

**Virtual Pipeline™ Technology**  
**The Concept & Active Companies Offering the Service**  
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The use of Virtual Pipeline™ technology to deliver CNG and LNG is a relatively new concept with only a hand full of industry players nationwide. In the U.S., the concept was born out of the lack of pipeline infrastructure in the New England area. The New England terrain makes the construction of pipelines very expensive, which has impeded their development. In an effort to take advantage of the low cost of natural gas that occurred as the shale energy revolution took off, a system for off-pipeline natural gas deliveries became of interest. Advancing technologies for compressed or liquefied gas storage and delivery, largely driven by the uptick in interest in utilizing natural gas by the transportation sector created the perfect conditions to launch the virtual pipeline industry in the gas starved New England region. A system that uses trailers specifically designed to carry large quantities of natural gas drawn from compression terminals strategically located at certain points along existing pipelines in the region has developed over the last few years, and a small group of companies are offering this “Virtual Pipeline™” service to off-pipeline manufacturers in the New England states.

To date, we have been able to identify only a hand full of companies offering CNG via the virtual pipeline method, with only one currently operational in the state of Pennsylvania. The others have made inroads primarily in the New England states, with one having at least one customer in New York State. Additionally there appears to be some activity in the Northwest US, specifically in Washington State.

The concept of utilizing natural gas in an off-pipeline manner has actually been around for decades (military uses and in other countries), but the first deliveries in the New England area didn't occur until 2011. Now this opportunity is coming to Pennsylvania as it has become clear that pipeline gas will not be readily available to many manufacturers as well as commercial/ institutional and even residential customers located across the Commonwealth. The installation of pipelines to remote industrial sites and certain sparsely populated regions of the state (or heavily populated areas where the installation of a pipeline would significantly impact existing infrastructure) simply aren't economically viable and likely never will be, making deliveries via the virtual pipeline the only practical solution.

\*“Virtual Pipeline” is trademarked by Xpress Natural Gas, Boston, MA, <http://xng.com/>

The following first provides an overview of the virtual pipeline concept, followed by information on the companies we have been able to identify that are active in the virtual pipeline space. The initial list focuses on companies providing the full service, followed by a few major equipment vendors.

### **The Virtual Pipeline™ Providers**

In order to be cost competitive versus other energy options such as fuel oil, coal, biomass, or electricity, the virtual pipeline providers are reliant on continuous improvements in multiple technologies and business strategies that include:

- The ability to identify the most strategically located sites to build compression stations that can access the large quantities of natural gas necessary to service prime markets. This may include identifying gas in transmission pipelines already at fairly high pressure, as the cost of compressing the gas to 3600PSI (to as high as 5000PSI) for storage in trailers is one of the most significant costs incurred. According to Compass Natural Gas, owners of the new Quaker Terminal located near Montoursville, the cost to build the terminal was roughly \$16 Million. This cost includes construction of the meter station, gas transmission main from the meter station to the terminal, the terminal itself including compressors, operations building, generator, dispensers, fill posts, site fencing, site lighting, concrete pads, paving, electrical work and piping and valves. Engineering, permitting, legal and property acquisition costs are not included. In addition, the engineering and permitting for the project was over a year long process.
- Employing trailer designs that use novel material compositions and configurations to minimize the weight of the empty trailers, while maximizing the pressure the gas can be compressed to inside the trailers, maintaining stringent safety requirements. Trailers cost anywhere from roughly \$235,000 for steel tube tank Type 1 trailers (maximum pressure of 2600 psi, carrying 175,000 SCF or 1350 DGEs of gas), to \$500,000 for new composite tank system trailers (Type 4) that are now available, carrying roughly 2500 DGEs of natural gas (roughly 364 MCFs) at 3600 psi.
- The ability to fast fill large trailers (balancing speed and temperature changes in the gas). The large composite trailers can take anywhere from 90 minutes to 6 hours to fill, with 90 minutes being the current time it takes Compass Natural Gas to fill their new Type 4 composite trailers.
- The ability to develop a delivery strategy that minimizes the number of necessary trailers and trucks while ensuring on time deliveries to all customers being serviced from a particular compression station
- Helping to educate customers regarding the most cost effective boiler system upgrades and modifications required to their current energy system that allows switchover customers to utilize natural gas as their primary fuel while providing both a dual-fuel option, and the ability to switch back to their existing fuel as a backup in emergency

situations. Boiler conversion costs vary depending on the size, age and style of burner used in the boiler. Typical conversion costs range from \$50,000 to \$400,000 per boiler and the actual conversion time can range from 1 to 3 weeks. With the current price of fuel oil hovering at or near historic lows based on oil selling in the \$30 per barrel range, it is still reasonable for customers to expect a payback on their investment to convert their boilers in 2 ½ to 3 years.

- Installing the necessary infrastructure at customer sites and the latest available equipment to allow the storage of multiple trailers (backup always on site), and the fast, low energy method to decompress the gas at the customer's site for use in the boiler system. A site near the customer's building that is level must be identified, and a roughly 50' X 150' fenced in area where three trailers and the decompression equipment is housed must be developed. Current decompression equipment can cost roughly \$400,000 not including engineering and costs for site clearing/preparation, concrete pads, site lighting, and fencing. The decompression and other ancillary natural gas equipment to serve the customer would typically be provided and maintained by the virtual pipeline company.

Thus, the cost of entry to the market by Virtual Pipeline™ providers is not non-trivial. Each compression station can economically compete with other fuel sources (fuel oil being the primary switchover target customer) in a range of 100 to 200 miles from the compression station location. Of course this range increases as the spread of price between fuel choices increases. Right now with fuel oil at close to record low prices, the distance shrinks. Clearly the cost of the natural gas is only one small component of the overall cost the virtual pipeline providers incur in order to service customers.

### **Virtual Pipeline™ Customers**

In many cases there are clear advantages to making the switch to natural gas delivered via the virtual pipeline. But as noted above, being a "first adopter" requires innovative thinking, and many manufacturers are risk adverse. The "if it isn't broken, don't fix it" mentality is a common barrier, and a risk-reward analysis will occur in every case. Also as noted previously the capital expense to convert the boiler system is an issue, even with an acceptable payback period.

#### Advantages:

First, focusing on manufacturers, long term stable energy costs can be very important. The ability to lock in a manufacturer's cost of energy can secure their long term viability, and also allow growth opportunities to be explored with knowledge that energy costs are fixed going forward. Virtual pipeline™ providers are able to offer this to their customers. Since the cost of the natural gas is only one component of their overall cost of service, and since they are also using natural gas to power their trailers (as their transportation fuel), they can lock in a rate for up to 5 years to customers.

Payback periods for covering the costs to switch over boilers will vary for each customer, but at this time with fuel oil near historic lows, it is still projected that even for high cost boiler conversions payback in the 2.5 to 3 year period is achievable. Obviously long term lower costs for energy are the goal, and it is projected that customers within the range noted above of a compression station can be expected to see significant savings as long as oil doesn't fall below its current \$30 per barrel range.

From an air quality perspective, the switch to natural gas provides a cleaner burning fuel source and that can be significant depending on the size of the manufacturer and can positively impact a facility's Title V permitting requirement or status. This can be very significant in some instances, securing the facility's ability to continue operating at current levels, or in some instances, allowing expansion that wasn't possible using fuel oil or another fuel source.

#### Concerns:

At this time the lack of other examples of companies that have made the switch to the virtual pipeline is clearly a barrier, holding back some manufacturers from making the move. This coupled with the required initial capital investment to change the boiler system over is delaying decisions to move forward. Although it seems logical that in essence there is little difference between natural gas deliveries via a trailer and propane deliveries to a stationary tank, or fuel oil deliveries to a tank, concerns exist. One is the frequency that trailers must be delivered and concerns with delays due to weather conditions, accidents, etc. To alleviate this concern, Compass currently requires all customers to maintain a backup energy system and build a pad capable of storing a minimum of three trailers on site. Although this may be an additional cost, these requirements can also be perceived as an advantage from an energy security perspective.

The BF SGICC is convinced that once a series of demonstration projects are up and running, successfully making the switch to using natural gas via the virtual pipeline model, and case studies are available to highlight the value to each customer gained from the switchover, the virtual pipeline industry will take off.

#### **Scale of the Virtual Pipeline Opportunity in the State**

While it is the intention of this initiative to primarily focus on manufacturers (since they typically are the largest energy users and thus, have the most to gain from fuel swapping), a variety of other opportunities exist. A significant portion of the state doesn't have access to natural gas, and the timeframe to build out additional pipeline infrastructure to new areas is a definite concern. Thus, in both the short term and long term there are significant opportunities to deliver natural gas via the virtual pipeline. Virtual pipeline™ opportunities exist to:

- Service small to very large manufacturers currently using other fuel sources

- Provide natural gas to brownfield sites or industrial parks not currently on pipelines to provide service to new manufacturers or commercial clients. This could be short term while they await the installation of a pipeline, or permanently if no pipeline is planned.
- Deliver natural gas to strategically placed “Hubs” that can then be used to distribute gas through a locally installed and maintained pipeline system connected to the Hub to service mixed users in communities not on pipeline gas at this time. Opportunities are currently being explored by groups such as SEDA COG to establish Nonprofit Cooperative Corporations to fund and construct needed infrastructure development on a continuing basis, utilizing virtual pipeline centrally located natural gas delivery sites and a “hub & spoke” model to service areas that are unlikely to have pipeline gas in the future.
- Provide natural gas to utilities to increase their available gas during high use periods such as during extreme cold or hot periods, allaying the necessity for customers to reduce their use
- Provide natural gas to commercial fleets, extending their travel distance by strategically placing refueling units along their travel routes
- Provide natural gas to large commercial entities, campuses, and state/ federal facilities that are off pipelines
- Provide natural gas to new housing developments that are off the pipeline.

The number of opportunities that potentially could benefit immediately is significant.

### **Company List:**

- **Compass Natural Gas:** <http://compassngp.com/>

Address: 1215 Manor Drive, Suite 302, Mechanicsburg, PA 17055

Details: Has operational compression station in Lycoming County (Quaker terminal, near Montoursville), and first customers in the state. Company is focusing on industrial/ manufacturing customers (mid to large size; greater than 300,000 gallons/ year fuel oil use, or G.T. 100MCF/Day NG) throughout the central part of the state that are located within 100 mile radius of the compression station. Has identified several interested customers that are seeking to either switch to NG from other fuel source or are looking at new operations that are off pipelines.

- Offering up to 5 year fixed contracts
- Working on permitting and building second compression station (near Milesburg, PA). Others compression station in planning stages in the state.

Service Area: Currently central part of the state of Pennsylvania (customers likely to be located within an approximate 100 mile radius from Montoursville, PA)

- **NG Advantage:** <http://www.ngadvantage.com/>  
Address: 480 Hercules Dr., Colchester, VT 05446

Details: Founded in 2011 and was the first in the nation to make deliveries of trucked CNG to industrial customers. In October 2014, Clean Energy Fuels (NASDAQ: CLNE) purchased a majority interest in the company, which is now expanding from its Northeast base to selected locations in the US and Canada. NG Advantage serves customers from an existing compressor station if they burn over 100,000 MMBtu of fuel and are located within 200 miles of that station. If they burn over 750,000 MMBtu and are not within 200 miles of an existing compressor station, then NG Advantage will build a new compressor station for their use on the closest transmission line. Customers currently receive between 1 and 18 loads of gas a day. Together with Clean Energy, NG Advantage's customers can purchase CNG or LNG, or both.

Service Area: Mostly New England area; one major client (International Paper) in Ticonderoga, NY

- **OsComp Systems:** <http://www.oscomp.com/>  
Address: 4140 World Houston Parkway, Suite 100, Houston, Texas 77032

Details: OSCOMP is a CNG service provider, but its competitive advantage derives from its technology foundation and internally developed intellectual property. OSCOMP's offerings are embedded with these proprietary technologies that increase equipment utilization, enabling it to lower costs to its customers:

- RapidFill™ – Fills high capacity trailers in < 1 hour, enabling high trailer throughputs at the source station.
- Chill-Fill™ – Counter the heat of compression so trailers can be filled to 100% full rather than the typical ~75%.
- Milk Run™ – Reverse cascade technology allows for delivery of CNG to low-cost storage at the customer site, enabling cost-effective CNG for smaller users.
- Downstream Process Control – Effective temperature and pressure control ensuring safety and reliability while delivering large flow rates.

Service Area: Non-specific; primary customers have been companies active in drilling and fracing, and we believe in the southwest/ Texas area

- **Xpress (XNG):** <http://xng.com/>  
Address: 160 State Street, 8th Floor, Boston, MA 02109

Details: Has list of current customers in New England area in their web site. Targeting natural gas fuel supply for individual companies, campuses and industrial , and Gas-on-demand for large industrial users that need a low-cost single fuel to address interruptible or curtailed pipeline service, as well as Off-Pipeline Fleet Fueling by providing LNG and CNG fueling for NGV use in off-pipeline locations.

Service Areas: Maine, Massachusetts, New York (through a partner), and parts of Canada

- **Global Partners, LP:** <http://www.globalp.com/products/product.cfm?productID=131>  
Address: 800 South Street, Suite 500, P.O. Box 9161, Waltham, MA 02454-9161

Details: Global Partners LP, a FORTUNE 500 company, is a leader in the storage, distribution and marketing of energy products across the Northeast. They are a 75 year old company that has served a diverse base of customers, including, in part, independent heating oil dealers, gasoline and diesel fuel distributors, state and municipal agencies, public utilities and large commercial organizations. Their expertise in traditional and emerging fuel markets enables us to be at the forefront of competitive, reliable energy supply. Has 7 terminals that provide various fuels in the state of Pennsylvania, but none handle CNG or LNG.

Service Area: One CNG Loading Compression Station in Bangor, Maine

- **Irving Oil:**  
<https://www.irvingoilcommercial.com/ProductsandServices/SpecialtyFuels/NaturalGas.aspx>  
Address: Headquartered in New Brunswick, Canada  
U.S. Operations: 190 Commerce Way, Portsmouth, New Hampshire 03801

Details: Provides a complete solution for compressed natural gas needs from transportation, to onsite decompression unit installation to backup fuels

Service Area: Natural Gas terminal appears to be located in Waasis, New Brunswick

- **Innovative Natural Gas & Liberty Utilities:**  
[http://www.libertyutilities.com/east/gas/about/news\\_04-07-14.html](http://www.libertyutilities.com/east/gas/about/news_04-07-14.html)  
Address: Concord, New Hampshire (Compression Station Location – proposed(?))  
Details: Unable to locate additional information on the compression station that is referenced in the article.
- **REV LNG:** <http://revlng.com/>  
Address: 1002 Empson Road, Ulysses, PA 16948

Details: Company supplies Liquid Natural Gas (LNG) for industries ranging from shipping to drilling to power generation, tailoring the LNG system to suit clients' specific needs. Operates a trucking fleet, and currently purchase LNG from peak shaving plants such as UGI's Wyomissing, PA facility. Utilizes unique mobile fueling unites and drops trailers at the customer's site that acts

as a mobile fueling station. Majority of customers are trucking fleets, but has serviced drilling rigs, and also targeting the marine market (tugboats and ferries).

Service Area: Focused on northeast and southeast US, and also Gulf Coast for marine opportunities.

- **UGI Energy Services:** <http://www.ugienergyservices.com/>  
Address: One Meridian Blvd., Suite 2C01, Wyomissing PA 19610\*  
\* A new proposed LNG facility is in planning stages adjacent to UGI Energy Services' Manning Natural Gas Compression Station located in Wyoming County. Expect this facility to offer merchant LNG available to virtual pipeline providers of LNG

Details: UGI Energy Services is an LNG Merchant Provider at its Wyomissing, PA facility. A subsidiary of UGI Corporation that markets natural gas, electricity and liquid fuels to approximately 19,000 residential, commercial, industrial, institutional and government customers at approximately 43,000 locations in nine states and Washington, D.C. In addition, it stores and delivers natural gas and generates electricity.

Service Area: Unclear if they are providing deliveries of LNG directly to any customers (primarily utilize LNG as a peak shaving fuel to use in their pipelines during extreme hot or cold periods; required by law to have this available). Appears they only currently offer LNG on the merchant market to companies (REV LNG is a customer) for these companies to deliver to their customers. Unaware if there are any other companies offering a service like REV LNG in our market area.

#### **Major Equipment Vendors:**

- **Quantum Technologies:** <http://www.qtw.com/product/virtual-pipeline-cng/>  
Address: 25242 Arctic Ocean Drive, Lake Forest, CA 92630

Details: Offering High Capacity Natural Gas Trailers that will be available in mid-2016 pending DOT approval. Significantly increases the capacity to carry CNG. The Q-VP<sup>650</sup> trailer stores gas at up to 5,000 psi enabling a single container to hold up to 645,000 SCF, the highest capacity in the industry.

- **Hexagon Lincoln, Inc.:** <http://www.hexagonlincoln.com/product-lines/titan>  
Address: 5117 NW 40th Street, Lincoln, Nebraska 68524

Details: Company provides Titan® 40ft. Module and XL trailers to the industry. Operate at 3600PSI and carry up to 526,000scf of compressed gas. Hexagon Lincoln has been part of Hexagon Composites Group since 2005, and HCG has a heritage that began in 1963 with filament-wound rocket motor cases. "Mother Company" has operations around the globe.



- **FIBA Technologies, Inc.:** <http://www.fibatech.com/>  
Address: 53 Ayer Rd., Littleton, MA 01460

Details: FIBA is a leading provider of gas containment equipment and services. FIBA provides both manufacturing and servicing, including DOT tubes and ASME pressure vessels, tube trailers and skids (MEGCs), cryogenic products, and equipment repair, rehabilitation, and requalification services.

- **OsComp Systems:** <http://www.oscomp.com/>  
Address: 4140 World Houston Parkway, Suite 100, Houston, Texas 77032

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