

The State of the Industry Global Gas Report 2019



INTERNATIONAL ENERGY FORUM

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Lecture Series 8 January 2020

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Global Gas Headline Trends in 2018





Note: All data points except gas price reflect 2018 annual change; 1. Calculated as Q1 2019 average less Q1 2018 average - average of Henry Hub, NBP, and NE Asia spot Source: IGU, Cedigaz, Bloomberg, Argus, EIA, GIIGNL, BCG analysis



| y recent developments in global gas | | | | Trade – Region average | | |
|-------------------------------------|-------------|--|------------|------------------------|---------|--|
| Region | Consumption | Gas price ¹ | Production | Imports | Exports | Infrastructure |
| Africa | 5.3% | | 4.5% | •31.8% | -2.3% | Nozambique and Tortue LNG FIDs |
| Asia | 7.3% | -\$4.9/MMBtu (NEA spot) | 3.5% | 12.9% | 5.4% | Regional LNG liquefaction & regas expansion; power of Siberia pipeline |
| CIS | 2.0% | | 4.7% | -5.8% | 9.3% | Russian LNG & pipeline capacity expansions |
| Europe | 1.0% | \$1.9/MMBtu (NBP) | -5.3% | 1.2% | -9.9% | Trans-Anatolian pipeline completed |
| Latin America | -2.9% | - | •1.7% | e -0.2% | 5.3% | No key developments |
| Middle East | 3.6% | - | 4.7% | -6.4% | 3.1% | Growing LNG export capacity |
| North America | 8.8% | •\$0.2/MMBtu (Henry Hub) | 9.8% | -1.9% | 12.8% | Pipeline and LNG export capacity growing |

Key recent developments in global gas

Note: All data points except gas price reflect 2018 annual change. 1 Calculated as Q1 2019 average less Q1 2018 average. Source: IGU, Cedigaz, Bloomberg, Argus, EIA, GIIGNL, BCG analysis.





Oil, Gas and Coal prices in major reference markets (2016-Q1 2019)





1. US coal price is Central Appalachia price, 2. Rotterdam index, 3. Australia coal Source: World Bank, Bloomberg, EIA, Argus, BCG analysis

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Average Levelized Cost of Energy of gas vs. coal (2018-2019)





Source: BNEF, Lazard, UT Austin, BCG analysis

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Global gas trade by year



Source: Cedigaz, BCG analysis.











2018 regional gas supply by source

% of total consumption

Source: Cedigaz, GIIGNL, BCG analysis.

Top LNG & inter-regional pipeline supply source

_

| | EUROP | E | ASIA PACIF | FIC |
|-----------------|----------|-----|--------------|-----|
| | EXPORTER | BCM | EXPORTER | BCM |
| LNG SUPPLY | Qatar | 19 | Australia | 90 |
| | Algeria | 8 | Qatar | 77 |
| <u>Trees</u> | Nigeria | 10 | Malaysia | 34 |
| | Russia | 6 | Indonesia | 25 |
| | Norway | 5 | Russia | 17 |
| | Other | 11 | Other | 79 |
| | Total | 59 | Total | 322 |
| INTER-REGIONAL | Russia | 174 | Turkmenistan | 41 |
| PIPELINE SUPPLY | Algeria | 35 | Uzbekistan | 4 |
| <u></u> | Libya | 5 | Kazakhstan | 1 |
| () | Total | 214 | Total | 46 |





International natural gas infrastructure capacity additions

Major 2018 natural gas infrastructure completions



| | Geography | Project | Capacity (BCM) |
|------------------------|--|---|---|
| Pipeline Expansions | US - Mexico US - Mexico US - Canada | Rio Bravo Hidalgo KM Border Portland Xpress | 4 2 <1 |
| New Pipelines | CIS - Turkey US - Mexico US -Canada | Trans-Anatonian Impulsora Xing SSA | 16 11 <1 |
| LNG Lique- faction | Russia Australia US Australia Cameroon | Yamal Icthys Cove Point Wheatstone T2 Cameroon FLNG | 15 12 7 6 2 |
| LNG Regas | China Japan Turkey India Thailand Bangladesh Greece Panama Sweden Finland | 6 onshore, 1 FSRU Soma Dortyol Mundra Mab Ta Phut Moheshkhali FSRU Revithoussa Costa Norte Gothenburg Tornio Manga | 24 12 8 7 7 5 2 2 2 <1 <1 |



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2. Key elements in the growth of gas





% 100 21.3 21.9 21.9 22.7 Coal 0il 0 2010 21.4 21.9 22.7 Coal 0il

Historic global primary energy demand mix

Forecasts of 2040 primary energy demand mix





1. New Policy Scenario 2. Evolving Transition 3. Sustainable Development Scenario 4. Rapid Transition Source: IEA, BP, EIA, Shell, Resources for the Future Global Energy Outlook, BCG analysis



Natural gas total technically recoverable resources by region (TCM)



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1. Calculated as total technical recoverable resources divided by 2018 region consumption Source: EIA, BCG analysis

Distribution of gas reserves <\$3/MMBtu average breakeven cost

100 2/3 total low cost 18 94 reserves Q 11 50 15 21 0 Algeria All other SD Russia Qatar China Australia Iran Canada Total Saudi Arabia Turkmenistan

Natural gas reserves <\$3/MMBtu breakeven (TCM)

Commercialization of <\$3/MMBtu reserves by region





1. Low cost defined as gas fields with an estimated break even of less than \$3 per mmbtu; Note: Gas fields with less than 1 MMBOE reserves excluded from analysis Source: Rystad, BCG analysis



Required investment to achieve natural gas market growth projections





Sustainability-focused policies in select markets



China: Mandated coal to gas switching to improve local air quality



South Korea: Reduction in coal and nuclear power generation



Saudi Arabia: Phase out of oil products used in power generation



United Kingdom: Carbon price floor driving coal out of power generation



India: Expansion of city gas distribution to improve air quality





<u>Global biomethane</u> capacity (2015-2019E)

<u>Global low carbon hydrogen</u> capacity¹ (2015-2019E) Global CCUS capacity (2015-2019E)



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3. Noticeable developments in the regions







1. 45Q tax range based on value of CO₂ avoided assuming 90% plant efficiency; assumes average of \$15/t transport and storage costs for sequestration.

Source: BCG - estimates sourced from published academic and research papers, excluding industry sources, all costs normalised to USD 2019. Cost/tonne avoided includes the emissions from power used from the grid.



1 Defined as projects using electrolysis or fossil fuel based hydrogen paired with carbon capture. Source: Cedigaz, IEA, Global CCS Institute, BCG analysis.





European countries by coal policy



Adopted coal phase out policy
Considering coal phase out policy

No coal phase out policy or negligible coal consumption

1. Assumes current operational coal power capacity operates at 60% utilization. Source: Beyond Coal EU; BCG analysis.



Maximum potential coal to gas power switching¹

Maximum potential gas demand growth (bcm)



 Assumes current operational coal power capacity operates at 60% utilization.
 Source: Beyond Coal EU; BCG analysis.



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Italy – NG Vehicles



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France – Bio Methane



Greece – LNG Bunkering Hub







4. Conclusion

- Governments and industry need to make gas more cost competitive with other fuels on the perspective of Energy Security, Substanability.

- Investment in gas infrastructure will be critical to sustaining growth in access to gas while also preparing for future energy transitions.

- To maximize the sustainability benefits of gas, the industry must continue to act to verifiably reduce methane emissions while governments implement new policies





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Thanks شکراً

Shukran



