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## **AFTER THE STORM – HURRICANE HARVEY AND THE IMPORTANCE OF GULF COAST REFINED PRODUCTS INFRASTRUCTURE [PART 1]**

**August 26, 2018**

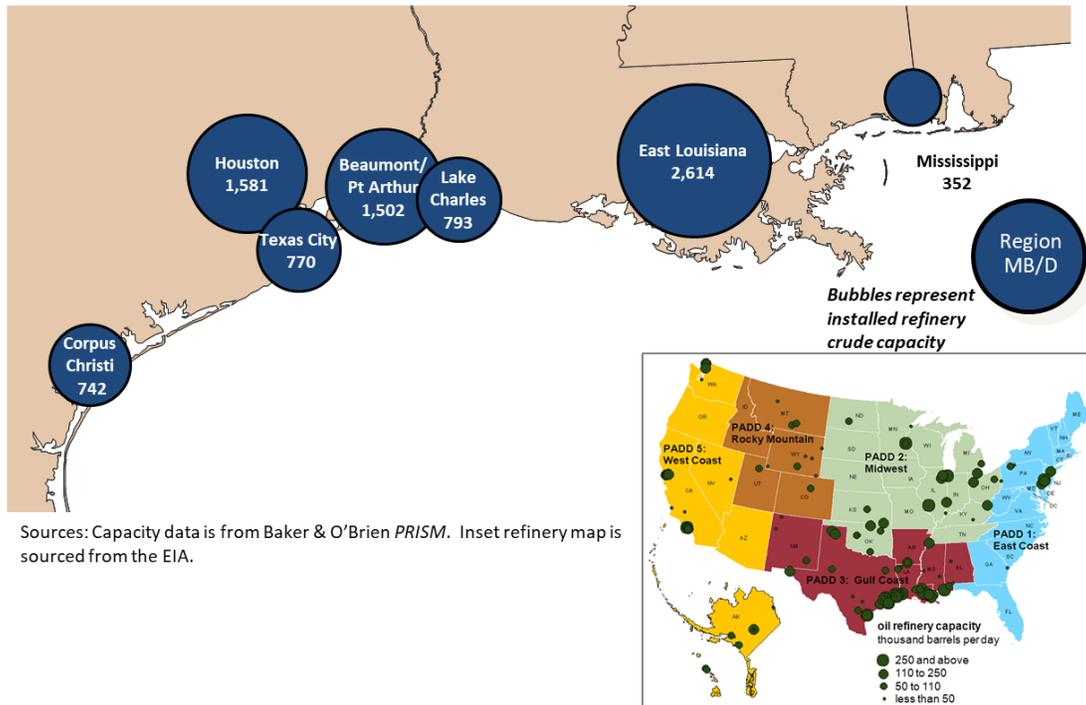
On August 25, 2017, Hurricane Harvey made landfall as a Category 4 hurricane near the popular Gulf Coast vacation town of Rockport, TX, just east of Corpus Christi. Harvey was the first major hurricane (Category 3 or higher) to make landfall along the U.S. Gulf Coast since the devastating 2005 hurricane season that included hurricanes Katrina, Rita, and Wilma, and is tied with Hurricane Katrina as the most expensive storm ever to hit the country. Harvey also highlighted just how important the Gulf Coast refining and refined product pipeline infrastructure is to the rest of the U.S. In today's blog, "After the Storm – Hurricane Harvey and the Importance of Gulf Coast Refined Products Infrastructure," Amy Kalt from Baker & O'Brien marks the one-year anniversary of the devastating storm with a three-part series on Gulf Coast refining and pipeline infrastructure, and how a natural disaster along the coast can impact the rest of the country.

In part 1 of this three-part series, let's set the stage for the unfolding of events that happened during hurricane Harvey. In this article, we cover the location of refineries and connectivity to other parts of the U.S., which will be important fundamental to understand before we move into discussion of the storm and its impact.

The U.S. Gulf Coast (USGC) is home to the largest centralized location of refineries in the U.S. with over 8.4 MMb/d of installed crude distillation capacity between Corpus Christi, TX and southern Mississippi (Figure 1). To put that in context, the refineries along this 650-mile stretch of coast produce enough to meet about half of total U.S. petroleum product demand. These refineries convert domestic and imported crude oils into refined products that are used for a variety of purposes, including: (1) transportation fuel for personal passenger vehicles (i.e. gasoline and diesel); (2) transportation fuel for commercial purposes (i.e. jet fuel, diesel, and bunker/marine fuel); (3) fuel for home heating (i.e. heating oil); (4) Intermediate products for a variety of other petrochemical industries that eventually turn into consumer goods (i.e. plastics, rubber, etc.); (5) asphalt; and (6) lubricants.



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**Figure 1. USGC Refining Infrastructure by Micro-Region (Mb/d). Source: Baker & O'Brien's PRISM Refinery Modeling system and Energy Information Administration (EIA)**

While there's an enormous amount of refining capacity along the Gulf Coast, production vastly exceeds local demand. Therefore, a substantial portion of these refined products need to be transported to other U.S. markets via pipeline or barge or to international markets via ship. Domestic markets connected to and affected by Gulf Coast refineries include the East Coast, Midwest, and West Texas/New Mexico/Arizona markets. Let's take a look at each of these in turn, starting with the East Coast, which in the hydrocarbon world is also known as Petroleum Administration for Defense (PADD) 1.

U.S. East Coast

PADD 1 spans the entire East Coast, from Florida to Maine and is home to more than 120 million people. But PADD 1 has only limited refining infrastructure, which is located mainly in Pennsylvania and New Jersey. Therefore, the region relies heavily on deliveries of fuel from the Gulf Coast and on imports.

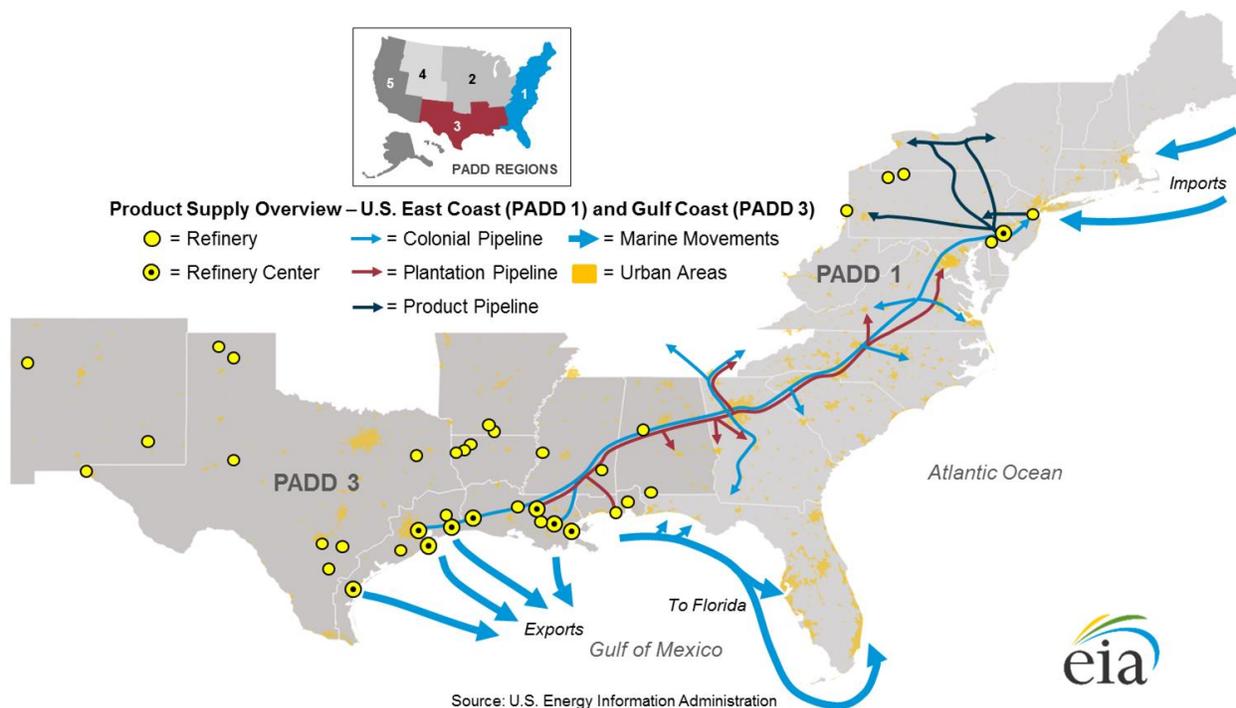
More than half of the population in PADD 1 is located between Florida and Maryland, which also corresponds to over half of the East Coast's transportation fuel demand. Because this part of PADD 1 has no refinery capacity to speak of — and because the refineries up in Pennsylvania do not have an option to ship fuels south via pipeline, nearly all of the fuel requirements in this area are brought in by pipeline from the Gulf Coast or via imports.

Two major pipelines travel from the Gulf Coast to the East Coast: Colonial Pipeline and Plantation Pipeline. Colonial Pipeline (thin blue line in Figure 2) originates in the Houston area and picks up various grades of gasoline, diesel and jet fuel as it heads east to Beaumont, TX; Lake Charles



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and eastern Louisiana; and southern Mississippi. This pipeline (technically multiple lines) can move about 2.6 MMb/d of refined products. There are various pipeline branches — or stublines — that pull off of the main line near Atlanta (GA) into Tennessee and the southern Georgia/Florida panhandle area. Plantation Pipeline (thin red line), with a capacity of 700 Mb/d, follows a similar path; however, it originates in Baton Rouge, LA, and terminates in the Washington, DC, area. Together, these two pipelines delivered almost 55% of the gasoline, diesel, and jet fuel consumed in PADD 1 during 2017. Some of the markets in PADD 1 are sufficiently inland that their only practical sources of refined product receipts are from Colonial and Plantation pipelines (such as Atlanta, GA and Charlotte, NC).



**Figure 2. Gulf Coast to East Coast Refined Product Supply Infrastructure. Source: EIA**

### US Midwest

Heading north out of the cluster of refineries near Houston, Texas City, Beaumont/Port Arthur, and Lake Charles area are three major pipelines that serve various parts of Central Texas and/or the PADD 2 region (the Great Plains and Midwest). These pipelines include Explorer, Enterprise TE Products (“TEPPCO” as many of us still call it), and Magellan:

- Explorer Pipeline (green line in Figure 3) has a capacity of 660 Mb/d and delivers gasoline, diesel, and jet fuel to delivery points in Dallas/Fort Worth (more on this shortly); Tulsa, OK; St. Louis, MO; and Chicago, IL. In the last five years, diluent (natural gasoline or condensate that is blended with heavy crude or bitumen to reduce its viscosity) has been sent through the pipeline in “batches” for delivery to Canada, replacing some of the finished product shipments. (See Refined, Piped, Delivered – They’re Yours for more on batching.)
- Magellan Pipeline (black line at top-center of map) has delivery points in the Dallas/Fort

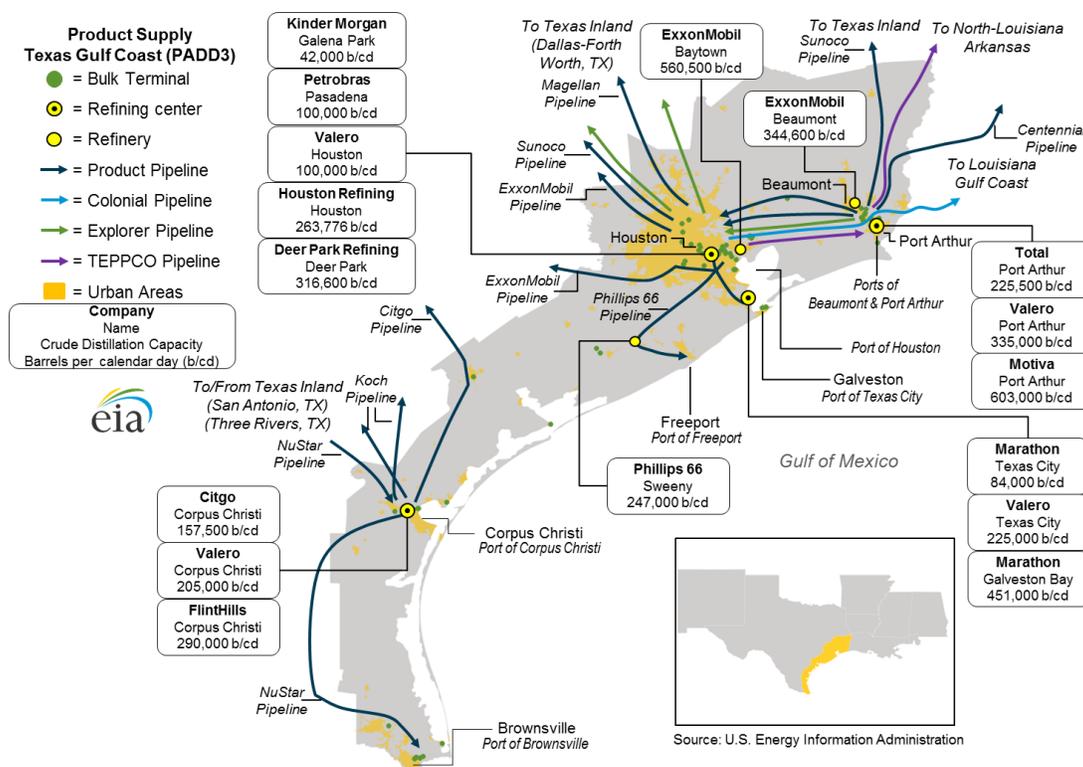


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Worth area, as well as a spiderweb of locations all through the Central Plains from Oklahoma to South Dakota.

- Finally, TEPPCO (purple line) shuffles a lot of barrels around the Houston and Beaumont regions, but also delivers fuel up into Arkansas, Indiana, and the Chicago area.

Movements of products from PADD 3 (Gulf Coast) to PADD 2 have been waning in recent years due to increases in refinery capacity and utilization of refineries in PADD 2. However, in 2017, PADD 3 still shipped 321 Mb/d of refined products directly into PADD 2; another 306 Mb/d of refined products came off the stublines of Colonial and Plantation from Georgia to Tennessee (the latter of which is in PADD 2).



**Figure 3. Texas Gulf Coast Refined Product Infrastructure. Source: EIA**

East Texas/Central Texas/West Texas/New Mexico/Arizona

Most people think of Texas as an oil and gas state with plenty of resources. However, it's also huge in area, and its population centers are widely dispersed. Big metro areas like San Antonio, Austin, and Dallas/Fort Worth are generally without refining capacity and are served via pipeline. The pipelines that supply these regions each originate in one of the major Texas refining centers: Beaumont/Port Arthur, Houston or Corpus Christi.

In East Texas, Energy Transfer Partners (Sunoco Logistics) owns a pipeline system called MagTex that originates in Beaumont/Port Arthur and delivers fuel north into small towns near the Louisiana border. The pipeline also has a western branch that can deliver fuels over to the Houston area for entry into various other pipeline systems.

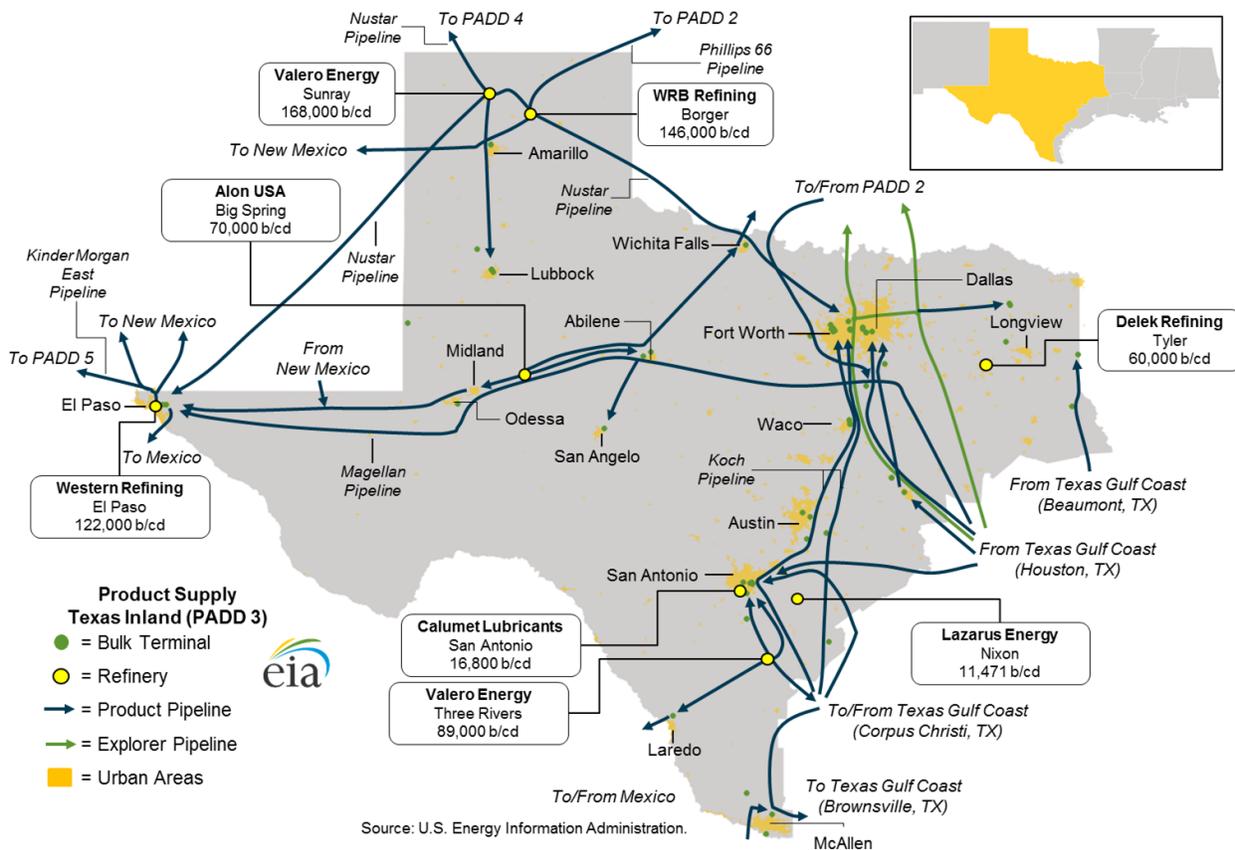


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For Central Texas, we already mentioned the Explorer and Magellan pipelines, which can reach Dallas/Fort Worth, but now we add to the mix the Flint Hills Resources (FHR) and CITGO pipelines from Corpus Christi, and some proprietary ExxonMobil pipelines:

- FHR owns a proprietary pipeline system that originates in Corpus Christi and delivers a significant volume of fuels up the I-35 corridor to San Antonio, Austin, Waco, and Dallas/Fort Worth.
- CITGO owns a pipeline that originates in Corpus Christi and delivers fuel to San Antonio.
- ExxonMobil has two pipelines that originate in the Houston area and deliver fuels to either Dallas/Fort Worth or San Antonio.

Finally, we can't forget about West Texas, New Mexico and Arizona. The Magellan pipeline system that delivers fuel up to the Dallas/Fort Worth area and PADD 2 has a fork just south of Dallas that brings fuel to the West and over into Midland, Odessa and El Paso. At El Paso, fuel can jump into Kinder Morgan's East Line pipeline to Tucson and Phoenix, AZ or into other lines serving Albuquerque, NM, or Ciudad Juárez, Mexico. As we discussed in a recent blog (see Fuel), increased drilling in the Permian has outstripped typical West Texas demand for diesel. As a result, Magellan is evaluating an expansion of its pipeline and other companies have proposed building new pipelines from the Houston and Beaumont/Port Arthur areas.



**Figure 4. Texas Refined Product Infrastructure. Source: EIA**



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The connectivity of Gulf Coast refineries is far reaching and therefore any impact to the Gulf Coast refining infrastructure can have consequences in places far away. In the next blog in this series, we'll walk through the timeline of events for Hurricane Harvey during the last week of August 2017. After that, we'll consider some "lessons learned" from Harvey and the steps being taken to help mitigate the effects of future hurricanes.

*"After the Storm" is the last track on Mumford & Sons debut studio album, Sigh No More, which was released in October 2009. The song was written by Marcus Mumford, Ben Lovett, Winston Marshall, and Ted Dwane. It's about hope, redemption, and that which came before, and that which lies ahead.*

*For those of us on the Gulf Coast, recovery is still ongoing from the devastation caused by Hurricane Harvey. Over 300,000 structures in the Gulf Coast region were flooded or destroyed and repairs are still underway. If you would like to donate to an organization engaged in rebuilding homes on the Gulf Coast, we would encourage you to look into SBP, Rebuilding Together Houston or Habitat for Humanity.*

*Note: The article was authored by Amy Kalt of Baker & O'Brien and published on RBN Energy's Daily Energy Post on August 26, 2018.*

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