



**Key Applications for
The Patented “VX™ Cycle”
Small-Scale & Mid-Scale LNG Production Plants**

Expansion Energy’s patented “VX™ Cycle” advances the cost-effective, small-scale (1,500 to 100,000 gallons per day) and mid-scale (100,000 to 1,000,000 gallons per day) production of liquefied natural gas (LNG) and cold compressed natural gas (“CCNG™”) from low-pressure (or high-pressure) natural gas. Capable of being trailer-mounted or skid-mounted, the VX Cycle is the world’s first “Mobile LNG™” production technology. Key applications of the VX Cycle include those described below.

Downstream Applications

Production of Vehicle-Grade LNG, CNG or CCNG™ at any point on existing high- or low-pressure natural gas pipelines or local (LDC) distribution lines, allowing LNG/CNG to compete effectively with diesel or gasoline fuels on a cost-per-energy-content (BTU) basis. In the U.S., LNG typically costs about \$1.50-\$2.00 less per gallon than diesel fuel (on an energy-equivalent basis), and burns much cleaner. With the VX Cycle technology, LNG can be produced right at LNG fueling stations (or at today’s gasoline and diesel fueling stations) by connecting to an existing commercial natural gas distribution pipeline (or an extension thereof). Payback periods can be quite short (often just 1-2 years).

Specific vehicle/transportation fuel applications include:

- Heavy-duty truck, van and bus fleets—commercial; municipal; DOT; sanitation trucks; airports; etc.
- Light-duty trucks and passenger cars fueled by LNG or CNG—rapidly growing worldwide
- Railroad locomotives
- Inland marine vessels—barges, tugs and ferries
- Ocean-going marine vessels—cargo ships, passenger ships & ferries, barges and workboats
- Military fleets, especially those vehicles that tend to remain “on base”
- Harbor and port service vehicles—trucks and “yard mules” at the port
- Off-road fleets and heavy equipment, including construction and mining equipment

Midstream Applications

- **Production of LNG for Inland Natural Gas Storage** at any point on existing natural gas pipelines, allowing for greater availability, security and deliverability of natural gas to existing customers, including peak-shaving and expanded capacity of gas transport systems. Gas storage facilities (such as inland LNG terminals) also allow gas traders to be more profitable in their trading activities.
- **Production of LNG to Serve Remote Communities and Industrial/Mining Sites** which are too distant to receive natural gas by pipeline. Instead, LNG can be produced (at small-scale) at the nearest point along a pipeline and transported by truck to the remote community, mine or industrial facility.

Upstream Applications

- **Production of Natural Gas at “Stranded” Gas Fields** which are not close to existing pipeline infrastructure. The liquefaction of these stranded reserves (via the VX Cycle) allows the natural gas (in dense liquid form) to be cost-effectively transported by LNG tanker truck to existing natural gas pipelines or gas processing plants, and re-gasified prior to insertion into a pipeline. Stranded gas applications can utilize a skid- or trailer-mounted VX Cycle unit that can be moved to other gas production areas once its work is completed at the original gas production field. VX Cycle plants can increase the value of natural gas in stranded fields by potentially tens-of-millions of dollars per field by making such reserves cost-effectively deliverable to the market. The VX Cycle can also be used as a “stepping stone” for high-potential gas fields that could support an extension of the natural gas pipeline system, but not until a sufficient number of gas wells in these new fields are drilled and producing. The VX plant’s generator can also provide surplus electricity to the well site.
- **Liquefaction & Monetization of Flared Gas/“Associated Gas”** to increase revenues for oil companies (and other companies that flare gas) and to eliminate the waste and environmental impacts of flaring. Gas gathering systems and gas pipelines are often not present at oil wells in remote locations or offshore, causing oil producers to flare this “associated gas.” The VX Cycle can be utilized to liquefy associated gas such that it can be cost-effectively transported to a natural gas pipeline or trucked to nearby LNG fuel users, such as drilling rigs and frac spreads. This represents a new revenue stream for many companies who today flare natural gas without monetizing its value.
- **Extraction of Natural Gas Liquids (NGLs) from “Wet Gas.”** NGLs such as propane, butane and ethane found in “liquids-rich” natural gas can be even more valuable than the gas (methane) itself. The deep refrigeration capability inherent in the VX Cycle can be utilized for the “dual purpose” of stripping NGLs from wet gas, which can then be trucked to nearby pipelines or gas processing plants. This application is particularly important at oil wells where gas gathering and pipeline systems are not present to take the “associated gas” (often containing NGLs) to market.
- **Offshore Liquefaction of Natural Gas on Oil & Gas Platforms.** Utilization of VX plants on offshore oil & gas platforms can eliminate the need to construct expensive subsea gas pipelines from the platform to shore. Gas can instead be transported to shore as LNG on a variety of ships or barges designed to carry LNG. VX plants can also be used on-platform to capture and liquefy “associated gas” that would otherwise be flared. Moreover, VX plants on offshore platforms produce a “value-added” product—LNG—that the market is typically willing to pay significantly more for than regular natural gas. Additionally, VX Cycle plants on platforms can fuel the workboats that service those platforms. Some workboat fleets have already begun to convert from diesel fuel to LNG.
- **LNG Fuel for Upstream Oil & Gas Operations.** Upstream oil & gas operations are rapidly converting their diesel-fueled equipment to instead run on LNG for substantial savings on operating costs and to reduce emissions. VX Cycle plants (deployed at well sites or elsewhere in upstream environments) can provide low-cost LNG fuel for such applications as:
 - Drilling rigs
 - “Frac spreads”—hydraulic fracturing pumps, etc.
 - Construction equipment / heavy equipment
 - Well-site power generation
 - Field trucks—oil tanker trucks; water tanker trucks; service trucks; etc.