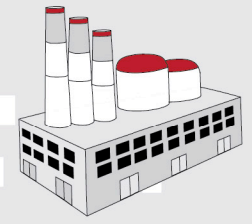
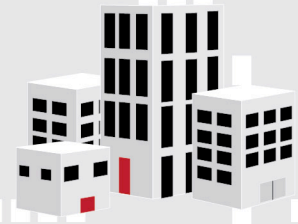
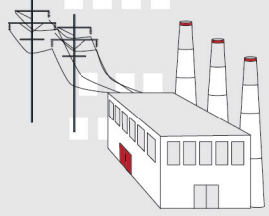
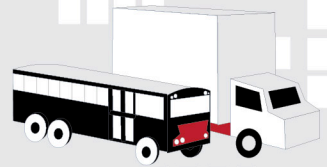




ENERGY

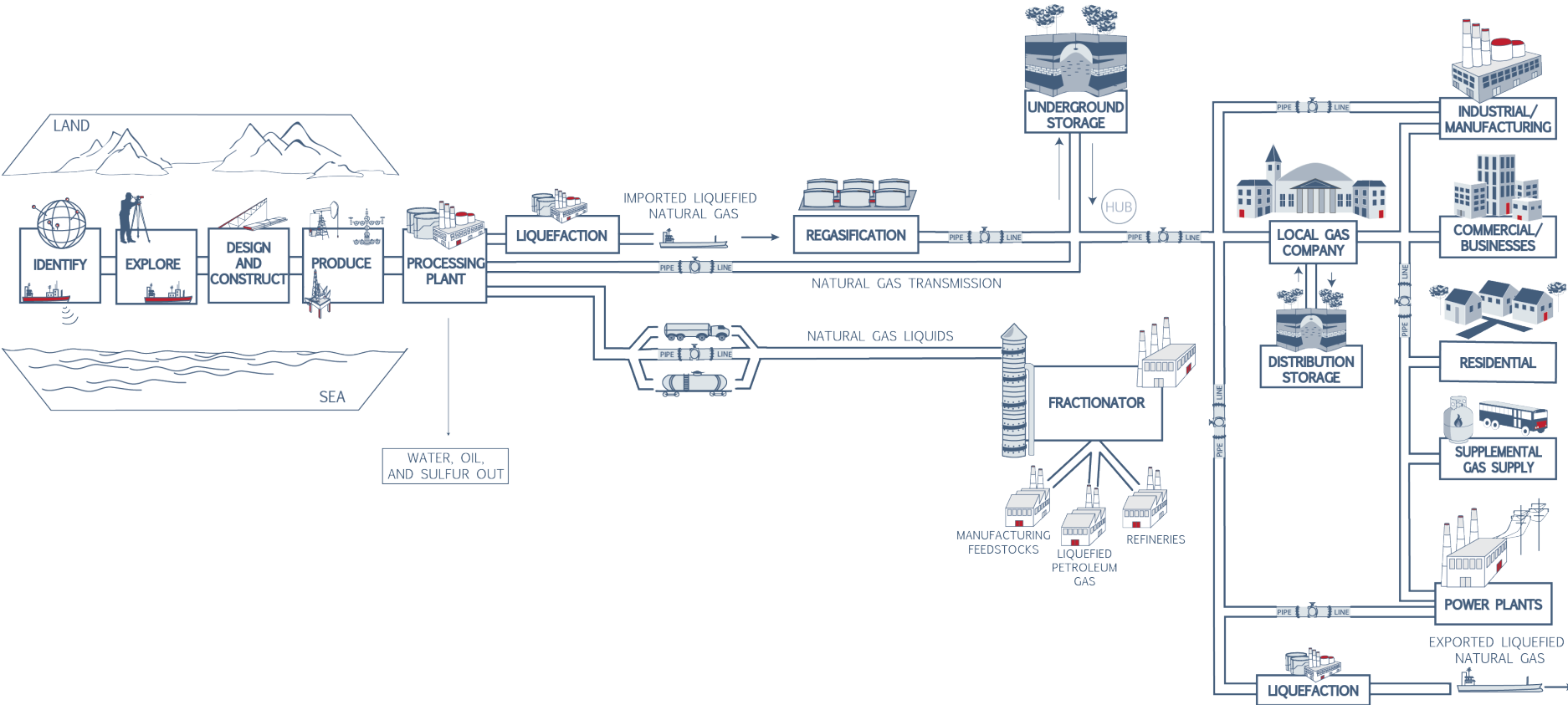
UNDERSTANDING OUR NATURAL GAS SUPPLY CHAIN



- Our goal is to raise the level of awareness around the natural gas supply chain among key stakeholders in order to facilitate positive working relationships and more informed decision making.
- We've built redundancy and resiliency into our supply chain in order to prevent incidents and ensure that if events occur, they produce the least possible impact.

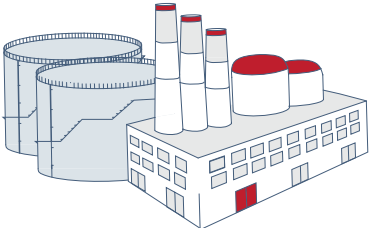
- Redundancy within the US natural gas supply chain enables critical components to continue to operate in case of disruptions to the system. Examples include:
 - Nearly 500 natural gas processing plants
 - Over 300,000 miles of natural gas pipeline
 - Over 30 major market hubs
 - Over 400 storage facilities
- The US natural gas supply chain is inherently resilient as a result of its design, which incorporates rapid response capabilities with automatic response triggers.
- The redundancy of components and the resiliency of the system design inhibit traditional chokepoints in the natural gas supply chain.

THE NATURAL GAS SUPPLY CHAIN



RESOURCES: PEOPLE (HUMAN BEHAVIOR, SKILLED/TRAINED PERSONNEL) POWER (ELECTRICITY) WATER IT (TELECOM, CYBER, ACCESS CONTROL)

UNDERSTANDING THE COMPONENTS



PROCESSING PLANT



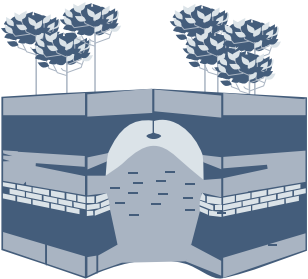
PIPELINE



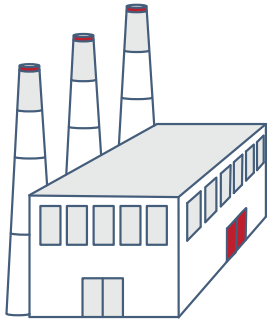
REGASIFICATION



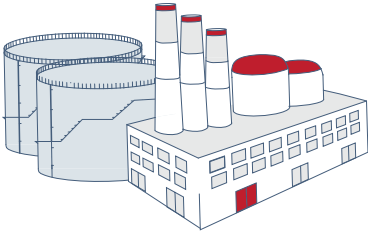
HUB



STORAGE



FRACTIONATOR

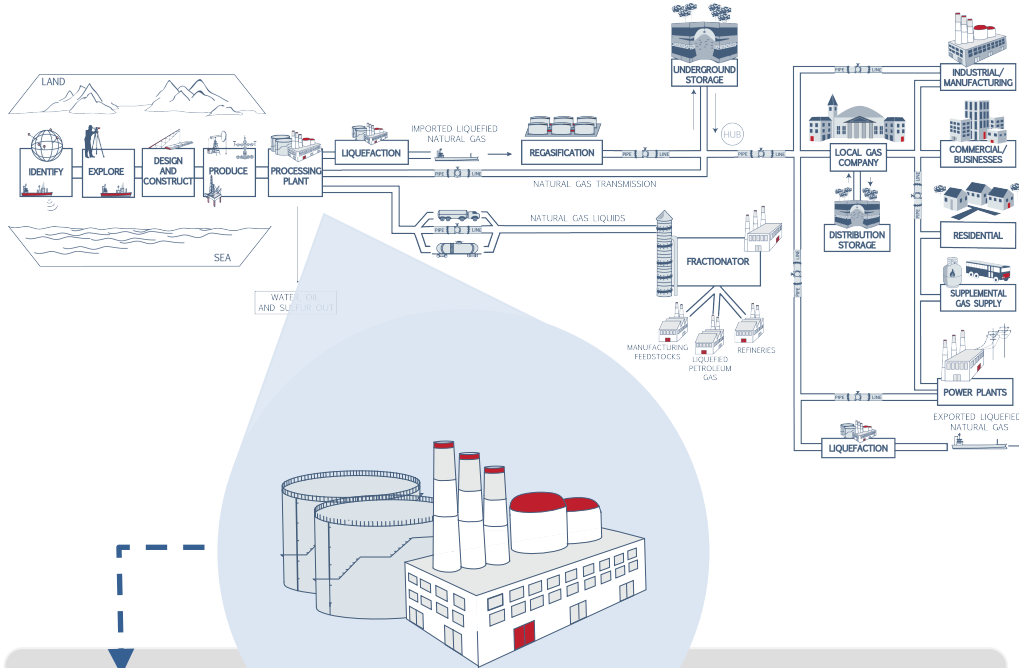


LIQUEFACTION



LIQUEFIED NATURAL GAS SHIPPING

PROCESSING PLANT



Overview

Processing plants clean raw natural gas by separating impurities and the various hydrocarbons and fluids from pure natural gas, producing what is known as 'pipeline quality' dry natural gas, also known as methane. A fully operational processing plant delivers pipeline quality dry natural gas that can be used as fuel by residential, commercial, and industrial consumers.

STATISTICS

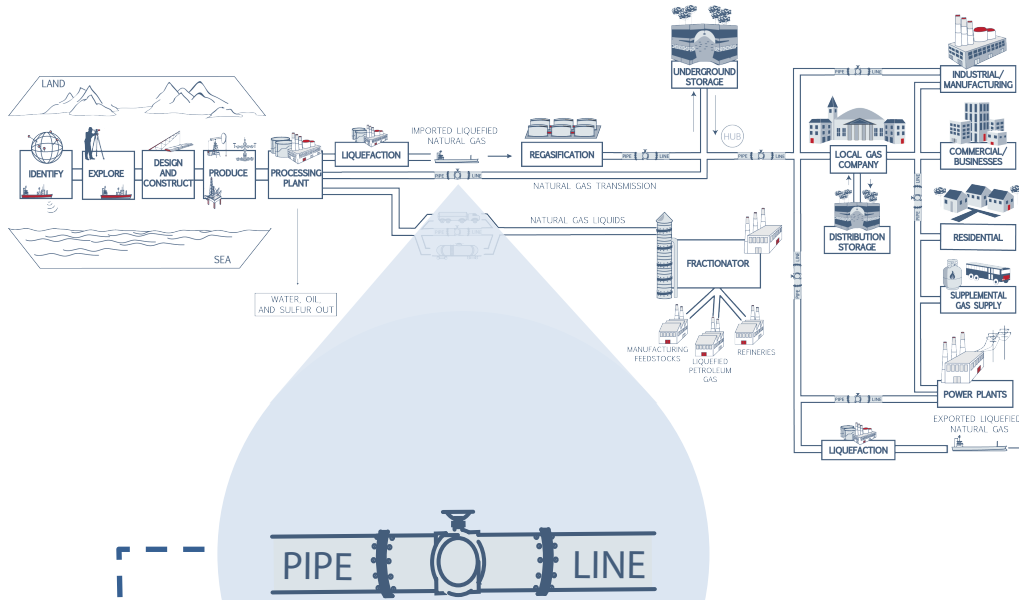
- Nearly 500 natural gas processing plants in the United States
- Over 20,000 billion cubic feet of natural gas processed in 2017
- Over 1.3 billion barrels of liquid natural gas extracted in 2017
- Natural gas heats about half of all US homes

KEY TAKEAWAY

We now have about a 100-year supply of clean-burning natural gas that we didn't know about just a few years ago. The natural gas industry (including all end-uses, infrastructure and production) provided \$550 billion in value to the U.S. economy in 2015 (approximately 3% of GDP) and over 4 million jobs.*

*Benefits and Opportunities of Natural Gas Use, ICF, June 2017.

<http://www.api.org/~media/Files/Policy/Natural-Gas-Solutions/NatGas-Benefits-Onepager.pdf>



Overview

The US natural gas pipeline network is a highly integrated transmission and distribution grid that can transport natural gas to and from nearly any location in the contiguous United States. Pipelines can be characterized as interstate or intrastate. Interstate pipelines are long-distance, high-capacity pipelines that transport natural gas throughout the nation. Intrastate pipelines link natural gas producers to local markets as well as the interstate pipeline system.

STATISTICS

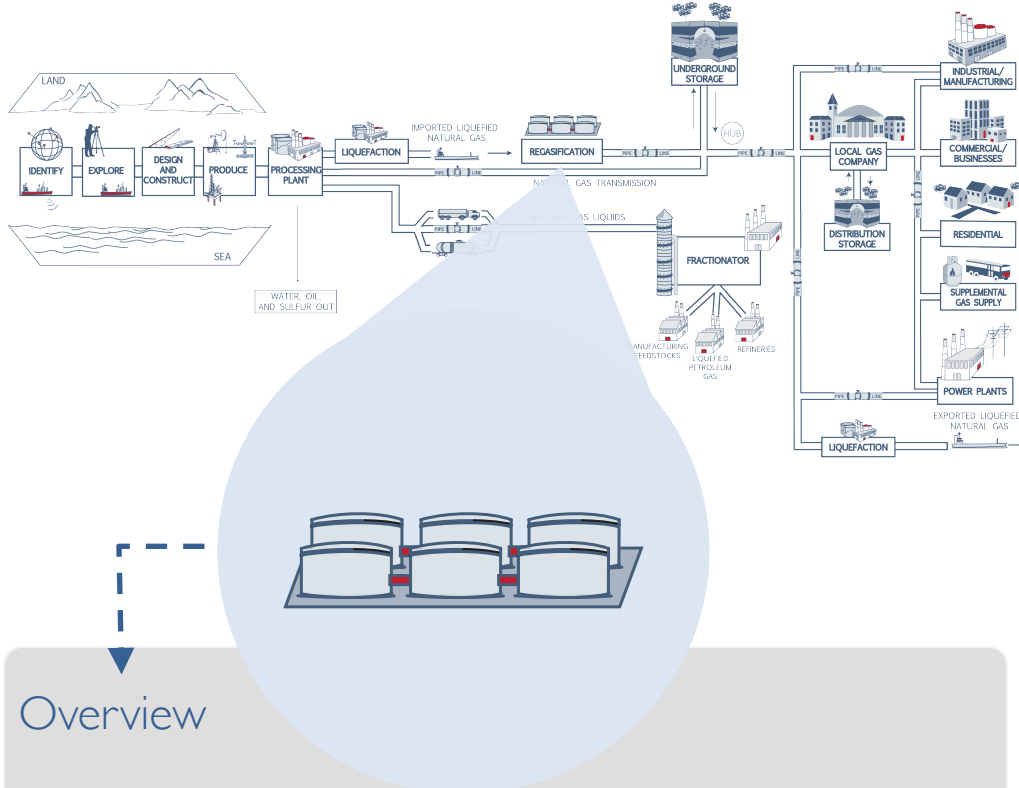
- Over 300,000 miles of natural gas transmission pipeline in the United States
- Over 95% of natural gas used in the United States moves from well to market entirely via pipeline
- Over 11,000 delivery points, 5,000 receipt points, and 1,400 interconnection points that provide for the transfer of natural gas

KEY TAKEAWAY

Natural gas meets nearly one-third of US energy demand = 28 quadrillion BTUs in 2017.*

*Estimates by Energy Sources

https://www.eia.gov/state/seds/sep_sum/html/pdf/su_m_btu_1.pdf



Overview

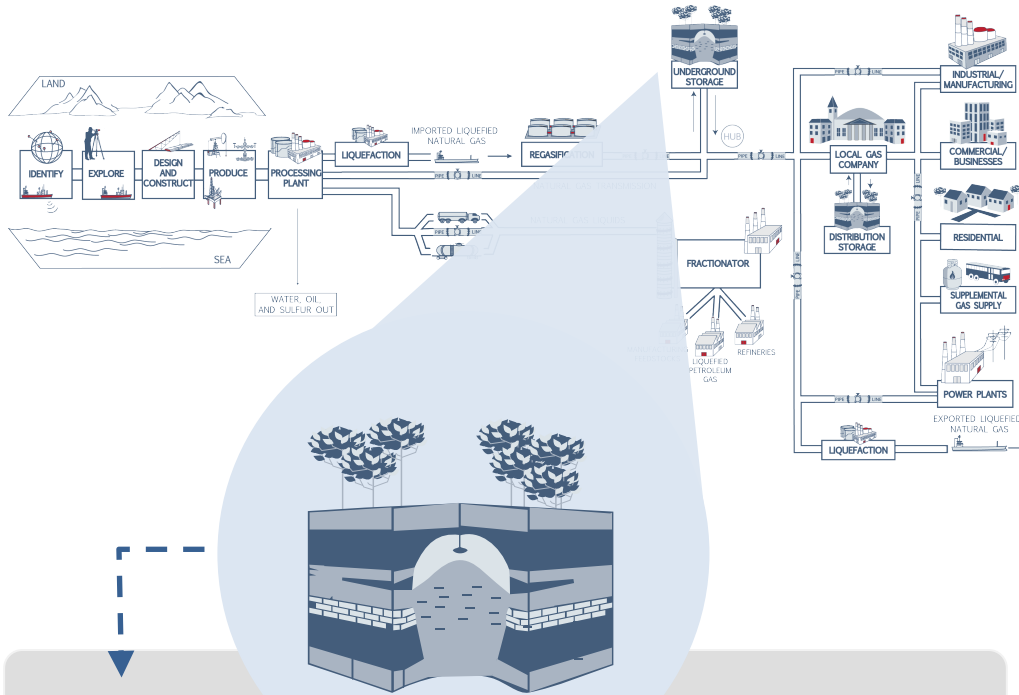
Regasification is the process of transforming liquefied natural gas (LNG) into a gaseous state through vaporization, preparing it for use. This process occurs at regasification plants, where the temperature of LNG is increased, typically through seawater vaporizers, transforming it into gas.

STATISTICS

- There are about 110 total LNG facilities in the US that perform a variety of services including storage for peak demand usage and for importing and exporting LNG.
- The US possesses significant LNG regasification capability (18.8 BCFD)
- There are about a dozen LNG import facilities in the US.
- In 2018, the United States imported 76 billion cubic feet of LNG, down from 351 billion in 2008.

KEY TAKEAWAY

Imports of natural gas have decreased significantly (nearly 78% from ten years ago) due to the tremendous increase in domestic production of natural gas.



Overview

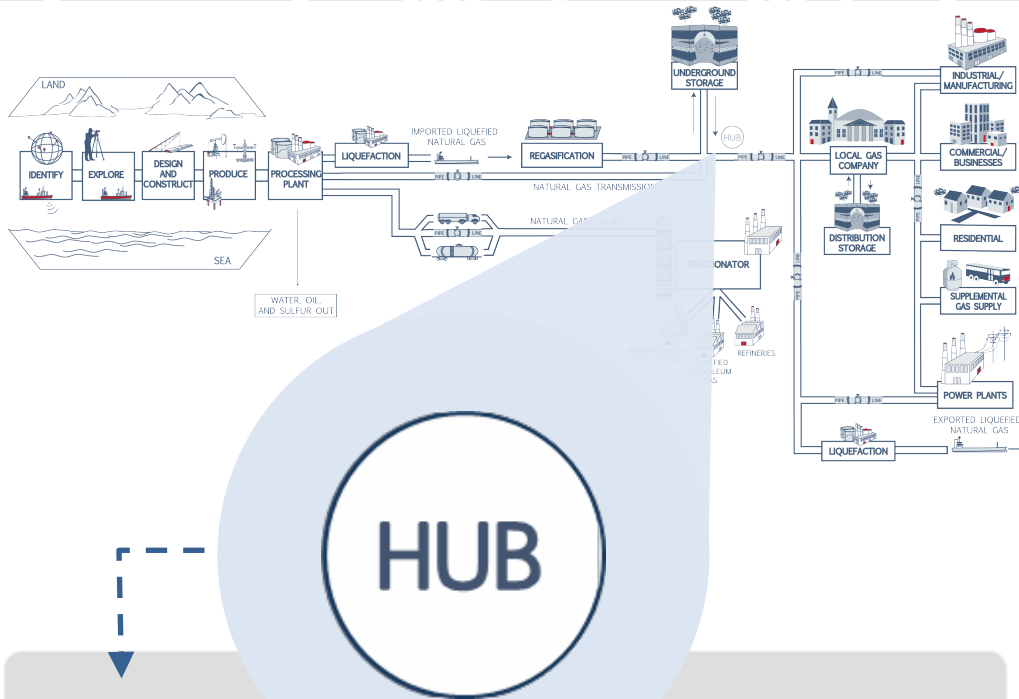
Natural gas is stored in three principal types of large underground storage systems: depleted natural gas reservoirs, aquifers, and salt caverns. More than 80% of natural gas storage capability consists of depleted reservoirs, which are relatively easy to convert to storage facilities after use and are typically located near consumption centers and existing pipeline systems. Natural gas can also be stored as liquefied natural gas (LNG), which reduces its volume to 1/600th of the volume of natural gas, making it more efficient and practical to store and transport.

STATISTICS

- The US has over 400 active underground storage facilities
- Total working storage capacity is nearly 5 trillion cubic feet

KEY TAKEAWAY

About 20 percent of all natural gas consumed each winter comes from underground storage. Storage is also used to keep natural gas flowing to customers in the event of temporary disruptions in production and also helps interstate pipeline companies balance system supply on their long-haul transmission lines. The flexibility and resiliency provided by storage critical to maintaining reliable and responsive natural gas delivery.



HUB

Overview

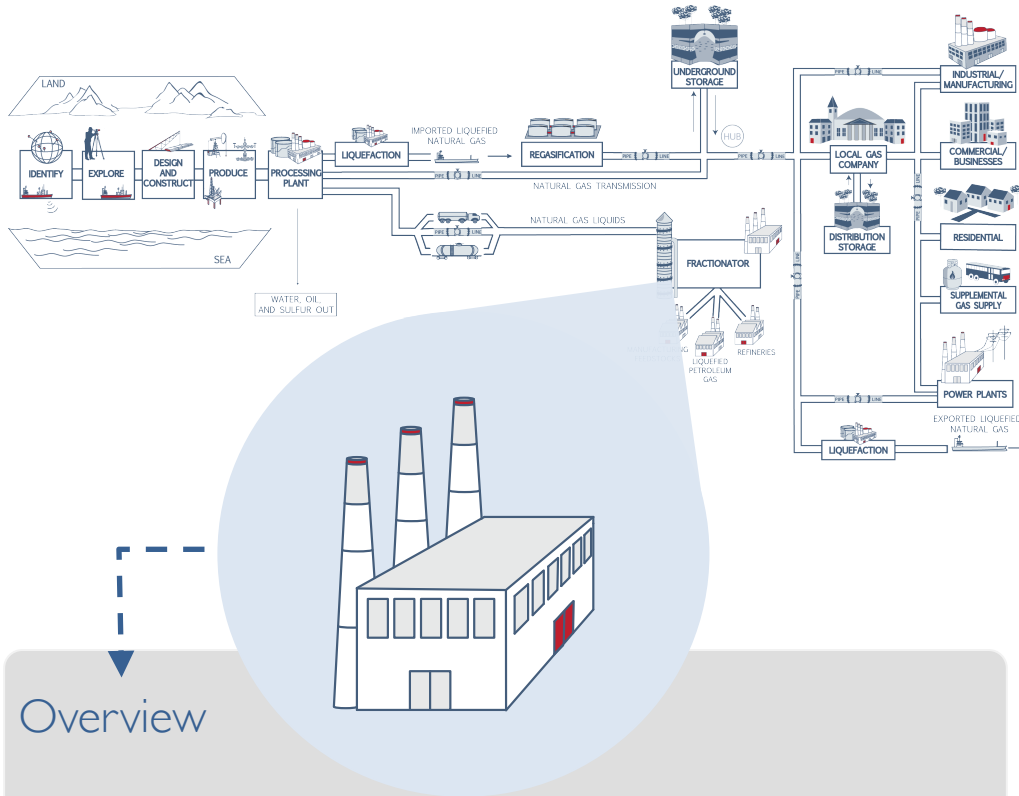
Natural gas hubs are a key feature of competitive gas markets. Hubs are locations where natural gas is priced and traded throughout the country. These 'market hubs' are generally located at the intersection of major pipeline systems. Natural gas is often benchmark priced at "Henry Hub" in Louisiana, though regional hub pricing also play a large part in the value of natural gas contracts.

STATISTICS

- Over 30 major market hubs in the United States
- Almost 33 billion cubic feet of marketed production in 2018
- The average natural gas spot price in 2018 of \$3.15 per million BTUs at Henry Hub was two-thirds lower than ten years ago.

KEY TAKEAWAY

Spot pricing at regional hubs plays a large role in determining local consumer gas pricing. For example, In the Northeast, where natural gas pipeline capacity is often constrained, cold weather can cause monthly average prices at hubs such as Algonquin Citygate (near Boston) and Transco Zone 6 NY (New York) to spike while prices at better interconnected and supplied hubs remains low.



Overview

The fractionation process is the breaking down of natural gas liquids (NGLs) into their base components in order to be useful, and occurs at a fractionator facility. Common base components of NGLs include ethane, propane, pentane and butane. Fractionation occurs in stages, separating each base component from the stream of mixed NGLs, one-by-one.

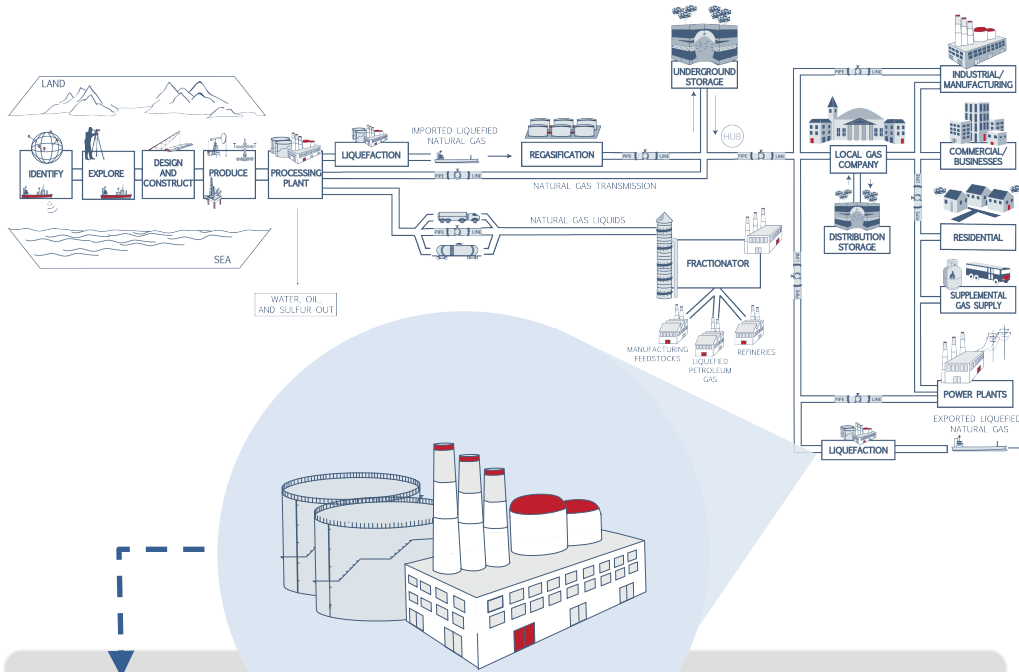
STATISTICS

- Ethane production has dramatically increased over the last decade to a record high of 1.7 million barrels per day in 2018. Ethane is used as a petrochemical feedstock and can be further processed to make ethylene, a feedstock for plastics and other consumer products
- US exports of ethane are also growing more than 255,000 barrels per day on average in 2018.*

KEY TAKEAWAY

The increased growth in NGL production is providing an opportunity for significant growth in the petrochemical industry including an expansion of new facilities to process these chemicals and create consumer goods.

https://www.eia.gov/dnav/pet/pet_move_exp_a_EPLLEA_EEX_mbbldpd_a.htm



Overview

Liquefaction is the physical conversion of a gas into a liquid state. Liquefaction occurs at normal atmospheric pressure by super-cooling the natural gas to -260°F , creating liquefied natural gas (LNG). Prior to liquefaction, certain unwanted components, such as dust, acid gases, helium, water, and heavy hydrocarbons, are removed as they can cause difficulty downstream.

STATISTICS

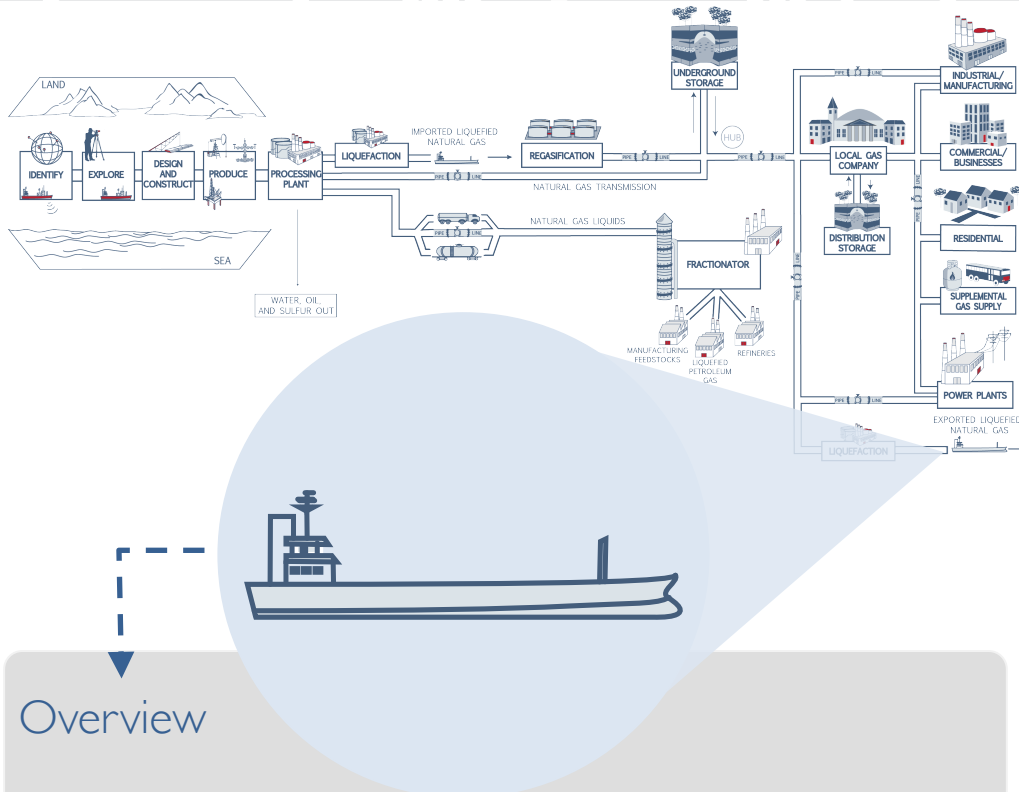
- There are 14 approved LNG export facilities in the US (8 of which are currently under construction)
- In 2018, the US exported 1.08 trillion cubic feet of liquefied natural gas to about 30 different countries.*

KEY TAKEAWAY

The US's status as the world's largest gas producers has created an opportunity for natural gas exports. The US became a net export of natural gas in 2017. This includes LNG exports as well as exports to Canada and Mexico via cross-border pipelines.

<https://www.eia.gov/todayinenergy/detail.php?id=39312>

*EIA, Natural Gas Exports by Country, https://www.eia.gov/dnav/ng/ng_move_expc_sl_a.htm



Overview

Liquefied natural gas (LNG) shipping provides a low-cost, safe, and environmentally responsible method to move large volumes of product long distances. LNG is transported in specially-built tanks on double-hulled ships. LNG carriers are among the safest in the shipping industry, having made more than 100,000 voyages without major incident.

SHIPPING LIQUEFIED NATURAL GAS

STATISTICS

- In liquid state, the volume of natural gas shrinks by approximately 600 times, creating easier storage and transport for marine shipments
- There are 525 LNG tankers in the global LNG fleet which completed 5119 voyages in 2018.*

KEY TAKEAWAY

Marine shipping is the most economical mode of commercial freight transportation, due to the enormous capacity of tankers and barges. The industry allows the United States to take advantage of its 25,000-mile waterway system and adds billions to the US economy.

*International Gas Union World LNG Report 2019, https://www.igu.org/sites/default/files/node-news_item-field_file/IGU%20Annual%20Report%202019_23%20loresfinal.pdf

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For more information on the visual depiction of this supply chain model, please contact:

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