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DISCUSSION PAPER

Increasing the Use of Natural Gas in the Asia-Pacific Region

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Introduction

Increased use of natural gas in the Asia-Pacific region could bring substantial local and global benefits. Countries in the region could take advantage of newly abundant global gas supplies to diversify their energy mix; the United States, awash in gas supplies thanks to the fracking revolution, could expand its exports; and climate change could slow as a result of gas displacing coal in rapidly growing economies.

However, many Asian countries have not fully embraced natural gas. In previous decades, the United States and Europe both capitalized on low gas prices by investing in infrastructure to transport and store gas and by creating vibrant gas trading systems. By contrast, Asian countries have not invested in infrastructure, nor have they liberalized gas markets. Strict regulations, price controls, and rigid contracts stifle gas trading. The window of opportunity for making the transition to gas is closing, as slowing Asian energy demand and copious global supplies are reducing prices and discouraging global investment in infrastructure for gas trading and distribution. If supply dries up, prices could increase markedly, making gas unattractive to Asian countries, especially when compared to coal.

Still, this scenario is not inevitable. If global gas demand increased modestly over the next decade, raising prices enough for production to be profitable but not so much that consumption became unaffordable, Asian countries could invest in infrastructure and enact reforms to enable a large increase in gas consumption. However, because of sluggish global economic growth, the Asia-Pacific region itself is the only plausible source of an initial uptick in new gas demand that can support a sustained surge. A simulation of global gas markets finds that a 25 percent increase in gas demand in both China and India, compared with current market forecasts, could help stabilize prices. The 25 percent increase would represent just a 2.9 percent increase in global demand but would be enough to boost Asian gas prices by more than 20 percent over the next decade. Such an increase in demand is plausible in both China and India, because they are large and growing economies that use relatively little gas today as a share of their energy mix and are motivated to use more gas to displace the burning of coal, which causes air pollution. At the same time, because China is the world's largest source of greenhouse gas (GHG) emissions and India is the third-largest and fastest-growing source, gas use that replaces coal would slow global GHG emissions.

Such demand increases are not necessarily favorable for U.S. strategic interests. Russia could benefit by selling 30 percent more gas than it currently does, primarily via pipeline to China, and U.S. producers would export less gas to Europe in favor of a more lucrative Asian market, thus exposing U.S. allies to increased dependence on Russian gas.

Still, the United States stands to gain more than it loses by promoting a transition to gas in the Asia-Pacific. Whether the initial increase in gas demand materializes will depend largely on domestic policy decisions—for example on infrastructure investment or on caps on local gas prices—in China and India. The United States can encourage Chinese and Indian governments to make these decisions by providing technical assistance to implement reforms and recommending that international institutions provide financial assistance. U.S. policymakers should also coordinate competing proposals from China, Japan, and Singapore to establish a thriving gas trading hub. Finally, to secure the environmental benefits of a transition to gas, the United States should develop best practices for measuring and minimizing methane leakage from natural gas infrastructure built in the region.

Background and Context

Natural gas is the third-largest source of primary energy worldwide, behind oil and coal.[1] It is also the world's largest source of heat.[2] Homes and businesses use natural gas for space and water heating; and industrial processes, including the manufacturing of plastics, pharmaceuticals, and glass, often rely on heat produced from the combustion of natural gas.[3] Natural gas is also used to generate electricity, and globally, gas-fired power plants are the second-largest source of power, behind coal.[4]

Gas brings several advantages compared with other fossil fuels. Burning natural gas—for heating or power generation—emits far fewer pollutants that cause local air pollution and half as much carbon dioxide as coal.[5] Additionally, natural gas can make it easier to integrate renewable sources into the grid, because gas-fired turbines used to produce power can vary their output easily to compensate for unpredictable wind and solar power.[6] As a result, natural gas can facilitate a transition to zero-carbon energy infrastructure.

But natural gas also has disadvantages. It has a lower energy density—the amount of energy stored per unit volume—than oil or coal, which makes the transport of gas expensive and capital intensive. Costly pipelines are required to transport natural gas in its gaseous phase, and even costlier facilities are needed to transport it around the world in its liquid phase, including facilities to condense the gas at ultralow temperatures and dedicated tankers to transport newly liquefied natural gas (LNG). In addition, storage of gas to meet seasonal or daily demand fluctuations is more expensive than that of other fossil fuels, as it requires the use of depleted oil or gas fields, underground salt domes, or LNG storage tanks.[7] These factors have historically limited the economic competitiveness of gas against coal and oil.

Because of its high energy density and transportability, oil is likely to remain the dominant fuel source for the transportation sector. But for stationary heating and power generation, gas could be cheaper than coal. Over the last half century, gas has become increasingly attractive, and its use around the world has steadily increased. In the early 1970s, gas accounted for only 18 percent of the world's primary energy demand.[8] Oil market volatility in that decade led governments to promote the use of gas over other fuels. In the power sector, in particular, gas use almost tripled from 1973 to 1990. Then, as a more efficient gas-fired power plant design—the combined-cycle gas turbine—became more popular, gas use in the power sector doubled between 1990 and 2010.

Now, the newfound global abundance of gas has made the fuel even more economically competitive, and trade in gas is thriving (see box 1). The International Energy Agency (IEA) projects that by 2020, global gas supply will increase by 160 billion cubic meters (bcm), over the current total of 3,640 bcm.[9] This is because new technologies have made it possible to extract gas from unconventional sources—including shale, coal-bed methane, and tight gas—at a reasonable cost. For example, in the United States, firms are using hydraulic fracturing—or fracking—and horizontal drilling to extract gas from shale deposits that were once considered uneconomic to drill. As a result, shale gas production in North America grew from around 30 bcm in 2005 to over 400 bcm in 2015.[10]

Facing saturated demand at home, U.S. gas producers have begun exporting LNG abroad. The U.S. Energy Information Administration projects that net U.S. LNG exports could climb to 124 bcm in 2040 from under 5 bcm today.[11] Elsewhere, Australia's LNG exports could rise to over 130 bcm from 40 bcm today, driven partly by its production of coal-bed methane.[12] Other major supply increases could come from Iran, Qatar, and Russia.[13]

Firms and governments around the world have made considerable investments in export terminals to liquefy and ship LNG; the IEA recorded fifteen LNG projects under construction as of 2016, with a total annual capacity of 150 bcm, with deliveries scheduled to begin between 2016 and 2018.[14] Complementing this trend, twenty-nine regasification facilities to import LNG, representing around 107 bcm of total capacity, are under construction. Of these, twenty-one are located in the Asia-Pacific region, representing almost 70 percent of total import capacity under construction.[15]

Box 1. A Primer on Natural Gas Trading

Because of the costly infrastructure required to transport natural gas, its trade has historically lagged behind that of other fossil fuels such as oil. But in recent decades, global trade in gas has risen rapidly, and by 2015, one-third of all extracted natural gas was sold outside the country of extraction.[16] Today, trade via pipeline accounts for 68 percent of total gas trade; Canada, Norway, and Russia account for 54 percent of pipeline gas exports, and Germany, Italy, and the United States account for 32 percent of imports.[17] Trade in LNG represents the remaining 32 percent of traded gas.[18] Australia, Malaysia, and Qatar account for 53 percent of LNG exports, and China, Japan, and South Korea account for 56 percent of imports.[19] Overall, trade in gas is projected to grow 45 percent by 2026, with LNG accounting for two-thirds of this growth, fueled by an almost 60 percent surge in global LNG supply over the next decade.[20]

Historically, there has not been a single global market for trading natural gas as there is for oil. Rather, there is a disparity in the regulations and pricing conventions among different regional markets. In the Asia-Pacific, where 38 percent of gas is imported via long-distance LNG shipping, the price of gas is most commonly linked to the price of oil.[21] Oil-linked pricing is a relic of earlier times when gas was primarily viewed as a competitive fuel for heating, power generation, and industrial applications. In Asia, long-term contracts often prohibit gas from being resold to third parties (through destination clauses) or compel buyers to pay for contracted supplies they do not take (through take-or-pay contracts). By contrast, the North American gas market relies on gas-on-gas, or hub-based, pricing to enable buyers and sellers to efficiently transact and update the market price of gas based on changes in supply and demand. This market is made possible by flexible regulations and an extensive network of pipelines, storage facilities, and LNG facilities that converge in Louisiana's Henry Hub, where a single market price is set and constantly updated. Over the last several years, the European gas market, which used to function like its rigid, outdated Asian counterpart, has moved toward gas-on-gas pricing like the North American market.

OPPORTUNITY FOR GAS TRADE IN THE ASIA-PACIFIC

Asian countries could be the biggest beneficiaries of the increasingly attractive natural gas. Although gas has historically been more expensive than coal, increased global LNG supplies, along with lower oil prices, have lowered prices in the Asia-Pacific.[22] In addition to lowering their energy bills, countries that increased their gas consumption would benefit from a diversity of supply and less air pollution. More gas use in Asia would mean that GHG emissions would fall as gas displaced coal. However, to take advantage of the gas opportunity, Asian countries will need to invest in gas infrastructure and discontinue regulations that inhibit gas trading. Countries in Europe and North America have acted decisively in the past to capitalize on a glut in gas supply, and the Asia-Pacific could now do the same.

Lessons From Europe and North America

In both Europe and North America, gas oversupply has helped liberalize gas markets to take advantage of a newly affordable energy source. Similar to contracts in the Asia-Pacific today, North American gas contracts through the 1970s were long-term arrangements in which prices were heavily regulated or indexed to oil prices, and destination clauses restricted the resale of gas. These contracts became unpopular in the 1980s when U.S. supply overtook demand. Pipeline companies found themselves over-contracted for high-priced supplies that had been secured when gas was scarce, just as their customers were looking to purchase cheap supplies in the emerging spot market, where gas could be purchased for immediate delivery.[23]

Such a free market began to emerge in the mid-1980s, thanks to regulatory reforms passed by the U.S. Congress. These reforms decontrolled the price of gas, unbundled interstate pipeline companies, and required those companies to allow open access to their pipelines so that any local gas distribution company could purchase gas from a faraway producer and pay for pipeline capacity to transport it. This brought gas prices down, encouraged greater use of gas, and ultimately stimulated investment in gas infrastructure to serve rising demand. The private sector has since invested heavily in developing gas supplies and building long-distance pipelines. These pipelines are not confined to the United States; pipelines built between the United States and both Canada and Mexico have resulted in a booming transcontinental gas trade. Across the continent, prices are set relative to the price that traders can obtain at the Henry Hub in Louisiana, where nine interstate gas pipelines converge.[24] Thanks to enabling regulations and infrastructure, the United States has increased its use of natural gas by 58 percent in the last thirty years, from roughly 489 bcm to 773 bcm.[25] The flexible market has made U.S. supply resilient to major supply disruptions, as demonstrated in the aftermath of Hurricane Katrina in 2005, when gas was redirected to wherever demand was the strongest.

Europe has more recently moved to liberalize its gas market. While the United States was enacting regulatory reforms in the 1980s, Europe still traded gas under long-term, bilateral, and inflexible contracts. But by the end of the decade and into the 1990s, after supply surged—from North Africa, Norway, Russia, and the United Kingdom—the UK led the liberalization of its own market and the European gas market.[26] The UK connected its gas infrastructure to that of continental Europe to export surplus gas. And over the next two decades, the European Union (EU) and its constituent governments passed regulations to unbundle vertically integrated gas suppliers, harmonize regulations across borders, remove barriers to cross-border trade, and allow third-party access to pipelines. On top of this, European governments and the private sector invested heavily in pipelines, storage infrastructure, and LNG facilities. National gas regulators across Europe cooperated to develop and operate a pan-European gas grid. As a result, hub-based pricing—based on hubs in Germany, the Netherlands, and the UK—became increasingly popular in Europe, dominating gas sales in the UK and slowly gaining ground from oil-indexed pricing in continental Europe. The EU's slow but steady energy market liberalization has improved Europe's collective energy security by diversifying supply away from Russia.

The Development of Natural Gas Markets in the Asia-Pacific

The Asia-Pacific's limited use of gas, its inflexible markets, and the impending oversupply of LNG all suggest that the region is in the same place that Europe and North America were decades ago when they embraced gas. If Asian countries enacted regulatory reforms and invest in infrastructure, they could create a hub-based trading system that enables them to rapidly expand their consumption of cheap gas.

Asia's gas market originated in Japan, which began importing LNG in 1969 to diversify an energy mix dominated by oil. In subsequent decades, gas trade rose in the Asia-Pacific, but, in contrast to the United States and Europe, trade within the region consisted almost entirely of LNG rather than pipeline gas.

Japan continued to drive Asia's gas demand through the 1990s, and its vertically integrated power utilities preferred to source gas from elsewhere in the Asia-Pacific, including Australia, Brunei, Indonesia, and Malaysia, as well as Russia. By pioneering seaborne gas trade, Japan set the conventions that still characterize the modern Asian market. Japanese utilities secured gas supplies through long-term, oil-indexed contracts with destination clauses restricting the ability to shift cargoes from the contracted buyers. Both buyers and sellers considered long-term commitments and predictable prices essential to underwrite the massive infrastructure required for the LNG trade.[27] In the 2000s, China took over as the driver of Asian gas demand as urban homes and factories switched to gas; the country increased consumption from 50 bcm in 2005 to 180 bcm in 2014.[28] Still, oil-indexed contracts pioneered by the Japanese persist across the Asia-Pacific.[29]

Recently, gas oversupply is stimulating changes in the way gas is traded in Asia, in a manner similar to what happened in Europe and North America. Even though LNG trade among countries in the Asia-Pacific retains oil-indexed contracts, U.S. LNG exporters, which entered the region in 2016, have adopted a more market-oriented pricing approach. They are charging Asian buyers prices that depend on the Henry Hub price, with the costs of liquefaction and shipping added in. Since Henry Hub prices are much lower than those in traditional Asian gas contracts, this new approach could undercut oil-indexed contracts and support the emergence of a spot market for Asian gas trade.[30] Moreover, even contracts among Asia-Pacific countries are becoming more flexible, through shorter terms and fewer rigid destination clauses.[31] New suppliers are seeking to undermine the privileged position of existing suppliers and their long-term, rigid, and oil-indexed contracts. Since LNG cargoes can be easily rerouted to match changing demand patterns—unlike pipelines that link fixed locations—flexible LNG markets could make it easier for both buyers and sellers to diversify their trading partners.

If economic pressure continues to undermine rigid contracts, and if Asian countries enact regulatory reforms and invest in infrastructure, gas consumption in the Asia-Pacific could rise dramatically. Although China is Asia's largest consumer of gas, gas only accounts for 5 percent of China's energy demand. Similarly, gas only accounts for 5 percent of energy demand in India, and despite its skyrocketing energy needs, growth in India's gas consumption is flat.[32] Gas could meet the needs of Asia's large and growing economies while providing significant associated benefits. By tapping into the vast pool of new LNG supplies from all over the world, Asian countries could diversify their energy supplies and enhance their energy security. A more flexible and liquid gas market would also reduce the market power exercised by any one producer. In addition, the replacement of coal by natural gas can ameliorate local pollution—a major public health issue in many cities in the Asia-Pacific—thanks to the lower levels of sulfur, mercury, and nitrogen oxide released from burning natural gas. Increased use of natural gas will make it easier for Asian countries to curtail their GHG emissions and meet international climate commitments; without embracing gas, such achievements will be nearly impossible.[33]

A CLOSING WINDOW

The window of opportunity for the Asia-Pacific to embrace natural gas is unlikely to stay open for long. If Asian countries fail to make infrastructure investments or enact regulatory reforms while prices are low, it is unlikely that they will begin investing when prices spike. Such a spike, counterintuitively, is exactly what could happen as a result of increasing gas market oversupply.

Natural gas exports are spiking globally, but demand is not keeping pace even as overall energy consumption grows. Although North America accounts for the most demand in the world—consuming 950 bcm annually—the IEA projects that the demand will grow tepidly, if at all, especially as renewable energy additions outpace gas use in the power sector.[34] In Europe, gas use—roughly 433 bcm per year—has not yet recovered to pre-2008 levels and will likely only increase modestly.[35] Within the Asia-Pacific, developed economies such as Japan and South Korea consume 240 bcm annually—half of all regional LNG trade—but that figure could fall, especially if Japan can successfully restart its nuclear reactors and displace gas-fired power generation.

That leaves emerging Asian economies, accounting for 300 bcm annually, as the possible source of gas demand growth, but those economies are poised to disappoint as well. In 2015, China's gas demand grew by only 4 percent, in contrast to the 15 percent growth it experienced over the previous five years. In India, gas demand could grow by 6 percent annually, but that forecast is uncertain. Gas demand in Latin America and the Middle East might grow but with only a modest effect on global demand. Altogether, the IEA projects that global demand might grow by 140 bcm by 2021, compared with 160 bcm of new global production.[36]

So far, this oversupply has caused gas prices to fall. As a result, the private sector has already begun scaling back on investments in infrastructure to produce, store, and transport gas. This trend is reminiscent of the oil market in the 1990s, when low prices dissuaded companies from investing in new sources of production. By the 2000s, demand outpaced supply and oil prices rose relentlessly for a decade. A similar boom-bust cycle could be on the horizon for the gas market. Low gas prices are deterring upstream producers from exploration, and globally, new investments in infrastructure to export LNG halted in 2016. Whereas the current oversupply is the result of decisions made over the last decade to invest in gas production and infrastructure, falling investment flows today could send the market into a shortage within the next decade, resulting in increasing prices as boom turns to bust.

Such a price spike would undermine the ability of countries in the Asia-Pacific to make substantial infrastructure investments to increase their consumption of gas. These investments include building national pipeline grids to distribute gas to urban centers where demand potential is the greatest as well as connecting with pipelines in neighboring countries to enable a flexible regional gas market. Still, unlike in North America, a single market hub where most pipelines intersect is unlikely to form in Asia because Asia's regional gas trade relies much more heavily on LNG. Instead, a strong Asian gas trading market could have several hubs, as in Europe, with each hub's price linked to others' but differing by the costs of shipping LNG. To realize this vision, terminals to import and regasify LNG are crucial to increasing imports of newly abundant LNG. Further, gas storage facilities are necessary to buffer seasonal swings in gas demand—for example, from heating or from the power sector—and to enhance energy security. But if gas prices rise, other fuels such as coal will become more attractive, depressing the investment climate in gas infrastructure and discouraging governments from promoting gas use.

If gas is considered expensive and uncompetitive, governments are unlikely to prioritize market reforms needed to speed gas adoption. For example, Asian countries need to require third-party open access to pipelines and LNG terminals and remove gas price controls in order to enable gas trading and the emergence of accurate, responsive, and transparent market prices at each of several hubs, based on the fundamentals of supply and demand. Only through such reforms can the region gain access to flexible and secure supplies of affordable gas. So long as Asian gas demand—especially in emerging economies—stagnates, global oversupply is in danger of rapidly giving way to a supply shortage and a spike in prices, and the Asia-Pacific will lose its opportunity to embrace gas.

How Asia Could Power a Sustained Increase in Gas Demand

Emerging Asian economies need a prolonged period of abundant and affordable gas supply for firms to make profitable infrastructure investments and for governments to enact enabling reforms. At the same time, the Asia-Pacific needs to step up its demand for gas suppliers around the world to invest in supply infrastructure. No other region has economies that do not already rely heavily on gas or are dynamic enough to boost demand to balance an oversupplied market. Therefore, with Asian demand currently flagging, suppliers are pulling back and priming the market for a shortage and price spikes.

It falls to the Asia-Pacific to self-start a sustained increase in demand. A sufficient uptick in Asian gas demand could stabilize gas markets long enough for the countries in the region to build infrastructure and enact regulations to gradually increase gas use. Determining if and how this might be possible requires, first, projecting the most likely trajectory for Asian gas demand and, second, identifying the countries that could plausibly increase their demand over those projections.

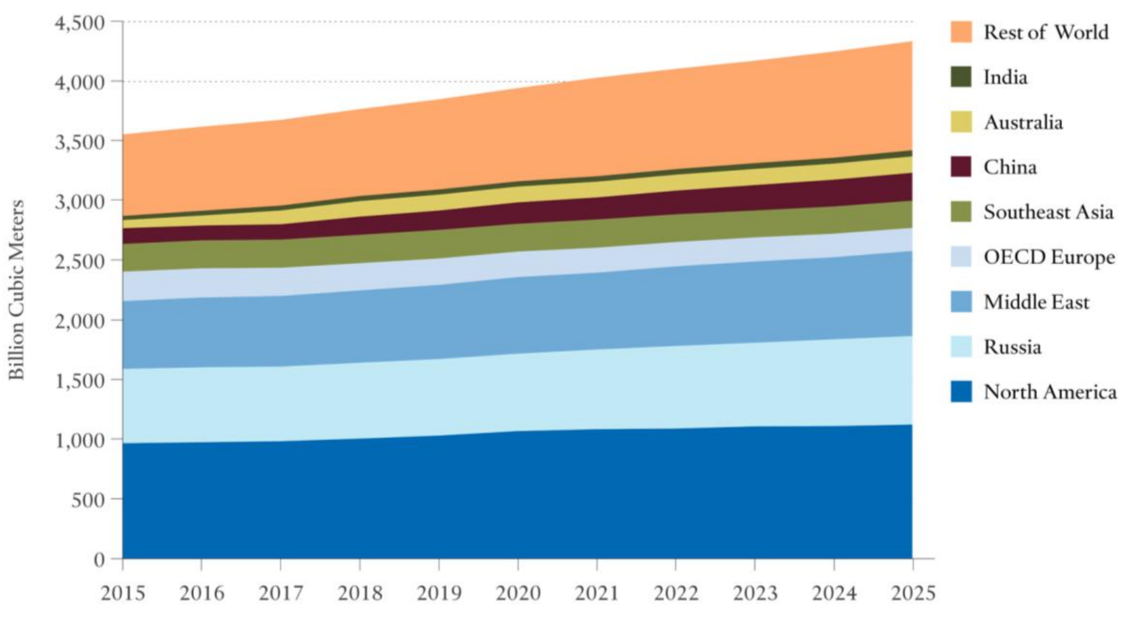
PROJECTING THE BASELINE SCENARIO

To develop a baseline projection for gas demand in the Asia-Pacific, the Nexant World Gas Model—as implemented by the Energy Studies Institute at the National University of Singapore—is used to project future natural gas supply and demand around the world (see appendix). The data used by the model is based on the 2015 New Policies Scenario in the IEA's World Energy Outlook and takes into account the effects of energy policies and pledges made by governments globally—even if they have not yet been implemented—on energy supply and demand. Assumptions about population changes and macroeconomic performance are taken from data from the United Nations, the Organization for Economic Cooperation and Development (OECD), the International Monetary Fund, and the World Bank. Assumptions about end-user fuel prices in the baseline scenario come mostly from time-series data for coal, oil, gas, electricity, heat, and biomass, drawn from the IEA's database on energy prices and taxes.[37] The resulting model projections for demand for different fuels is disaggregated by sector for each country, yielding demand estimates for national industry, transport, residential, services, and agricultural sectors.[38]

Although the baseline projection of global gas demand reveals growth over the next decade, the increase is not enough to match the enormous supply projected to become available in the next five years. Consistent with the IEA data from which the baseline scenario is derived, the model predicts that demand for natural gas will increase from 3,500 bcm in 2014 to 4,100 bcm in 2025, with much of the projected growth in global gas demand centered on the Asia-Pacific region, specifically China and India.[39] Natural gas demand from China, for example, increases annually by 7.8 percent on average in the baseline scenario. Demand in India is projected to increase at 7.1 percent, although from a much lower base.

The model projects that the increase in demand would be served by incremental supplies from Australia, the Middle East, North America, Russia, and Caspian countries (Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan) (see figure 1).[40] This gas is projected to be transported via pipelines and sea. Pipeline gas transport is expected to increase from 2,020 bcm in 2015 to 2,660 bcm in 2025, while seaborne LNG exports would rise from 330 bcm in 2015 to 550 bcm in 2025.

Figure 1. Global Natural Gas Supply by Region in Baseline Scenario



Source: Authors' estimation from the model.

Breaking down these numbers can set baseline expectations for gas flows around the world and make it possible to discern geopolitical effects of a potential uptick in Asian demand and resultant shifts in global flows. In the baseline scenario, one-third of the increase in LNG trade would come from a thirty-fold increase in U.S. LNG exports, which would be destined for Europe, India, Japan, and South Korea. India's reliance on LNG in particular means that Australia, the Middle East, and North America would benefit from the projected increase in Indian demand, with the majority of LNG coming from the Middle East. By contrast, in China, the incremental increase in gas demand under the baseline scenario would be met by a mix of pipeline gas and LNG imports. Pipeline imports to China—mostly from Russia and Caspian countries—would increase from just over 50 bcm in 2016 to 126 bcm by 2025. China's LNG imports, on the other hand, would only grow from 38 bcm in 2016 to 50 bcm by 2025, mostly from Australia, the Middle East, and Southeast Asia, and, from 2020 onward, from Papua New Guinea and Russia.

IDENTIFYING INCREASE IN DEMAND FROM CHINA AND INDIA

Having defined the baseline scenario of gas demand, the next step is to identify the most plausible source and magnitude of an increase in Asian gas demand. Expectations of future gas supply and demand can change unpredictably. The rise of unconventional gas production transformed North

America's gas prospects. On the demand side, China emerged as a significant consumer of gas rapidly, with demand increasing from 28 bcm to 188 bcm between 2000 and 2014, before the recent slowdown that threatens global gas market stability. A similar increase in gas demand over the baseline projection could most plausibly come from the Asia-Pacific, which is projected to account for over two-thirds of global energy demand through 2025.

A three-part test can narrow down where that increase could come from. First, a demand increase significant enough to help stabilize global markets would only come from a large economy, which narrows the scope to China, India, Japan, South Korea, and Thailand. The Association of Southeast Asian Nations (ASEAN) treated as a single unit could be a significant source of future gas demand, but energy market decisions remain almost wholly under the domestic control of ASEAN members. Therefore, this analysis does not consider ASEAN as a single demand center. Second, a candidate economy should be growing, thus requiring incremental energy supplies. Third, the economy should not already have achieved a high degree of gas penetration to enable gas, rather than another fuel, to fulfill the increase in energy demand. This test narrows down the sources of increased future demand to China and India, ruling out Japan, South Korea, and Thailand (see table 1). Japan, for example, is the second largest gas market in the Asia-Pacific, but Japan's already-high per capita income, low economic growth, declining population, and potential substitution from gas to nuclear power in the coming years make it highly unlikely that Japan's gas demand will increase considerably by 2025.

Table 1. Natural Gas Demand in the Asia-Pacific

	2015 Demand (in BCM)	Average Year-Over-Year Change (2006–2015)
Australia	34.3	3.4%
Bangladesh	26.8	7%
China	197.3	15.3%
Hong Kong	3.2	3%
India	50.6	4.1%
Indonesia	39.7	1.2%
Japan	113.4	3.9%
Malaysia	39.8	1.5%
New Zealand	4.5	2.6%
Pakistan	43.4	1.1%
Philippines	3.3	1%
Singapore	11.3	6.1%
South Korea	43.6	4.1%
Taiwan	18.4	7.1%
Thailand	52.9	5.1%
Vietnam	10.7	5.4%
Other Asia-Pacific	7.8	4.3%
Total Asia-Pacific	**701.1**	**5.5%**

Source: BP Statistical Review of World Energy 2015.

Unlike Japan, China and India are developing countries with huge populations. They also have large projected future energy demand and infrastructure investment needs. Looking to 2025, for example, China and India account for 53 percent of the increase in global energy demand. At present, gas is a relatively small part of their energy use—5 percent each for China and India. By contrast, the share of gas in energy demand is around 28 percent in the United States and around 25 percent in Europe.

Although gas demand in both China and India grow in the baseline projection by 7 to 8 percent annually—doubling by 2025 with increases of 190 bcm and 45 bcm, respectively—there is potential for much higher growth. Even if Chinese and Indian gas demand increased 25 percent beyond the baseline projection, gas use as a proportion of total energy demand in these countries would still be at levels well below those of OECD countries, implying substantial latent gas demand in both countries.

The power sectors of the two countries offer the most scope for increasing gas demand. For example, gas is the energy source for little more than 4 percent of Indian electricity generation, with some 28 gigawatts of gas-fired capacity that is chronically underutilized—the capacity factor is 24 percent—despite massive unmet power demand, especially at peak load times. China has a similar situation.

Raising utilization rates for existing and planned power generators would be desirable for both countries and would deliver increased power supplies with much lower pollutant levels compared with coal. It would also buffer and help integrate intermittent wind and solar energy. In India, any increase in power capacity is welcome, given the quarter of a billion people without access to electricity supply and chronic gap between power supply and demand. If both China and India raised even existing power plant utilization to 50 percent, gas demand in the power sector alone would increase by about 25 bcm and 18 bcm, respectively; this means respective increases in gas demand of 13 percent and 40 percent over the incremental increase in the baseline projection. In China, the projected increase in demand could be more than doubled by including the potential for increased use of gas for heating in factories and urban homes. Altogether, 25 percent increases over the baseline projection for gas demand growth are plausible for both China and India and would result in overall gas use that would still be surpassed by OECD averages.

Nevertheless, there are obstacles to increased gas use in China and India. The Chinese government is wary of increased reliance on natural gas, which would increase dependence on imports. In India, financially embattled power distribution utilities struggle to procure sufficient power from generators, which makes it difficult for gas plants to increase their output; moreover, expensive import terminals for LNG are needed to bring in new gas supplies, but domestic project finance is scarce. Neither country has energy and power markets that give gas-fired power generators an advantage over coal, unlike in the United States. Moreover, in both countries, price ceilings on the sale of natural gas discourage private sector investment in the infrastructure to import and transport gas.

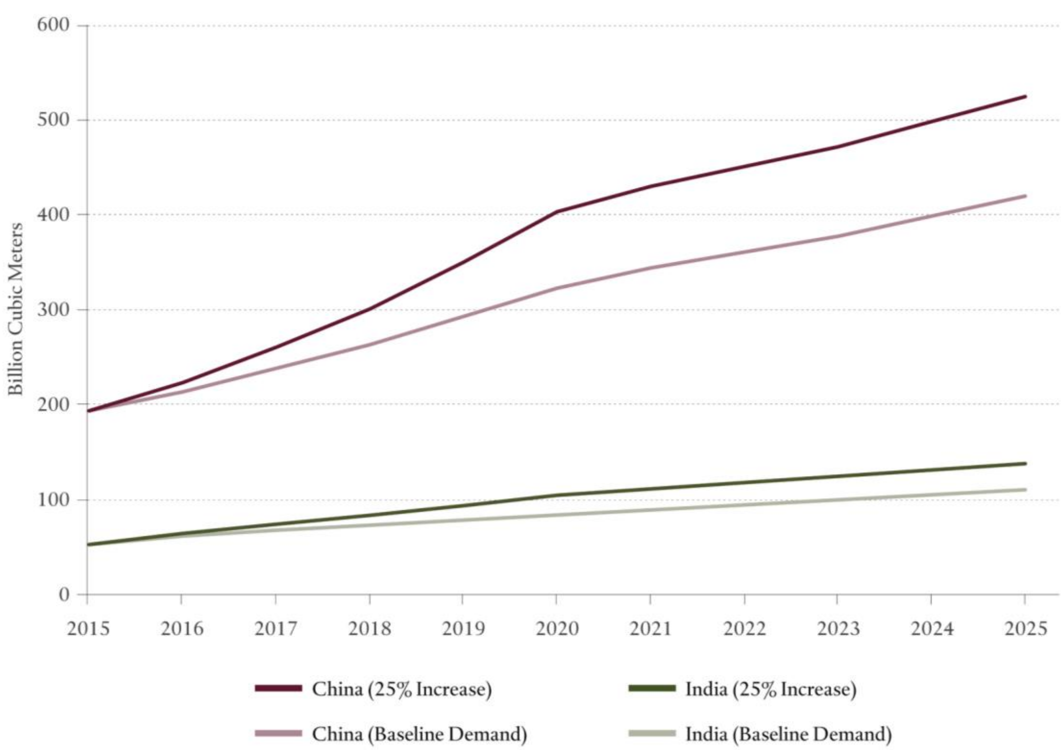
Yet, both countries' governments have demonstrated interest in increasing natural gas use. China's thirteenth five-year plan calls for switching from coal to gas, and India's Prime Minister Narenda Modi has prioritized the shift to a natural gas economy.[41] If policy shifts in China and India improve the investment climate for gas, demand could rise above the baseline projections. That incremental demand is unlikely to be met by local supply, as both China and India have struggled to boost domestic production.[42] Thus, China and India could plausibly increase their gas demand by 25 percent through 2025 over the baseline projection.

Insights From Simulating an Increase in Asian Gas Demand

With the source and magnitude of a potential increase in Asian gas demand over the baseline projection established, the final step is to rerun the model to see if China and India could successfully stabilize global gas markets by bringing global gas prices to levels high enough to sustain investment in new supply and export infrastructure yet sufficiently low to keep consumption affordable. This would keep the window of opportunity open for the Asia-Pacific to embrace natural gas. The model results can also reveal which suppliers are likely to benefit the most from an increase in Asian gas demand and the potential geopolitical implications.

Rerunning the model entails retaining the same assumptions—including supply sources, supply infrastructure, and pricing—and evaluating the effects of a 25 percent increase in Chinese and Indian gas demand over the baseline scenario for global gas prices and flows from 2020 through 2025.[43] The difference in projected gas demand under the baseline scenario compared with the increased Chinese and Indian gas demand scenario is shown in figure 2. By 2025, collective Chinese and Indian gas demand would increase from 529 bcm to 670 bcm, with China accounting for 81 percent of the incremental amount.

Figure 2. Scenarios for Natural Gas Demand Increases in China and India

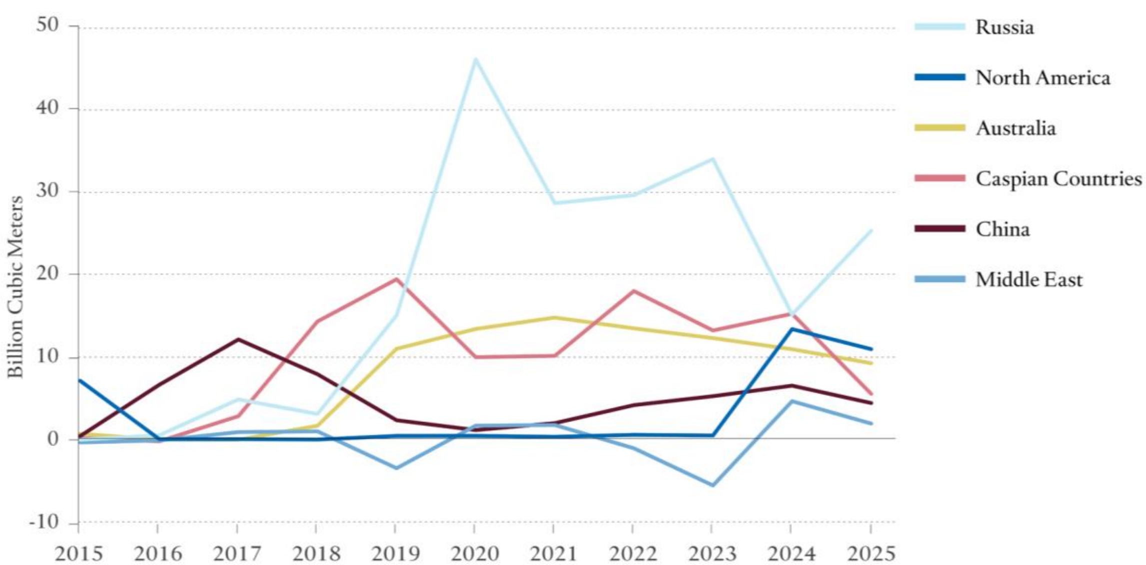


Source: Authors' estimation from the model.

EFFECTS OF HIGHER DEMAND ON GLOBAL GAS FLOWS

Feeding in both scenarios and comparing the model output yield projections for which gas producers would benefit the most from the increase in Asian gas demand. Figure 3 plots the change in each global supplier's gas production relative to the baseline case. A marked increase in Chinese and Indian gas demand is projected to be met through imports rather than by producers in the two countries, where only limited supplies of unconventional gas could be tapped economically before 2025.

Figure 3. Modeled Changes in Global Gas Production, Relative to Baseline

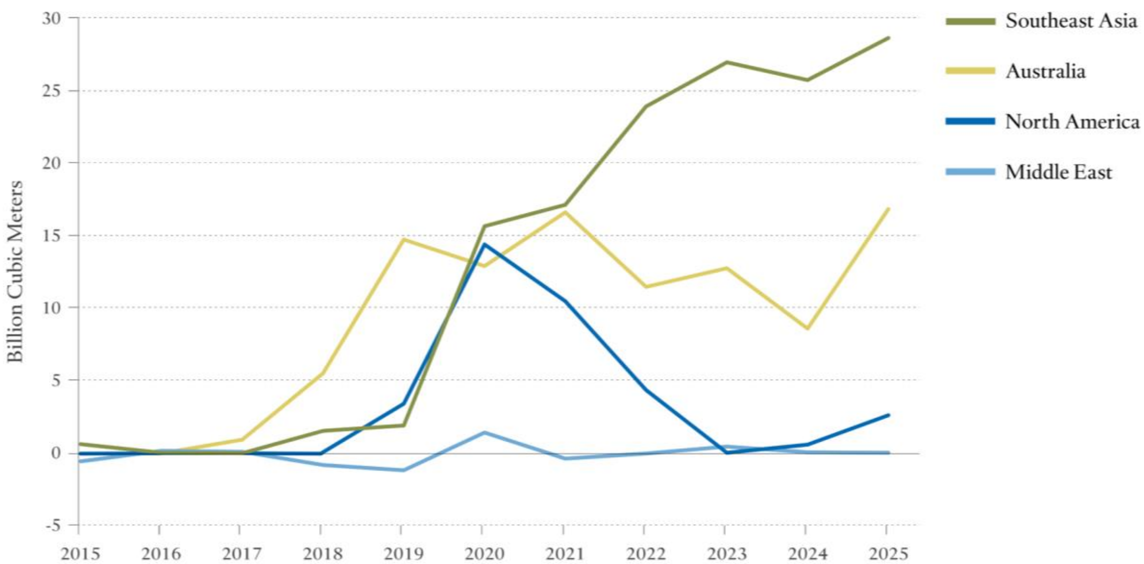


Source: Authors' estimation from the model.

Of the global producers that serve the incremental demand from China and India, Russia benefits the most. Its projected gas production increases by a cumulative total of 200 bcm over the 2015–2025 period, with mean annual production of 885 bcm compared with 667 bcm in the base case. Australia and Caspian countries, with production increased by 87 bcm and 100 bcm, respectively, would also gain. North America, on the other hand, would experience little production change between the two scenarios, although it would produce the largest volumes of gas throughout the forecast period, buoyed by the size of domestic markets.

Russia's production could increase so sizably because its pipeline exports to China are projected to account for one-third of China's incremental demand. Russian exports would begin in 2020 with the opening of the Power of Siberia pipeline and grow slowly through 2025 (see figure 4). The utilization rate of import pipeline capacity into China is close to 100 percent over the forecast period, demonstrating the superior economics of these projects compared with LNG trade with China. However, because pipeline capacity is limited, the remaining two-thirds of China's incremental demand is projected to be met by LNG imports, 87 percent of which would come from Australia, Indonesia, and Malaysia.

Figure 4. Modeled Changes in LNG Exports to China by Supplying Region, Relative to Baseline



Source: Authors' estimate from the model.

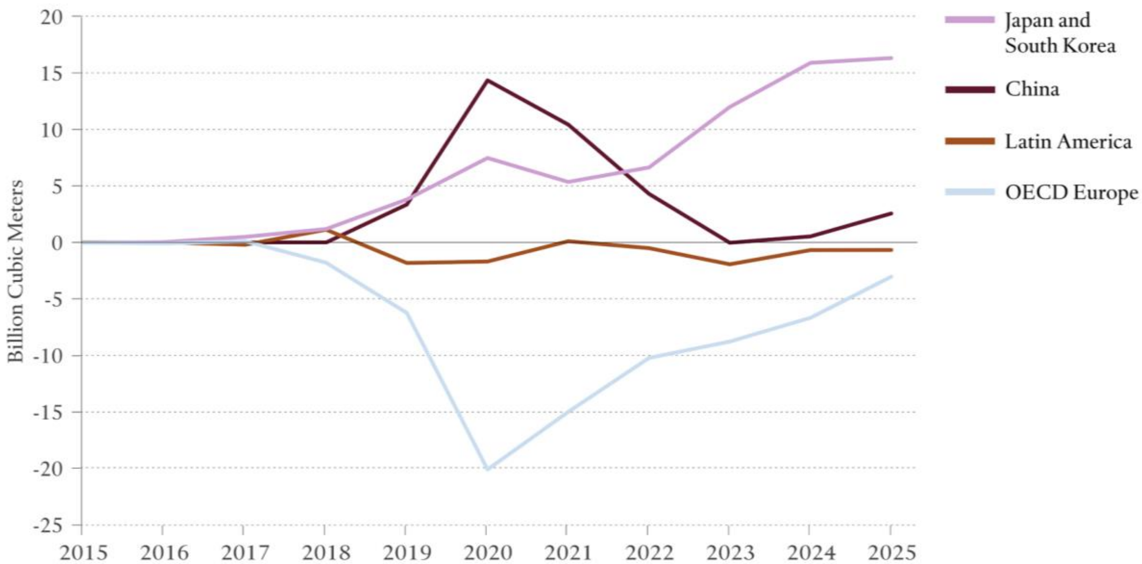
In contrast to Chinese demand, Indian incremental gas demand is projected to be met solely through increased LNG imports, owing to the absence of additional import pipeline capacity within this time frame. Incremental LNG supplies are projected to originate in sub-Saharan Africa (46 percent) and the Middle East (54 percent); North American LNG exports to India would not increase because of disadvantageous freight costs.

In addition to increased Russian pipeline exports, the other major effect of a potential increase in Chinese and Indian gas demand would be a reorganization of LNG trade flows within the Asia-Pacific and globally. LNG cargoes from Australia and Southeast Asia would be diverted from Japan, South Korea, and South Asia to reach China, which would be paying higher prices. Altogether, the two exporters would increase their shipments to China by nearly 200 bcm and reduce their exports to the rest of the region by a similar amount. North American suppliers would help fill the gap, most notably by increasing exports to Japan and South Korea by over 15 bcm (see figure 5). The secondary effect is that North American LNG exports to Europe are projected to decline as gas increasingly flows toward the higher-priced Asia-Pacific markets.

These changes in global gas flows, as a result of increased Asian gas demand over the baseline project, could compromise U.S. foreign policy interests. The increase in production would give Russia an economic boost, thus weakening the efficacy of U.S. economic sanctions and strengthening Russia's hand in situations in which its stance conflicts with U.S. interests, such as its ongoing military operations in Syria or prior operations in Ukraine. Moreover, the reduction in U.S. LNG exports to Europe could expose U.S. allies to higher levels of import dependence on Russia.

Notably, however, even though overall U.S. exports do not increase significantly, the shift of U.S. cargoes toward Asian countries such as Japan and South Korea could strengthen economic ties between the United States and its allies. Increased U.S. gas exports to Asia, priced via flexible contracts, could continue to erode the rigid Asian gas markets, opening new opportunities for the United States and enabling a more diverse market with multiple supply sources for Asian countries.

Figure 5. Modeled Changes in North American LNG Exports by Destination, Relative to Baseline



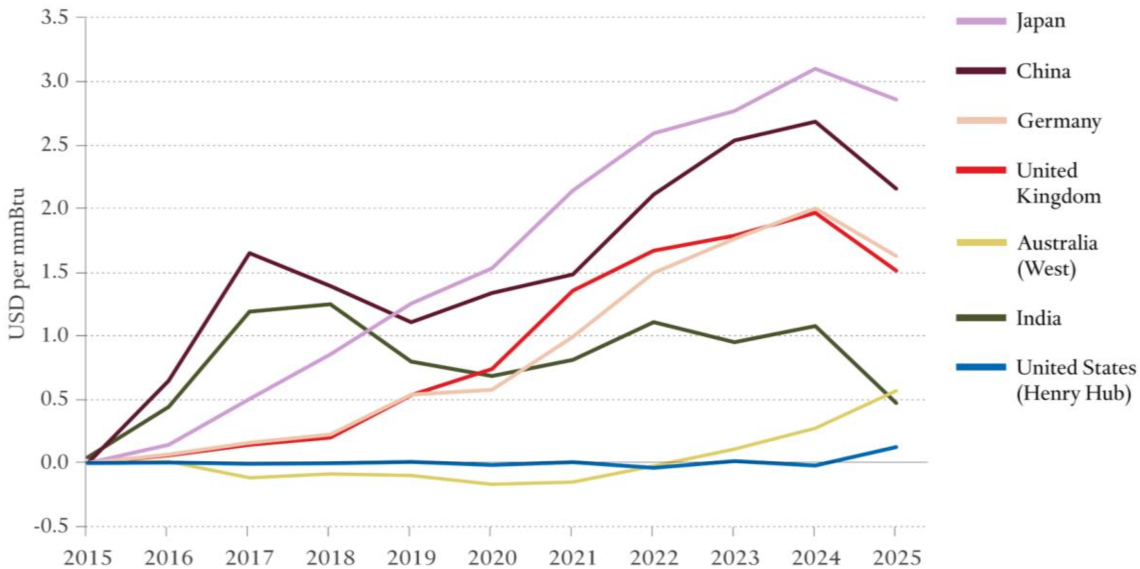
Source: Authors' estimation from the model.

EFFECTS OF HIGHER ASIAN GAS DEMAND ON GLOBAL PRICES

Despite potentially strengthening Russia's gas market position, an increase in Asian gas demand would likely advance U.S. interests overall by stabilizing the global gas market and paving the way for a long-term demand increase in Asia, which is a lucrative market for U.S. gas exports. In addition to predicting shifting flows, the model projects stable and moderately higher gas prices that justify continued global investment in gas supplies and infrastructure, thanks to an increase in Asian gas demand.

Figure 6 shows the change in selected gas prices relative to the baseline scenario. Overall, the results show that a 25 percent rise in consumption in China and India would lead to wholesale price increases in markets outside Australia and North America. Gas spot prices would rise on average by $1.5 per million British thermal units (mmBtu) in China and by $0.8 per mmBtu in India. As a result of reorganized Asia-Pacific trade flows, Japanese and South Korean prices are projected to rise by $1.5 per mmBtu, relative to the baseline; European prices should also increase. The link with crude oil prices in many current contracts means that the projected price path is influenced by assumptions about the future path of oil prices, which is unpredictable. This analysis uses the World Bank's forecast to 2025, with gas prices calculated as a function of lagged oil prices for oil-indexed contracts, given that many contracts are priced one or two quarters in lag with oil prices. Brent prices are projected to steadily increase into the $80 per barrel–range in 2025.

Figure 6. Modeled Changes in Natural Gas Prices by Region, Relative to Baseline



Source: Authors' estimation from the model.

The model results suggest that natural gas spot prices would increase by more than 20 percent even with a modest 3 percent increase in global demand, from the assumed increases in Chinese and Indian gas demand. This suggests that an increase in demand from these two countries could lead to significant price increases in import nations in the Asia-Pacific. These price increases should be sufficient to reverse the trend of global gas suppliers withdrawing investment in new production or infrastructure to export gas. Yet, a 20 percent increase in gas prices is not enough to erase the attractive economics of gas compared with coal—for example, with respect to power generation—that will be needed for Asian countries to embrace gas and enjoy the attendant benefits of energy security, decreased air pollution, and lower GHG emissions. (That is not to downplay the importance of environmental regulations limiting the uptake of coal, which can speed the transition toward natural gas over and above the rate induced by the favorable economics of natural gas.) In other words, the 25 percent increase in gas demand from China and India—a plausible change from the baseline projection—is a Goldilocks boost to global demand that could stabilize gas markets and make both production and consumption economically attractive.

North American exporters—predominantly those based in the United States—are critical in moderating this increase in prices from a comparatively small increase in Asian gas demand. These producers collectively act as swing suppliers, shifting gas from Europe to more profitable markets in the Asia-Pacific, particularly China, Japan, and South Korea. Thus, while U.S. exports of cheap, unconventional gas are only a small share of global gas use, they have a disproportionate effect on markets, pitting Asian and European consumers against one another in a competition for those supplies, leading to the rerouting of cargoes in response to small demand changes, and promoting global integration of markets. Although there are substantial price differences among the different regions where gas is traded, prices should start to converge by 2025 because of the competition between the Asia-Pacific and the rest of the world for flexibly priced and traded North American LNG.

Recommendations

Increasing Asia's demand for natural gas—first by just enough in China and India to stabilize global markets, then ultimately in a substantial and sustained way that displaces coal use and opens new markets—advances U.S. interests. Whether gas demand in China and India will exceed baseline projections over the next decade depends on the countries' domestic policies. To encourage such an outcome, the United States should provide technical assistance and urge multilateral financial institutions like the World Bank to also provide financial assistance. At the same time, the United States should help the broader region transition toward a hub-based gas market to lay the groundwork for a sustained increase in regional gas demand. Further, recognizing that gas only mitigates climate change insofar as it offsets GHG emissions resulting from consumption of coal, the United States should provide technical assistance to Asian countries to minimize leakage of methane and other gases.

ENCOURAGE CHINESE AND INDIAN EFFORTS TO INCREASE GAS CONSUMPTION OVER THE NEXT DECADE

Both China and India will need to invest in gas infrastructure and reform their internal gas markets to increase their consumption of gas over baseline projections. The Indian government should fast-track permits for additional LNG import terminals across the country, new pipelines for a national gas grid, and strategic storage facilities to protect against supply disruptions. Public financing or credit enhancements could supplement private sources of infrastructure funding. In addition, the government should reform the gas industry and create a liberalized market by, for example, unbundling gas transportation from retail and removing price controls. In China, the government should improve access to imported gas outside Beijing and Shanghai by constructing LNG terminals and pipelines. Currently, in twenty-two out of China's thirty-one regions, less than 40 percent of the population has access to gas. The Chinese government should also reform the way gas is sold, particularly by removing administrative price controls on the price of gas-fired electricity generation, which is a valuable buffer for intermittent renewable energy generation and should increase if compensated fairly.

In India, removing price controls is politically fraught because large industrial gas consumers (e.g., in the fertilizer sector) exert influence to maintain an illiberal gas sector. In China, the coal power sector prevents gas-fired generators from receiving higher revenues for providing peaking power to compensate for variable renewable energy. While these domestic political considerations lie largely outside of U.S. influence, there is cause for optimism: India, for example, has, over the last two years, incrementally reformed its gas prices and taken steps to increase gas use in the power sector.

The United States has succeeded, through regulatory reform, in sparking investments in infrastructure and developing a liberal market that has supported a sustained increase in gas consumption. Therefore, it should sponsor technical exchanges with China and India, sending officials from the U.S. Federal Energy Regulatory Commission, which oversees the domestic gas sector, and the Department of Energy, which oversees exports and imports of LNG, to share their expertise. Such efforts need not be limited to these two countries, but they are important priorities given the large potential for increase in gas demand. In addition, given U.S. influence over the governance of multilateral financial institutions such as the World Bank, the United States should advocate for these institutions to provide financial assistance for gas infrastructure projects, especially in India to increase its capability to import and use LNG. Moreover, the United States should continue to urge China and India to pursue more ambitious targets for reducing GHG emissions, which would be well served by adopting gas, in tandem with renewables, as a replacement for coal.

ADVISE ASIAN COUNTRIES ON SETTING UP HUB-BASED MARKETS

Besides supporting China and India in building up their gas demand, the United States should help establish a thriving Asia-Pacific gas market that enables substantially higher consumption in the region. Private sector actors are already responding to changing market conditions in the Asia-Pacific by increasing the use of gas contracts linked to globalized gas prices, such as the Henry Hub, and enabling flexibility in destination clauses used in contracts. The United States has a crucial role in promoting the development of a gas market in the Asia-Pacific based on transparency and nondiscrimination.

Although only a small share of global gas use, U.S. exports of LNG, based on gas-based pricing and fully flexible in terms of destination, claim a relatively large share of trade in gas among regions of the world—such as the Asia-Pacific, North American, and European regions—whereas many other producers tend to supply gas intra-regionally. Therefore, U.S. LNG exports can have an outsize effect on the prices and flows of traded gas by competitively linking oversupplied regional markets. In this sense, U.S. commitment to permit gas exports outside North America is an important policy setting that provides both domestic and global benefits, especially in the Asia-Pacific region.

China, Japan, and Singapore are currently developing competing plans for hub-based mechanisms to facilitate trading. Even if multiple trading hubs emerge, if they are connected within a single market with uniform and transparent regulations, they could lead to regional gas market pricing that links fundamental supply and demand across the Asia-Pacific. The European experience suggests that coordinating initiatives designed to improve market functioning can help. Therefore, the U.S. government, through the Department of State and other agencies, and in conjunction with counterparts in the Australian government, should help regional governments coordinate regulations for establishing a hub-based trading system in the Asia-Pacific. This coordination could occur on a bilateral basis or through international organizations such as the Asia-Pacific Economic Cooperation. In addition to examining the technical requirements for the establishment of a trading hub, the United States should advise on issues such as third-party access to infrastructure in consumer countries—notably LNG terminals and large gas pipelines—as well as the development of appropriate regulatory institutions.

SHARE BEST PRACTICES TO MINIMIZE METHANE LEAKAGE

As the United States promotes gas use in the Asia-Pacific, it should seek to ensure that increased emissions of methane, a potent GHG, do not offset the environmental benefits of switching from coal to gas. Across the gas supply chain, from extraction to transportation and delivery, methane can leak out of wells, pipelines, and storage containers. The U.S. Environmental Protection Agency has developed best practices for minimizing the so-called fugitive methane emissions, and these guidelines could help Asian countries avoid such emissions.

The Department of Energy and its national laboratories and the Environmental Protection Agency should partner with gas producers such as Australia to provide technical assistance to countries in designing their gas infrastructure in order to minimize leaks across the entire supply chain. The United States should seek collaboration with the IEA to help disseminate these guidelines broadly. If Asian countries follow these best practices while creating thriving gas markets, they can enjoy the benefits of a transition to natural gas while limiting global climate change.

Appendix: Technical Details

This paper uses a quantitative model to assess the implications of an increase in demand in China and India on natural gas prices and on gas suppliers. In general, to understand the effect of such a change, the authors compare the results of this simulated demand increase with a base-case scenario developed by the Energy Studies Institute at the National University of Singapore.[44] Demand and supply projections in the base case are similar to those in IEA New Policies Scenario. In the base case, global natural gas production capacity is set to increase from 3,884 bcm to 6,025 bcm (1.77 percent compound annual growth rate [CAGR]) while demand increases from 3,584 bcm in 2015 to 5,077 bcm in 2040 (1.47 percent CAGR). This can be compared to the IEA reference case estimate of 5,007 bcm in 2035.

The model incorporates all countries that produce or consume natural gas. Supply data is included in the database as a cost curve for each producing country. The cost curves include a maximum production profile over time and cost of production. Production capacity and forecasting data include all active and future or potential natural gas production fields in natural gas producing countries. Annual production capacity, type of field, and marginal cost of production are the important parameters. The cost curves are made by aggregating reservoir production capacity and marginal cost of production for each of the production fields in the country.

The model also incorporates infrastructure capacity constraints implicit in trade by pipeline, LNG liquefaction facilities, and regasification and storage capacity, together with associated costs. The infrastructure information includes information on location, start and end dates of operation, source and destination, pipeline capacity, start and end dates of pipelines, and transportation tariffs.

Trade is simulated through nodes, with less significant countries in the global gas market modeled as single nodes, and larger countries, including Australia, Canada, China, Indonesia, Malaysia, Russia, and the United States, divided into multiple nodes. Demand for each node is treated as exogenous in the simulation. The model balances supply and demand through the price mechanism while minimizing gas procurement costs, which include both production and transport costs. Balancing is done on a quarterly basis, allowing the model to simulate the effects of variation in seasonal demand.

Contracted and uncontracted flows of gas are also modeled in order to take into account the effect of existing contractual arrangements, such as contract clauses restricting destination. Of the 207 active LNG contracts in East Asia, only fourteen contracts are hub-based (Henry Hub or National Balancing Point); one is mixed contract (Japan Crude Cocktail and Henry Hub), and the rest are all oil (Japan Crude Cocktail). All pipeline contracts are indexed to oil derivatives, or heavy fuel oil, in China. Thus, the model approximates the physical and contractual characteristics of the gas market that shape trade.

Prices in the spot market are delivered-ex-ship prices. The model first calculates a shadow price, defined as the marginal cost of procurement of gas to a specific country after optimizing the model.

This is determined by how tight the market is, as a function of supply conditions in the region, and competing fuel prices. In the base case, competing fuels are oil derivatives and coal. This spot price modeling means tighter markets lead to higher prices, constrained by alternate fuel costs. Over-supplied market prices can go as low as the marginal cost of production. Hence, the spot price range is constrained within these limits, with regional contract prices and oil prices affecting the price level. Price changes in the model can be explained by changes in oil price, which has a significant effect on the rise in prices in the 2016–2020 period, and changes in supply. Thereafter, the price rise is moderated by increase in the market's gas supply.

Data for demand is based on historical data on economic growth projections, energy intensity, and population for the industrial, commercial, and residential sectors. Demand for major fuels that compete with gas are also included in the model, with historical prices for both oil and coal taken from the IEA's energy prices and taxes database and adjusted to 2012 real-price levels. For supply, nodes are characterized by annual production capacity, field type, and marginal production costs. Thus, the marginal production costs for unconventional gas production is higher than those for conventional fields. Historical gas prices reflect lagged oil prices for contracts that are indexed to oil, an important feature given the role of oil-indexed gas prices in the Asia-Pacific region.

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quently affect prices, scenario projections out to 2025 should be considered as indicative of possible trends and represent relative effects on production and prices. They do not represent a forecast of what will be the actual state of gas markets in 2025. In other words, the model results provide a lens on the possible effects of increased gas demand in China and India, relative to a baseline, rather a definitive prediction of outcomes. The purpose of the modeling and presentation of the findings is not to provide definitive advice as to what will happen in 2025 but to give an indication of relative supply and price impacts of a scenario that assumes increased gas demand in China and India relative to a baseline.

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