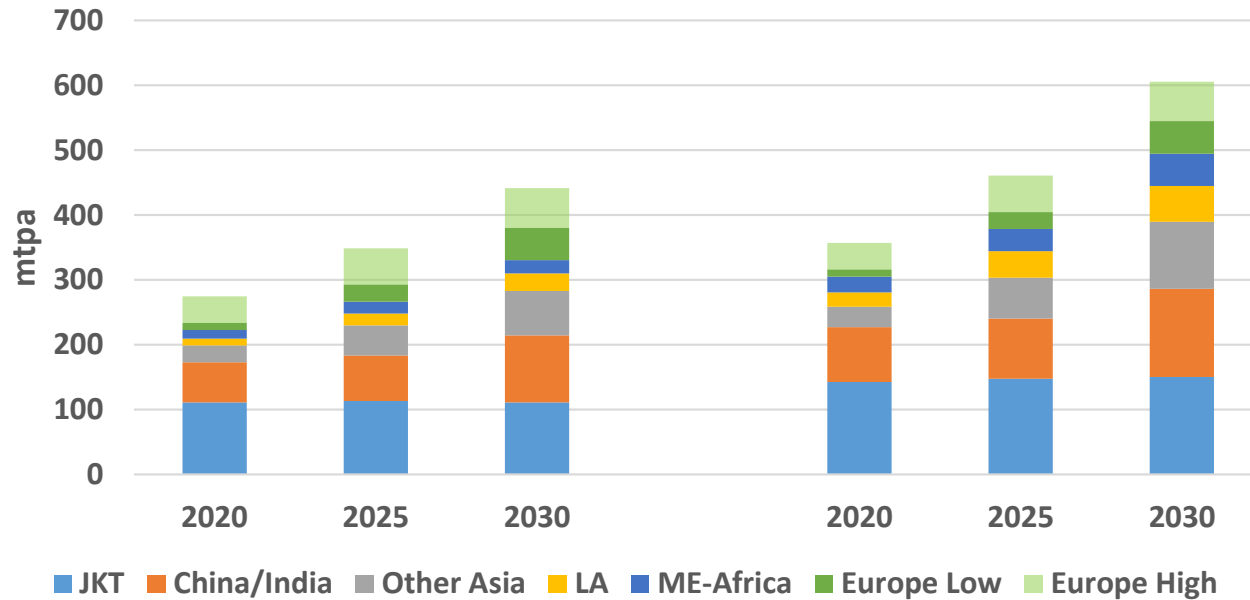
Sabine Pass tolling structure





Where is LNG demand heading?

Regional LNG demand outlooks

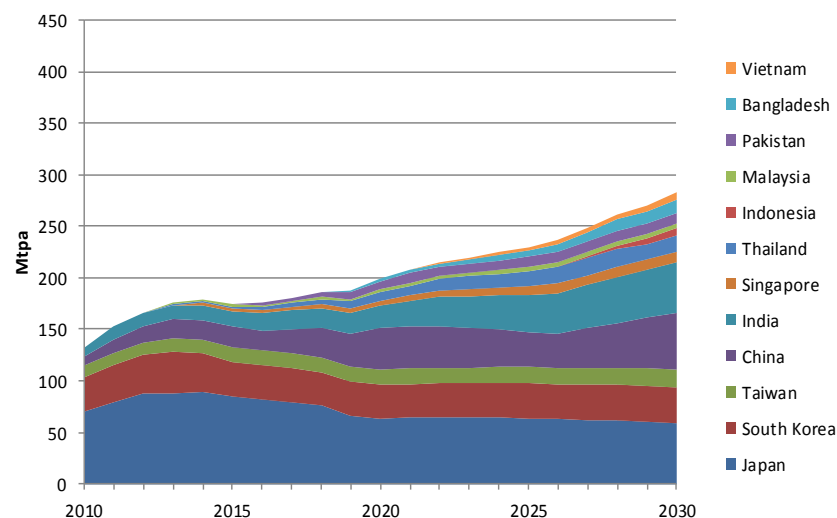


- Considerable regional uncertainty
- Europe will play a balancing role, absorbing unwanted volumes in the low demand case and letting LNG go to other markets in the high demand case
- Potential upside in the transport sector

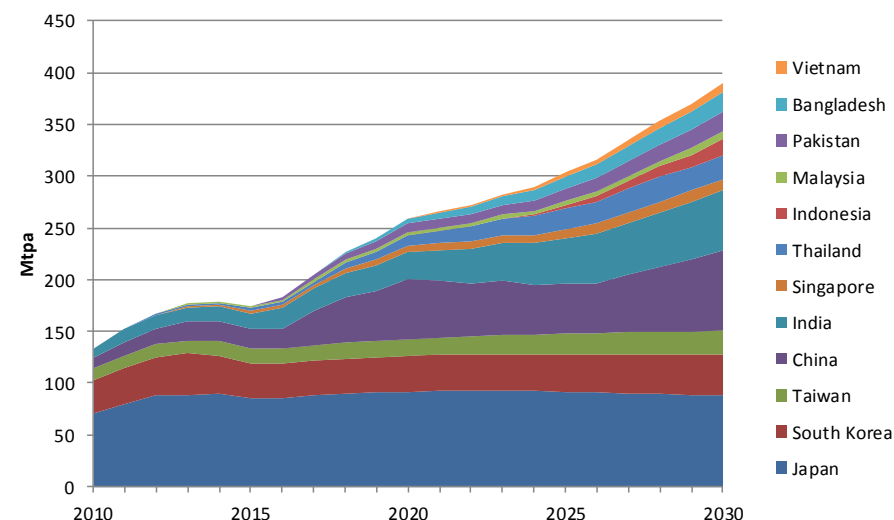


Focus on Asian LNG demand

Low case



High case



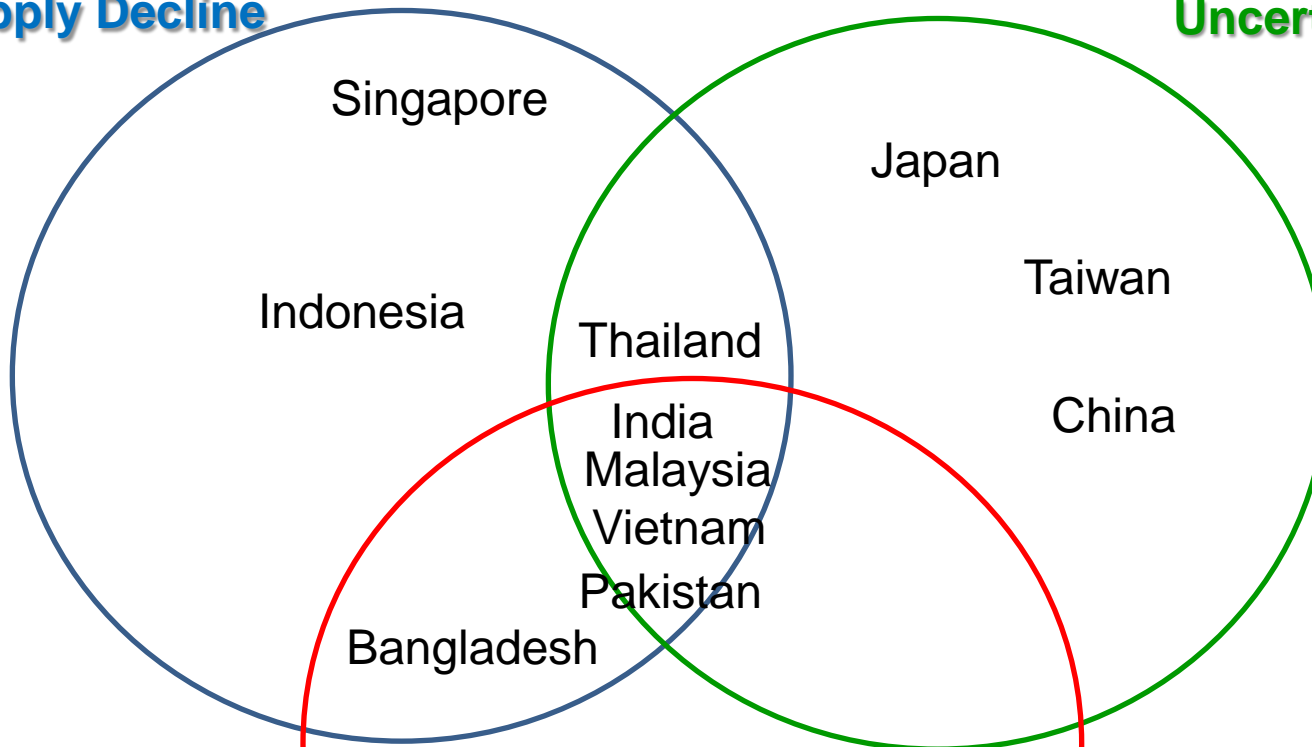
- Asia will remain the largest LNG importing region
- Individual factors can result in very different outlooks for Asian countries



Key drivers for Asian demand

**Production/Pipeline
Supply Decline**

**Energy Mix
Uncertainty (Policy)**



- Potential for LNG demand growth – in aggregate significant.
- Needs a change in marketing strategy – credit risks higher in many cases.
- But current low prices help establish markets
- And FRSUs can float away if bills not paid.

DEMAND

**Investment/Price
Framework**



Mature Asian markets

Japan:

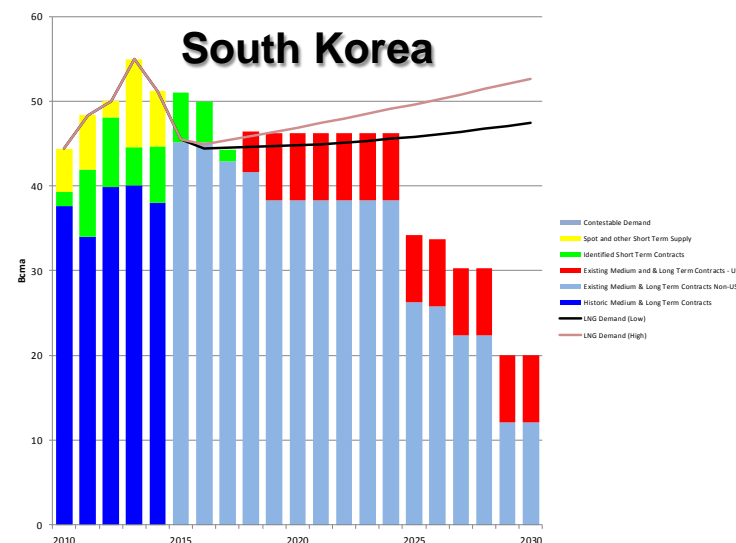
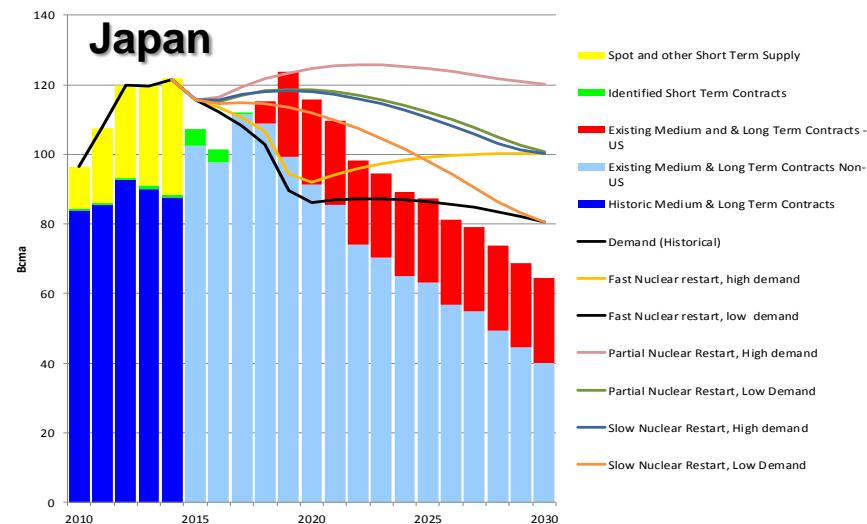
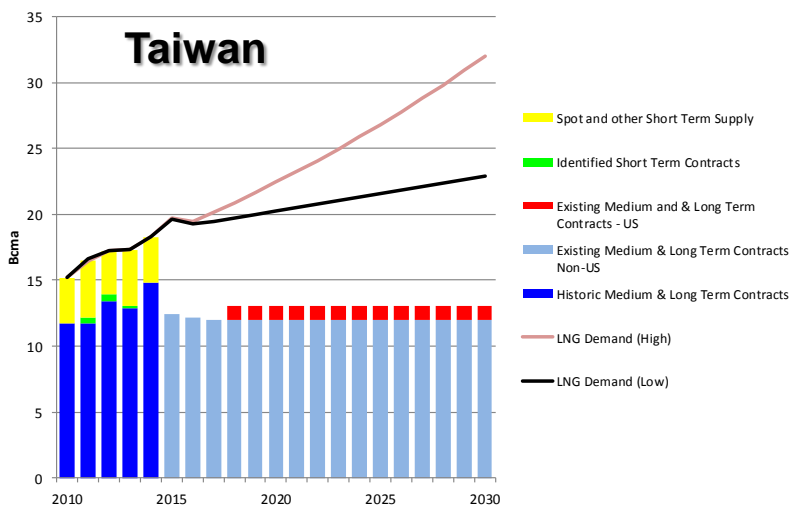
- Huge uncertainty range driven by a) pace and extent of nuclear re-start and b) achievement of energy efficiency policy.

South Korea:

- Future LNG demand growth muted by government policy to limit LNG in power sector, hoping to offset coal GHG's by renewables and nuclear.

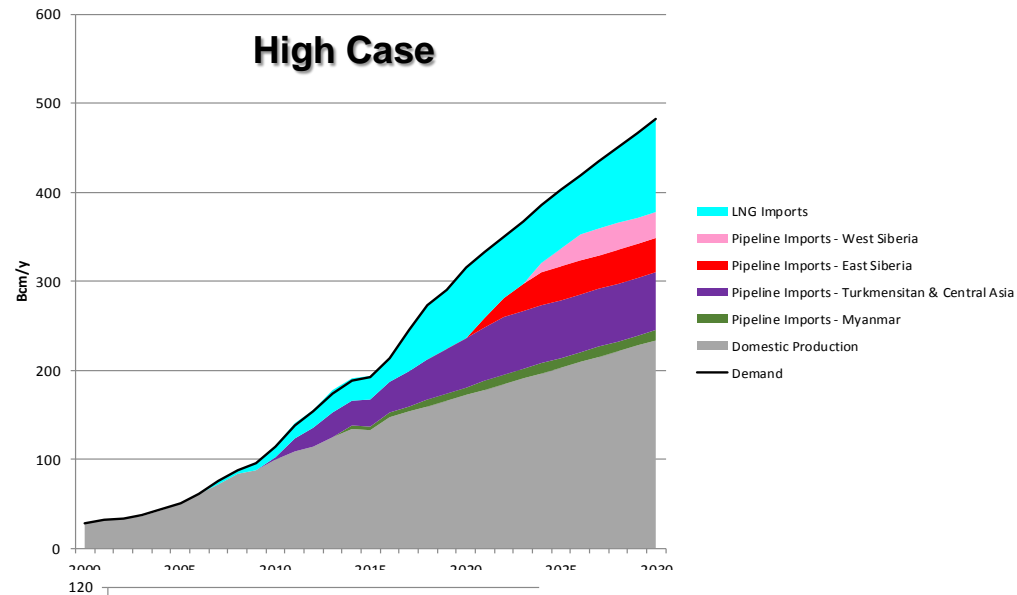
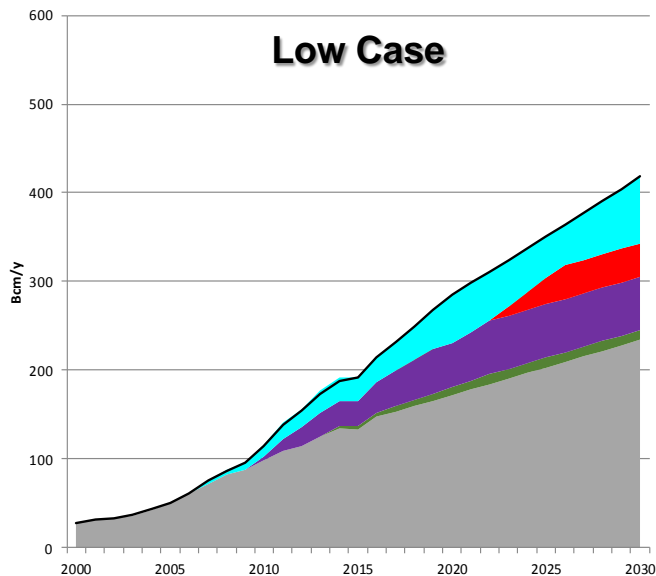
Taiwan:

- LNG the beneficiary of government commitment to phase out nuclear in the 2020s while containing growth of coal.
- Future power demand growth also a large uncertainty.



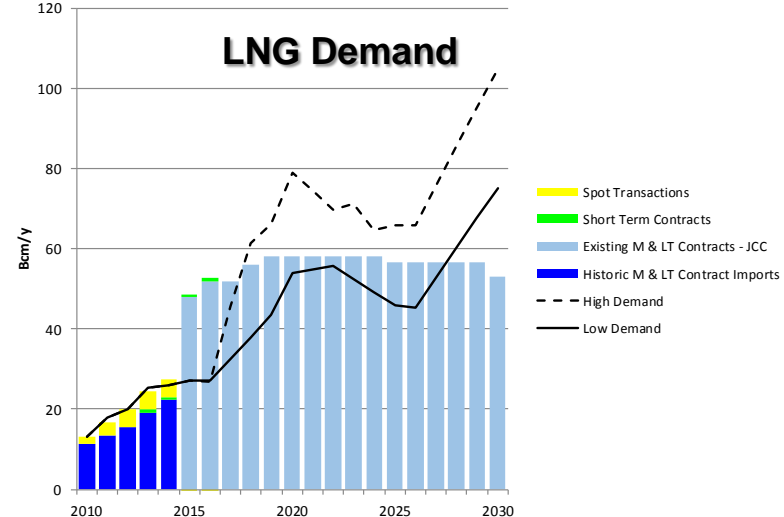


China



China:

- Gas Demand growth subject to:
 - Changed patterns in the 'New Normal'.
 - Success of policy to displace coal with gas in power generation, space heating in Industry – 100 bcma in 5 years ?
- Growth of domestic production dependent on shale gas success.
- Scale of Central Asian imports expandable and timing and number of Russian pipeline projects uncertain.
- LNG Imports therefore lie in a wide range: 75 to 105 bcma by 2030.





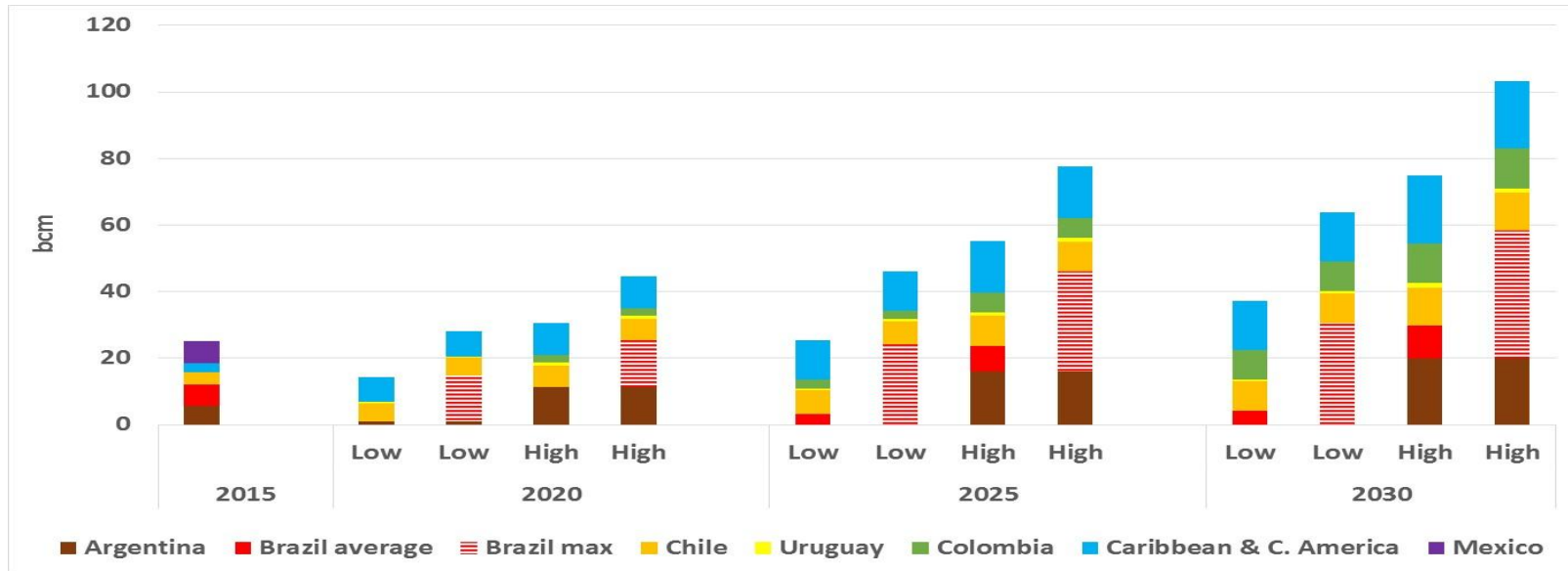
The role of LNG in Europe

- Europe is acting as the swing market for LNG and as a result, the region is expected to help absorb the LNG surplus coming on to the market in the second half of the 2010s and early 2020s
- But the region is facing major uncertainties:
 - The future role of natural gas in the whole energy system is in question, primarily as a result of greater governmental support for renewables
 - The region will face a decline of its indigenous (conventional) production. Unconventional gas and biogas production will increase but it will have little impact on the major decline. In a low energy price environment, it is difficult to envisage more optimistic scenarios
- **Despite low demand growth, declining indigenous production means that Europe will have to increase its gas imports, but how much and from which sources is unclear**
 - In 2015, most of the gas imported arrived in the form of pipeline gas (88% of total demand) with a predominant role of Russia (33% of total demand), the main competitor to LNG

“Europe” = EU28 + Albania, Bosnia and Herzegovina, Macedonia, Norway, Serbia, Switzerland, and Turkey



Latin America: substantial potential for additional LNG imports



- Energy demand (and in particular power demand) is still growing and the development of local resources is taking more time than expected
- Natural gas has a role to play as a clean and efficient complementary source of firm energy to hydropower and intermittent renewable sources, but flexibility of supply will be an important element
- In 2030, the region is expected to need 37 – 103 bcm of LNG (uncertainties about the pace of development of local resources and great variability of LNG demand in Brazil)



Middle East and Africa: more than a niche market?

- Currently a very small market representing 10 mtpa
- Both regions are overall exporters, but intraregional pipeline trade has proven difficult to put in place or expand
- Middle East
 - Many countries facing gas shortages and struggle to develop new generation of gas fields
 - Currently four countries importing, more looking at LNG imports
 - Most ME countries have low wholesale gas prices, which are increasing
- Africa
 - Egypt started importing in 2015, but scale and duration highly depends on future domestic production
 - At least eight other countries are looking at importing LNG for variable durations
 - Most of them opt for FSRUs (except for Morocco)
 - Many issues related to financing, need to provide regulatory certainty to prospective sellers, affordability and payment issues



Prospects for LNG use in transport

- Low oil prices make the financial case harder
- The environmental case is primarily driven by legislation.
- The benefits from reduced GHGs are less than other emissions though methane slip can be reduced/eliminated through technical enhancements
- Initial prospects are stronger in marine than in road apart from China
 - Already established for LNG tankers
 - Greater scale (1 ferry \cong 1,300 buses)
 - Legislation in place
 - “LNG ready” a no regrets step for some new build
 - Easier to establish refuelling facilities
 - Norway has demonstrated what is possible
- Could be a significant market by 2030



The Main Markets

N America

- + Regulatory (mainly marine)
- + Supply surplus (availability and price)
- + LNG storage
- + Active and Innovative equipment supply chain
- + Many new entrants
- + Good prospects in rail and off-road
- Limited LNG infrastructure
- Variable taxation
- Consumer resistance
- Restricted vehicle range

Europe

- + Regulatory (road and marine)
- + Price advantage
- + Potential supply surplus
- + LNG terminals & storage
- + Number of active and innovative players
- Variable taxation
- Consumer resistance
- Restricted vehicle range

China

- + Regulatory (concern over pollution)
- + Price advantage (though can be eroded)
- + Existing LNG supply chain (with surplus capacity)
- + Extensive LNG vehicle availability and experience
- Impact of state price control
- Regional pricing differentials
- Fragmented haulage market



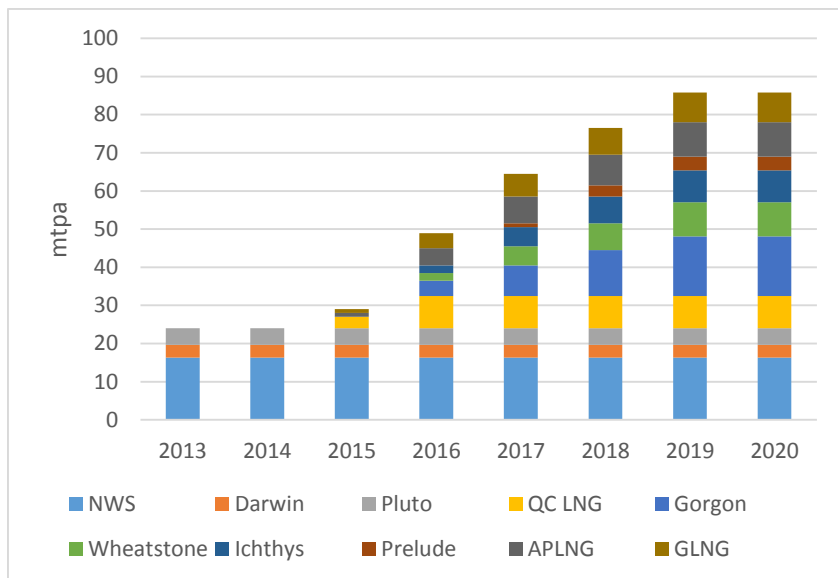
Who will provide new LNG supply?

- Well documented upsurge in output underway (+150 mtpa)
- Some declines in existing producers
- Qatar a continuing constant
- Economics of new projects very challenged – will there be new FIDs in the US, Australia, Russia, East Africa before 2020?
- Canada has missed the short-term window – no output until well into 2020s
- Opportunities for new producers are politically as well as commercially difficult
- Portfolio aggregation can help to support some projects
- Brownfield expansion in politically stable areas the most likely source of new LNG post 2020



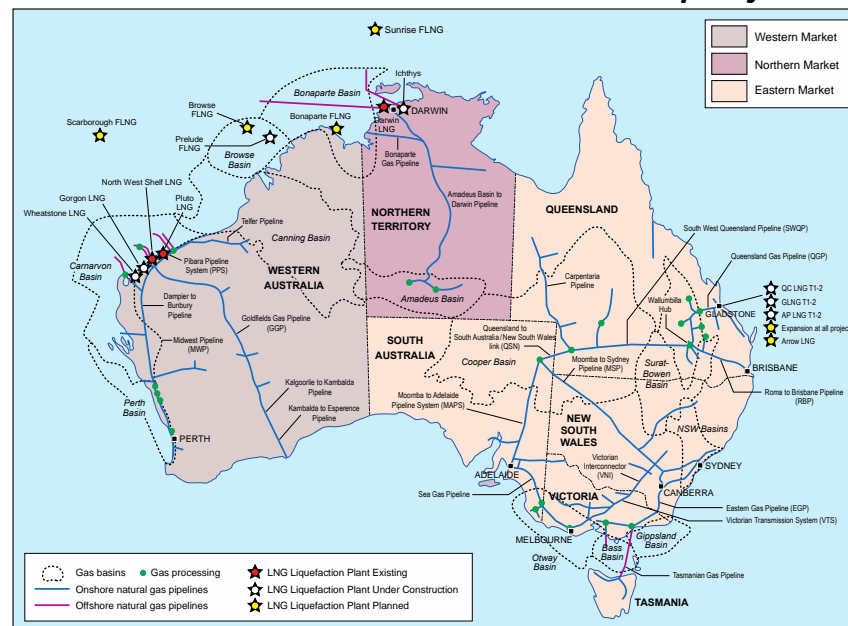
Australia LNG

Outlook for Australian LNG



- Australia ramp up well under way, despite low prices
- Some delays, but set to overtake Qatar by 2019
- Cash costs low, especially in Asia

Location of Australian LNG projects



- Potential for new projects very limited, despite falling costs
- Some brownfield expansion possible in 2020s
- An extra 20mt of capacity by 2025?



North American LNG

Summary of North American LNG projects

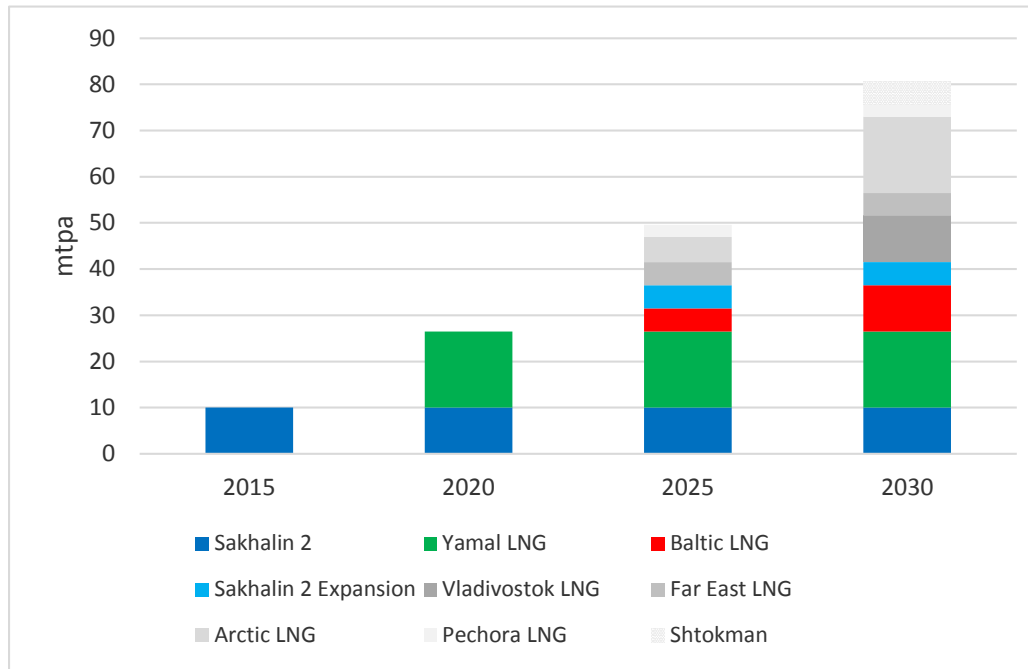
Region	Total number of projects	Total capacity Including under construction (mtpa)	Number of projects under construction	Capacity (mtpa)
United States				
US Gulf and East Coasts	35	364	5	64
Oregon	2	16.6	0	0
Alaska	1	18	0	0
Canada				
British Columbia	18	301	0	0
Eastern Canada	5	52	0	0

- US project output ramping up towards end of decade, but impact still being felt in global LNG market
- Is there any incentive for new project development, or could current projects default?
- Will there be any Canadian LNG projects within the next decade?



Russian LNG

Outlook for Russian LNG

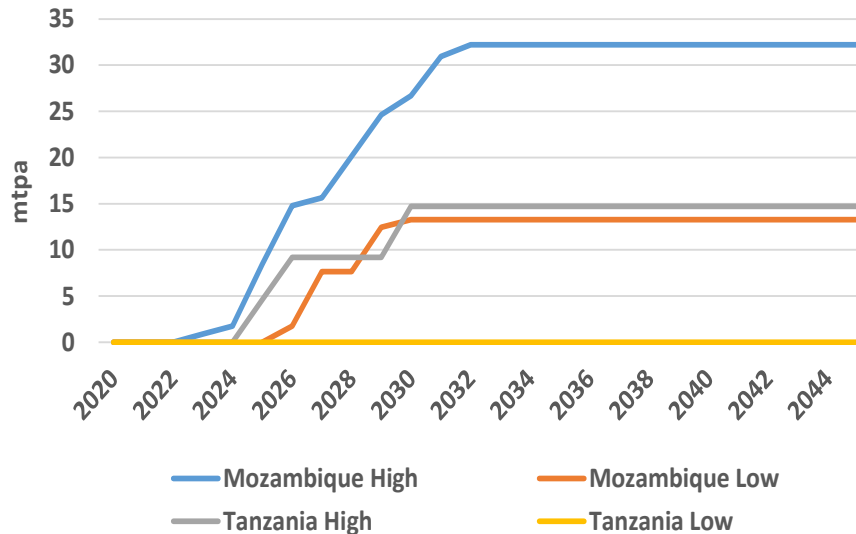


- Yamal LNG to start up in 2017, fully online by 2020
- Sakhalin 2 expansion logical but (politically difficult so) and not before 2021
- Baltic LNG – 5-10 mt or a limited project for bunker market and Kaliningrad?
- Other projects significantly delayed



Eastern Africa LNG

Scenarios for Eastern Africa LNG developments



- Prospects for Eastern Africa undermined by low prices
- Regulatory, legislative and fiscal issues also major hurdles
- Tanzania could fail altogether
- Mozambique reserves very large, but timing of output in doubt



Other LNG supply developments

Key existing producers to note

- North Africa
- Qatar
- Other Middle East
- Indonesia/Malaysia
- PNG

Potential new producers

- Iran
- East Mediterranean
- Latin America
- Where can projects be made commercially viable?

	No. of Sites	Total Trains	Total Capacity <i>mt</i>	First Output <i>year</i>	2015 Sales <i>mt</i>	% change 2015/2014) <i>%</i>
Atlantic Basin						
Algeria	5	17	28.5	1972	12.1	-4%
Angola (stopped)	1	1	5.2	2013		-100%
Egypt (stopped)	2	3	12.2	2005		-100%
Equatorial Guinea	1	1	3.7	2007	3.7	7%
Libya (stopped)	1	4	3.2	1970		na
Nigeria	3	6	21.8	1999	19.5	2%
Norway	1	1	4.3	2007	4.3	20%
Trinidad & Tobago	3	4	15.5	1999	11.8	-10%
Sub-Total	17	37	94.4		51.4	-2%
Middle East						
Abu Dhabi	1	3	5.8	1977	5.7	-7%
Oman	1	3	10.7	2000	7.6	-2%
Qatar	12	14	77.0	1999	78.4	3%
Yemen (stopped)	1	2	6.7	2009	1.5	-76%
Sub-Total	15	22	100.2		93.2	-3%
Pacific Basin						
Australia	7	10	36.6	1989	29.5	25%
Brunei	1	5	7.1	1973	6.5	6%
USA	1	1	0.4	1969	0.3	7%
Indonesia	3	11	31.9	1977	18.0	4%
Malaysia	4	9	24.2	1983	25.0	1%
PNG	1	2	6.9	2014	7.2	111%
Peru	1	1	4.5	2010	3.6	-11%
Russia	1	2	9.6	2009	10.6	0%
Sub-Total	19	41	121.2		100.6	12%
Total	51	100	315.8		245.2	3%



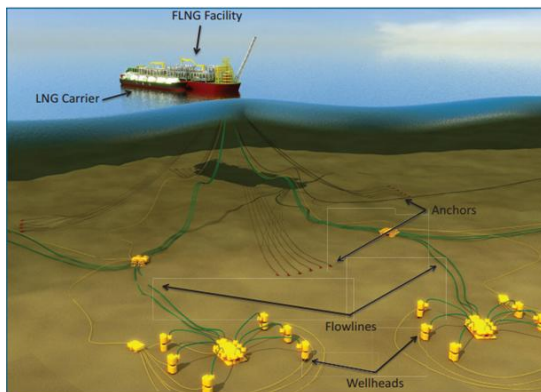
Economics of FLNG

- Configurations
- Inshore/pipeline



Courtesy Höegh LNG

- Offshore/subsea



Courtesy Shell International Ptd.

- Costs & Schedule
- Major Energy Companies
 - \$1700-3200/tpa including subsea, complete project (\$5.9-11.2/tpa)
- Leasing Companies
 - \$600 quoted for vessel only (\$2.1/MMBtu) – add contingency for first of a kind
 - Similar to US Gulf Coast Plants – good opportunity for high cost locations as inshore alternative
 - OPEX: \$1.3/MMbtu
 - Schedule 32-66 months



Prospects for FLNG

- Prospects

- In addition to 7 in construction - 17 mtpa
- 17 in study phase – 55 mtpa
- If 50% of these proceed then 34 mtpa
- 18% of 241 mtpa global production in 2014 – significant market share

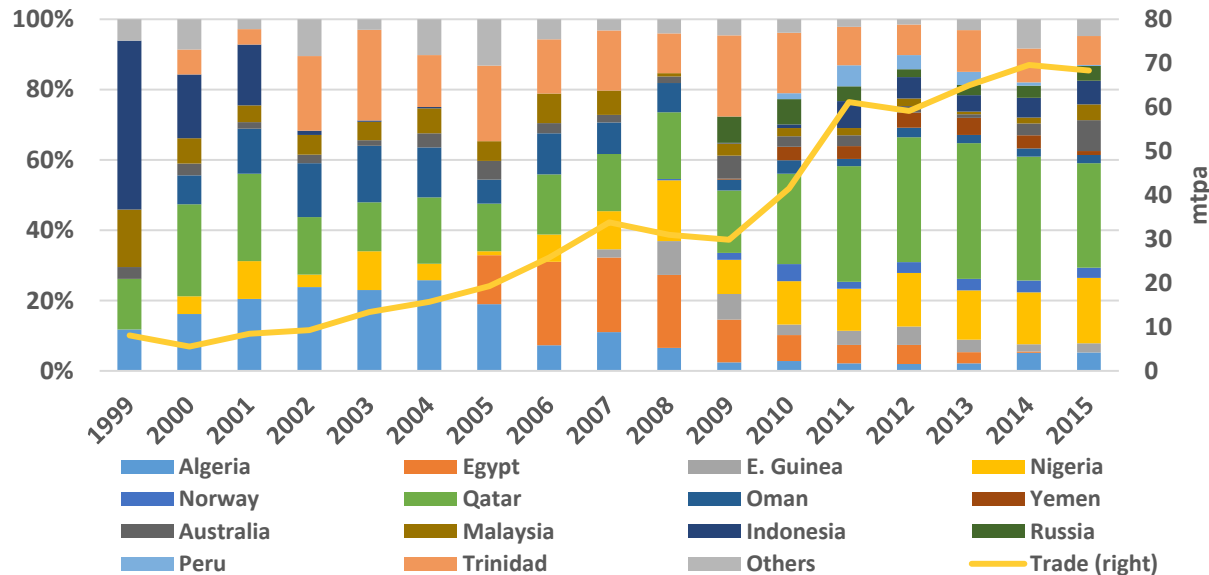
- Conclusions

- First FLNG in production late 2016
- More in construction – some on speculative basis – new builds and conversions
- Offshore and inshore configurations
- Option to lease reducing capital outlay
- Opportunity to deliver lower cost plants (similar to US Gulf Coast) to high cost areas e.g. Australia, Eastern Africa, Canada in under 3 years – enabling earlier and higher revenue stream
- More major offshore leasing companies looking to enter the market increasing competition



The evolution of spot and short-term LNG trade

Spot and short-term LNG trade, 1999-2015



Source: forthcoming 'LNG markets in transition: the great reconfiguration' (OIES/KAPSARC).

- Spot and short-term LNG trade represented 28% of global LNG trade in 2015, down from 29% in 2014



Drivers behind the growth of spot and short-term LNG trade

- Supply side developments
 - Uncommitted or 'spare' LNG capacity
 - Ramp-up volumes
 - Volumes initially committed to a market, but released and redirected
 - Portfolio LNG (without secondary sales)
- Demand side developments
 - Demand shocks leading to more flexibility on TOP
 - Expansion of LNG import capacity more rapidly than liquefaction
 - The impact of liberalization in Europe and the U.S.
 - The creation of liquid hubs
 - TPA to infrastructure (Europe)
 - End of final destination clauses (Europe)
 - Change in the nature of buyers from government monopolies or utilities in OECD countries to smaller players, IPPs and traders



The buyers' dilemma

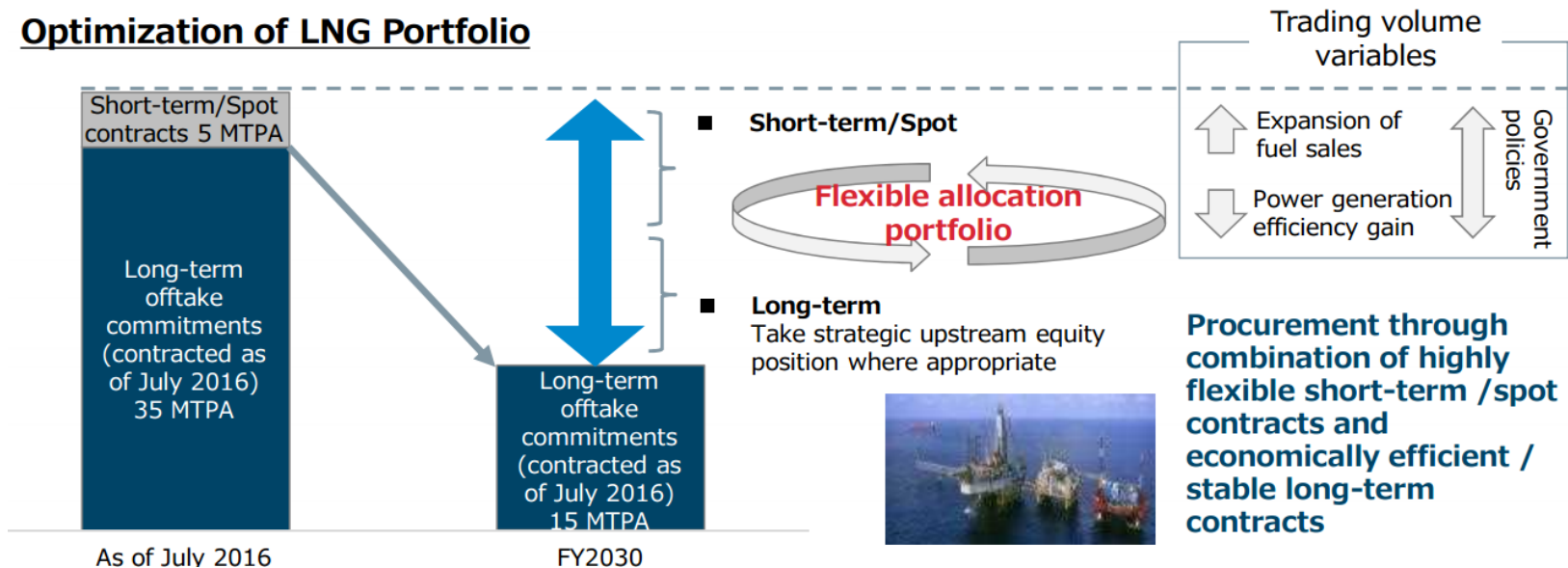
- Future gas demand over the next 10-20 years is uncertain
 - Economic growth
 - Competitiveness of gas against coal
 - Development of renewables and
 - Evolution of nuclear policy
- Liberalisation processes in Asia means higher competition on the markets
- Difficulties to pass through LNG costs to end-users in periods of high(er) prices
- **How to commit for 20 years?**



Adapting to markets uncertainties

JERA's business plan, February 2016

Optimization of LNG Portfolio





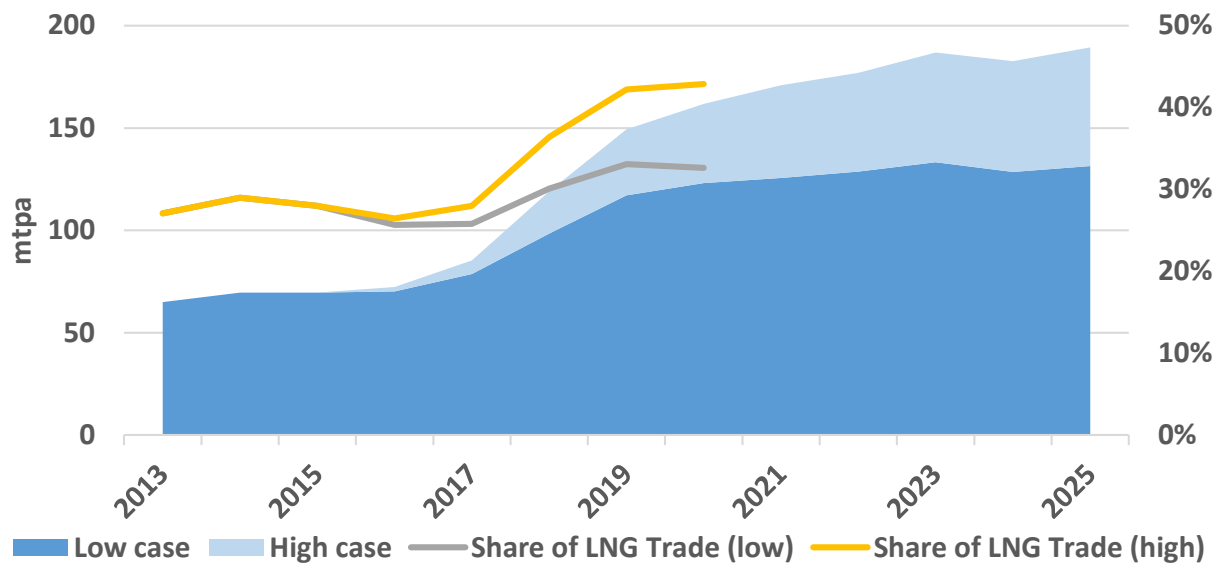
Further growth of spot LNG trade

- Further growth of spot and short-term LNG trade will be supported by the following elements:
 - Uncommitted LNG
 - (Ramp-up volumes)
 - Lack of contracts extension and renegotiation at lower volumes
 - Portfolio LNG
 - The role of Qatar and US LNG



Towards 43% of total LNG trade by 2020

Evolution of spot and short-term LNG trade



Source: Forthcoming 'LNG markets in transition: the great reconfiguration' (OIES/KAPSARC).

- Potentially some upside in the short term depending on ramp-up volumes



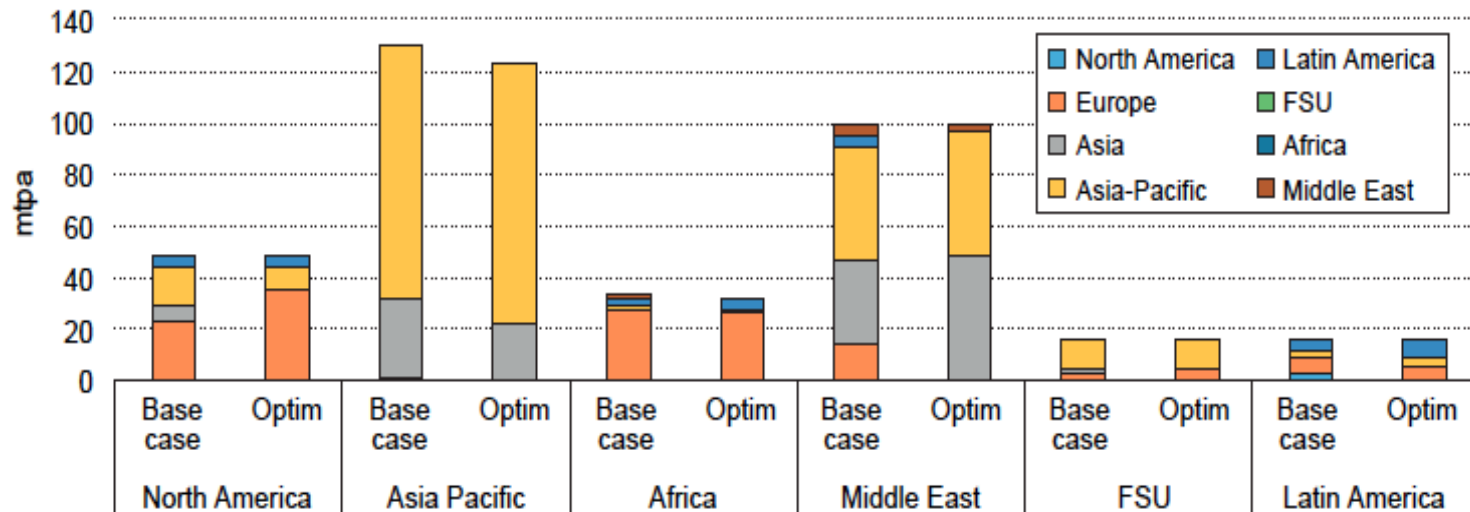
Implications for long-term contracts

- Existing LT contracts:
 - Increased pressure on price and flexibility terms
 - This could be exacerbated by discontinuity between term and spot prices, financial distress of buyers
- LT contracts supporting new LNG plants:
 - Moving without the support of LT contracts seems a bridge too far at this stage
 - For that to happen, we would need
 - Spot LNG trade to become the norm
 - Reliable price benchmarks
 - Support/agreement from banks
 - And a substantial drop in LNG costs for project sponsors to take that risk



Tackling a \$2bn/y inefficiency

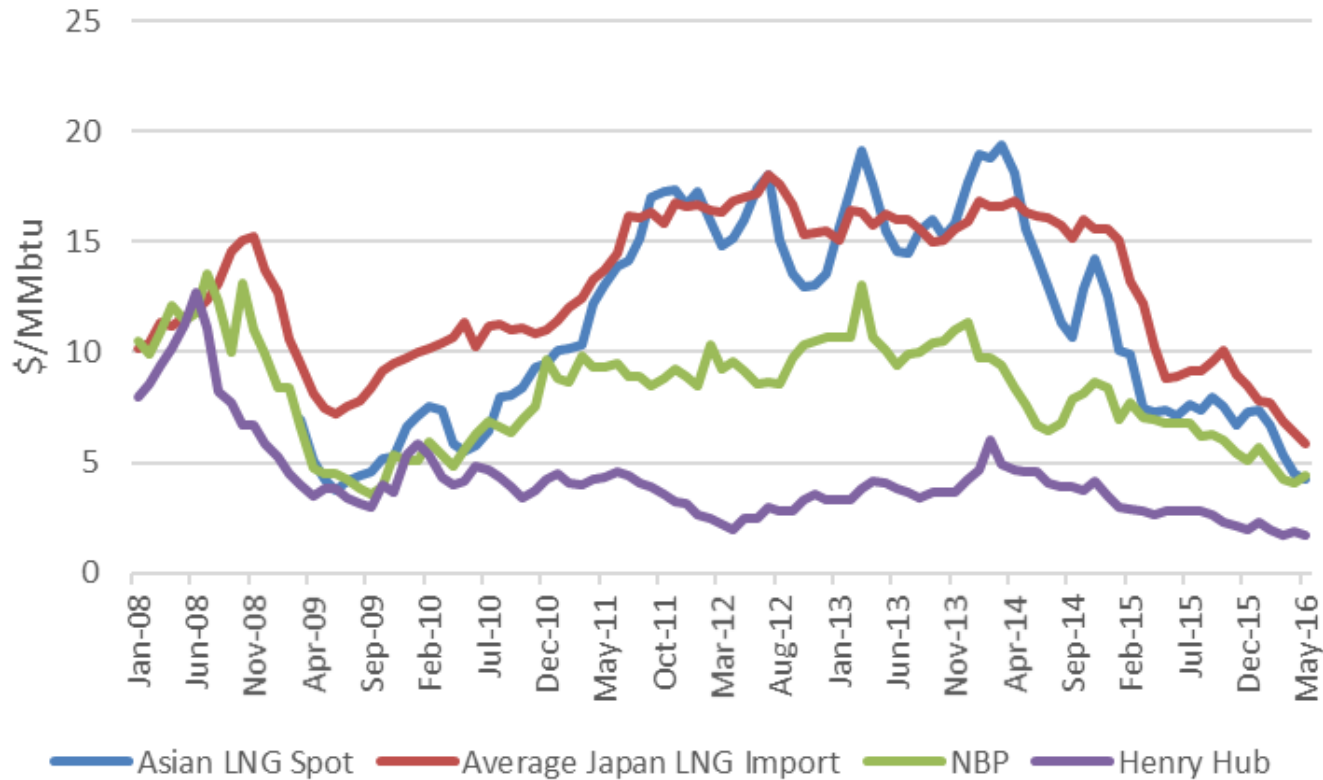
Optimising shipping



- If we were to optimize shipping based on the shortest route, we could save \$2bn/y
- Unrealistic? Margins are low! It is time for collaboration...



Regional gas and LNG prices



- Europe and North America price gas mainly at hubs; (most of) Asia still prices LNG in relation to oil



Price formation mechanisms which could replace JCC

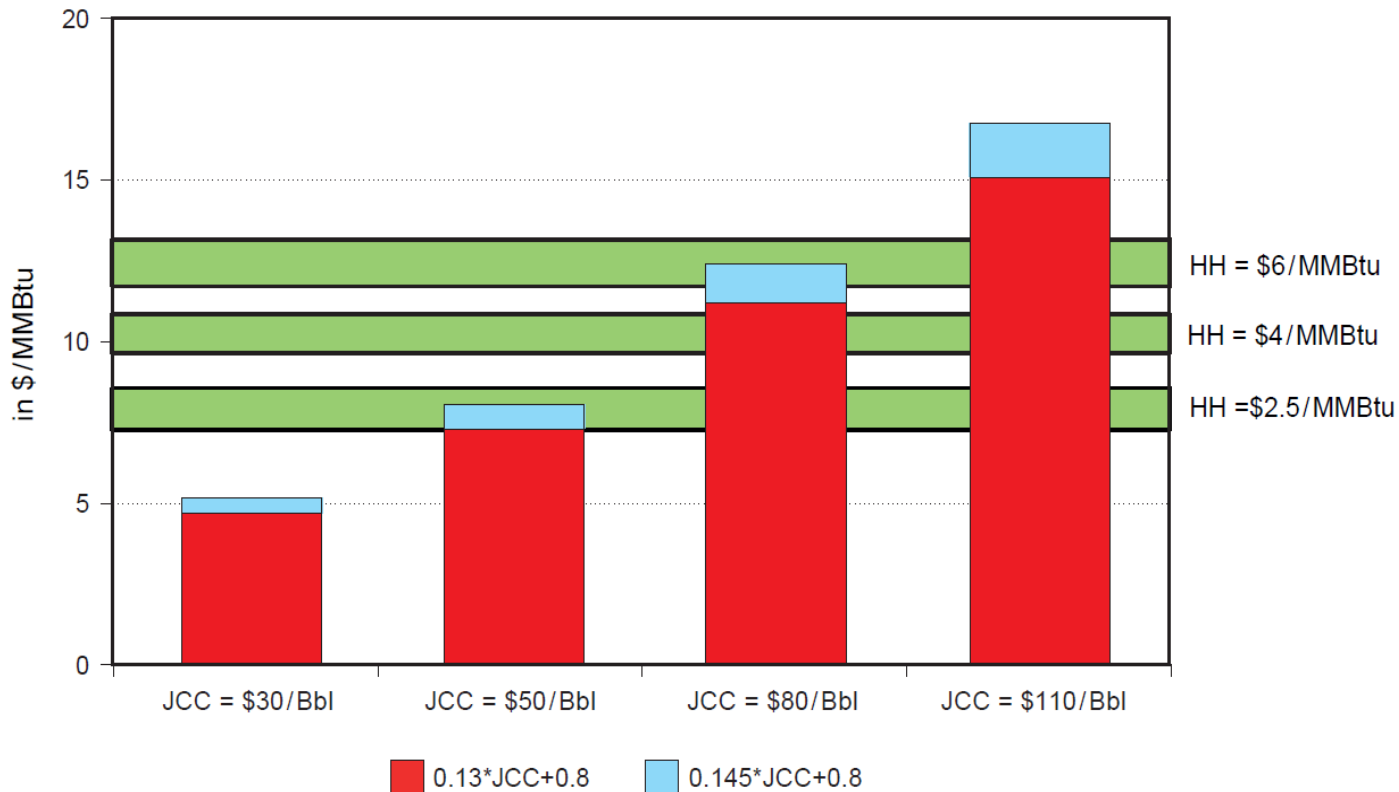
- Henry Hub or European (NBP/TTF) hub prices
- Asian spot price Index (eg JKM, RIM, Argus, JOE): too few cargos (at least currently) on which to base long term contracts
- Prices at an Asian hub or hubs
- Average Japanese/Korean LNG import prices – JLC/KLC
- ‘Hybrid pricing’ – a mixture of all of these + JCC/oil+ electricity +

Which of these mechanisms best reflects gas supply/demand conditions in Asian countries



Comparing oil-indexed LNG to US HH-indexed LNG

US LNG export cost* to Asia at different Henry Hub prices compared with different JCC prices

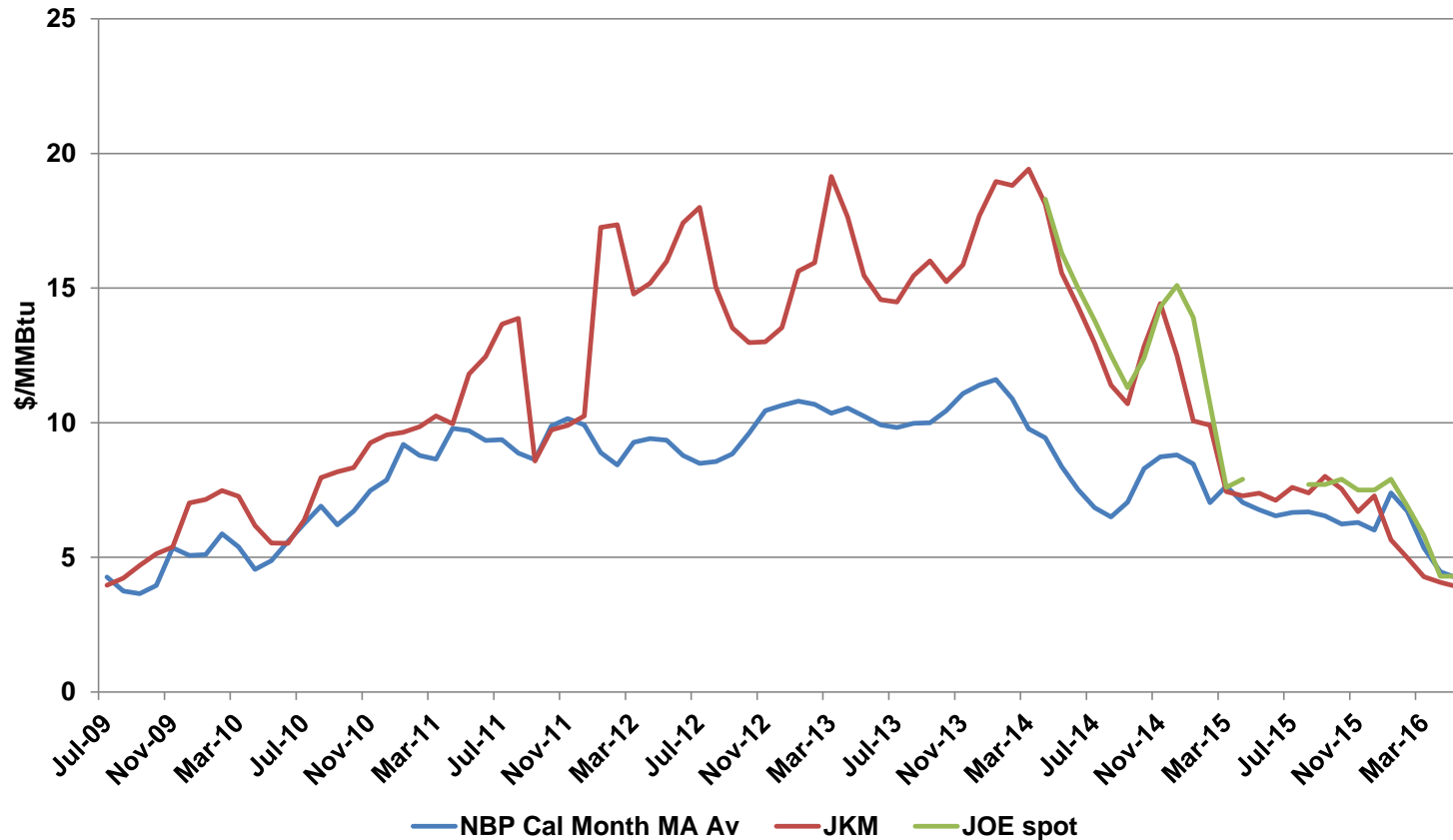


- US LNG exports looked very profitable in Asia at \$100/bbl oil, but at \$2.50/MMbtu Henry Hub will struggle to cover full costs below \$50/bbl oil



Japanese LNG spot import prices

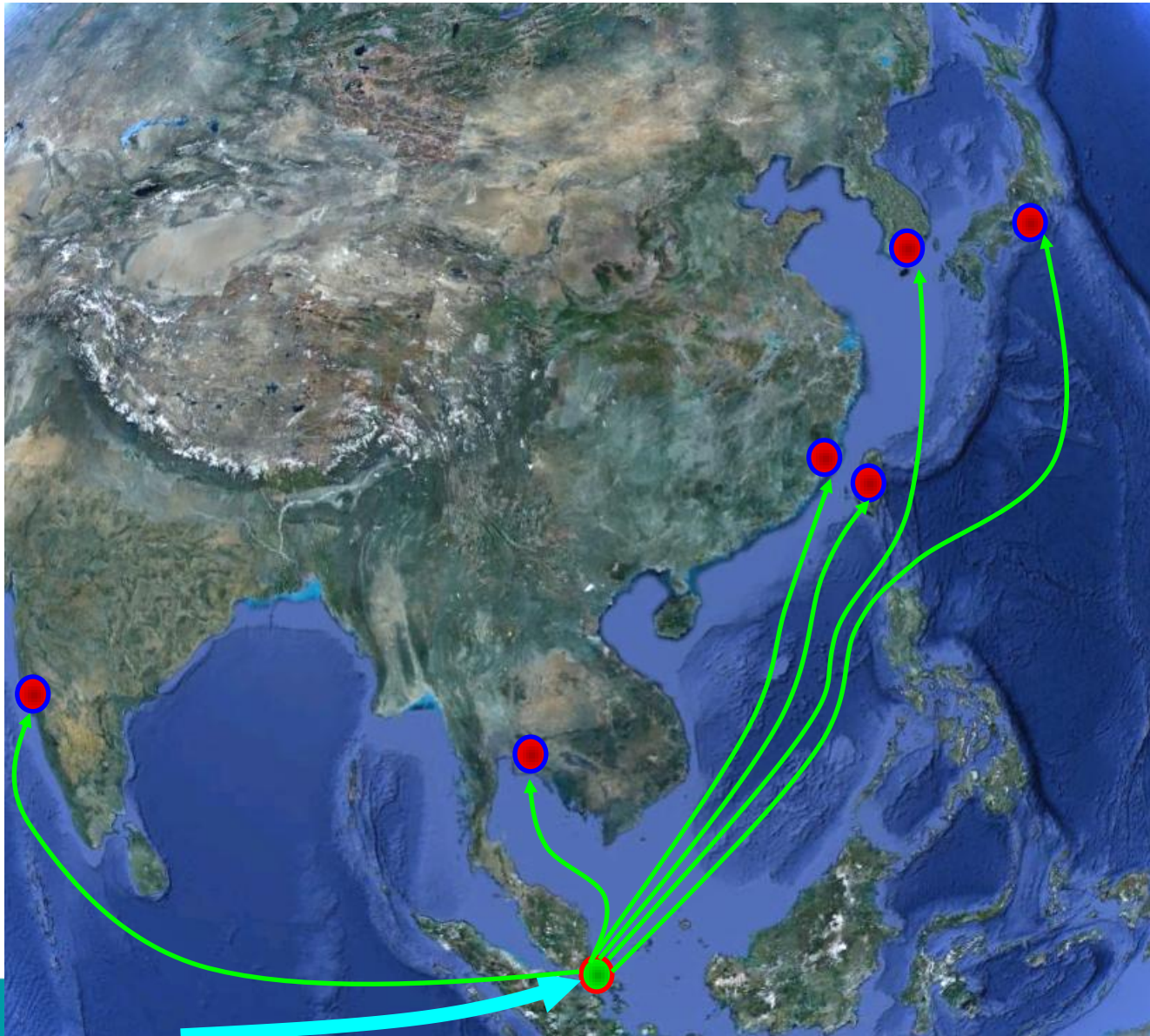
Japanese LNG spot prices, 2009-2016



- In 2016, JKM and NBP converged in the first half of the year

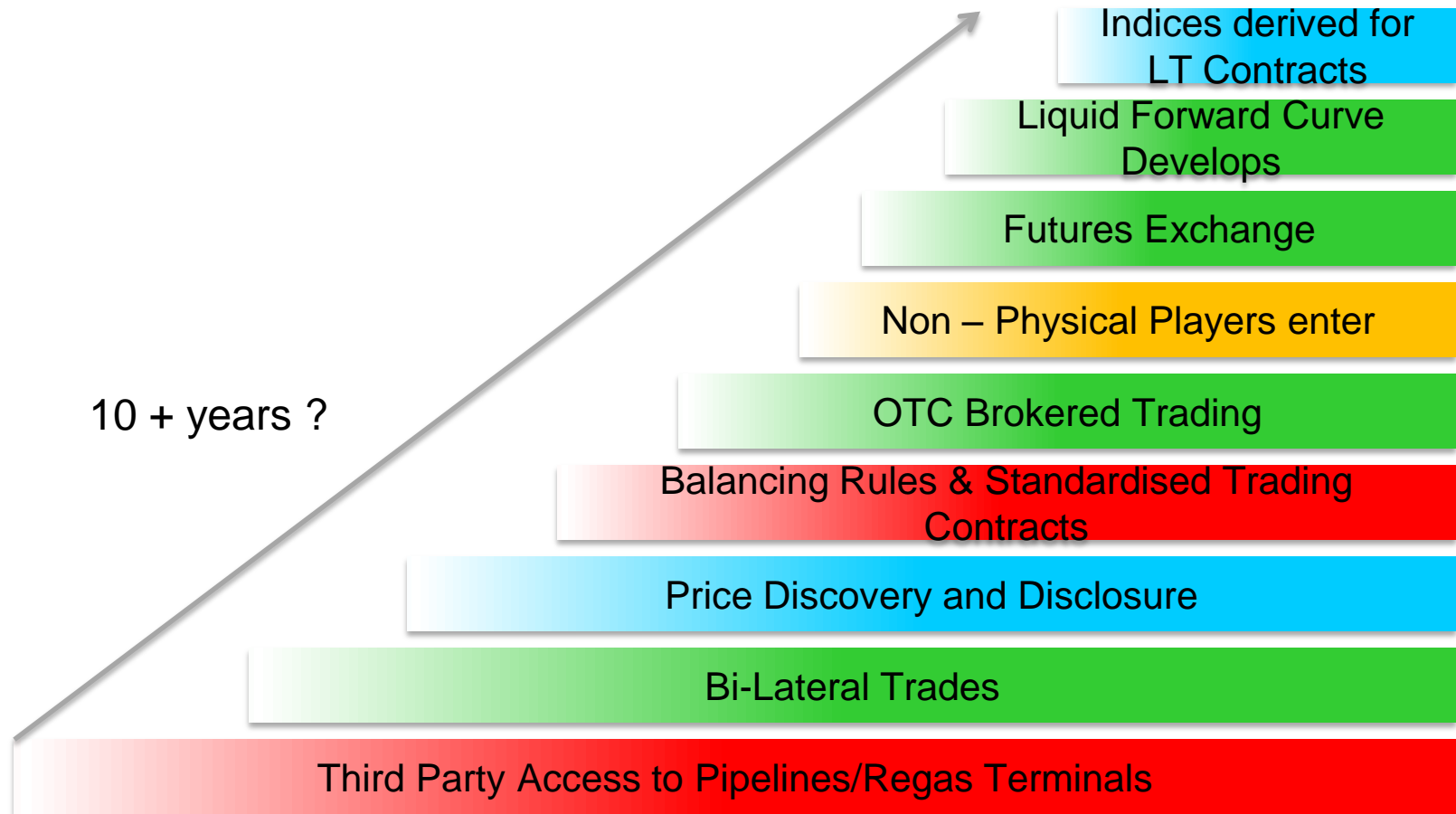


A Future Asian LNG Hub: Singapore, Shanghai or Tokyo?





Establishing a liquid hub takes time and commitment



Based on Experience in US, UK and Continental Europe:

- This could take 10 years in Asia
- It requires the commitment of government, suppliers and system operators
- An over-supplied market with strong competition accelerates the process



A Singapore Hub?

POTENTIAL DISADVANTAGES:

- A market of 6mt – although with plans to expand significantly – may not be large enough to set prices for Asia. (LNG Imports in 2015 2.2 mt)
- Location may be too far from the major Asian LNG markets to provide a compelling price reference; but close enough to SE Asian countries

ADVANTAGES:

- First mover – current location of 24 companies operating in the Asian LNG space
- Sufficiently neutral politically that others may accept it as an index

A virtual hub for SE Asia? Unlikely to develop enough depth and liquidity to be a reference for the big Asian LNG markets



Shanghai: a hub or a city gate?

ADVANTAGES:

- The location where domestic and international (LNG and pipeline) gas supplies come together in Asia's biggest (and most rapidly expanding) gas market
- Result of a price reform with a compelling market logic (but lacks market flexibility)
- TPA in principle to pipelines and LNG terminals

POTENTIAL DISADVANTAGES:

- Lack of transparency of supply and demand ie not genuinely “market-driven”
- Overly dominated by three Chinese state-owned companies (and hence the Chinese government)

Shanghai is currently a “city gate benchmark” rather than a hub price, but it could evolve over time



The Exchanges: how much progress?

SINGAPORE:

- 2015 the SGX LNG Index Group creates the 'Sling' price, first derivative contract reported in early 2016

SHANGHAI:

- Petroleum Exchange trades small volumes of LNG but
- is overly dominated by Chinese market players and hence not a neutral body for market trading

TOKYO:

- TOCOM and Gingga Energy – created the JOE LNG forward platform in 2014 to become a futures market
- Has traded very little LNG since creation (first contract August 2015)

Progress still very much in early stages



METI's May 2016 LNG Strategy

- `Develop an internationally accepted trading hub...by the early 2020s' which will..strengthen the power to negotiate prices for the nation as a whole
- `important for both parties to permit anonymous information disclosure to an agreed PRA from the perspective of developing better indices
- LNG trading contracts using price indices will be positively taken into account for evaluation of national interest by JBIC, NEXI and JOGMEC
- Rules concerning TPA to LNG terminals and information disclosure to be formulated (consider best practice in Europe)

METI can facilitate but **it will require Japanese market players to make this happen!**



Asian markets do not need to adopt the same price mechanism

- SINGAPORE: an LNG trading location which develops a regional price for South East Asia
- CHINA: a Shanghai citygate benchmark price reflecting domestic/international gas prices, and prices of competing fuels (fuel oil and LPG)
- JAPAN: a hybrid/spot JCC/JKM/HH/NBP price developed by competition which could evolve into a hub

These prices will have a relationship with each other and in time will create a “messy transition” to a converged Asian composite price; meanwhile expansion of spot pricing will put continued pressure on JCC-based long term contracts, especially if oil prices increase



Conclusions on pricing

- North America and Europe price gas at hubs
- Asian LNG prices are still largely JCC-based but this has diminishing market logic
- By early 2016, important status quo players (eg JERA) begin to openly speak about the need for transition to market prices – recalls start of the transition in Europe
- May 2016: METI LNG Strategy makes transition to hub pricing `official policy`
- Asian hubs may evolve over the next decade and this could be accelerated by:
 - Over-supply of LNG up to 2020 (and perhaps up to mid 2020s)
 - Increasing spread between JCC and spot prices (if oil prices increase beyond \$50/bbl)



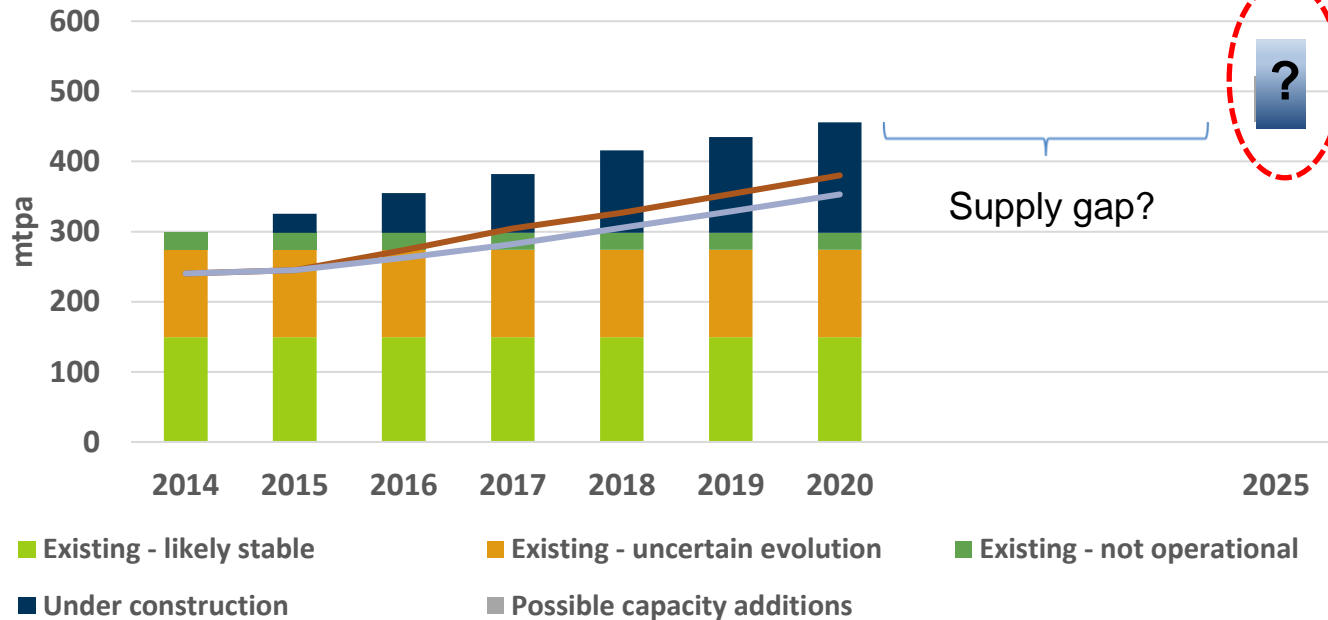
Why a reconfiguration?

- The supply/demand balance will look significantly different in 5 years from now and there is great uncertainty about the future supply
- There is increasing pressure from the buyer's side for more flexibility and a change in price formation, from oil indexation to hub indexation, to address:
 - Uncertainties around future gas demand growth
 - Market liberalization in Asia
 - Maintaining gas competitiveness versus coal
- Long-term contracts under threat from flexible LNG supply
 - Share of spot trade to increase from 28% in 2015 to about 43% by 2020



When will markets rebalance?

LNG supply and capacity outlook



**1000 mtpa
planned**
 North America
 Russia
 Eastern Africa
 Qatar
 Others

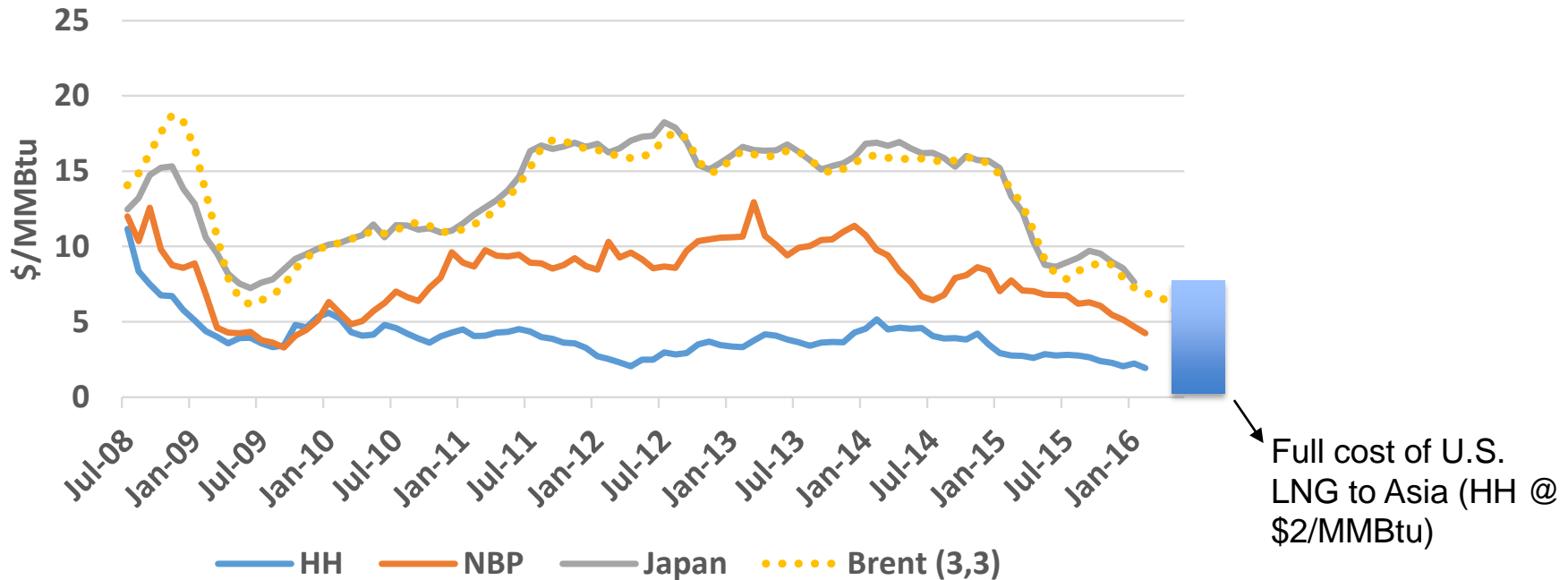
- Project sponsors will take FID depending on their views on the timing of market rebalancing, future prices and cost reduction

CONCLUSIONS



Difficult for projects to take FID in this price environment

Global gas price environment, 2008-2016



Source: Bloomberg, EIA.

- Pressure on pricing mechanisms, notably in Asia
- Pressure on costs

CONCLUSIONS

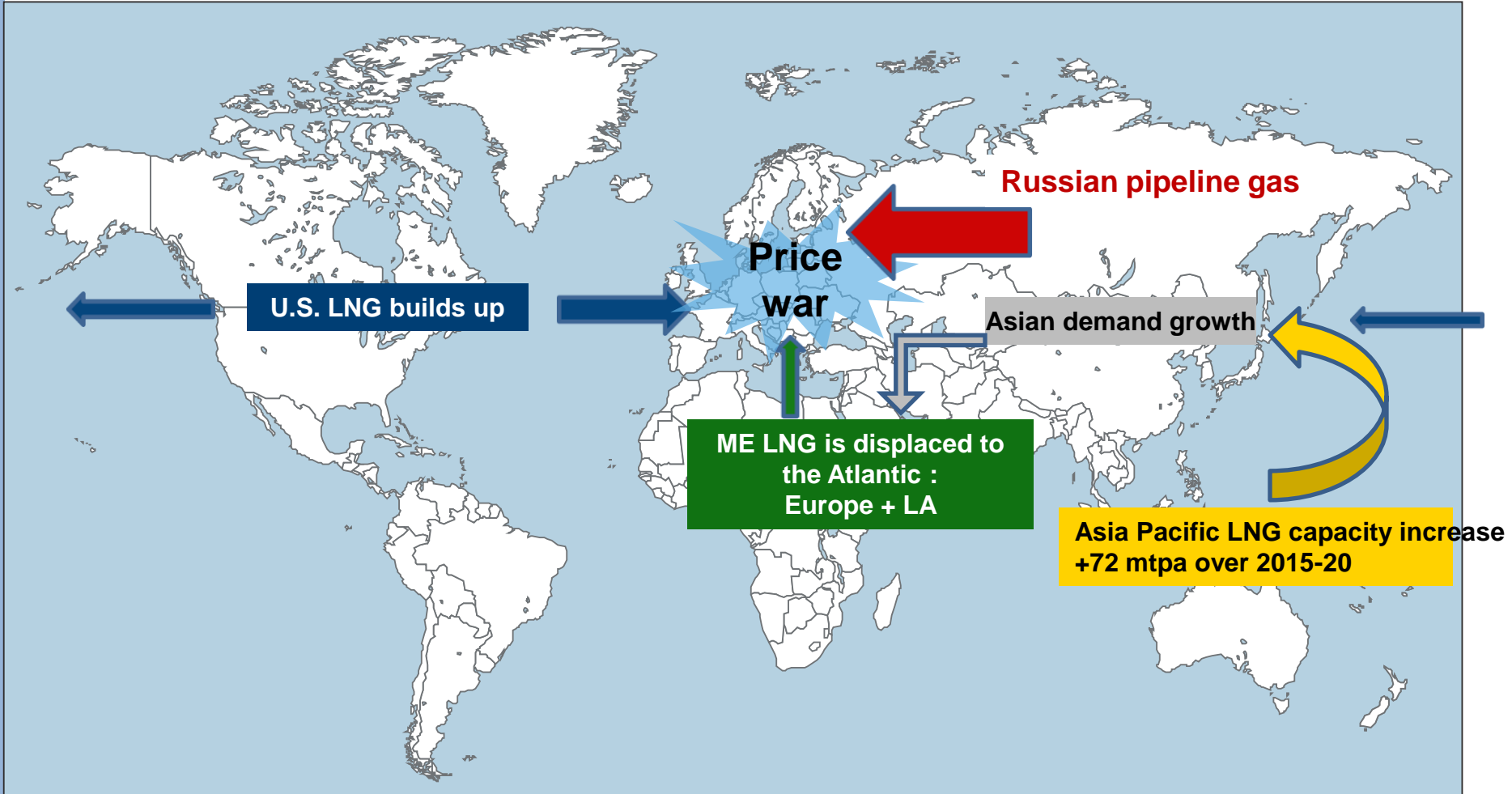


Which projects will move forward?

- The cost competitive projects
 - Brownfield expansion
 - Notably Qatar, the low cost LNG producer
 - Utilisation of existing under utilized LNG capacity in Egypt, Trinidad and Oman
 - Projects with strategic involvement from buyers
 - FLNG
 - Liquid-rich projects
- And those left behind
 - Uncompetitive fiscal framework, uncertain regulation, potentially rapidly growing domestic demand, politically unstable



Price war in Europe?



CONCLUSIONS



So where does this leave us?

- Companies realizing that they have to adapt to the new market environment
- Companies have to change the way they operate
 - What do we mean by collaboration?
 - Cost is king; innovative and cost-competitive projects could proceed
 - Lots of potential in new markets ... as long as LNG is 'affordable' and competitive
 - Changes in pricing formation are coming, but there is resistance
 - Existing projects can accept more flexible contract structure, while new projects will require some form of LT commitments unless conditions are fundamentally different
 - Contract sanctity?



Thank you for your attention