

The State of the Gas Business: Uncertainties amid Abundance

For the 2018 Gas/Electric Partnership Conference

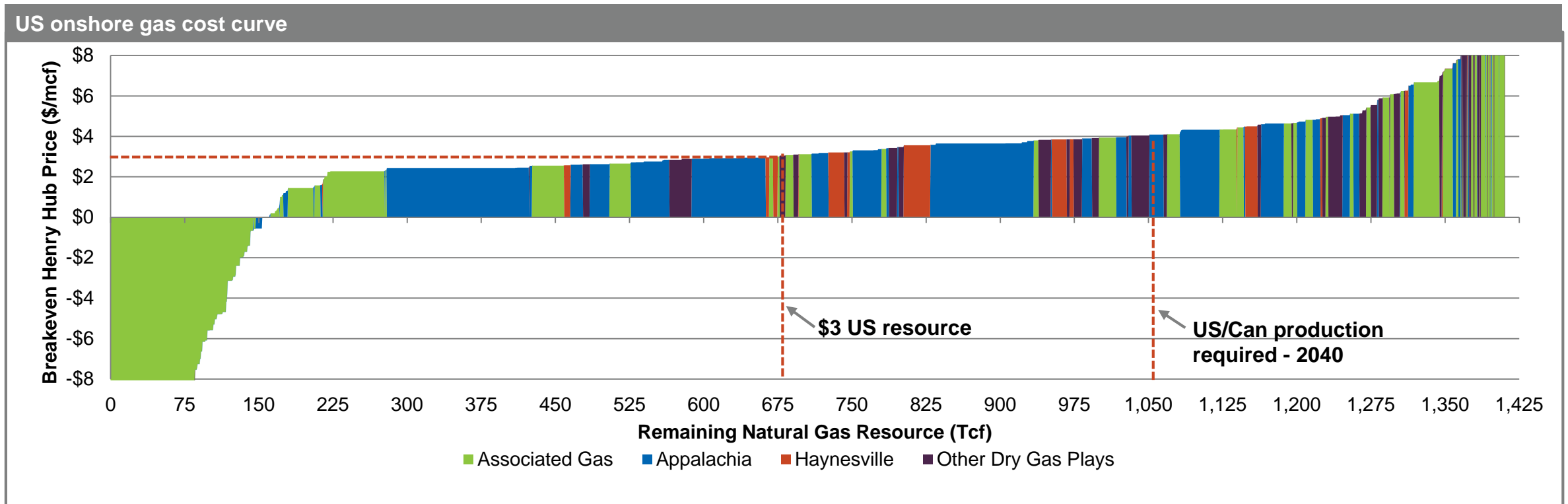
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North American Natural Gas – Abundance, at a price...

- **A large resource base is becoming more established as fact:**
 - IHS research has found >1,000 trillion cubic feet (Tcf) of economic natural gas resource at less than \$4.00/MMBtu and over 600 Tcf at sub \$3.00
 - The US resource at \$4 is approximately equal to the US/Canadian production requirement through 2040 (~1,050 Tcf)
 - Note the geographic concentration of the best plays in the “Associated” and “Appalachia” categories



Since the North American resource is abundant, is growth predetermined? Yes, but how much is not - not by a long shot...

- **If the resource is established, where are the strategic uncertainties?**
 - *The existence of a resource is – almost - irrelevant to the size of the investment opportunity (Argentina anyone?)*
 - *Ability to capture power demand growth*
 - Power load growth is moribund - < 1% annually
 - Subsidized renewables and socialized T&D are crowding out almost every other source of generation
 - Ultimate gas demand growth for power is still likely positive, but the pace of growth is decelerating
 - 15-minute FT? Matching firm gas services to power system needs remains challenging
 - More nuke and coal retirements on the horizon?
 - *The social license to frac, build infrastructure, and develop markets*
 - No stage of the permitting process occurs without increasingly organized and intense intervention, affecting project timelines
 - “Keep it in the ground” – will it gain broad traction?
 - Potential “decarbonization” of the heating sector longer term
 - Is this administration an enduring shift, or a short-term window of opportunity?
 - *The ultimate size and impact of export markets*
 - Mexico’s ultimate import need will be driven by its renewables policies, economic growth, and domestic production
 - LNG export potential is driven by a host of global factors, but the US is the high variable cost supplier, and exports will be volatile when the global market is in excess

Happening Now in the US Gas Business

- **Gas on gas competition is concentrating production in a few most productive areas:**
 - Appalachia growth is tied to pipeline expansions, and the timing can be uneven as a result, but growth is strong near term. Longer term, Pipelines become more expensive, and Appalachian growth is constrained.
 - Associated gas growth, virtually predetermined at oil prices of \$55 and above, is concentrated in Texas and Oklahoma.
 - Overall likely excess through 2019 based on the capex surge to oil and pipeline expansion completions.
- **Going global:**
 - Shale and US LNG exports changing how global gas prices are set; influential alternative for global buyers.
 - High variable cost Henry Hub-based pricing leaves the US uncompetitive until the LNG market grows into new liquefaction capacity.
 - Global oil markets impact domestic gas markets through associated gas
 - Oil price and associated gas production inversely correlated to Henry Hub.
- **Longer term, for the first time, export demand potential exceeds power growth**
 - LNG and MX exports account for ~46% of all market growth through 2040; power 35%, vehicles 12%, industrial 6%
 - Some value returns to the storage market as LNG/MX demand swings, larger spreads likely to increase inventory cycling.
 - Expect larger fall surplus and spring deficits to accommodate 5-6 Bcf/d LNG feed gas demand swings.

Crosscurrents – The New Gas/Oil/Global Linkage

North American Natural Gas



Global Oil Markets

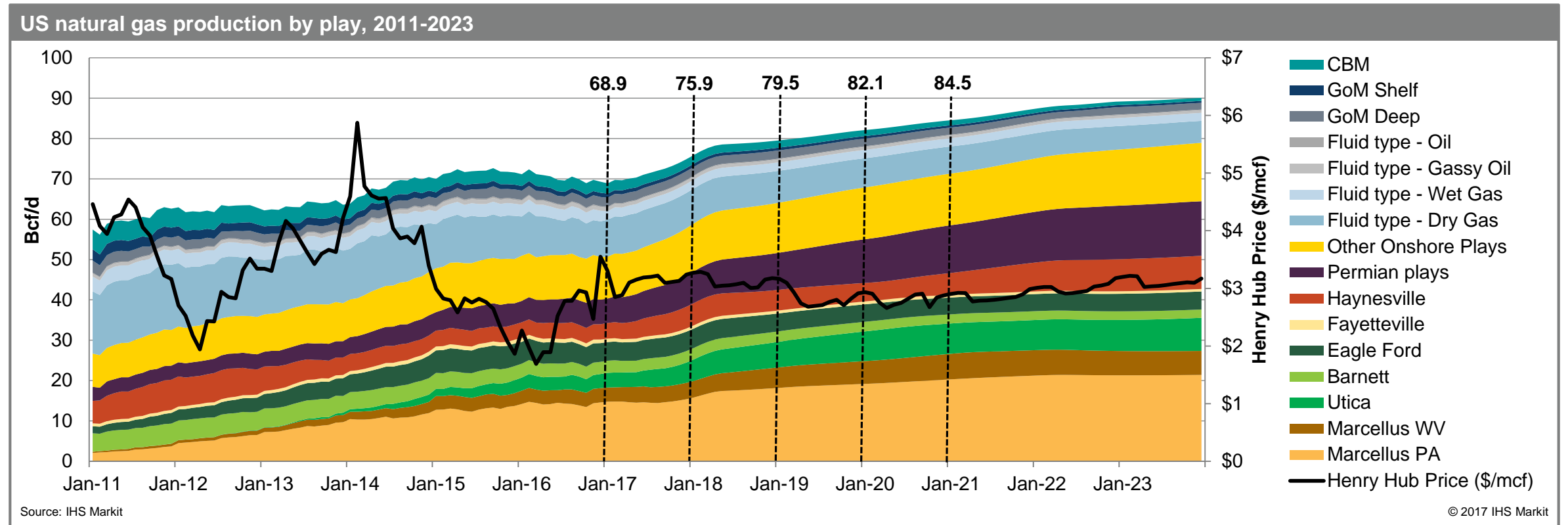
High Oil Prices

- Shift toward oil-directed drilling, and an increase in associated gas production; *adds to price-inelastic supplies* (avg recently ~ 400 Mmcf/d per MMBbl/d). **For the next 3-5 years, this is the dominant effect in the gas market, and creates potentially an inverse relationship of oil price to gas price**
- Relative decline in dry gas drilling, affects marginal supplies
- Opportunity for US LNG in global markets – increases demand
 - Short term: add exports to the extent flexibility exists in consuming markets, and US export capacity is available (potential ~2 Bcfd counter-seasonal during global excess period 2019-2023)
 - Longer term: demand support from competitiveness of US LNG

Low Oil Prices

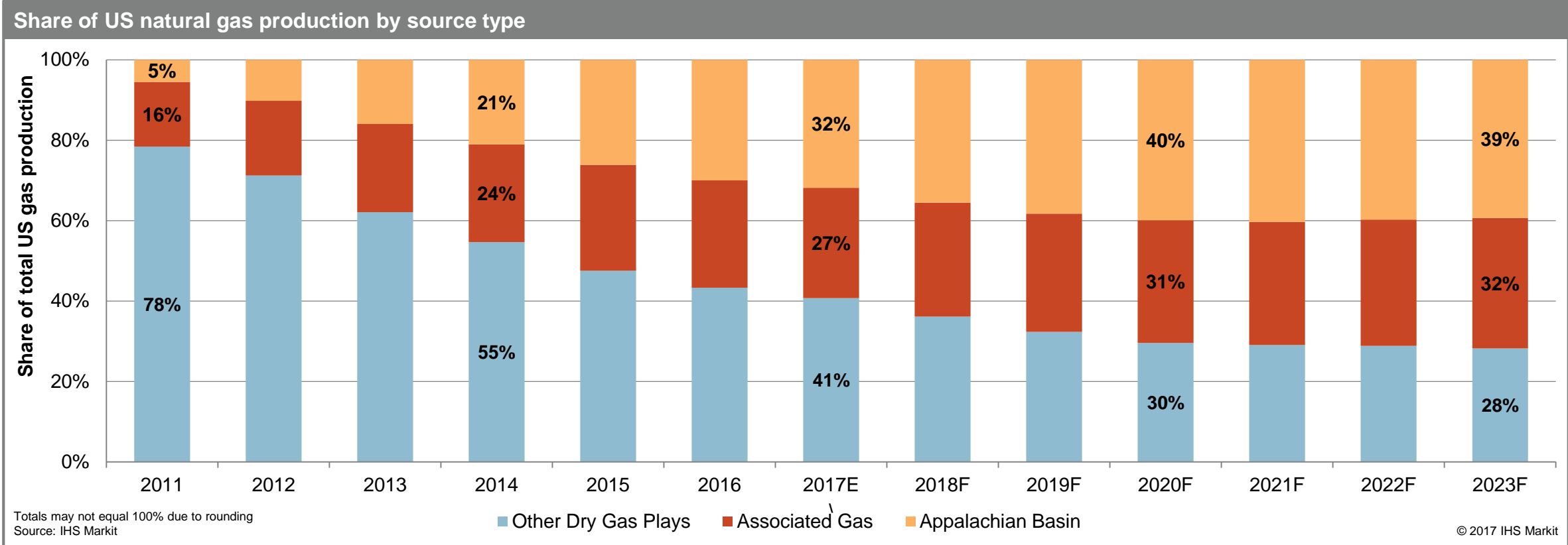
- Gas market growth is more dependent on gas-directed drilling; *net gas price support*
- US/Canadian LNG exports face increased challenges in the world market; long-term, dampens demand

US natural gas production rises by nearly 4% per annum through 2023, driven almost entirely by the Marcellus, Haynesville, and Permian plays



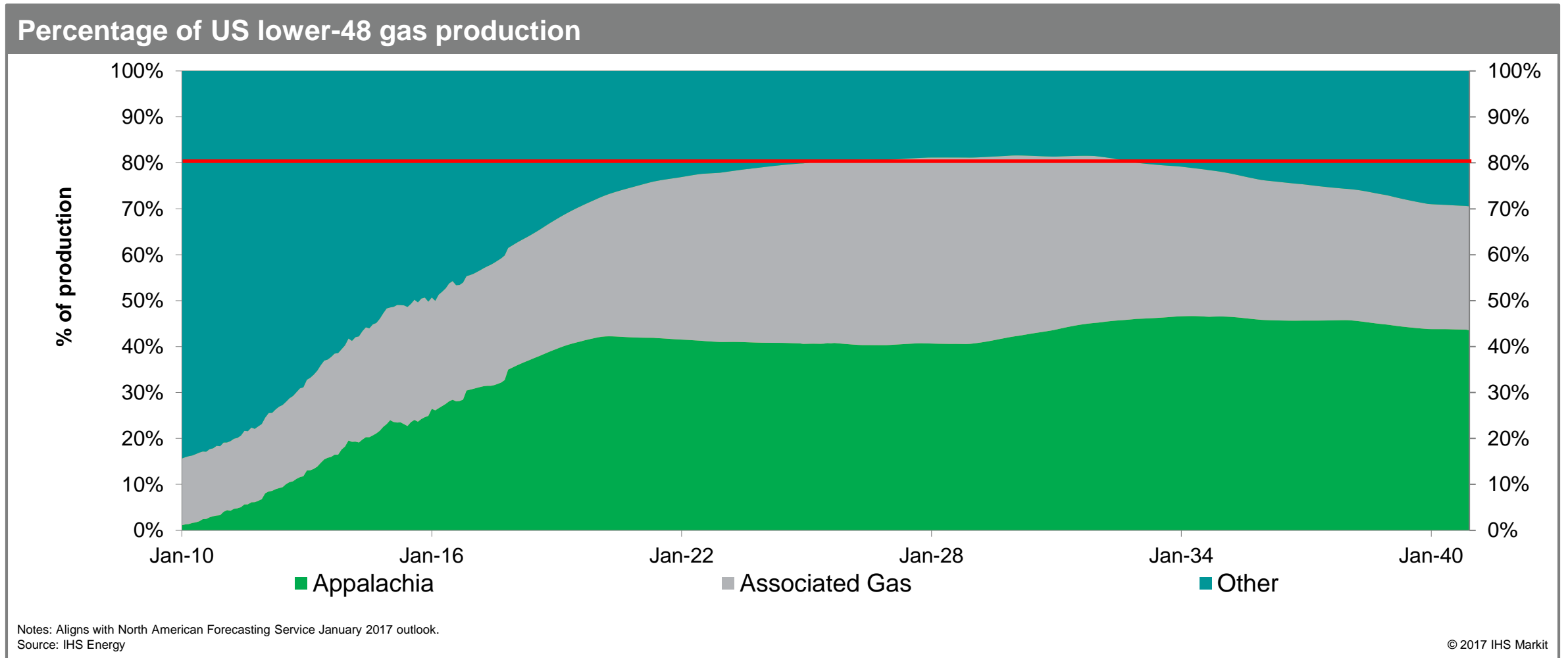
- US natural gas production growth from 2017 onward is almost entirely driven by Appalachian plays and associated gas from liquids-focused plays including Permian unconventionals and SCOOP/STACK. Associated gas, largely driven by Permian and Eagle Ford oil-directed operations, will grow to 29.1bcf/d in 2023, comprising nearly one-third of total US dry gas output.
- Production growth from gas-focused plays will remain concentrated in Appalachia, which will account for 39% of total US dry gas production in 2023.
- The Haynesville acts as the marginal source of supply in the US system. Based on current expectations for Appalachia and associated gas production, the call on the Haynesville – that is, volumes needed for market equilibrium – requires 4.5bcf/d of production growth by 2023.

Associated gas and Appalachia are the twin pillars of supply growth, accounting for about 60% of total US natural gas output



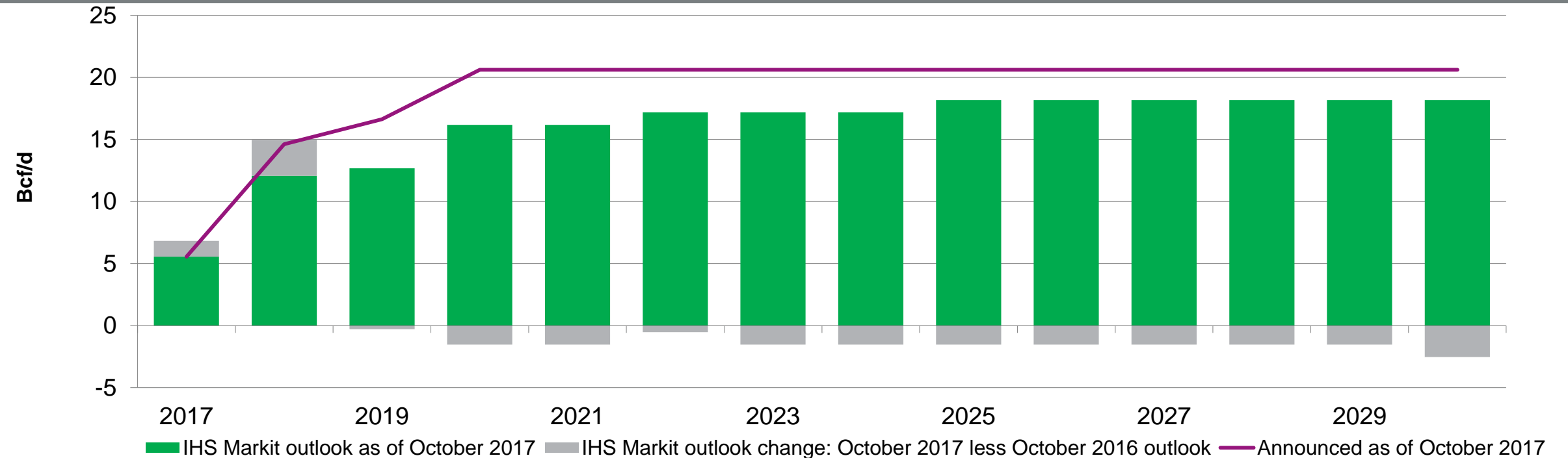
- More than 80% of associated gas production growth between 2016 and 2013 is expected to be driven by Permian unconventional plays, while the balance is almost entirely contributed by SCOOP/STACK and Wattenberg/Niobrara volumes.
- Appalachia dry gas output is expected to reach nearly 35.2 bcf/d in 2023, representing a 67% increase over 2016 levels of 21.1 bcf/d.
- With the exception of the Haynesville, other dry gas plays will continue to see limited investment, thus continuing a longstanding trend of declining production.

Appalachian plays and associated gas are taking over US lower-48 market share



Appalachian takeaway pipeline capacity additions are 4.4 Bcf/d below the level that had been expected in October 2016

Cumulative Appalachian takeaway pipeline capacity: announced capacity versus IHS Markit modeled capacity



Note: Sponsor-announced capacity includes all proposed projects regardless of project status.

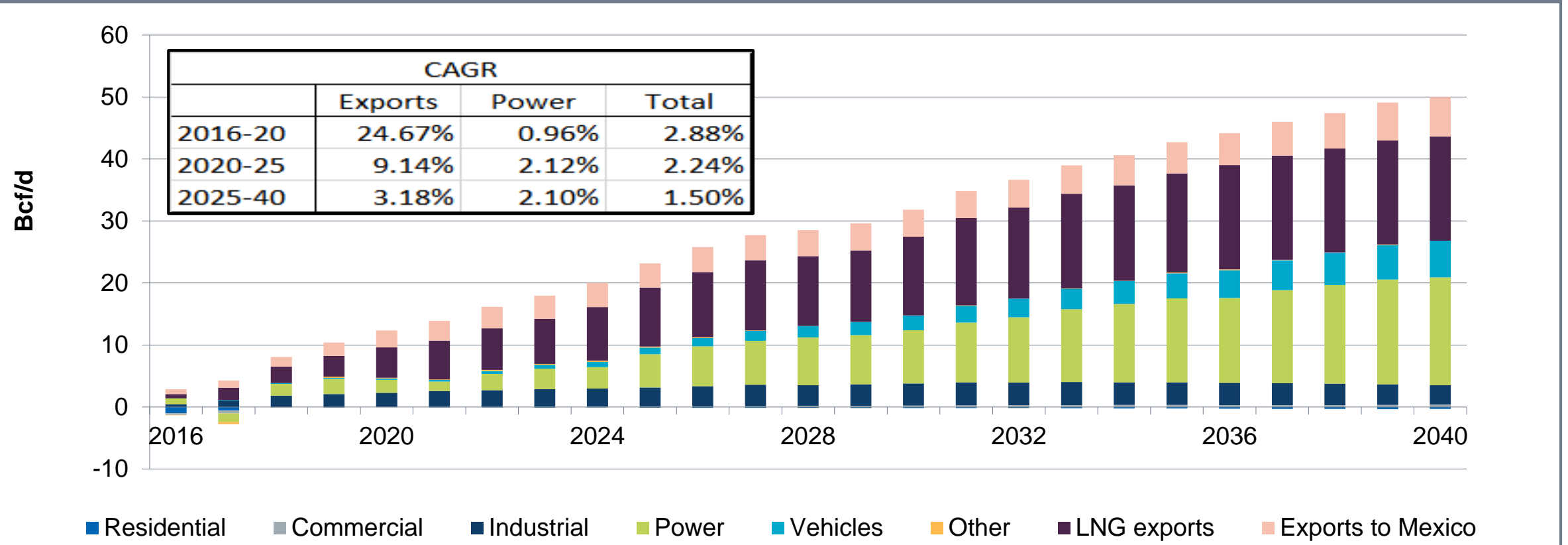
Source: IHS Markit

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- We have reduced our expectations for Appalachian takeaway capacity additions by 4.4 Bcf/d since October 2016.
- **We assume that the pace and volume of Appalachian grid expansion to be less than has been announced by the market**, given the concentrated opposition to infrastructure development and the scale and scope of the projects themselves.

Exports and power sector provide almost all of the expected demand growth through 2040

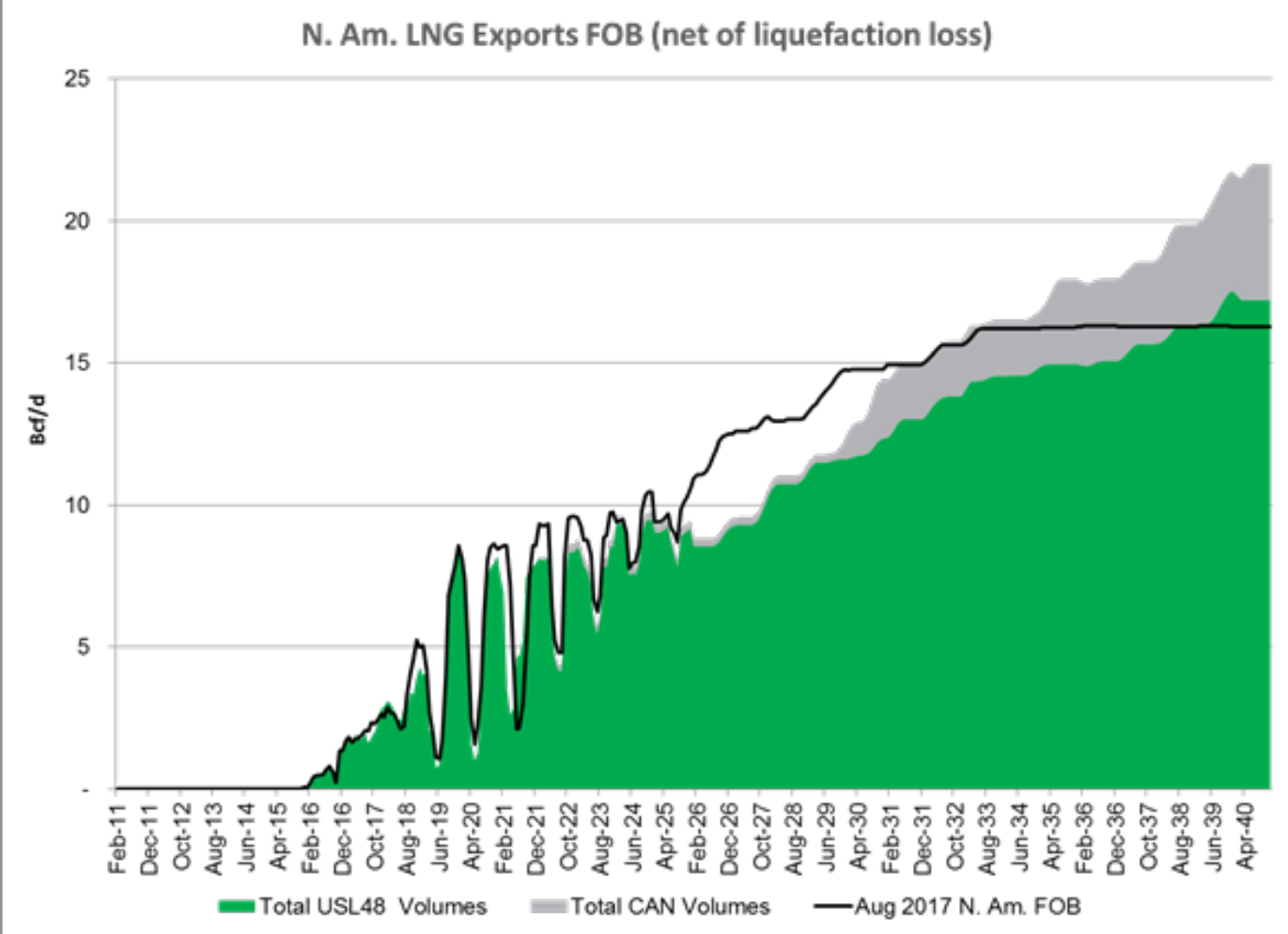
North American year-over-year demand growth relative to 2015



Note: CAGR = compound annual growth rate.
Source: IHS

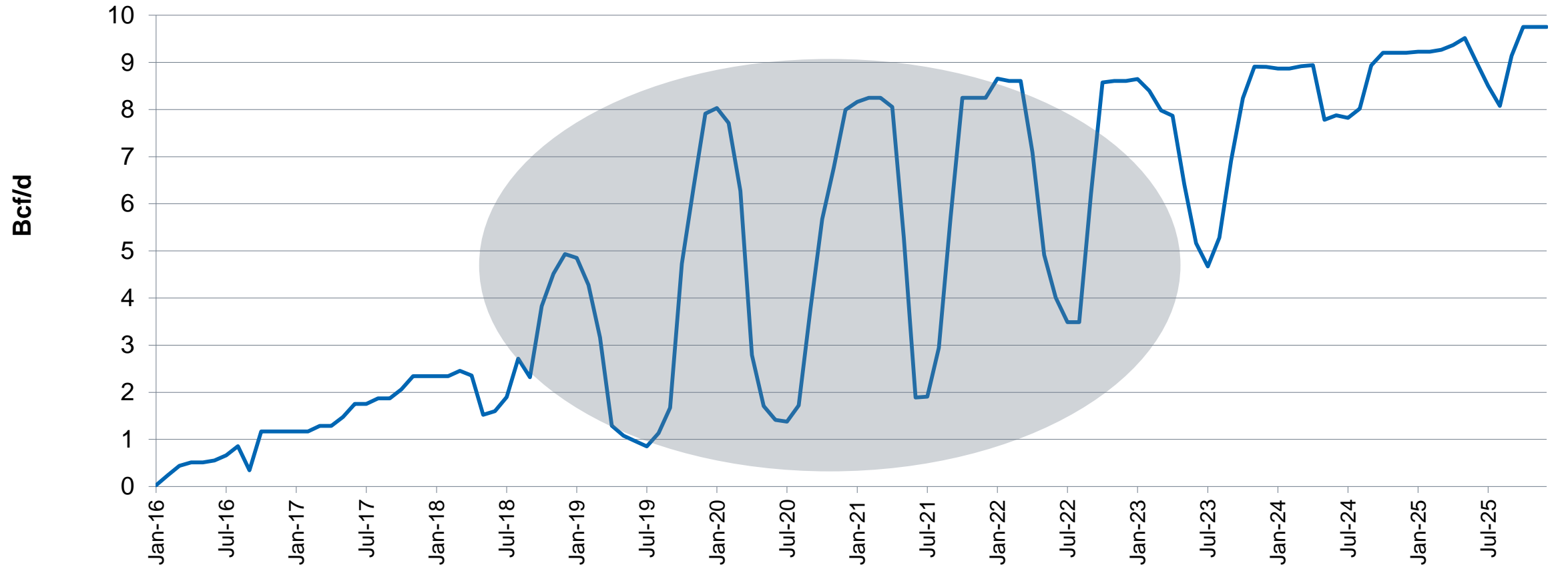
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But we are also increasing our outlook for LNG exports from the US Lower 48. Longer term, the potential for exports may help offset some or all of the power demand weakness.



Excess liquefaction capacity reduces US utilization

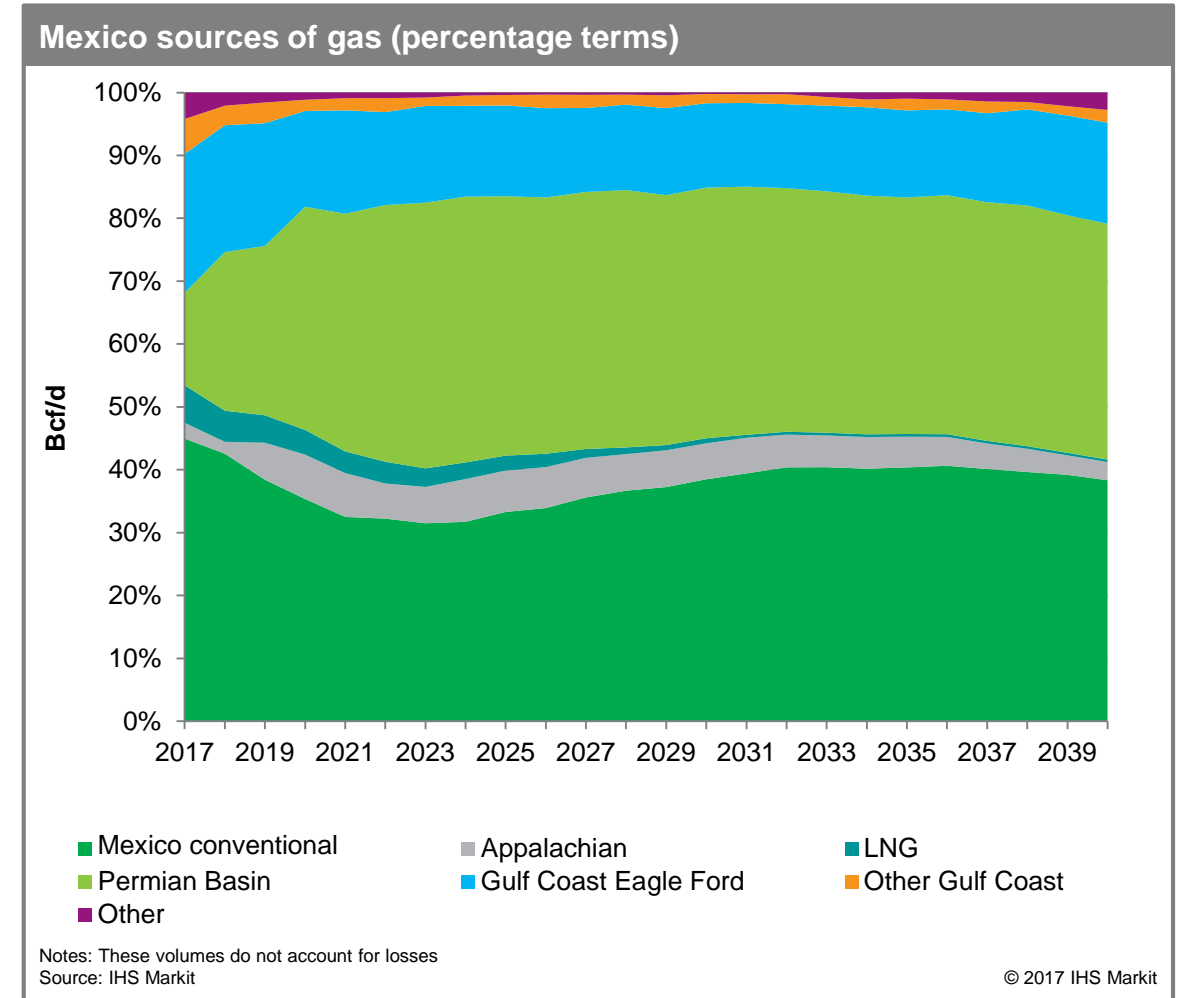
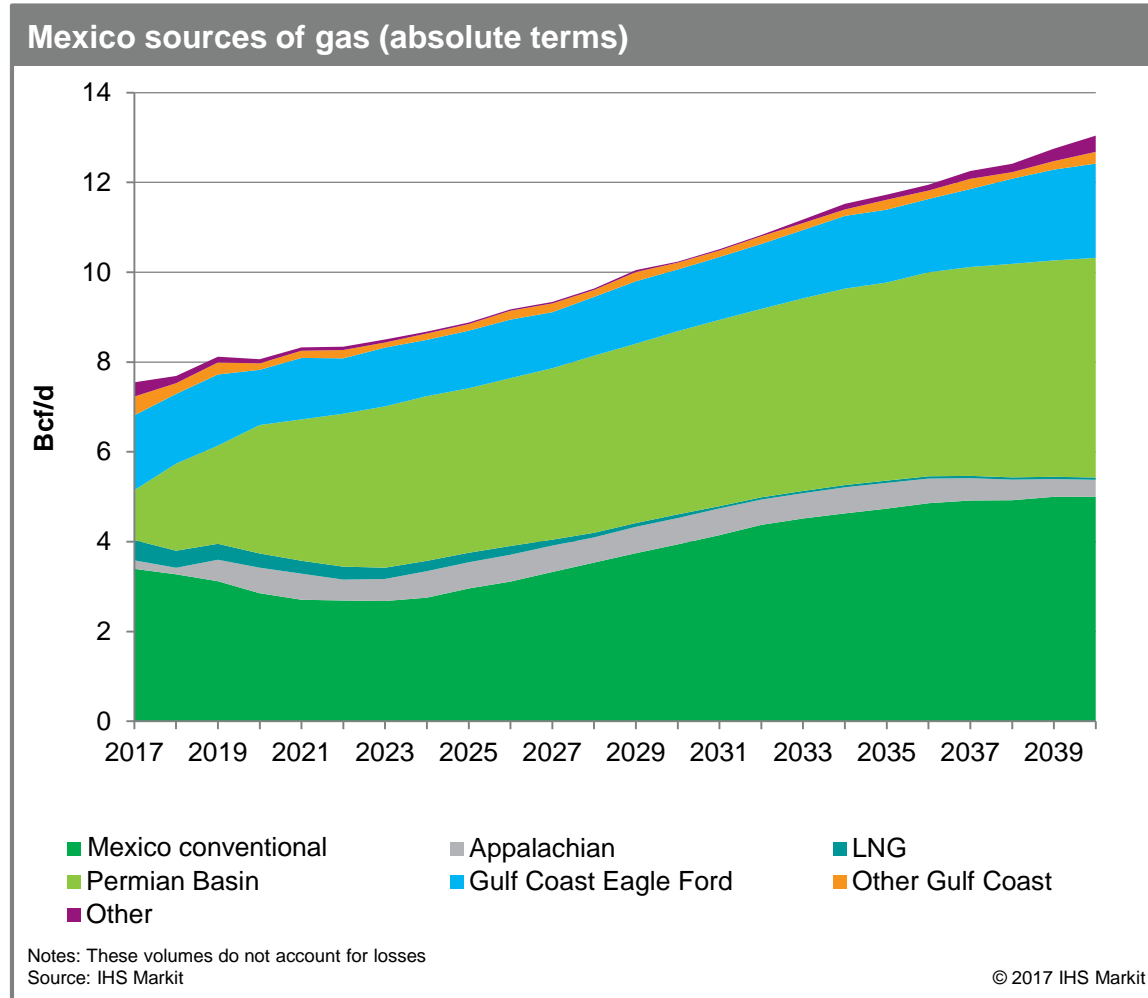
US lower-48 LNG exports



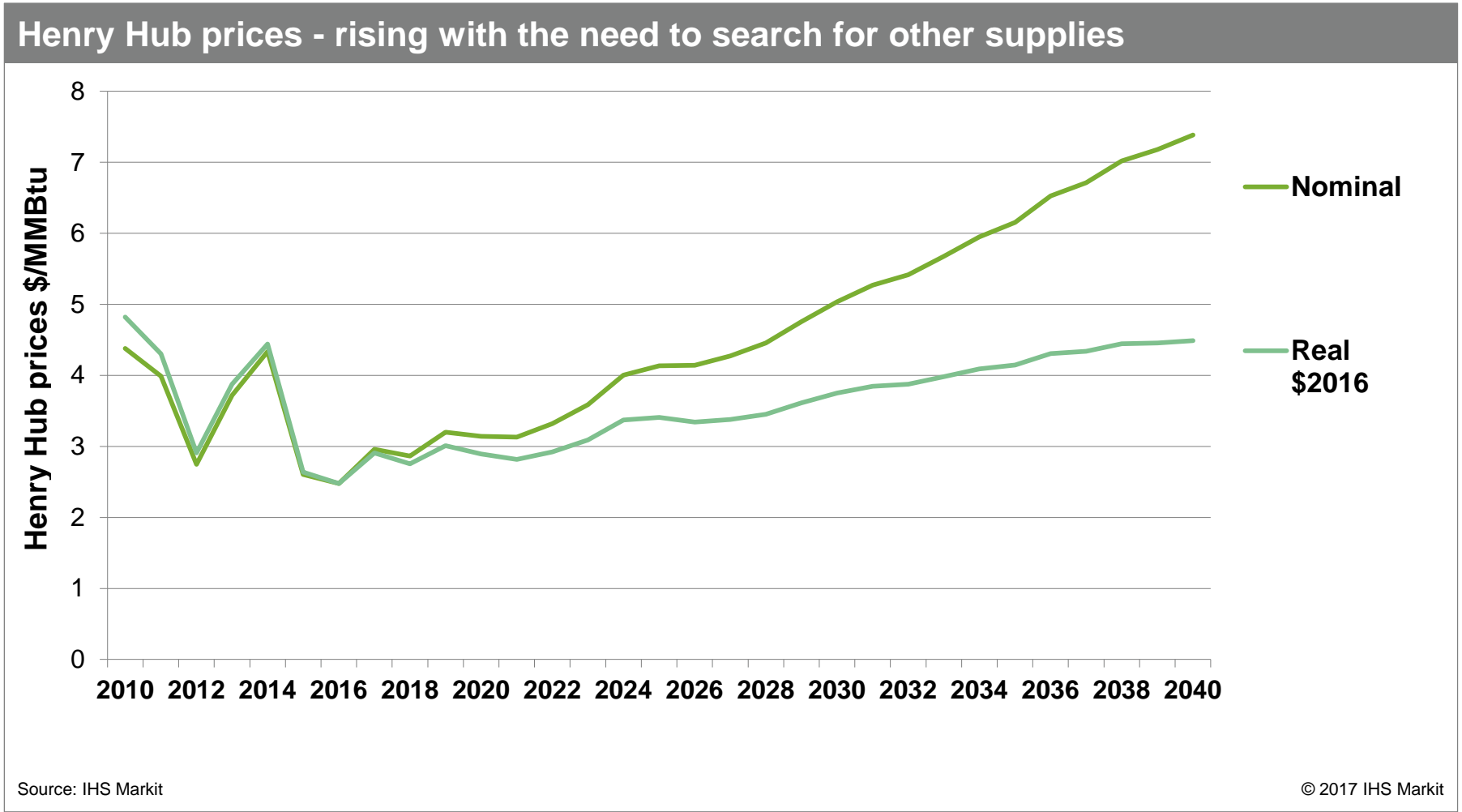
Notes: Excludes liquefaction losses.
Source: ABB Velocity Suite, IHS Markit

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Mexico's dependence on Permian and Eagle Ford gas in the United States rises as domestic production stagnates



Near term, demand growth is matched by supply growth, so that prices remain moderate; longer term, price appreciation takes hold



MARKET PHASES

2017 - \$2.96: Mild start, production growth re-emerges, healthy late storage inventories

2018 - \$2.86 (nominal): production growth (App pipes and associated gas) enables export growth and moderate prices, despite normal weather.

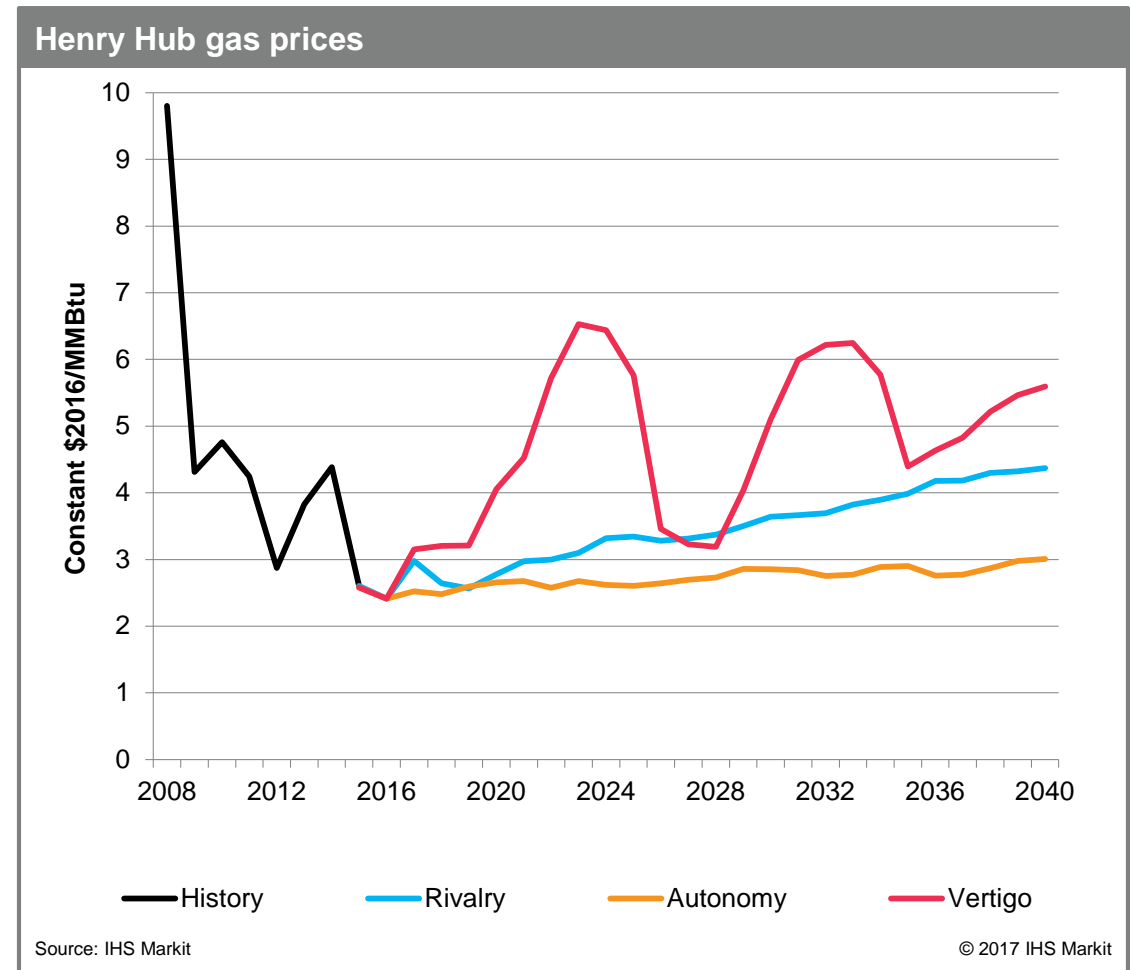
2019-22 - \$3.20 Nom/\$2.91 real: strong export demand growth, though delayed, supports prices despite rapid App and associated gas production growth.

2023-2026 - \$3.97 nom/\$3.29 real: Associated gas, App production reach plateaus as power demand growth accelerates.

2027-2040 - \$5.84 nom/\$3.99 real: Steady price increases, as power demand emerges as growth driver again, while associated gas depletion and pipe constraints out of Appalachia drive producers to look elsewhere for supplies.

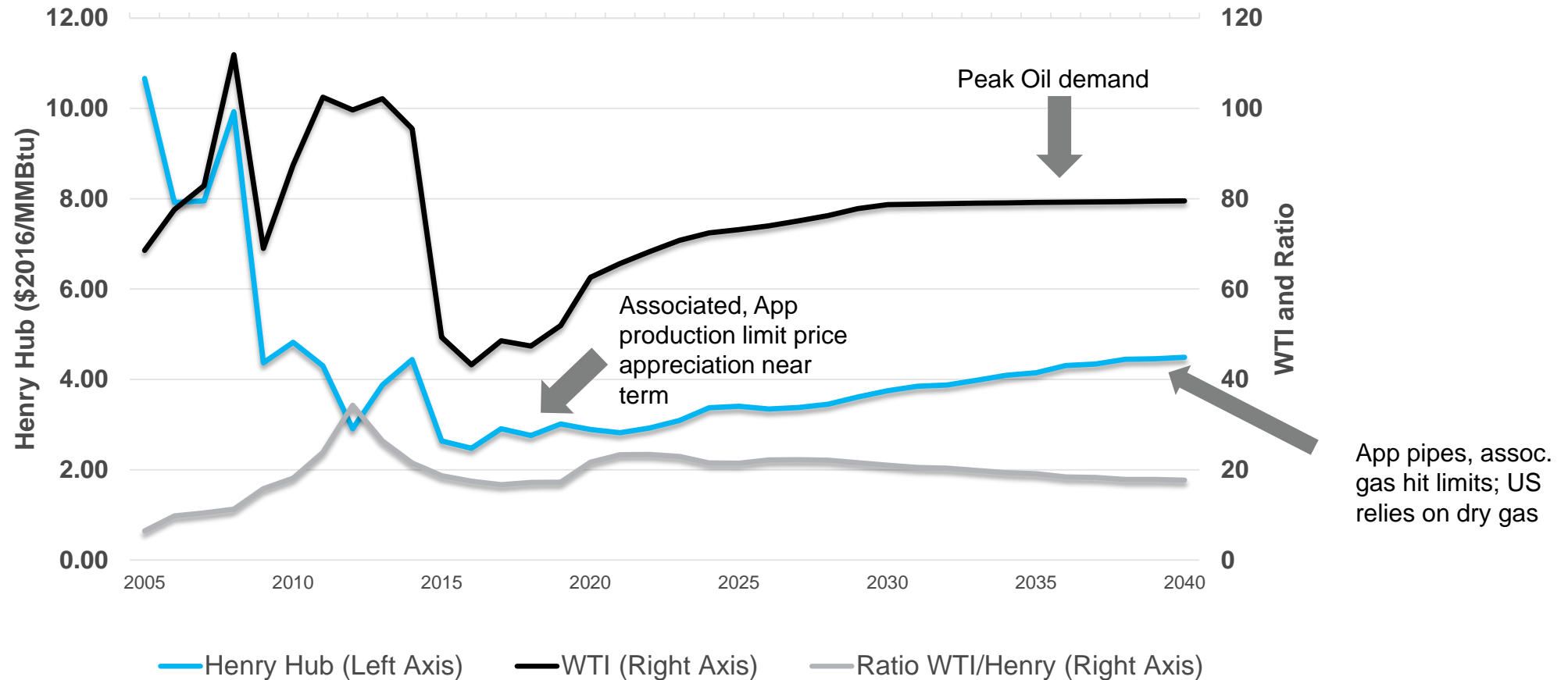
Scenarios for the natural gas price outlook: the “predetermined” reality of the resource base means costs drive the price in 2 of 3

- **In Rivalry**, the plentiful shale resource base and continuing improvements in extraction technology result in a slow increase in natural gas prices through 2040.
- **In Autonomy**, lower domestic and export demand serve to hold prices below those of Rivalry, and intense competition among marginal supply sources ensues. An ongoing productivity increase of 1–1.5% annually is sufficient to support long-term prices in this range given current knowledge of the resource base.
- **In Vertigo**, higher Henry Hub gas prices arise from a combination of above-ground constraints and producer caution and reluctance to invest in new areas. Instead, they exploit known plays more intensively and wait for significant price signals before increasing capital outlays. This strategy results in generally higher costs and a chronic mismatch between production and prices.



Oil prices increase first, but reach a long-term equilibrium in the \$75 - \$80 range (real), while gas increases toward \$4.00

Natural Gas and Crude Oil Price Histories and Outlooks (annual average \$2016)



Source: IHS, CME, Intelligence Press

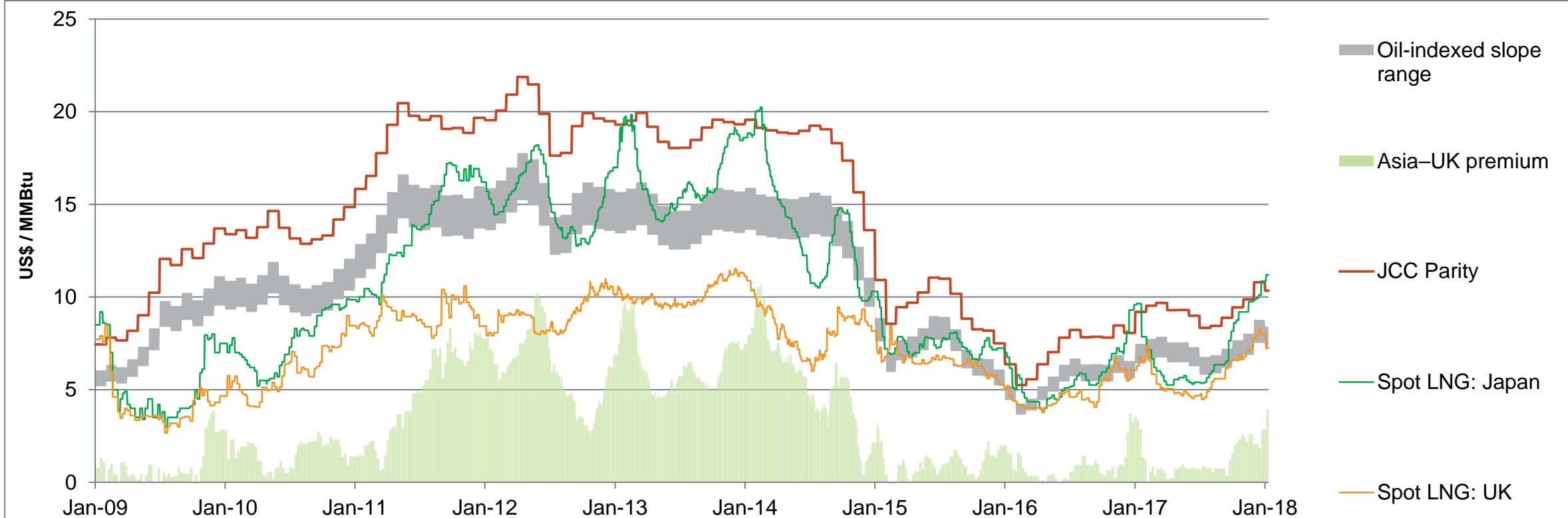
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Global Gas: key themes for 2018

- Global LNG market: On the edge of oversupply?
- Breaking the impasse / who blinks first: How will the next wave of LNG projects move forward?
- Consolidation vs commoditization of the gas industry
- What is the long-term future role of natural gas?
- Pricing dynamics: Relationship between oil and gas prices in North America

Act 1: Asian spot LNG prices approached oil parity over winter 2017/18 as the market tightened

Benchmark LNG prices



Notes: US LNG to Japan calculated as LRM: Henry Hub * 1.15 + \$3 liquefaction fee + \$1.5 transportation.
 SRMC: Henry Hub * 1.15 + \$1.5 transportation
 Spot LNG prices assessed by IHS Waterborne LNG for delivery the following month
 Oil-indexed slope range is 12-14% of JCC.
 Source: IHS Market, Japan Association of Petroleum

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Acts 2 and 3: LNG market in the short and long term

Two periods of competition

Act 2: Short term to 2022 Global oversupply

Rapid buildup in supply

Supply exceeds price-responsive demand

Prices fall to SRMC of US LNG

Act 3: Long term New supply required

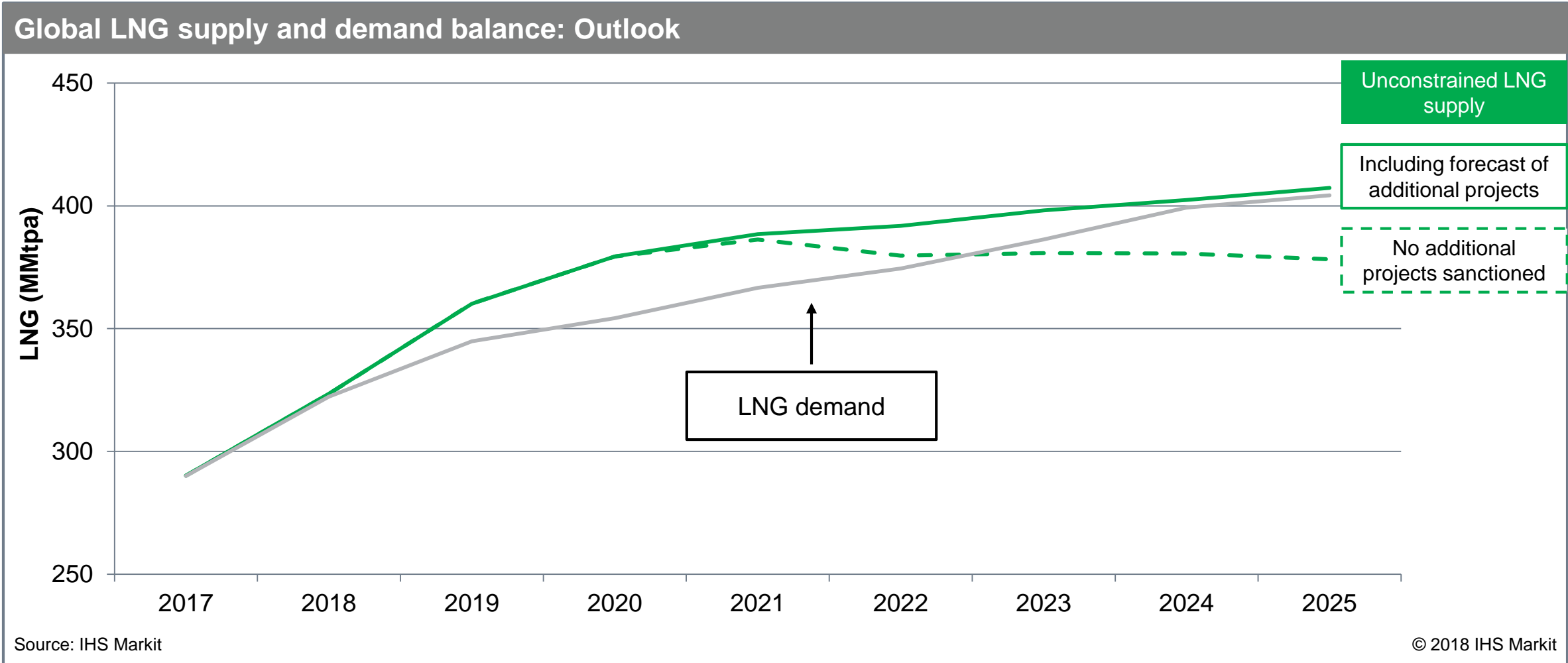
Global gas supply abundant

Gas increasingly delinked from oil

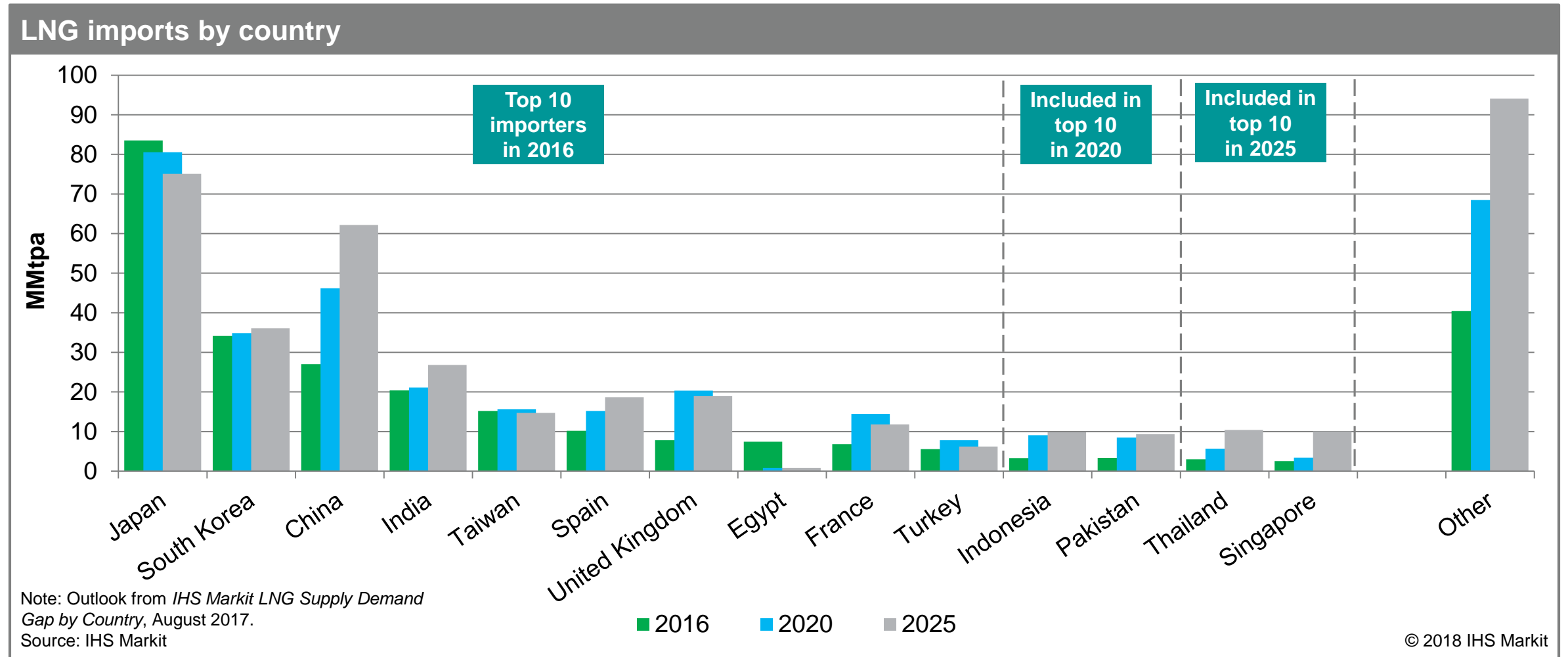
LRMC of supply drives prices

Europe is the “residual” market for global LNG

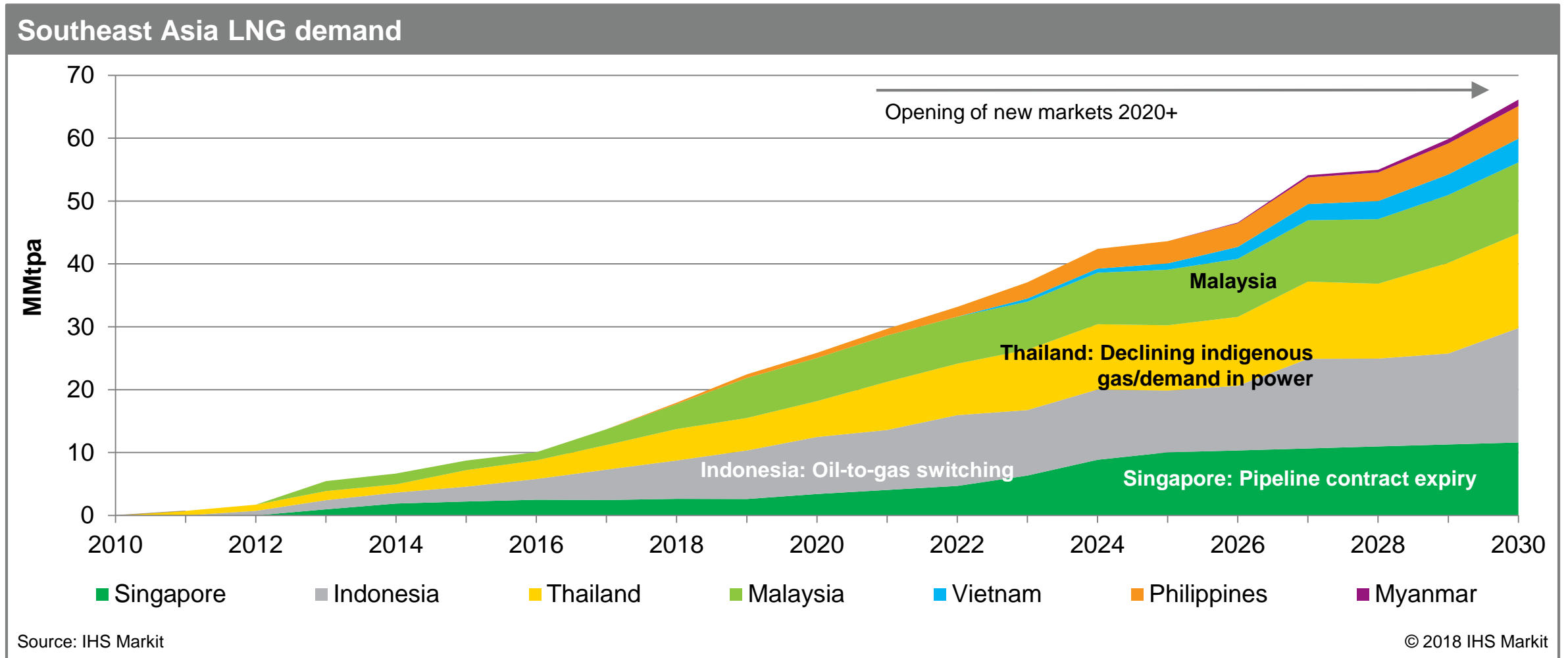
Global LNG oversupply expected to peak in 2020



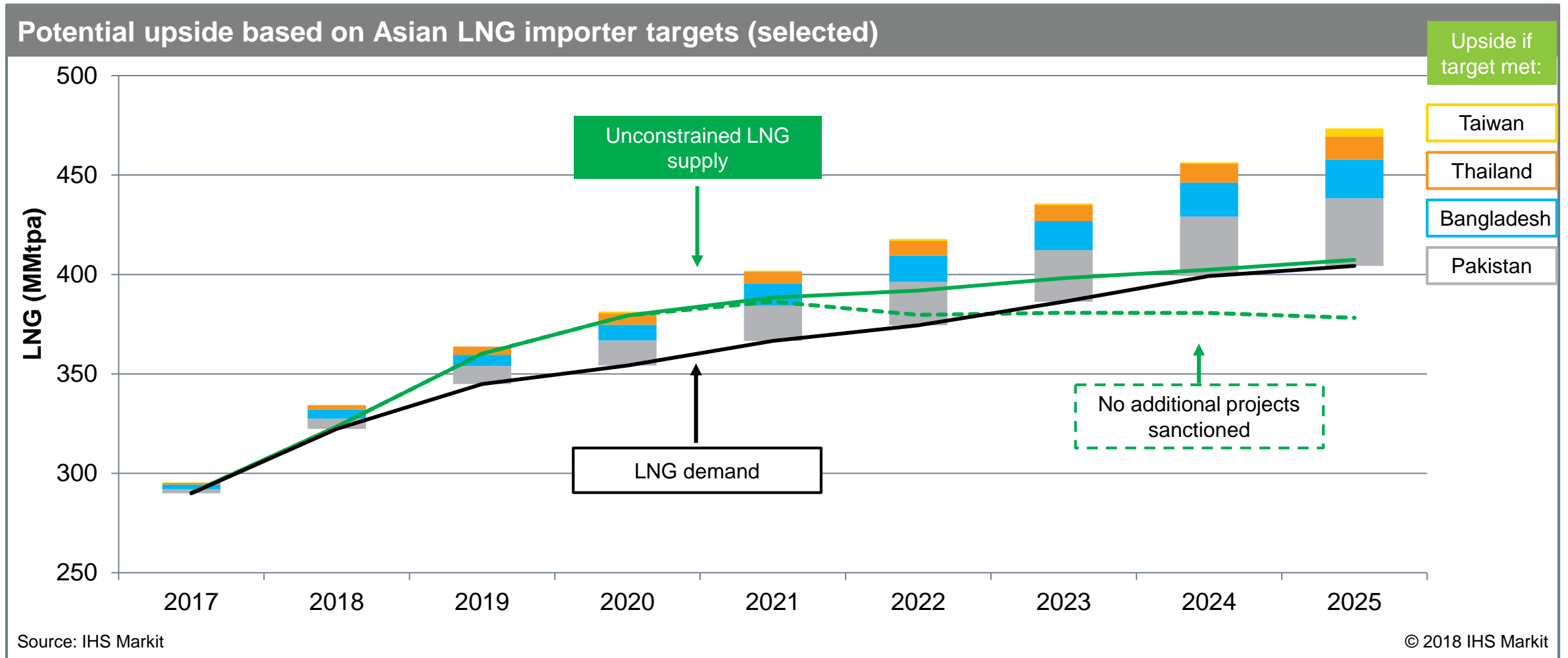
LNG imports by country: Shift to emerging markets, with Asian buyers driving future demand



The search is on to access new markets: Southeast Asia LNG demand to reach 60 MMtpa by 2030

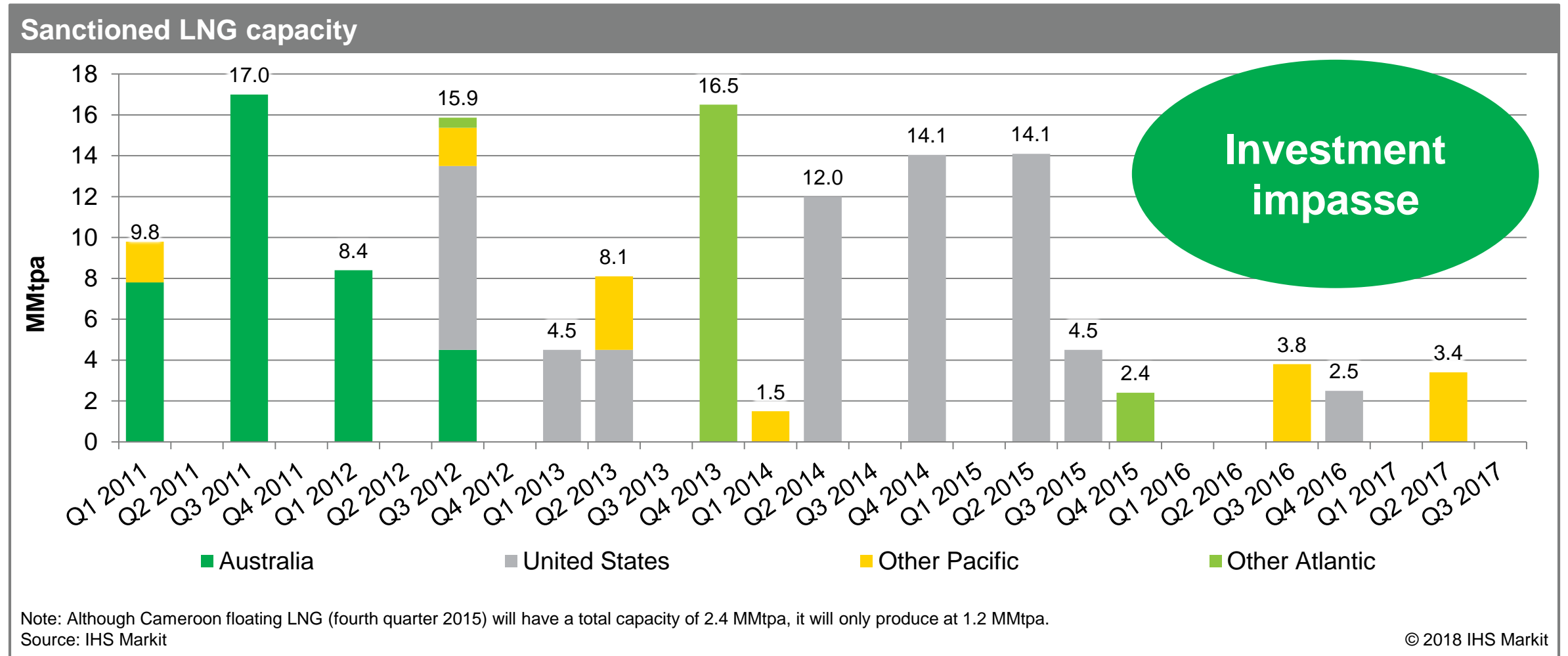


Ambitious government targets are driving higher expectations for future LNG demand: Can they be achieved?

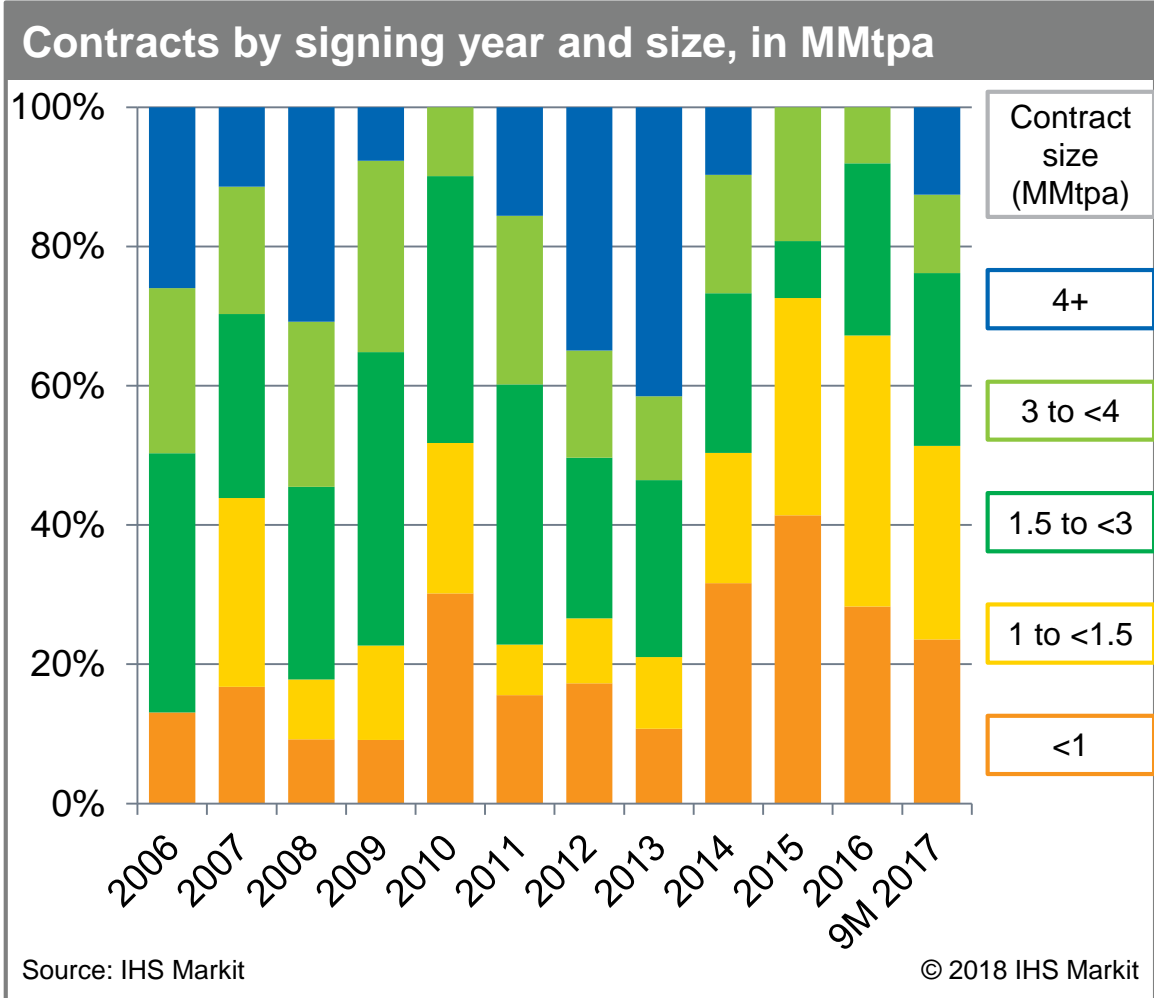


Global LNG musical chairs

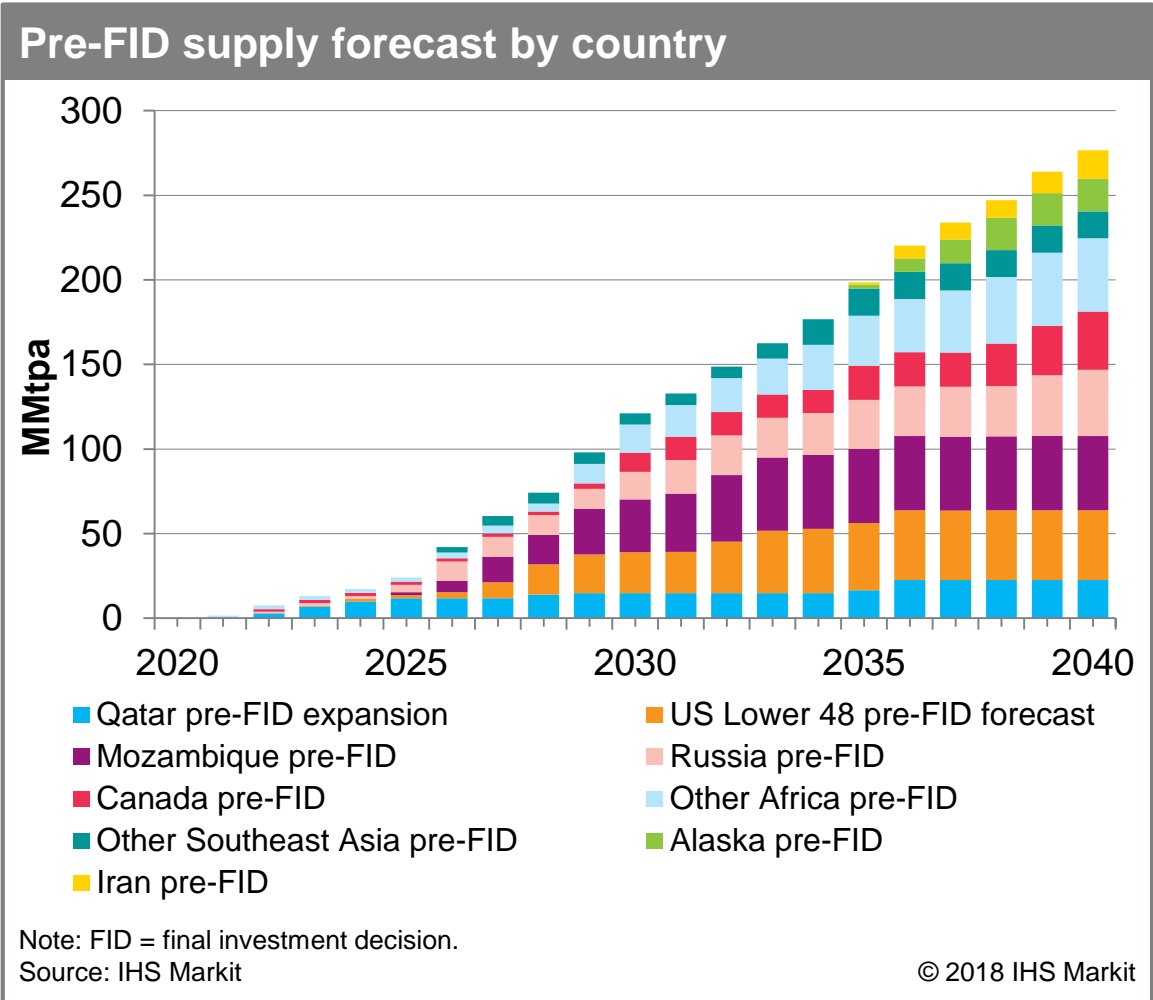
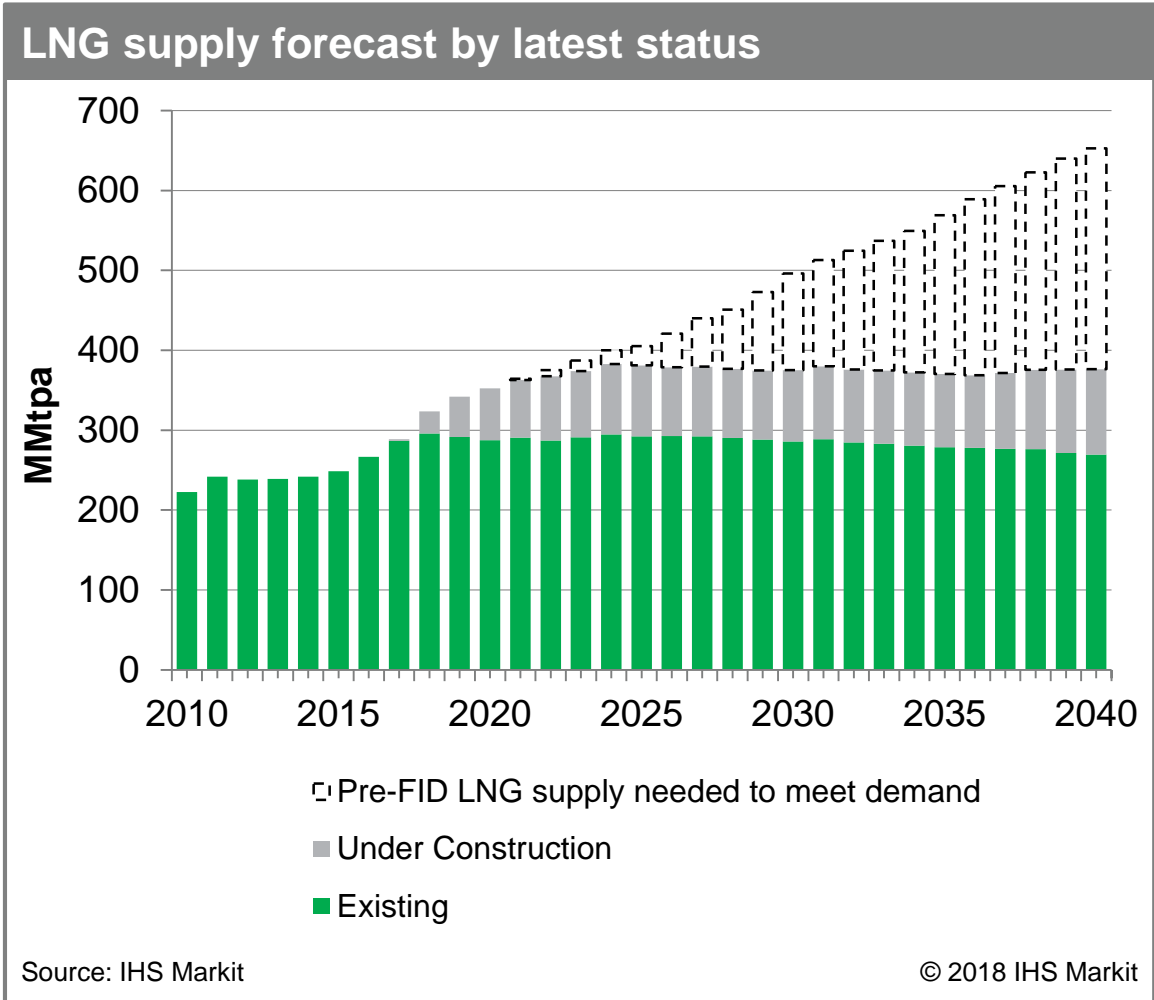
LNG investment impasse: Little sanctioned supply capacity in last two years



Buyers increasingly want shorter contracts and smaller volumes: problematic for underpinning new LNG projects



Opportunity gap: A crowded space for new LNG supply



State of the Gas Business? It's on an upward trajectory, but the slope is highly uncertain. "Peak gas" is highly unlikely before 2040.

