



Step Off the Gas:

International public finance, natural gas, and clean alternatives in the Global South

IISD REPORT



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Step Off the Gas: International public finance, natural gas, and clean alternatives in the Global South

June 2021

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Photo: Pressure meter on natural gas pipeline (Shutterstock)





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Executive Summary

Overview

This report examines international public financing for natural gas expansion in the Global South and the choices countries face in how to develop their energy systems while meeting socio-economic needs. The report finds that:

- Gas projects in low- and middle-income countries are receiving more international public finance than any other energy source: four times as much as wind or solar.
- This investment risks driving a new dash for gas that locks countries into a high-carbon pathway, imperilling their economic future and the global climate.
- Gas is not needed, as renewable-based alternatives for most of its uses are either already cheaper or are expected to be within a few years.
- Renewable electricity is an increasingly cost-competitive and effective means of providing clean cooking, helped by improvements in the efficiency of electric stoves and devices.
- Countries in the Global South need greater international support to finance clean energy projects, including to help integrate renewables into often weak or unstable electricity grids.

The COVID-19 pandemic has exposed how rapid global change can affect countries in deeply inequitable ways and re-emphasizes the importance of building resilient and socially just economies. As economic resources remain constrained in the coming years, it will be vital that scarce public funds are devoted to building back better.

This report recommends that international public finance should no longer support fossil fuels, focusing instead on creating the enabling conditions for countries to build energy systems based on renewable energy.





International Public Finance Is Driving a New Dash for Gas

The greatest impacts of climate change will be felt in the Global South, especially by the poorest people. Southern countries differ widely in their circumstances and needs. What they have in common is that they have done less to date to cause climate change and have access to fewer resources to mitigate it compared to the wealthier countries of the Global North. Often, significant portions of their populations are energy-poor, while energy demand is growing fast.

The gas industry increasingly sees its future growth potential in the Global South. Gas advocates are calling on governments to pave the way for gas expansion, especially in Asia and Africa. New liquefied natural gas (LNG) exporters, such as the United States and Australia, are seeking new markets while gas companies look for new resources to extract and export.

Efforts to expand gas are being underpinned by international public finance from multilateral development banks (MDBs) and from G20 bilateral financial institutions such as bilateral development banks and export credit agencies. While accounting for only a small portion of total energy finance, international public finance plays a disproportionate role: it both unlocks private finance by reducing project risk and gives signals that influence wider investment trends. According to the International Energy Agency (IEA), public funding and policy support for gas in these economies in the coming years will be a key factor in determining whether global gas demand increases into the 2030s.

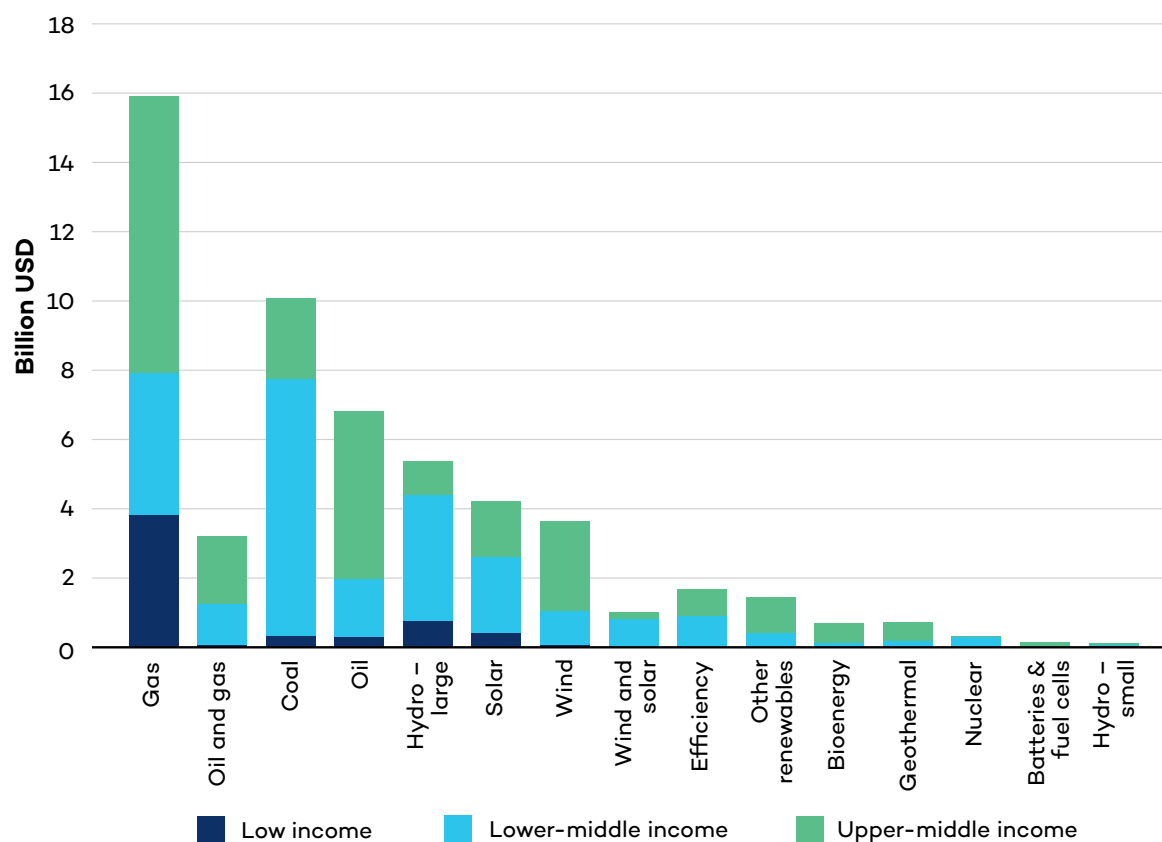
Using Oil Change International's Shift the Subsidies database, this report finds that in low- and middle-income countries:

- Gas projects received an average of nearly USD 16 billion in international public finance per year from 2017 to 2019. This is more than any other source of energy and four times as much as wind or solar.
- The majority of this finance is going to power generation, where gas is least needed, and high-emission LNG infrastructure that risks locking large sections of the economy into gas.
- International public finance invested in all fossil fuels was more than twice as high as for clean energy.
- Initial data on the MDBs' direct project finance shows that they continue to prioritize gas during the COVID-19 pandemic: gas accounted for more than 75% of MDBs' support for fossil fuels in 2020.





Figure ES1. International public finance for energy in low- and middle-income countries, annual average 2017–2019



Sources: Oil Change International, n.d.; World Bank, 2021.

Gas Investments Are Environmentally Damaging and Economically Risky

Gas advocates have long argued that gas can serve as a “bridge fuel” until renewable energy can be developed at a larger scale. Today, this idea is obsolete for three reasons. First, the climate crisis is now urgent: remaining atmospheric space is so limited that there is no room for any additional fossil fuels. Second, since wind, solar, and energy storage and other supporting technologies have fallen rapidly in cost and are deployable at a large scale, there is no longer a need for a bridge. Third, recent findings on the extent of methane leakage from gas infrastructure undermine claims of environmental benefits over other fossil fuels.

Furthermore, now that renewables are competitive, additional gas tends to displace renewable energy as well as coal. Gas starts to look more like a wall than a bridge, impeding rather than enabling the energy transition.

In the median 1.5°C scenario used in the IPCC *Special Report on 1.5°C*, global gas use is halved from 2020 to 2040. Most scenarios see power generation almost completely decarbonized by mid-century, even in a 2°C world.

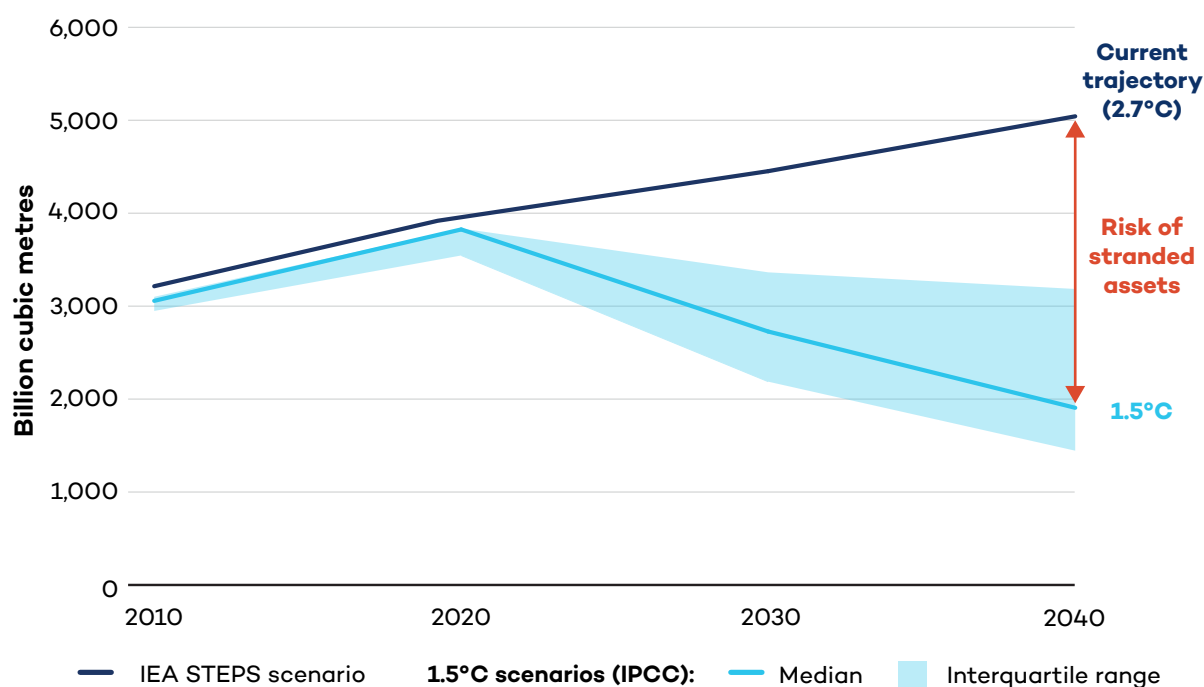




As climate limits drive an accelerating global energy transition, the falling costs of renewable energy will squeeze the whole gas supply chain, creating financial risks for investments in both producing and consuming facilities. Meanwhile, long-lived infrastructure can lock an economy into a carbon-intensive development path that is difficult to leave. Countries are in danger of being left behind in the global energy transition, saddled with stranded assets, more expensive energy, dependence on imports, and trading disadvantages.

Some countries plan to increase their domestic gas production either to generate export revenue or to reduce dependence on imports. However, as global energy markets change, these look like increasingly risky investments. Evidence of the resource curse suggests racing to stay ahead of the energy transition is likely to lead to disappointment: without taking time to build institutions and domestic supply chains, much of the revenues and jobs will flow overseas. Ironically, domestic gas production can increase dependency on imports by creating public expectations and political pressure for gas subsidies, which then encourages consumption to grow faster than production. Rapid gas development in Mozambique is already showing signs of a “presource curse” through deepening public debt, increasing militarization, and exacerbation of militia violence.

Figure ES2: Global gas use in 1.5°C scenarios in IPCC’s Special Report on 1.5°C, compared to the International Energy Agency’s Stated Policies scenario



Sources: IEA, 2020a; International Institute for Applied Systems Analysis & Integrated Assessment Modeling Consortium, 2018.





Gas Is Not Needed, as Renewable-Based Alternatives Are Available and Affordable for Most Uses

The Global South has the world's largest wind and solar resources, and harnessing them creates opportunities to develop without depending on volatile international markets.

For the majority of present uses of gas, alternative technologies are either already cheaper than gas or are expected to become cheaper within a few years (Figure ES2). Often, the lowest-cost decisions are those that reduce energy requirements, such as efficiency standards, insulation, or urban planning. For the minority of gas uses where clean alternatives are not yet available or affordable—such as in heavy industry—rapid technological development is underway, with commercialization expected by the early 2030s.

In most countries for which data are available, wind and solar now generate power at a lower cost than gas. Battery costs are also falling rapidly, and in some countries, the combined cost of wind or solar with batteries is less than that of flexible “peaker” gas plants. Tropical countries have a strong advantage, as greater sunlight consistency through the year makes solar energy strongly pairable with batteries, creating less need for longer-term storage. At the low penetration levels currently seen in most of the Global South, grid management needs for integrating renewables are modest and low-cost; well-tested approaches will be adequate until penetration rises, by which time storage costs will have fallen further.

Gas is a poor solution to the energy access problem. Of the 800 million people worldwide who are lacking electricity, 85% live in rural areas where distributed renewable energy is, in most cases, better able to provide electrification at a lower cost. To provide clean cooking fuels for the 3 billion people relying on dangerous solid biomass, costly plans to expand natural gas connections to residential consumers will face competition from electric solutions due to both reductions in the cost of renewables and improvements in the efficiency of electric stoves and cooking devices.

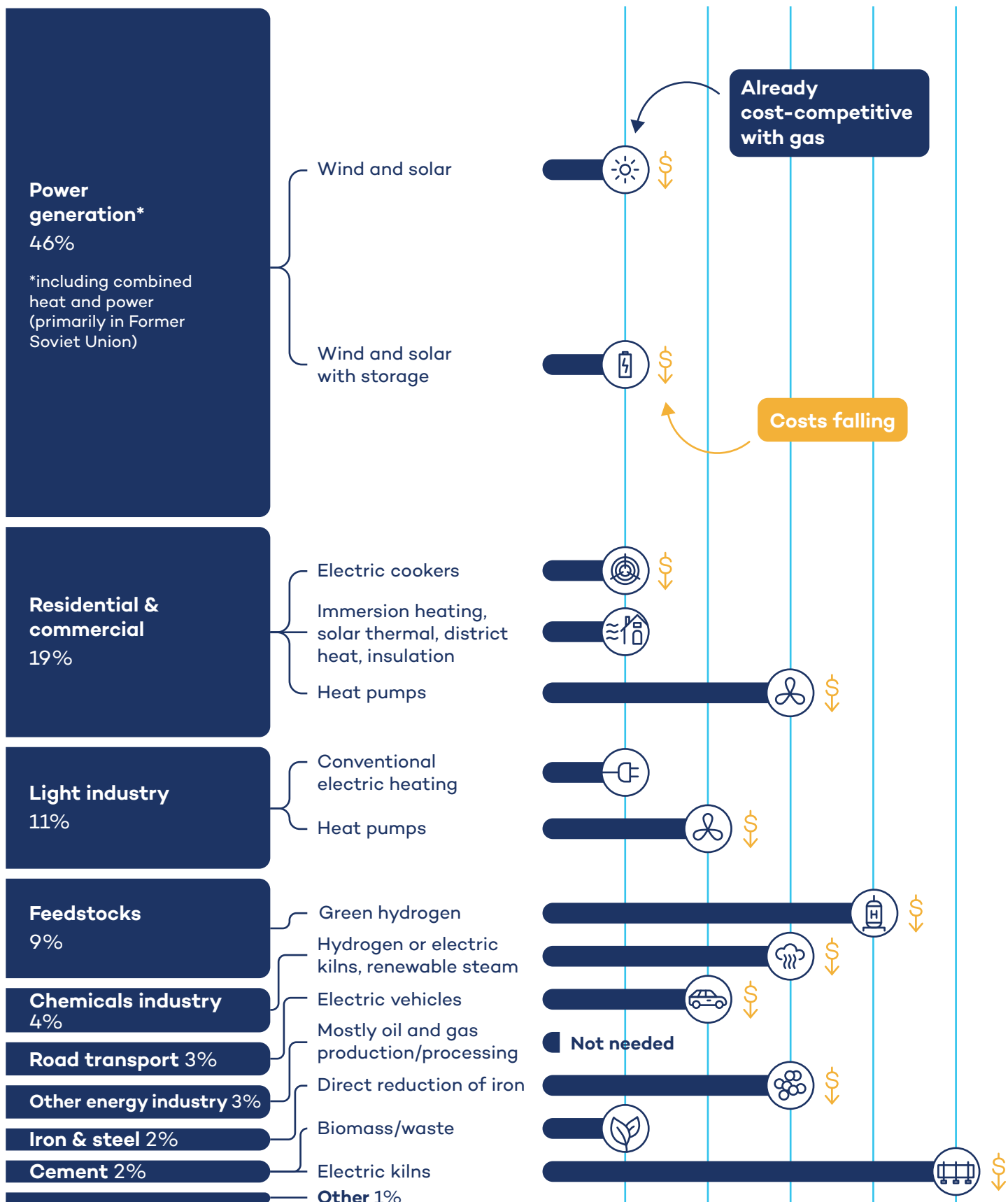
As sustainable alternatives become cheaper and easier to implement, and since they are more suited to meeting development needs, there is little rationale for international public finance institutions to continue supporting gas at scale in the Global South.





Figure ES3. Status of alternatives to gas

Percentages represent share of low- and middle-income countries' use of gas



Sources: see Section 4.





International Public Finance Can Enable the Global South to Overcome Energy Transition Challenges

International public finance can play a vital role in overcoming three challenges Southern countries often face in building renewable-based energy systems. The first obstacle is obtaining finance when private investors perceive high risks and low returns. The second is accessing and benefiting from technology whose patents and manufacturing capacity are held abroad. The third is integrating renewable energy into grids that suffer from blackouts due to poorly maintained infrastructure, ineffective grid management, and financially weak utilities.

This report argues that, if well targeted, public support can unlock the clean energy future instead of supporting large incumbent industries. The report recommends that international public finance institutions:

- End all direct and indirect support to gas exploration and production, as well as to new gas power plants and other long-lived gas infrastructure, such as pipelines and LNG terminals.
- Reorient and substantially scale up clean energy finance to enable countries to transition from (or leapfrog) gas by:
 - Investing in the technologies and institutions that facilitate grid integration of variable renewable energy
 - Enabling technology transfer to contribute to local technological and industrial development
 - De-risking private investments in renewable energy while providing concessional finance where need is greatest
 - Supporting achievement of universal access to clean electricity and cooking in line with Sustainable Development Goal 7, including off-grid renewable energy in regions where access is lowest
 - Ensuring the free, prior, and informed consent of impacted communities for all clean energy projects.
- Prioritize support to the poorest countries that face the greatest challenges in developing renewable energy systems, notably least-developed countries and small island states.
- Provide support to help enable a just transition for affected workers and communities.

The report recommends that governments in the Global South:

- Plan energy and climate development strategies that are based primarily on renewable energy, energy efficiency, and electrification, and aligned with the Paris Agreement goals.
- Avoid building new infrastructure that locks their economies into gas or other fossil fuels.





- Build experience and skills in managing variable renewables in the grid and in deploying non-fossil technologies in industry, buildings, and transport.
- Stop issuing new licences for oil and gas exploration and extraction.
- Enact policies that enable a just transition for workers and communities currently dependent on gas production and consumption.

Box ES1. Argentina, Egypt, and India: Exemplifying the challenges for emerging economies

This report examines the future of gas in three case study countries based on interviews with government officials, stakeholders, and researchers, and supplemented by desk research. We focus on these three large, emerging economies because it is such countries that will have the largest impact on global gas demand.

Today, Argentina relies heavily on gas consumption and remains trapped between high subsidies and debt. When Argentina was previously a gas exporter, plentiful supplies created public pressure for subsidies, which in turn led to a rapid increase in gas consumption that now exceeds dwindling production. While renewable energy is cheaper over its full life cycle, the higher upfront capital costs have been prohibitive, especially with unfavourable borrowing terms. The government has instead pursued unconventional gas extraction, providing production subsidies to overcome the resource's unfavourable economics.

Egypt has ambitious plans to increase renewable energy's share of generation, but its development has been put on hold in order to prioritize gas. The country aims to become a gas trading hub, pooling its own production with that of neighbouring countries for export to Europe. This strategy, however, depends on European gas demand, which may not be sustained as climate pressures increase. Support for domestic gas consumption is driven by fears of dependence on oil imports. Egypt incentivizes the conversion of vehicles to gas fuelling but is now also seeking to expand electric vehicle manufacturing and use, creating a danger of redundancy with parallel charging and gas-fuelling infrastructure.

India is a fast-growing importer of gas. Given the high costs of imported gas, more than half of installed gas power capacity sits idle, and renewables are now the main competitor with coal in power generation. Meanwhile, new import and distribution infrastructure is now being built, with the threat of a second phase of redundancy as energy economics transform. The largest use of gas is in the industrial sector, largely dominated by fertilizer production, which has little alternative feedstock until green hydrogen becomes competitive or the use of fertilizer decreases due to land use or other practices; meanwhile, India remains vulnerable to gas import costs. Like Egypt, the government is encouraging increased use of both compressed natural gas and electric vehicles, building out two parallel sets of infrastructure for fuelling and charging.





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Abbreviations and Acronyms

bcm	billion cubic metres
CCGT	combined cycle gas turbine
CCS	carbon capture and storage
CNG	compressed natural gas
CO₂	carbon dioxide
CO₂e	carbon dioxide equivalent
DRI	direct reduction of iron
EAF	electric arc furnace
EGAS	Egyptian Natural Gas Holding Company
EIA	Energy Information Administration
ESMAP	Energy Sector Management Assistance Program
EU	European Union
EV	electric vehicle
G20	Group of 20 major economies
GDP	gross domestic product
GECF	Gas Exporting Countries Forum
IEA	International Energy Agency
IISD	International Institute for Sustainable Development
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
LCOE	levelized cost of energy
LDCs	least-developed countries
LNG	liquefied natural gas
LPG	liquefied petroleum gas
MDB	multilateral development bank
MMbtu	million British thermal units
MoPNG	Ministry of Power and Natural Gas





mtpa	million tonnes per annum
NDC	Nationally Determined Contribution
OCI	Oil Change International
OECD	Organisation for Economic Co-operation and Development
PIB	Press Information Bureau
PPAC	Petroleum Planning & Analysis Cell
PV	photovoltaic
SDG	Sustainable Development Goal
SEforALL	Sustainable Energy for All
SMR	steam methane reforming
UNFCCC	United Nations Framework Convention on Climate Change





1.0 Introduction

Global gas consumption has nearly tripled since 1985 and now accounts for a fifth of global primary energy. Low- and middle-income countries account for just under half of this, but their consumption has increased 12-fold over the same period (International Energy Agency [IEA], 2020h). Global gas consumption fell 3% in 2020 due to the COVID-19 crisis but is expected to rebound after the pandemic (IEA, 2020e).

This report examines the future of natural gas in the Global South and the role of international public finance in expanding gas or enabling its alternatives. The debate about gas has been underway for some years in Europe and North America (Anderson & Broderick, 2017; Stockman et al., 2019), but there has been less attention given to the question of gas's role in the Global South. This report aims to help fill that gap.

Box 1. What is gas?

Gas is one of the three fossil fuels, alongside coal and oil, formed by the decomposition of ancient organisms at high pressure and temperatures over millions of years. It is found thousands of metres below the Earth's surface and is extracted by drilling in a similar way to oil, and generally by the same companies.¹ Gas can be found on its own or in the same reservoirs as oil; in the latter case, it is extracted as “associated gas.”²

Extracted gas commonly contains between 80% and 95% methane, the simplest hydrocarbon molecule. It also contains smaller amounts of higher alkanes, including ethane, propane, and butane. These latter components are mostly separated out of the gas stream at a processing plant and used as feedstocks (e.g., ethane to make ethylene for plastics) or fuels (e.g., propane and butane in liquefied petroleum gas [LPG]). The processing plant also removes impurities such as carbon dioxide and nitrogen.

Processed gas—primarily methane—is transported and distributed for use primarily in power generation, industry, and buildings (see Section 4). About two thirds of the world's gas is consumed in the country in which it was extracted. Most gas is transported by pipeline, though a growing share of international trade—currently about 12% (BP, 2020)—is in liquefied natural gas (LNG), for which gas is cooled and pressurized to convert it into a liquid then carried long distances by ship before being regasified.

To avoid ambiguities with other gases, the term “natural gas” is commonly used. It is sometimes referred to as “fossil gas” to emphasize its non-renewable and polluting nature. In this report, we generally just use the term “gas.”

¹ About a quarter of the world's gas (mostly in North America) is extracted using hydraulic fracturing, where high-pressure water, chemicals, and sand are injected into impermeable rock formations to create fractures that allow gas to escape.

² Where companies do not build infrastructure to transport and market the associated gas, it is flared or sometimes vented.





1.1 The Gas Dilemma

Since the 1980s, gas advocates have argued that gas can serve as a “transition fuel” on the way to renewables (Hamilton, 1988). However, with a carbon budget now equivalent to just 11 years of current emissions, limiting average global warming to 1.5°C requires the use of all fossil fuels to decline rapidly, with new energy investments focused on zero-carbon energy (Section 3). This creates a dilemma in the Global South, where the worst impacts of climate change will be felt, especially by the poorest people (Intergovernmental Panel on Climate Change [IPCC], 2014; Special Rapporteur 2019), but where energy demand is growing.

As Denton (2019, p. 5) puts it, in the context of Africa, “Governments are caught between two agendas: meeting their developmental needs using available natural resources and at the same time achieving climate action ambitions. At the intersection are stranded assets.”

Southern countries differ widely in their circumstances and needs. The features they broadly share, for the purposes of this report, are that they did less than the Global North to cause the climate crisis and have more limited financial and technical resources to contribute to mitigating it. Commonly, significant portions of their populations are energy-poor.

The apparent advantages of gas development are far from straightforward. Some countries plan to increase gas consumption to fuel industrialization, expand power generation, and replace dirtier fuels in residential and transport uses. Gas has the advantages of incumbency—better-known technologies delivered by existing companies—but over the medium and long terms, it brings economic risks. While a common policy motivation is to reduce dependence on oil imports, relying on imported gas can leave countries equally vulnerable to price shocks. In India, more than half of installed gas power capacity is stranded due to the high cost of imported gas, with domestic production having failed to meet expectations (see the India country study, Section 6.3). India is now building new import and distribution infrastructure, which risks also becoming redundant as alternatives grow increasingly competitive.

In order to mitigate vulnerability to import prices, some countries plan to increase their domestic gas production. Paradoxically, however, the development of domestic supplies can create greater dependence, as growing supplies create political pressures for subsidies, in turn driving greater consumption. Argentina, for instance, ceased being a gas exporter in 2008 as consumption growth outstripped production. Subsidies have remained one of the largest elements of government expenditure, contributing to the country’s debt crisis and making finance for alternative energy development often unaffordable (see the Argentina country study, Section 6.1).

Other producers hope to export gas to generate public revenues. But studies of the resource curse warn that this often comes at the expense of other sectors of the economy, as increased input costs and currency appreciation make other exports uncompetitive (Stevens et al., 2015). Once a resource extraction/export sector becomes established, it tends to create structural barriers to economic diversification (Alsharif et al., 2016). In light of climate change, this can leave whole economies at risk of becoming stranded as the world moves away from fossil fuels.





The global energy transition will squeeze the economics of both gas production and consumption (Section 3). The costs of wind and solar power, as well as battery storage, have fallen dramatically over the last 10 years, and they continue to fall. In many countries, renewables are already the cheapest options for new power generation (Section 4). This raises the question of whether countries with little gas infrastructure can leapfrog to renewable energy, echoing the success story of countries leapfrogging landline infrastructure straight to mobile phones (Doig & Adow, 2011; Khennas & Sokona, 2020). Similarly, these falling costs suggest advantages to existing gas consumers focusing their new growth on renewable energy and/or transitioning existing infrastructure. Renewable energy can potentially bring co-benefits (Dubash et al., 2013) beyond climate mitigation by supplying energy at a lower cost and reducing import dependence, as well as by reducing air pollution and creating resilient jobs.

Countries that do not yet have significant gas infrastructure will see the greatest opportunities to develop along non-fossil-fuelled paths, but in many cases, they also face the greatest challenges. Least-developed countries (LDCs) see little interest from private investors and correspondingly high finance costs; meanwhile, weaker institutions are less able to manage electricity grids in a way that can accommodate variable renewables (Section 5). External energy investment in LDCs is often geared to exports, such as Mozambique's offshore gas fields and LNG terminals, which have attracted both oil company capital and international public finance but bring significant risks (Section 3).

Some countries have decided against allowing the extraction of gas. The first countries to end new exploration licensing were in the Global South: Costa Rica in 2011 and Belize in 2018. They have since been joined by Denmark, New Zealand (offshore), France, Spain, Portugal, and Ireland. In a joint op-ed in December 2020, the energy ministers of Costa Rica and Denmark called on other countries to join them to “stop expanding fossil fuel production and begin a just transition with a clear cut-off point in sight” (Jørgensen & Murillo, 2020). Hydraulic fracturing has been banned or subject to a moratorium in several countries and subnational jurisdictions, including Uruguay, Colombia, Argentina's Entre Ríos province, and Brazil's Paraná state (Herrera, 2020).

1.2 A New Dash for Gas

In 2019, five countries—the United States, Russia, Iran, Qatar, and China—accounted for 55% of global gas production and 47% of its global consumption (BP, 2020). With the exception of China, these key producing countries are exporters of gas. China, Japan, Germany, Italy, and Mexico are the top importers (Figures 1 and 2).

The rapid rise of LNG is changing the shape of markets. While previously gas was mostly traded through long-term supply contracts, today, it is increasingly treated as a flexible commodity; for importers, this may increase vulnerability to international price swings (Robertson, 2021). Fast-growing exporters such as Australia and the United States are keen to find new export markets (Figure 3).

The gas industry sees its greatest future demand growth potential in the Global South, especially in power generation in Africa and Southeast Asia, and in the industry sectors in Pakistan, Bangladesh, and Indonesia (Snam et al., 2020, p. 36). According to the Gas



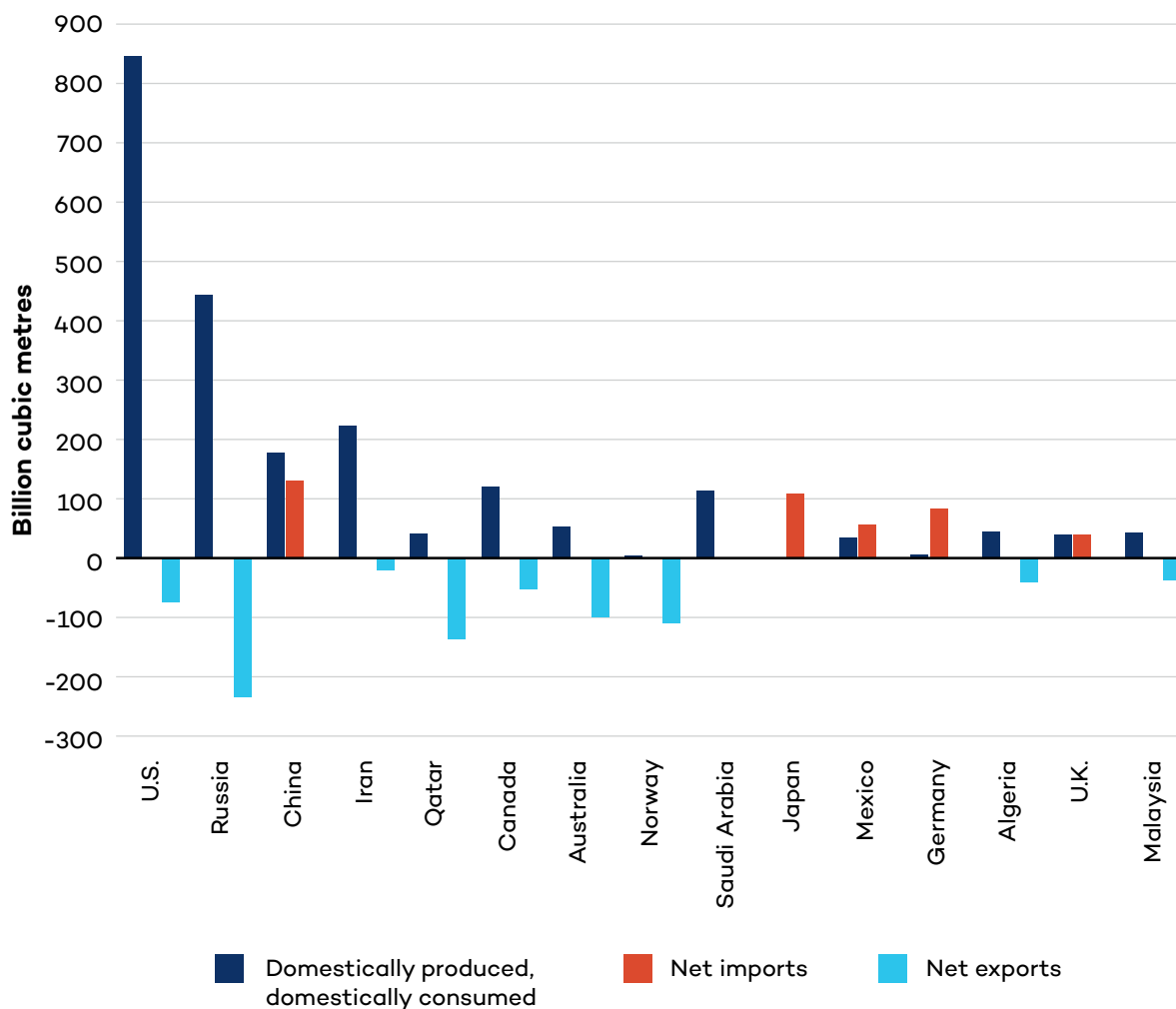


Exporting Countries Forum (GECF), “most [energy demand] growth will come from countries and regions with under-developed energy infrastructures and access, meaning that there will be a big opportunity for gas” (GECF, 2020, p. 17). The IEA (2020), p. 338 projects that under existing policies, 57% of global gas demand growth between 2019 and 2040 will occur in Asia-Pacific and a further 34% in Africa, the Middle East, and Central and South America.

Governments that are considering where to direct their energy economies face numerous influences in global forums, investment flows, and bilateral relations. Following major efforts to promote gas as a climate change solution, the GECF (2020, p. 14) states that gas has “embedded itself into all the important discussions, from the G20 to the UNFCCC, and from BRICS to the World Economic Forum.”

There has been strong advocacy for gas expansion in Africa (Ayuk, 2020; Konadu, 2020; Thurber & Moss, 2020). In its Malabo Declaration, for example, the GECF (2019) prioritized working with African countries to expand their gas consumption and infrastructure. Exporters and international institutions are meanwhile pressing Asian governments on the supposed climate benefits of imported gas (see Section 3) (IEA, 2019d; Townsend, 2019; Winstel, 2020).

Figure 1. Gas market players: domestic consumption (above the zero line) and exports (below the zero line) of gas by key economies (billion cubic metres [bcm] in 2019)

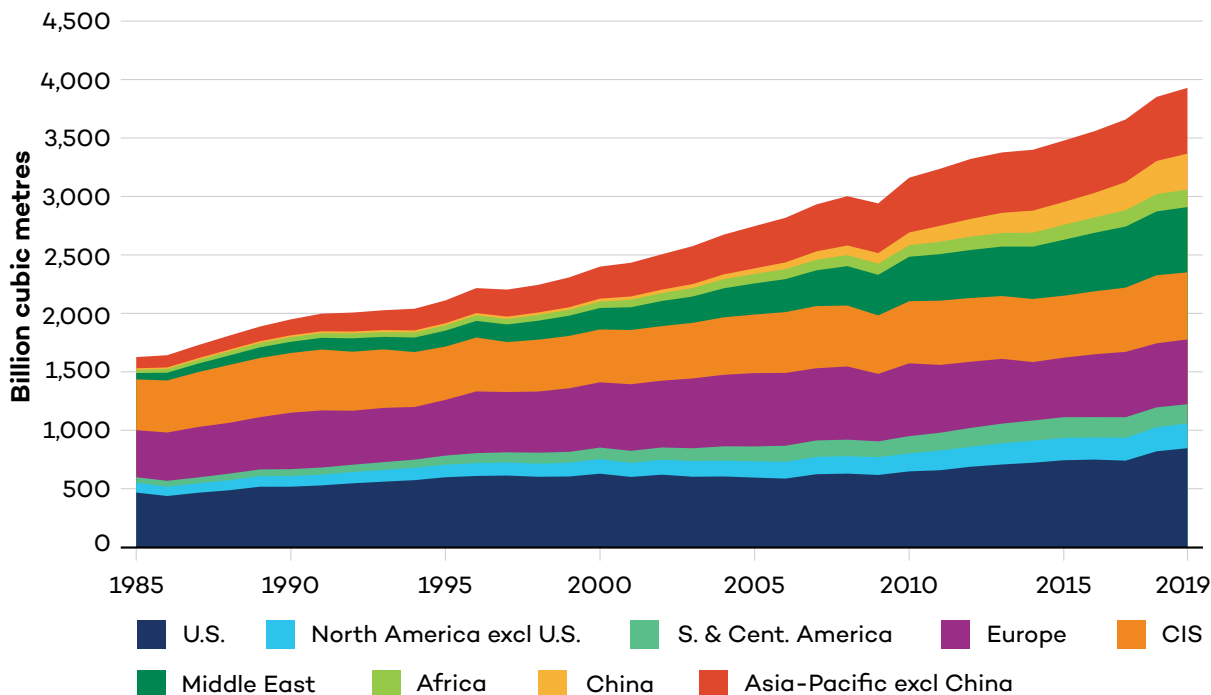


Source: BP, 2020.



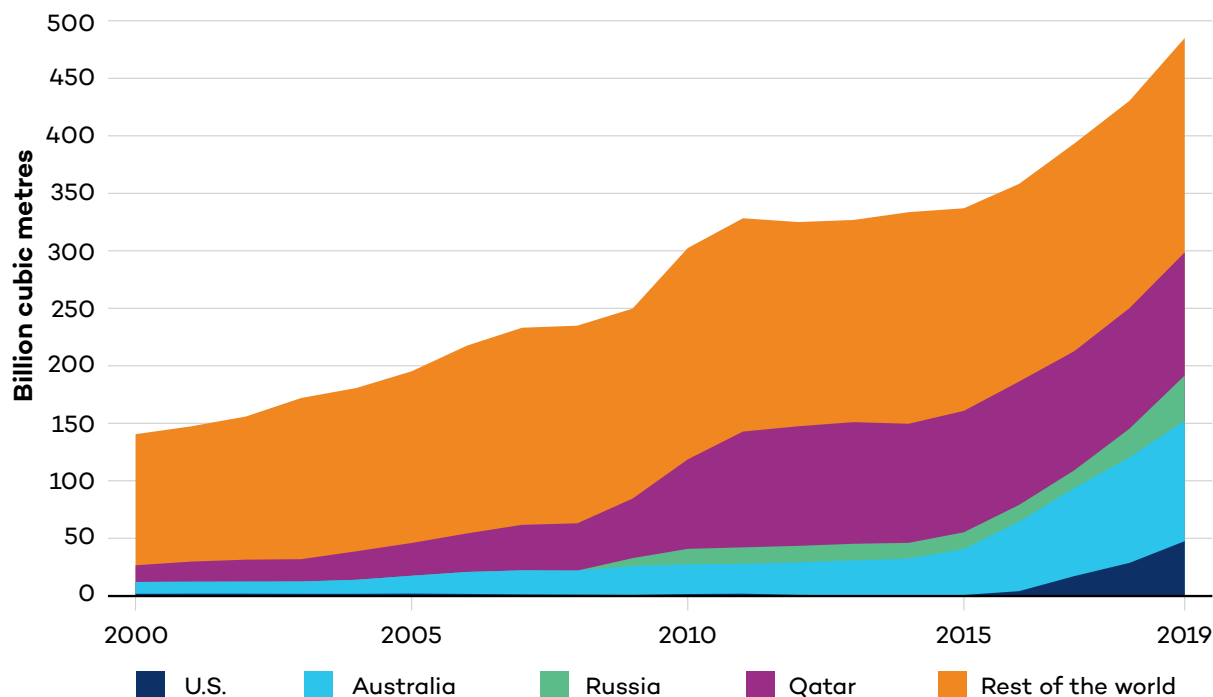


Figure 2. Gas consumption by key countries and regions from 1985 to 2019 (bcm)



Source: BP, 2020.

Figure 3. LNG exports by country



Source: BP, 2020.





1.3 Structure of This Report

After this introduction, the following four sections of the report review issues common to many countries. Section 2 presents a new analysis of the international public finance and policy support that are driving a new dash for gas. Section 3 examines scenarios for the future of gas in a climate-constrained world and discusses the risk of stranded assets for both gas export and gas-consuming investments. Section 4 assesses the availability of affordable alternative technologies in the power, industry, residential, and transport sectors. Section 5 examines some of the challenges experienced, especially by low-income countries but also to a varying degree in emerging economies: access to energy, weaker electrical grids and institutions, and obtaining finance and technology.

Section 6 then looks in more detail at how these issues manifest in three emerging economies that foresee greater roles for gas in their energy systems and thus are key drivers of global demand growth. Argentina is a former gas exporter but now a net importer; it is seeking to increase domestic unconventional gas production to reduce import reliance and potentially return to exporting. Egypt, which has major gas reserves and is a modest exporter, is seeking to increase both its domestic production and its role as a regional hub. India is a large economy that seeks to use imported gas to drive development and reduce air pollution. All three case studies are based on interviews with experts and officials in the countries and supplemented by desk research.





2.0 Public Finance: Driving the dash for gas

Finance from public (government-owned) institutions plays an important role in shaping the direction of finance as a whole. While accounting for only a small portion of total energy finance,³ international public finance plays a disproportionate role: it both unlocks private finance by reducing project risk and gives signals that influence wider investment trends. Given its scarcity and high impact, there is a strong case that public finance flows should be aligned with public policy priorities (Tucker & DeAngelis, 2020, p. 8–9).

This section reviews the provision of international public finance and other policy support for gas and its alternatives.

2.1 International Public Finance for Gas

This section analyzes data from Oil Change International’s (OCI’s) Shift the Subsidies database (see the methodology in Appendix A), which tracks energy finance from international public finance institutions from the bottom up at the project level.

Multilateral development banks (MDBs) and G20 bilateral finance institutions provided an average of USD 15.9 billion to gas⁴ in low- and middle-income countries from 2017 to 2019 (OCI, n.d.; World Bank, 2021b) (Figure 4).⁵ This is more than for any other source of energy and four times as much as for wind or for solar.

³ The Shift the Subsidies database records an average of USD 72 billion per year in public finance for energy during 2017–2019. The IEA (2020i) estimates nearly USD 2 trillion per year in energy investment over the same period.

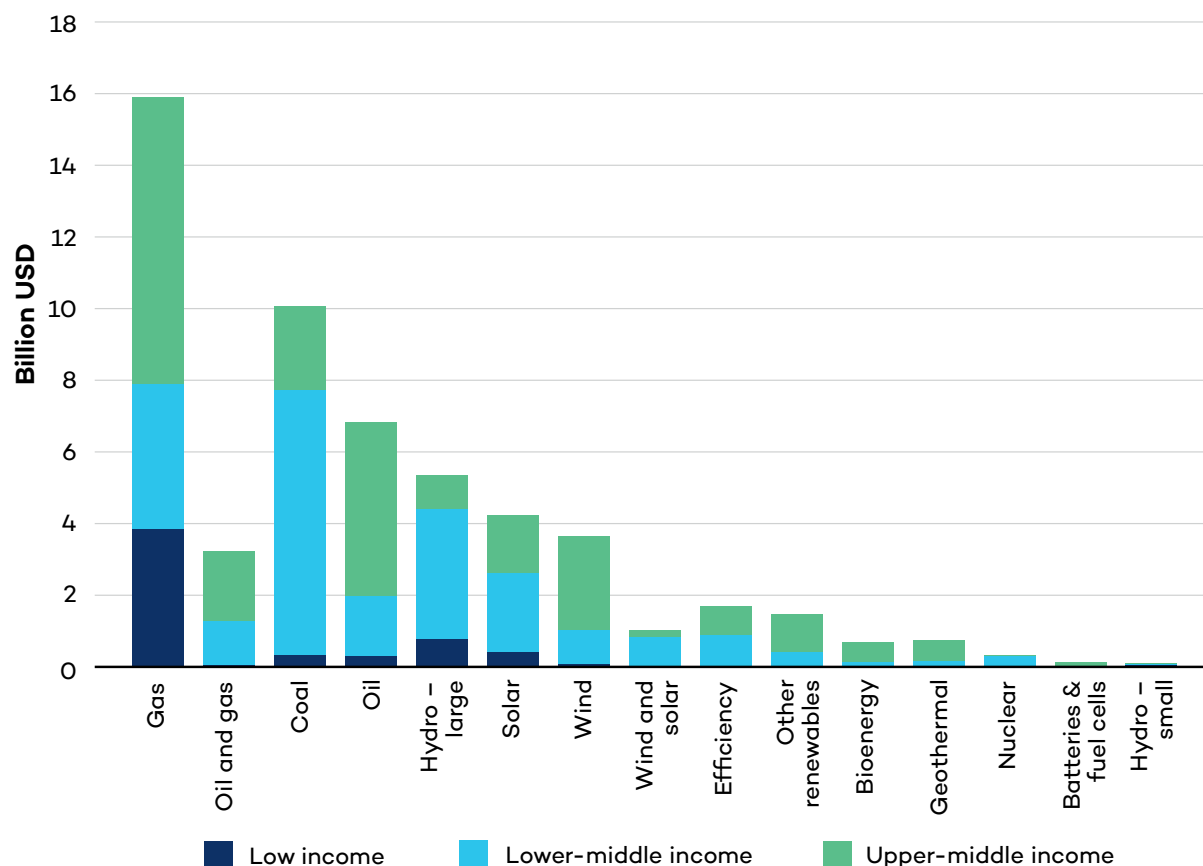
⁴ This does not include USD 3.2 billion in finance for combined oil and gas projects.

⁵ 96% of this finance was international (i.e., provided to a project in a country other than that of the financial institution itself).





Figure 4. Energy finance from MDBs and G20 bilateral institutions to low- and middle-income countries by fuel, annual average 2017–2019⁶



Sources: OCI, n.d.; World Bank, 2021b.

Financing for all fossil fuels was more than double that for clean energy (Figure 5).⁷ This imbalance was greatest for Russian public finance (282 times as much for fossil fuels as clean), followed by Italy (120 times), Korea (94 times), China (25 times), India (20 times), Canada (13 times), and Japan (11 times) (OCI, n.d.; World Bank, 2021b) (Appendix B).

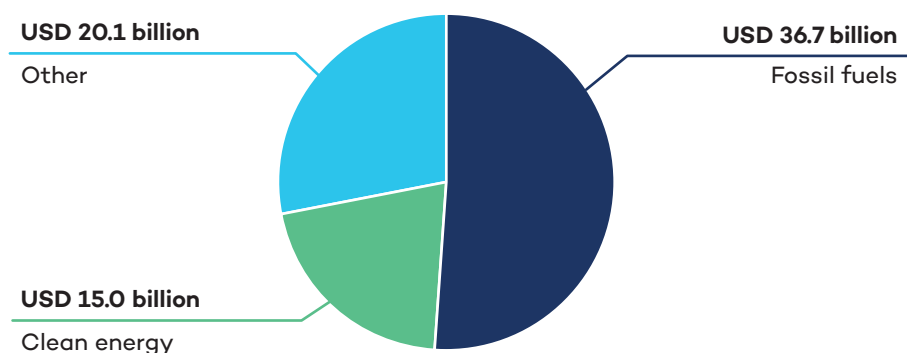
⁶ Transactions to multiple sectors or where the recipient sector is unclear are not shown in Figure 4 (USD 16.3 billion). Country income groups and regions are as defined by the World Bank (2021b) as of April 1, 2021.

⁷ "Clean energy" here refers to wind, solar, geothermal, small hydro, other renewables, energy efficiency, and batteries/fuel cells. "Other energy" refers to non-fossil fuel energy that has major environmental impacts including large-scale hydro, bioenergy, and nuclear, as well as energy infrastructure that cannot be differentiated by fuel type (such as transmission and distribution).





Figure 5. Energy finance from MDBs and G20 bilateral institutions to low- and middle-income countries by energy category, annual average 2017–2019



Sources: OCI, n.d.; World Bank, 2021b.

Fully 18% of international public finance for gas in low- and middle-income countries went to a single country, Mozambique, for the development of offshore gas extraction and LNG export, with questionable developmental benefits (see Box 3, Section 3.5).

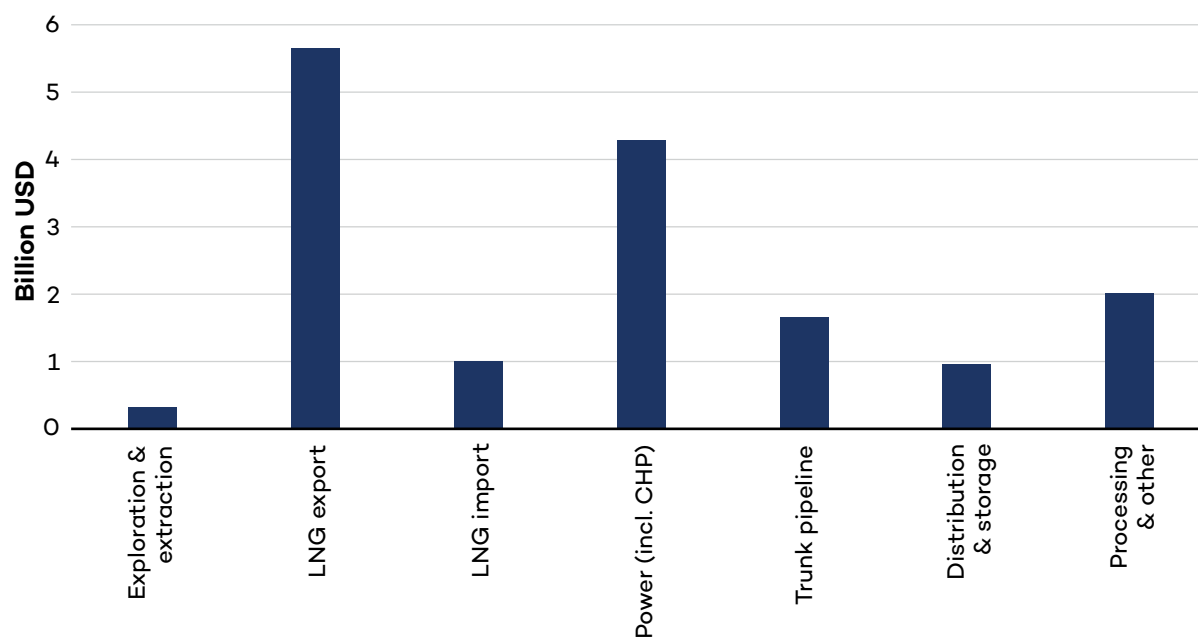
Of the average USD 15.9 billion per year of international public finance for gas, 48% came from just three countries: Japan, China, and the United States (Appendix B). A further 12% came from the World Bank, which, after phasing out finance for oil and gas exploration and production in 2019, has recently been criticized for continued investments in other parts of the oil and gas supply chain (“Open Letter to World Bank Group,” 2021).

The largest shares of international public finance were for LNG export and for power generation, with 36% and 27%, respectively, of the total between 2017 and 2019 (Figure 6). Power generation is the sector where gas is least needed, as alternatives are affordable and deployable at scale (Section 4), so most 1.5°C or 2°C scenarios see power almost completely decarbonized before 2050. Meanwhile, LNG has the highest life-cycle greenhouse gas emissions (Section 3.1), and new LNG infrastructure risks locking large sections of the economy into trading gas that is not needed.





Figure 6. Gas finance from MDBs and G20 bilateral institutions to low- and middle-income countries by activity, annual average 2017–2019



Sources: OCI, n.d.; World Bank, 2021b.

In light of the COVID-19 pandemic, there is widespread public and political agreement that economic recovery packages should be focused on “building back better” to a clean economy. However, initial data on MDBs shows that they continue to prioritize gas during the pandemic. Gas projects received USD 2.1 billion from MDBs in 2020, accounting for more than 75% of MDBs’ support for fossil fuels (Big Shift Global, 2021; Energy Policy Tracker, n.d.). While clean energy as a whole received four times as much finance as fossil fuels, contrary to previous trends, the disproportionate finance for gas—twice as much as wind and five times as much as solar—continues to threaten to lock in new emissions.

2.2 Why International Public Finance Matters

The industry’s *Global Gas Report* (Snam et al., 2020, pp. 5, 36) notes that it is new infrastructure that will propel future demand. Since this in turn shapes emissions, the question of investment is thus crucial. A multi-model study by McCollum et al. (2018) finds that under current trends, investments in fossil fuel extraction and conversion are set to be USD 550 billion per year higher than would be consistent with limiting warming to 1.5°C, while investments in renewable energy and energy efficiency are set to be USD 550 billion lower.

Public finance can play an important role in reshaping the direction of energy investment, both by de-risking private finance and by sending market signals (Delina, 2019, pp. 125, 130). According to the IEA (2020), p. 276), public support for gas in the Global South in the coming years will be a key factor in determining whether global gas demand increases into the 2030s.





As a matter of government accountability, public funds should be used for purposes that advance policies and serve the public interest. A key element of this is contributing to the challenge of climate change mitigation: in the Paris Agreement (United Nations Framework Convention on Climate Change [UNFCCC], 2015, Art. 2.1c), governments committed to “making finance flows consistent with a pathway toward low greenhouse gas emissions and climate-resilient development.”

As for wider developmental and economic objectives, gas investments carry significant risks for both the environment and host economies (Section 3). And for most uses of gas, alternatives are available and cost-competitive, or expected to be cost-competitive in the coming years (Section 4). Meanwhile, international public finance can significantly help overcome barriers to expanding renewable energy in the South in a way that supports the achievement of the Sustainable Development Goals (SDGs) (Section 5).

In the case of ending investment in coal, international public finance institutions have led the way. A number of institutions began to exclude support for coal-fired power plants, with some bilateral institutions taking this step in 2009, and the World Bank Group ended its support for coal-fired power following its 2013 *Energy Sector Directions Paper*. These decisions by leading institutions had knock-on effects not only on other public finance actors but also commercial finance institutions, many of which followed suit from 2013 onward, contributing to a financial exodus from the thermal coal sector. This was further enhanced in the Organisation for Economic Co-operation and Development (OECD) Arrangement on Officially Supported Export Credits in 2015.

As with the rapid shift away from coal finance, international public finance could play an outsized role in the transition of public support away from gas and toward enabling climate solutions.





Box 2. Momentum toward ending international public finance for oil and gas

In 2017, the World Bank Group committed to ending its support for upstream oil and gas from 2019. In late 2019, the European Investment Bank established a new Energy Lending Policy that goes considerably further, effectively ending its support for oil and gas beyond 2021. All MDBs and a growing number of other public finance institutions have committed to aligning their activities and portfolios with the Paris Agreement.

Bilateral public finance institutions have also made full or partial commitments to exclude gas: Swedfund and Agence Française de Développement, along with export credit agencies like BPIFrance, the Svensk Exportkredit (SEK), and Exportkreditnämnden (EKN), have either fully excluded oil and gas financing or have introduced major exclusions. And in December 2020, the United Kingdom announced an end to financing for fossil fuels overseas, choosing a whole-of-government approach that will cover bilateral development finance, export finance, trade promotion, and the United Kingdom's voice and vote at the MDBs. Following the British commitment, in January 2021 in the United States, the Biden administration similarly issued Executive Orders with a section on ending U.S. public finance for fossil fuels, which U.S. Climate Envoy John Kerry (2021) described as "a plan for ending international financing of fossil fuel projects with public money." During the same week, the European Union (EU) Foreign Affairs Council agreed to "discourage further investments in fossil fuel-based energy infrastructure projects in third countries" and to promote a global phase-out of harmful fossil fuel subsidies (European Council, 2021).

While it remains necessary to ensure effective implementation, these actions represent a significant shift in the perspective of international public finance actors on the role of public finance in supporting gas.

2.3 Domestic Subsidies for Gas

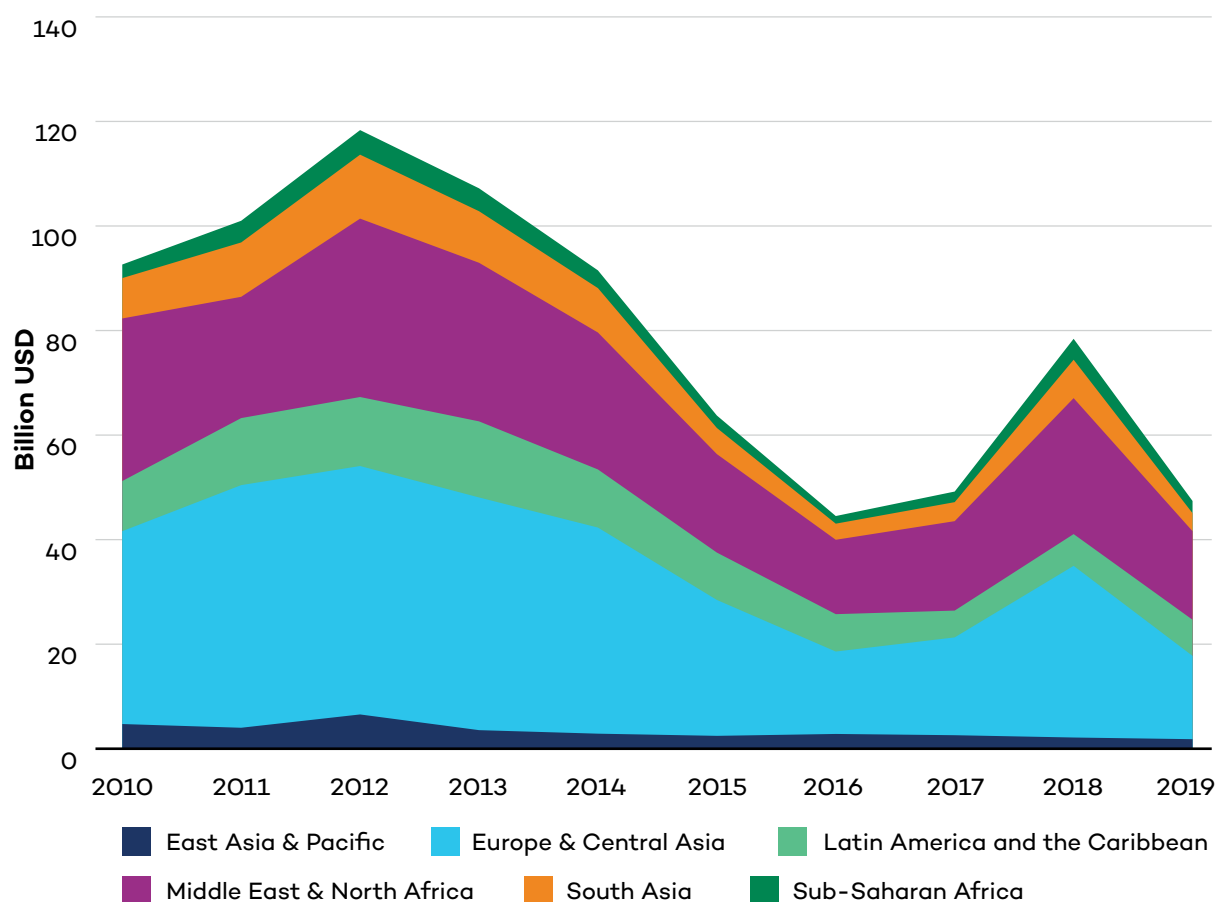
It is not just internationally that public resources tilt the playing field in favour of gas. According to data collected by the OECD (n.d.) and the IEA (n.d.), governments of low- and middle-income countries provided USD 47 billion in domestic subsidies for gas production and consumption in 2019 through direct transfers, tax expenditures, and price controls (Figure 7; see methodology in Appendix A). By far the largest providers of subsidies for gas were Iran (USD 16.3 billion) and Russia (USD 10.5 billion), followed by Uzbekistan (USD 2.7 billion), Mexico (USD 2.6 billion), and Algeria (USD 2.3 billion).⁸

⁸ High-income countries also provided large amounts of public support for gas, the largest being the United Kingdom (USD 5.9 billion), the United Arab Emirates (USD 5.0 billion), and Saudi Arabia (USD 4.7 billion).





Figure 7. Government subsidies for gas production and consumption, low- and middle-income countries



Sources: OECD, n.d.; IEA, n.d.; International Institute for Sustainable Development [IISD] & OECD, n.d.; World Bank, 2021b.

These subsidies create a significant fiscal burden on governments, using up resources that could be much better spent on delivering social needs, including meeting the SDGs and enabling renewable energy development (Merrill & Chung, 2015). Consumption-oriented subsidies encourage wasteful consumption and make gas more attractive or competitive relative to alternatives such as renewable energy (see the Argentina case study, Section 6). They generally increase inequality because the greatest beneficiaries are richer people who consume more rather than those who need government support (Coady et al., 2015). Production-oriented subsidies keep “zombie energy” projects operating that would otherwise be economically unviable (Gerasimchuk et al., 2017). In all these respects, subsidies slow the energy transition and deepen dependence on gas (Merrill et al., 2017). For these reasons, SDG 12 (target 12.c and indicator 12.c.1) calls on governments to reform subsidies for the consumption and production of fossil fuels.





3.0 The Environmental and Economic Case Against Gas

This section reviews the climate impacts of gas and examines the role of gas in a world that achieves the Paris Agreement goals. Contrasting this with the current trajectory, it explores the risks of stranded assets, and indeed stranded economies, and the costs they threaten for countries in the Global South. Finally, it observes the often missed promise of economic benefits from gas extraction.

3.1 A Collapsed Bridge

Gas advocates have long argued that gas can serve as a “bridge fuel” until renewable energy can be developed at a larger scale. When this idea was first proposed in the 1980s (Hamilton, 1988), it might have made some sense as an easy first step toward decarbonization, as gas combustion causes about half as much carbon dioxide (CO₂) emissions as coal (EIA, 2020c; IPCC, 2006, p. 1.21). Today, however, three factors make the idea obsolete.

First, after decades of continued rising global emissions, the climate crisis has become more urgent, and to avoid its worst impacts, cuts must be more rapid than fuel switching can deliver (Stockman, 2018). The carbon budget for 1.5°C is equivalent to just 11 years of current global CO₂ emissions; for 2°C, it is 26 years.⁹ And with net-zero emissions targeted for mid-century, new gas infrastructure is likely to lock in emissions beyond the time horizons for emissions reduction (IEA, 2019d, pp. 10, 12).

Second, the costs of renewable energy have fallen dramatically, and renewables are now cheaper than fossil fuels in most of the world; meanwhile, techniques and technologies are becoming increasingly available and affordable to balance variable supply (Section 4).

Third, methane¹⁰ leaks from gas infrastructure at every stage of the supply chain, and some recent studies have found that leakage is far greater than previously thought (Alvarez et al., 2018; Hmiel et al., 2020; Schwietzke et al., 2016).¹¹ Methane is 28 times more potent than CO₂ over a 100-year timescale and 86 times more potent over 20 years (Myhre & Shundell, 2013, p. 714), so this leakage significantly increases the climate impact of gas over its full life cycle, beyond the emissions from the combustion phase. Above a given “break-even” leakage rate, gas will be no better for the climate than coal. This break-even rate varies with the differing coal emissions in different sectors and applications; methane leakage has been observed to exceed this rate in some cases (Howarth, 2015; Qin et al., 2017).

⁹ In January 2018, the carbon budget for a 50% probability of keeping warming below 1.5°C was 580 gigatonnes (Gt); for a 66% probability of keeping below 2°C, it was 1,170 Gt (IPCC, 2018, p. 108). Current global emissions of CO₂ are about 40 Gt per year (Global Carbon Project, 2020)

¹⁰ Methane is the primary ingredient of natural gas.

¹¹ There is significant variation in leakage between sites and variation in measurements using different methodologies. Average leakage rates have been extensively debated, with numerous scientific studies conducted, especially in North America. Research institute PSE Healthy Energy maintains a database of studies at https://www.zotero.org/groups/248773/repository_for_oil_and_gas_energy_research_roger_-_pse_healthy_energy/collections/WEICK6IC/items/E9FMHN42/collection





In summary, we have missed the opportunity to cross by bridge, but we do not actually need a bridge—and what we are seeing may not be a bridge anyway. Furthermore, with renewables now competitive, additional gas tends to displace renewable energy as well as coal (McJeon et al., 2014; Zhang et al., 2016). For example, in Egypt, renewable energy is cheaper than gas, but its development has been stalled in order to focus investments on more gas (see Section 6.2). Gas starts to look more like a wall than a bridge, impeding rather than enabling the energy transition.

Any environmental advantage of gas further diminishes when transported as LNG due to both the energy requirements of liquefaction and additional leakage (including evaporation) during liquefaction, transport, and regasification.¹²

Perhaps cognizant of the collapse of the “bridge fuel” idea, some companies now promote gas as a “destination fuel,” claiming it to be a preferred long-term solution rather than a transitional step (BP, 2017).¹³ To accept this claim would be to give up on stabilizing the climate at all because as long as CO₂ is emitted (for example, from burning fossil fuels), temperatures will keep rising (IPCC, 2013, p. 1108).¹⁴

3.2 Gas and the Paris Agreement Goals

Under existing policies, the IEA (2020j, p. 338) projects that gas demand will grow nearly 30% globally from 2019 to 2040, with most of the growth in the Global South.¹⁵ However, in this event, the Paris Agreement climate goals will not be met, setting the world on course for at least 2.7°C of warming by the end of the century (IEA, 2020j, p. 87).

In its 2018 Special Report, *Global Warming of 1.5°C*, the IPCC examined how energy systems would need to change in order to limit global average temperature rise to 1.5°C above pre-industrial levels. As shown in Figure 8, global gas use is halved from 2020 to 2040 in the median 1.5°C scenario.¹⁶

¹² There is limited literature on LNG’s relative emissions, and the impact can vary significantly with infrastructure availability and quality and, indeed, with the production systems in the source country (Stern, 2019, p. 11–14). One study of British LNG imports from Qatar estimates that these LNG stages of the supply chain can account for 50% of LNG’s total life-cycle emissions, doubling the total emissions compared to pipeline gas (Tagliaferri et al., 2017); this is echoed by a finding by the Oil and Gas Authority (2020) that average life-cycle emissions for LNG from all sources are more than double those of domestic gas.

¹³ BP originally coined the “destination fuel” term (Hayward, 2009) but no longer uses it. In a survey by the Atlantic Council (Bell et al., 2021, p. 21) of hundreds of energy leaders, 21% described gas as a destination fuel that will maintain a large market share over the long term.

¹⁴ Unless those continued emissions are entirely offset by CO₂ removals from the atmosphere.

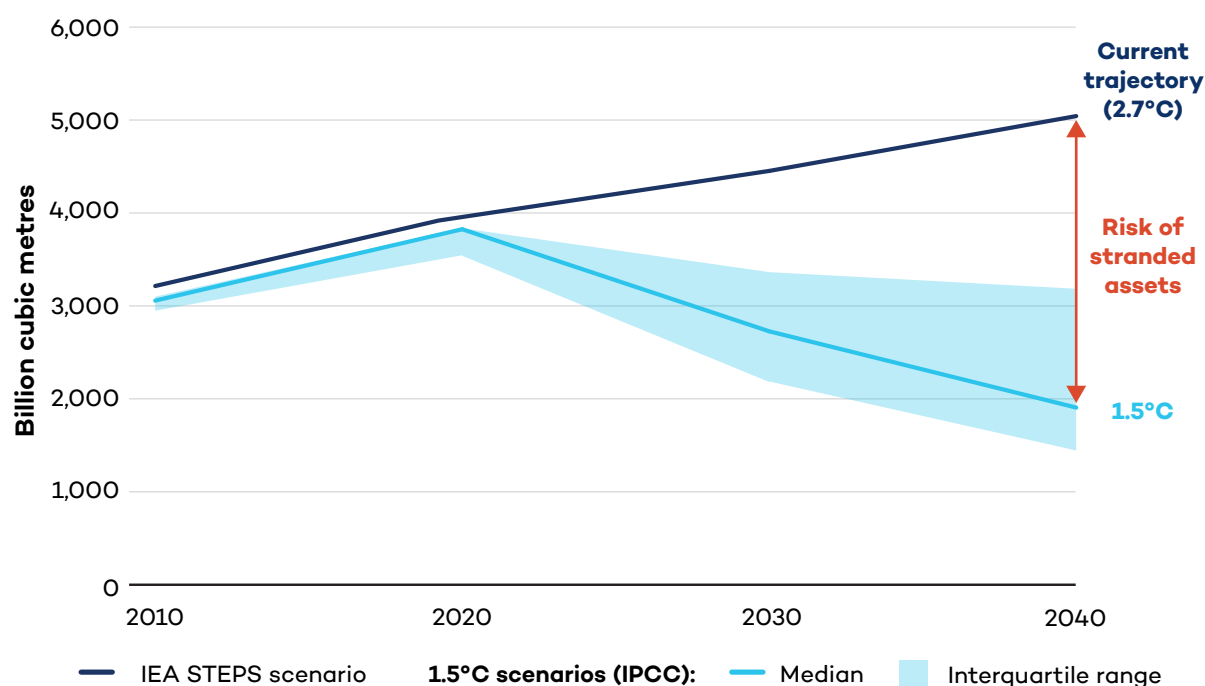
¹⁵ The IEA’s Stated Policies Scenario reflects all of today’s announced policy intentions and targets, insofar as they are backed up by detailed measures for their realization.

¹⁶ Following the approach of the Climate Action Tracker and *The Production Gap* report (New Climate Institute et al., 2018; Stockholm Environmental Institute et al., 2020, p. 13), the scenarios shown here are limited to those whose reliance on CO₂ removal does not exceed the maximum sustainable potential reported by the IPCC (2018, p. 343–345). Specifically, those scenarios where land use-based removal does not exceed 3.6 Gt per year and bioenergy with carbon capture and storage (BECCS) does not exceed 5 Gt per year, on average over the period 2040–2060.





Figure 8. Global gas use in 1.5°C scenarios in IPCC’s Special Report, compared to the current trajectory



Sources: IEA, 2020j; Integrated Assessment Modelling Consortium & International Institute for Applied Systems Analysis, 2018.

These scenarios used by the IPCC are derived from least-cost models of the energy-economy system, which prioritize emission cuts where they are cheapest to achieve.¹⁷ With readily available and affordable clean alternatives, power generation is almost completely decarbonized by mid-century in these scenarios: there is little or no role for gas power after 2050 in a 1.5°C or 2°C world (IPCC, 2018, p. 112).

3.3 The Risk of Stranded Assets

As the world decarbonizes, some of today’s investments in carbon-intensive infrastructure are likely to become stranded assets in which investors or governments make a loss on capital invested.

The stranded assets problem is best understood in relation to producing assets: if climate policy drives reductions in gas demand, the price of gas will fall to a lower point on the cost curve, potentially below the assets’ break-even price (Cust et al., 2017). The problem is exacerbated if major new sources of supply come to market, for example, shale gas from the United States and elsewhere.

But this does not mean consumption infrastructure is not at risk. The falling costs of renewable energy will squeeze the whole gas supply chain, creating financial risks for both

¹⁷ They may do so directly through an explicit objective function or indirectly through simulating competitive economic behaviours (Trutnevyte, 2016).





producing and consuming infrastructure. As Stern (2017, p. 1) notes, the economic viability of most new supply infrastructure would require gas prices that few countries outside the OECD can afford.

Furthermore, the energy transition is unlikely to be a smooth or linear process.¹⁸ Thus, if expectations of falling demand lead investment capital to be diverted elsewhere, there could be a supply crunch, forcing prices upward (Fattouh et al., 2019, p. 6–7) and damaging the economics of import, distribution, and consumption assets. Rather than predicting consistently lower prices, the energy transition will be characterized by inherently more unstable prices. The European gas industry is now struggling to plan even a few years ahead as Europe’s energy markets are transformed (Stern, 2017, p. 5).

One way gas infrastructure can become stranded is if competing alternatives become cheaper. As renewables expand, existing gas plants, pipelines, and LNG terminals can be left operating at lower utilization rates and being paid lower prices, doubly eating into their economic viability. Thus, BloombergNEF (2020b, p. 10) projects that global average capacity factors (utilization rates) for combined cycle gas turbines (CCGTs)—the most common form of gas power plant—will fall from 46% in 2019 to 27% in 2050, making it harder to achieve a return on investment. Wind and solar are already the cheapest sources of new electricity in most of the world (see Section 4), and their costs continue to fall. Countries that continue to build gas power risk either the disruption of these investments becoming obsolete and losing money or being saddled with expensive energy supplies.

Some have proposed that gas infrastructure can be built today and later repurposed for clean gaseous fuels such as hydrogen, biogas, and biomethane¹⁹ (Baker et al., 2021; Bothe & Janssen, 2019). In the case of hydrogen, repurposing would, however, require substantial adaptation to make the infrastructure technically viable with hydrogen’s lower density and smaller molecule size (Lambert, 2020; Stockman et al., 2019, p. 9), and there has been little consideration so far of the likely costs of this.²⁰ For all three gases, a more fundamental problem is that the geography of future infrastructure is likely to be very different for both supply and demand. Not only will sources of hydrogen, biogas, and biomethane likely be in different locations from today’s gas fields, gaseous fuels will likely be a relatively scarce and costly part of decarbonized energy systems, and therefore used in hard-to-abate industry applications and possibly freight transport (Section 4) rather than widely in homes and power stations (except perhaps in a minority of cases for balancing purposes). Thus, even if distribution infrastructure can

¹⁸ Rather, the transition is likely to be erratic and bumpy, characterized by tensions between political inertia on the one hand and tipping points in behaviours and market decisions on the other. For example, positive feedback loops in the system will likely cause the pace of change to accelerate as human talent and investment—and design compatibility of auxiliary technologies—anticipate the decline of fossil fuels and switch to clean energy, hastening the decline of incumbent industries (Geels, 2002, 2014). Thus the most visible economic manifestations—asset write-downs—happen only at the end of a process in which organizations have shifted strategy, prices have adjusted, and markets have adapted (Bond et al., 2020).

¹⁹ Biogas is produced by anaerobic (oxygen-free) digestion of organic materials such as agricultural wastes or biomass crops. It consists of methane and CO₂, commonly in proportions of around 60/40. Through various processes, it can be purified into biomethane, which is chemically equivalent to natural gas. Biomethane can also be produced via gasification of woody biomass at high temperatures.

²⁰ So far, most consideration is given to blending 5%–20% hydrogen into natural gas supplies.





technically be repurposed for zero-carbon gaseous fuels, much of it will go from the wrong places to the wrong places.

3.4 Stranded Economies

It is not just individual assets that can suffer long-term economic losses. Long-lived infrastructure can lock an economy into a carbon-intensive development path that is difficult to leave (Friedrichs & Inderwildi, 2013).²¹ This lock-in arises from economic, political, social, or legal inertia (Seto et al., 2016; Unruh, 2000).

Economically, existing energy facilities have a competitive advantage over new ones because their capital is already sunk. Even if alternatives become cheaper overall, existing facilities will continue to operate to reduce their losses, as long as they can sell energy at more than their marginal operating cost. Politically, there will be pressure from companies, investors, workers, and consumers to introduce or increase subsidies to protect an incumbent industry from change. Subsidies can create “zombie energy” that does not die in spite of being inherently economically unviable (Gerasimchuk et al., 2017). Socially, public perceptions of plentiful fossil fuel supplies tend to disincentivize energy efficiency and alternative energy sources and create habits and behaviours that reinforce the role of the existing energy system.

Legally, companies might challenge any policy change that negatively affects their profits, including in international investment tribunals. For example, take-or-pay contracts with gas suppliers or gas-fired power suppliers can leave energy purchasers having to pay for gas well into the future, even if it becomes obsolete as the world decarbonizes (Boute, 2021).

Or operators of power plants can resist change. A good example is Grenada, whose second Nationally Determined Contribution (NDC) under the Paris Agreement is no more ambitious than its first NDC of 5 years earlier. The reason, Grenada’s government explained, is that the power utility objected to Grenada shifting its power generation from fossil fuels to cheaper renewables. The utility—which had been granted an 80-year monopoly under a 1994 World Bank-advised privatization deal—began arbitration proceedings at the International Centre for Settlement of Investment Disputes. Grenada was ordered to repurchase the utility and pay legal costs (Antonich, 2020; Lo, 2021).²²

²¹ Note that asset stranding and carbon lock-in are not mutually exclusive: both can happen simultaneously. A stranded asset is one that fails to deliver economic returns on investment. Commonly, a facility may be making losses but still remain in operation to try to reduce those losses.

²² Long-term contracts can also constrain governments’ flexibility to shape their energy systems to meet domestic needs: when Egypt enacted a policy to increase gas feedstock supply to domestic plants, oil companies claimed that constituted a breach of contract and began arbitration through the International Centre for Settlement of Investment Disputes; the tribunal ultimately ordered Egypt to pay the companies USD 2 billion in compensation (Section 6).





Countries locked into fossil fuels face being left behind in the global energy transition, saddled with more expensive energy, dependence on imports, and trading disadvantages. For example, if border carbon adjustments become a trend, as proposed in the EU and the United States, the carbon intensity of production could price countries out of some export markets (Goldthau et al., 2020).

3.5 Gas Extraction Failing to Deliver

Some countries aim to exploit domestic reserves of gas to limit reliance on energy imports or to obtain revenue through gas exports. However, the potential of domestic production to deliver on either objective is less straightforward than it may seem.

Based on detailed case studies of Argentina, Indonesia, and Malaysia, Gomes (2020) observes a common pattern where domestic gas extraction leads to rapid demand growth, which in turn creates political pressure for subsidies for gas consumption, resulting in further growth that outpaces production, even when production too is subsidized (see Section 6). The irony is that in such cases, domestic production can in fact lead to greater import dependence (often of costly LNG) to meet the newly locked-in demand. Beyond her three case studies, Gomes (2020) observes similar effects in Oman, the United Arab Emirates, and Myanmar.

One of the most important lessons from the experience of new producers is that they generally only benefit from oil and gas if they take it slowly: building up local supply chains, workforce skills, and experienced public institutions (Karl, 1997; Stevens et al., 2015). These institutions must manage contracts with multinational companies, oversee their accounts to ensure correct tax payments, and enforce local content requirements for job creation (e.g., Ackah & Mohammed, 2018). When countries try to move too fast, large shares of the jobs and revenues flow overseas, leaving the hopes for socio-economic development frustrated. Equatorial Guinea, Peru, Trinidad and Tobago, and Yemen (Centre for Public Integrity, 2015; Lassourd et al., 2019) each experienced a common issue with LNG development: initial contracts with a multinational oil company provide government revenues based on the gas sales price in one country, but the company can choose to divert shipments to another country where prices are higher (in some cases many times higher). As a result, the majority of income flows to companies rather than government. Whereas contracts can be designed to ensure the true revenues are fairly shared, governments' ability to negotiate such contracts commonly depends on their past experience and institutional capacity.

The lesson about the benefits of slower development clashes with new producers' hope to develop their gas reserves quickly before global demand falls (Sinn, 2012). Potential exporters are thus squeezed between the resource curse and stranded assets.





Box 3. Mozambique's presource curse and unmet gas hopes

Mozambique acts as a cautionary tale of how the lure of gas revenues can turn out to be more of a curse than a blessing. In 2010, the discovery of 5,000 bcm of gas in the offshore Rovuma basin created high expectations for the country's economic development. In 2012, Mozambique's Minerals Minister announced that gas could earn Mozambique USD 5.2 billion per year by 2026 (SAPA, 2012). *Petroleum Review* magazine (2012) suggested gas "could catapult the country from being one of the poorest African nations to one of the richest," with major industrialization, airports, and other infrastructure, potentially becoming "the new Qatar."

However, a more recent government analysis suggests that annual revenues will not exceed USD 500 million before 2030, peaking at USD 3.2 billion in 2040 (Ministério da Economia e Finanças, 2018). A large part of the reason is that the contracts are structured such that most revenues flow to the oil companies in the early years, with government revenues backloaded in time (Hubert et al., 2019). As a result, it will be government revenues more than company returns that will be at risk as the world transitions away from fossil fuels (Fuhr & West, 2014). While some researchers link the foreign direct investment boom with an increase in direct and indirect jobs, others are more skeptical, pointing to higher-skilled jobs going to foreign nationals and urban residents (Africa Intelligence, 2020; Toews & Pierre-Louis, 2017).

Following the gas discoveries, in 2013 the government took USD 2 billion in state-backed loans, ostensibly for acquiring fishing boats but in reality mainly for naval forces to protect offshore gas fields (Wirz & Wernau, 2016). The loans were not disclosed to Mozambique's parliament as required by law and emerged as a scandal in 2016. They are now subject to criminal investigations in Switzerland and the United States (Qing, 2020; Reuters, 2020; Spotlight on Corruption, 2020). Following the loans, Mozambique's public debt ballooned, increasing from 46% to 126% of gross national income from 2012 to 2016 (World Bank, 2021a). This high public debt has created a vicious circle where LNG export revenues are now seen as the only viable option for the government to reduce its debt, so revenues from the gas projects will mostly serve debt reduction purposes in the years to come rather than enabling economic development (World Institute for Development Economics Research, 2018). Scholars have called the pattern of high revenue expectations, increased public debt, and social instability a "presource curse" (Frynas & Buur, 2020).

In Cabo Delgado province, the construction of gas facilities has led to the displacement of people from their land while the area has been militarized to protect the facilities. Rising inequality and human rights violations, against a backdrop of earlier promises of rapid wealth, have exacerbated existing social, political, and religious tensions, contributing to worsening outbreaks of militia violence that have so far claimed more than a thousand lives (Friends of the Earth International 2020; Mahumane & Mulder, 2019; Rawoot, 2020). Delays due to COVID-19, insecurity, and fluctuating oil and gas prices, which hit a record low during the pandemic, further threaten the viability of Mozambique's LNG outlook (Leigh & Derby, 2020).



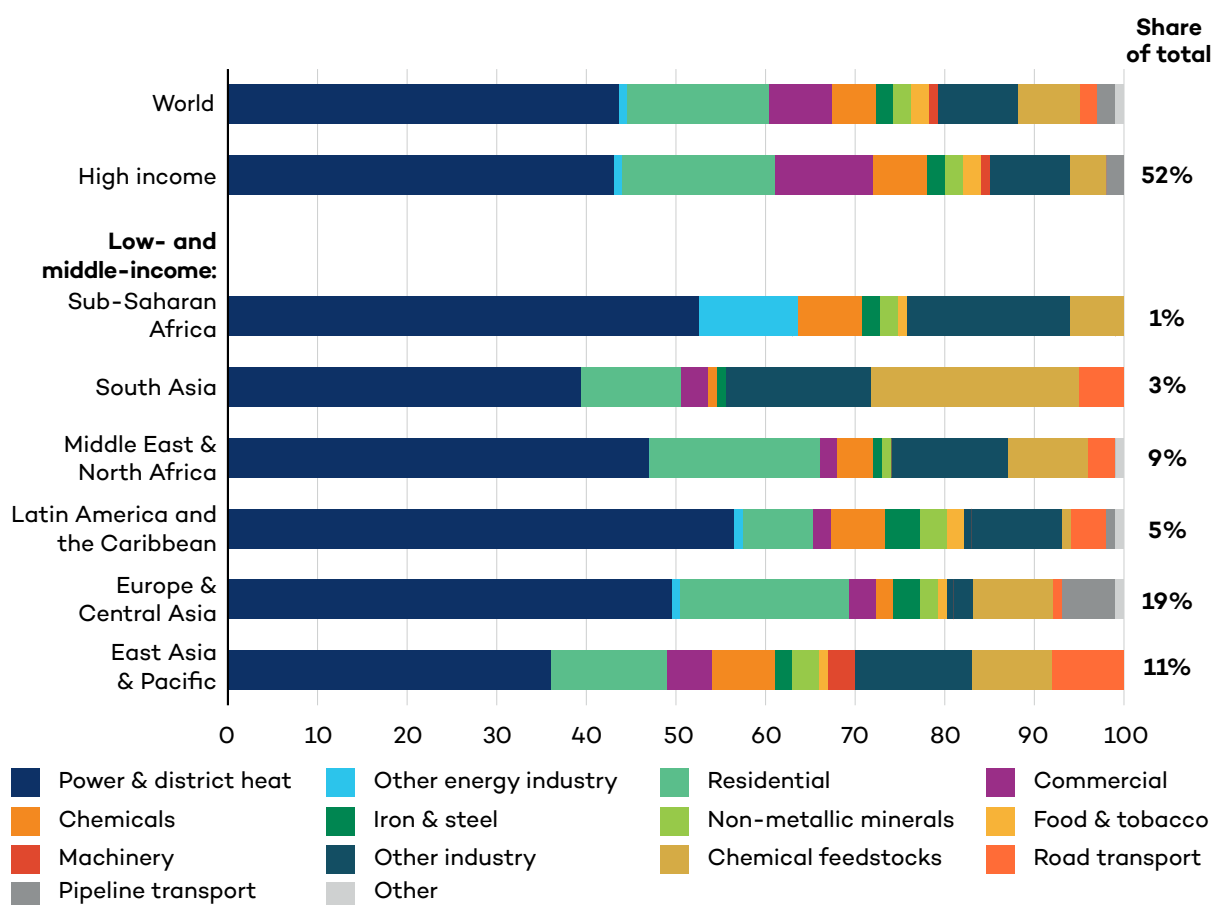


4.0 Alternatives to Gas

Given the environmental and economic risks associated with fossil fuels, a key question for countries' energy decisions is the availability of viable alternatives. This section examines the alternatives to gas in each of its major uses and the state of technological development, including cost. Often the lowest-cost solutions are those that reduce energy requirements, such as efficiency, insulation, or urban planning; these also make the transition easier and reduce strains on energy systems.

The largest present uses of gas in low- and middle-income countries are power (46%), industry (28%) (including feedstocks), and residential and commercial buildings (19%), as shown in Figure 9.²³ In all of these uses, growth pressures arise not only from increasing energy demand but also to replace dirtier fuels: coal (mainly in power and industry), oil (industry and transport), and solid biomass (cooking). Road transport consumption of gas—through compressed natural gas (CNG)—remains low despite programs to promote its consumption over the past 20 years.

Figure 9. Gas consumption by sector, 2018



Sources: IEA, 2020h; World Bank, 2021b.

²³ An additional 12% is used in the energy industry—primarily oil refineries and gas processing plants—and 2% in fuelling pipeline pumps. Since these uses are specific to oil and gas, they will mostly not be needed in a decarbonized world, so alternatives are not explored in this section.



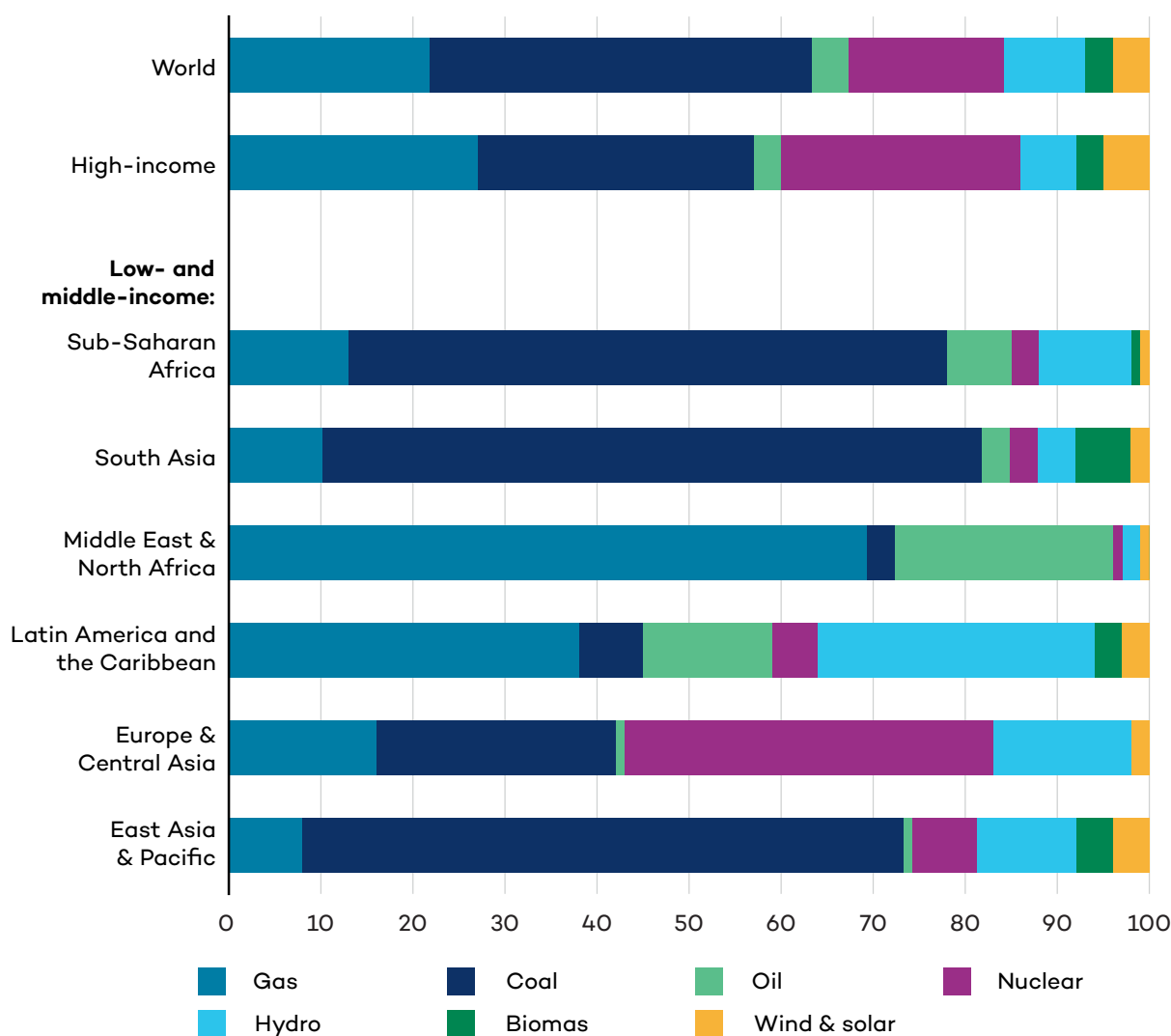


In the IEA's Stated Policies Scenario (2020j), the largest component of projected non-OECD growth in gas demand is in industry, approximately doubling over the period, while demand for gas in power generation is projected to grow by about 30%.

4.1 Alternatives to Gas in Power Generation

Gas fuels 17% of power generation in low- and middle-income countries (Figure 10). While hydro, nuclear, biomass, and geothermal have been used for decades, the fastest growth and greatest zero-carbon prospects are in wind and solar. Even in the IEA's (2020i, pp. 372, 392) Stated Policies Scenario, where the world fails to meet the Paris Agreement goals as no new policies are introduced, wind and solar provide over a quarter of Africa's and over a quarter of Asia-Pacific's electricity by 2040.

Figure 10. Shares of power generation by region, 2018



Sources: IEA, 2020h; World Bank, 2021b.

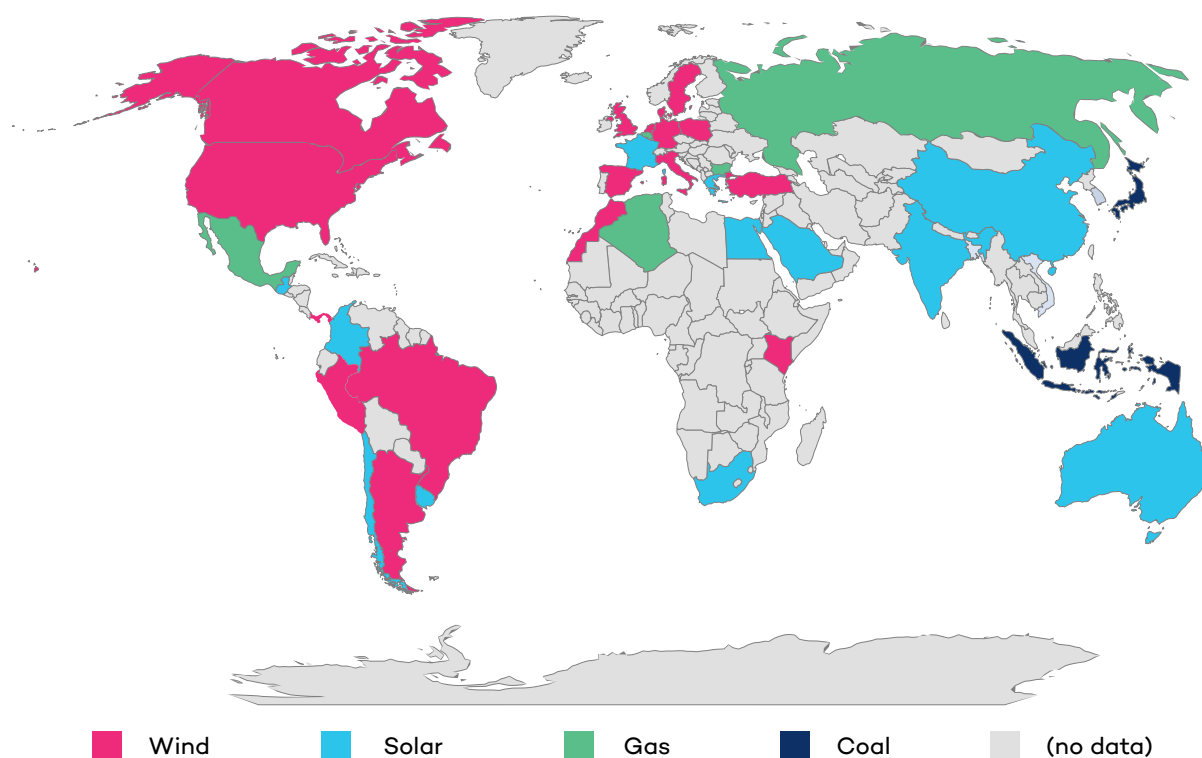




According to BloombergNEF (2020b, p. 8), utility-scale wind or solar-photovoltaic (PV) are already the cheapest sources of new-build power generation in countries, accounting for two thirds of the world's population and 85% of total generation (Figure 11).²⁴ Between 2010 and 2019, the global average levelized cost of energy (LCOE)²⁵ fell by 29% for offshore wind, 38% for onshore wind, and 82% for solar PV. Costs continue to fall, with auction data suggesting further 29%, 18%, and 42% reductions, respectively, between 2019 and 2021 (International Renewable Energy Agency [IRENA], 2020c, pp. 14–15).

It is notable that these costs do not include the major avoided environmental costs from fossil fuel use—for example, IISD research indicates that pollution costs would double the true cost of electricity generation from coal in Indonesia (Attwood et al., 2017).

Figure 11. Cheapest (lowest LCOE) source of unsubsidized new bulk power generation by country



Source: BloombergNEF, 2020c.

²⁴ Note that there is a cost data gap for most developing countries. By comparison with the larger countries, we can infer that renewable energy will have the lowest physical cost in most countries, especially in tropical countries where the solar resource will generally be plentiful. Financing costs may be a barrier in developing countries since most costs of renewables are incurred upfront (there are no fuel costs, etc.). This issue is discussed in Section 5.

²⁵ LCOE is a measure of the effective cost per unit generated when taking into account both capital and operating costs. It allows a simple rule-of-thumb cost comparison between technologies, primarily from a societal perspective. With the exception of fixed-price arrangements such as power purchase agreements, LCOE is not a good tool for deciding on investments (Gross et al., 2013, p. 17), as it does not reflect a generator's ability to capture the highest hourly prices (Joskow, 2011). Investors primarily assess investments using net present value and internal rate of return.





In many respects, countries of the Global South are well suited to renewable energy. They often have ample sunshine and/or wind resources, they are relatively unconstrained by legacy power systems, and modular development can be well matched to where and when demand growth is occurring, including electrifying remote rural populations (Arndt et al., 2019, pp. 150, 155–156). Wind and solar already provide 30% of power generation in Uruguay and more than 10% in Chile, Republic of the Congo, Costa Rica, Honduras, Morocco, Nicaragua, and Yemen (IEA, 2020h). In Uruguay, wind power was prioritized in the 2010s in order to cut electricity costs and successfully delivered by encouraging investment through fixed 20-year feed-in tariffs and public–private partnerships (Bertram, 2020). Studies have proposed pathways to 100% renewable energy for countries including Iran, Mauritius, Nigeria, and Pakistan and regions including Central America and sub-Saharan Africa (Vanegas Cantarero, 2020, p. 7).

4.2 Integrating Renewables Into Power Grids

The key issue for renewables is how to manage their variability. Electricity systems require supply and demand to be matched at all times, and while grid operators are well accustomed to varying demands, wind and solar add an extra dimension with variable supply as well.²⁶ There are three approaches to balancing the system: balance supplies, manage demand to match supplies, or store energy.

Some gas proponents have advocated for gas to provide grid flexibility to support the integration of renewables. However, the types of gas generation that could play this role—flexible “peaker” units such as open cycle and reciprocating gas engines—are very costly per unit of energy due to their inefficiency and resulting high fuel consumption (Figure 12). The more efficient CCGT plants are not suited to providing grid balancing: they are designed for relatively constant use due to high upfront capital costs. If they are used for grid balancing (i.e., only part of the time), their capacity factor will be lower, and hence the LCOE will be higher compared to Figure 12 (Stockman et al., 2019, pp. 14–15).²⁷ In reality, gas is more often a competitor than a complement to renewables.

Where countries already have significant hydropower—which provides a significant share of capacity in many countries of the South (IEA, 2020h)—it can be an effective partner to wind and solar (Edwards et al., 2017; Gebretsadik et al., 2016). New large-scale hydro projects, however, generally have severe social and environmental impacts, including displacing communities and deforestation (Moran et al., 2018; World Commission on Dams, 2000).

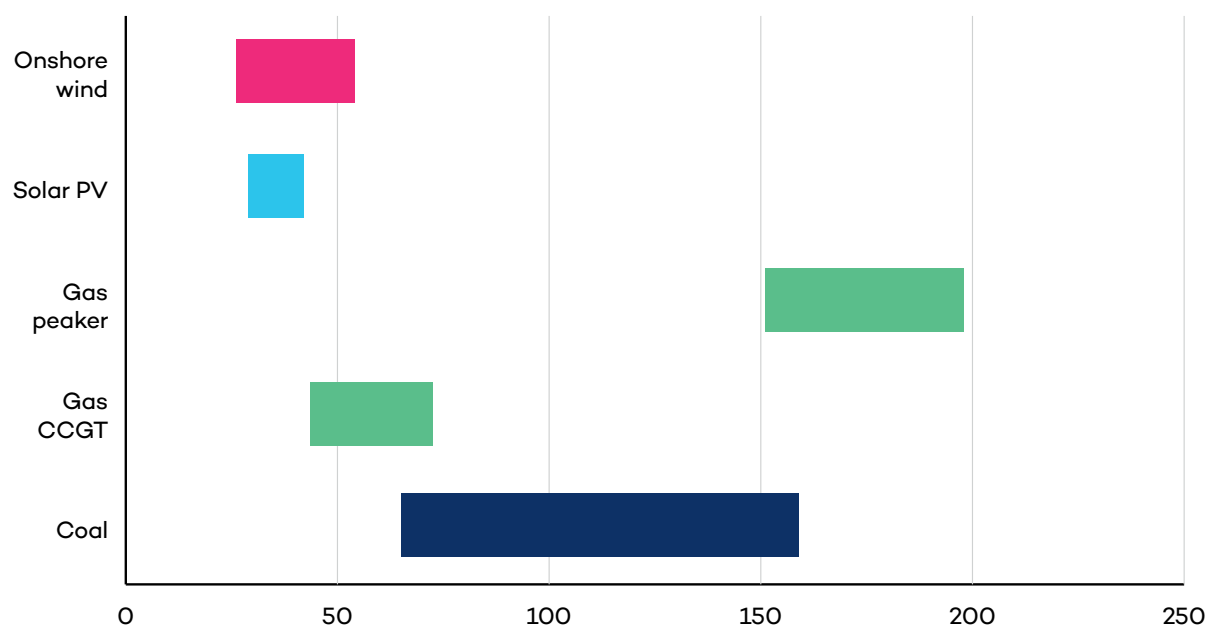
²⁶ The grid operator plans most of the supply the day before, based on forecast demand, then receives updated forecasts through the day and adapts supply as required using flexible options that take less time to ramp up. In efficient systems, a grid operator buys power from generating plants in “merit order,” that is, starting with the plants with the lowest marginal costs and adding more until the cumulative supply matches demand. “Spinning reserve” generation capacity is available to switch on very quickly in the event of an unexpected supply interruption. Failure to make the system sufficiently flexible will require renewable generation to be curtailed (not used), which, if done significantly, will damage the economics and raises costs (Cochran et al., 2014).

²⁷ CCGT plants have relatively high capital costs but (due to efficiency) lower fuel costs. Peakers are the other way round and so are suited to providing capacity that is often idle.





Figure 12. LCOE (unsubsidized) of renewables versus gas and coal



Source: Lazard, 2020.

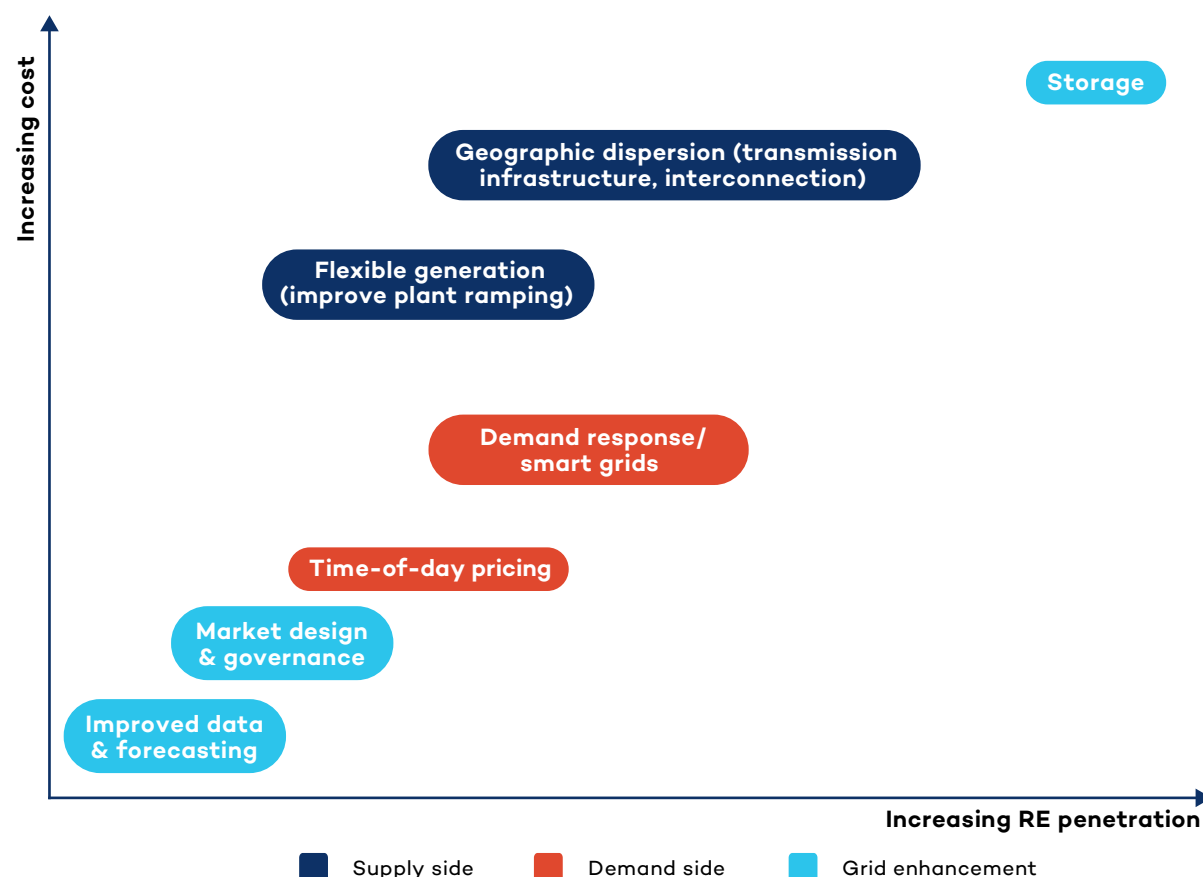
Integration of variable renewables is relatively straightforward at low levels of penetration, such as below 10% (IEA, 2019b, 2020g). Only in eight countries in the Global South (listed above) do wind and solar exceed this share, and in most Southern countries, the share is well below 5% (IEA, 2020h). This means that most countries should not see grid management as a significant barrier to scaling up renewables in the near future. The IEA has classified integration of variable renewables into six stages, with the latter stages requiring more investments in power system flexibility but with few challenges posed at initial stages (1 and 2) (IEA, 2019b).

Low-cost options at these levels include improved forecasting of supply and demand, more frequent and/or more sophisticated grid management, and improved power market design. As penetration increases, modest-cost options include enhancing the ramping characteristics of existing flexible power stations (to allow quicker response) and managing demand to better match supply (Figure 13). Residential and industrial electricity consumers can be incentivized (with lower prices) to reduce their non-essential or time-shiftable uses of power, such as charging of electric vehicles (EVs), stored water heating, or using washing machines. Time-of-day tariffs are increasingly common for large electricity users and are being progressively rolled out for smaller consumers in some countries. Often, simple strategic decisions can aid the process of integration, such as targeting energy-efficiency policies for peak-hour energy uses (Delina, 2019, p. 81–84).





Figure 13. Measures to integrate variable renewables into grids (not to scale)



Source: adapted from Denholm et al., 2010, p. 34; Nikolakakis & Chatopadhyay, 2015, p. 5.

More substantive physical investments need to be added only at higher penetration levels, such as strengthening transmission infrastructure and adding storage (Cochran et al., 2014, p. 11; IRENA, 2017b; Lund et al., 2015) (Figure 13). Thus, by the time penetration has grown to the extent that significant storage is required, its costs will have fallen further, and institutional and management experience with higher renewable shares will also be accumulating fast, for example, in Denmark, Ireland, and Portugal (Arndt et al., 2019). In a study of Kenya, Carvalho et al. (2017) find that at 30% wind penetration, the storage requirement is one tenth the capacity of wind generation.

With near-instantaneous response times, batteries are better suited than gas to short-term grid balancing, which has a discharge time of 1–4 hours (Stockman et al., 2019, p. 14). Lithium-ion battery costs are declining even faster than wind and solar costs, having fallen 75% between 2015 and 2020, and wind-plus-battery or solar-plus-battery systems are now cheaper than gas peaker plants in much of the world (BloombergNEF, 2020c). The first gigawatt-scale battery was given regulatory approval in California in 2020 (Zubrinich, 2020).

For countries in or near the tropics, where there is less seasonal variation in daily solar resources, batteries are well suited to filling the gap between the mid-day peak of solar generation and the evening peak of demand (Goodall, 2016, pp. 211–212). They will have an advantage over countries at higher latitudes where longer-term storage is required, such





as to cover windless winter periods of days or weeks. Pumped hydro and compressed air storage are mature technologies; their costs vary with the characteristics of available sites (IRENA, 2017b). Hydrogen could be an important future option, either in a storage function where surplus renewable generation is used to produce green hydrogen (see below) or to fuel dispatchable power plants (Lambert, 2020, pp. 12–13).

However, planning the system's development will be important, as the diversity of supply sources will reduce supply variability. For example, solar facilities generate more supply in the summer and wind generates more in the winter. Supply variability is further reduced if generators are connected over greater geographical areas, as, on average, it is then more likely that somewhere in the connected area will be windy or sunny. In Europe, for instance, increasing interconnection between countries' systems is driving continental-scale grid integration sufficient to contain more than one weather system within the catchment. Four regional power pools in Africa (Southern, East, West, and Central) allow power to be transmitted across borders.

4.3 Alternatives to Gas in Hydrogen Production

Hydrogen markets are relatively small at present but are likely to become important for decarbonized chemicals and steel (Section 4.4), and possibly to address seasonal variations in power generation. Almost all global hydrogen outside China is currently produced from gas by the steam methane reforming (SMR) process, which separates hydrogen (H_2) from methane (CH_4), with CO_2 as the by-product. In China, the primary source is coal gasification.

There are two options for producing decarbonized hydrogen: combine SMR of gas with carbon capture and storage (CCS) (“blue hydrogen”) or separate water (H_2O) into hydrogen (H_2) and oxygen (O_2) by electrolysis powered by renewable energy (“green hydrogen”). Blue hydrogen, which would sustain demand for gas, is so far the cheaper option but also still emits CO_2 due to incomplete capture.²⁸ As a mature technology, SMR's costs are not significantly falling, and they remain vulnerable to volatility in gas prices.²⁹ Green hydrogen is a zero-carbon option, with presently higher but decreasing costs.

The cost of electrolysis will fall as production gets scaled up, through economies of scale and learning-by-doing combined with ongoing cost reductions in the renewable energy used to power it. IRENA (2020a, p. 9) projects that with rapid scale-up, green hydrogen could be cheaper than blue hydrogen in a wide range of countries by 2030. In 2020, seven major companies launched an initiative aiming to reduce the cost of green hydrogen to USD 2/kg by 2026, which is believed to be a tipping point at which it would become competitive across multiple uses (Climate Champions, 2020; Hydrogen Council, 2020).

²⁸ CCS can commonly achieve capture rates of 80%–90%.

²⁹ Furthermore, the costs of CCS have remained high compared to expectations, and after 30 years of attempts to commercialize CCS, there remain only 21 commercial-scale plants in existence worldwide, with capacity to capture 40 Mt/year (about 0.1% of total global CO_2 emissions). All but five of the plants are used for enhanced oil recovery rather than long-term CO_2 storage (IEA, 2020b, pp. 25–26).





To date, there have been several green hydrogen demonstration projects, as well as, in recent years, the first commercial-scale projects (IEA, 2019c, p. 45) and an outpouring of political support (Bridle & Beedell, 2021). There is now a global project pipeline exceeding 60 GW, including gigawatt-scale projects in China, Chile, and Saudi Arabia (Rystad Energy, 2020). The EU's hydrogen strategy prioritizes green hydrogen, calling for 40 GW of electrolyzer capacity to be installed in Europe by 2030 and a further 40 GW in North Africa and other neighbouring countries (European Commission, 2020).

Industrial uses could be the key to upscaling hydrogen production and reducing costs, especially in coastal industrial clusters (BloombergNEF, 2020a, p. 6; Lambert, 2020, p. 22). The production-cost advantages of concentration are likely to outweigh transport costs (IEA, 2019c, pp. 49; 82–83). This will create significant export opportunities for some countries in the Global South with large renewable resources. Prime locations include Patagonia, the Atacama Desert, eastern Brazil, southern Africa, Somalia, Western Sahara, Saudi Arabia, and Australia (Philibert, 2017, p. 36).

Countries are beginning to develop supply chains for consuming hydrogen, which will help drive down costs and generate knowledge spillovers and innovations. For example, fuel cell applications are being piloted in Argentina, China, Costa Rica, India, Indonesia, Malaysia, Mali, Martinique, Namibia, the Philippines, South Africa, Thailand, and Uganda (Energy Sector Management Assistance Program [ESMAP], 2020b, p. xviii).

4.4 Alternatives to Gas in Industry

Gas is used in industry both for heat—such as for washing, cooking, drying, curing, melting, or enabling chemical processes—and as a chemical feedstock. The industry sector is heterogeneous, and decarbonization options will vary greatly between industrial sectors and processes, according to temperatures needed and how heat is applied (such as using a kiln or by contact of flame with materials).

In most industries, a first step toward decarbonization in industry is to improve efficiency through process optimization, insulation, and waste heat recovery. According to IRENA (2018a, p. 38), global industrial energy consumption could be reduced by a quarter if today's most efficient technologies were adopted everywhere, with most of the gains in the Global South. Recycling can also significantly reduce energy needs, especially (in relation to future gas demand) of steel and some basic chemicals.

More than 40% of current global gas use in industry is in three heavy-industry sectors, where it is used to generate high-temperature (above 500°C) process heat: chemicals, iron and steel, and non-metallic minerals (mainly cement) (Figure 9). Gas is the dominant fuel in chemicals outside China and is proposed as a lower-carbon alternative to coal in iron/steel and cement.

High-temperature process heat can be generated using fossil fuels, electricity, hydrogen, or bioenergy. Hydrogen-fuelled industrial heat is still expensive and may not be cost-competitive with gas until the 2040s (Hydrogen Council, 2020, pp. 9–10), though it may be earlier in applications where it also serves as a feedstock, such as chemicals and iron/steel (Fuel Cells and Hydrogen Joint Undertaking, 2019, pp. 37–39).





The IEA (2019c, p. 118) projects that bioenergy will be cost-competitive for this purpose by 2030 in markets where gas is expensive, such as China, India, and Japan. However, in many circumstances, bioenergy risks undermining food security if grown on former agricultural land, displacing forest-dwelling peoples, or damaging biodiversity if grown on former forest lands (IPCC, 2019, pp. 575–576, 581–582; Kill, 2015). There are thus limits to the amount of bioenergy that can be supplied³⁰ and significant governance challenges to ensuring its sustainability (Creutzig et al., 2015; Fuss et al., 2018; Smith et al., 2015).

4.4.1 Chemicals

In the chemicals sector, gas is used as feedstock as well as an energy source. The largest use of gas as a feedstock is to produce ammonia, primarily for fertilizers,³¹ and methanol.³² In both cases, steam reforming of gas produces hydrogen as an intermediate product. In India, for instance, fertilizer production is the largest use of gas (see Section 6.3). The principal alternative to gas feedstock is green hydrogen (Section 4.3). Philibert (2017, pp. 33–37) estimates green ammonia production costs at USD 400–750 per tonne, depending on electricity costs and assuming 50% capacity factor. This would make it competitive with ammonia from gas at USD 200–600/t (plus 140–170 if CCS is used). Green methanol costs are projected to be USD 400–700/t in 2030, compared to USD 320–376 from fossil fuels. An alternative decarbonized option is biomethanol, produced from wood (USD 225–1,300/t) or waste streams (USD 280–700/t).

Ethane and propane—minor components of gas—are sometimes used in polymer production as an alternative to oil products. There are numerous research projects, pilots, and semi-commercial plants exploring the use of biomass as a feedstock for organic chemicals (IEA, 2017, p. 185).

Processes used in the production of organic and inorganic chemicals typically operate at temperatures between 500°C and 800°C, mostly using steam. Steam can alternatively be generated using bioenergy or electric boilers; however, costs remain higher. Electric furnaces have been tested in laboratories and could be future options (de Pee et al., 2020, p. 45).

4.4.2 Iron and Steel

About 90% of global primary steel production uses the blast furnace/basic oxygen furnace method (BF-BOF), with coal providing heat (at temperatures of 1,500°C and 1,700°C) and acting as a chemical-reducing agent. About 7% is made using direct reduction of iron (DRI) and an electric arc furnace (EAF), with gas commonly used for heat in the DRI process (800°C) as a source of hydrogen-reducing agent (via steam reforming) and to generate electricity for the EAF (at 1,500°C) (IEA, 2019c, pp. 108–109). The most promising route for decarbonizing steel is to use renewable electricity to produce green hydrogen and to power the EAF process and renewable heat in the DRI process (IRENA, 2020d). There is a

³⁰ Especially if some bioenergy is used with CCS to remove CO₂ from the atmosphere.

³¹ Ammonia is also used in the production of dyes, explosives, plastics, nylon, and acrylics

³² Methanol is used in plastics, plywood, textiles, paints, explosives, aerosols, and fuels.





pilot green hydrogen DRI-EAF plant in Sweden, which aims to produce commercial carbon-free steel by 2035 (the Hybrit project). Initial cost projections were 20%–30% higher than conventional steel production but are expected to come down with further technological developments (Honoré, 2019, pp. 34–35). Some of the world’s largest steel producers, such as ThyssenKrupp (2019) and ArcelorMittal (2020), are also developing DRI-EAF technologies, aiming to achieve commercialization by the 2030s and company-wide net-zero emissions by 2050.

4.4.3 Cement

Cement kilns use temperatures of about 1,600°C. The principal fuel used worldwide is coal, with 63% of cement industry energy consumption, while gas accounts for 9%. Biomass and waste provide 5% of energy usage in global cement production, with large shares in Europe (Philibert, 2017, p. 42). Increasing biomass and waste’s share will depend on local availability, as they cannot easily be transported; however, the world’s largest cement producer, LafargeHolcim (2020), aims to double its use of waste-based fuels to 37% in 2030, and several other major producers also have plans to increase their use of alternative fuels and to reduce their CO₂ emissions to net-zero by mid-century.³³ In the longer term, heat could alternatively be provided by an electric or hydrogen kiln furnace, but these are not yet commercially available (Lambert, 2020, p. 5).

4.4.4 Light/Medium Industry

Beyond the above sectors, gas is used in manufacturing and other lighter industries, mostly for lower-temperature heat (up to 100°C), for example, in wood, textiles, and most food. A smaller amount is used at mid-temperature (100°C– 500°C), for example, in paper and some food (Honoré, 2019, p. 30). In these sectors, gas’s share is rising in preference to costlier oil products or more polluting coal (IEA, 2019d, pp. 31, 84).

Electric alternatives are commercially available for many of these applications, including induction, resistance, infrared and microwaves, and electric boilers, which can be used up to about 300°C. These are cost-competitive with gas in most processes and locations, depending on local gas and electricity prices, and often with policy intervention. Heat pumps are expected to become competitive with gas boilers after 2025 for temperatures below 100°C in industrial applications, where their high efficiency makes them attractive (Honoré, 2019, p. 23). Solar thermal can be used up to 100°C and biomass up to 200°C, both of them cost-competitive and commonly used in various applications, and especially suited to regions with limited infrastructure.

³³ Note that net-zero cement requires reducing, capturing, or offsetting process emissions from the calcination reaction as well as energy-related emissions.





4.5 Alternatives to Gas in the Residential and Transport Sectors

Residential and commercial buildings account for 14% of gas consumption in non-OECD countries (Figure 9). Although globally the largest residential use of gas is in space heating, in the Global South, cooking is the largest, as many countries have warmer climates. Both cooking and water heating uses of gas are expected to grow as distribution pipelines connect more homes to gas supplies, often to replace LPG (“bottled gas”) (IEA, 2019d, p. 31; Ürge-Vorsatz et al., 2012, pp. 660, 662).

However, as more efficient electric cookers become available and renewable energy costs continue to fall, new long-lived gas pipelines risk proving redundant, either losing money on investments or locking in costlier and more polluting energy. Electric cooking is growing fast, with government programs such as Ecuador’s target to replace 3 million LPG stoves with electric induction stoves under its Efficient Cooking Plan (Goldemberg et al., 2018, pp. 8–9) or Nepal’s aim to have an electric stove in every house (Sustainable Energy for All [SEforALL] & Climate Policy Initiative, 2020, p. 60). In many circumstances, electric cooking solutions are already the cheapest (Couture & Jacobs, 2019), and electricity is also increasingly seen as a key plank of delivering access to safe cooking (see Section 5). In remote areas, biogas digesters are also a viable alternative and will often be cheaper where local biogas is available from livestock manure, agricultural waste, or other sources (IRENA, 2017b).

Where heating is required (for example, in parts of Asia and South America and in higher-altitude regions), insulation often provides the cheapest—and even overall cost-saving—option. The IEA (2017, p. 125) estimates that if average global efficiency standards for space heating and cooling, water heating, and lighting were implemented in all countries, energy demand in these sectors would fall by 8%; implementing the highest standards would reduce demand by 20%; and using best-available technologies would reduce demand by two thirds. Solar water heating is competitive in much of the world. Heat pumps offer significant efficiency gains compared to (direct) electric heating but may not reach cost parity in a residential setting until the 2040s in the absence of government efforts to speed their deployment (BloombergNEF, 2020b, p. 21). District heating systems also offer efficiency gains and can more easily deploy low-carbon heat sources such as solar thermal or waste heat; they will often constitute a cheaper alternative to building gas infrastructure (IEA, 2017, p. 147; 2019c, pp. 37–38).

Vehicular transport accounts for only 2% of non-OECD gas consumption. CNG has been used in some municipal fleets to reduce local air pollution, and some countries are building a fuelling infrastructure for wider use (see the Egypt and India country studies, Sections 6.2 and 6.3). However, this risks redundancy, as EVs are generally expected to be technically superior to CNG (IEA, 2017, p. 223) with lower carbon emissions. While purchase prices remain higher than CNG so far, they are falling fast due to battery advances (Boudway, 2020). Building two new parallel sets of infrastructure—for CNG fuelling and electric charging—would be very costly.

LNG has been proposed as a shipping fuel, though it is likely to deliver little or no climate benefit over fuel oil; more promising decarbonization options are likely to be fuel cells or ammonia (IEA, 2017, pp. 259–260; Lambert, 2020, p. 9).





5.0 Developing Countries: Opportunities and challenges for leapfrogging gas

Debates on the role of gas in energy transitions have taken place mainly in Europe and North America. This section discusses the particular energy challenges that the Global South commonly faces in developing renewable energy in place of gas and ways that international public finance can help. While these challenges are present in most countries of the Global South, they are experienced most strongly in the poorest LDCs.

SDG 7 (target 7.1) aims to deliver universal access to electricity and clean cooking by 2030. This section reviews the challenges of delivering these two aspects of energy access and of integrating renewables into weaker power systems and creating employment. The oil and gas industry proposes gas as a solution to all of these (American Petroleum Institute, 2019; IPIECA et al., 2019; Shell, 2018); however, while the problems are real, gas is not the only solution or even the best one. Finally, the chapter considers barriers that countries face to deploying foreign-owned technology and obtaining finance.

5.1 Access to Electricity

According to the progress report by the SDG 7 custodian agencies, nearly 800 million people worldwide lack access to electricity, and the world remains off-track to achieve universal access by 2030.³⁴ The global total with connections has declined from 1.2 billion in 2010, with the greatest progress in Asia. In sub-Saharan Africa, still only 47% of people have access (IEA et al., 2020, pp. 1, 4).

With rural dwellers accounting for 85% of the people lacking electricity (IEA et al., 2020, p. 4), distributed solutions often provide the quickest and lowest-cost means to provide basic electricity services. Renewable energy, especially solar, offers the flexibility to meet a wide range of energy needs, from home-scale to community-scale mini-grids to utility-scale generation for national and regional grids (Khennas & Sokona, 2020, p. 6). These scales offer a progression in terms of the services they currently support: home-scale systems often provide basic services such as lighting, phone charging, and radio; mini-grids generally also support fans, some larger appliances, and some productive uses; and connection to large, usually national, grids provides a full range of services (Bhatia & Angelou, 2015, p. 33). Even for centralized generation, wind and/or solar are already cheaper than gas in most of the world (Section 4).

Commercial investors tend to view power projects for unconnected populations as high risk due to households' low or unstable incomes. A key role of public finance is therefore to provide guarantees to unlock private investments supported by social assistance and grants in the areas of greatest need (Mini-Grids Partnership et al., 2020). SEforAll and Climate Policy Initiative (2020) estimate that universal electrification requires an investment of

³⁴ In countries using the Multi-Tiered Framework (about 20 countries), access to electricity is defined as Tier 1 and above (Bhatia & Angelou, 2015); in other countries, it is binary based on household surveys.





USD 41 billion per year, whereas currently only USD 16 billion is being invested in residential electricity in the 20 countries that are home to 80% of unconnected people and only 1% to 1.5% of this is targeted at distributed solutions. Furthermore, the vast majority of this finance has benefited multinational companies based in Europe or North America or led by entrepreneurs from those regions, thus failing to build local capacity, secure wider benefits, or make use of local knowledge (Tucker, 2020).

While decentralized systems avoid the costs and construction time of long-distance infrastructure, national grids still offer cheaper unit costs through economies of scale once connections are built (Khennas & Sokona, 2020, pp. 4–5; Morrissey, 2017, pp. 7–9). And connections across larger geographical areas, such as by forming regional power pools and country interconnectors, can help balance weather variations. The key therefore is to develop integrated energy strategies, planning for the long term by electrifying remote areas with distributed systems, building up to connect to national grids, and ultimately establishing cross-border connections (SEforALL, 2019). In many cases, such strategies will be limited by institutional capacity, making building institutions a priority area for investment.

In the longer run, the role of centralized generation may diminish. Rapid improvements in batteries (Section 4) suggest distributed approaches can provide increasing energy service levels, with less need for the geographical spread of generation, especially in tropical regions where sunlight is more consistent throughout the year. Micro-grids, which connect with larger grid systems but can be operated autonomously some or most of the time, offer an important hybrid solution.

5.2 Clean Cooking

Roughly 3 billion people lack access to clean cooking, relying primarily on traditional solid fuels such as firewood (mainly in rural areas) or charcoal (especially in urban areas) (IEA et al., 2020, pp. 1, 56). This number has remained largely unchanged for two decades, as improvements in East and Southeast Asia have been offset by worsening access in sub-Saharan Africa. Those without access exceed half of the national population in most of South Asia and three quarters in most of sub-Saharan Africa (IEA et al., 2020, pp. 1, 46, 50). The World Health Organization (2018) estimates that 4 million people die prematurely every year due to cooking-related air pollution, with women and young children especially affected.

The challenges go well beyond availability and cost of alternatives. There are strong cultural dimensions to cooking methods, which have resisted educational efforts to change behaviours; even where new stoves and fuels have been made available, households have often continued to use traditional fuels, sometimes in conjunction with old ones (“fuel stacking”). In some countries, people feel their food becomes less tasty with modern cooking. And since women’s household labour is often not valued, firewood collection is considered “free” and so preferable to purchased LPG, gas, or electricity (Zinecker et al., 2018, p. 11).





Historically, the preferred solution has been improved with less-polluting firewood stoves, but take-up was very slow despite many years of efforts to promote these stoves. There are also questions about their effectiveness at reducing health damage, particularly if they are not used as intended. LPG is now commonly considered a better alternative. While LPG is a fossil fuel,³⁵ its greenhouse gas emissions are only marginally greater than those of firewood,³⁶ while it offers significant health benefits (Goldemberg et al., 2018, pp. 3–4, 8). However, LPG programs also have challenges. Subsidies are often poorly targeted; as a result, they are extremely costly, and the largest share of benefits goes to better-off households, who can afford to consume more (Global Subsidies Initiative-IISD & Integrated Research and Action for Development, 2019).

A longer-term solution lies in electricity.³⁷ Based on the difference between the two energy access statistics, Batchelor et al. (2019) observe that 2 billion people have access to electricity but do not use it for cooking. This suggests that integrated solutions are appropriate. In many contexts, electric cooking can be cost effective compared to traditional cooking fuels and sometimes LPG (Couture & Jacobs, 2019; ESMAP, 2020a).³⁸ While cost comparisons vary, it is widely agreed that the arrival of efficient induction stoves and ultra-efficient devices such as pressure cookers, rice cookers, and slow cookers has significantly reduced the relative costs of electric cooking and that those costs will continue to fall.

The fact that people have access to electricity does not mean it is necessarily reliable enough for cooking or that grids are strong enough to support the higher power requirements of cooking. Integrated solutions must therefore include strengthening grids and improving reliability (Section 5.3). Batteries, meanwhile, offer an increasingly affordable means either to store solar energy or to manage unreliable grid supplies.³⁹ The use of ultra-efficient electric devices is helping to reduce the load on weak grids (SEforALL & Climate Policy Initiative, 2020, pp. 59–60). Cultural preferences can work either for or against electricity: in some contexts, it is favoured as an aspirational symbol of modernity (Brown & Sumanik-Leary, 2015, p. 18); in others, a flame is preferred (see the India study, Section 6.3). Often, public finance and policy support will be needed to help enable poor households to meet the upfront costs of electric cookers and on- and off-grid connections. This could be done using social programs, potentially funded by redirecting existing subsidies, and by developing financing models to spread around the costs.

³⁵ LPG—consisting mainly of propane and butane—is produced either by refining crude oil or by separating these components from natural gas.

³⁶ Firewood greenhouse gas emissions arise both from harvesting in excess of renewable rates and from emissions of black carbon.

³⁷ Biogas digesters are also appropriate in some rural areas (see Section 4.5).

³⁸ In terms of “levelized” cost of cooking, spreading upfront costs over the lifetime of the equipment.

³⁹ Batteries used alongside grids must be combined with inverters to convert between alternating and direct currents.





As discussed in Section 4, there are economic reasons not to build long-lived, fixed pipeline infrastructure to distribute gas for residential uses. Since homes require electricity supply in any case, scarce public investments could be better targeted at overcoming barriers to effective electrification than in supporting two parallel sets of infrastructure for gas and electricity, especially with vulnerability to unstable gas import prices and the need to ultimately phase out fossil fuels. This argument is all the stronger with the ongoing technological improvements and cost reductions in electric cooking and electricity supply and while LPG is available as a less capital-intensive interim measure where electric cooking is not yet available. Because it is distributed by the road transportation of canisters, LPG has less of an infrastructural lock-in effect than piped gas. However, LPG subsidies can create dependence and political inertia, so it is preferable to leapfrog directly from traditional fuels to electric solutions wherever feasible.

5.3 Managing Weaker Power Systems

Even in regions of the Global South that are connected, electricity supply is often costly and unreliable. Many areas experience frequent blackouts, lasting hours or even days. The three main causes are weak or poorly maintained infrastructure, insufficient generation to meet peak demand, and ineffective grid management. All three causes are exacerbated where utilities are financially weak (Kojima & Trimble, 2016).

In relation to maintenance, transmission lines are a relatively small part of total capital costs but can have a disproportionate impact on system performance: sub-Saharan Africa, for example, experiences technical losses of 16% (IEA, 2019a, p. 62). Addressing these issues will not only improve reliability but also reduce the generation requirement as less is wasted. While fossil fuel-powered systems are often particularly brittle, as they expose users to risks arising throughout the supply chain, renewable plants are generally easier to maintain and do not expose utilities to fuel price shocks. Yet, like renewable energy, transmission line costs are concentrated in upfront capital, so they may need public support in obtaining finance (Section 5.6).

As for adding new generation capacity, wind and solar will usually be the cheapest means to do this, as long as they are integrated to manage variability through grid management practices and investments in supply-side and demand-side integration mechanisms (Section 4). Grid management is important even with status quo generation technologies, but the growing use of renewables should give added impetus. With a strong understanding of the local resource and energy market, renewables can effectively add to the adequacy of the system (Edwards et al., 2017). Furthermore, most countries in the South are well below the penetration levels where integration becomes challenging. While it will be important to plan ahead for the development of their systems, the larger flexibility additions (such as storage and interconnections) can be made later, as the technology becomes cheaper. The countries with the highest renewable shares are in the Global North; it will be important to ensure that lessons from their experience and technologies (Section 5.5) are transferred.

International public finance for low- and middle-income countries should focus especially on enabling technologies and institutions, such as electricity storage, interconnection, and grid management (Spencer & Mathur, 2019).





5.4 Just Transition

For countries that have existing gas infrastructure, the question is one of transition rather than leapfrogging. In these cases, governments may see short-term economies of scale in expanding that infrastructure rather than building renewable energy and strengthening electrical systems. These economies apply to already existing industries and workforce skills as well as physical infrastructure. Yet, as discussed in sections 3 and 4, countries will generally see longer-term economic advantage in building energy systems based on renewables and electricity. Transition thus requires bold policy-making, far-sighted planning, active societal debate, and, in many cases, external financial support (Section 5.6).

The largest transitional challenges will be in countries that depend heavily on export revenues, though this more commonly occurs with oil than with gas (Muttitt & Kartha, 2020). Economic diversification has been a policy priority for many major oil exporters since at least the 1970s, but few have made significant progress, not least because oil-related economic inflation makes alternative sectors uncompetitive (Alsharif et al., 2016; Van de Graaf & Bradshaw, 2018).

An estimated 6 million people are currently employed in oil and gas extraction worldwide (International Labour Organization, 2020), compared to 11 million in renewable energy (IRENA, 2020b). In many countries, oil and gas extraction jobs are among the best paid. Even in major exporters, oil and gas account for a small share of employment compared to other sectors, such as agriculture and services. However, for large exporters, there are also public sector jobs supported by gas revenues. For example, in Algeria, 350,000 people are employed in oil and gas, or 3% of the total workforce (Belalloufi, 2014); but oil and gas account for 34% of government revenue and hence the salaries of a further 1.7 million workers, or 14% of Algeria's workforce (International Monetary Fund, 2016, 2018).

Detailed job numbers are only rarely available. For comparison, in the United States (the world's largest gas producer and consumer), an industry report estimates direct and supply-chain jobs as 610,000 in gas extraction, 625,000 in distribution and processing, and 720,000 in use (ICF International, 2017, p. 80).

Renewable energy creates significantly more jobs than fossil fuels for the same investment or power generated. The United Nations Industrial Development Organization and Global Green Growth Institute (2015) find that investing USD 1 million in renewable energy and energy efficiency generates 37 jobs in Brazil, 103 in Indonesia, and 66 in South Africa, whereas investing the same amount in fossil fuels generates respectively 31, 22, and 33 jobs. In a review of 50 studies, Blyth et al. (2014, p. 33) find that coal and gas power plants create an average of 0.15 jobs per gigawatt-hour generated, while renewable energy creates an average of 0.65 jobs.





Decarbonization thus offers major opportunities for job creation. There are, however, transitional issues relating to the potential mismatch of skills or geography between old and new jobs and protecting the rights of existing fossil fuel workers. There is considerable literature on how to deliver a just transition that protects the rights of workers and fossil fuel-dependent communities. The key elements include (Gambhir et al., 2018; International Trade Union Confederation, 2015; Rosemberg, 2010):

- Early assessment of social and employment impacts
- Sound investments in low-emission and job-rich sectors
- Social dialogue with trade unions, employers, and community leaders
- Training and skills development of affected workers
- Social protection for affected workers and communities
- Local economic diversification plans.

In parts of the Global South, in addition to challenges of high unemployment and large informal sectors, there is neither an enabling environment for social dialogue nor mechanisms of social protection, and in some cases, there are systematic violations of workers' and activists' rights. Trade unions—and some governments and employers—are, however, working to overcome these barriers and increasingly making efforts to ensure a just transition for those affected by efforts to address climate change (Union to Union & Just Transition Centre, 2020).

There have been some positive examples of just transition principles being applied in the Global South. India and Argentina both run training programs to develop skills needed for green jobs. In the Philippines, mine closures have been suspended while worker compensation and re-employment packages are agreed upon and implemented. When closing inefficient coal mines, China allocated CNY 30 billion (USD 4.6 billion) to redeploy a million workers. Indonesia's reform of fossil fuel subsidies was combined with simultaneous investment in social programs, infrastructure, and rural development (International Labour Organization, 2018, pp. 107, 133; Rosemberg, 2017, pp. 9-10; Zinecker et al., 2018, p. 27).

5.5 Deploying Technology

Another hurdle to renewable-based energy deployment in the Global South is affordable access to technology. Most patents for renewable energy technology are held by companies in the OECD countries or China, where manufacturing and installation capacity largely resides. For example, in a survey of new South African renewable energy projects under the Renewable Energy Independent Power Producers Procurement Agreement (RE-IPPPA) program, Newell and Bulkeley (2016, p. 11) find that project ownership was dominated by companies from Spain (21%), Italy (16%), and France (14%), while project construction was led by companies from Germany (24%) and Spain (22%). Beyond renewable energy, industries such as steel and cement are in danger of getting left behind as better-resourced multinationals develop the low-carbon technologies discussed in Section 4.





One consequence for Southern countries—constrained by the threat of litigation over intellectual property rights—is that accessing technology will be more expensive, while much of the value generated from its deployment remains outside their borders. Unless these problems are addressed, countries face being locked into technological disadvantages, as they do not attract the investment in deployment that would both spur innovation and build installation capacity (Eicke et al., 2019, p. 6). In many respects, this could resemble a situation that has persisted in the gas industry, where projects are often owned by multinational companies, profits are exported, and senior and technical jobs are awarded to expatriates, with only lower-salaried jobs going to country staff. Countries that have begun to develop domestic fossil fuel industries might fear that a switch to renewables risks resetting any progress they have made.

The issue then is not just about access to technology but the ability to develop domestic industries to install or manufacture it, as set out in the UNFCCC (United Nations, 1992, Art. 4.5): “the developed country Parties shall support the development and enhancement of endogenous capacities and technologies of developing country Parties.”

Technology transfer mechanisms must include knowledge, skills, and institutions in addition to hardware, such as solar panels or wind turbines. A survey by the Institute for Advanced Sustainability Studies finds that fewer than half of technology transfer mechanisms in non-OECD countries include these “soft” dimensions that would enable innovation and growing deployment (Eicke et al., 2019). Furthermore, technology transfer must include a right to use and develop the technologies, not simply to purchase or lease goods and services (Third World Network, 2012).

5.6 Obtaining Finance

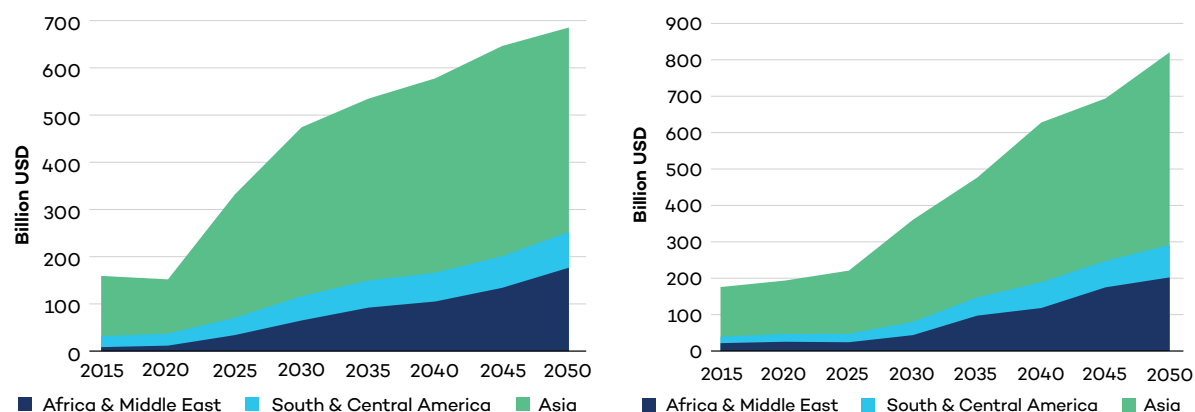
While in most countries renewable energy is cheaper than gas or coal overall—as indicated by the LCOE—it often has higher upfront capital costs (offset by lower subsequent operating costs) (see the Argentina case study, Section 6.1). This raises a challenge in financing renewable energy development in low- and middle-income countries, particularly where private investors are concerned about regulatory or currency risk or the capacity of consumers to pay for supplies (Delina, 2019, p. 124).

A study by McCollum et al. (2018) assessed the energy investments that would be needed to achieve the Paris Agreement goals using six integrated assessment models. As Figure 14 shows, investment in renewable electricity in non-OECD countries in Asia, Africa, the Middle East, and the Americas needs to increase from the current USD 150 billion per year to nearly USD 500 billion by 2030.





Figure 14. Annual non-OECD electricity investments for 1.5°C, multi-model mean



Source: McCollum et al., 2018.

In 2017, USD 159 billion was invested in non-OECD renewable power generation, more than 60% of it in China and over 20% in Brazil and India (IEA, 2018, p. 26). While these major markets are generally the most attractive to private investors, international public finance is failing to shift the imbalance, with only 12% of it to LDCs, which are furthest from achieving SDG 7 (IEA et al., 2020, p. 3).

Clean energy finance suffers not only from limits to its absolute amount but also relative to competing fossil fuel investments. States may be reluctant to embrace energy transition when powerful companies and international institutions are pushing them in the opposite direction (Newell & Bulkeley, 2016). According to the IEA (2018, p. 26), USD 89 billion was invested in non-OECD fossil fuel power generation in 2017 and USD 282 billion in non-OECD oil and gas extraction. Indeed, in the case of Egypt (Section 6.2), renewable energy investments have been put on hold in order to prioritize gas.

As discussed in Section 2, international public finance can play an important role in de-risking investments to unlock private finance and influencing the direction of wider energy investment markets. International public finance can also help to address the other challenges discussed in this section: enabling energy access investments; supporting the techniques, technologies, and institutions for managing power grids; supporting employment rights and a just transition; and facilitating technology transfer.





6.0 Emerging Economies: Case studies of gas's role

6.1 Argentina: Trapped between subsidies and debt

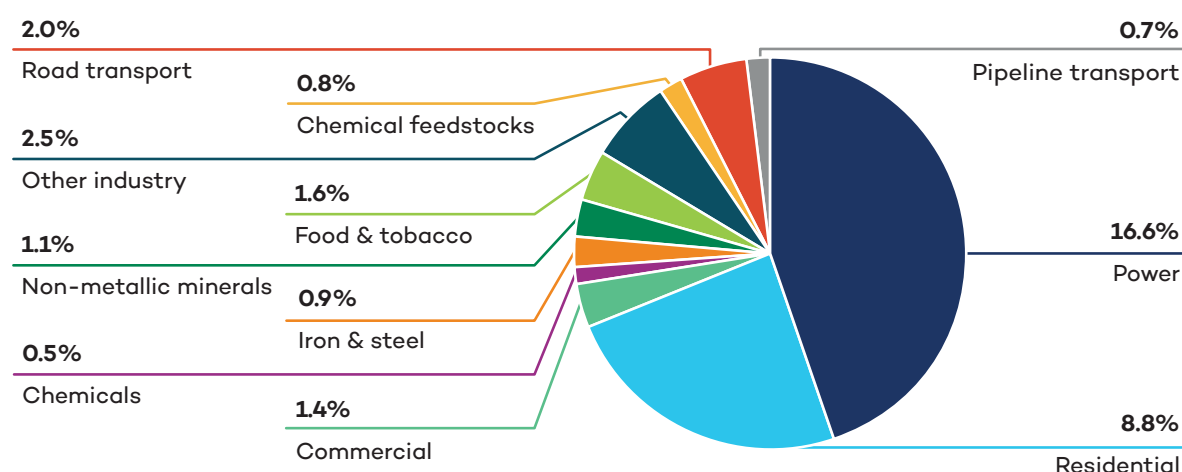
6.1.1 Summary

Argentina today relies heavily on gas consumption and remains trapped between high subsidies and debt. When Argentina was previously a gas exporter, plentiful supplies created public pressure for subsidies, which in turn led gas consumption to grow fast, now exceeding dwindling production. While renewable energy is cheaper over its full life cycle, the higher upfront capital costs have been prohibitive, especially with unfavourable borrowing terms. The government has instead pursued unconventional gas extraction, providing production subsidies to overcome the resource's unfavourable economics.

6.1.2 Baseline Statistics

Argentina has a high dependence on gas: about half of its energy use and 65% of its electricity generation is provided by gas. Domestic gas production peaked in 2006, and since 2008, Argentina has been importing gas, mainly from Bolivia, plus a smaller amount as LNG, which is expensive. In 2019, imports covered 28% of domestic gas demand (IEA, 2020a). The largest share of gas is consumed in power (45%), followed by buildings (28%) and industry (20% including feedstocks) (IEA, 2020h) (Figure 15).

Figure 15. Gas uses in Argentina, 2018 (million tonnes of oil equivalent)



Source: IEA, 2020h.





6.1.3 Government Position on Gas and Climate Change

The first Argentinian NDC in 2016 did not mention gas and assumed growth in emissions over this decade (República Argentina, 2016). The recently announced second NDC revises 2030 emissions downward from the previous goal of 483 million tonnes of CO₂ equivalent (tCO₂e) to 359 million tCO₂e per annum, roughly on the same level as 2016 emissions (364 million tCO₂e). The Argentinian government sees gas as a transition fuel in electricity generation and transport, even increasing overall extraction numbers over the next years (Ministerio de Ambiente y Desarrollo Sostenible, 2020b). The government plans to develop a low-carbon development strategy with a 2050 horizon in 2021 (Ministerio de Ambiente y Desarrollo Sostenible, 2020a). On its website, it mentions a move from fossil fuels, including gas to renewables, as a mitigation strategy but also switching from oil to gas in the transport sector (Ministerio de Ambiente y Desarrollo Sostenible, 2018).

There are several 100% renewable energy scenarios for Argentina, and renewables are cheaper in the long run. The Argentinian Renewable Energy Law establishes a goal of 20% solar and wind electricity by 2025, but the country does not currently seem on track to reach that target due mainly to financing challenges.

A few tens of thousands of workers are employed in the Argentinian oil and gas industry: 20,000 by YPF (Cronista, 2020) and a few thousand by smaller oil and gas companies and gas distribution companies each. Some provinces (Neuquén, Chubut, Santa Cruz, and Tierra del Fuego) are especially dependent on the industry. Therefore, the energy transition must include some specific support for a just transition and provincial economic diversification, both of which are lacking so far.

Meanwhile, communities are suffering the impacts of pollution from the gas industry, and there was a recent scandal around fracking waste in Neuquén (Cunningham, 2021). In some places, such as Mendoza Province, a strong anti-fracking movement is pushing back against the gas industry.

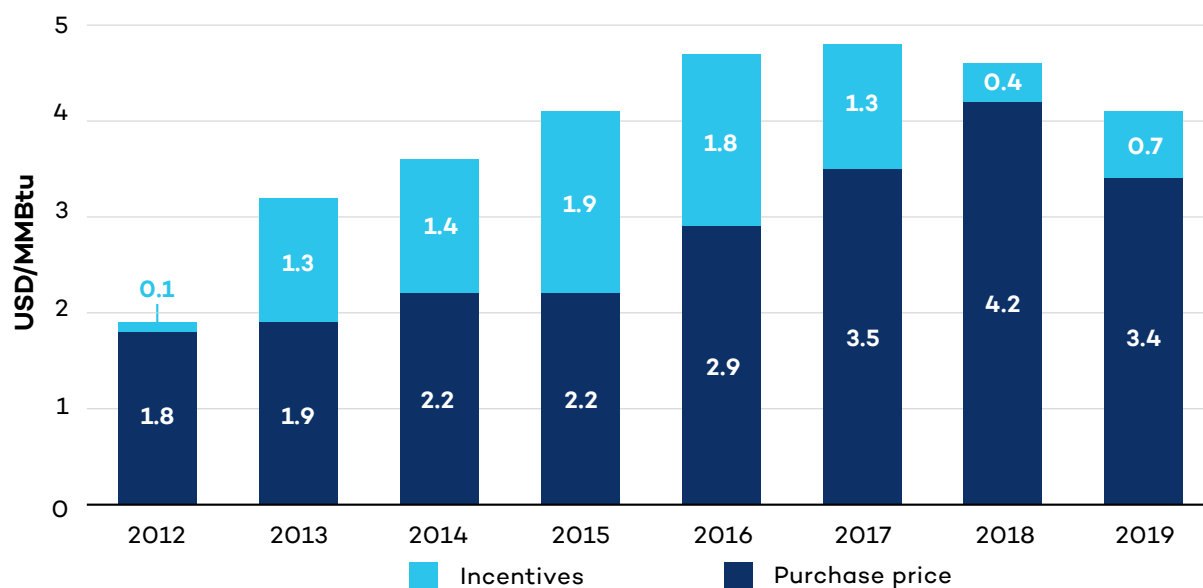
6.1.4 Domestic Gas Production

Since 2006, when gas production peaked, the country has tried to find a solution to gas imports that mean a negative trade balance and dollar deficit. Rather than a transition to energy efficiency and renewables, the strategy has been to exploit the non-conventional gas of the Vaca Muerta formation, one of the biggest potential sources of shale oil and gas in the world. Gas extraction in Vaca Muerta is subsidized by the government by guaranteeing above-market prices to companies (Figure 16).





Figure 16. Gas purchase prices and producer incentives in Argentina



Source: Gomes, 2020, p. 34.

This subsidy has resulted in heavy investments in Vaca Muerta over the last years, reversing the downward trend in gas production. Due to heavy fluctuation in seasonal gas demand and more consistent production, there is often a surplus in summer, resulting in exports to Chile, and a shortfall in winter.

6.1.5 Gas Infrastructure

Argentina has a sizable fleet of gas-fired power stations and a gas pipeline network spanning the country, as well as pipelines to Chile, Uruguay, and Brazil that are little used due to a lack of gas surplus. It has two LNG import facilities that cover demand peaks in the winter: GNL Escobar with 3.8 million tonnes per annum (mtpa) capacity near Buenos Aires (since 2011) and another one in Bahía Blanca. Since 2019 and with the expectation of higher output from Vaca Muerta, there is also a floating LNG export vessel (Tango FLNG) with 0.5 mtpa in export capacity. Another pipeline would be necessary to export more gas from Vaca Muerta as LNG, but the project for a pipeline to the coast was shelved in December 2020 (BNamericas, 2020) because building a 5–10 mtpa LNG export terminal, as envisioned until 2019 by YPF, seems at least questionable now. Argentina would only have a gas surplus in its summer because in winter, the gas is absorbed by the domestic market, and LNG plants running below 80% capacity on an annual basis are not economically attractive. Netback from exporting LNG would be negative due to relatively high extraction costs and low LNG market prices, so feeding the domestic market and exporting via pipeline to neighbouring countries seem to be the only options for Vaca Muerta gas (Gomes, 2020, pp. 37–40).





6.1.6 Gas Use in Power

Gas dominates the Argentinian electricity sector with 65% of annual generation, alongside about 20% hydropower and less than 10% oil, nuclear, biomass, solar, and wind (IEA, 2020h). However, it is not the cheapest. Under current public contracts in 2020, wind and solar power cost on average USD 63/MWh versus gas at USD 69/MWh (Secretaría de Energía, 2019, p. 19).

The challenge in increasing the renewables share lies in financing them because they require high upfront capital investments that are very expensive due to repeated Argentinian financial crises. Another challenge lies in the saturation of high-voltage transmission lines from favourable windy and sunny regions toward the big cities. Building additional lines is also capital intensive. Even with very unfavourable Argentinian domestic financing conditions, renewables and gas are roughly equal in price; if a finance mechanism at international prices of capital could be found, renewables would be even cheaper. Gas is an attractive business for companies, because although contracts are awarded by competitive auction, once a company has a market share, they will receive a significant subsidy. In the case of electricity subsidies, a reform between 2014 and 2018 caused average residential consumer prices to increase by over 2,000% in local currency, but the resulting end price of USD 69/MWh is still lower than in other countries in the region (Contreras, 2020, p. 30).

6.1.7 Gas Use in Industry

The second-largest share of Argentina's gas consumption is in the industrial sector. About 40% of industrial consumption is shared between "food and tobacco" and "non-specified" industries (IEA, 2020h). Both categories will mostly require low-temperature heat, for which electric alternatives may be available, although these have not been actively explored in Argentina. A further 40% is in iron and steel (high temperatures) and in petrochemical feedstocks, both of which do not yet have readily available and affordable alternatives (Section 4.4).

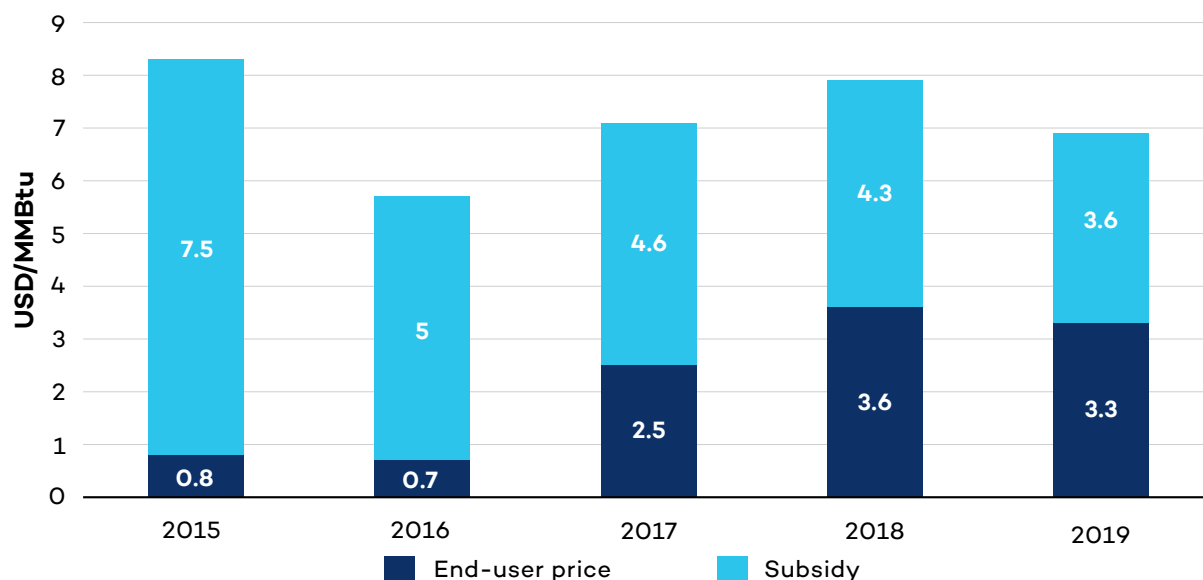
6.1.8 Gas Use in the Residential Sector

The residential sector is the third-largest gas demand sector for both heating and cooking. In addition, the sector consumes about one third of Argentina's electricity, which is generated predominantly by burning gas. Subsidies keep end consumer prices very low. These amounted to USD 7.5 out of USD 8.3/million British thermal units (MMbtu) in 2015 and have been reduced to a still substantial level of USD 3.6 out of USD 6.9/MMbtu in 2019 (Gomes, 2020) (Figure 17).





Figure 17. Gas subsidies to end users in Argentina



Source: Gomes, 2020, p. 34.

However, this encourages wasteful consumption and makes investments in efficiency unlikely to occur. Previous attempts to eliminate subsidies have only been partly successful. The sector is thus a prime candidate for improving efficiency, for example, in air conditioning (powered today mainly by gas-fired electricity). Electrification, combined with an increase in other sources in the power mix, is another strategy to lower gas use in residences.

6.1.9 Gas Use in Transport

Oil products dominate Argentina's transport sector, but 1.6 million vehicles have been converted to instead burn CNG (Martínez, 2020). Argentina's pioneering system of railroads has stalled and even been reduced since the 1990s, and most transport is done over roads.

6.1.10 Government Strategy on Gas

With its first Gas Plan in 2013, Cristina Fernández de Kirchner's government aimed to substitute expensive LNG imports with national production, using subsidies as an incentive for producers to increase production. During the Macri government from 2015 to 2019, successful renewables auctions were held. At the same time, public financial support for unconventional gas extraction in Vaca Muerta continued while consumer subsidies were removed, with negative implications for the poor (ENARGAS, 2021). The pushback against higher prices and the overall economic crisis meant trouble for renewables. Under the new government under Alberto Fernández, in power since the end of 2019, a new Gas Plan has been approved to increase domestic production with continuing production subsidies of USD 5 billion over the next years.





Key challenges for both gas and the energy transition are recurring economic crises and the weakness of the Argentinian peso, resulting in a high borrowing cost for the Argentinian government and for Argentinians in general. While Vaca Muerta has been seen as a potential source of foreign exchange revenue, its relatively high production cost of USD 3.5–5 /MMbtu (Iguacel, 2018, p. 8) means that international investments are hard to come by—unless a deal is struck to pay high subsidies and allow profits to be expatriated, which is disadvantageous for the Argentinian economy. International equipment and know-how are needed for fracking Vaca Muerta, and thus there is no “domestic only” strategy available to extract it. For renewables, in spite of some key components such as solar panels and inverters being cheapest in China, a relatively high percentage of the value chain can be covered by the 700 domestic suppliers (Cámara Argentina de Energías Renovables, 2018, pp. 88–90; INTI, 2021). In this case, the challenge is the high upfront investment needed for renewables, storage, and the required transmission lines. If a way could be found to finance those, they could replace gas as it depletes.

The high energy subsidy bill (at its height, USD 19 billion in 2015, still USD 6 billion in 2019) poses a challenge for the Argentinian government and its economy. In December 2020, Argentina passed a “millionaire tax” to alleviate the impacts of COVID-19 (Boletín Oficial República Argentina, 2020), with a quarter of it—about USD 1 billion—destined to go to the gas sector. This support has been qualified as a subsidy (Revista Petroquímica, 2020), but the amount does not significantly alter the greater dynamics described above. The International Monetary Fund, which supported Argentina with the biggest loan in its history (USD 57.1 billion) in 2018, has questioned energy subsidies. It could also become a key player in facilitating the shift to renewables, for example, with a debt-for-climate swap.

6.2 Egypt: Betting on gas exports to Europe

6.2.1 Summary

Egypt has ambitious plans to increase renewable energy’s share of generation, but its development has been put on hold in order to prioritize gas. The country aims to become a gas trading hub, pooling its own production with that of neighbouring countries for export to Europe. This strategy, however, depends on European gas demand, which may not be sustained as climate pressures increase. Support for domestic gas consumption is driven by fears of dependence on oil imports. Egypt incentivizes the conversion of vehicles to gas fuelling but now also seeks to expand EV manufacturing and use, creating a danger of redundancy with parallel charging and gas-fuelling infrastructure.

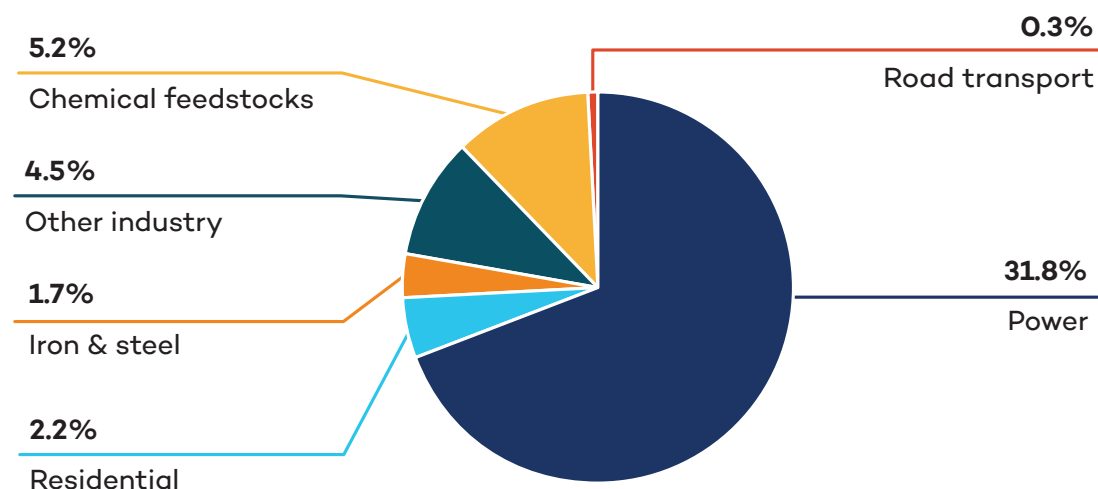
6.2.2 Baseline Data

In 2019, Egypt produced 58.9 bcm of gas for domestic consumption and exported an additional 6 bcm (BP, 2020). The majority of domestic consumption is in power (69%), followed by industry (25%, including feedstocks) (IEA, 2020h) (Figure 18).





Figure 18. Gas uses in Egypt, 2018 (million tonnes of oil equivalent)



Source: IEA, 2020h.

6.2.3 Government's Position on Gas and Climate Change

The Egyptian government views natural gas as the least-emitting fuel and aims to replace more polluting fuels, such as gasoline and diesel, with gas, having already largely replaced heavy fuel oils in power generation. The Egyptian government aims to 1) reduce its oil imports, 2) increase the use of surplus natural gas, 3) reduce financial pressure on its population by offering a cheaper fuel alternative, and 4) improve air quality.

In addition to increasing exports, Egypt aims to position itself as a regional energy hub, which includes efforts such as improving the natural gas market regulatory laws to ensure the availability of gas to and from the Egyptian market without any technical or regulatory obstacles, to cooperate with the Eastern Mediterranean countries and link existing gas fields in the area to the liquefaction facilities in Egypt, and to sign agreements between Egypt and Cyprus to establish direct marine pipelines between the two countries. The Egyptian Natural Gas Holding Company (EGAS) will also expand the establishment of natural gas fuel stations and construct infrastructure for the natural gas network to feed 1,500 villages. It notes that since July 2013, 6.5 million housing units have been linked to natural gas, and a plan is being implemented to connect 1.5 million housing units throughout the year (Egypt Oil & Gas Newspaper, 2021). In terms of subsidies provided by the government to different forms of energy, a time series of IEA data suggests that subsidies stood at approximately USD 15.8 billion in 2019 (5.2% of GDP), of which about USD 0.4 billion was spent on natural gas (IEA, 2020d).





6.2.4 Domestic Gas Production

Egypt's gas production fell from its 2009 peak, dropping below domestic consumption in 2015 (BP 2020). That same year, several offshore discoveries, including Zohr, the largest gas field in the Mediterranean, began a reversal, resulting in production exceeding the previous peak and Egypt becoming an exporter again in 2019. Egypt is taking steps toward increasing its gas exports. The latest milestone in that regard was the reopening of the Damietta LNG plant after several years out of service due to a major dispute with international oil companies Eni and Naturgy. The settlement involved paying the companies USD 2 billion in compensation for a previous policy to divert feedstock gas for domestic use (Battersby, 2021).

On March 14, 2021, Minister of Petroleum and Gas Tarek El Molla announced plans for EGAS to sign three contracts reaching USD 377.7 million, whereby the natural gas production rate is planned to increase to 74 bcm.

6.2.5 Planned Gas Import and Export Infrastructure

Egypt is looking to capitalize on its geographical location and existing energy infrastructure to position itself as a regional energy hub. One such initiative to achieve this goal is the USD 20 billion deal to export natural gas from the Tamar and Leviathan fields in Israel to Egypt in early 2020 to eventually be re-exported to other markets.

Egypt signed a Memorandum of Understanding for a Strategic Cooperation in Energy with the EU. The energy sector cooperation agreement aims to portray gas as part of a clean energy transition alongside renewables and does not address the limitations of gas for this purpose or the need to reduce all energy-related greenhouse gas emissions. This agreement also looks to diversify Europe's energy suppliers and routes.

As a step toward connecting the energy infrastructure between Egypt and the EU, Egypt has concluded an agreement with Cyprus to build a subsea pipeline between the two countries. The expected timeline for project completion is by 2025–2027. Another important part of the project is connecting Cyprus to mainland Europe through Greece. Egypt plans to import gas for domestic use and to also re-export to global markets through its LNG facilities on the Mediterranean coast (International Trade Administration, 2019). This leaves Egypt reliant on the outcome of the gas debate in Europe.

6.2.6 Gas Use in Power Generation

Conventional thermal generation is approximately 90% of electricity generation in Egypt, of which natural gas-fired generation stood at approximately 75% of total electricity output (EIA, 2018), following fuel switching at many previously oil-fired plants and the construction of new CCGT plants. Hydroelectric power and renewables (including wind and solar PV) account for 7% and 1.5% of the electricity mix, respectively (IEA, 2020h).

Egypt's Integrated Sustainable Energy Strategy to 2035 (ISES2035) aims to diversify the country's electricity generation to 42% renewable energy, 3.3% nuclear energy, 16% coal power—postponed indefinitely—and 38.7% gas energy (IRENA, 2018b).





Currently, Egypt has an electricity surplus due to the power sector upgrade and the building of several new gas-fired power plants. The country has plans to expand its electricity grid to neighbouring countries such as Saudi Arabia, Sudan, and Cyprus (EuroAfrica Interconnector, 2019).

Egypt underwent a massive fossil fuel and electricity subsidy reform program in 2013/14 and has since implemented tariff changes at the beginning of each fiscal year until today (ESMAP, 2017). Similar to the transportation sector, the natural gas consumed for electricity generation is priced according to several factors, such as the importance of the sector to the economy, LNG prices, and other economic factors. According to a report by Environics and EBRD and based on IEA data, subsidizing gas for the power sector will continue to weigh on Egypt's public finances (Economic Consulting Associates et al., 2017).

The Government of Egypt sees an opportunity to transition to renewable energy over the coming decade. The most recent power shortages in 2013/14 and an annual electricity demand growth of 6% have pushed the government to reconsider its energy mix, particularly when it comes to electricity generation. That said, recent discoveries of natural gas fields have stalled renewable energy plans.

A 2016 study by Fraunhofer Institute found that onshore wind power and ground-mounted PV systems both had similar LCOE to gas (Fraunhofer ISE, 2016). Most recent renewable energy auctions indicate that the LCOE for PV systems and wind is decreasing and is expected to become cheaper than the LCOE for CCGT in the short term (IRENA, 2019). However, due to falling oil and LNG prices as well as COVID-19 circumstances, the government has put the brakes on renewable projects and has sought to soften its plan to remove fossil fuel subsidies.

6.2.7 Gas Use in Cooking

The Government of Egypt is currently developing a project that will develop pipelines and extend infrastructure to 20 governorates to replace the highly subsidized LPG. Initially, the project was expected to serve 1.5 million households, but since its inception, it has been updated to connect 2.3 million households to domestic natural gas between 2016 and 2021. When comparing natural gas to electric consumption, an environmental and social impact assessment framework conducted by EGAS suggests that while electricity is more efficient at the point of use when compared to natural gas, there are inefficiencies in power distribution; additional power stations would be needed to meet the demand for electricity in homes (EGAS, 2017).

6.2.8 Gas (CNG) Use in Transport

Gas accounts for just 4% of road transportation fuels, with gasoline and diesel providing the vast majority (Kinab et al., 2015). The Government of Egypt is encouraging vehicle owners to convert their vehicles to replace fuel engines with dual-fuel engines that run on gasoline and CNG. The government announced its plan to convert around 1.8 million vehicles in the coming years, mainly focusing on vehicles older than 20 years. This would come with a price of EGP 10k (EUR 640) per vehicle, totalling about EGP 250 billion (USD 15.5 billion).





The government is planning on subsidizing and providing low-interest instalment payments for conversions. The financing will vary depending on the vehicle, from EGP 5,000 to 7,500 (USD 310–465), and assembly plants and importers will be encouraged to provide vehicles with built-in systems.

The government is planning on expanding its CNG fuelling stations across the country. Egypt has two state-run companies, GasTech and Car Gas, that dominate the sector. Both companies have plans to add new dual-fuel stations with CNG over the next 3 years. At the moment, Egypt has 187 CNG fuelling stations and 72 conversion centres (Natural Gas Vehicle Company, 2019).

Over the past year, the Government of Egypt revealed its plans to manufacture EVs and enforced policies that encourage the adoption of EVs to reduce fuel consumption that includes natural gas. However, three main challenges still prevail: the demand has been low due to the high cost of EVs, the EV legislation is still maturing (e.g., licensing), and there are limited charging stations concentrated in a few cities. However, as EV prices fall due to battery improvements, the country will risk the redundancy of building two parallel sets of new infrastructure for CNG fuelling and EV charging.

6.3 India: Infrastructure growth and vulnerability to import prices

6.3.1 Summary

India is a fast-growing importer of gas. Given the high costs of imported gas, more than half of installed gas power capacity sits idle, and renewables are now coal's main competitor in power generation. Meanwhile, new import and distribution infrastructure is now being built, with a threat of a second phase of redundancy as energy economics transform. The largest use of gas is in the industrial sector, largely dominated by fertilizer production, which so far has little alternative feedstock until green hydrogen becomes competitive or the use of fertilizer decreases due to land use or other practices; meanwhile, India remains vulnerable to gas import costs. In transport, the government is encouraging increased use of both CNG and EV, building out two parallel sets of infrastructure for fuelling and charging.

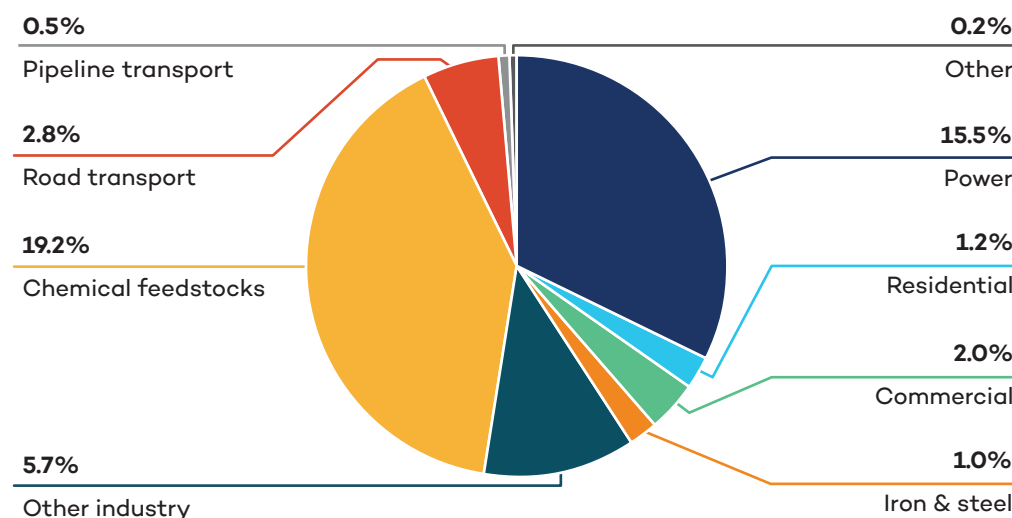
6.3.2 Baseline Statistics

In 2019, India produced 26.9 bcm of gas for domestic consumption and imported 32.8 bcm of gas as LNG (BP, 2020). Imports are thus 55% of total consumption but have been increasing to keep pace with growing domestic consumption of gas (Figure 20). In 2019, India was the fifth largest importer of LNG (International Gas Union, 2020). Qatar is the single largest supplier for India under a long-term contract, supplying 41% of total gas imports in 2019 (EIA, 2020b). The largest use of gas is in industry (54%), especially feedstocks. The second largest is power (32%) (IEA, 2020h) (Figure 19).





Figure 19. Gas uses in India, 2018 (million tonnes of oil equivalent)



Source: IEA, 2020h.

6.3.3 Government's Position on Gas and Climate Change

India is aiming to significantly increase gas use, motivated in part by concerns about rising dependence on oil, and has announced a target of increasing gas in its primary energy mix to 15% by 2030 from the current 6% (Public Information Bureau [PIB], 2019b). In relation to climate change, the government sees gas as a “significant transition fuel” (Mint, 2021). Key policies include creating a national gas grid to promote the consumption of gas in the cooking sector by aiming to expand access from 5 million to 100 million households by 2024 (PIB, 2019c); increasing CNG fuelling stations across highways (PIB, 2020a); and increasing LNG import capacity from 5.2 to 7.7 mtpa by 2023 (EIA, 2020a).

Most subsidies for gas are offered through tax breaks for producers and investments in infrastructure. A subsidy is also given to gas producers to support the consumption of domestically produced gas for consumers in the northeast of the country. In 2018/19, tax breaks totalled at least USD 195 million (Garg et al., 2020), and the consumer subsidy totalled USD 83 million (Petroleum Planning & Analysis Cell [PPAC], 2020b). In 2020, the construction of the northeastern gas grid, which officials suggested may not be commercially viable, received a capital grant of INR 9,265 crore (USD 1.3 billion) (PIB, 2020a). While direct subsidies for gas are lower than for oil, coal, and renewables, total taxation on gas is lower than gasoline (petrol) and diesel and may see a further reduction in tax rates when gas is included under the Goods and Services Tax.

The total workforce of the national public oil and gas companies was 106,733 in March 2019 (Ministry of Power and Natural Gas [MoPNG], 2019). There is currently no government strategy for a just transition for the sector.

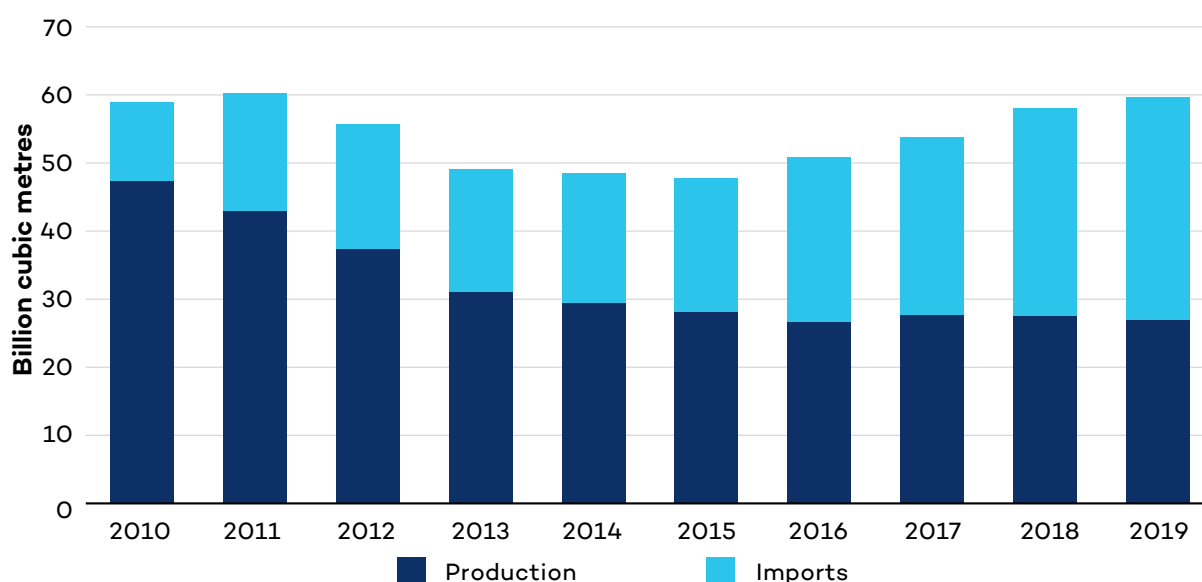




6.3.4 Domestic Gas Production

Since 2014, India's domestic gas production has been fairly static, after falling from a peak in 2010. With consumption growing, dependence on imports is rising (Figure 20). About two thirds of production is offshore (MoPNG, 2020).

Figure 20. Gas production and imports in India



Source: PPAC, 2020a

6.3.5 Planned Gas Import Infrastructure

Several LNG import infrastructure projects are planned. In 2020, India had six operational LNG import terminals, with the total number of terminals planned to increase to 10 by 2023 (EIA, 2020b). As of April 2020, the gas transport network had 16,575 km of pipelines connecting the northern, western, and southern parts of the country (PPAC, 2020a). Another 15,000 km of pipelines are planned to connect the eastern and northeastern parts of the country to form a national gas grid (IEA, 2020f). The government has also expanded the city gas distribution network that supplies CNG (used as auto fuel) and piped gas (for cooking and industrial use). This network has expanded to 406 districts covering 53% of the country's geography (MoPNG, n.d.).

India has not announced any plans to diversify the usage of the existing and planned gas transmission pipelines in transporting any other fuel, like hydrogen or biogas.





6.3.6 Gas Use in Power Generation

The role of gas in India's electricity generation is small compared to cheaper alternatives like coal and renewables, contributing just 7% of the total installed capacity in February 2021 (Ministry of Power, 2021).

Gas-powered generation was built on the anticipation of rising domestic gas production that would be cheaper. However, limited domestic production means coal and renewables remain a cheaper source of electricity, leaving much of the country's 25 GW of gas-based installed generating capacity as stranded assets because of annual shortfalls in gas supply to the plants. In 2019/20, gas power plants operated at 23% of their capacity, owing to a shortfall of 74% in gas supplies (Central Electricity Authority, 2020).

6.3.7 Gas Use in the Fertilizer Industry

The fertilizer sector is the largest consumer of gas, using 29% of the total gas consumed in 2019/20 (PPAC, 2020b), and is expected to continue to grow fast. From 2010 to 2018, feedstock use of gas grew 40%, an average compound annual growth rate of 4.3% per year (IEA, 2020h).

India is the third-largest ammonia consumer in the world. Ammonia-based fertilizers like urea are subsidized by the government, and the subsidy burden can be controlled if the cost of production is low. Gas forms the bulk of the cost of production (Ravichandran et al., 2020), and hence rising gas prices directly impact the government's subsidy bill.

The government forced fertilizer plants to convert from using oil-based naphtha to gas in the hope of reducing production costs. The government's focus is to supply more domestically produced gas and run the fertilizer plants at full capacity. In the long run, green hydrogen will be the zero-carbon alternative, but as of yet, it is not cost-competitive with manufacturing with gas. In early 2021, the government launched a National Hydrogen Energy Mission, aiming to hold auctions to develop green hydrogen later in the year (FE Bureau, 2021). Energy think tank The Energy and Resources Institute (Hall et al., 2020, pp. 15–17) projects that the cost of green hydrogen will fall by 50% by 2030, making it competitive with hydrogen produced from gas.

6.3.8. Gas Use in the Residential Sector (Cooking)

Between 2015 and 2019, the number of households with piped gas connections grew by 79%, from 2.8 million in 2015 to 5 million in 2019 (PPAC, 2015, 2016, 2017, 2018, 2019). The government's strategy is to transition urban households away from cooking with LPG and toward piped gas. Most rural households, meanwhile, are being transitioned toward using LPG that is cleaner than conventional solid fuels like firewood and biomass.

For the consumer, piped gas emerges as the cheapest cooking fuel when compared with subsidized LPG and subsidized electricity (Jain, 2016). But this does not include the costs of built infrastructure required for piped gas (laying pipelines) and electricity (grid-based supply). One compelling reason to avoid a lock-in with gas-based cooking infrastructure is that grid-





based electricity infrastructure has recently achieved universal electrification (Patnaik et al., 2019); it also has wider uses and electricity costs are falling over time. Electric cooking faces cultural challenges to adoption, however, because of flame-based cooking practices.

6.3.9 Gas Use in Transport

In the transport sector, the number of CNG fuelling stations grew by 74%, from 995 stations in 2015 to 1,730 in 2019 (PPAC, 2017, 2018, 2019). The number of CNG vehicles has not grown at the same pace, only increasing by 14% from 2.9 million in 2017 to 3.3 million in 2019 (PPAC, 2017, 2018, 2019). Part of the reason is that most existing CNG stations are concentrated in larger metros like Delhi and Mumbai, ruling out long-distance travel; there are also significant wait times at refuelling stations at peak times. The national gas grid will allow highway fuelling stations and is expected to be active in the same timelines as the EV policy targets (Bhattacharjee, 2019). The government's focus on EVs is through an ambitious policy that has allocated USD 1.4 billion for 3 years from 2019 onwards to incentivize the purchase of EVs and deploy charging infrastructure (IEA, 2020f; PIB, 2019a). The government feels both CNG and EV can coexist (Ghosh & Pathak, 2019) until EVs are more affordable, but this has unsettled the gas industry, which now questions the viability of its transport projects (Bhattacharjee, 2019; Choudhary, 2019).

Currently, the upfront purchase cost of a CNG vehicle is far cheaper compared to an EV. However, the running and maintenance costs of EVs are lower. Forecasts predict that battery costs, which make up 40%–50% of the cost of an EV, are set to fall and could make EVs cheaper than CNG or oil-based vehicles by 2023 (Priya, 2020). The charging infrastructure for EVs is also currently limited compared to the number of CNG fuelling stations (HT Auto, 2020), but continuous efforts by national and state governments to increase EV charging infrastructure could increase market confidence (Council on Energy, Environment and Water Centre for Energy, 2020).





7.0 Conclusions

The world needs to urgently move away from all fossil fuels. In the median 1.5°C scenario used by the IPCC, global gas use halves between 2020 and 2040 (Section 3).

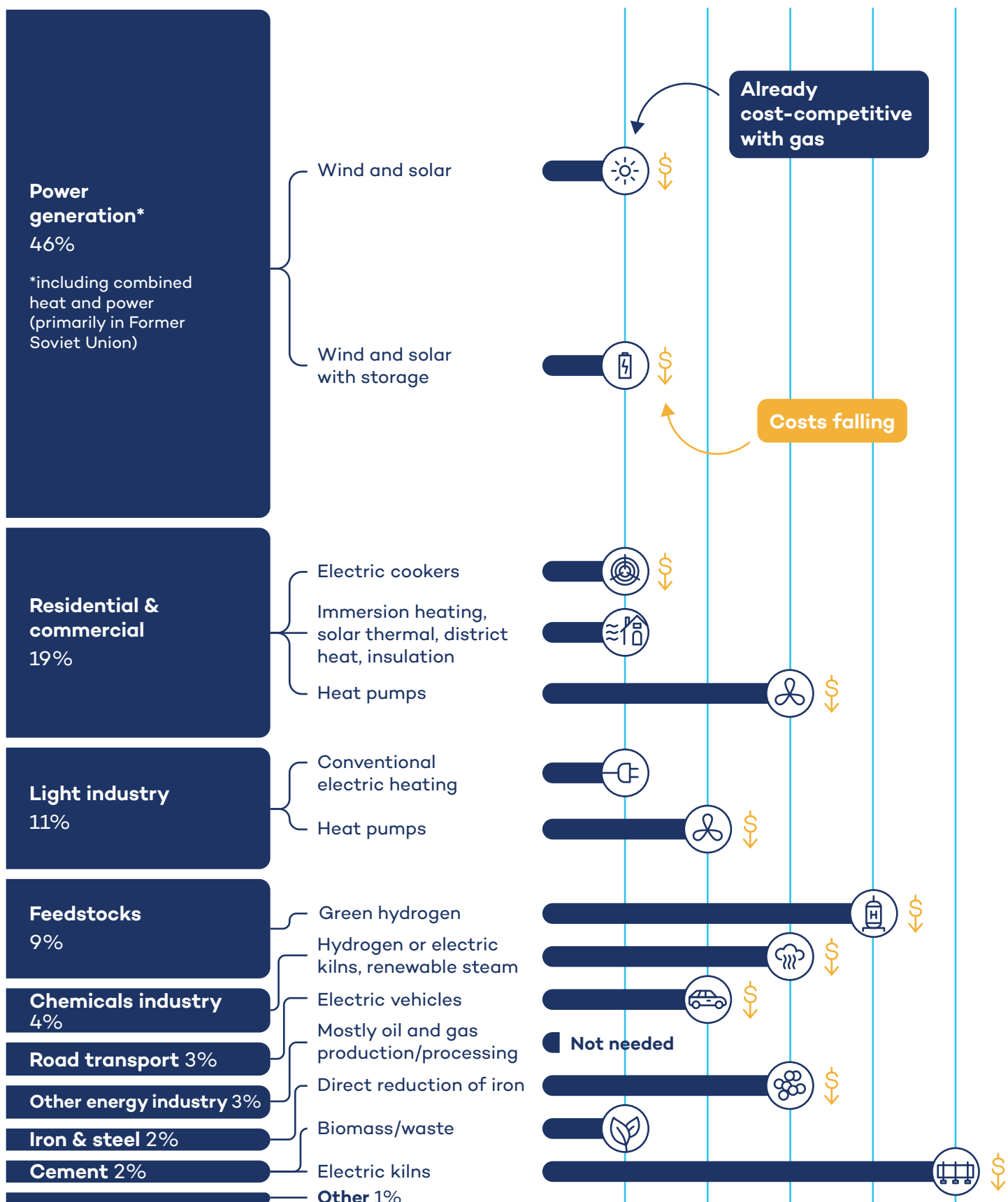
This report has examined the alternatives to gas (Section 4) based on a review of the literature. It finds that renewable-based alternatives are available for the majority of gas consumption and cost-competitive in most countries/circumstances. For other uses of gas, costs of alternative new technologies are falling, with competitiveness expected to be achieved in the 2020s or 2030s. This is summarized in Figure 21.





Figure 21. Status of alternatives to gas use

Percentages represent share of low- and middle-income countries' use of gas



Sources: see Section 4.





These findings have two major implications. First, countries can potentially choose renewable energy over gas at low or zero cost. Second, they are likely to fare better by doing so in the longer run, as new gas infrastructures are at risk of becoming stranded assets due to competition from cheaper alternatives or of holding countries' economies back as the world goes through an energy transition (Section 3).

Our three emerging-economy case studies (Section 6) illustrate the dangers of being locked into high-carbon energy pathways. Argentina's emphasis on gas has created political demand for costly subsidies that both reinforce inefficient gas dependency and add to the country's debt problems, all while the high cost of finance blocks renewable energy development. Both Egypt and India are counting on gas to reduce oil dependence in transport, so they are building gas-fuelling infrastructure at the same time as the rise of EVs is creating demand for parallel charging infrastructure. Egypt is prioritizing gas development over renewables in order to serve as a gas trading hub for export, but in so doing, it is potentially vulnerable to reduced gas demand due to Europe's energy transition. India has the opposite problem: it is very vulnerable to cost spikes in imported gas, which have already created stranded assets in power plants that cannot compete with either coal or renewables.

7.1 Overcoming the Challenges of Energy Transition

For developing countries (Section 5), gas is not generally a good means to provide access to electricity: since most unconnected households are rural and many remote, distributed renewables can close more of the gap. In the wider group of countries lacking universal access to clean cooking, LPG has been a preferred cooking solution for some time, but electric options are now showing potential for lower costs. In most circumstances, there will not be a good case for building gas distribution infrastructure. Conversely, the deployment of clean energy can bring substantial co-benefits in terms of access to energy, jobs, and healthcare, contributing in turn to achieving the SDGs.

Still, many countries may be more attracted to tried-and-tested fossil fuels rather than newer technologies in which they have less experience. Gas investments present their own set of challenges (in addition to climate change), including vulnerability to price spikes, limited employment in a capital-intensive industry, and the brittleness of the energy system. However, they are often favoured due to the advantages of incumbency: they use familiar technologies delivered through existing companies and institutions, are compatible with a wider set of components and uses, and are promoted by powerful lobbying interests.

While wind and solar generate power more cheaply than gas in most countries for which data are available, there are challenges to integrating variable supplies into electricity systems. Managing grid flexibility is relatively straightforward at the current low levels of renewables penetration in most countries but becomes more complex as renewables provide a larger share. These challenges apply especially to countries that have weak transmission capacity, limited forecasting data, or poorly designed power markets. Often investment will be required in infrastructure, technologies, and institutions.





Most of the countries with the highest penetration of renewables are in the Global North. While it is appropriate that wealthier countries with greater historic emissions should incur the costs of developing technology and manage the risks of new approaches, this conversely raises a danger of limiting the deployment of technology in the South. Accessing foreign-owned technology will be more expensive, while much of the value generated from its deployment remains outside their borders. It is important then that technologies and experience are transferred to the South, both to accelerate clean energy deployment and help ensure local economic benefits.

A further challenge is accessing finance, as we saw in the case of Argentina. This is also especially a problem in the poorest countries, where private investors often fear that consumers will be unable to pay for energy supplies or that weak institutions create political risks. Since most costs of renewable energy are incurred upfront (there are no fuel costs), the resulting high finance costs can be a significant barrier, even where the LCOE (reflecting all dimensions of cost) is lower.

In all three of these challenges—grid management, access to technology, and affordable capital—international public finance can play an important role in enabling the Global South to develop renewables-based energy systems. Unfortunately, we find (Section 2) that financial institutions are instead prioritizing gas and other fossil fuels.

7.2 Recommendations

International public finance has led the way in steering investments away from coal over the last decade. It is time—following the lead of the European Investment Bank and the United Kingdom—to also move away from financing oil and gas.

We recommend that international financial institutions:

- End all direct and indirect support to gas exploration and production, new gas power plants, and other long-lived gas infrastructure, such as pipelines and LNG terminals.
- Reorient and substantially scale up clean energy finance to enable countries to transition from (or leapfrog) gas by:
 - Investing in the technologies and institutions that facilitate grid integration of variable renewable energy
 - Enabling technology transfer to contribute to local technological and industrial development
 - De-risking private investments in renewable energy while providing concessional finance where need is greatest
 - Supporting universal access to clean electricity and cooking in line with SDG 7, including off-grid renewable energy in regions where access is lowest
 - Ensuring the free, prior, and informed consent of impacted communities for all clean energy projects.





- Prioritize support to the poorest countries that face the greatest challenges in developing renewable energy systems, notably LDCs and small island states.
- Provide support to help enable a just transition for affected workers and communities.

The report recommends that governments in the Global South:

- Plan energy and climate development strategies that are based primarily on renewable energy, energy efficiency, and electrification, aligned with the Paris Agreement goals.
- Avoid building new infrastructure that locks their economies into gas or other fossil fuels.
- Build experience and skills in managing variable renewables in the grid and in deploying non-fossil technologies in industry, buildings, and transport.
- End the issuing of new licences for oil and gas exploration and extraction.
- Enact policies that enable a just transition for workers and communities currently dependent on gas production and consumption.





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Appendix A. Methodology

International Public Finance

Analysis of public finance in Section 2 covers bilateral public finance institutions controlled by G20 governments, including export credit agencies and development finance institutions, as well as the nine major multilateral development banks (MDBs). It does not include public finance directly from G20 government departments due to the unavailability of data. It also does not cover majority government-owned banks without a clear policy mandate, sovereign wealth funds, or public finance institutions with subnational governance. For a list of institutions covered, see Tucker and DeAngelis (2020, p. 37).

The finance provided by these institutions includes direct public transfers to beneficiaries through grants, equity, and loans, as well as the facilitation of private or other public transfers to beneficiaries through guarantees and insurance. In this report, 100% of the support provided to fossil fuel production through domestic and international financing is considered public finance when a government holds more than 50% of the shares in the bank or financial institution.

Data on public finance are collated from Oil Change International's Shift the Subsidies database (Oil Change International, n.d.), which tracks energy finance from public finance institutions from the bottom up at the project level (Tucker & DeAngelis, 2020, p. 11–12). Each finance entry is classified by energy type, activity, institution, and energy category (fossil fuel, clean, or other) based on the description of the project and project documents. In addition to reviewing information made publicly available by majority government-owned financial institutions and other public sources of information, the database draws information from the Infrastructure Journal Global database and Boston University's Global Economic Governance Initiative's China Global Energy Database. The amounts recorded reflect only the public finance dedicated to a project and not the value of the private finance mobilized by such transactions. Entries are included based on the date a transaction is finalized, not its initial announcement.

Energy categories are defined as follows:

- **Fossil fuel:** The oil, gas, and coal sectors, including access, exploration and appraisal, development, extraction, preparation, transport, plant construction and operation, distribution, and decommissioning. It also includes energy-efficiency projects where the energy source(s) involved are primarily fossil fuels.
- **Clean:** Energy that is both low carbon and has negligible impacts on the environment and human populations if implemented with appropriate safeguards. This includes projects with energy coming from naturally replenished resources such as sunlight, wind, rain, tides, and geothermal heat. This classification also includes energy-efficiency projects where the energy source(s) involved are not primarily fossil fuels.
- **Other:** Projects where (a) the energy source(s) are unclear or unidentified, as with many transmission and distribution projects, as well as (b) non-fossil energy sources





that typically have significant impacts on the environment and human populations. This means large hydropower, biofuels, biomass, nuclear power, and incineration—among other forms of energy that are not fossil fuels but also not consistently low impact, low carbon, and renewable—are included in the “other” category.

Domestic Subsidies

Domestic subsidy data used in this report is developed from two sources: the Organisation for Economic Co-operation and Development (OECD) Inventory of Support Measures for Fossil Fuels (OECD, n.d.) and the International Energy Agency (IEA) energy subsidies database (IEA, n.d.). Data include estimates for direct budgetary transfers, induced transfers (e.g., regulations keeping consumer prices below market level), and tax expenditures. These estimates are based on the data and aligned with the methodology from the IISD and OECD (n.d.) Fossil Fuel Subsidy Tracker, considering the following adjustments:

- OECD estimates under the “general services support estimates” category for all countries from that database have been categorized under producer support estimates in this report.
- For the disaggregation between consumption and production subsidies for all fuels, a correction factor has been applied to 11 economies for which OECD and IEA provide overlapping subsidy estimates in order to adjust to the global estimates provided in the Fossil Fuel Subsidy Tracker.

The subsidies and broader support measures documented in the OECD inventory cover direct budgetary transfers and tax expenditures that provide a benefit or preference for fossil fuel production or consumption. The scope is broad, also covering measures that create enabling conditions for the fossil fuel sector through the development of private or public services, institutions, and infrastructure that may benefit fossil fuel production or consumption in the long term and fund activities to address the legacy of past mining or drilling (“general services support”). The IEA database of energy subsidies compares the end-use prices paid by fuel consumers with reference prices (such as import-parity prices).

Fossil fuel subsidies are defined based on the Agreement on Subsidies and Countervailing Measures (ASCM) under the World Trade Organization (1994: Article 1.1(ii)).

A subsidy shall be deemed to exist:

1. “if there is a financial contribution by a government or any public body within the territory of a Member (“government”), i.e. where:
 - a government practice involves a direct transfer of funds (e.g. grants, loans, and equity infusion), potential direct transfers of funds or liabilities (e.g. loan guarantees);
 - government revenue that is otherwise due is foregone or not collected (e.g. fiscal incentives such as tax credits);





- a government provides goods or services other than general infrastructure, or purchases goods;
 - a government makes payments to a funding mechanism, or entrusts or directs a private body to carry out one or more of the type of functions illustrated in (i) to (iii) above which would normally be vested in the government and the practice, in no real sense, differs from practices normally followed by governments.
2. Or if there is any form of income or price support in the sense of Article XVI of GATT 1994.
 3. And if a benefit is thereby conferred.”



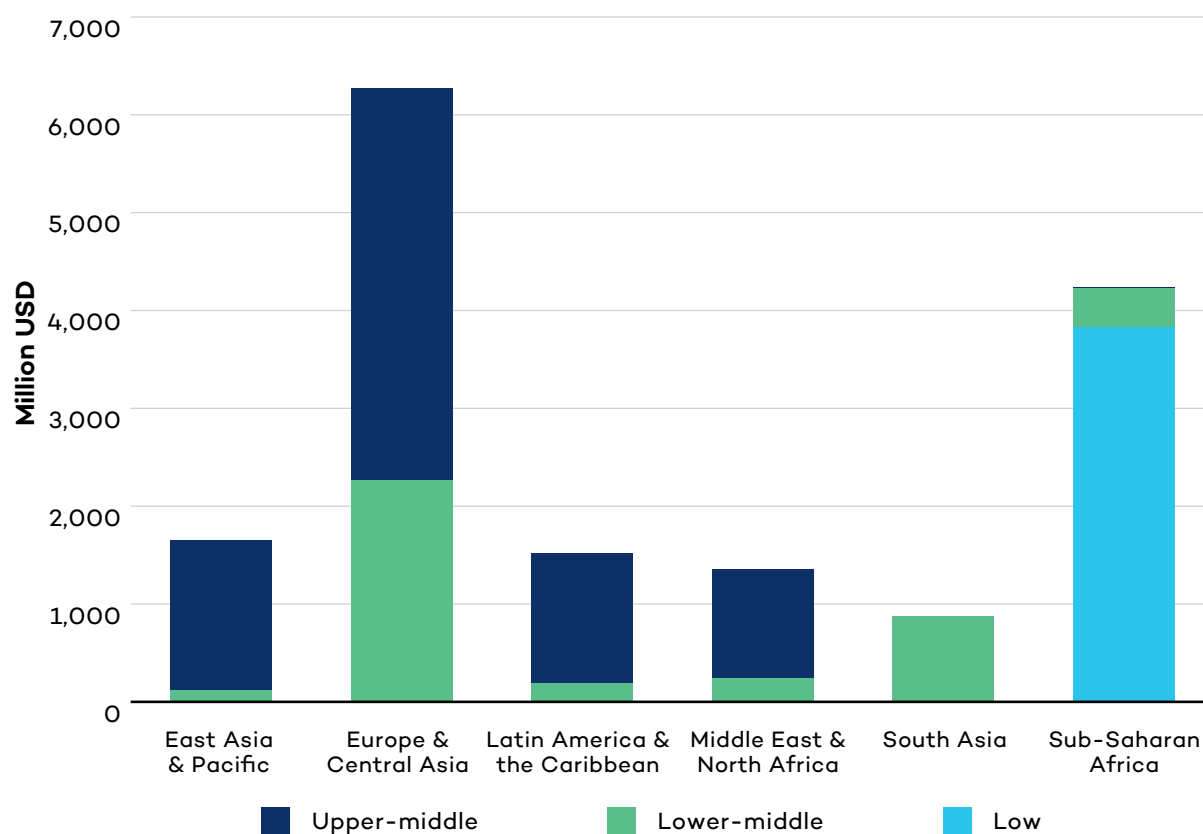


Appendix B. Additional Data

Country income groups and regions are as defined by the World Bank (2021b) as of April 1, 2021.

International Public Finance for Gas

Figure B1. Gas finance from MDBs and G20 bilateral institutions to low- and middle-income countries by region, annual average 2017–2019

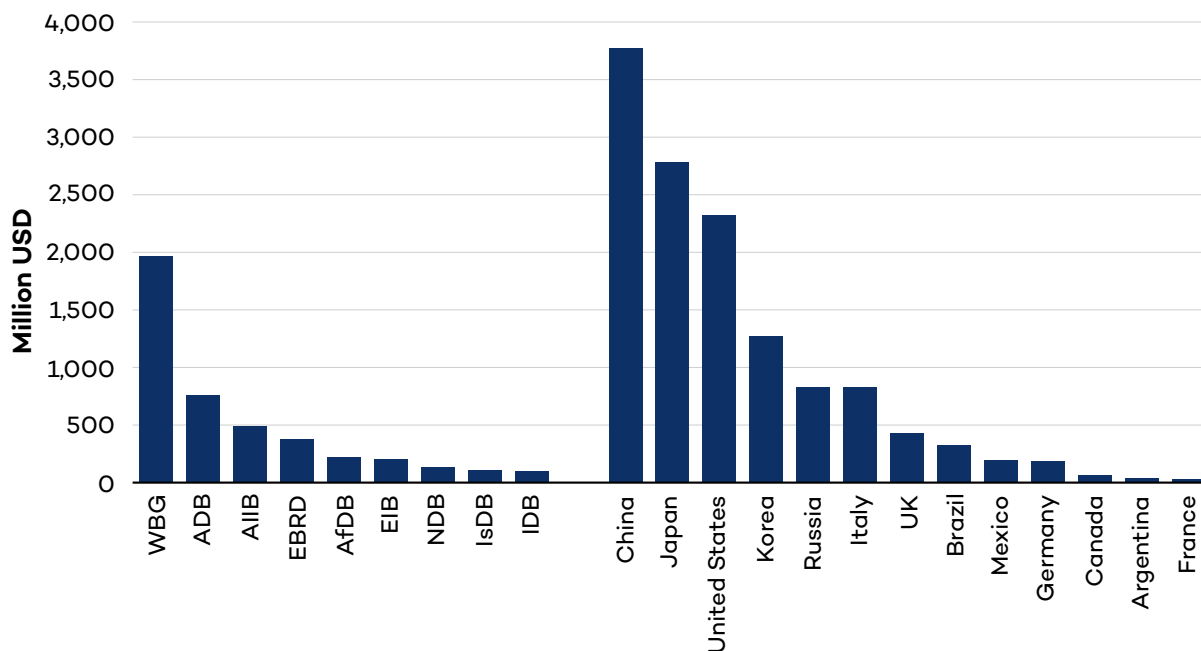


Sources: Oil Change International (OCI, n.d.); World Bank, 2021b.





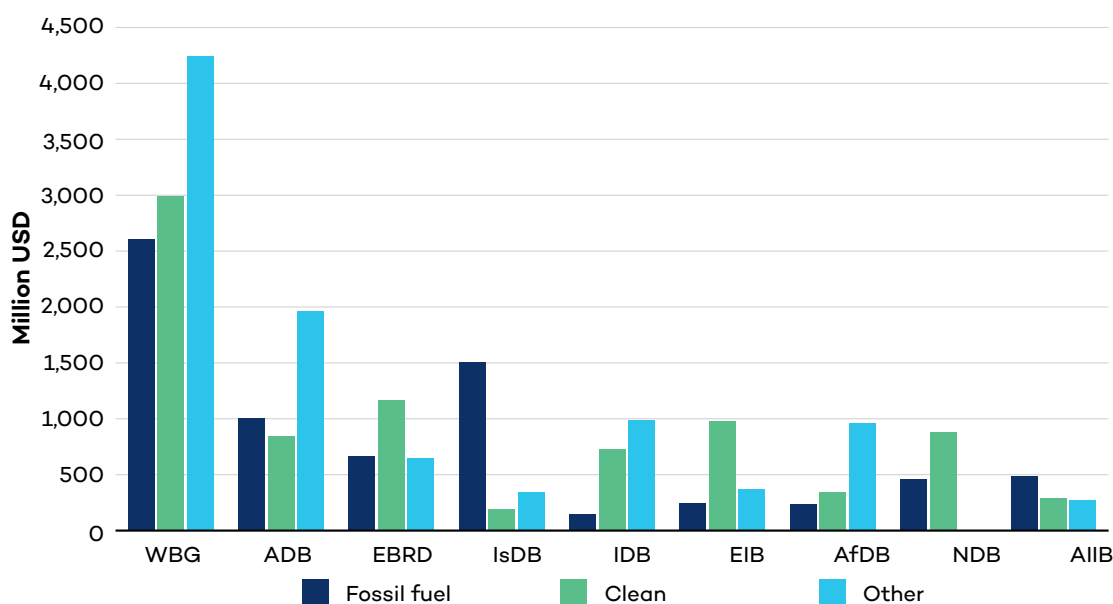
Figure B2. Gas finance from MDBs and G20 bilateral institutions to low- and middle-income countries by institution, annual average 2017–2019



Sources: OCI, n.d.; World Bank, 2021b.

International Public Finance for Energy: Fossil fuel versus clean

Figure B3. Energy finance from MDBs to low- and middle-income countries by energy category, annual average 2017–2019



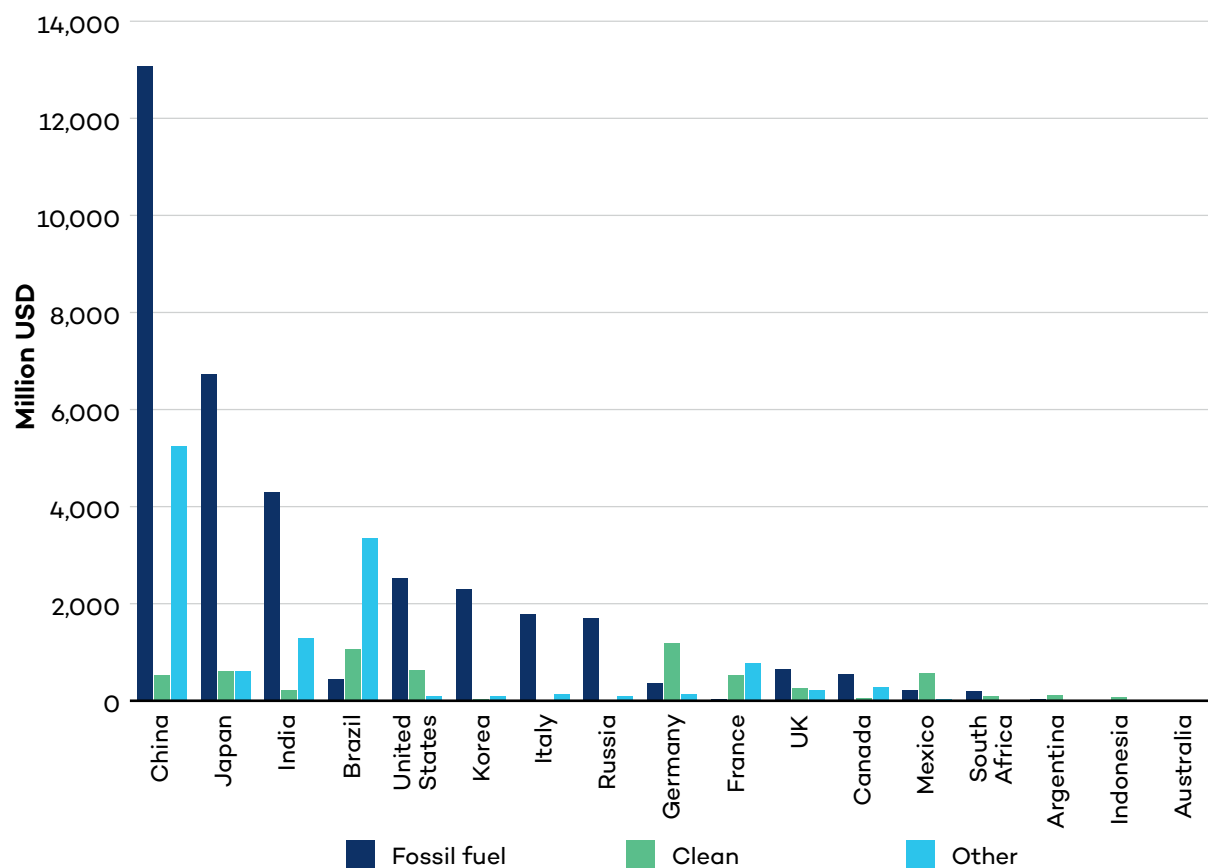
Sources: OCI, n.d.; World Bank, 2021b.

World Bank Group (WBG), Asian Development Bank (ADB), European Bank for Reconstruction & Development (EBRD), Islamic Development Bank (IsDB), Inter-American Development Bank (IDB), European Investment Bank (EIB), African Development Bank (AfDB), New Development Bank (NDB), Asian Infrastructure Investment Bank (AIIB).





Figure B4. Energy finance from G20 bilateral institutions to low- and middle-income countries by energy category, annual average 2017–2019



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