

U.S. LNG: A Brief Introduction

Natural gas—one of the world’s most useful substances—is burned to heat homes and run highly-efficient electrical powerplants. It is used as a feedstock in the manufacture of chemicals and fertilizers. And, it can also replace diesel and bunker fuel to power trucks, locomotives, and even the largest seagoing vessels.

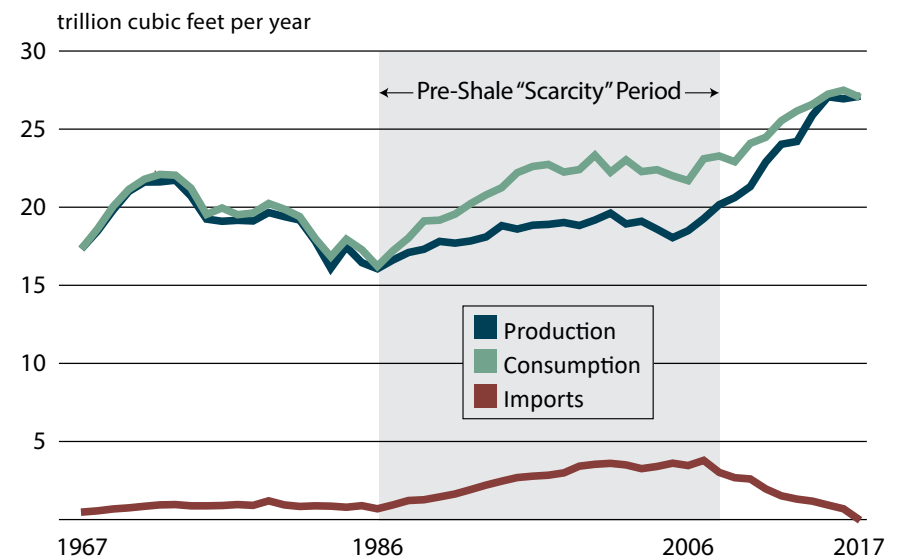
Because of its clean-burning nature and tremendous versatility, U.S. natural gas use has grown over the past 50 years. (Fig. 1) From the mid-1960s to the mid-1980s U.S. gas production and consumption were closely aligned. However, for the two decades beginning in 1986, demand increased faster than supply. As a result, substantial volumes of pipeline gas were imported from Canada and 11 terminals were built to import liquefied natural gas (LNG) from countries such as Nigeria and Trinidad.

This was all before the shale energy revolution.

Starting in the mid-2000s, American hydrocarbon entrepreneurs began to combine two techniques—horizontal drilling and hydraulic fracturing—to extract oil and gas from shale formations. (Fig. 2) Since then, shale gas production has grown from a rarity to about 60 percent of U.S. production. As a result, the United States now has more than enough gas to meet domestic consumption indefinitely. (Fig. 3)

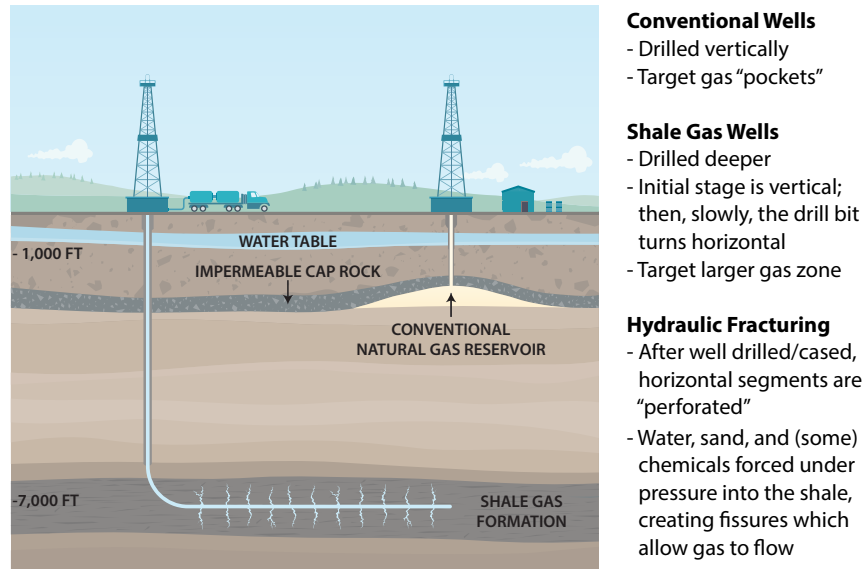
As U.S. gas production grew, there was little need to import higher-priced LNG and most of the U.S. LNG import terminals were idled in the late 2000s. (The Northeastern states were and remain an exception.) Subsequently, the owners of the LNG import terminals began to contemplate adding export capabilities. In July 2010, Cheniere Energy filed an application with the federal government to add liquefaction capabilities its Sabine Pass facility. Other import terminal owners soon followed suit.

Fig. 1 - U.S. Natural Gas Production, Consumption, Imports



Source: EIA Annual Energy Outlook - 2018

Fig. 2 - Shale Gas Versus Conventional Extraction



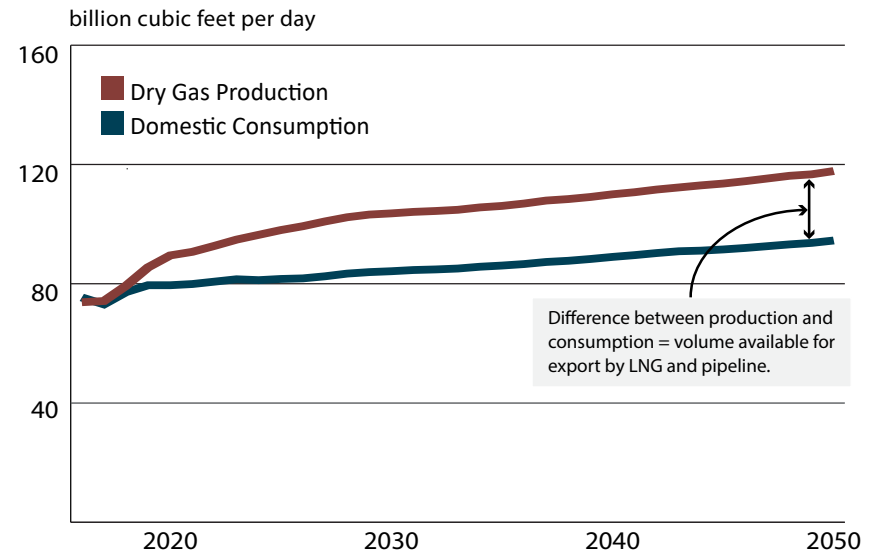
Source: LNG Allies

U.S. government approval is necessary because the Natural Gas Act requires Federal Energy Regulatory Commission (FERC) authorization to construct an LNG export facility (or U.S. Maritime Administration in the case of a floating offshore facility) and an authorization from the U.S. Department of Energy (DOE) to export the gas itself.

Under the law, LNG exports are presumed to be “in the public interest,” unless DOE finds otherwise. For nations that have a free trade agreement (FTA) with the United States that includes the “national treatment of natural gas,” such exports are automatically deemed to be in the public interest and must be approved “without modification or delay.” For nations without FTAs, DOE conducts a “public interest” review (in which “interested parties” can intervene).

To support its public interest reviews, DOE commissioned four macroeconomic studies on LNG exports between Jan. 2012 and Oct. 2015. All four studies found that: (1) the macroeconomic benefits of LNG exports are “net positive” for the United States; (2) nearly

Fig. 3 - EIA Gas Production / Consumption Estimates



Source: EIA Annual Energy Outlook - 2018 (Reference Case)

all of the gas to be exported will come from additional production (rather than domestic demand reduction); and (3) the price effects of LNG exports are minor.

Currently, DOE has issued full (FTA + non-FTA) long-term export authorizations to the 10 major U.S. LNG projects which have received a FERC or MARAD license.

Long-term DOE authorizations are granted for a 20-year period that commences on the earlier of the date of first export or within seven years from the date of the issuance of the authorization. Under these authorizations, the only nations that cannot receive U.S. LNG are those on the applicable sanctions lists kept by the Office of Foreign Assets Control of the U.S. Department of the Treasury.

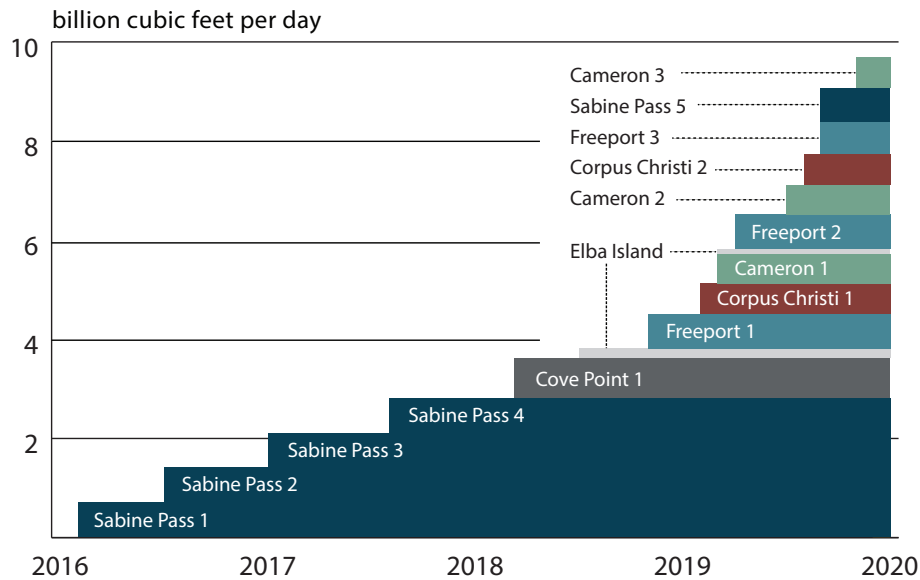
Although U.S. LNG exports from the contiguous 48 states only began in Feb. 2016, the International Energy Agency now predicts that the United States will become the world’s leading LNG exporter by 2025.

Currently, there are six LNG export projects under construction in the United States (four large terminals on the Gulf of Mexico and two smaller facilities on the East Coast), representing ≈ 71 million metric tons per annum (mtpa) of capacity which requires ≈ 10 billion cubic feet per day (bcf/d) of feedgas.

LNG from the first of these projects—Cheniere Energy’s Sabine Pass liquefaction and export terminal in Louisiana—began shipping in Feb. 2016 and has increased in steps as the project’s first four trains entered service over the past 18 months.

The first shipment from the second U.S. export facility—Dominion Energy’s Cove Point project in Maryland—is expected in Q1 2018. The four other terminals under construction should all commence operations between mid-2018 and early 2020, with the greatest capacity increase expected to occur in 2019. (Fig. 4)

Fig. 4 - U.S. Liquefaction Capacity Growth thru 2020



Source: EIA (“Based on FERC, IHS, and Trade Press”)

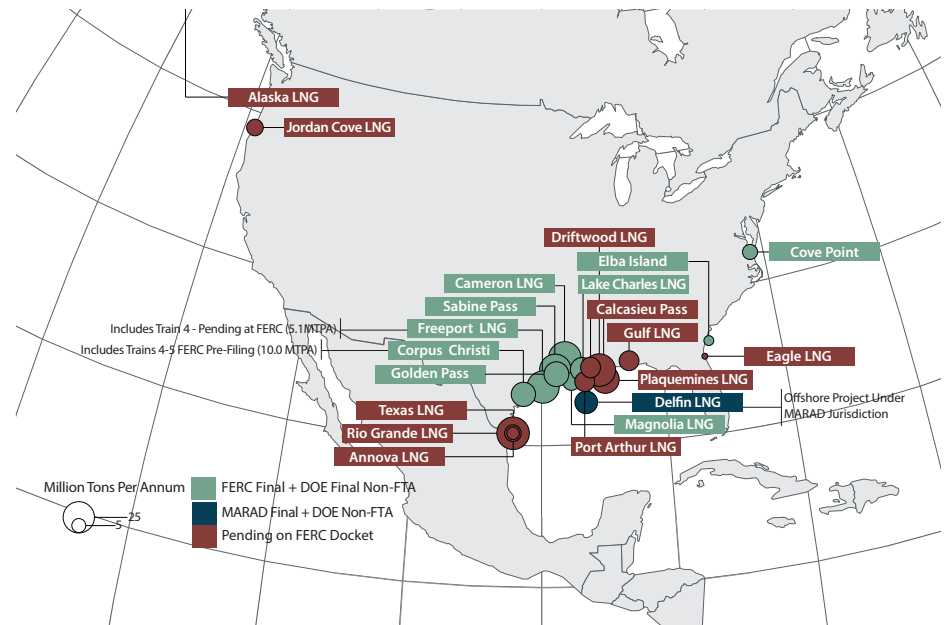
In addition to the six projects being built, four more have been fully permitted (but have not yet taken a “final investment decision”), another 11 projects are under formal environmental review at FERC, and three have received approval to enter the mandatory FERC pre-filing process. (Fig. 5, the pre-filing projects not displayed.)

At this juncture, it is difficult to predict how much additional U.S. liquefaction capacity will be built. (This will depend upon the growth of LNG demand worldwide, the availability of project financing, and many other factors.)

However, the EIA’s Annual Energy Outlook 2018 (AEO-2018) estimates that U.S. LNG exports could reach 14.5 bcf/d by 2029 in the “Reference Case” and 22.7 bcf/d in the “High Oil & Gas Resource and Technology Case.” (Fig. 7)

The IEA’s World Energy Outlook 2017 (Nov. 14, 2017) sees global LNG demand

Fig. 5 - Existing and Planned U.S. LNG Export Projects



Source: LNG Allies

growing to 71 bcf/d by 2040 and U.S. LNG exports reaching 15 bcf/d by then. (IEA predicts that the U.S. will be the world's leading LNG exporting nation by 2025.)

Corporate forecasts fall into a similar range. The 2017 Energy Outlook by BP, for example, finds global LNG demand doubling over the next two decades and predicts that U.S. LNG exports could reach 19 Bcf/d by 2035.

Fortunately, the U.S. has sufficient gas to meet domestic needs and support high levels of LNG exports without exhausting supplies or raising prices unduly for consumers.

With regard to supply, the Potential Gas Committee (PGC)—a group of 80 natural gas experts from industry, academia, and government—has been conducting biennial U.S. natural gas surveys since 1964.

The latest PGC assessment (July 17, 2017) found that the future supply of U.S. natural gas at year-end 2016 stood at 3,141 trillion cubic feet, an increase of 10% from year-end 2014 and a doubling since 2006. (Fig. 8) This is enough gas to meet U.S. domestic requirements and support robust exports for eight decades or more.

Fig. 6 - U.S. LNG Export Projects Under Development

Project Stage	Projects	MTPA	Bcm/yr	Bcf/day
Operating / Under Construction	6	70.9	97.7	10.0
Fully Permitted (Major Projects)	4	68.9	95.0	9.7
Fully Permitted (Small Projects)	N/A	9.0	12.4	1.3
Formal FERC Review	11	146.9	202.6	20.9
FERC Pre-Filing	2	24.0	33.1	3.3
Total	23	310.7	428.5	44.0

Notes: (1) Projects = individual projects. (2) Additional trains for existing projects not included in the project count, but in the MTPA, Bcm/year, and Bcf/day totals.

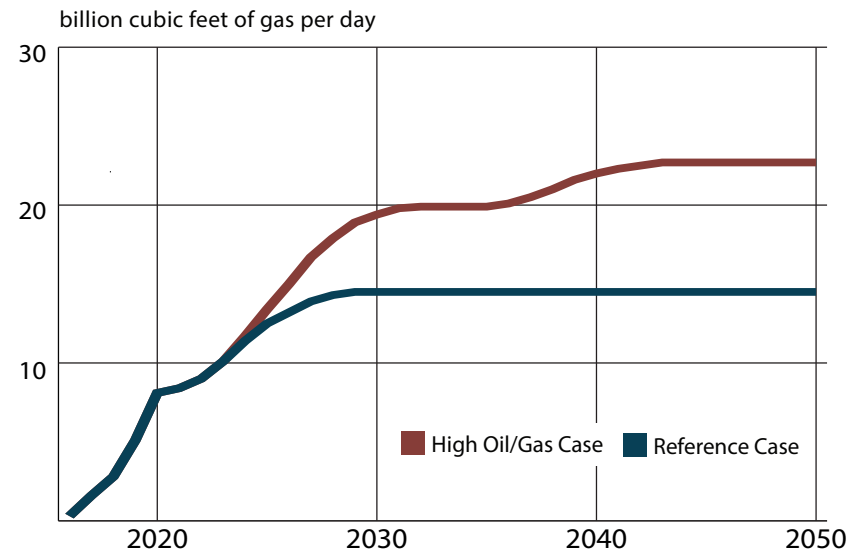
Source: FERC and LNG Allies (Nov. 2017)

And, with regard to prices, the recently released AEO-2018 estimated that Henry Hub prices should remain at or below \$4.25/mmbtu through 2035 in the Reference Case and slightly above/below \$3.00/mmbtu in the High Oil & Gas Case, even as LNG exports increase significantly in the years ahead. (Fig. 9)

Natural gas has a bright future as a clean, reliable, and affordable fuel. With flexible contract terms, U.S. LNG exports are driving the transformation of the international gas trade to an increasingly well-connected and liquid global market. This benefits global energy security, especially for those of America's allies who are dependent on energy imports. LNG exports also provide important economic benefits to the United States—most importantly at the local and regional levels—by stimulating job creation, increased economic activity, and tax revenues.

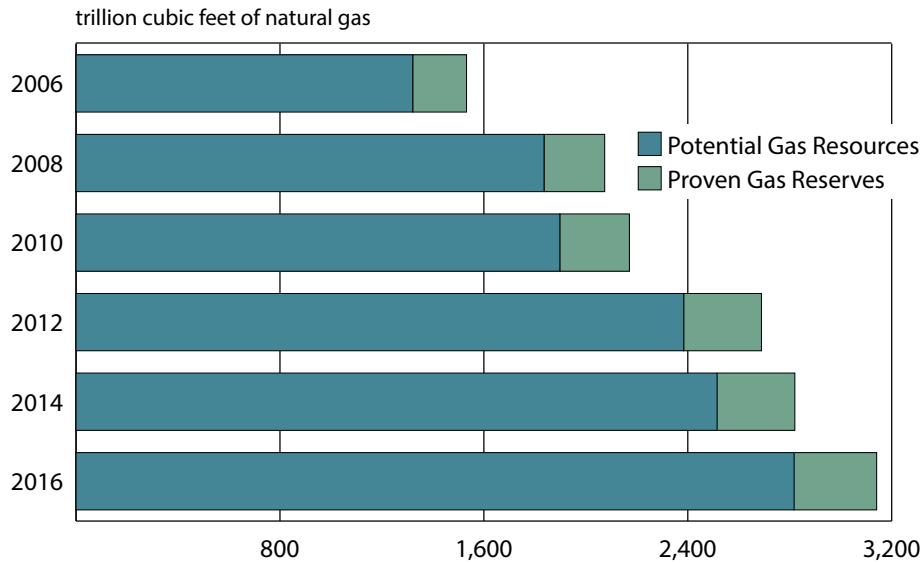
For additional information about U.S. LNG exports: www.lngallies.com

Fig. 7 - EIA Estimates of U.S. LNG Exports to 2050



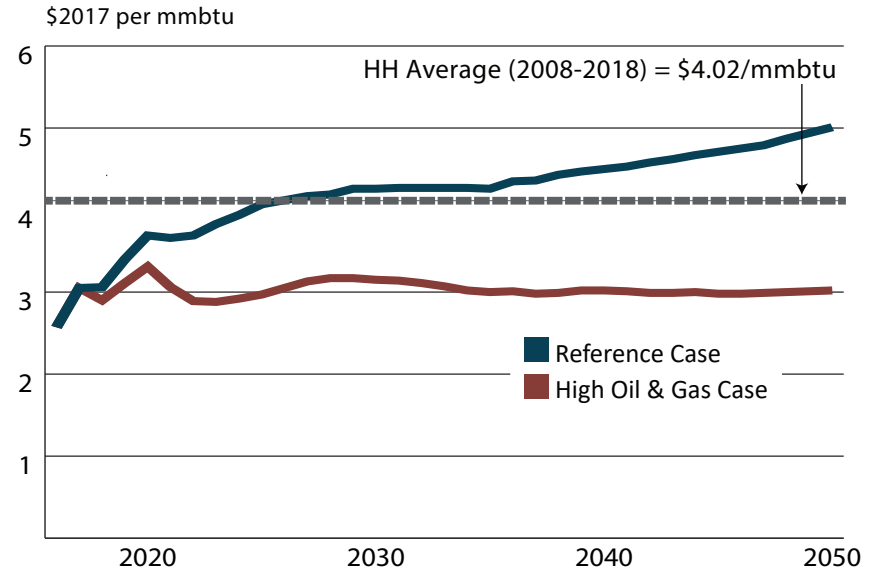
Source: EIA Annual Energy Outlook - 2018

Fig. 8 - PGC/EIA Estimates of the Future U.S. Gas Supply



Sources: Potential Gas Committee (Resources); EIA (Reserves)

Fig. 9 - EIA Estimates of U.S. Henry Hub Prices to 2050



Source: EIA Annual Energy Outlook - 2018