FRESH IDEAS ABOUT BUSINESS IN EMERGING MARKETS EMCompass

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# Natural Gas and the Clean Energy Transition

**By Alan F. Townsend**

In the clean energy transition, the value of natural gas infrastructure is very important for operating the energy system. Gas-fired power plants contribute to optimized energy systems when they are designed to operate flexibly, responding to demand patterns and the variable supply of renewable energy. Smart electricity grids, renewable energy, battery storage technology, and gas-fired power plants in combination will generally be the lowest cost, low-carbon solution to the growing energy requirements of emerging markets. Private investors and financiers are responding to these opportunities, but the full potential will only be reached with improvements in policy, regulation, and procurement in destination markets.

The de-carbonizing power sector solution for most countries will be characterized by several factors, including:

- A smart, integrated, and expansive network;
- Increasing penetration of photovoltaic (PV) solar, wind, and other lower cost renewables;
- Battery storage serving the short duration requirements of the network and its need to balance variable renewables in real time;
- A mix of gas-fired power generation capacity that supports further penetration of renewable energy, provides long-duration balancing resources, and ensures supply is reliable even when renewable energy generation is low.

Technically, this mix is already available on a commercial basis and its components are becoming more efficient and cheaper over time—dramatically so in some cases. This evolution will provide time for discovery and development of revolutionary breakthroughs that are expected to bring an end to both expansive integrated networks and fossil fuel-fired generation, though it is far from clear when exactly this will happen.

Figure 1 highlights the importance of gas-fired generation and the logic of de-carbonization. In many countries, especially in Asia, new energy has been a mix of coal and variable renewables, with natural gas sometimes marginalized. Flexible and efficient, gas produces half the

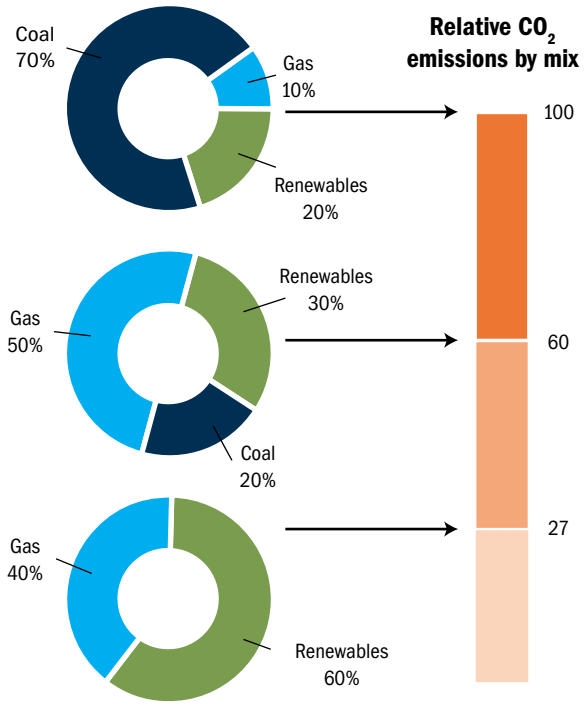


**FIGURE 1 Gas and the Clean Energy Transition**

*Source: Author*

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emissions of coal per kilowatt hour (kWh), plus low or no sulfur oxides (SOx), nitrogen oxides (NOx), and particulate matter (though methane leakages need to be kept low). If its use can be expanded, so can renewables. The result is a 40 percent decrease in total emissions, even with some coal remaining in the system.

Gas can be economical even when the capacity is utilized flexibly, leaving room for more renewables. In the stylized example, when coal is eliminated from the system, emissions have been reduced by 73 percent. The final step toward zero greenhouse gas emissions, which is some years away, is when new storage technology, more efficient renewables, and ultra-smart grids obviate the need for gas at all.

The renewables/flexible gas solution is economically available now. That is, for most countries, the combination of flexible gas, variable renewables, smart networks, and storage will be least-cost for all capacity additions going forward. This is because, even without considering the cost of carbon emissions:

- PV solar, wind, and natural gas-fired turbines and engines have lower unit capital costs than coal-fired equipment, and there are natural incentives to combine solar, wind, and gas such that the required capital expenditure is least-cost compared to a coal-heavy mix.
- The all-in cost of PV solar and wind in many markets is below the marginal cost of natural gas, so total fuel costs can also be minimized.

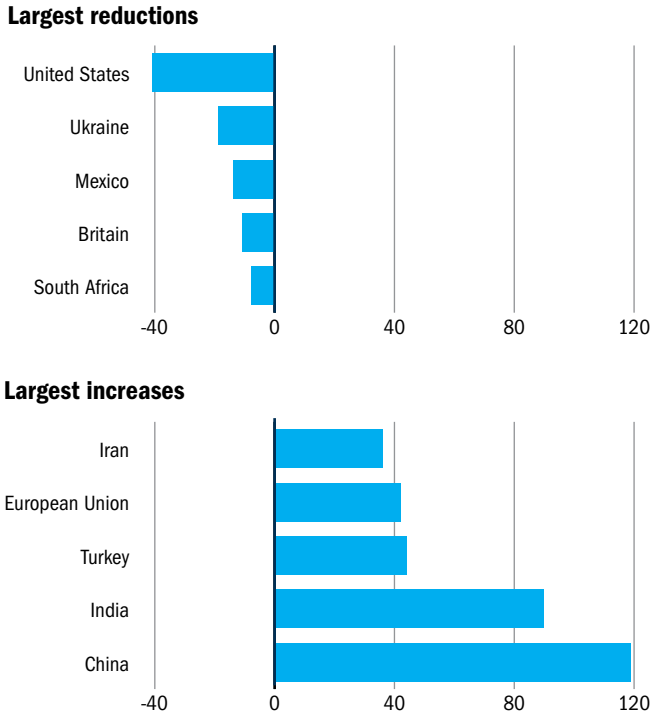


**FIGURE 2 Change in CO2 emissions, 2016-17, million tons**

*Source: The Economist*

## Developed Markets Show the Way

Two of the biggest de-carbonizers on an absolute and relative basis are the United States and the United Kingdom (Figure 2). They have dramatically reduced their coal burn in the power generation sector while greatly increasing the penetration of renewables and natural gas. In the United Kingdom, a modest carbon tax has been enough to essentially eliminate coal from the country's power generation mix. The United States has no carbon tax, but the shale gas revolution has lowered the cost of natural gas to a level that leaves many coal-fired power plants unable to compete. In Europe and Korea, despite the occasional policy inconsistency, trends are in a similar direction—the combination of renewables and natural gas is pushing coal out of the mix.

Emerging markets have embraced natural gas as a power generation fuel but rarely as a strategic component of a clean energy mix. Grids are often weaker, battery storage has not entered most such markets, renewables policies vary widely and have sometimes been volatile, and many markets continue to develop new coal-fired power projects. Access to natural gas has frequently been a significant issue. Most emerging markets only had access to local gas reserves that came to market via pipelines. Until 2008, almost no emerging markets imported liquefied natural gas (LNG).

That changed with the advent of floating storage and regasification units (FSRUs), which are essentially floating LNG terminals. First in Brazil and soon thereafter in nations such as Argentina, United Arab Emirates, Indonesia, and Malaysia, FSRUs have opened new markets to LNG. In 2007 there were 17 importing countries. By end-2018 there were 40 importing countries and almost all new importers are emerging markets that have developed FSRU-based terminals.

IFC has analyzed FSRU examples globally to understand the motivations behind the individual projects, and the findings are striking (see Figure 3). Countries have turned to FSRUs primarily for three reasons: they needed LNG for a secure supply of natural gas, to provide back-up to hydroelectricity, or to make up for declining domestic gas reserves. In many cases, the consequence of not having access to LNG was a steep increase in the amount of oil burned in power generation. That changed when FSRUs came on-line.

There isn't a single emerging market LNG terminal in which the initial investment was primarily or even partly driven by the desire to complement variable renewables. And coal substitution is the primary motivating influence for only one project, Indonesia's Java-1 LNG-to-power, which is under construction (LNG-to-power refers to facilities that import and regasify LNG and then use it to generate power). These findings suggest that, although natural gas has a compelling role in a clean energy mix, LNG development in emerging economies has so far been driven by other concerns. As policy catches up to power

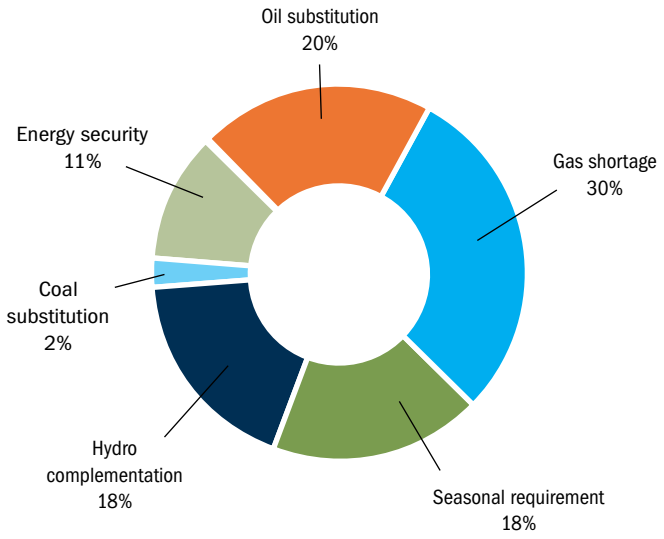


**FIGURE 3 Primary motivation for floating storage and regasification units (FSRUs) – 44 projects total**

*Source: Author*

sector decarbonization pressure, new opportunities will arise for gas-to-power.

## Unbalanced Supply and Demand

Meanwhile, the LNG-to-power market is struggling. Even as the industry has responded to the potential for FSRUs by speculatively ordering many new, state-of-the-art vessels, there has been a noticeable slowdown in FSRU awards (Figure 4). While projects already under construction will add new importers to the roster of LNG consuming countries, no new emerging market terminals outside of China are scheduled to open beyond the early months of 2021.

About two dozen FSRUs are either available today or will be available as they come off contract between now and 2024. Rates for FSRUs are barely half what they were five years ago and several FSRUs are being used as LNG carriers.

While there are several reasons for the combination of demand contraction and supply expansion in the FSRU space, one factor looms especially large in explaining the steep fall in bankable projects: bad procurement practices. Of three dozen operating or under-construction projects in emerging markets, it can be argued that almost all have either been fully competitively bid or have had significant aspects subjected to competition by tender.

The flip side of this is that bilateral negotiation has produced almost no examples of FSRU projects being successfully concluded. Yet parallel, bilateral negotiation is an approach that is commonly seen in markets ranging from Ghana and Sri Lanka to Myanmar. And this approach has not seen any projects obtain financing and be brought into operation. This raises an important question: Why haven't the negotiated deals been financeable? Probably because they have lacked legitimacy across a wide range of stakeholders in politics, the media, the donor community, finance, and in the end-user/consumer community.

The dearth of financed deals may also result from governments having too many deals under negotiation (the logic seems to be that is the way to get the best deal). But when saying "yes" to one party is a de facto "no" to everyone else, sometimes no decision can be made. When the various ministries across the government apparatus are not aligned and not effectively coordinating across energy, transportation, industrial, and environmental policy streams, decision-making can also be paralyzed.

The market seems to be waking up to the peril of negotiated deals that can't be closed. Accordingly, the industry has become enthusiastic about participating in transparent and competitive tendering processes. Such processes are now ongoing in a diverse range of markets, including Benin, Lebanon, Cyprus, Sharjah (United Arab Emirates), Colombia, and Australia, and drawing significant interest from LNG suppliers, traders, and FSRU firms.

The next step is to recognize the capacity value of LNG-to-power infrastructure. Brazil's Porto de Sergipe, a 1,500 MW project, demonstrates this value. The project, now under construction, is economically supported by a fixed annual capacity fee sufficient to paying for a full range of fixed and non-fuel operating costs, including the lease on the FSRU. The plant is fully dispatchable. And when it runs, it will run because hydro reservoirs are low, and its energy will be very valuable indeed in a country with memories of drought-induced power rationing.

Porto de Sergipe will be the most efficient gas-fired plant in Latin America, with thermal efficiency of 62 percent. But

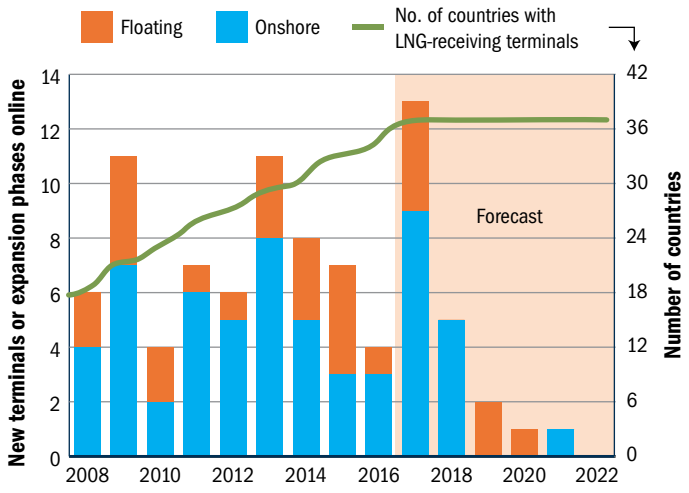


**FIGURE 4 New terminals or expansion phases online 2008-22 for floating or onshore LNG storage**

*Source: International Gas Union (IGU)*

when it rains it will not be needed, and LNG offtake can be reduced because the supply contract is highly flexible as well. Brazilian power customers will benefit: if the plant is forced to run because it must buy the gas, the annual cost of LNG will be about $600 million (at $10/million British thermal units (mmBtu)). Projects like Porto de Sergipe and Panama's AES Colon illustrate a critical fact of today's LNG-to-power space: that all players in the supply chain, other than the LNG supplier, can be indifferent to actual LNG consumption if contracts are structured appropriately.

This is a key insight because, consistent with the clean energy mix approach, there are two steps for gas in the transition. First, an increased market share for gas as it replaces dirtier fuels. And second, a decreasing share for gas as it is replaced by the combination of renewables and storage. This path for gas should be a conscious goal of energy policy makers.

Like the LNG-to power market, power generation equipment suppliers are also struggling. The big equipment manufacturers, especially General Electric and Siemens, are under pressure. Siemens estimates that suppliers of turbines of over 100 MW can manufacture 400 such units per year, but demand going forward will be no more than 110 units per year. Demand is soft for smaller units too, including both turbines and reciprocating engines.

LNG supply is nonetheless growing rapidly. The world is currently in the middle of the biggest LNG supply expansion in history, driven in recent years by rapid expansion of Australian and U.S. supply. By 2023, the International Energy Agency (IEA) projects that gas liquefaction capacity will exceed 500 billion cubic meters (bcm) of natural gas per annum, or about 400 million tons of LNG (Figure 5). And recent investment decisions—in Qatar, Canada, the United States, and other places—will add to supply after 2023.

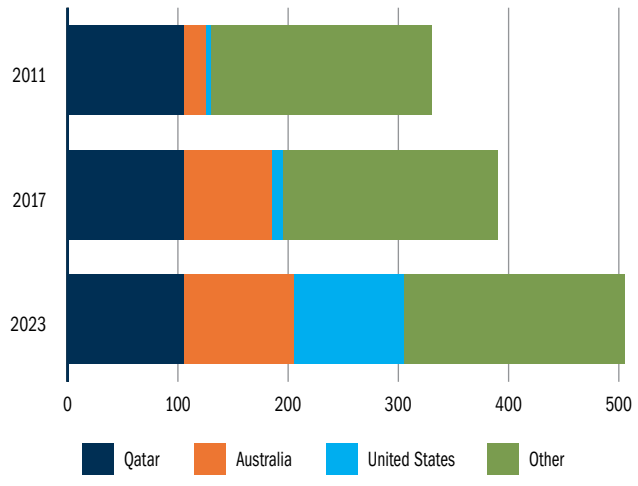


**FIGURE 5 Global LNG supply growth 2011-23 (bcm)**

*Source: International Energy Agency (IEA)*

Significantly, the basis for investment decisions has changed. Older projects have been underpinned by long-term offtake contracts with creditworthy buyers. Recent investment decisions have relied much less on contractual offtake and more on the equity strength of sponsors like Qatar Petroleum, Shell, Petronas, and Mitsubishi. Markets newly opening to LNG are always steps down the credit quality ladder.

## Abundant LNG Reserves

This raises an important question: Why are producers committing billions to new LNG production despite the difficulties now seen in opening new emerging markets, and amid a global slowdown in gas turbine sales? There are several factors involved in the answer: Natural gas reserves are plentiful, but often far from potential markets; and LNG is often the preferred solution for remote gas reserves.

Those plentiful reserves mean that there is plenty of competition to get new projects to market, and firms that can take the equity approach (as opposed to being dependent on limited recourse project financing) have a distinct advantage. The LNG market is globalizing and commoditizing, reducing the risk of bringing on new supply if production costs can be contained. Finally, there is the reality that climate politics might turn some natural gas reserves into stranded assets at some point. This was certainly a factor behind Qatar's recent decision to lift the moratorium on further North Field development and commit to increasing LNG production capacity by nearly 50 percent, taking its output potential to 110 million tons per year, or over 140 billion cubic meters (bcm) per year.

A more flexible market helps. LNG companies know that, at worst, they will need to dump unsold LNG into the liquid markets of Europe, where annual utilization of LNG import capacity runs at 20 to 30 percent. Chinese demand is the wildcard: In 2017–18, China bought many of the available cargos, and European terminal utilization was low. In late 2018 and into 2019, China's appetite waned because of a warmer winter, and LNG suppliers had to put more into Europe.

The truism of the current market is that when China buys LNG, it turns a buyer's market into a seller's market. China is now the second largest buyer of LNG globally. It surpassed Korea this year and may overtake Japan as the largest LNG destination by 2020. China underscores a core environmental truth about natural gas: it is not just about the carbon. The purpose of Chinese LNG purchases has been to improve air quality in northern China, an effort that has been stunningly successful and is expected to continue for some time. China's LNG binge has contributed directly to increased confidence among LNG project sponsors, and that confidence translates, in part, to positive investment decisions for new capacity.

## Conclusion

For emerging markets, LNG-to-power should be an essential part of a clean energy strategy. To make that happen, a handful of principles should be incorporated into the policy framework of individual countries:

- Countries need to embrace transparent and competitive tendering processes when awarding rights for energy infrastructure and energy supply.
- Natural gas has proven its carbon advantage relative to coal, and as China has shown, natural gas can have an immediate impact in reducing local pollution; these benefits should be incorporated in policy frameworks.
- Attention should be paid to replacing coal with a mix of flexible gas and renewables.
- In an increasingly flexible and commoditizing sector, LNG buyers and FSRU lessors should be clear about their requirements and should be careful about overcommitting on volume, tenor, or other factors; but contracts (with the right flexibility) remain critical pieces of the commercial supply chain. Buyers in today's gas market should be assertive but should also value stable relationships with reputable providers of LNG and infrastructure.

### Box 1: Maximizing Finance for Development—Cascade Objective and Algorithm

Maximize financing for development by leveraging the private sector and optimizing the use of scarce public resources. WBG support will continue to promote good governance and ensure environmental and social sustainability.

When a project is presented, ask: "Is there a sustainable private sector solution that limits public debt and contingent liabilities?"

- If the answer is "Yes"—promote such private solutions.
- If the answer is "No"—ask whether it is because of:
  - Policy or regulatory gaps or weaknesses? If so, provide WBG support for policy and regulatory reforms.
  - Risks? If so, assess the risks and see whether WBG instruments can address them.

If you conclude that the project requires public funding, pursue that option.

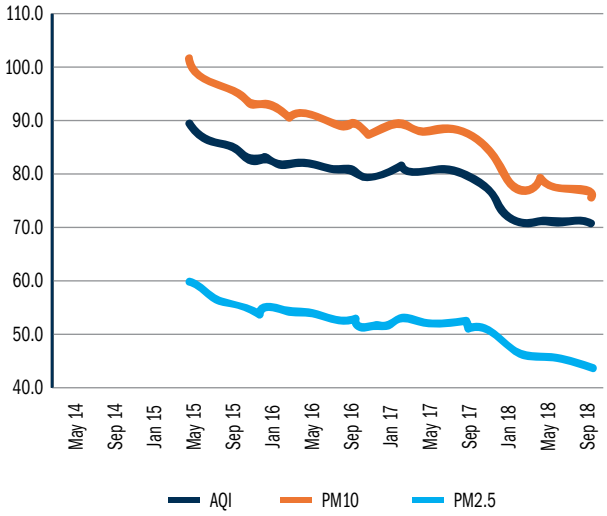


**FIGURE 6 China: Particulate Matter and the Air Quality Index have been decreasing since 2015 (annualized basis)**

*Source: CNEMC, Citi Research*

The private sector needs to be at the heart of efforts to mobilize finance for the clean energy transition. There is an opportunity to apply a maximizing finance for development (MFD) approach (Box 1) for gas that will address policy reform, market readiness, and enabling investments aligned to country climate targets.[1]


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**Please see the following additional EM Compass Notes about energy opportunities in emerging markets:** *Energy Storage–Business Solutions for Emerging Markets* (Note 23); *Creating Markets in Turkey's Power Sector* (Note 33); *Using Blockchain to Enable Cleaner, Modern Energy Systems in Emerging Markets* (Note 61).

[1] See for example: World Bank Group. 2017. "Maximizing Finance for Development: Leveraging the Private Sector for Growth and Sustainable Development." Report prepared by the World Bank Group for the Development Committee, September 17, 2017, p. 6–7.

## Box 2: About IFC and investing in LNG in emerging markets

IFC—a sister organization of the World Bank and member of the World Bank Group—is the largest global development institution focused on the private sector in emerging markets. We work with more than 2,000 businesses worldwide, using our capital, expertise, and influence to create markets and opportunities in the toughest areas of the world. In fiscal year 2018, we delivered more than $23 billion in long-term financing for developing countries, leveraging the power of the private sector to end extreme poverty and boost shared prosperity. For more information, visit www.ifc.org.

IFC has invested equity and debt in the first LNG terminals to come into operation in Pakistan and Bangladesh. IFC is senior lender ($150 million) to the AES/Motta Group Colon LNG-to-power project in Panama, and a senior lender ($200 million) to the Golar Power/ebrasil Porto de Sergipe Project. IFC has been the lead or co-lead debt arranger for LNG projects in Bangladesh, Panama, Brazil, and El Salvador.

IFC operates in partnership with the most significant companies in the LNG and power businesses. Our projects involve supply commitments from Qatar Petroleum, ExxonMobil, Shell, BP, and Total. Equipment and sometimes equity and EPC services have come from General Electric, Siemens, and Wartsila. Three of the four largest FSRU owners, Excelerate, Golar, and BW, provide vessels to IFC-financed projects. The largest commodity firms trade LNG through IFC-financed infrastructure, including IFC client Vitol. Leading financial institutions such as FMO, JICA, and Goldman Sachs work with IFC to support lending and project bonds.

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