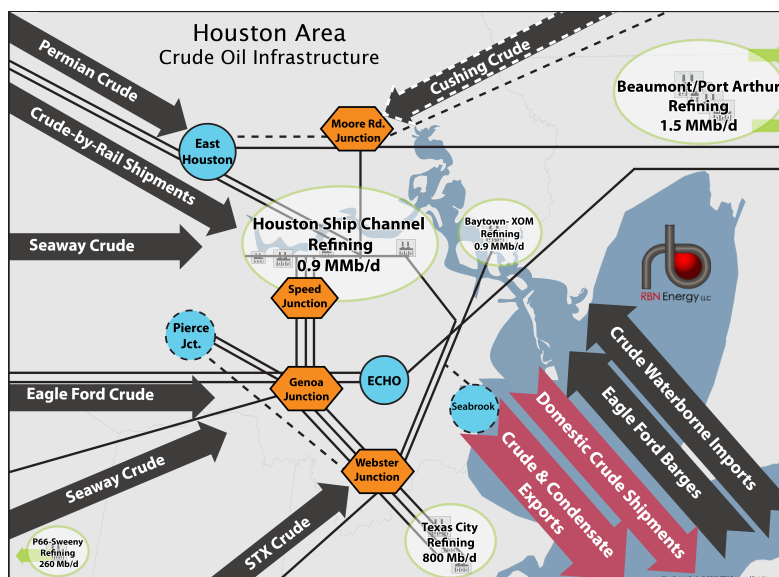


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Stairway to Houston

Infrastructure Response to Shale Era Crude Supply Transformation

- Producers, shippers and refiners currently underutilize Houston area crude infrastructure – both pipelines and storage capacity – much of it newly minted.
- The infrastructure build out is far from over and both new pipelines and storage capacity continue to come online – increasing the potential for an over-build.
- Incoming Houston crude supplies closely match area refinery demand even though new pipeline capacity exceeds local requirements. As a result some of these pipelines – especially from the Eagle Ford - are running half full.
- Congestion in the Houston crude distribution system as well as difficulties for refiners to absorb pipeline flows of very light Eagle Ford crude and condensate are some of the factors responsible for the underutilization of infrastructure.
- A current lack of significant thruway capacity for crude to bypass congestion in the Houston area and reach refineries further east in Port Arthur/Beaumont or Louisiana is now being addressed by planned pipeline additions.
- Demand for new storage capacity, that is needed to smooth out logistic challenges in the crude delivery system, appears to reflect the fact that existing underutilized Houston area storage is generally not used for “merchant” purposes.
- *With this report we introduce RBN's new Midstream Infrastructure Database Interface – called MIDI, an online map-based system for crude oil, natural gas and NGLs.*



Houston Area Crude Oil Infrastructure; Source: RBN Energy

1. Introduction

Prior to 2011, Houston area refineries were primarily supplied with crude by waterborne imports or pipelines delivering offshore Gulf of Mexico or domestic Louisiana production. That was before the surge in domestic production of light sweet crude oil in the shale era that has seen U.S. crude output increase by roughly a million barrels per day each year between 2011 and 2014. Three production basins have provided the majority of this growth – the Williston Basin in North Dakota (the Bakken), the Eagle Ford in South Texas and the Permian Basin in West Texas. Supplies from North Dakota rapidly overwhelmed refinery demand in the Midwest during 2011 and 2012 requiring a re-plumbing of the existing crude distribution system to deliver inland crude to refineries located at the Gulf Coast. Increased supplies from the Eagle Ford and Permian have also increasingly been directed via new and repurposed pipelines to the Gulf Coast region that is home to 50% of the nation's refining capacity (9 MMb/d).

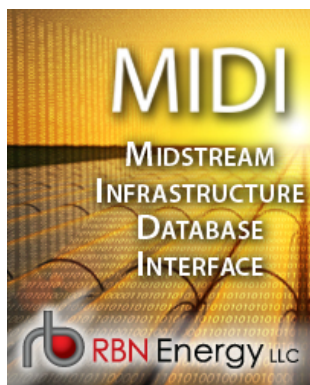
This pipeline re-plumbing process took time and was preceded by workarounds to relieve the congestion such as crude-by-rail transport. But since 2012, a flood of new domestic light crude began to arrive in the Houston area by pipeline – replacing the need for overseas imports of similar quality crudes. Another new source of crude deliveries to the Houston area has come in the form of heavy Canadian crude delivered by pipeline (and to a lesser extent by rail) from Western Canada to the Gulf Coast. In all nearly 3.7 MMb/d of incoming pipeline capacity into the Houston area was built and came online between 2012 and 2015. More than 1MMb/d of additional capacity is expected online by 2016.

This report is an assessment of Houston area crude oil infrastructure and includes a step-by-step build out of a crude supply/demand balance in the area in Section 2. The results of the crude balance show that despite significant new incoming crude pipeline capacity being online, these pipelines are still largely delivering only to meet local refinery requirements – meaning that they are underutilized. Reasons for new pipelines being underutilized are explored in Section 3, including an examination of the impact of crude quality issues and export constraints on the existing crude logistics system. A major limitation for producers and shippers delivering crude into Houston is the lack of thruway pipeline capacity to refineries located east of Houston in Beaumont/Port Arthur, TX as well as further along the Gulf Coast in Louisiana. Section 4 reviews plans underway to extend thruway capacity that may allow pipelines coming into Houston to deliver greater volumes to the Eastern Gulf region in the future.

As new incoming pipeline supplies of domestic and Canadian crude have replaced waterborne imports Houston area refiners have had to adjust to the new logistics. A major difference is the loss of the floating storage flexibility that waterborne crude provides to refiners – allowing crude to be delivered in large batches in a timely fashion. With new pipeline supplies this floating storage functionality needs to be replaced with inland storage at refineries and terminals. To this end significant new crude storage capacity has been built (including 10 MMBbl of capacity brought online since August 2014) and is currently under construction (6.7 MMBbl) in the Houston area. In Section 5 we compare regional crude inventory levels for the Gulf Coast to the utilization of Houston storage – finding that the latter is about 50% underutilized. Some of that underutilized storage is refinery and operational capacity not available to market players. There is continued demand for new merchant storage that can provide flexibility for staging new crude supplies and addressing crude quality issues as well as the segregation of processed condensate supplies prior to their export.

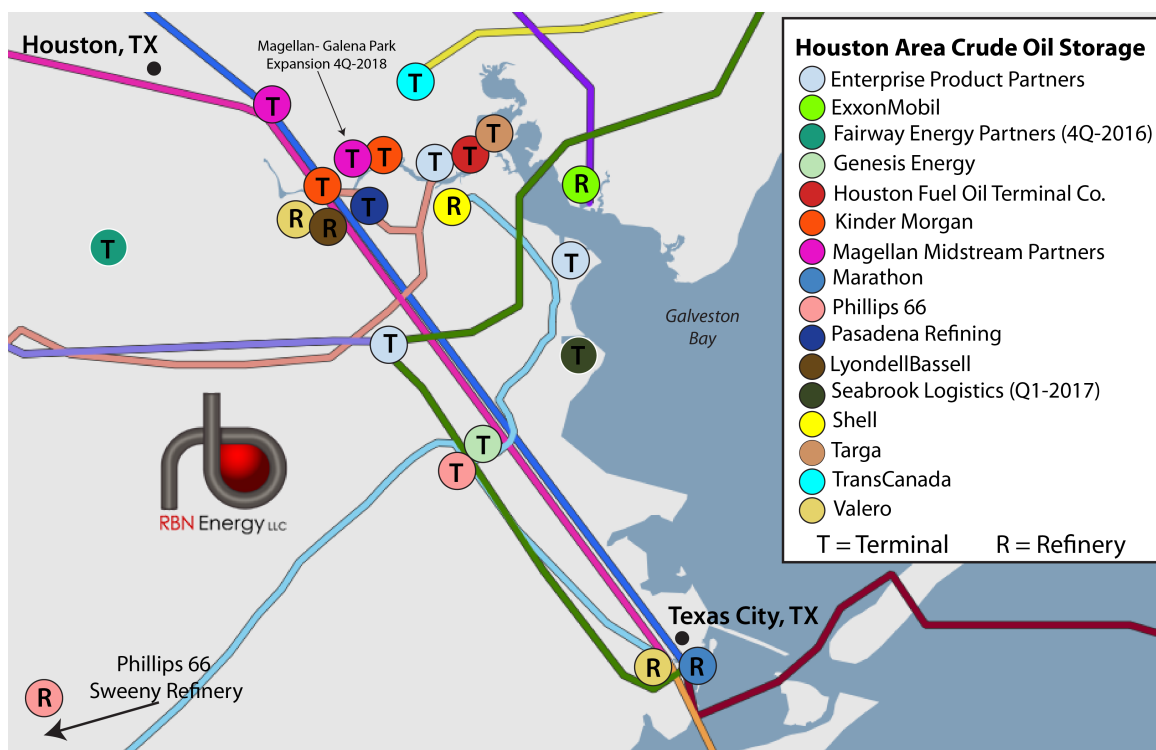
The report concludes that the build out of Houston area crude infrastructure is still a work in progress. While area refiners have successfully adapted to pipeline delivery and secured supplies to meet their needs, the existing infrastructure system does not fully meet the needs of producers and shippers wanting to deliver barrels to refineries in Texas and Louisiana that are

located east of Houston. Midstream companies should also be concerned that the leveling off of crude production in the past 6 months could leave some existing and planned new infrastructure over-built.



With this report we introduce RBN's new Midstream Infrastructure Database Interface – called MIDI. It is an online tool that links crude oil, natural gas and NGL infrastructure data with interactive maps of new projects and selected existing energy infrastructure.

You can access MIDI by clicking on the image to the left or the map below. The table view is a summary of all pipeline projects in the database. Click on each project for more details about the project. You can also click on a map display for each individual project, or see the Map View for all projects in that commodity category. The Featured Maps include dynamic versions of the static maps in this report that give you the ability to zoom, scroll and add other pipelines and features to the map.



Houston Area Crude Storage Locations; Source: RBN Energy (click to open in MIDI)

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