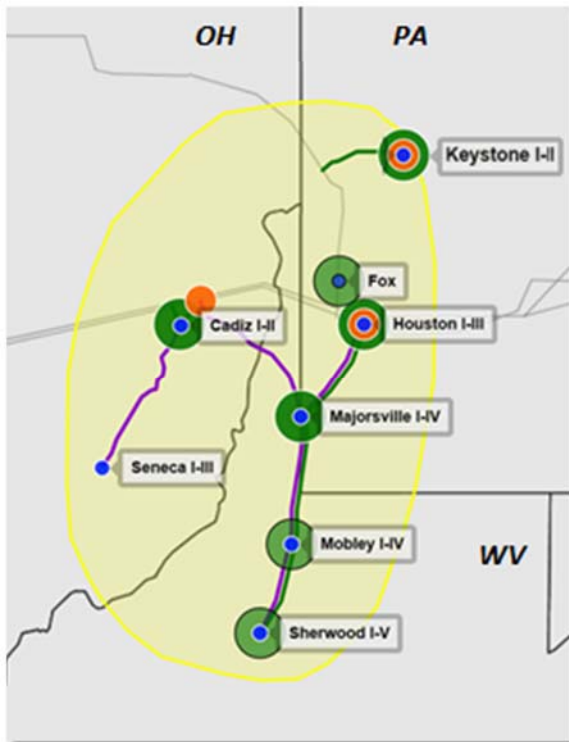


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Join Together With Demand: *The Who and How of Marcellus/Utica Midstream*



**MarkWest Processing and Fractionation Plants
RBN Pipeline GIS**

- Appalachia NGL production volumes have skyrocketed -- up almost 5 times in less than three years
- Even with lower NGL prices, production from the Marcellus/Utica is expected to continue increasing
- Midstream development in the region has been booming
- But building all this midstream infrastructure in Appalachia does not work the way it does in other high-growth shale plays:
 - There is a spider web of legacy natural gas pipelines across the region being repurposed as take-away systems
 - Huge expansions of gas processing and fractionation capacity have been required
 - There is a paucity of NGL storage in the region, complicating all aspects of product logistics
 - Local NGL demand and take-away capacity are limited
- Midstream companies are developing innovative solutions to these challenges

In the five years since natural gas production began to take off in Appalachia, volumes in the Marcellus and Utica basins have increased from less than 2 Bcf/d in 2010 to more than 18 Bcf/d today. Much of that natural gas production growth is high BTU, so called “wet” gas containing significant volumes of natural gas liquids (NGLs). Consequently NGL production volumes have skyrocketed. As recently as 2012, EIA reported that PADD 1 NGL production averaged less than 50 Mb/d. That number is now more than 235 Mb/d, an increase of almost 5 times in less than three years. Even with NGL prices significantly lower due to the crude oil price crash, growth in NGL production from the Marcellus/Utica is expected to continue ramping up, with the potential to yield more than 1.0 MMb/d – more than four times today’s number – within the next three or four years.

All of that new production requires significant additions to the gathering, processing and pipeline infrastructure in the region, and consequently midstream development has been booming. But

building all this midstream infrastructure in Appalachia does not work the way it does in other high-growth shale plays, particularly in terms of natural gas take-away pipelines, gas processing, fractionation facilities, NGL storage and access to NGL markets. This RBN Drill Down report catalogues the key midstream assets in the Marcellus/Utica, describes how these assets work together to meet the needs of regional players and explains how planned infrastructure will continue to enable growth in both natural gas and NGL production in the region. The findings of this report are summarized below.

Natural gas pipelines in the region are a complex spider web of interlocking systems, some of which have been in place for more than one hundred years. The oldest systems were built to gather the first wave of Appalachian production early in the 20th century, were repurposed as distribution systems when that production played out, and now find themselves in the back yard of the most prolific shale gas producing area in the country and are being repurposed again to move gas out of the region. Others are some of the largest capacity long-line pipes in the U.S., developed almost seventy years ago to move volumes from Texas, Louisiana, Oklahoma and other traditional producing states into the Northeast – a service no longer required. These pipelines also traverse the Marcellus/Utica producing regions and have for the past few years been preparing to reverse their flows – to bring Appalachian gas to markets as far south as the Gulf Coast and in the process provide more take-away capacity for Marcellus/Utica gas producers.

Gas Processing Capacity. In 2009 before the boom there was only 600 MMcf/d of natural gas processing capacity in the entire Northeast region. Most of that capacity was legacy infrastructure dating back decades, scattered across the region with each facility operating on a stand-alone basis. Today there is about 7,600 MMcf/d of gas processing capacity in the region, with more than 40 new plants or expansions of existing plants added since 2009. Like the trajectory of natural gas production, the growth in gas processing capacity is continuing with 25 new plants or expansions planned to come on line over the next few years, bringing continued growth in NGL production.

Fractionation Capacity. Unlike the other major U.S. shale plays, there are no mixed NGL (Y-grade) pipelines in place today for moving all these liquids to the major fractionation centers in Mont Belvieu, TX and Conway, KS for separation into “purity” NGL products – ethane, propane, butanes and natural gasoline (also called pentanes-plus). That has created the opportunity – and the necessity – for midstream players to build fractionation capacity in the region, providing producers and marketers the option to sell barrels locally or move those NGLs to distant markets. There is now almost 500 Mb/d of fractionation (C3+ or full range) and another 240 Mb/d of de-ethanization capacity in the region, and more is on the way.

NGL Storage. There is a problem for midstream companies that have built all of this capacity to process NGLs – a paucity of NGL storage. Although the region sits in the middle of the largest natural gas storage fields in the world, there are few salt formations suitable for development as NGL storage. The major fractionation centers in Mont Belvieu and Conway sit on top of salt formations that have been developed into huge NGL storage facilities, providing a ready mechanism for handling disruptions in the NGL supply chain – both upstream and downstream. This is particularly important for ethane, which is very difficult to handle in above ground storage. Marcellus/Utica midstream companies have developed creative solutions to this NGL storage problem, unique in U.S. midstream infrastructure.

Access to NGL Markets. In addition to the lack of storage, ethane has another problem. There is no demand for ethane in the Northeast. Today liquid ethane has only one market – petrochemical plants – steam crackers – that use ethane to produce ethylene and other petrochemicals. There are three U.S. steam crackers in locations other than the Gulf Coast,

none of which had access to Marcellus/Utica ethane until a pipeline connection was made to one of these plants in Calvert City, KY last year. Otherwise ethane must be shipped out of the region – to Canada, to the Gulf Coast or to overseas markets. Pipelines to move ethane to these markets have been or are being built and expanded. But it will not be enough. Marcellus/Utica producers can produce more ethane than these systems can handle. Ethane which cannot be sold as ethane can be ‘rejected’ into the gas stream and sold as gas at its heating value – up to a point. That point is the maximum BTU specification on natural gas pipelines taking the ethane rich gas away from the region. Midstream companies must manage this issue to the satisfaction of producers and gas pipelines, keep options open for petrochemical plants to eventually be built in the Northeast (several have been announced but none have started construction), and handle the disposition of the other NGLs – propane, butane and natural gasoline via rail, barge, truck and exports to overseas markets.

RBN Pipeline GIS

The key to understanding how all of this infrastructure in the Marcellus/Utica region fits together is geography – where processing and fractionation assets are located, how they interconnect with each other, and their connections with take-away facilities for natural gas and NGLs. But putting all of these assets in geographic perspective turns out to be more of a challenge than you might think – because most industry maps tend to focus only on one commodity or type of facility, or they are provided by a single company in their investor presentations and only show that company’s facilities. Thus it is difficult to get an integrated picture of the entire midstream infrastructure of the region. While there are services available that provide the tools to build your own maps that pull all of these facilities together, most require a GIS professional (geographical information system technician) to handle the mechanics.

That is, until now. To help with our analysis of Marcellus/Utica midstream assets, RBN has introduced a new website mapping capability. We are calling this new tool ***Pipeline GIS***, since (a) it is mostly used to display pipelines, (b) it shows what is in the pipeline (meaning in development) and (c) *Pipeline* is one of our favorite instrumentals from the early 60s. (It was recorded by The Chantays in 1962, later covered by the Ventures and many other artists). In this report we provide static maps which can be ‘clicked through’ to provide access to the dynamic maps in Pipeline GIS, assuming of course that you are reading this report in electronic format, your computer is connected to the internet and you are logged on to the RBN website.

Figure #1 below includes a subset of the Marcellus/Utica infrastructure described in this report. Click on the map and the link will take you to ***Pipeline GIS***. There you can zoom, scroll and add other pipelines and features to the map. Instructions are provided with the map. Note that if you have a slow internet connection, you may have problems accessing Pipeline GIS. These maps require a minimum level of bandwidth to function correctly.

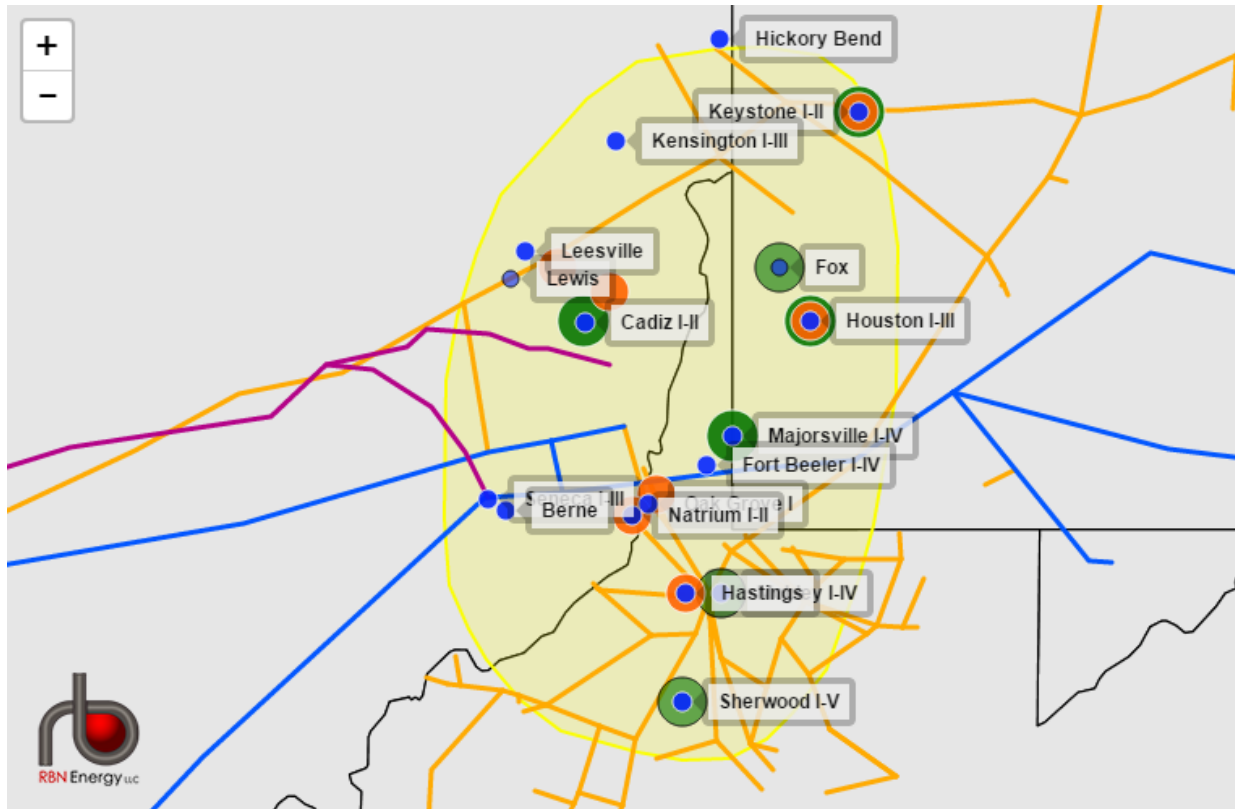


Figure 1 – Selected Gas Plant and Pipelines; Source: RBN Energy (click to open in [Pipeline GIS](#))

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