Gas Grows Up
Part 1: Developing New Sources of LNG Demand
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Executive Summary

Wind the clock back five years and leading industry commentators were hailing the golden age of gas. The IEA’s 2011 World Energy Outlook introduced “the Gas scenario”, foreseeing more than 50 per cent growth in demand by 2035. Estimates from the World Energy Council and International Gas Union indicated that the natural gas share of primary energy supply would grow to ~25 per cent in 2030.¹

However, as illustrated in Figure 1, natural gas supply growth is not located in the highest demand areas. Up to now, a common view was that growth in Liquified Natural Gas (LNG) trade flows would be primarily driven by Asia. This expectation led producers in Australia, the Middle East, Africa, and North America to make large investments to bring their LNG supplies to Asia.

In Australia alone more than $250 billion has been invested since 2009 in what will soon be the world’s largest, most modern and technologically advanced LNG industry.² Just as many operators around the world are beginning to transition their newly built, state-of-the-art assets into the operations phase, it seems the future may not be as bright as first anticipated.

Today, demand in the largest markets for LNG is uncertain just as new independent US exporters such as Cheniere Energy are appearing and many long-term gas contracts in Asia are expiring. With access to flexible U.S. shale gas supply (compared to the long position of vertically integrated gas producers), these new players will disrupt the global trading of LNG.

Accenture’s Energy industry group is conducting research into the drivers reshaping the LNG market and the implications as it enters a new stage of maturity. This paper, the first in a series entitled Gas Grows Up, examines the increasing uncertainty of LNG demand in some of LNG’s traditional markets as well as the opportunity in new geographies. It outlines the implications for producers and marketers of LNG and sets out the critical actions needed to increase their competitiveness in today’s volatile markets.

Figure 1: Global Supply and Demand for Natural Gas 2014–2040

Increasing competitiveness in a buyers' market

The future for LNG at least for the next 5–10 years, looks set to be a buyers' market, with spot LNG prices, particularly in Asia, lower than over the past few years. Demand for LNG will look very different, with more countries and customers consuming LNG rather than the domination of several very large demand countries and customers we see today. As supply exceeds demand, there could be an exponential increase in the number of customers as suppliers look for new markets beyond the traditional countries and large utilities.

Today, three countries, China, Korea and Japan, make up approximately 60 per cent of global LNG imports. For different reasons, LNG demand in all three countries could be less than expected. In Japan, government policies are targeting energy efficiency and the restarting of nuclear power plants after the Fukushima plant was destroyed by a tsunami in 2011. Recent announcements by Japan’s Ministry of Economy, Trade and Industry (METI) indicate that Japanese natural gas consumption could settle at 84 bcm by 2030. This is almost 32 per cent less than the LNG imported in 2014 (123 bcm). (Note: Both Japan and South Korea import virtually all of their natural gas in the form of LNG, so natural gas estimates in both countries can be used as proxy for LNG demand.) In South Korea, the decline in natural gas demand is related to the relative cost of LNG compared with higher efficiency, lower cost coal, nuclear, and renewable energy. For example, in 2015 the use of natural gas for power generation continued to decline in South Korea due to increasing use of nuclear, coal and renewables. By the end of 2015, South Korea’s total LNG demand is expected to show a continued decline in natural gas consumption. In China, LNG imports could decline in favor of domestic conventional and unconventional natural gas production, imports of pipeline gas (105 bcm of imported pipeline capacity is scheduled to be online by 2018), and increased use of fuel oil.

India is currently the fourth-largest importer of LNG globally. It imported 20 bcm (15 mt) in 2014, but the government forecasts demand will almost triple to ~52 bcm by 2020. However, natural gas use has been declining over the last four years due to the country’s inability to expand its domestic natural gas production, lack of midstream infrastructure, and the cost of natural gas relative to other primary energy sources. India has almost 60 MMTPA capacity of LNG regasification and floating storage projects (FSRUs) planned for 2018–2020 and three to four pipeline import projects planned. In total, the capacity of these projects could be nearly five times India’s total LNG imports in 2014. However, it is unlikely that all of these projects will go ahead and total LNG demand is likely to be lower than current forecasts.

More than 30 countries now have infrastructure to import LNG, with new countries such as Lithuania, Jordan, Egypt and Pakistan added in 2014 and 2015. As demand falls in Japan, South Korea and China, the customer base elsewhere may grow beyond the traditional large utilities, even in existing LNG import markets. This new demand is already evident as some utilities that over-contracted sell their excess supply. South Korea’s Kogas has sold on some of its committed US LNG capacity to Total and China’s Sinopec is also looking to sell some of its contracted LNG capacity and may set up a trading desk in Singapore.

Producers and marketers need to act now to increase their competitiveness in a market where supply will exceed demand, where markets are more global (we are already seeing the influence of Henry Hub contract structures and pricing) and where customers are geographically diverse and numerous. They will succeed if they can bring LNG to the market in a cost-competitive way, optimize their contract and asset portfolios, encourage new applications for natural gas, and are agile enough to take advantage of the next opportunities.
There are six core implications for producers and marketers of LNG:

1. Protect market share in Japan, South Korea, China and India
2. Diversify to other markets and smaller customers
3. Prepare for a very different competitive landscape with non-traditional players exporting and trading U.S. LNG
4. Build flexibility in contract portfolios through trading and midstream
5. Invest in science, technology, and engineering for small scale LNG and new applications
6. Drive down the costs of delivered LNG

It looks like the global gas market is here, accelerated by unexpected circumstances, U.S. LNG supply, resulting in a market where supply will exceed demand for the near future; historical barriers to entry (i.e., access to supply and infrastructure) are removed, and the entry of non-traditional players and traders is much easier. Producers and marketers who embrace the six core implications will have a stronger chance of survival in this competitive new age of uncertainty. This report, the first in our Gas Grows Up series, examines the uncertainty of LNG demand of the largest LNG importing countries and the opportunity and challenges that come with new customers in new geographies who are smaller and more diverse.
Facing facts: LNG demand in the Largest Markets is Uncertain

Three countries (China, South Korea and Japan) made up approximately 60 per cent of global LNG imports in 2014, but these markets could account for much less than 60 per cent in the future. The use of LNG for power generation is challenged with coal proving resilient, more nuclear, the costs of renewables falling, and planned pipeline gas imports into China.⁷

LNG makes up about 10 per cent of the current total natural gas market demand, with about 241 mt (332 bcm).⁸ China, South Korea and Japan approximately 60 per cent of global LNG imports in 2014.⁹ Forecasts from the oil and gas companies BG Group and BP indicate that the LNG market will grow to ~500 mt (~680 bcm) by 2030 and will represent 16 per cent of the global natural gas market demand by 2030.

Accenture’s analysis of the future LNG demand in Japan, South Korea and China indicates that these markets could account for much less than 60 per cent of LNG demand in the future. The use of LNG for power generation, in particular, is challenged with coal proving resilient and super critical higher efficiency plants under construction. Nuclear power generation is starting to increase, the costs of renewables is falling, and China is also planning pipeline gas imports. For example, China has some of the most efficient coal plants in the world, reaching 45 per cent efficiency compared to the global average efficiency of 33 per cent. Both Japan and South Korea also have new higher efficiency coal plants under construction.¹⁰

Figure 2: Global LNG Demand: Largest Importers (and Other) 2014 and 2030 Global Estimates (mt)

<table>
<thead>
<tr>
<th>Year</th>
<th>China</th>
<th>Japan</th>
<th>South Korea</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>20</td>
<td>89</td>
<td>38</td>
<td>99</td>
</tr>
<tr>
<td>2030</td>
<td>241</td>
<td></td>
<td></td>
<td>-500</td>
</tr>
</tbody>
</table>

Recently announcements by the Japanese Ministry of Economics, Trade and Industry (METI) indicate that Japanese natural gas consumption will continue to decline past 2020 and settle at 84 bcm by 2030. This is 32 per cent less than the 123 bcm of LNG imported by Japan in 2014.11
The IEA estimated in its 2014 World Energy Outlook that under its Current Policies Scenario, natural gas demand in Japan would decline to 90 bcm by 2020 from 127 bcm in 2012 and rebound slightly to 106 bcm by 2030. In its New Policies Scenario, the IEA estimated natural gas demand would be 90 bcm in 2020, reaching 92 bcm in 2030.

However, recent announcements by the Japanese Ministry of Economy, Trade and Industry (METI) indicate that the country’s natural gas consumption will continue to decline past 2020 and settle at 84 bcm by 2030 (~10 per cent below the IEA New Policies Scenario), unless there is a breakthrough in transportation or other potential new demand sources. This is 32 per cent less than the 123 bcm (89 mt) of LNG imported in 2014 and largely the result of continued increases in energy efficiency and the restarting of its nuclear power stations.

The Institute of Energy Economics in Japan (IEEJ) published its primary energy and electricity mix supply structure in July 2015. In analysis of the primary energy supply/demand structure in 2030, energy conservation reduces demand to below 2013 levels and self-sufficiency of energy supply through nuclear and renewables increases to 24 per cent from six per cent in 2013. The share of natural gas in the primary energy mix falls to 18 per cent.

In the electricity sector, energy conservation significantly mitigates growth. The share of natural gas in power generation falls to 27 per cent as the share of renewables increases to 24 per cent. If these estimates are realized, demand for natural gas would be similar in the make-up of Japan’s primary energy mix as before the Fukushima accident.

The restarting of nuclear power generation may affect LNG exports as early as 2016. The IEEJ developed a number of scenarios on the impact of the restarts. In the IEEJ’s Reference Scenario, LNG imports in 2016 are estimated to fall to 83 mt (113 bcm) after the first commercial operation resumed in 2015 and three to five plants were scheduled to restart every six months from then. In the scenario where with the most (24) plants under assessment coming on stream and generating electricity with a capacity factor of 80 per cent, LNG imports to Japan in 2016 could fall to 76 mt (103 bcm).

Figure 3: Energy supply/demand structure in 2030—Primary energy

- While energy demand growth is projected in line with economic growth (an average 1.7 per cent) energy efficiency is expected to improve through energy conservation (35 per cent in 20 years)
- Energy supply/demand structure improvement (energy self-efficiency rate: 6 per cent in 2014–24.3 per cent in 2030)
- Energy-related CO2 emissions: down 21.9 per cent from 2013

Through energy conservation (electricity savings) and the maximum renewable energy diffusion will cover about 40 per cent of electricity demand, reducing the dependence on nuclear power generation substantially (from 29 per cent before the 3/11 disaster to 20–22 per cent).

- Base load share: 56 per cent (63 per cent before the 3/11 disaster)
- Electricity costs to decline by 2–5 per cent from the present level

Figure 5: Impact of restart of nuclear reactors on the Japanese economy

### (IEEJ estimate)

<table>
<thead>
<tr>
<th></th>
<th>FY2010</th>
<th>FY2016</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low Case</td>
<td>Reference Scenario</td>
</tr>
<tr>
<td>Cumulative number of (FY2015)</td>
<td>-</td>
<td>[2]</td>
</tr>
<tr>
<td>Restarted nuclear reactors FY2016</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Average period for operation (months)</td>
<td>-</td>
<td>8</td>
</tr>
<tr>
<td>Electricity generation by nuclear (TWh)</td>
<td>288.2</td>
<td>15.3</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th></th>
<th>FY2010</th>
<th>FY2016 (Changes from FY 2010)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low Case</td>
<td>Reference Scenario</td>
</tr>
<tr>
<td>Power generation cost (JPY/kWh)</td>
<td>(8.2)</td>
<td>+3.3</td>
</tr>
<tr>
<td>Total fossil fuel imports (JPY trillion)</td>
<td>18.1</td>
<td>+3.1</td>
</tr>
<tr>
<td>Oil</td>
<td>12.3</td>
<td>+1.2</td>
</tr>
<tr>
<td>LNG</td>
<td>3.5</td>
<td>+2.0</td>
</tr>
<tr>
<td>Trade balance (JPY trillion)</td>
<td>5.3</td>
<td>-9.2</td>
</tr>
<tr>
<td>Real GDP (JPY2005 trillion)</td>
<td>512.7</td>
<td>+32.1</td>
</tr>
<tr>
<td>Gross national income (JPY trillion)</td>
<td>493.8</td>
<td>+46.3</td>
</tr>
<tr>
<td>Primary energy supply</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil (GL)</td>
<td>232.3</td>
<td>-23.7</td>
</tr>
<tr>
<td>Natural gas (Mt of LNG equivalent)</td>
<td>73.3</td>
<td>+17.2</td>
</tr>
<tr>
<td>LNG imports (Mt)</td>
<td>70.6</td>
<td>+17.9</td>
</tr>
<tr>
<td>Self sufficiency rate</td>
<td>18.0%</td>
<td>-8.5p</td>
</tr>
<tr>
<td>Energy related C02 emissions (Mt)</td>
<td>1,139</td>
<td>+33</td>
</tr>
<tr>
<td>Changes from FY2013</td>
<td>(-7.8%)</td>
<td>(-5.1%)</td>
</tr>
</tbody>
</table>

1. 39 reactors operated at the end of 2010.
2. Power generation cost in FY2010 is for the general electric utilities, estimated based on their profit-and-loss statements.

### Reference Scenario

The first commercial operation resumes in late summer or early fall 2015. Restarts of three to five plans follow in every about six months.

### Low Case

The first restarts delay a bit compared with the Reference Scenario. The second group restarts about one year later.

### High Case

The first commercial operation resumes in late summer or early fall 2015. Then one plant restarts about a month on average thanks to more efficient assessment.

### Highest Case

A hypothetical case in which 24 applicant plants for the assessment generate electricity with 80 per cent of capacity factor.

Our view is that Japan is likely to succeed in its energy efficiency targets as it continues to lead the way in this area. The growth in renewables is aggressive, more than doubling to 23 per cent of the electricity mix. The reference scenario for nuclear restarting is also aggressive with 13 restarts in 2016. The low case for the start-up of nuclear is probably more likely. We believe Japan’s LNG demand will decline, but is unlikely to be as steep as 84 bcm by 2030.
South Korea

In 2014, South Korea consumed 38 mt of LNG, lower than the initial forecasts from the beginning of 2014. In 2015, South Korea's LNG demand continued to decline and now looks unlikely to grow before 2030.¹⁹
South Korea currently imports 97 per cent of its energy resources, therefore, it has been considerably exposed to both oil and LNG price volatility. Consequently, the South Korean government has placed a lot of effort and resources into energy planning to reduce dependency on imported oil and gas. During the high oil price period from 2009 to 2013, South Korea suffered from high energy costs and electricity shortages. During this period, the demand for LNG increased significantly due to the shortage of electricity. However, since 2014, the market situation has changed again and South Korea has enjoyed the benefits of lower oil prices and sufficient electricity supply.

In 2014, South Korea imported 38 mt LNG and was the second largest importer of LNG globally. The South Korean Energy and Economics Institute (KEEI) estimates that after strong natural gas consumption growth each year following 2009, natural gas consumption fell by 10 per cent in 2014.

In 2015, natural gas demand fell more than expected in South Korea. Use of natural gas in generation decreased in the first half of the year due to increasing use of nuclear or coal for generation. The usage of natural gas for industrial use also decreased, while for commercial and residential use it decreased slightly (by about 0.4 per cent). Across all sectors, South Korea’s use of LNG is expected to decline as part of total natural gas consumption.

This change in the outlook for natural gas demand is reflected in South Korea’s current National Gas Demand and Supply Plan, which was released in December 2015. The South Korean government now expects its total natural gas demand to fall by 5% over the next 15 years. This will be offset by some residential and industrial gas demand growth but will not offset the decline expected in gas demand for power generation (LNG accounted for just over 21 percent of South Korea’s power generation in 2014). South Korea’s Ministry of Trade, Industry and Energy’s (Motie) 12th long-term gas demand forecast shows South Korean natural gas consumption declining to 35 mt in 2029. According to Motie, South Korea’s natural gas imports fell more than nine percent to below 30 million tonnes in the first 11 months of 2015, with November gas imports down 34 per cent on the same period in 2014. Motie said in July that gas-based power generation is too costly compared with nuclear power, which reduces greenhouse gas emissions more efficiently than thermal fuels.

As illustrated in Figure 7, the primary challenge for natural gas in the South Korea energy market is the cost compared to other alternatives.

The generation cost of nuclear in South Korea has increased slightly due to safety issues. The generation cost of coal and diesel has decreased significantly due to low oil price. The spot prices of LNG in South Korea have decreased, however, not as much as coal and diesel, while the cost of solar has been continuously decreasing for the last five years.

Figure 6: Power Generation: South Korea Installed Capacity (GW) 2014–2029

![Power Generation: South Korea Installed Capacity (GW) 2014–2029](image)

Source: South Korea 7th master plan for the supply and demand of electricity power. The monthly report on major electric power statistics 2014.12, No.434
Structural changes in South Korea’s economy and energy mix have resulted in a sharp decline in demand for natural gas. The share of nuclear, coal and renewables in power generation have increased with nuclear and coal continuing to dominate base-load generation. There is also currently new nuclear and coal capacity under construction. Additionally, renewables are making steady progress. South Korea added almost one GW capacity of renewables in 2013 and again in 2014. New natural gas power plants also came online between 2009 to 2013, but utilization has so far been low. Therefore, no new power plants running on natural gas are expected to be built in the near future.

South Korea will be dependent on LNG imports for its natural gas demand as neither pipeline gas from Russia or domestic production are currently economic options.

Our view is that South Korea’s LNG demand will stay flat or slightly decline. The new nuclear and coal plants coming onstream, the increased emphasis on renewables, and the reduction in industrial activity as a result of both the low-oil price and slow-down in China has reduced demand at least in the short-term.

Figure 7: Generation costs by fuel type

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Cost/kwh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear Power</td>
<td>4</td>
</tr>
<tr>
<td>Solar Power</td>
<td>17</td>
</tr>
<tr>
<td>Coal Power</td>
<td>5</td>
</tr>
<tr>
<td>Wind Power</td>
<td>12</td>
</tr>
<tr>
<td>LNG Power</td>
<td>11</td>
</tr>
</tbody>
</table>

Source: Accenture Research
China remains the highest growth market globally for natural gas but not necessarily for LNG. In 2014, China imported 20 mt (27 bcm) of LNG. In 2014, natural gas demand was 5.5 per cent of primary energy mix (148 mt or ~200 bcm), ~70 per cent domestic, 16 per cent pipeline imports, 14 per cent LNG imports. Natural gas demand is expected to grow to ~eight per cent (222 mt or ~300 bcm) by 2020. However, the current plan is for a significant portion of this to be produced domestically, from conventional and unconventional sources, and to be transported via pipelines.
The Chinese government is also strongly encouraging the development of renewable energy, investing $83 billion in 2014 to diversify the energy mix and meet increasingly stringent environmental standards (particularly for air pollution). China exceeded its target for non-hydrocarbon energy generation in 2015, with renewables and nuclear generation targets set at 11.4 per cent share; 40GW nuclear generating capacity; 100GW wind generating capacity; and 21GW solar capacity. The latest estimates from the China Electricity Council (CEC) show 25 per cent of electricity was generated from non-fossil energy sources in 2014.27

China remains the highest growth market globally for natural gas but not necessarily for LNG. China imported 20 mt (27 bcm) of LNG28 in 2014 and natural gas demand was 5.5 per cent (0.2 billion tons standard coal/165.2 mtoe) and hydro, nuclear, wind and other renewables 11.3 per cent (0.5 billion tons of standard coal/338.8 mtoe). As indicated in the Communist Party’s 12th five-year plan, coal and renewables are expected to continue to dominate power generation with some natural gas. Natural gas use will be driven by industry and transportation.

Natural gas demand in China has grown substantially since the beginning of the century. The 12th five-year plan forecasts natural gas consumption as a percentage of the overall energy mix will increase to more than 10 per cent by 2020 (266 mt or ~360 bcm). The plan aims greater use in cities and for transportation and, to a lesser extent, for power generation to replace coal. However, natural gas was only 5.5 per cent of the overall energy mix at the end of 2014.

The construction of the Siberian pipeline (38 bcm) will also have a significant impact on how much LNG is imported. If all of the pipelines under construction in China through to 2018 are fully operational by 2020, LNG imports for the 2020 natural gas demand target of eight per cent, or 300 bcm, may remain at 2014 volumes or less, depending on domestic natural gas production.

China’s primary energy demand is estimated at ~35,000 TWh in 2015 and is expected to grow at a steady 1.76 per cent CAGR per year to ~39,000 TWh to 2020. This is significantly less than the 5.65 per cent CAGR per year for energy demand from 2010-2015.

China’s primary energy mix in 2014 was: coal 66 per cent (2.8 billion tons of standard coal/1,968 million tons of oil equivalent (mtoe)), oil 17.1 per cent (0.7 billion tons of standard coal/511.7 mtoe), natural gas 5.5 per cent (0.2 billion tons of standard coal/165.2 mtoe) and hydro, nuclear, wind and other renewables 11.3 per cent (0.5 billion tons of standard coal/338.8 mtoe).

As indicated in the Communist Party’s 12th five-year plan, coal and renewables are expected to continue to dominate power generation with some natural gas. Natural gas use will be driven by industry and transportation.

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The Chinese government is also strongly encouraging the development of renewable energy, investing $83 billion in 2014 to diversify the energy mix and meet increasingly stringent environmental standards (particularly for air pollution). China exceeded its target for non-hydrocarbon energy generation in 2015, with renewables and nuclear generation targets set at 11.4 per cent share; 40GW nuclear generating capacity; 100GW wind generating capacity; and 21GW solar capacity. The latest estimates from the China Electricity Council (CEC) show 25 per cent of electricity was generated from non-fossil energy sources in 2014.27

China remains the highest growth market globally for natural gas but not necessarily for LNG. China imported 20 mt (27 bcm) of LNG28 in 2014 and natural gas demand was 5.5 per cent (0.2 billion tons standard coal/165.2 mtoe/148 mt/~200 bcm)29, 70 per cent domestic production, 16 per cent pipeline imports, 14 per cent LNG imports (20 mt/27 bcm).30 Natural gas is expected to grow to ~eight per cent share (222 mt/300 bcm) by 2020, two per cent less than the initial 10 per cent target (266 mt/360 bcm) in the 12th five-year plan. However, the current plan is for a significant portion (137 mt/185 bcm) of this natural gas to be domestically produced, conventional (125 bcm) and unconventional (60 bcm). Significant import pipeline gas capacity is also being constructed (105 bcm) which will pose significant competition with LNG for the remaining demand.31

The main risks to the natural gas supply estimates above are in two main areas: the 30 bcm shale gas (half of the 60 bcm unconventional target with the balance coal seam gas production) and the 105 bcm of imported pipeline gas. The potential for shale gas to meet the 30 bcm target relies heavily on the continued success of the Fuling shale gas and developing more basins. Sinopec’s 2015 Fuling capacity will be five bcm, well ahead of 2015 target. The Ministry of Land and Resources verified proven reserves of over 380 bcm in the Fuling shale gas field in Chongqing municipality. Production rates of 60,000-200,000 cubic metres per day per well are comparable to Marcellus wells in the US. Sinopec’s production in Fuling could be 10 bcm by the end of 2017 and 15 bcm by 2020. However, this would still be only 50 per cent of the 30 bcm target.

Figure 8: China Energy Mix Consumption 2014
Figure 9: China Natural Gas Supply by Source 2014 and 2020 (mt)
Finally, there is the fact that Chinese GDP growth is slowing, impacting energy demand and imports of natural gas.

Given recent trends, even China's 2020 300 bcm consumption target is aggressive. In 2015 natural gas demand has grown just five per cent, significantly lower than the eight per cent CAGR seen from 2010-2015, when natural gas demand growth was in the double digits.

One key area of natural gas demand growth is transportation. China leads the world in the number of natural gas vehicles, particularly medium and heavy duty trucks, but even this sector is experiencing slower growth than recent years. Nevertheless, natural gas vehicle growth in China is still faster than anywhere else in the world, with 1.6 million vehicles and 250,000 trucks expected to be on the road at the end of 2015. Falling diesel prices are, however, making natural gas prices less competitive.\(^{32}\)

Accenture's view is that China's LNG demand will be lower than initially estimated. It could be well after 2020 when China's natural gas demand increases to 300 bcm (50 per cent increase relative to 2014). On the supply side, there is a real risk that it will take much longer to reach the unconventionals target and to build the Siberian pipeline.
Demand in the three largest markets for LNG, Japan, South Korea, and China, will be less than originally forecast as recently as last year.
India's demand forecasts are optimistic

India could be the largest and fastest growing market for LNG. India imported 19 bcm of LNG in 2014, but the government forecasts demand will almost triple by 2020, growing to more than 52 bcm, and a significant increase in natural gas supply from LNG and non-LNG sources to 146 bcm in 2020 from 51 bcm in 2014. However, natural gas use has been declining over the past four years.\textsuperscript{33}
India is the fourth-largest importer of LNG, taking 20 bcm of LNG in 2014, but the government forecasts demand to almost triple by 2020, growing to more than 52 bcm. Nevertheless, despite government forecasts to 2020 showing a significant increase in natural gas supply to 146 bcm from 51 bcm in 2014\textsuperscript{44}, natural gas use has been declining over the past four years. This is largely due to India’s delay in expanding its natural gas infrastructure and the cost of natural gas relative to other options. LNG is still too expensive for power generation, with coal the preferred economic option. Coal’s share of power generation increased to 67 per cent in 2014 from 51 per cent in 2010.

The Indian government supports LNG growth, with almost 60 mmtpa capacity of LNG regasification and floating storage regasification unit projects (FSRUs) and three or four pipeline projects planned for 2018–20 (see following tables). These projects would expand India’s LNG total import volumes to nearly five times what they were in 2014. However, infrastructure to transport the gas across India would have to be developed at the same time for its use to grow as forecast. While there is no doubt India’s LNG imports will grow, it is unlikely the rate of growth will be sufficient for all projects to go ahead. However, even if only the FSRUs were built and there was no LNG regasification or pipeline import capacity, India’s gas import capacity would still more than double, adding 26 bcm (18.5 mt) by 2020.

The Indian government has also introduced a policy for converting all naphtha based fertilizer plants to natural gas, and announced plans to connect a large number of households to natural gas and to use natural gas in 100 smart cities. Renewable energy sources are also part of India’s energy policy but will likely take much longer to scale, with natural gas a key part of its strategy to improve its environmental footprint.

<table>
<thead>
<tr>
<th>Year</th>
<th>Power Generation</th>
<th>Industrial Fuel</th>
<th>Domestic Fuel</th>
<th>Captive Use</th>
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Source: Energy Statistics 2015

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Source: Energy Statistics 2015
Accenture’s view is that LNG demand in India will grow (and India has the potential to be one of the highest growth markets for LNG) but is unlikely to be as high as government forecasts and is dependent on the cost competitiveness of LNG.
There are now more than 32 countries with LNG receiving capacity and growing. The lower cost and higher availability of LNG is creating opportunities for LNG in markets that are looking to diversify their natural gas sources and to switch from coal or fuel oil to natural gas generation. However, many of these markets require infrastructure development and investment to develop.
As LNG demand in the largest markets declines, there are opportunities in other markets. The excess supply of LNG could be absorbed by other markets in Western Europe, the Baltics, the Middle East, Asia and Latin America. There are now over 32 countries with LNG receiving capacity. Some of the most interesting markets are described below.

Europe

Although demand in Europe has been declining, demand in Europe significantly exceeds domestic supply, and there is already the infrastructure in many European markets to import LNG. In addition, there is an overall desire to diversify natural gas sources to reduce dependency on pipeline gas from Russia. Finally, the relatively high coal use in power generation is resulting in higher than desired CO2 emissions.

Russia is the biggest supplier of natural gas to Europe, and the European Commission is attempting to diversify energy sources across many EU countries, with the aim of increasing energy security and ensuring each member state has access to a minimum of three different energy sources.

In recent years, the low cost of coal and big push for renewables has squeezed out some natural gas demand in Europe. However, Europe’s CO2 emissions have not declined, as forecast, largely because of Europe’s coal consumption. The most cost effective way for Europe to reduce its CO2 emissions is to swap its current coal use for natural gas as existing natural gas capacity is significantly underutilized.

Total LNG import capacity in Spain, UK, France, Italy, Netherlands, Belgium, and Portugal is over 131 MMTPA (~180 BCM) with more capacity under construction. Although Spain and Portugal may be difficult markets for new LNG supply given their current long-term over-contracted positions, we expect to see increasing gas on gas competition. Russian pipeline gas vs. US LNG, and coal on gas competition in the rest of Western Europe. The existing hubs with LNG import capacity, such as the Dutch TTF, British NBP and Belgium’s Zeebrugge are obvious markets for excess LNG. At competitive LNG prices, LNG should be displacing higher CO2 emitting coal and take some market share from Russian pipeline gas. For example, on October 28th, French company Engie had signed a five-year deal with Cheniere Marketing International LLP. As a result of that deal, Engie will purchase 12 cargoes of liquefied natural gas each year. Last July, French Utility company EDF closed a similar agreement with Cheniere. EDF (85 per cent) will buy and provide to its customers an average of 770,000 tons of LNG every year for 20 years starting in 2019. Today, for Western Europe, growth of LNG is dependent on displacement – primarily displacement of lower cost Russian pipeline gas and displacement of lower cost coal.

In some of the Baltic countries, where the infrastructure is just being developed, the opportunities could be bigger given the strong desire to diversify away from Russian gas. A significant story in 2015 was Lithuania’s importing of LNG. The appropriately named FSRU ‘Independence’ terminal has changed Lithuania’s natural gas supply options and more significantly, has changed the country’s economic and political situation. Lietuvos Energija CEO Dalius Misiunas said the decision to build an LNG import facility had fundamentally changed market dynamics in Lithuania and the wider Baltic region. Lithuania and its neighbours previously were totally dependent on Russian gas supplies with LNG now giving Lithuania more security of supply and access to a more competitive gas market. By introducing competition, Lithuania has been able to achieve a significant discount on its Russian imports. LNG represented around 25 per cent of Lithuania’s total gas consumption in 2015 (2.0-2.1 bcm) with Russia still supplying 75 per cent of its gas. Lithuania’s LNG import capacity is significantly higher than domestic natural gas demand and it has already exported natural gas to Estonia. Lithuania could expand this activity to Latvia and even Poland via a planned gas interconnector.

In addition, Poland’s LNG terminal will be commissioned in Q2 2016. There are already plans to expand the LNG terminal in Swinoujscie, with the government investing in a second gas port. Officials have stated that in four to six years Poland will be fully prepared to become independent from natural gas supplies from Russia.

Other European markets with current plans to import LNG include Finland, Ireland, Croatia and Greece.

Middle East

Although the Middle East, as a region, is a significant exporter of natural gas, there are many markets where natural gas demand is increasing and where oil is still used for power generation and other applications better suited to natural gas. Established and growing LNG markets in the Middle East include Kuwait, the UAE and Oman. In 2015, shipping data suggest that Kuwait’s imports increased by nearly 13 per cent year-to-year in January-September. Dubai’s imports rose by 62 per cent.

2015 also saw the arrival of Jordan and Egypt as LNG importers. Jordan has also started to export to Egypt via pipeline.

Egypt used to be an LNG exporter, but it is suffering major gas shortages, forcing the government to divert gas meant for export via LNG to the domestic market. Longer-term, Egypt will develop the Zohr gas field, but in the short-term, it remains heavily reliant on LNG to meet its natural gas demand. LNG is a key opportunity for many countries in the Middle East where electricity demand is growing and oil that could be exported is being used for power generation.
Figure 15: Receiving LNG Terminal Import Capacity and Utilization Rate by Country in 2014 and 2020

Other Asia

Although LNG demand in Asia's largest (northern) markets like South Korea and Japan is declining, there is a growing LNG market in other Asian countries. LNG imported by Asian buyers overall increased by 4.2 per cent year on year in November 2015 to 14.79 million mt, as increasing purchases by South and Southeast Asian buyers offset decreased demand from North Asian buyers (notably South Asian buyers in Pakistan and Thailand). For example, in Thailand, natural gas imports are up more than 68 per cent in 2015. Pakistan is also an interesting new market. Pakistan has had an energy deficit for the last decade or so with its domestic gas production flat at around 4.2 Bcf/day while demand has been surged to 6.2 Bcf/day in summer and nearly seven bcf/d in winter. Pakistan is now importing LNG from Qatar with Qatargas will supply a minimum 1.5 mt of LNG which will be increased to three mt from 2018 (2018-2030). There are already discussions of a second LNG import terminal for Pakistan.

Latin America

While Latin America, a market for natural gas, should remain relatively balanced with respect to supply and demand similar to the Middle East, there is a growth opportunity in some markets. In 2015, demand in Chile was strong and, with support from suppliers, like Cheniere, who are willing to invest to lock in demand, looks set to grow. In the short-term Argentina is also a growth market for LNG imports. In 2015, the fall in LNG prices has made it a competitive alternative to fuel oil. However, longer-term, Argentina, like Egypt with its Zohr gas field, will have new domestic natural gas supply via the Vaca Meurta shale gas.

New customers and applications

Historically, the main customers of LNG have been the large utilities for generation. To date, this has been a concentrated market with few large customers. Increasingly, we are seeing industrial, city gas and other industrial users become customers of LNG. There is potential to grow this market, even in the countries like Japan and South Korea where LNG demand for generation is declining. In addition, going forward, there is also an opportunity to use LNG for marine and heavy duty transport. These customer bases and additional applications of natural gas must be developed. However, producers and marketers of LNG need to support market and infrastructure development as many of these customers will not have the experience to bring together the natural gas value chain. An important consideration is how the producers and marketers of LNG move from a model where it's a partnership or venture with a large customer or transactional trades for spot or short-term LNG to service many small customers in many markets. The operating model will need to evolve to more of a business to business or wholesale model, somewhere in between the key account management of a handful of big customers and the transactional nature of spot and short-term contracts or tenders.
Figure 16: LNG Regasification Capacity by Country (MTPA) and Utilization, 2014

Note: “Smaller Markets” includes the Dominican Republic, Greece, Israel, Lithuania, Malaysia, Puerto Rico and the UAE. Each of these markets has less than 4 MTPA of capacity. Source: IHS, IGU
There are new markets for LNG, but growth in these markets is dependent on lower and more competitive LNG prices and many of these markets will require midstream infrastructure and financial support from LNG suppliers to develop. In addition, the contracted volumes of LNG will be much smaller than the traditional LNG markets and contracts in Japan, South Korea and China.
India will be a growth market for LNG, but it's unlikely that India will grow as much as currently forecast. Natural gas use could continue to decline in generation given the relative cost of coal. India could even follow China and Germany and use coal with renewables. Although significant LNG import and pipeline gas projects are planned, given the low oil price, it might only be the FSRU's planned before 2020 that are built by 2030.

In the worst case scenario, demand in these four countries falls from the published 268 mt (in the China MLR 2014, Japan IEA New Policies Scenario, S.Korea 2014 Ministry of Energy, Indian Oil Ministry) to 150 mt. The worst case assumes that Japan hits its nuclear and energy efficiency targets in 2030, that South Korea's demand stays flat, that China's natural gas demand slows so that it reaches 300 bcm closer to 2030 than 2020 while domestic supply and pipeline gas capacity grows, and that, in India, only the FSRU's planned for 2020 are developed by 2030. In the 2030 demand falls example, the fall in demand in these four markets reduces the total LNG market- i.e., the demand is not made up elsewhere and the market size falls from 500 mt to 382 mt.

However, it is also unlikely that LNG demand in Japan, S. Korea, and China will be this low. Japan's nuclear build out could be slower than expected, China's growth rate could be larger and China's unconventional development and Russian pipeline projects delayed. Imported pipeline gas and imported LNG will continue to compete for China demand. India's LNG demand could grow more significantly, taking advantage of the oversupplied market as it is unlikely that India will be able to pursue a policy of coal only, and it has stated that renewables are a longer-term solution.

Finally, growth in new markets and applications could be larger than expected.

**Figure 17: Possible LNG Demand to 2030: China, Japan, South Korea, India (mt)**

2030 Published

2030 Demand increases elsewhere

2030 Worst Case- total demand falls


LNG's traditional markets are declining. The future of LNG in an oversupplied world is dependent on finding new markets and customers.
Implications for LNG producers and marketers

The future for LNG, at least for the next 10 years, looks set to be a buyers’ market which will keep prices lower than we have seen in the past. Although today, LNG volume is dominated by a few large countries, the number of countries importing LNG is growing. In 2015, there were 32 countries importing LNG including new importers such as Lithuania, Jordan, Egypt, and Pakistan.46 LNG Demand will look very different, with more countries making up demand vs. a few very large demand countries.

LNG producers need to diversify their portfolio to include Europe and small countries. They need to invest in science and engineering to support smaller LNG shipments that will allow them to widen their customer base and also technologies that encourage the use of natural gas in transport and other applications. They need to create flexibility in how they contract and manage their trading portfolios and to leverage the midstream to maximise margins.

The following are six key implications for natural gas producers and marketers:

1. Japan, South Korea, China and India are still critical markets

Although a large number of long-term contracts in Japan and South Korea are due to expire before 2020, Japan and South Korea will still have some of the largest customers. Those with these contracts need to protect this market share, and those marketers of LNG who are looking for an opportunity, buyers in Japan and South Korea will certainly be contemplating whether to renew long-term contracts, how much demand to leave short-term/spot, and how to build capability to clear excess supply.

Although China has aggressive plans for domestic production and pipeline gas, there is a risk to this supply that could be mitigated by LNG. Today’s LNG prices could also make LNG very competitive to more expensive domestic natural gas production. Natural gas demand in the southeast coastline would also logically be better met with imported LNG, particularly if the LNG is competitively priced.

For India, it is largely about cost competitiveness. India could grow significantly if LNG prices become competitive with coal or, like China, air quality becomes a top government priority.

In all of these markets, although there is a renewables agenda combined with coal use in generation, LNG will be needed for city gas and other applications and to provide seasonal, flexible capacity often required when uneven weather patterns impacts renewables generation.

2. Diversify to additional markets and customer segments

Producers and marketers need to diversify customer base to other markers where LNG demand is likely to increase.

- **Europe.** Although natural gas demand in Europe has been declining, there remains a real opportunity for LNG in Europe. There is a desire to reduce Europe’s dependence on Russian pipeline gas. Also, given Europe’s focus on renewables and emissions, the continued increase in the use of coal to supplement renewables and overall coal demand for generation is unlikely to be sustainable. The most cost effective way to reduce CO2 emissions in Europe is to replace coal with natural gas. It has significant underutilized natural gas power generation capacity.

- **Other countries.** The LNG import market will continue to diversify through 2030 with countries in Asia, the Middle East, and Latin America emerging as new importers. For example, in 2015, Egypt, Jordan, and Pakistan have all become LNG importers. Demand from existing small LNG importers is also expected to grow. In Thailand LNG imports are still quite small, but are expected to grow to four mt in 2015 and the government is actively pursuing other supply options for the future.

- **New customers and applications.** Expand customer base to include new customer segments and applications (e.g. industrial, city gas, transport, marine). In addition to the new markets, there is an opportunity to grow these segments even in the large markets like Japan and South Korea where LNG demand for generation is declining. In addition, going forward, there is also an opportunity to use LNG for marine and heavy duty transport. These customer bases and additional applications of natural gas must be developed. However, producers and marketers of LNG need to support market and infrastructure development as many of these customers will not have the experience to bring together the natural gas value chain. An important consideration is how the producers and marketers of LNG move from a model where it’s a partnership or venture with a large customer or transactional trades for spot or short-term LNG servicing many smaller customers in many markets. The operating model will need to evolve to more of a business to business or wholesale model, somewhere
in between the key account management of a handful of big customers and the transactional nature of spot and short-term contracts or tenders.

3. Prepare for a very different competitive landscape with non-traditional players exporting and trading U.S. LNG

As illustrated in the following chart, there is over 53 MMTPA LNG export capacity under construction in the US and another 27.9 MMTPA pre-FID. This is ~22 per cent of 241 MMTPA (or almost 34 per cent including pre-FID capacity) that was traded in 2014.51 Much of this volume is being brought on-stream by non-traditional players with a large trading emphasis, e.g., Cheniere Energy. Cheniere Energy has invested in a significant sales, trading and marketing arm with staff based in London, Houston, Santiago, and Singapore to deliver LNG internationally and already chartered three LNG vessels for deliveries in 2015 and 2016. The LNG volume that will be available from the U.S., coupled with the excess supply, will drive a bias towards trading as owners of LNG compete for buyers and opportunities.

4. Build flexibility in contract portfolios through trading and midstream

The spot and short-term market for LNG was 27 per cent of the global LNG trade in 2014.52 In a buyers’ market, there is likely to be an increase in optimization and arbitrage opportunities, particularly as demand becomes more geographically diverse. As many large long-term natural gas contracts expire, LNG buyers may choose to lock-in a much smaller percentage into long-term contracts. In addition, there is the question of whether the market will move more

Figure 18: The US Shale Revolution has driven capital into liquefaction facilities

- Change in Rig Count Dec 2014 – Dec 2015
- Change in Oil and Natural Gas Production Dec 2014 – Dec 2015
- Proposed LNG Projects Approved and Under Construction (UC) as of 2015

IGU World LNG Report 2015 Edition | Cheniere | Accenture Analysis
quickly than expected from oil-linked (relatively attractive in this low oil price environment) to Henry Hub (or other gas hub) linked contracts. LNG suppliers and marketers should carefully consider how much of their capacity should be tied up versus sold short-term and spot LNG. LNG buyers should look at secondary markets and how to sell excess supply to smaller customers. Careful consideration of contract portfolios is also critical in markets where the seasonal peaks in natural gas demand could be magnified because baseload generation is dominated by less flexible coal and renewables.

Commercial optimization of the midstream becomes more critical as access to markets, the flexibility to move product to the highest margin markets, and the ability to quickly take advantage of opportunities will be a key differentiator in a buyers’ market.

5. Invest in science, technology, and engineering for small scale LNG and new applications

Science, technology and engineering have been responsible for much of the change in today’s energy system. For example:

- Science and engineering to support small scale LNG plants, shipments and applications and to grow the FSRU market. There have been significant advancements in driving down the cost of small scale liquefaction and regasification, but this is still relatively expensive. Small scale liquefaction and regasification will add flexibility to how LNG can be deployed

- Engineering that supports the growth of LNG applications in trucking and marine. The use of both LNG and CNG in transportation, road and marine is increasing. Of late, engineering design in the U.S. for large truck, long haul CNG has outpaced LNG. Some class seven-eight CNG trucks can now travel 600 miles without refuelling. This was not even thought to be possible for CNG three-four years ago, when the view was that the heavy duty class seven-eight had to be LNG.

- Technologies that can reduce the cost of delivered LNG. Big data and digital has had an impact on the operational effectiveness and efficiency of many heavy industries. LNG is not an exception.

6. Drive down the costs of delivered LNG

The days of Asian spot LNG prices at $16-18/MMBTU may be behind us. Today, LNG cargoes are trading at less than half this. Projects that have not passed FID before the price collapse are unlikely to go forward. We see high profile projects being cancelled, and many projects in Australia were justified at prices that are unlikely to materialize.

However, the LNG project development costs in many markets, e.g., Australia and Canada, were much higher than they should have been. Services costs in particular were inflated. There continues to be significant opportunities to reduce costs in the same way that we have seen dramatic cost reductions in onshore U.S. project development.

Accenture will continue to explore these themes in future papers in the Gas Grows Up series.

In summary, we expect the next 5-10 years to be a buyers’ market for LNG globally. This means that producers and marketers need to act now to increase their competitiveness in a market where the demand outlook is less optimistic than it was. It will be those LNG producers and marketers who can be cost competitive in bringing LNG to the market, who can develop new markets and customers, who are able to optimize their contract and asset portfolios, and who are agile enough to take advantage of opportunities as they arise who will succeed in the next 5-10 years.
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53. Accenture research

Glossary

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<tr>
<th>Abbreviation</th>
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<tr>
<td>Bcm</td>
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<td>mmtoe/mtoe</td>
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<td>FSRUs</td>
<td>floating storage and regasification unit</td>
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Authors

Melissa Stark
Accenture Energy LNG lead
melissa.stark@accenture.com

Melany Vargas
Accenture Strategy
Accenture Research (London, China, South Korea, India)

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