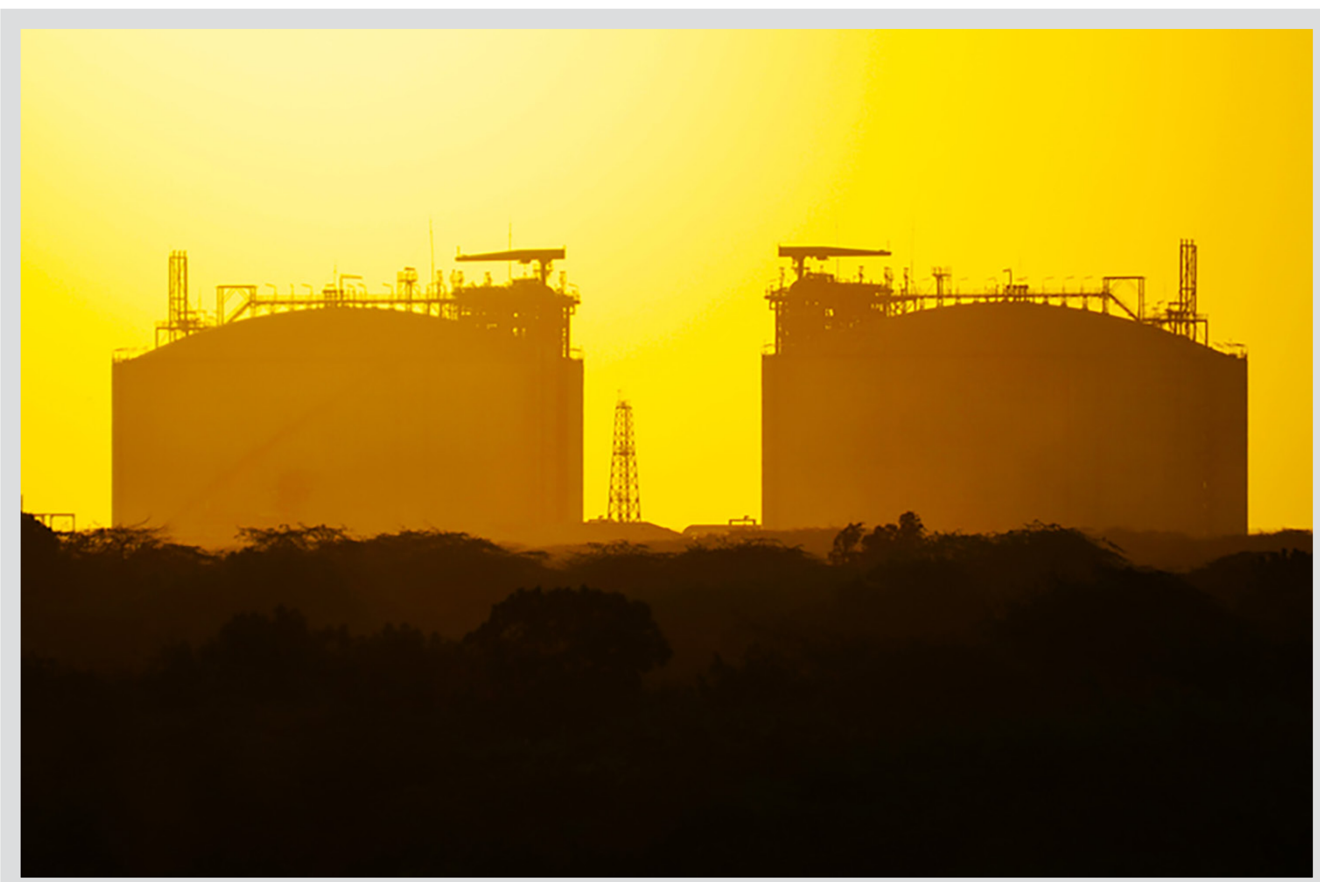
# Asia's Gas Lock-In

2021

## PROPOSED GAS INFRASTRUCTURE EXPANSIONS ARE POOR INVESTMENTS FOR THE REGION—AND THE WORLD

Robert Rozansky



## ABOUT GLOBAL ENERGY MONITOR

Global Energy Monitor (GEM) is a network of researchers developing collaborative informational resources on fossil fuels and alternatives. Current projects include:

- Global Coal Plant Tracker
- Global Fossil Infrastructure Tracker
- Europe Gas Tracker
- Global Gas Plant Tracker
- Global Coal Mine Tracker
- Global Steel Plant Tracker
- Global Wind Power Tracker
- Global Solar Power Tracker
- Inside Gas newsletter
- CoalWire newsletter
- GEM.wiki

## ABOUT THE GLOBAL GAS PLANT TRACKER AND GLOBAL FOSSIL INFRASTRUCTURE TRACKER

The Global Gas Plant Tracker (GGPT) and Global Fossil Infrastructure Tracker (GFIT) are online databases that identify, map, describe, and categorize gas infrastructure. The GGPT tracks gas-fired power plants and the GFIT tracks oil and gas pipelines and liquefied natural gas (LNG) terminals. Developed by Global Energy Monitor, these trackers use footnoted wiki pages to document each gas project.

## ABOUT THE COVER

The cover photo shows LNG tanks in Hazira, Gujarat, India. Image from Getty Images, with photo credit to Puneet Vikram Singh.


## AUTHOR

Robert Rozansky is a research analyst at Global Energy Monitor.



## EDITING AND PRODUCTION

Edited by Ted Nace, Mason Inman, and James Browning. Design and page layout by David Van Ness. Maps created by Scott Zimmerman. The author would also like to acknowledge the contributions of Lorne Stockman, Gerry Arances, Greig Aitken, and Susanne Wong.




## FURTHER RESOURCES

The Global Gas Plant Tracker (GGPT) is under development and set for release in Q4 2021, with a full dataset available on request. The Global Fossil Infrastructure Tracker (GFIT) provides over 35 summary data tables on oil and gas pipelines and terminals broken down by region, country, and company; methodology notes; and an interactive global map. Summary tables for the Asian gas infrastructure analyzed in this report are available here. To obtain primary data for either the GGPT or GFIT, contact Ted Nace (ted.nace@globalenergymonitor.org).

# Asia's Gas Lock-In

## PROPOSED GAS INFRASTRUCTURE EXPANSIONS ARE POOR INVESTMENTS FOR THE REGION—AND THE WORLD

Robert Rozansky

## EXECUTIVE SUMMARY

Plans in Asia to develop hundreds of billions of dollars of new power plants, pipelines, and terminals for imported gas pose a major threat to limiting global warming to 1.5° Celsius. This gas infrastructure in development threatens to lock in high levels of greenhouse gas emissions and lock out the adoption of energy sources that are cleaner, cheaper, and more secure.

This report focuses on gas infrastructure that is proposed and in construction in Asia, including power plants, pipelines, and terminals for importing liquefied natural gas (LNG). It includes the following highlights:

- **Across East, South, and Southeast Asia there are plans to build US$380 billion of new gas infrastructure:** US$189 billion of gas-fired power plants, US$54 billion of gas pipelines, and US$137 billion of new LNG import and export terminals. This new infrastructure could become stranded assets as the global economy shifts toward clean energy.
- **There are 320 gigawatts (GW) of gas-fired power plants in development across Asia, which, if built, would nearly double gas power capacity in the region.** This expansion would be the size of the entire gas-fired power fleet in Europe and Russia, and it would increase global gas-fired power capacity by one-fifth.

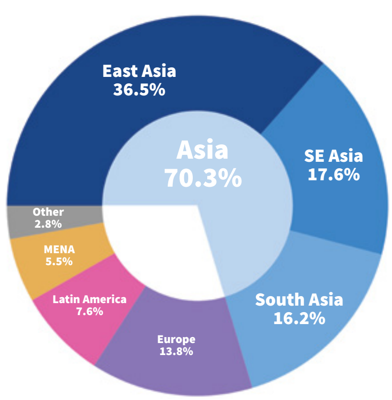
- **Asia is the most important part of the world for a global LNG industry seeking to expand.** There are plans in Asia to develop 455 million tonnes per annum (mtpa) of new LNG import terminal capacity, which comprises 70% of such global capacity in development (Figure ES1). There are more than enough import terminals in development to absorb the entire global LNG trade of 2020.

- **The expansion could consume a large portion of the world's carbon budget.** If built and run at full capacity, the LNG import terminals and gas pipelines in development in Asia would enable enough consumption of imported gas to produce 117 gigatonnes of carbon dioxide equivalent (Gt $CO_2$-eq) over their lifespans. This is a quarter of all emissions the world can produce while maintaining a good chance of limiting global warming to 1.5° C.

- **Gas infrastructure is expensive and long-lived.** Assets often cost billions of dollars and operate for decades. If built, many projects will likely be uncompetitive with renewables even before they are finished. Gas infrastructure also presents economic risks due to gas price volatility, security issues, and the potential that it will cease to be viable in an increasingly low-carbon world.

- **Renewables are a cost-effective, reliable alternative to gas in power generation, especially when combined with storage and demand-side management.** Renewables are also a superior option for distributed generation, which can increase energy access in rural parts of the world. Decarbonization of the power sector with

**Figure ES1: LNG Import Capacity in Development by Region, June 2021**




**East Asia** includes China with Hong Kong and Macao, Japan, South Korea, and Taiwan.

**Southeast Asia** includes Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Papua New Guinea, the Philippines, Singapore, Thailand, Timor L'este, and Vietnam.

**South Asia** includes Bangladesh, India, Pakistan, and Sri Lanka.

**MENA** refers to the Middle East and North Africa.

Source: Global Energy Monitor. Includes projects in construction and in pre-construction development.

renewables would lay the groundwork for clean electrification of other sectors, including applications that currently use gas such as residential and commercial heating.

- **Governments have supported the expansion of gas infrastructure in Asia through public finance institutions.** There is a risk that they will continue to do so. A survey of global public financing shows that public institutions provided US$22.4 billion in financing for gas projects in Asia between 2014 and 2018. Recent announcements by the Asian Development Bank, World Bank, and others show that these institutions have not yet committed to withdrawing from gas financing, and remain open to funding midstream infrastructure and power plants. International public finance signals confidence in project viability that encourages private sector investment, and redirection of such finance away from gas would help align both private investment and public policy with net-zero goals.

## INTRODUCTION

With Asian planners increasingly moving away from coal to meet the region's growing energy needs, gas has been widely embraced as the inevitable alternative on both economic and environmental grounds. Based on that rationale, new gas infrastructure projects, including pipelines, LNG terminals, and gas-fired power plants, have been rapidly advanced across the region, amounting to over US$380 billion for projects in the construction or pre-construction stages as of June 2021. Asia is home to nearly three-quarters of all LNG import capacity in development; it will have a tremendous influence on the global gas trade. Increasingly, however, the logic underlying the expansion of gas is being called into question. According to climate analysts, the assumption that gas is a climate-friendly alternative to coal is seriously misguided, in light of increasing evidence that the magnitude and significance of the climate-damaging methane emissions produced along the gas supply chain are greater than previously appreciated. Rather than benefiting the climate, the growth in gas combustion that would result from a massive lock-in of new gas infrastructure would wreak havoc on plans to rein in emissions and mitigate some of the worst effects of climate change. On economic terms, the ground has also shifted. The rapidly falling cost of renewable alternatives, in particular those accompanied by reliability enhancing components such as battery storage and demand management, has undermined the status of gas as the most economically favorable option for new power. Falling solar, wind, and storage costs threaten to make long-term gas projects such as LNG terminals obsolete long before their normal lifespans. Overall, the combination of a better understanding of the climate damage caused by gas and a rapidly changing economic equation means that the rationales for Asia's expansion of gas infrastructure are no longer supportable.

## GAS LOCK-IN: PLANS FOR EXPANDING POWER PLANTS, PIPELINES, AND TERMINALS

GEM's surveys of gas infrastructure find that across East, South, and Southeast Asia there is a massive buildout of gas infrastructure in development—i.e. projects that are proposed or under construction.[1] GEM finds that there are plans within Asia to build 320 GW of new gas-powered generation. This expansion would be the size of the entire gas-fired power fleet in Europe and Russia. It would add a fifth to global gas-fired power capacity, and it would nearly double gas power capacity in Asia. GEM has identified over 63,000 kilometers of gas pipelines in development in Asia, enough to wrap around the Earth one and a half times. These additions would increase the length of pipelines in the region by roughly 50%, and would triple import capacity by pipeline to Asia. Finally, GEM has catalogued 25 mtpa and 455 mtpa of new LNG export and import capacity, respectively, in development. Import capacity additions of this scale would allow for over 3 million annual shipments of LNG by tanker and the reception of more LNG per year than the entire world imported in 2020 (BP 2021, GIIGNL 2019).[2]

GEM's data on gas-fired power plants is recorded in the Global Gas Plant Tracker. Its data on gas pipelines and LNG terminals is recorded in the Global Fossil Infrastructure Tracker. GEM has catalogued the Asian gas infrastructure analyzed in this report in a set of summary tables.

Once built, gas infrastructure is designed to operate for decades. The pipelines and terminals currently in construction in Asia could import enough gas over their lifetimes to release 43 gigatonnes of $CO_2$ equivalent (Gt $CO_2$-eq), if operated at full capacity and the imported gas is burned—and associated methane emissions in the supply chain are evaluated on a 100-year horizon.[3,4] Under the same assumptions, pipelines and terminals in pre-construction phases of development could enable 73 Gt $CO_2$-eq. Since developers will likely abandon some projects in the early stages and projects typically do not operate at full capacity, these are upper-bound estimates. Nonetheless, these are staggering figures: the total of 117 Gt $CO_2$-eq is a quarter of the world's carbon budget to maintain a 50% chance of limiting global warming to 1.5° C. If associated methane emissions in the supply change are evaluated on a 20-year horizon, the scale of the impact would be even greater: 144 Gt $CO_2$-eq, about a third of the carbon budget.

GEM estimates that Asia's infrastructure plans would amount to US$189 billion of investment in new gas-fired power plants, US$54 billion in gas pipelines, and US$137 billion in LNG import and export terminals. As the global economy shifts toward clean energy, much of this US$380 billion in new infrastructure could become stranded assets: projects that cease to be economically viable before the end of their anticipated lifetimes due to changes associated with the energy transition. Gas projects could become stranded as a result of economic conditions, such as declining competitiveness with cheap renewable power, or regulatory conditions, such as new policies to decarbonize the electric grid (Carbon Tracker 2017). Stranded assets represent wasted capital. The premature retirement of gas facilities will harm the public and private institutions that have invested in them, the workforces that are employed by them, and the economies that have grown to rely on them (OCI 2016).

1. GEM's surveys of gas pipelines, LNG terminals, and gas plants were completed in January 2021, June 2021, and August 2021 respectively. Methodology and full results may be found at http://Globalenergymonitor.org.

2. Assuming tanker capacities of 175,000 cubic meters LNG.

3. See the methodology section for more details.

4. The lifecycle emissions estimates used in this calculation account for uncaptured venting and fugitive emissions of methane, the primary component in gas, along the gas supply chain. Methane has a much greater global warming potential evaluated over a 20-year horizon than over a 100-year horizon.

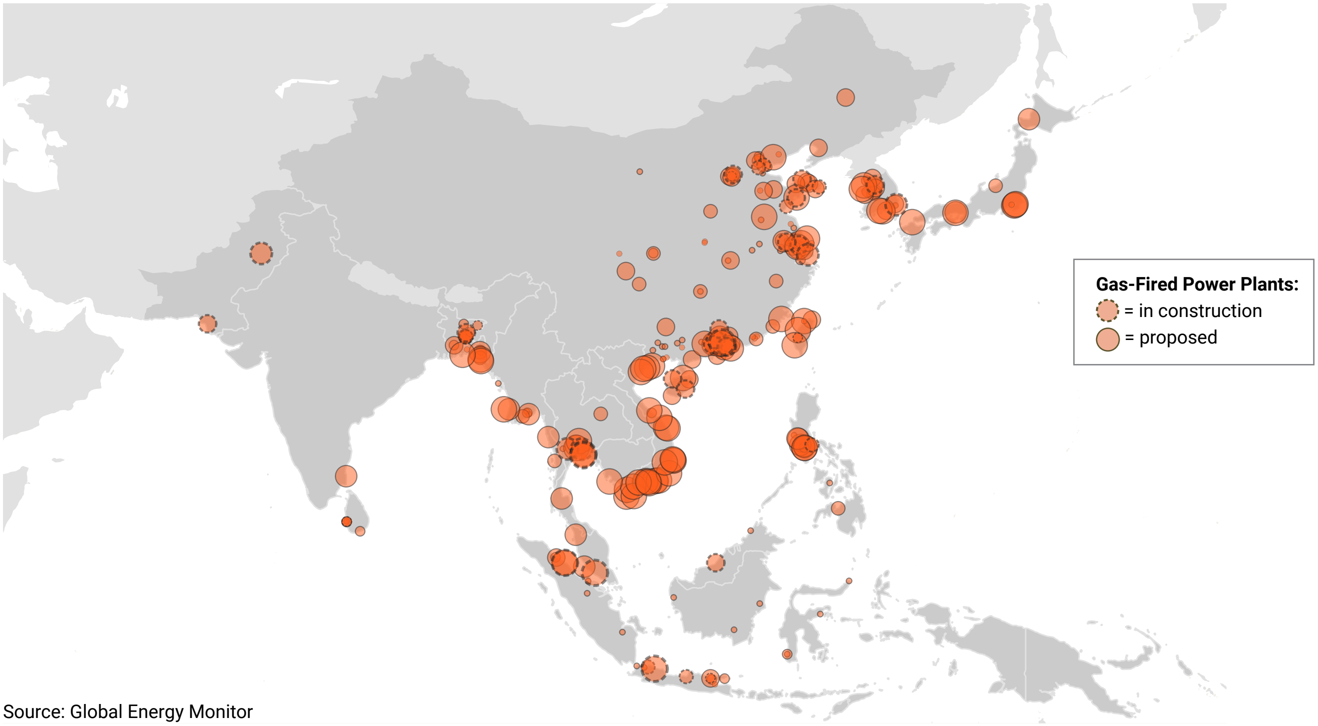
Table 1 shows investment in projects that are proposed and in construction across East, South, and Southeast Asia. China dominates planned investment, accounting for US$127 billion. Beyond China, the largest gas expansions by investment are planned in Vietnam, Indonesia, India, Thailand, Bangladesh, South Korea, the Philippines, Japan, Myanmar, Taiwan, and Pakistan. Of those, India, Thailand, and Indonesia are the countries with the most investment in infrastructure currently under construction, building projects amounting to about US$16 billion, US$8 billion, and US$7 billion, respectively. Vietnam's exceptionally large proposed investment is both a result of anticipated increases in electricity demand and the high level of interest from government and industry in building new gas projects; these figures may evolve with the upcoming release of a new power development plan. Less than 1% of Vietnam's planned investments are actually in projects that have reached the construction phase.

**Table 1: Planned investment for Gas Infrastructure in Asia (US$ billions)**

| | Power Plants | | Pipelines | | Terminals | | |
|---|---|---|---|---|---|---|---|
| Country | Proposed | Construction | Proposed | Construction | Proposed | Construction | Total |
| China | 41.3 | 13.7 | 9.2 | 10.1 | 32.5 | 23.8 | 130.5 |
| Vietnam | 52.8 | 0 | 0.2 | 0 | 5.4 | 0.3 | 58.6 |
| Indonesia | 5.4 | 3.3 | 2.7 | 0.8 | 16.6 | 2.9 | 31.8 |
| India | 0.7 | 0 | 7.6 | 7.3 | 5.0 | 8.9 | 29.5 |
| Thailand | 5.6 | 5.0 | 0.5 | 0.6 | 6.1 | 2.1 | 19.9 |
| Bangladesh | 10.4 | 1.9 | 1.9 | 0.3 | 2.1 | 0 | 16.5 |
| South Korea | 9.6 | 1.3 | 2.0 | 0 | 3.2 | 0 | 16.1 |
| Philippines | 8.6 | 0.4 | 0 | 0 | 2.9 | 2.1 | 14.0 |
| Japan | 8.7 | 0.1 | 2.8 | 0.5 | 0.7 | 1.0 | 13.7 |
| Myanmar | 5.6 | 0 | 2.7 | 0 | 1.6 | 2.5 | 12.3 |
| Taiwan | 5.6 | 0.5 | 2.5 | 0.1 | 3.0 | 0 | 11.7 |
| Pakistan | 0 | 1.4 | 1.2 | 0.5 | 3.8 | 0.8 | 7.6 |
| Papua New Guinea | 0 | 0 | 0 | 0 | 6.5 | 0 | 6.5 |
| Malaysia | 1.5 | 1.9 | 0.7 | 0 | 0 | 0 | 4.1 |
| Cambodia | 2.3 | 0 | 0 | 0 | 1.0 | 0 | 3.3 |
| Sri Lanka | 0.9 | 0.2 | 0 | 0 | 1.0 | 0 | 2.0 |
| Singapore | 0 | 0 | 0 | 0 | 1.5 | 0 | 1.5 |
| Brunei | 0 | 0 | 0.1 | 0 | 0 | 0 | 0.1 |
| Timor L'este | 0 | 0 | 0.1 | 0 | 0 | 0 | 0.1 |

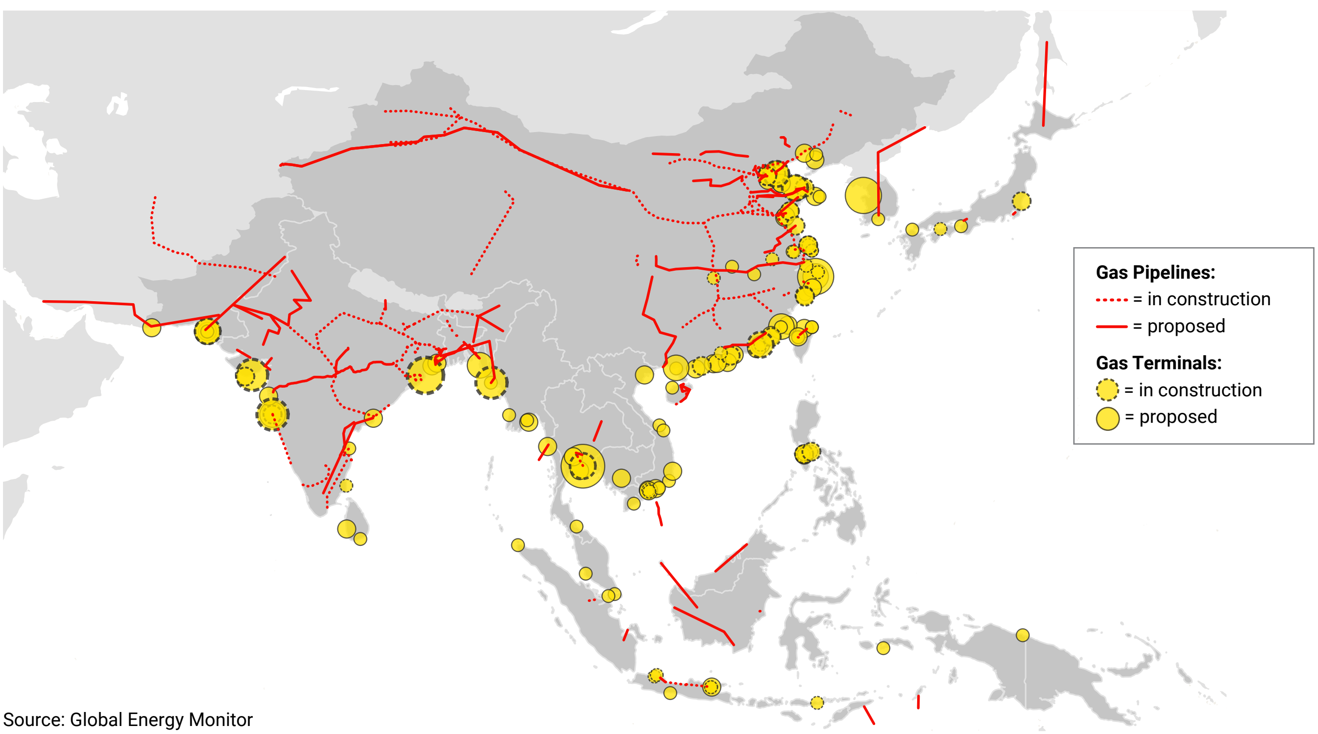
Source: Global Energy Monitor. Estimates are based on global and regional average capital expenditures for building new gas infrastructure, and may diverge from projected costs at the project level. See the Methodology appendix for details.

**Figure 1: Gas-Fired Power Plants in Development in Asia**




Source: Global Energy Monitor

**Figure 2: Gas Pipelines and Terminals in Development in Asia**




Source: Global Energy Monitor

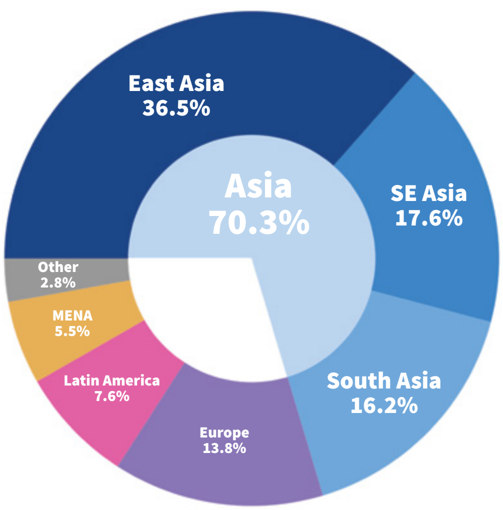
## BACKGROUND: ASIA'S CLIMATE AND ENERGY FUTURE AT A CROSSROADS

GEM's data shows that Asia is at the center of the growing global LNG market: it is home to 59% of the world's existing LNG import capacity and 70% of the world's capacity in construction or pre-construction development. Asia will be a dominant force determining the future of gas in the energy transition.

In response to the worsening climate crisis, all Asian countries have signed on to the Paris Climate Agreement (beyond a few exceptions in the Middle East). In addition, several of the region's largest economies have pledged to achieve carbon neutrality by mid-century: Japan and South Korea by 2050 through legislated commitments, and China by 2060 through a stated policy.

Whether such diplomatic and policy measures will be translated into reality depends on what type of energy investments are made in the coming decade. The announcement of carbon neutrality goals by three major East Asian economies is evidence for hope, as is the rapid growth in Asia's renewable power capacity, which now accounts for nearly half the global total and is expected to double in less than five years, led by deployment of new solar photovoltaics (PV)(IRENA 2021a, Rystad 2020). But despite these positive steps, reports from governments, news outlets, and companies across Asia reveal a disturbing trend: the region is planning a massive buildout of infrastructure to import foreign fossil gas to satisfy rising energy demand. As described in the following section, that buildout poses major problems both on environmental and economic grounds.

**Figure 3: LNG Import Capacity in Development by Region, June 2021**




**East Asia** includes China with Hong Kong and Macao, Japan, South Korea, and Taiwan.

**Southeast Asia** includes Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Papua New Guinea, the Philippines, Singapore, Thailand, Timor L'este, and Vietnam.

**South Asia** includes Bangladesh, India, Pakistan, and Sri Lanka.

**MENA** refers to the Middle East and North Africa.

Source: Global Energy Monitor. Includes projects in construction and in pre-construction development.

# THE PROBLEMS WITH GAS

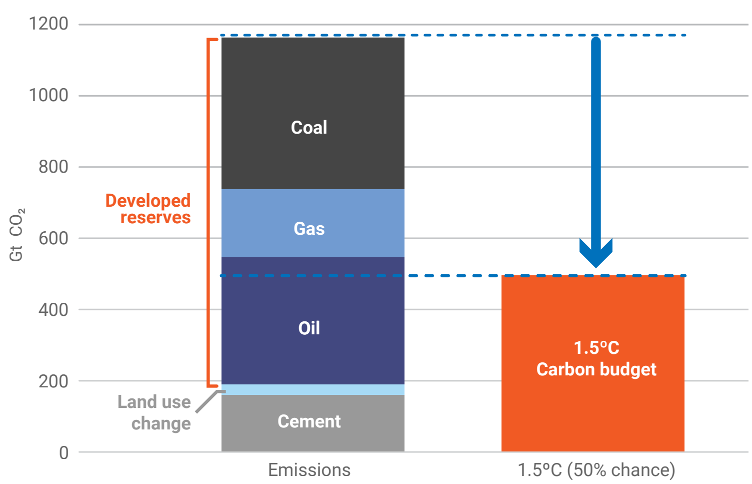
Gas is composed of methane and other hydrocarbons known as natural gas liquids (EIA 2020). It is among the most widely consumed fuels worldwide. In 2020, the global economy consumed 3.8 trillion cubic meters of gas, and the electricity sector relied on gas for 23% of its generation (BP 2021).[5] Despite misperceptions, gas is dirty, it is expensive, and it undermines efforts to avert the worst impacts of the climate crisis.

## Emissions

Gas burned worldwide is one of the main sources of $CO_2$ emissions. In 2019, gas accounted for 22% of all fossil fuel emissions (IEA 2020c). Burning more gas will contribute to the continued rise of global emissions, at a time when they must begin a sharp decline if the world is to avert the worst effects of climate change. Even if $CO_2$ were the only greenhouse gas released by gas consumption—and as discussed below, it is not—there is no room for developing new gas fields and expanding gas consumption. Figure 4 shows that emissions from currently producing gas, oil, and coal projects are already too great to maintain a 50% chance of limiting global warming to 1.5° C (OCI 2016). If emissions continue at current rates for ten years, the world will exhaust its carbon budget: the amount of $CO_2$ that can be emitted while maintaining a good chance of meeting this climate target. Coal-to-gas switching is also not a viable solution. A 2019 analysis from Bloomberg New Energy Finance (BNEF) modeled a scenario in which coal plants were replaced by 2035 primarily by gas, and found that emissions levels were still significantly above a 1.5° C pathway (BNEF 2021).

In addition to emitting $CO_2$ through combustion, new findings over the past decade have revealed that the production, transportation, and consumption of gas all leak large amounts of methane, a potent greenhouse gas. For example, research led by the

**Figure 4: Carbon Dioxide Emissions from Developed Global Fossil Fuel Reserves, Compared to Carbon Budgets within Range of the Paris Goals.**




Sources: Oil Change International analysis based on data from Rystad Energy, IEA, World Energy Council, IPCC, and Global Carbon Project. Remaining carbon budgets are as of January 1, 2020.

5. Gas can be used in diverse applications including electricity generation, commercial and residential heating, and transportation, and industrial processes. Electricity generation is the sector driving much of the planned gas expansion in Asia, and thus is the focus of this report.

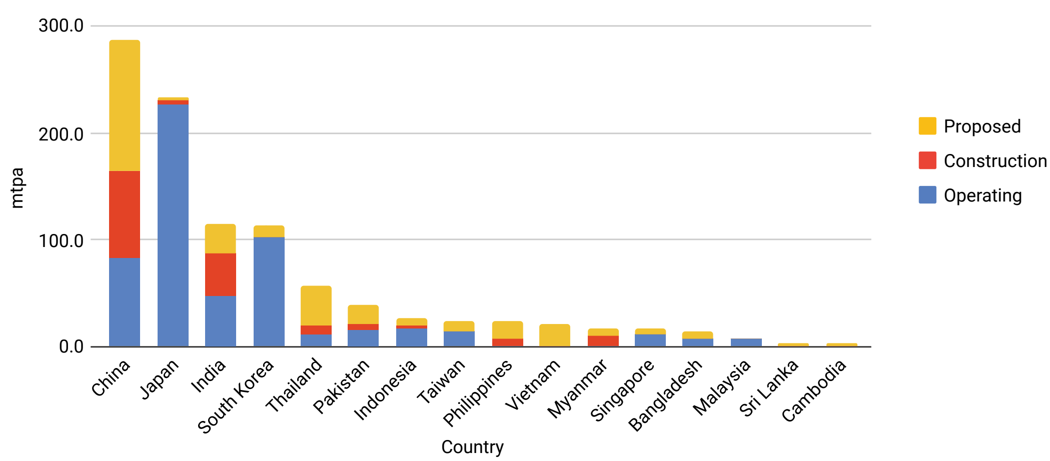
Environmental Defense Fund found that 60% more methane is leaking along the U.S. supply chain than the U.S. Environmental Protection Agency estimated in 2015 (Alvarez et al. 2018). Methane has a global warming impact that is 86 times that of $CO_2$ on a 20-year time scale and 34 times that of $CO_2$ on a 100-year time scale (Myhre et al. 2014).

Even more gas is leaked and burned when it is shipped across the world. LNG is gas that has been cooled to –162° C and condensed into a liquid so that it may be transported by ocean tanker from gas producers to consumers. Countries in Asia are advancing plans to dramatically expand LNG imports, which is of grave concern from an emissions perspective. The liquefaction of gas requires large amounts of energy and can consume up to 10 percent of the feed gas (Total 2018). This process also uses ozone-depleting refrigerants. Furthermore, the ships transporting LNG burn additional fossil fuels for power. The Natural Resources Defense Council has estimated that liquefaction, shipping, and regasification of LNG can increase the lifecycle emissions of gas by 8% to 21% on a 20-year time frame. As a result, lifecycle emissions for US LNG are only 27% to 33% lower than coal evaluated over this time frame. This stands in stark contrast to the lifecycle emissions for solar and wind power, which are just 7% and 2% of LNG emissions, respectively (NRDC 2020).

Figure 5 shows the flurry of planned new LNG import capacity under development across the region. The purpose of some of this new capacity is to replace some dwindling supplies. For instance, gas provides 20% of electricity generation in the Philippines, but the country's primary gas resource, the Malampaya gas field, is expected to run out by 2027 (Shiga et al. 2021). China is the main exception, with domestic gas production expected to double by 2040 (IEA 2020c). However, the level of planned new LNG import capacity for the region far exceeds the amount needed to replace declining domestic gas supplies. The LNG import capacity in development in Asia is approximately equivalent to the existing export capacity of every LNG exporter in the world combined. It is enough infrastructure to absorb the entire global LNG trade of 2020 (GIIGNL 2021).

Expanding gas consumption across Asia is incompatible with net-zero emissions scenarios that would seek to limit global warming to 1.5° C, in line with the Paris Agreement. The IEA's Net-Zero Emissions by 2050 Scenario, consistent with these international goals, finds that global gas consumption should peak around

**Figure 5: LNG Import Capacity Operational and in Development in Asia, June 2021.**




Source: Global Fossil Infrastructure Tracker, Global Energy Monitor

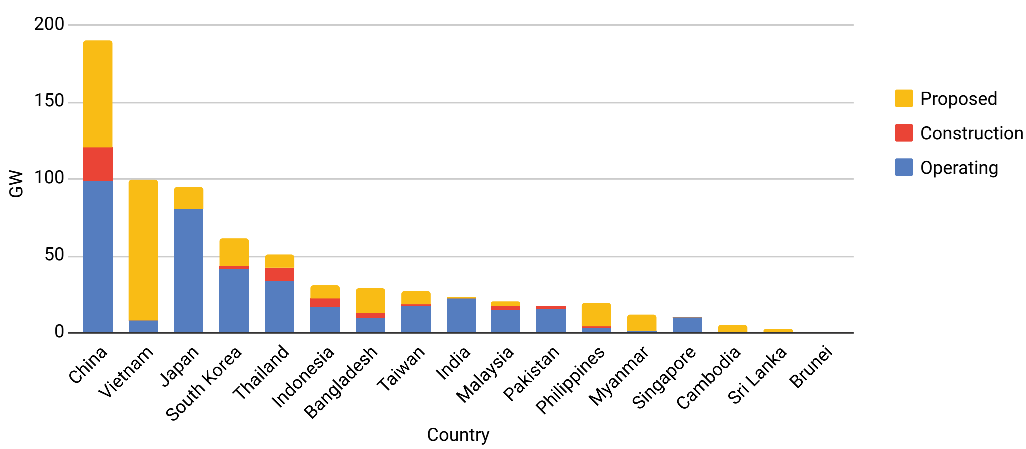
2025 and then decline rapidly through 2050. Under this scenario, there is no need for expanding LNG capacity, as fossil gas traded as LNG would fall by 60% between 2020 and 2050 (IEA 2021). The Intergovernmental Panel on Climate Change (IPCC) describes its P1 scenario as one in which "social, business and technological innovations result in lower energy demand up to 2050 while living standards rise, especially in the global South," and which relies little on carbon capture and storage. For this scenario, IPCC finds that, with respect to 2010 levels, primary energy from gas consumption should fall by 25% by 2030 and 74% by 2050 (IPCC 2019).

## Economic Challenges

Building gas infrastructure is financially risky, especially in the power sector, where costs for renewables are falling rapidly. Plans to sink hundreds of billions of dollars into new gas infrastructure in Asia rest on the assumption that gas is the most cost effective and reliable option for producing power. Yet that assumption is no longer valid, given the dramatically rapid decline in clean energy costs—over 90% since 2009. Planned growth in gas power capacity in Asia is shown in Figure 6.

Electricity generation is the primary driver for new gas development in most countries in Asia (China and India are exceptions, with most new gas targeted for industrial uses such as the production of methanol and fertilizer). The power sector is responsible for 60% of anticipated incremental demand growth for gas in Emerging Asia between 2019 and 2025, according to IEA (IEA 2020a). In Indonesia, for instance, a proposed 6 GW increase in gas capacity is being used to boost the amount of "clean" power in the current draft of its national energy plan for 2021–2030 (Enerdata 2021). Demand for electricity is growing in much of Asia. In Thailand, electricity consumption is forecast to increase 50% by 2030, up to 300 Terawatt-hours (TWh), while Vietnam's electricity consumption is forecast to nearly double by 2035, reaching 388 TWh (OIES 2020). Even so, many planned gas projects are not needed to meet countries' future demand. Bangladesh's thermal fleet of power plants, for example, operated at only 40% of its capacity between 2019 and 2020 (IEEFA 2021c). In some countries in the region, governments subsidize power companies' lost revenue due to overcapacity. In Pakistan, it is estimated that such payments will cost the government US$10 billion a year by 2023 (IEEFA 2021d).

**Figure 6: Gas-fired Power Plant Capacity Operating and in Development in Asia, June 2021**




Source: Global Energy Monitor, Global Gas Plant Tracker, September 2021.

Clean energy portfolios (CEPs), comprising renewable power with storage and demand-side management, now outcompete gas-fired power in much of the world, including Asia, and are expected to become even more competitive as solar PV, wind, and storage costs continue to decline. Today, the International Renewable Energy Agency (IRENA) has found that 62% of all renewable power generation worldwide, or 162 GW, has lower costs than the cheapest new fossil fuel option. The share of renewable generation competitive with fossil fuels doubled in 2020 with respect to the previous year (IRENA 2021b). BNEF has forecast that by 2050 the average global levelized costs of electricity for solar PV, onshore wind, and offshore wind will fall by an additional 70%, 50%, and 45%, respectively (ETC 2021). Adding storage and demand-side management only improves the economics by increasing the renewables' capacity factor (i.e., how much capacity is actually used). Rocky Mountain Institute found that 2019 was the break-even year in the United States when CEPs began to outcompete new gas (RMI 2019).

In addition to being cheaper and more climate friendly, renewable power has distinct energy security advantages with respect to gas. Volatility in fuel prices or fuel availability can make gas project revenues unpredictable or facilities prohibitively expensive to run during price spikes. This past year has seen a number of such price spikes caused by shocks including the Covid-19 pandemic and the blockage of the Suez Canal by a stuck ship.

Spot prices for LNG in Asia ranged from $2 to $30 per million British thermal units (MMBtu) in 2020 (S&P Global 2021). In Japan, a major importer of gas, electricity prices surged to record levels during a global gas shortage in January 2021 (IEEFA 2021b). More recently, Pakistan was forced to purchase LNG for September 2021 at $15 per MMBtu, the highest prices since it began imports, to avoid blackouts (Stapczynski 2021). Volatility in the global gas market is expected to increase over the coming years. As the Institute for Energy Economics and Financial Analysis (IEEFA) has written, "Emerging markets, which almost by definition are more price sensitive, will find the forthcoming price environment challenging. They may find their newly installed gas generators being underutilised, while tariffs for gas and electricity customers will rise." IEEFA has estimated that around US$50 billion of proposed gas-fired power projects in Vietnam, Bangladesh, and Pakistan are at risk of cancellation because of increasing LNG price volatility (IEEFA 2021a).

## RENEWABLES: A VIABLE SOLUTION FOR ASIA

As discussed elsewhere in this report, in most parts of the world renewables are now or will soon be more affordable than gas. Utility-scale solar PV is the cheapest electricity source in China and India (BNEF 2021). Renewables are already competitive with new gas plants in South Korea, and are expected to be competitive with existing gas plants as early as 2023 (Carbon Tracker 2020). There is little financial advantage in waiting to build; IRENA projects that renewable projects built by emerging economies in 2020 will save up to US$156 billion over their lifespans (IRENA 2021b). Furthermore, scaling up renewables now is a cheaper and faster pathway to net-zero emissions than having to build and eventually retire a new fleet of fossil infrastructure.

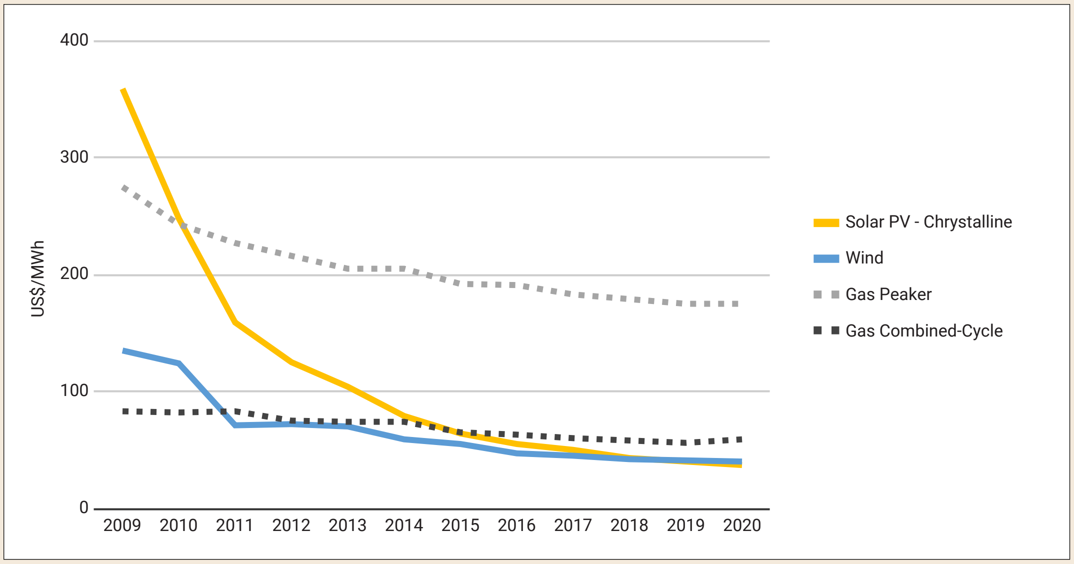
Even for the provision of flexible power, renewables are a preferred option. Flexible "peaker" gas-fired power plants are more expensive because they are less efficient and require more gas to run. Lazard finds that the unsubsidized levelized cost of energy from gas peaker plants is $175 per megawatt-hour (MWh), compared to $40/MWh and $37/MWh for wind and utility-scale crystalline solar PV, respectively (Lazard 2020). Furthermore, batteries are better suited to short-term (1–4 hours) fluctuations in energy.

Most Asian countries have ample renewable resources. Carbon Tracker has found that China, India, Vietnam, and Thailand have 10 to 100 times more solar and wind resources available than total energy demand requirements. Indonesia, Laos, and Cambodia have over 100 times more. Because renewable costs are declining so rapidly, it is quickly becoming economical to harness these resources. Globally, half of all renewable resources that are technically available today may be captured economically; by the end of the decade, 90% of all such resources could be captured economically (Carbon Tracker 2021b). The widespread geographic availability of renewable resources is also beneficial for providing distributed generation that increases energy access. According to the International Institute for Sustainable Development (IISD), renewables are well matched for many developing economies, such as those in Asia, because "they often have ample sunshine and/or wind resources . . . and modular development can be well matched to where and when demand growth is occurring, including electrifying remote rural populations" (IISD 2021).

Although renewable technologies generate power intermittently due to the natural variability of wind speeds and solar intensity, intermittency can be managed with existing technical, policy, and regulatory solutions, even at high rates of renewable deployment. The Energy Transitions Commission states with the "application of new technologies and approaches to system operation, supported by appropriate power market design," it will be "feasible and cost-effective" to achieve variable renewable penetration levels of 75–90%. Some markets already operate with variable renewable penetration levels of 30% or greater, such as Denmark and Uruguay, and regions in China operate with levels of 15–20% (ETC 2021). On average, emerging markets outside of China had renewable penetration rates of 4.1% as of 2020 (Carbon Tracker 2021a).

Across Asia, renewable power is rapidly gaining momentum. Starting from very little installed solar, Vietnam installed 4.8 GW in 2019 and 11.5 GW in 2020 (Ha 2021). The country's draft eighth power development plan anticipates that renewable power will account for about 25% of the country's energy mix by 2030, surpassing generation from oil and gas-fired power (Huong 2021). Last year Myanmar had a 1 GW solar auction that brought in prices between $35/MWh to $51/MWh, easily cost-competitive with gas (Bellini 2020). South Korea recently announced an 8.2 GW offshore wind project, set to be the largest in the world (Renewable Energy World staff 2021). Bangladesh's power minister recently set a target to provide 40% of power generation from renewable sources by 2041 (Dhaka Tribune staff 2021). Japan's government has announced goals of generating 10 GW of electricity from offshore wind by 2030 and 30–45 GW by 2040 (Okutsu et al. 2021).

**Figure 7: Levelized Costs of Energy for Renewables vs. Gas**

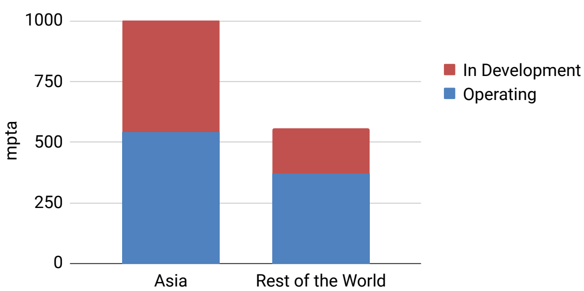



Source: Lazard's Levelized Cost of Energy Analysis - Version 14.0. The data presented in this figure are global, unsubsidized mean values for utility-scale generation.

# THE GAS INDUSTRY'S VISION: ASIA AS THE INEVITABLE CENTER OF THE NEW GLOBAL LNG MARKET

Imperiled by the rise of cheap renewables and public alarm about climate change, the gas industry has painted a vision of a world in which rapid growth in gas consumption continues for decades, with Asia leading the way. As shown in Figure 8, this vision of rapid global gas growth led by Asia is reflected in the distribution of both existing and planned LNG import infrastructure.

**Figure 8: LNG Import Capacity in Asia vs. the Rest of the World**

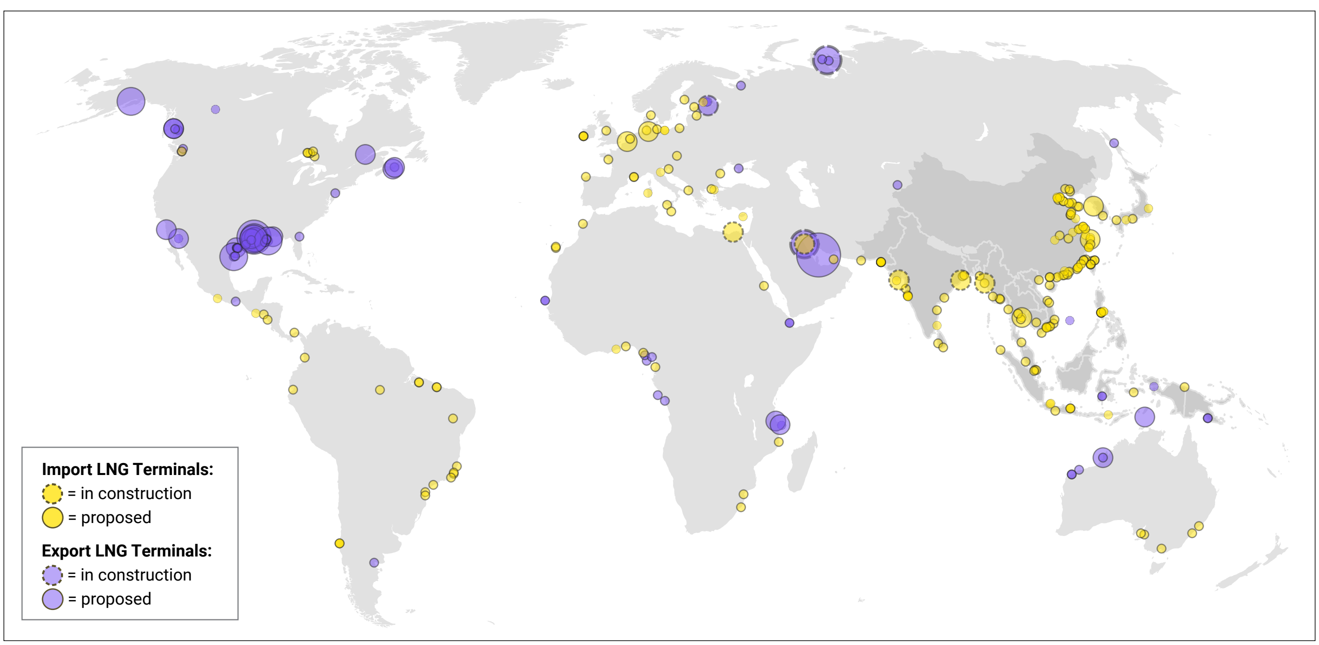



Source: Global Energy Monitor, Global Fossil Infrastructure Tracker, June 2021.

Wood Mackenzie forecasts that Asia will account for 95% of global LNG demand growth between 2020 and 2022 (Wood Mackenzie 2021). Demand for gas, and LNG in particular, is growing faster in Asia than anywhere else in the world. Shell forecasts that Asia will continue dominating global LNG demand growth for decades, accounting for 75% by 2040 (Shell 2021). In line with industry projects, the IEA has forecast that emerging Asian economies such as Bangladesh, Pakistan, Thailand, and Vietnam will be the major driver of expanding LNG imports globally. According to the IEA, Emerging Asia will be the second-biggest contributor to global gas demand growth between now and 2025 (IEA 2020a).

Demand growth in Asia is central to the strategies of gas exporters and traders, such as the United States and Japan. Broadly, the efforts of these countries and others are part of a larger trend as the fossil gas industry seeks to restructure itself from a collection

**Figure 9: LNG Terminals in Development Worldwide**




Source: Global Energy Monitor, Global Fossil Infrastructure Tracker, June 2021 of regional markets into a wider and more integrated global system.

Against the backdrop of a struggling domestic fracking industry, the United States has sought to expand gas exports. The United States was on track to become the world's largest gas exporter by 2024 before the Covid-19 pandemic, which led to a collapse in gas prices and wreaked havoc on financing for new gas export terminals and pipelines (GEM 2021b). Still, US LNG exports to Asia increased by 67% in 2020, with South Korea, Japan, and China as the primary destinations (Boudreau 2021).

There are signs that the gas industry is beginning to see the writing on the wall, as civil society, businesses, and governments around the world are increasingly recognizing the need to shift to a net-zero economy. The current global expansion of gas infrastructure has been appropriately called by *Quartz* "the last great fossil fuel gold rush." According to a gas market analyst with the Center for Strategic and International Studies, "People are starting to appreciate that this could be the last window. . . . If you don't sanction a project in the next few years, you may never sanction a project" (McDonnell 2020). From the perspective of gas producers and traders, building gas projects in Asia and building them now may be the most important factor for locking in future demand.

## HOW PUBLIC POLICY AND FINANCE ARE PROPPING UP THE GAS EXPANSION

The Trump administration pushed LNG diplomacy in Asia, securing commitments from Japan to purchase US LNG and invest in American infrastructure, and funding trade missions and research initiatives to boost LNG purchases in Vietnam (GEM 2020, Boudreau 2021). The Biden administration's stance toward LNG exports remains unclear. The administration's Department of Energy recently announced that it would assess lifecycle emissions associated with a proposed LNG export project as part of an environmental review, but it has not yet moved to enforce such reviews for over 20 other proposed export projects; eliminate public subsidies or other incentives for LNG infrastructure around the world; signal opposition to expanding LNG; or undertake other actions that would significantly curtail LNG exports (Anchondo 2021).

Increased LNG consumption around the world is central to the strategy of Japan, a major trader and importer, which has sought to enhance the stability of a volatile global LNG market. Japan is one of the largest funders of gas projects beyond its borders; between January 2017 and June 2020, its public and private financing institutions provided at least US$23.4 billion of financing for LNG terminals, tankers, and pipelines in other countries (GEM 2020). In June, Japan pledged to offer US$10 billion in public and private financial aid for "decarbonization" projects in Asia including coal-to-gas switching (Reuters staff 2021a). South Korea, another major gas trader and importer, has also heavily financed LNG projects through its public finance institutions. Research by Solutions for Our Climate has found that The Export-Import Bank of Korea, Korea Trade Insurance Corporation, and Korea Development Bank have provided US$23.1 billion in financing to shipbuilding of LNG carriers over the past ten years (SFOC 2021).

Much of the funding for Asia's gas expansion is coming from governments themselves, through public finance institutions. Multilateral development banks, bilateral development banks, and export credit agencies continue to support gas development around the world. A recent report from IISD examined public financing for gas in low- and middle-income countries across Asia, Oceania, Europe, Africa, and Latin America and the Caribbean. IISD found that countries were receiving more financing for gas than any other energy source, and that four times as much public finance went to gas as did to wind or solar. Such public support is vital to the success of expensive energy projects. While international finance is typically a small fraction of total finance, it signals confidence in project viability that encourages private sector investment (IISD 2021). According to the IEA, public financing and policy support for gas in countries in Asia will be a key determinant in whether global gas demand increases into the 2030s (IEA 2020c).

The Shift the Subsidies database compiled by Oil Change International (OCI) reveals the nature of public finance in Asia in recent years (OCI 2021). A review of the database finds that US$22.4 billion in public finance went to gas projects in Asia between 2014 and 2018, led by the Export-Import Bank of China, Japan Bank for International Cooperation (JBIC), and Asian Development Bank (ADB) (see Table 2). According to OCI's data, only 4% of this financing went toward gas projects that expanded energy access. Gas is not well-suited for expanding energy access, given that 85% of those worldwide without access to electricity live in rural areas. Renewables are much better suited for distributed generation (IISD 2021).

There is a high risk that public funding for gas could continue. The ADB is currently updating its Energy Policy, and a draft version states that it "may finance natural gas projects (including gas transmission and distribution pipelines, terminals, storage facilities, gas-fired power plants, natural gas for heating and cooking)" (Pardiker 2021). In June 2021, JBIC announced a new three-year business plan through March 2024. JBIC Governor Tadashi Maeda said that JBIC will continue financing upstream development of LNG and gas-fired power generation projects (Reuters staff 2021b). In June 2021, the World Bank published its Climate Change Action Plan for 2021–2025. The World Bank Group says this plan signals a shift toward "greening entire economies," yet leaves the door open for choosing fossil gas projects to meet energy access needs (World Bank Group 2021).

**Table 2: Top Public Financiers of Gas Projects in Asia (2014–2018)**

| | Institution | Financing (US billions) |
|---|---|---|
| 1 | Export-Import Bank of China | 4.3 |
| 2 | Japan Bank for International Cooperation | 4.1 |
| 3 | Asian Development Bank | 2.9 |
| 4 | Nippon Export and Investment Insurance | 2.4 |
| 5 | International Finance Corporation | 1 |

Source: Oil Change International's Shift the Subsidy database

## CONCLUSION

Asia's gas buildout deserves a re-examination, based on the rapidly changing economics of energy. Clean energy portfolios such as solar PV and wind power paired with storage and demand-side management are safer and ultimately more beneficial investments. Asia is an engine of growth, and it does not need to run on gas. Redirection of public finance away from gas infrastructure can be a determinative signal for private investment, aligning both private investment and public policy with net-zero goals. As shown by the remarkable speed at which the tide has turned against coal power, change is occurring quickly in the energy industry.

Asia's gas buildout is not inevitable. For example, over the past five years new coal power capacity in the planning stage in Southeast Asia has declined by 80% (GEM 2021a). Political and financial institutions, civil society, and energy providers have the power to change course in the region, and with good reason. New gas infrastructure in Asia is a risky bet for the climate, imperiling its countries' net zero commitments. New gas is a risky economic investment for the region as well, locking countries into dependency on a volatile, foreign resource that is quickly losing out to cleaner alternatives.

# METHODOLOGY

The data on gas infrastructure in this report is based on GEM's Global Gas Plant Tracker (power plants) and Global Fossil Infrastructure Tracker (terminals and pipelines), as of June 2021.

GEM analyzed data from the following countries in East, South, and Southeast Asia: Bangladesh, Brunei, Cambodia, China with Hong Kong and Macao, India, Indonesia, Japan, Laos, Malaysia, Myanmar, Pakistan, Papua New Guinea, the Philippines, Singapore, South Korea, Sri Lanka, Taiwan, Thailand, Timor L'este, and Vietnam.

To estimate theoretical maximum lifecycle emissions associated with Asian gas infrastructure in development, GEM calculated the total amount of gas that could be imported into Asia through gas terminals and pipelines in development, based on the following assumptions: (1) all Asian gas infrastructure currently in development is built, (2) all infrastructure is used for its full lifetime at full capacity, and (3) the lifetimes of new gas terminals and pipelines are 50 years. There is little data available on gas terminal and pipeline lifetimes because the vast majority that have been constructed have yet to be retired; 50 years is a conservative estimate based on GEM's data. The National Energy Technology Laboratory has modeled the 20-year and 100-year lifecycle emissions associated with scenarios including gas delivered by pipeline from Russia to China, LNG shipped from Australia to China, and LNG shipped from the US to China (NETL 2019). The first scenario was used to estimate the lifecycle emissions associated with gas imported by pipeline, and the average of the two latter scenarios was used to estimate the lifecycle emissions associated with LNG imported through terminals.

To calculate investment in Asian gas infrastructure, the following figures were used to convert power plant capacities, terminal capacities, and pipeline lengths into capital expenditures in US dollars.

**Table 3: Costs of Gas Infrastructure used to Estimate Investment**

| Gas Infrastructure | Type | Cost | Source |
|---|---|---|---|
| Power Plant | Combined-Cycle | $630/kW [a] | (IEA 2020c, p.418) |
| Power Plant | Other | $482/kW [b] | (IEA 2020b, p.43; IEA 2020d, p.418) |
| Import Terminal | Onshore | $274/tonne [c] | (IGU 2018, p.53) |
| Import Terminal | Floating | $129/tonne [d] | (IGU 2018, p.54) |
| Export Terminal | Onshore (Greenfield) | $1501/tonne [e] | (IGU 2018, p.25) |
| Export Terminal | Onshore (Brownfield) | $458/tonne [f] | (IGU 2018, p.25) |
| Export Terminal | Floating | $1501/tonne [g] | (IGU 2018 p.25; OIES 2019, p.16) |
| Pipeline | N/A | $5033/meter [h] | (Smith 2020, p.2) |

**Notes**

a. Based on the average of (IEA 2020c, p.418) estimates for combined-cycle plants in China and India.

b. Based on GEM's estimate for Asian combined-cycle plants from (IEA 2020c), scaled according to the ratio between mean overnight costs for CC plants and open-cycle/internal combustion plants presented in (IEA 2020b, p.43).

c. Based on average global cost of new onshore LNG import capacity in 2017 per (IGU 2018, p.53).

d. Based on average global cost of floating import terminal capacity in 2017 per (IGU 2018, p.54).

e. Based on average global onshore greenfield export terminal capacity costs in 2017 per (IGU 2018, p.25).

f. Based on average global onshore brownfield export terminal capacity costs in 2017 per (IGU 2018, p.25).

g. Based on average global onshore greenfield export terminal capacity costs in 2017 (IGU 2018, p.25). (OIES 2019, p.16) finds that floating export terminal costs are in approximately the same range as onshore terminal costs, and most new floating capacity is assumed to be greenfield.

h. Based on (Smith 2020, p.2) estimate for the cost of building new gas pipelines in the US in 2020, and applied to all East Asian countries excluding China. For South Asian countries (and China), a regional estimate of $687/meter was applied, based on an average of known pipeline costs in India. For Southeast Asian countries, a regional estimate of $1330/meter was applied, based on an average of known pipeline costs in Indonesia.

## REFERENCES


Alvarez, R et al. Assessment of methane emissions from the U.S. oil and gas supply chain. Science. Published July 13, 2018. DOI: 10.1126/science.aar7204

Anchondo, C et al. Surging U.S. LNG puts Biden in climate bind. E&E News. Published July 8, 2021.

Bellini, E. Myanmar's 1 GW solar tender concludes with lowest bid of $0.0348/kWh. PV Magazine. Published September 24, 2020.

BloombergNEF (BNEF). New Energy Outlook 2021. Published July, 2021.

Boudreau, J et al. The U.S. Risks Losing Out From Its Own Trade Push in Vietnam. Vietstock. Published July 2, 2021.

BP. Statistical Review of World Energy 2021. Published July 8, 2021.

Carbon Tracker (2021a). Reach for the Sun: The emerging market electricity leapfrog. Published July 14, 2021.

____. Stranded Assets. Published August 23, 2017.

____ (2021b). The Sky's the Limit: Solar and wind energy potential is 100 times as much as global energy demand. Published April 23, 2021.

____. Whack-A-Mole: Will South Korea's coal power transition be undermined by overcompensated gas? Published April 21, 2020.

Dhaka Tribune staff. State Minister Nasrul: 40% of power will come from renewable sources in 2041. Dhaka Tribune. Published June 25, 2021.

Enerdata. Indonesia's PT Pertamina plans to add 10 GW of capacity by 2026. Published July 7, 2021.

Energy Information Administration (EIA). Natural gas explained. Published December 9, 2020.

Energy Transitions Commission (ETC). Making Clean Electrification Possible: 30 Years to Electrify the Global Economy. Published April, 2021.

Global Energy Monitor (GEM) (2021a). Boom and Bust 2021: Tracking the Global Coal Plant Pipeline. Published April, 2021.

____. Gambling on Gas: Risks Grow for Japan's $20 Billion LNG Financing Spree. Published June, 2020.

____ (2021b). Pipeline Bubble 2021: Tracking Global Oil and Gas Pipelines. Published February, 2021.

Ha, T. Renewables are booming in Vietnam. Will the upswing last? Eco-Business. Published April 13, 2021.

Huong, T. Latest draft of national Power Development Plan VIII up for comments. Vietnam Investment Review. Published September 7, 2021.

Institute for Energy Economics and Financial Analysis (IEEFA). 2021a. Gas and LNG Price Volatility to Increase in 2021. Published January, 2021.

____ (2021b). IEEFA: Bangladesh needs a renewables focus, not a switch from 'coal to gas'. Published April 13, 2021.

____ (2021c). IEEFA: Bangladesh's power system overcapacity problem is getting worse. Published January 20, 2021.

____ (2021d). IEEFA: Fossil fuel pressure and risks mounting for multilateral development banks. Published April 19, 2021.

Intergovernmental Panel on Climate Change (IPCC). Presentation on IPCC Special Report on Global Warming of 1.5°C. Published September, 2019.

International Energy Agency (IEA). 2020a. Gas 2020. Published June, 2020.

____. Net Zero by 2050: A Roadmap for the Global Energy Sector. Published May 2021.

____ (2020b). Projected Costs of Generating Electricity 2020. Published December 2020.

____ (2020c). World Energy Outlook 2020. Published October, 2020.

International Gas Union (IGU). 2018 World LNG Report (27th World Gas Conference Edition). Published July 7, 2018.

The International Group of Liquefied Natural Gas Importers (GIIGNL). LNG Information Paper #3 2019 Update: LNG Ships. Published in 2019.

____. The LNG Industry GIIGNL Annual Report 2021. Published in 2021.

International Institute for Sustainable Development (IISD). Step Off the Gas: International public finance, natural gas and clean alternatives in the Global South. Published June 6, 2021.

International Renewable Energy Agency (IRENA). 2021a. Renewable Capacity Statistics 2021. Published March, 2021.

____ (2021b). Renewable Power Generation Costs in 2020. Published June, 2021.

Lazard. Lazard's Levelized Cost of Energy Analysis—Version 14.0. Published October 2020.

McDonnell, T. Qatar is winning the last great fossil fuel gold rush. Quartz. Published October 6, 2020.

Myhre, G et al. Anthropogenic and Natural Radiative Forcing in Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Published March 24, 2014.

National Energy Technology Laboratory (NETL). Life Cycle Greenhouse Gas Perspective on Exporting Liquefied Natural Gas from the United States: 2019 Update. Published September 12, 2019.

Natural Resources Defense Council (NRDC). Sailing to Nowhere: Liquefied Natural Gas is Not an Effective Climate Strategy. Published December 8, 2020.

Oil Change International (OCI). Shift the Subsidies Database: Public Finance Still Funding Fossils. Accessed April, 2021.

____. The Sky's Limit: Why the Paris Climate Goals Require a Managed Decline of Fossil Fuel Production. Published September, 2016.

Okutsu, A et al. Suga plan for greener Japan stirs hope in wind energy sector. Nikkei Asia. Published May 7, 2021.

The Oxford Institute for Energy Studies (OIES). Emerging Asia LNG Demand. Published September, 2020.

____. Floating LNG Update – Liquefaction and Import Terminals. Published September 2019.

Pardiker, R. Asian Development Bank will stop financing coal, but leaves a door open for gas. Climate Tracker. Published June 17, 2021.

Reuters staff (2021a). Japan pledges $10 bln financial support for Asia's energy transition. Reuters. Published June 21, 2021.

____ (2021b). JBIC to support exports of coal power plants with CCS or ammonia co-firing. Reuters. Published June 29, 2021.

Renewable Energy World staff. South Korea announces ambitious 8.2GW wind complex. Renewable Energy WorldPublished February 17, 2021.

Rocky Mountain Institute (RMI). The Growing Market for Clean Energy Portfolios. Published in 2019.

Rystad Energy. Asia-Pacific's renewable energy capacity set for 58% growth over five years, driven by solar. Published October 20, 2020.

S&P Global. Platts JKM™ (Japan Korea Marker) LNG Price Assessment. Accessed 2021.

Shell. Shell LNG Outlook 2021. Published February, 2021.

Shiga, Y et al. Southeast Asia scrambles for LNG with gas fields tapping out. Nikkei Asia. Published June 2, 2021.

Smith, C. Liquids pipeline operators' net incomes increase 23.5%. Oil & Gas Journal. Published October 5, 2020.

Solutions for Our Climate (SFOC). Fueling the Climate Crisis: South Korea's Public Financing for Oil and Gas. Published August 31, 2021.

Stapczynski, S et al. Pakistan Forced to Buy Priciest LNG Shipments to Avoid Blackouts. Bloomberg. Bloomberg. Published July 29, 2021.

Total. Innovation: Using less energy to liquefy natural gas. CNBC. Published October 8, 2018.

Wood Mackenzie. How Asia changed the global LNG market in the space of a year. Published April 21, 2021.

World Bank Group. World Bank Group Climate Change Action Plan 2021–2025 : Supporting Green, Resilient, and Inclusive Development. Published June 22, 2021.