



— TEXAS LNG: —
**POISED TO MEET
THE WORLD'S**



Energy & Climate
NEEDS





TABLE OF CONTENTS

Executive Summary	3
How Texas LNG Will Meet the World’s Energy & Climate Goals	4
A Brief Overview of LNG.....	5
What is LNG?	6
How is LNG Regulated?.....	6
A History of LNG in the United States	7
The Shale Revolution Transforms U.S. and Global LNG Markets.....	8
The Gulf Coast is the Heart of U.S. LNG	8
Meeting Growing Energy Demand	10
Texas Natural Gas Production Rises to Meet Demand	10
Global Gas Demand Feeds on U.S. LNG	11
Long Term Global LNG Demand Will Continue to Increase	13
LNG Will Be Critical to Meeting Global Climate Goals	15
Natural gas has a much lower carbon footprint than other energy sources.....	15
American natural gas is much cleaner than the natural gas from other countries.....	16
Asia Turns to U.S. LNG.....	19
Case Study: China.....	20
Case Study: Taiwan.....	22
Case Study: India	24
Case Study: South Korea	26
Case Study: Japan	27
Natural Gas Will Support the Growth of Renewable Energy Production	28
Natural Gas Facilitates De-carbonized Hydrogen	30
Conclusion: Texas LNG Is Vital to Our Future	31

An abundance of natural gas – made possible by the Shale Revolution that began in Texas’ Barnett Shale nearly two decades ago – has enabled the United States to become one of the world’s largest exporters of the resource in only a few short years. Global demand for natural gas continues to grow as the world seeks to increase energy access and reduce emissions, and the bottom line is that Texas is poised to help meet the world’s energy needs.

The United States is currently the third largest exporter of liquefied natural gas and is forecast to surpass Qatar and Australia to become the top exporter by 2023.¹ The growth of LNG has occurred as the international market for natural gas has grown, giving rise to the use of natural gas in its liquefied form for efficient transportation.

Since Texans For Natural Gas’ last report on the proposed build-out of LNG export facilities in Texas, both U.S. and global markets have transformed significantly.² U.S. LNG exports went from zero in 2016 to 10 billion cubic feet per day (Bcf/d) delivered to 38 countries, with exports reaching a new high in late 2020.³ Two of the seven facilities proposed for Texas’ Gulf Coast in 2018 are now operational, delivering economic benefits within the state and supplying affordable, reliable, clean energy to the world.

The United States currently has seven operational LNG export facilities with a takeaway capacity of 11.66 Bcf/d of natural gas.⁴ Nearly all the LNG exported by the United States (88 percent) comes from four Gulf Coast facilities located in Texas and Louisiana. The two Texas facilities represent nearly 37 percent of current U.S. LNG export capacity, and Texas will be home to more than 25 percent of the

additional capacity that is currently being built or has been proposed.

Global natural gas demand has risen in recent years and is expected to continue to grow well into the future as countries look to reduce emissions and bring energy access to developing nations. Natural gas has more than 50 percent lower carbon dioxide emissions than coal, which makes it a clean power source on its own and reliable back-up for increased renewable generation.⁵ The switch from coal to natural gas for power generation in the United States has cut greenhouse gas emissions in half, and natural gas transported as LNG is seen as a way for large economies like China and India to similarly reduce their emissions.

Asia overtook Europe to become the largest importer of U.S. LNG in 2020, with the region receiving 46 percent of U.S. LNG exports and Europe receiving 37 percent in 2021.⁶ Countries like France and the U.K. are looking to build LNG import terminals, forecasting continued growth for the product in the region. As of now, Spain has Europe’s largest number of LNG import terminals while Rotterdam’s port in the Netherlands, known to be Europe’s largest, has an LNG storage capacity of 19 million cubic feet with plans for continued growth.⁷

North America, led by the United States, is expected to contribute to 75 percent of total global LNG growth by 2024 with the development and expansion of new infrastructure.⁸ With most of the supply of natural gas coming out of the Gulf Coast and the bulk of the export facilities being built there, that means Texas will play an even more important role in supplying the energy that will help lower global emissions and reduce global energy poverty.

¹ <https://www.forbes.com/sites/ianpalmer/2021/08/19/why-lng-exports-from-the-us-are-off-to-the-moon/?sh=5af5cca72639>

² https://www.texansfornaturalgas.com/liquefied_natural_gas_facilities_in_texas_study

³ <https://www.eia.gov/todayinenergy/detail.php?id=47136>

⁴ <https://cms.ferc.gov/media/north-american-lng-export-terminals-existing-approved-not-yet-built-and-proposed-2>

⁵ <https://www.eia.gov/tools/faqs/faq.php?id=73&t=11>

⁶ <https://www.eia.gov/todayinenergy/detail.php?id=47136>

⁷ <https://www.portofrotterdam.com/en/logistics/cargo/lng/lng-terminal>

⁸ <https://oilmanmagazine.com/north-america-to-contribute-75-percent-of-global-lng-liquefaction-capacity-additions-by-2024/>

HOW TEXAS LNG WILL MEET THE WORLD'S ENERGY & CLIMATE GOALS

LNG is the key to a sustainable and reliable global energy future. LNG will reduce air pollution in India, power ever-growing cities like Beijing and will keep the lights on in developing regions across the world. Texas

opens the door to these possibilities, producing natural gas at record-breaking rates and delivering it across the globe through the LNG export terminals spanning its coast.

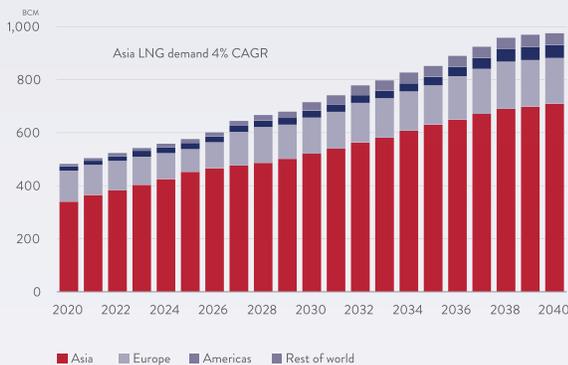
TEXAS HOUSES AMERICA'S LNG POTENTIAL ALONG ITS COAST.

Not only is Texas a leader in oil and gas production, but the proximity of the state's prolific shale basins to its coastline and critical energy infrastructure are making Texas a leader in energy exports as well. The shores of the Gulf Coast – and in particular, the Lone Star State's coast – are home to premier LNG export terminals. In fact, more than 85 percent of the additional planned U.S. LNG export capacity will be located in the Gulf of Mexico and supplied largely by Texas natural gas.



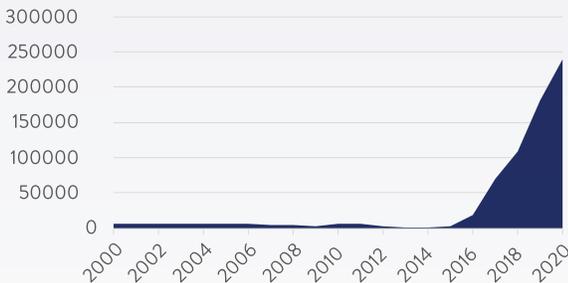
Global energy demand – especially in Asia – is rising. The world needs U.S. LNG in order to meet both its voracious appetite for energy and to transition away from higher-emitting fuels, drastically reducing greenhouse gas emissions.

LNG imports by region



Source: Shell - LNG Outlook 2021

Liquefied U.S. Natural Gas Exports (MMcf)



Source: Energy Information Administration

American LNG export capacity has risen sharply, and will continue to rise, to meet global demand. Texas natural gas production has and will continue to follow suit.

- **10-FOLD INCREASE:** U.S. LNG capacity grew from near zero in 2015 to 10.8 Bcf/d in 2020.
- **GLOBAL EXPORTER:** In 2019, America became the world's 3rd largest LNG exporter.
- **NEARLY 24% of U.S. Natural Gas Production:** Texas single-handedly accounts for roughly a quarter of total U.S. natural gas production.

American LNG is the clear option for countries to cut emissions in electric generation.

- **50% LESS EMISSIONS:** U.S. LNG is far cleaner than coal when used for power generation in countries like China, India, and Germany.
- **143% LOWER FLARING INTENSITY THAN RUSSIA:** Russia's flaring intensity is 143 percent higher than the United States and 239 percent higher than Texas' Permian, demonstrating that America produces natural gas in a much more sustainable fashion than other global producers.

Natural gas complements renewable energy, allowing countries to gear up their renewable energy production while stepping away from coal.

- **HALF THE CO₂:** Natural gas emits about half the amount of carbon dioxide than coal.
- **74%: NATURAL GAS AND RENEWABLES** combined make up nearly three-quarters of total world energy growth by 2040.
- **24/7:** In addition to having fewer emissions than coal, natural gas provides a reliable back-up energy supply that can quickly be ramped up or down no matter the weather or time of day.



"Natural gas will continue to help decrease carbon dioxide emissions from electricity production while providing secure, on-demand power needed for wind and solar energy to scale up."

– U.S. Department of Energy



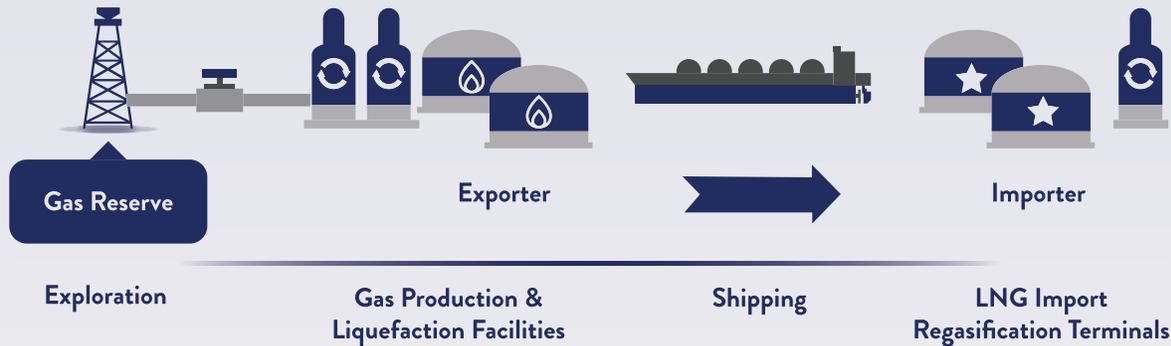
A BRIEF
Overview
OF LNG

WHAT IS LNG?

Liquefied Natural Gas (LNG) is natural gas that has been cooled to -260°F , resulting in its change of state from a gas to a clear, colorless, non-toxic liquid. In its liquid state, natural gas becomes 600 times more compact, which facilitates transportation and distribution to places where pipelines are unavailable.

In its liquid form, natural gas can be shipped in special tankers to terminals around the world. When shipped

across oceans and other long distances, LNG is transported in double-hulled ships with cryogenic tanks that keep the gas in its liquid form. Once at the terminals, LNG is returned to its gaseous state and transported by pipeline to distribution companies, industrial consumers, and power plants. From there, it is either stored or used by consumers.



Source: International Gas Union

HOW IS LNG REGULATED?

Exporting LNG is a strictly regulated process that comes under the jurisdiction of several federal agencies, as well as the Texas Commission on Environmental Quality, which must approve air quality permits for the facilities.⁹ The Federal Energy Regulatory Commission (FERC), for instance, is responsible for the siting (determining the location), construction, and operation of U.S. export facilities.¹⁰ The Department of Energy (DOE) must make a public interest determination on all applications for export facilities.¹¹ The Pipeline and Hazardous Materials Safety Administration (PHMSA) is the agency responsible for developing the regulations that LNG facilities must abide by, as well as overseeing the pipelines that transport natural gas to these facilities.¹²

Other agencies that have jurisdiction over some aspects of LNG export include the Environmental Protection Agency, the U.S. Coast Guard, the Bureau of Safety and Environmental Enforcement, and the Federal Railroad Administration.

Federal and state oversight at all steps of the LNG export process ensures U.S. natural gas is being changed into LNG and exported around the world with the highest safety standards. Not only do companies have to adhere to strict standards, but regular communication with local safety personnel and maintenance are built into required safety plans, and PHMSA has several LNG safety research studies underway to improve this even further.

“Prior to commencing operations, the LNG facility operator must **establish detailed procedures** that specify the normal operating parameters for all equipment. When a piece of equipment is modified or replaced, **all procedures must be reviewed and modified** if necessary to assure the integrity of the system. All personnel **must complete training** in operations & maintenance, security, and firefighting. The operator **must coordinate with local officials** and apprise them of the types of fire control equipment available within the facility. Additionally, Federal regulations require tight security for the facility, including controlled access, communications systems, enclosure monitoring, and patrols.”[†]

– Pipeline and Hazardous Materials Safety Administration

[†] <https://www.phmsa.dot.gov/pipeline/liquified-natural-gas/lng-safety>

⁹ https://www.tceq.texas.gov/permitting/air/air_permits.html

¹⁰ <https://www.ferc.gov/natural-gas/lng>

¹¹ <https://www.energy.gov/fecm/articles/does-role-lng-sector>

¹² <https://www.phmsa.dot.gov/pipeline/liquified-natural-gas/lng-regulatory-documents>

A HISTORY OF LNG IN THE UNITED STATES

While the United States has only recently joined the global LNG market, thanks to the abundance of natural gas unlocked by the Shale Revolution that

started in Texas near the turn of the century, the country actually has an extensive history with LNG dating back more than a century.

TIMELINE: LNG'S DEVELOPMENT IN THE UNITED STATES



¹³ https://books.google.com/books?id=ZqTgDwAAQBAJ&pg=PA245&lpg=PA245&dq=Godfrey+Cabot+1915+liquid+gas+storage+patent&source=bl&ots=2luZAJ82Fq&sig=ACFU3U2uA4S7XajviAn2-BMq3Yh-3ulQ0wQ&hl=en&sa=X&ved=2ahUKewi_oZazzy0AhUdKnIEHcEWC2lQ6AF6BAgCEAM#v=onepage&q=Godfrey%20Cabot%201915%20liquid%20gas%20storage%20patent&f=false

¹⁴ Ibid

¹⁵ Ibid

¹⁶ Ibid

¹⁷ <https://www.eia.gov/todayinenergy/detail.php?id=16771>

¹⁸ <https://d3n8a8pro7vhmx.cloudfront.net/northtexasfornaturalgas/pages/2374/attachments/original/1588786994/TexasForNaturalGas-BarnettShaleReport.pdf?1588786994>

¹⁹ <https://www.eia.gov/dnav/ng/hist/n9070us2A.htm>

²⁰ <https://www.energy.gov/sites/prod/files/2013/04/f0/LNG%20Import%20&%20Export%20Terminal%20Maps%202012-18-2012.pdf>

²¹ <https://d3n8a8pro7vhmx.cloudfront.net/northtexasfornaturalgas/pages/2374/attachments/original/1588786994/TexasForNaturalGas-BarnettShaleReport.pdf?1588786994>

²² <https://www.eia.gov/dnav/ng/hist/n9070us2A.htm>

²³ <https://www.naturalgasintel.com/early-2012-groundbreaking-planned-for-sabine-pass-lng-export/>

²⁴ <https://www.pii.com/blogs/realtime-economic-issues-watch/lng-exports-opportunity-america>

²⁵ <https://www.reuters.com/article/us-usa-cheniere-lng/taiwan-to-get-first-lng-shipment-from-u-s-sabine-pass-reuters-data-idUSKBN1932IN>

²⁶ <https://www.houstonchronicle.com/business/energy/article/Cheniere-Energy-ships-first-cargo-of-LNG-from-13456979.php>

²⁷ <https://www.bloomberg.com/news/articles/2018-01-10/u-s-became-a-net-gas-exporter-for-the-first-time-in-60-years>

²⁸ <https://www.reuters.com/article/us-usa-lng-freeport/freeport-lng-ships-first-commissioning-cargo-from-texas-plant-idUSKCN1VP0BH>

²⁹ <https://www.eia.gov/todayinenergy/detail.php?id=44196#:~:text=ln%202019%2C%20on%20an%20annual,in%20Texas%20began%20commercial%20operations.>

THE SHALE REVOLUTION TRANSFORMS U.S. AND GLOBAL LNG MARKETS

The Shale Revolution ushered in a new era for U.S. LNG by enabling record-breaking U.S. natural gas production that grew nearly 50 percent from 2005 to 2015.³⁰ That decade of growth was so prolific that it transformed how the country, and more importantly, the government and private sector viewed the U.S. potential for exporting LNG.

The late 1970s through the early 2000s were a period of stagnation for U.S. natural gas production, where LNG import facilities were built to accommodate growing domestic demand.

But because of the abundance of natural gas that was unlocked from shale, that all changed. Companies began applying for permits to build export facilities. Nine companies in 2013 alone submitted applications to transform import facilities into those capable of exporting LNG.³¹ A few years later, in 2018, the United States became a net exporter of natural gas.³² As of 2021, there are seven operating U.S. LNG export facilities, two of which are in Texas, and today, America stands as the third largest exporter of LNG in the world.³³

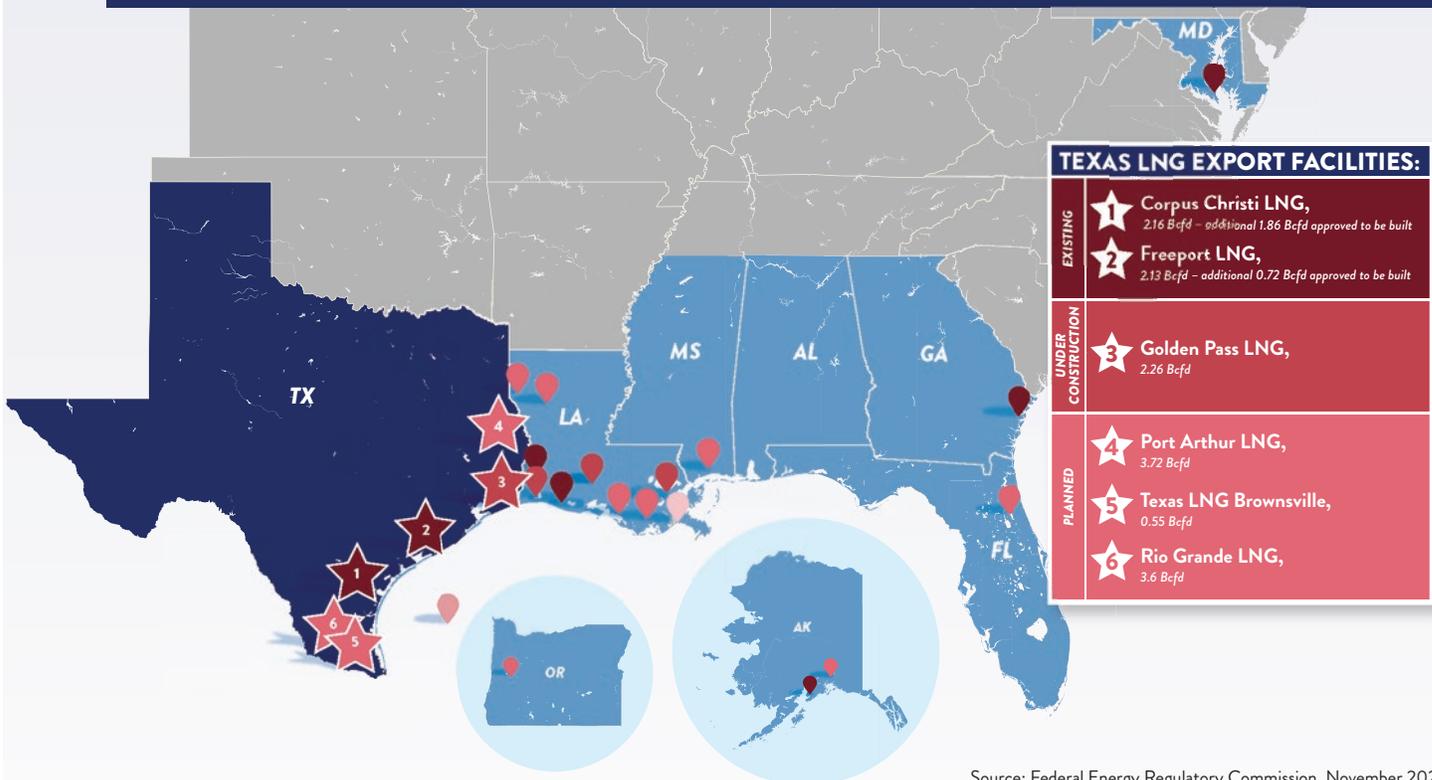
THE GULF COAST IS THE HEART OF U.S. LNG

The Gulf Coast is the U.S. LNG export capital. Not only did the first trans-ocean shipment of LNG originate in the Gulf,³⁴ but it is home to four of the seven active U.S. LNG export facilities and all the new facilities currently under construction.³⁵

The facilities clustered along Texas and Louisiana shores not only serve as essential arteries to the global energy trade – transporting LNG to the world – but are also vital to the local economies dotting the coast.

For example, Cheniere’s Corpus Christi LNG terminal is bringing a huge positive local economic impact. The Corpus Christi Regional Economic Development Corporation pledged \$1.9 billion in new investments for projects at the terminal that would create more than 1,000 new jobs, cumulatively.³⁶ Cheniere’s recent deal for more land at the Port of Corpus Christi will also help expand the area by over 700 new acres,³⁷ which will raise the jurisdiction’s property tax revenue to \$147.8 million and \$800 million over the next 10 and 20 years, respectively.³⁸

U.S. LNG EXPORT FACILITIES



Source: Federal Energy Regulatory Commission, November 2021

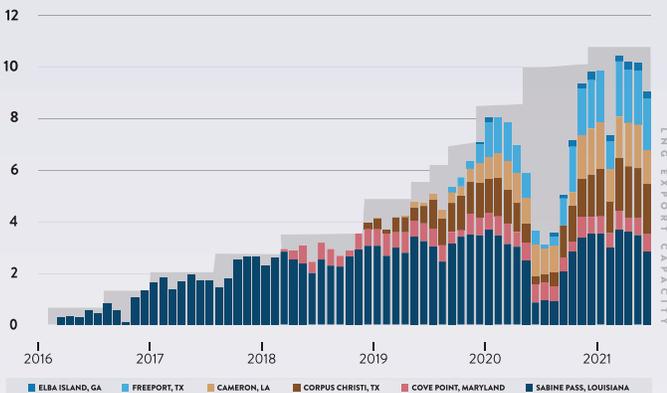
³⁰ <https://www.eia.gov/dnav/ng/hist/n9070us2A.htm>
³¹ <https://www.piie.com/blogs/realtime-economic-issues-watch/lng-exports-opportunity-america>
³² <https://www.bloomberg.com/news/articles/2018-01-10/u-s-became-a-net-gas-exporter-for-the-first-time-in-60-years>
³³ <https://www.eia.gov/todayinenergy/detail.php?id=44196#:~:text=In%202019%2C%20on%20an%20annual,in%20Texas%20began%20commercial%20operations.>
³⁴ <https://www.eia.gov/todayinenergy/detail.php?id=16771>
³⁵ <https://cms.ferc.gov/media/north-american-lng-export-terminals-existing-approved-not-yet-built-and-proposed-1>
³⁶ <https://www.caller.com/story/news/2021/07/15/mayor-road-projects-key-corpus-christis-future-success/7977328002/>
³⁷ <https://www.caller.com/restricted/?return=https%3A%2F%2Fwww.caller.com%2Fstory%2Fnews%2F2021%2F06%2F17%2Fport-corpus-christi-buys-700-acres-land-cheniere%2F687257002%2F>
³⁸ <https://www.caller.com/story/news/2021/07/15/mayor-road-projects-key-corpus-christis-future-success/7977328002/>

Freeport, Texas is another Texas-based export terminal, owned by Freeport LNG. Freeport LNG has been pivotal to the economic growth of the community in which it operates by creating over 8,000 skilled construction jobs when the plant was first being built. Today, Freeport LNG currently employs about 370 highly skilled individuals to support its operations. Across the United States, Freeport LNG created an

estimated 24,000 to 30,000 direct and indirect jobs, including in the areas of natural gas exploration, drilling, production, and commercial operation. Between Houston and Brazoria County, Freeport LNG has invested over \$13 billion into the local economy from the initial construction of its three liquefaction trains alone and estimates its total positive economic impact on the U.S. economy to be over \$5 billion per year.³⁹

MONTHLY U.S. LIQUEFIED NATURAL GAS (LNG) EXPORTS

(1 billion cubic feet per day)



Source: EIA

These export facilities, while supporting local economies, also power the economies of cities across the globe. Looking at the chart below, one can see that in 2021 export terminals along the Gulf Coast – namely, Sabine Pass, Corpus Christi and Freeport – are handling the majority of America’s LNG exports.

It is clear that the Gulf Coast – especially Texas – will continue to be the heart of LNG for decades to come in the United States.

THE GULF COAST CONTINUES TO PLAN FOR LNG’S FUTURE

The demand for LNG is only set to grow in coming years. Several LNG export terminals that are either planned, under construction, or set to be expanded promise to be boons to their surrounding communities.



New facilities in Texas located in Sabine Pass, Port Arthur, and Brownsville will add more than 10 bcf/d of LNG capacity– **or a little more than 25 percent of the total additional planned U.S. capacity.**



More than 85 percent of the additional planned U.S. LNG export capacity will be located in the Gulf of Mexico **and supplied largely by Texas natural gas.**



Texas’ existing Corpus Christi LNG and Freeport LNG facilities **have been approved to add an additional nearly 3 bcf/d.**



TOTAL POSITIVE ECONOMIC IMPACT ON THE U.S. ECONOMY TO BE OVER \$5 BILLION PER YEAR.

³⁹ <https://scir.freeportlng.com/about-freeport-lng/>



MEETING GROWING ENERGY DEMAND

Natural gas has accounted for almost one-third of total energy demand and growth over the last decade, surpassing all other fuels. Today, it is the fastest growing fossil fuel, accounting for 23 percent of energy demand and nearly 25 percent of electricity

generation. Its storability and the operational flexibility of gas-fired power plants makes natural gas a preferred choice when responding to seasonal and short-term changes in demand and is a pillar of many countries' energy supplies.

TEXAS NATURAL GAS PRODUCTION RISES TO MEET DEMAND

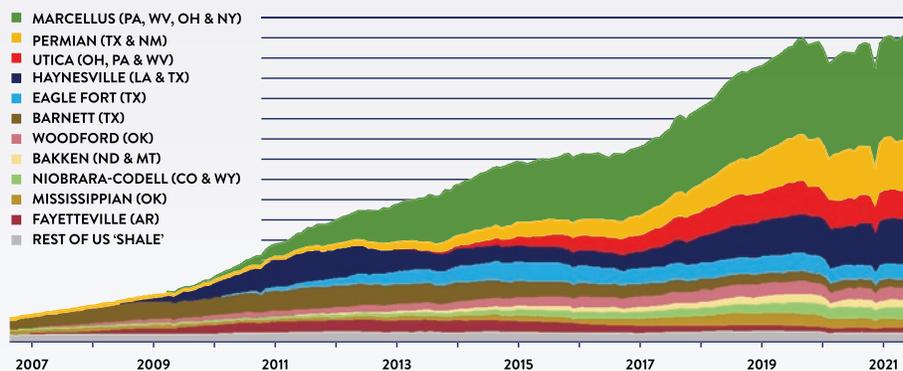
Today, Texas single-handedly accounts for roughly a quarter of America's natural gas production, making up 23.9 percent of the country's natural gas in 2020.⁴⁰

In addition to the Permian Basin, natural gas is produced in Texas's Barnett Shale, Eagle Ford Shale, and Haynesville Shale.

As U.S. natural gas production has risen, so have U.S. LNG exports. In part driven by regulatory improvements, the United States has become one of the world's leading LNG exporters since it first became a net exporter of natural gas in 2018.^{41,42} In fact, U.S. LNG export capacity has grown more than tenfold over the last decade, from less than 1 Bcf/d in 2015 to 10.8 Bcf/d in 2020.^{43,44}

U.S. DRY SHALE GAS PRODUCTION

billion cubic feet per day



Sources: Graph by the U.S. Energy Administration (EIA) based on state administrative data collected by Enverus. Data are through October 2021 and represent EIA's official tight gas estimates, but are not survey data. State abbreviations indicate primary state(s).
 Note: Improvements to play identification methods have altered production volumes between various plays.

Today, 
 Texas single-handedly accounts for roughly a quarter of America's natural gas production, making up 23.9% of the country's natural gas in 2020.⁴⁰

⁴⁰ <https://www.eia.gov/energyexplained/natural-gas/where-our-natural-gas-comes-from.php>

⁴¹ <https://www.iea.org/news/the-us-shale-revolution-has-reshaped-the-energy-landscape-at-home-and-abroad-according-to-latest-iea-policy-review>

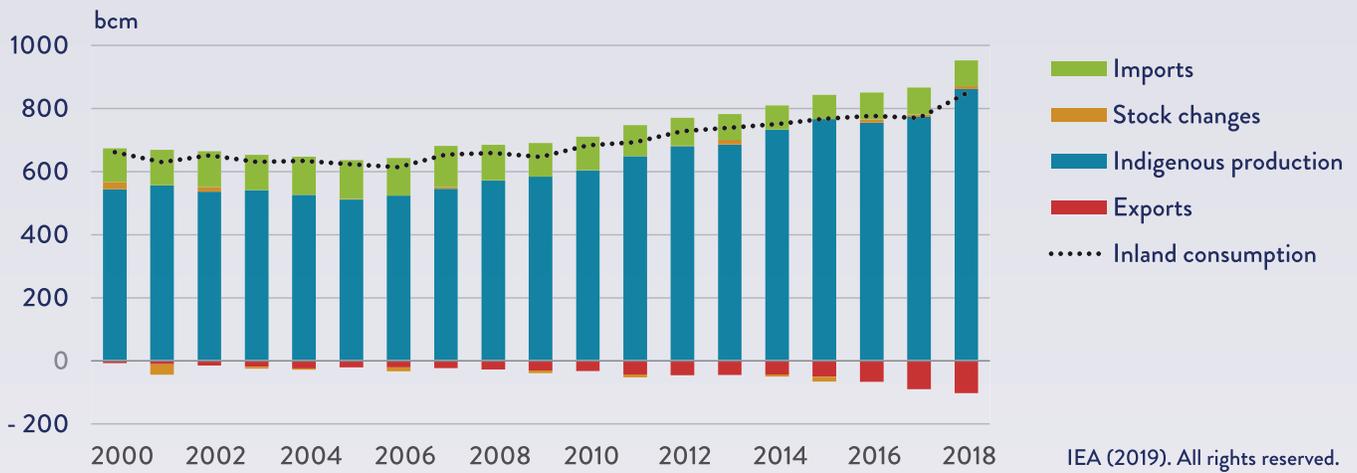
⁴² https://iea.blob.core.windows.net/assets/7c65c270-ba15-466a-b50d-1c5cd19e359c/United_States_2019_Review.pdf

⁴³ <https://www.iea.org/news/the-us-shale-revolution-has-reshaped-the-energy-landscape-at-home-and-abroad-according-to-latest-iea-policy-review>

⁴⁴ <https://www.eia.gov/energyexplained/natural-gas/liquefied-natural-gas.php>

OVERVIEW OF US TOTAL SUPPLY OF NATURAL GAS, 2000-2018

The U.S. has been the top gas producer since 2009 and a net exporter since 2018.



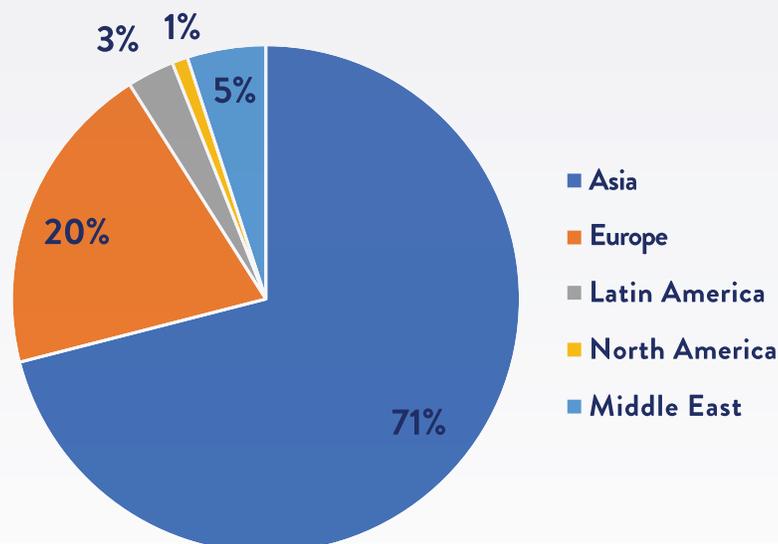
Source: International Energy Agency (2019)

GLOBAL GAS DEMAND FEEDS ON U.S. LNG

Global natural gas trade is expected to reach pre-pandemic levels by the end of 2021 after abruptly contracting in 2020 due to the COVID-19 pandemic. While short-term global demand growth has been driven by both the end of mobility restrictions and the resumption of economic activity, annual data shows a steady growth in natural gas demand.⁴⁵

Over the past decade, Asia's need for natural gas has surged, resulting in the region leading the world in terms of LNG imports. Most recently, in 2020, over 63 percent of global LNG demand came from four Asian countries: Japan (21 percent), China (19 percent), South Korea (11 percent), and India (7 percent).⁴⁶

LNG IMPORTS BY MARKET, 2020



Source: International Gas Union

⁴⁵ <https://www.iea.org/reports/gas-2020/2021-2025-rebound-and-beyond>

⁴⁶ <https://www.igu.org/resources/world-lng-report-2021/>

Natural gas' prominence within the Asian energy market is the result of the continent's growing economic activity, particularly in the industrial and manufacturing sectors, as well as several national energy transition policies and climate commitments (to be further explained in the following section).⁴⁷

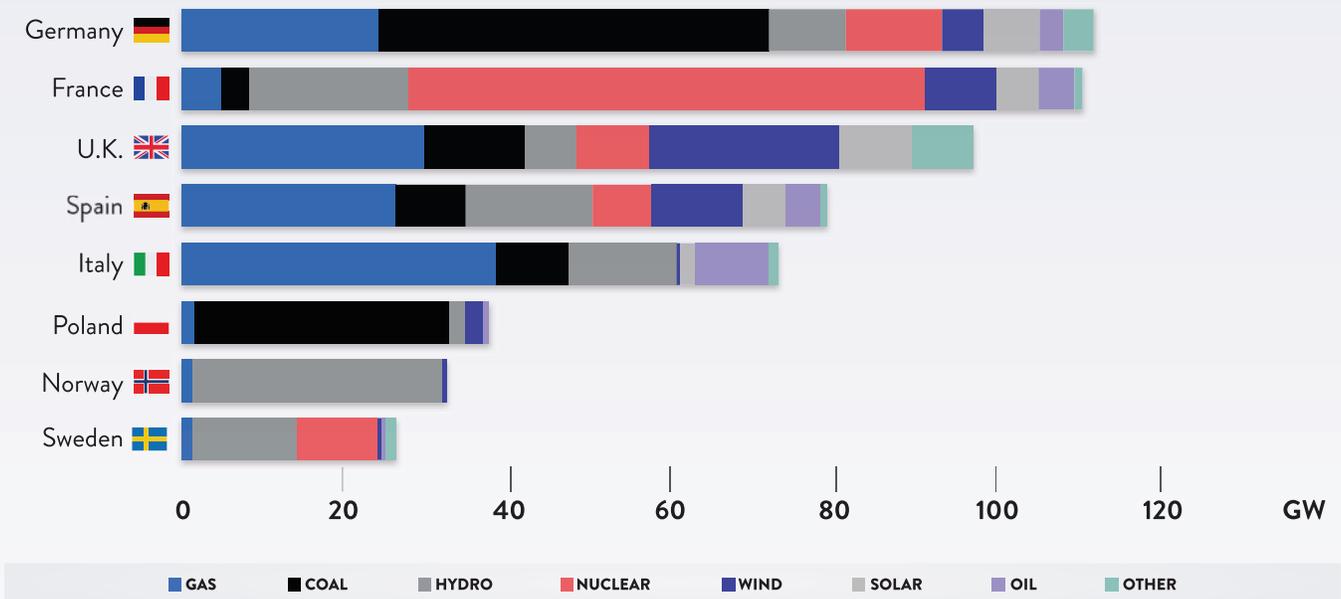
Likewise, Europe's demand for natural gas has significantly contributed to the LNG trade. While the region accounts for 20 percent of total global LNG imports, Spain (4 percent), the United Kingdom (3 percent), and Italy (3 percent), represent the bulk of the region's imports.⁴⁸

However, unlike Asian countries, Europe is highly dependent on natural gas for power generation and

heating. As shown below, natural gas is the primary energy source for Spain, Italy, and the United Kingdom. Likewise, natural gas demand is expected to grow in markets that are phasing out their coal-fired power plants, such as Germany.⁴⁹

Unsurprisingly, both Asian and European markets are top destinations for U.S. LNG exports, accounting for 46 percent and 37 percent of U.S. exports, respectively, through the first five months of 2021.⁵⁰ In 2020, the top five destinations of U.S. LNG exports were: South Korea (316.2 Bcf, 13.3 percent), Japan (287.7 Bcf, 12.1 percent), China (200 Bcf, 9 percent), Spain (200 Bcf, 8.4 percent), and the United Kingdom (160.2 Bcf, 6.7 percent).⁵¹

ITALY, U.K., SPAIN AND GERMANY RELY HEAVILY ON GAS FOR POWER GENERATION.



Source: World Resources Institute

⁴⁷ *ibid.*

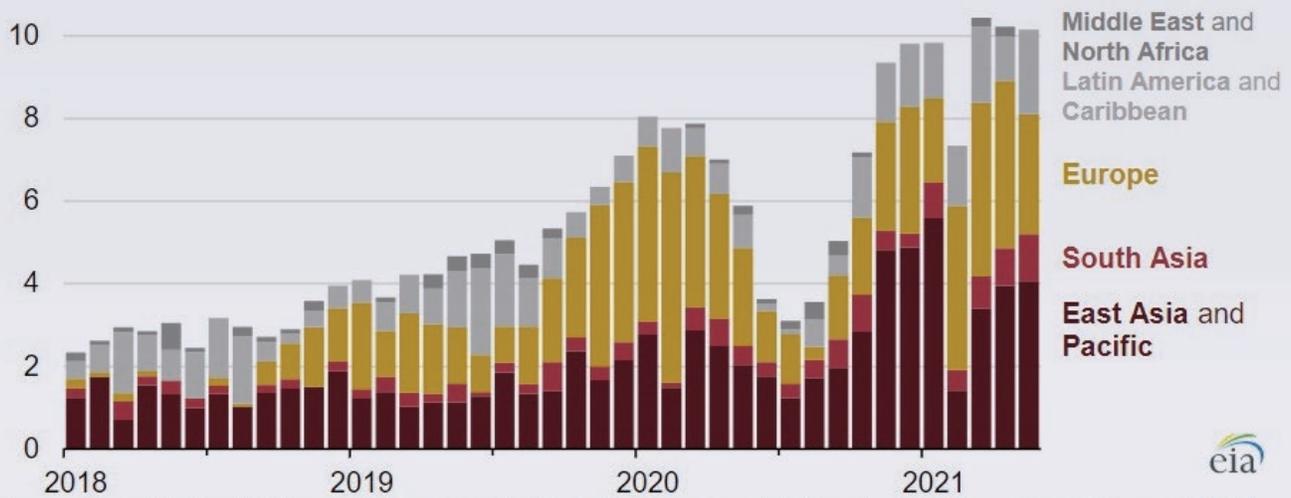
⁴⁸ *ibid.*

⁴⁹ <https://insideclimatenews.org/news/15102020/germany-coal-transition/>

⁵⁰ <https://www.eia.gov/todayinenergy/detail.php?id=48876>

⁵¹ <https://www.eia.gov/energyexplained/natural-gas/liquefied-natural-gas.php>

Monthly U.S. liquefied natural gas exports by destination region (Jan 2018–May 2021) billion cubic feet per day



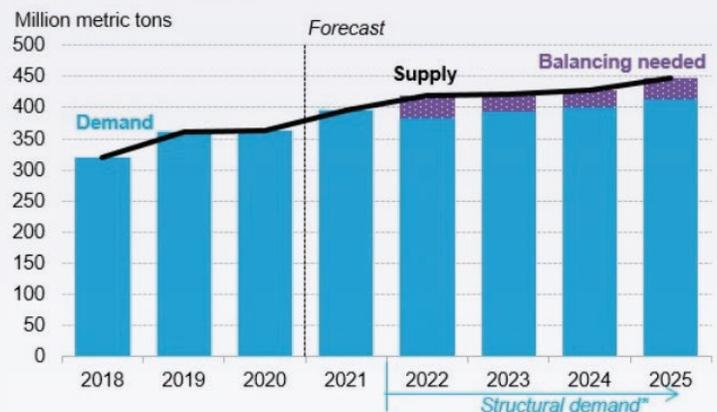
Source: Graph by the U.S. Energy Information Administration, based on data from the U.S. Department of Energy's *LNG Monthly* reports



LONG TERM GLOBAL LNG DEMAND WILL CONTINUE TO INCREASE

Global natural gas demand is expected to grow through 2024, reaching 7 percent above pre-COVID-19 levels.⁵² Contributing to this growth in demand, particularly throughout 2022 to 2024, are efforts in developing and emerging countries to switch from oil and coal to natural gas, which is expected to account for half of gas consumption growth in this period.⁵³ Throughout the rest of the decade, this trend could strengthen if countries take policy action to increase investments in line with their objectives to reduce their emissions.⁵⁴ Importantly, U.S. exports to China could spike in the next few years as China looks to reach new long-term supply agreements for LNG that play a key role in the country's 2060 carbon-neutral goal.⁵⁵

Global LNG supply and demand



Source: BloombergNEF. Note: *Structural demand is the demand based on current prices and 30-year weather average. For 2021, demand forecast assumes Northwest Europe and Italy takes all volumes, or excess supply, needed to balance the market after non-European demand is met.

⁵² https://iea.blob.core.windows.net/assets/4fee1942-b380-43f8-bd86-671a742db18e/GasMarketReportQ32021_includingGas2021Analysisandforecastto2024.pdf

⁵³ Ibid

⁵⁴ Ibid

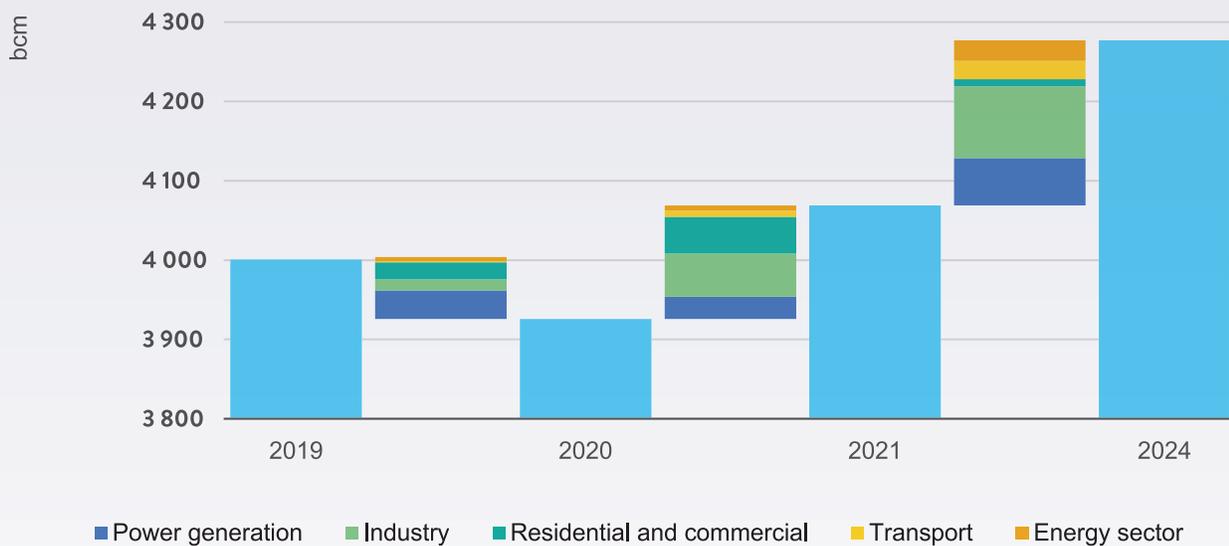
⁵⁵ <https://www.reuters.com/business/energy/exclusive-china-looks-lock-us-lng-energy-crunch-raises-concerns-sources-2021-10-15/>

Likewise, another main driver for the increase in demand through 2024 is the industrial sector, which uses gas as a fuel source for industrial purposes (particularly in China, India, and emerging Asian markets) and as a feedstock for chemicals and fertilizers.

The industrial sector not only contributed more than any other sector to the 2021 recovery in global gas demand, but it will also continue to play a leading role in the years to come. Asia's industrial sector is expected to drive demand for natural gas through 2024, especially in India and China.⁵⁶

THE INDUSTRIAL SECTOR ALONE ACCOUNTS FOR 40% OF GLOBAL GROWTH IN GAS CONSUMPTION OVER 2020-2024

Sectoral breakdown of global gas demand growth, 2019-2024



Source: International Energy Agency

The need for natural gas is also expected to increase in other parts of the world, including the Middle East and North America as Alberta, Canada seeks to phase out coal by 2023.

In the long run, as countries move toward net-zero emissions, global gas demand will eventually start to decline.⁵⁷ However, it will remain an important component of electricity security, especially in countries where there are large seasonal variations in electricity demand.



⁵⁶ https://iea.blob.core.windows.net/assets/4fee1942-b380-43f8-bd86-671a742db18e/GasMarketReportQ32021_includingGas2021Analysisandforecastto2024.pdf
⁵⁷ <https://www.iea.org/news/statement-on-recent-developments-in-natural-gas-and-electricity-markets>

LNG WILL BE CRITICAL TO MEETING GLOBAL CLIMATE GOALS

As we look to the future, policymakers must view natural gas as a foundational fuel, not a transitional fuel. It's an essential building block thanks to its affordability, transportability, and comparatively low emissions footprint. With global energy demand only continuing to rise, LNG provides a clear answer to the growing call for economical, clean energy.

NATURAL GAS HAS A MUCH LOWER CARBON FOOTPRINT THAN OTHER ENERGY SOURCES.

Perhaps more than any other sector, power generation has benefited the most from emissions reductions associated with switching to natural gas. While coal once dominated this sector, the Shale Revolution of the past decade-plus has served as a catalyst in the move away from coal toward cleaner natural gas. Producing about half the emissions of coal when burned, natural gas is an abundant, reliable energy source that keeps our lights on and our homes warm in the winter.

The United States has already begun to reap the benefits of switching from more emissions-intensive fuel sources, like coal, to natural gas. The EIA found that after 2010, the carbon intensity from energy-related CO₂ emissions significantly decreased in the United States.⁵⁸ The EIA attributed this decrease to a significant rise in natural gas production, which lowered the cost of natural gas, making it cost competitive with coal for electric power generation. In 2019 alone, the carbon intensity of U.S. energy consumption declined by two percent.⁵⁹

The EIA found that after 2010, the carbon intensity from energy-related CO₂ emissions *significantly decreased in the United States*.⁵⁸ The EIA attributed this decrease to a significant rise in natural gas production, which lowered the cost of natural gas, making it cost competitive with coal for electric power generation.

PERCENT OF U.S. ELECTRICITY GENERATION BY SOURCE

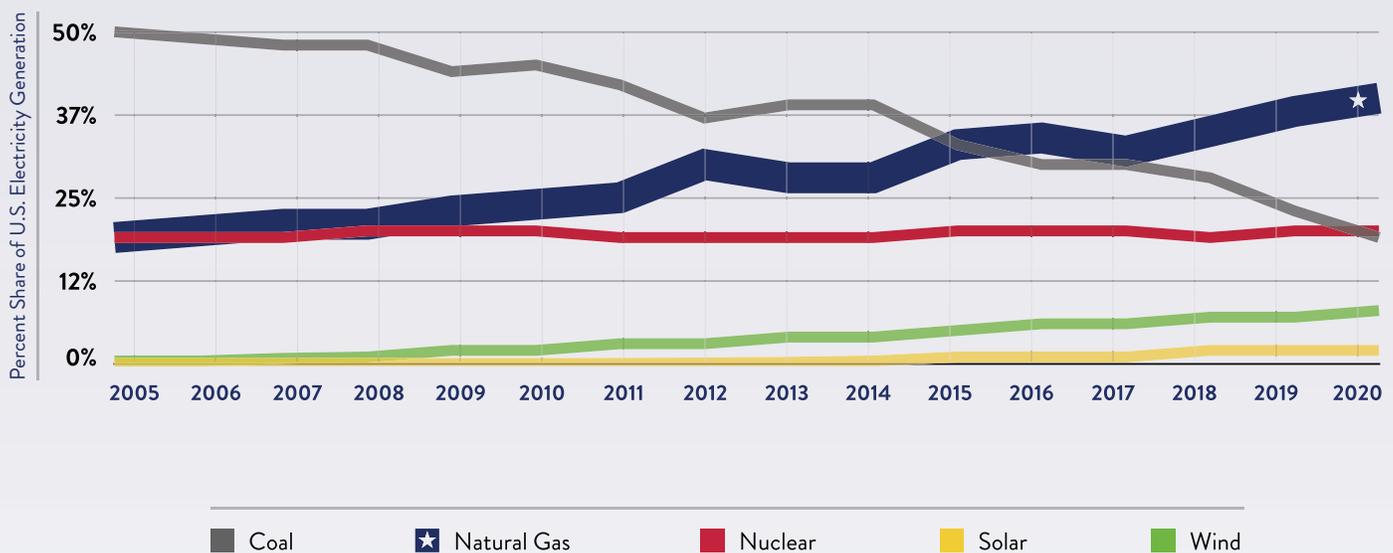


Chart Source – EIA Total Energy Monthly Data, November 2021

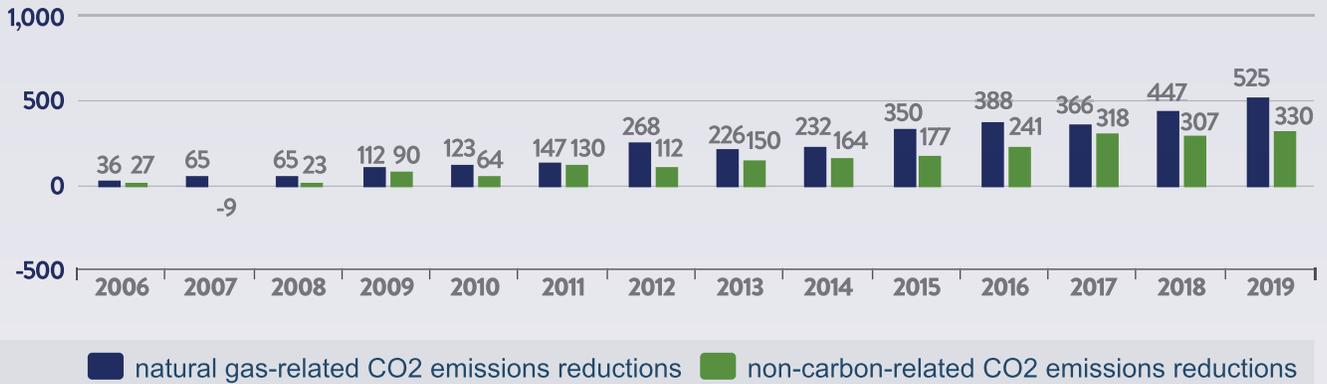
⁵⁸ <https://www.eia.gov/environment/emissions/carbon/>

⁵⁹ <https://www.eia.gov/environment/emissions/carbon/>

CO₂ EMISSIONS REDUCTIONS IN ELECTRICITY GENERATION FROM CHANGES IN THE FUEL MIX SINCE 2005

million metric tons of carbon dioxide

SWITCHING TO NATURAL GAS RESULTED IN 61 PERCENT OF THE ELECTRICITY GENERATION CO₂ EMISSIONS REDUCTIONS SINCE 2005.



Source: Energy Information Administration, 2020⁶⁰

AMERICAN NATURAL GAS IS MUCH CLEANER THAN THE NATURAL GAS FROM OTHER COUNTRIES.



In Europe, predicted energy demand and domestic supply tell a worrying tale: Europe faces an extreme natural gas shortage. Europe's hunger for energy is increasing while its domestic energy production has gradually fallen. European leaders are faced with two options: import LNG via pipeline from Russia or import LNG from the U.S. and other allies via tankers.

The choice becomes clear when viewing LNG through the lens of emissions intensity: natural gas produced in the United States has a much lower emissions intensity footprint than other global energy producers. Gazprom, Russia's state-owned oil company, says it released enough methane to trap the same amount of heat as 25.5 million tons of CO₂ last year.⁶¹ In fact, according to the World Bank, Russia contributed to 19.4 percent of global methane emissions in 2020.⁶² In contrast, the United States – and specifically, the prolific producing Permian Basin – is far ahead of Russia when it comes to limiting emissions and flaring intensity in oil and gas production. In 2020, Russia's

flaring intensity was 239 percent higher than the Permian Basin and 143 percent higher than the United States as a whole.⁶³

It's not just Russia. Pitting the United States and Texas against other global energy producers shows a pattern. Other members of OPEC, like Venezuela, can't stand up to Texas' low emissions profile. In 2020, Venezuela's flaring intensity was 1,467 percent higher than the United States and more than 2,000 percent higher than the Permian Basin.⁶⁴

Recent research has already shown that U.S. LNG is already a cleaner option than coal in China, India, and Germany.⁶⁵ In fact, on average, U.S. LNG produces about 50.5 percent less emissions when used for power generation in these countries.

On average, U.S. LNG produces about 50.5 percent less emissions when used for power generation in contrast to China, India, and Germany which use coal.

⁶⁰ <https://www.eia.gov/environment/emissions/carbon/index.php?&src=email>

⁶¹ <https://www.gazprom.com/f/posts/13/041777/gazprom-environmental-report-2020-en.pdf>

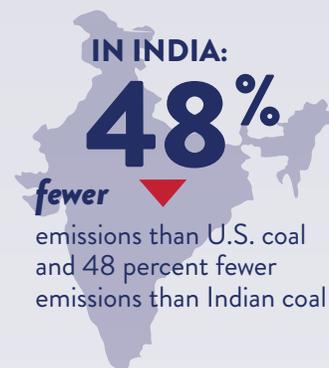
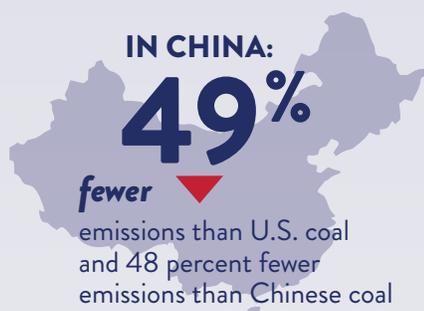
⁶² <https://www.iea.org/articles/methane-tracker-database>

⁶³ https://www.texansfornaturalgas.com/permian_basin_producers_charting_a_cleaner_energy_future

⁶⁴ *Ibid*

⁶⁵ <https://www.api.org/news-policy-and-issues/lng-exports/new-lifecycle-analysis-of-us-lng-exports>

PERCENTAGE DECREASE IN EMISSIONS FROM THE USE OF U.S. LNG VERSUS U.S. & DOMESTIC COAL



Source: American Petroleum Institute, 2020⁶⁶

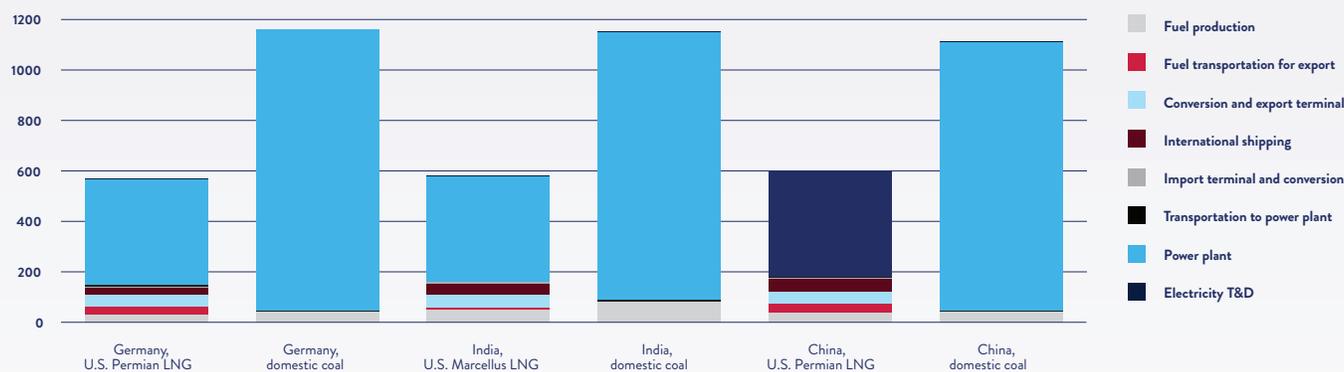
Importantly, that same report included direct comparisons of Permian natural gas with Chinese and German domestic coal, finding that the emissions from the Permian are significantly lower.

American energy producers have instituted extensive research and applied innovative technologies in order to more cleanly produce oil and natural gas. Technology

solutions like carbon capture and direct air capture aim to reduce CO₂ emissions associated with the production, transportation, and refining of oil and gas products. Along Houston's ship channel, several Texas oil and gas companies have joined together to propose a large-scale carbon capture and storage (CCS) project that would capture nearly 75 million tons of CO₂ per year by 2040.⁶⁸

NATURAL GAS AND COAL-FIRED LCA EMISSIONS

CO₂e kg/MWh delivered to consumer



SOURCES:

<https://www.iea.org/reports/world-energy-investment-2020/fuel-supply#abstract>

Source: American Petroleum Institute, 2020⁶⁷

⁶⁶ Ibid

⁶⁷ Ibid

⁶⁸ <https://www.houston.org/news/momentum-accelerates-houston-carbon-capture-hub>

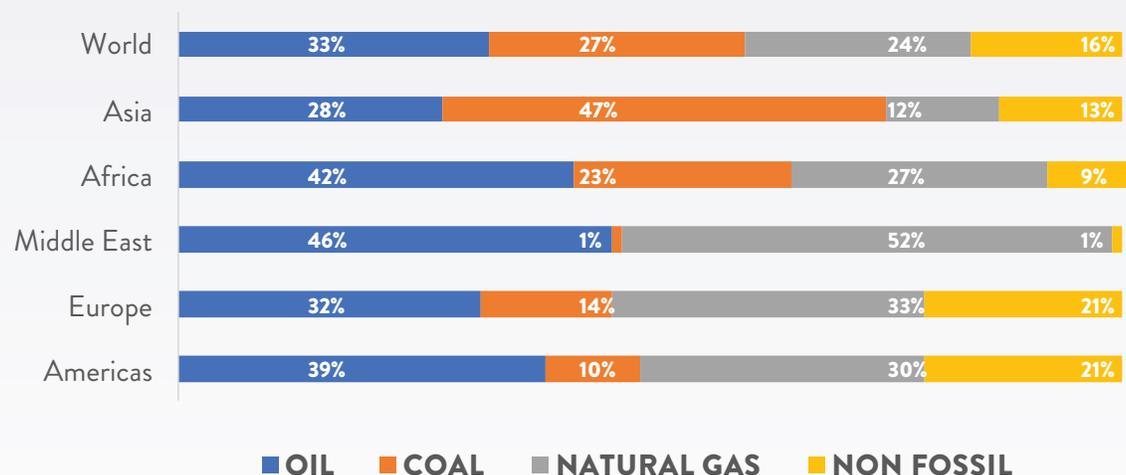


The Environmental Partnership, which includes over 90 U.S. oil and natural gas companies, created a flare management program which resulted in participating companies reporting a 50 percent reduction in flare volumes from 2019 to 2020.⁶⁹ American industry advancements like these ensure natural gas is as clean and reliable as possible.

What the data in this section makes clear is that it is not just that the world needs to embrace natural gas to lower emissions. More specifically, the world needs to embrace American, and Texan, natural gas – which is produced in a far more sustainable and responsible manner than natural gas produced by other world leaders.

ASIA DEPENDS ON COAL MORE THAN ANY OTHER REGION

Primary energy consumption, breakdown by fuel, % of total



Source: BP Statistical Review of World Energy, June 2020⁷⁰

⁶⁹ <https://theenvironmentalpartnership.org/what-were-doing/flare-management-program/>

⁷⁰ <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2020-full-report.pdf>

ASIA TURNS TO U.S. LNG

Many developing countries still rely on coal as their primary fuel source to power their homes and businesses and grow their economies. As these countries weigh the need for greater energy access within their borders against the necessity to limit the emissions from these increases, many are looking to natural gas to meet growing energy demand.

Asia, in particular, represents a key growth region for natural gas over the next decade, as the populations and economies of countries in the region are forecast to continue to grow. The region is also expected to see the most significant increase in natural gas demand, specifically due to commitments for cleaner air quality policies and climate agreements.



Not only will natural gas demand increase for electrical generation, but for industrial uses as well.

Natural gas promises significant emissions savings in this regard. Projections suggest, by embracing natural gas, hydrogen, and LNG for direct reduced iron (DRI) steel production, the world can achieve a **36% CO₂ emissions savings**.⁷¹

LNG imports by region



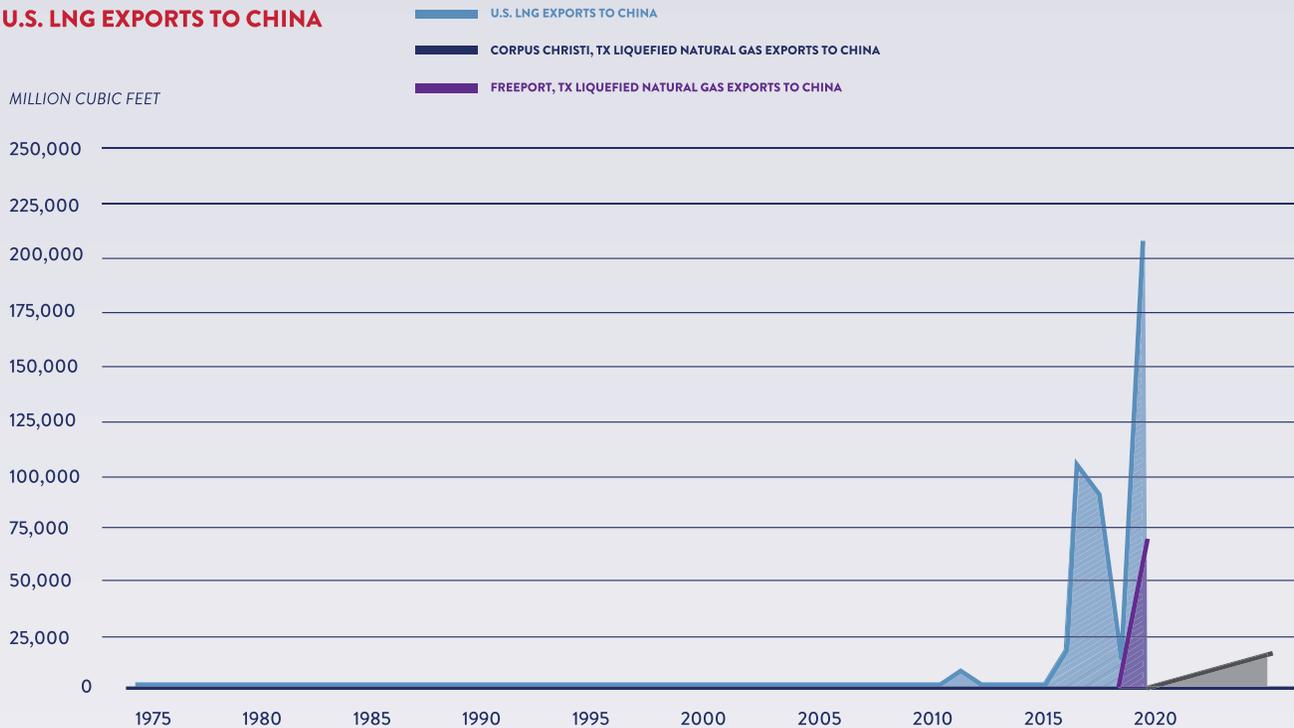
Source: Shell - LNG Outlook 2021



⁷¹ https://www.shell.com/promos/energy-and-innovation/download-the-shell-lng-outlook-2021/_jcr_content.stream/1614823770264/2b5b3fdaa9feba-85dad9b3408c200f26eadf85f/lng-outlook-2021-final-pack-updated.pdf

CASE STUDY: CHINA (ASIA TURNS TO U.S. LNG CONTINUED)

U.S. LNG EXPORTS TO CHINA



Source: U.S. Energy Information Administration (EIA)

With a population of 1.4 billion and a growing economy, China consumes more energy than any other country in the world. In 2020, China represented 24 percent of total global energy consumption⁷² and 29 percent of global electricity

consumption.⁷³ As a result, it is also the world's largest emitter of carbon dioxide,⁷⁴ with the International Energy Agency (IEA) estimating that the country's emissions will increase in 2021 to about 6 percent higher than 2019 levels.⁷⁵



⁷² <https://yearbook.enerdata.net/total-energy/world-consumption-statistics.html>

⁷³ <https://yearbook.enerdata.net/electricity/electricity-domestic-consumption-data.html>

⁷⁴ <https://www.statista.com/statistics/270499/CO2-emissions-in-selected-countries/>

⁷⁵ <https://www.iea.org/reports/global-energy-review-2021/CO2-emissions>

IEA credits coal with 70 percent of this increase, “predominantly due to greater coal use in the power sector,” which is the country’s dominant fuel source. Coal currently makes up about 60 percent of China’s electricity generation and roughly 78 percent of its carbon emissions.^{76,77}

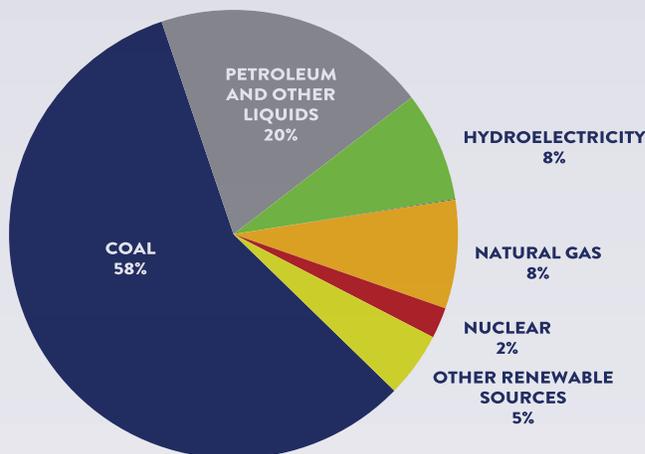
But pressure from world leaders to phase out unabated coal usage in order to reduce emissions has left the country reevaluating its future energy mix.⁷⁹ In April 2021, China and the United States released a “Joint Statement Addressing the Climate Crisis” in which the two countries committed to participating in national negotiations and implementing policies to reduce emissions.⁸⁰

In November 2021 as part of COP26 announcements, the countries again recommitted to “work individually, jointly, and with other countries during this decisive decade, in accordance with different national circumstances, to strengthen and accelerate climate action and cooperation aimed at closing the gap, including accelerating the green and low-carbon transition and climate technology innovation.”⁸¹

That low-carbon transition is a reflection of China’s increased interest in growing its natural gas consumption to replace coal in order to reduce emissions. As part of its 13th Five-Year Plan, the Chinese government announced it would cut annual coal consumption by 160 million metric tons by 2020 and raise the natural gas proportion of the country’s energy consumption to 10 percent by 2020 and 15 percent by 2030 – up from 7 percent in 2017.⁸² Increased reliance on natural gas, which emits about half the greenhouse gases of coal, will provide essential stability to the power grid as more renewables are integrated into the electricity system.

Because it cannot meet demand with its domestic natural gas supply, the Asian giant is increasingly turning to LNG imports. China overtook Japan as the world’s largest LNG importer in 2021, largely from increased demand in the power generation sector.⁸³

CHINA TOTAL PRIMARY ENERGY CONSUMPTION BY FUEL TYPE, 2019



Source: BP Statistical Review of World Energy 2020
 Note: Total may not equal 100% because of independent rounding. Includes only commercial fuel sources and does not account for biomass used outside of power generation.

Source: Energy Information Administration, 2020⁷⁸

China is looking to the United States to supply its growing natural gas demand. In October 2021, Chinese utility ENN signed a 13-year contract with U.S. LNG export company, Cheniere. With the deal, around 900,000 metric tons of LNG annually, largely supplied by Texas’ natural gas production, will begin being shipped to China in July 2022.^{84, 85} On the heels of this deal, Cheniere signed an agreement with one of China’s largest oil producing companies, Sinochem, in November 2021 to supply an additional 900,000 mt/year beginning in July that will grow to 1.8 million mt/year over the course of the 17.5-year contract.⁸⁶

Cheniere’s Enn and Sinochem contracts alone can provide nearly **13 billion kWh of energy annually** and nearly 19.5 billion kWh once the Sinochem contract increases. **In the United States that could power roughly 1.3 million to 1.9 million homes a year.**⁸⁷

⁷⁶ Rives, Karen, IEA study: China can peak emissions by mid-2020s to help meet global Paris goal. S&P Global, 2021.

⁷⁷ <https://www.forbes.com/sites/woodmackenzie/2021/09/22/the-future-of-chinas-gas-demand/?sh=120069d6765d>

⁷⁸ <https://www.eia.gov/international/analysis/country/CHN>

⁷⁹ <https://china.lbl.gov/china-energy-outlook-2020#:~:text=The%20new%202030%20goals%20are,generation%20from%20non%2Dfossil%20sources>

⁸⁰ <https://www.state.gov/u-s-china-joint-statement-addressing-the-climate-crisis/>

⁸¹ <https://www.state.gov/u-s-china-joint-glasgow-declaration-on-enhancing-climate-action-in-the-2020s/>

⁸² [https://www.uscc.gov/sites/default/files/Research/The%2013th%20Five-Year%20Plan_Financial_2.14.17_Updated%20\(002\).pdf](https://www.uscc.gov/sites/default/files/Research/The%2013th%20Five-Year%20Plan_Financial_2.14.17_Updated%20(002).pdf)

⁸³ <https://www.icis.com/explore/resources/news/2021/06/30/10658118/china-overtakes-japan-as-world-s-largest-lng-importer>

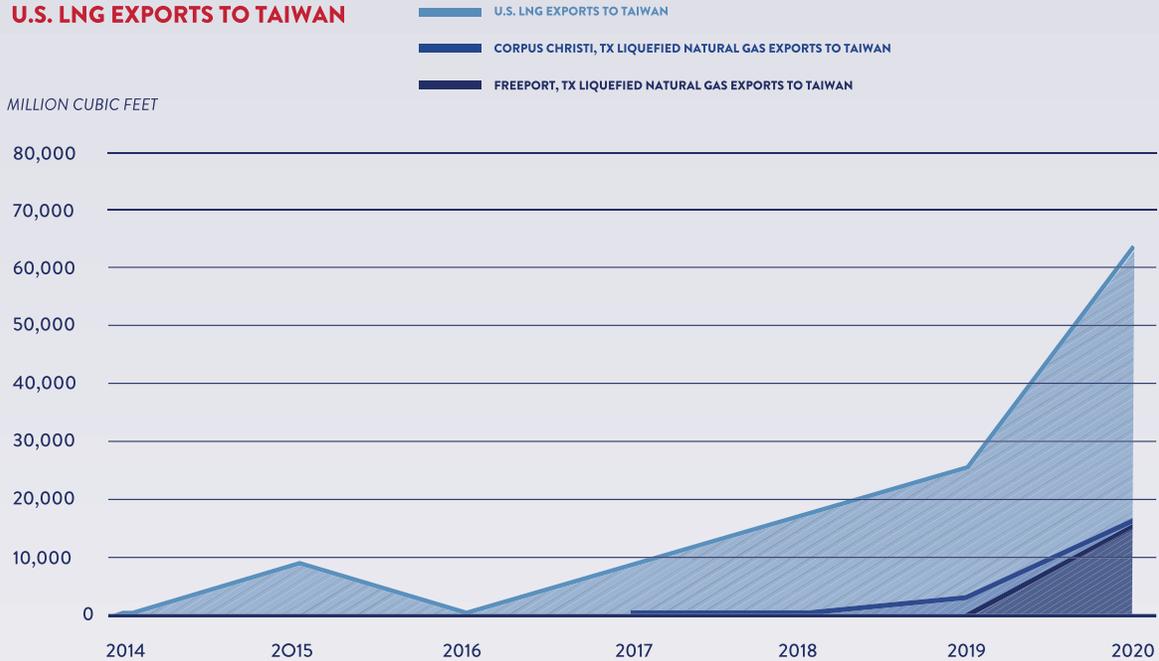
⁸⁴ <https://www.cheniere.com/where-we-work/cc-pipeline>

⁸⁵ <https://www.reuters.com/business/energy/chinas-enn-agrees-long-term-gas-deal-with-us-energy-firm-cheniere-2021-10-11/>

⁸⁶ <https://www.spglobal.com/platts/en/market-insights/latest-news/lng/110521-cheniere-to-supply-lng-to-sinochem-in-latest-term-us-offtake-deal-with-china>

⁸⁷ https://www.petroskills.com/blog/entry/00_totm/aug19-fac-a-primer-on-lng#.YZezRGDMI2w

U.S. LNG EXPORTS TO TAIWAN



Source: U.S. Energy Information Administration (EIA)

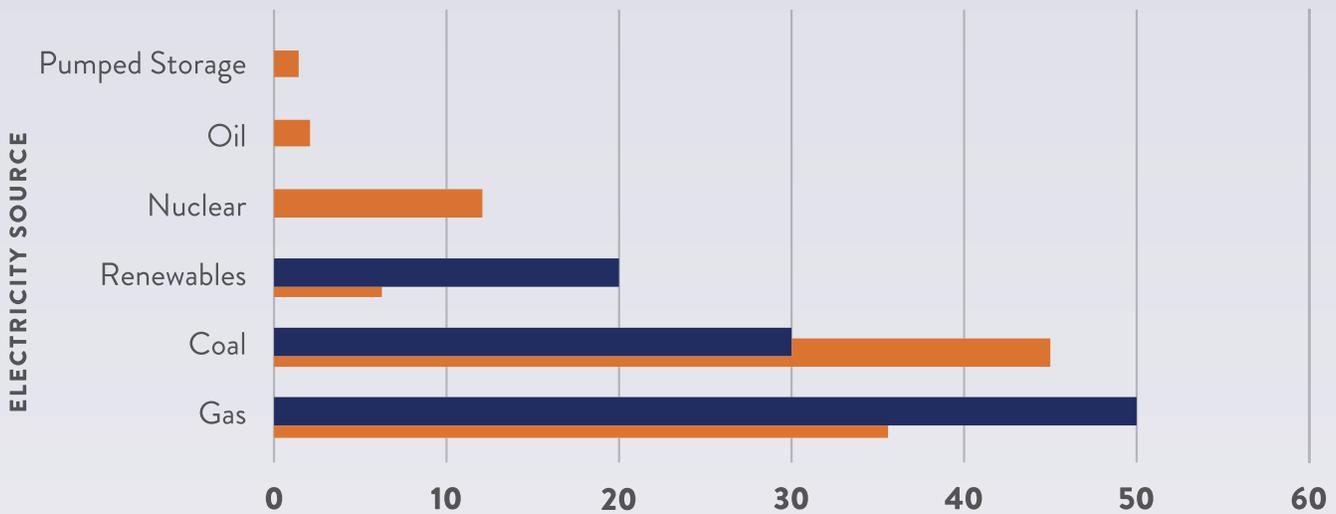
Like their neighbor China, coal is the primary fuel source in Taiwan, representing about 46 percent of electricity generation.⁸⁸ In 2016, Taiwan’s Democratic Progressive Party (DPP) proposed an energy mix of 50 percent natural gas, 30 percent

coal, and 20 percent renewables by 2025, and stipulated in the revised Electricity Act, passed by the country’s legislative body in January 2017, that nuclear energy use will cease by 2025.⁸⁹



⁸⁸ <https://eias.org/op-ed/taiwans-energy-security-liquefied-natural-gas-renewables-and-the-eu/>
⁸⁹ <https://www.powermag.com/taiwan-shuts-another-reactor-as-part-of-nuclear-free-goal/>

TAIWAN'S ELECTRICITY GENERATION 2020 VS 2025 (%)



■ 2025 PLAN ■ 2020 MIX

Source: <https://eias.org/op-ed/taiwans-energy-security-liquefied-natural-gas-renewables-and-the-eu/>

Since 2006, natural gas has been Taiwan’s second greatest electricity-generation source, and as of 2020, it makes up 33 percent of the island’s power-generation mix. Due to the island’s geography, Taiwan’s domestic natural gas production industry is minuscule relative to its demand for the resource, making the country reliant on other nations to maintain its supply of LNG. In 2020, nearly 70 percent of Taiwan’s total LNG imports of more than 18 million tons came from only three suppliers,

Qatar (28 percent), Australia (27 percent), and Russia (14 percent).⁹⁰

In January 2021, Taiwan began receiving its first shipments of LNG from Cheniere’s Corpus Christi facility as part of a 25-year contract that will deliver about 30 shipments,⁹¹ totaling 2 million tons of LNG – that includes Texas natural gas – to the country annually.⁹²

CHENIERE’S CONTRACT WITH TAIWAN EQUATES TO ROUGHLY 14.4 BILLION KWH OF ENERGY OR *enough to power about 1.4 million* U.S. HOMES A YEAR.⁹³

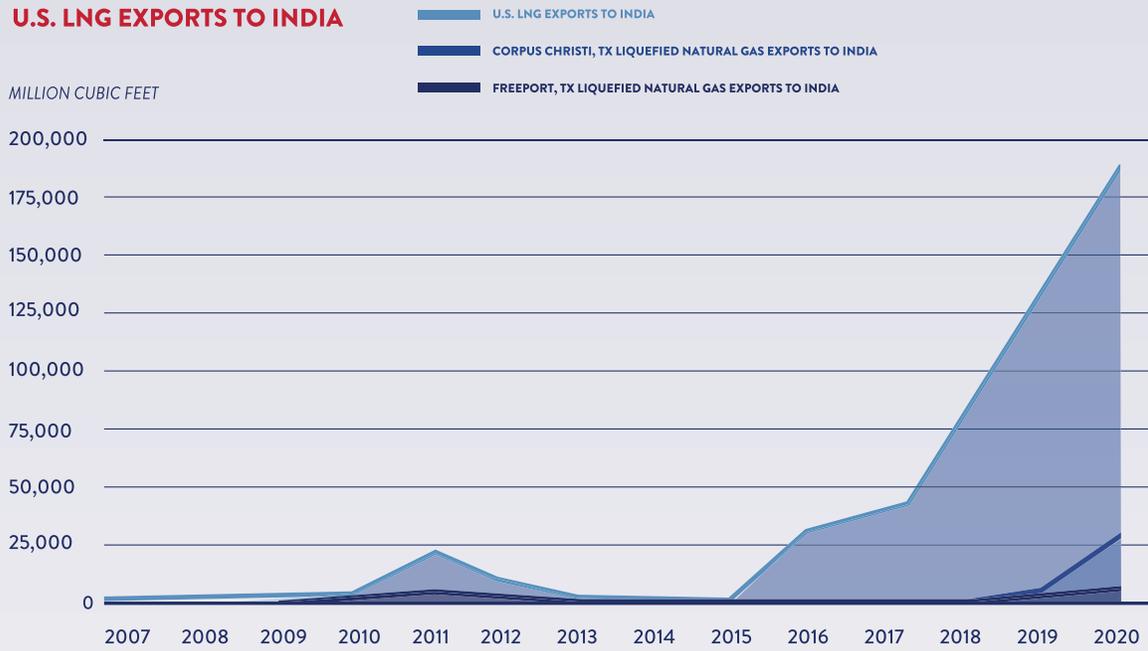
⁹⁰ <https://www.nationalreview.com/2021/06/energy-and-foreign-policy-a-double-victory-for-lng/>

⁹¹ <https://www.reuters.com/article/taiwan-lng/taiwan-starts-receiving-lng-from-cheniere-to-get-30-shipments-annually-idUSL1N2JL02N>

⁹² <http://gasprocessingnews.com/news/taiwan-agrees-preliminary-lng-purchase-deal-with-us-producer.aspx>

⁹³ https://www.petroskills.com/blog/entry/00_totm/aug19-fac-a-primer-on-lng#.YZezRGDMI2w

U.S. LNG EXPORTS TO INDIA

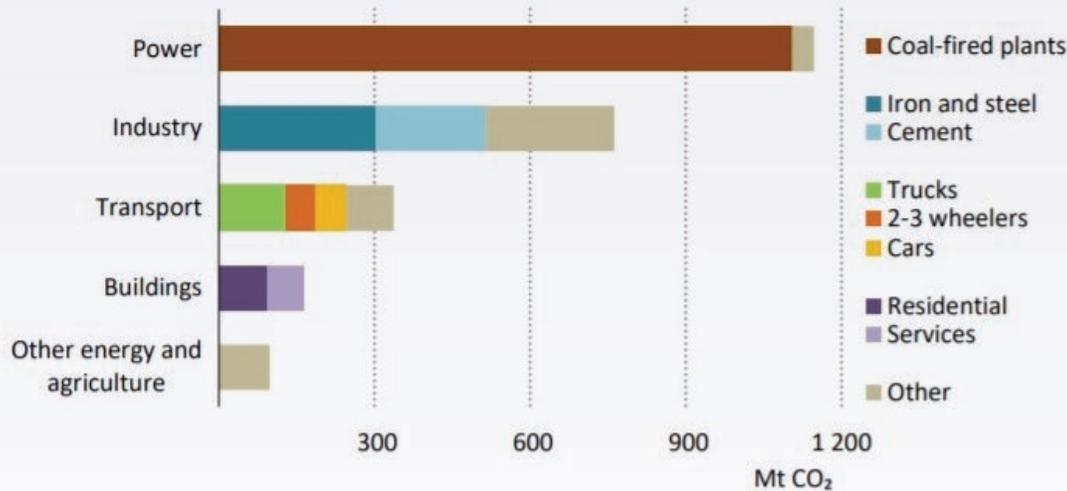


Source: U.S. Energy Information Administration (EIA)

India is the world’s third largest energy consuming country, thanks to its massive population, rising incomes, and improving standards of living. Expanding urbanization and industrialization, along with a growing population and economy, mean that India sees the largest increase in energy demand of any country

through 2024, according to IEA.⁹⁴ Just between 2010 and 2019, India’s electricity demand increased by two-thirds.⁹⁵ Today, India’s primary fuel source for power generation is coal – which has not only presented serious air quality issues, but also stands as a barrier to India’s emissions reductions goals.

Figure 1.23 ▶ CO₂ emissions from the Indian energy sector, 2019



India’s power sector is the largest contributor to its CO₂ emissions, and coal-fired power plants are responsible for the great majority of power sector emissions.

Note: Other includes other energy sector and agriculture

Source: International Energy Agency, 2021⁹⁶

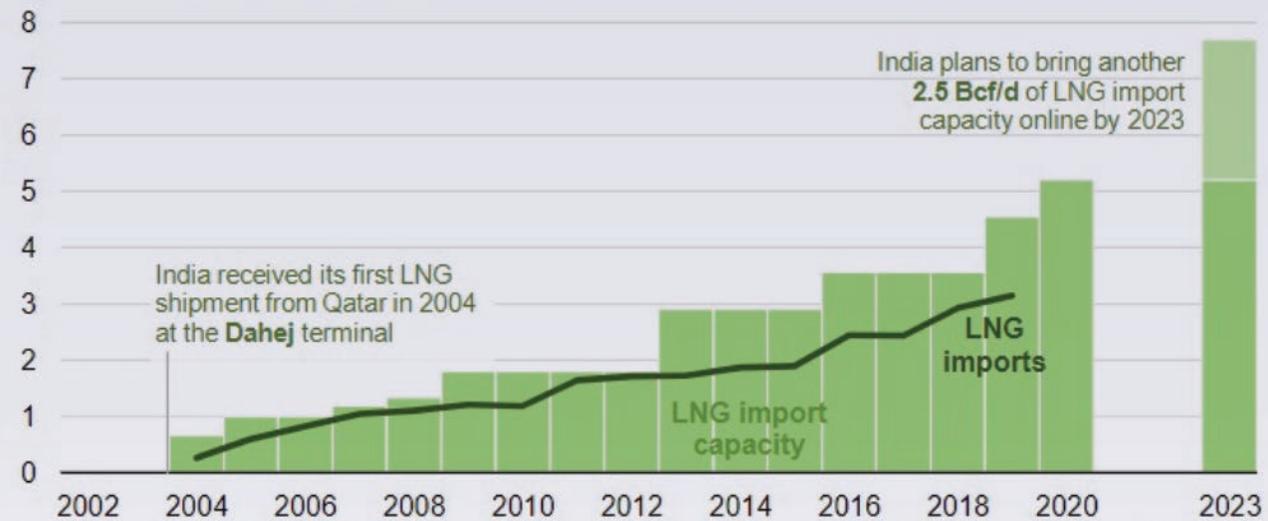
⁹⁴ <https://www.iea.org/reports/india-energy-outlook-2021>

⁹⁵ <https://www.eia.gov/todayinenergy/detail.php?id=43655>

⁹⁶ https://iea.blob.core.windows.net/assets/1de6d91e-e23f-4e02-b1fb-51fdd6283b22/India_Energy_Outlook_2021.pdf

India liquefied natural gas (LNG) imports and import capacity (2004-2023)

billion cubic feet per day (Bcf/d)



Source: U.S. Energy Information Administration, International Group of Liquefied Natural Gas Importers (GIIGNL) annual LNG trade reports and trade press

Source: Energy Information Administration, 2020¹⁰⁰

India has pledged to reduce the emissions intensity of its economy by 45 percent by 2030 and to meet net zero greenhouse gas emissions by 2070.⁹⁷ India's leaders have made clear that in order to meet their ambitious emissions goals, the country will need to transition away from coal and embrace natural gas.

During CERAWeek in 2021, Indian Prime Minister Narendra Modi shared his goal of growing the share of natural gas in India's fuel mix to 15 percent by 2030.⁹⁸ Today, the share of natural gas in India's current energy mix is among the lowest in the world.⁹⁹ However, by building out the country's natural gas infrastructure, India can address multiple

needs in its energy system, including efforts to help improve air quality and near-term emissions goals. Most of the natural gas needed to meet India's increased energy appetite will come from LNG imports. India has been the world's fourth largest importer of LNG since 2011, gradually increasing LNG imports as the country's domestic natural gas production declined and domestic consumption increased. In June 2021, India received a record nine shipments in one month of U.S. LNG – up from a previous record of seven in November 2020.¹⁰¹ Moreover, in the past 10 years, India's LNG import capacity has more than doubled, and it is expected to increase by a third in the next three years.¹⁰²

THE U.S. EXPORTED MORE THAN 26 MILLION TONS OF LNG TO INDIA IN 2020,^{103,104} WHICH EQUATES TO ROUGHLY **188 BILLION KWH OF ENERGY** or enough to power 18.3 million U.S. homes annually.¹⁰⁵

⁹⁷ <https://www.bbc.com/news/world-asia-india-58922398>

⁹⁸ <https://www.spglobal.com/platts/en/market-insights/latest-news/natural-gas/030521-ceraweek-indias-modi-talks-up-role-of-natural-gas-in-global-energy-transition>

⁹⁹ <https://www.iea.org/reports/india-energy-outlook-2021>

¹⁰⁰ <https://www.eia.gov/todayinenergy/detail.php?id=43655>

¹⁰¹ <https://www.naturalgasintel.com/u-s-lng-cargoes-delivered-in-june-to-india-hit-record-the-offtake/>

¹⁰² <https://www.eia.gov/todayinenergy/detail.php?id=43655>

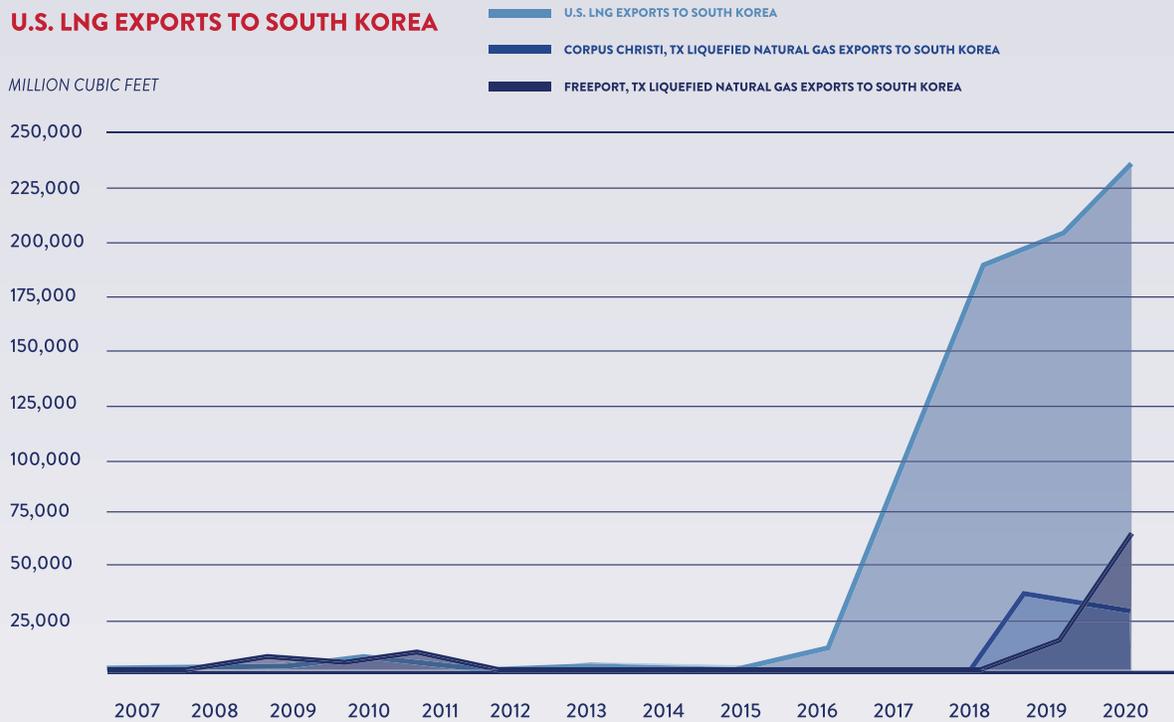
¹⁰³ https://www.eia.gov/dnav/lng/move_poe2_dcu_NUS-NIN_a.htm

¹⁰⁴ EIA's data was converted to tons using: <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2021-approximate-conversion-factors.pdf>

¹⁰⁵ https://www.petroskills.com/blog/entry/00_totm/aug19-fac-a-primer-on-lng#.YZezRGDMI2w

U.S. LNG EXPORTS TO SOUTH KOREA

MILLION CUBIC FEET



Source: U.S. Energy Information Administration (EIA)

Because South Korea lacks sufficient domestic energy supplies, the country relies on imported energy commodity sources to meet approximately 95 percent of its fossil fuel energy requirements, thereby sustaining its status as one of the world’s largest importers of energy.¹⁰⁶ In 2019, South Korea was the fourth largest global coal importer, following China, India, and Japan. With no international oil or natural gas pipelines, South Korea relies exclusively on tanker shipments of LNG and crude oil. The country is one of the largest importers of U.S. LNG.¹⁰⁷

In October 2021, South Korean President Moon Jae-In committed the country to achieving carbon neutrality by 2050. While the country’s two

roadmaps to achieve this include both reduced coal and LNG imports, the plans include measures to replace coal-fired facilities with natural gas and incorporate hydrogen into the energy mix, as well as implementing carbon capture technologies on all its power generation facilities to eliminate emissions.¹⁰⁸

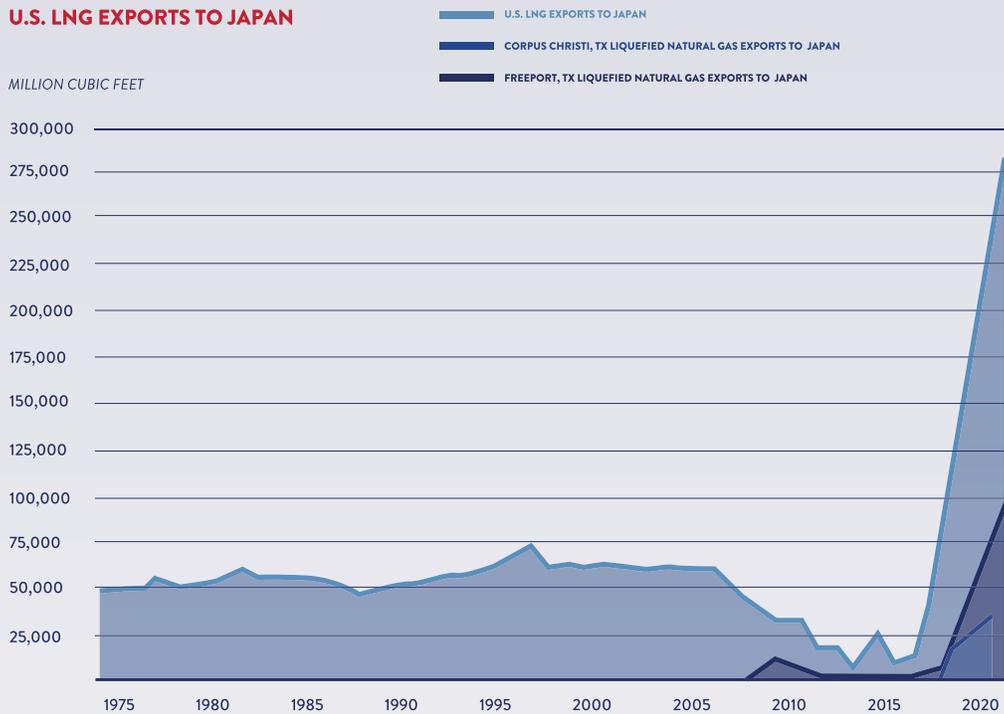
One of South Korea’s key methods for decreasing air pollution is the conversion of aging coal plants. Approximately 30 coal plants have been selected to either transition into natural gas-fired energy plants or shut down completely by 2034. This process will increase the capacity of LNG-based power plants in South Korea to 43 percent, while reducing coal-fired power plants and nuclear reactors under its long-term energy transition blueprint.¹⁰⁹

THE U.S. EXPORTED 66.5 MILLION TONS OF LNG TO SOUTH KOREA IN 2020,^{110,111} WHICH EQUATES TO ROUGHLY **479 BILLION KWH OF ENERGY** or enough to power 47 million U.S. homes annually.¹¹²

¹⁰⁶ <https://www.naturalgasworld.com/south-korea-plans-to-eliminate-lng-use-by-2050-gas-in-transition-90862?#signin>
¹⁰⁷ <https://www.trade.gov/market-intelligence/korea-energy-market-lng>
¹⁰⁸ <https://www.spglobal.com/platts/en/market-insights/latest-news/energy-transition/101921-south-korea-finalizes-2050-carbon-neutrality-roadmaps>
¹⁰⁹ <https://www.spglobal.com/platts/en/market-insights/latest-news/electric-power/042721-s-koreas-lng-demand-forecast-to-rise-15-through-2034-ministry>
¹¹⁰ https://www.eia.gov/dnav/ng/ng_move_poe2_dcu_NUS-NKS_a.htm
¹¹¹ EIA’s data was converted to tons using: <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2021-approximate-conversion-factors.pdf>
¹¹² https://www.petroskills.com/blog/entry/00_totm/aug19-fac-a-primer-on-lng#.YZezRGDMl2w

CASE STUDY: JAPAN (ASIA TURNS TO U.S. LNG CONTINUED)

U.S. LNG EXPORTS TO JAPAN



Source: U.S. Energy Information Administration (EIA)

Coal is the second-largest primary energy source in Japan after oil. Japan abolished domestic coal exploration and production in 2001 and imported 185 metric tons of hard coal in 2019, making it the world's third largest importer of the fossil fuel.¹¹³

In October 2020, Japan's new Prime Minister, Yoshihide Suga, declared that the country will aim to reduce GHG emissions to net-zero by 2050 in order to realize a carbon-neutral, decarbonized society. As part of that plan, the government is aiming to reduce Japan's coal-fired power generation significantly and turn to natural gas and renewable energy instead.

In 2017, Japan's Ministry of Economy, Trade and Industry announced a plan to finance new LNG infrastructure projects in Asia with a value of up to

USD 10 billion over a period of five years and to train 500 skilled workers and government officials.¹¹⁴ The reform also has three main objectives regarding Japan's electricity market: enhance security of supply, decrease prices, and expand consumer choice and business opportunities.

Japan is one of the largest LNG buyers in the world, importing approximately 77 million tons (or approximately 22 percent of the global LNG market) in 2019.¹¹⁵ As LNG volumes from legacy exporters like Malaysia and Indonesia are becoming more constrained, Japan has tried to diversify its contracts and investments into other LNG ventures. It was reported in April 2021 that Japan's imports of U.S. LNG now rival those of its imports from Qatar, and U.S. imports are expected to increase even more in coming years.¹¹⁶

THE U.S. EXPORTED 60.5 MILLION TONS OF LNG TO JAPAN IN 2020,^{117, 118} WHICH EQUATES TO ROUGHLY **463 BILLION KWH OF ENERGY**¹¹⁹ or enough to power nearly 45 million U.S. homes annually.

¹¹³ https://iea.blob.core.windows.net/assets/3470b395-cfdd-44a9-9184-0537cf069c3d/Japan2021_EnergyPolicyReview.pdf

¹¹⁴ <https://www.reuters.com/article/us-lng-japan-met/japan-to-offer-10-billion-to-back-asia-lng-infrastructure-push-idUSKBN1C01M>

¹¹⁵ https://www.eia.gov/international/content/analysis/countries_long/Japan/japan.pdf

¹¹⁶ <https://www.reuters.com/article/us-lng-asia-us-exports/u-s-lng-export-bonanza-reshapes-energy-map-in-asia-idUSKBN2BP0MJ>

¹¹⁷ https://www.eia.gov/dnav/ng/ng_move_poe2_dcu_NUS-NKS_a.htm

¹¹⁸ EIA's data was converted to tons using: <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2021-approximate-conversion-factors.pdf>

¹¹⁹ https://www.petroskills.com/blog/entry/00_totm/aug19-fac-a-primer-on-lng#.YZezRGDM12w



NATURAL GAS WILL SUPPORT
the Growth
OF RENEWABLE ENERGY

NATURAL GAS WILL SUPPORT THE GROWTH OF RENEWABLE ENERGY PRODUCTION

NATURAL GAS IS THE FOUNDATION OF RENEWABLES

- When renewable energy can't meet demand, natural gas can ramp up quickly for electricity generation.
- U.S. natural gas has a significant cost advantage on the global market, with wholesale natural gas standing at about one-third of the price of other industrial countries.
- Lower natural gas prices help make renewables more affordable for consumers by lowering the overall cost of electricity.

Source: Interstate Natural Gas Association of America

Countries across the world are committing to rapidly adding significant renewable energy sources for power generation. While some have used those efforts to call for an end to fossil fuels, that's far from a realistic outcome. In fact, natural gas will be a key component in ensuring energy security and grid reliability for years to come. The reason for that is simple: natural gas is clean, abundant, and affordable. Perhaps more importantly, natural gas-fired electricity can be ramped up or down quickly, making it highly compatible with renewable resources.

While battery technology continues to improve, it is not yet available for widescale, long-duration storage to mitigate the intermittent nature of renewables like wind and solar. Available capacity for these resources is often dependent on environmental factors, like time of day and weather-related phenomena that can impact grid reliability, particularly during unanticipated spikes in demand.¹²⁰

According to the U.S. Energy Information Agency's (EIA) 2021 International Energy Outlook, global energy generation is primed to grow rapidly through 2050, with renewables driving the majority of growth. As energy generation shifts, nations will be forced to balance prioritizing clean energy with affordability and reliability. This is where natural gas can complement

and supplement intermittent renewables. In fact, by 2040, gas and renewables together will constitute 74 percent of total world energy growth.¹²¹

*"Lower relative prices of natural gas in the near term as well as the need to provide back-up supply to intermittent renewables are important drivers in natural gas consumption."*¹²²

Further, affordable natural gas coupled with renewables helps keep electricity costs lower for consumers. The Department of Energy estimates that increased supplies of natural gas in the United States have helped lower energy costs, including electricity, for consumers nearly \$160 billion annually.¹²³ As the Foundation for Renewable Energy and Environment explains, "Low natural gas price benefits renewables by reducing the overall leveled costs of energy, thus deepening further complementarity opportunities between utility-scale PV (photovoltaics) and natural gas."¹²⁴

"Now is the time to pursue what is promising, but not forsake what is working."

We should make sure to embrace natural gas and renewables as highly complementary, and celebrate these two necessary energy solutions that will help us meet the goals of cutting emissions while ensuring reliable and affordable electric power for American consumers.¹²⁵

- Richard D. Kauzlarich, former U.S. ambassador and co-director of the Center for Energy Science and Policy at George Mason University

Government agencies, like the U.S. Department of Energy's Office of Fossil Energy and Carbon Management, view natural gas as a key step toward our long-term sustainability goals.

¹²⁰ https://www.texasfornaturalgas.com/in_from_the_cold_an_analysis_of_natural_gas_supply_and_demand_in_feb_2021

¹²¹ https://www.shell.com/promos/energy-and-innovation/the-shell-lng-outlook-2021-fact-sheet/_jcr_content.stream/1614240279889/ffe7cb8de36ba5b29a7b95f89cd5e1f9534a2944/nsr-r-fact-sheel-2021.pdf

¹²² https://www.eia.gov/outlooks/ieo/pdf/IEO2021_Narrative.pdf Pg. 5

¹²³ <https://www.energy.gov/sites/default/files/2020/10/f79/Natural%20Gas%20Benefits%20Report.pdf>

¹²⁴ <https://www.ingaa.org/File.aspx?id=38583>

¹²⁵ <https://www.powermag.com/blog/natural-gas-and-renewables-as-natural-partners-especially-in-challenging-times/>

Natural gas is not only used as a reliable back-up fuel for renewables, but it also has a critical role to play in the daily operations of renewable facilities. In the United States, for instance, solar thermal facilities often have hybrid systems that use fuels like natural gas to supplement and also to start up daily operations. An example of this is California's Ivanpah Solar Power Facility, which has two natural gas steam boilers that are used both on cloudy days when solar output is not sufficient to meet demand and in the morning start-up procedure to get the plant running for the day.¹²⁸

The European Union is using similar technology, making a case for the continued need for natural gas imports, including U.S. LNG, even as members transition to more renewable-based power generation.¹²⁹ And a 2021 German Aerospace Center report explains that these types of hybrid facilities are "doubly protected against longer periods of darkness – if the thermal storage system is depleted, the steam process of the power plant can also be powered with other renewable or fossil fuels instead of solar heat."¹³⁰

“Natural gas will continue to help decrease carbon dioxide emissions from electricity production while providing secure, on-demand power needed for wind and solar energy to scale up.”

NATURAL GAS FACILITATES DECARBONIZED HYDROGEN

Natural gas is key to the growth and development of low-carbon technologies like hydrogen, which has the capability to dramatically decarbonize hard-to-abate sectors like transportation, industry, and power generation. Through a process called steam methane reforming (SMR), steam is combined with methane to produce hydrogen.¹³² When carbon capture and storage technology is paired with this process, that hydrogen becomes a low-carbon energy carrier that can power long-haul trucks, produce the heat necessary for steelmaking and cement production, and provide reliable, zero-carbon back-up power for data centers and hospitals.¹³³ Further, certain amounts of hydrogen can be blended with natural gas and used in existing pipelines to decarbonize the energy people use to heat their homes and cook meals.¹³⁴



¹²⁶ <https://www.energy.gov/sites/default/files/2020/10/f79/Natural%20Gas%20Benefits%20Report.pdf> Pg. 4

¹²⁷ <https://www.eia.gov/energyexplained/solar/solar-thermal-power-plants.php>

¹²⁸ <https://www.energy.ca.gov/powerplant/solar-thermal/ivanpah-solar-energy-generating>

¹²⁹ <https://cordis.europa.eu/article/id/170121-a-peek-into-tomorrows-solar-hybrid-technology>

¹³⁰ https://www.solarpaces.org/wp-content/uploads/Study_Solar_thermal_power_plants_DLR_2021-05.pdf

¹³¹ Ibid

¹³² <https://www.energy.gov/eere/fuelcells/hydrogen-production-natural-gas-reforming>

¹³³ <https://www.rff.org/publications/reports/decarbonizing-hydrogen-us-power-and-industrial-sectors/>

¹³⁴ <https://www.energy.gov/eere/fuelcells/hyblend-opportunities-hydrogen-blending-natural-gas-pipelines>



CONCLUSION: TEXAS LNG IS VITAL TO OUR FUTURE

World energy consumption is set to increase a staggering 50 percent between 2020 and 2050. And under almost every recent future scenario depicting the world's energy mix, natural gas remains a foundational fuel.

It's no surprise why natural gas – liquefied natural gas in particular – will be a building block for our sustainable energy future. Liquefied natural gas is easy to transport, affordable, and extremely reliable. By facilitating the transition away from coal for power generation and embracing U.S. LNG, research has shown that some countries could reduce their CO₂ emissions by more than 50 percent. Clean-burning natural gas is built into the long-term sustainability plans of some of the world's largest and fastest growing countries, including China and India. Moreover, natural gas will enable renewable energy to grow and thrive, supporting it by providing a reliable fuel source that ensures homes and businesses have power when the intermittent nature of renewable energy simply can't meet demand.

A brighter energy future for our world doesn't just include natural gas – it needs natural gas. More specifically, it needs Texas natural gas. Texas is uniquely capable of ramping production of oil and natural gas in a sustainable and safe manner. When comparing Texas natural gas production to other major producers like Algeria, Venezuela, or Russia, it's clear that Texas producers stand head-and-shoulders above global competition when looking at emissions intensity. The innovation of Texas oil and gas companies continues to minimize the environmental impact of energy production. By embracing carbon capture and developing and instituting industry-leading safety and sustainability practices, Texas operators are capable of delivering the most responsibly produced natural gas on the world market.

Texas is keen to defend its title as “Energy Capital of The World.” The world's leading oil and gas companies call Texas – and its shale basins – home. The extensive energy infrastructure of Texas can safely and quickly transport natural gas from its shale basins to the Gulf Coast and its LNG facilities. The numerous and growing LNG export terminals dotting the Lone Star State's waters are ready to handle immense volumes of natural gas. The Texas oil and gas industry has invested heavily to prepare itself to deliver LNG to the world, and it will continue to do so.

The reality is the world needs liquefied natural gas to meet growing energy demand and its climate goals – and Texas is poised to deliver.