



U.S. – INDIA ENERGY MONITOR

THE NATURAL GAS ISSUE

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Compiled by
Shayak Sengupta



The U.S.-India Energy Monitor is a quarterly snapshot of climate and energy in the United States and India: two of the world's largest economies, largest consumers of energy, and largest emitters of greenhouse gas emissions responsible for climate change. Each quarter, the monitor provides a roundup of energy and climate news, followed by a detailed analysis of a topic relevant to energy and climate in both countries. The monitor provides readers timely, policy-relevant analysis on issues affecting the trajectories of two countries who will shape the world's energy and climate future.



The United States passes the Inflation Reduction Act

In August 2022, the United States Congress passed the Inflation Reduction Act (IRA) which invests \$370 billion in clean energy technologies over the next decade. Primarily through tax credits and loans to homes, businesses, and local governments, the investments, if fully realized, will reduce U.S. greenhouse gas emissions by about 40% by 2030.¹ The law aims to boost a suite of

sectors including electric vehicles, clean energy manufacturing, carbon capture and sequestration, and hydrogen, by providing financing to increase deployment of clean energy technologies.² The act's passage increased U.S. credibility on the international stage as the country prepared to enter international climate talks at COP 28 in Egypt in November 2022.³

If fully realized, the Inflation Reduction Act will reduce U.S. greenhouse gas emissions ~40% by 2030

India passes legislation to establish a carbon trading scheme

The lower house of the Indian Parliament passed amendments to the country's Energy Conservation Bill in August 2022 to give the Government of India the authority to establish a carbon credit trading scheme for high-emissions industries.⁴ Under the scheme, industries such as power, steel, and aluminum can trade carbon credits for their emissions. Initially voluntary, the intention is to make the plan mandatory in the future through a government-imposed cap, establishing a "cap-and-trade" carbon emission system.⁵ Such a market-based system would give flexibility to industries to either purchase credits for their emissions or invest in technologies to reduce their emissions. India has previous experience in similar programs through the Performance, Achieve and Trade (PAT) scheme which required heavy industry to trade energy efficiency credits.⁶ While the Government of India along with stakeholders will determine the exact details of the system, including monitoring and data collection methods, once passed by the parliament's upper house the legal authority to establish a scheme is one step forward to meeting India's goals of net-zero greenhouse gas emissions by 2070.

The G7 proposes a price cap on imports of Russian oil

The G7 group of countries, led by the United States, has proposed a price cap on seaborne imports of Russian oil. The goal of the cap is to reduce oil export revenues for Russia while simultaneously keeping flows of crude oil flowing.⁷ Any reduction in Russian oil output would further increase global oil prices. The price cap attempts to accomplish this by enforcing a cap on the price per barrel of Russian oil just above the average cost of production per barrel in Russia but below the global market price for oil. This would in theory keep the economic incentive for Russia to produce oil for export (price exceed cost) but reduce the revenues (price below the global price). The G7 plans to enforce the cap through insurance and services companies for oil tankers, most of which are European. It is unclear how the price cap would play out. Enforcement will likely be difficult since individual shipments must meet the cap. Large importers of oil like India and China are already getting Russian oil at a discount. Moreover, Russia's reaction to the cap is still uncertain.⁸

NATURAL GAS: A REFLECTION OF DIFFERING INCOMES IN THE UNITED STATES AND INDIA

The focus of this issue of the U.S.-India Energy Monitor is natural gas in the United States and India. As a cleaner burning fossil fuel energy source, natural gas has taken on renewed importance in the global energy market due to efforts to mitigate climate change. However, the role of natural gas is significantly higher for the United States than India, both in consumption and exports. The United States has emerged as

the global leader in natural gas production, while gas plays an important, but smaller role in India's energy mix given the presence of cheaper alternatives. These diverging paths reflect differing income levels in each country as natural gas is associated with higher incomes.⁹ This issue provides an overview of the current state of the natural gas sector and opportunities for the future.

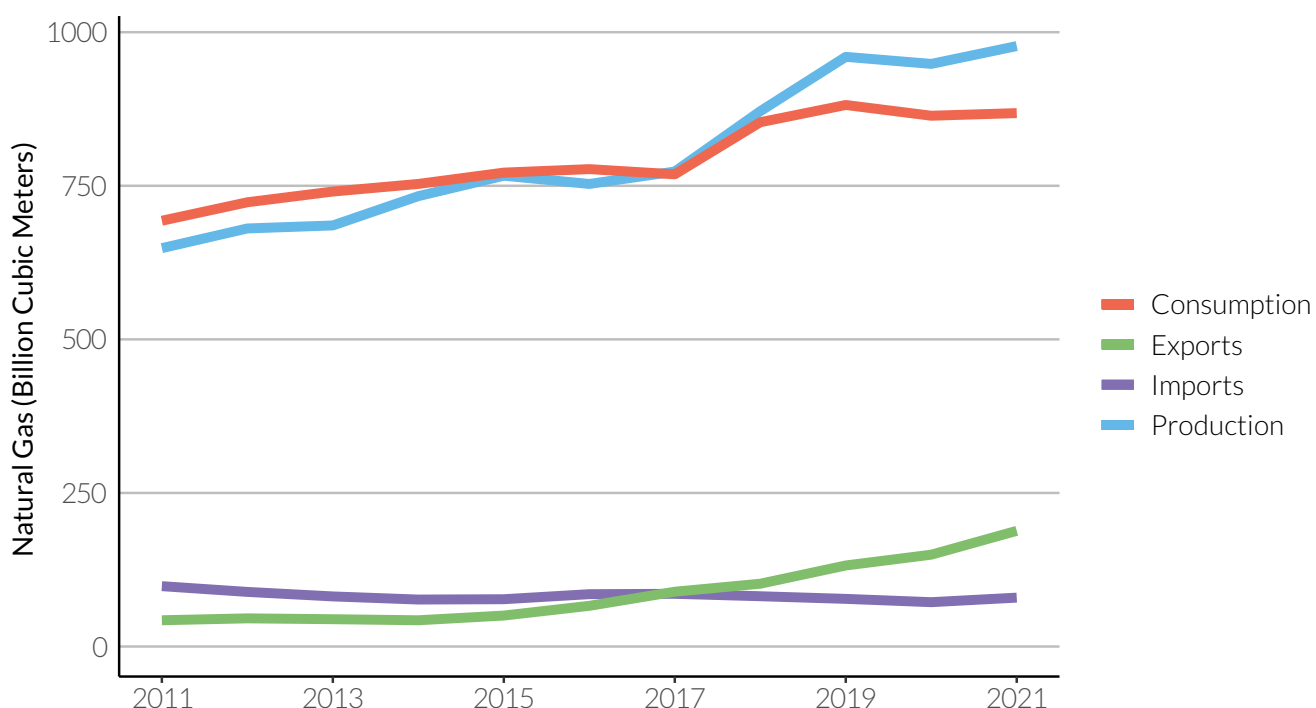
THE RECENT RISE OF NATURAL GAS IN THE UNITED STATES

Production of natural gas in the United States has steadily risen over the last decade and the United States is now the largest producer in the world.¹⁰ Natural gas production peaked in 2021 at 980 billion cubic meters (BCM), mostly through newer

drilling technologies such as hydraulic fracturing ("fracking") and horizontal drilling (Figure 1).¹¹ The size of the workforce is also noteworthy: the natural gas value chain employed approximately 540,000 workers in the United States in 2021.¹²

FIGURE 1.

The United States recently became a net exporter of natural gas. Negative net imports mean export of gas. Source: U.S. Energy Information Administration¹³



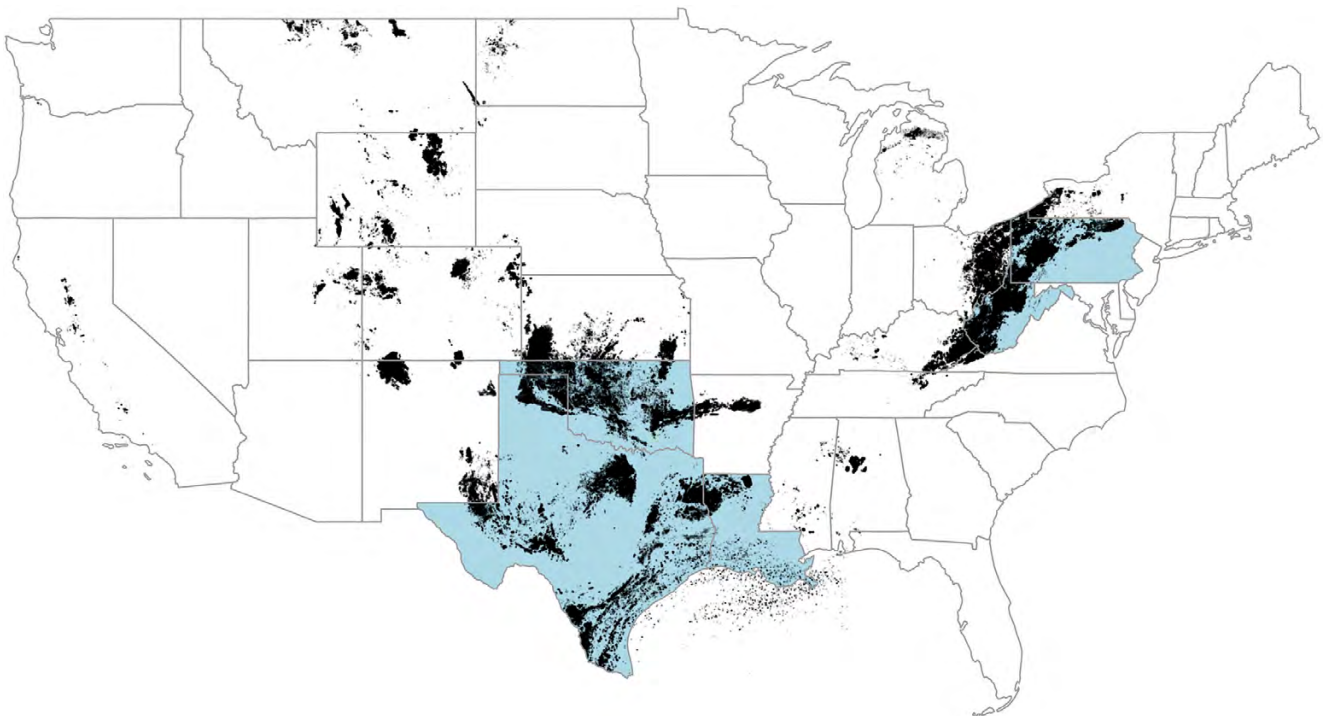


While natural gas wells sit throughout the country, **five states collectively produce 70% of the country's onshore natural gas**: Texas (25%), Pennsylvania (22%), Louisiana (10%), West Virginia (7%), and Oklahoma (7%) (Figure 2).

These states sit on large areas of natural gas-producing rock, known as shale plays. Pennsylvania sits on the Marcellus and Utica plays, and Texas sits on the Permian, Haysville, Eagle Ford, and Barnett plays.¹⁴

FIGURE 2.

Natural gas wells throughout the United States. Colored states are the top producers.
Source: U.S. Energy Information Administration¹⁵

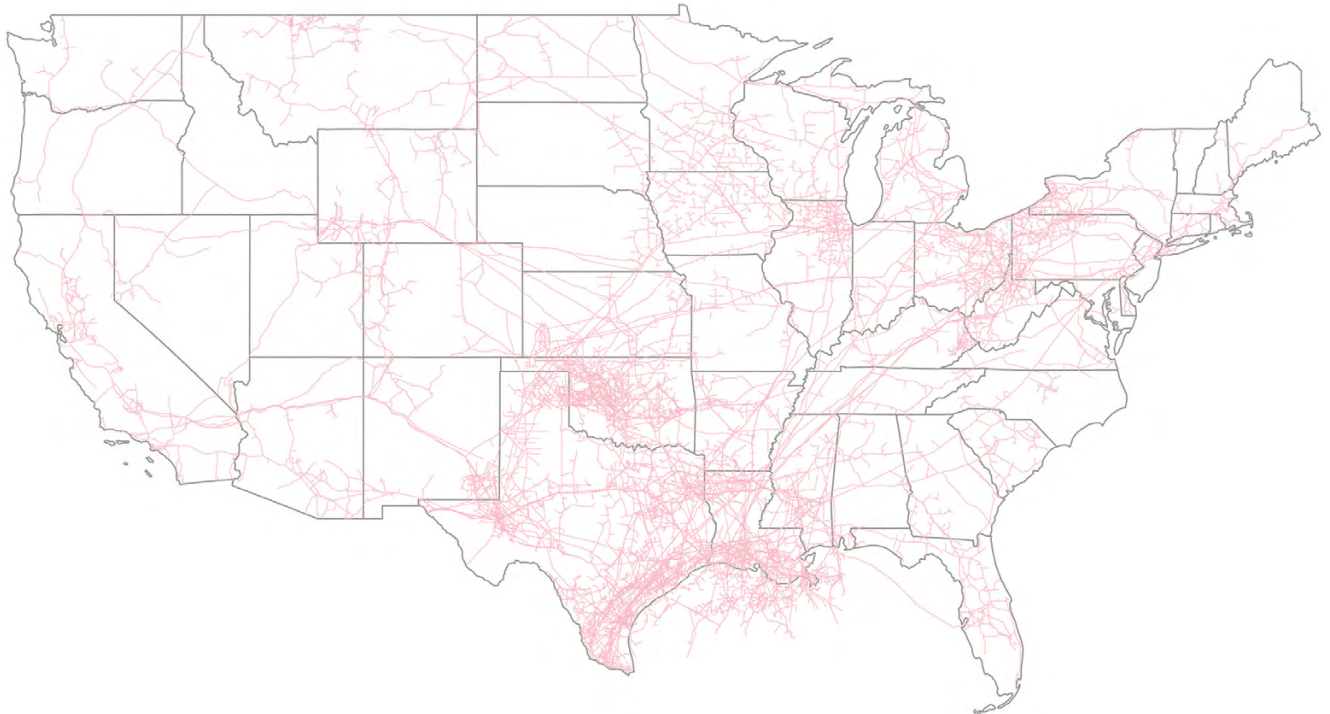


The United States has an extensive network of pipelines to deliver natural gas from drilled wells to consumers. In 2021, **the network of natural gas pipelines in the United States numbered three million miles in length**, enough to move about 780 BCM of gas annually to consumers.

These include large intrastate and interstate lines, along with smaller lines to consumers such as residences and businesses. Increases in the demand for natural gas over the last decade have fueled further expansion of this pipeline network (Figure 3).¹⁶

FIGURE 3.

The United States has an extensive network of pipelines to deliver natural gas from wells to consumers
Source: U.S. Energy Information Administration¹⁷



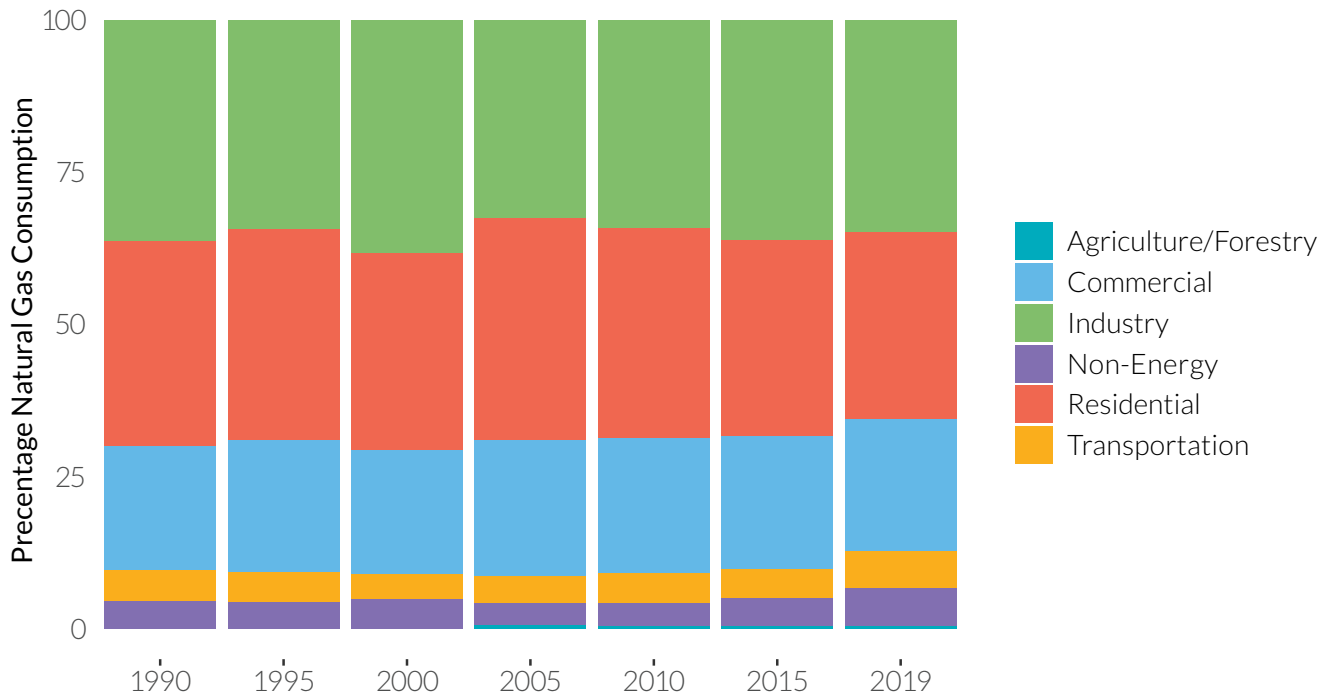
The United States is also the largest consumer of natural gas in the world, consuming about 870 BCM of natural gas in 2021.^{18,19} This formed about one-third of all energy consumed in the United States.²⁰ Most natural gas consumed in the United States is used directly for heat and indirectly for electricity in a variety of sectors. Across all sectors about 40% of natural gas consumed in the United States is for electricity

generation which has seen the largest growth over the last decade as increased domestic production has lowered prices. When counting both heat and electricity, about one-third of natural gas in the United States goes to the industrial sector, followed by residential (30%) and commercial (22%) uses. A small amount of natural gas also goes directly as input to create products such as fertilizer (Figure 4).

The United States is also the largest consumer of natural gas in the world.

FIGURE 4.

Most natural gas in the United States is used for heat or electricity in a variety of sectors. Sector distributions include both heat and electricity. Source: International Energy Agency²¹



Natural gas production in the United States has increased enough for the country to become a net exporter of natural gas in 2017 when total exports reached 90 BCM (Figure 1). In 2021, about half of all exports occur as liquefied natural gas (LNG) where gas is supercooled into liquid form and shipped on tankers around the world while the remaining half occurred via pipeline to Mexico and Canada.²² **A plurality of U.S. LNG exports in 2021 went to Asia:** China (13%), South Korea (13%), Japan (10%), and India (6%).²³

While natural gas is the cleanest fossil fuel when fully burned, leaks of unburned natural gas release methane, a powerful greenhouse gas, into the atmosphere. When burned for energy, natural gas emits about half the carbon dioxide emissions than an equivalent amount of energy from burning coal. Consequently, the shift of electricity generation from coal to natural gas has reduced U.S. greenhouse gas emissions by about 30% since 2007.²⁴ Likewise, it emits little of the sulfur or particles responsible for air pollution.²⁵

While natural gas is the cleanest fossil fuel when fully burned, leaks of unburned natural gas release methane, a powerful greenhouse gas, into the atmosphere.

However, unburned natural gas is mostly methane, a greenhouse gas about 30 times more potent than carbon dioxide when inducing warming in the atmosphere over 100 years.²⁶ Left unabated, methane emissions from natural gas can cancel any emissions reductions compared to dirtier fossil fuels like coal.²⁷ The United States is the world's second largest emitter of methane.²⁸ To control these emissions from the natural gas sector, the United States has instituted a fee to unabated natural gas-sector methane emissions as part of the broader IRA as well as stricter regulations on oil and gas infrastructure from the Environmental Protection Agency.²⁹ Globally, the United States is a member of the Global Methane Pledge which aims to collectively reduce methane emissions of member countries by at least 30% of 2020 levels by 2030.³⁰

Over the next decade with full realization of the IRA, modeling from Princeton University, Rhodium Group, and Energy Innovation Policy & Technology all suggests natural gas in the United States will likely see a decrease in domestic consumption, while production and exports remain about the same. The IRA's clean energy tax credits slow down natural gas expansion for power generation, and total national natural gas consumption may decrease by up to 30% by 2030. Production and exports stay about same assuming there is sufficient demand globally for U.S. LNG exports and there is enough export terminal capacity to meet this demand.³¹ As a result, U.S. LNG offers an alternative to meet European demand over the next decade as Europe looks to shift away from Russian natural gas.³²



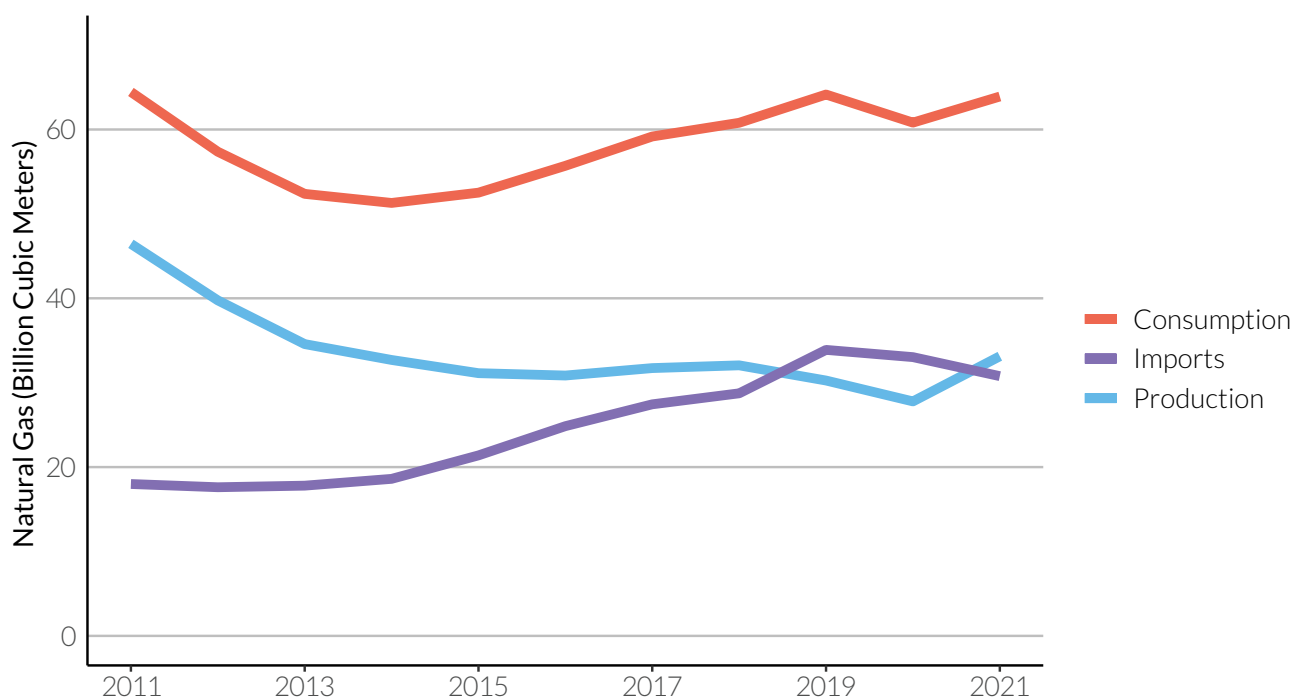
THE EXPANSION OF NATURAL GAS IN INDIA

Natural gas does not play a large role in India's energy system. India is not a large producer of natural gas ranking 26th among countries for natural gas production.³³ In 2021, production totaled at 27 BCM, about half of total consumption

of 61 BCM (Figure 5).³⁴ However, it is a significant source of employment as oil and gas production employed approximately 700,000 workers in India in 2019.³⁵

FIGURE 5.

India is a net importer of natural gas and imports of liquefied natural gas have risen over the last decade. Source: Government of India³⁶



Gas production in India happens across seven basins: the Krishna-Godavari and Cauvery basins in southern and southeastern India, the Mumbai offshore, Rajasthan and Cambay basins in western India, and the Assam Shelf and Assam-Arakan Fold Belt basins in northeastern India.³⁷ Oil and gas wells largely dot these

locations. About 60% of natural gas produced in India comes from the Mumbai offshore area off the coast of Mumbai (Figure 6). Over the last decade domestic production has decreased in the country, as production from the Krishna-Godavari basin off the southeastern India has decreased (Figure 5).³⁸

FIGURE 6.

Oil and gas wells in India are predominantly in the northeast, west, south, and offshore areas. The colored western offshore area dominates natural gas production in India.
Source: Government of India³⁹

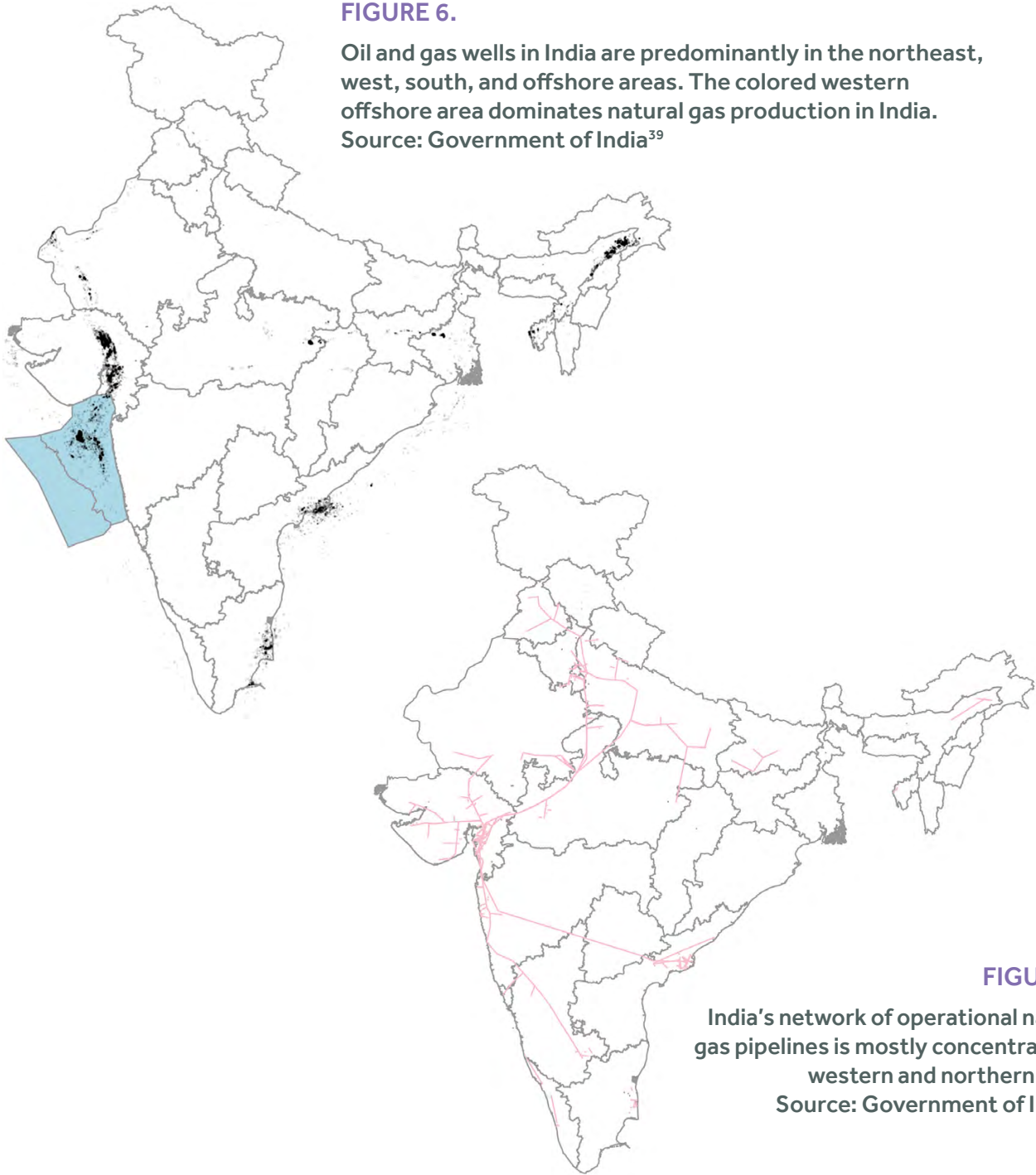


FIGURE 7.

India's network of operational natural gas pipelines is mostly concentrated in western and northern India.
Source: Government of India⁴²

India does not have as extensive of a network of pipelines to transport gas as the United States. Major pipelines totaled about 14,000 miles and are disproportionately concentrated in northern India near Delhi and western India in Gujarat and near Mumbai (Figure 7).⁴⁰ The Government of India has plans to double this capacity through

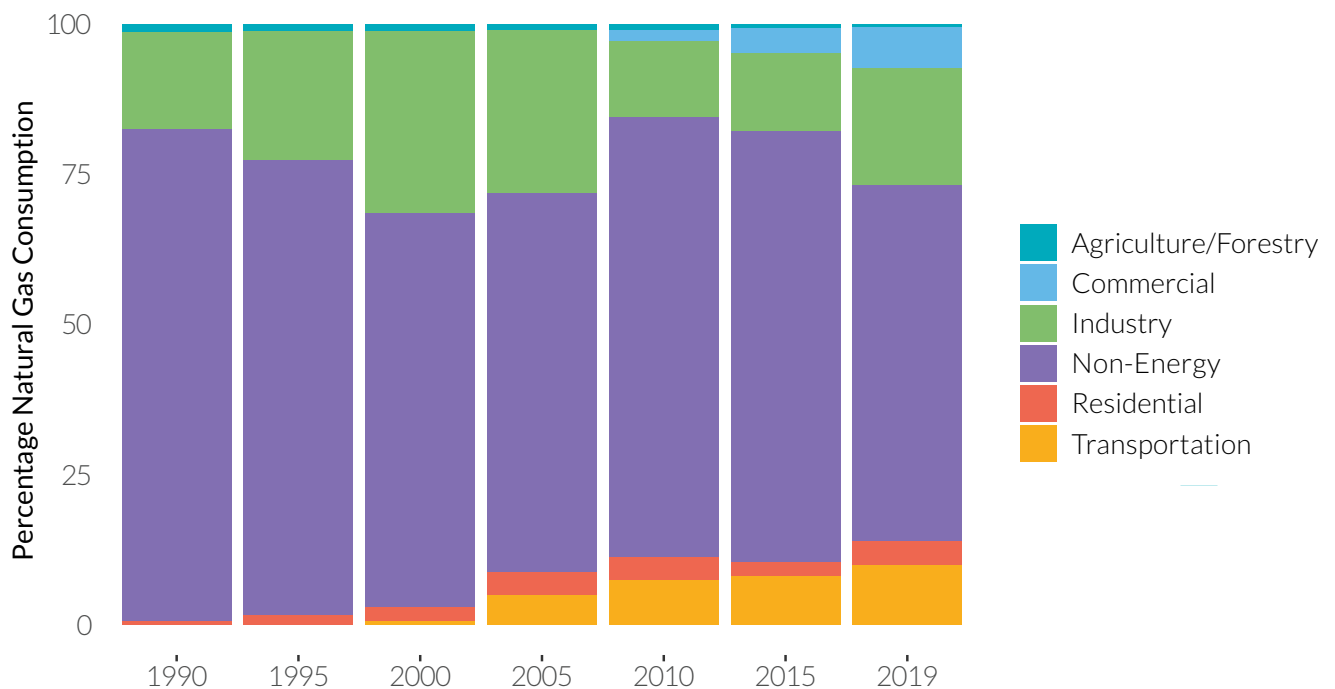
expansion of interstate lines and urban networks known as city gas distribution (CGD) networks for residential, commercial, and industrial consumers. However, current utilization rates of pipelines vary by geography and remain on average about 50% of capacity.⁴¹

Over the last decade, India has been a net importer of natural gas: total consumption in 2021 stood at about 60 BCM, about evenly split between domestic production and imports of LNG (Figure 5). The country does not rank high among natural gas consumption, consuming less than smaller countries such as Italy and Mexico.⁴³ However, India is among the fourth largest importers of LNG in the world.⁴⁴ Much of gas consumed in India goes to non-energy uses as raw feedstock for fertilizer or for energy use in the CGD network, i.e. residential and transportation use (Figure 8).

Under the Government of India’s gas allocation policy, these sectors get priority for domestically produced gas supply, which yield the shares of consumption by sector.⁴⁵ Non-priority sectors include industry and commercial sectors. While all sectors must meet any short falls in energy demand through more expensive LNG imports or other fuels such as coal, non-priority sectors depend on LNG more.⁴⁶ The power sector is also a priority sector for gas, but natural gas faces stiff competition from cheaper coal-based power thus limiting gas-based electricity generation in India.⁴⁷

FIGURE 8.

Much of India’s natural gas consumption goes to feedstock for products such as fertilizer or residential and transportation use through city gas distribution (CGD) networks. Source: International Energy Agency⁴⁸



India is among the fourth largest importers of LNG in the world.

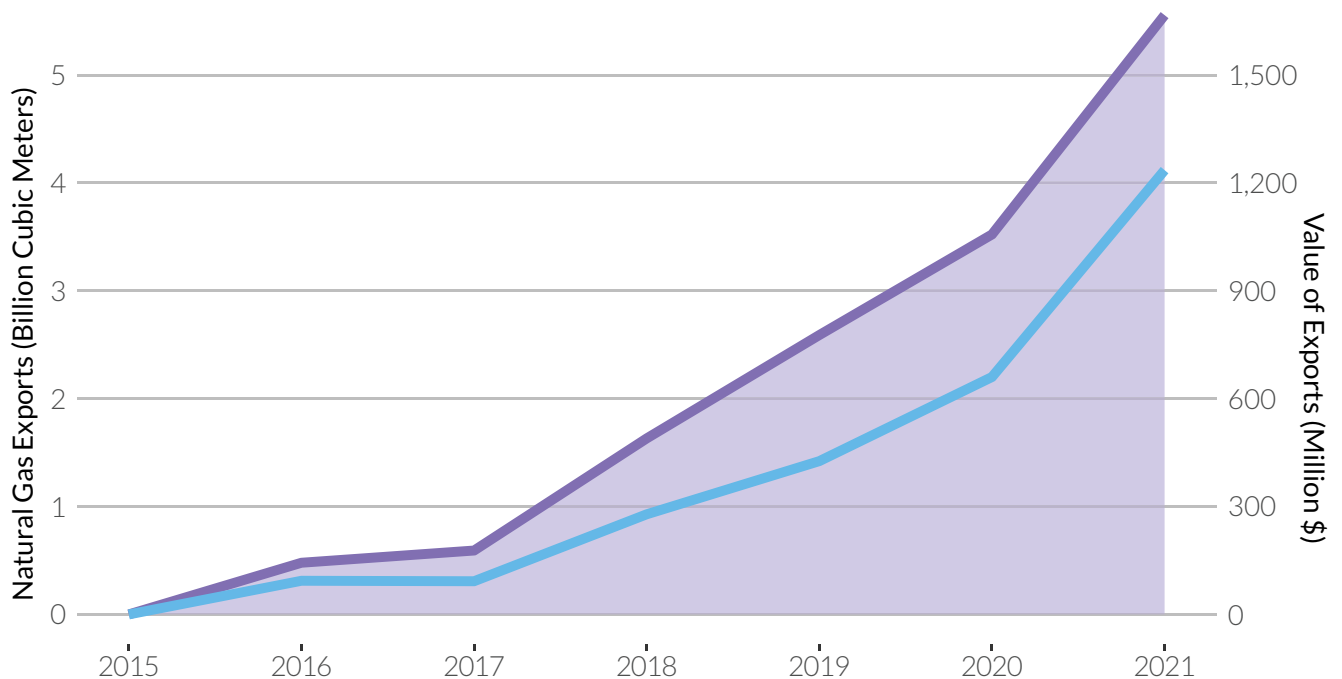
As opposed to the United States where fluctuations in supply and demand, i.e. market mechanisms, largely determine natural gas prices, in India the price of natural gas is partially controlled by the government through complex pricing mechanisms.⁴⁹ Imported natural gas is priced at market rates higher than controlled domestic prices. There are many inputs that factor into the price of domestically produced natural gas in India including the source of gas, end-use sector, pipelines, and taxes from states through which the gas travels. The pricing mechanism's goal is to subsidize price-sensitive consumers like fertilizer for the agriculture sector and residential consumers. Consequently, distortions in price along with competition from cheaper fuels like

coal make investment in further natural gas infrastructure like pipelines in India challenging.⁵⁰ This stands in contrast to the United States where efficient prices have spurred recent investment in pipeline capacity.⁵¹

The volume and value of LNG exported from the United States to India has steadily increased since the first shipments in 2015. In 2021, total volumes exported from the United States reached 5.6 BCM, worth about \$1.2 billion (Figure 9). India ranked sixth for the United States' LNG exports after South Korea, China, Japan, Brazil, and Spain.⁵² The United States, meanwhile, ranked second among sources of imported LNG for India after Qatar in 2021.⁵³

FIGURE 9.

The volume (purple line, left axis) and value (blue line, right axis) of LNG exports from the U.S. to India have steadily grown over the last five years. Source: U.S. Energy Information Administration⁵⁴, U.S. Census Bureau⁵⁵, U.S. International Trade Administration⁵⁶



The outlook for natural gas in India depends on future demand because domestic production of natural gas is limited and has declined. This holds likely for demand for both relatively expensive imported LNG and domestic production from higher cost, currently untapped basins in India. The Government of India has ambitious plans to raise the proportion of gas in India's energy mix to 15% by 2030 through investments in supply-side infrastructure such as urban pipelines, interstate pipelines, and regasification terminals for imported

LNG.⁵⁷ However, given price sensitivities in many smaller consumer segments, substitutes for cheaper alternatives like coal in many commercial and industrial applications, and high prices of imported LNG from the Ukraine war, the outlook for demand is likely lower than expected to meet this 15% target.⁵⁸ Pricing reform could stimulate domestic investment and production and increase transparency for consumers to make the switch to gas from more polluting fuels like coal.⁵⁹



In the United States, the IRA has decreased the outlook for gas consumption especially in the electricity sector. In residential and commercial sectors, electrification efforts will further diminish natural gas demand for uses such as cooking, water heating, and space heating. However, the outlook for exports and continued production is steady. An important assumption in the outlook for natural gas in the United States is sufficient export demand to fuel continued domestic production. The war in Ukraine has increased Europe's demand for LNG over the next decade, but this demand has recently been at expense of emerging markets in Asia.⁶⁰ Medium term demand projections show both European and Asian demand for LNG sufficient to support U.S. exports.⁶¹

India will remain dependent on imports to meet its natural gas demand. Industrial uses like fertilizer and CGD sectors like residential and transport will drive this growth. However, general price sensitives along with higher prices from the Ukraine war will diminish demand growth. Given continued growth in U.S. LNG exports to India, there is potential for U.S. supplies to meet Indian demand over the coming years. However, exports from the United States are unlikely to meet a substantial portion of Indian demand because cheaper alternatives exist.

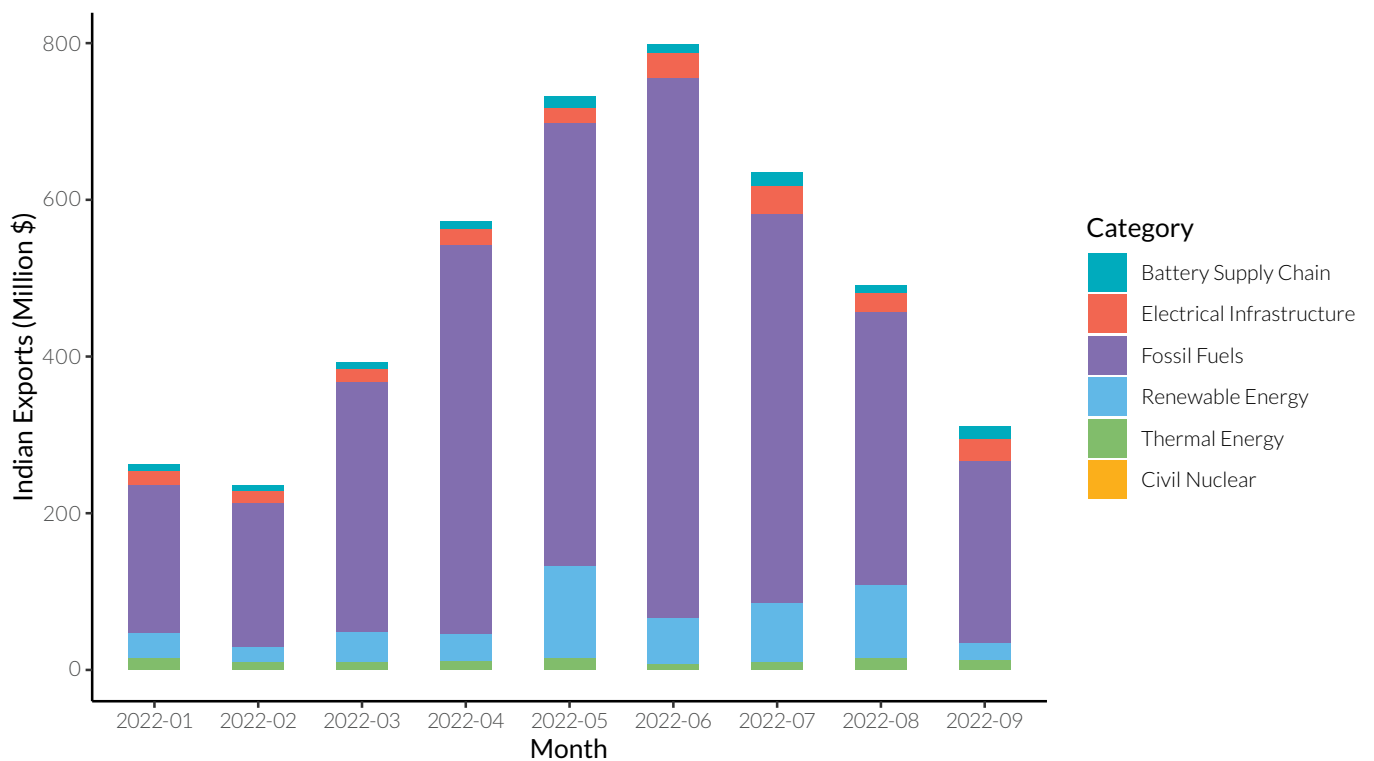


INDIA-U.S. ENERGY TRADE

INDIAN EXPORTS TO THE U.S. (MILLION \$)



CATEGORY	JULY 2022	AUGUST 2022	SEPTEMBER 2022
Fossil Energy	497	349	232
Renewable Energy	75	93	37
Electrical Infrastructure	36	25	28
Thermal Power	10	15	12
Battery Supply Chain	17	10	17
Civil Nuclear	-	-	-



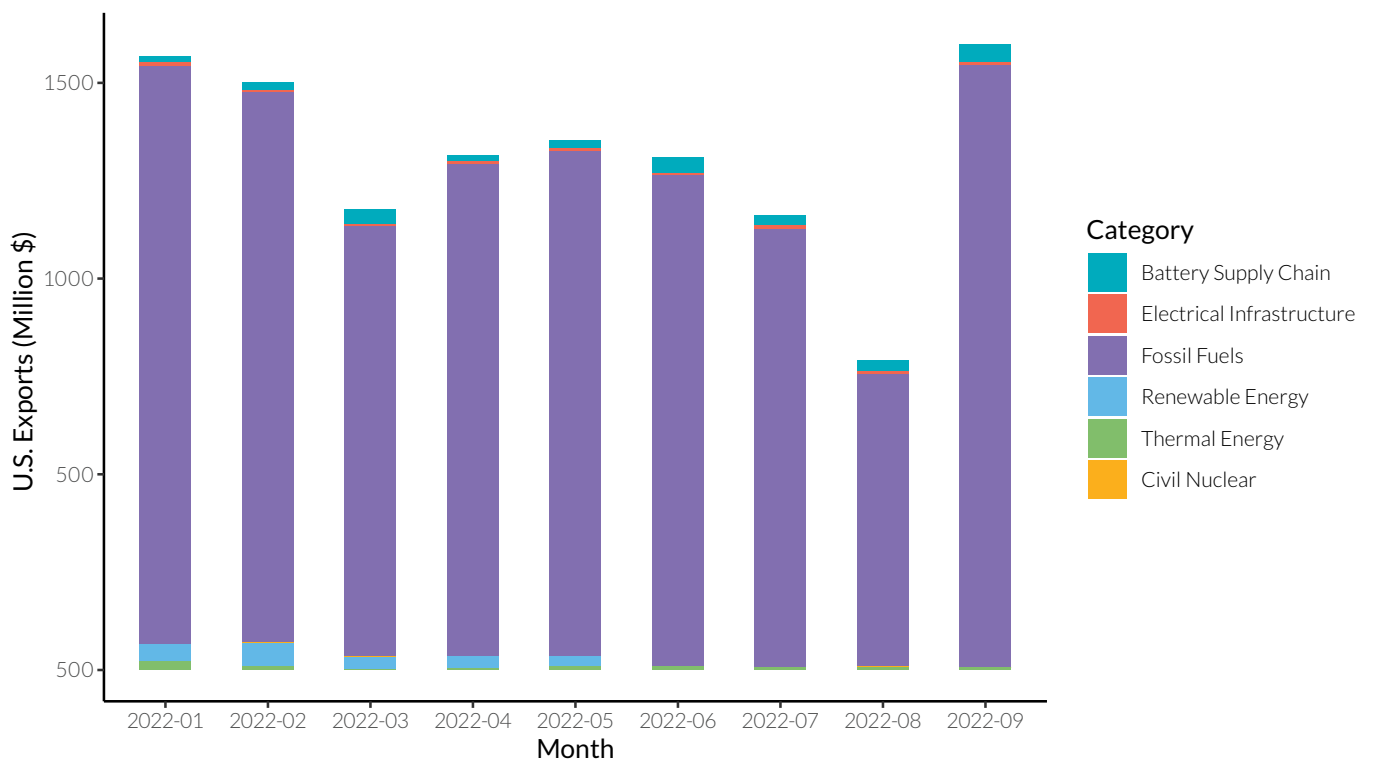
Source: U.S. Census Bureau⁶², U.S. International Trade Administration⁶³

U.S.-INDIA ENERGY TRADE

U.S. EXPORTS TO INDIA (MILLION \$)



CATEGORY	JULY 2022	AUGUST 2022	SEPTEMBER 2022
Fossil Energy	1,120	748	1,540
Renewable Energy	0.01	0.05	0.01
Electrical Infrastructure	8	8	8
Thermal Power	7	8	6
Battery Supply Chain	27	27	46
Civil Nuclear	0.05	0.10	-



Source: U.S. Census Bureau⁶⁴, U.S. International Trade Administration⁶⁵

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