

Global gas & LNG outlook to 2035

H1 2019



Energy Insights
By McKinsey

Key messages



A Recap 2018–2019 YTD¹

- China emerged as the world's largest gas/LNG importer, overtaking Japan, and second largest LNG importer, overtaking South Korea
- 76 million tonnes per annum (mtpa) of LNG-related infrastructure became operational; the LNG industry registered an all time high volume of liquefaction projects taking final investment decisions (FIDs) (8 projects, ~84 mtpa)

B Gas demand

- Gas is the only fossil fuel that is expected to grow continuously to 2035; demand growth will slow to 1.3% per annum (p.a.) between 2018 and 2023 and to 0.7% p.a. between 2023 and 2035
- Asia remains the engine for growth in gas demand, with growth of 2.1% p.a. between 2018-2035
- Demand growth in gas-intensive industry sectors (+313 bcm) and in power (+135 bcm) represents ~70% of total global growth of 635 bcm until 2035

¹ Till September 8th 2019

C Gas supply

- More than half of global gas supply growth of 635 bcm by 2035 is expected to be driven primarily by the United States (+380 bcm (billion cubic meters)), followed by Russia (+110 bcm) and Africa (+110 bcm), while production in Europe and Rest of Asia will decline rapidly

D LNG outlook and infrastructure

- While LNG demand grows at 3.6% p.a. between 2018-35, we see oversupply returning to the market in 2024-2026¹ with new capacity required only from 2028-2029 onward
- China, ASEAN, and South Asia will account for more than 95% of global LNG demand growth until 2035
- Over 100 LNG projects totaling 1,100 mtpa of capacity are competing to fill the 125 mtpa supply gap by 2035; many of the marginal projects are from the US

E Business model

- Traditional LNG models are evolving with players expanding across the LNG value chain (i.e., forward or backward integration) and new business models emerging (e.g., traders, utility resellers)



¹ We assume all post-FID capacity and Qatar North Field expansion to come onstream before 2025

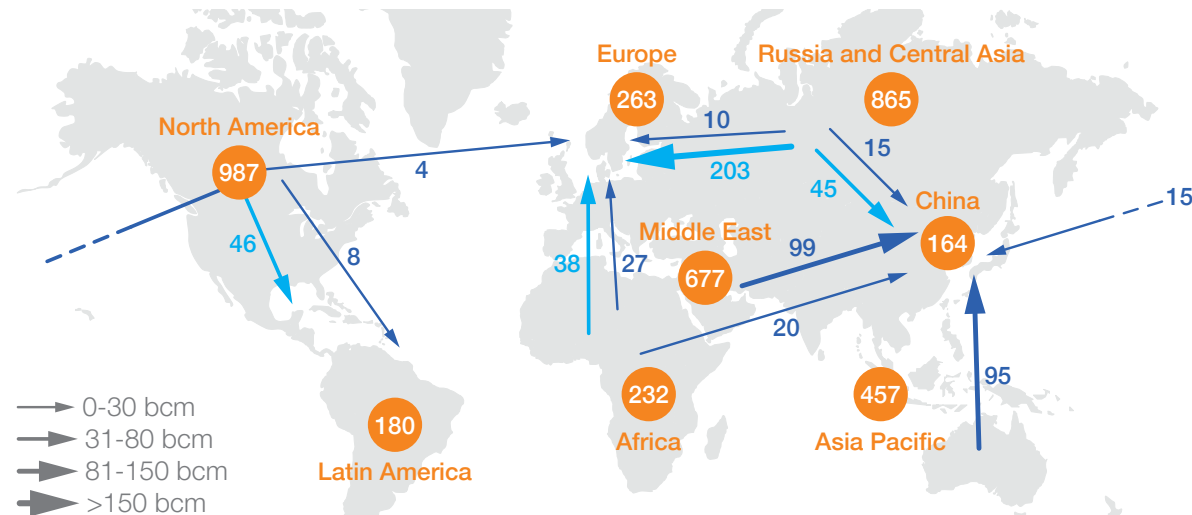
A Gas registered its highest year-over-year growth rate (5.3%) since 2010; 2018 saw increased flows across both LNG and cross-border pipeline flow

- China grew 18% year over year, with growth driven by implementation of the “blue sky” policy, and emerged as the largest total gas and LNG importer overtaking Japan
- Nine new liquefaction projects came onstream, increasing global liquefaction capacity by ~49 mtpa
- Two new countries joined the LNG importing club (Panama and Bangladesh) and global regasification capacity increased by ~28 mtpa
- 2019 YTD LNG industry has already registered all-time high volume of liquefaction projects taking FID (5 projects, ~63 MTPA)

Main 2018 pipeline and LNG flows

bcm

● Supply 2018 2018 flows ■ LNG ■ Cross-border piped gas ■ Domestic



HH benchmark price

July 2018: 2.83 \$/MMBtu¹
July 2019: 2.36 \$/MMBtu

TTF benchmark price

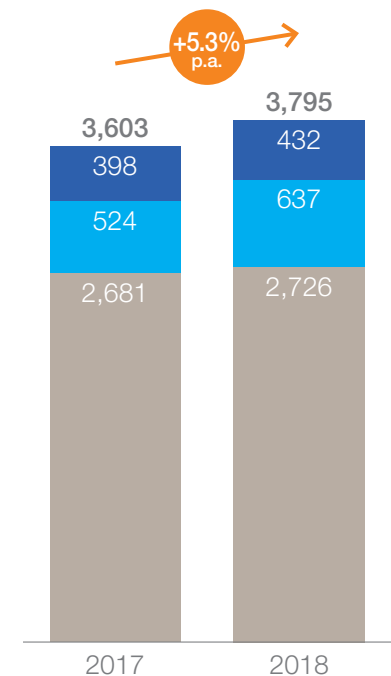
July 2018: 7.62 \$/MMBtu
July 2019: 3.58 \$/MMBtu

JKM benchmark price

July 2018: 8.15 \$/MMBtu
July 2019: 4.65 \$/MMBtu

Flow

bcm

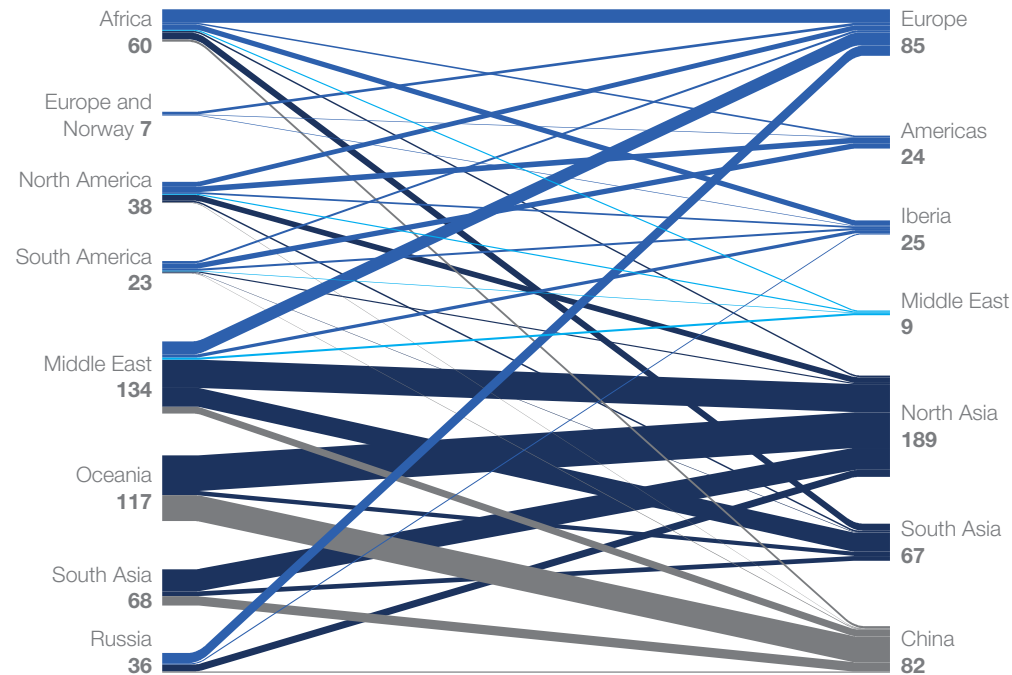


Asia is the main destination for LNG flows; global share of spot and short-term cargoes represents ~35%

- In the last 12 months, the LNG industry has registered an all-time high volume of liquefaction projects taking FID (6 projects, ~84 MTPA), which is equivalent to 20% of the market
- The LNG market continued its expansion with a notable 14% year-over-year growth between August 2018–July 2019
- LNG market growth has been supply-led with the United States growing ~60%, Australia growing ~23%, and Russian LNG nearly doubling
- Demand growth has been driven by Europe (~81% growth), China, and South Asia (20 -26% growth), while JKT remained nearly flat and the Middle East contracted by ~20%
- Average LNG shipping tonne mile increased by ~14% as cargoes moved over long distances from the United States and the Middle East to Asian markets
- ~20 mtpa out of 41 mtpa of LNG volume contracted had duration longer than 20 years

Actual LNG demand flow

Aug 2018 to Jul 2019, bcm

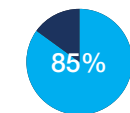


Source: Energy Insights by McKinsey

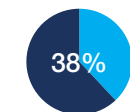
Global average utilization

Jan 2018 to Jun 2019, %

Liquefaction

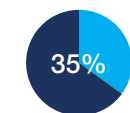


Regasification



Liquidity

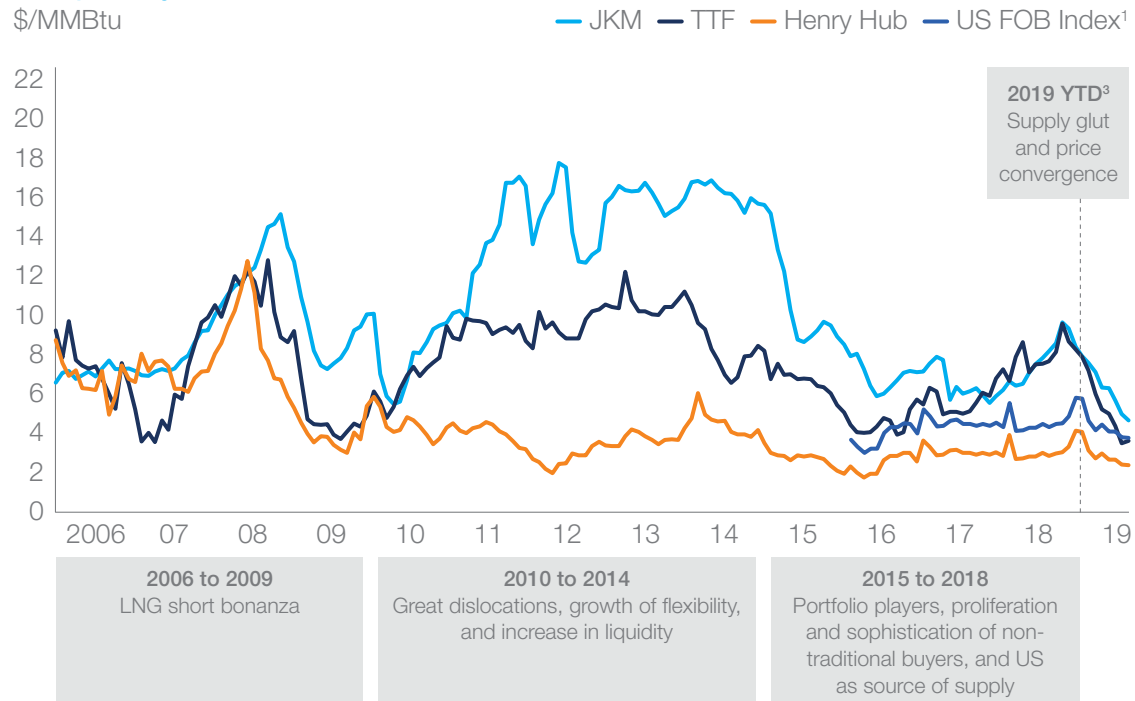
Jan 2018 to Jun 2019, % of spot and short-term trade



A Global LNG price indicators have converged in H1 2019; short-term prices will reflect cash costs while long-term Asia (baseload) prices may reflect US full costs

LNG price by market

\$/MMBtu



Price economics logic

\$/MMBtu¹

	Residual cash costs ²		Cash cost		Full cost	
Henry Hub (price setter)	Base		Base		Base	Abundant supply drives gas towards coal competition pricing
+						
Liquefaction cost	0.4–0.5	Tolling ToP fixed fee	+0.8	LNG cash cost in short-term oversupplied market (opex)	+2.2–2.7	LNG full costs in a balanced market (opex and capex)
Shipping cost	+0.5	Bunker fuel/boil off only	+1.7	Short-term charter rates	+1.8–2.2	Full cost shipping (opex and capex) to Tokyo Bay
Delivered LNG to Asia	Base +0.9–1.0	Near-term cash costs	Base +2.5	Short-term cash costs	Base + 4–5	Full cost

¹ US long-term LNG contracts FOB price. The formula is 115% HH+1.1\$/MMBtu ² Costs that are variable in the very short term ³ Until July 2019

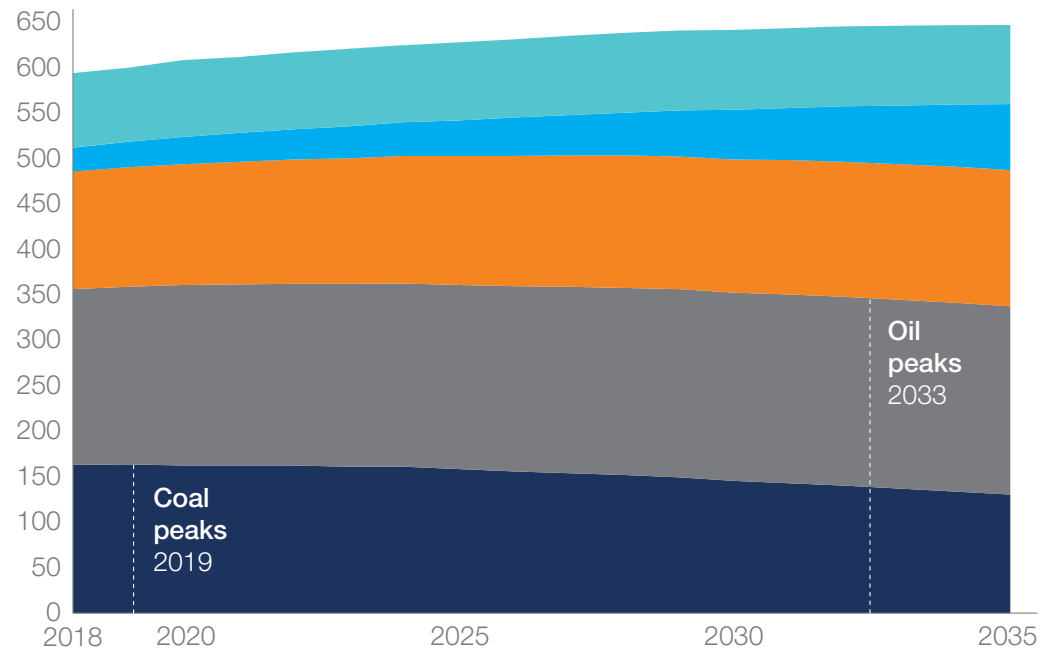
Source: Energy Insights by McKinsey, BP Statistical Review of World Energy, EIA, Japan Ministry of Economy Trade and Industry, IGU Wholesale Gas Price Survey

B Gas is the only fossil fuel that is expected to grow through 2035

Global primary energy demand per fuel

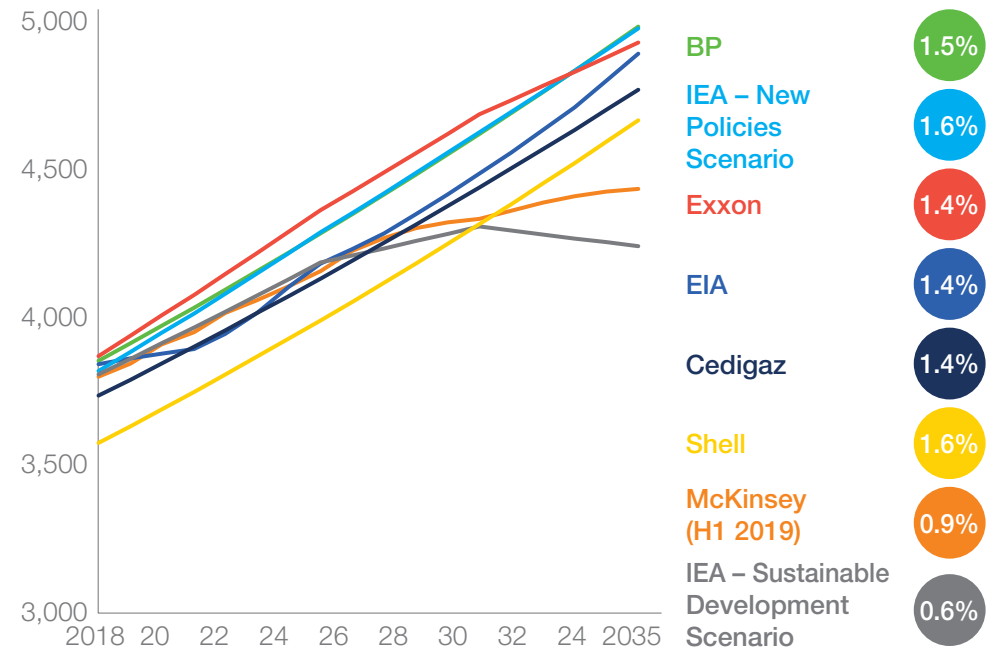
Million terajoules

Other¹ Renewables Natural gas Oil Coal



Projected gas demand

bcm



¹ Includes nuclear and biomass

Source: BP Energy Outlook 2019, EIA International Energy Outlook 2018, IEA World Energy Outlook 2018, Energy Insights by McKinsey 2019; Shell LNG Outlook 2019; Exxon Outlook for Energy 2018

B Global gas demand expected to grow at 0.9% p.a. between 2018–35 driven by many regions' power/gas-intensive industry and China's residential/commercial sectors

1 Geographically, China represents ~40% of total global demand growth to 2035, while North America, South Asia, and ASEAN represent another ~40% of global gas demand growth

2 Gas demand growth in the power and gas-intensive industry sectors represents ~70% of total global growth; China residential accounts for additional ~65 bcm

- Power growth is driven by rapid electricity demand growth in China, ASEAN, Africa, and North America
- Strong industrial demand growth in China, the Middle East, and North America is driven by gas-intensive industries (e.g., petrochemicals) taking advantage of accessible and competitive gas supplies
- Growth in residential and commercial sectors in China is driven by a government push from coal-to-gas conversion for residential end-usage

Global gas demand by sector and region between 2018 and 2035

bcm

□ Key growth segments ▽ 2018 ▽ 2035

■ Δ>200 bcm ■ Δ 50–200 bcm ■ Δ 25–50 bcm ■ Δ 0–25 bcm ■ Δ <0 bcm

	China ¹	JKT	South Asia	Middle East	ASEAN & Pacific	Europe	Africa	Latin America	Central Asia and Russia	North America	Total	CAGR ²
Power	287	200	130	553	209	570	144	225	562	915	1,509	0.5%
Industry	551	179	195	559	276	544	205	283	590	1,048	1,644	1.7%
Rescom ³											818	0.5%
Transport											56	3.9%
Other											452	0.6%
Total	287	200	130	553	209	570	144	225	562	915	3,795	0.9%
CAGR	3.9%	-0.5%	2.4%	0.3%	1.4%	-0.4%	2.0%	0.5%	0.3%	0.8%	0.9%	

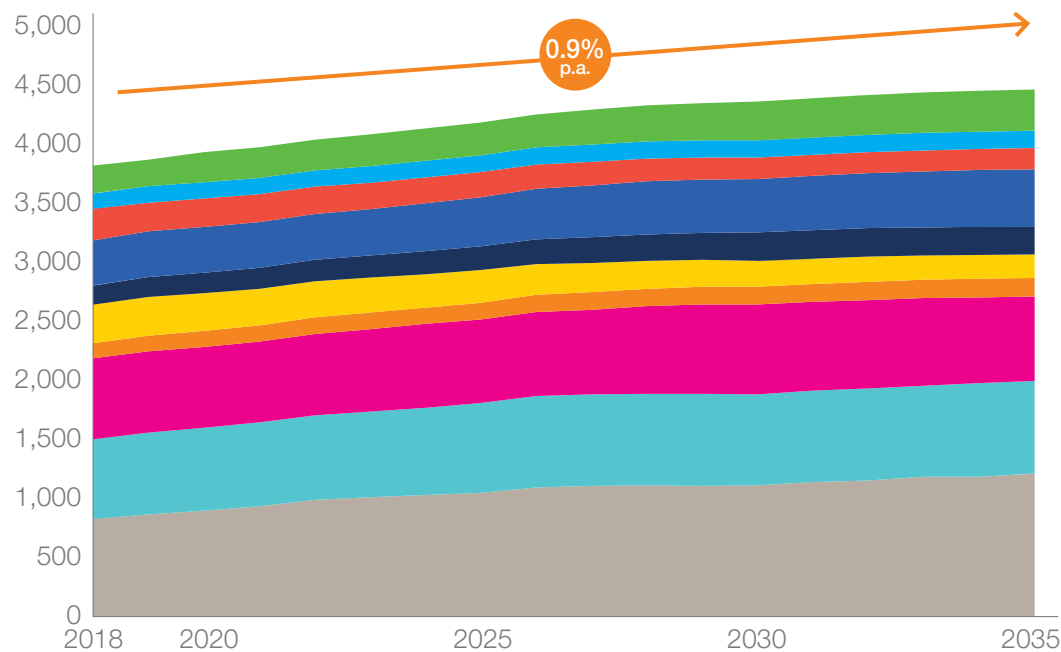
¹ Includes Hong Kong ² Compound annual growth rate 2018–35 ³ Household and commercial gas demand Source: Energy Insights by McKinsey

More than half of the global growth of 635 bcm by 2035 is predicted to be driven by the US (+380 bcm)

- The main drivers are the United States, Africa, Russia, and China
- In addition to unconventional gas expansion, China will double its conventional gas production from 2018 to 2035
- Shale gas production growth in the US will continue, helping the US join Qatar and Australia as the top global LNG exporters
- Russia will further increase its role as a key supplier to gas-scarce Europe and China
- Production in Europe and Rest of Asia will decline rapidly as fields mature

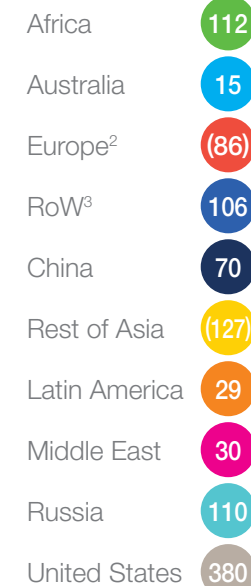
Global gas supply by region to 2035¹

bcm



Growth in gas supply

2018–35, bcm



¹ Assuming the LNG market oversupply gap in the short- to medium-term will be evenly filled by LNG supply and demand

² Including Norway ³ Rest of World Source: Energy Insights by McKinsey; Energy Insights Gas Intelligence Model; IHS Vantage

C The share of LNG in global gas trade will grow from 11% to 18% by 2035

LNG imports

- Domestic supplies face growth limitations (e.g., China, Western Europe)
- LNG is more cost competitive than piped gas over long distance (e.g., Thailand)

Pipe imports

- Russian exports growth to Europe (modest) and China (strong)
- US exports to Mexico

Domestically produced and consumed

- Gradual decline in Europe
- Strong growth in the US

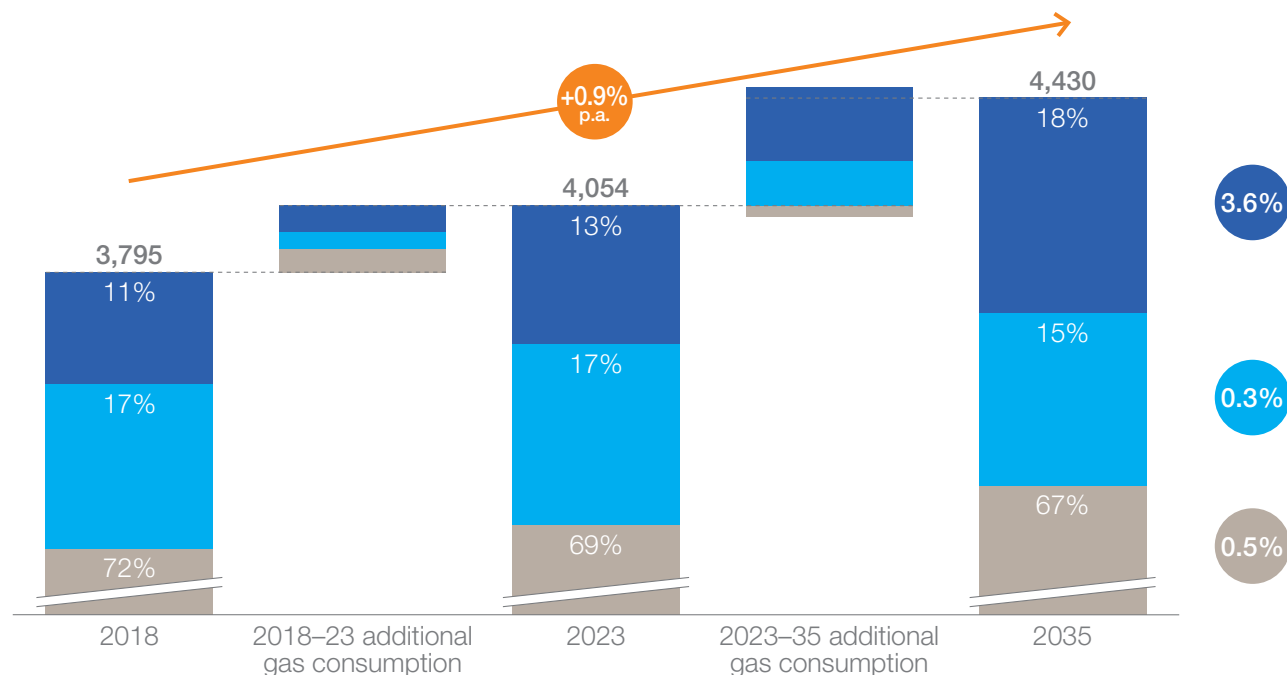
2018–35 gas consumption breakdown per delivery mechanism

%

■ LNG flows ■ Pipeline flows ■ Gas consumed where produced

CAGR

2018–35, %



B/C China gas demand expected to grow at ~4% p.a., driven by industry/building sector growth, but China's dependence on imports expected to increase to 58% by 2035

Demand

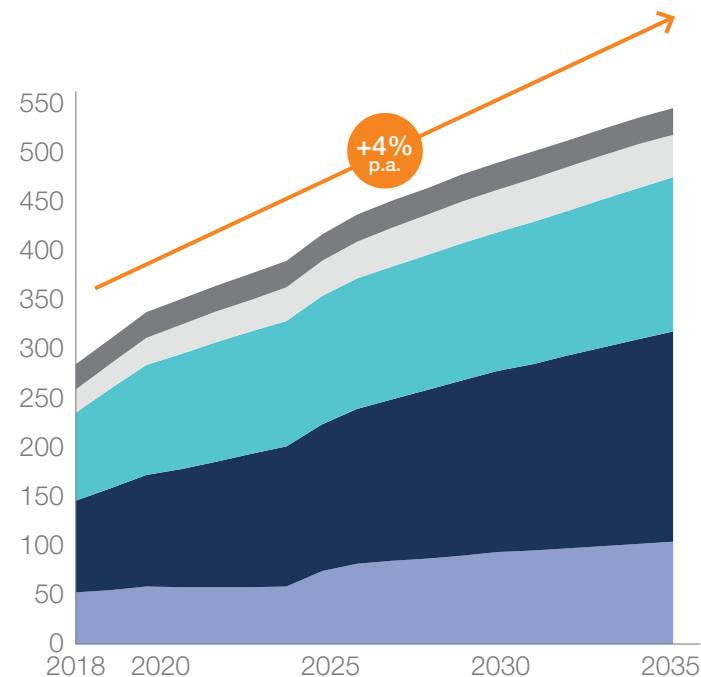
- Gas demand in China is expected to grow at 4% p.a. mainly driven by the industrial and building sector, which is being driven by coal-to-gas policy

Supply

- China's dependence on imports is expected to increase from 43% to 58%. The United States, Australia, Russia, and Turkmenistan are expected to be the key suppliers to China
- Central Asia is expected to double (i.e., 75 bcm) its piped gas exports, while Russia through Power of Siberia will add ~38 bcm of piped gas supply
- The United States and Australia are expected to be the largest LNG suppliers to China by 2035, making up ~75% of total LNG imports

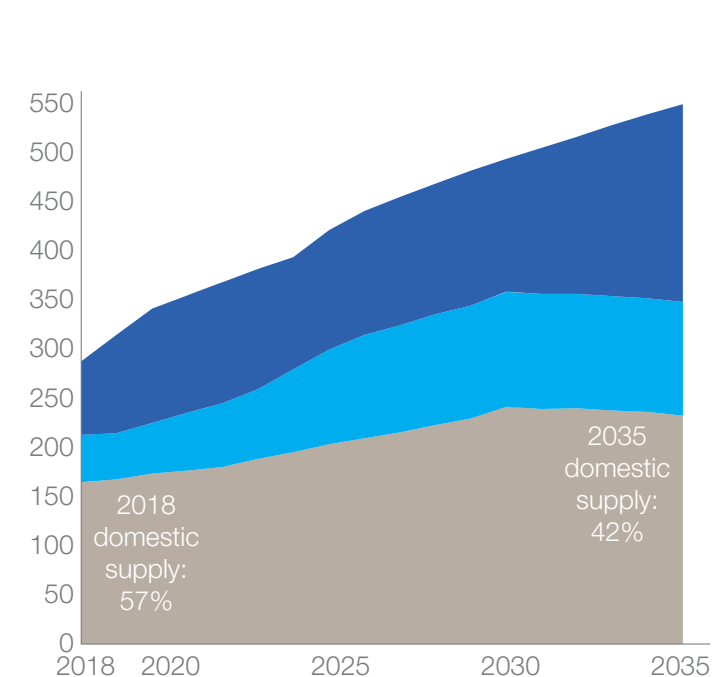
Demand

bcm



Supply

bcm



Source: Energy Insights by McKinsey; press search

B/C North American gas demand expected to grow ~2% p.a., driven by strong exports; Appalachian and Permian basins will supply ~53% of North American market by 2030

Demand

- LNG exports: US is poised to become the largest LNG exporter globally by 2022, overtaking Australia and Qatar
- Power: Expected to grow another ~50 bcm as an additional ~70 GW of gas capacity comes online by 2025, but the sector will flatten from 2026 as it faces strong competition from renewables

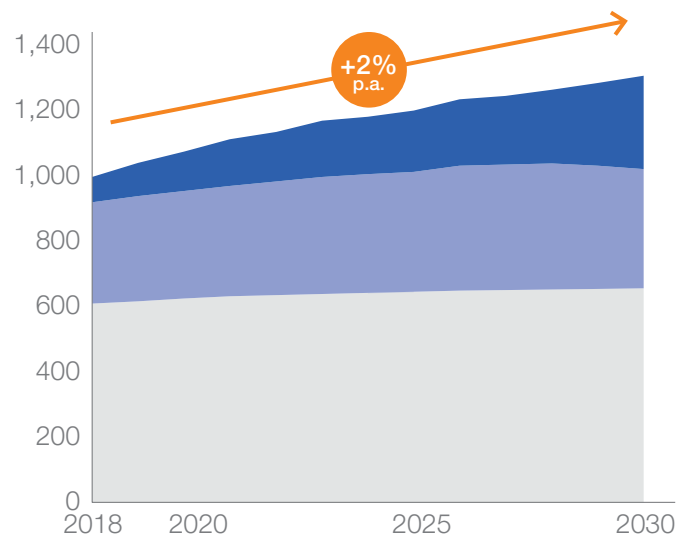
Supply

- Appalachian: Production grows at 6% p.a. as the basin is debottlenecked in 2018-2019
- Permian: Production will increase by ~75 bcm from 2018 to 2030

North America gas demand

bcm

- Residential, commercial, industrial, and other
- Power
- LNG and Mexico export



CAGR

2018–30, %

11.6%

1.4%

0.6%

North America gas supply

bcm

■ Shale gas production

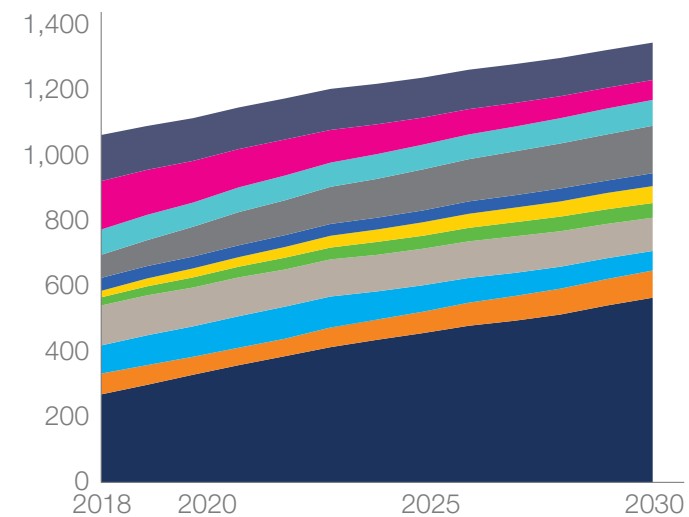
- Appalachia
- Canada Shale
- Haynesville
- Other US shale

■ Associated gas¹

- Niobrara
- SCOOP/STACK
- Eagle Ford
- Permian
- Other associated gas

■ Other

- Conventional²
- Tight and CBM

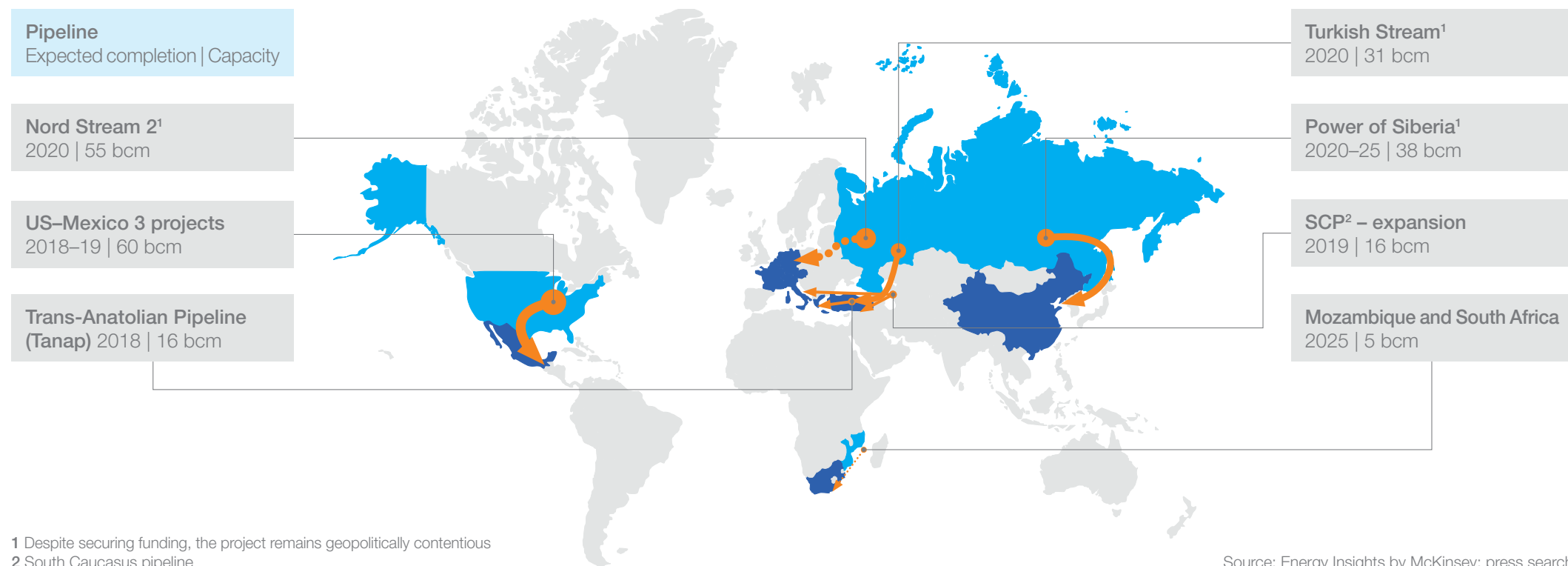


¹ Including conventional and unconventional ² Including conventional gas basins, Alaska, and offshore
Source: Energy Insights by McKinsey

D Pipeline projects proposed to add more than 200 bcm of cross-border capacity by 2025, with Russia and the US retaining their positions as major piped gas exporters

Cross-border pipeline projects expected to come online by 2023

■ Importing country ■ Exporting country — Gas flow

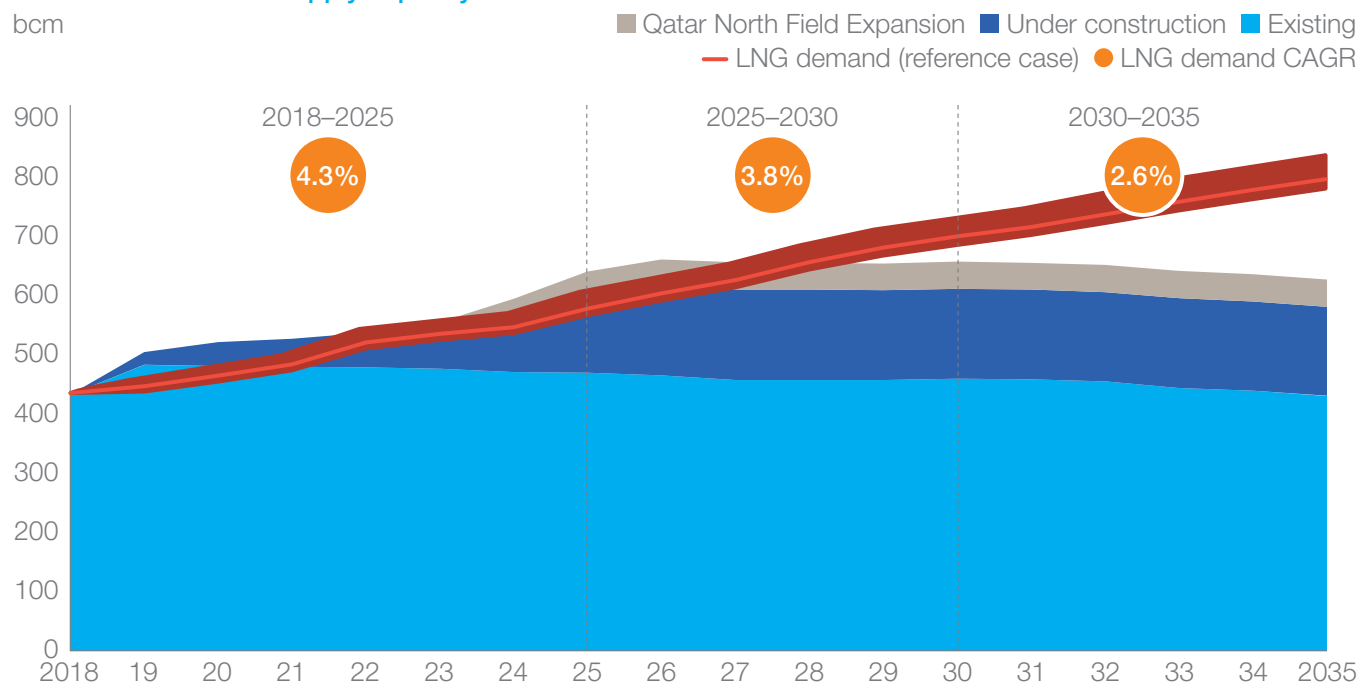


Source: Energy Insights by McKinsey; press search

D Given record-high LNG project FIDs, we see market rebalancing in late 2020s; given strong demand growth a supply gap of 200-220bcm will open by 2035

- Our updated supply-demand balance reflects two key changes since previous reports:
 - Supply from existing and under-construction facilities will peak around 2026 and then remain largely flat
 - LNG demand growth will increase significantly at 4.3% p.a. over the next five years driven by Asia and then slow-down gradually driven by new pipeline additions and lower growth in gas demand
- Temporary market tightness may emerge with seasonal demand surges, high demand response to low spot LNG prices or unexpected supply disruptions

Global LNG available supply capacity and demand to 2035^{1,2}



¹ Qatar LNG expansion project (formally still pre-FID)

² Existing supply increases in 2019 as we assume 90% availability from year two onwards of recently-commissioned plant versus 50% in year one

Source: Energy Insights by McKinsey, Energy Insights Gas Intelligence Model, IHS Vantage

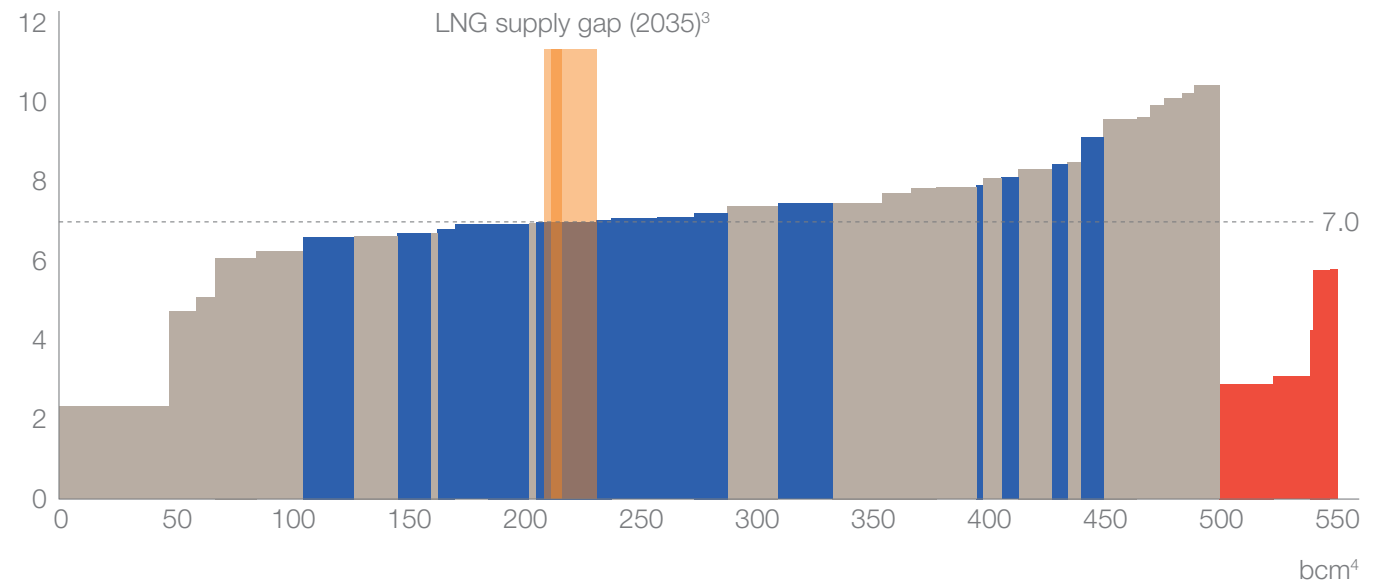
D The long-term market clearing price for LNG is expected to be ~\$7/MMBtu reflecting full cost of supply from US projects

- Latest project economics indicate a substantial amount of pre-FID projects below \$7/MMBtu (DES Asia), in particular from Qatar, Iran, and Russia
- However around 50 bcm of low cost projects face major roadblocks that make FID unlikely
- Accordingly, the large block of US projects is expected to be the marginal supply

LNG cost curve of the future (LCF)¹

DES to Asia, full cycle cost²

\$/MMBtu



¹ Includes only pre-FID projects selected in the funneling process ² CAPEX costs included

³ Global LNG supply gap (ref case +/- 5%), based on expected demand minus available post-FID and existing LNG capacity in 2035

⁴ Effective sendout capacity (nameplate capacity x 50% in 1st year of operations and 95% thereafter)

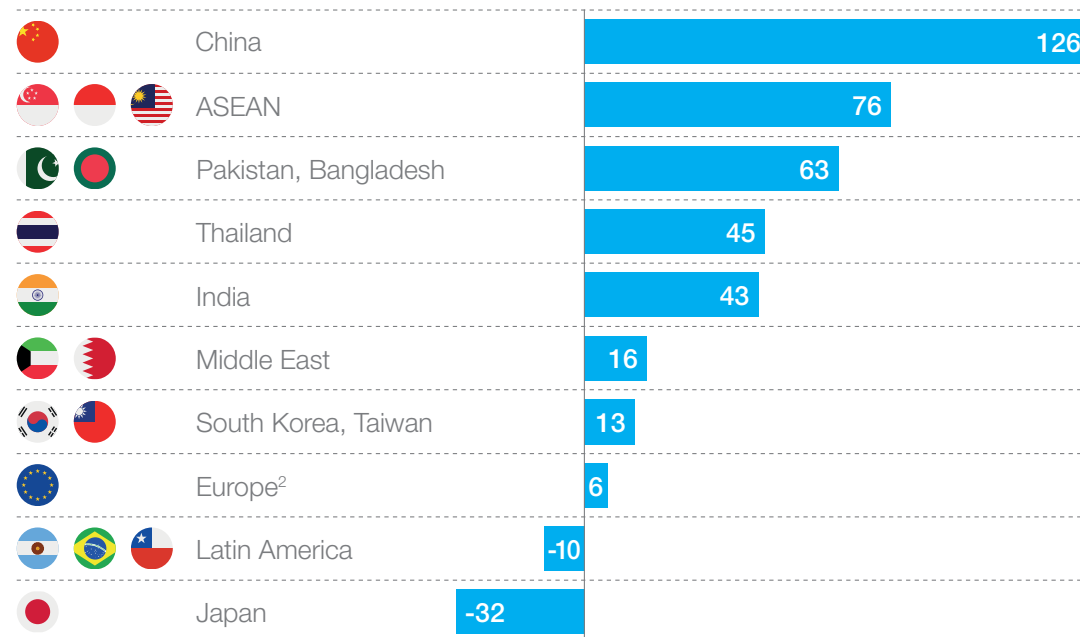
Source: Energy Insights Gas Intelligence Model, LNG Cost Curve of the Present by Energy Insights

D By 2035, new LNG demand growth is expected to come primarily from China, ASEAN, and South Asia

- China is expected to experience the largest growth in LNG imports between 2018 and 2035 adding 126 bcm
- South Asia and South East Asia will be relevant LNG demand growth centers amid declining local supply and strong demand profile
- Japan will show an almost 32 bcm LNG decline between 2018 and 2035 amid growing competition from other fuels (mainly the power sector) and improving energy efficiency

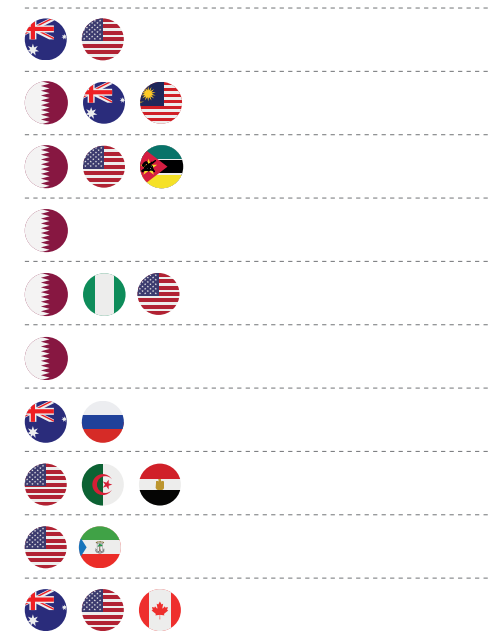
Key changes in LNG imports over 2018-35

bcm



Top LNG suppliers per country/region¹

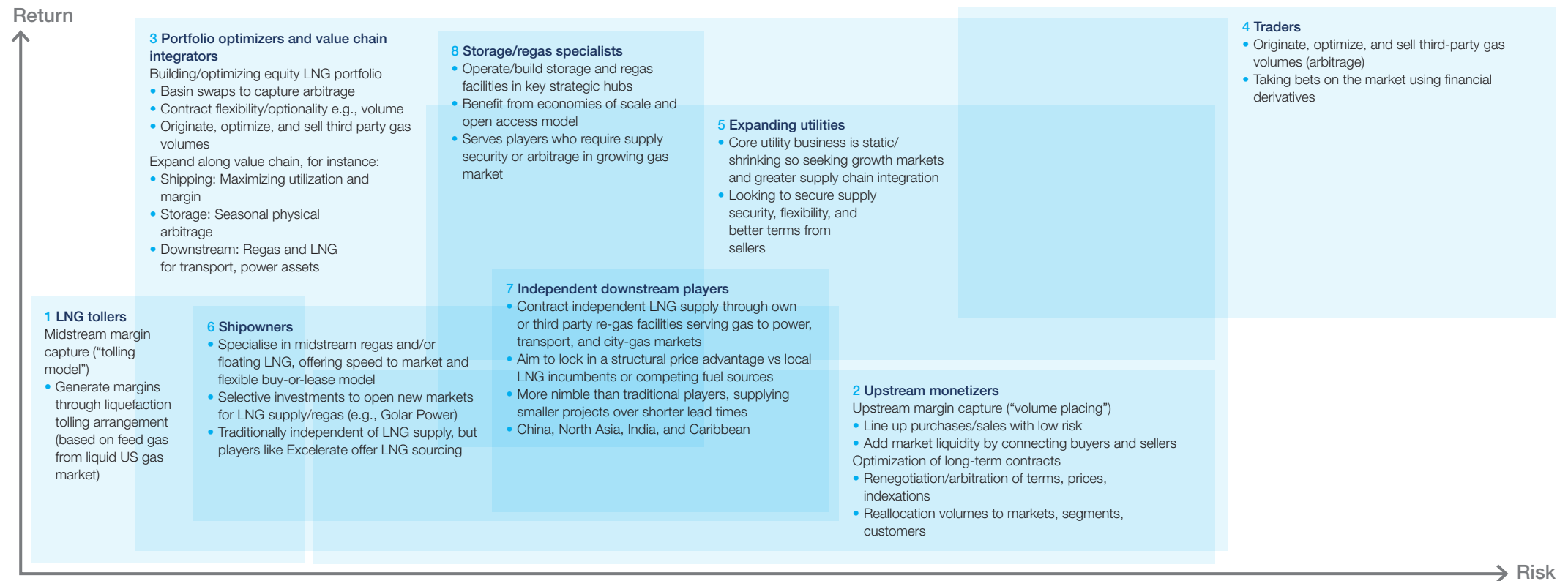
2035



¹ Suppliers which in aggregate supply more than 75% of LNG volumes ² Including Iberia

Source: Energy Insights by McKinsey, Energy Insights Gas Intelligence Model

A wide spectrum of LNG business models is emerging with increased competition between producers, portfolio players, traders, and utilities



Source: Expert interviews; team analysis

Emerging themes and key decisions: LNG marketers and buyers face distinct choices about how to respond

Emerging themes

Gas price

Global LNG price indicators have converged and differentials between US, Europe, and Asia are smallest in more than a decade. *Will we see sustained LNG prices below \$6/MMBtu in the future?*

Market liberalization

Asia now leads the next wave of market liberalization. *What learnings from US and Europe can be applied to Asian markets?*

Contract pricing outlook

Long-term contract pricing mechanisms are evolving as buyer preferences change and new supplies become available. *How will the gas/LNG contract pricing mechanism evolve in different geographies?*

CAPEX investment

LNG demand is expected to increase 3.6% p.a. from 2018 to 2035. *Which parts of the LNG value chain and which geographies will require the most investment?*

Changing business models

Market changes pose significant challenges for traditional LNG business models. *What new business models are required to compete in future market conditions?*

Distinct choices

LNG marketers

Become a low-cost LNG supplier

- Deliver upstream operations excellence
- Limit investments in trading, optimization, risk management
- Be a “price taker” for LNG sales

Become a flexible portfolio optimizer

- Ensure portfolio scale and diversity
- Build trading, optimization, and risk capabilities
- Integrate across value chain
- Offer structured pricing and flexibility to third parties

Protect margin

- Focus on retaining “sticky” customers
- Build customer loyalty through improved experience and value added services
- Renegotiate legacy contracts to maintain margins

LNG buyers

Protect market share

- Compete aggressively with new entrants on price
- Access new markets to offset loss of share in core
- Shift to short-term/spot-priced supply (or lowest source of supply)



About us

We are a global market intelligence and analytics group focused on the energy sector. We enable organizations to make well-informed strategic, tactical, and operational decisions, using an integrated suite of market models, proprietary industry data, and a global network of industry experts. We work with leading companies across the entire energy value chain to help them manage risk, optimize their organizations, and improve performance.

For more information about our global gas perspectives, please contact:
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www.mckinsey.com/gasoutlook

Methodology

The global gas & LNG outlook provides projections of the key trends in the global gas market through 2035. These projections represent a reference case of the future market developed by specialists at Energy Insights with input from the experts and practitioners of McKinsey & Company's Global Oil & Gas Practice. The projections are not statements of what will happen but are the result of the modeling simulations of the integrated gas market system, based on a set of specific assumptions derived from the current legal, technological, and demographic trends.

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