



*Independent Statistics & Analysis*  
U.S. Energy Information  
Administration

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# East Coast and Gulf Coast Transportation Fuels Markets

A report prepared by ICF International for EIA

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## Acknowledgements

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## Introduction

This study, commissioned by the U.S. Energy Information Administration (EIA), examines supply, consumption, and distribution of transportation fuels in Petroleum Administration for Defense District (PADD) 1 and PADD 3. PADD 1 (the East Coast) is comprised of 17 states and the District of Columbia, most of which have coastlines along the Atlantic Ocean. PADD 3 (the Gulf Coast) is comprised of four states bordering the Gulf of Mexico (Texas, Louisiana, Mississippi, and Alabama), as well as Arkansas and New Mexico. A map of all five U.S. PADDs are shown in Figure 1 below.

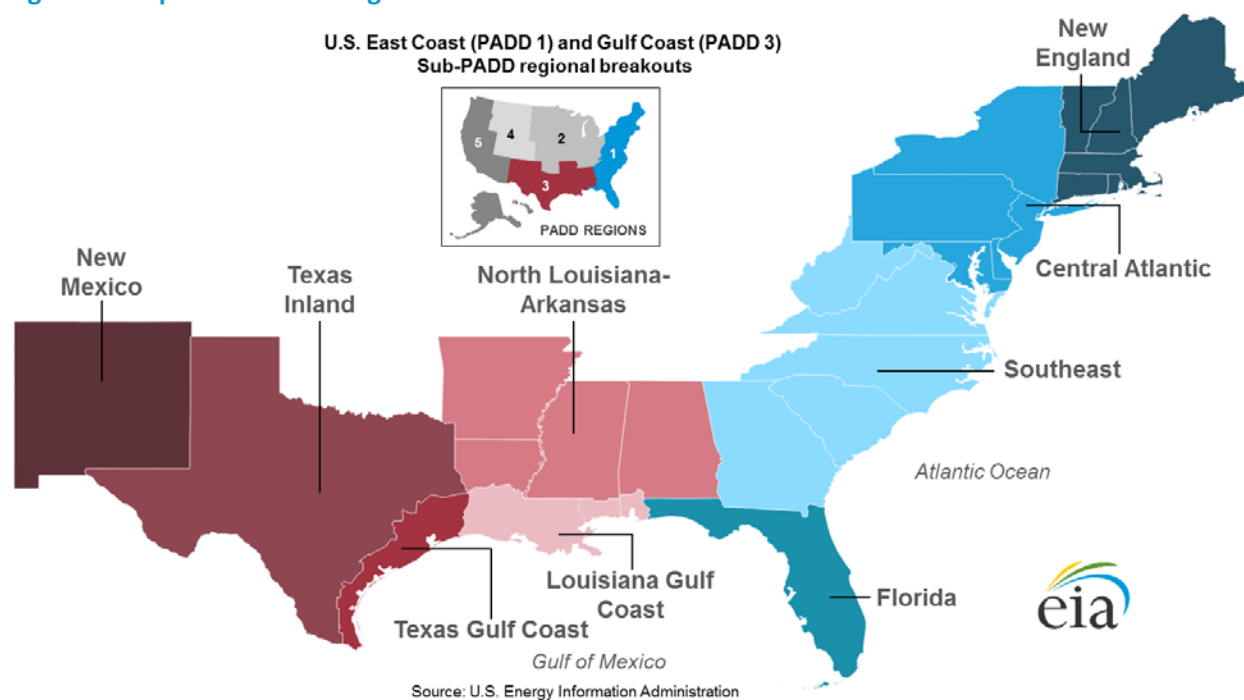
**Figure 1. Petroleum Administration for Defense Districts (PADDs)**



Source: U.S. Energy Information Administration

This study examines transportation fuels supply, consumption, and distribution at both the PADD level and for specific areas within each PADD, which are referred to as sub-PADD regions in this analysis. PADDs 1 and 3 cover a large and diverse geography, and supply/demand balances and supply patterns vary within each PADD. For the purpose of this study, the East Coast (PADD 1) has been sub-divided into four sub-PADD regions: New England, the Central Atlantic, the Southeast, and Florida. The Gulf Coast (PADD 3) has been sub-divided into five sub-PADD regions that correspond with EIA's refining districts: Texas Gulf Coast, which consists of Texas counties located on or just inland from the state's Gulf of Mexico coastline; Texas Inland, which consists of the remainder of Texas; Louisiana Gulf Coast, which includes coastal portions of Louisiana, Mississippi, and Alabama; North Louisiana-Arkansas, which consists of Arkansas and the inland portions of Louisiana, Mississippi, and Alabama; and New Mexico. The sub-PADD regions are summarized in Figure 2.

Figure 2. Map of sub-PADD regions



Source: U.S. Energy Information Administration

For each of these regional markets, as well as for PADDs 1 and 3, the study considers consumption, supply, supply patterns, and distribution infrastructure, using 2014 as a base year and taking into account expected changes in balances and infrastructure in subsequent years. Consumption includes in-region consumption, movements of fuels to other parts of the United States (other PADDs and sub-PADDs), and exports to the global market. Supply includes in-region refinery production, receipts of fuels produced in other U.S. regions and other PADD 1 and 3 regional markets, and imports. Distribution infrastructure includes storage terminals, pipelines, marine loading and unloading facilities, marine vessel availability, and rail facilities.

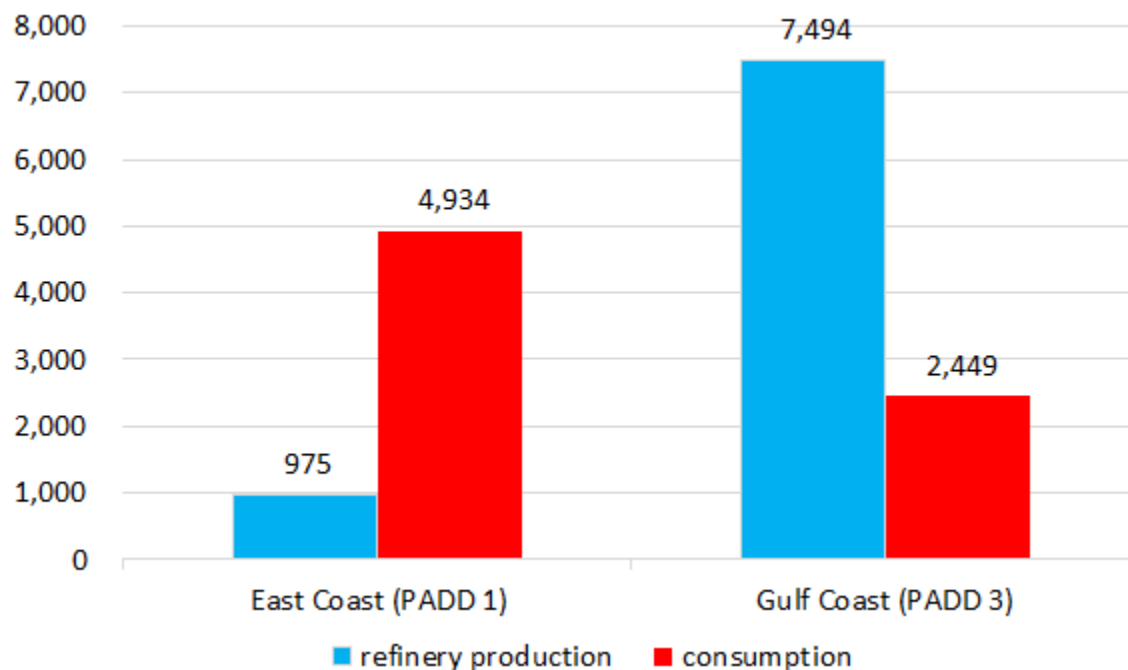
EIA retained ICF International, LLC, a Fairfax, Virginia-based energy, environment and transportation fuels consultant, to conduct the research and analysis for the PADD 1 and PADD 3 study. ICF analyzed data and information from EIA, Federal Highway Administration (FHWA), Airlines for America, the Federal Energy Regulatory Commission (FERC), the Army Corps of Engineers (USACE) Waterborne Commerce Statistics Center, the U.S. International Trade Commission (USITC), and publicly available data on companies and fuels infrastructure from company 10-K reports, investor presentations, and various other sources.

This study is the second in a series of studies that EIA plans to conduct to inform its analyses of petroleum product markets, especially during periods of supply disruption and market change. Additional studies are planned to analyze PADD 5 crude supply, and PADD 2 (Midwest) and PADD 4 (Rocky Mountains) transportation fuels markets.

## Executive Summary

Movement of transportation fuels (motor gasoline, distillates, and jet fuel) between the Gulf Coast (PADD 3) and East Coast (PADD 1) represents the largest movement of such products in the United States. This relationship is underpinned by supply/demand imbalances in each region. The Gulf Coast is the largest petroleum refining region in the country, producing 7.5 million barrels per day (b/d) of transportation fuels in 2014, or nearly half of total U.S. refinery production. Gulf Coast transportation fuels production is three times the region's consumption of 2.5 million b/d. The densely populated East Coast, by contrast, is the largest consuming region in the country, consuming more than 4.9 million b/d in 2014, accounting for more than one-third of total U.S. consumption. However, East Coast refinery production of transportation fuels is just under 1.0 million b/d or roughly 20% of the region's total consumption. Figure 3 below compares refinery production of transportation fuels against consumption in PADDs 1 and 3.

**Figure 3. East Coast and Gulf Coast transportation fuels production vs. consumption**  
thousand barrels per day



Source: Energy Information Administration, Supply and Disposition

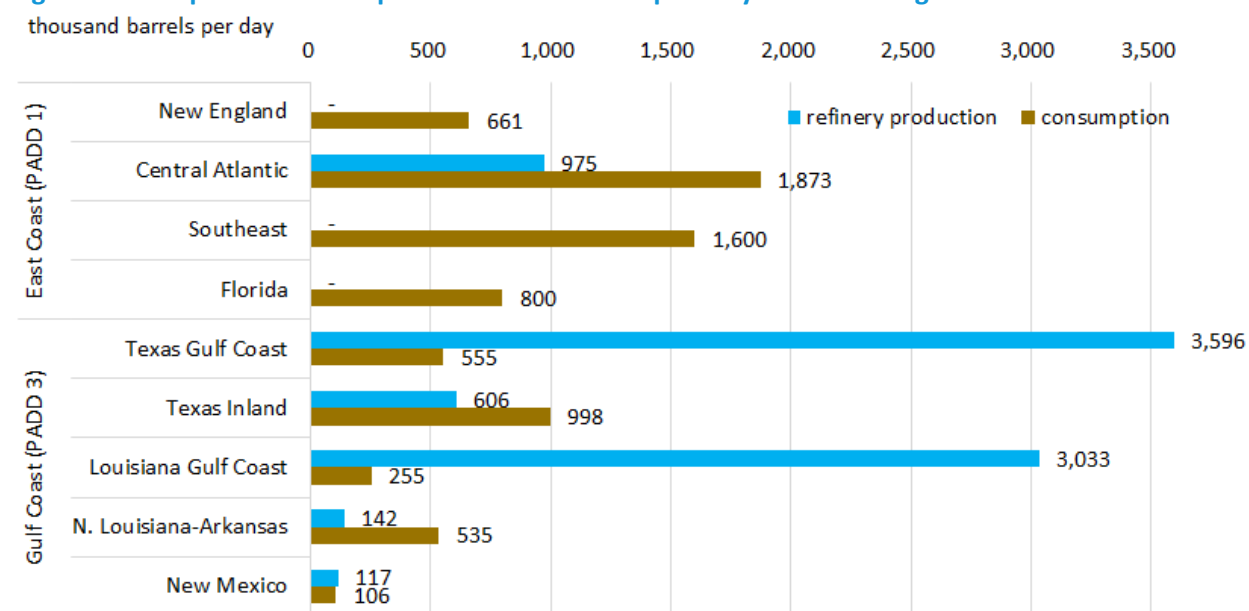
The deficit between East Coast production and consumption is primarily filled by pipeline and waterborne movements of transportation fuels from the Gulf Coast. In 2014, approximately 2.8 million b/d of transportation fuels were delivered from the Gulf Coast to locations in the East Coast, equal to 58% of the East Coast's total consumption. Critical to this inter-PADD trade are two interstate pipeline systems—the Colonial Pipeline and the Plantation Pipeline—which together supplied 2.3 million b/d of transportation fuels to East Coast markets, equal to 47% of the region's consumption.

The heavy concentration of refinery production in the Gulf Coast, and the East Coast's dependency on that production and on supply pipelines from the Gulf Coast, are simultaneously a strength and a weakness. The concentration of refining capacity in the Gulf Coast, and the connection of most of that capacity to the Colonial and Plantation pipelines, means that the unplanned loss of any one refinery—or even multiple refineries—can typically be compensated for by increasing production at other refineries in the region, or by drawing on the region's abundant inventories of transportation fuels. Furthermore, transportation fuel exports from the Gulf Coast are high—approximately 1.5 million b/d in 2014 or 20% of total Gulf Coast refinery production—meaning the region's refineries have a significant export buffer, allowing them to shift production away from exports to make up for shortages in domestic markets.

The concentration of refinery production in the Gulf Coast also presents a vulnerability to supply security in both PADDs. Designed to take advantage of the region's deepwater ports, Gulf Coast refineries and associated infrastructure are heavily concentrated in coastal areas, making them particularly vulnerable to disruption from hurricanes and other tropical weather patterns that threaten the Gulf Coast. These weather phenomenon can cause widespread damage to both crude oil and refined product infrastructure and can disrupt essential power supply, rendering refineries, terminals, and pipeline pumping stations inoperable. Several major hurricanes have disrupted the Gulf Coast's transportation fuels production and distribution infrastructure in recent years, including hurricanes Katrina and Rita in 2005, and Ike and Gustav in 2008.

### **Sub-PADD regions**

Supply/demand balances and supply logistics are not uniform within PADDs 1 and 3. This study examines four sub-PADD regional markets in PADD 1 and five regional markets in PADD 3, each of which is characterized by different supply and consumption patterns, and each of which interacts differently with other regions and global markets. Refinery production and consumption of transportation fuels in each of these sub-PADD regions is summarized in Figure 4.

**Figure 4. Transportation fuels production vs. consumption by sub-PADD region**

Source: ICF Analysis of EIA, FHWA, and Airlines for America data

Figure 4 shows that transportation fuels production and consumption vary significantly within each PADD. The Texas Gulf Coast and Louisiana Gulf Coast sub-PADD regions are the only two regions where transportation fuels production significantly outstrips consumption. The New Mexico market is essentially balanced, with refinery production only slightly exceeding consumption, while the remaining six regions are all net consumers of transportation fuels. The supply and consumption dynamics and supply logistics of each of sub-PADD region are briefly summarized in the sections below.

### East Coast (PADD 1)

#### *New England*

New England consumption for transportation fuels was 661,000 b/d in 2014. With no refineries operating in the region, New England is a net consumer of fuels. Markets in the New England region rely entirely on the delivery of petroleum products from outside the region, primarily delivered to coastal ports by marine tanker and barge but also, to a lesser degree, by rail and truck from New York and Canada. Distillate fuel oil consumption in New England is driven by heating oil consumption during the winter months. Swing supply to meet peak heating oil consumptions is satisfied by increased domestic deliveries from consumption centers in the Central Atlantic region and increased imports, primarily from Canada.

#### *Central Atlantic*

Central Atlantic consumption for transportation fuels was nearly 1.9 million b/d in 2014. The Central Atlantic refinery production of transportation fuels averaged nearly 1.0 million b/d in 2014, enough to meet more than half of in-region consumption. Much of the remainder of the region's supply came from pipeline movements, primarily from the Gulf Coast region via the Colonial Pipeline, and via foreign waterborne imports. As in New England, distillate consumption is seasonally driven by heating oil consumption during the winter months. Most supply in the Central Atlantic region passes through two

major supply hubs, located in the Greater Philadelphia and New York Harbor areas, before being distributed to coastal markets primarily by barge, or pushed to inland markets on the Buckeye and Sunoco Logistics pipeline systems.

### *Southeast*

Southeast consumption for transportation fuels was 1.6 million b/d in 2014. The Southeast has one operable refinery, located in West Virginia, but this refinery provides no transportation fuel to the region. Virtually all of the Southeast's supply came from the Gulf Coast via the Colonial and Plantation pipeline systems. Markets along the region's Atlantic coast also receive smaller volumes via ocean-going marine vessels from foreign and domestic sources, while markets in West Virginia receive fuel from Kentucky by truck and by river barge.

### *Florida*

Florida consumption for transportation fuels averaged 800,000 b/d in 2014. Consumption is high on a per capita basis due to the state's tourism industry, which brings in out-of-state visitors, and because of several large airports that serve as hubs for both domestic and international flights. Florida has no refineries and no exogenous pipelines provide fuel directly into the state. Florida's transportation fuel supply relies overwhelmingly on domestic- and foreign-sourced waterborne deliveries to the state's Atlantic and Gulf of Mexico ports (primarily to Port Everglades, Tampa, and Jacksonville), and—to a much lesser extent—on truck deliveries into northern Florida from neighboring states.

### *Gulf Coast (PADD 3)*

#### *Texas Gulf Coast*

The Texas Gulf Coast is the largest fuel producing region in PADDs 1 and 3 and refinery output of transportation fuels, at 3.6 million b/d, exceeds in-region consumption by more than 3 million b/d. The region's 17 refineries are clustered in three refining centers in the Houston, Port Arthur, and Corpus Christi areas. The majority of the region's refined product surplus is distributed via major interstate pipeline systems to markets throughout the country, including the Colonial Pipeline, the Explorer Pipeline, and the Enterprise TEPPCO Pipeline. These pipeline systems supply other markets in PADD 3 en route to larger markets in the East Coast (Colonial) and Midwest (Explorer and TEPPCO). In addition to these interstate systems, numerous smaller intrastate pipelines push fuel into Texas Inland markets. The Texas Gulf Coast region also ships significant volumes of transportation fuels to the East Coast (primarily Florida) via tanker and barge, and to export markets. In 2014, Texas Gulf Coast foreign exports averaged 864,000 b/d.

#### *Texas Inland*

Containing two-thirds of Texas's total population, the Texas Inland region accounts for the majority of the state's consumption for petroleum products—approximately 1.0 million b/d in 2014. The region's refinery production, at roughly 600,000 b/d, supplies 60% of consumption. The remaining supply is shipped in by pipeline from the Texas Gulf Coast. Texas Inland refineries, which are spread out throughout the state, focus primarily on producing transportation fuels, and yield of such fuels, at 91%, is higher than any other region in PADDs 1 and 3.

### *Louisiana Gulf Coast*

The Louisiana Gulf Coast is the second largest transportation fuel producing region in the PADDs 1 and 3, behind the Texas Gulf Coast. Production averaged more than 3.0 million b/d in 2014, exceeding in-region consumption by approximately 2.8 million b/d. The region has 16 refineries, which are clustered along the Lower Mississippi River between Baton Rouge and New Orleans in southeastern Louisiana, in the Lake Charles area in southwestern Louisiana, and in coastal Mississippi and Alabama. Production that is not consumed locally is shipped from the refining centers directly into the Colonial or Plantation pipeline systems or is shipped on feeder pipelines to storage hubs in Baton Rouge and Collins, Mississippi where they are staged for delivery into Colonial or Plantation systems. Production also moves on coastwise-complaint ships to markets in Florida, and up the Mississippi River to markets in the Midwest (PADD 2), or is exported. Foreign exports averaged 542,000 b/d in 2014.

### *North Louisiana-Arkansas*

Transportation fuels consumption in the North Louisiana-Arkansas region averaged 535,000 b/d in 2014. In-region refinery production was enough to meet approximately 25% of consumption. The remainder of supply is primarily delivered via the Colonial and Plantation pipelines to markets in Mississippi and Alabama and via the TEPPCO pipeline to markets in northern Louisiana and Arkansas. Smaller markets are also served by barge deliveries along the Mississippi River and other regional waterways.

### *New Mexico*

New Mexico's transportation fuel market is largely balanced, on an annual net basis, with in-state refinery production of 117,000 b/d only slightly exceeding consumption. Despite this net balance, significant volumes move in and out of the state by pipeline, with supply moving from New Mexico's Artesia refinery to a supply hub in El Paso, Texas, and supply from El Paso and the Texas Panhandle region moving into the state's primary consumption center in the Albuquerque-Santa Fe metropolitan area. Supply also moves through the state from El Paso to markets Arizona (PADD 5).

## **Conclusion**

The relationship between the Gulf Coast (PADD 3) and East Coast (PADD 1) markets is underpinned by inherent supply/demand imbalances: PADD 3 is characterized by a surplus of production while PADD 1 is characterized by a deficit. The supply/demand dynamics in specific markets within each PADD, however, can vary significantly. In PADD 3, the Texas Gulf Coast and Louisiana Gulf Coast regions, are the only two regions with excess refinery production. Other markets in PADD 3 are either internally balanced on a net basis (New Mexico) or rely on movements from the Texas and Louisiana Gulf Coast regions to meet consumption (Texas Inland and North Louisiana-Arkansas). Three of the four regions in the PADD 1 (New England, the Southeast, and Florida) have no refineries and are entirely dependent on pipeline or waterborne deliveries from neighboring regions or foreign imports to meet consumption. Each of these regions differs in their supply logistics, including access to major interstate pipeline systems and access to domestic and foreign waterborne supply. This report provides detailed descriptions of each region's unique transportation fuels consumption patterns and supply logistics to inform EIA analyses, especially during periods of supply disruption and market change.



## Overview

Movement of transportation fuels (motor gasoline, distillates, and jet fuel) between the Gulf Coast (PADD 3) and East Coast (PADD 1) represents the largest movement of such products in the United States. This relationship is underpinned by supply/demand imbalances in each region. The Gulf Coast is the largest petroleum refining region in the country, producing 7.5 million barrels per day (b/d) of transportation fuels in 2014, or nearly 50% of total U.S. refinery production. This compares with 2.5 million b/d of consumption in the Gulf Coast. The densely populated East Coast, by contrast, is the largest consuming region in the country, consuming more than 4.9 million b/d in 2014, accounting for more than 33% of total U.S. consumption. However, East Coast refinery production is just under 1.0 million b/d. Table 1 presents 2014 consumption of gasoline, distillate, and jet fuel in both PADDs and for each sub-PADD region. The table also indicates each PADD or sub-PADD region's share of total PADD and total U.S. consumption.

**Table 1. East Coast and Gulf Coast regional transportation fuels consumption**

thousand barrels per day, or %

Consumption by region	Gasoline			Distillate fuel			Jet fuel			Total
	2014	% of PADD	% of U.S.	2014	% of PADD	% of U.S.	2014	% of PADD	% of U.S.	2014
<b>East Coast (PADD 1)</b>										
New England	405	13%	5%	221	18%	5%	35	6%	2%	661
Central Atlantic	1,135	36%	13%	505	41%	13%	233	41%	16%	1,873
Southeast	1,051	34%	12%	384	31%	10%	166	29%	11%	1,601
Florida	535	17%	6%	135	11%	3%	130	23%	9%	800
<b>Total</b>	<b>3,126</b>	<b>100%</b>	<b>35%</b>	<b>1,244</b>	<b>100%</b>	<b>31%</b>	<b>564</b>	<b>100%</b>	<b>38%</b>	<b>4,935</b>
<b>Gulf Coast (PADD 3)</b>										
Texas Gulf Coast	311	22%	3%	179	22%	4%	66	36%	4%	556
Texas Inland	569	39%	6%	327	40%	8%	101	54%	7%	997
Louisiana Gulf Coast	141	10%	2%	105	13%	3%	8	4%	1%	254
North Louisiana-Arkansas	364	25%	4%	164	20%	4%	7	4%	0%	535
New Mexico	61	4%	1%	41	5%	1%	3	2%	0%	105
<b>Total</b>	<b>1,448</b>	<b>100%</b>	<b>16%</b>	<b>816</b>	<b>100%</b>	<b>20%</b>	<b>185</b>	<b>100%</b>	<b>12%</b>	<b>2,447</b>

Note: Totals may not sum due to independent rounding.

Source: ICF analysis of EIA, FHWA, and Airlines for America data

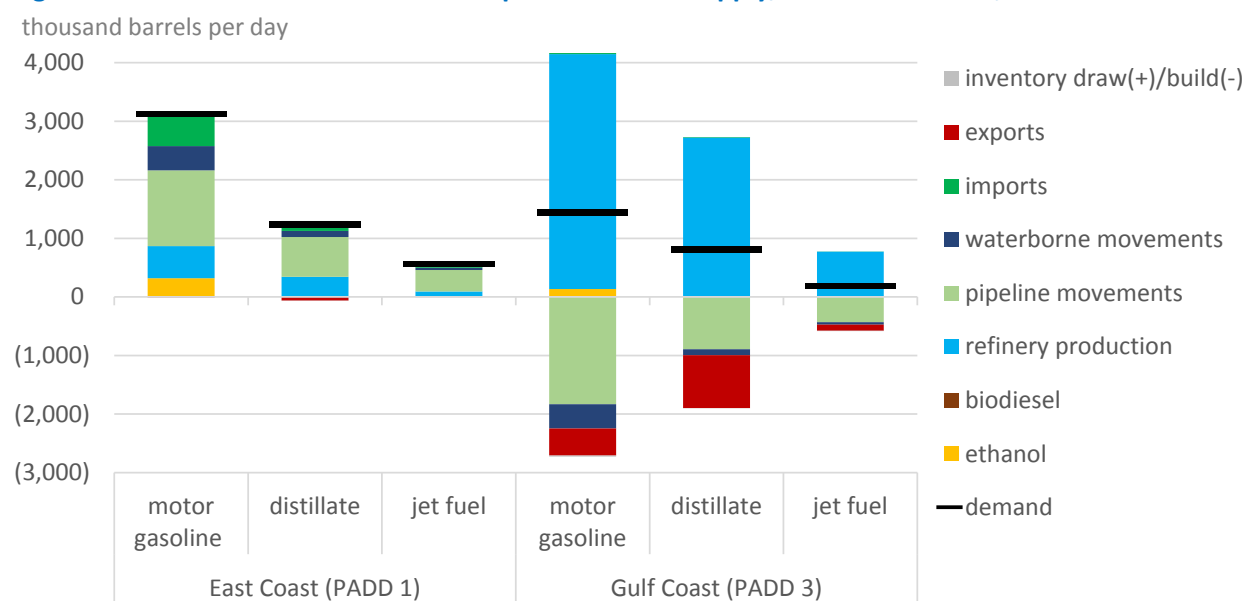
Table 1 shows that the East Coast consumed 3.13 million b/d of motor gasoline in 2014, accounting for 35% of total U.S. gasoline consumption; 1.24 million b/d of distillate (including diesel fuel), accounting for 31% of the U.S. total; and 564,000 b/d of jet fuel consumption, or about 38% the U.S. total. Within the PADD, consumption is concentrated in the Central Atlantic and Southeast regions. Meanwhile, the Gulf Coast consumes 1.45 million b/d of gasoline (16% of U.S. total); 816,000 b/d, of distillate (including diesel fuel) (20% of the U.S. total); and 187,000 b/d of jet fuel (13% of the U.S. total). Consumption is concentrated primarily in the Texas Gulf Coast and Texas Inland regions.



## Supply/demand balances

The East Coast supply/demand balance is characterized by a deficit of in-region transportation fuels production, with consumption met through domestic pipeline and waterborne supply from the Gulf Coast, and to a lesser extent from the Midwest (PADD 2), and through foreign waterborne imports into East Coast ports. By contrast, the Gulf Coast (PADD 3) balance is characterized by a surplus of transportation fuels supply, as refinery production far exceeds consumption within the PADD. Surplus production is delivered by pipeline and tanker/barge to markets throughout the country, including the East Coast, and is exported by tanker primarily to foreign markets in the Atlantic Basin. Figure 5 presents the motor gasoline, distillate, and jet fuel supply/demand balances for the East Coast and Gulf Coast in 2014. The figure breaks out sources of supply, including in-PADD refinery production, net pipeline movements to or from other PADDs, net waterborne movements to or from other PADDs, imports, exports, and net inventory changes. For a full accounting of supply, the figure also indicates how much ethanol was blended into gasoline (either in E10 or E85 blends) and how much biodiesel was blended into distillate fuels.

**Figure 5. East Coast and Gulf Coast transportation fuels supply/demand balances, 2014**



Note: All domestic movements and inventory changes are on a net basis

Source: ICF analysis of EIA, FHWA, and Airlines for America data

East Coast transportation fuels consumption is met through a combination of in-PADD refinery production (20%), net pipeline receipts from other PADDs (47%), net waterborne receipts from the Gulf Coast (11%), and foreign imports (16%). The remainder of supply is mostly ethanol, which is blended into gasoline at terminals and refineries before loading onto trucks, and to a much lesser extent biodiesel, which is blended with diesel fuel. A small volume of transportation fuels—less than 2% of total supply—is exported. While the East Coast has a diversity of supply sources, supply/demand profiles of specific sub-PADD regions can vary significantly. The New England and Florida sub-PADD regions, for instance, are highly dependent on domestic and foreign waterborne supplies delivered to coastal ports, while the Southeast sub-PADD region is more heavily dependent on pipeline deliveries from the Gulf

Coast. The Central Atlantic region is the only region of the East Coast where refinery production accounts for a significant portion of supply.

Gulf Coast transportation fuels consumption is met almost entirely by in-PADD refinery production. The Gulf Coast has a total of 52 refineries with a combined nameplate capacity of nearly 9.3 million barrels per calendar day (b/cd)<sup>1</sup>, which represents more than half of the total U.S. refining capacity. In 2014, these refineries produced 7.5 million b/d of transportation fuels; three times in-PADD consumption. Approximately 2.4 million b/d of this supply (31%) was consumed within the PADD; 3.2 million b/d (42%) was shipped to other PADDs by pipeline; 556,000 b/d (7%) was shipped to other PADDs by tanker/barge; and 1.5 million b/d (20%) was exported.

## Refineries

Table 2 lists the number and operable capacity of petroleum refineries in PADDs 1 and 3. The Gulf Coast and East Coast have a total of 61 refineries with a total atmospheric crude distillation unit capacity of 10.5 million barrels per calendar day (b/cd). The vast majority of this capacity—9.3 million b/cd or 88%—is located in the Gulf Coast region. Within the Gulf Coast region, refining capacity is further concentrated in the Texas Gulf Coast and Louisiana Gulf Coast sub-PADD regions, which together make up approximately 78% of total refining capacity in the two PADDs.

**Table 2. East Coast and Gulf Coast refineries and operable capacity, 2015**

Region	Number <sup>A</sup>	Operable capacity, b/cd <sup>B</sup>	Share of PADDs 1 & 3 total
<b>East Coast (PADD 1)</b>			
Central Atlantic <sup>C</sup>	9	1,268,500	12%
<b>Total</b>	<b>9</b>	<b>1,268,500</b>	<b>12%</b>
<b>Gulf Coast (PADD 3)</b>			
Texas Gulf Coast	17	4,550,476	43%
Texas Inland	8	683,271	6%
Louisiana Gulf Coast	16	3,654,800	35%
North Louisiana-Arkansas	9	242,920	2%
New Mexico	2	127,500	1%
<b>Total</b>	<b>52</b>	<b>9,258,967</b>	<b>88%</b>
<b>PADDs 1 &amp; 3 total</b>	<b>61</b>	<b>10,527,467</b>	<b>100%</b>

(A) Count only includes refineries with atmospheric crude distillation capacity

(B) Barrels per calendar day, as of Jan. 1, 2015

(C) Includes Newell, West Virginia refinery, which is in the Southeast region but logistically part of the Central Atlantic supply network.

Source: U.S. Energy Information Administration, Refinery Capacity Report

The concentration of refining capacity in the Gulf Coast reflects the growth of a petroleum refining industry cluster, developed over decades, based on the geographic proximity of crude oil production,

<sup>1</sup> Barrels per calendar day is a measure of the amount of input that a distillation unit can process in a 24-hour period under usual operating conditions. It takes into account both planned and unplanned maintenance. Stream day capacity is the maximum number of barrels of input that a distillation facility can process within a 24-hour period when running at full capacity under optimal crude and product slate conditions with no allowance for downtime. Stream day capacity is typically about 6% higher than calendar day capacity.

access to foreign waterborne crude oil imports via deepwater ports, including the Louisiana Offshore Oil Port (LOOP), and a product distribution system that is well-connected by pipeline and marine infrastructure to major consumer markets in the East Coast (PADD 1), the Midwest (PADD 2), and even eastern portions of the West Coast (PADD 5). The Gulf Coast refining cluster leverages business efficiencies from abundant liquids storage capacity and actively traded markets for crude oil, transportation fuels, gas oil, naphtha, residual fuels, petrochemicals, natural gas liquids (NGLs), lubes, specialty products, and asphalt, as well as numerous support services.

The concentration of refining capacity also presents a vulnerability to supply security, especially for coastal refineries, which can be disrupted in the short-term by hurricanes from the Gulf of Mexico and, in the longer term, by potential sea level rise. Gulf Coast refineries experienced significant disruptions during hurricanes Katrina and Rita (2005) and hurricanes Gustav and Ike (2008). Although less common, East Coast refineries, and associated distribution infrastructure, are also exposed to severe weather, such as Hurricane Irene in 2011 and Superstorm Sandy in 2012.

Refinery capacity in the Gulf Coast and East Coast have trended in opposite directions since 2000. East Coast refining capacity has contracted 24% from 1.7 million b/d in 2000 to 1.3 million b/d in 2015 due to refinery closures, which saw the total number of operable refineries drop from 17 to 9 over the same time period.<sup>2</sup> Meanwhile, the number of operable refineries on the Gulf Coast has largely remained constant, but total refining capacity has expanded due primarily to major expansions of existing refineries (such as Motiva's Port Arthur, Texas, refinery and Marathon's Garyville, Louisiana, refinery), as well as process debottlenecking and optimization, and smaller expansions, many of which have been designed to process more domestically-produced light oil stemming from the shale oil revolution. Gulf Coast refining capacity has expanded 22% from 7.6 million b/d in 2000 to 9.3 million b/d in 2015.<sup>3</sup>

### Refinery Yields

At a typical refinery, each barrel of crude oil processed yields approximately 0.8 to 0.85 barrels of transportation fuels. However, refiner yields can vary from refinery to refinery due to a number of factors, including the type of crude oil processed and the specific configuration of the refinery's processing units. All things equal, a refinery processing light sweet, crude produces higher yields of lighter, cleaner products (which are primarily used as transportation fuels), while a refinery processing heavy, sour crude will produce higher yields of heavier products, such as asphalt and residual fuel oil. Regardless of the crude type, refiners can increase yields of transportation fuels by the addition of secondary processing units that crack, combine, and reshape molecules from initial crude distillation yields. In such a way, a sophisticated refinery with the right configuration of secondary units can produce a higher yield of transportation fuels from a heavy crude stream than a simple refinery running a lighter crude stream.

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<sup>2</sup> U.S. Energy Information Administration, "Number and Capacity of Petroleum Refineries," (Accessed January 8, 2016), [http://www.eia.gov/dnav/pet/pet\\_pnp\\_cap1\\_dcu\\_R10\\_a.htm](http://www.eia.gov/dnav/pet/pet_pnp_cap1_dcu_R10_a.htm).

<sup>3</sup> U.S. Energy Information Administration, "Gulf Coast (PADD 3) Refinery Operable Atmospheric Crude Oil Distillation Capacity as of January 1," (Accessed January 8, 2016), [http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=8\\_NA\\_8D0\\_R30\\_4&f=A](http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=8_NA_8D0_R30_4&f=A).

The makeup of the U.S. refining system reflects the sum of individual refinery configurations, processing of different domestic and foreign crude oil varieties, and the regional market consumption patterns and regulatory requirements, all of which drive refinery investment and yield patterns. Table 3 shows the average refinery yields in 2014 for the United States, the East Coast, the Gulf Coast, and for individual sub-PADD regions within the Gulf Coast. Refinery yields are broken out between transportation fuels (gasoline, distillate, and jet fuel) and other products, including petrochemical feedstocks, residual fuels, petroleum coke, lubricants, and other—a category, which includes LPG, asphalt and road oil, still gas, kerosene, special naphthas, waxes and miscellaneous petroleum products. The table also indicates the “volume gain”, which is represented as a negative value and indicates the volume gained from distilling and cracking heavier crude oil into lighter, less dense products.

**Table 3. U.S., East Coast, and Gulf Coast refinery yields by sub-PADD region, 2014**

Percent (%)

Product	U.S. total	East Coast (PADD 1)	Gulf Coast (PADD 3)	Gulf Coast (PADD 3) sub-PADD regions				
				Texas Gulf Coast	Texas Inland	Louisiana Gulf Coast	N. Louisiana-Arkansas	New Mexico
<b>Transportation fuels</b>								
Gasoline	45.0	46.1	42.1	41.5	53.4	41.3	26.3	50.4
Distillate	29.9	29.1	31.7	31.4	31.3	31.5	36.8	39.4
Jet fuel	9.6	8.1	9.1	8.4	6.4	11.1	2.9	0.0
<b>Total</b>	<b>84.5</b>	<b>83.3</b>	<b>82.9</b>	<b>81.3</b>	<b>91.1</b>	<b>83.9</b>	<b>66.0</b>	<b>89.8</b>
<b>Other products</b>								
Petchem. feedstocks	2.0	0.3	3.3	4.4	0.5	2.7	0.1	0.0
Residual	2.7	4.9	2.2	1.8	1.0	3.1	-2.1	3.8
Pet. coke	5.4	2.8	5.8	6.8	2.2	5.7	2.0	1.2
Lubricants	1.0	1.1	1.5	1.3	0.1	1.4	12.5	-
Other	11.2	12.3	11.6	11.7	10.9	10.8	22.9	7.4
<b>Total</b>	<b>22.3</b>	<b>21.4</b>	<b>24.4</b>	<b>26</b>	<b>14.7</b>	<b>23.7</b>	<b>35.4</b>	<b>12.4</b>
Volume gain	(6.7)	(4.5)	(7.2)	(7.5)	(6.1)	(7.5)	(1.6)	(2.4)

Notes: Totals may not equal sum of components due to independent rounding. Total yields exceed 100% due to processing gains (volume gain). Based on crude oil input and net reruns of unfinished oils.

Source: Energy Information Administration, Petroleum Supply Monthly

Table 3 indicates that the yield of transportation fuels in the East Coast and Gulf Coast are nearly identical at 83.3% and 82.9% of refinery input, respectively, compared to the U.S. average of 84.5%. Gulf Coast gasoline yield is nearly 3 percentage points lower than the U.S. average due to volumes of naphtha and other petrochemical feedstocks that are diverted from the gasoline producing process units, as well as higher distillate production versus gasoline. Jet fuel yields in both the East Coast and Gulf Coast are slightly below the U.S. average due primarily to very high jet fuel yields in the West Coast (PADD 5) where refineries are configured to produce more jet fuel. Overall volume gain per barrel of input in the Gulf Coast is 2.7 percentage points higher than the East Coast due to the greater use of coking units, which upgrade heavy residuals from crude distillation into lighter components. This also is evident from the Gulf Coast’s higher yield of petroleum coke.

Product yield patterns in the Gulf Coast sub-PADD regions will be discussed in greater detail in the chapters of this report covering those regions. While yield patterns in the Texas Gulf Coast and Louisiana Gulf Coast are largely consistent with yields in the overall PADD, the smaller sub-PADD regions (New Mexico, Texas Inland, and North Louisiana-Arkansas) exhibit greater variability due to fewer refineries in each grouping.

Refiners' investment decisions are influenced by long-term market trends in both product consumption and crude supply. Declining gasoline consumption in the U.S. and growth in distillate export markets have led a number of refiners to add process units to increase distillate yield at the expense of gasoline. Similarly, the rapid increase in domestic shale oil supply over the past few years has led refiners to modify refineries to allow higher processing rates of light, sweet crude. Steered by these dynamics, Gulf Coast refineries have exhibited a fundamental shift in product yields over the past decade. Since 2005, yields of distillate fuel oil at Gulf Coast refineries have expanded by more than 7 percentage points from 24.5% in 2005 to 31.7% in 2014.<sup>4</sup> The increase in distillate yield has been at the expense of residual, jet fuel, and gasoline yields across the same timeframe. Yield changes in East Coast are less transparent as there have been numerous refinery closures and re-starts over the period, which have impacted the basis for the trend.

### Supply and logistics

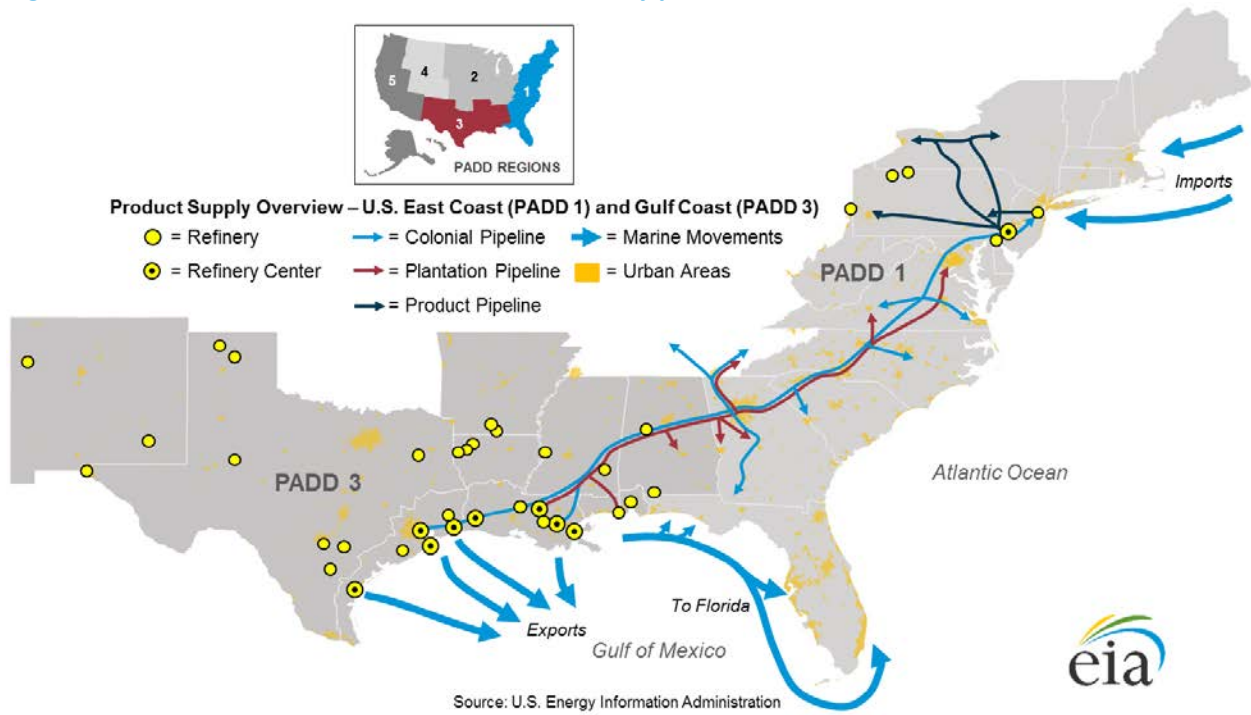
The East Coast and Gulf Coast are highly dependent on each other to balance supply and consumption. East Coast transportation fuels consumption is met through a number of supply sources but none is more important than supply from the Gulf Coast. Conversely, surplus supply in the Gulf Coast is distributed to a number of domestic and foreign markets, but none is larger than the East Coast. Critical to this inter-PADD trade are two interstate pipeline systems—the Colonial Pipeline and the Plantation Pipeline. In 2014, these two pipelines moved approximately 2.6 million b/d of transportation fuels from the Gulf Coast to the East Coast, including around 300,000 b/d that was shipped through the East Coast to destinations in Tennessee, which is part of the Midwest (PADD 2). The net movement to the East Coast on these systems—2.3 million b/d—is equal to 47% of total East Coast consumption and 30% of Gulf Coast supply. An additional 0.5 million b/d is shipped from the Gulf Coast to the East Coast via coastwise-compliant tankers and barges, primarily to ports in Florida. Altogether, net pipeline and waterborne shipments from the Gulf Coast to delivery points in the East Coast are equal to 58% of East Coast consumption and 37% of Gulf Coast supply.

Figure 6 presents the paths of the Colonial and Plantation pipeline systems, as well as other key pipeline systems, refining centers, ports, and terminals in the East Coast and Gulf Coast PADDs.

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<sup>4</sup> U.S. Energy Information Administration, "Gulf Coast (PADD 3) Refinery Yield of Distillate Fuel Oil," (Accessed January 8, 2016), <https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=MDIRYP33&f=A>.

Figure 6. East Coast and Gulf Coast refineries and key product flows



## Pipelines

The Colonial and Plantation pipelines are the two key inter-PADD pipeline systems delivering transportation fuels from refining centers in the Gulf Coast to consumption centers on the East Coast. These two pipelines, which have a combined throughput capacity of 3.2 million b/d, typically operate at or near full capacity. In 2014, Colonial and Plantation delivered fuel to markets in the Gulf Coast (Mississippi and Alabama) before moved approximately 2.6 million b/d of transportation fuels to the East Coast. Around 300,000 b/d of this volume was shipped through the East Coast to destinations in Tennessee, which is part of the Midwest (PADD 2). These systems, including destination regions, origin regions, and throughput capacities are summarized in Table 4, and are described in detail in the sections below.

**Table 4. Major Gulf Coast to East Coast pipeline systems**

Pipeline System	Origin Regions	Destination Regions	Capacity, b/d
Colonial Pipeline	Texas Gulf Coast Louisiana Gulf Coast	North Louisiana-Arkansas Southeast Central Atlantic Tennessee (in PADD 2)	2,530,000
Plantation Pipeline	Louisiana Gulf Coast	North Louisiana-Arkansas Southeast Tennessee (in PADD 2)	700,000

Source: Colonial Pipeline, Plantation Pipeline

In addition to these inter-PADD pipelines, several pipeline systems play important roles in moving product within the East Coast—the Buckeye and Sunoco Logistics pipeline systems—and in moving product within the Gulf Coast and from the Gulf Coast to the Midwest and West Coast—the TEPPCO, Magellan, Explorer, and Kinder Morgan SFPP pipeline systems. These pipelines will be discussed in greater detail in the regional chapters of this report.

### Colonial Pipeline

The 2.5 million b/d Colonial Pipeline is one of two major interstate pipelines systems supplying petroleum products from Gulf Coast refining centers to Mississippi and Alabama in PADD 3, and the Southeast and Central Atlantic regions in PADD 1. The Colonial system consists of 5,500 pipeline-miles and has connections to 29 refineries and 267 customer terminals.<sup>5</sup> Colonial, which is a common carrier pipeline<sup>6</sup>, operates on a five-day shipping cycle and typically runs at full capacity due to high demand by shippers and a lack of cost-effective alternatives for moving products from the Gulf Coast to the East Coast.

The Colonial mainline system is made up of four segments, which are divided into a southern system (Lines 1 and 2), with a capacity of 2.5 million b/d, and northern system (Lines 3 and 4), with a capacity of

<sup>5</sup> Whitehead, Sam. “Colonial Pipeline Company: Moving the Energy that Moves America” (Accessed December 15, 2015), Office of Public & Government Affairs, <http://www.ncleg.net/DocumentSites/Committees/HSCIEAF/Meetings/2012%20February%208/Presentations%20and%20Handouts/Whitehead%20-%20Colonial%20Pipeline%202-8-12.pdf>.

<sup>6</sup> As defined by FERC and in the code of federal regulations, a common carrier pipeline is one that transmits oil or other petroleum products across state borders, and which does not meet the “private line” test upheld in *Valvoline Oil Co. v. U.S.*, 308 U.S. 141 (1939). Common carrier pipelines are subject to FERC oversight under the Interstate Commerce Act.



1.4 million b/d. These segments and their capacities are summarized in Table 5. A major juncture in the system is in Greensboro, North Carolina, where products shipped on dedicated gasoline and distillate lines (Lines 1 and 2, respectively) are delivered into breakout tankage before being batched into mixed products lines for northbound delivery on Lines 3 and 4.

**Table 5. Colonial Pipeline Company mainlines**

Line	Fuel	From	To	Capacity, b/d
<b>Southern Lines</b>				
Line 1	Gasoline	Houston, TX	Greensboro, NC	1,370,000
Line 2	Distillate	Houston, TX	Greensboro, NC	1,160,000
<b>Total</b>				<b>2,530,000</b>
<b>Northern Lines</b>				
Line 3	Mixed Products	Greensboro, NC	Linden, NJ	885,000
Line 4	Mixed Products	Greensboro, NC	Dorsey, MD	504,000
<b>Total</b>				<b>1,389,000</b>

Source: Colonial Pipeline, trade press

Supply on the Colonial Pipeline originates in the Gulf Coast. Major injection points are located in the Texas Gulf Coast region (Houston, Pasadena, Beaumont, and Port Arthur); in the Louisiana Gulf Coast region (Lake Charles, Krotz Springs, and Baton Rouge); and in the North Louisiana-Arkansas region (Collins, Mississippi, and Moundville, Alabama). The Colonial system receives products from several connecting pipeline systems that deliver supply from Louisiana refineries to Colonial receipt points in Baton Rouge and Collins, including the Bengal Pipeline and the Collins Pipeline. The Collins facility is a critical point on the Colonial system. In 2005, following widespread damage to the Gulf Coast's electric transmission and distribution system, Colonial's Collins terminal (including its pump station) was without power for several days, cutting off northbound flows on the system from Collins, leading to fuel shortages in parts of the Southeast, and increased prices across the eastern Seaboard.<sup>7</sup>

The Colonial Pipeline delivers products to markets in PADDs 3 and 1. Major metropolitan areas served from Colonial's mainline include Birmingham, Alabama; Atlanta, Georgia; Charlotte, North Carolina; Richmond, Virginia; Washington, DC; Baltimore, Maryland; Philadelphia, Pennsylvania; and New York, New York. In addition, Colonial spur lines push fuel into secondary markets. From Atlanta, spur lines deliver products north into Tennessee (in PADD 2), and south into central and southern Georgia. From Mitchell Junction in Virginia a spur delivers fuel to Richmond and the Norfolk and Virginia Beach areas. Other spur lines supply markets in North and South Carolina and in western Virginia. Colonial delivers products into several connecting pipeline systems in the Central Atlantic region, including the Buckeye and Sunoco Logistics systems. Colonial has direct connections to seven major airports and has transfer service to three airports in New York City area via an interconnection with the Buckeye Pipeline system. Colonial also delivers products to five U.S. military installations, from which up to 10 additional bases from North Carolina to Maine are served.<sup>8</sup>

Markets in the Southeast are highly dependent on the Colonial Pipeline for petroleum product supply. Colonial delivers more than 70% of the transportation fuels supply to Georgia, South Carolina, North

<sup>7</sup> U.S. Department of Energy: Office of Electricity Delivery and Energy Reliability, "Comparing the Impacts of the 2005 and 2008 Hurricanes on U.S. Energy Infrastructure" (Accessed December 12, 2015), <http://energy.gov/oe/downloads/comparing-impacts-2005-and-2008-hurricanes-us-energy-infrastructure-february-2009>.

<sup>8</sup> Ibid.



Carolina, and Virginia. Colonial also provides 30% to 70% of the fuel supply to Alabama in the North Louisiana-Arkansas region, and Maryland in the Central Atlantic region.<sup>9</sup> The Plantation pipeline system, and to a lesser extent receipts at coastal ports, make up the balance of supply in these states.

### *Plantation Pipeline*

The 700,000 b/d Plantation Pipeline, a joint-venture between Kinder Morgan and ExxonMobil, supplies products from Gulf Coast refining centers to markets in PADD 3 (Mississippi and Alabama) and the Southeast region in PADD 1. The Plantation system consists of 3,100 miles of pipeline and 36 pumping stations, and has connections to 90 terminals at 34 delivery locations.<sup>10</sup> The Plantation Pipeline system is made up of three major segments: a supply segment, a mainline segment, and an extension segment.

The supply segment consists of two lines—originating at supply centers in Baton Rouge, Louisiana, and Pascagoula, Mississippi—that meet in Collins, Mississippi. At Collins, the Plantation system can also receive products from connecting pipeline systems, including the Parkway Pipeline. From Collins, Plantation’s mainline extends northeast to Greensboro, North Carolina. Major metropolitan areas served from Plantation’s mainline include Birmingham, Alabama; Atlanta, Georgia; and Charlotte, North Carolina. From Greensboro, an extension segment pushes products north to Richmond, Virginia, and the Washington, DC, metropolitan area. Plantation directly serves four major airports along its mainline and extension segments. Flows on the Plantation system ramped up throughout 2014 from an average of 600,000 b/d in the first quarter to an average of 663,000 b/d in the fourth quarter.<sup>11</sup>

### *Ports*

Waterborne movements—both coastwise and internal river movements—connect supply and consumption centers between and within the Gulf Coast and East Coast PADDs. Table 6 lists the volume of inbound and outbound waterborne shipments of transportation fuels at ports in each PADD and each sub-PADD region in 2013, the latest year for which domestic waterborne data is available from the U.S. Army Corp of Engineers (USACE). The table shows estimated movements broken out between domestic shipments, as tracked by USACE, foreign imports as tracked by EIA, and foreign exports, as tracked by the U.S. International Trade Commission (USITC) using U.S. Census data. Many ports in the Central Atlantic, Texas Gulf Coast, and Louisiana Gulf Coast regions have both inbound and outbound movements of transportation fuels, with some shipments originating and terminating wholly within those regions. For example, in the Central Atlantic region refined product terminals in the New York Harbor area ship volumes up the Hudson River to Albany, New York, and this movement is registered both as an outbound domestic movement in New York Harbor and an inbound movement in Albany. As a result, the totals for inbound and outbound movements characterize the level of waterborne activity in each region, but involve some double-counting of volumes.

<sup>9</sup> Whitehead, Sam. “Colonial Pipeline Company: Moving the Energy that Moves America” (Accessed December 15, 2015), Office of Public & Government Affairs, <http://www.ncleg.net/DocumentSites/Committees/HSCIEAF/Meetings/2012%20February%2008/Presentations%20and%20Handouts/Whitehead%20-%20Colonial%20Pipeline%202-8-12.pdf>.

<sup>10</sup> Kinder Morgan, “Products Pipelines: Plantation Pipeline,” (Accessed January 6, 2016), [http://www.kindermorgan.com/business/products\\_pipelines/plantation.aspx](http://www.kindermorgan.com/business/products_pipelines/plantation.aspx).

<sup>11</sup> FERC Financial Report FERC Form No. 6: Annual Report of Oil Pipeline Companies and Supplemental Form 6-Q: Quarterly Financial Report of Planation Pipeline Company (2014/Q1, 2014/Q2, 2014/Q3, 2014/Q4).

**Table 6. Waterborne movements of transportation fuels at East Coast and Gulf Coast ports, 2013**

PADD/sub-PADD region	Inbound			Outbound		
	Domestic	Foreign	Total	Domestic	Foreign	Total
<b>East Coast (PADD 1)</b>						
New England	263,278	296,077	559,353	4,586	88	4,674
Central Atlantic	207,438	206,191	413,629	480,547	106,759	587,306
Southeast	44,886	27,327	71,916	8,092	619	8,711
Florida	553,674	89,239	642,913	1,479	2,638	4,117
<b>PADD 1 total</b>	<b>1,069,276</b>	<b>618,834</b>	<b>1,687,811</b>	<b>494,704</b>	<b>110,104</b>	<b>604,808</b>
<b>Gulf Coast (PADD 3)</b>						
Texas Gulf Coast	56,382	33,236	89,618	169,755	875,723	1,045,478
Texas Inland	-	-	-	-	-	-
Louisiana Gulf Coast	30,601	8,936	39,537	421,006	717,903	1,138,909
North Louisiana-Arkansas	31,073	-	31,073	-	-	-
New Mexico	-	-	-	-	-	-
<b>PADD 3 total</b>	<b>118,056</b>	<b>42,172</b>	<b>160,228</b>	<b>590,761</b>	<b>1,593,626</b>	<b>2,184,387</b>
<b>PADDs 1 and 3 total</b>	<b>1,187,332</b>	<b>661,004</b>	<b>1,848,336</b>	<b>1,085,465</b>	<b>1,703,730</b>	<b>2,789,195</b>

Note: includes movements of gasoline, distillate, and jet fuel only

Source: U.S. Army Corp of Engineers 2013 Waterborne Commerce of the United States Waterways and Harbors; EIA Company Level Imports, 2013; U.S. International Trade Commission, 2013

Table 6 indicates that significant inbound and outbound shipments of transportation fuels occur in both PADDs. The Gulf Coast region, particularly the Texas Gulf Coast and Louisiana Gulf Coast sub-PADD regions, are characterized by large outbound shipments of products—2.2 million b/d in 2013—which are primarily delivered to markets in the East Coast (primarily Florida) and export destinations, but also to coastal and riverine markets within PADD 3, and to riverine markets in the Midwest (PADD 2). The East Coast is characterized by various inbound and outbound movements. Ports in Florida primarily receives products from Gulf Coast supply centers and via foreign imports. The Southeast receives domestic receipts and imports at Atlantic coast ports, but also at river ports in West Virginia. Ports in the Central Atlantic region (primarily in New York Harbor and along the Delaware River) receive foreign imports and distribute products from a variety of supply sources to markets in New England and to other ports within the Central Atlantic region. New England receives waterborne imports from Canada and domestic receipts from Central Atlantic region ports.

The most important inter-PADD waterborne movement is between ports in the Gulf Coast (in the Texas Gulf Coast and Louisiana Gulf Coast regions) and ports in the East Coast (primarily Florida). In 2013 and 2014, waterborne shipments of transportation fuels from the Gulf Coast to the East Coast averaged more than 500,000 b/d.<sup>12</sup> Much smaller volumes of fuel also moved internally along the Mississippi River between the Gulf Coast and the Midwest, and along the Ohio River from the Midwest to the East Coast (from the refinery in Catlettsburg, Kentucky to ports in West Virginia and southwest Pennsylvania). The most important intra-PADD movement of transportation fuels is from New York Harbor to ports in New

<sup>12</sup> U.S. Energy Information Administration, "Movements by Tanker and Barge between PAD Districts," (Accessed January 8, 2016), [http://www.eia.gov/dnav/pet/pet\\_move\\_tb\\_dc\\_R10-R30\\_mbbbl\\_a.htm](http://www.eia.gov/dnav/pet/pet_move_tb_dc_R10-R30_mbbbl_a.htm).

England and up the Hudson River to Albany. In 2013, domestic receipts at New England ports averaged 263,000 b/d, while receipts on the Hudson River averaged 120,000 b/d.

The Merchant Marine Act of 1920, also known as the Jones Act, requires that all goods transported by water between U.S. ports be carried on U.S.-flag ships that were built in the United States, and are owned, staffed, and maintained by U.S. citizens. Such vessels are considered “coastwise-compliant.” The supply of coastwise-compliant ships capable of transporting petroleum products has fallen in recent years as older ships have been removed from service and as coastwise-compliant tankers and barges have been increasingly employed in the movement of domestic crude oil between U.S. ports. According to the U.S. Maritime Administration, there were 46 coastwise-compliant tankers with a combined gross tonnage of 2.0 million tons as of October 2014.<sup>13</sup>

### Supply vulnerability

The relationship between the East Coast and Gulf Coast PADDs is characterized by supply and consumption imbalances. The Gulf Coast PADD is characterized by a surplus of transportation fuels supply. In 2014, refinery production averaged 7.5 million b/d, exceeding in-PADD consumption by more than 200%. The heavily populated East Coast, by contrast, met only 20% of its transportation fuels consumption through in-PADD refinery production in 2014. The remainder was met primarily by imports (16%) and pipeline and waterborne shipments from other PADDs (58%). The vast majority of inter-PADD shipments to the East Coast originated in the Gulf Coast, with more than 2.3 million b/d, or nearly half of total East Coast consumption, supplied to East Coast destinations via two pipeline systems (Colonial and Plantation).

The heavy concentration of refining infrastructure in the Gulf Coast, and the East Coast’s dependency on that infrastructure and on transportation infrastructure to move supply, is simultaneously a strength and a weakness. The concentration of refining assets in the Gulf Coast allows refiners the flexibility to manage operational issues (planned maintenance, unscheduled outages, etc.) by arranging product exchanges or purchases and sales to fulfill pipeline nomination commitments. Similarly, geographic concentration better positions refiners to sell surplus crude or unfinished stocks (naphtha, gas oil, etc.) to other refiners during unplanned outages. Furthermore, transportation fuel exports from the Gulf Coast are high—approximately 1.5 million b/d in 2014—allowing regional refineries the ability to shift production away from exports to make up for shortfalls in domestic markets. As a result, the loss of any one—or even multiple—refineries in the Gulf Coast are unlikely to lead to product shortages in dependent U.S. markets.

The concentration of critical supply infrastructure in the Gulf Coast is also a considerable vulnerability due to Gulf Coast’s exposure to hurricanes and other tropical weather patterns, which can cause widespread damage to both crude and refined product infrastructure or disrupt essential power supply, rendering refineries, terminals, and pipeline pumping stations inoperable. In recent years, several major hurricanes have devastated Gulf Coast refining centers and associated transportation infrastructure. The

<sup>13</sup> U.S. Department of Transportation Maritime Administration (MARAD), “United States Flag Privately-Owned Merchant Fleet Summary,” (October 30, 2015), [http://www.marad.dot.gov/wp-content/uploads/pdf/DS\\_CY15-US-Flag-Fleet-Summary-20151030.pdf](http://www.marad.dot.gov/wp-content/uploads/pdf/DS_CY15-US-Flag-Fleet-Summary-20151030.pdf).

impacts from hurricanes Katrina and Rita in 2005, and Hurricanes Ike and Gustav in 2008 are documented in a [2009 report](#) by the DOE Office of Electricity Delivery and Energy Reliability.<sup>14</sup> The impacts from these storms stemmed from both disruptions to refinery production, as well as disruptions to key pipelines transporting products from the Gulf Coast to the East Coast and other PADDs. A number of industry stakeholders (refiners, pipelines, etc.) have made investments since 2005 and 2008 to improve resilience and harden supply assets in the Gulf Coast, as well as to improve response and restoration planning. These efforts include investments in backup power generators, flood walls, and elevation of equipment, among others.

The dependence of the East Coast on the Colonial and Plantation pipelines to meet consumption is also a major vulnerability. Following Hurricane Katrina in 2005, power outages to key pumping facilities in Mississippi rendered both pipelines inoperable, cutting off transportation fuels supply to dependent markets across Southeast and the eastern Seaboard. Supply from these pipelines is difficult to replace in many markets in the Southeast that lack waterborne access. Although markets in the Northeast can conceivably receive replacement volumes from the Gulf Coast via tanker and barge, waterborne movements between U.S. ports are limited by the availability of coastwise-complaint vessels capable of transporting petroleum products. The Merchant Marine Act of 1920, also known as the Jones Act, requires that all goods transported by water between U.S. ports be carried on U.S.-flag ships that were built in the United States, are owned by U.S. citizens, and are staffed by U.S. citizens. During previous supply shortages, the Department of Homeland Security has waived the Jones Act, allowing non-coastwise compliant vessels to move petroleum products from the Gulf Coast to the East Coast.

## Fuel specifications

Various gasoline, distillate, and jet fuel products are used for different purposes and in different locations across the country. Many fuel grades and specifications exist within each broad fuel category (gasolines, distillates, and jet fuels), although on-road vehicles and other consumer applications may allow the interchangeable use of these formulations. However, federal, state, and local laws regulate the type of fuels that are allowed to be sold in specific areas in order to control air emissions of ground level ozone (smog)-forming and toxic pollutants. In densely populated urban areas, regulations on motor gasoline may be effective year round, while in other areas regulations may only apply during the summer months when ambient temperatures increase evaporative emissions. Regulations on distillate fuels typically involve limits on sulfur content and often apply differently to on-road and off-road applications. The EPA does not regulate jet fuel, and a single commercial grade is used throughout the country, although various grades of jet fuel are used by the military. The various gasoline and distillate fuel specifications required in PADDs 1 and 3 mean refinery production must adhere to different specifications depending on the time of the year and market where the fuel will be sold. The seasonal nature of some regulations mean that pipeline and terminal operators must carefully schedule deliveries of various product grades and manage storage and distribution dynamics to ensure compliance.

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<sup>14</sup> U.S. Department of Energy: Office of Electricity Delivery and Energy Reliability, "Comparing the Impacts of the 2005 and 2008 Hurricanes on U.S. Energy Infrastructure" (Accessed December 12, 2015), <http://energy.gov/oe/downloads/comparing-impacts-2005-and-2008-hurricanes-us-energy-infrastructure-february-2009>.

## Gasoline

Motor gasoline regulations are primarily designed to control smog formation and toxic emissions in urban areas. There are three main types of gasoline specifications: reformulated gasoline, summer-grade (low RVP) gasoline, and winter oxygenated gasoline.

### Reformulated gasoline

In many urban areas, the U.S. Environmental Protection Agency (U.S. EPA) requires the sale of reformulated gasoline, abbreviated RFG. RFG is gasoline that has been blended with an additive to raise the oxygen content of the fuel, a characteristic that reduces the emissions of ozone-forming volatile organic compounds during vehicle operation.<sup>15</sup> The most common oxygenate additive is ethanol. Finished RFG is produced by refineries and blenders only when ethanol is added to gasoline, however, ethanol cannot be shipped with gasoline in pipelines due to the corrosive nature of ethanol. As a result, refineries produce and ship an unfinished blendstock product—reformulated blendstock for oxygenate blending (RBOB)—to distribution terminals in end user markets. At the terminals, ethanol is blended with RBOB during the loading of tanker trucks, either in out-loading pipelines as they move to the trucks (in-line blending) or in the truck itself (splash blending). Although U.S. EPA only requires reformulated gasoline in select metropolitan areas in PADDs 1 and 3, several surrounding counties and cities have “opted in” to the RFG program. Currently, RFG is used across much of the coastal Northeast, from the Washington D.C. metropolitan area to southeastern Maine, including the Baltimore, Philadelphia, New York City, and Boston metropolitan areas, and the entire states of Delaware, New Jersey, Connecticut, Rhode Island, and Massachusetts. In addition, RFG is used in the Richmond and Hampton Roads region in Virginia. In the Gulf Coast, RFG is used in the Houston and Dallas metropolitan areas.<sup>16</sup> Table 7 shows prime supplier sales of motor gasoline by gasoline type (reformulated or conventional) and PADD.

**Table 7. Motor gasoline prime supplier sales by type and PADD, 2014**

thousand barrels per day

Gasoline Type	East Coast (PADD 1)	Gulf Coast (PADD 3)	Total
Reformulated	1,051	390	<b>1,441</b>
Conventional	1,693	1,045	<b>2,737</b>
<b>Total</b>	<b>2,743</b>	<b>1,435</b>	<b>4,178</b>

Source: Energy Information Administration, Monthly Report of Prime Supplier Sales of Petroleum Products Sold for Local Consumption

Table 7 shows that approximately 38% of gasoline sales in the East Coast were reformulated gasoline in 2014 compared with approximately 27% of gasoline sales in the Gulf Coast.

### Summer-grade gasoline

In urban areas that are not required to use RFG, U.S. EPA regulates the volatility of conventional gasoline during the summer ozone season. Gasoline volatility is commonly measured by Reid Vapor Pressure (RVP), which is stated in pounds per square inch (psi) when ambient temperature is 100 degrees F. A

<sup>15</sup> U.S. Environmental Protection Agency, “Reformulated Gasoline” (Accessed December 10, 2015), <http://www2.epa.gov/gasoline-standards/reformulated-gasoline>.

<sup>16</sup> Ibid.

higher RVP indicates higher evaporative characteristics. Depending on the state and month, U.S. EPA limits gasoline RVP to 9.0 psi or 7.8 psi. EPA provides a 1.0 psi RVP allowance for conventional gasoline that is blended with ethanol at 9 to 10 volume %.<sup>17</sup> In addition to limiting evaporative emissions, low-RVP gasoline is important for avoiding engine vapor lock in hot climates. Refineries produce low-RVP gasoline by including less butane (a lighter, more volatile hydrocarbon component of gasoline) in conventional gasoline blends. During the winter months, conventional gasoline RVP is allowed to be as high as 15 psi in some areas. Refineries typically switch production from winter grade to summer grade gasoline in the spring, and switch from summer grade to winter grade gasoline in the early fall. The inclusion of butane in gasoline in the winter increases gasoline refinery yields by as much as 4-5 percentage points. A 9.0 psi RVP limit is in place for all states in the PADDs 1 and 3, although several metropolitan areas observe a 7.8 psi RVP lower limit, including the Atlanta, Charlotte, and Pittsburgh metro areas in PADD 1; and all of eastern Texas, and the New Orleans, Baton Rouge, Lake Charles, and Birmingham metro areas in PADD 3.<sup>18</sup> The El Paso metropolitan area is the only area in PADDs 1 and 3 that requires a 7.0 psi RVP gasoline in the summer months.

#### *Winter oxygenated gasoline*

The Clean Air Act requires the use of oxygenated gasoline, which is required in certain areas of the country where wintertime carbon monoxide levels exceed federal air quality standards. Vehicles using oxygenated gasoline emit lower levels of carbon monoxide during operation. Winter oxygenated gasoline programs, which are managed by the states, are only effective in the El Paso and Albuquerque metropolitan areas in PADD 3. No areas in PADD 1 require wintertime oxygenated gasoline.<sup>19</sup>

#### *Distillate*

Regulations on distillate fuel oils primarily concern limits on sulfur content aimed at reducing toxic emissions, including nitrogen oxide, sulfur oxide, and particulate matter. As of December 2014, all highway, non-road, locomotive, and marine diesel fuel in the United States is required by the U.S. EPA to be ultra-low sulfur diesel (ULSD)—diesel fuel with sulfur content less than 15 parts per million (ppm).<sup>20</sup> Ocean-going vessels and large ships have traditionally used “bunker fuel” (either distillate or residual fuel oil) with sulfur levels as high as 50,000 ppm. However, under an international treaty through the International Maritime Organization, U.S. EPA and the U.S. Coast Guard established Emission Control Areas (ECAs) extending 200 miles from the shores of North America, Puerto Rico, and the U.S. Virgin Islands. Beginning in 2015, large marine diesel engines propelling large ships and ocean-going vessels (Category 3 Engines) operating within the ECAs must generally use fuel with 1,000 ppm sulfur or less.<sup>21</sup>

The U.S. EPA does not regulate the sulfur content of distillate fuel oil used for space heating (“heating oil”), however several states in the Northeast, where heating oil use is the highest, have transitioned or

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<sup>17</sup> U.S. Environmental Protection Agency, “Gasoline Reid Vapor Pressure” (Accessed December 11, 2015), <http://www.epa.gov/gasoline-standards/gasoline-reid-vapor-pressure>.

<sup>18</sup> Ibid.

<sup>19</sup> U.S. Environmental Protection Agency, “State Winter Oxygenated Fuel Program Requirements for Attainment or Maintenance of CO NAAQS” (Accessed December 11, 2015), <http://epa.gov/otaq/regs/fuels/420b08006.pdf>.

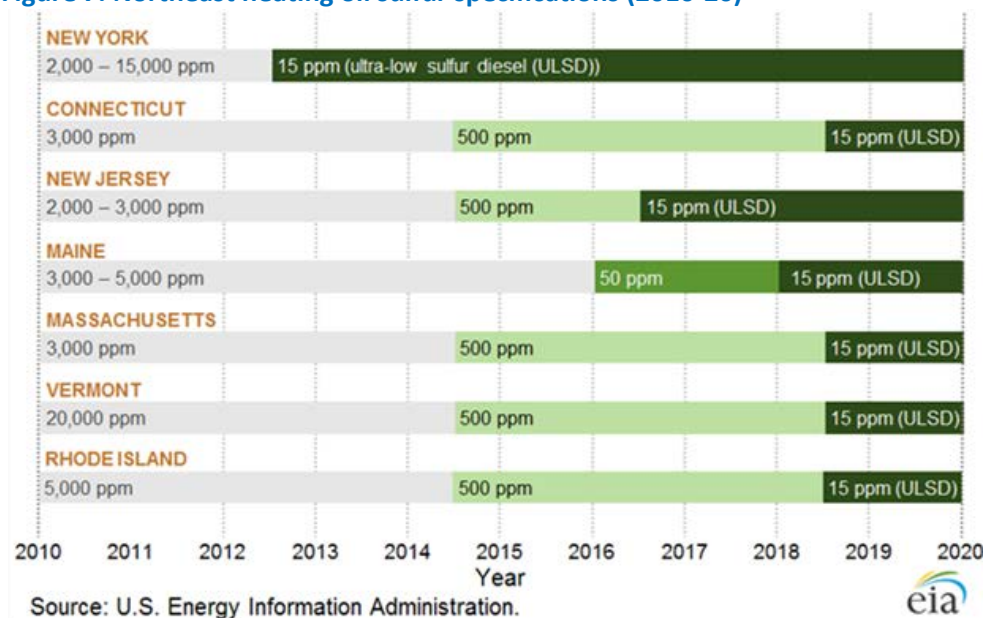
<sup>20</sup> U.S. Environmental Protection Agency, “Diesel Fuel Standards & Rulemakings,” (Accessed January 8, 2016), <http://www.epa.gov/diesel-fuel-standards/diesel-fuel-standards-rulemakings>

<sup>21</sup> Ibid.



are planning to transition to establish lower sulfur limits. In 2012, New York state became the first state to fully transition to ULSD heating oil. A number of other states in the Northeast are phasing out higher sulfur heating oils in favor of ULSD. By mid-2018, seven states in the Northeast will require ULSD heating oil, including New York, Connecticut, New Jersey, Maine, Massachusetts, Vermont, and Rhode Island. Figure 7 presents the timeline for these transitions.

**Figure 7. Northeast heating oil sulfur specifications (2010-20)**



### Renewable Fuels

Renewable fuels, particularly ethanol, are an important part of U.S. transportation fuels supply. For the most part, this study will not discuss the supply, consumption, or movement of renewable fuels. Ethanol blending as an oxygenate in both reformulated and conventional gasoline is widespread due to the phase-out of the oxygenate MTBE, and mandates included in the federal Renewable Fuels Standard, which require oil companies to blend increasing volumes of renewable fuels into the gasoline and diesel supplies. Ethanol consumption averaged 319,000 b/d in PADD 1 in 2014, accounting for 10% of total gasoline supply, and 135,000 b/d in PADD 3, accounting for 9% of total gasoline supply. In-PADD ethanol production is not enough to meet consumption in either PADD. Table 8 shows the number and production capacity of ethanol and biodiesel plants in PADDs 1 and 3.

**Table 8. Renewable fuels plants and production capacity by PADD, 2015**

PADD	Fuel ethanol		Biodiesel	
	Number	Production capacity (b/cd) <sup>A</sup>	Number	Production capacity (b/cd) <sup>A</sup>
East Coast (PADD 1)	5	30,000	21	9,000
Gulf Coast (PADD 3)	5	29,000	16	37,000
<b>Total</b>	<b>10</b>	<b>59,000</b>	<b>37</b>	<b>46,000</b>

(A) Barrels per calendar day. Ethanol plants as of Jan. 2015; Biodiesel plants as of Oct. 2015.

Source: Energy Information Administration, Monthly Oxygenate Report, and Monthly Biodiesel Production Report

Total production capacity in both PADDs is 59,000 b/d, approximately 13% of total ethanol consumption in the two PADDs. The vast majority of ethanol supply in both PADDs is brought in by rail from the Midwest (PADD 2) and, to a lesser extent, via foreign marine imports. Biodiesel is a small, but growing renewable fuel. It is typically blended with conventional diesel at 2% (B2), 5% (B5), or 20% (B20). Biodiesel consumption in PADDs 1 and 3 averaged 23,000 b/d in 2014, well below 2015 production capacity of 46,000 b/d.

## Gasoline market structure<sup>22</sup>

The East Coast and Gulf Coast markets for gasoline are large and complex due to the varying gasoline specifications required in different regions. The gasoline markets in the East Coast and Gulf Coast include four separate but interrelated markets:

**The spot market**, where sizeable volumes, typically parcels of at least 1 million gallons (approximately 24,000 barrels), are sold at the refinery gate or from imported cargoes, and delivered into a specified pipeline or storage facility, as agreed by the buyer and seller. There are about numerous participants in this market, including refiners that buy and sell products to balance refinery production and sales commitments, trading companies that are in the business of buying and selling gasoline but that typically have no presence in wholesale or retail gasoline markets, brokers with market knowledge and understanding that identify buyers and sellers and arrange deals, and independent retail marketers that move large volumes of gasoline through their own retail outlets. Prices in the spot market move with perceived changes in supply and consumption. There are numerous spot markets for gasoline in East Coast and Gulf Coast located in both supply and consumption centers. Prices in these markets reflect regional supply/demand balances as well as the cost to move product between the markets and product quality differences.

**The rack market**, where wholesale buyers such as independent retailers or distributors that operate their own trucks purchase product delivered into a tank truck at a truck loading rack located at a storage and distribution terminal or refinery. Rack market participants may buy branded products that will be sold at a retail outlet under the name of a major oil company or may alternatively purchase unbranded products destined for sale at independent service stations or for use by commercial/industrial consumers. Branded and unbranded rack pricing varies.

**The dealer tank wagon (DTW) market**, where branded retail outlets (dealers) purchase branded gasoline that is delivered by tank truck (tank wagon) to their retail outlets. The price of the gasoline reflects the cost of the product and the cost of delivery.

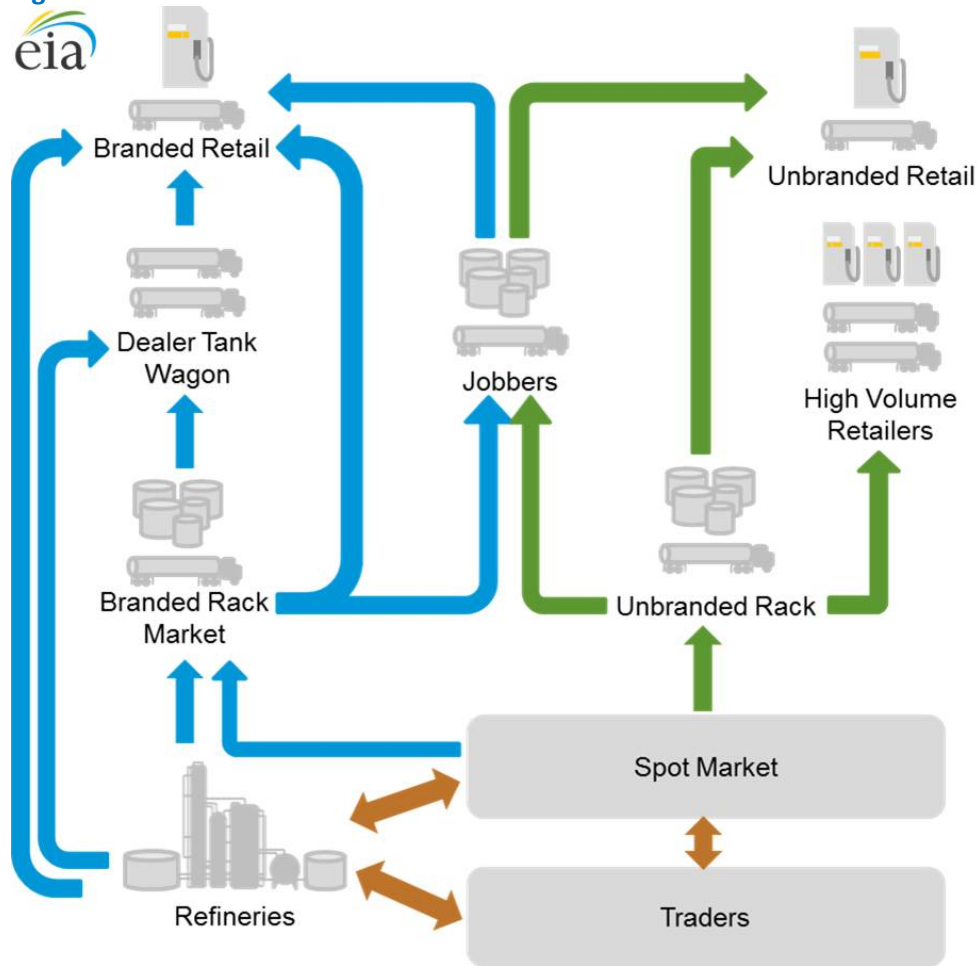
**The retail market**, where gasoline is sold to the end consumer at the pump at a gas station or other retail outlet. Retailers typically set prices by comparison to prices at other retail outlets. However, high volume retailers (HVRs), such as large chain stores, or *big box* stores, that are focused on selling large volumes of gasoline at low margins, tend to price gasoline based on cost plus the desired margin, rather than based on prices at other retail outlets.

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<sup>22</sup> This section has been adapted from EIA's "PADD 5 Transportation Fuels Markets" report published in September 2015. [https://www.eia.gov/analysis/transportationfuels/padd5/pdf/transportation\\_fuels.pdf](https://www.eia.gov/analysis/transportationfuels/padd5/pdf/transportation_fuels.pdf)



Figure 8. Gasoline market structure



Source: U.S. Energy Information Administration, California Strategic Reserve Study<sup>23</sup>

Gulf Coast and East Coast gasoline markets are generally robust due to numerous buyers and sellers, and a diversity of supply sources in each PADD, including in-PADD refinery production, pipeline and marine movements to and from other PADDs, and numerous import and export opportunities in the actively traded Atlantic Basin.

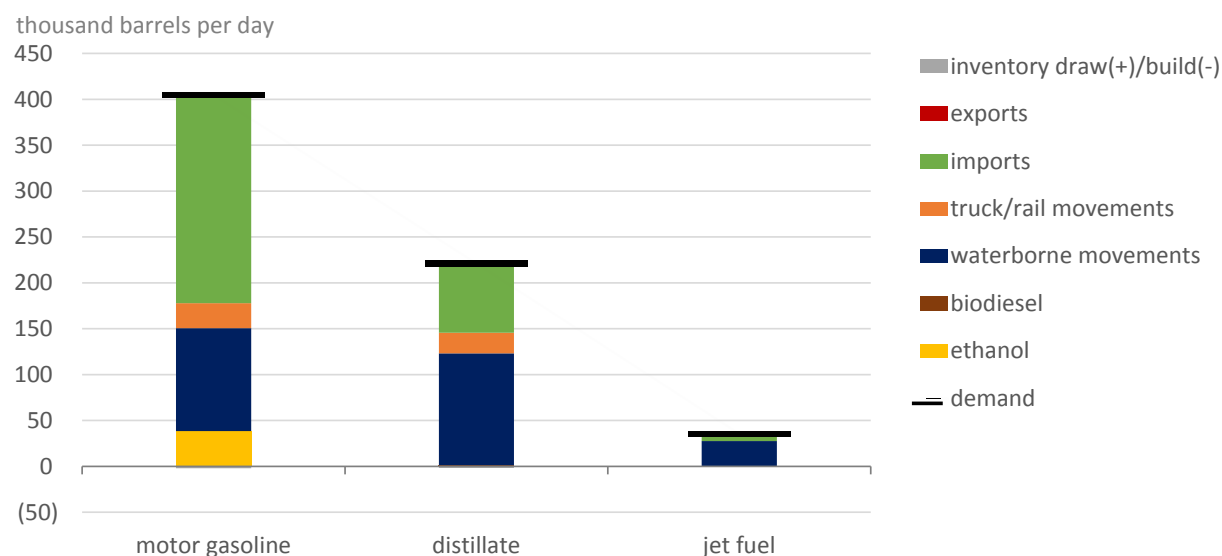
<sup>23</sup> Stillwater Associates. *California Strategic Reserve Study – Consultant Report*. March 10, 2002. [http://www.energy.ca.gov/reports/2002-03-11\\_600-02-004CR.PDF](http://www.energy.ca.gov/reports/2002-03-11_600-02-004CR.PDF).

## New England

The New England region consists of six states in the northeastern United States: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont. Estimated total consumption for motor gasoline, distillate fuel oil, and commercial jet fuel in New England was 661,000 b/d in 2014. Within the region, two major population corridors define the principal consumption centers. The first extends from southwest Connecticut along the border with New York to Springfield in western Massachusetts, by way of the Stamford, New Haven, and Hartford, Connecticut metropolitan areas. The second corridor runs from Providence, Rhode Island to the Boston, Massachusetts metropolitan area.

With no refineries operating in the region, New England is a net consumer of fuels. The vast majority of New England's petroleum products are delivered to the region via tanker and barge from domestic and foreign supply sources. Import volumes, primarily received at coastal New England ports from eastern Canadian refineries, meet just over 45% of New England's total transportation fuels consumption. Most of the balance is supplied by marine deliveries from the Central Atlantic region—primarily from supply centers in New York Harbor and the Greater Philadelphia area—although products are also brought into the region by truck and rail from Albany, New York. Figure 9 presents the region's 2014 annual supply and demand balances for motor gasoline, distillate, and jet fuel.

**Figure 9. New England supply/demand balances, 2014**



Source: ICF Analysis of EIA, FHWA, Airlines for America, FERC, and company 10-K data

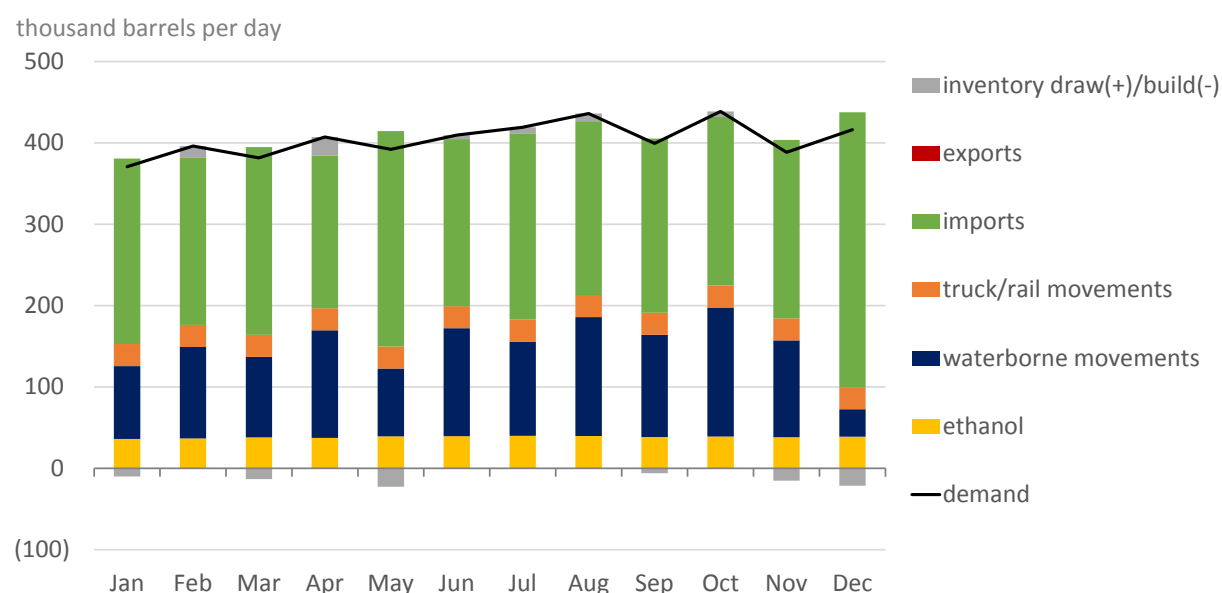
## Supply/demand balances

### Gasoline

New England's motor gasoline consumption in 2014 averaged 405,000 b/d, including 38,000 b/d of ethanol. Figure 10 presents the 2014 monthly motor gasoline supply/demand balance for the region. Much of New England's motor gasoline supply is imported—229,000 b/d on average, accounting for nearly 57% of consumption. Of this import volume, approximately 85% comes from refineries in Eastern Canada. Domestic supply is transported to New England on coastwise-compliant vessels from Central

Atlantic ports and by truck and rail movements from Albany, New York to western New England. In 2014, motor gasoline consumption in New England was generally higher in the summer months than in the winter months. Consumption peaked above 430,000 b/d in August and October 2014, up roughly 18% from the low in January. In December 2014, New England saw a sharp increase in gasoline imports, which primarily displaced marine supply from the Central Atlantic region, leading to a large build in gasoline inventory in the Central Atlantic region.

**Figure 10. New England motor gasoline supply/demand balance, 2014**



Source: ICF Analysis of EIA, FHWA, FERC, and company 10-K data

The U.S. Environmental Protection Agency (U.S. EPA) requires the use of reformulated gasoline in seven counties in Connecticut.<sup>24</sup> Reformulated gasoline is not required anywhere else in New England, however, several counties that surround urban areas in Connecticut, Maine, Massachusetts, New Hampshire and Rhode Island are designated as ‘opt-in’ areas, and have chosen to use reformulated gasoline. Over the past few years, reformulated gasoline sales have accounted for roughly four-fifths of all motor gasoline sales in New England.<sup>25</sup> In accordance with the Clean Air Act, the U.S. EPA requires the adoption of a summer RVP standard that limits the volatility of conventional gasoline sold in certain areas of the country. From May 1 through September 15, the states of Maine, New Hampshire and Vermont each enforce a statewide 9.0 RVP limit.<sup>26</sup> None of the six New England states maintains a winter oxygenated fuels program to limit carbon monoxide emissions.<sup>27</sup>

<sup>24</sup> U.S. Environmental Protection Agency, “Reformulated Gasoline,” (Accessed January 6, 2015), <http://www.epa.gov/gasoline-standards/reformulated-gasoline>.

<sup>25</sup> U.S. Energy Information Administration, “Sales of Distillate Fuel Oil by End Use” (Accessed November 26, 2015), [http://www.eia.gov/dnav/pet/pet\\_cons\\_821dst\\_dcu\\_nus\\_a.htm](http://www.eia.gov/dnav/pet/pet_cons_821dst_dcu_nus_a.htm).

<sup>26</sup> U.S. Environmental Protection Agency, “Gasoline Reid Vapor Pressure” (Accessed December 11, 2015), <http://www.epa.gov/gasoline-standards/gasoline-reid-vapor-pressure>.

<sup>27</sup> U.S. Environmental Protection Agency, “State Winter Oxygenated Fuel Program Requirements for Attainment or Maintenance of CO NAAQS” (Accessed December 11, 2015), <http://epa.gov/otaq/regs/fuels/420b08006.pdf>.

**Table 9. New England motor gasoline regulations**

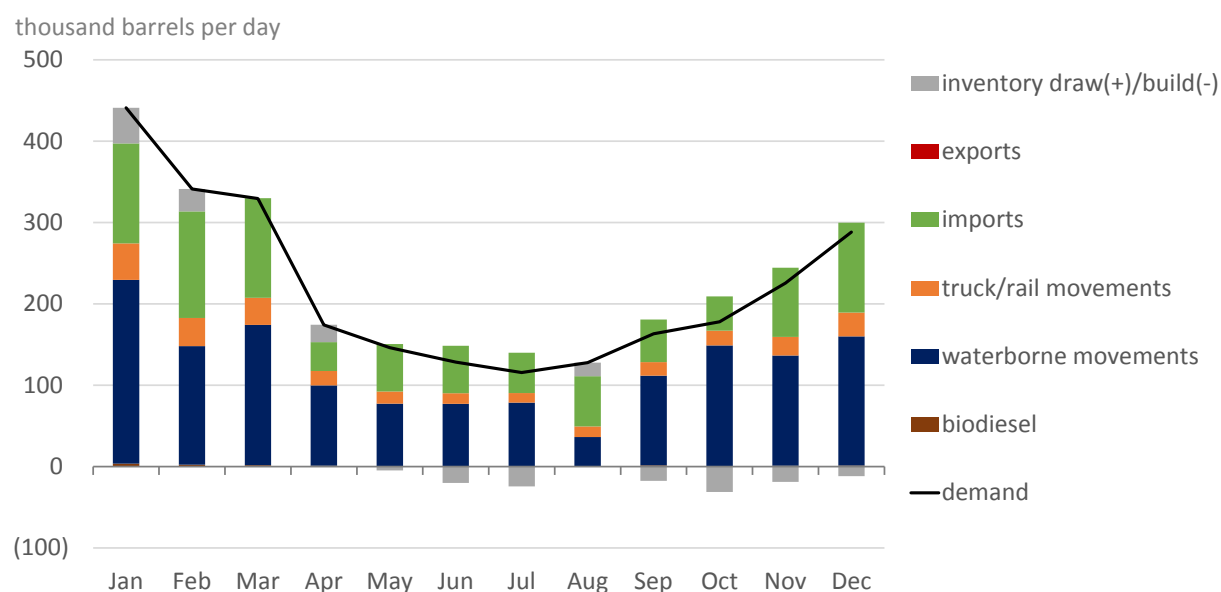
Regulation	Area (s)	Dates
Reformulated Gasoline	Fairfield, Hartford, Litchfield, Middlesex, New Haven, New London & Tolland counties in Connecticut	Year-round
Reformulated Gasoline (Opt-in areas)	Connecticut statewide; Select counties in Maine, Massachusetts, New Hampshire & Rhode Island	Year-round
Summer Gasoline Volatility <9.0 RVP	Maine, New Hampshire & Vermont statewide	May 1 – Sept. 15

Source: U.S. EPA

### Distillate

Distillate fuel oil consumption in New England is driven primarily by on-highway use, as well as residential and commercial use. Households in the New England are much more reliant on distillate fuel oil for space heating than in the rest of the country. In 2013, approximately 39% of homes in New England used heating oil as their primary fuel for space heating, and the residential and commercial sectors typically account for more than half of the region’s total annual distillate consumption.<sup>28</sup> Figure 11 presents the 2014 monthly distillate supply/demand balance for the region. In 2014, New England distillate fuels consumption averaged 221,000 b/d with large seasonal variation due to high use of heating oil during the winter months. In 2014, consumption peaked at 441,000 b/d in January, nearly four times August consumption, which was 116,000 b/d. Seasonal consumption of heating oil is met from a number of sources, including increased foreign imports, increased marine and truck deliveries from the Central Atlantic region, and drawdowns from inventory. New England distillate suppliers typically build heating oil inventories in the summer and fall months and draw down inventories during the coldest winter months—typically January and February. The first three months of 2014 were, on average, much colder than corresponding months in previous years, and overall heating oil consumption was higher than normal in 2014. The unpredictability of winter weather and heating oil consumption makes New England more vulnerable to shortages than other regions covered in this study.

<sup>28</sup> U.S. Department of Energy- Office of Electricity Delivery and Energy Reliability, “An Assessment of Heating Fuels and Electricity Markets During the winters of 2013-2014 and 2014-2015,” Prepared by ICF International, (October 19, 2015), [http://www.energy.gov/sites/prod/files/2015/10/f27/DOE\\_OE\\_Two%20Winters%20Report\\_Final\\_10.19.15.pdf](http://www.energy.gov/sites/prod/files/2015/10/f27/DOE_OE_Two%20Winters%20Report_Final_10.19.15.pdf) and U.S. Energy Information Administration, “Sales of Distillate Fuel Oil by End Use” (Accessed November 26, 2015), [http://www.eia.gov/dnav/pet/pet\\_cons\\_821dst\\_dcu\\_nus\\_a.htm](http://www.eia.gov/dnav/pet/pet_cons_821dst_dcu_nus_a.htm).

**Figure 11. New England distillate supply/demand balance, 2014**

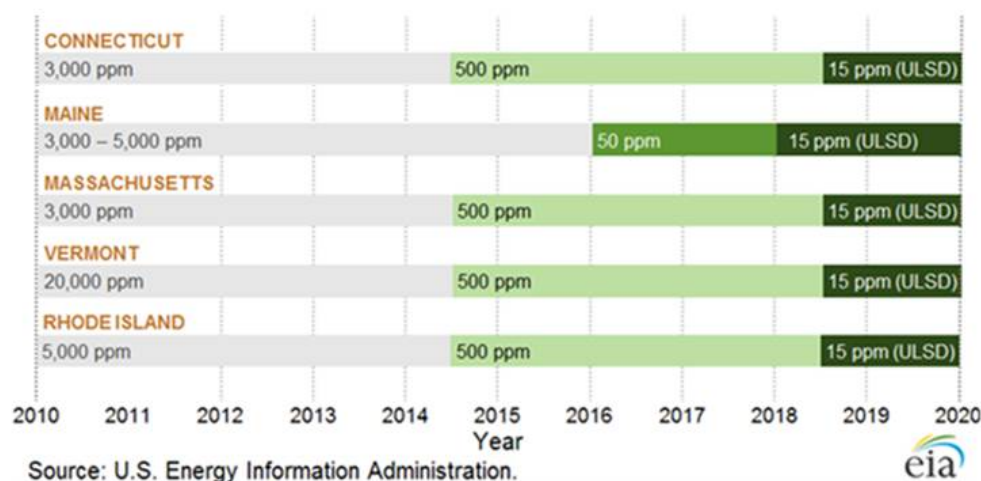
Source: ICF Analysis of EIA, FHWA, FERC, and company 10-K data

The New England region, as with the rest of the country, is required by Federal law to use ultra-low sulfur diesel (ULSD)—diesel fuel with a maximum sulfur content of 15 parts per million (ppm)—for all highway, non-road, locomotive and marine diesel fuel. No such Federal restrictions are in place for heating oil—a distillate fuel oil from the same boiling-range portion of crude oil as diesel fuel—however, several New England states have enacted state-level regulations to phase out the use of higher-sulfur heating oil blends in favor of ULSD. The timelines for these transitions are shown below in Table 10. Connecticut, Massachusetts, Rhode Island, and Vermont stopped the use of the highest-sulfur oils—those with a sulfur content greater than 500 ppm—in 2014, with ULSD use being required beginning in 2018.<sup>29</sup> Maine enacted a slightly altered timeline, eliminating the use of heating oil with 50 ppm or greater by 2016 and mandating ULSD use by 2018. As of 2015, New Hampshire is the only state in New England with no formal plans to eliminate higher sulfur heating oil blends, however, with all adjacent states and New York phasing out ULSD in the next few years, distributors in New Hampshire are shifting to an all-ULSD supply.<sup>30</sup>

<sup>29</sup> U.S. Energy Information Administration, “Today in Energy: [Sulfur content of heating oil to be reduced in northeastern states](http://www.eia.gov/todayinenergy/detail.cfm?id=5890)” (April 18, 2012), <http://www.eia.gov/todayinenergy/detail.cfm?id=5890> and U.S. Energy Information Administration, “State Profile and Energy Estimates: Rhode Island” (Last updated June 18, 2015), <https://www.eia.gov/state/analysis.cfm?sid=RI> and Connecticut Department of Energy and Environmental Protection, “Fact Sheet: Reduction of Sulfur Dioxide Emissions and Fuel Sulfur Content,” (Accessed January 6, 2016), [http://ct.gov/deep/lib/deep/air/siprac/2013/fuel\\_sulfur\\_factsheet.pdf](http://ct.gov/deep/lib/deep/air/siprac/2013/fuel_sulfur_factsheet.pdf).

<sup>30</sup> U.S. Energy Information Administration, “State Profile and Energy Estimates: New Hampshire” (Last updated June 18, 2015), <https://www.eia.gov/state/analysis.cfm?sid=NH>.

Table 10: New England heating oil specifications (2010-2020)



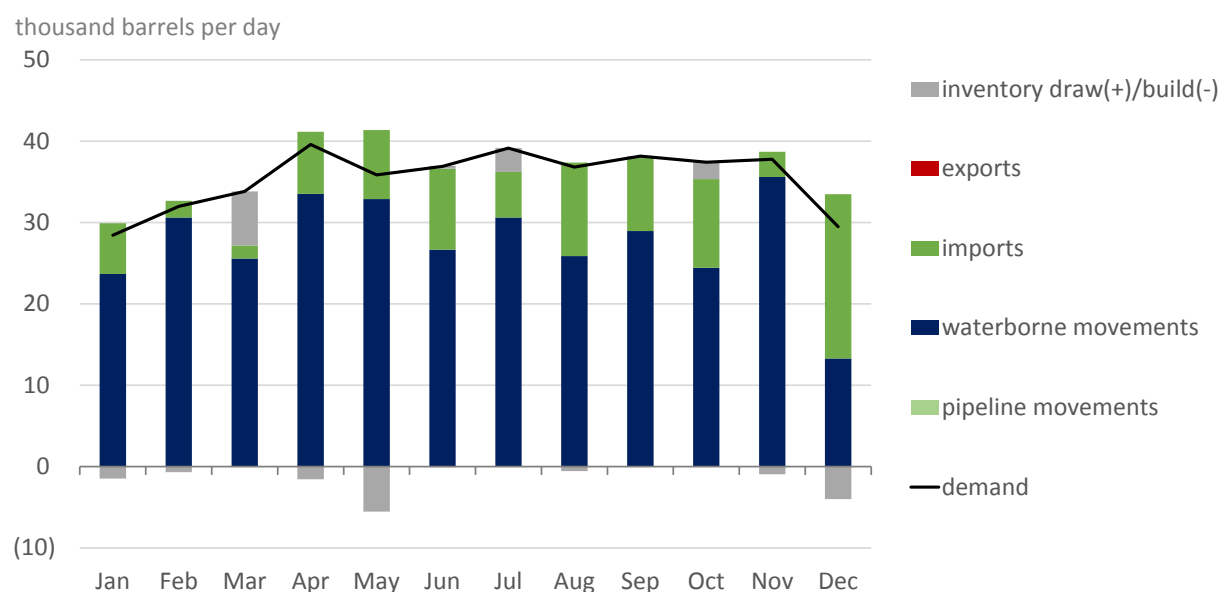
In addition to sulfur-content limits, four New England states—Connecticut, Massachusetts, Rhode Island, and Vermont—have put measures in place to increase the blending of biodiesel in heating oil, however, implementation for several of these states is contingent on neighboring states establishing similar requirements.<sup>31</sup> In 2010, Massachusetts decided not to implement a portion of a 2008 law, which would have mandated a 5% biodiesel blend by 2013, due to the “unreasonable cost” to heating oil dealers.<sup>32</sup>

#### Jet fuel

Figure 12 presents New England’s 2014 jet fuel supply/demand balance. Commercial jet fuel consumption in New England averaged 35,000 b/d in 2014, with a low mark of 28,000 b/d in January and a peak of 40,000 b/d in April. Average quantities consumed were generally higher in the summer and early fall months than in the winter months.

<sup>31</sup> National Oilheat Research Alliance, “Sulfur & Bioheat Requirements for No. 2 Heating Oil in the Northeast & Mid-Atlantic States,” (Updated November 13, 2014), [https://noraweb.org/wp-content/uploads/2014/11/NEMARegion\\_ULSDBioChart2014.pdf](https://noraweb.org/wp-content/uploads/2014/11/NEMARegion_ULSDBioChart2014.pdf).

<sup>32</sup> Massachusetts Department of Energy Resources, “Massachusetts Advanced Biofuels Mandate Program Announcement: DOER Suspends Formal Requirements, Establishes Voluntary Program,” (June 30, 2010), <http://www.mass.gov/eea/docs/doer/renewables/biofuels-mandate-announcement-jun302010.pdf>.

**Figure 12. New England jet fuel supply/demand balance, 2014**

Source: ICF Analysis of EIA, Airlines for America, FERC, and company 10-K data

The two largest airports in New England are Boston's General Edward Lawrence Logan Airport (BOS) and Hartford-Springfield's Bradley International Airport (BDL) in Windsor Locks, Connecticut. The New England region also includes four small hubs, as defined by the Federal Aviation Administration.<sup>33</sup> In addition to these hubs, 66 smaller commercial airports also operate in the region, as well as two air force bases (Hanscom Air Force Base and Westover Air Reserve Base, both in Massachusetts), which may consume commercial-quality Jet-A fuel in addition to higher-performance blends.<sup>34</sup>

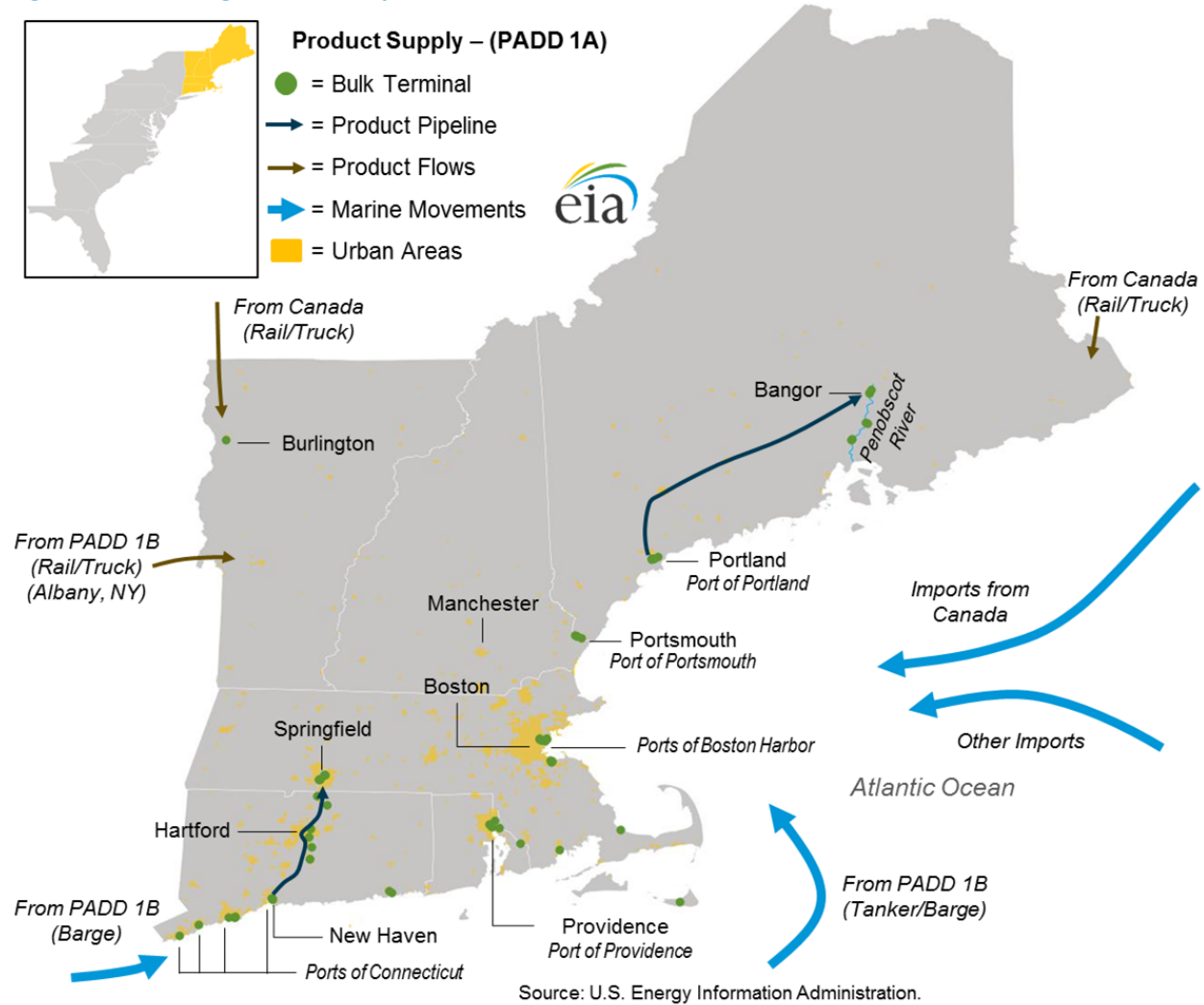
### Supply and logistics

Markets in the New England region rely entirely on the delivery of petroleum products from outside the region, primarily by marine tanker and barge but also, to a lesser degree, by rail and truck. The region's largest population centers are located along the Atlantic coast, where marine terminals receive bulk products on ocean-going barges or smaller-sized tankers from the Central Atlantic region, Canada, and other foreign countries. From the marine terminals, products are further distributed throughout the region by truck and via pipeline to inland bulk terminals. Additionally, rail and truck movements from New York and Canada supply inland markets in western New England and along the northern border with Canada. Figure 13 presents the ports, terminals, and pipelines serving New England. The ports of Boston, Massachusetts; New Haven, Connecticut; Providence, Rhode Island; Portland, Maine; Portsmouth, New Hampshire; and ports along the Penobscot River in Maine are the major delivery points for domestic receipts and foreign imports, and terminals at these ports have the greatest in-region capacity to store and distribute petroleum products.

<sup>33</sup> Federal Aviation Administration, "Calendar Year 2014 Passenger Boardings at Commercial Service Airports," (September 22, 2015), [http://www.faa.gov/airports/planning\\_capacity/passenger\\_allcargo\\_stats/passenger/media/cy14-commercial-service-enplanements.pdf](http://www.faa.gov/airports/planning_capacity/passenger_allcargo_stats/passenger/media/cy14-commercial-service-enplanements.pdf).

<sup>34</sup> MilitaryBases.com, "State Military Bases" (Accessed November 5, 2015), <http://militarybases.com>.

Figure 13: New England refined petroleum infrastructure



Ports

Table 11 lists ports in New England that received marine deliveries of refined petroleum products in 2013, the latest year for which domestic marine receipt data is available from the U.S. Army Corps of Engineers (USACE). The table shows estimated 2013 inbound movements at the region’s ports broken out between domestic receipts, as tracked by USACE, and foreign imports, as tracked by EIA. The final column in the table presents the share of each port’s import volumes that originated in Canada.



**Table 11. Waterborne receipts of transportation fuels at New England ports, 2013**

barrels per day

Port	Domestic	Foreign	Total	Canadian % of foreign
Boston, MA	83,166	110,304	193,470	61%
New Haven, CT	95,217	50,868	146,085	46%
Providence, RI	40,100	64,356	104,456	34%
Portland, ME	10,865	54,608	65,473	94%
Portsmouth, NH	7,041	8,501	15,542	100%
Penobscot River, ME <sup>(B)</sup>	1,493	7,438	8,931	100%
Other, CT <sup>(C)</sup>	22,907	0	22,907	0%
Other, MA <sup>(C)</sup>	2,489	0	2,489	0%
<b>Total</b>	<b>263,278</b>	<b>296,077</b>	<b>559,353</b>	<b>60%</b>

(A) Includes Searsport, Belfast, and Bucksport, Maine

(B) Includes Bridgeport, New London, and Stamford, Connecticut

(C) Includes Fall River, New Bedford, Nantucket, and Martha's Vineyard, Massachusetts

Source: U.S. Army Corp of Engineers 2013 Waterborne Commerce of the United States Waterways and Harbors; EIA Company Level Imports, 2013

New England ports collectively received around 559,000 b/d of transportation fuels in 2013. Foreign imports accounted for just over half of all inbound marine movements in 2013. Of these imports, 179,000 b/d, or approximately 60%, were delivered by tanker or barge from Canada, primarily by Irving Oil, which operates a 320,000 b/cd refinery in St. John, New Brunswick. In 2013, the largest volumes of domestic receipts were delivered to New Haven, Connecticut; Boston, Massachusetts; and Providence, Rhode Island. These domestic volumes primarily originated in the New York Harbor area or at refineries in the Greater Philadelphia area.

### Pipelines

Two long-distance pipelines transport products from coastal marine receipt terminals to inland markets. Table 12 details these pipelines.<sup>35</sup> Buckeye's 62,000 b/d New Haven-to-Springfield pipeline interconnects seven marine terminals at the Port of New Haven and delivers products to eight truck distribution terminals across central and northern Connecticut and to eight terminals in Springfield, Massachusetts. According to FERC data, this pipeline transported approximately 23,000 b/d in 2014 with volumes reaching as high as 31,000 b/d in the first quarter of 2014 amid high heating oil consumption.<sup>36</sup> Buckeye's Portland-to-Bangor pipeline ships products received at the company's joint-venture South Portland, Maine marine terminal to two distribution terminals in Bangor, Maine. This pipeline shipped an average of 12,000 b/d in 2014 with a high of 13,000 b/d during the first quarter, according to FERC data.<sup>37</sup> A third pipeline, Buckeye's East Providence-to-Springfield line, running from Rhode Island to western Massachusetts, was recently acquired and idled by Buckeye Partners.<sup>38</sup> In 2014, prior to idling,

<sup>35</sup> *Petroleum Storage and Transportation: System Dynamics, Volume II*. National Petroleum Council. April 1989. Page: D-9, PDF Page: 250. [http://www.npc.org/reports/petrol\\_storage\\_transport-1989-v2.pdf](http://www.npc.org/reports/petrol_storage_transport-1989-v2.pdf)

<sup>36</sup> FERC Financial Report FERC Form No. 6: Annual Report of Oil Pipeline Companies and Supplemental Form 6-Q: Quarterly Financial Report of Buckeye Partners (2014/Q1, 2014/Q2, 2014/Q3, 2014/Q4).

<sup>37</sup> *Ibid.*

<sup>38</sup> Town of Wilbraham Massachusetts, "Buckeye Partners L.P. Notice of pipeline purchase," (May 2015), <http://www.wilbraham-ma.gov/DocumentCenter/View/1512>.

this line transported 14,000 b/d. Volumes on this line will likely shift to Buckeye's New Haven-to-Springfield line, which has excess capacity to absorb them.

**Table 12. Select New England refined product pipelines**

Pipeline	Origin	Destination	Distance, miles	Capacity, b/d
Buckeye Partners	New Haven, CT	Springfield, MA	100	62,000
	East Providence, RI	Springfield, MA	84	Idle <sup>(A)</sup>
	Portland, ME	Bangor, ME	124	19,200

(A) Buckeye notified FERC on July 31, 2015 of plans to idle service by September 1, 2015. No shippers were affected by the tariff cancellation.

Source: Buckeye Partners 10-Ks; FERC Filing No. 454.1.0; National Petroleum Council; ICF Estimates

## Markets

### Massachusetts

The region's largest port, the Port of Boston, Massachusetts handled nearly 200,000 b/d of domestic receipts and foreign imports of motor gasoline, distillate fuel oil, and jet fuel in 2013. Terminals are situated along the Chelsea and Mystic Rivers in east Boston Harbor, and along the tributaries of the Weymouth Fore River in south Boston Harbor. Products received by vessel are offloaded, stored, and loaded on to trucks for inland distribution, or loaded onto barges for distribution to delivery points along Cape Cod Bay. Logan International Airport receives all of its jet fuel from a dedicated pipeline originating at Sunoco Logistics' East Boston terminal.<sup>39</sup> Smaller markets along the southern Massachusetts coastline in Fall River and New Bedford, and on Nantucket Island and Martha's Vineyard, typically receive less than 5,000 b/d of marine shipments in aggregate. Consumption centers in western Massachusetts, including and the Westover Air Force Base, are supplied by Buckeye's New Haven-to-Springfield pipeline and by tanker truck from terminals in Albany, New York.

### Connecticut

The Port of New Haven, Connecticut, received more than 145,000 b/d of motor gasoline, distillate, and jet fuel in 2013, of which nearly two-thirds was sourced from the Central Atlantic (PADD 1B) region, primarily from New York Harbor. New Haven is the origin of Buckeye's New Haven-to-Springfield pipeline, which serves eight terminals in the Hartford, Connecticut area and supplies jet fuel to Bradley International Airport north of Hartford, before entering Massachusetts. Smaller markets around the Ports of Bridgeport, New London, Groton, and Stamford received nearly 23,000 b/d in 2013, primarily from New York Harbor.

### Rhode Island

The Port of Providence, Rhode Island, includes two marine terminal clusters along the Providence River in Providence, and along the Seekonk River in East Providence. More than 100,000 b/d of motor gasoline, distillate fuel oil, and jet fuel were delivered by marine vessel in 2013, of which more than 60% were foreign imports. Unlike other New England ports, the Port of Providence relies on a diversified source of foreign imports—nearly 60% of transportation fuel imports were delivered from European

<sup>39</sup> Business Wire, "Sunoco Logistics to Buy Eagle Point Tank Farm and East Boston Terminal" (June 29, 2011), <http://www.businesswire.com/news/home/20110629005835/en/Sunoco-Logistics-Buy-Eagle-Point-Tank-Farm>.

refineries. Until the fall of 2015, the East Providence-to-Springfield pipeline, formerly owned by ExxonMobil, shipped approximately 14,000 b/d of products to markets in Springfield, Massachusetts. During the summer of 2015, Buckeye Partners acquired ExxonMobil's associated terminal assets and the pipeline, which was idled by September 1, 2015.<sup>40</sup>

### Maine

Maine receives marine shipments at the Port of Portland, as well as at ports along the Penobscot River including Belfast, Searsport, Bucksport, and Bangor. In 2013, the Port of Portland received more than 65,000 b/d of transportation fuels, whereas only about 9,000 b/d were delivered to the smaller ports along the Penobscot River. Buckeye's South Portland-to-Bangor pipeline links the South Portland marine terminal, owned as a joint venture between Buckeye and Irving Oil, to two terminals in the Bangor area. The line shipped approximately 12,000 b/d in 2014. Inland Maine is sparsely populated. In 2013, railway and highway border crossings along the Canadian border in Maine imported just over 1,500 b/d of transportation fuels.

### New Hampshire

The Port of Portsmouth, New Hampshire received nearly 16,000 b/d of domestic receipts and Canadian imports in 2013. Receipts to Portsmouth mainly supply local markets in coastal New Hampshire. Manchester and other markets in southern New Hampshire receive fuel primarily by truck from Boston Harbor. Northern New Hampshire is sparsely populated.

### Vermont

With no access to marine deliveries, Vermont relies primarily on rail and truck deliveries from Canadian refineries and from storage terminals in Albany, New York, which are supplied by barge up the Hudson River from New York Harbor. In 2013, railway and highway border crossings along the Canadian border in Vermont imported nearly 11,000 b/d of transportation fuels. The vast majority of this fuel came by rail from Valero's Quebec City refinery. In addition to imports, approximately 15,000 b/d of products was railed from Albany, New York to Burlington, Vermont, in 2013, according to provisional data from the U.S. Department of Transportation (U.S. DOT).<sup>41</sup> Markets in southern Vermont are primarily supplied by truck from Albany.

## Supply vulnerability

New England has neither in-region refinery production nor any pipeline connections to refining centers outside the region. The region's largest markets, located along the Atlantic coast, are dependent on reliable port operations and a continuous supply of marine deliveries from both foreign and domestic sources. Disruptions to New England ports resulting from hurricanes, severe winter storms, or extensive ice accumulation, pose the greatest threat to the continuity of the region's fuel logistics. There are no

<sup>40</sup> Federal Energy Regulatory Commission, "Cancellation Notice: Mobil Pipe Line Company, Local Tariff Applying on Petroleum Products from Providence (Providence County), Rhode Island to Point in Massachusetts," FERC No. 1216.4.0 Cancels FERC No. 1216.3.0 (Effective May 8, 2015), [http://www.exxonmobil.com/Files/EMPCo/FERC\\_1216.4.0.pdf](http://www.exxonmobil.com/Files/EMPCo/FERC_1216.4.0.pdf).

<sup>41</sup> Federal Highway Administration, *Freight Analysis Framework 3 Provisional Annual Data for 2013*. (Accessed October 30, 2015), [http://ops.fhwa.dot.gov/freight/freight\\_analysis/faf/faf3/faf3\\_6\\_prov2013.zip](http://ops.fhwa.dot.gov/freight/freight_analysis/faf/faf3/faf3_6_prov2013.zip).

feasible alternatives to marine supply, and an extended disruption to the region's ports can lead to product shortages, particularly during the winter months when heating oil consumption is the highest.

Realizing this vulnerability, the U.S. Department of Energy (DOE) maintains emergency reserves of heating oil and motor gasoline at commercial terminals in several New England ports. DOE stores 500,000 barrels of ULSD and 500,000 barrels of motor gasoline products at Global Companies' Revere terminal in East Boston, Massachusetts; 500,000 barrels of ULSD at Buckeye Partner's terminal in Groton, Connecticut; and 99,000 barrels of motor gasoline at Buckeye and Irving Oil's South Portland Terminal in Maine. DOE can draw down these reserves to address fuel shortages if an emergency is declared by the President of the United States.<sup>42,43</sup>

New England supply can also be impacted by disruptions further up the supply chain, specifically disruptions to terminal operations in New York Harbor, which delivers the bulk of New England's domestic marine supply, or to Irving Oil's 320,000 b/cd refinery in St. John, New Brunswick, which delivers more than half of the region's foreign imports. In the event that either of these sources is disrupted, alternative supply could be imported from other sources in the Atlantic Basin, or from the U.S. Gulf Coast, subject to the availability of coastwise-compliant vessels or a waiver from the U.S. Department of Homeland Security to allow the delivery of products from Gulf Coast ports aboard non-compliant vessels.

## Retail markets

There are 5,575 retail service stations in New England<sup>44</sup>. Figure 14 shows the share of these outlets that are branded versus unbranded by state. Stations are classified as 'branded' if they are associated with and display a major oil company brand. 'Unbranded' stations are not affiliated with a major oil company brand. Seventy one percent of New England's retail stations are branded, slightly higher than the national average of 69%. The share of branded outlets varies considerably within the region; from as high as 83% in Connecticut to as low as 57% in Maine. The top five brands in New England are Mobil, Citgo, Shell, Gulf, and Sunoco, and these brands together account for 59% of the region's retail outlets. Forty-three percent of the region's stations offer diesel fuel, compared to a national average of 53%. There are 11 service stations in New England offering E85 and 29 offering biodiesel (B20 and above).<sup>45</sup>

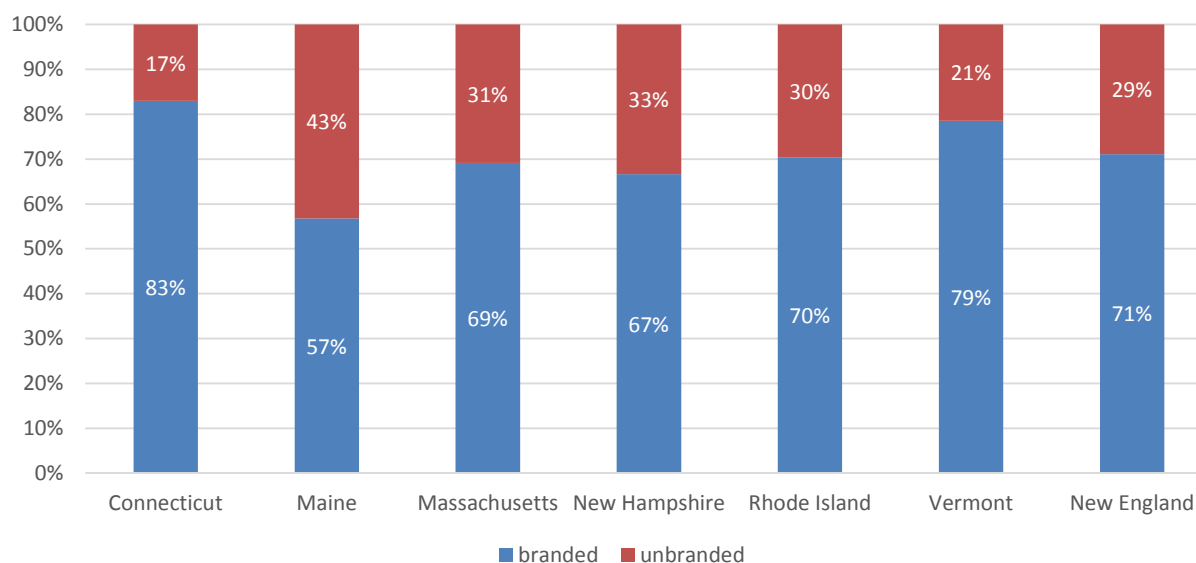
<sup>42</sup> U.S. Department of Energy: Office of Fossil Energy, "Heating Oil Reserve," (Accessed January 6, 2015), <http://energy.gov/fe/services/petroleum-reserves/heating-oil-reserve>.

<sup>43</sup> U.S. Department of Energy: Office of Fossil Energy, "Northeast Regional Refined Petroleum Product Reserve," (Accessed January 6, 2015), <http://energy.gov/fe/services/petroleum-reserves/northeast-regional-refined-petroleum-product-reserve>.

<sup>44</sup> Retail station data provided by the Homeland Security Infrastructure Program (HSIP).

<sup>45</sup> U.S. Department of Energy: Office of Energy Efficiency & Renewable Energy, "Alternative Fuels Data Center" (Accessed December 2, 2015), <http://www.afdc.energy.gov/states/>.

**Figure 14. New England retail market structure**  
percent of retail stations



Source: HSIP 2015

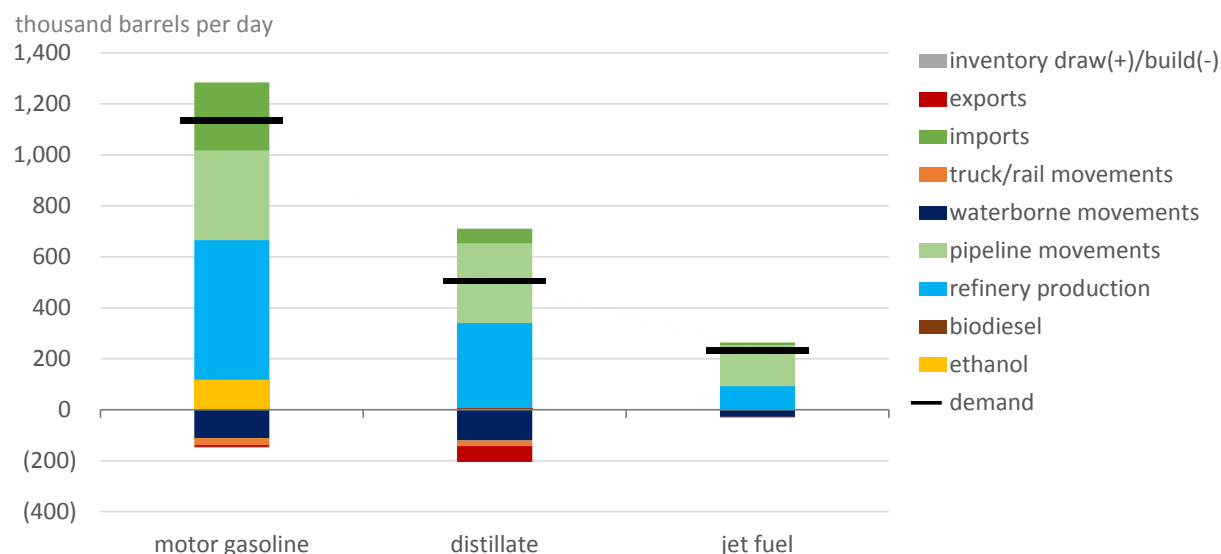
### Future changes

Five of the six New England states are planning to transition to ULSD for heating oil by 2018. At that time, there will be a single sulfur specification for heating oil and on-highway diesel fuel. Suppliers in the region may respond to this change by consolidating storage capacity for the two products at bulk terminals in the region, potentially resulting in lower overall storage capacity and lower overall distillate inventories. Furthermore, New England's sources of foreign imports may shift as the region brings in more distillate from foreign or domestic refineries capable of making ULSD. The stricter sulfur content regulations may limit the region's ability to quickly bring in cargoes of heating oil to respond to unexpected spikes in heating oil consumption brought on by cold weather, or to disruptions from the region's normal supply sources.

## Central Atlantic

The Central Atlantic region consists of five states in PADD 1—Delaware, Maryland, New Jersey, New York, and Pennsylvania—as well as the District of Columbia. The region is densely populated, particularly in the metropolitan corridor from New York City south to Washington, D.C. The region includes the metropolitan areas of Newark and Trenton in New Jersey; Philadelphia, Pennsylvania; Wilmington, Delaware; and Baltimore, Maryland. In addition, several consumption centers are located inland, including Pittsburgh in western Pennsylvania; and Buffalo, Rochester, and Albany in New York. Estimated total consumption of motor gasoline, distillate fuel oil, and commercial jet fuel in the Central Atlantic region was nearly 1.9 million b/d in 2014, or roughly 13% of total U.S. consumption. Figure 15 presents the region’s 2014 annual supply and demand balances for motor gasoline, distillate, and jet fuel.

**Figure 15. Central Atlantic supply/demand balances, 2014**



Note: All domestic movements and inventory changes are reported on a net basis.

Source: ICF Analysis of EIA, FHWA, Airlines for America, FERC, and company 10-K data

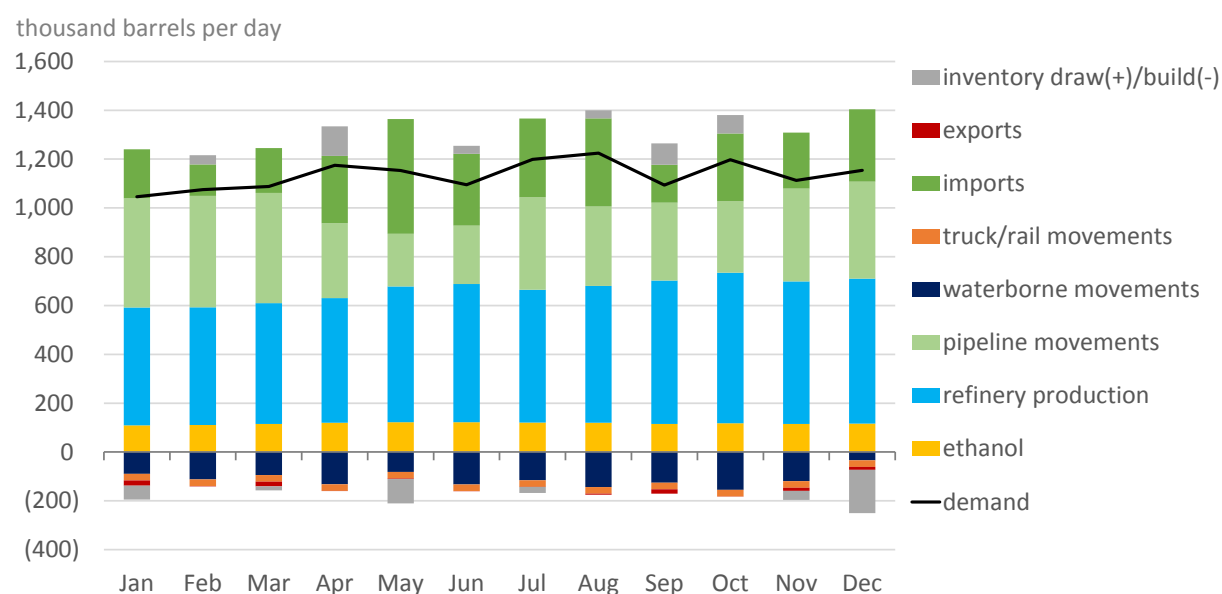
The Central Atlantic region’s refinery production of transportation fuels averaged nearly 1.0 million b/d in 2014, enough to meet more than half of in-region consumption. In addition to in-region refinery production, the Central Atlantic region receives approximately 823,000 b/d of pipeline shipments and 336,000 b/d of foreign imports. Total supply from all sources, including ethanol and biodiesel, averaged 1.93 million b/d in 2014. This supply is consumed in-region and also sent by coastwise-compliant tanker/barge to other domestic markets, primarily in New England, and to a lesser extent, to coastal markets in the Southeast. Estimated waterborne shipments from the Central Atlantic to domestic markets averaged 259,000 b/d in 2014. In addition, refineries in the Central Atlantic region shipped approximately 72,000 b/d of petroleum products—primarily distillates—to export markets.

## Supply/demand balances

### Gasoline

Figure 16 presents the 2014 monthly motor gasoline supply/demand balance in the Central Atlantic region. In 2014, in-region consumption averaged 1.14 million b/d, including 0.12 million b/d of ethanol. Consumption typically follows a seasonal pattern with consumption highest in the summer months and lowest during the winter months. Peak consumption for 2014 occurred in August at more than 1.23 million b/d, up from the year's low of 1.05 million b/d in January. In-region refinery production of gasoline averaged nearly 0.55 million b/d in 2014, enough to meet approximately 54% of annual consumption (net of ethanol inputs). Pipeline movements into the region averaged 0.35 million b/d while imports averaged 0.27 million b/d for a total supply (including ethanol) of 1.28 million b/d. Of this supply, approximately 0.11 million b/d was sent to other markets in PADD 1, while 8,000 b/d was exported.

**Figure 16. Central Atlantic motor gasoline supply/demand balance, 2014**



Note: All domestic movements and inventory changes are reported on a net basis.

Source: ICF Analysis of EIA, FHWA, FERC, and company 10-K data

The U.S. Environmental Protection Agency (U.S. EPA) requires the use of reformulated gasoline in the entire District of Columbia, as well as in 18 counties in New Jersey, 12 in Maryland, 11 in New York, five in Pennsylvania, and two in Delaware.<sup>46</sup> These areas generally align with the densely populated metropolitan corridor along the Atlantic coast from Washington D.C. to New York City. In accordance with the Clean Air Act, the U.S. EPA also requires the adoption of a summer RVP standard that limits the volatility of conventional gasoline sold in certain areas of the country. From May 1 through September 15, the states of Maryland, New York, and Pennsylvania each enforce statewide 9.0 RVP limits. In addition, the state of Pennsylvania maintains a stricter 7.8 RVP limit for seven counties in the Pittsburgh

<sup>46</sup> U.S. Environmental Protection Agency, "Reformulated Gasoline," (Accessed January 6, 2015), <http://www.epa.gov/gasoline-standards/reformulated-gasoline>.

metropolitan area.<sup>47</sup> No locations in the Central Atlantic region maintain a winter oxygenated fuels program to limit carbon monoxide emissions.<sup>48</sup> Table 13 below lists mandatory fuel regulations that are in effect in the Central Atlantic region.

**Table 13. Central Atlantic motor gasoline regulations**

Regulation	Area (s)	Dates
Reformulated gasoline	District of Columbia	Year-round
	Delaware: Kent County and New Castle County	
	Maryland: Anne Arundel, Baltimore, Calvert, Carroll, Charles, Cecil, Frederick, Harford, Howard, Montgomery and Prince George's counties, as well as the city of Baltimore	
	New Jersey: Bergen, Burlington, Camden, Cumberland, Essex, Gloucester, Hudson, Hunterdon, Mercer, Middlesex, Monmouth, Morris, Ocean, Passaic, Salem, Somerset, Sussex and Union counties	
Reformulated gasoline (Opt-in areas)	New York: Bronx, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk and Westchester counties.	Year-round
	Pennsylvania: Bucks, Chester, Delaware, Montgomery and Philadelphia counties	
	Delaware statewide; Kent and Queen Anne's counties in Maryland; Atlantic, Cape May and Warren counties in New Jersey; and Dutchess and Essex counties in New York	
Summer gasoline volatility <9.0 RVP	Maryland, New York & Pennsylvania statewide	May 1 – Sept. 15
Summer gasoline volatility <7.8 RVP	Pennsylvania: Allegheny, Armstrong, Beaver, Butler, Fayette, Washington and Westmoreland counties	May 1 – Sept. 15

Source: U.S. EPA

## Distillate

Figure 17 presents the 2014 monthly distillate supply/demand balance for the Central Atlantic region. In 2014, regional distillate fuels consumption averaged 510,000 b/d. Distillate fuel oil consumption in the Central Atlantic is driven primarily by on-highway use, as well as use for residential and commercial space heating.<sup>49</sup> Approximately 18% of residential homes in the Central Atlantic region use distillate fuel oil as their primary energy source for space heating, and the residential and commercial sectors accounted for one-third of the region's annual distillate fuel oil use in 2013.<sup>50</sup> Due to heavy use for heating during the winter months, Central Atlantic distillate consumption is highly seasonal. In 2014, which was colder than normal from January through March, distillate consumption peaked at 780,000

<sup>47</sup> U.S. Environmental Protection Agency, "Gasoline Reid Vapor Pressure" (Accessed December 11, 2015), <http://www.epa.gov/gasoline-standards/gasoline-reid-vapor-pressure>.

<sup>48</sup> U.S. Environmental Protection Agency, "State Winter Oxygenated Fuel Program Requirements for Attainment or Maintenance of CO NAAQS" (Accessed December 11, 2015), <http://epa.gov/otaq/regs/fuels/420b08006.pdf>.

<sup>49</sup> U.S. Energy Information Administration, "Sales of Distillate Fuel Oil by End Use" (Accessed November 26, 2015), [http://www.eia.gov/dnav/pet/pet\\_cons\\_821dst\\_dcu\\_nus\\_a.htm](http://www.eia.gov/dnav/pet/pet_cons_821dst_dcu_nus_a.htm).

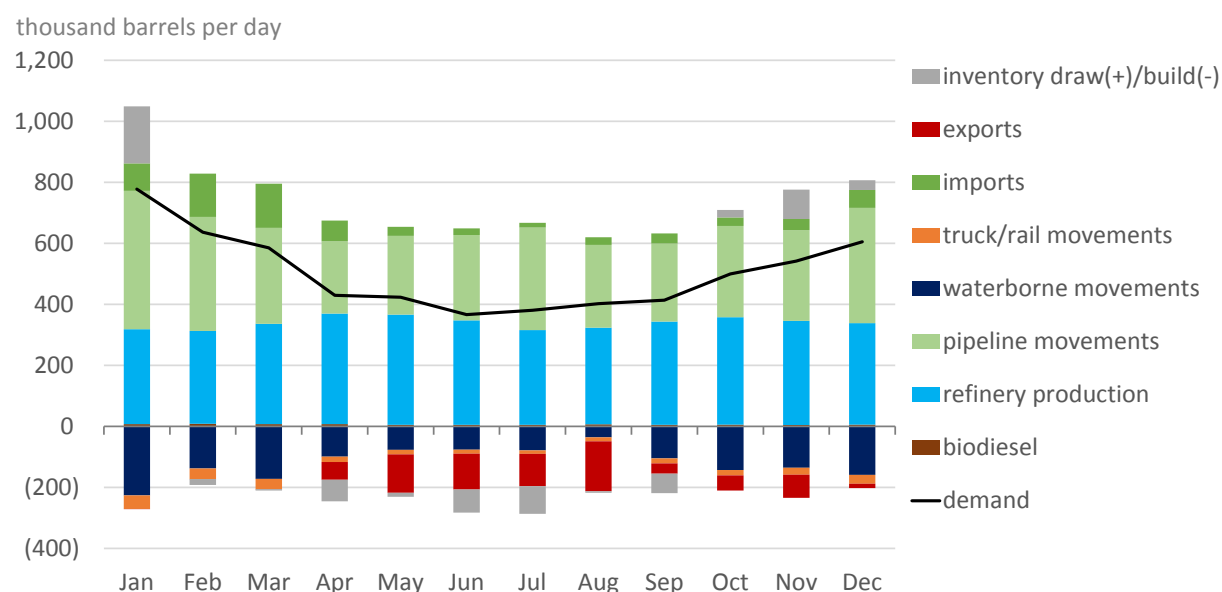
<sup>50</sup> ICF calculations from U.S. Census Bureau 2013 American Community Survey data.



b/d in January, more than double the consumption in the lowest consumption month (June). The nearby New England market, which is dependent on the Central Atlantic region for much of its supply, as well as on imports of distillate fuels, also experiences winter peaking of distillate consumption. In 2014, domestic waterborne, truck, and rail shipments of distillate fuel oil to New England peaked at 270,000 b/d in January, up from a low of 49,000 b/d in August.

Inventories and imports play an important role in balancing consumption between the warm and cold weather months. Heating oil inventories typically build during the spring, summer, and early fall months and are drawn down in the late fall and winter months. Imports and exports follow a similar pattern, with the region becoming a net exporter of distillate fuel oil during the spring, summer, and early fall months, and a net importer during the winter months. Distillate exports averaged 62,000 b/d over the course of 2014 with volumes peaking at 163,000 b/d in August. Conversely, imports averaged 57,000 b/d in 2014 with volumes peaking at 145,000 b/d in March.

**Figure 17. Central Atlantic distillate supply/demand balance, 2014**



Note: All domestic movements and inventory changes are reported on a net basis.

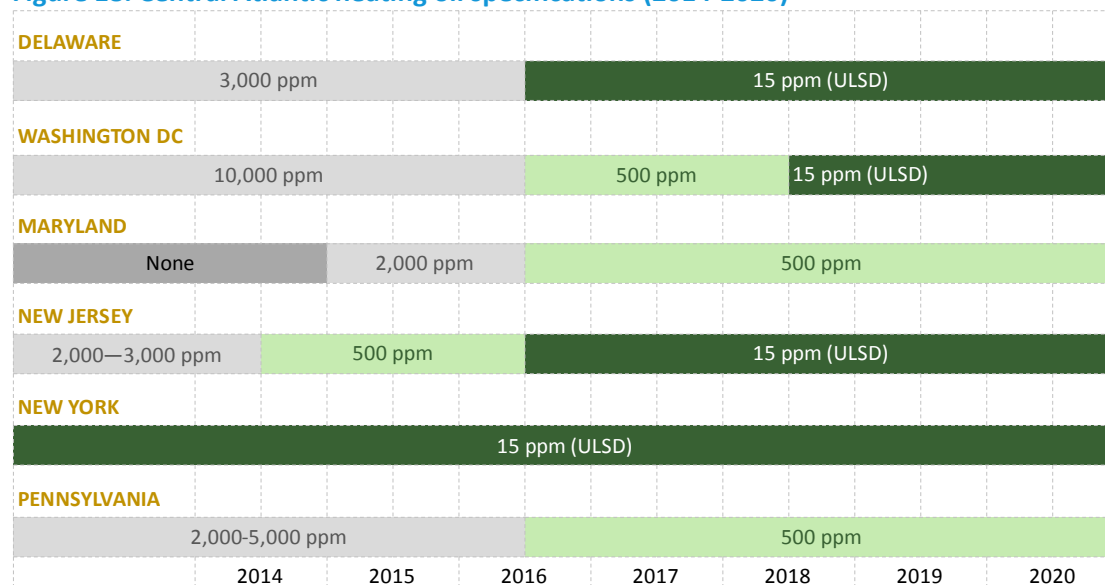
Source: ICF Analysis of EIA, FHWA, FERC, and company 10-K data

The Central Atlantic region, as with the rest of the country, is required by Federal law to use ultra-low sulfur diesel (ULSD)—diesel fuel with a maximum sulfur content of 15 parts per million (ppm)—for all highway, non-road, locomotive and marine diesel fuel.<sup>51</sup> No such Federal restrictions are in place for heating oil—a distillate fuel oil from the same boiling-range portion of crude oil as diesel fuel. However, three states in the Central Atlantic region—New York, New Jersey, and Delaware—and Washington D.C., have enacted state-level regulations to phase out the use of higher-sulfur heating oil blends in favor of cleaner burning ULSD. Figure 18 presents the timelines for heating oil regulations in each state. As of

<sup>51</sup> U.S. Environmental Protection Agency, “Diesel Fuel Standards & Rulemakings” (Accessed November 30, 2015), <http://www2.epa.gov/diesel-fuel-standards/diesel-fuel-standards-rulemakings>. Note that large marine diesel engines fall under Emission Control Area (ECA) rules. Beginning in 2015, large marine diesel engines propelling large ships and ocean-going vessels (Category 3 Engines) operating within the ECAs must generally use fuel with 1,000 ppm sulfur or less, but not ULSD.

July 2012, New York became the first state to completely transition to ULSD in all heating oil.<sup>52</sup> As of July 2014, New Jersey eliminated the use of heating oil with 500 ppm or greater, with ULSD use being mandated by July 2016.<sup>53</sup> Delaware is proposing the same date—July 2016—for ULSD use, transitioning from a current state sulfur limit of 3,000 ppm. Washington D.C. is transitioning to a 500 ppm limit by July 2016, and ULSD by July 2018. Other states in the Central Atlantic region are proposing stricter sulfur limits on heating oil but are not mandating ULSD: Maryland enacted a 2,000 ppm limit in July 2014, with the limit lowering to 500 ppm by July 2015; while Pennsylvania has committed to a statewide sulfur limit of 500 ppm by July 2016.<sup>54</sup> While most refineries in the Gulf Coast and East Coast have converted to produce ULSD, some East Coast refiners have not invested to produce all ULSD. These refiners, as well as blenders, may look to position higher sulfur diesels in the states that allow the higher sulfur use as heating oil. As Figure 18 shows, these options will be decreasing as states implemented phase down of sulfur in heating oil.

**Figure 18. Central Atlantic heating oil specifications (2014-2020)**



Sources: U.S. EIA, National Oilheat Research Alliance

States and municipalities in the Central Atlantic region have also enacted laws to mandate biodiesel blending in heating oil supply. Effective in October 2012, New York City enacted a regulation requiring

<sup>52</sup> U.S. Energy Information Administration, “Today in Energy: Sulfur content of heating oil to be reduced in northeastern states” (Accessed November 30, 2015) <http://www.eia.gov/todayinenergy/detail.cfm?id=5890>; and New England Fuel Institute, “State Sulfur & Bioheat Requirements for No. 2 Heating Oil in the Northeast & Mid-Atlantic States” (Accessed December 4, 2015), <http://www.nefi.com/news/docs/heating-oil-standards-chart.pdf>; and U.S. Energy Information Administration, “Rhode Island: State Profile and Energy Estimates” (Accessed December 4, 2015), <https://www.eia.gov/state/analysis.cfm?sid=RI>; and Connecticut Department of Energy and Environmental Protection, “Fact Sheet: Reduction of Sulfur Dioxide Emissions and Fuel Sulfur Content” (Accessed December 4, 2015), [http://ct.gov/deep/lib/deep/air/siprac/2013/fuel\\_sulfur\\_factsheet.pdf](http://ct.gov/deep/lib/deep/air/siprac/2013/fuel_sulfur_factsheet.pdf).

<sup>53</sup> U.S. Energy Information Administration, “This Week in Petroleum: Changes in heating oil sulfur specifications in the U.S. Northeast will likely increase ultra-low sulfur diesel demand this winter,” (Accessed December 4, 2015), <http://www.eia.gov/petroleum/weekly/archive/2014/140910/twipprint.html>.

<sup>54</sup> Ibid.

that all heating oil categorized as No. 2, 4, or 6 must include a 2% biofuel blend.<sup>55</sup> In Maryland, as of 2014, state law mandates that at least 50% of the oilheat equipment in use in state buildings use at least a 5% biofuel blend.<sup>56</sup>

### Residual fuel

Historically, the Central Atlantic region used substantial quantities of residual fuel oil for electric power generation. In 2014, residual fuel sales in the Central Atlantic averaged around 75,000 b/d.<sup>57</sup> However, nearly three-fourths of sales were used for vessel bunkering purposes.<sup>58</sup> Although annual consumption of residual fuel oil by the electric power sector has typically been below 5,500 b/d since 2010, consumption can occasionally surge during cold spells when natural gas pipelines serving power plants are constrained and natural gas prices spike, making power sector fuel switching economical. In 2014, annual power sector purchases of residual fuel oil were above 7,400 b/d amid one of the coldest January, February, and March months on record.<sup>59</sup> Consumption from the power sector helped push total sales of residual fuel (from all sectors) to as high as 95,000 b/d in February 2014, the peak consumption month.<sup>60</sup>

### Jet fuel

Figure 19 presents the Central Atlantic region's 2014 jet fuel supply/demand balance. Commercial jet fuel consumption in the region averaged 233,000 b/d in 2014, while in-region refinery production averaged 93,000 b/d, enough to meet 40% of consumption. The remainder of jet fuel supply is received from other regions, primarily through the Colonial Pipeline system from the Gulf Coast. Jet fuel consumption generally follows a seasonal pattern with consumption higher in the summer months. In 2014, consumption peaked at 256,000 b/d in July and was lowest in February, at 200,000 b/d.

<sup>55</sup> New England Fuel Institute, "Heating Oil Standards Chart" (Accessed December 4, 2015), <http://www.nefi.com/news/docs/heating-oil-standards-chart.pdf>.

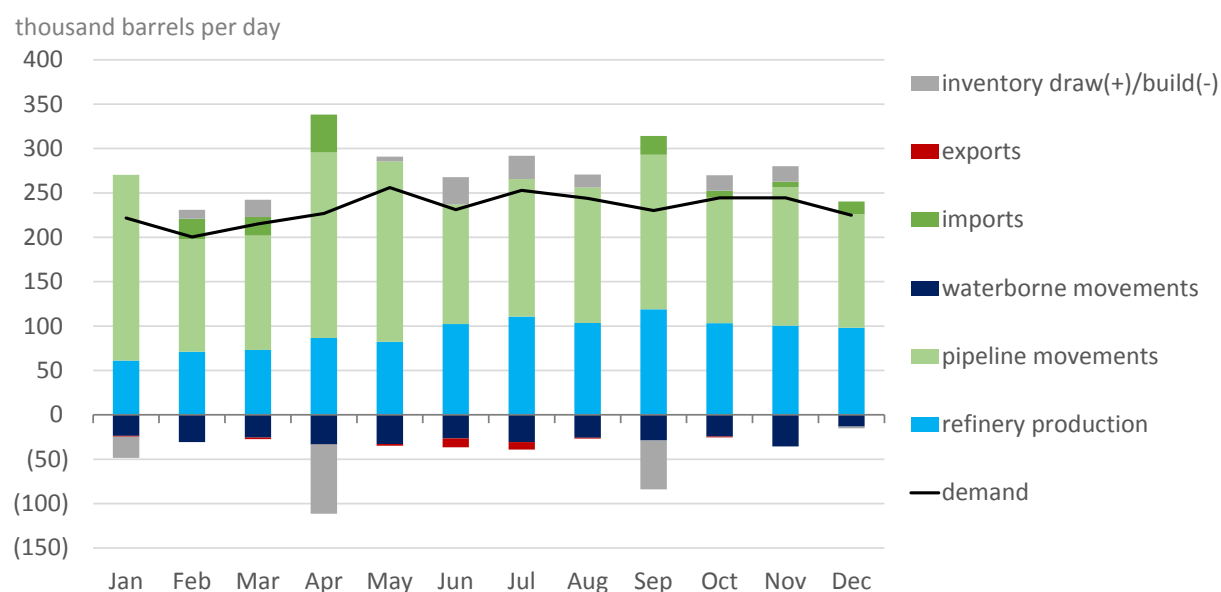
<sup>56</sup> New England Fuel Institute, "Heating Oil Standards Chart" (Accessed December 4, 2015), <http://www.nefi.com/news/docs/heating-oil-standards-chart.pdf>.

<sup>57</sup> U.S. Energy Information Administration, "Central Atlantic (PADD 1B) Total Residual Fuel Oil All Sales/Deliveries by Prime Supplier (Annual)" (Accessed December 22, 2015) <http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=C300012001&f=A>.

<sup>58</sup> U.S. Energy Information Administration, "Sales of Residual Fuel Oil by End Use" (Accessed December 22, 2015), [https://www.eia.gov/dnav/pet/pet\\_cons\\_821rsd\\_dcu\\_R1Y\\_a.htm](https://www.eia.gov/dnav/pet/pet_cons_821rsd_dcu_R1Y_a.htm).

<sup>59</sup> U.S. Energy Information Administration, "Central Atlantic (PADD 1B) Residual Fuel Oil Sales/Deliveries to Electric Utility Consumers" (Accessed December 22, 2015), <https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=KPRVEUROY1&f=A>

<sup>60</sup> U.S. Energy Information Administration, "Central Atlantic (PADD 1B) Residual Fuel Oil Sales/Deliveries by Prime Supplier (Monthly)" (Accessed December 22, 2015), <http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=C300012001&f=M>

**Figure 19. Central Atlantic jet fuel supply/demand balance, 2014**

Source: ICF Analysis of EIA, FHWA, FERC, and company 10-K data

Five airports in the Central Atlantic region are designated as large hubs by the Federal Aviation Administration: John F. Kennedy International Airport (JFK), Newark Liberty International (EWR), and LaGuardia (LGA) serving the New York City metropolitan area; Philadelphia International Airport (PHL); and Baltimore/Washington International Thurgood Marshall Airport (BWI). The Central Atlantic region also includes two medium hubs and seven small hubs, which serve inland geographies in Upstate New York and western Pennsylvania.<sup>61</sup> In addition to these hubs, 109 smaller commercial service airports operate in the region, as well as two air force bases: Dover Air Force Base in Delaware and McGuire Air Force Base in New Jersey. These bases may consume commercial-quality Jet-A fuel in addition to higher-performance jet fuel blends.<sup>62</sup>

## Refineries

Refineries in the Central Atlantic region are concentrated in two areas: the East Coast, which includes refineries in the Greater Philadelphia area and in the New York Harbor area; and refineries in the Appalachia region, which includes refineries in western Pennsylvania and in the North Panhandle of West Virginia (technically in the Southeast region but included in the Central Atlantic chapter due to its greater integration with Central Atlantic markets).

### East Coast

The East Coast refining region consists of six refineries with a combined atmospheric crude distillation capacity of nearly 1.2 million barrels per calendar day (b/cd).<sup>63</sup> Table 14 lists each refinery and its

<sup>61</sup> Federal Aviation Administration, "Airport Safety" (Accessed November 5, 2015), [http://www.faa.gov/airports/airport\\_safety/airportdata\\_5010/menu/](http://www.faa.gov/airports/airport_safety/airportdata_5010/menu/).

<sup>62</sup> MilitaryBases.com, "State Military Bases" (Accessed November 5, 2015), <http://militarybases.com>.

<sup>63</sup> Barrels per calendar day is a measure of the amount of input that a distillation unit can process in a 24-hour period under usual operating conditions. It takes into account both planned and unplanned maintenance. Stream day capacity is the maximum number of barrels of input that a distillation facility can process within a 24-hour period when running at

operable capacity as of January 1, 2015. With the exception of the Phillips 66 refinery in Linden, New Jersey, the refineries in this region are all located along the Delaware River in Pennsylvania, New Jersey, and Delaware. Collectively, this study refers to the regions in which these refineries are located as the Greater Philadelphia area. The Linden refinery, which has the capability to produce up to 91% transportation fuels, primarily supplies local markets in the New York Metropolitan area.<sup>64</sup> The Greater Philadelphia area refineries supply the Philadelphia and Wilmington area markets by truck, deliver products to other parts of the Central Atlantic region by pipeline, and ship fuels to domestic and foreign markets by marine vessel. The Greater Philadelphia area refining cluster includes two specialized refineries: Monroe Energy's refinery in Trainer, Pennsylvania, which is owned by parent company Delta Air Lines, is configured to maximize production of jet fuel, while Axeon's refinery in Paulsboro, New Jersey, specializes in asphalt production.<sup>65 66</sup>

**Table 14. East Coast refineries**

Owner	Site	Operable Capacity, b/cd <sup>A</sup>
Philadelphia Energy Solutions	Philadelphia, PA	335,000
Phillips 66 Company	Linden,	238,000
Monroe Energy	Trainer, PA NJ	185,000
PBF Energy Co., LLC	Delaware City, DE	182,200
PBF Energy Co., LLC	Paulsboro, NJ	160,000
Axeon Specialty Products, LLC <sup>B</sup>	Paulsboro, NJ	70,000
	<b>Total</b>	<b>1,170,200</b>

(A) Barrels per calendar day, as of Jan. 1, 2015

(B) Asphalt refinery

Source: U.S. Energy Information Administration, Refinery Capacity Report

Figure 20 shows monthly refinery utilization and yield percentages for motor gasoline (both finished gasoline and blendstocks), distillate fuel oil, residual fuel oil, and other secondary products. In 2014, production of transportation fuels (motor gasoline, distillate, and jet fuel) accounted for 84.9% of the region's annual yield, which was close to the national average of 84.5%. East Coast refineries have a slightly higher average yield of motor gasoline than the national average, at 46.9% compared to 45%, and an equivalent yield for distillate at 29.3%, compared to 29.9% nationally. East Coast jet fuel yield, at 8.7%, is also approximately equivalent to the national average. East Coast refineries yield of residual fuel oil, at 5.3%, is more than double the national average of 2.5%. East Coast refineries yield slightly lower gasoline volumes during the spring and summer months due to the need to conform to seasonal RVP limits, which are achieved by adding less butane to gasoline.

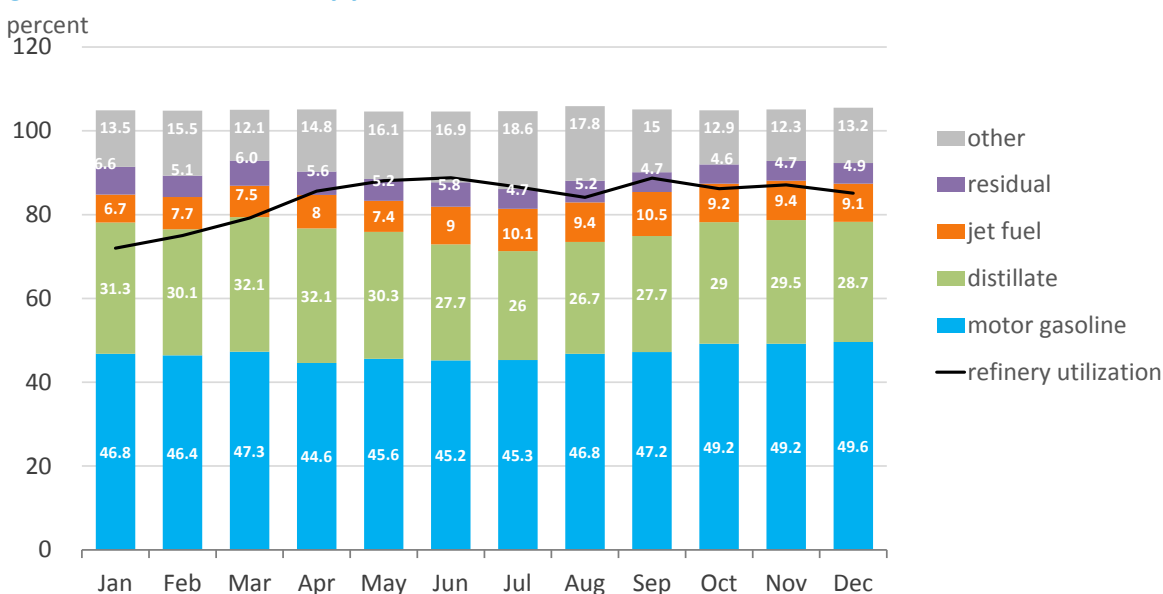
full capacity under optimal crude and product slate conditions with no allowance for downtime. Stream day capacity is typically about 6% higher than calendar day capacity.

<sup>64</sup> Phillips 66 Company, "Bayway Refinery" (Accessed December 8, 2015), <http://www.phillips66.com/EN/about/our-businesses/refining/Pages/bayway-refinery.aspx>.

<sup>65</sup> Monroe Energy, Homepage, (Accessed January 6, 2016), <http://www.monroe-energy.com/>.

<sup>66</sup> Axeon Specialty Products, "Paulsboro Refinery" (Accessed December 8, 2015), <http://axeonsp.com/manufacturing/refinery/>.

Figure 20. East Coast refinery yields



Note: yield percentages sum to higher than 100% due to processing gains.

Source: U.S. Energy Information Administration, Petroleum Supply Monthly

### Appalachia

The Appalachian No.1 region has three refineries with a combined atmospheric crude distillation capacity of 98,300 b/cd. Table 15 lists each refinery in the Appalachian No. 1 Refining District and its operable capacity as of January 1, 2015. Two of these refineries—operated by United Refining and American Refining Group—are located in northwest Pennsylvania’s near the state’s border with Buffalo New York. The third refinery, operated by Ergon, is located in Newell, West Virginia, at the very tip of the state’s Northern Panhandle. United Refining’s Warren, refinery is the only refinery in the group that places primary emphasis on maximizing yields of ground transportation fuels (gasoline and diesel), which it distributes by truck to local markets in Pennsylvania, western New York, and eastern Ohio.<sup>67</sup> The other two refineries in this group primarily produce specialty products such as lubricants and base oils, though also produce small volumes of transportation fuels. Ergon’s Newell refinery produces approximately 8,000 b/d of ultra-low sulfur diesel (ULSD) and an unknown volume of ultra-low sulfur gasoline, which are distributed by barge and truck to local markets, primarily in the Pittsburgh, Pennsylvania, metropolitan area.<sup>68</sup>

<sup>67</sup> United Refining Company, “About United Refining,” (Accessed January 6, 2016), [http://www.urc.com/about\\_urc/index.php](http://www.urc.com/about_urc/index.php).

<sup>68</sup> Ergon, Inc. “Ergon- West Virginia, Inc. Invests in New Diesel Technology,” (July 31, 2006), <http://ergon.com/news/6-ergon-west-virginia-inc-invests-in-new-diesel-technology>.

**Table 15. Appalachian No.1 refineries**

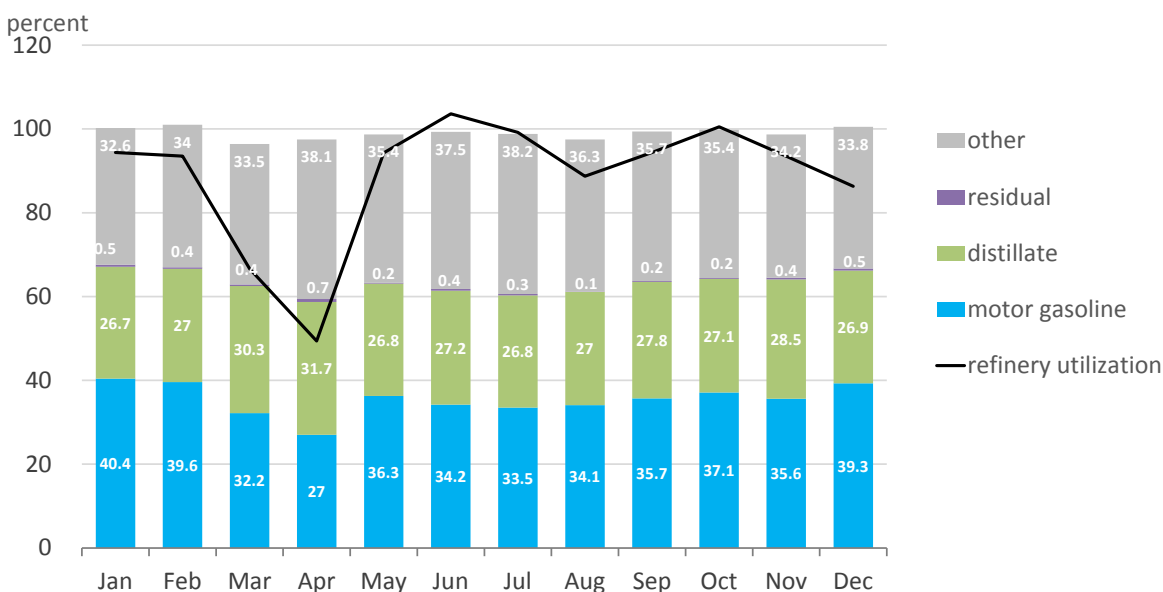
Owner	Site	Operable Capacity, b/cd <sup>A</sup>
United Refining	Warren, PA	65,000
Ergon <sup>B</sup>	Newell, WV	22,300
American Refining Group <sup>B</sup>	Bradford, PA	11,000
<b>Total</b>		<b>98,300</b>

(A) Barrels per calendar day, as of Jan. 1, 2015

(B) Refinery specializes in non-transportation fuels

Source: U.S. Energy Information Administration, Refinery Capacity Report

Figure 21 shows monthly refinery utilization and yield percentages in 2014 for motor gasoline (both finished gasoline and blendstocks), distillate fuel oil, residual fuel oil, and other secondary products. In 2014, Appalachian No. 1 refinery production of transportation fuels, at 63.2%, was well below the U.S. average of 84.5%. United Refining's refinery shut down for a major turnaround in March and April of 2014 and this resulted in both lower refinery utilization and lower regional yields of transportation fuels in those months and in the annual average. Appalachian No. 1 refineries produce gasoline and distillates but not jet fuel. In 2014, nearly 37% of the group's yield was comprised of products other than transportation fuels—such as lubricants and base oils. As in other regions, refinery yield of motor gasoline is slightly lower during the summer months due to less butane volume added gasoline to control engine vapor lock and to meet required gasoline RVP regulations.

**Figure 21. Appalachian No. 1 refinery yields**

Note: yield percentages sum to higher than 100% due to processing gains.

Source: U.S. Energy Information Administration, Petroleum Supply Monthly

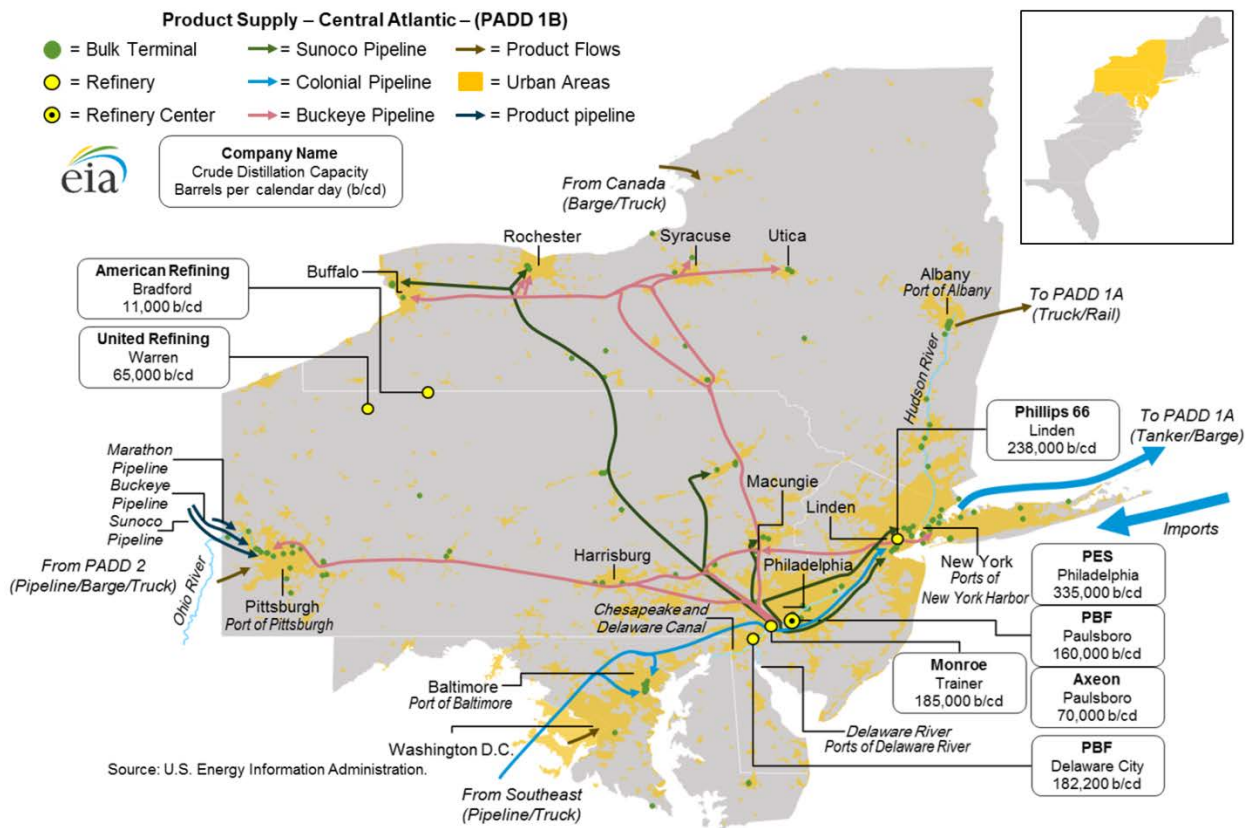
## Supply and logistics

The Central Atlantic refined product supply chain is a complex system with multiple inbound and outbound movements of transportation fuels. The core of the system lies in two refining and supply



centers in the New York Harbor area and in the Greater Philadelphia area. The New York Harbor supply center, which is mostly located in northern New Jersey, consists of the Linden, New Jersey refinery and numerous pipeline and marine terminals with a combined storage capacity of about 70 million barrels.<sup>69</sup> The Greater Philadelphia area supply center, which is an area that includes parts of southeast Pennsylvania, southwest New Jersey, and northern Delaware, consists of four refineries located along the Delaware River and numerous pipeline and marine terminals. The two supply hubs gather product from a variety of sources, including in-region refineries, the Colonial Pipeline system from the Gulf Coast, and marine imports from the Atlantic Basin. Supply is distributed by truck and pipeline to markets within the Central Atlantic region, by barge to other markets in PADD 1, and by marine tanker to export markets in the Atlantic Basin. Figure 22 presents the refineries, product pipelines, storage terminals, and petroleum ports serving the Central Atlantic region.

**Figure 22. Central Atlantic refined petroleum infrastructure**



<sup>69</sup> U.S. Energy Information Administration, “Hurricane Sandy: New York/New Jersey Intra Harbor Petroleum Supplies Following Hurricane Sandy: Summary of Impacts Through November 13, 2012,” (Released November 21, 2012), [https://www.eia.gov/special/disruptions/hurricane/sandy/petroleum\\_terminal\\_survey.cfm](https://www.eia.gov/special/disruptions/hurricane/sandy/petroleum_terminal_survey.cfm).



## Ports

Table 16 lists the ports in the Central Atlantic region that shipped and received marine cargos of transportation fuels in 2013, the latest year for which domestic marine movement data is available from the U.S. Army Corp of Engineers (USACE). The table shows estimated inbound and outbound movements at the region's ports broken out between domestic shipments, as tracked by USACE, foreign imports as tracked by EIA, and foreign exports, as tracked by the U.S. International Trade Commission (USITC) using U.S. Census data. Ports in Table 16 have been generally organized into four geographic areas: New York Harbor & Long Island; Greater Philadelphia area; Upstate New York; and Other—a category that includes the geographically distant ports of Baltimore and Pittsburgh. Many ports in the Central Atlantic region have both inbound and outbound movements of transportation fuels, with some shipments originating and terminating wholly within region. For example, refineries along the Delaware River ship coastwise-compliant marine volumes to terminals in the New York Harbor, and terminals in the New York Harbor area ship internal volumes up the Hudson River to markets in Upstate New York. As a result, the totals for inbound and outbound movements characterize the level of waterborne activity in the region, but may involve some double-counting of volumes.

**Table 16. Waterborne movements of transportation fuels at Central Atlantic ports, 2013**

Port/Waterway	Inbound			Outbound		
	Domestic	Foreign	Total	Domestic	Foreign	Total
<b>NY Harbor &amp; Long Island</b>						
New York Harbor	29,867	186,444	216,311	396,149	58,485	454,634
Port Jefferson	24,146	-	24,146	-	-	-
Hempstead	4,431	-	4,431	-	-	-
<b>Total</b>	<b>58,444</b>	<b>186,444</b>	<b>244,888</b>	<b>396,149</b>	<b>58,485</b>	<b>454,634</b>
<b>Greater Philadelphia</b>						
Philadelphia, PA	686	9,340	-	-	45,510	125,003
Wilmington, DE	6,007	3,279	-	46,648	-	-
Paulsboro, NJ	1,033	1,745	-	19,538	-	-
Camden, NJ	-	1,342	-	-	-	-
Marcus Hook, PA	448	203	-	13,307	-	-
<b>Total</b>	<b>8,174</b>	<b>15,909</b>	<b>24,083</b>	<b>79,493</b>	<b>45,510</b>	<b>125,003</b>
<b>Upstate New York</b>						
Hudson River <sup>A</sup>	120,469	559	-	-	-	-
Ogdensburg, NY	-	-	-	-	2,356	2,356
Buffalo, NY	-	-	-	-	27	27
<b>Total</b>	<b>120,469</b>	<b>559</b>	<b>121,028</b>		<b>2,384</b>	<b>2,384</b>
<b>Other</b>						
Baltimore, MD	4,791	3,279	8,070	4,905	381	5,286
Pittsburgh, PA	15,560	-	15,560	-	-	-
<b>Total</b>	<b>20,351</b>	<b>3,279</b>	<b>23,630</b>	<b>4,905</b>	<b>381</b>	<b>5,286</b>
<b>Central Atlantic Total</b>	<b>207,438</b>	<b>206,191</b>	<b>413,629</b>	<b>475,642</b>	<b>103,995</b>	<b>587,307</b>

(A) Includes deliveries to terminals in Albany, Newburgh, Poughkeepsie, Kingston, Roseton, and Cortland Manor

Source: U.S. Army Corp of Engineers 2013 Waterborne Commerce of the United States Waterways and Harbors; EIA Company Level Imports, 2013; U.S. International Trade Commission, 2013

According to 2013 estimates, the Central Atlantic region was a net supplier of fuels to other regions by tanker and barge, with domestic flows into the region's ports exceeding outflows by approximately 273,000 b/d, and a net importer from other countries, with imports exceeding exports by 99,000 b/d. The New York Harbor brought in about 210,000 b/d of transportation fuels from both foreign and domestic sources, and shipped out nearly 455,000 b/d of transportation fuels, including movements to markets in New England, markets along the Hudson River in New York, and exports. The Greater Philadelphia area supply center brought in approximately 24,000 b/d from foreign and domestic sources via ports along the Delaware River, and shipped out approximately 125,000 b/d to domestic and export markets in aggregate.

### Pipelines

Refined product pipeline infrastructure in the Central Atlantic region generally transports fuel into the region from the Gulf Coast and PADD 2, and distributes product within the region from coastal supply centers to inland markets in western Pennsylvania and western New York. Table 17 lists select refined product pipelines operating in the Central Atlantic region as well as their origin points, destination points, and capacities, where publically available. Three main entities operate product pipeline systems serving the Central Atlantic region: Colonial Pipeline Company, Buckeye Partners, and Sunoco Logistics.

**Table 17. Select Central Atlantic refined product pipelines**

Pipeline	Segment	Origin	Destination	Capacity, b/d
Colonial Pipeline System	Line 3	Greensboro, NC	Linden, NJ	885,000
	Line 4	Greensboro, NC	Sykesville, MD	504,000
Buckeye Pipeline System	Long Island System	Linden, NJ	JFK and LaGuardia airports, NY	120,000
		Linden, NJ	Brooklyn and Inwood, NY	138,500
		Linden, NJ	Newark, NJ	66,000
		Linden, NJ	Macungie, PA	302,000
	Eastern System	Eagle Point, PA	Macungie and Sinking Spring, PA	204,000
		Macungie, PA	Rochester, Brewerton, and Utica, NY	not avail.
		Malvern, PA	Buffalo and Syracuse, NY	30,000
	Midwest System	Malvern, PA	Harrisburg, PA	48,000
		Mantua, OH	Coraopolis, PA	55,200
	Laurel Pipeline	Booth, PA	Mechanicsburg, PA	312,000
Mechanicsburg, PA		Duncansville, PA	216,000	
Duncansville, PA		Coraopolis, PA	180,000	
Sunoco Logistics Pipeline System	Harbor	Woodbury, NJ	Linden, NJ	180,000
		Twin Oaks, PA	Newark, NJ	125,000
	Philadelphia, PA	Rochester and Buffalo, NY	64,800	
	Philadelphia, PA	Syracuse, NY	29,400	
	Montello, PA	Kingston, PA	11,000	
Allegheny Access	Toledo and Lima, OH	Delmont, PA	85,000	

Marathon Pipeline	East Sparta, OH	Midland, PA	36,000
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Source: ICF estimates and research of FERC Documents; Buckeye, Sunoco, Laurel, and Colonial Pipeline System Maps; Buckeye Pipe Line Company, L.P. – Prepared Answering Testimony to Commission Trial Staff and Related Exhibits in Docket Nos. OR14-4-000 and OR14-4-001, Exhibit Nos. BPL-79, 80, 82, 83, and 84 (Transmitted on June 26, 2015).

The Colonial Pipeline system is the only pipeline system supplying markets in the Central Atlantic from refining centers on the Gulf Coast. Within the region, the Colonial Pipeline system consists of two mainline segments that ship segregated batches of petroleum products from a logistics hub in Greensboro, North Carolina, to Central Atlantic markets in the Washington, D.C., Baltimore, Philadelphia, and New York City metropolitan areas. Colonial’s 504,000 b/d Line 4 terminates at the Dorsey junction in Maryland, and primarily supplies the Baltimore-Washington metropolitan area. Meanwhile, Colonial’s 885,000 b/d Line 3, continues further north, interconnecting with Sunoco and Buckeye pipeline facilities in the Greater Philadelphia area supply center, before terminating in Linden, New Jersey, where it interconnects with storage facilities in New York Harbor area and Buckeye’s Long Island Pipeline system.

Buckeye Partners operates two interstate pipeline systems in the Central Atlantic region that source product from the Greater Philadelphia area and New York Harbor supply centers. From Buckeye’s Linden origin, the company’s Long Island Pipeline System serves terminals and airports in the New York City metropolitan area. Two of the system’s lines run east from Linden to Long Island: the 120,000 b/d Line 601 supplies jet fuel to JFK and LaGuardia airports, while the 138,000 b/d Line 602 supplies gasoline and distillates to truck distribution terminals on western Long Island. A third line, the 66,000 b/d Line 607, supplies jet fuel south from Linden to Newark Airport.

The Buckeye Eastern Products Pipeline system gathers supply from New York Harbor (from the Linden origin) and from multiple origins in the Philadelphia area, and delivers them to two key junctions in Macungie and Malvern in southeast Pennsylvania. From these hubs multiple lines ship product north to markets in Upstate New York, including Buffalo, Rochester, Brewerton, and Utica; and west to Harrisburg, Pennsylvania, and to Sinking Spring, where the Eastern Products system interconnects with Buckeye’s Laurel Pipeline system, which has the capacity to ship up to 312,000 b/d to markets in central and western Pennsylvania markets as far west as Pittsburgh. The system typically increases distillate flows during the winter, to meet heating oil consumption, and also supplies small volumes of jet fuel to the Pittsburgh and Rochester markets.

Sunoco Logistics operates several pipeline systems that originate in the Greater Philadelphia area supply hub. Two lines—Sunoco’s 180,000 b/d Harbor pipeline and 125,000 b/d Twin Oaks/Newark pipeline—run northeast from the Greater Philadelphia area refineries supplying New York Harbor; while two additional lines run northwest from the Greater Philadelphia area supplying markets in eastern Pennsylvania and Upstate New York, including Buffalo, Rochester, and Syracuse. In addition to lines originating in Philadelphia, Sunoco Logistics operates the 85,000 b/d Allegheny Access Pipeline, which connects western Ohio refineries (in PADD 2) to the Pittsburgh metropolitan area.

## Markets

### New York City

Markets in the New York City metropolitan area are supplied from the New York Harbor supply hub, which gathers products from a variety of sources, including the Colonial Pipeline system from the Gulf Coast; Sunoco's Harbor and Twin Oaks/Newark pipelines from the Greater Philadelphia area refining center; local supply from Phillips 66's 238,000 b/cd Linden, New Jersey refinery; and domestic and imported supply delivered by marine tanker and barge. Total pipeline capacity into New York Harbor is nearly 1.2 million b/d. Supply from New York Harbor is distributed to terminals serving the New York City metropolitan area via multiple modes. Buckeye Pipeline's 324,000 b/d Long Island Pipeline System delivers fuels from New York Harbor to terminals in western Long Island that serve New York City, as well as to JFK, LaGuardia, and Newark airports. Barge movements out of New York Harbor ship fuel to terminals in the Bronx and on the north shore of Long Island via the Long Island Sound, and to markets north of New York City via the Hudson River. Truck movements out of the Harbor supply fuel to Staten Island, and Newark, as well as other markets in northern New Jersey. Trenton, New Jersey, located in the southern portion of the New York metropolitan area is served by a spur of the Colonial Pipeline before it reaches the New York Harbor area.

Supply from the New York Harbor area is also distributed to markets outside the New York City metropolitan area. From Linden, a 302,000 b/d Buckeye pipeline delivers fuels to Macungie, Pennsylvania, where it is staged for further delivery to inland markets in the Central Atlantic region. Barge movements out of the Harbor move to markets coastal markets in New England and up the Hudson River to Albany, and a sizeable volume of fuel—approximately 58,000 b/d of mostly distillates in 2013—was exported.

### Albany

Albany and other markets along the Hudson River in central New York rely on the waterway for barge supply of transportation fuels from the New York Harbor. Inbound barge movements to locations on the Hudson River averaged nearly 121,000 b/d in 2013, a figure that includes receipts in Albany as well as receipts in Newburgh, which is in the New York City metropolitan area. Direct imports along the Hudson River are limited as most large vessels exceed the river draft limit. Supply received at barge terminals in the Albany area is distributed by truck to local markets and to markets in western New England. In addition to truck movements, approximately 15,000 b/d of products was railed from Albany to Burlington, Vermont, in 2013, according to provisional data from the U.S. Department of Transportation (U.S. DOT).<sup>70</sup>

### Greater Philadelphia area

The Greater Philadelphia area includes portions of southeast Pennsylvania, southwest New Jersey, and northern Delaware, including and the principal consumption centers of Philadelphia, Pennsylvania; Camden, New Jersey; and Wilmington, Delaware. The Greater Philadelphia area is predominantly supplied by four area refineries with a combined refining capacity of more than 0.9 million b/d. Supply

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<sup>70</sup> Federal Highway Administration. *Freight Analysis Framework 3 Provisional Annual Data for 2013*. [http://ops.fhwa.dot.gov/freight/freight\\_analysis/faf/faf3/faf3\\_6\\_prov2013.zip](http://ops.fhwa.dot.gov/freight/freight_analysis/faf/faf3/faf3_6_prov2013.zip)

also enters the area by tanker and barge from foreign and domestic sources, and is delivered to area terminals via the Colonial Pipeline from the Gulf Coast. Transportation fuels produced and gathered in the Greater Philadelphia region are distributed locally by short haul pipelines and from truck racks at area refineries and terminals. Surplus supply in the Greater Philadelphia area is distributed via an extensive network of long haul pipelines to New York Harbor and to inland markets in the Central Atlantic region, and by tanker/barge to New York Harbor, New England, and other coastal markets in PADD 1. The Chesapeake and Delaware Canal connects the Delaware River to the Baltimore market area, allowing barge movement of products into Baltimore from the Philadelphia area refiners.

Major pipeline systems originating in the Greater Philadelphia area, include Sunoco Logistics' Harbor and Twin Oaks/Newark pipelines that run northeast to New York Harbor, two Sunoco lines that deliver fuel northwest to markets eastern Pennsylvania and western New York, and two Buckeye Pipelines that move product to logistics hubs in southeastern Pennsylvania for further transport to inland markets. All told, pipelines originating in the Greater Philadelphia area have the capacity to ship more than 600,000 b/d of products to markets within the Central Atlantic region. In 2013, the region shipped approximately 125,000 b/d of transportation fuels to domestic and foreign markets by tanker and barge, compared with domestic inflows and imports of 24,000 b/d.

#### Upstate New York and northern Pennsylvania

Upstate New York and Northern Pennsylvania are primarily supplied by the Buckeye and Sunoco Logistics pipeline systems that draw products from the Greater Philadelphia area and New York Harbor supply centers via pipeline logistics hubs in southeastern Pennsylvania (Macungie, Malvern, Montello, and Sinking Spring). Products gathered at these hubs are shipped on the Buckeye and Sunoco lines to markets in northeastern Pennsylvania, including Reading, Allentown, Williamsport, and Scranton; and to markets across Upstate New York, including to the Buffalo, Rochester, Syracuse, and Utica. Upstate New York markets also receive products from United's 65,000 b/cd Warren refinery in northwest Pennsylvania—the only refinery in the Appalachia region that produces appreciable quantities of transportation fuels. In addition, a small import volumes by truck and barge from Canada at the port of Ogdensburg, New York, on the St. Lawrence River.

#### South central and southwest Pennsylvania

South central and southwestern Pennsylvania, and its principal consumption centers in Pittsburgh and Harrisburg, primarily receive transportation fuel supply by pipeline from the Greater Philadelphia area refining center and from PADD 2. The primary source of supply in south central Pennsylvania is Buckeye's 312,000 b/d Laurel Pipeline system, which extends west from southeast Pennsylvania supplying Harrisburg, Mechanicsburg, and Altoona, before terminating near Pittsburgh, where capacity narrows to 180,000 b/d. Pittsburgh, and other markets in southwest Pennsylvania, are also supplied from Ohio via a 55,200 b/d Buckeye pipeline and Marathon's 36,000 b/d East Sparta pipeline. Additionally, Sunoco Logistics brought its 85,000 b/d Allegheny Access project into operation in 2015, directly connecting the Pittsburgh market with refineries in Toledo and Lima, Ohio. All told, inbound pipeline capacity to ship transportation fuels into southwest Pennsylvania totals more than 350,000 b/d. In addition to pipeline supply, south central and southwest Pennsylvania markets also have access to truck supply from United's 65,000 b/d Warren, Pennsylvania, refinery and from Ergon's 22,300 b/cd

Newell refinery in the Northern Panhandle of West Virginia (technically located in the Southeast region). The Pittsburgh market can also receive barge deliveries via the Ohio River from the Catlettsburg, Kentucky refinery (in PADD 2). In 2013, an estimated 16,000 b/d of transportation fuels moved into the port of Pittsburgh along the Ohio River, according to USACE.

### Baltimore-Washington

The Baltimore-Washington metropolitan area receives the majority of its transportation fuel supply via the Colonial and Plantation pipelines from the Gulf Coast. The Washington D.C. market is primarily served by truck from terminals connected to the Colonial and Plantation mainlines in Northern Virginia (located in the Southeast region). In 2013, approximately 42,000 b/d was trucked to markets in Washington D.C. and southern Maryland from Virginia, according data from U.S. DOT. Baltimore's supply, including jet fuel supply to Baltimore-Washington International (BWI) airport, is received via spur pipelines originating at Dorsey Junction in Sykesville, Maryland, which is the terminus of Colonial's 504,000 b/d Line 4. Baltimore is also supplied by via a spur pipeline from Colonial's 885,000 b/d Line 3 at Aberdeen junction, north of Baltimore. In addition, the Port of Baltimore received approximately 8,000 b/d of waterborne supply from domestic and foreign sources in 2013, including the Chesapeake and Delaware Canal from Philadelphia. Outbound barge movements from the Port of Baltimore, which averaged around 5,000 b/d in 2013, were primarily delivered to small markets along the rivers and tributaries of the Chesapeake Bay.

### Supply vulnerability

The Central Atlantic supply chain has a great deal of flexibility due its diverse mix of supply sources, including production from in-region refineries, supply from the Gulf Coast via the Colonial Pipeline, and foreign imports from Atlantic Basin suppliers. The region's two major supply hubs in the Greater Philadelphia area and New York Harbor have a unidirectional connection (south to north), but both hubs supply many of the same regional pipeline systems—operated by Buckeye and Sunoco—offering flexibility to supply dependent inland markets from either hub. Similarly, both hubs have the capability to load tankers and barges to supply dependent coastal markets in the New England region. In addition, the New York Harbor area has about 70 million barrels of storage capacity (including capacity holding transportation fuels, ethanol, residual fuels), providing significant flexibility to manage temporary disruptions.<sup>71</sup>

Despite these advantages, the concentration of supply infrastructure in the Greater Philadelphia and New York Harbor areas, and the multiple interconnections between the region's pipeline systems, make the Central Atlantic region vulnerable to disruptions impacting these hubs and pipelines. This vulnerability was exposed in 2011 and 2012 when hurricanes Irene and Sandy made landfall in the Central Atlantic region, disrupting operations at in-region refineries, pipelines, ports, and terminals in both supply centers. The disruptions occurred due to direct damage to infrastructure—from wind and storm surge—as well as interruptions to essential utility power supply. The region's problems were

<sup>71</sup> U.S. Energy Information Administration, "Hurricane Sandy: New York/New Jersey Intra Harbor Petroleum Supplies Following Hurricane Sandy: Summary of Impacts Through November 13, 2012," (Released November 21, 2012), [https://www.eia.gov/special/disruptions/hurricane/sandy/petroleum\\_terminal\\_survey.cfm](https://www.eia.gov/special/disruptions/hurricane/sandy/petroleum_terminal_survey.cfm).

compounded by the interconnections between the pipeline systems. For instance, after Sandy, power was out to Buckeye's Long Island Pipeline System for several days. At the time of the outage, Buckeye was scheduled to receive a large delivery of jet fuel from Colonial Pipeline for delivery to New York City area airports. The Buckeye outage prevented Colonial from clearing the jet fuel from its system, backing up shipments on its 885,000 b/d Line 3 as far south as the line's origin in Greensboro, North Carolina.

Following Hurricane Sandy, U.S. DOE established the Northeast Gasoline Supply Reserve, which stores gasoline at several sites in the Central Atlantic and New England regions, including 700,000 barrels in the New York Harbor area.<sup>72</sup>

The region's supply infrastructure can also be challenged by winter weather. The winters of 2013-2014 and 2014-2015 brought extreme cold temperatures and record precipitation to Central Atlantic markets, increasing consumption for heating oil (distillate fuel oil), impacting refinery production, and inhibiting marine transportation logistics. In February 2014, cold-weather-related shutdowns and operational issues at East Coast refineries resulted in a nearly 25% drop in refinery production. In addition to refinery curtailments, the extreme cold in both early 2014 and early 2015 caused unprecedented thick ice and freezing in Central Atlantic ports and waterways, delaying marine deliveries to terminals along the Hudson River and on Long Island.<sup>73</sup> To meet high heating oil consumption, swing supply to the Central Atlantic region, for the most part, was imported from global suppliers.

The U.S. DOE previously maintained an emergency reserve of heating oil in the New York Harbor area, but discontinued its use due to the abundance of commercial stocks, connections to local refineries, and the ability of the Colonial Pipeline to provide resupply. U.S. DOE continues to maintain a heating oil reserve at two sites in the New England region, which can be drawn down in the event of a disruption to supply from the Central Atlantic region.<sup>74</sup>

## Retail markets

There are 12,608 retail service stations in the Central Atlantic region.<sup>75</sup> Figure 23 shows the share of these outlets that are branded versus unbranded by state. Stations are classified as 'branded' if they are associated with and display a major oil company brand. 'Unbranded' stations are not affiliated with a major oil company brand. Seventy percent of the Central Atlantic's retail stations are branded, slightly higher than the national average of 69%. The share of branded outlets varies moderately within the region; from as high as 83% in the District of Columbia to as low as 62% in Pennsylvania. The top five brands in the Central Atlantic are Sunoco, Citgo, BP, Exxon, and Shell, and these brands together account for 47% of the region's retail outlets. Forty-three percent of the region's stations offer diesel fuel, compared to a national average of 53%. As of 2015, there were 97 public and 40 private filling

<sup>72</sup> U.S. Department of Energy: Office of Fossil Energy, "Northeast Regional Refined Petroleum Product Reserve," (Accessed January 6, 2015), <http://energy.gov/fe/services/petroleum-reserves/northeast-regional-refined-petroleum-product-reserve>.

<sup>73</sup> U.S. Department of Energy- Office of Electricity Delivery and Energy Reliability, "An Assessment of Heating Fuels and Electricity Markets During the winters of 2013-2014 and 2014-2015," Prepared by ICF International, (October 19, 2015), [http://www.energy.gov/sites/prod/files/2015/10/f27/DOE\\_OE\\_Two%20Winters%20Report\\_Final\\_10.19.15.pdf](http://www.energy.gov/sites/prod/files/2015/10/f27/DOE_OE_Two%20Winters%20Report_Final_10.19.15.pdf).

<sup>74</sup> U.S. Department of Energy: Office of Fossil Energy, "Heating Oil Reserve," (Accessed January 6, 2015), <http://energy.gov/fe/services/petroleum-reserves/heating-oil-reserve>.

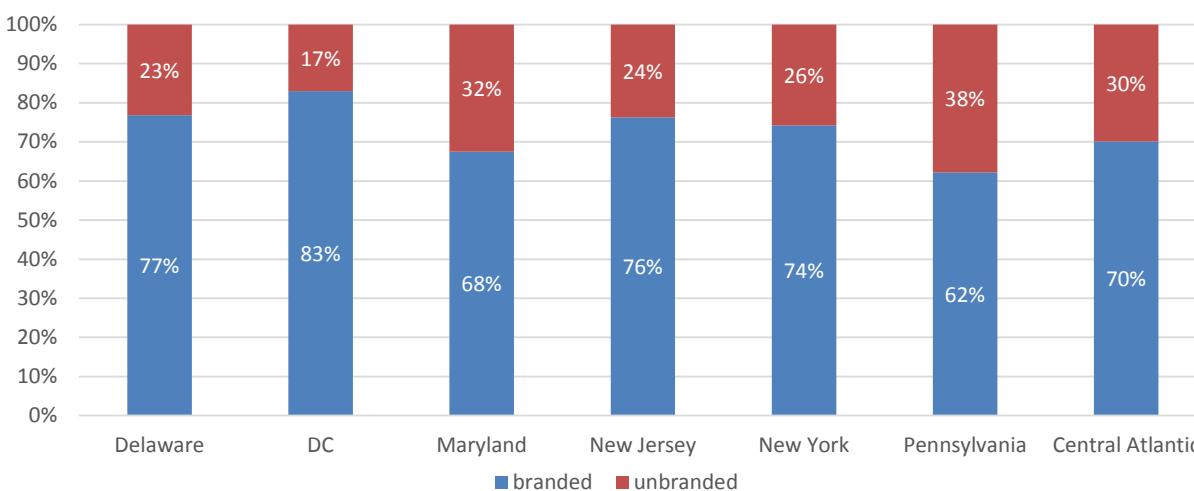
<sup>75</sup> Retail station data provided by the Homeland Security Infrastructure Program (HSIP).



stations in the Central Atlantic region offering E85 and 12 public and 52 private filling stations offering biodiesel (B20 and above) in the region.<sup>76</sup> New York leads the region in both the ethanol and biodiesel station tallies, with 85 total stations offering E85 and 36 total stations offering biodiesel.

**Figure 23. Central Atlantic retail market structure**

percent of retail stations



Source: HSIP 2015

## Future Changes

Buckeye Partners, L.P. announced in April 2015 that one of its operating subsidiaries, Buckeye Transportation, would move ahead with a pipeline expansion project designed to move refined petroleum products from origins in Ohio and Michigan to destinations in Ohio and western Pennsylvania.<sup>77</sup> Project completion is expected by December, 2016. The project would provide western Pennsylvania to increased access to Midwest (PADD 2) refineries, possibly including refineries as far west as Illinois and Indiana.<sup>78</sup>

On the regulatory frontier, the Air Quality Technical Advisory Committee of the Pennsylvania Department of Environmental Protection (DEP) has recommended that the Pennsylvania DEP adopt proposed regulation to end the summer 7.8-lb. RVP gasoline requirement for seven counties in Pennsylvania. If adopted, this change could take effect as early as summer 2016. Several Pennsylvania gasoline marketers support the potential action in light of a pump-price differences that "routinely

<sup>76</sup> U.S. Department of Energy: Office of Energy Efficiency & Renewable Energy, "Alternative Fuels Data Center" (Accessed December 2, 2015), <http://www.afdc.energy.gov/states/>.

<sup>77</sup> Buckeye Partners, L.P., "News Release: Buckeye Partners, L.P. Announces Successful Open Season for Michigan/Ohio Pipeline Expansion Project" (Accessed December 8, 2015), <http://www.buckeye.com/LinkClick.aspx?fileticket=hRiN17FblQk%3D&tabid=36>.

<sup>78</sup> Argus Media, "Buckeye expands US midcon products push east" (February 6, 2015), <https://www.argusmedia.com/News/Article?id=989425>.



cause gasoline to be at least 10 to 15 cents per gallon more expensive in the Pittsburgh region than in nearby states and counties," according to the Pennsylvania Environmental Digest.<sup>79</sup>

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<sup>79</sup> Pennsylvania Environmental Digest, "DEP Air Quality Committee to discuss repeal of low-RVP gasoline in Pittsburgh" (Accessed Jan 4, 2016), <http://paenvironmentdaily.blogspot.com/2015/11/dep-air-quality-committee-to-discuss.html>.

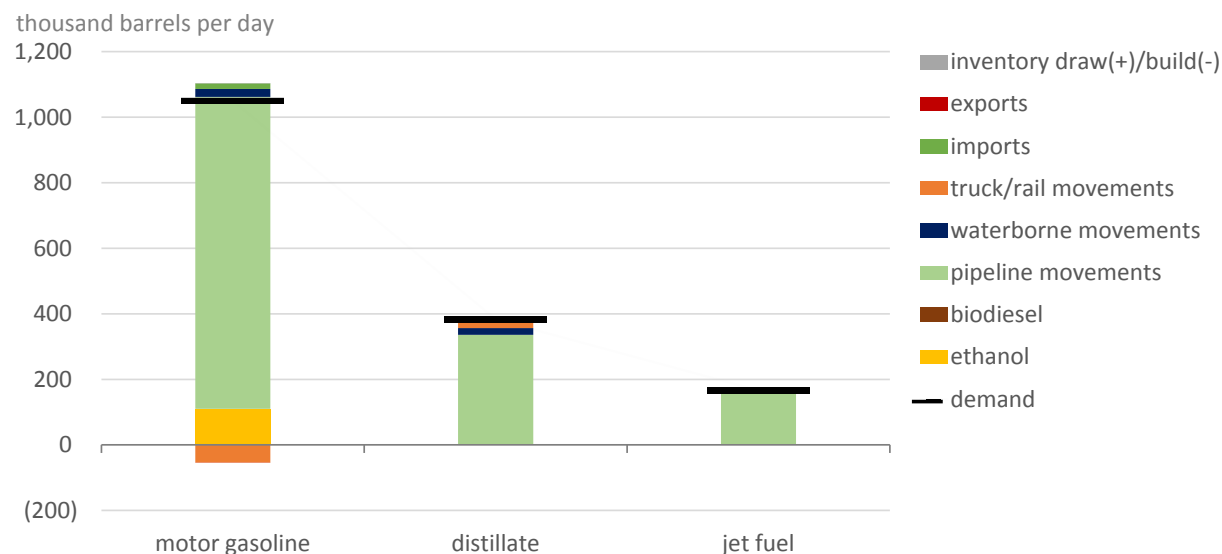
## Southeast

The Southeast region includes five states: Georgia, North Carolina, South Carolina, Virginia, and West Virginia. This region encompasses all of the states in EIA’s Lower Atlantic sub-PADD (PADD 1C) except for Florida, which is discussed in a separate chapter of this report. Given the region’s limited refinery capacity, nearly all consumption for transportation fuels comes from other regions and therefore has limited supply options.

Estimated total consumption of motor gasoline, distillate fuel oil, and commercial jet fuel in the Southeast was 1.6 million b/d in 2014. Within the region, several major metropolitan areas define the principal consumption centers: the Washington D.C. metro area, which is mostly located in the Central Atlantic region but extends into Northern Virginia and West Virginia; Atlanta, Georgia; Charlotte and Raleigh in North Carolina, and Richmond and the Hampton Roads area in Virginia. Smaller population centers in the region include the cities making up the “Research Triangle” (Durham, Chapel Hill, and Winston-Salem) and Greensboro in North Carolina; Greenville, Columbia, and Charleston in South Carolina; and Augusta in Georgia.

The Southeast region has one refinery—Ergon’s Newell, West Virginia refinery—which focuses on producing paraffinic process and base oils with negligible production of transportation fuels. The Southeast is a net consumer of fuels with the vast majority of petroleum products delivered to the region via pipeline from the Gulf Coast (PADD 3). Figure 24 presents the region’s 2014 annual supply and demand balances for motor gasoline, distillate, and jet fuel.

**Figure 24. Southeast supply/demand balances, 2014**



Note: All domestic movements and inventory changes are reported on a net basis.

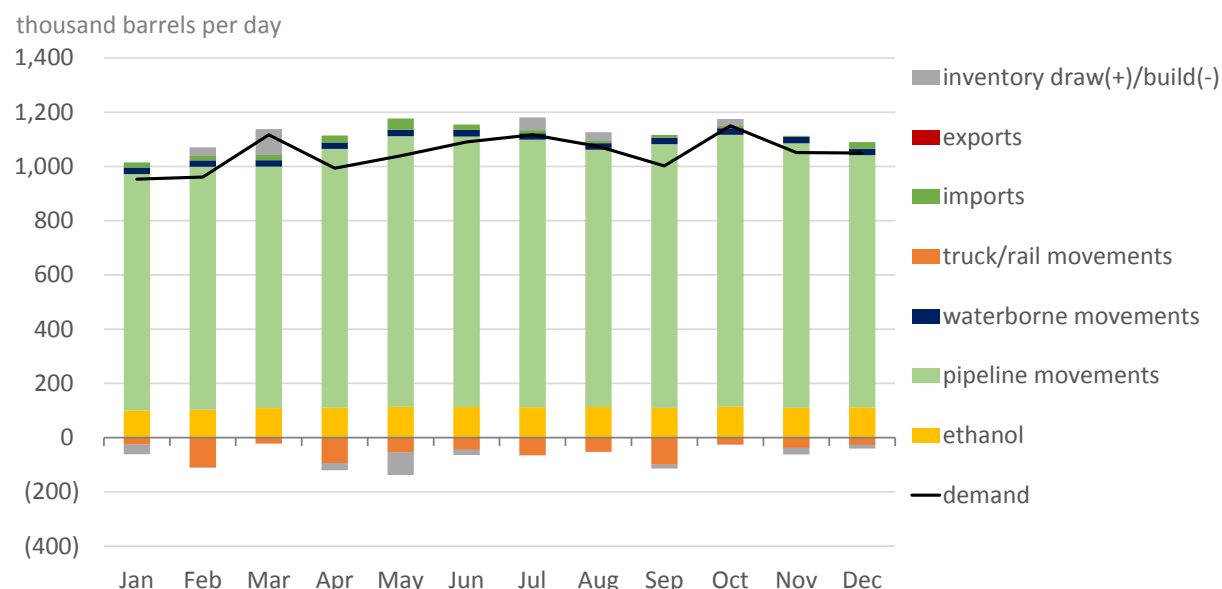
Source: ICF Analysis of EIA, FHWA, Airlines for America, FERC, and company 10-K data

## Supply/demand balances

### Gasoline

Figure 25 presents the 2014 monthly motor gasoline supply/demand balance for the Southeast region. Motor gasoline consumption in 2014 averaged approximately 1.05 million b/d, including 110,000 b/d of ethanol. The vast majority of the motor gasoline supplied in the Southeast is transported via pipeline from refineries in PADD 3. Smaller volumes of gasoline are imported or delivered to the region from domestic sources via marine vessels. In 2014, consumption of motor gasoline in the Southeast was generally higher in the summer months than in the winter months, with consumption reaching as high as 1.1 million b/d, up roughly 20% from a low of 953,000 b/d in January.

**Figure 25. Southeast motor gasoline supply/demand balance, 2014**



Note: Note: All domestic movements and inventory changes are reported on a net basis.

Source: ICF Analysis of EIA, FHWA, FERC, and company 10-K data

The U.S. Environmental Protection Agency (U.S. EPA) requires the use of reformulated gasoline in ten counties in Northern Virginia.<sup>80</sup> These counties—all located in the Washington D.C. metro area—are the only areas of the Southeast region in which the use of reformulated gasoline (RFG) is mandated. In addition to RFG-mandated areas, 18 Virginia counties are “opt-in” areas, where the Governor has chosen to require the use of reformulated gasoline. These counties are located in the Richmond and Hampton Roads areas, including the cities of Newport News, Virginia Beach, and Williamsburg. In accordance with the Clean Air Act, the U.S. EPA requires the adoption of a summer RVP standard that limits the volatility of conventional gasoline sold in certain areas of the country.<sup>81</sup> From May 1 through September 15, the states of Georgia, North Carolina, South Carolina, Virginia, and West Virginia each enforce a statewide 9.0 RVP limit. In addition, the state of Georgia maintains a stricter RVP limit for

<sup>80</sup> U.S. Environmental Protection Agency, “Reformulated Gasoline,” (Accessed January 6, 2015), <http://www.epa.gov/gasoline-standards/reformulated-gasoline>.

<sup>81</sup> U.S. Environmental Protection Agency, “Gasoline Reid Vapor Pressure” (Accessed December 11, 2015), <http://www.epa.gov/gasoline-standards/gasoline-reid-vapor-pressure>.

selected counties. From June 1 through September 15, 13 counties in Georgia—all of which surround the greater Atlanta metro area—observe a 7.8 RVP limit. None of the five states comprising the Southeast maintains a winter oxygenated fuels program to limit carbon monoxide emissions. Table 18 below lists mandatory gasoline regulations that are in effect in the Southeast region.

**Table 18. Southeast motor gasoline regulations**

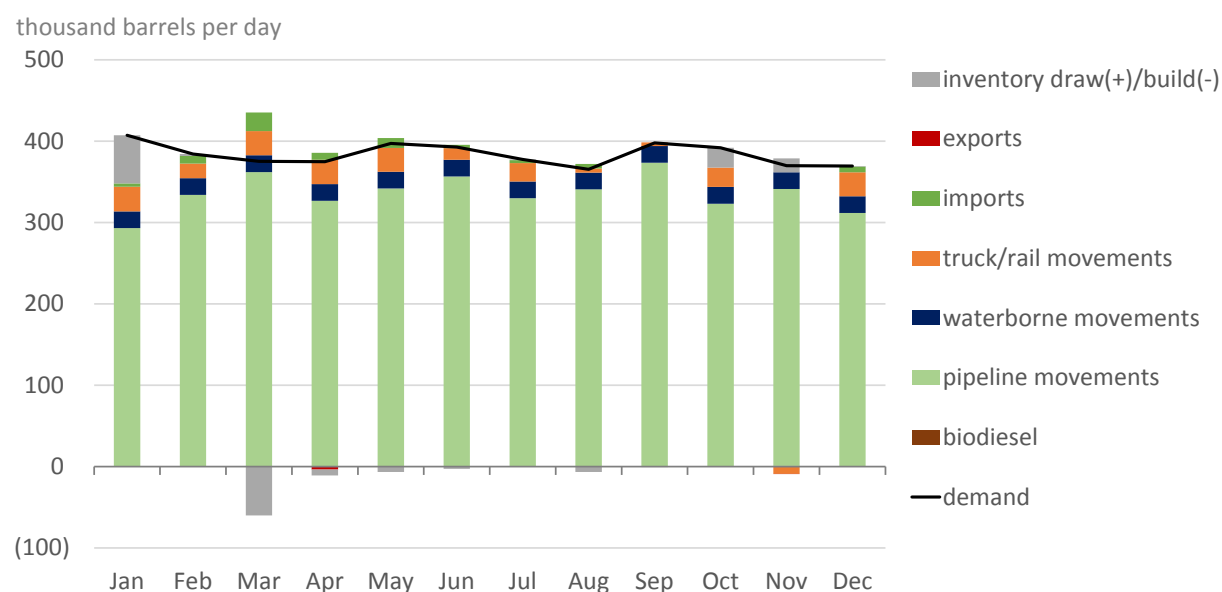
Regulation	Area (s)	Dates
Reformulated Gasoline	Virginia: Alexandria, Arlington, Fairfax, Falls Church, Loudon, Manassas, Manassas Park, Prince William, and Stafford counties, as well as the neighboring District of Columbia	Year-round
Reformulated Gasoline (Opt-in areas)	Virginia: Charles City, Chesapeake, Chesterfield, Colonial Heights, Hampton, Hanover, Henrico, Hopewell, James City, Newport News, Norfolk, Poquoson, Portsmouth, Richmond, Suffolk, Virginia Beach, Williamsburg and York counties	Year-round
Summer Gasoline Volatility <9.0 RVP	Georgia, North Carolina, South Carolina, Virginia, and West Virginia – statewide	May 1 – Sept. 15
Summer Gasoline Volatility <7.8 RVP	Georgia: Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Henry, Paulding, and Rockdale counties	June 1 – Sept. 15

Source: U.S. EPA

### Distillate

Figure 26 presents the 2014 monthly distillate supply/demand balance for the region. Approximately 75% of the region’s distillate use was consumed on-highway.<sup>82</sup> The next most frequent uses are in the off-highway, industrial, and railroad sectors. Over the course of 2014, consumption in the Southeast averaged 384,000 b/d and did not exhibit significant seasonal variation. Pipeline movements from the Gulf Coast make up the vast majority of supply into the Southeast. Marine shipments delivered to Southeast ports from both domestic and foreign origins typically account for the remainder of consumption. The Southeast sent a small percentage of its distillate supply by truck to Florida.

<sup>82</sup> U.S. Energy Information Administration, “State Energy Data System (SEDS): 2013 (updates by energy source - completed)” (Accessed November 15, 2015, <http://www.eia.gov/state/seds/seds-data-fuel-prev.cfm>).

**Figure 26. Southeast distillate supply/demand balance, 2014**

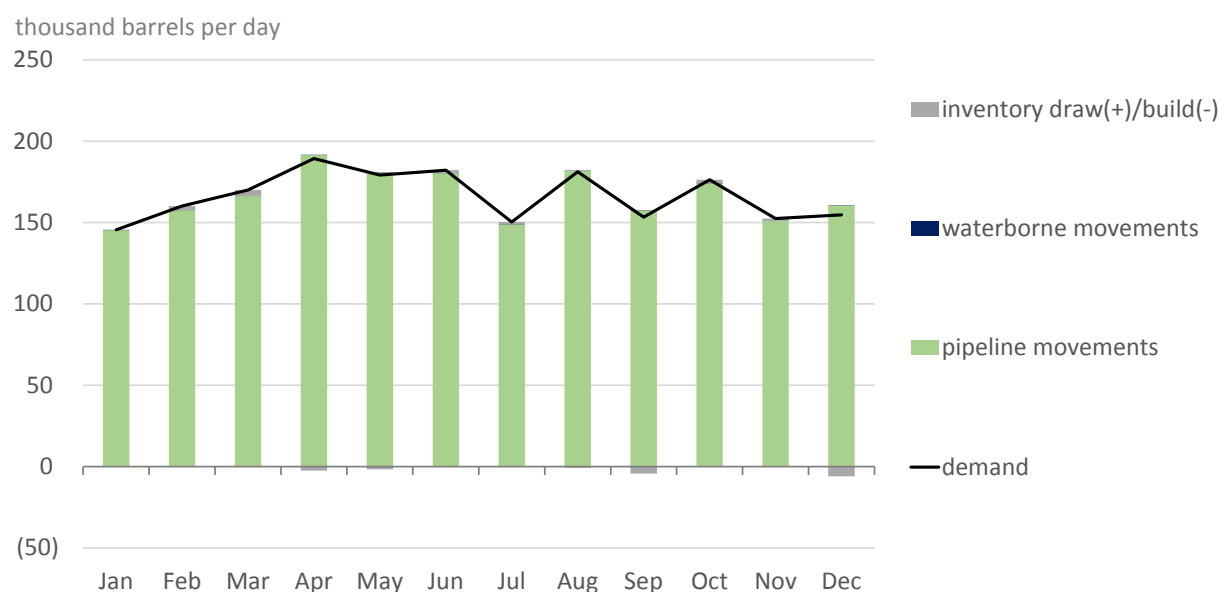
Note: All domestic movements and inventory changes are reported on a net basis.

Source: ICF Analysis of EIA, FHWA, FERC, and company 10-K data

### Jet fuel

Figure 27 presents the Southeast region's 2014 jet fuel supply/demand balance. Commercial jet fuel consumption in the Southeast averaged 166,000 b/d in 2014.<sup>83</sup> Jet fuel supply is entirely dependent on deliveries to the region via pipeline from supply centers along the Gulf Coast. The region received no jet fuel imports in 2014. Jet fuel consumption was generally stable through much of year, however, consumption rates dipped to a low of 146,000 b/d in January, with peak consumption of 189,000 b/d occurring in April.

<sup>83</sup> U.S. Energy Information Administration, "U.S. States: State Profiles and Energy Estimates – Table F2: Jet fuel consumption, price, and expenditure estimates, 2014" (Accessed November 9, 2015), [http://www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep\\_fuel/html/fuel\\_jf.html&sid=US](http://www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep_fuel/html/fuel_jf.html&sid=US).

**Figure 27. Southeast jet fuel supply/demand balance, 2014**

Note: All domestic movements and inventory changes are reported on a net basis.

Source: ICF Analysis of EIA, Airlines for America, FERC, and company 10-K data

Four airports in the Southeast are designated as large hubs by the Federal Aviation Administration: Hartsfield-Jackson Atlanta International Airport (ATL) in Georgia; Charlotte/Douglas International (CLT) in North Carolina; and Washington Dulles International Airport (IAD) and Ronald Reagan Washington National Airport (DCA) in Northern Virginia. The Southeast region also includes one medium hub and nine small hubs.<sup>84</sup> In addition to these hubs, 108 smaller commercial service airports also operate in the region, as well as seven air force bases (AFBs): Joint Base Charleston and Shaw AFB in South Carolina; Pope AFB and Johnson AFB in North Carolina; Moody AFB and Robins AFB in Georgia; and Langley AFB in Virginia. These bases may consume commercial-quality jet fuel in addition to higher-performance jet fuel blends.<sup>85</sup>

## Refineries

Ergon's Newell refinery located in the Northern Panhandle of West Virginia is the only refinery in the Southeast. The refinery, which has a refining capacity of 22,300 barrel per calendar day (b/cd), produces a very high yield of paraffinic process and base oils, which are used in a wide variety of non-fuel applications.<sup>86</sup> The refinery also produces approximately 8,000 b/d of ultra-low sulfur diesel (ULSD) and an unknown volume of ultra-low sulfur gasoline.<sup>87</sup> Transportation fuels are distributed from the refinery's truck rack and via barge to local markets, primarily in the Pittsburgh, Pennsylvania, metropolitan area.

<sup>84</sup> Federal Aviation Administration, "Airport Safety" (Accessed November 5, 2015), [http://www.faa.gov/airports/airport\\_safety/airportdata\\_5010/menu/](http://www.faa.gov/airports/airport_safety/airportdata_5010/menu/).

<sup>85</sup> MilitaryBases.com, "State Military Bases" (Accessed November 5, 2015), <http://militarybases.com>.

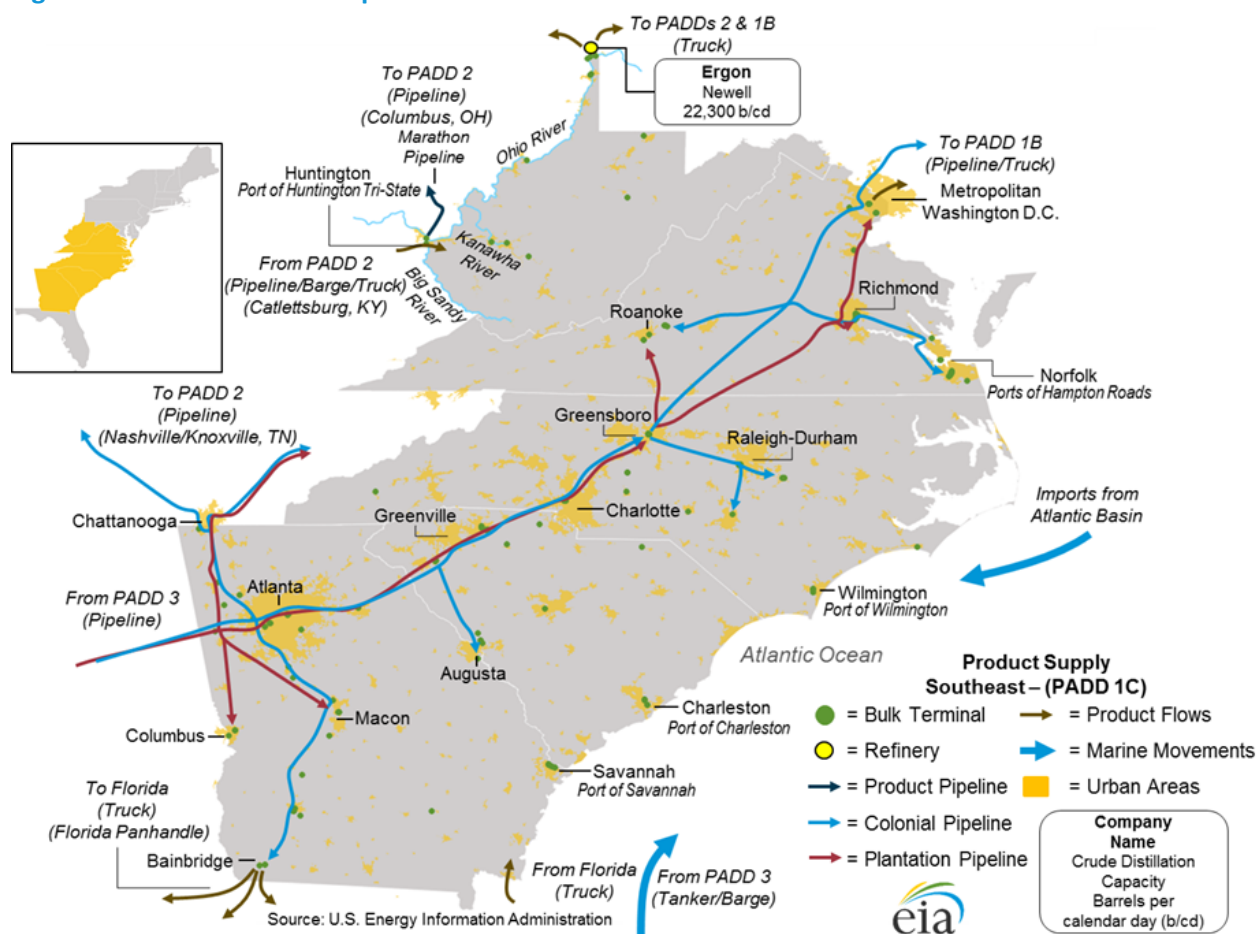
<sup>86</sup> Ergon, Inc. "Refining and Marketing," (Accessed October 29, 2015), <http://ergon.com/refining-marketing>.

<sup>87</sup> Ergon, Inc. "Ergon- West Virginia, Inc. Invests in New Diesel Technology," (July 31, 2006), <http://ergon.com/news/6-ergon-west-virginia-inc-invests-in-new-diesel-technology>.

## Supply and logistics

Virtually all transportation fuels supplied to the Southeast region are produced in Gulf Coast refining centers and delivered to the region via the Colonial and Plantation pipeline systems. Markets along the region’s Atlantic coast also receive smaller volumes via ocean-going marine vessels from foreign and domestic sources, while markets in West Virginia receive fuel from Appalachian refineries by truck and by river barge. Figure 28 presents a map of the Colonial and Plantation pipeline systems, the supporting network of bulk storage and distribution terminals, several Atlantic ports that receive petroleum products, and the region’s lone refinery in Newell, West Virginia.

**Figure 28. Southeast refined petroleum infrastructure**



## Pipelines

Figure 28 shows that the Colonial and Plantation pipeline systems share the same general route, and in many places share the same right-of-way as they pass through the region. Although products are not typically transferred between the systems, they offer a high degree of interconnection for supplying various markets across the Southeast. Table 19 leverages public information to detail each system’s mainline segments, major spur lines, origin and destination points, and capacities.

Table 19. Select Southeast refined product pipelines

Pipeline	Segment/Spur	Origin	Destination	Distance, miles	Capacity, b/d
Colonial Pipeline	Line 1/2 (Main)	Houston, TX	Greensboro, NC	5,550	2,530,000
	Line 3/4 (Main)	Greensboro, NC	Linden, NJ / Sykesville, MD		1,389,000
	Line 17	Atlanta, GA	Bainbridge, GA	150,000	
	Line 19/20	Atlanta, GA	Chattanooga, TN	not avail.	
		Belton, SC	North Augusta, GA	not avail.	
		Greensboro, NC	Apex/Selma/Fayetteville, NC	not avail.	
		Mitchell, VA	Norfolk, VA	not avail.	
	Mitchell, VA	Roanoke, VA	not avail.		
Plantation Pipeline	(Main)	Baton Rouge, LA	Greensboro, NC	3,100	700,000
		Greensboro, NC	Northern Virginia		
		Bremen, GA	Columbus, GA		
		Bremen, GA	Macon, GA		
		Bremen, GA	Knoxville, TN		
		Greensboro, NC	Roanoke, VA		
Marathon Pipeline		Catlettsburg, KY	Kenova, WV	2.5	130,000
		Kenova, WV	Columbus, OH	150	68,000

Source: ICF research and estimates; Colonial and Plantation pipeline system maps; Colonial Pipeline Exhibit B for FERC Tariff 98.22.0

The 2.50 million b/d Colonial pipeline system consists of four mainline segments. Two dedicated lines: the 1.37 million b/d Line 1 (gasoline) and 1.16 million b/d Line 2 (distillates) originate in Houston, Texas, and ship fuel to the markets in Georgia and the Carolinas before terminating in Greensboro, North Carolina. From Greensboro, the 885,000 b/d Line 3 and 504,000 b/d Line 4 ship fungible, segregated product batches to markets in Virginia, before continuing further north into the Central Atlantic region.<sup>88</sup> In addition to the mainlines, several spur lines originate from the Colonial system at junctions in Atlanta, Georgia; Belton, South Carolina; and Greensboro, North Carolina; and push fuels to other markets in the Southeast, and into Tennessee. The Colonial Pipeline system has direct connections to four major airports in the Southeast: Hartsfield-Jackson in Georgia; Charlotte-Douglas and Raleigh-Durham in North Carolina; and Dulles in Northern Virginia.

The 700,000 b/d Plantation pipeline system extends from Baton Rouge, Louisiana, to Northern Virginia, just south of Washington, D.C., and is mostly dedicated to serving inland Southeast markets. Two mainlines primarily serve Georgia, South Carolina, and North Carolina, and single line extends from the Greensboro, North Carolina, junction serving markets in eastern Virginia. Spur lines originate from junctions in Bremen, Georgia, and Greensboro, North Carolina. From Bremen, lines push south into central Georgia and north into northern Georgia and Tennessee. From Greensboro, a single line supplies

<sup>88</sup> Each line carries gasoline blendstocks, distillates and jet fuel



western Virginia. Plantation has direct jet fuel connections to Hartsfield-Jackson, Charlotte-Douglas, Dulles, and Washington Reagan National.

Marathon Petroleum Corporation operates a pipeline system that runs from its Catlettsburg, Kentucky refinery to a terminaling and logistics hub in Kenova, West Virginia. From Kenova, fuel is shipped on Marathon's 68,000 b/d Cardinal Pipeline to markets in Ohio and is transloaded onto barges for delivery via the Ohio River. (See West Virginia for details)

## Ports

Table 20 lists the Southeast ports that received marine deliveries of transportation fuels in 2013, the latest year for which domestic marine receipt data is available from the U.S. Army Corps of Engineers (USACE). The table shows estimated 2013 inbound receipts at the region's ports broken out between domestic volumes, as tracked by USACE, and foreign volumes, as tracked by EIA. In 2013, waterborne deliveries averaged nearly 72,000 b/d in the Southeast region—lower than any other region in PADD 1. Approximately 48,000 b/d of these deliveries, including volumes from both domestic and foreign sources, arrived at ports along the region's Atlantic coast, including Charleston, South Carolina; Savannah, Georgia; Wilmington, NC; and ports in the Hampton Roads area in Virginia. In addition, approximately 24,000 b/d arrived at ports in West Virginia, including deliveries to terminals in Huntington, along the Kanawha River in the Charleston area, and along the Monongahela River to Morgantown. In addition to the inbound volumes presented in Table 20, the Port of Huntington Tristate outloads approximately 105,000 b/d of transportation fuels on to barges for delivery via the Ohio River. These volumes include supply loaded at Marathon's Catlettsburg, Kentucky refinery and at the company's associated logistics terminal in Kenova, West Virginia.

**Table 20. Waterborne receipts of transportation fuels at Southeast ports, 2013**

barrels per day

Ports	Domestic	Foreign	Total
<b>Atlantic</b>			
Charleston, SC	7,748	8,784	16,532
Savannah, GA	5,156	7,474	12,630
Wilmington, NC	6,267	5,244	11,511
Hampton Roads, VA <sup>A</sup>	1,844	5,825	7,372
<b>Total</b>	<b>21,015</b>	<b>27,327</b>	<b>48,045</b>
<b>West Virginia</b>			
Huntington, WV	4,681	-	4,681
Kanawha River <sup>B</sup>	16,662	-	16,662
Monongahela River <sup>C</sup>	2,528	-	2,528
<b>Total</b>	<b>23,871</b>	<b>-</b>	<b>23,871</b>
<b>Southeast Total</b>	<b>44,886</b>	<b>27,327</b>	<b>71,916</b>

(A) Includes Norfolk, Newport News, and Yorktown

(B) Includes Charleston, St. Albans, and Hugheston

(C) A portion of these volumes may be received at points in Pennsylvania in the Central Atlantic region

Source: U.S. Army Corp of Engineers 2013 Waterborne Commerce of the United States Waterways and Harbors; EIA Company Level Imports, 2013

## Markets

### Georgia

The Atlanta metropolitan area and Athens, Georgia are served directly by the Colonial and Plantation mainline systems, while major spur lines originating near Atlanta supply fuel to markets in northern and southern Georgia. Spurs from both systems supply jet fuel to Atlanta's Hartsfield-Jackson International Airport. From the Atlanta area, Colonial and Plantation spur lines push fuel north to Rome and other markets in northern Georgia, before crossing into Tennessee (PADD 2). According to EIA data on movements between PADDs, approximately 303,000 b/d of transportation fuels moved from Georgia to Tennessee along these pipeline spurs in 2014. Spur lines moving south from the Atlanta area include two small Plantation lines supplying fuel to Columbus and Macon, and a 150,000 b/d Colonial spur supplying Macon and points further south, before terminating in Bainbridge near the Florida border. From Bainbridge, fuel is trucked into nearby Tallahassee, Florida, and other markets in the Florida Panhandle. Savannah, on the state's Atlantic coast, received more than 12,000 b/d of marine supply from domestic and foreign sources in 2013, in addition to truck deliveries from inland pipeline terminals. Augusta, Georgia is supplied by a Colonial pipeline spur terminating in North Augusta, South Carolina.

### South Carolina

Greenville and Spartanburg, South Carolina, are supplied from the Colonial and Plantation mainline systems. A spur system, composed of two lines, from Colonial's Belton, South Carolina junction ships supply to terminals in North Augusta, South Carolina, which supply the Augusta, Georgia metropolitan area. Charleston, on the state's Atlantic coast, is supplied by marine shipments, which averaged more than 16,000 b/d in 2013, in addition to truck shipments from inland pipeline terminals.

### North Carolina

Charlotte and Greensboro, North Carolina are supplied from the Colonial and Plantation mainline systems and spurs from each system directly supply jet fuel to the Charlotte-Douglas Airport. Greensboro, North Carolina, is the termination point for Colonial's gasoline (Line 1) and distillate (Line 2) mainlines, and for the parallel Plantation mainlines from the Gulf Coast. Breakout tankage in Greensboro accommodates the transfer of product from Colonial's dedicated mainlines (Lines 1 and 2) to batched fuel shipments on Colonial's two northern mainline segments (Lines 3 and 4), which terminate in the Central Atlantic region. Greensboro is also the origin point for Plantation's extension line to Northern Virginia, and its lateral to Roanoke, Virginia. In addition, a Colonial spur system extends from the Greensboro junction to North Carolina delivery points in Apex, Fayetteville, Selma, and at the Raleigh-Durham Airport.

### Virginia

Northern Virginia is supplied directly by the Colonial mainline system and from the Plantation extension from Greensboro, North Carolina. Both systems have spur lines supplying jet fuel to Dulles Airport and Plantation also has a spur supplying Reagan National Airport. Plantation terminates in Northern Virginia, while the Colonial system extends into the Central Atlantic region. Other markets in Virginia are supplied by spur lines from Colonial and Plantation originating in central Virginia. Two spur lines originate at Colonial's Mitchell junction: one spur extends west to supply Roanoke and one line extends east

towards Richmond and the Hampton Roads area. The Plantation pipeline, which passes directly through the Richmond metropolitan area, supplies Richmond terminals via a short spur. In addition to receiving supply from the Colonial lateral, the Hampton Roads area also receives marine deliveries of products from domestic and foreign sources. In 2013, ports in Norfolk, Newport News, and Yorktown received more than 7,000 b/d of transportation fuels via tanker and barge.

### West Virginia

The West Virginia market is largely isolated from the major pipeline systems supplying the Southeast. The 22,300 b/cd Ergon refinery in Newell, West Virginia, is the only refinery in the Southeast but it only produces small volumes of gasoline and diesel fuel, and it primarily markets those fuels in the Pittsburgh, Pennsylvania, metropolitan area in the Central Atlantic region. The largest consumption centers in West Virginia are located in the southwestern portion of the state—in Huntington and Charleston—and are supplied by truck and barge from Marathon’s 242,000 b/cd refinery in Catlettsburg, Kentucky, which is located in the Kentucky portion of the Huntington metropolitan area. In 2013, approximately 35,000 b/d of transportation fuels moved from Catlettsburg by truck to retail outlets in the Huntington area, according to preliminary data from the U.S. Department of Transportation. The Catlettsburg refinery is also integrated with a pipeline and barge transloading terminal in Kenova, West Virginia. From Catlettsburg, products are shipped by pipeline across the Big Sandy River to Kenova, where product is shipped via a 68,000 b/d Marathon pipeline to Columbus, Ohio, and transloaded on to barges for further distribution via the Ohio River.<sup>89</sup> According to USACE data, approximately 105,000 b/d of products were loaded on to barges in 2013 at the Port of Huntington Tri-State, which includes docks at Kenova and Catlettsburg. Barges loaded in Huntington are delivered to markets in West Virginia, Ohio, and Pennsylvania. Receipts of transportation fuels to terminals along the Kanawha River near Charleston, West Virginia, averaged 17,000 b/d in 2013, according to USACE. Meanwhile, Morgantown, located on West Virginia’s northern border with Pennsylvania, receives barge deliveries from the Pittsburgh area via the Monongahela River. Barge supply in West Virginia is supplemented by truck deliveries from neighboring states. Aside from the deliveries from Kentucky previously noted, West Virginia received approximately 25,000 b/d by truck primarily from Ohio, Virginia, and North Carolina.

### Supply vulnerability

Southeast transportation fuels markets are critically dependent on the reliable and continuous operation of the Colonial and Plantation pipelines systems and their supporting infrastructure, including refinery production and injection facilities in the Gulf Coast, pipeline booster stations across both systems, and breakout tankage at key pipeline junctions. This infrastructure is most vulnerable to the impacts of Gulf Coast hurricanes and tropical storms, which can disrupt pipeline operations, or disrupt refinery production needed to fill the lines. In the Southeast region, the Colonial and Planation systems

<sup>89</sup>West Virginia Department of Environmental Protection, “Title V Renewal Application: Marathon Petroleum Company - Kenova Terminal, Kenova, West Virginia,” Prepared by Arcadis, (January, 2010), <http://www.dep.wv.gov/daq/permitting/Documents/T5%20Apps%20July%208.%202010/Marathon%20Ashland%20Kenova%20%20099-00100.pdf> and MPLX L.P. Energy Logistics, *2014 Annual Report*, (December 31, 2014), [http://www.mplx.com/content/documents/mplx/investor\\_center/MPLX\\_2014\\_AR\\_10-K.pdf](http://www.mplx.com/content/documents/mplx/investor_center/MPLX_2014_AR_10-K.pdf).

are primarily located inland from the coast, making them less vulnerable to Atlantic storms, although heavy rains and flooding can expose pipelines and threaten integrity at river crossings.

There are few alternatives to replace lost volumes on the Colonial and Plantation systems. Replacement supplies can be delivered by ship to Atlantic coast ports and trucked inland or trucked directly from the Gulf Coast, but the capability to do so is very limited and the magnitude of consumption in the Southeast market—approximately 1.6 million b/d—makes full replacement infeasible.

In September 2005, Hurricane Katrina curtailed production at refining centers in the Louisiana Gulf Coast region for several months and interrupted power supply to a critical pipeline hub in Mississippi. As a result of the power outage, the Colonial and Plantation pipelines were fully offline for nearly a week and operated at reduced rates for an additional week while running on emergency generators. The loss of the pipeline systems led to shortages and price spikes across the Southeast region. Just as Louisiana Gulf Coast refineries were beginning to restore operations following Katrina, Hurricane Rita made landfall in the Texas Gulf Coast, disrupting additional refining capacity in PADD 3. After Colonial and Plantation pipeline operations were restored, offline refineries with operable ports imported petroleum products to maintain flows on the pipeline systems. Since 2005, Colonial and Plantation have focused time and resources on preparing for and responding to extreme weather events. Colonial has invested in several tractor-trailer mounted portable generators that would allow the company to bring its system back on-line during prolonged disruptions to the power grid.<sup>90</sup>

## Retail markets

There are 15,004 retail service outlets in the Southeast region<sup>91</sup>. Figure 29 shows the share of these outlets that are branded versus unbranded by state. Stations are classified as ‘branded’ if they are associated with and display a major oil company brand. ‘Unbranded’ stations are not affiliated with a major oil company brand. Sixty-six percent of the Southeast’s retail stations are branded, slightly less than the national average of 69%. The share of branded outlets varies only slightly within the region; Georgia and North Carolina are highest with 68% branded, while South Carolina’s 62% is lowest. The top five brands in the Southeast are BP, Shell, Exxon, Citgo and Chevron, and these brands together account for 55% of the region’s retail outlets. Fifty-five percent of the region’s stations offer diesel fuel, compared to a national average of 53%. As of 2015, there were 124 public and 54 private filling stations in the Southeast region offering E85 and 30 public and 161 private filling stations offering biodiesel (B20 and above).<sup>92</sup> North Carolina is home to the largest number of biodiesel stations in the region and in the nation, with 131, while South Carolina leads the region with 68 total E85 stations.

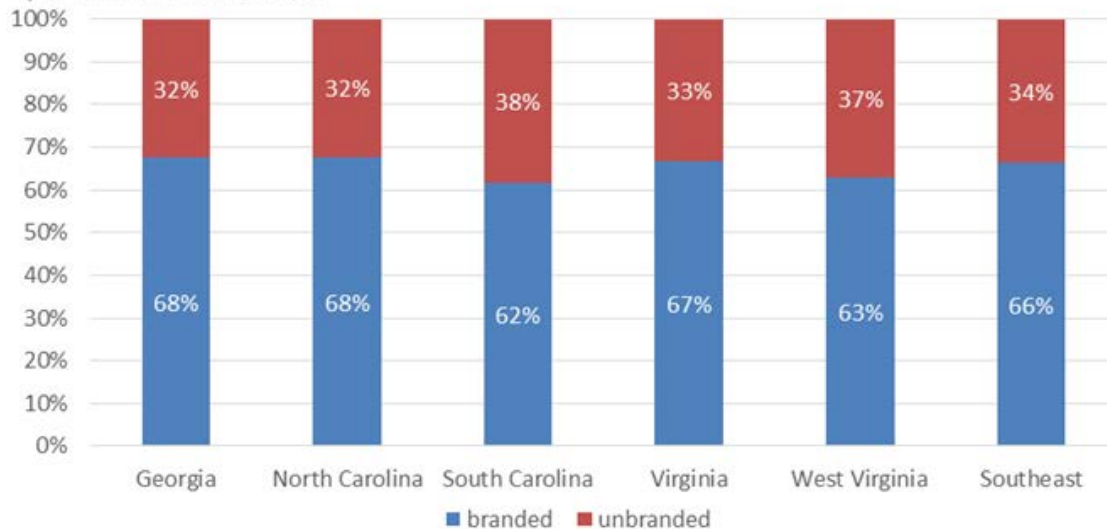
<sup>90</sup> Felt, Tim, President and CEO Colonial Pipeline Company, “Testimony at Quadrennial Energy Review Stakeholder Meeting: Transmission, Storage and Distribution Issues Relating to Petroleum and Refined Products,” QER Stakeholder Meeting, New Orleans, Louisiana, (May 27, 2014), [http://energy.gov/sites/prod/files/2014/06/f16/tfelt\\_statement\\_qer\\_nola.pdf](http://energy.gov/sites/prod/files/2014/06/f16/tfelt_statement_qer_nola.pdf).

<sup>91</sup> Retail station data provided by the Homeland Security Infrastructure Program (HSIP).

<sup>92</sup> U.S. Department of Energy: Office of Energy Efficiency & Renewable Energy, “Alternative Fuels Data Center” (Accessed December 2, 2015), <http://www.afdc.energy.gov/states/>.

**Figure 29. Southeast retail market structure**

percent of retail stations



Source: HSIP 2015

### Future changes

Two companies have announced projects designed to make the Southeast's transportation fuel markets less dependent on marine supply.

Kinder Morgan is proposing the 360-mile Palmetto Pipeline, which would allow the company deliver petroleum products from an interconnection with the Plantation Pipeline in Belton, South Carolina, to markets in South Carolina, coastal Georgia, and as far south as Jacksonville Florida. The system will have a design capacity of up to 167,000 b/d and will consist of a segment of expansion capacity that Palmetto will lease from Plantation Pipe Line Company between Baton Rouge, Louisiana and Belton.<sup>93</sup> Kinder Morgan expects to deliver approximately 70,000-80,000 b/d to Jacksonville on Palmetto. The project has a targeted in-service date of July 2017.<sup>94</sup>

Florida Fuel Connection (FFC) announced plans in 2015 to ship fuel by rail from the Colonial Pipeline in Baton Rouge, Louisiana to three new rail offloading terminals that the company would build in southeast Georgia and South Florida. The project, which is designed to enhance supply security to Florida and Georgia, is expected to be fully operation by the first quarter of 2017 and at its peak will transport 240,000 b/d of transportation fuels by rail.<sup>95</sup>

<sup>93</sup> Kinder Morgan, "Products Pipelines: Palmetto Pipeline," (Accessed January 6, 2016), [http://www.kindermorgan.com/business/products\\_pipelines/palmetto/](http://www.kindermorgan.com/business/products_pipelines/palmetto/).

<sup>94</sup> [Ibid.](#)

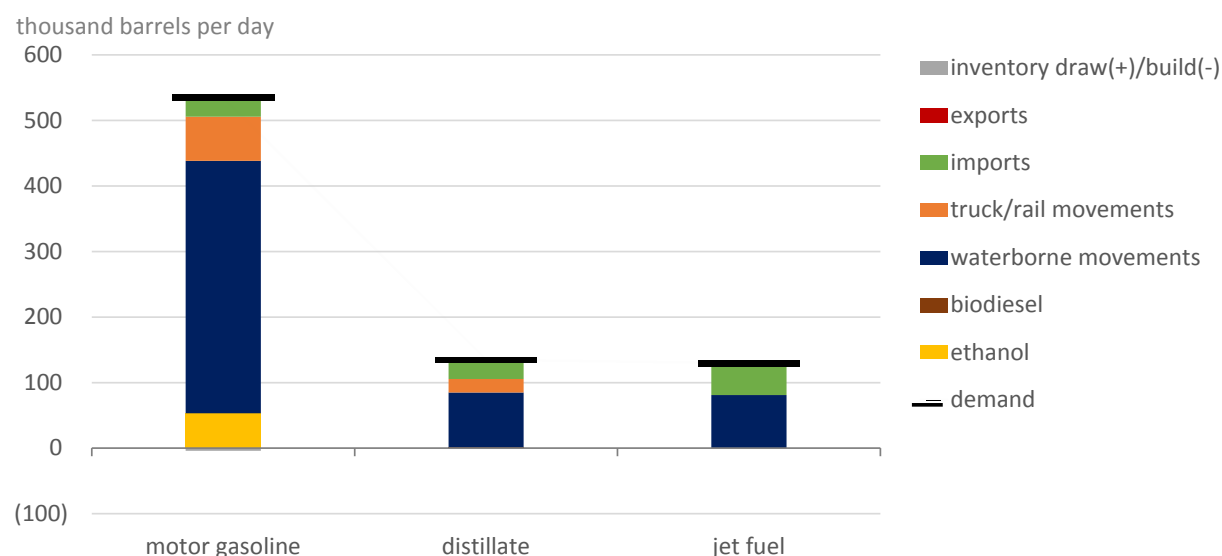
<sup>95</sup> Florida Fuel Connection, "Florida Fuel Connection to Build Infrastructure for Stable, Efficient, Eco---Friendly Petroleum Supply throughout State: Integrated Project Creates Long---Term Solution to Stabilize Petroleum Supply and Significantly Improve Fuel Efficiencies for State of Florida" (July 28, 2015), <http://www.floridafuelconnection.com/Portals/0/FFCRelease072715-FinalDoc.pdf>.

## Florida

Florida's consumption of transportation fuels is elevated by tourism industry, which creates high seasonal consumption from highway and airline travel from out-of-state visitors. Estimated total consumption of motor gasoline, distillate fuel oil, and commercial jet fuel in Florida was 800,000 b/d in 2014. Within the region, the principal consumption centers are the Miami metropolitan area in south Florida, the Tampa Bay and Orlando metropolitan areas in central Florida, and the Jacksonville metropolitan area in northeast Florida. A number of smaller population centers are located in the Florida Panhandle, including Tallahassee, Pensacola, and Panama City.

Florida has no refineries and no exogenous pipelines provide fuel directly into the state. Florida's transportation fuel supply relies overwhelmingly on domestic- and foreign-sourced marine deliveries to the state's Atlantic and Gulf of Mexico ports, and—to a much lesser extent—on truck deliveries into northern Florida from neighboring states. Figure 30 presents Florida's 2014 annual supply and demand balances for motor gasoline, distillate, and jet fuel.

**Figure 30. Florida supply/demand balance, 2014**



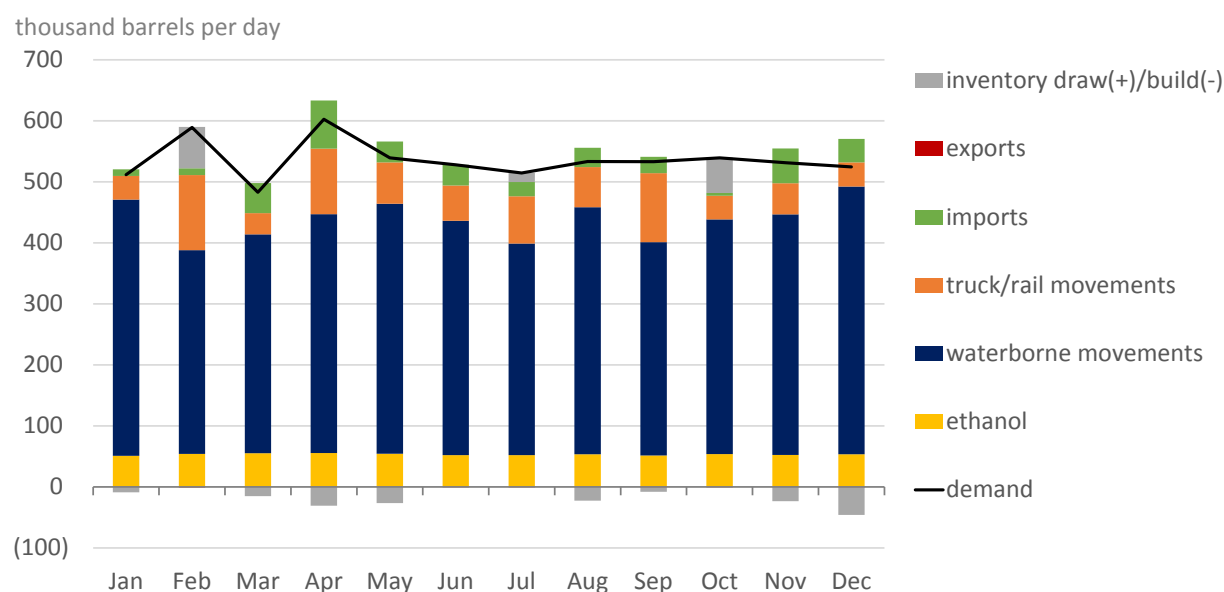
Note: All movements and inventory changes are on a net basis

Source: ICF Analysis of EIA, FHWA, Airlines for America, FERC, and company 10-K data

### Supply/demand balances

#### Gasoline

Florida's motor gasoline consumption averaged 535,000 b/d in 2014, including 53,000 b/d of ethanol. Figure 31 presents the 2014 monthly motor gasoline supply/demand balance for the Florida region. In 2014 consumption was highest in February and April, while monthly consumption variation during the rest of the year was relatively slight. Approximately 33,000 b/d of motor gasoline, or about 7% of consumption (net of ethanol inputs) was imported in 2014.

**Figure 31. Florida motor gasoline supply/demand balance, 2014**

Note: All movements and inventory changes are on a net basis

Source: ICF Analysis of EIA, FHWA, FERC, and company 10-K data

The U.S. Environmental Protection Agency (U.S. EPA) does not require the use of reformulated gasoline in any of the counties in Florida.<sup>96</sup> In accordance with the Clean Air Act, the U.S. EPA requires the adoption of a summer RVP standard that limits the volatility of conventional gasoline sold in certain areas of the country. From May 1 through September 15, the state of Florida enforces a statewide 9.0 RVP limit.<sup>97</sup> Six counties in southern Florida were previously required to observe a stricter federal summer RVP limit of 7.8, however the EPA issued a final rule—effective May 30, 2014—that relaxed the limit to 9.0, as in the rest of the state. The state of Florida is not mandated by the EPA to maintain a winter oxygenated fuels program for any of its counties or metropolitan areas.<sup>98</sup>

**Table 21. Florida motor gasoline regulations**

Regulation	Area (s)	Dates
Summer Gasoline Volatility <9.0 RVP	Florida statewide	May 1 – Sept. 15

Source: U.S. EPA

### Distillate

Distillate fuel oil consumed in the state of Florida is nearly all ultra-low sulfur diesel (ULSD).<sup>99</sup> Figure 32 presents the 2014 monthly distillate supply/demand balance for the Florida region. In 2014, consumption of distillate fuels in Florida averaged 135,000 b/d. Just over two-thirds of this volume is

<sup>96</sup> U.S. Environmental Protection Agency, “Reformulated Gasoline,” (Accessed January 6, 2015), <http://www.epa.gov/gasoline-standards/reformulated-gasoline>.

<sup>97</sup> U.S. Environmental Protection Agency, “Gasoline Reid Vapor Pressure” (Accessed December 11, 2015), <http://www.epa.gov/gasoline-standards/gasoline-reid-vapor-pressure>.

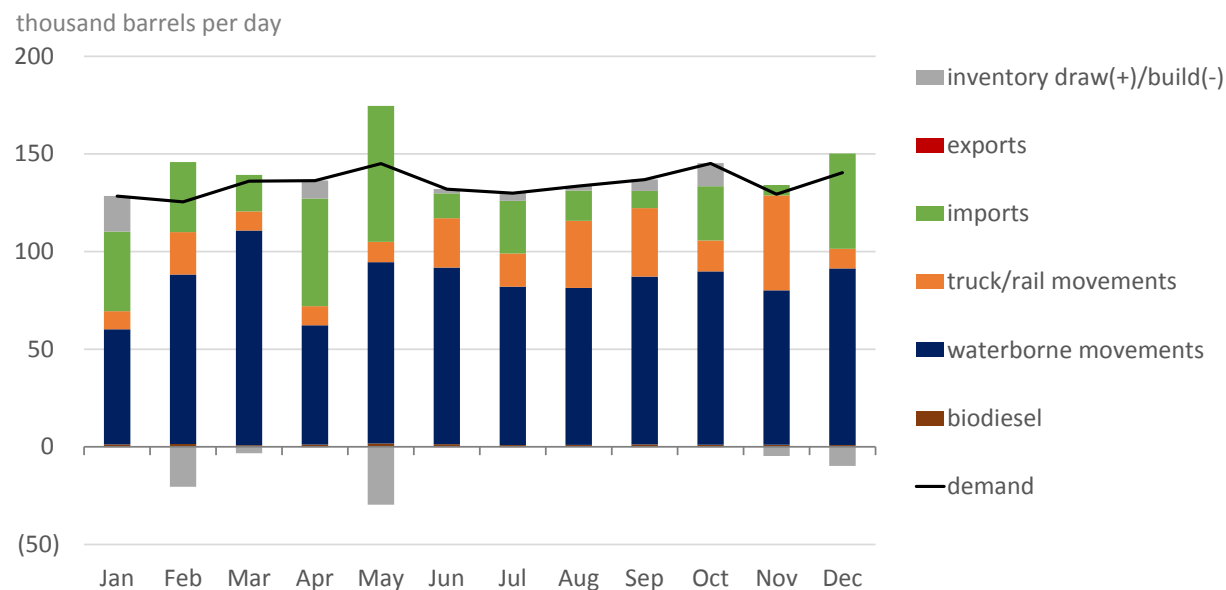
<sup>98</sup> U.S. Environmental Protection Agency, “State Winter Oxygenated Fuel Program Requirements for Attainment or Maintenance of CO NAAQS” (Accessed December 11, 2015), <http://epa.gov/otaq/regs/fuels/420b08006.pdf>.

<sup>99</sup> U.S. Energy Information Administration, “Prime Supplier Sales Volumes – Florida”, (Accessed December 8, 2015), [http://www.eia.gov/dnav/pet/pet\\_cons\\_prim\\_dcu\\_SFL\\_m.htm](http://www.eia.gov/dnav/pet/pet_cons_prim_dcu_SFL_m.htm).



consumed on-highway. The remaining consumption is distributed fairly equitably between the next largest end-use sectors: vessel bunkering, commercial, farm, and other off-highway uses.<sup>100</sup> Negligible volumes of distillate fuel oil is used for home heating in Florida and consumption does not exhibit significant seasonal variation. In 2014, consumption fluctuated between a high of 145,000 b/d in October and a low of 125,000 b/d in February. In 2014, imports accounted for more than one-third of consumption.

**Figure 32. Florida distillate supply/demand balance, 2014**



Note: All movements and inventory changes are on a net basis

Source: ICF Analysis of EIA, FHWA, FERC, and company 10-K data

### Residual fuel

Historically, Florida consumed a substantial volume of residual fuel oil in its electric power sector. However, in 2014 residual fuels made up a small portion of the state's consumption of petroleum products. Residual fuel use nation-wide has dropped more than 85% from its peak in the late 1970s and early 1980s, with Florida experiencing a similar trend.<sup>101</sup> In 2014, Florida consumption totaled just over 18,000 b/d, down from a peak of nearly 164,000 b/d in 1993.<sup>102</sup> The vast majority of Florida's consumption for residual fuel—more than 90%—is used for vessel bunkering purposes.<sup>103</sup> Less than 5% of the state's residual fuel consumption is for use in the electric power sector, while smaller amounts yet are consumed in the industrial and commercial sectors. Sales of residual fuel oil increased markedly

<sup>100</sup> U.S. Energy Information Administration, "Sales of Distillate Fuel by End Use – Florida", (Accessed December 11, 2015), [http://www.eia.gov/dnav/pet/pet\\_cons\\_821dst\\_dcu\\_SFL\\_a.htm](http://www.eia.gov/dnav/pet/pet_cons_821dst_dcu_SFL_a.htm).

<sup>101</sup> U.S. Energy Information Administration, "Florida Residual Fuel Oil All Sales/Deliveries by Prime Supplier (Annual)" (Accessed December 11, 2015), <https://www.eia.gov/todayinenergy/detail.cfm?id=4250>.

<sup>102</sup> <http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=C300013121&f=A>

<sup>103</sup> U.S. Energy Information Administration, "Sales of Residual Fuel by End Use – Florida", (Accessed December 11, 2015), [https://www.eia.gov/dnav/pet/PET\\_CONS\\_821RSD\\_DCU\\_SFL\\_A.htm](https://www.eia.gov/dnav/pet/PET_CONS_821RSD_DCU_SFL_A.htm).

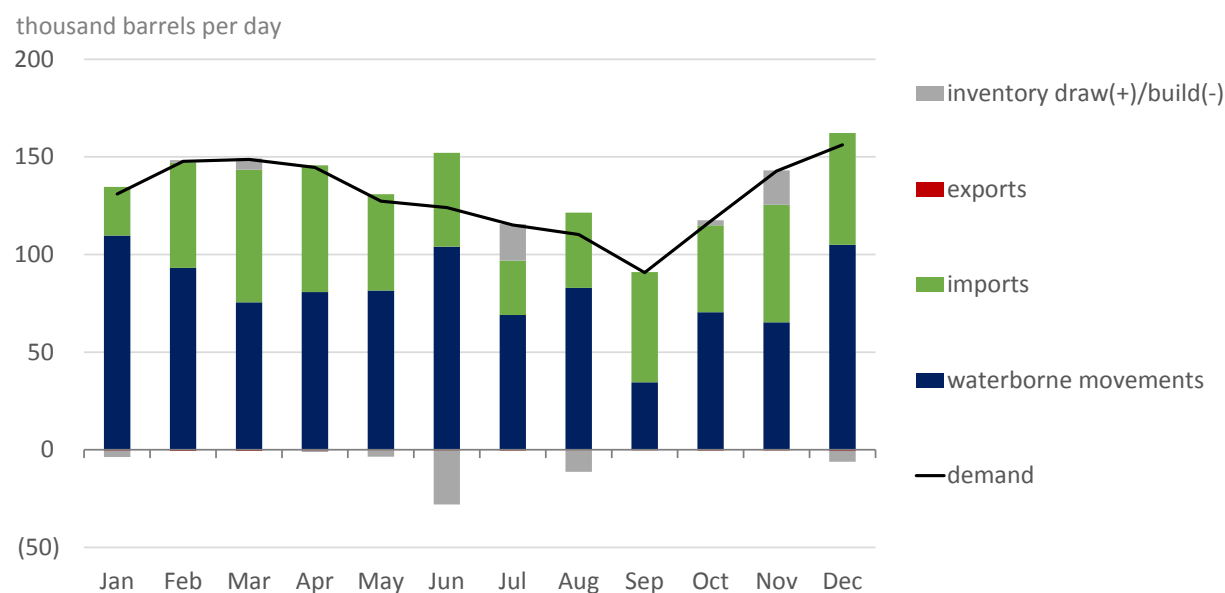


in late 2014 to as high as 51,000 b/d in November.<sup>104</sup> The rise in sales came ahead of new regulations requiring ships travelling within 200 miles of the North America coast to use fuel with a maximum sulfur content of 0.1%. The new sulfur limits took effect January 1, 2015.<sup>105</sup>

### Jet fuel

Commercial jet fuel consumption in Florida averaged approximately 130,000 b/d in 2014. Figure 33 presents Florida's monthly 2014 jet fuel supply/demand balance. With a low mark of 91,000 b/d in September and a peak consumption of 156,000 b/d in December, Florida's consumption varied significantly in 2014, compared to other regions. Generally, jet fuel consumption is higher in the winter months, with the exception of January, coinciding with Florida's peak tourism season.

**Figure 33. Florida jet fuel supply/demand balance, 2014**



Note: All movements and inventory changes are on a net basis. Net marine movements of jet fuel into Florida exceed EIA's reported tanker/barge movements from PADD 3 to PADD 1C due to suspected undercounting of EIA inter-PADD movements. Source: ICF Analysis of EIA, Airlines for America, FERC, and company 10-K data

Thirteen Florida airports have been designated as hubs by the FAA, including four large hubs, three medium hubs, and six small hubs.<sup>106</sup> Two of the large hubs—Miami International (MIA) and Fort Lauderdale- Hollywood International (FLL)—are located in south Florida, while the other two large hubs—Orlando International (MCO) and Tampa International (TPA)—are located in the central Florida region. In addition to the FAA-designated hubs, there are 55 smaller commercial airports in the state, as

<sup>104</sup> U.S. Energy Information Administration, "Florida Residual Fuel Oil All Sales/Deliveries by Prime Supplier (Monthly)" (Accessed December 11, 2015), <http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=C300013121&f=M>.

<sup>105</sup> Platts McGraw Hill Financial, "Bunkers International Offering ECA-Compliant 0.1% S Bunker Fuel in Cartagena," (Accessed December 12, 2015), <http://www.platts.com/latest-news/shipping/houston/bunkers-international-offering-eca-compliant-21953613>.

<sup>106</sup> Federal Aviation Administration, "Airport Safety" (Accessed November 5, 2015), [http://www.faa.gov/airports/airport\\_safety/airportdata\\_5010/menu/](http://www.faa.gov/airports/airport_safety/airportdata_5010/menu/).

well as five U.S. Air Force bases, which may consume commercial-quality Jet-A fuel in addition to higher-performance blends.<sup>107</sup>

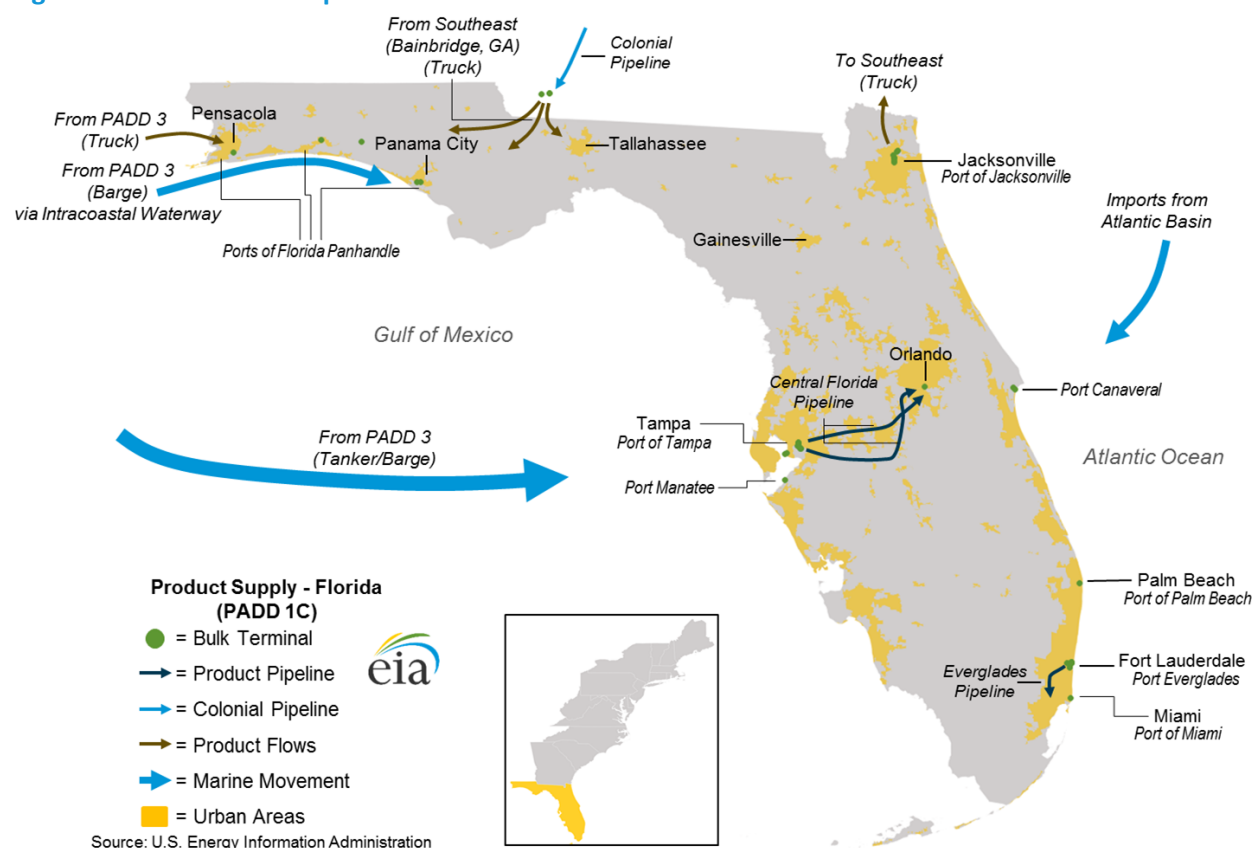
### Supply and logistics

Transportation fuel markets in Florida rely entirely on supply from outside the region, primarily by marine tanker and barge, but also, to a lesser degree, by truck. Marine terminals, which are primarily concentrated at deepwater ports along Florida's Gulf of Mexico and Atlantic coastlines, receive bulk products on tankers and ocean-going barges from Gulf Coast refining centers and foreign supply sources. From the marine terminals, products are further distributed to markets along the coastline by intrastate barge and truck movements, and via pipeline to Orlando. Markets in the Florida Panhandle are also supplied from distribution terminals in Mobile, Alabama, as well as terminals in Bainbridge, Georgia that receive fuels off of the Colonial Pipeline. These deliveries into Florida from the Southeast region are made by truck. Figure 34 presents the ports, terminals, and pipelines serving Florida. The ports of Tampa, Everglades, Jacksonville, and Canaveral are the major receipt points for inbound marine volumes.

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<sup>107</sup> MilitaryBases.com, "State Military Bases" (Accessed November 5, 2015), <http://militarybases.com>.

Figure 34. Florida refined petroleum infrastructure



### Ports

Table 22 lists ports in Florida that received marine deliveries of transportation fuels in 2013, the latest year for which domestic marine receipt data is available from the U.S. Army Corps of Engineers (USACE). The table shows estimated 2013 inbound movements at the region’s ports broken out between domestic volumes, as tracked by USACE, and foreign volumes, as tracked by EIA. Florida ports received 642,000 b/d of inbound marine volumes of motor gasoline, distillate fuel oil, and jet fuel in in 2013. Domestic receipts accounted for nearly 86% of these volumes, coming primarily from refineries in Texas, Louisiana, Mississippi, and Alabama. In addition to ocean-going marine deliveries, approximately 28,000 b/d of transportation fuels are delivered to markets in the Florida Panhandle on smaller barges via the Gulf Intracoastal Waterway from to Gulf Coast refining centers, including Mobile, Alabama; Pascagoula, Mississippi; and New Orleans, Louisiana. Generally, transportation fuels are received in bulk at Florida’s major ports, and then distributed by truck to coastal markets.

Table 22. Waterborne receipts of transportation fuels at Florida ports, 2013

Barrels per day

Port	Domestic	Foreign	Total
<b>Central Florida</b>			
Tampa	271,141	2,545	273,686
Port Manatee	127	597	724
Canaveral	9,834	22,329	32,163

Total	281,102	25,471	306,573
<b>South Florida</b>			
Port Everglades	191,798	44,255	236,053
Miami	371	1,129	1,500
Palm Beach	501	-	501
<b>Total</b>	<b>192,670</b>	<b>45,384</b>	<b>238,054</b>
<b>Northeast Florida</b>			
Jacksonville	51,702	18,055	69,757
<b>Total</b>	<b>51,702</b>	<b>18,055</b>	<b>69,757</b>
<b>Florida Panhandle</b>			
Pensacola	11,347	-	11,347
Niceville	3,591	-	3,591
Freeport	5,082	-	5,082
Panama City	8,180	329	8,509
<b>Total</b>	<b>28,200</b>	<b>329</b>	<b>28,529</b>
<b>Florida Total</b>	<b>553,674</b>	<b>89,239</b>	<b>642,913</b>

Source: U.S. Army Corp of Engineers 2013 Waterborne Commerce of the United States Waterways and Harbors; EIA Company Level Imports, 2013

## Pipelines

Kinder Morgan's 115,000 b/d Central Florida Pipeline System is the largest product pipeline system in Florida. The system ships products received at terminals in Tampa on two pipelines to the company's Taft terminal near Orlando. A 16-inch diameter line is dedicated for transporting motor gasoline and batched denatured ethanol and is the only U.S. pipeline that transports ethanol over long distances. A 10-inch diameter pipeline transports distillate fuel oil and jet fuel, and is the sole petroleum pipeline serving the Orlando International Airport.<sup>108</sup> Also originating at terminals in Tampa, the 18,000 b/d Tampa Airport Pipeline delivers jet fuel to Tampa International Airport. In South Florida, Buckeye Partners' 55,000 b/d Everglades Pipeline transports primarily jet fuel approximately 40-miles from Port Everglades to Ft. Lauderdale-Hollywood International Airport and Miami International Airport.<sup>109</sup>

**Table 23. Select Florida refined product pipelines**

Pipeline	Origin	Destination	Distance, miles	Capacity, b/d
Kinder Morgan Central Florida Pipeline	Tampa, FL (16-inch)	Orlando, FL	110	115,000
	Tampa, FL (10-inch)	Orlando, FL	85	
Tampa Airport Pipeline	Port Tampa	Tampa Int'l Airport	not avail.	18,000
Buckeye Everglades Pipeline	Everglades, FL	Miami Int'l Airport	40	55,000

Source: ICF Research, Kinder Morgan and Buckeye Partners 10-Ks, investor presentations

## Markets

### South Florida

The principal market in South Florida is the Miami-Ft. Lauderdale metropolitan area. Virtually all transportation fuels consumed in South Florida are delivered by tanker and ocean-going barge to seven

<sup>108</sup> Kinder Morgan, "Products Pipelines: Central Florida Pipeline Co.," (Accessed January 6, 2016), [http://www.kindermorgan.com/business/products\\_pipelines/central\\_florida.aspx](http://www.kindermorgan.com/business/products_pipelines/central_florida.aspx).

<sup>109</sup> CBS Miami, "More Flights Cancelled at MIA Due to Fuel Supply," (March 28, 2011), <http://miami.cbslocal.com/2011/03/28/more-flights-canceled-at-mia-due-to-fuel-supply/>.

berths in the Northport area of Port Everglades. Terminals in Port Everglades sit adjacent to the berths and utilize shared manifolds to direct flows to their facilities from vessels offloading at the berths. In 2013, Port Everglades handled just over 236,000 b/d of total inbound volumes, of which more than 80% were sourced from Gulf Coast refineries. Transportation fuels offloaded at the berths are stored and distributed by tanker truck to the South Florida markets, which are concentrated along the coast. Port Everglades is also the origin of the 55,000 b/d Everglades Pipeline, which is owned and operated by a subsidiary of Buckeye Partners, and supplies jet fuel to the Ft. Lauderdale-Hollywood International Airport and Miami International Airport. The Everglades Pipeline supplies Miami International Airport with substantially all of its jet fuel requirements.<sup>110</sup>

### Central Florida

The Central Florida market, which spans south from Tampa to Naples along the Gulf of Mexico coastline, inland to Orlando, and all the way to Port Canaveral on the Atlantic coast, is supplied primarily by marine deliveries to Tampa Bay area ports, and to a lesser degree to Port Canaveral. In 2013, the ports in the Tampa area received nearly 275,000 b/d of inbound marine volumes of motor gasoline, distillate fuel oil, and jet fuel, compared to only 32,000 b/d received at Port Canaveral. The largest marine terminals in Central Florida are located in Tampa Bay, primarily on Hookers Point in South Tampa, and in Port Tampa. In addition, Port Manatee, near the mouth of Tampa Bay, also receives shipments of gasoline and diesel. Kinder Morgan operates the 115,000 b/d Central Florida Pipeline System, which originates on Hookers Point and supplies Orlando with the majority of its transportation fuel supplies. Smaller volumes are also trucked to Orlando from Tampa and from Port Canaveral, which primarily serves markets on Florida's central eastern coast

### Northeast Florida

The Port of Jacksonville is the only petroleum port serving northeast Florida, primarily the Jacksonville and Gainesville markets, but also Daytona Beach. The marine terminals are concentrated within the city of Jacksonville along the St. Johns River, and further northeast at the mouth of the Broward River. All terminals are supplied primarily via marine vessels. The Jacksonville terminals redistribute products by truck locally, inland to the Gainesville market, and along the coastline to St. Augustine and Daytona. There are no major pipelines serving northeast Florida.

### Florida Panhandle

The Florida Panhandle market—primarily Pensacola, Panama City, and Tallahassee—receives supply by barge via the Gulf Intracoastal Waterway, which links the Panhandle markets to Gulf Coast refining centers in PADD 3, and also by truck from Georgia and Alabama. In 2013, 28,000 b/d of transportation fuels were delivered the Florida Panhandle via the Waterway. The Panhandle's marine receipt terminals are located in bays and inlets along the coastline in Pensacola, Niceville, Freeport, and Panama City. The Florida Panhandle also receives deliveries by truck from terminals in Bainbridge, Georgia, which are supplied by a 150,000 b/d Colonial Pipeline spur line originating in Atlanta, and by truck from Mobile,

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<sup>110</sup> Buckeye Partners, L.P., *2014 Annual Report*, (December 31, 2014), <http://www.buckeye.com/LinkClick.aspx?fileticket=o18FdCpNz8s%3D&tabid=92&mid=2194>.

Alabama. The Tallahassee market has no access to marine supply, and receives all of its transportation fuels from Bainbridge.

### Supply vulnerability

Florida has no in-state refinery production nor any interstate pipeline connections to refining centers outside the region. The continuity of the state's supply chain is overwhelmingly dependent on the continuous flow of domestic- and foreign-sourced transportation fuels through its ports, which bring in more than three-fourths of the state's total consumption, and a continuous waterborne supply from domestic refining centers in PADD 3, which account for roughly two-thirds of total consumption. This dependency on marine volumes makes Florida's supply chain particularly vulnerable to hurricanes and tropical storms, which can disrupt both Florida's port operations and production in coastal PADD 3 supply centers.

Florida's largest ports bring in the majority of the state's transportation fuels, and are critical chokepoints for the state's supply. Specifically, extended disruptions to port operations in Tampa Bay and Port Everglades could very quickly lead to fuel shortages in Central Florida and South Florida, respectively. Port Everglades is particularly vulnerable, as the port's petroleum terminals are tightly clustered within the port and share tanker offloading infrastructure. Due to the long distances from South and Central Florida markets to refining centers on the Gulf Coast and pipeline terminals in Georgia, disruptions to Tampa Bay or Port Everglades would be difficult to make up through other modes of delivery.

In 2004, hurricanes Frances and Jeanne both closed Port Everglades for several days, leading to shortages at South Florida terminals. Tampa was closed during hurricanes Charley, Frances, and Jeanne in 2004. Following Jeanne, Tampa was closed for three days, and supply to Orlando moving along Kinder Morgan's Central Florida Pipeline System was interrupted. This reduced gasoline supplies available to evacuating residents and resulted in supplies being trucked in from Atlantic Coast ports. Waivers were obtained from the U.S. Department of Transportation to permit more daily hours for truck drivers to deliver transportation fuels to storm-ravaged areas. Portable fuel sales points were created from transport trucks, and petroleum operators in the state also obtained waivers from the U.S. Environmental Protection Agency to permit sales of higher RVP gasoline and high-sulfur diesel for on-road vehicles.<sup>111</sup>

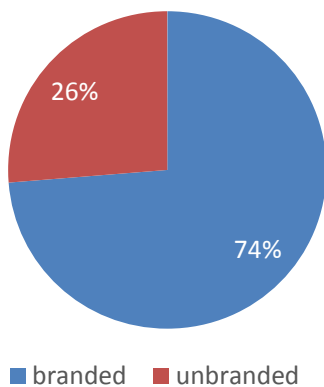
Florida is also vulnerable to disruptions at Gulf Coast refining centers in Texas, Louisiana, Mississippi, and Alabama. An indirect supply shortfall stemming from disruptions to Gulf Coast refining or marine out-loading capabilities could be replaced by importing spot cargoes of transportation fuels from Atlantic Basin or global supply centers.

<sup>111</sup> U.S. Energy Information Administration- Office of Electricity Delivery and Energy Reliability, in conjunction with the National Association of State Energy Officials, "Florida State's Energy Emergency Response to the 2004 Hurricanes," (June 2005), <http://www.oe.netl.doe.gov/docs/fl2004energy.pdf>.

## Retail markets

There are 6,148 retail service outlets in the state of Florida<sup>112</sup>. Figure 35 shows the share of these outlets that are branded versus unbranded. Stations are classified as ‘branded’ if they are associated with and display a major oil company brand. ‘Unbranded’ stations are not affiliated with a major oil company brand. Seventy four percent of Florida’s retail stations are branded, slightly higher than the national average of 69%. The top five brands in Florida are Shell, BP, Chevron, Citgo, and Sunoco, and these brands together account for 28% of the region’s retail outlets. The state’s top unbranded retailer is 7-Eleven with nearly 13% of Florida’s retail outlets. Fifty percent of the region’s stations offer diesel fuel, compared to a national average of 53%. As of 2015, there were 62 public and 10 private filling stations in Florida offering E85 and seven public and 10 private filling stations offering biodiesel (B20 and above) in the region.<sup>113</sup>

**Figure 35. Florida retail market structure**  
percent of retail stations



Source: HSIP 2015

## Future changes

Two companies have announced projects designed to make Florida’s transportation fuel markets less dependent on marine supply.

Kinder Morgan is proposing the 360-mile Palmetto Pipeline, which would allow the company deliver petroleum products from an interconnection with the Plantation Pipeline in Belton, South Carolina, to markets in South Carolina, coastal Georgia, and as far south as Jacksonville Florida. The system will have a design capacity of up to 167,000 b/d and will consist of a segment of expansion capacity that Palmetto will lease from Plantation Pipe Line Company between Baton Rouge, Louisiana and Belton.<sup>114</sup> Kinder Morgan expects to deliver approximately 70,000-80,000 b/d to Jacksonville on Palmetto. The project has a targeted in-service date of July 2017.<sup>115</sup>

<sup>112</sup> Retail station data provided by the Homeland Security Infrastructure Program (HSIP).

<sup>113</sup> U.S. Department of Energy: Office of Energy Efficiency & Renewable Energy, “Alternative Fuels Data Center” (Accessed December 2, 2015), <http://www.afdc.energy.gov/states/>.

<sup>114</sup> Kinder Morgan, “Products Pipelines: Palmetto Pipeline,” (Accessed January 6, 2016), [http://www.kindermorgan.com/business/products\\_pipelines/palmetto/](http://www.kindermorgan.com/business/products_pipelines/palmetto/).

<sup>115</sup> [Ibid.](#)

Florida Fuel Connection (FFC) announced plans in 2015 to ship fuel by rail from the Colonial Pipeline in Baton Rouge, Louisiana to three new rail offloading terminals that the company would build in South Florida and southeast Georgia. The project, which is designed to enhance supply security to Florida and Georgia, is expected to be fully operation by the first quarter of 2017 and at its peak will transport 240,000 b/d of transportation fuels rail.<sup>116</sup>

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<sup>116</sup> Florida Fuel Connection, "Florida Fuel Connection to Build Infrastructure for Stable, Efficient, Eco-Friendly Petroleum Supply throughout State: Integrated Project Creates Long-Term Solution to Stabilize Petroleum Supply and Significantly Improve Fuel Efficiencies for State of Florida" (July 28, 2015), <http://www.floridafuelconnection.com/Portals/0/FFCRelease072715-FinalDoc.pdf>.

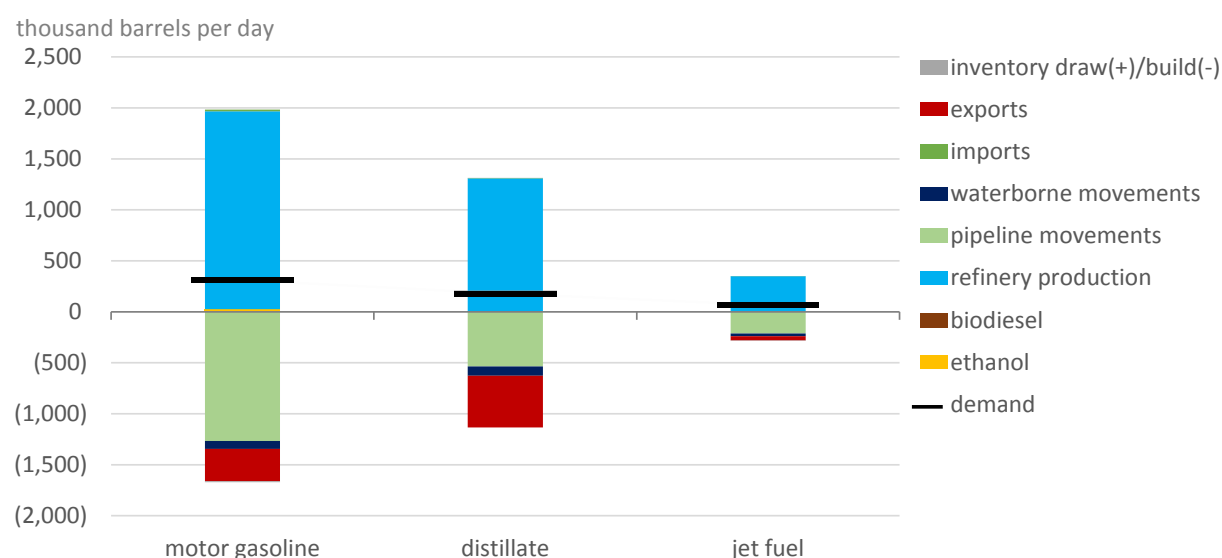


## Texas Gulf Coast

The Texas Gulf Coast region consists of 29 Texas counties located on or just inland from the state's Gulf of Mexico coastline. Estimated total consumption of motor gasoline, distillate fuel oil, and commercial jet fuel in the Texas Gulf was 555,000 b/d in 2014. Within the region, the principal consumption center is the Greater Houston metropolitan area on the central coast. Houston is the fifth most populous metropolitan area in the country.<sup>117</sup> Other consumption centers include the Corpus Christi, Brownsville, and Beaumont-Port Arthur metropolitan areas.

The Texas Gulf is the country's largest fuel producing region and refinery output of gasoline, distillates and jet fuel exceeds in-region consumption by approximately 3 million b/d. The Texas Gulf Coast is a net exporter of fuels to other countries and a net shipper of fuels to other regions of the country. Products primarily move out of the region by pipeline to domestic destinations and by tanker/barge to both domestic and international destinations. Figure 36 presents the 2014 annual supply and demand balances for motor gasoline, distillate, and jet fuel.

**Figure 36. Texas Gulf Coast supply/demand balances, 2014**



Note: All movements and inventory changes are on a net basis

Source: ICF Analysis of EIA, FHWA, Airlines for America, FERC, and company 10-K data

### Supply/demand balances

#### Gasoline

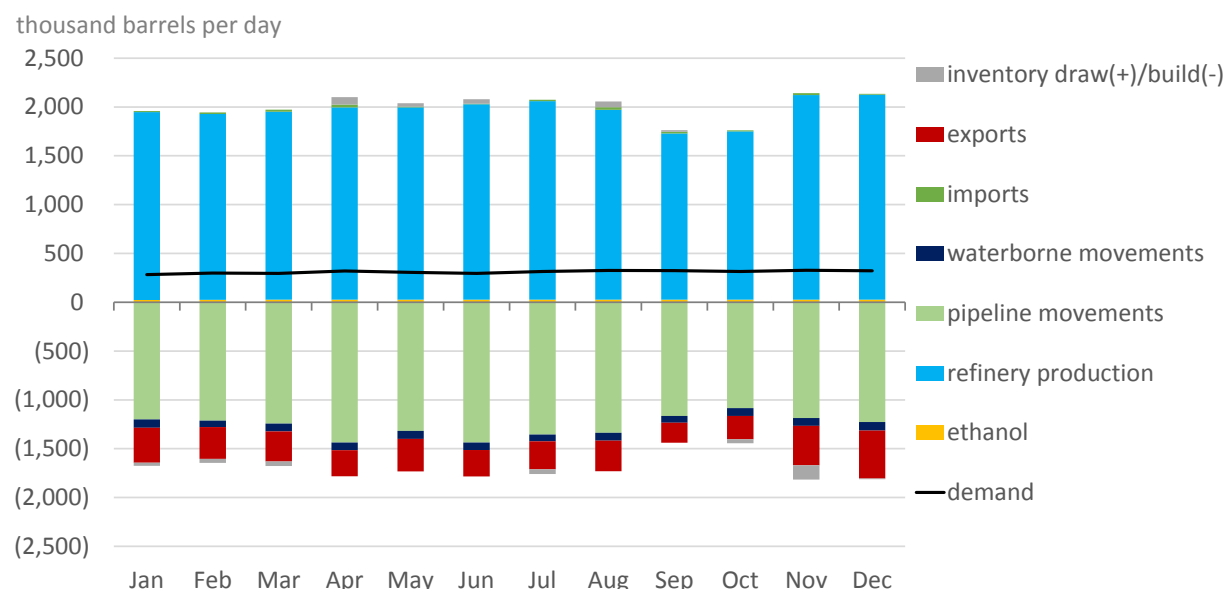
Figure 37 presents the Texas Gulf Coast's 2014 monthly motor gasoline supply/demand balance. In 2014, gasoline consumption averaged 311,000 b/d, including 26,000 b/d of ethanol. Motor gasoline consumption does not follow a seasonal pattern and monthly variation is relatively low, with consumption fluctuating less than 10% between the lowest- and highest-consumption months in 2014. In 2014, in-region refinery production exceeded consumption (net of ethanol inputs) by 1.6 million b/d.

<sup>117</sup> Google Maps, "Gasoline Stations in the U.S." (Accessed December 6, 2015)

<https://www.google.com/maps/search/gasoline+stations+in+the+us/@28.1037524,-96.4885368,7.35z>

Approximately 300,000 b/d of this surplus was exported by marine tanker to foreign countries with the remainder shipped to other U.S. markets by pipeline and tanker/barge. Refinery production of gasoline and other fuels tends to be lower in the first quarter and in September and October, when refiners shut down portions of their refineries to perform required maintenance work.

**Figure 37. Texas Gulf Coast motor gasoline supply/demand balance, 2014**



Note: All movements and inventory changes are on a net basis

Source: ICF Analysis of EIA, FHWA, FERC, and company 10-K data

The U.S. Environmental Protection Agency (U.S. EPA) requires the use of reformulated gasoline in eight counties in the Greater Houston area.<sup>118</sup> The state of Texas has a waiver under the Clean Air Act to adopt a conventional gasoline summer RVP standard more stringent than federal requirements.<sup>119</sup> From June 1 through September 15, Texas enforces a statewide 9.0 RVP limit.<sup>120</sup> In the Texas Gulf Coast region, this limit applies to counties from the Corpus Christi area south to the Mexican border. For selected counties in eastern Texas, including all counties north of Corpus Christi not in the Greater Houston or Beaumont-Port Arthur metro areas, a 7.8 RVP limit is enforced from May 1 through October 1. The three counties in the Beaumont/Port Arthur area—Hardin, Orange, and Jefferson counties—enforce a 9.0 RVP limit from May 1 through June 1, and a 7.8 RVP limit from June 1 through September 15. Refiners in Texas must produce fuels to meet these statewide and local requirements, and at the same time meet requirements in multiple markets outside Texas into the Midwest and the East Coast.

<sup>118</sup> U.S. Environmental Protection Agency, "Reformulated Gasoline," (Accessed January 6, 2015),

<http://www.epa.gov/gasoline-standards/reformulated-gasoline>.

<sup>119</sup> Texas Commission on Environmental Quality, "The Regional Low Reid Vapor Pressure (RVP) Gasoline Program", (Accessed January 6, 2015),

<https://www.tceq.texas.gov/airquality/mobilesource/vetech/fuelprograms.html/#rvp1>.

<sup>120</sup> U.S. Environmental Protection Agency, "Gasoline Reid Vapor Pressure" (Accessed December 11, 2015),

<http://www.epa.gov/gasoline-standards/gasoline-reid-vapor-pressure>.

The state of Texas does not maintain a winter oxygenated fuels program for any of the counties that make up the Texas Gulf Coast region.<sup>121</sup>

**Table 24. Texas Gulf Coast motor gasoline regulations**

<b>Regulation</b>	<b>Area (s)</b>	<b>Dates</b>
Reformulated gasoline	Houston metropolitan area	Year-round
Summer gasoline volatility <9.0 RVP	Texas statewide	May 1 – Sept. 15
Summer gasoline volatility <7.8 RVP	Select eastern Texas counties, including all counties north of Corpus Christi in the Texas Gulf Coast region	May 1 – Oct. 1
	Beaumont/Port Arthur metropolitan area (Hardin, Orange, and Jefferson counties).	June 1 – Sep. 15

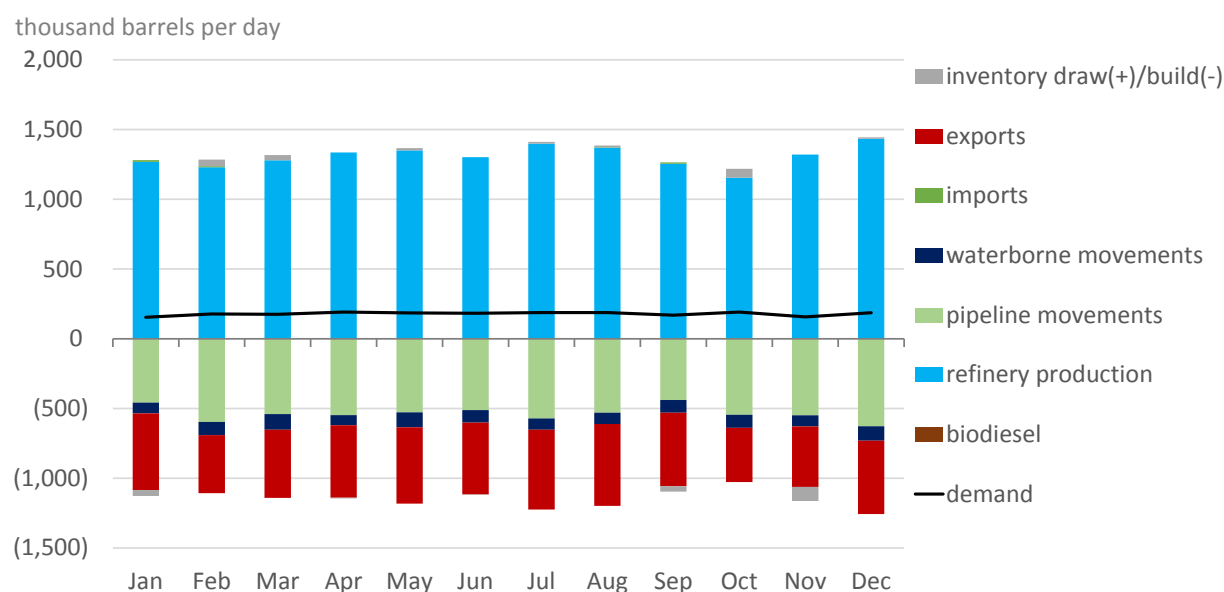
Source: U.S. EPA

### Distillate

Figure 38 presents the Texas Gulf Coast region’s 2014 monthly supply/demand balance. In 2014, distillate consumption averaged 179,000 b/d. More than two-thirds of distillate fuel consumption in the state of Texas is consumed on-highway. Off-road consumption in Texas is led by oil company and railroad consumption, which each account for 5 to 10% of total state consumption.<sup>122</sup> Consumption does not follow a seasonal pattern. The Texas Gulf Coast’s refinery production of distillates exceeds consumption (net of biodiesel inputs) by approximately 1.1 million b/d. Nearly half of this surplus—just over 500,000 b/d—was exported to international markets, mostly in Latin America and Europe. The remainder was shipped to other U.S. markets by pipeline and tanker/barge.

<sup>121</sup> U.S. Environmental Protection Agency, “State Winter Oxygenated Fuel Program Requirements for Attainment or Maintenance of CO NAAQS” (Accessed December 11, 2015), <http://epa.gov/otaq/regs/fuels/420b08006.pdf>.

<sup>122</sup> U.S. Energy Information Administration, “Sales of Distillate Fuel by End Use – Texas”, (Accessed December 11, 2015), [http://www.eia.gov/dnav/pet/pet\\_cons\\_821dst\\_dcu\\_STX\\_a.htm](http://www.eia.gov/dnav/pet/pet_cons_821dst_dcu_STX_a.htm).

**Figure 38. Texas Gulf Coast distillate supply/demand balance, 2014**

Note: All movements and inventory changes are on a net basis

Source: ICF Analysis of EIA, FHWA, FERC, and company 10-K data

Distillate fuel oil consumption in the state of Texas is nearly all ultra-low sulfur diesel (ULSD).<sup>123</sup> The state requires the year-round use of low emission blends for all diesel fuel sold or supplied as fuel for motor vehicles and non-road equipment operating in 110 counties, including all but four of the 29 counties that make up the Texas Gulf Coast region.<sup>124</sup> These requirements specify a minimum cetane number of 48 and a maximum aromatic hydrocarbon content of 10% by volume for fuels supplied to consumers in the specified counties.<sup>125</sup>

### Jet fuel

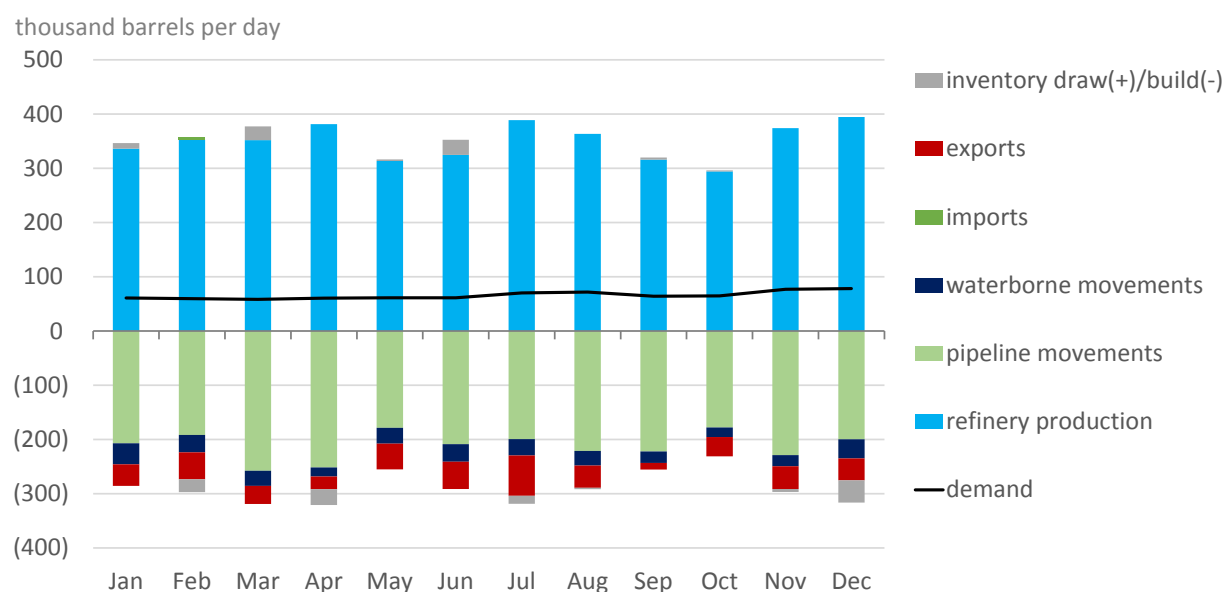
Figure 39 presents the Texas Gulf Coast region's 2014 jet fuel supply/demand balance. Commercial jet fuel consumption in the Texas Gulf Coast region averaged approximately 66,000 b/d in 2014.<sup>126</sup> Consumption was relatively steady throughout the year. Refinery production exceeded consumption by approximately 280,000 b/d in 2014, with foreign exports averaging 41,000 b/d.

<sup>123</sup> U.S. Energy Information Administration, "Sales of Distillate Fuel by End Use – Texas", (Accessed December 11, 2015), [http://www.eia.gov/dnav/pet/pet\\_cons\\_821dst\\_dcu\\_STX\\_a.htm](http://www.eia.gov/dnav/pet/pet_cons_821dst_dcu_STX_a.htm).

<sup>124</sup> Texas Administrative Code, "Texas Commission on Environmental Quality: Control of Air Pollution from Motor Vehicles— Low Emission Fuels: Low Emission Diesel – Low Emission Diesel Standards," TAC: Title 30, Part 1, Chapter 114, Subchapter H, Division 2: Rule §114.312, (Effective May 11, 2000), [http://texreg.sos.state.tx.us/public/readtac\\$ext.TacPage?sl=R&app=9&p\\_dir=&p\\_rloc=&p\\_tloc=&p\\_ploc=&pg=1&p\\_tac=&ti=30&pt=1&ch=114&rl=312](http://texreg.sos.state.tx.us/public/readtac$ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=30&pt=1&ch=114&rl=312).

<sup>125</sup> Texas Commission on Environmental Quality, "Texas Low Emission Diesel (TxLED) Program," (May 8, 2012), <https://www.tceq.texas.gov/airquality/mobilesource/txled>.

<sup>126</sup> U.S. Energy Information Administration, "State Energy Data System (SEDS): State Profiles and Energy Estimates -- Table F2: Jet fuel consumption, price, and expenditure estimates, 2014" (Accessed December 4, 2015), [http://www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep\\_fuel/html/fuel\\_jf.html&sid=US](http://www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep_fuel/html/fuel_jf.html&sid=US).

**Figure 39. Texas Gulf Coast jet fuel supply/demand balance, 2014**

Note: All movements and inventory changes are on a net basis

Source: ICF Analysis of EIA, Airlines for America, FERC, and company 10-K data

The George Bush Intercontinental (IAH) and the William P. Hobby (HOU) airports, both serving the Greater Houston area, are the two busiest airports in the Texas Gulf Coast region, and are the only airports designated as hubs by the Federal Aviation Administration. Sixteen smaller commercial airports also operate in the region. There are no military bases in the region.<sup>127</sup>

## Refineries

The Texas Gulf Coast region is the largest fuel producing region in the United States, with 17 refineries and a combined atmospheric crude distillation capacity of approximately 4.6 million barrels per calendar day (b/cd)<sup>128</sup>. The refineries, which account for more than a quarter of the nation's refining capacity, are clustered around deepwater ports in three of the region's metropolitan areas. The Greater Houston area, which includes the Houston Ship Channel, Baytown, Texas City, and Sweeny, has 10 refineries with a combined capacity of 2.4 million b/d. The Beaumont-Port Arthur area has four refineries situated around Sabine Lake and the Neches River with a combined capacity of 1.5 million b/d. The Corpus Christi area has three refineries clustered in the Port of Corpus Christi with a combined capacity of 0.7 million b/d. Table 25 lists each refinery in the Texas Gulf Coast region including the owner, site, and operable capacity of each facility as of January 1, 2015. These refineries supply local markets in the Texas Gulf Coast region via truck distribution and ship surplus production to other U.S. markets via a vast network of pipeline systems, to Florida and southeastern U.S. ports via coastwise-compliant marine vessels, and to international markets on foreign-flagged tankers.

<sup>127</sup> MilitaryBases.com, "State Military Bases" (Accessed November 5, 2015), <http://militarybases.com>.

<sup>128</sup> Barrels per calendar day is a measure of the amount of input that a distillation unit can process in a 24-hour period under usual operating conditions. It takes into account both planned and unplanned maintenance. Stream day capacity is the maximum number of barrels of input that a distillation facility can process within a 24-hour period when running at full capacity under optimal crude and product slate conditions with no allowance for downtime. Stream day capacity is typically about 6% higher than calendar day capacity.

Table 25. Texas Gulf Coast refineries

Owner	Site	Operable capacity, b/cd <sup>A</sup>
<b>Greater Houston</b>		
ExxonMobil	Baytown, TX	560,500
Marathon	Galveston Bay, TX	451,000
Deer Park Refining	Deer Park, TX	316,600
Houston Refining	Houston, TX	263,776
Phillips 66	Sweeny, TX	247,000
Valero	Texas City, TX	225,000
Petrobras	Pasadena, TX	100,000
Valero	Houston, TX	100,000
Marathon	Texas City	84,000
Kinder Morgan <sup>B</sup>	Galena Park, TX	42,000
<b>Total</b>		<b>2,389,876</b>
<b>Beaumont-Port Arthur</b>		
Motiva	Port Arthur, TX	603,000
ExxonMobil	Beaumont, TX	344,600
Valero	Port Arthur, TX	335,000
Total SA	Port Arthur, TX	225,500
<b>Total</b>		<b>1,508,100</b>
<b>Corpus Christi</b>		
Flint Hills	Corpus Christi, TX	290,000
Valero	Corpus Christi, TX	205,000
Citgo	Corpus Christi, TX	157,500
<b>Total</b>		<b>652,500</b>
<b>Texas Gulf Coast Total</b>		<b>4,550,476</b>

(A) Barrels per calendar day, as of Jan 1, 2015

(B) Condensate processing facility. Expected to double capacity by end of 2015<sup>129</sup>

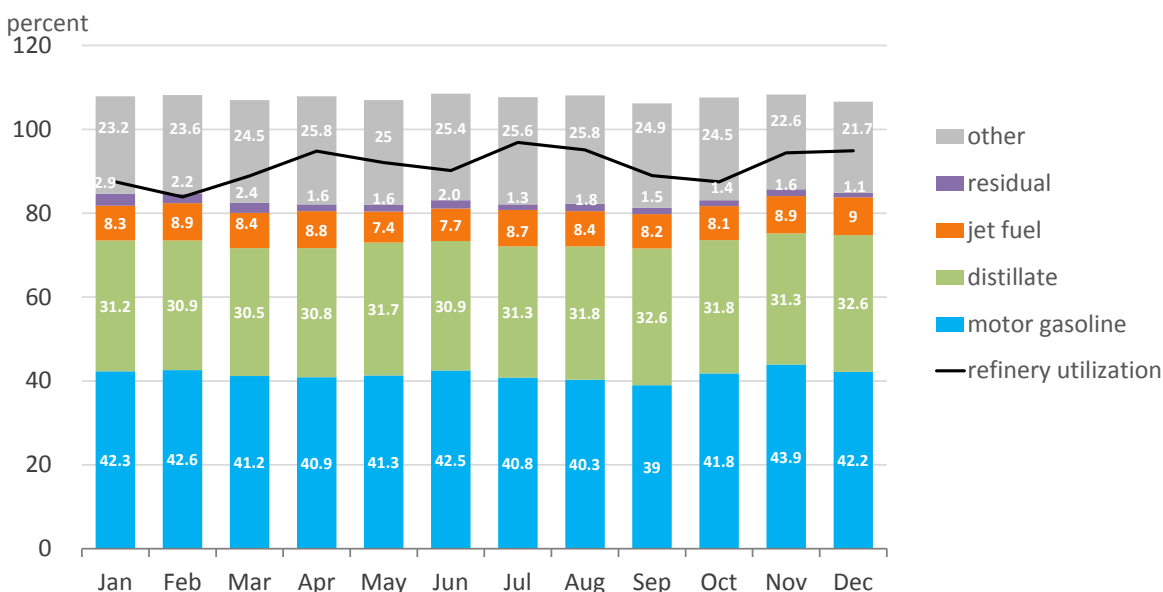
Source: U.S. Energy Information Administration, Refinery Capacity Report

Figure 40 shows monthly refinery utilization and yield percentages for motor gasoline (both finished gasoline and blendstocks), distillate fuel oil, residual fuel oil, and other secondary products in the Texas Gulf Coast region in 2014. Production of petroleum products in the Texas Gulf Coast region is more diverse than in other U.S. refining centers due to consumption in the petrochemical industry, including plastics manufacturers. Texas Gulf Coast refineries produce the highest yield of non-transportation fuel products (24.4%) of any region in the country. The products are comprised primarily of petroleum coke, LPG, naphtha and other petrochemical feedstocks, and still gas. Production of transportation fuels (gasoline, distillate, and jet fuel), accounts for 81.4% of the region's annual yield, compared to over 90% in the Texas Inland region and a national average of 84.5%. Texas Gulf Coast motor gasoline yield, at

<sup>129</sup> Kinder Morgan, "Kinder Morgan Condensate Processing Facility," (Accessed January 6, 2016), <http://www.kindermorgan.com/projects/condensate> and U.S. Energy Information Administration, "Frequently Asked Questions: When was the last refinery built in the U.S.?", (January 1, 2015), <https://www.eia.gov/tools/faqs/faq.cfm?id=29&t=6>.

41.6%, is lower than the national average of 45%; distillate yield, at 31.2%, is slightly higher than the national average of 29.9%; and jet fuel yield, at 8.4%, is lower than the national average of 9.6%. During the summer months less butane is added to gasoline to control engine vapor lock and to meet required gasoline RVP regulations, leading to slightly lower gasoline yields in summer months when compared to winter months.

**Figure 40. Texas Gulf Coast refinery yields**



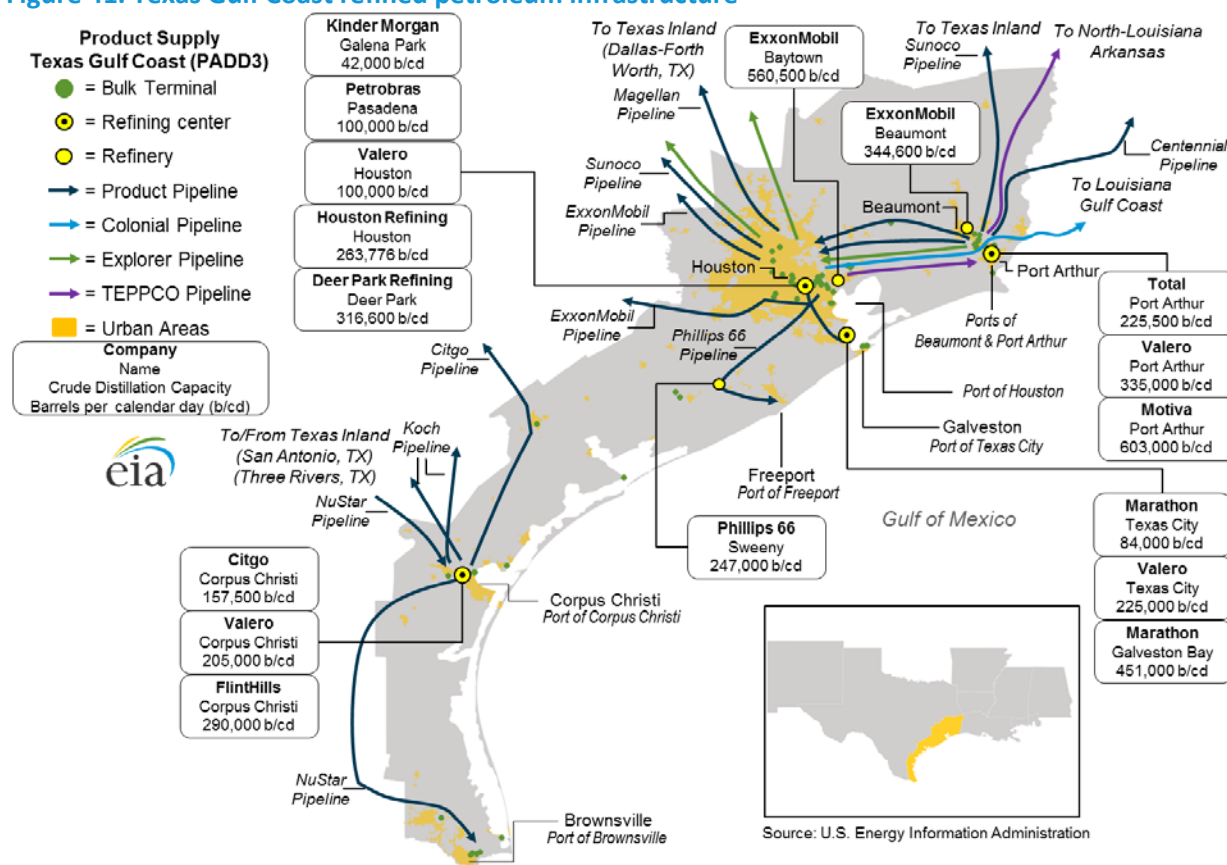
Note: yield percentages sum to higher than 100% due to processing gains.

Source: U.S. Energy Information Administration, Petroleum Supply Monthly

## Supply and logistics

Refined product infrastructure in the Texas Gulf Coast region is primarily designed to move products from the region's three refining centers to domestic and international markets outside the region. Products shipped to domestic markets in the Midwest, in the Southeast, along the East Coast, and as far west as Arizona, primarily move on long-distance pipelines. Domestic waterborne shipments to Florida and southeastern U.S. ports move on coastwise-compliant tankers and barges. Foreign exports are loaded onto foreign-flagged ships for delivery to markets primarily in the Atlantic Basin. Figure 41 presents a map of the refineries, product pipelines, product terminals, and major ports in the Texas Gulf Coast region.

Figure 41. Texas Gulf Coast refined petroleum infrastructure



### Pipelines

The majority of the Texas Gulf Coast region’s refined product surplus is distributed via major interstate pipeline systems to markets throughout the country. Table 26 lists select refined product pipelines operating within the Texas Gulf Coast region as well as their origin points, destination points, and capacities, if publically available. Three major interstate pipeline systems originate in the Texas Gulf Coast region: the Colonial Pipeline, the Explorer Pipeline, and the Enterprise TEPPCO Pipeline. In addition to the region’s major interstate pipelines, smaller intrastate pipelines transport fuels to markets in the Texas Inland region, and through connecting pipeline systems, can reach markets as far west as New Mexico and Arizona.



**Table 26. Select Texas Gulf Coast refined product pipelines**

<b>Pipeline</b>	<b>Origin</b>	<b>Destination</b>	<b>Distance, miles</b>	<b>Capacity, b/d</b>
Colonial Pipeline	Houston, TX	Greensboro, NC	5,500	2,500,000
Explorer Pipeline	Port Arthur, TX	Houston, TX	1,830	660,000
	Houston, TX	Wood River, IL		
	Houston, TX	Ardmore, OK		
Enterprise TEPPCO Pipeline	Texas City, TX	Selkirk, NY	4,700	330,000
Exxon Mobil Pipeline	Baytown, TX	San Antonio, TX	not avail.	not avail.
	Baytown, TX	Irving, TX	not avail.	not avail.
Magellan Midstream Pipeline	Houston, TX	Dallas/Fort Worth, TX	not avail.	not avail.
	Houston, TX	Odessa, TX	not avail.	110,000
Centennial Pipeline	Beaumont, TX	Bourbon, IL	795	210,000
Sunoco Logistics Pipeline	Beaumont/Port Arthur, TX	Waskom, TX	not avail.	not avail.
	Beaumont/Port Arthur, TX	Houston, TX	not avail.	not avail.
	Beaumont/Port Arthur, TX	Hearne, TX	not avail.	not avail.
NuStar Central West Pipeline	Three Rivers, TX	Corpus Christi, TX	72	15,000
	Corpus Christi, TX	Brownsville, TX	194	45,000
Koch Pipeline	Corpus Christi, TX	Dallas/Fort Worth, TX	not avail.	not avail.
Citgo Pipeline	Corpus Christi, TX	San Antonio, TX	not avail.	not avail.

Source: ICF research and estimates

The Colonial Pipeline, which is the largest product pipeline system in the world, has a system capacity of 2.5 million b/d and delivers products to markets in the Southeast and along the Eastern Seaboard as far north as the New York Harbor area. Receipts into Colonial at Texas Gulf Coast origin points averaged 1.3 million b/d in 2014, according to FERC filings.<sup>130</sup> Colonial injection points in the Texas Gulf Coast region are located in Houston, the pipeline's origin, and in the Beaumont-Port Arthur area.

The 660,000 b/d Explorer Pipeline originates in the Beaumont-Port Arthur area and receives additional products at injection points in Houston, before splitting into two lines that supply markets in the Texas Inland region and markets throughout the Midwest as far north as Chicago. In 2014, Explorer received an average of 570,000 b/d of transportation fuels at Texas injection points.<sup>131</sup> Explorer also transports diluent from points in Texas to the Midwest for transshipment to Alberta, Canada for bitumen blending.

The 330,000 b/d Enterprise TEPPCO Pipeline supplies products, including LPG, from the Texas Gulf Coast region to markets as far north as Chicago in the Midwest and as far north as Selkirk, New York on the East Coast. TEPPCO originates in Texas City in the Greater Houston area and has additional injection points in the Beaumont-Port Arthur area.

<sup>130</sup> FERC Financial Report FERC Form No. 6: Annual Report of Oil Pipeline Companies and Supplemental Form 6-Q: Quarterly Financial Report of Colonial Pipeline Company (2014/Q1, 2014/Q2, 2014/Q3, 2014/Q4).

<sup>131</sup> FERC Financial Report FERC Form No. 6: Annual Report of Oil Pipeline Companies and Supplemental Form 6-Q: Quarterly Financial Report of Explorer Pipeline Company (2014/Q1, 2014/Q2, 2014/Q3, 2014/Q4).

## Ports

The Texas Gulf Coast region exports more transportation fuels to other countries than any other refining region in the United States, and is a major supplier of products by tanker/barge to Florida and other U.S. Southeast coastal markets. Table 27 lists ports in Texas Gulf Coast region that shipped waterborne cargoes of transportation fuels in 2013, the latest year for which domestic waterborne commerce data is available from the U.S. Army Corps of Engineers (USACE). The table shows estimated 2013 outbound movements at the region's ports broken out between domestic shipments, as tracked by USACE, and foreign exports, as tracked by the U.S. International Trade Commission (USITC) using U.S. Census data. USITC export data is aggregated to the U.S. Customs District. Texas Gulf Coast ports are located in two Customs Districts: Houston-Galveston, which includes Houston, Texas City, Freeport, and Corpus Christi; and Port Arthur, which includes Port Arthur and Beaumont. Total outbound shipments of transportation fuels from these districts totaled over 1.0 million b/d in 2013 with exports accounting for more than 80% of this volume. Domestic shipments, which make up the balance of the region's outbound marine shipments, were primarily destined for ports in Florida and in the U.S. Southeast aboard coastwise-compliant vessels.

**Table 27. Outbound waterborne shipments of transportation fuels from Texas Gulf Coast ports, 2013**  
barrels per day

U.S. Customs District	Port	Domestic	Foreign	Total
<b>Houston-Galveston</b>	Houston Ship Channel	4,403	665,646	<b>757,064</b>
	Texas City	44,998		
	Galveston	0		
	Freeport	1,145		
	Corpus Christi	40,872		
<b>Port Arthur</b>	Port Arthur	36,174	210,077	<b>288,414</b>
	Beaumont	42,163		
<b>Total Texas Gulf Coast</b>		<b>169,755</b>	<b>875,723</b>	<b>1,045,478</b>

Source: U.S. Army Corp of Engineers 2013 Waterborne Commerce of the United States Waterways and Harbors; U.S. International Trade Commission, 2013

## Markets

### Greater Houston

The Greater Houston area is the largest refining center in the United States with nearly 2.4 million b/d of processing capacity. In addition to local refinery production, the area also receives transportation fuels from the Beaumont-Port Arthur area via two Sunoco pipelines, as well as from domestic and foreign sources via marine receipts. In 2013, Greater Houston area ports imported approximately 29,000 b/d of finished petroleum products, mostly motor gasoline, and brought in approximately 17,000 b/d of domestic marine receipts from other Gulf Coast refining centers. Products produced and gathered in the Greater Houston area are distributed by truck throughout the metropolitan area, which is the most populous in the Texas Gulf Coast region and fifth most populous in the United States, and by pipeline and tanker/barge to domestic and foreign markets. Two major pipelines—Colonial and Enterprise TEPPCO—originate in the Greater Houston area and deliver fuels to markets throughout the Midwest and East Coast. In addition, the Explorer Pipeline, which originates in Port Arthur, receives additional

fuel injections in the Houston area, where it splits in to two lines that supply markets in the Texas Inland region and the Midwest. Numerous other pipelines originate in the Houston area, including two Exxon Mobil pipelines that deliver fuel from the company's Baytown refinery to markets in San Antonio and Irving, Texas; and two Magellan Pipelines that deliver fuel to markets in the Dallas-Fort Worth area and to western Texas, where fuel can be further shipped to markets in New Mexico and Arizona. Ports in the Greater Houston area are part of the Houston-Galveston Customs District, which also includes the Port of Corpus Christi. In 2013, the Houston-Galveston District exported 571,000 b/d, according to USITC. Marine shipments from the Greater Houston area (not including Corpus Christi) to domestic markets, totaled approximately 51,000 b/d in 2013, according to USACE.

### Beaumont-Port Arthur

The Beaumont-Port Arthur area is the second largest refining center in the Texas Gulf Coast region with 1.5 million b/d of processing capacity. Total inbound marine receipts of transportation fuels (both domestic and foreign) averaged roughly 8,000 b/d in 2013. Area refineries and terminals distribute fuel to local retail stations by truck and fill major product pipeline systems, including the Explorer Pipeline, which originates in the area, and the Colonial and Enterprise TEPPCO lines, which originate in the Greater Houston area. The 210,000 b/d Centennial Pipeline, which originates in the Beaumont-Port Arthur area and runs to southern Illinois, has largely been idle since mid-2011 and the pipeline's owners are considering taking the pipeline out of petroleum product service and reversing its flow to carry natural gas liquids (NGLs) from the U.S. Northeast to Texas (See Future changes section for more information on this project). In 2014, flows of petroleum products on Centennial averaged less than 2,000 b/d, according to FERC filings.<sup>132</sup> In addition to these interstate pipelines, a smaller intrastate pipeline operated by Sunoco carries transportation fuels from the Beaumont-Port Arthur area to Waskom in northeast Texas. The ports of Beaumont and Port Arthur are part of the Port Arthur Customs District, which exported approximately 246,000 b/d in 2013, according to USITC. The ports shipped an additional 78,000 b/d to domestic markets via tanker/barge in 2013, according to USACE.

### Corpus Christi

The Corpus Christi area is the smallest of the region's refining centers with approximately 650,000 b/d of refining capacity. Total inbound marine receipts of transportation fuels (both domestic and foreign) averaged less than 5,000 b/d in 2013. One 15,000 b/d NuStar pipeline connects Corpus Christi to Valero's Three Rivers refinery, which is located in the Texas Inland region. The Corpus Christi area is not directly connected to any major interstate pipelines, however numerous intrastate pipelines distribute fuel from Corpus Christi to markets within Texas. NuStar operates a 45,000 b/d pipeline from Corpus Christi supplying McAllen and Brownsville, Texas. In addition, Citgo operates a pipeline from its Corpus Christi refinery to San Antonio, Texas, and Koch Industries operates a pair of pipelines from its Flint Hills Corpus Christi refinery that supply San Antonio, Austin, and the Dallas-Fort Worth area. The Port of Corpus Christi is part of the Houston-Galveston Customs District, which also includes ports in the Greater Houston area. This Customs District exported 571,000 b/d in 2013, according to USITC. Marine

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<sup>132</sup> FERC Financial Report FERC Form No. 6: Annual Report of Oil Pipeline Companies and Supplemental Form 6-Q: Quarterly Financial Report of Centennial Pipeline LLC (2014/Q1, 2014/Q2, 2014/Q3, 2014/Q4).

shipments from the Port of Corpus Christi to domestic markets averaged 41,000 b/d in 2013, according to USACE.

### Brownsville

The Brownsville metropolitan area is the third most populous consumption center in the Texas Gulf Coast region. Brownsville does not have any refineries and receives all of its supply via NuStar's 45,000 b/d pipeline from Corpus Christi and via tanker/barge from Corpus Christi and other Gulf Coast supply centers. In 2013, domestic marine receipts at the Port of Brownsville averaged nearly 30,000 b/d. The port did not receive any foreign imports.

### Supply vulnerability

With roughly 3.5 million b/d of transportation fuel production, the Texas Gulf Coast region is critical for supplying both coastal and inland markets in Texas, as well as domestic markets throughout much of the central and eastern United States. As a result, major disruptions to the region's refinery production can have cascading supply impacts in markets as far away as New York, Chicago, and Phoenix.

Given the abundance of supply in the Texas Gulf Coast region, the loss of any one refinery is unlikely to have a significant impact on supply. Unplanned refinery outages in the Texas Gulf Coast are typically managed by drawing on ample regional inventories; by ramping up production at other in-region refineries, either by increasing processing rates or delaying planned maintenance outages; by diverting refinery production intended for export to domestic markets; and, if necessary, by importing supply from Atlantic Basin suppliers or shipping volumes on coastwise-compliant vessels from other Gulf Coast refining centers.

Pipeline infrastructure is the biggest chokepoint for the region's refined product supply distribution. The Texas Gulf Coast region ships approximately 3.0 million b/d of transportation fuels by pipeline and tanker/barge to other regions of the country and to international markets. More than 40% of this volume is shipped on the Colonial Pipeline, and any extended disruption to Colonial would back up refinery output in the Texas Gulf Coast with no available outlet. The Texas Gulf Coast moves a considerable share of its production on coastwise-compliant vessels to Florida and other coastal markets but the availability of such vessels is in short supply, and there is limited capacity for refiners to move disrupted Colonial volumes to U.S. markets by ship. A waiver of the Jones Act could allow some disrupted Colonial volumes to move on foreign-flagged tankers to domestic ports on the East Coast, but many markets served by Colonial, particularly in the inland parts of the Southeast, lack direct waterborne access.

Another potential chokepoint is the region's port infrastructure: the Houston Ship Channel, the Port of Corpus Christi, and the Sabine Pass (which connects the Beaumont-Port Arthur refineries to the Gulf of Mexico). This infrastructure is essential for inbound shipments of crude oil to the region's refineries and for outbound shipments of petroleum products. The importance of these port facilities for domestic markets has decreased in recent years as outbound shipments of refined products have largely been destined for export markets and as Texas Gulf Coast refineries have sourced more of their crude oil by pipeline from the Eagle Ford and Permian Basin production regions in inland Texas. Furthermore, the

U.S. Department of Energy maintains two Strategic Petroleum Reserve (SPR) sites in Texas and one in Louisiana that can deliver crude oil to the Texas Gulf Coast region's refineries by pipeline if port disruptions interrupt deliveries of waterborne crude. The Bryan Mound SPR site in Texas can deliver up to 1.35 million b/d to refineries in the Greater Houston area, while the Big Hill site in Texas and the West Hackberry site in Louisiana can deliver 1.1 million b/d and 1.3 million b/d respectively to the Beaumont-Port Arthur area refineries.<sup>133</sup>

Designed to take advantage of the region's deepwater ports, the Texas Gulf Coast's 17 refineries and associated infrastructure are heavily concentrated in three logistics clusters along the Texas coastline, making them particularly vulnerable to disruption from hurricanes, tropical storms, and associated storm surge. These weather phenomenon can directly damage the region's petroleum infrastructure or disrupt essential power supply, rendering refineries, terminals, and pipeline pumping stations inoperable. Hurricane Rita (2005) and Hurricane Ike (2008) both caused widespread damage and power outages to the Texas Gulf Coast region's petroleum infrastructure.

## Retail markets

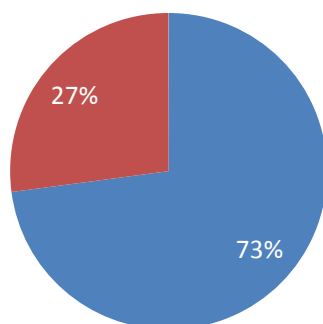
There are 9,693 retail service stations in the state of Texas (including both the Texas Gulf Coast and Texas Inland regions)<sup>134</sup>. Figure 42 shows the share of these outlets that are branded versus unbranded. Stations are classified as 'branded' if they are associated with and display a major oil company brand. 'Unbranded' stations are not affiliated with a major oil company brand. Seventy three percent of Texas's retail stations are branded, slightly higher than the national average of 69%. The top five brands in Texas are Shell, Valero, Exxon, Chevron, and Texaco, and these brands together account for 58% of the region's retail outlets. Sixty-one percent of the region's stations offer diesel fuel, compared to a national average of 53%. There are 77 public service stations and one private station in the Texas Gulf Coast region offering E85 and one public and one private service station each offering biodiesel (B20 and above) in the region.<sup>135</sup>

<sup>133</sup> United States Fuel Resiliency. Volume III. U.S. Fuels Supply Infrastructure Vulnerabilities and Resiliency. FINAL REPORT. Prepared for: Office of Energy Policy and Systems Analysis. September 2014. Intek. Inc. and AOC Petroleum Support Services, LLC. <http://energy.gov/sites/prod/files/2015/04/f22/QER%20Analysis%20-%20United%20States%20Fuel%20Resiliency%20Volume%20III.pdf>

<sup>134</sup> Retail station data provided by the Homeland Security Infrastructure Program (HSIP).

<sup>135</sup> U.S. Department of Energy: Office of Energy Efficiency & Renewable Energy, "Alternative Fuels Data Center" (Accessed December 2, 2015), <http://www.afdc.energy.gov/states/>.

**Figure 42. Texas retail market structure**  
percent of retail stations



■ branded ■ unbranded

Source: HSIP 2015

## Future changes

Several infrastructure investments are planned in the Texas Gulf Coast region that impact transportation fuels supply. In the refining sector, many of these investments involve upgrading units to process greater quantities of light crude oil produced in the nearby Eagle Ford shale area in southern Texas, and increasing the capacity to export finished products. As of 2015, the following projects have been announced at Texas Gulf Coast facilities:

### Refineries

- **Marathon Texas City and Galveston:** Marathon Petroleum Corp plans to integrate its 451,000 b/cd Galveston Bay refinery and its adjacent 84,000 b/cd Texas City refinery to merge them from a process standpoint and build one new hydrotreater between the two. This project will increase diesel fuel output. The company has also announced plans to expand export capabilities at its Galveston Bay refinery.
- **Valero Houston and Corpus Christi:** crude unit investments to provide a total of 160,000 b/cd of new capacity to process light, sweet crude at its 100,000 b/cd Houston and 205,000 b/cd Corpus Christi refineries. The projects will allow the refineries to supplant approximately 55,000 b/d of imported feedstocks, leaving a net increase in throughput capacity of 105,000 b/d. The Corpus project is expected to add 70,000 b/d of new capacity and the Houston project is expected to add 90,000 b/d of capacity. Expected project completion is in 2016.<sup>136</sup>
- **Flint Hills Corpus Christi:** upgrades to increase its light oil processing capacity. Engineering works for the project are expected to be completed in mid-2016.
- **Kinder Morgan Energy Corp Galena Park Refinery:** plans to double the capacity of the 42,000 b/cd condensate processing facility by the end of 2015. The company also has plans to add storage capacity at its Pasadena and Galena Park terminals, a new ship dock, and various other infrastructure improvements providing enhanced product export capabilities.

<sup>136</sup> Valero Energy Corporation, *2014 Summary Annual Report*, p. 25, (December 31, 2014), [http://www.valero.com/Financial%20Documents/2014\\_Valero\\_Annual\\_Report\\_Web.pdf](http://www.valero.com/Financial%20Documents/2014_Valero_Annual_Report_Web.pdf).

## Pipelines

- **Centennial Pipeline:** the 210,000 b/d Centennial Pipeline, which originates in the Beaumont-Port Arthur area and runs to southern Illinois, has largely been empty since mid-2011 and the pipeline's owners—Enterprise Products Partners and Marathon Petroleum Corp.—are considering taking the pipeline out of petroleum product service and reversing its flow to carry natural gas liquids (NGLs) to Texas. As part of the project, the owners would repurpose other lines to connect Centennial with NGL production in the Utica and Marcellus shale plays in the Pennsylvania and Ohio.<sup>137</sup> In 2014, flows of petroleum products on Centennial averaged less than 2,000 b/d, according to FERC filings.<sup>138</sup>

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<sup>137</sup> Reuters, "Enterprise: Centennial conversion to NGLs a two-year project" (September 8, 2015), <http://www.reuters.com/article/2015/09/08/centennial-pipeline-enterprise-idAFL1N11E18720150908#OvzzO2XKgG2bbezW.97>.

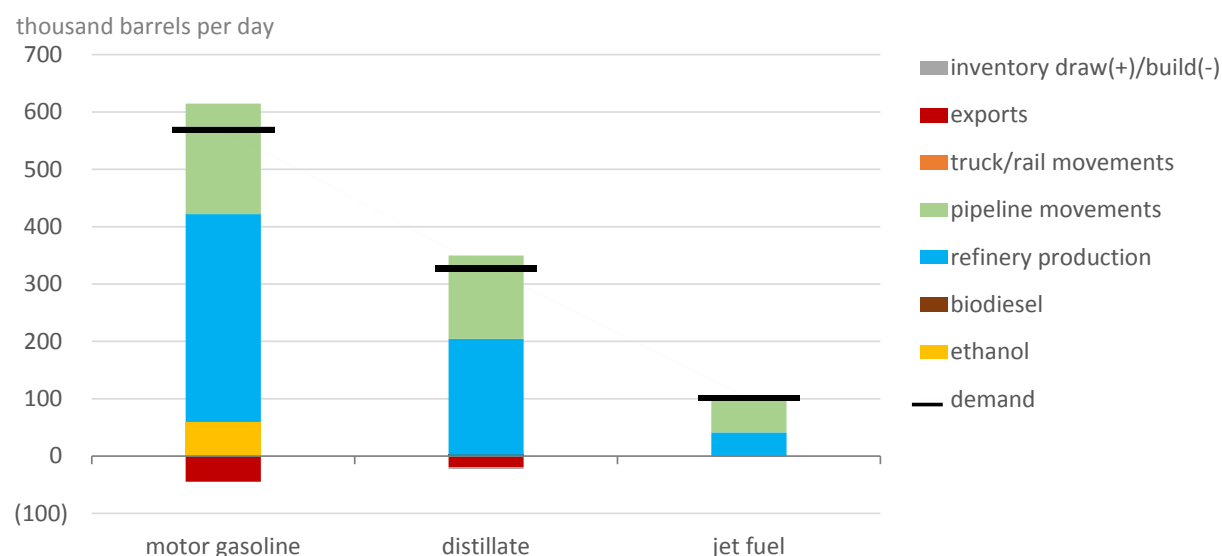
<sup>138</sup> FERC Financial Report FERC Form No. 6: Annual Report of Oil Pipeline Companies and Supplemental Form 6-Q: Quarterly Financial Report of Centennial Pipeline LLC (2014/Q1, 2014/Q2, 2014/Q3, 2014/Q4).

## Texas Inland

The Texas Inland region consists of the majority of the state of Texas, representing 225 of the state's 254 counties, excluding only the 29 counties situated along the Gulf of Mexico that constitute the Texas Gulf Coast region. Containing two-thirds of the state's total population, the Texas Inland region accounts for the majority of the state's consumption of petroleum products. Estimated total consumption of motor gasoline, distillate fuel oil, and commercial jet fuel in the Texas Inland region was nearly 1.0 million b/d in 2014. Within the region, the principal consumption centers are the Dallas/Fort Worth Metroplex in northern Texas, the Austin-San Antonio Corridor in south central Texas, and the El Paso metropolitan area in western Texas. Smaller metropolitan areas are spread throughout the Texas Inland region, including Amarillo, Lubbock, Midland, and Odessa.

The region's refinery production meets approximately 70% of in-region consumption of gasoline (net of ethanol inputs) and 60% of distillates (net of biodiesel inputs), while jet fuel production provides for just under half of the in-region consumption. The Texas Inland region is a net consumer of fuels, with pipeline movements from the Texas Gulf Coast region making up the majority of the gap between in-region production and in-region consumption. The Texas Inland region also exports gasoline and distillates to northern Mexico. Figure 43 presents the Texas Inland region's 2014 annual supply and demand balances for motor gasoline, distillate, and jet fuel.

**Figure 43. Texas Inland supply/demand balances, 2014**



Note: All movements and inventory changes are on a net basis

Source: ICF Analysis of EIA, FHWA, Airlines for America, FERC, and company 10-K data

## Supply/demand balances

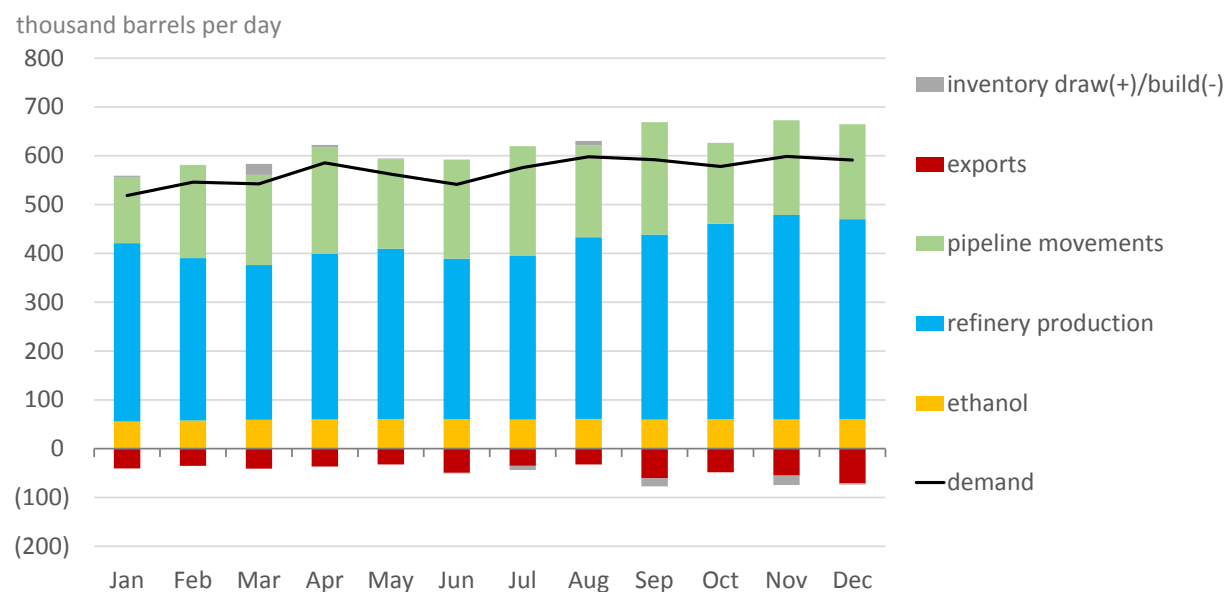
### Gasoline

The Texas Inland region's motor gasoline market is in deficit with in-region consumption (net of ethanol inputs) exceeding refinery production by approximately 150,000 b/d on average. Figure 44 presents the 2014 monthly motor gasoline supply/demand balance for the Texas Inland region. In 2014, gasoline



consumption averaged 569,000 b/d, including 60,000 b/d of ethanol. Motor gasoline consumption in the Texas Inland region does not follow a seasonal pattern, but in 2014 consumption was generally higher in the second half of the year than over the first six months. The Texas Inland region exported approximately 45,000 b/d of motor gasoline to northern Mexico in 2014.

**Figure 44. Texas Inland motor gasoline supply/demand balance, 2014**



Note: All movements and inventory changes are on a net basis

Source: ICF Analysis of EIA, FHWA, FERC, and company 10-K data

The U.S. Environmental Protection Agency (U.S. EPA) does not require the use of reformulated gasoline in any of the counties in the Texas Inland region.<sup>139</sup> With regard to volatility standards, the state of Texas has a waiver under the Clean Air Act that allows the state to adopt a conventional gasoline summer RVP standard more stringent than federal requirements. From June 1 through September 15, Texas enforces a statewide 9.0 RVP limit.<sup>140</sup> For selected Texas Inland counties in eastern Texas, a 7.8 RVP limit is enforced from May 1 to October 1. Additionally, in El Paso County in western Texas, the summer RVP limit is 7.0 and is in effect from May 1 to September 15. El Paso County is also the only county that maintains a State Winter Oxygenated Fuel Program under direction of the U.S. EPA. Between October 1 and March 31, gasoline sold in the El Paso area is required to have 2.7% oxygen content by volume. El Paso County's oxygenated fuel is produced by blending with ethanol.<sup>141</sup>

<sup>139</sup> U.S. Environmental Protection Agency, "Reformulated Gasoline," (Accessed January 6, 2015), <http://www.epa.gov/gasoline-standards/reformulated-gasoline>.

<sup>140</sup> U.S. Environmental Protection Agency, "Gasoline Reid Vapor Pressure" (Accessed December 11, 2015), <http://www.epa.gov/gasoline-standards/gasoline-reid-vapor-pressure>.

<sup>141</sup> U.S. Environmental Protection Agency, "State Winter Oxygenated Fuel Program Requirements for Attainment or Maintenance of CO NAAQS" (Accessed December 11, 2015), <http://epa.gov/otaq/regs/fuels/420b08006.pdf>.

**Table 28. Texas Inland motor gasoline regulations**

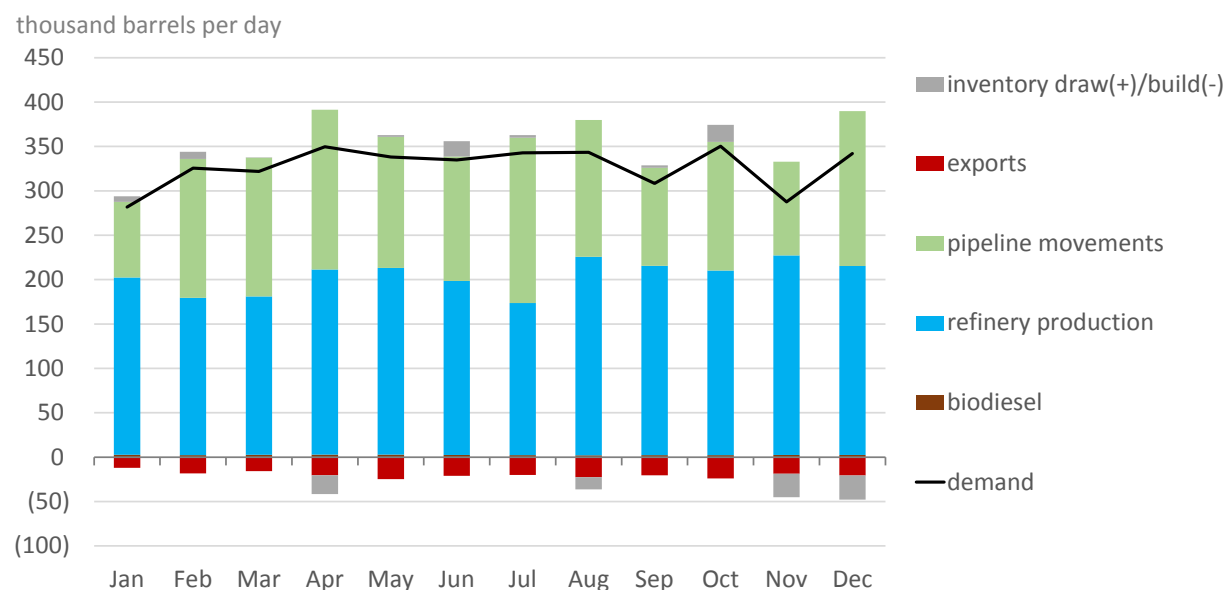
Regulation	Area (s)	Dates
Reformulated gasoline (Opt-in areas)	Collin, Dallas, Denton & Tarrant counties	Year-round
Summer Gasoline Volatility <9.0 RVP	Texas statewide	May 1 – Sept. 15
Summer Gasoline Volatility <7.8 RVP	Select Texas Inland counties	May 1 – Oct. 1
Summer Gasoline Volatility <7.0 RVP	El Paso County	May 1 – Sep. 15
Winter Oxy. Fuel Program - 2.7% oxygen*	El Paso County	Oct. 1 – Mar. 31

\*content by volume

Source: U.S. EPA

### Distillate

Figure 45 presents the 2014 monthly distillate supply/demand balance for the Texas Inland region. In 2014, consumption of distillate fuels in the Texas Inland region averaged 327,000 b/d. More than two-thirds of this volume is consumed on-highway. Off-road consumption in Texas is led by oil company and railroad consumption, which each account for 5 to 10% of total state consumption.<sup>142</sup> Consumption does not exhibit significant seasonal variation as very little distillate fuel oil is used for home heating. Overall, the Texas Inland region consumes more distillate than it produces. In-region production is primarily supplemented through pipeline movements from other regions, particularly the Texas Gulf Coast. The Texas Inland region exported approximately 20,000 b/d of distillate fuel oil to northern Mexico in 2014.

**Figure 45. Texas Inland distillate supply/demand balance, 2014**

Note: All movements and inventory changes are on a net basis

Source: ICF Analysis of EIA, FHWA, FERC, and company 10-K data

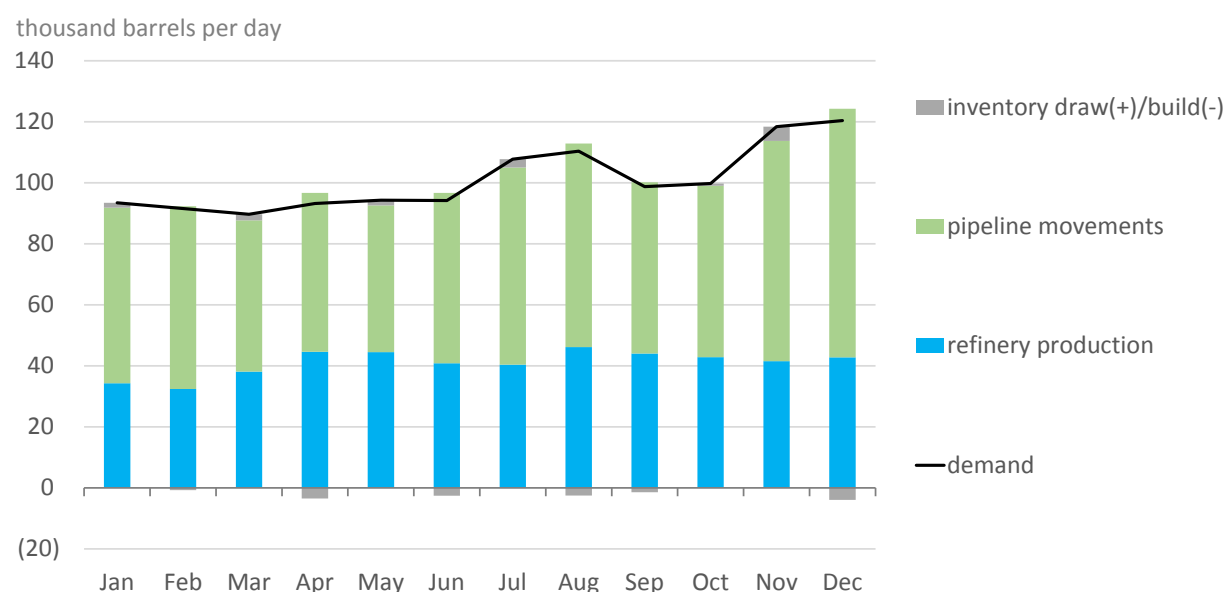
<sup>142</sup> U.S. Energy Information Administration, "Sales of Distillate Fuel by End Use – Texas", (Accessed December 11, 2015), [http://www.eia.gov/dnav/pet/pet\\_cons\\_821dst\\_dcu\\_STX\\_a.htm](http://www.eia.gov/dnav/pet/pet_cons_821dst_dcu_STX_a.htm).

Distillate fuel oil consumption in the state of Texas is nearly all ultra-low sulfur diesel (ULSD).<sup>143</sup> The state of Texas requires the year-round use of low emission blends for all diesel fuel sold or supplied as fuel for motor vehicles and non-road equipment operating in 110 Texas counties, 85 of which are located in the Texas Inland region.<sup>144</sup> These requirements specify a minimum cetane number of 48 and a maximum aromatic hydrocarbon content of 10% by volume for fuels supplied to consumers in the specified counties.<sup>145</sup>

### Jet fuel

Commercial jet fuel consumption in the Texas Inland region averaged approximately 101,000 b/d in 2014.<sup>146</sup> The region consumes more jet fuel than it produces and is a net receiver of jet fuel from other regions, primarily through pipeline movements from the Texas Gulf Coast. Consumption rose throughout 2014, with monthly consumption higher in the second half of the year than in the first half. Figure 46 presents the Texas Inland region's 2014 jet fuel supply/demand balance.

**Figure 46. Texas Inland jet fuel supply/demand balance, 2014**



Note: All movements and inventory changes are on a net basis

Source: ICF Analysis of EIA, FHWA, FERC, and company 10-K data

<sup>143</sup> U.S. Energy Information Administration, "Prime Supplier Sales Volumes – Texas", (Accessed December 8, 2015), [http://www.eia.gov/dnav/pet/pet\\_cons\\_prim\\_dcu\\_STX\\_m.htm](http://www.eia.gov/dnav/pet/pet_cons_prim_dcu_STX_m.htm).

<sup>144</sup> Texas Administrative Code, "Texas Commission on Environmental Quality: Control of Air Pollution from Motor Vehicles—Low Emission Fuels: Low Emission Diesel – Low Emission Diesel Standards," TAC: Title 30, Part 1, Chapter 114, Subchapter H, Division 2: Rule §114.312, (Effective May 11, 2000), [http://texreg.sos.state.tx.us/public/readtac\\$ext.TacPage?sl=R&app=9&p\\_dir=&p\\_rloc=&p\\_tloc=&p\\_ploc=&pg=1&p\\_tac=&ti=30&pt=1&ch=114&rl=312](http://texreg.sos.state.tx.us/public/readtac$ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=30&pt=1&ch=114&rl=312).

<sup>145</sup> Texas Commission on Environmental Quality, "Texas Low Emission Diesel (TxLED) Program," (May 8, 2012), <https://www.tceq.texas.gov/airquality/mobilesource/txled>.

<sup>146</sup> U.S. Energy Information Administration, "State Energy Data System (SEDS): State Profiles and Energy Estimates -- Table F2: Jet fuel consumption, price, and expenditure estimates, 2014" (Accessed December 4, 2015), [http://www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep\\_fuel/html/fuel\\_jf.html&sid=US](http://www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep_fuel/html/fuel_jf.html&sid=US).

The Texas Inland region has more primary commercial service airports than any other region included in this study, with 19 airports reporting 10,000 enplanements (passenger boardings) or more during the 2014 calendar year. The Federal Aviation Administration has designated eight of these airports as hubs, including one large hub (Dallas-Fort Worth International Airport (DFW)) and three medium hubs (Austin-Bergstrom International (AUS), Dallas Love Field (DAL), and San Antonio International (SAT)).<sup>147</sup> In addition to the hubs, forty smaller commercial airports also operate in the region, as well as seven U.S. Air Force bases—which may consume commercial-quality Jet-A fuel in addition to higher-performance blends.<sup>148</sup>

## Refineries

The Texas Inland region has eight refineries with a combined atmospheric crude distillation capacity of 638,271 barrels per calendar day (b/cd).<sup>149</sup> The two largest refineries in this region, Valero’s 168,000 b/cd Sunray refinery and WRB’s 146,000 b/cd Borger refinery are located in the Texas Panhandle and comprise nearly 50% of the region’s refining capacity. These refineries supply products by pipeline to markets in western Texas, New Mexico, and destinations in PADDs 2 and 4. There are two refineries in western Texas: Western Refining’s 122,000 b/cd El Paso refinery and Alon’s 70,000 b/cd Big Spring refinery. These refineries supply local markets in western Texas and New Mexico, and connect by pipeline to markets in Arizona and to Ciudad Juarez, across the border in Mexico. Three refineries are located in southern Texas, including Valero’s 89,000 b/cd Three Rivers refinery, and two smaller plants totaling less than 30,000 b/cd of capacity. These refineries supply local markets in southern Texas, and move products by pipeline to Corpus Christi on the Texas Gulf Coast and to Nuevo Laredo, across the border in Mexico. Table 29 lists each refinery and its operable capacity as of January 1, 2015.

**Table 29. Texas Inland refineries**

Owner	Site	Operable Capacity, b/cd*
Valero Energy	Sunray, TX	168,000
WRB Refining	Borger, TX	146,000
Western Refining	El Paso, TX	122,000
Valero Energy	Three Rivers, TX	89,000
Alon USA	Big Spring, TX	70,000
Delek Refining	Tyler, TX	60,000
Calumet Lubricants	San Antonio, TX	16,800
Lazarus Energy	Nixon, TX	11,471
<b>Total</b>		<b>683,271</b>

\*Barrels per calendar day, as of Jan. 1, 2015

Source: U.S. Energy Information Administration, Refinery Capacity Report

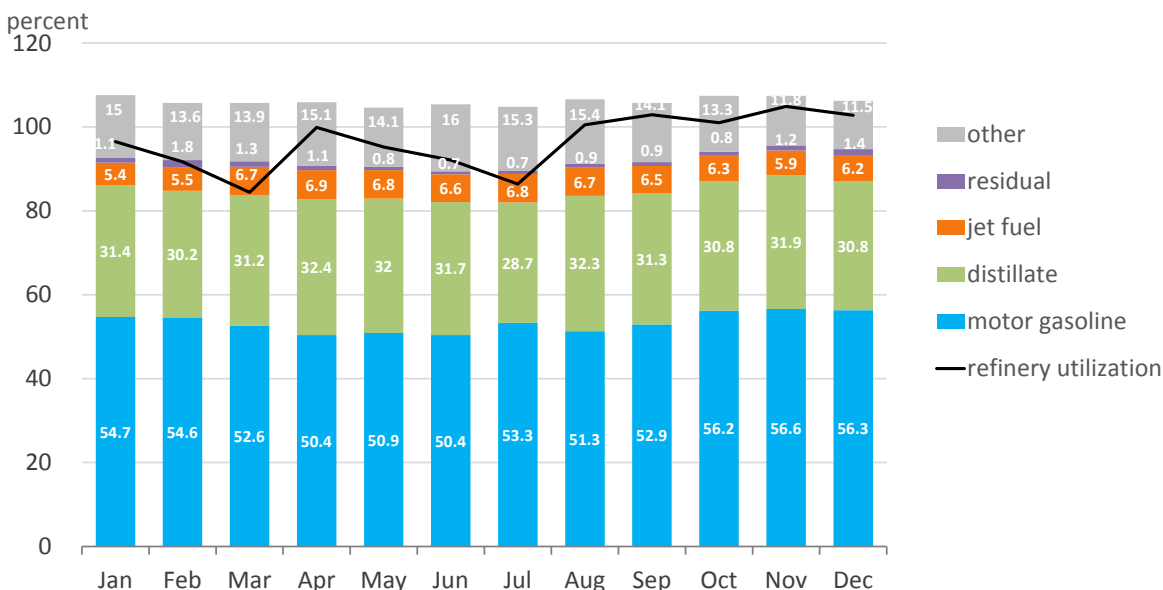
<sup>147</sup> Federal Aviation Administration, “Airport Safety” (Accessed November 5, 2015), [http://www.faa.gov/airports/airport\\_safety/airportdata\\_5010/menu/](http://www.faa.gov/airports/airport_safety/airportdata_5010/menu/).

<sup>148</sup> MilitaryBases.com, “State Military Bases” (Accessed November 5, 2015), <http://militarybases.com>.

<sup>149</sup> Barrels per calendar day is a measure of the amount of input that a distillation unit can process in a 24-hour period under usual operating conditions. It takes into account both planned and unplanned maintenance. Stream day capacity is the maximum number of barrels of input that a distillation facility can process within a 24-hour period when running at full capacity under optimal crude and product slate conditions with no allowance for downtime. Stream day capacity is typically about 6% higher than calendar day capacity.

Figure 47 shows monthly refinery utilization and yield percentages for motor gasoline (both finished gasoline and blendstocks), distillate fuel oil, jet fuel, residual fuel oil, and other secondary products in the Texas Inland region. In 2014, the region's refineries operated at an average utilization of 96.5% compared to a U.S. average of 90.4%. Texas Inland refineries focus primarily on producing ground transportation fuels, and produce the highest average yield of motor gasoline of any region in PADD 3. Texas Inland average yields for motor gasoline and distillate were 53.4% and 31.2%, respectively, compared to national averages of 45.0% and 29.9%. Compared with Texas and Louisiana Gulf Coast refineries, Texas Inland refineries have lower average yields of jet fuel, as well as non-transportation fuel products, including petrochemical feedstocks and petroleum coke. During the winter months from October through March, Texas Inland's motor gasoline yields increase by approximately 3-4% as refineries produce winter-grade gasoline, which reflects additional butane content. During the summer months less butane is added to gasoline to control engine vapor lock and to meet required gasoline RVP regulations.

**Figure 47. Texas Inland refinery yields**



Note: yield percentages sum to higher than 100% due to processing gains.

Source: U.S. Energy Information Administration, Petroleum Supply Monthly

## Supply and logistics

Markets in the Texas Inland region are supplied primarily by in-region refineries and by pipeline from refineries in the Texas Gulf Coast and in PADD 2. Petroleum product distribution terminals are clustered around the region's major consumption centers: the Dallas-Fort Worth Metroplex in north-central Texas, the Austin-San Antonio Corridor in south-central Texas, the McAllen metropolitan area in far southern Texas, and the El Paso metropolitan area in far western Texas. Figure 48 presents the refineries, product pipelines, and product terminals in the Texas Inland region. Table 30 lists select refined product pipelines serving markets within the region as well as their origin points, destination points, and capacities, if publically available. Table 30Table 19 indicates that the Texas Inland market has a number of pipeline supply options.

Figure 48. Texas Inland refined petroleum infrastructure

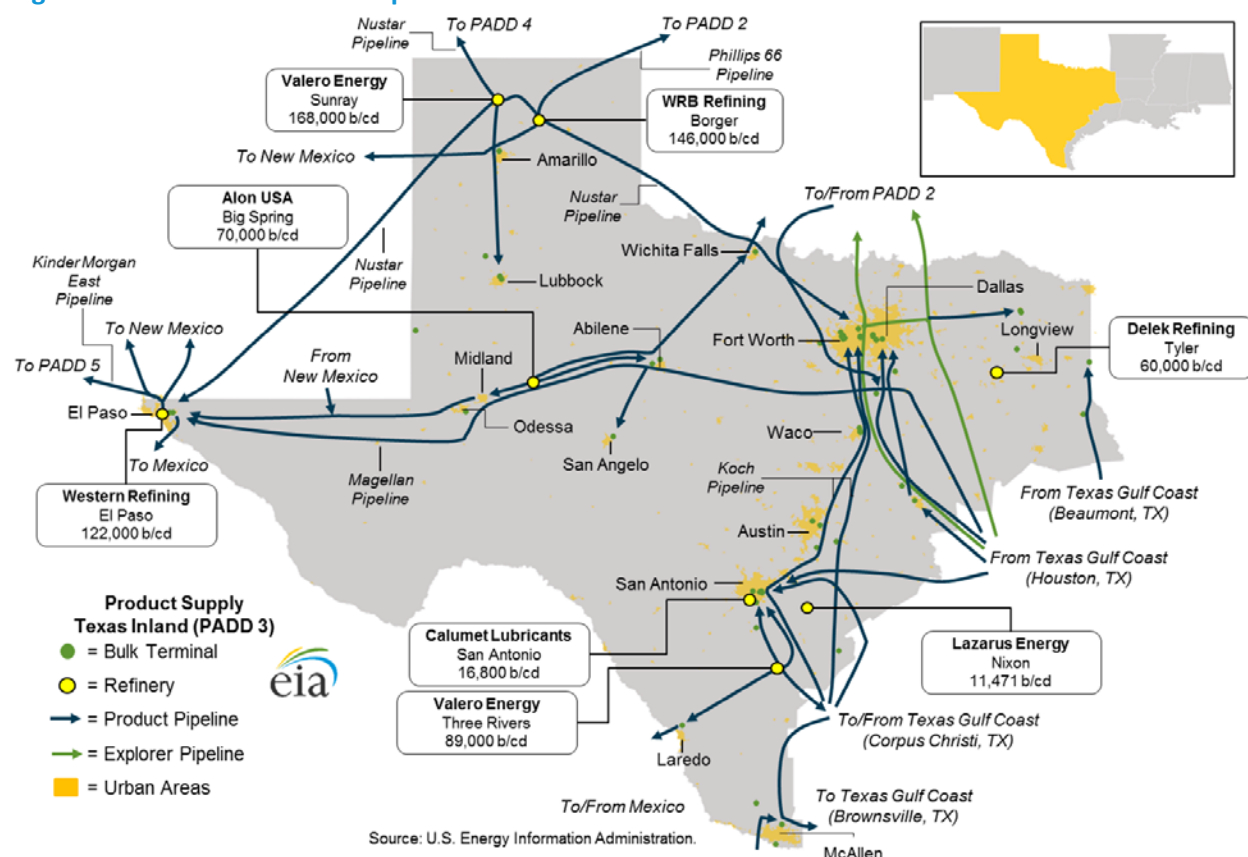


Table 30. Select Texas Inland refined product pipelines

Pipeline	Origin	Destination	Distance (miles)	Capacity (b/d)
Explorer Pipeline	Texas Gulf Coast	Wood River, IL	1,830	660,000
	Texas Gulf Coast	Ardmore, OK		
	Greenville, TX	Grapevine, TX		
Exxon Mobil Pipeline	Baytown, TX	San Antonio, TX	Not avail.	Not avail.
	Baytown, TX	Irving, TX	Not avail.	Not avail.
Magellan Midstream	OK and KS	West Fort Worth, TX	Not avail.	Not avail.
	Houston, TX	Dallas, TX and Fort Worth, TX	Not avail.	Not avail.
	Houston, TX	Odessa, TX	Not avail.	110,000
	Hearne, TX	Dallas, TX	Not avail.	Not avail.
	Odessa, TX	El Paso, TX	Not avail.	64,000
Holly Energy Partners	El Paso, TX	Albuquerque, NM	257	28,200
	Artesia, NM	El Paso, TX	156	19,000
	Artesia, NM	Orla, TX and El Paso, TX	214	70,000
	Midland, TX	Orla, TX	135	25,000
	Big Spring, TX	Abilene, TX	100	20,000
	Big Spring, TX	Wichita Falls, TX	227	23,000

	Wichita Falls, TX	Duncan, OK	47	21,000
Alon USA	Big Springs, TX	Midland, TX	Not avail.	Not avail.
Epic Midstream	El Paso, TX	Alamogordo, NM	Not avail.	Not avail.
Kinder Morgan SFPP East Line	El Paso, TX	Phoenix, AZ	230	200,000
PMI Frontera Juarez	El Paso, TX	Ciudad Juarez, Mexico	49	45,000
Phillips 66	Borger, TX	East St. Louis, IL	681	120,000
	McKee, TX	Denver, CO	405	38,000
NuStar Central West Refined Product Pipeline System	McKee, TX	Denver, CO	321	11,000
	McKee, TX	Colorado Springs, CO and Denver, CO	357	32,500
	McKee, TX	Amarillo, TX	49	51,000
	Amarillo, TX	Albuquerque, NM	293	17,200
	McKee, TX	Abernathy, TX	102	16,800
	Abernathy, TX	Lubbock, TX	19	8,000
	McKee, TX	Southlake, TX	375	26,000
	McKee, TX	El Paso, TX	408	42,000
	Three Rivers, TX	San Antonio, TX	85	33,500
	Three Rivers, TX	Pettus, TX and San Antonio, TX	112	27,500
	Three Rivers, TX	Corpus Christi, TX	72	15,000
	Three Rivers, TX	U.S.-Mexico border near Laredo, TX		
	Corpus Christi, TX	Brownsville, TX	194	45,000
	U.S.-Mexico border near Penitas, TX	Edinburg, TX	33	24,000
	Koch Pipeline	Corpus Christi, TX	Dallas/Fort Worth, TX	Not avail.
Citgo Pipeline	Corpus Christi, TX	San Antonio, TX	Not avail.	Not avail.
Sunoco Logistics	Beaumont/Port Arthur, TX	Hearne, TX	Not avail.	Not avail.
	Beaumont/Port Arthur, TX	Waskom, TX	Not avail.	Not avail.

Source: ICF research

## Markets

### Dallas-Fort Worth

The Dallas-Fort Worth Metroplex has no local refineries and receives all products via a number of pipeline systems. The Explorer Pipeline delivers products to the Metroplex from the Texas Gulf Coast along two separate trunklines: the Houston-to-Ardmore line, which runs directly into the Metroplex, and the Houston-to-Wood River line, which passes to the east of the Metroplex but is connected to the area's terminals via Explorer's Greenville-to-Grapevine spur line.<sup>150</sup> Product from Houston also flows to the Dallas-Fort Worth area via ExxonMobil's Baytown-to-Irving pipeline and via a Magellan pipeline from

<sup>150</sup> Federal Energy Regulatory Commission, "Explorer Pipeline: Local Pipeline Tariff," FERC Order No. 100.46.0 cancels FERC Order No. 100.45.6, (Effective October 1, 2015), [http://www.expl.com/Media/tariffs/FERC\\_100\\_46\\_eff100115.pdf](http://www.expl.com/Media/tariffs/FERC_100_46_eff100115.pdf).



Hearne, Texas, which is supplied via an interconnected pipeline operated by Sunoco Logistics from Houston. In addition, another Magellan pipeline delivers products to the Metroplex from refineries in Oklahoma and Kansas (in PADD 2), and NuStar Energy's 27,300 b/d Southlake Products Pipeline (part of the company's Central West system) delivers products to the Metroplex from refineries in the Texas Panhandle.<sup>151</sup>

### San Antonio

The San Antonio metropolitan area is supplied by local refineries in and around the San Antonio area, including Valero's 89,000 b/cd Three Rivers refinery, and two smaller plants with a combined refining capacity of less than 30,000 b/cd, as well as several pipeline systems originating in Corpus Christi and Houston. NuStar Energy operates a number of pipelines originating at Three Rivers refinery as part of the company's Central West System. From Three Rivers, products can be shipped to the San Antonio area via 33,500 b/d and 27,500 b/d pipelines; to Corpus Christi via a 15,000 b/d pipeline; and to Laredo, Texas, via a 32,000 b/d pipeline.<sup>152</sup> From Laredo, products can be shipped on NuStar's Dos Laredos pipeline for export to Nuevo Laredo in northern Mexico. The Dos Laredos pipeline has a capacity of 32,400 b/d when transporting LPG and 24,000 b/d when transporting other petroleum products.<sup>153</sup> Two pipelines provide supply to the San Antonio area from refineries in Corpus Christi: Koch Pipeline Company's Texas Pipeline System delivers products to several markets in central Texas from the Flint Hills Corpus Christi refinery, and Citgo Products Pipeline's CASA Pipeline System supplies the San Antonio area from the Citgo's Corpus Christi refinery. A third pipeline, ExxonMobil's Baytown-to-San Antonio, delivers products from Exxon's Baytown, Texas refinery located in the Houston area.

### Austin

The Austin metropolitan area is supplied via Koch's Texas Pipeline System, which originates in at the company's Corpus Christi refinery and ships products to San Antonio, Austin, Waco, and Dallas/Fort Worth.<sup>154</sup>

### McAllen

The McAllen-Edinburg-Mission metropolitan area in the far south of Texas is supplied by pipeline from the Corpus Christi refining center via a 45,000 b/d NuStar pipeline, which runs from Corpus Christi to Brownsville.<sup>155</sup> Edinburg also receives imports of naphtha—a gasoline blending component—via NuStar's 64,000 b/d Burgos-Valley pipeline, which originates at Pemex's Reyonosa-Burgos Complex in northern Mexico. From Edinburg, the naphtha is delivered into TransMontaigne's terminal in Brownsville, Texas.<sup>156</sup>

<sup>151</sup> NuStar Energy 2013 10-K and Federal Energy Regulatory Commission, "Tariff Browser: Magellan Pipeline Company, L.P. - Magellan Pipeline Company, L.P. Oil Pipeline Tariffs," (January 6, 2016), <http://etariff.ferc.gov/TariffBrowser.aspx?tid=1894>.

<sup>152</sup> NuStar Energy 2013 10-K

<sup>153</sup> U.S. Department of State Bureau of Energy Resources, "NuStar Dos Laredos Environmental Review Process," (May 27, 2015), <http://www.state.gov/e/enr/applicant/applicants/review/242897.htm>.

<sup>154</sup> Koch Pipeline, "About Us", (November 30, 2015), <http://www.kochpipeline.com/about-us/kpl-facts/>.

<sup>155</sup> NuStar Energy 2013 10-K

<sup>156</sup> Business Wire, "NuStar and PMI Have Announced an Expansion and Extension of an Existing Agreement to Transport and Store Naphtha," (April 10, 2015), <http://www.businesswire.com/news/home/20150410005961/en/NuStar-PMI-Announced->



## El Paso

The El Paso metropolitan area in far western Texas is a major supply hub for markets in western Texas, New Mexico and Arizona. El Paso collects supply from a variety of sources: from Western Refining's 122,000 b/cd El Paso refinery; from the Holly Frontier's 102,000 b/cd Artesia, New Mexico, refinery; from the Texas Panhandle via NuStar's 42,000 b/d El Paso pipeline, which cuts across southeastern New Mexico; and from the Houston area via Magellan Midstream's South System, which has a 64,000 b/d capacity into El Paso.<sup>157</sup> The Magellan line also receives product from Alon's 73,000 b/cd Alon Big Spring, Texas refinery. From El Paso, a number of pipelines ship products outside of the Texas Inland region: Kinder Morgan's 200,000 b/d SFPP East Line ships products from El Paso to Tucson and Phoenix, Arizona; a 28,200 b/d Magellan pipeline ships products to the Albuquerque, New Mexico metropolitan area; and a pipeline carrying military-grade jet fuel runs from El Paso to a terminal serving an Airforce base near Alamogordo, New Mexico. In addition, PMI Services North America, a subsidiary of Mexico's state oil company Pemex, operates the 45,000 b/d Frontera Juarez Pipeline, which exports products from El Paso to Ciudad Juarez in northern Mexico.<sup>158</sup>

## Other markets

Other petroleum product markets in Texas include the Midland and Odessa metropolitan areas in western Texas, which are supplied by the Big Spring refinery and Magellan's Houston-to-El Paso pipeline; Amarillo and Lubbock in the Texas Panhandle, which are supplied by the Borger and Sunray refineries; and Tyler and Longview in northeastern Texas, which are supplied by Delek's Tyler refinery, from a Magellan pipeline delivering products off of Explorer's Houston-to-Wood River mainline, and from a Sunoco Logistics pipeline running from the Beaumont/Port Arthur refining center to Waskom, Texas. The refineries in the Texas Panhandle, which account for nearly half the Texas Inland region's refining capacity, have the ability to ship products to Albuquerque, New Mexico via a 17,200 b/d NuStar pipeline; markets in PADD 2 via Phillips66's Gold Line, which runs from the Panhandle to East St. Louis, Illinois; and to the Denver metropolitan area (in PADD 4) via Phillips 66's 38,000 b/d Borger-to-Denver pipeline and NuStar's 32,500 b/d McKee Colorado pipeline.<sup>159</sup>

## Supply vulnerability

Petroleum markets in the Texas Inland region have access to a diversity of supply sources, including in-region refinery production and pipeline movements into the region from refineries in the Texas Gulf Coast, PADD 2, and New Mexico. The loss of any one refinery or pipeline system could likely be made up by increasing volumes from other supply sources, subject to available capacity, or trucking fuel further distances from alternative refineries and pipeline terminals.

[Expansion-Extension-Existing-Agreement](#) and U.S. Department of State Bureau of Energy Resources, "Presidential Permit Application for the New Burgos Pipeline," (December 18, 2014), <http://www.state.gov/e/enr/applicant/applicants/240646.htm>.

<sup>157</sup> Federal Energy Regulatory Commission, "Magellan Pipeline Company, L.P – Order on Petition for Declaratory Order" Docket No. OR12-7-000, (Issued March 15, 2012), <http://www.ferc.gov/whats-new/comm-meet/2012/031512/G-3.pdf>.

<sup>158</sup> PMI Services North America, submitted to U.S. Department of State, "FINAL ENVIRONMENTAL ASSESSMENT FOR 10.75-INCH GASOLINE/DIESEL PIPELINE PROJECT: FRONTERA JUÁREZ PIPELINE, EL PASO COUNTY, TEXAS," (August, 2008), <http://nepalibrary.s3.amazonaws.com/juarez-pipeline-el-paso-aug2008.pdf> and PMI Comercio Internacional, "Juarez Border Pipeline," (October 29, 2015), [http://www.pmi.com.mx/Public/Paginas/DuctosJ\\_En.aspx?IdSec=27&IdPag=140](http://www.pmi.com.mx/Public/Paginas/DuctosJ_En.aspx?IdSec=27&IdPag=140).

<sup>159</sup> NuStar 2013 10-K and Phillips 66, "Form 10-K," (February 20, 2015), <http://d1lge852tjjqow.cloudfront.net/CIK-0001534701/9f424388-2e59-4bf0-936d-303c95f411de.pdf?noexit=true>.

The proximity of eastern and central Texas Inland markets to major refining and pipeline supply centers in the Texas Gulf Coast region is simultaneously a strength and a weakness. The abundant supply available in the Texas Gulf Coast means that sufficient replacement volumes are almost always available to make up for a loss in supply from in-region refineries, such as Valero’s Three Rivers refinery or Delek’s Tyler refinery. However, eastern and central Texas Inland markets are heavily reliant on pipeline movements from Texas Gulf Coast supply centers to meet consumption, and this dependency makes those Texas Inland markets susceptible to major disruptions affecting the Gulf Coast. The Texas Gulf Coast region has historically been vulnerable to major hurricanes and tropical weather patterns that can damage petroleum infrastructure or cause widespread power failure affecting petroleum infrastructure. Specifically, the Dallas-Fort Worth Metroplex relies heavily on supply from the Houston area, the Austin-San Antonio Corridor relies on supply from Corpus Christi, and markets in northeastern Texas receive substantial volumes from the Beaumont/Port Arthur area.

The western Texas markets (Midland, Odessa, and El Paso) have local refining (Western Refining’s El Paso refinery and Alon’s Big Spring refinery) but the area is also connected to the Texas Gulf Coast region via Magellan’s Houston-to-El Paso pipeline and to the Texas Panhandle refineries via NuStar’s Amarillo-to-El Paso pipeline. This supply diversity means that any individual refinery or pipeline outage can likely be made up by increasing volumes from other sources. Furthermore, El Paso is a major staging point for supply to Arizona markets via Kinder Morgan’s SFPP East Line. During a supply shortage affecting western Texas, supply intended for this pipeline could be diverted for local use, while Arizona markets could increase shipments—to the extent possible—along Kinder Morgan’s SFPP Phoenix line running from the Los Angeles, California refining center on the West Coast (PADD 5).

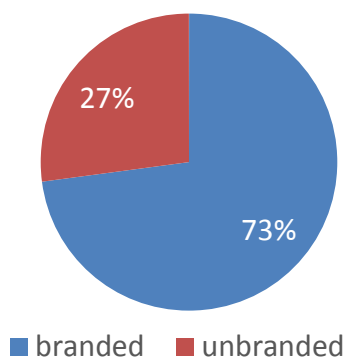
## Retail markets

There are 9,693 retail service outlets in the state of Texas (including both the Texas Gulf Coast and Texas Inland regions)<sup>160</sup>. Figure 49 shows the share of these outlets that are branded versus unbranded. Stations are classified as ‘branded’ if they are associated with and display a major oil company brand. ‘Unbranded’ stations are not affiliated with a major oil company brand. Seventy three percent of Texas’s retail stations are branded, slightly higher than the national average of 69%. The top five brands in Texas are Shell, Valero, Exxon, Chevron, and Texaco, and these brands together account for 58% of the region’s retail outlets. Sixty-one percent of the region’s stations offer diesel fuel, compared to a national average of 53%. As of 2015, there were 104 public filling stations and 13 private stations in the Texas Inland region offering E85 and seven public and 12 private filling stations in the region offering biodiesel (B20 and above).<sup>161</sup>

<sup>160</sup> Retail station data provided by the Homeland Security Infrastructure Program (HSIP).

<sup>161</sup> U.S. Department of Energy: Office of Energy Efficiency & Renewable Energy, “Alternative Fuels Data Center” (Accessed December 2, 2015), <http://www.afdc.energy.gov/states/>.

**Figure 49. Texas retail market structure**  
percent of retail stations



Source: HSIP 2015

### Future changes

NuStar Energy and Mexico's state-owned oil company, Pemex, are planning a 108,000 b/d pipeline project, expected in service in the second half of 2016, to export LPG and other petroleum products from the United States to northern Mexico. The project—known as the New Burgos Pipeline—would deliver products to northern Mexico from NuStar Energy's Edinburg, Texas terminal in the far south of the state. The pipeline route would run parallel to NuStar's existing Burgos pipeline, which transports naphtha from northern Mexico to Edinburg, Texas.<sup>162</sup>

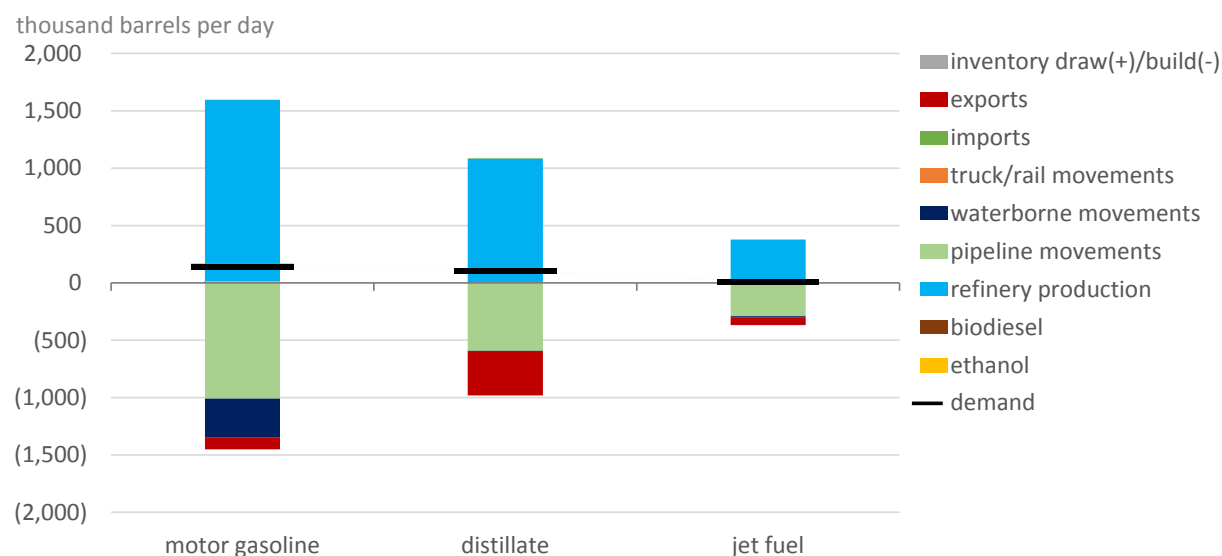
<sup>162</sup> U.S. Department of State Bureau of Energy Resources, "Presidential Permit Application for the New Burgos Pipeline," (December 18, 2014), <http://www.state.gov/e/enr/applicant/applicants/240646.htm>.

## Louisiana Gulf Coast

The Louisiana Gulf Coast region consists of 38 parishes in the southern half of Louisiana (all counties south of the parishes of Vernon, Rapides and Ayatolles), as well as eight counties located along the Gulf Coast in Mississippi and Alabama.<sup>163</sup> Estimated total consumption of motor gasoline, distillate fuel oil, and commercial jet fuel in the Louisiana Gulf Coast was 255,000 b/d in 2014. Within the region, the principal consumption centers are New Orleans, Baton Rouge, and Lafayette in Louisiana; the Gulfport-Biloxi-Pascagoula metropolitan area in Mississippi, and Mobile in Alabama.

The Louisiana Gulf Coast is the second largest transportation fuel producing region in the country, behind the Texas Gulf Coast. The region's refinery production of gasoline, distillates, and jet fuel averaged more than 3.0 million b/d in 2014, exceeding in-region consumption by approximately 2.8 million b/d. The Louisiana Gulf Coast region is a net shipper of transportation fuels to other regions of the country. Products primarily move in and out of the region by pipeline and by marine tanker and barge to both domestic and international destinations. Domestic pipeline and marine shipments out of the region averaged nearly 2.3 million in 2014, while foreign exports averaged more than 542,000 b/d. Figure 50 presents the 2014 annual supply and demand balances for motor gasoline, distillate, and jet fuel.

**Figure 50. Louisiana Gulf Coast supply/demand balances, 2014**



Note: All movements and inventory changes are on a net basis

Source: ICF Analysis of EIA, FHWA, Airlines for America, FERC, and company 10-K data

## Supply/demand balances

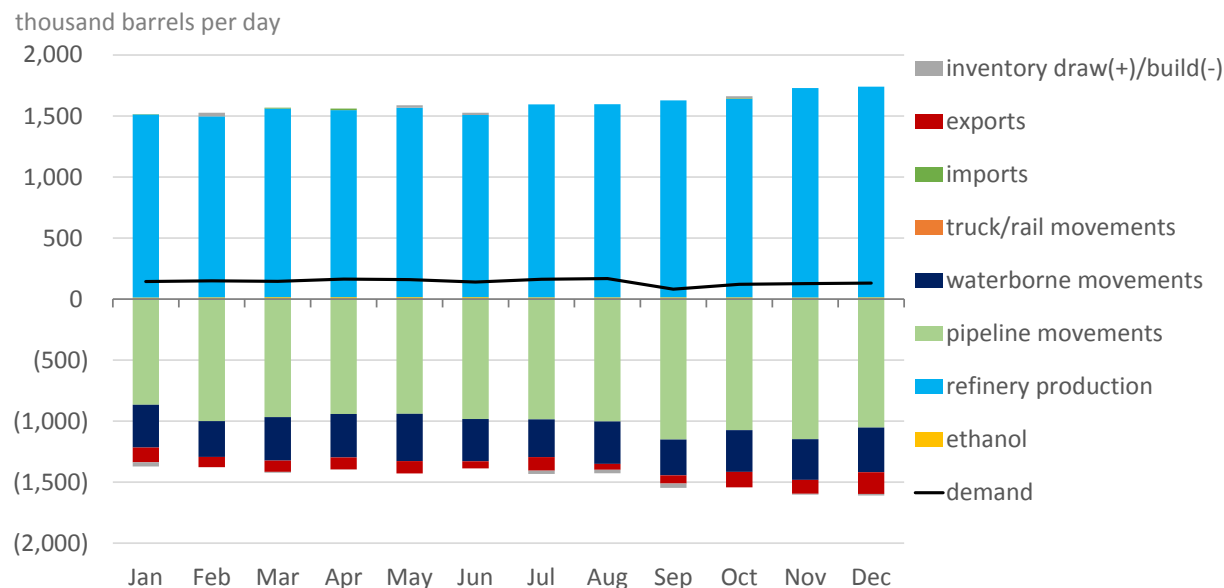
### Gasoline

Figure 51 presents the Louisiana Gulf Coast's 2014 motor gasoline supply/demand balance. In 2014, gasoline consumption averaged 141,000 b/d, including 14,000 b/d of ethanol, compared with refinery

<sup>163</sup> U.S. Energy Information Administration, "Petroleum Supply Monthly: Appendix A – District Descriptions and Maps," (Accessed January 6, 2016), <https://www.eia.gov/petroleum/supply/monthly/pdf/append.pdf>.

production of nearly 1.6 million b/d. Motor gasoline consumption in the region does not typically follow a seasonal pattern. Excess production is shipped to other regions by pipeline, but also by tanker and barge. Foreign exports in 2014 averaged 100,000 b/d.

**Figure 51. Louisiana Gulf Coast motor gasoline supply/demand balance, 2014**



Note: All movements and inventory changes are on a net basis

Source: ICF Analysis of EIA, FHWA, FERC, and company 10-K data

The U.S. Environmental Protection Agency (U.S. EPA) does not require the use of reformulated gasoline in any of the parishes or counties in the Louisiana Gulf Coast region.<sup>164</sup> In accordance with the Clean Air Act, the U.S. EPA requires the adoption of a summer RVP standard that limits the volatility of conventional gasoline sold in certain areas of the country. From May 1 through September 15, Louisiana, Mississippi and Alabama each enforce a statewide 9.0 RVP limit.<sup>165</sup> In addition, 16 parishes in Louisiana—all of which are located in the Louisiana Gulf Coast region—have stricter RVP limits.<sup>166</sup> From June 1 through September 15, these 16 parishes must observe a 7.8 RVP limit. The states of Louisiana, Mississippi and Alabama do not maintain a winter oxygenated fuels program for any locations in the Louisiana Gulf Coast region.<sup>167</sup>

**Table 31. Louisiana Gulf Coast motor gasoline regulations**

Regulation	Area (s)	Dates
Summer Gasoline Volatility <9.0 RVP	Louisiana, Mississippi, Alabama statewide	May 1 – Sept. 15
Summer Gasoline Volatility <7.8 RVP	Select Louisiana Parishes	June 1 – Sep. 15

<sup>164</sup> U.S. Environmental Protection Agency, "Reformulated Gasoline," (Accessed January 6, 2015), <http://www.epa.gov/gasoline-standards/reformulated-gasoline>.

<sup>165</sup> U.S. Environmental Protection Agency, "Gasoline Reid Vapor Pressure" (Accessed December 11, 2015), <http://www.epa.gov/gasoline-standards/gasoline-reid-vapor-pressure>.

<sup>166</sup> "The Parishes of Louisiana," (Accessed January 6, 2016), [http://www.louisianafolklife.org/images\\_creole/parishes.jpg](http://www.louisianafolklife.org/images_creole/parishes.jpg).

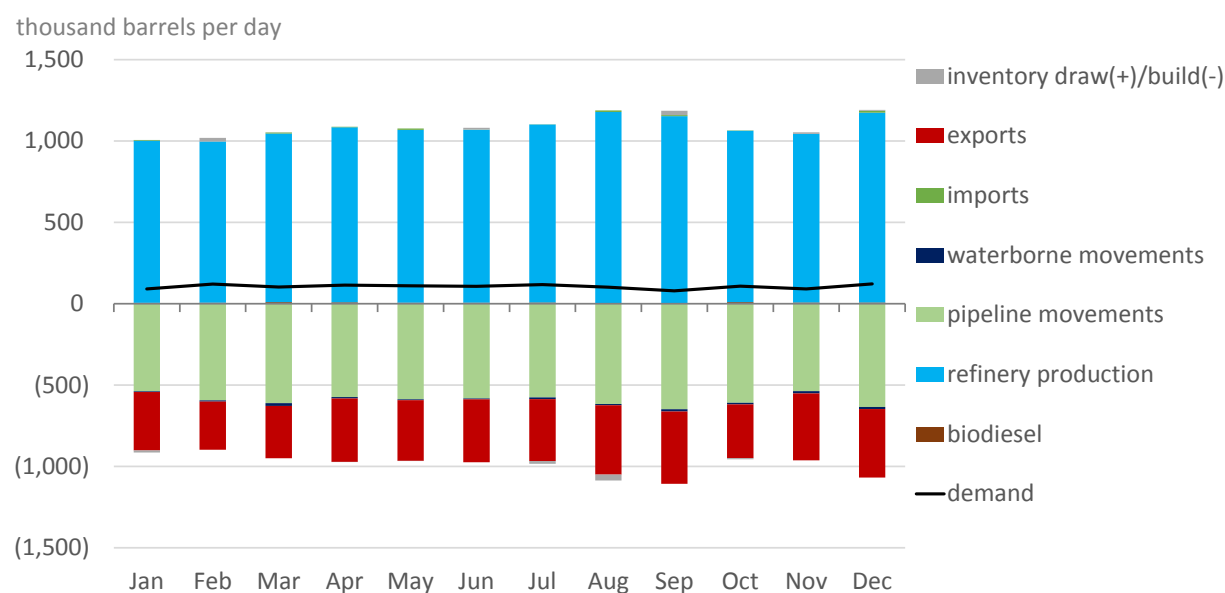
<sup>167</sup> U.S. Environmental Protection Agency, "State Winter Oxygenated Fuel Program Requirements for Attainment or Maintenance of CO NAAQS" (Accessed December 11, 2015), <http://epa.gov/otaq/regs/fuels/420b08006.pdf>.

Source: U.S. EPA

## Distillate

Figure 52 presents the Louisiana Gulf Coast's 2014 supply/demand balance for distillate. In 2014, distillate consumption averaged 105,000 b/d, compared to in-region refinery production of nearly 1.1 million b/d. Louisiana Gulf Coast consumption does not follow a seasonal pattern as very little distillate is used for residential or commercial space heating. More than four-fifths of the distillate fuel oil sold in Louisiana, Mississippi and Alabama is ultra-low sulfur diesel (ULSD).<sup>168</sup> In Louisiana, less than 50% of all distillate sales are consumed for on-highway use, while more than one-quarter is consumed for vessel bunkering and more than one-tenth is used by oil companies.<sup>169</sup> In Mississippi and Alabama, more than two-thirds of distillate sales are used on-highway, with the farm sector accounting for largest share of off-road sales in Mississippi, and the industrial sector accounting for the largest share of off-road sales in Alabama.<sup>170</sup> The Louisiana Gulf Coast is a net shipper of distillates to other regions of the country, primarily by pipeline. In 2014, the region exported 379,000 b/d to other countries, accounting for nearly 40% of all shipments out of the region.

**Figure 52. Louisiana Gulf Coast distillate supply/demand balance, 2014**



Note: All movements and inventory changes are on a net basis

Source: ICF Analysis of EIA, FHWA, FERC, and company 10-K data

<sup>168</sup> U.S. Energy Information Administration, "Prime Supplier Sales Volumes – Mississippi", (Accessed December 8, 2015), [http://www.eia.gov/dnav/pet/pet\\_cons\\_prim\\_dcu\\_SMS\\_m.htm](http://www.eia.gov/dnav/pet/pet_cons_prim_dcu_SMS_m.htm).

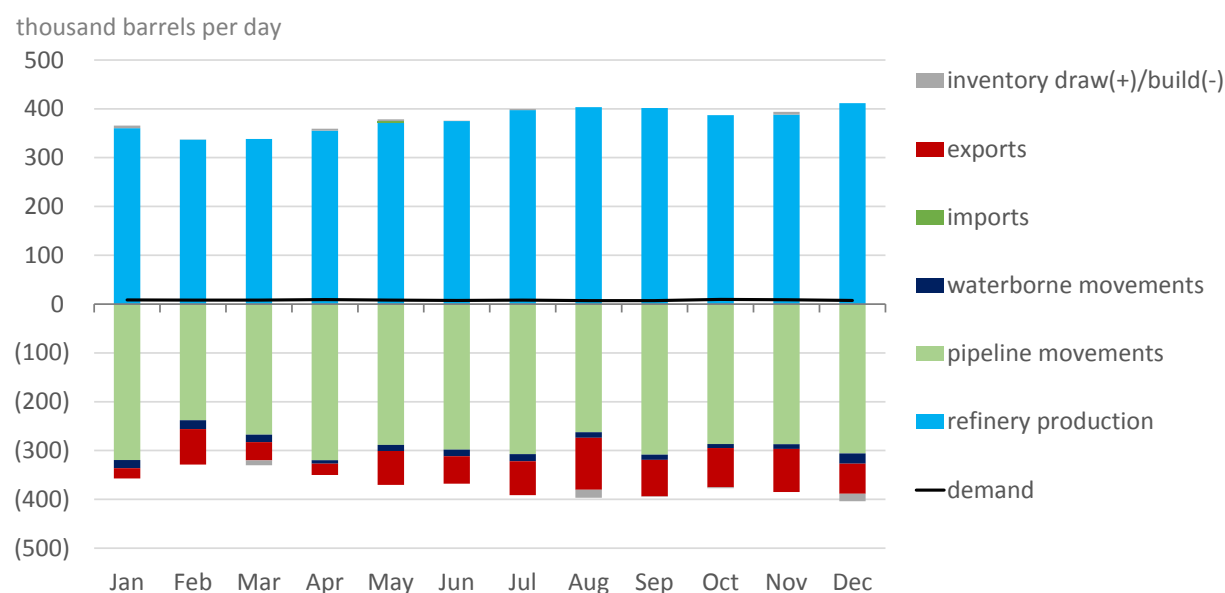
<sup>169</sup> U.S. Energy Information Administration, "Sales of Distillate Fuel by End Use – Louisiana", (Accessed December 11, 2015), [http://www.eia.gov/dnav/pet/pet\\_cons\\_821dst\\_dcu\\_SLA\\_a.htm](http://www.eia.gov/dnav/pet/pet_cons_821dst_dcu_SLA_a.htm).

<sup>170</sup> U.S. Energy Information Administration, "Sales of Distillate Fuel by End Use – Mississippi", (Accessed December 11, 2015), [http://www.eia.gov/dnav/pet/pet\\_cons\\_821dst\\_dcu\\_SMS\\_a.htm](http://www.eia.gov/dnav/pet/pet_cons_821dst_dcu_SMS_a.htm) and U.S. Energy Information Administration, "Sales of Distillate Fuel by End Use – Alabama", (Accessed December 11, 2015), [http://www.eia.gov/dnav/pet/pet\\_cons\\_821dst\\_dcu\\_SAL\\_a.htm](http://www.eia.gov/dnav/pet/pet_cons_821dst_dcu_SAL_a.htm).

## Jet fuel

Figure 53 presents the Louisiana Gulf Coast region's 2014 jet fuel supply/demand balance. Commercial jet fuel consumption in the Louisiana Gulf Coast region averaged approximately 8,000 b/d in 2014, compared to refinery production of 377,000 b/d. Approximately 63,000 b/d was exported to other countries in 2014, while the remaining surplus was shipped to other regions of the United States by pipeline and tanker/barge.

**Figure 53. Louisiana Gulf Coast jet fuel supply/demand balance, 2014**



Note: All movements and inventory changes are on a net basis

Source: ICF Analysis of EIA, Airlines for America, FERC, and company 10-K data

There are seven primary commercial service airports in the Louisiana Gulf Coast region, including five in southern Louisiana, one in Gulfport, Mississippi, and one in Mobile, Alabama. Of these, only Louis Armstrong New Orleans International Airport (MSY) is designated as a hub by the Federal Aviation Administration. Twelve smaller commercial airports also operate in the region. Keesler Air Force Base (AFB) in Biloxi, Mississippi, is the only AFB in the Louisiana Gulf Coast region.<sup>171</sup>

## Refineries

The Louisiana Gulf Coast region has 16 refineries with a combined atmospheric crude distillation capacity of approximately 3.7 million barrels per calendar day (b/cd). The refineries—which account for just under 23% of the nation's refining capacity—are clustered around three geographic areas: the Mississippi River in southeastern Louisiana, Lake Charles in the southwestern Louisiana, the and Pascagoula/Mobile area along the Gulf Coast in Mississippi and Alabama. Most of the refineries process domestic sweet and sour crudes, and most (but not all) have access to imported crudes through the Louisiana Offshore Oil Port.

<sup>171</sup> MilitaryBases.com, "State Military Bases" (Accessed November 5, 2015), <http://militarybases.com>.

Table 32 lists each refinery in the region and its operable capacity as of January 1, 2015. The Mississippi River refinery cluster contains 11 refineries—stretching from Belle Chasse in the southeast to Baton Rouge in the northwest (and including nearby Krotz Springs)—with a combined operating capacity of approximately 2.5 million b/cd. These refineries have marine access to the Gulf of Mexico via the Mississippi River. The Lake Charles refining cluster is comprised of three refineries with a combined operating capacity of 0.8 million b/cd. These refineries have marine access to the Gulf of Mexico via the Calcasieu Ship Channel. The Pascagoula/Mobile cluster includes two refineries with a combined capacity of 0.4 million b/cd. The refineries have access to the Gulf of Mexico via the Mississippi Sound and Mobile Bay.

**Table 32. Louisiana Gulf Coast refineries**

Owner	Site	Operable capacity, b/cd <sup>A</sup>
<b>Mississippi River</b>		
Marathon	Garyville, LA	522,000
ExxonMobil	Baton Rouge, LA	502,500
Phillips 66	Belle Chasse, LA	247,000
Motiva	Norco, LA	238,000
Motiva	Convent, LA	235,000
Valero	Norco, LA	215,000
PBF <sup>B</sup>	Chalmette, LA	192,500
Valero	Meraux, LA	125,000
Alon	Krotz Springs, LA	80,000
Placid Refining	Port Allen, LA	75,000
Shell <sup>C</sup>	Saint Rose, LA	45,000
	<b>Total</b>	<b>2,477,000</b>
<b>Lake Charles</b>		
Citgo	Lake Charles, LA	427,800
Phillips 66	Westlake, LA	260,000
Calcasieu Refining	Lake Charles, LA	80,000
	<b>Total</b>	<b>767,800</b>
<b>Pascagoula/Mobile</b>		
Chevron	Pascagoula, MS	330,000
Shell	Saraland, AL	80,000
	<b>Total</b>	<b>410,000</b>
<b>Louisiana Gulf Coast Total</b>		<b>3,654,800</b>

(A) Barrels per calendar day, as of Jan 1, 2015

(B) Previously Chalmette Refining. Acquisition by PBF Energy completed November 2, 2015

(C) Asphalt plant

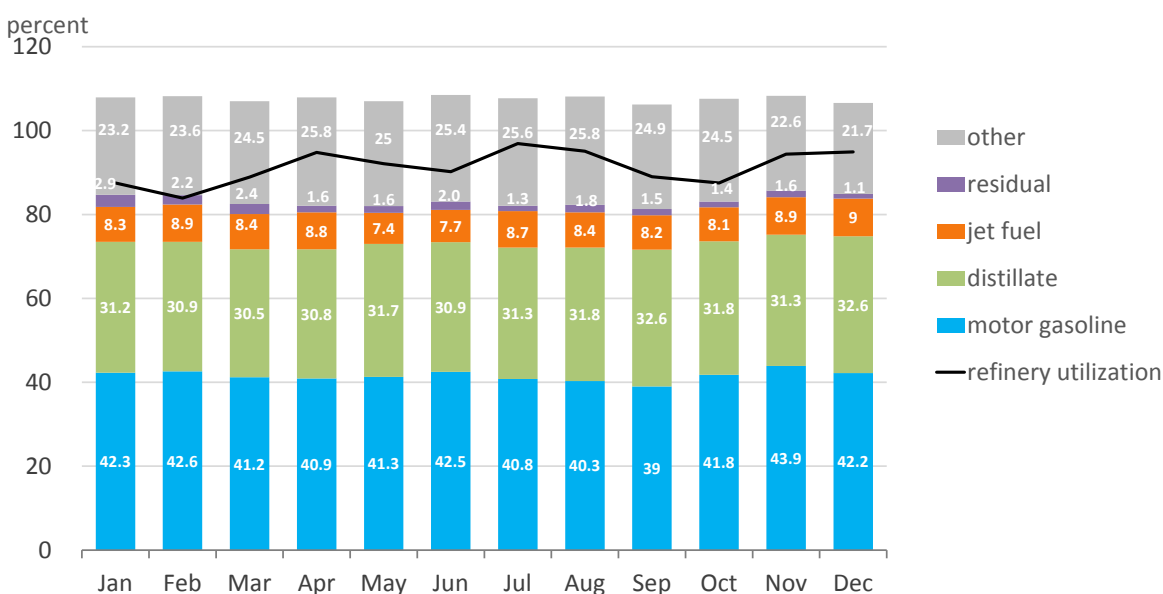
Source: U.S. Energy Information Administration, Refinery Capacity Report

Figure 54 shows monthly refinery utilization and yield percentages for motor gasoline (both finished gasoline and blendstocks), distillate fuel oil, residual fuel oil, and other secondary products in the Louisiana Gulf Coast region in 2014. Production of transportation fuels (gasoline, distillate, and jet fuel)



accounted for 83.9% of the region's annual yield in 2014, slightly lower than the national average of 84.5%. The Louisiana Gulf Coast's motor gasoline yield, at 41.3%, is lower than the national average of 45%; distillate yield, at 31.5%, is slightly higher than the national average of 29.9%, and jet fuel, at 11.1%, is slightly higher than the national average of 9.6%. The Louisiana Gulf refineries, as in the Texas Gulf Coast, tend to divert a greater portion of naphtha and gas oil into petrochemicals and lube production than refineries in other regions, impacting gasoline yield. The region's yield of secondary products in 2014 was 14.1%, attributed primarily to LPG, still gas, and petroleum coke production. The region's overall yield of secondary products is lower than the PADD 3 overall average of 19.9%. During the summer months less butane is added to gasoline to control engine vapor lock and to meet required gasoline RVP regulations, leading to slightly lower gasoline yields in the summer months when compared to winter months.

**Figure 54. Louisiana Gulf Coast refinery yields**



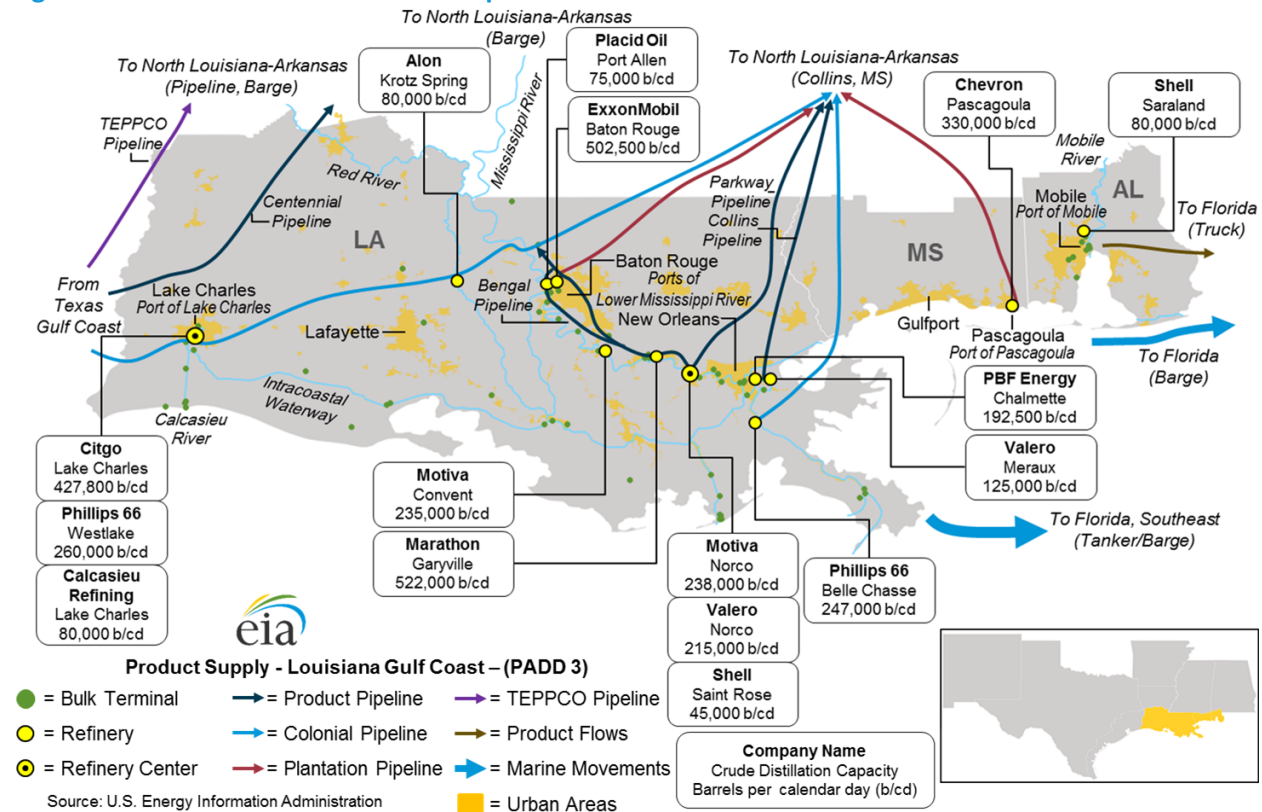
Note: yield percentages sum to higher than 100% due to processing gains.

Source: U.S. Energy Information Administration, Petroleum Supply Monthly

## Supply and Logistics

Refined product infrastructure in the Louisiana Gulf Coast region is primarily designed to move products from the region's three refining centers to domestic markets in the eastern United States and for export international markets. The Colonial and Plantation pipeline systems, which ship products to markets on the East Coast (PADD 1), are the primary outlets for Louisiana Gulf Coast refinery production. In addition, products move to Florida and other coastal markets in the southeastern U.S. on coastwise compliant tankers and barges, and are exported on foreign-flagged ships, primarily to markets in the Atlantic Basin. Figure 55 presents a map of the refineries, product pipelines, product terminals, and major ports in the Louisiana Gulf Coast region.

Figure 55. Louisiana Gulf Coast refined petroleum infrastructure



### Pipelines

The pipeline networks in the Louisiana Gulf Coast region are primarily configured to deliver products from the region’s refineries to storage hubs in Baton Rouge, Louisiana, and Collins, Mississippi, which act as staging points for deliveries on the Colonial and Plantation pipeline systems. The storage hub in Collins, Mississippi, is located in the North Louisiana-Arkansas region, but receives all of its products via interconnecting pipelines from the Louisiana Gulf Coast. Table 33 lists the pipelines serving the Louisiana Gulf Coast region, including each line’s origin, destination, length, and capacity, if publically available.

**Table 33. Select Louisiana Gulf Coast refined product pipelines**

Pipeline	Origin	Destination	Distance, miles	Capacity, b/d
Colonial Pipeline	Houston, TX	Greensboro, NC	5,500	2,500,000
	Belle Chasse, LA	Collins, MS		
Plantation Pipeline	Baton Rouge, LA	Greensboro, NC	3,100	700,000
	Pascagoula, MS	Collins, MS		
Bengal Pipeline	Garyville and Norco, LA	Baton Rouge, LA	158	305,000
	Convent, LA	Baton Rouge, LA		
Collins Pipeline	Meraux, LA	Collins, MS	125	130,000
Parkway Pipeline	Norco, LA	Collins, MS	141	110,000
Centennial Pipeline <sup>A</sup>	Beaumont, TX	Bourbon, IL	795	210,000

(A) Largely idle since mid-2011. No receipt or delivery points within the region.

Source: various company reports, ICF estimates

The Colonial and Plantation pipelines are the primary outlets for Louisiana Gulf Coast production. The 2.5 million b/d Colonial Pipeline, which originates in Houston, Texas, received nearly 1.1 million b/d of transportation fuels at receipt points in Louisiana and Mississippi in 2014, according to data filed with the FERC.<sup>172</sup> The Colonial Pipeline typically operates at or near full capacity. In addition to its mainline system from Houston, Colonial operates a feeder line from the Phillips 66 refinery in Belle Chasse, Louisiana, that interconnects with the Colonial mainline in Collins, Mississippi.

The 700,000 b/d Plantation Pipeline, which originates in Baton Rouge, received an average of 628,000 b/d at receipt points in Louisiana and Mississippi in 2014, according to the FERC.<sup>173</sup> Volumes on the Plantation system steadily ramped up over the course of 2014, from about 600,000 b/d in the first quarter to about 662,000 b/d in the fourth quarter. The system's mainline from Baton Rouge also receives products in Collins from a Plantation-operated feeder line from the Chevron refinery in Pascagoula, Mississippi.

Several additional pipelines move refined products from Louisiana Gulf Coast refineries to the Baton Rouge and Collins transportation hubs. The Bengal Pipeline consists of two separate lines delivering products to Baton Rouge—a 305,000 b/d line running from the Motiva and Valero refineries in Norco, Louisiana, and from the Marathon refinery in Garyville, Louisiana; and a 210,000 b/d pipeline from the Motiva refinery in Convent, Louisiana.<sup>174</sup> The 130,000 b/d Collins Pipeline consists of a single pipeline delivering products to Collins from PBF's (formerly Chalmette Refining's) refinery in Chalmette,

<sup>172</sup> FERC Financial Report FERC Form No. 6: Annual Report of Oil Pipeline Companies and Supplemental Form 6-Q: Quarterly Financial Report of Colonial Pipeline Company (2014/Q1, 2014/Q2, 2014/Q3, 2014/Q4).

<sup>173</sup> FERC Financial Report FERC Form No. 6: Annual Report of Oil Pipeline Companies and Supplemental Form 6-Q: Quarterly Financial Report of Plantation Pipeline Company (2014/Q1, 2014/Q2, 2014/Q3, 2014/Q4).

<sup>174</sup> Bengal Pipeline, "Home," (Accessed January 6, 2016), <http://www.bengalpipeline.com/>.

Louisiana, and from Valero's refinery in Meraux, Louisiana.<sup>175</sup> Finally, the 110,000 b/d Parkway Pipeline, which began service in 2013, delivers products to Collins from the two Norco refineries.<sup>176</sup>

The 210,000 b/d Centennial Pipeline, which originates in the Beaumont-Port Arthur area in the Texas Gulf Coast and runs to southern Illinois, passes through the western portion of the Louisiana Gulf Coast region but has no receipt or deliveries points within the region. The line has largely been idle since mid-2011 and the pipeline's owners are considering taking the pipeline out of petroleum product service and reversing its flow to carry natural gas liquids (NGLs) from the U.S. Northeast to Texas.<sup>177</sup>

## Ports

Table 34 lists ports in the Louisiana Gulf Coast region that shipped coastwise marine cargoes of transportation fuels in 2013, the latest year for which domestic marine movement data is available from the U.S. Army Corps of Engineers (USACE). The table shows estimated 2013 outbound movements at the region's ports broken out between domestic shipments, as tracked by USACE, and foreign exports, as tracked by the U.S. International Trade Commission (USITC) using U.S. Census data. The domestic shipments only include coastwise movements—marine volumes that exited the region via the Gulf of Mexico—and do not include shipments on internal waterways if those shipments terminated within that same waterway. This excludes shipments from Louisiana Gulf Coast refineries northbound on the Mississippi River, as well as shipments to the Florida Panhandle via the Gulf Intracoastal Waterway. The export data from USITC is aggregated to the U.S. Customs District. Louisiana Gulf Coast ports are located in two Customs Districts: New Orleans, which includes the ports of New Orleans, South Louisiana, Baton Rouge, and Lake Charles; and Mobile, which includes the ports of Mobile and Pascagoula.

**Table 34. Outbound waterborne shipments of transportation fuels from Louisiana Gulf ports, 2013**

barrels per day

U.S. Customs District	Port	Domestic <sup>A</sup>	Foreign	Total
<b>New Orleans</b>	New Orleans, LA	28,709	623,379	<b>971,041</b>
	South Louisiana	242,822		
	Baton Rouge, LA	2,488		
	Lake Charles, LA	73,643		
<b>Mobile</b>	Mobile, AL	1,272	94,524	<b>167,868</b>
	Pascagoula, MS	72,072		
<b>Louisiana Gulf Coast Total</b>		<b>421,006</b>	<b>717,903</b>	<b>1,138,909</b>

(A) Coastwise shipments only. Outbound shipments on Mississippi River to North Louisiana-Arkansas and Gulf Intracoastal Waterway to Florida not included.

Source: U.S. Army Corp of Engineers 2013 Waterborne Commerce of the United States Waterways and Harbors; U.S. International Trade Commission/U.S. Census Bureau

<sup>175</sup> Collins Pipeline Company, "About," (Accessed January 6, 2016),

[http://sitemanager.pdigm.com/user/file/Louisiana%20\(PAL\)/Collins\\_Pipeline\\_Company.pdf](http://sitemanager.pdigm.com/user/file/Louisiana%20(PAL)/Collins_Pipeline_Company.pdf).

<sup>176</sup> Kinder Morgan, "Kinder Morgan/Valero Place Parkway Pipeline into Service: Pipeline expands fuel supply to eastern U.S. and brings economic benefits to local regions," (September 3, 2013), <http://ir.kindermorgan.com/press-release/all/kinder-morganvalero-place-parkway-pipeline-service>.

<sup>177</sup> Reuters, "UPDATE 2-Enterprise mulls options for low-volume Centennial pipe," (April 17, 2013), <http://www.reuters.com/article/enterprise-pipeline-centennial-idUSL2N0D41L320130417>.

Total outbound shipments from the Louisiana Gulf Coast totaled over 1.1 million b/d in 2013 with exports accounting for nearly two-thirds of this volume. Coastwise-compliant domestic shipments, which make up the balance of the region's outbound marine shipments, were primarily destined for ports in Florida and in the southeastern U.S. In addition to the coastwise-compliant domestic volumes presented in Table 34, approximately 49,000 b/d of transportation fuels were shipped northbound on the Mississippi River to markets in northern Louisiana, Arkansas, and the Midwest (PADD 2), and approximately 34,000 b/d were shipped along the Gulf Intracoastal Waterway to markets in the Florida Panhandle, according to data from USACE.

## Markets

### New Orleans-Baton Rouge

New Orleans and Baton Rouge, Louisiana are the largest consumption centers in the Louisiana Gulf Coast region. Consumption is met by local refineries situated along the Mississippi River, which have a combined refining capacity of 2.5 million b/cd. ExxonMobil's Baton Rouge refinery and Placid Refining's Port Allen refinery are directly connected to the Colonial and Plantation pipelines at the Baton Rouge junctions, while Alon USA's Krotz Springs refinery, located to the west of Baton Rouge, has a direct tie-in to the Colonial Pipeline. Other refineries in the area are connected to the Baton Rouge junctions via feeder pipelines. The Motiva and Valero refineries in Norco, Louisiana, move products along the 305,000 b/d Bengal Pipeline to Baton Rouge and along the 110,000 b/d Parkway Pipeline to Collins, Mississippi. The Bengal Pipeline's Norco-to-Baton Rouge segment also serves production from Marathon's Garyville refinery. A separate segment of the Bengal Pipeline carries up to 210,000 b/d to Baton Rouge from Motiva's Convent refinery.

East of New Orleans, PBF's (formerly Chalmette Refining's) refinery in Chalmette, Louisiana, and Valero's refinery in Meraux, Louisiana ship products to Collins on the 130,000 b/d Collins Pipeline. Meanwhile, Phillips 66's refinery in Belle Chasse, Louisiana, located to the south of New Orleans, ships products to Collins via a feeder pipeline operated by Colonial Pipeline Company.

The Mississippi River refineries also ship fuel by marine tanker and barge to both domestic and international markets. In 2013, coastwise shipments from the Mississippi River refineries to domestic markets—shipments that transited the Gulf of Mexico to Florida and other southeastern U.S. markets—averaged 274,000 b/d, while approximately 49,000 b/d was shipped northbound on the Mississippi River. Exports from Louisiana ports—including exports from both Mississippi River and Lake Charles refineries—averaged nearly 1.0 million b/d in 2013.

### Lake Charles

Lake Charles is one of the smaller metropolitan areas in the Louisiana Gulf Coast region and transportation fuel consumption is met by local refinery production. Citgo, Phillips 66, and Calcasieu Refining operate refineries in Lake Charles with a combined capacity of approximately 0.8 million b/d. The Lake Charles refineries ship products via the Colonial Pipeline, and on marine tankers and barges via the Calcasieu Ship Channel. Coastwise outbound shipments from Lake Charles to other U.S. ports averaged 74,000 b/d in 2013.

## Pascagoula and Mobile

The Gulfport-Biloxi-Pascagoula and Mobile metropolitan areas are two of the larger consumption centers in the Louisiana Gulf Coast region. Transportation fuel consumption is met by production from Chevron's Pascagoula refinery and by Shell's Saraland, Alabama refinery. In addition, approximately 7,000 b/d of coastwise domestic shipments are brought in to terminals in Mobile Bay. The Pascagoula refinery ships approximately 30% of its production, or about 100,000 b/d to Collins, Mississippi via a pipeline operated by Colonial Pipeline Company. Most of the balance of the refinery's production leaves by way of marine shipment, and to a much lesser degree, by truck or rail.<sup>178</sup> In 2013, coastwise marine shipments from Pascagoula and Mobile—shipments that transited the Gulf of Mexico—totaled 168,000 b/d, including both domestic shipments and exports. In addition to coastwise movements via the Gulf of Mexico, approximately 34,000 b/d was shipped to markets in the Florida along the Gulf Intracoastal Waterway—a navigable inland waterway connecting Mobile Bay to coastal markets in the Florida Panhandle.

### Supply vulnerability

With roughly 3.0 million b/d of transportation fuels production, the Louisiana Gulf Coast region is critical for supplying markets throughout the eastern United States. As a result, major disruptions to the region's refinery production can have cascading supply impacts in markets as far away as New York.

Given the abundance of supply in the Louisiana Gulf Coast region, the loss of any one refinery is unlikely to lead to supply shortages. Unplanned refinery outages in the region are typically managed by drawing on ample regional inventories; by ramping up production at other Louisiana or Texas Gulf Coast refineries, either by increasing processing rates or delaying planned maintenance outages; by diverting product exports to domestic markets as economic; or, if necessary, by importing supply from Atlantic Basin suppliers.

Pipeline infrastructure is the biggest chokepoint for the region's refined product transportation. The Louisiana Gulf Coast ships approximately 2.8 million b/d of transportation fuels by pipeline and tanker/barge to other regions of the country and to international markets. More than two-thirds of this volume is shipped on the Colonial Pipeline and Plantation Pipelines, and an extended disruption to either of these systems would back up refinery output in the Louisiana Gulf Coast with few alternative outlets. Although some Louisiana Gulf Coast production is already distributed via coastwise-compliant tankers and barges, supply of such vessels is limited, and would not be adequate to move stranded production in the event of a major pipeline outage. A waiver of the Jones Act could allow some stranded production to move out of the region on foreign-flagged vessels to domestic ports on the East Coast, but many markets served by Colonial and Plantation, particularly in the inland southeastern U.S., lack direct marine access.

Another potential chokepoint is the region's waterways: the Mississippi River, the Calcasieu Ship Channel, the Mississippi Sound, and Mobile Bay. These waterways are essential for inbound shipments

<sup>178</sup> Chevron Pascagoula Refinery, "Refinery Products," (Accessed January 6, 2016), <http://pascagoula.chevron.com/home/abouttherefinery/whatwedo/refineryproducts.aspx>.

of crude oil to the region's refineries and for outbound shipments of petroleum products. The importance of these waterways for domestic markets has decreased in recent years as outbound shipments of refined products have largely been destined for export markets, and as Louisiana Gulf Coast refineries have reduced crude oil imports in favor of domestic supply. Furthermore, the Louisiana Gulf Coast's refineries have pipeline access to crude oil from three Strategic Petroleum Reserve (SPR) sites operated by the U.S. Department of Energy—two in Louisiana and one in Texas—in the event that a port or waterway disruption interrupts deliveries of waterborne crude. The West Hackberry SPR site near Lake Charles and the Big Hill site in eastern Texas can deliver up to 1.3 million b/d and 1.1 million b/d respectively to the Lake Charles area refineries, while the Bayou Choctaw site near Baton Rouge has a deliverability of up to 0.5 million b/d to the Mississippi River area refineries.<sup>179</sup> The SPR sites can also be tapped to provide supply in the event of a disruption to offshore crude oil production in the Gulf of Mexico.

Designed to take advantage of the region's deepwater ports, the Louisiana Gulf Coast's 16 refineries and associated infrastructure are heavily concentrated in coastal areas, making them particularly vulnerable to disruption from hurricanes, tropical storms, and associated storm surge. These weather phenomenon can directly damage the region's petroleum infrastructure or disrupt essential power supply, rendering refineries, terminals, and pipeline pumping stations inoperable. Hurricane Katrina (2005) and Hurricane Gustav (2008) both caused widespread damage and power outages to the region's petroleum infrastructure, leading to price spikes and shortages in parts of the country that depend on the Louisiana Gulf Coast for transportation fuel supply. During Katrina, power outages to Colonial and Plantation pump stations in Collins, Mississippi, shut flows on the systems, disrupting supply of transportation fuels to the East Coast. Since Katrina, Colonial has focused time and resources on preparing for and responding to extreme weather events, including investing in several tractor-trailer mounted portable generators that would allow the company to bring its system back on-line during prolonged disruptions to the power grid.<sup>180</sup>

## Retail markets

There are 1,935 retail service stations in Louisiana, the state whose parishes comprise the majority of the Louisiana Gulf Coast region<sup>181</sup>. This count includes stations in northern Louisiana (part of the North Louisiana-Arkansas region) and does not include stations in the Mississippi and Alabama portions of the Louisiana Gulf Coast region. Figure 56 shows the share of Louisiana service stations that are branded versus unbranded. Stations are classified as 'branded' if they are associated with and display a major oil company brand. 'Unbranded' stations are not affiliated with a major oil company brand. Statewide, 68% of Louisiana retail stations are branded, just under the national average of 69%. The top five brands in

<sup>179</sup> United States Fuel Resiliency. Volume III. U.S. Fuels Supply Infrastructure Vulnerabilities and Resiliency. FINAL REPORT. Prepared for: Office of Energy Policy and Systems Analysis. September 2014. Intek. Inc. and AOC Petroleum Support Services, LLC. <http://energy.gov/sites/prod/files/2015/04/f22/QR%20Analysis%20-%20United%20States%20Fuel%20Resiliency%20Volume%20III.pdf>

<sup>180</sup> Felt, Tim, President and CEO Colonial Pipeline Company, "Testimony at Quadrennial Energy Review Stakeholder Meeting: Transmission, Storage and Distribution Issues Relating to Petroleum and Refined Products," QER Stakeholder Meeting, New Orleans, Louisiana, (May 27, 2014), [http://energy.gov/sites/prod/files/2014/06/f16/tfelt\\_statement\\_qer\\_nola.pdf](http://energy.gov/sites/prod/files/2014/06/f16/tfelt_statement_qer_nola.pdf).

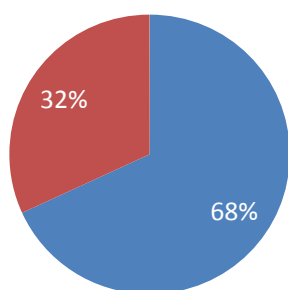
<sup>181</sup> Retail station data provided by the Homeland Security Infrastructure Program (HSIP).



Louisiana are Chevron, Shell, Exxon, Texaco, and Citgo, and these brands together account for 27% of the region's retail outlets. Fifty-eight percent of the region's stations offer diesel fuel, compared to a national average of 53%. As of 2015, there were two public filling stations and no private stations in the Louisiana Gulf Coast region offering E85 and no public and three private filling stations offering biodiesel (B20 and above) in the region.<sup>182</sup>

**Figure 56. Louisiana retail market structure**

percent of retail stations



■ branded ■ unbranded

Source: HSIP 2015

## Future changes

Several infrastructure investments are planned in the Louisiana Gulf Coast region that impact the production and transportation of petroleum products. The proposed projects are primarily focused on increasing distillate production and expanding dock facilities to serve export markets. Additionally, two transportation projects—one pipeline expansion and one rail terminal—are designed to expand the Louisiana Gulf Coast's ability to transport fuels to markets in the southeastern U.S. As of 2015, the following projects have been announced:

### Refineries

- **Motiva Convent and Norco Refineries:** According to company press releases, Motiva has announced plans to integrate its 238,000 b/cd Norco and 235,000 b/cd Convent refineries, which are located on the Mississippi River in southeast Louisiana. The project is designed to increase access to advantaged light oil, optimize inter-plant intermediates and conversion units, increase distillates yield, and reduce operating costs.<sup>183</sup> Project completion is slated for 2017.
- **Marathon Garyville Refinery:** Marathon plans to continue dock expansions through the end of 2015 at its 522,000 b/cd Garyville refinery. The project is expected to allow an export capacity of 510,000 b/cd by 2018. A previously scheduled 80,000 b/cd expansion of diesel production capacity at the same refinery, which was expected to be complete by the end of 2016, has been put on hold indefinitely. Marathon cited prolonged low oil prices as a factor in the decision.<sup>184</sup>

<sup>182</sup> U.S. Department of Energy: Office of Energy Efficiency & Renewable Energy, "Alternative Fuels Data Center" (Accessed December 2, 2015), <http://www.afdc.energy.gov/states/>.

<sup>183</sup> Motiva Enterprises, "Motiva Integrates Refineries to Create Louisiana Refining System" (Accessed December 5, 2015), <http://www.motivaenterprises.com/media-center/2015/motiva-integrates-refineries-to-create-louisiana-refining-system.html>.

<sup>184</sup> The Times-Picayune, "Marathon pulls plug on \$2 billion Garyville refinery upgrade" (Accessed December 5, 2015), [http://www.nola.com/business/index.ssf/2015/11/marathon\\_cancels\\_garyville\\_pro.html](http://www.nola.com/business/index.ssf/2015/11/marathon_cancels_garyville_pro.html).



- **ExxonMobil Baton Rouge Refinery:** ExxonMobil announced plans in 2014 to extend their capability to run higher-sulfur crudes at its 502,500 b/cd Baton Rouge refinery.<sup>185</sup>

## Pipelines

- **Florida Fuel Connection Rail Terminal:** In 2015, Florida Fuel Connection LLC announced a planned investment in the construction of a petroleum terminal and rail transportation facility adjacent to the Mississippi River in East Feliciana Parish, near Baton Rouge, Louisiana. Upon completion, the complex will be able to facilitate the transportation of gasoline, jet fuel, and diesel from the Colonial Pipeline system near Baton Rouge to existing rail lines that will facilitate the delivery of these fuels to destinations in Florida and Georgia.<sup>186</sup> The project, which is expected to be fully operational in the first quarter of 2017, will transport 240,000 b/d of transportation fuels at its peak.<sup>187</sup>
- **Plantation Pipeline Expansion/Palmetto Pipeline Project:** Kinder Morgan is proposing a capacity expansion of the Plantation Pipeline between Baton Rouge, Louisiana, and Belton, South Carolina, to serve its 167,000 b/d Palmetto Pipeline project. The Palmetto project would lease the new Plantation capacity to deliver transportation fuels from Belton on a newly constructed 360-mile pipeline to markets in South Carolina, coastal Georgia, and as far south as Jacksonville Florida. The project has a targeted in-service date of July 2017.<sup>188</sup>

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<sup>185</sup> Reuters, "Exclusive: Exxon eyes expanding Texas refinery into biggest in U.S." (Accessed December 5, 2015), <http://www.reuters.com/article/us-refinery-operations-exxon-mobil-beaum-idUSKBN0FU12O20140725>.

<sup>186</sup> Florida Fuel Connection Announces \$75 Million Capital Investment in Louisiana Rail Terminal Project. Press Release. Florida Fuel Connection LLC. July 2, 2015 (Accessed December 8, 2015).

[http://www.floridafuelconnection.com/Portals/0/Louisiana\\_PressRelease\\_7-29.pdf](http://www.floridafuelconnection.com/Portals/0/Louisiana_PressRelease_7-29.pdf)

<sup>187</sup> Kinder Morgan, "Products Pipelines: Palmetto Pipeline," (Accessed January 6, 2016), [http://www.kindermorgan.com/business/products\\_pipelines/palmetto/](http://www.kindermorgan.com/business/products_pipelines/palmetto/).

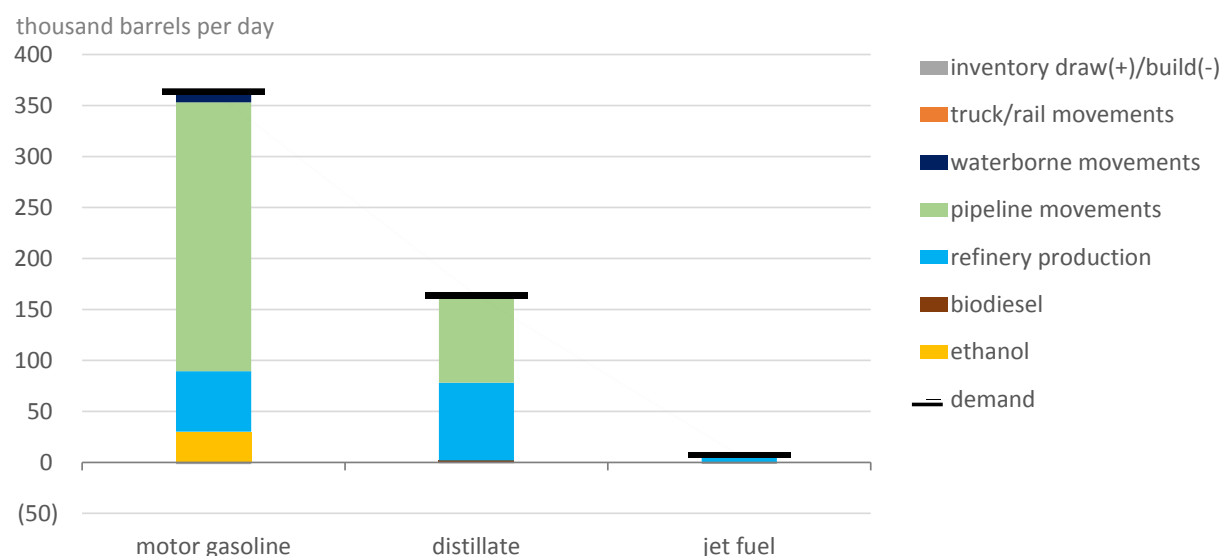
<sup>188</sup> [Ibid.](#)

## North Louisiana-Arkansas

The North Louisiana-Arkansas region consists of the northern and inland portions of Louisiana (26 parishes), Mississippi (76 counties), Alabama (65 counties), and the entire state of Arkansas. Estimated total consumption of motor gasoline, distillate fuel oil, and commercial jet fuel in the region was 535,000 b/d in 2014. Within the region, principal consumption centers include Birmingham, Huntsville, and Montgomery in Alabama; Little Rock and Fayetteville in Arkansas; Jackson, Mississippi; and Shreveport, Louisiana.

North Louisiana-Arkansas refinery production meets approximately 25% of in-region consumption for transportation fuels with the balance delivered by pipeline, and to a lesser degree by barge along the region's river systems, from the Louisiana and Texas Gulf Coast regions. Figure 57 presents the 2014 annual supply and demand balances for motor gasoline, distillate, and jet fuel.

**Figure 57. North Louisiana-Arkansas supply/demand balances, 2014**



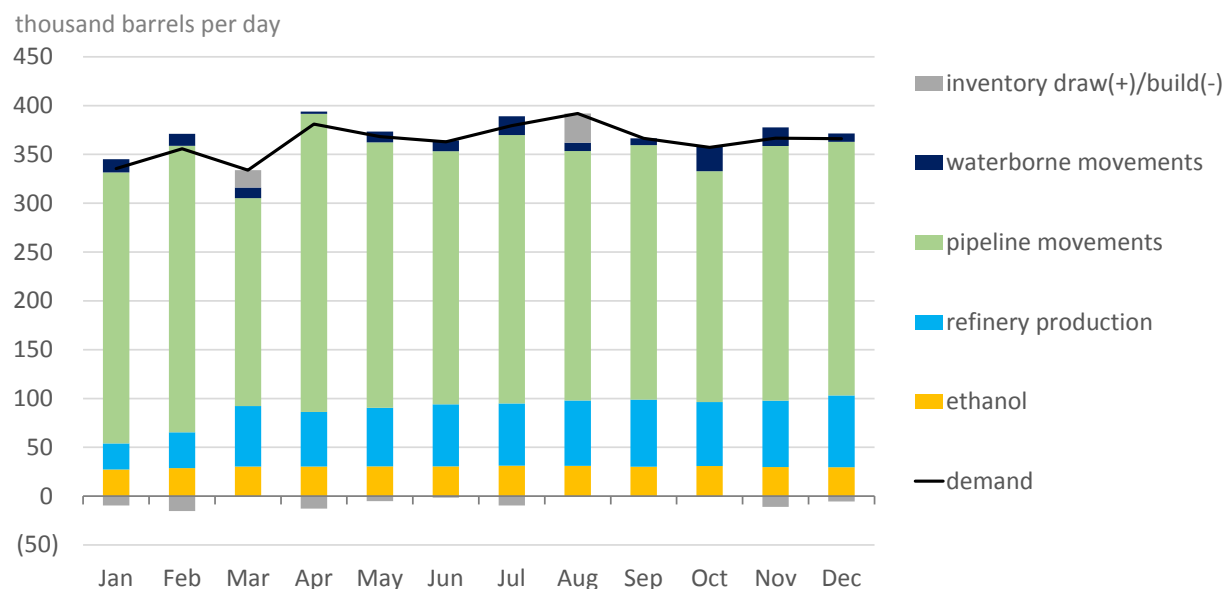
Note: All domestic movements and inventory changes are reported on a net basis.

Source: ICF Analysis of EIA, FHWA, Airlines for America, FERC, and company 10-K data

### Supply/demand balances

#### Gasoline

Figure 58 presents North Louisiana-Arkansas's 2014 motor gasoline supply/demand balance. In 2014, gasoline consumption averaged 364,000 b/d, including 30,000 b/d of ethanol. Consumption generally follows a seasonal pattern, with peak consumption occurring during the summer months. In 2014, peak consumption occurred in August with 392,000 b/d, up from a low of 334,000 b/d in March. On an annual basis, in-region refinery production met approximately 18% of gasoline consumption, net of ethanol inputs, in 2014.

**Figure 58. North Louisiana-Arkansas motor gasoline supply/demand balance, 2014**

Note: All domestic movements and inventory changes are reported on a net basis.

Source: ICF Analysis of EIA, FHWA, FERC, and company 10-K data

The U.S. Environmental Protection Agency (U.S. EPA) does not require the use of reformulated gasoline in any locations in the North Louisiana-Arkansas region.<sup>189</sup> In accordance with the Clean Air Act, the U.S. EPA requires the adoption of a summer Reid Vapor Pressure (RVP) standard that limits the volatility of conventional gasoline sold in certain areas of the country. From May 1 through September 15, the states of Alabama, Arkansas, Louisiana, and Mississippi each enforce a statewide 9.0 RVP limit.<sup>190</sup> No locations in the North Louisiana-Arkansas region observe RVP limits stricter than the statewide regulations, and no locations maintain winter oxygenated fuels programs.<sup>191</sup>

**Table 35. North Louisiana-Arkansas motor gasoline regulations**

Regulation	Area (s)	Dates
Summer gasoline volatility <9.0 RVP	Alabama, Arkansas, Louisiana, and Mississippi statewide	May 1 – Sept. 15

Source: U.S. EPA

### Distillate

Figure 59 presents the 2014 monthly distillate supply/demand balance for the North Louisiana-Arkansas region. In 2014, distillate consumption averaged 164,000 b/d. Consumption generally follows a seasonal pattern, with consumption higher during the summer months. Consumption peaked at 177,000 b/d in

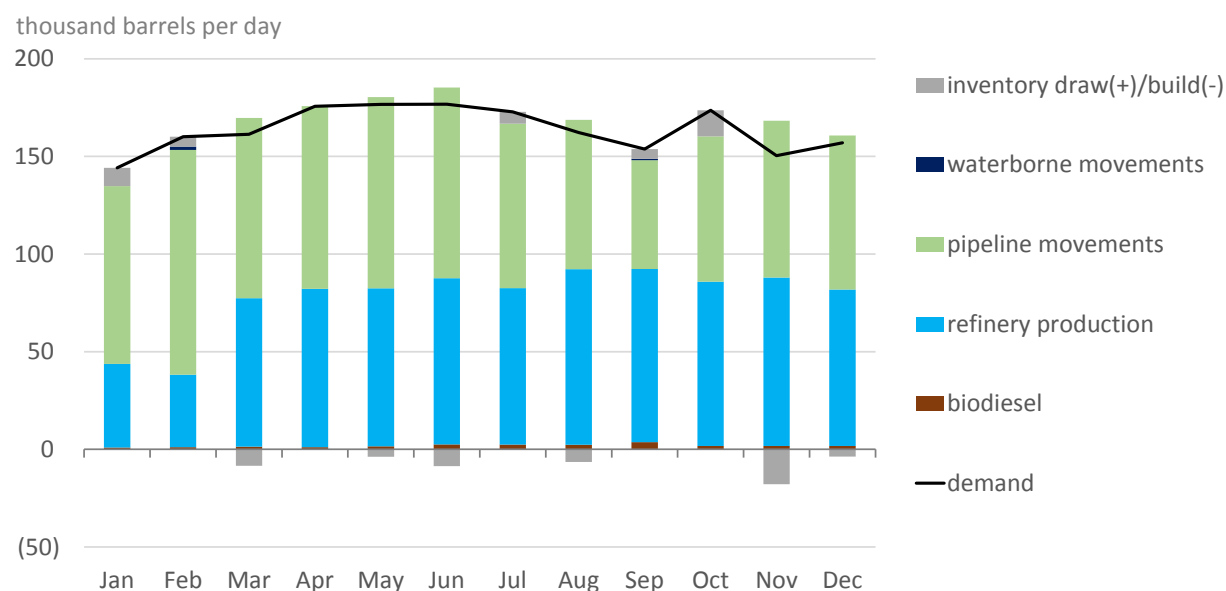
<sup>189</sup> U.S. Environmental Protection Agency, "Reformulated Gasoline," (Accessed January 6, 2015), <http://www.epa.gov/gasoline-standards/reformulated-gasoline>.

<sup>190</sup> U.S. Environmental Protection Agency, "Gasoline Reid Vapor Pressure" (Accessed December 11, 2015), <http://www.epa.gov/gasoline-standards/gasoline-reid-vapor-pressure>.

<sup>191</sup> U.S. Environmental Protection Agency, "State Winter Oxygenated Fuel Program Requirements for Attainment or Maintenance of CO NAAQS" (Accessed November 9, 2015), <http://epa.gov/otag/regs/fuels/420b08006.pdf>.

May and June 2014, up from a low of 144,000 b/d in January. In-region refinery production met approximately 47% of consumption on an annual basis in 2014.

**Figure 59. North Louisiana-Arkansas distillate supply/demand balance, 2014**

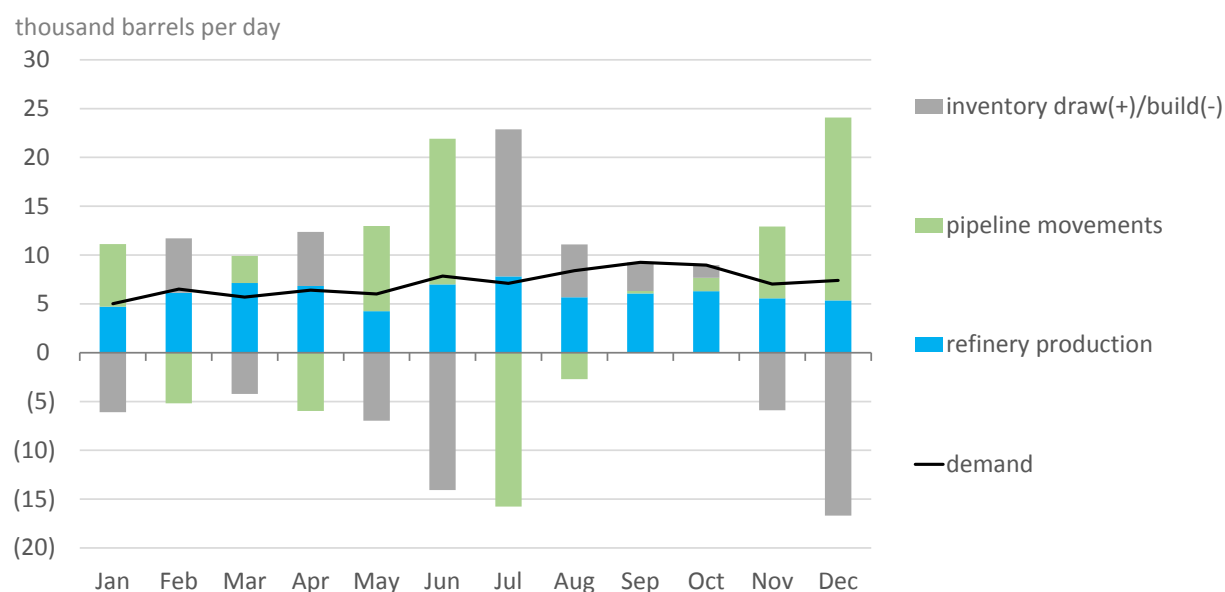


Note: All domestic movements and inventory changes are reported on a net basis.

Source: ICF Analysis of EIA, FHWA, FERC, and company 10-K data

### Jet fuel

Figure 60 presents the North Louisiana-Arkansas region's 2014 jet fuel supply/demand balance. Commercial jet fuel consumption averaged approximately 7,000 b/d in 2014, with very little month to month variation. On an annual basis, in-region refinery production met approximately 86% of consumption with pipeline deliveries from other regions making up the difference. Monthly jet fuel consumption was higher in the second half of 2014, with consumption peaking in the late summer and fall months.

**Figure 60. North Louisiana-Arkansas jet fuel supply/demand balance, 2014**

Note: All domestic movements and inventory changes are reported on a net basis.

Source: ICF Analysis of EIA, Airlines for America, FERC, and company 10-K data

Five airports in the North Louisiana-Arkansas region are designated as primary commercial service hubs by the Federal Aviation Administration, although all are classified as small hubs. The two largest airports in the region are the Birmingham-Shuttleworth International Airport (BHM) in Alabama and the Bill and Hillary Clinton National Airport (LIT) in Little Rock, Arkansas. Sixty-nine smaller commercial airports also operate in the region, in addition to four Air Force Bases (AFBs): Maxwell-Gunter AFB in Alabama; Little Rock AFB in Arkansas; Barksdale AFB in Louisiana; and Columbus AFB in Mississippi.<sup>192</sup>

## Refineries

The North Louisiana-Arkansas region has nine refineries with a combined atmospheric crude distillation capacity of 243,000 barrels per calendar day (b/cd).<sup>193</sup> The majority of this capacity—169,000 b/cd—is at five refineries clustered along the Louisiana-Arkansas border, while the remaining capacity is at four refineries that are geographically spread out in Alabama and Mississippi. Table 36 lists each refinery and its operable capacity as of January 1, 2015. Delek's El Dorado, Arkansas refinery is the only refinery in the North Louisiana-Arkansas region that is configured to produce high yields of ground transportation fuels.<sup>194</sup> The three Calumet refineries and the Cross Oil refinery on the Louisiana-Arkansas border primarily produce specialty, non-fuel products, such as lubricants, process oils, waxes, and solvents, although Calumet's Shreveport refinery yields some transportation fuels.<sup>195</sup> Transportation fuels from

<sup>192</sup> MilitaryBases.com, "State Military Bases" (Accessed November 5, 2015), <http://militarybases.com>.

<sup>193</sup> Barrels per calendar day is a measure of the amount of input that a distillation unit can process in a 24-hour period under usual operating conditions. It takes into account both planned and unplanned maintenance. Stream day capacity is the maximum number of barrels of input that a distillation facility can process within a 24-hour period when running at full capacity under optimal crude and product slate conditions with no allowance for downtime. Stream day capacity is typically about 6% higher than calendar day capacity.

<sup>194</sup> Delek U.S., "Refining Segment," (Accessed January 6, 2016), <http://www.delekus.com/companies/refining-segment>.

<sup>195</sup> Calumet Specialty Products Partners, L.P., "Calumet Shreveport Refining – Shreveport, Louisiana," (Accessed January 6, 2016), <http://www.calumetspecialty.com/about-us/facilities/calumet-shreveport-refining>.

the El Dorado and Shreveport refineries are primarily distributed to local markets in northern Louisiana and Arkansas by truck and barge but are also distributed to markets in PADD 2 via the Enterprise TEPPCO pipeline system.<sup>196</sup> The inland Mississippi and Alabama refineries specialize in non-fuel products, such as lubricants and specialty oils (Ergon and Goodway), and asphalt (Hunt). These refineries also yield small volumes of transportation fuels, which are distributed in local markets by truck.<sup>197 198</sup>

**Table 36. North Louisiana-Arkansas refineries**

Owner	Site	Operable capacity, b/cd <sup>A</sup>
<b>Louisiana-Arkansas Border</b>		
Delek	El Dorado, AR	83,000
Calumet	Shreveport, LA	57,000
Calumet <sup>B</sup>	Cotton Valley, LA	13,020
Calumet <sup>B</sup>	Princeton, LA	8,300
Cross Oil <sup>B</sup>	Smackover, AR	7,500
<b>Total</b>		<b>168,820</b>
<b>Inland Mississippi and Alabama</b>		
Hunt <sup>C</sup>	Tuscaloosa, AL	36,000
Ergon Refining <sup>B</sup>	Vicksburg, MS	23,000
Hunt <sup>C</sup>	Sandersville, MS	11,000
Goodway <sup>B</sup>	Atmore, AL	4,100
<b>Total</b>		<b>74,100</b>
<b>North Louisiana-Arkansas Total</b>		<b>242,920</b>

(A) Barrels per calendar day, as of Jan. 1, 2015

(B) Primarily produces specialty products

Source: U.S. Energy Information Administration, Refinery Capacity Report

In addition to the in-region refineries listed in Table 36, Valero's 180,000 b/d refinery in Memphis, Tennessee (located in PADD 2), is a key supplier of transportation fuels to markets in the North Louisiana-Arkansas region, particularly in Arkansas and northern Mississippi. According to EIA data, barge movements from PADD 2 to PADD 3 averaged 9,000 b/d in 2014; almost all of this volume was gasoline that likely originated at the Memphis refinery and was delivered via the Mississippi River. In addition, approximately 8,000 b/d of gasoline, distillates, and jet fuel was trucked from Tennessee to Arkansas in 2013, while 7,000 b/d was trucked to Mississippi, according to preliminary data on freight movements from the U.S. Department of Transportation (U.S. DOT). Truck movements from Memphis were likely higher in 2014 due to changes in the TEPPCO pipeline's service to North Louisiana and Arkansas (See Supply and logistics section for additional details).

Figure 61 shows monthly 2014 refinery utilization and yield percentages for motor gasoline (both finished gasoline and blendstocks), distillate fuel oil, residual fuel oil, and other secondary products for the North Louisiana-Arkansas region. A major turnaround at Delek's El Dorado, Arkansas refinery

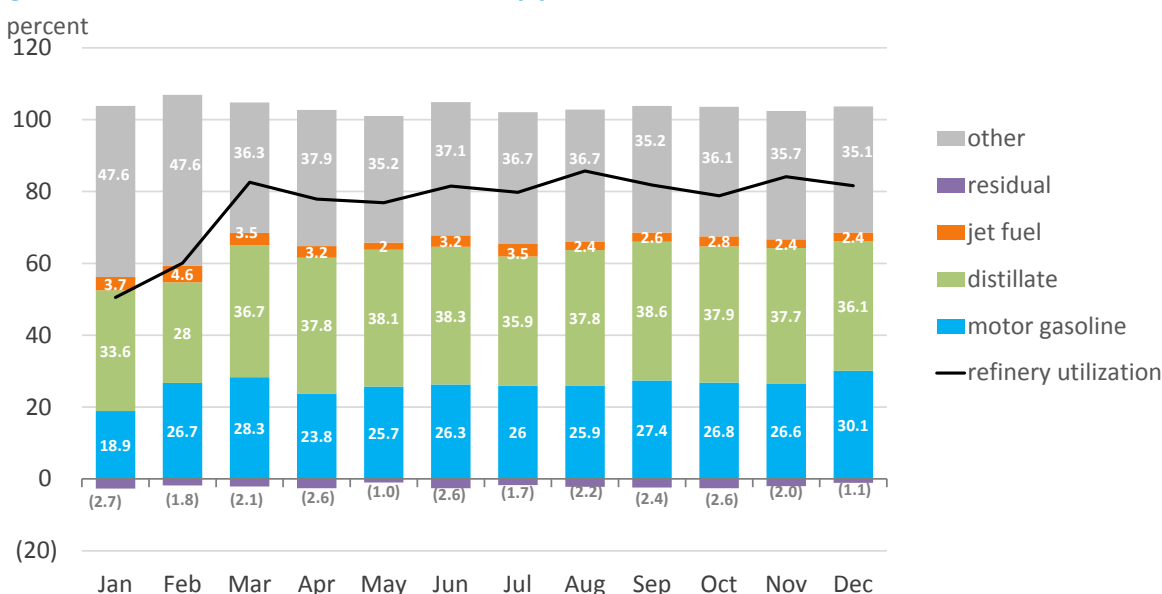
<sup>196</sup> Delek U.S., "Refining segment" (Accessed December 7, 2015), <http://www.delekus.com/companies/refining-segment>.

<sup>197</sup> Ergon, Inc. "Refining & Marketing" (Accessed December 7, 2015), <http://www.ergon.com/refining-marketing>.

<sup>198</sup> Goodway Refining, LLC, "Products," (Accessed January 6, 2016), <http://www.goodwayrefining.com/product.html>.

brought the region’s utilization down and altered the region’s yield pattern in January and February 2014. Production of transportation fuels (gasoline, distillate, and jet fuel) accounted for 59.2% of the region’s annual yield from March through December, when normal refinery operations were in effect, compared to a national average of 84.5%. From March through December, the region’s motor gasoline yield, at 26.7%, was well below the national average of 45%; distillate yield, at 37.5%, exceeded the national average of 29.9%; and jet fuel yield, at 2.8%, was well below the national average of 9.6%. The North Louisiana-Arkansas region produces a higher yield of non-fuel products; asphalt and road oil yield is 14.6% at the region’s refineries, compared to a national average of 2.0%, while lubricants yield is 12.5% compared to a national average of 1.0%. A peculiarity of the North Louisiana-Arkansas yield profile is the negative yield of residual fuels, which ranged from -1.0 to -2.7% in 2014. The negative yield may indicate that the region’s refineries are consuming residual fuel oils, shipped in from other regions, as a feedstock in production.

**Figure 61. North Louisiana-Arkansas refinery yields**

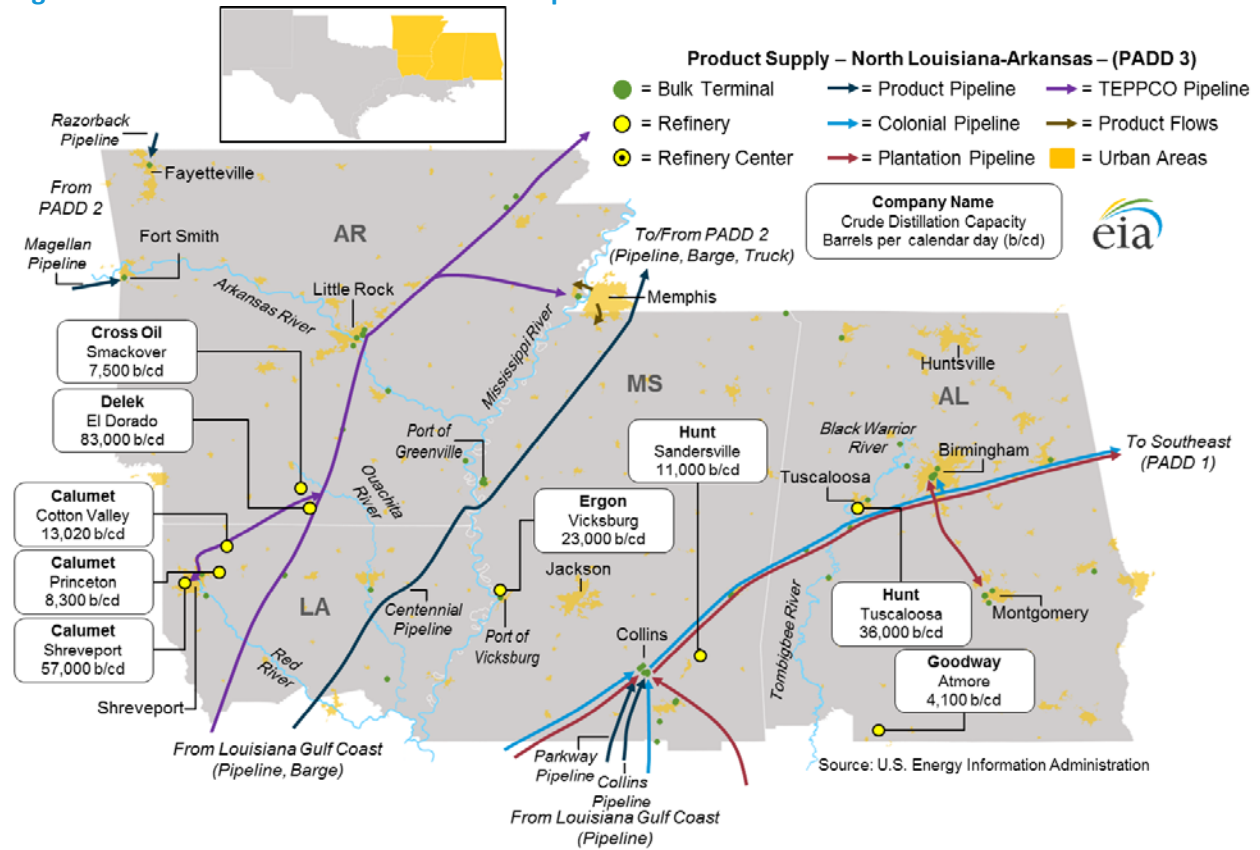


Note: yield percentages sum to higher than 100% due to processing gains.  
 Source: U.S. Energy Information Administration, Petroleum Supply Monthly

### Supply and logistics

Markets in the North Louisiana-Arkansas region are primarily supplied by the Colonial, Plantation, and Enterprise TEPPCO pipelines that pass through the region on their way to larger markets in other parts of the country. In-region refineries supply local markets, particularly in Arkansas, while waterborne shipments move along the region’s river systems to smaller markets that lack pipeline access. Figure 62 presents a map of the refineries, product pipelines, product terminals, and major waterways in the North Louisiana-Arkansas region.

Figure 62. North Louisiana-Arkansas refined petroleum infrastructure



### Pipelines

Several major petroleum product pipelines supply markets in the North Louisiana-Arkansas region as they pass through the region en route to larger markets on the East Coast (Colonial and Plantation) and Midwest (TEPPCO). In addition, several smaller feeder lines pump fuel from refineries in the Louisiana Gulf Coast region to a major pipeline transportation hub in Collins, Mississippi, for staging onto the Colonial and Plantation systems. Meanwhile, markets in western Arkansas are served by pipelines from Oklahoma and Missouri in PADD 2. Table 37Table 19 lists the pipelines serving the North Louisiana-Arkansas region, including each line’s origin, destination, length, and capacity, if publically available.



**Table 37. Select North Louisiana-Arkansas refined product pipelines**

Pipeline	Origin	Destination	Distance, miles	Capacity b/d
Colonial Pipeline	Houston, TX (Main)	Greensboro, NC	5,500	2,500,000
	Belle Chasse, LA	Collins, MS		
	Helena, AL	Birmingham, AL		
Plantation Pipeline	Baton Rouge, LA	Greensboro, NC	3,100	700,000
	Pascagoula, MS	Collins, MS		
	Helena, AL	Birmingham, AL		
	Helena, AL	Montgomery, AL		
Enterprise TEPPCO Pipeline	Texas City, TX (Main)	Selkirk, NY	4,700	230,000
	El Dorado, AR	Shreveport, LA		
	Beebe, AR	Memphis, TN		
Collins Pipeline	Meraux, LA	Collins, MS	125	130,000
Parkway Pipeline	Norco, LA	Collins, MS	141	110,000
Centennial Pipeline <sup>A</sup>	Beaumont, TX	Bourbon, IL	795	210,000
Razorback Pipeline	Mount Vernon, MO	Rodgers, AR	67	30,000
Magellan Pipeline	Allen, OK	Fort Smith, AR	120	not avail.

(A) Largely idle since mid-2011. No receipt or delivery points within the region.

Source: ICF research and estimates

The Colonial and Plantation pipelines supply markets in Mississippi and Alabama. The 2.5 million b/d Colonial Pipeline, which originates in Houston, Texas, has six delivery locations in Mississippi and Alabama, including points along a short spur line to Birmingham, Alabama.<sup>199</sup> The 700,000 b/d Plantation Pipeline, which originates in Baton Rouge, has eight delivery points in the two states, including points along spur lines to Birmingham and Montgomery, Alabama.<sup>200</sup> In aggregate, Colonial and Plantation are estimated to deliver about 300,000 b/d to markets in Mississippi and Alabama. Four additional pipelines supply fuel to the Collins hub from the Louisiana Gulf Coast region but do not have other delivery points in Mississippi—the Collins Pipeline, the Parkway Pipeline, Colonial Pipeline Company’s Belle Chasse-to-Collins feeder line, and Plantation Pipeline’s Pascagoula-to-Collins feeder line.

The Enterprise TEPPCO pipeline, with an estimated capacity of 230,000 b/d, supplies markets in northern Louisiana and Arkansas. TEPPCO, which originates in the Texas Gulf Coast region, has five delivery locations in Louisiana and Arkansas, including points on spur lines to Shreveport, Louisiana, and Memphis, Tennessee. The TEPPCO system currently delivers gasoline to the region from Texas, and also receives gasoline, distillates, and jet fuel from the El Dorado and Shreveport refineries. In 2014, flows into TEPPCO from these refineries averaged 72,000 b/d. The TEPPCO system ceased interstate distillates and jet fuel service from Texas to Louisiana and Arkansas in 2013 when one of the two pipelines that made up the system was taken out of service as part of a project to ship ethane from the Northeast to

<sup>199</sup> Colonial Pipeline Company, “Schedule of Rates” (Accessed December 20, 2015), <http://www.colpipe.com/docs/default-source/schedule-of-rates/2015-colonial-schedule-of-rates.pdf?sfvrsn=2>.

<sup>200</sup> Kinder Morgan, “Pipeline Tariffs – Plantation” (Accessed December 20, 2015), [http://www.kindermorgan.com/business/products\\_pipelines/tariffs\\_plantation.aspx](http://www.kindermorgan.com/business/products_pipelines/tariffs_plantation.aspx).

Texas. TEPPCO still moves intrastate jet fuel volumes within Arkansas from the El Dorado refinery to the Bill and Hillary Clinton Airport.<sup>201</sup>

The 210,000 b/d Centennial Pipeline, which originates in the Texas Gulf Coast and runs to southern Illinois, passes through Louisiana, Arkansas, and northern Mississippi but has no receipt or deliveries points within the region. The line has largely been idle since mid-2011.

### Ports

The Mississippi River and its connecting waterways, including the Red, Black, Ouachita, and Arkansas rivers, provide avenues for the movement of transportation fuels to markets without direct access to pipeline systems. In addition, the Black Warrior-Tombigbee river system in northern Alabama provides supply to smaller communities in that part of the region. Table 38 lists the ports and waterways in the North Louisiana-Arkansas region that received inbound shipments of transportation fuels in 2013, the latest year for which domestic marine movement data is available from the U.S. Army Corps of Engineers (USACE). Total inbound shipments at ports along the region's waterways was approximately 31,000 b/d in 2013.

**Table 38. Waterborne receipts of transportation fuels at North Louisiana-Arkansas ports, 2013**

Port/Waterway	Domestic, b/d
Greenville, MS	11,167
Vicksburg, MS	6,049
Arkansas River (AR)	5,745
Ouachita and Black Rivers (LA)	2,130
Little River (LA)	4,475
Black Warrior and Tombigbee Rivers (AL)	1,507
<b>North Louisiana-Arkansas Total</b>	<b>31,073</b>

Source: U.S. Army Corp of Engineers 2013 Waterborne Commerce of the United States Waterways and Harbors

### Markets

#### North Louisiana

The Shreveport metropolitan area in northeast Louisiana is supplied by Calumet's 57,000 b/d Shreveport refinery, which specializes in lubricants but also produces transportation fuels. In addition, Shreveport receives products via a TEPPCO pipeline spur originating in El Dorado, Arkansas, and by truck from the nearby Sunoco Logistics pipeline terminal in Waskom, Texas (in PADD 2).<sup>202</sup> Calumet's Shreveport refinery also supplies gasoline into the TEPPCO system—volumes originating in Shreveport averaged 18,000 b/d in 2014, according to quarterly pipeline data filed with the Federal Energy Regulatory Commission (FERC). Markets to the east of Shreveport in north central and northwest Louisiana are supplied via the TEPPCO mainline system at Arcadia, Louisiana; via barge to terminals along the Ouachita and Black rivers; and by truck from Vicksburg, Mississippi.

<sup>201</sup> Federal Energy Regulatory Commission, "Order Accepting Tariff Filing: Enterprise TE Products Pipeline, LLC," <http://www.ferc.gov/EventCalendar/Files/20130531173940-IS13-265-000.pdf>, May 31, 2013.

<sup>202</sup> Sunoco Logistics, "Terminal Data" (Accessed December 20, 2015), <http://www.sunocologistics.com/Terminal-Data/132/terminalid--306/>.

## Arkansas

Little Rock in central Arkansas and Jonesboro in northeast Arkansas are primarily supplied by the Enterprise TEPPCO pipeline system from the Gulf Coast, although Little Rock also receives products by barge along the Arkansas River, and by truck from Memphis, Tennessee, and Fort Smith Arkansas.<sup>203</sup> In addition to supply from the Gulf Coast, the TEPPCO system receives products from Delek's 83,000 b/d El Dorado refinery in southern Arkansas. Over the last three quarters in 2014, when the refinery was fully operational, Delek delivered approximately 61,000 b/d of transportation fuels into the TEPPCO system, according to FERC data. West Memphis in eastern Arkansas is supplied by Valero's 180,000 b/cd refinery in Memphis, Tennessee (in PADD 2) and via a pipeline spur running from the TEPPCO mainline running to Memphis. Other markets in eastern Arkansas are supplied by barge terminals, which lie on both the Arkansas and Mississippi sides of the Mississippi River, and by a barge terminal in Pine Bluff, Arkansas, along the Arkansas River. Approximately 6,000 b/d of transportation fuel was received along the Arkansas River in 2013, which includes deliveries to Pine Bluff and Little Rock, according to USACE. Markets in western Arkansas are primarily supplied by pipeline from PADD 2: Fort Smith, Arkansas, receives products from refineries in Oklahoma via the Magellan pipeline system, while Fayetteville in northeast Arkansas, receives product from Missouri via the 30,000 b/d Razorback pipeline. The Razorback pipeline only shipped around 8,000 b/d in 2014, according to FERC data. Fayetteville also receives truck supply from Tulsa, Oklahoma (in PADD 2). In 2013, truck movements of transportation fuels from Oklahoma to Arkansas averaged 18,000 b/d.

## Inland Mississippi

Markets in inland Mississippi are primarily supplied by the Colonial and Plantation pipeline systems, and feeder lines from the Louisiana Gulf Coast region that converge in Collins, Mississippi. The Collins hub receives products from the Colonial mainline system from Houston, Texas; the Colonial feeder line from Belle Chasse, Louisiana; the Plantation mainline from Baton Rouge, Louisiana; the Plantation feeder line from Pascagoula, Mississippi; the Collins Pipeline from Meraux, Louisiana; and the Parkway Pipeline from Norco, Louisiana. All told, nearly 3.2 million b/d of transportation fuels flowed through the Collins hub in 2014, or more than one-fifth of total U.S. product supplied. Products gathered in Collins flow via the Colonial and Plantation mainlines to markets across the eastern United States as far north as the New York Harbor area. In addition, terminals at the Collins hub distribute fuel by truck to local markets, including Jackson, Mississippi. Jackson, and markets to the west, also receive supply from Ergon's 23,000 b/d Vicksburg, Mississippi refinery, which specializes in lubricants but also yields small volumes of ULSD, and via barge on the Mississippi River to the Port of Vicksburg, which received approximately 6,000 b/d of transportation fuels in 2013. Markets in northern Mississippi are supplied by truck from Memphis, Tennessee (in PADD 2), and from terminals in the Memphis area, by barge from the Port of Greenville, Mississippi, on the Mississippi River which brought in 11,000 b/d of transportation fuels in 2013. Markets in western Mississippi are supplied by the Colonial and Plantation pipelines at Meridian, Mississippi, and from Hunt Refining's 11,000 b/d refinery in Sandersville, Mississippi, which specializes in asphalt but also yields small volumes of transportation fuels.

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<sup>203</sup> Times Record, "Magellan Secures Fort Smith Terminal Extension Building Permit," (Accessed December 20, 2015), <http://swtimes.com/business/magellan-pipeline-secures-fort-smith-terminal-extension-building-permit>.

## Inland Alabama

Central Alabama, including Birmingham, Montgomery, Tuscaloosa, and Oxford, is supplied by the Colonial and Plantation pipeline systems. From Pelham, Alabama, short spurs from the two mainline systems deliver fuel north to Birmingham, while a longer Plantation spur supplies fuel south to Montgomery. Tuscaloosa and Oxford are supplied directly from the mainline systems. In addition, Hunt Refining operates a 36,000 b/d asphalt refinery in Tuscaloosa, which also yields transportation fuels that are marketed locally. Huntsville in northern Alabama, is primarily supplied by truck from terminals in Chattanooga, Tennessee (in PADD 2), which are fed by spurs from the Colonial and Plantation pipelines originating near Atlanta, Georgia. Florence, in northwest Alabama, is supplied by barge via the Tennessee River from supply origins in PADD 2.

### Supply vulnerability

The North Louisiana-Arkansas region is critically dependent on transportation fuel supply delivered by pipeline from the Texas and Louisiana Gulf Coast regions. Markets in inland Mississippi and inland Alabama are dependent on the Colonial and Plantation pipelines systems, while markets in North Louisiana and Arkansas are dependent on the TEPPCO pipeline system. Generally, these markets have a limited ability to make up for pipeline outages via alternative supply sources.

The Little Rock, Arkansas market, which is one of the largest markets in the region, could potentially replace lost volumes on the TEPPCO pipeline system, at a higher cost, by trucking fuel directly from the in-region 83,000 b/d El Dorado, Arkansas refinery; from the 180,000 b/d Memphis, Tennessee refinery (in PADD 2); or from pipelines from the Midcontinent region (in PADD 2) that terminate in western Arkansas. Additional volumes can also be shipped by barge to terminals along the Arkansas River in the Little Rock area, or trucked from barge terminals at the Port of Greenville, Mississippi.

Markets in central Alabama—primarily Birmingham and Montgomery, which are two of the largest markets in the region—have few alternative supply options to compensate for outages on the Colonial and Plantation pipelines. Some replacement volumes could be trucked from the pipeline storage hub in Collins, Mississippi, or trucked directly from refineries in the Louisiana Gulf Coast region, however, the ability to do so is limited by the availability of trucks and the long distances to supply sources.

The pipeline hub in Collins, Mississippi, is a critical asset for the Colonial and Plantation pipelines supplying inland Mississippi and inland Alabama, and markets in PADD 1. The Collins site stages supply from multiple feeder pipelines originating in the Louisiana Gulf Coast region, for transport on the Colonial and Plantation systems. During Katrina, power outages to pumping facilities at the Collins shut flows on both systems, disrupting supply of transportation fuels to downstream markets. Since Katrina, Colonial and Plantation have focused time and resources on preparing for and responding to extreme weather events. Colonial has invested in several tractor-trailer mounted portable generators that would allow the company to bring its system back on-line during prolonged disruptions to the power grid.<sup>204</sup>

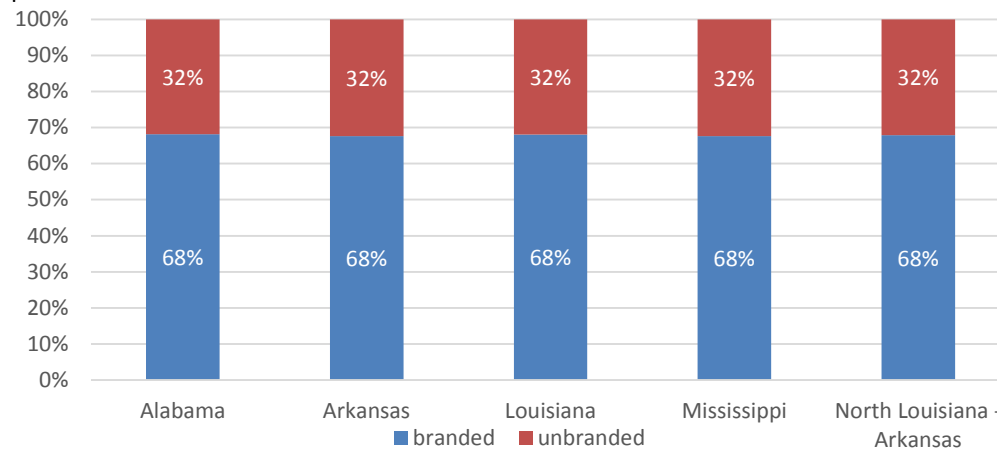
<sup>204</sup> Felt, Tim, President and CEO Colonial Pipeline Company, "Testimony at Quadrennial Energy Review Stakeholder Meeting: Transmission, Storage and Distribution Issues Relating to Petroleum and Refined Products," QER Stakeholder Meeting, New Orleans, Louisiana, (May 27, 2014),

## Retail markets

There are 7,114 total retail service stations in Alabama, Arkansas, Louisiana and Mississippi; a count that includes outlets in both the North Louisiana-Arkansas region and the Louisiana Gulf Coast region<sup>205</sup>. Figure 63 shows the share of these outlets that are branded versus unbranded by state. Stations are classified as ‘branded’ if they are associated with and display a major oil company brand. ‘Unbranded’ stations are not affiliated with a major oil company brand. Sixty-eight percent of the retail stations in the four states are branded, just under the national average of 69%. The share of branded outlets does not vary within the region; even though each state has a different number of stations. The top five brands in the four states are Shell, Chevron, Exxon, BP, and Citgo, and these brands together account for 52% of the region’s retail outlets. Fifty-four percent of the region’s stations offer diesel fuel, compared to a national average of 53%. As of 2015, there were 71 public filling stations and 11 private stations in the North Louisiana-Arkansas region offering E85 and four public and eight private filling stations offering biodiesel (B20 and above) in the region.<sup>206</sup>

**Figure 63. North Louisiana-Arkansas retail market structure**

percent of retail stations



Source: HSIP 2015

## Future changes

Magellan Midstream Partners is planning a 75,000 b/d pipeline project to connect the company’s Fort Smith, Arkansas, terminal to the Little Rock, Arkansas market. The project, which is expected to be operational in mid-2016, will supply gasoline, diesel, and jet fuel produced at refineries in the Midcontinent region (in PADD 2) as well as products transported through the Magellan system from the Texas Gulf Coast. The Fort Smith-to-Little Rock project was conceived in 2014 after Enterprise TEPCO discontinued interstate distillate and jet fuel service to Arkansas on its mainline system as part its ATEX

<sup>205</sup> Retail station data provided by the Homeland Security Infrastructure Program (HSIP).

<sup>206</sup> U.S. Department of Energy: Office of Energy Efficiency & Renewable Energy, “Alternative Fuels Data Center” (Accessed December 2, 2015), <http://www.afdc.energy.gov/states/>.

project to carry ethane to Texas from the Marcellus Shale Play. Magellan's project will diversify supply in Arkansas by opening up the Little Rock market to Midcontinent refinery supply.<sup>207</sup>

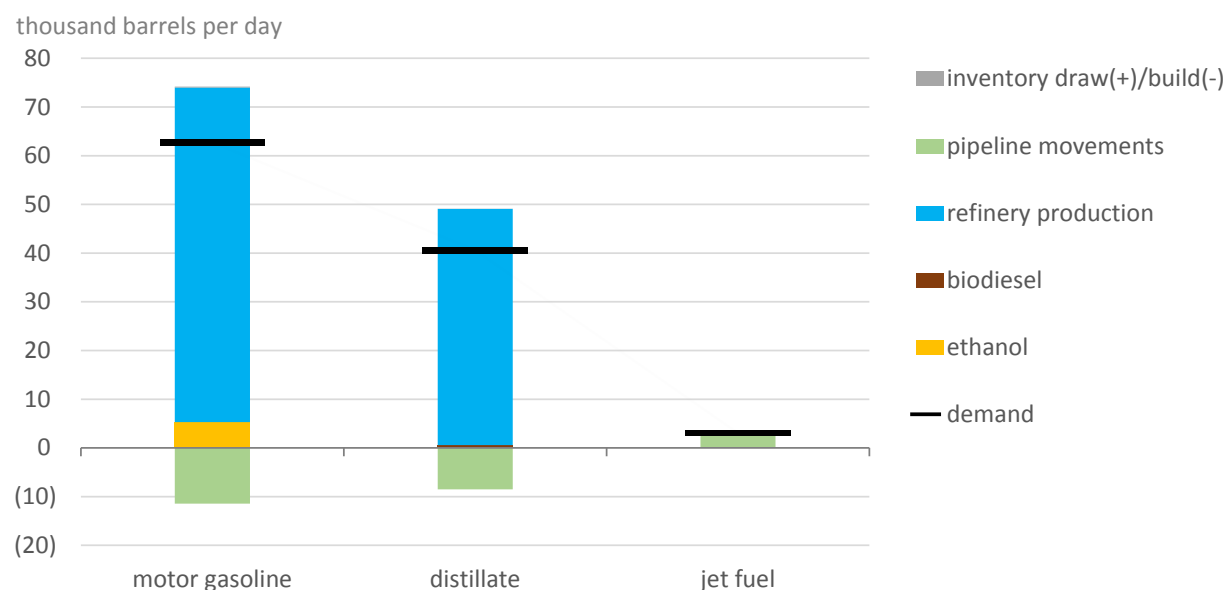
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<sup>207</sup> Port Storage Group and OPIS/ Stalsby, "Magellan's Fort Smith Products Terminal to Reopen in Early August," (July 20, 2015), [https://www.tankterminals.com/news\\_detail.php?id=3267](https://www.tankterminals.com/news_detail.php?id=3267).

## New Mexico

The New Mexico region consists of the state of New Mexico. New Mexico is less populous than other regions addressed in this study and, as such, overall market consumption of petroleum products is lower. Principal consumption centers are located in the Albuquerque, Santa Fe, and Farmington metropolitan areas in the north and Las Cruces in the south. Estimated total consumption of motor gasoline, distillate fuel oil, and commercial jet fuel in New Mexico was 106,000 b/d in 2014. The state's refinery production of gasoline and distillates are higher than in-state consumption and the state is net exporter of those products to other regions on an annual basis. Products primarily move in and out of the state by pipeline, although cross border trade also takes place by truck between New Mexico and neighboring states. New Mexico refineries do not produce jet fuel and all supply is brought into the state by pipeline. There are no waterborne movements of petroleum products in New Mexico, the region does not import or export product from foreign countries. Figure 64 presents the 2014 annual supply and demand balances for motor gasoline, distillate, and jet fuel.

**Figure 64. New Mexico supply/demand balances, 2014**



Note: All movements and inventory changes are on a net basis.

Source: ICF analysis of EIA, FERC, FHWA, and company 10-K data

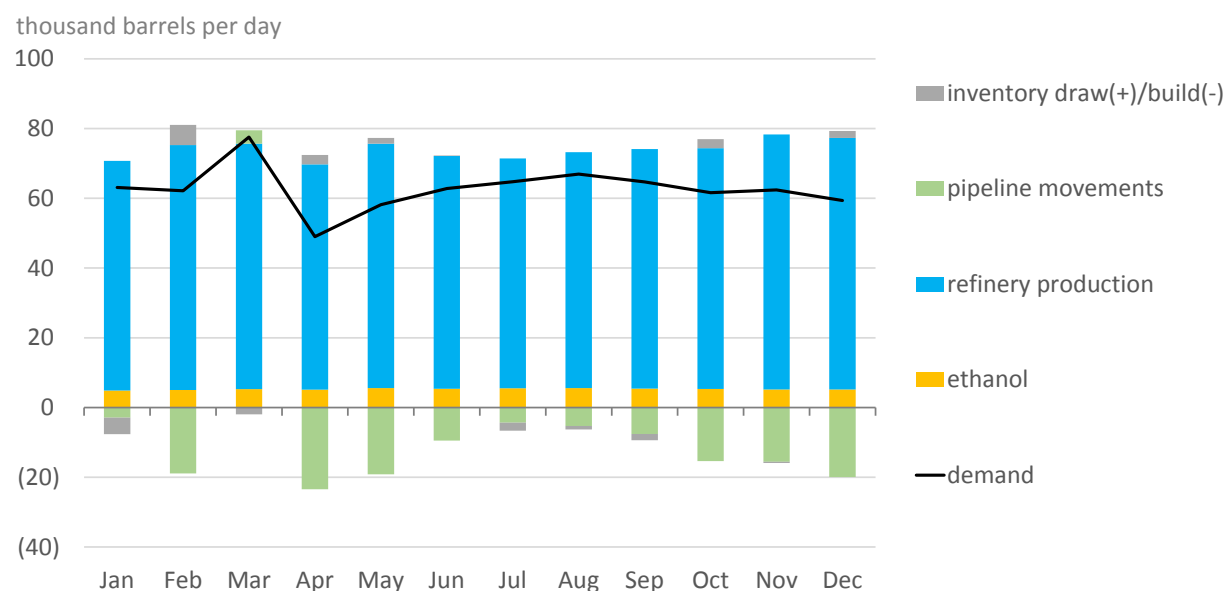
### Supply/demand balances

#### Gasoline

New Mexico's motor gasoline market is in surplus on an annual net basis, with in-state production exceeding consumption. Figure 65 presents New Mexico's 2014 motor gasoline supply/demand balance. In 2014, gasoline consumption, all of which is conventional gasoline, averaged 69,000 b/d, including 5,000 b/d of ethanol. Gasoline consumption typically follows a seasonal pattern, rising during the summer driving season. New Mexico is a net shipper of gasoline to other regions during most of the year but net pipeline movements out of the region decline from June through September as consumption

risers and refinery production declines due to the transition to summer gasoline. In 2014, net pipeline movements out of New Mexico averaged more than 11,000 b/d.

**Figure 65. New Mexico motor gasoline supply/demand balance, 2014**



Note: All movements and inventory changes are on a net basis.

Source: ICF analysis of EIA, FERC, FHWA, and company 10-K data

The U.S. Environmental Protection Agency (U.S. EPA) does not require the use of reformulated gasoline anywhere in New Mexico.<sup>208</sup> During the summer months, the U.S. EPA regulates the volatility of conventional gasoline sold in all counties in New Mexico. From May 1 through September 15, gasoline with a Reid Vapor Pressure (RVP) higher than 9.0 is prohibited.<sup>209</sup> The state of New Mexico does not require more stringent summer volatility limits than those required by U.S. EPA. During the winter months (November through February), the state of New Mexico maintains an oxygenated fuel program in the Albuquerque metropolitan area that requires gasoline to have an oxygen content of 2.7%, in order to reduce carbon monoxide emissions.<sup>210</sup> Oxygenated gasoline is produced by blending with ethanol.

**Table 39. New Mexico fuel regulations**

Regulation	Area (s)	Dates
Summer Gasoline Volatility <9.0 RVP	New Mexico statewide	May 1 – Sept. 15
Winter Oxygenated Fuel (2.7%)	Albuquerque metro area	Nov. 1 – Feb. 28

Source: U.S. EPA

<sup>208</sup> U.S. Environmental Protection Agency, "Reformulated Gasoline," (Accessed January 6, 2015), <http://www.epa.gov/gasoline-standards/reformulated-gasoline>.

<sup>209</sup> U.S. Environmental Protection Agency, "Gasoline Reid Vapor Pressure" (Accessed December 11, 2015), <http://www.epa.gov/gasoline-standards/gasoline-reid-vapor-pressure>.

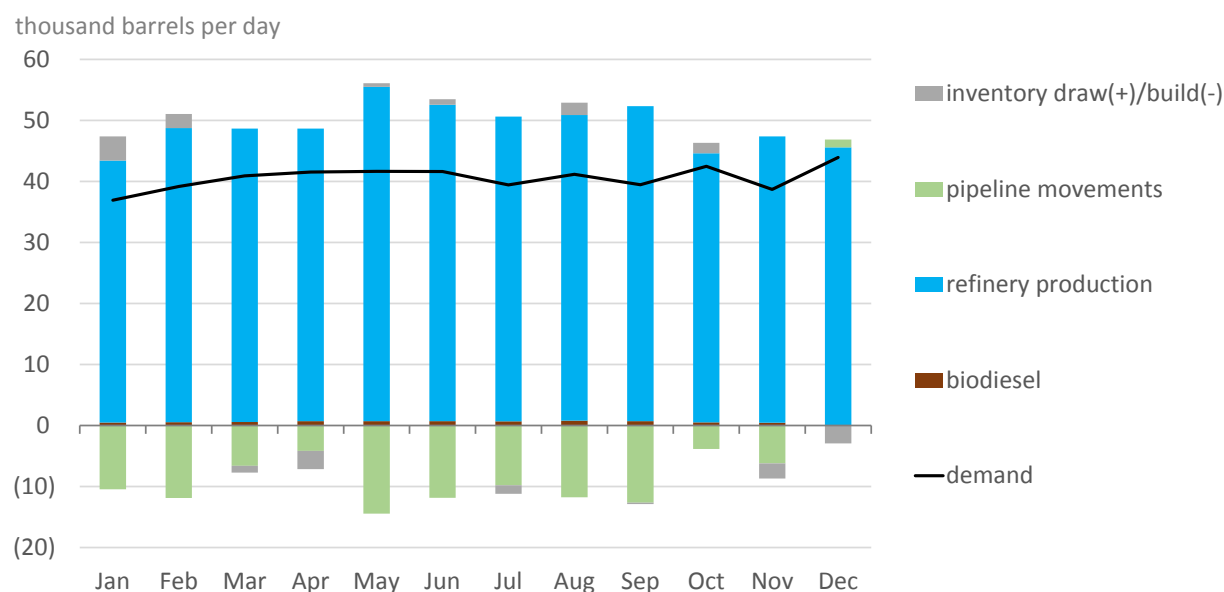
<sup>210</sup> U.S. Environmental Protection Agency, "State Winter Oxygenated Fuel Program Requirements for Attainment or Maintenance of CO NAAQS" (Accessed December 11, 2015), <http://epa.gov/otaq/regs/fuels/420b08006.pdf>.



## Distillate

Distillate fuel oil consumption in New Mexico is all ultra-low sulfur diesel (ULSD). In 2014, consumption averaged 41,000 b/d. More than three fourths of New Mexico's distillate is consumed for on-highway vehicle use, although the state also has substantial railroad and industrial consumption.<sup>211</sup> Very little distillate is used for residential and commercial space heating. Figure 66 presents New Mexico's 2014 supply/demand balance for distillate. Consumption does not follow a seasonal pattern. The state produces more distillate than it consumes and is a net shipper of distillate during most of the year. In 2014, net distillate movements by pipeline to other regions averaged more than 8,000 b/d.

**Figure 66. New Mexico distillate supply/demand balance, 2014**



Note: All movements and inventory changes are on a net basis.

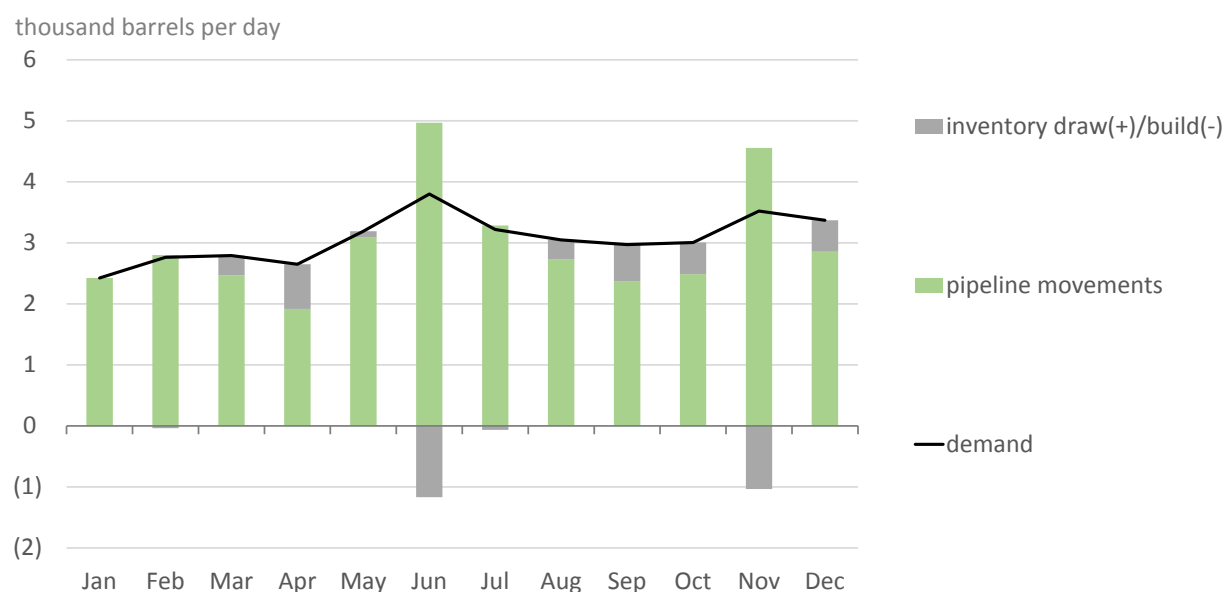
Source: ICF analysis of EIA, FERC, FHWA, and company 10-K data

## Jet fuel

New Mexico's jet fuel consumption averaged approximately 3,000 b/d in 2014.<sup>212</sup> New Mexico refineries do not produce jet fuel and the state is dependent on pipeline shipments from other regions to meet consumption. Figure 67 presents New Mexico's 2014 jet fuel supply/demand balance.

<sup>211</sup> U.S. Energy Information Administration, "Sales of Distillate Fuel by End Use – New Mexico", (Accessed December 11, 2015), [http://www.eia.gov/dnav/pet/pet\\_cons\\_821dst\\_dc\\_u\\_SNM\\_a.htm](http://www.eia.gov/dnav/pet/pet_cons_821dst_dc_u_SNM_a.htm).

<sup>212</sup> U.S. Energy Information Administration, "State Energy Data System (SEDS): State Profiles and Energy Estimates -- Table F2: Jet fuel consumption, price, and expenditure estimates, 2014" (Accessed December 4, 2015), [http://www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep\\_fuel/html/fuel\\_jf.html&sid=US](http://www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep_fuel/html/fuel_jf.html&sid=US).

**Figure 67. New Mexico jet fuel supply/demand balance, 2014**

Note: All movements and inventory changes are on net basis.

Source: ICF analysis of EIA, FERC, Airlines for America, and company 10-K data

Albuquerque International Sunport is one of four primary commercial service airports in New Mexico; however, it is the only New Mexico airport that is designated as a “hub” by the Federal Aviation Administration.<sup>213</sup> There are other smaller airports throughout the state, as well as three air force bases and two army bases that may consume commercial jet fuel, in addition to military grades.<sup>214</sup>

## Refineries

New Mexico has two refineries with a combined atmospheric crude distillation capacity of 127,500 barrels per calendar day (b/d).<sup>215</sup> Over 80% of New Mexico’s refining capacity is located at HollyFrontier Corporation’s 102,000 b/d refinery in Artesia, in the state’s southeastern corner. The remaining capacity is located at Western Refining’s 25,500 b/d refinery Gallup in northwestern New Mexico. Both refineries primarily supply refined products to local markets in New Mexico and West Texas, but also provide supply into Arizona and southern Colorado. Table 40 lists each refinery and its operable capacity as of January 1, 2015.

<sup>213</sup> Federal Aviation Administration, “Airport Safety” (Accessed November 5, 2015), [http://www.faa.gov/airports/airport\\_safety/airportdata\\_5010/menu/](http://www.faa.gov/airports/airport_safety/airportdata_5010/menu/).

<sup>214</sup> MilitaryBases.com, “State Military Bases” (Accessed November 5, 2015), <http://militarybases.com>.

<sup>215</sup> Barrels per calendar day is a measure of the amount of input that a distillation unit can process in a 24-hour period under usual operating conditions. It takes into account both planned and unplanned maintenance. Stream day capacity is the maximum number of barrels of input that a distillation facility can process within a 24-hour period when running at full capacity under optimal crude and product slate conditions with no allowance for downtime. Stream day capacity is typically about 6% higher than calendar day capacity.

Table 40. New Mexico refineries

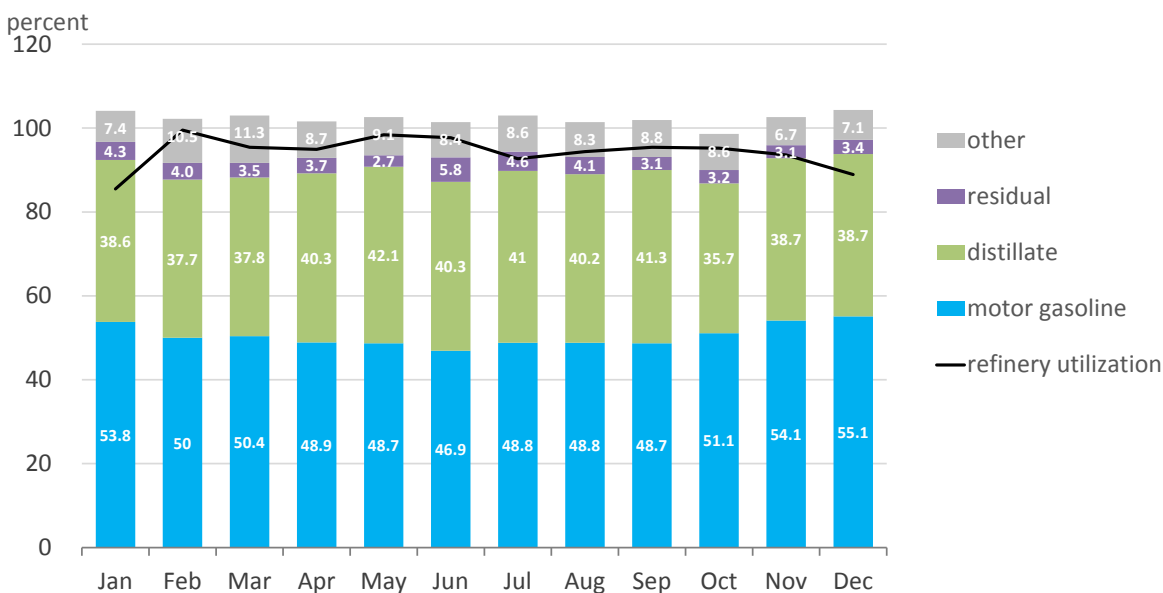
Owner	Site	Operable Capacity, b/d*
HollyFrontier Corp	Artesia, NM	102,000
Western Refining Inc.	Gallup, NM	25,500
<b>Total</b>		<b>127,500</b>

\*Barrels per calendar day, as of Jan. 1, 2015

Source: U.S. Energy Information Administration, Refinery Capacity Report

Figure 68 shows monthly refinery utilization and yield percentages for motor gasoline (both finished gasoline and blendstocks), distillate fuel oil, residual fuel oil, and other secondary products. New Mexico refineries do not produce any jet fuel, reflecting relatively low consumption in the state, and instead produce greater volumes of gasoline and distillate fuel oil. In 2014, average yields for motor gasoline and distillate fuel oil were 50.4% and 39.4%, respectively, compared to national averages of 45.0% and 29.9%. New Mexico refineries focus primarily on producing ground transportation fuels, in contrast with Texas and Louisiana Gulf Coast refineries, which produce a wider range of products, including jet fuel, petrochemical feedstocks, lubes, and other non-fuel yields. During the winter months from October through March, New Mexico's motor gasoline yields increase as refineries produce winter-grade gasoline, which includes additional butane content. During the summer months less butane is added to gasoline due to the impact of butane on the gasoline's overall RVP.

Figure 68. New Mexico refinery yields



Note: yield percentages sum to higher than 100% due to processing gains.

Source: U.S. Energy Information Administration, Petroleum Supply Monthly

## Supply and logistics

New Mexico's primary population centers in Albuquerque and Santa Fe are supplied by four refined product terminals in the Albuquerque area and one terminal in Moriarty to the east of Albuquerque. The retail market in Farmington is served by a local terminal in Bloomfield, while the Las Cruces and Alamogordo retail markets are served by truck deliveries from El Paso, Texas, and the Artesia, New

Mexico, refinery. The Gallup refinery serves local markets in western New Mexico and eastern Arizona. A terminal in Alamogordo is dedicated to military jet fuel for the nearby Holloman Air Force Base, and a terminal in Lordsburg is dedicated to diesel fuel for truck traffic along the I-10 highway from El Paso to Phoenix. Figure 69 presents a detailed map of refined product terminals, refineries, and pipelines in New Mexico and adjacent regions of Texas. Table 41 lists the refined product pipelines serving New Mexico markets.

Figure 69. New Mexico refined petroleum infrastructure

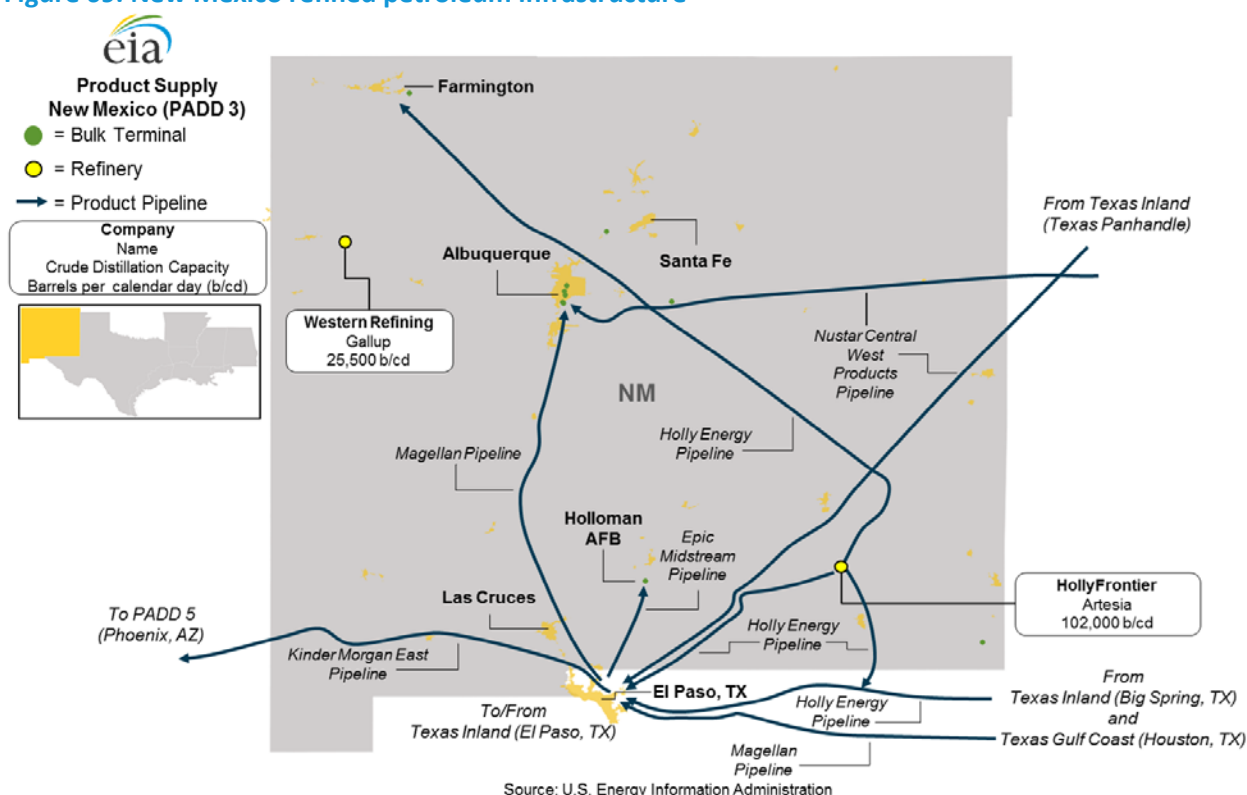


Table 41. Select New Mexico refined product pipelines

Pipeline	Origin	Destination	Distance, miles	Capacity, b/d
Holly Energy Partners Pipeline	Artesia, NM	El Paso, TX	156	19,000
	Artesia, NM	Orla, TX and El Paso, TX	214	70,000
	Artesia, NM	Moriarty, NM	215	27,000
	Moriarty, NM	Bloomfield, NM	191	14,400
	Artesia, NM	Roswell, NM	35	5,300
NuStar Central West Pipeline	Amarillo, TX	Albuquerque, NM	293	17,200
Magellan Midstream Pipeline	El Paso, NM	Albuquerque, NM	257	28,200
Kinder Morgan SFPP East Line	El Paso, NM	Phoenix, AZ	230	200,000
Epic Midstream Pipeline	El Paso, NM	Alamogordo, NM	not avail.	not avail.

(A) leased by HEP from Mid-America Pipeline, LLC

Source: Holly Energy Partners, NuStar, Kinder Morgan, Magellan, Plains All American 10-Ks

Gasoline and distillates are produced within New Mexico at the 102,000 b/d Holly Frontier refinery in Artesia and at the 25,500 b/d Western Refining refinery in Gallup. From Artesia, products are shipped

northwest through a 27,000 b/d Holly Energy Partners (HEP) pipeline to Moriarty, and from Moriarty via a 14,400 b/d line to Bloomfield.<sup>216</sup> In addition, Artesia products are shipped southwest to the El Paso, Texas supply hub through two separate HEP pipelines with a combined capacity of 89,000 b/d. Products from Artesia are also shipped to customers in Roswell via a 5,300 b/d HEP pipeline, and distributed to other local markets via the refinery's truck rack. The Gallup refinery supplies local customers in western New Mexico and across the border in Arizona via its truck rack.

Two pipeline systems operated by NuStar Energy and Magellan Midstream Partners connect the Albuquerque terminals to out-of-state supply sources. NuStar's 10-inch, 17,200 b/d Amarillo-to-Albuquerque pipeline provides supply from Valero's 172,000 b/d McKee refinery in the Texas Panhandle.<sup>217</sup> Magellan operates a 28,200 b/d pipeline that supplies Albuquerque from El Paso. In addition, the Alamogordo terminal receives out-of-state supply of military grade jet fuel (JP-8) from El Paso via a NuStar pipeline.

The largest pipeline system operating in New Mexico is Kinder Morgan's 200,000 b/d SFPP East Line, which primarily transports gasoline, distillate, and jet fuel from El Paso through the state to the Phoenix and Tucson markets in Arizona. This line transported approximately 138,000 b/d of gasoline and jet fuel, and 26,000 b/d of distillates in the fourth quarter of 2014, according to receipt data filed with FERC.<sup>218</sup> The SFPP line has one delivery point in New Mexico in Lordsburg, near the border with Arizona. This terminal receives diesel fuel to supply local truck stops on I-10.

The El Paso supply hub just south of New Mexico is the source of much of the volume supplied into New Mexico markets and through the state to Arizona. El Paso collects supply from a variety of sources: from Western Refining's 122,000 b/d El Paso refinery; from the Artesia, New Mexico, refinery; from the Texas Panhandle via NuStar's 408-mile, 40,000 b/d El Paso pipeline, which cuts across southeastern New Mexico; and from the Houston area via Magellan's South System, which has a 64,000 b/d capacity into El Paso.<sup>219</sup>

### Supply vulnerability

The Albuquerque/Santa Fe market is supplied by three pipelines: the 28,200 b/d Magellan pipeline from El Paso, the 27,000 b/d Holly pipeline from Artesia, and the 17,000 b/d NuStar pipeline from the Amarillo. Despite this diversity, the unplanned loss of the Magellan or NuStar lines could significantly impact fuel supplies into the market. If either line were unavailable for an extended period, increased volumes would likely shift to the two remaining lines, subject to the availability of excess capacity on those lines. In the short term, inventory drawdowns at Albuquerque terminals and long-distance truck deliveries from El Paso or Artesia could be used to meet consumption.

<sup>216</sup> U.S. Securities and Exchange Commission, "Holly Energy Partners L.P. – Form 10-K," (February 25, 2015), <http://investor.hollyenergy.com/secfiling.cfm?filingID=1283140-15-12&CIK=1283140>.

<sup>217</sup> A second 6-inch Nustar line along this same route, is listed as temporarily idle.

<sup>218</sup> FERC Financial Report FERC Form No. 6: Annual Report of Oil Pipeline Companies and Supplemental Form 6-Q: Quarterly Financial Report of SFPP, L.P. (2014/Q1, 2014/Q2, 2014/Q3, 2014/Q4).

<sup>219</sup> Federal Energy Regulatory Commission, "Magellan Pipeline Company, L.P – Order on Petition for Declaratory Order" Docket No. OR12-7-000, (Issued March 15, 2012), <http://www.ferc.gov/whats-new/comm-meet/2012/031512/G-3.pdf>.

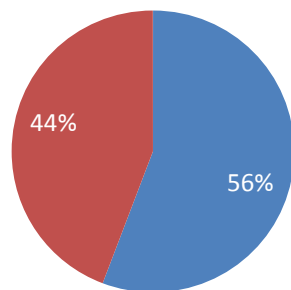
The unplanned loss of either the 102,000 b/d Artesia refinery or the 122,000 b/d El Paso refinery would significantly affect regional production and supply availability for markets in New Mexico, West Texas, and Arizona. While the extended loss of the one of these refineries would impact supply in the region, New Mexico consumption would likely continue to be met through increased deliveries to the region from Magellan’s Houston-to-El Paso pipeline, subject to available capacity. In addition, supply in El Paso destined for Arizona via Kinder Morgan’s 200,000 b/d SFPP East Line could be diverted to New Mexico markets, while Arizona markets may be able to increase shipments from Los Angeles via Kinder Morgan’s Phoenix Line to make up the difference.

## Retail markets

There are 683 retail service outlets in the state of New Mexico<sup>220</sup>. Figure 70 shows the share of these outlets that are branded versus unbranded. Stations are classified as ‘branded’ if they are associated with and display a major oil company brand. ‘Unbranded’ stations are not affiliated with a major oil company brand. Seventy three percent of New Mexico’s retail stations are branded, slightly higher than the national average of 69%. The top five brands in New Mexico are Phillips 66, Chevron, Shell, Fina, and Conoco, and these brands together account for 26% of the region’s retail outlets. Sixty-five percent of the region’s stations offer diesel fuel, compared to a national average of 53%. As of 2015, there were eight public and three private filling stations in New Mexico offering E85 and three public and four private filling stations in New Mexico offering biodiesel (B20 and above).<sup>221</sup>

**Figure 70. New Mexico retail market structure**

percent of retail stations



■ branded ■ unbranded

Source: HSIP 2015

## Future changes

HFC is planning to add a 17,000 b/d gasoline hydrotreater at its 102,000 b/d refinery in Artesia by first quarter 2017. The hydrotreater will reduce the sulfur content of gasoline production at the refinery, allowing HFC to increase its output of cleaner-burning transportation fuels. In addition to the hydrotreater, HFC is also considering a project to fix ancillary fractionators at the plant that would

<sup>220</sup> Retail station data provided by the Homeland Security Infrastructure Program (HSIP).

<sup>221</sup> U.S. Department of Energy: Office of Energy Efficiency & Renewable Energy, “Alternative Fuels Data Center” (Accessed December 2, 2015), <http://www.afdc.energy.gov/states/>.

debottleneck 4,000 b/d of processing capacity at the refinery's crude and distillate hydrotreating units. This second project is scheduled for completion in 2017.<sup>222</sup>

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<sup>222</sup> Oil & Gas Journal, "HollyFrontier lets contract for unit at Navajo refinery," (October 8, 2015), <http://www.ogj.com/articles/2015/10/hollyfrontier-lets-contract-for-unit-at-navajo-refinery.html>.

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## Appendix. Data Methodology

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Consumption and supply volumes presented in this report are based on a careful analysis of number of publically available data sources, including data from the following sources:

- The Energy Information Administration (EIA)
- The Federal Highway Administration (FHWA)
- The Federal Energy Regulatory Commission (FERC)
- U.S. International Trade Commission (USITC)
- Federal Aviation Administration (FAA)
- Airlines for America (A4A)
- U.S. Army Corps of Engineers (USACE)
- Various company websites, 10-K reports, and investor presentations
- Trade press and other publically available data

### Consumption

EIA uses [Product Supplied](#) as an approximation for consumption of petroleum products because it measures the disappearance of these products from primary sources, i.e., refineries, natural gas processing plants, blending plants, pipelines, and bulk terminals. EIA provides Product Supplied values for each PADD but not for each sub-PADD region. In order to estimate consumption at the sub-PADD level, state-level gasoline and diesel sales data from FHWA and jet fuel consumption data from Airlines for America were utilized.

#### Motor Gasoline

The FHWA compiles [state-level monthly sales data](#) for motor gasoline based on taxed volumes reported to FHWA by the states. For motor gasoline, this sales data very closely matches EIA's annual Product Supplied estimates when state-level sales are aggregated to the PADD-level. In order to ensure perfect fit, FHWA motor gasoline sales were adjusted to ensure that the sum of estimated consumption in each state would equal EIA Product Supplied at PADD-level for each month. After adjustment, state-level consumption estimates were aggregated to the sub-PADD regions. Where states were split between sub-PADD regions (e.g. Texas Gulf Coast vs. Texas Inland), sales were apportioned within the state according to county-level population data.

#### Distillate

To estimate distillate consumption, state-level on-road sales were taken directly from FHWA, while all other sales were estimated using EIA's state-level [prime supplier sales volumes](#) (PSSV). This was done by subtracting each state's on-road distillate sales, as reported by FHWA, from each state's Total Distillate and Kerosene PSSV, and then dividing the result by the same measure at the PADD level. This quotient yields each state's share of PADD-level off-road consumption. This share was then multiplied by the PADD-level off-road distillate consumption estimate, which is equal to EIA's total PADD-level distillate product supplied less FHWA on-road sales, to produce an off-road distillate consumption estimate for each state. Finally, each state's off-road consumption estimate was added to its on-road sales, as



reported by FHWA, to produce the each state's total consumption of distillate fuel. This methodology is summarized in Equation 1.

#### Equation 1. Distillate consumption estimation formula

$$Demand_{State} = FHWA Sales_{State} + \left( \frac{EIA Total Distillate and Kerosene PSSV_{State} - FHWA Sales_{State}}{EIA Total Distillate and Kerosene PSSV_{PADD} - FHWA Sales_{PADD}} \right) \times (EIA Product Supplied_{PADD} - FHWA Sales_{PADD})$$

Note that state-level consumption estimates are forced to sum to PADD-level product supplied when aggregated. As with gasoline, state-level distillate consumption is aggregated to each sub-PADD region, with state-level estimates apportioned within states by county-level population when necessary.

#### Jet Fuel

[Airlines for America](#) (A4A), an industry group representing U.S. airlines, provided ICF International and EIA non-public data on commercial jet fuel consumption in 2014 at 79 of the largest airports in the country. Jet fuel consumption reported by A4A covered more than 80% of EIA's total 2014 U.S. jet fuel Product Supplied. To estimate jet fuel consumption at airports not covered by A4A data, a multivariate regression analysis was conducted to establish a statistical relationship between jet fuel consumption at individual airports, and reported enplanements (passenger boardings) and cargo volumes (by landed weight) at those airports, [as reported by FAA](#). Because the airports not included in the A4A dataset were smaller airports, the regression was only run using similarly sized airports. Outlier airports in Hawaii and Alaska were also removed from the regression data. Overall, 40 airports were used in the analysis and the regression achieved a multiple R squared value of 0.9917. The resulting correlation equation is expressed in Equation 2.

#### Equation 2. Jet fuel correlation equation

$$Demand_{Airport} = (0.33445 \times Enplanements_{Airport}) + (0.00026 \times Landed Cargo_{Airport})$$

In the Equation 2, *Consumption* is expressed in annual barrels of jet fuel consumption, *Enplanements* are expressed as an annual count of passenger boardings, and *Landed Cargo* is expressed in annual tons. Equation 3 was used to estimate jet fuel consumption at airports not included in the A4A dataset. Combining reported airport jet fuel consumption from the A4A dataset with estimated consumption from non-reporting airports produced a comprehensive consumption dataset for all the airports in PADDs 1 and 3. Data for each airport was then adjusted so that the sum of all airports would match EIA's jet fuel Product Supplied data at the PADD-level. The annual consumption numbers for each airport were then apportioned to each month in 2014, using monthly shares of [state-level PSSV of jet fuel](#). For each month, jet fuel consumption estimates for each airport were aggregated to the sub-PADD level.

#### Supply

Supply data includes refinery production, imports, exports, inventory changes, domestic pipeline movements, and domestic marine movements. Ethanol and biodiesel are also treated as supply elements but the source of these fuels are not broken out.

## Refinery Production

Refinery production volumes for motor gasoline, distillate, and jet fuel were taken directly from EIA's Monthly Refinery Report. Calculating refinery production of motor gasoline and diesel required adjustments to subtract renewable fuel additives (fuel ethanol and biodiesel), which are sometimes blended into finished fuels that are distributed via the refinery's truck rack. Motor gasoline refinery production was calculated as the sum of two components: finished motor gasoline from EIA's [net refinery production](#) data and motor gasoline blending components from EIA's [refinery net input](#) data. From this sum, net [refinery input](#) of ethanol was subtracted to arrive at the petroleum-only component of refinery gasoline production. Similarly, for distillate, refinery inputs of [renewable diesel fuel](#) were subtracted from EIA's [net refinery production](#) of distillates to arrive at the petroleum-only component of refinery gasoline production. Jet fuel [net refinery production](#) did not require any adjustments for renewable fuels.

## Imports

Import of motor gasoline, motor gasoline blending components, distillates, and jet fuel were sourced from EIA's 2014 [company level imports](#) data and aggregated to sub-PADD level.

## Exports

Exports of transportation fuels were sourced from the USITC's [Interactive Tariff and Trade Dataweb](#) and aggregated to the sub-PADD level.

## Inventories

Inventory changes to transportation fuels were calculated as the sum of changes to refinery and blender stocks. Monthly refiner stocks are [publically available](#) at the sub-PADD level, however; monthly blender stocks are not publically available at the sub-PADD level and non-public EIA data was used.

## Ethanol and Biodiesel

Ethanol and biodiesel supplies were calculated as the sum of [refinery and blender inputs](#) of those products. This data is publicly available data for sub-PADD regions in PADD 3 (which correspond with EIA's refinery districts) but not for sub-PADD regions in PADD 1. Non-public EIA data was ethanol and biodiesel supply used for these sub-PADDs.

## Domestic Movements

[Pipeline](#) and [tanker/barge](#) movements between PADD regions are sourced from EIA's Monthly Tanker and Barge Movements Report. Movements between sub-PADD regions not available and analyst judgement was used to estimate the volumes of fuel moving into and out of these regions based on a careful analysis of inter-PADD movements; sub-PADD regional consumption; reported supply sources within, into, and out of each sub-PADD region; and data on specific waterborne and truck movements published from other sources, including:

- USACE's [Waterborne Commerce of the United States](#) (2013 data), which provided domestic inbound and outbound movements of gasoline, distillate, and jet fuel to U.S. ports. UASCE data is reported in tons and was converted to barrels using product-specific conversion factors.

- FHWA's [Freight Analysis Framework](#) (Provisional Annual Data for 2013), which provided inbound and outbound movements of gasoline, distillate, and jet fuel between states and metropolitan areas by truck and rail. FHWA data is reported in tons and was converted to barrels using product-specific conversion factors.
- FERC's [Form 6/6-Q – Annual/Quarterly Report of Oil Pipeline Companies](#) (2014), which provided quarterly receipts into interstate pipeline systems by product and state.

#### Retail Markets

Data on the number of service stations and their branding in each region was obtained from the [Homeland Security Infrastructure Program](#). Data on the number of renewable fuel service stations was obtained from the Department of Energy's [Alternative Fuel Data Center](#).