The State of the Industry
Global Gas Report 2019

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President, International Gas Union (IGU)

Lecture Series
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Contents

1. Recent performances in the global gas market

2. Key elements in the growth of gas

3. Noticeable developments in the region

4. Conclusion
Global Gas Headline Trends in 2018

- **Global production & consumption growth:** +4.9%
- **Change in average gas price at key global hubs**\(^1\): -$2.1/MMBtu
- **International pipeline & LNG trade growth:** +4.1%
- **Gas import & export capacity growth:** +143 BCMA

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
<table>
<thead>
<tr>
<th>Region</th>
<th>Consumption</th>
<th>Gas price ¹</th>
<th>Production</th>
<th>Trade - Region average Imports</th>
<th>Exports</th>
<th>Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>5.3%</td>
<td>-</td>
<td>4.5%</td>
<td>-31.8%</td>
<td>-2.3%</td>
<td>Mozambique and Tortue LNG FIDs</td>
</tr>
<tr>
<td>Asia</td>
<td>7.3%</td>
<td>-4.9/MMBtu (NEA spot)</td>
<td>3.5%</td>
<td>12.9%</td>
<td>5.4%</td>
<td>Regional LNG liquefaction &amp; regas expansion; power of Siberia pipeline</td>
</tr>
<tr>
<td>CIS</td>
<td>2.0%</td>
<td>-</td>
<td>4.7%</td>
<td>-5.8%</td>
<td>9.3%</td>
<td>Russian LNG &amp; pipeline capacity expansions</td>
</tr>
<tr>
<td>Europe</td>
<td>1.0%</td>
<td>-1.9/MMBtu (NBP)</td>
<td>-5.3%</td>
<td>1.2%</td>
<td>-9.9%</td>
<td>Trans-Anatolian pipeline completed</td>
</tr>
<tr>
<td>Latin America</td>
<td>-2.9%</td>
<td>-</td>
<td>-1.7%</td>
<td>-0.2%</td>
<td>5.3%</td>
<td>No key developments</td>
</tr>
<tr>
<td>Middle East</td>
<td>3.6%</td>
<td>-</td>
<td>4.7%</td>
<td>-6.4%</td>
<td>3.1%</td>
<td>Growing LNG export capacity</td>
</tr>
<tr>
<td>North America</td>
<td>8.8%</td>
<td>-0.2/MMBtu (Henry Hub)</td>
<td>9.8%</td>
<td>-1.9%</td>
<td>12.8%</td>
<td>Pipeline and LNG export capacity growing</td>
</tr>
</tbody>
</table>

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

North America

Europe

Asia

1. US coal price is Central Appalachia price, 2. Rotterdam index, 3. Australia coal
Source: World Bank, Bloomberg, EIA, Argus, BCG analysis
Average Levelized Cost of Energy of gas vs. coal (2018-2019)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>$89 MWh</td>
<td>-29%</td>
</tr>
<tr>
<td>South Korea</td>
<td>$63 MWh</td>
<td>-32%</td>
</tr>
<tr>
<td>China</td>
<td>$100 MWh</td>
<td>-26%</td>
</tr>
<tr>
<td>Germany</td>
<td>$90 MWh</td>
<td>-20%</td>
</tr>
<tr>
<td>UK</td>
<td>$218 MWh</td>
<td>-19%</td>
</tr>
</tbody>
</table>

Source: BNEF, Lazard, UT Austin, BCG analysis
Global gas trade by year

2018 annual change in net exports

Source: Cedigaz, BCG analysis.
2018 regional gas supply by source

Top LNG & inter-regional pipeline supply source
International natural gas infrastructure capacity additions

Major 2018 natural gas infrastructure completions

<table>
<thead>
<tr>
<th>Geography</th>
<th>Project</th>
<th>Capacity (BCM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>US - Mexico</td>
<td>Rio Bravo Hidalgo</td>
<td>4</td>
</tr>
<tr>
<td>US - Mexico</td>
<td>KM Border</td>
<td>2</td>
</tr>
<tr>
<td>US - Canada</td>
<td>Portland Xpress</td>
<td>&lt;1</td>
</tr>
<tr>
<td>CIS - Turkey</td>
<td>Trans-Anatolian</td>
<td>16</td>
</tr>
<tr>
<td>US - Mexico</td>
<td>Impulsora Xing</td>
<td>11</td>
</tr>
<tr>
<td>US - Canada</td>
<td>SSA</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Russia</td>
<td>Yamal</td>
<td>15</td>
</tr>
<tr>
<td>Australia</td>
<td>Ichthys</td>
<td>12</td>
</tr>
<tr>
<td>US</td>
<td>Cove Point</td>
<td>7</td>
</tr>
<tr>
<td>Australia</td>
<td>Wheatstone T2</td>
<td>6</td>
</tr>
<tr>
<td>Cameroon</td>
<td>Cameroon FLNG</td>
<td>2</td>
</tr>
<tr>
<td>China</td>
<td>6 onshore, 1 FSRU</td>
<td>24</td>
</tr>
<tr>
<td>Japan</td>
<td>Soma</td>
<td>12</td>
</tr>
<tr>
<td>Turkey</td>
<td>Dortyol</td>
<td>8</td>
</tr>
<tr>
<td>India</td>
<td>Mundra</td>
<td>7</td>
</tr>
<tr>
<td>Thailand</td>
<td>Mab Ta Phut</td>
<td>7</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>Moheshkali FSRU</td>
<td>5</td>
</tr>
<tr>
<td>Greece</td>
<td>Revithoussa</td>
<td>2</td>
</tr>
<tr>
<td>Panama</td>
<td>Costa Norte</td>
<td>2</td>
</tr>
<tr>
<td>Sweden</td>
<td>Gothenburg</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Finland</td>
<td>Tornio Manga</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>
2. Key elements in the growth of gas
Historic global primary energy demand mix

2010: 21.3\% Coal, 22.7\% Gas, 50\% Renewables, 100\% Total

2014: 21.9\% Coal, 22.7\% Gas, 50\% Renewables, 100\% Total

2018: 22.7\% Coal, 22.7\% Gas, 50\% Renewables, 100\% Total

Forecasts of 2040 primary energy demand mix

21.9\% Coal, 22.7\% Gas, 50\% Renewables, 100\% Total

Source: IEA, BP, EIA, Shell, Resources for the Future Global Energy Outlook, BCG analysis
Natural gas total technically recoverable resources by region (TCM)

1. Calculated as total technical recoverable resources divided by 2018 region consumption.

Source: EIA, BCG analysis.

118
648
World

122
118
North America

127
214
Middle East

218
CIS

47
Europe

506
Africa

77
214
Asia Pacific

70
117
Latin America

443

123

95

134

118
Unconventional

Conventional

# of years of technically recoverable resources
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

- **Upstream**: Low - 240, High - 260
- **LNG liquefaction**: Low - 30, High - 40
- **Mid/downstream**: Low - 130, High - 150
- **Gas power gen**: Low - 40, High - 50
- **Total**: Low - 440, High - 500

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

Source: Cedigaz, BCG analysis
1. Defined as projects using electrolysis or fossil fuel based hydrogen paired with carbon capture
Source: Cedigaz, IEA, Global CCS Institute, BCG analysis
3. Noticeable developments in the regions
**Estimated CCUS cost ranges per sector**

<table>
<thead>
<tr>
<th>Sector</th>
<th>45Q tax credit range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron &amp; Steel</td>
<td>0-50</td>
</tr>
<tr>
<td>Aluminium</td>
<td>50-100</td>
</tr>
<tr>
<td>NGL</td>
<td>100-150</td>
</tr>
<tr>
<td>Refining</td>
<td>150-200</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>200-250</td>
</tr>
<tr>
<td>Cement</td>
<td>250-300</td>
</tr>
<tr>
<td>Petchem</td>
<td>300-350</td>
</tr>
<tr>
<td>Ammonia</td>
<td>350-400</td>
</tr>
<tr>
<td>Biomass-to-Biofuel</td>
<td>400-450</td>
</tr>
<tr>
<td>Natural gas processing</td>
<td>450-500</td>
</tr>
</tbody>
</table>

$ per ton of CO₂ avoided

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: BCC – estimates sourced from published academic and research papers, excluding industry sources, all costs normalised to USD 2016.

**Global biomethane capacity (2015-2019E)**

- 2015: 3.0
- 2016: 3.4
- 2017: 3.8
- 2018: 4.5
- 2019E: 5.0

**Global low carbon hydrogen capacity**

- 2015: 4.5
- 2016: 5.6
- 2017: 4.4
- 2018: 4.5
- 2019E: 6.2

**Global CCUS capacity (2015-2019E)**

- 2015: 32
- 2016: 34
- 2017: 36
- 2018: 37
- 2019E: 43

1. Defined as projects using electrolysis or fossil fuel based hydrogen paired with carbon capture.

Source: Cinga, IEA, Global CCS Institute, BCC analysis.
European countries by coal policy

Maximum potential coal to gas power switching¹

Maximum potential gas demand growth (bcm)

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

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

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

- 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.
28th World Gas Conference - Where Culture & Energy Meet

VISIT WGC2021.ORG

12,000 PARTICIPANTS
350 EXHIBITORS
500 SPEAKERS
Thanks

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Shukran