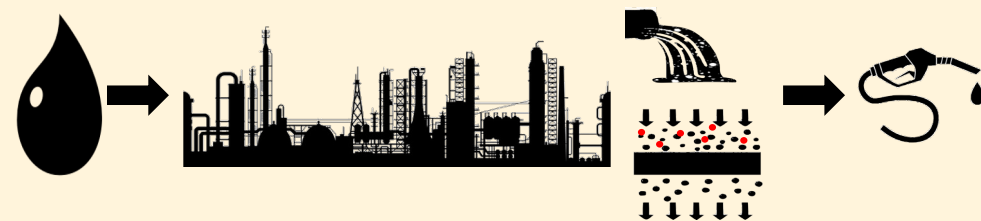
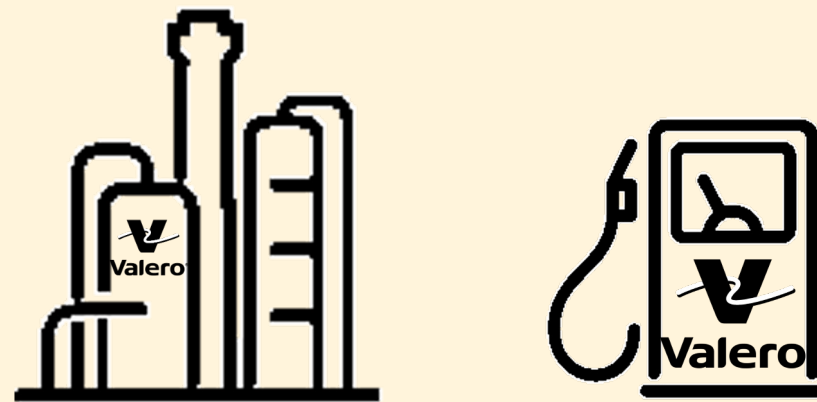


## REFINERIES

(2024 Revenue: \$123.9 Billion)

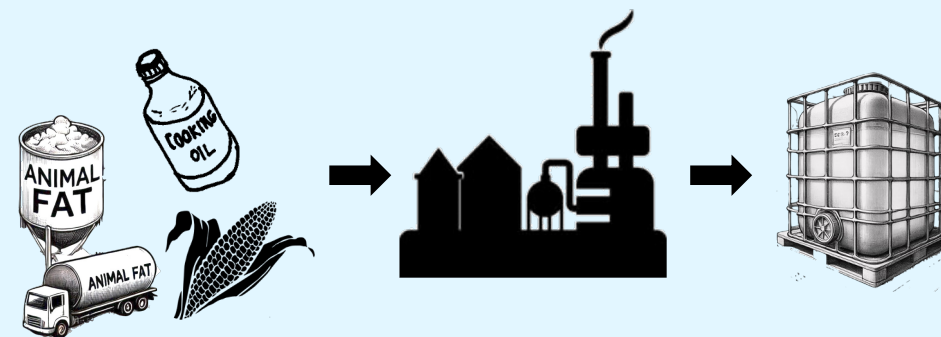
The Refining segment (1) owns petroleum refineries that refine crude oil into fuel, petrochemical feedstocks, and specialty products (e.g., asphalt and solvent) at 15 petroleum refineries in the U.S., Canada, and U.K., with a combined throughput capacity of 3.2 million barrels per day (BPD), (2) conducts associated activities to market the refined petroleum products, and (3) owns logistics assets that support refining operations. Valero's sells the refined petroleum products it manufactures as well as those it purchases from third parties (or via an exchange) into wholesale rack and bulk markets



## RENEWABLE DIESEL

(2024 Revenue: \$2.4 Billion)

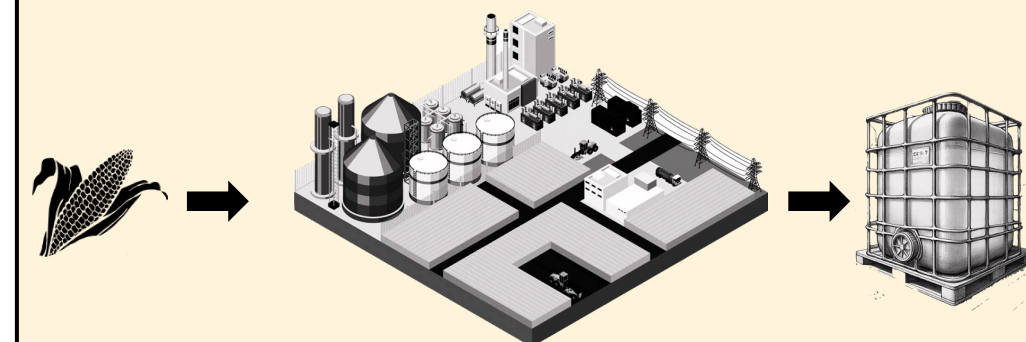
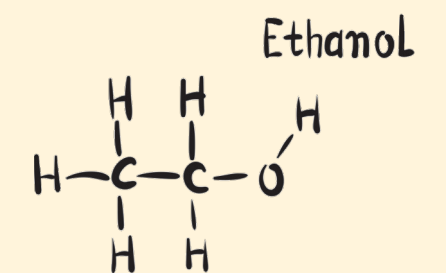
The Renewable Diesel segment consists of Diamond Green Diesel Holdings LLC (DGD), a consolidated 50/50 joint venture with Darling Ingredients Inc., that produces low-carbon intensity renewable liquid diesel fuel from recycled animal fats, used cooking oil and inedible corn oil. DGD is the world's second largest renewable diesel producer.



## ETHANOL

(2024 Revenue: \$3.6 Billion)

The Ethanol segment is the world's second largest corn ethanol producer and includes 12 dry mill ethanol facilities in the Mid-Continent region of the U.S. that process corn to produce ethanol and various co-products.





# Valero Energy: Ecosystem

**Valero Energy Corporation**  
One Valero Way  
San Antonio, Texas 78249  
(210) 345-2000; valero.com

### Outside Relationships

Regulators	Capital	Suppliers	Customers
<b>Key Subjects of Regulation</b> <b>Environmental</b> U.S. Environmental Protection Agency (EPA) generation, storage, treatment, transport, and disposal of hazardous substances and waste materials to prevent releases into soil, groundwater, and surface water "Superfund" clean-up liability and remediation requirements for hazardous substances handling, storage and disposal of non-hazardous waste monitoring and reporting of air emissions from processing plants, processing and completion facility construction and modification approvals and air permits installation of control technology and adoption of work practices to control hazardous emissions general permits to discharge pollutants in federal and state waters; storm water runoff permits; permits to discharge dredge and fill material in wetlands spill prevention control, containment dikes, other countermeasures, and emergency spill response plan requirements to prevent oil spills in navigable waters South Coast Air Quality Management District (local agency focused on improving air quality in Los Angeles, Orange, Riverside and San Bernardino counties—e.g., staged reduction of ozone emissions) California Air Resources Board (CARB) sets air quality standards and benchmarks for low-carbon and petroleum fuels; credits granted if above, and remedy required if below, benchmark Interstate Pipelines and Oil and Gas Products Sales Federal Energy Regulatory Commission (FERC) Interstate Crude Oil, Refined Petroleum Products, and Crude Oil-Based NGL Pipelines (reasonable, non-discriminatory tariffs for petroleum pipelines; requirement to file rates, terms of service complaint-based regime) Intrastate Crude Oil, Refined Petroleum Products, and Crude Oil-Based NGL Pipelines (review and approve rates, terms and conditions where intrastate pipeline systems transport crude oil, petroleum products, or NGLs in interstate commerce) U.S. Department of Transportation (USDOT) (includes Pipeline and Hazardous Materials Safety Administration and Federal Railroad Administration; requires reduction of volatile or flammable constituents in crude oil that are transported by rail; pipeline regulation; safety standards for hazardous liquids pipeline) PHMSA Pipeline and Hazardous Materials Safety Administration U.S. Coast Guard (USCG) (restricts marine transportation of crude oil to U.S. vessels) Intrastate Pipelines, and Oil & Gas Products Sales Federal Energy Regulatory Commission (FERC) Intrastate Natural Gas Pipelines (review and approve rates, terms and conditions where intrastate pipeline systems transport natural gas in interstate commerce) Intrastate Crude Oil, Refined Petroleum Products, and Crude Oil-Based NGL Pipelines (review and approve rates, terms and conditions where intrastate pipeline systems transport crude oil, petroleum products, or NGLs in interstate commerce) State Public Utility Commissions (FERC for interstate pipelines)	Public Debt Holders Hedge Counterparties Commercial Banks (Lead Bank: JP Morgan Chase) Other Banks: Citibank, RBS, Bank of America, Bank of New Scotia, Barclays Bank, MUFG Bank, Wells Fargo Bank, Mizuho Bank, BNP Paribas, Credit Suisse, Royal Bank of Canada, Sumitomo Mitsui Banking Corporation, Trust Bank, Toronto Dominion Bank, U.S. Bank, Lloyds Bank, Morgan Stanley Bank, Royal Bank of Canada, Comerica Bank, Northern Trust Company, National Bank of Egypt)	United Steel Workers and Oil, Chemical and Atomic Workers Union (1,777 employees, or ~18% of workforce, covered by collective bargaining agreements) USW Key Categories of Supply Crude Oil and Natural Gas Crude Oil Producers Raw Natural Gas Producers Petrochemical Feedstocks Ethane, Propane, Natural Gasoline, Naphtha, and Gas Oil Used Cooking Oil, Animal Fat, and Distiller's Corn Oil Transportation Company-Owned and Common Carrier Pipelines, Railcar, Barges, Trucks, and Ships Commercial Elevators and Local Farmers Wind Turbine, Blade and Platform Makers (gas in interstate commerce) Wind Turbine, Blade and Platform Makers (NW wind farm)	Business Regulation Bond Financing Commodity Derivatives Working Capital Financing Labor Union Representation and Collective Bargaining Services (on behalf of Valero employees) Supplies of (1) Crude Oil and Natural Gas, (2) Petrochemical and Other Feedstocks, (3) Transportation Services, (4) Corn, and (5) Windmill Supplies Wholesale Rack Sales of Refined Petroleum Products to Valero-Branded and Third Party-Branded Motor Fuel Retailers and Distributors (gasoline, distillate products, asphalt, tube oils, and natural gas liquids (NGLs)) Wholesale Rack Sales of Refined Petroleum Products or Received on an Exchange from Third Parties to Major Tank Farms and Trading Hubs (gasoline, distillate products, asphalt, and petrochemicals) Bulk Sales Market (oil companies, traders, and bulk end users, such as railroads, airlines, and utilities) Retail Sales of Motor Fuel and Merchandise Motorists, Airports and U.S. Military Bases Renewable Diesel and Naphtha Customers (government agencies, fuel wholesalers, fuel retail outlets, diesel trucking service providers, and commercial customers) End-Users (government agencies, fuel wholesalers, fuel retail outlets, diesel trucking service providers, and commercial customers) Valero Refining (renewable diesel only)

### Valero Energy Corporation (a Delaware corporation)

#### Debt Structure

Total Debt (\$8.1 Billion @ 12/31/2024; \$10.5B if finance lease obligations included) | Credit Ratings: Baa2 (Moody's), BBB (S&P), BBB (Fitch)

Working Capital	Committed Facilities of VIEs	Valero	Valero Energy Partners LP
\$4B Valero Revolving Credit Facility Outstanding: \$0 (Matures 2027)	\$1.3B A/R Sales Facility Outstanding: \$0 (Matures 2024)	\$400M DGD Revolver Outstanding: \$0 (Matures 2026)	\$100M DGD Loan Agreement Outstanding: \$0 (Matures 2026)
\$830M Enova Revolver Outstanding: \$58M (Matures 2028)	2025-2029 Senior Notes (\$2.5B) @ 2.15%-4.35%	2030-2039 Senior Notes (\$2.0B) @ 2.80%-10.5%	2045-2097 Senior Notes (\$2.0B) @ 3.65%-7.45%
			2026-2028 Senior Notes (\$722M) @ 4.375%-7.65%

#### Governance

**Board of Directors**

Lane Riggs	Kimberly S. Greene (G chair), P	Randall J. Weisenburger (C)	Committees: Audit (A), Human Resources and Compensation (C), Nominating and Corporate Governance (G), Sustainability and Public Policy (P)
Fred M. Diaz (A)	Deborah P. Majoras (G, P chair)		
H. Paulett Eberhart (A chair), P	Eric D. Mullins (A)		
Marie A. Folkes (G)	Robert A. Profusek (C, P)	Rayford Wilkins, Jr. (C chair), P	

**Executive Team**

<b>CEO and President, Director:</b> Lane Riggs	<b>SVP Renewables Operations and Low Carbon Fuels:</b> Eric Honeyman	<b>VP Refining Operations:</b> Greg Gehtsky
<b>EVP and CFO:</b> Jason Fraser	<b>SVP Corporate Development and Strategy:</b> Rich Lashway	<b>VP Crude and Feedstocks Supply and Trading:</b> Randy Hawkins
<b>EVP and COO:</b> Gary K. Simmons	<b>SVP and CHRO:</b> Julia Rendon Reinhart	<b>VP and Treasurer:</b> John Locke
<b>EVP and General Counsel:</b> Rich Walsh	<b>VP - Investor Relations and Finance:</b> Homer Bhullar	<b>VP and Controller:</b> Elizabeth Selva
<b>SVP Product Supply, Trading and Wholesale:</b> Eric Fisher	<b>VP - Refining Services:</b> Greg Bram	<b>VP Information Services and Technology:</b> Mike Zacho

#### Operations

**Refining Segment (2024 Revenues \$123.9B)**

<b>Segment Revenue (\$123.6B)</b>	<b>Production Capacity</b>	<b>Labor</b>
Gasoline and Blend Stocks: \$56.0B	Feedstock Throughput (crude oil/other feedstocks): 3.2M BPD	Employees: ~6,000
Distillates: \$55.6B	Other Products: \$12.2B	

**Specialty Products / Other Products**

Asphalt (45K barrels/day)	Propane (28K barrels/day)	Sulphur (1.2M tons/year)	Naphthenic Oils (produced at Three Rivers, TX refinery)
Solvents and Aromatics (toluene and mixed xylenes)	Aromatics (benzene, toluene and mixed xylenes)	Natural Gas Liquids (NGLs)	Petroleum Coke (6M tons/year)

**Petroleum Refineries**

Petroleum Refineries and Throughput Capacity (15 in the U.S., Canada, and the U.K.)			
<b>Benicia, CA</b> 170K BPD	<b>Armdors, OK</b> 90K BPD	<b>McKee, TX</b> 200K BPD	<b>Quebec City, Quebec</b> 235K BPD
<b>Wilmington, CA</b> 135K BPD	<b>Memphis, TN</b> 195K BPD	<b>Port Arthur, TX</b> 435K BPD	<b>Pembroke, Wales, UK</b> 270K BPD
<b>Meroux, LA</b> 135K BPD	<b>Corpus Christi, TX</b> 370K BPD	<b>Texas City, TX</b> 260K BPD	
<b>St. Charles, LA</b> 340K BPD	<b>Houston, TX</b> 255K BPD	<b>Three Rivers, TX</b> 100K BPD	

**Transportation and Logistics Assets (supporting Valero's refining and renewables operations)**

Rail: ~12,000 owned or leased rail cars	Pipeline: ~3,000 miles	Docks: 50+
Marine Vessels: Two Panamax class vessels	Trucks: 200+ truck rack bays	Storage: ~130 million barrels of storage capacity

**Production Process**

- Shipping: Acquires 2.6 million barrels of crude oil a day from suppliers. The crude is shipped to Valero Energy refineries via pipeline, rail, trucks, ships, and barges.
- Storage: The crude oil is stored in Valero Energy Refineries, which have a storage capacity of 26.2 million barrels.
- Refining: The crude oil is heated by a furnace and sent to a distillation tower, where it is separated by boiling point. The material is converted by heat, pressure or a catalyst into finished products such as fuel (gasoline and diesel) and specialty products (e.g., asphalt and solvents).
- Transportation: Finished refined products are shipped to customers via pipeline, rail, trucks, ships, and barges.
- Consumers: Valero distributes motor fuel to Valero-branded fuel stations and third-party fuel outlets (e.g., Sunoco, which is controlled by Phillips 66) for sale to motorists and other end consumers. Valero also sells fuel directly to the military and airports.

**Refineries Competition**

**Wholesale Bulk Sales of Renewable Diesel and Renewable Naphtha (to be blended with petroleum-based diesel and gasoline)**

**Renewable Diesel Competitors**

#### Logo History

1980-1994: VALERO ENERGY CORPORATION  
1994-2018: VALERO  
2018-Present: Valero

#### Equity Structure

**Share Repurchase Program**  
Authorized: \$5.0B  
Expiration: none  
Balance: \$4.3B

**Preferred Stock**  
Authorized: 20.0M shares  
Issued: 0  
Record Holders: n/a

**Common Stock**  
Authorized: 1.2B shares  
Issued: 673.5M shares  
Outstanding: 315.0M shares  
Record Holders: 4,196

#### Corporate Matters

<b>Commercial</b> Crude Supply and Products Trading Wholesale Marketing Transportation International Commercial Operations Groups Corporate Development and Strategy Company Strategy Innovation	<b>Supply, Trading and Wholesale</b> Product Supply and Trading Global Wholesale Marketing Specialty Marketing Business Refining Services Crude Oil and Intermediate Supply Sale of Fuel Oil and Asphalt Paper Trading / Hedging Activities Transportation Services Engineering	<b>Crude and Feedstocks Supply and Trading</b> Refining Operations Refining Capital Projects Procurement Refining Technology Refining Capital Projects Engineering
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#### Renewables (2024 Revenues: \$6.0B)

**Ethanol (2024 Revenues \$3.6 Billion)**

<b>Segment Revenue (\$3.6B)</b>	<b>Production Capacity</b>	<b>Labor</b>
Ethanol: \$2.6B	Ethanol: 1.7B gallons	Employees: ~800
Distillers Grains: \$971M	Dry Distillers Grains (DDG): 4.4M tons	
Intersegment: \$868B	Corn Processing: 583M bushels	

**Facilities**

Ethanol Plants (12)	Production Capacity
<b>Bluffton, Indiana</b> Ethanol Capacity: 140M gallons DDG Capacity: 368K tons Corn Processing Capacity: 49M bushels	
<b>Linden, Indiana</b> Ethanol Capacity: 140M gallons DDG Capacity: 368K tons Corn Processing Capacity: 49M bushels	
<b>Mount Vernon, Indiana</b> Ethanol Capacity: 100M gallons DDG Capacity: 263K tons Corn Processing Capacity: 35M bushels	
<b>Albert City, Iowa</b> Ethanol Capacity: 140M gallons DDG Capacity: 368K tons Corn Processing Capacity: 49M bushels	
<b>Charles City, Iowa</b> Ethanol Capacity: 165M gallons DDG Capacity: 434K tons Corn Processing Capacity: 57M bushels	
<b>Fort Dodge, Iowa</b> Ethanol Capacity: 150M gallons DDG Capacity: 394K tons Corn Processing Capacity: 52M bushels	
<b>Hartley, Iowa</b> Ethanol Capacity: 150M gallons DDG Capacity: 368K tons Corn Processing Capacity: 52M bushels	
<b>Lakota, Iowa</b> Ethanol Capacity: 110M gallons DDG Capacity: 289K tons Corn Processing Capacity: 38M bushels	
<b>Welcome, Minnesota</b> Ethanol Capacity: 150M gallons DDG Capacity: 394K tons Corn Processing Capacity: 52M bushels	
<b>Albion, Nebraska</b> Ethanol Capacity: 140M gallons DDG Capacity: 368K tons Corn Processing Capacity: 49M bushels	
<b>Bloomington, Ohio</b> Ethanol Capacity: 140M gallons DDG Capacity: 368K tons Corn Processing Capacity: 49M bushels	
<b>Aurora, South Dakota</b> Ethanol Capacity: 150M gallons DDG Capacity: 394K tons Corn Processing Capacity: 52M bushels	

**Production Process**

- Receiving: Local farmers and suppliers deliver field corn to the plants by truck and rail.
- Distillation: The fermented mash is heated to separate the ethanol from the water and solids in distillation.
- Downstream Transport to Ethanol Markets: Ethanol is shipped primarily by rail to wet providers who mix the ethanol with gasoline to be sold at Valero stations and other fuel outlets.
- Distiller's Grains Markets: Distiller's grains are shipped primarily by truck, rail and barge to businesses that process them into livestock feed. The corn oil is shipped primarily to plants to make renewable diesel fuel.

**Valero Ethanol Footprint**

**Valero Ethanol Data**

- Ethanol has at least 30% lower life cycle GHG emissions compared with petroleum gasoline.
- Valero produces 1.7 billion gallons per year.
- Ethanol is a low-carbon fuel well-positioned for export growth.
- Valero is the world's second largest ethanol producer.
- Valero's ethanol business has ~800 employees.

**Ethanol Competitors**

### Outside Relationships

Customers	Suppliers	Capital	Regulators
<b>Significant Shareholders</b> Vanguard (10.97%) BlackRock (8.01%) State Street Corporation (6.48%) Charles Schwab Investment Management (3.38%) Ameriprise Financial (2.51%) Institutional Ownership (84.28%)	<b>Professional Service Firms</b> KPMG (audit services) Campbell Ewald (advertising services) Bracewell and Ernst & Young (lobbying services) Pillsbury Winthrop Shaw Pittman (environmental legal services) Microsoft Azure and VMware (cloud computing, storage, and data analytics services platform) VMware by Broadcom	<b>Securities Regulators</b> U.S. Securities and Exchange Commission (regulation of offers and sales securities, material event disclosure and financial reporting requirements; recordkeeping requirements under anti-bribery law) New York Stock Exchange (listing, maintenance and corporate accountability rules) NYSE Delaware Secretary of State (administration and enforcement of Delaware corporation law governing business entity formation and dissolution, shareholders, board and officer governance / meetings, fiduciary duties of loyalty and care of directors, executive management files, financial reporting, charter document amendments, mergers and acquisitions, and compliance / penalties for non-compliance)	<b>Equity Capital</b> Dividends and Common Stock Repurchases <b>Professional Services</b> Sales of Ethanol Under Term and Spot Contracts in Bulk Markets (to enable petroleum producers to meet renewable fuels standards) Sales of Motor Fuel and Merchandise Ethanol Products Consumers Airports Military and Other Motor Fuel Customers Cattle Ranchers and Pig and Poultry Farmers (in U.S., Mexico and Asia) Renewable Diesel Producers Diamond Green Diesel Joint Venture (50/50 joint venture between Valero Energy and Darling Ingredients) Sales of Renewable Diesel and Feedstocks (at market prices under raw material supply agreement) Darling Ingredients (reprocesses and recycles materials from the animal agriculture and food industries, transforming them into essential ingredients that feed animals, fertilize crops, fuel planes and nourish people) <b>Operations Agreement</b> Outlining Operations at Two Renewable Diesel Plants (as operator, Valero runs the plant and performs certain day-to-day operating and management functions for DDG as an independent contractor; the DDG joint venture agreement provides Valero (as operator) with the power to direct the activities that most significantly impact DDG's economic performance)

#### Key Company Data (as of 12/31/2024)

**Business Overview:** San Antonio, Texas-based Valero Energy Corporation is a multinational manufacturer and marketer of petroleum-based and low-carbon liquid transportation fuels and petrochemical products. Valero sells its products primarily in the U.S., Canada, the U.K., Ireland, and Latin America. Valero owns 15 petroleum refineries in the U.S., Canada, and the U.K. with throughput capacity of ~3.2 million barrels per day. Valero is a joint venture member in Diamond Green Diesel, which owns (1) two renewable diesel plants located in the Gulf Coast region of the U.S. with production capacity of 1.2 billion gallons per year and (2) 12 ethanol plants located in the Mid-Continent region of the U.S. with production capacity of 1.7 billion gallons per year.

Share Data	Financial Highlights
Stock Exchange (NYSE) Ticker Symbol: VLO	Net Revenues: \$129.9B
Share Price: \$125.1B (03/14/2025)	Cost of Sales: \$125.1B
Earnings Per Share (Trailing 12 Months): \$8.58	Gross Profit: \$4.8B (3.70% Margin)
Forward Annual Dividend: \$4.52/share	Operating Income: \$3.8B
Market Capitalization: \$60.1B (03/14/2025)	Net Income: \$2.8B
Resources	Balance Sheet
Employees: 9,922 (U.S. 8,273, Canada 647, U.K. and Ireland 839, Mexico and Peru 163)	Total Assets: \$60.1B
	Total Liabilities: \$32.6B
	Long-Term Debt: \$10.1B
	Equity: \$28.5B
	Cash Flow
Headquarters: San Antonio, TX	From Operations: \$6.7B
Core Values:	Used in Investing: \$2.0B
• Safety	Used in Financing: \$5.0B
• Accountability	
• Teamwork	Financial Returns
• Doing the Right Thing	Return on Equity: 13.80%
• Excellence	

#### Key Developments

**Sustainable Aviation Fuel (SAF) Project**  
 completed on October 25, 2024, Valero announced it reached mechanical completion on an SAF project at its Diamond Green Diesel JV (DGD) renewable diesel plant in Port Arthur, Texas. The project provides DGD the optionality to upgrade approximately 50% of its current 470-million-gallon renewable diesel annual production capacity to neat SAF—i.e., 100% pure, unleaded SAF—in raw, unprocessed form before it's mixed with conventional jet fuel.

**A**

## GLOSSARY

**Bulk Sales:** Bulk sales refer to the purchase of 40,000 gallons or more of fuel. Large-scale businesses that depend on fuel for their operation can make the most of their time and prevent downtime by stocking fuel in their inventories or on-time scheduled deliveries.

**Butane:** Natural Gas Liquids (NGLs) refer to a group of hydrocarbons that are found in natural gas as it is extracted from the ground and include ethane, propane, butane, isobutane, and pentane. These hydrocarbons are in gaseous form under the ground but are condensed into liquid at surface pressure and temperature conditions, hence the name "liquids." NGLs are separated from natural gas at processing facilities due to their valuable applications. They are used across a wide range of industries: propane is widely utilized for heating and as a fuel for cooking and vehicles, butanes are used in lighters and as a propellant in aerosol sprays, and ethane and pentanes play crucial roles as feedstocks for the petrochemical industry, particularly in the production of plastics and synthetic rubber. The extraction and sale of NGLs can significantly enhance the economic value of natural gas production, making them a key component in the energy market.

**Condensate:** Condensate is valuable as a feedstock for various petroleum products, including gasoline and jet fuel, making its production rate an essential metric for assessing the productivity and economic potential of natural gas fields.

**Crude Oil:** Also known as petroleum, crude oil is a naturally occurring, yellowish-black liquid found in geological formations beneath the Earth's surface. It is formed from the decayed remains of ancient marine organisms such as zooplankton and algae. Over millions of years, heat and pressure transform these remains into crude oil. Crude oil is a fossil fuel that consists of a complex mixture of hydrocarbons, along with small amounts of other substances. It is a highly valuable resource because it can be refined into various forms of energy and chemical products, including gasoline, diesel, jet fuel, heating oil, and petrochemicals. Crude oil is extracted through drilling and is a critical component of the global economy, with its price affecting energy markets and economic policies worldwide.

**Dry Gas:** Dry natural gas is a type of natural gas that primarily consists of methane (CH<sub>4</sub>), making it a highly efficient and clean-burning fossil fuel. Unlike wet natural gas, which contains a significant amount of hydrocarbon liquids, dry natural gas has most of these heavier hydrocarbons removed, leaving mostly methane and small amounts of other gases like carbon dioxide, nitrogen, and possibly trace amounts of hydrogen sulfide. Dry natural gas is used extensively for heating, electricity generation, and as a fuel for vehicles. It is called "dry" because it lacks the heavier hydrocarbon liquids found in wet natural gas, making it ready for use in natural gas-fired plants and appliances without further processing beyond basic filtering and pressure adjustments. Its extraction and transport require a network of wells, pipelines, and storage facilities. Due to its lower carbon footprint compared to coal and oil, dry natural gas plays a crucial role in energy policies aimed at reducing greenhouse gas emissions.

**Ethane:** Ethane is a significant component of natural gas, from which it is extracted as a valuable feedstock for the petrochemical industry. The primary use of ethane is in the production of ethylene, one of the most important organic chemicals, through a process called steam cracking. Ethylene serves as a foundational building block for manufacturing a wide array of products, including plastics, rubber, and other important chemicals. Ethane's abundance, especially in shale gas formations, and its role in the petrochemical industry make it a crucial element in the global supply chain for various consumer goods and materials, highlighting its economic importance beyond its simplicity as a hydrocarbon.

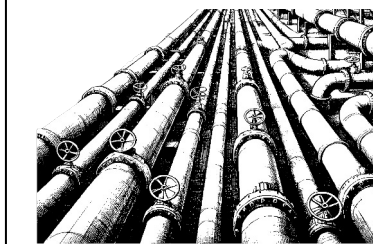
**Ethanol:** Ethanol is a renewable biofuel, most commonly produced from corn, that is blended with gasoline to create a "gasohol" mixture, usually at a 10% ethanol concentration (E10), which is used to oxygenate the fuel and reduce air pollution; essentially, it's a cleaner-burning alternative to pure gasoline and is widely used in the U.S. as a component of most gasoline sold at the pump. Ethanol is considered a renewable fuel because it is made from plants like corn, which can be regrown.

**Feeder Pipeline:** Feeder pipelines are designed to transport oil, gas, or refined products from storage facilities, processing plants, and smaller gathering systems to larger transmission pipelines or directly to distribution centers and refineries. Feeder pipelines essentially "feed" the larger systems with the necessary raw materials or semi-processed products for further processing, distribution, or export. Operating at various pressures and sizes, these pipelines are integral for ensuring the steady flow of energy resources across different stages of the supply chain. They are engineered to meet specific transport requirements and are strategically placed to optimize the efficiency and reliability of the oil and gas infrastructure, ensuring that resources reach their intended destinations safely and efficiently.

**FERC:** The Federal Energy Regulatory Commission (FERC) is an independent agency of the United States government that plays a critical role in regulating the oil and gas markets, among other energy-related sectors. Specifically, within the oil and gas domain, FERC's responsibilities include the oversight of interstate natural gas pipelines and storage facilities, as well as the regulation of natural gas and oil pipeline transportation rates. FERC ensures that the rates and services associated with oil and gas transportation are reasonable, nondiscriminatory, and in the public interest. Although FERC does not directly regulate oil and gas production or drilling, its authority over the transmission and wholesale sale of nature gas in inter-State commerce, as well as the transportation of oil by pipeline, makes it a key player in ensuring the reliability and fairness of the U.S. energy markets. Additionally, FERC is involved in the approval and oversight of liquefied natural gas (LNG) terminal projects, which are critical to the import and export of natural gas.



**Gathering Pipeline:** Gathering pipelines are designed to transport raw natural gas or crude oil from wellheads to processing facilities or larger transmission pipelines. These pipelines form an intricate network that collects the produced hydrocarbons from multiple production sites, often spread over a large area, and conveys them to centralized locations for preliminary treatment or refinement. Gathering pipelines typically operate at lower pressures compared to transmission pipelines and vary in size, depending on the volume of gas or oil they need to transport. They play a crucial role in the initial stages of the oil and gas supply chain, ensuring that the extracted resources are efficiently and safely moved to the next phase of processing or distribution. The design and operation of gathering pipelines prioritize minimizing environmental impact and ensuring safety, given their proximity to production areas and communities.



**Inedible Distillers Corn Oils (DCO):** Inedible distillers corn oil is a coproduct of ethanol production that is used to make renewable diesel fuel and livestock feed. DCO is extracted from distillers' grains, which are a byproduct of ethanol production. DCO is a byproduct of the evaporation process used to make ethanol. DCO has similar properties to conventional corn oil, but it has higher levels of lutein and zeaxanthin, which makes it a valuable poultry feed ingredient.

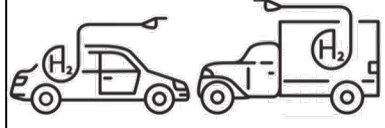
**Interstate Pipelines:** These are feeder pipelines that transport dry gas across two or more state directly (or indirectly through other pipelines) to storage and LNG processing facilities, and subsequently to end markets.

**Intrastate Pipelines:** Energy Transfer's intrastate pipelines are Feeder pipelines in Texas, Louisiana, and Oklahoma that transport dry gas solely within one state directly (or indirectly via other pipelines) to storage facilities, and then to end markets.

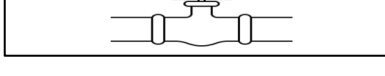
**Isobutane:** Isobutane is a colorless, flammable gas at room temperature and pressure, commonly used as a refrigerant, a propellant in aerosol sprays, and as a feedstock in the petrochemical industry for the production of isocyanates and other chemicals. In the refrigeration industry, isobutane is valued for its low global warming potential compared to other refrigerants, making it an environmentally friendly choice for small cooling applications, such as in domestic refrigerators and air conditioning units. Its use as a propellant in aerosol products is due to its ability to vaporize quickly and completely, providing an effective means of dispersing products without affecting the ozone layer. Isobutane's role in synthesizing isocyanate, a high-octane gasoline component, also highlights its importance in enhancing fuel efficiency and reducing engine knocking.

**LNG:** Also known as liquefied natural gas, LNG is a form of natural gas that has been cooled down to liquid form for ease and safety of non-pressurized storage or transport. It is made primarily of methane and small amounts of other hydrocarbons, water, carbon dioxide, sulfur compounds, and sometimes nitrogen. The process of liquefaction reduces the volume of the gas by about 600 times, making it more efficient to transport over long distances where pipelines do not exist. LNG is odorless, colorless, non-toxic, and non-corrosive. Upon reaching its destination, LNG is re-gasified and distributed as natural gas to be used for heating, cooking, and electricity generation, making it a crucial component in meeting global energy demands. Its use is expanding as it represents a cleaner alternative to other fossil fuels, contributing to lower emissions of carbon dioxide and pollutants.

**Low Carbon Liquid Transportation Fuels:** Low carbon liquid transportation fuels are gas alternatives like biofuels (ethanol, biodiesel) or synthetic fuels made from renewable sources, which produce significantly less carbon dioxide when burned compared to petroleum-based options

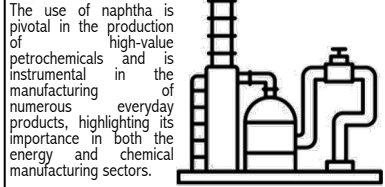


**Main:** Gas mains are the principal pipelines in a natural gas distribution system that transport gas from the supply point to various parts of a city or region. These large pipelines are the backbone of the gas distribution network, designed to carry large volumes of gas under pressure to ensure a consistent and reliable supply to residential, commercial, and industrial consumers. From the gas mains, smaller pipelines, often referred to as service lines, branch off to deliver natural gas directly to homes, businesses, and other facilities. Gas mains are constructed using materials that can withstand high pressures and diverse environmental conditions, such as steel or polyethylene, ensuring safety and durability. The maintenance and monitoring of gas mains are critical for preventing leaks and ensuring the safe and efficient distribution of natural gas, a key energy source for heating, cooking, and electricity generation in many parts of the world.



**Midstream:** Refers to gathering pipelines that transport, from the wellhead, (a) dry gas to interstate or intrastate feeder pipelines for storage and (b) wet and associated gases to gas processing plants.

**Naphtha:** Naphtha is a volatile, flammable liquid hydrocarbon mixture obtained through the distillation of crude oil or the refining of natural gas. It serves as a critical intermediate in the petrochemical industry, primarily used as a feedstock for producing a wide range of chemical products, including plastics, synthetic rubber, and fibers. Naphtha is also employed as a solvent, a fuel for camping stoves and portable heaters, and as a component in the formulation of gasoline. Its composition can vary depending on the source and the specific refining processes it undergoes, but it typically contains a mixture of paraffinic, naphthenic, and aromatic hydrocarbons in the C5 to C10 range.



**Natural Gas:** Natural gas is a fossil fuel formed from the decay of organic matter over millions of years under the Earth's surface. It is composed primarily of methane (CH<sub>4</sub>), along with small amounts of other hydrocarbons, carbon dioxide, nitrogen, hydrogen sulfide, and in some cases, helium. Natural gas is extracted through drilling and is considered one of the cleanest, safest, and most efficient forms of energy. It is used for heating, electricity generation, and as fuel for vehicles. In its processed form, natural gas is odorless, colorless, and non-toxic. It emits less carbon dioxide and pollutants compared to coal and oil, making it a preferred choice for environmentally conscious energy consumption. Natural gas is transported via extensive pipeline networks or as liquefied natural gas (LNG) to be used domestically and commercially, playing a vital role in meeting the world's increasing energy demands while contributing to lower greenhouse gas emissions.

**Natural Gasoline:** Natural gasoline, also known as pentanes plus, is a mixture of hydrocarbons, primarily consisting of pentanes and heavier hydrocarbons obtained from the processing of natural gas or the distillation of crude oil. It is a liquid at room temperature and is separated from natural gas in gas processing plants or during the petroleum refining process. Natural gasoline has a high energy content and is primarily used as a blend stock in the formulation of gasoline to increase its octane rating or as a feedstock for petrochemical plants to produce ethylene and other chemicals. Its properties make it a valuable component in the energy sector, particularly in areas where its contribution can optimize the performance and efficiency of fuel products.

**NGLs:** NGLs refers to natural gas liquids (NGLs), a group of hydrocarbons that are found in natural gas as it is extracted from the ground and include ethane, propane, butane, isobutane, and pentane. These hydrocarbons are in gaseous form under the ground but are condensed into liquid at surface pressure and temperature conditions, hence the name "liquids." NGLs are separated from natural gas at processing facilities due to their valuable applications. Each of these liquids has distinct physical and chemical properties, and they are used in a variety of applications:

- Ethane is primarily used as a feedstock for petrochemical plants to produce ethylene, a building block for plastics, anti-freeze, and detergents.

- Propane is widely used for heating, cooking, and as fuel for some vehicles. It's also used as a petrochemical feedstock.

- Butanes (Normal Butane and Isobutane) can be blended into gasoline, used as feedstocks for making synthetic rubber, and for other petrochemical uses.

- Isobutane is also used in refrigeration systems.

- Natural Gasoline (Pentanes Plus) serves as a blend stock for motor gasoline or as a feedstock in petrochemical plants for the production of ethylene and other chemicals.

NGLs are used across a wide range of industries; propane is widely utilized for heating and as a fuel for cooking and vehicles, butanes are used in lighters and as a propellant in aerosol sprays, and ethane and pentanes play crucial roles as feedstocks for the petrochemical industry, particularly in the production of plastics and synthetic rubber. The extraction and sale of NGLs can significantly enhance the economic value of natural gas production, making them a key component in the energy market.

**NGL Pipelines:** These are pipelines that transport (a) NGLs from gas processing plants to fractionator plants and (b) NGL byproducts (e.g., ethane, propane, butane) from fractionator plants to byproducts customers.

**Petroleum Based Liquid Transportation Fuels:** Petroleum based liquid transportation fuels are traditional transportation fuels like gasoline and diesel, derived directly from crude oil.



**Propane:** Propane, also known as liquefied petroleum gas (LPG), is a highly flammable hydrocarbon gas used extensively as a fuel source for heating, cooking, and in vehicles. It is derived from natural gas processing and crude oil refining, making it a fossil fuel. Propane is colorless and odorless in its natural state, but an odorant is usually added to help detect leaks. When stored under pressure in a liquid state, propane vaporizes into a gas as it is released, making it convenient for use in a variety of settings, from residential homes to industrial environments. Its clean-burning properties and portability have made propane a popular choice for off-grid energy needs and as an alternative to electricity and heating oil.

**Renewable Diesel:** Renewable diesel is a hydrocarbon fuel that's chemically identical to petroleum diesel but doesn't use fossil fuels. It's made from fats and oils, such as soybean or canola oil and is produced using a variety of technologies, including hydrotreating, gasification, pyrolysis, and other biochemical and thermochemical processes. The most common feedstocks are fats, oils, and greases. Renewable diesel can be used in heavy-duty equipment like garbage trucks, long-haul semi-trucks, and trains. It can be transported using existing infrastructure like pipelines, terminals, and fueling stations.

**Renewable Feedstock:** A renewable feedstock is a raw material that can replenish itself through natural processes and is used in the production of renewable diesel. Renewable feedstocks for Valero are items such as animal fats, used cooking oils, vegetable oils, and inedible distillers corn oils. Renewable feedstocks are a cornerstone of modern green chemistry and are gradually replacing fossil sources of energy and raw materials.

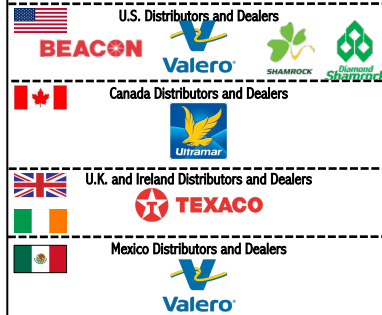
**Storage Tanks:** Natural gas, LNG, crude oil, and NGL storage tanks differ significantly in terms of the substances they contain, their physical properties, and their operational requirements. Natural gas storage tanks typically hold gaseous methane and other hydrocarbons at ambient temperature and pressure, requiring tanks designed to withstand these conditions. LNG storage tanks, however, are specifically engineered to contain liquefied natural gas at extremely low temperatures, typically around -260°F (-162°C), necessitating specialized materials and insulation to maintain cryogenic conditions. Crude oil storage tanks are constructed to store unrefined petroleum, requiring the ability to withstand a range of temperatures and pressures. Often necessitating corrosion-resistant materials due to the presence of sulfur and other corrosive elements, NGL storage tanks hold natural gas liquids, such as ethane, propane, and butane, which are typically stored under moderate pressure but require considerations for vapor pressure control and potential volatility.

**Terminalling and Terminals:** Terminalling refers to the storage and handling of petroleum products and crude oil at terminal facilities. These terminals serve as crucial nodes in the supply chain, acting as intermediary points where oil and gas are received, stored, and then distributed to end-users or further processed at refineries. Terminalling facilities are equipped with large storage tanks and complex logistics systems, including pipelines, trucks, and ship or rail loading and unloading capabilities. This infrastructure allows for the efficient movement of oil and gas products from production sites to markets. Terminals play a key role in managing the flow and availability of oil and gas, facilitating international trade, and ensuring energy security by enabling stockpiling and the balancing of supply and demand fluctuations. Effective terminalling operations are essential for the smooth operation of the global energy ecosystem, impacting everything from local fuel supply to the stability of global energy prices.

**Transmission Pipeline:** A transmission pipeline is a major component of the energy infrastructure, designed to transport large volumes of gas or liquid fuels, such as natural gas, crude oil, or refined petroleum products, over long distances. These pipelines are the arteries of the energy sector, connecting production areas, refineries, and processing plants with distribution networks and end users. Transmission pipelines are constructed using high-strength steel or plastic tubes and can stretch across continents, traversing a variety of terrains, including under oceans. They operate under high pressure to efficiently move the products from point A to point B. The management of these pipelines involves sophisticated control systems to monitor pressure, flow rate, and to ensure the integrity of the pipeline, thereby preventing leaks and ensuring safety. Transmission pipelines play a critical role in ensuring energy security, enabling the reliable and continuous supply of supply of energy resources necessary for economic development and daily life.

**Transmixing:** When multiple fuel products are distributed through a common pipeline, transportation mixing — or transmix — occurs. Transmix is an unusable mixture of primarily gasoline and diesel that no longer meets the specifications of any original fuel product. Transmix processing plants separate this mixture and return it to salable products of gasoline and diesel.

**Valero Retail Brands:** Valero sells petroleum products to distributors and dealers that are members of the Valero family of brands that operate branded sites in the U.S., Canada, the U.K., Ireland, and Mexico. Its key brands are as follows:

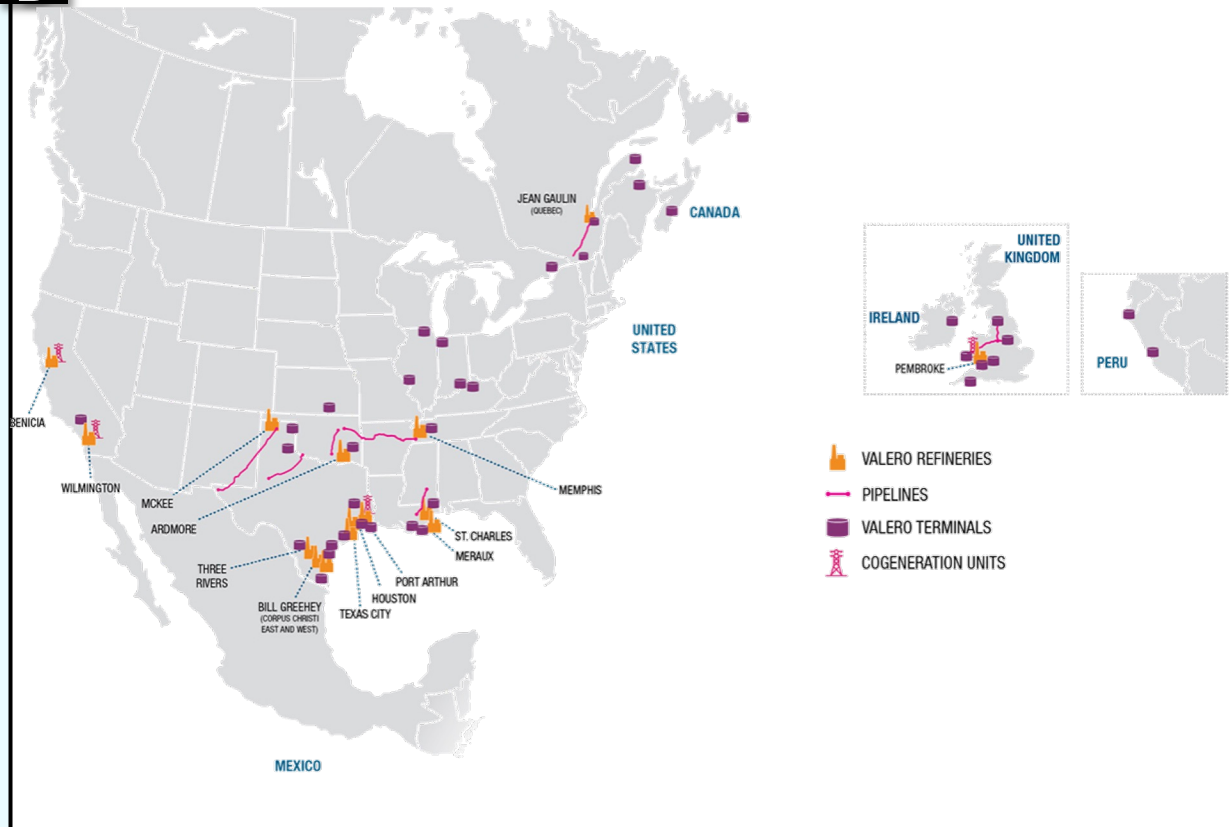


**Wet Gas:** Wet gas refers to a type of natural gas that contains a higher proportion of liquid hydrocarbons in addition to the primary component, methane. These liquid hydrocarbons, including ethane, propane, butane, and natural gasoline, are often referred to as natural gas liquids (NGLs). The presence of these heavier hydrocarbons makes the gas "wet," as opposed to "dry gas," which is almost purely methane and has few, if any, liquid hydrocarbons. Wet gas is valuable because the NGLs it contains can be separated and sold individually for various uses, such as in petrochemical manufacturing, residential heating, and as feedstocks for producing plastics and synthetic materials. The separation process typically occurs at a processing facility where the wet gas is treated to remove water vapor, sulfur compounds, and carbon dioxide, followed by fractionation to separate the NGLs.

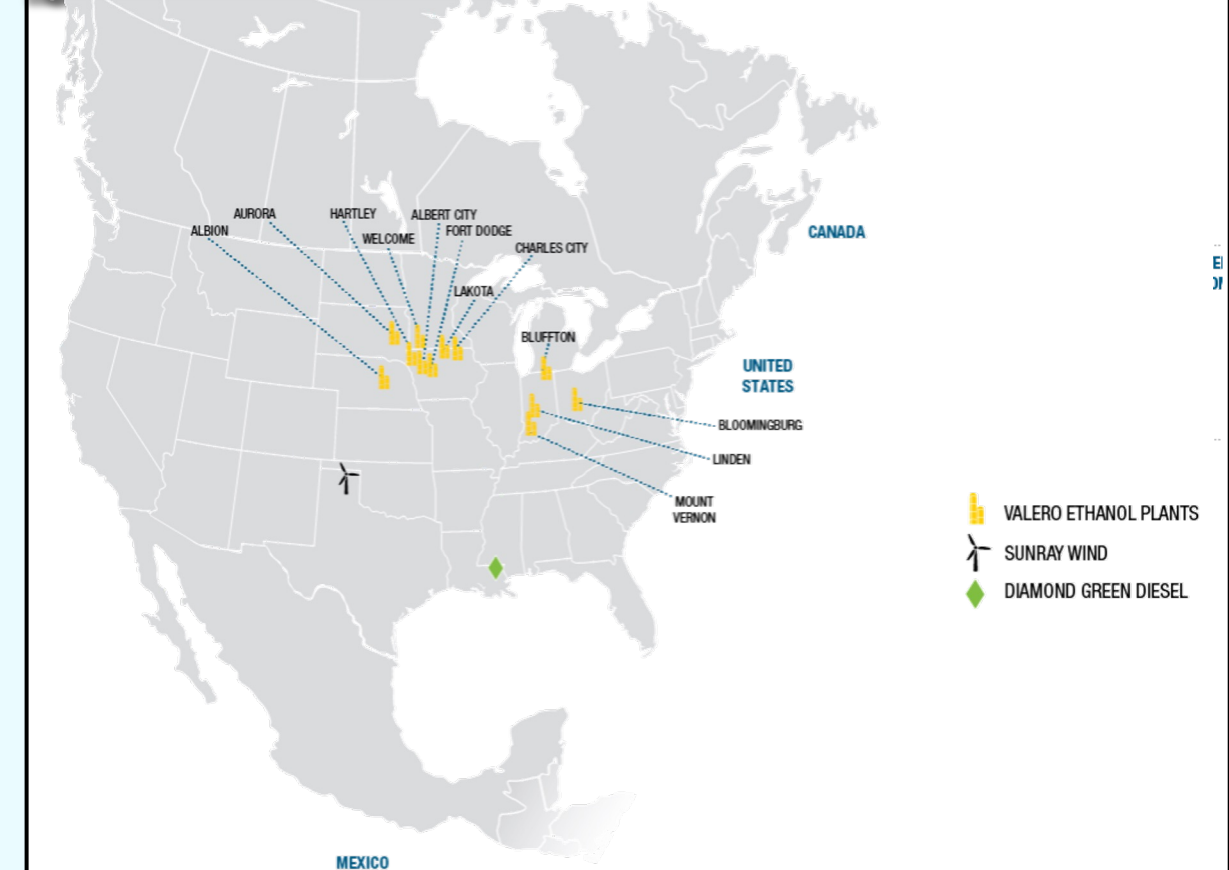
**Wholesale Rack Sales:** Wholesale rack sales are the purchase of fuel at a fuel distribution point, or "rack," where trucks pull up to receive fuel from suppliers. These racks are usually located along a pipeline and fuel is stored there until trucks arrive to take up to 8,000 gallons fuel from there to an end user for resale, like a retail gas station. Jobbers, retailers, and end users, such as trucking companies, purchase fuel from wholesale racks.


**B**

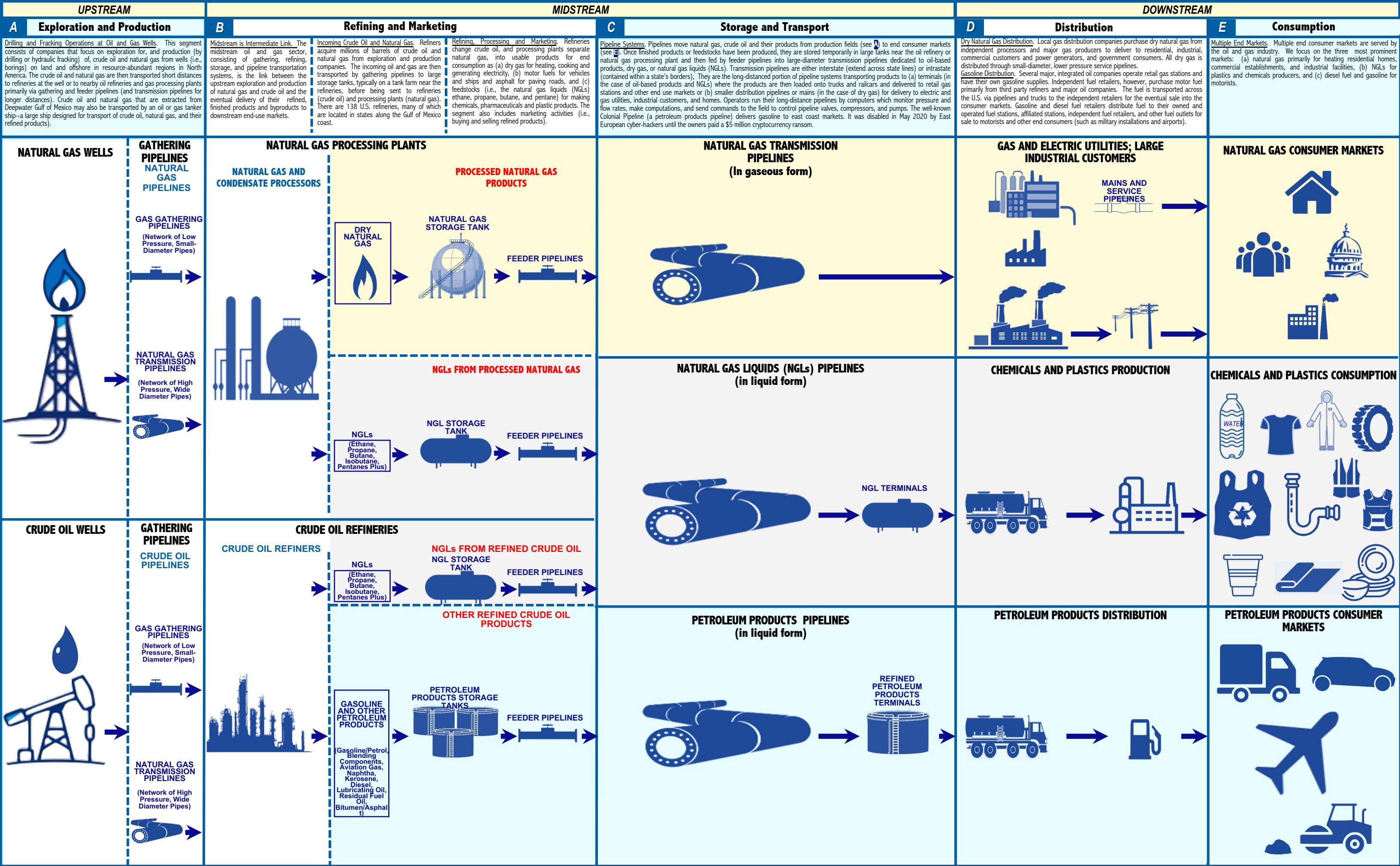
## VALERO REFINERY FOOTPRINT


**C**

## VALERO RENEWABLES FOOTPRINT







# United States Oil and Gas System: Key Players

UPSTREAM		MIDSTREAM		DOWNSTREAM					
A	Exploration and Production	B	Refining and Marketing	C	Storage and Transport	D	Distribution	E	Consumption
<p><b>Drilling and Fracking Operations at Oil and Gas Wells.</b> This segment consists of companies that focus on exploration for, and production (by drilling or hydraulic fracturing) of, crude oil and natural gas from wells (i.e., borings) on land and offshore in resource-abundant regions in North America. The crude oil and natural gas are then transported short distances to refineries at the well or to nearby oil refineries and gas processing plants primarily via gathering and feeder pipelines (and transmission pipelines for longer distances). Crude oil and natural gas that are extracted from Deepwater Gulf of Mexico may also be transported by an oil or gas tanker ship—a large ship designed for transport of crude oil, natural gas, and their refined products).</p>		<p><b>Midstream is Intermediate Link.</b> The midstream oil and gas sector, consisting of gathering, refining, storage, and pipeline transportation systems, is the link between the upstream exploration and production of natural gas and crude oil and the eventual delivery of their refined, finished products and byproducts to downstream end-use markets.</p> <p><b>Incoming Crude Oil and Natural Gas.</b> Refiners acquire millions of barrels of crude oil and natural gas from exploration and production companies. The incoming oil and gas are then transported by gathering pipelines to large storage tanks, typically on a tank farm near the refineries, before being sent to refineries (crude oil) and processing plants (natural gas). There are 138 U.S. refineries, many of which are located in states along the Gulf of Mexico coast.</p> <p><b>Refining, Processing and Marketing.</b> Refineries change crude oil, and processing plants separate natural gas, into usable products for end consumption as (a) dry gas for heating, cooking and generating electricity, (b) motor fuels for vehicles and ships and asphalt for paving roads, and (c) feedstocks (i.e., the natural gas liquids (NGLs) ethane, propane, butane, and pentane) for making chemicals, pharmaceuticals and plastic products. The segment also includes marketing activities (i.e., buying and selling refined products).</p>		<p><b>Pipeline Systems.</b> Pipelines move natural gas, crude oil and their products from production fields (see A) to end consumer markets (see E). Once finished products or feedstocks have been produced, they are stored temporarily in large tanks near the oil refinery or natural gas processing plant and then fed by feeder pipelines into large-diameter transmission pipelines dedicated to oil-based products, dry gas, or natural gas liquids (NGLs). Transmission pipelines are either interstate (extend across state lines) or intrastate (contained within a state's borders). They are the long-distanced portion of pipeline systems transporting products to (a) terminals (in the case of oil-based products and NGLs) where the products are then loaded onto trucks and railcars and delivered to retail gas stations and other end use markets or (b) smaller distribution pipelines or mains (in the case of dry gas) for delivery to electric and gas utilities, industrial customers, and homes. Operators run their long-distance pipelines by computers which monitor pressure and flow rates, make computations, and send commands to the field to control pipeline valves, compressors, and pumps. The well-known Colonial Pipeline (a petroleum products pipeline) delivers gasoline to east coast markets. It was disabled in May 2020 by East European cyber-hackers until the owners paid a \$5 million cryptocurrency ransom.</p>		<p><b>Dry Natural Gas Distribution.</b> Local gas distribution companies purchase dry natural gas from independent processors and major gas producers to deliver to residential, industrial, commercial customers and power generators, and government consumers. All dry gas is distributed through small-diameter, lower pressure service pipelines.</p> <p><b>Gasoline Distribution.</b> Several major, integrated oil companies operate retail gas stations and have their own gasoline supplies. Independent fuel retailers, however, purchase motor fuel primarily from third party refiners and major oil companies. The fuel is transported across the U.S. via pipelines and trucks to the independent retailers for the eventual sale into the consumer markets. Gasoline and diesel fuel retailers distribute fuel to their owned and operated fuel stations, affiliated stations, independent fuel retailers, and other fuel outlets for sale to motorists and other end consumers (such as military installations and airports).</p>		<p><b>Multiple End Markets.</b> Multiple end consumer markets are served by the oil and gas industry. We focus on the three most prominent markets: (a) natural gas primarily for heating residential homes, commercial establishments, and industrial facilities, (b) NGLs for plastics and chemicals producers, and (c) diesel fuel and gasoline for motorists.</p>	
<p><b>NATURAL GAS WELLS</b>  </p> <p><b>GATHERING PIPELINES</b>  </p>		<p><b>NATURAL GAS PROCESSING PLANTS</b></p> <p><b>NATURAL GAS AND CONDENSATE PROCESSORS</b>  </p> <p><b>PROCESSED NATURAL GAS PRODUCTS</b>  </p> <p><b>NGLs FROM PROCESSED NATURAL GAS</b>  </p>		<p><b>NATURAL GAS TRANSMISSION PIPELINES (In gaseous form)</b>  </p> <p><b>NATURAL GAS LIQUIDS (NGLs) PIPELINES (in liquid form)</b>  </p>		<p><b>GAS AND ELECTRIC UTILITIES; LARGE INDUSTRIAL CUSTOMERS</b>  </p> <p><b>CHEMICALS AND PLASTICS PRODUCTION</b>  </p>		<p><b>NATURAL GAS CONSUMER MARKETS</b>  </p> <p><b>CHEMICALS AND PLASTICS CONSUMPTION</b>  </p>	
<p><b>CRUDE OIL WELLS</b>  </p> <p><b>GATHERING PIPELINES</b>  </p>		<p><b>CRUDE OIL REFINERIES</b></p> <p><b>CRUDE OIL REFINERS</b>  </p> <p><b>NGLs FROM REFINED CRUDE OIL</b>  </p> <p><b>OTHER REFINED CRUDE OIL PRODUCTS</b>  </p>		<p><b>PETROLEUM PRODUCTS PIPELINES (in liquid form)</b>  </p>		<p><b>PETROLEUM PRODUCTS DISTRIBUTION</b>  </p>		<p><b>PETROLEUM PRODUCTS CONSUMER MARKETS</b>  </p>	

# United States Oil and Gas System: Detailed Product Flows

## UPSTREAM MIDSTREAM DOWNSTREAM

### A Exploration and Production

**Drilling and Fracking Operations at Oil and Gas Wells.** This segment consists of companies that focus on exploration for, and production (by drilling or hydraulic fracturing) of, crude oil and natural gas from wells (i.e., borings) on land and offshore in resource-abundant regions in North America. The crude oil and natural gas are then transported short distances to refineries at the well or to nearby oil refineries and gas processing plants primarily via gathering and feeder pipelines (and transmission pipelines for longer distances). Crude oil and natural gas that are extracted from Deepwater Gulf of Mexico may also be transported by an oil or gas tanker ship—a large ship designed for transport of crude oil, natural gas, and their refined products).

#### 1 NATURAL GAS WELLS

##### 2 NATURAL GAS PRODUCERS

ConocoPhillips
ExxonMobil
Royal Dutch Shell (UK and Dutch-Owned)
Chevron
bp (UK-Owner of BPX Energy and ARCO)
Occidental Petroleum
Devon Energy

**3 KEY UPSTREAM NATURAL GAS PIPELINE OPERATORS**

Enbridge (Canadian-Owned)
Williams Companies (Transco System)
Energy Transfer
Enterprise Products Partners
Pinnacle Midstream
TC Energy (TransCanada Pipeline)
ONEOK
Enterprise Products
Williams
ENERGY TRANSFER
KOCH PIPELINE SERVICES
PINNACLE MIDSTREAM
ENBRIDGE

**4 CRUDE OIL WELLS**

##### 5 CRUDE OIL PRODUCERS

ConocoPhillips
ExxonMobil
Royal Dutch Shell (UK and Dutch-Owned)
Chevron
bp (UK-Owner of BPX Energy and ARCO)
Occidental Petroleum
Devon Energy

**6 KEY UPSTREAM CRUDE OIL PIPELINE OPERATORS** (80,000 Miles of Crude Oil Gathering Pipelines in the U.S.)

Enbridge (Canada) (27)
Plains All American Pipeline (Midstream Energy) (25)
Energy Transfer (20)
Centurion Pipeline (11)
Royal Dutch Shell (11)
Enterprise (10)
Phillips 66 Partners (9)
Koch Pipeline (7)
MPLX / Marathon Energy
TC Energy (formerly TransCanada)
Kinder Morgan
Pembina Pipeline

**7 U.S. Strategic Petroleum Reserve** (Held by U.S. Government for Emergency Purposes)

### B Refining and Marketing

**Midstream is Intermediate Link.** The midstream oil and gas sector, consisting of gathering, refining, storage, and pipeline transportation systems, is the link between the upstream exploration and production of natural gas and crude oil and the eventual delivery of their refined, finished products and byproducts to downstream end-use markets.

**Incoming Crude Oil and Natural Gas.** Refiners acquire millions of barrels of crude oil and natural gas from exploration and production companies. The incoming oil and gas are then transported by gathering pipelines to large storage tanks, typically on a tank farm near the refineries, before being sent to refineries (crude oil) and processing plants (natural gas). There are 138 U.S. refineries, many of which are located in states along the Gulf of Mexico coast.

**Refining, Processing and Marketing.** Refineries change crude oil, and processing plants separate natural gas, into usable products for end consumption as (a) dry gas for heating, cooking and generating electricity, (b) motor fuels for vehicles and ships and asphalt for paving roads, and (c) feedstocks (i.e., the natural gas liquids (NGLs) ethane, propane, butane, and pentane) for making chemicals, pharmaceuticals and plastic products. The segment also includes marketing activities (i.e., buying and selling refined products).

#### 8 NATURAL GAS AND CONDENSATE PROCESSORS

MPLX / Marathon Petroleum
Enterprise Products Partners
ConocoPhillips
Williams Cos.
ExxonMobil
Kinder Morgan
Energy Transfer
ONEOK Partners
Royal Dutch Shell
DCP Midstream

**9** Separation of the Natural Gas Stream. Natural gas is processed so that the methane (dry gas) is separated from the other components (wet gas)—i.e., (a) other hydrocarbons (e.g., ethane, butane, propane), (b) impurities such as, water vapor, carbon dioxide, helium, nitrogen, sulfur, and other chemical compounds, and (c) some crude oil (if the gas comes from an oil well). After separation, the wet gas is sent to another processing facility for further modification into usable gases.

**10** Transport of Remaining Natural Gas Liquids (NGLs) (Sent via Intraplant Pipeline to Separate Facility for Further Processing into Usable Gases)

**11** Fractionation of NGLs. The remaining NGLs will contain a broad mixture of hydrocarbons. To create usable finished products, the remaining hydrocarbons will be fractionated so that each hydrocarbon is separated into a distinct gas (e.g., ethane, propane, butane, and pentane). Ethane and propane comprise of 70% of the NGLs.

#### 12 PROCESSED NATURAL GAS PRODUCTS

**13** DRY GAS. Pure or "pipeline quality" natural gas (consisting of 94% methane) that has been separated from all other hydrocarbons and fluids. It exists in gaseous form but can be converted to liquefied natural gas (LNG) by cooling the natural gas below its boiling point (-259 °F) at one of the 110 active liquefied processing plants in the U.S. Liquefying natural gas makes it easy to store (in double-walled cryogenic containers) and transport overseas on ships because LNG is 600 times smaller than natural gas in its gaseous form. LNG can be converted back to its gaseous form (i.e., re-gasified) by simply raising its temperature.

**14** NGLs FROM PROCESSED NATURAL GAS

**15** ETHANE. A feedstock that will be sold into industrial markets for processing into ethylene for plastics production

**16** PROPANE. A feedstock that will be sold into industrial, residential, and commercial markets for processing into plastics, cleaning fluids, solvents, and heating and cooking fuels

**17** BUTANE. A feedstock that will be sold into industrial and transportation markets for blending with propane or gasoline to produce rubber for tires, jet fuel, and lighter fuels for heating, lighting, and cooking

**18** PENTANE. Natural gasoline sold into transportation markets for processing into gasoline and polystyrene/foam solvents

#### 19 CRUDE OIL REFINERIES

Motiva Enterprises (Saudi Aramco-Owned)
ExxonMobil
MPLX / Marathon Petroleum
bp Products
Citgo Petroleum
Chevron
Valero Energy
Phillips 66

**20** Refining Process. Petroleum refineries are complex and expensive industrial facilities that break crude oil down to its various components, which are then reconfigured into new fuel products. The petroleum refining process involves piping crude oil through hot furnaces. The resulting liquids and vapors are discharged into distillation towers that are very hot and get cooler as the gas travels up the tower. The liquids and vapors separate into petroleum components (called fractions) according to their boiling points. Some of the resulting liquids undergo additional processing (e.g., cracking, reforming, or isomerization) after the distillation process to create other products. These processes ensure every drop of crude oil is converted into a usable product.

**21** LIQUEFIED REFINERY GASES (< 85°F). Light hydrocarbons (ethane, propane, butane, and pentane) rise to the top of the distillation tower, and condense back to liquid (i.e., natural gas liquids or NGLs); used as feedstocks for processing of chemicals, pharmaceuticals, and plastics

**22** OTHER REFINED CRUDE OIL PRODUCTS

**23** GASOLINE/PETROL AND BLENDING COMPONENTS (85 – 185°F). A light hydrocarbon that vaporizes, rises near the top of the distillation tower, and condenses back to liquid; used in internal combustion motor engines

**24** NAPHTHA (185 – 350°F). Used for making petrochemicals, plastics, cleaning fluids, and industrial solvents; blend stock for gasoline

**25** KEROSENE (350 – 450°F). Used in aviation (jet fuel) and in households for heating, lighting, and cooking

**26** DISTILLATE/DIESEL FUEL (450 – 650°F). Liquid fuel used in diesel engines (i.e., engines whose fuel ignition occurs without any spark and instead occurs through compression of air and then the injection of fuel); also used for heating oil

**27** LUBRICATING OIL (650 – 1050°F). Heavy gas oil used to reduce friction, heat, and wear between mechanical components inside machines and engines

**28** RESIDUAL FUEL OIL (> 1050°F). A relatively cheap, heavy oil used for power generation for ships and tankers

**29** BITUMEN. Low-grade oil with the consistency of peanut butter and riddled with impurities; used to surface roads (i.e., asphalt)

### C Storage and Transport

**Pipeline Systems.** Pipelines move natural gas, crude oil and their products from production fields (see A) to end consumer markets (see E). Once finished products or feedstocks have been produced, they are stored temporarily in large tanks near the oil refinery or natural gas processing plant and then fed by feeder pipelines into large-diameter transmission pipelines dedicated to oil-based products, dry gas, or natural gas liquids (NGLs). Transmission pipelines are either interstate (extend across state lines) or intrastate (contained within a state's borders). They are the long-distance portion of pipeline systems transporting products to (a) terminals (in the case of oil-based products and NGLs) where the products are then loaded onto trucks and railcars and delivered to retail gas stations and other end use markets or (b) smaller distribution pipelines or mains (in the case of dry gas) for delivery to electric and gas utilities, industrial customers, and homes. Operators run their long-distance pipelines by computers which monitor pressure and flow rates, make computations, and send commands to the field to control pipeline valves, compressors, and pumps. The well-known Colonial Pipeline (a petroleum products pipeline) delivers gasoline to east coast markets. It was disabled in May 2020 by East European cyber-hackers until the owners paid a \$5 million cryptocurrency ransom.

#### 23 NATURAL GAS STORAGE TANKS (Above Ground)

For efficient storage, dry gas is first liquefied before entering expensive double-walled cryogenic storage tanks. Once dry gas is ready to be transported in transmission pipelines, it is re-gasified so that it moves more efficiently across long distances.

#### 24 NATURAL GAS TRANSMISSION PIPELINE OPERATORS (321,000 miles of natural gas transmission and gathering pipelines)

Berkshire Hathaway-Owned Pipelines
Marathon Petroleum / MPLX
Enterprise Products Partners
DCP Midstream (Enbridge / Phillips 66 Joint Venture)
William Companies (Transco System)
Plains All American Pipeline (Midstream Energy Company)
Royal Dutch Shell
Chevron
ONEOK Partners
Enbridge
Kinder Morgan
TC Energy
Energy Transfer
Pembina Pipeline

**25** NGL STORAGE TANKS (Above Ground)

#### 26 NGL TRANSMISSION PIPELINE OPERATORS (208,700 miles of NGL pipelines)

Long Distance Transport, in Batches, of NGLs (Ethane, Propane, Butane, Isobutane, Pentane, Condensate)

ONEOK Partners
Energy Transfer
Enterprise Products Partners (includes Mid-America Pipeline System)
Enbridge
Phillips 66 Partners
TC Energy (formerly TransCanada)
ExxonMobil Pipeline
Kinder Morgan
Plains All American Pipeline (Midstream Energy Company)
ENERGY TRANSFER
Phillips 66
ExxonMobil Pipeline
TC Energy
Enterprise Products Partners
KINDER MORGAN
ENBRIDGE
MPLX
ONEOK

#### 27 PETROLEUM PRODUCTS PIPELINES (transport in liquid form)

##### 28 PETROLEUM LIQUIDS TERMINALS OPERATORS

Kinder Morgan Liquids
Energy Transfer Refined Products
Buckeye Partners
Marathon Oil
Enterprise Products

Local Transport of Jet Fuel, Residual Fuel Oil, Distillate, Lubricating Oil, Kerosene, and Propane, to End Users (via Truck)

Local Transport of Gasoline and Diesel Fuel to Retail Gas Stations and Wholesalers (via Truck)

At the terminals, petroleum products may be blended and additives (octane enhancers, anti-knock agents, rust inhibitors) may be injected into the fuel prior to end consumption.

#### 29 NGL PIPELINES (transport in liquid form)

##### 29 NGL TERMINAL OPERATORS

Kinder Morgan Liquids Terminal
Energy Transfer NGL Terminals
Plains All American Pipeline
NGL Energy Partners
Enterprise Products Partners
Total (Polypropylene, Styrene, and Polystyrene, and Polyethylene Plants)

Transport by Railcar

Transport by Truck

Transport by Main Pipeline Systems

The feedstock gases (ethane, propane, butane, and pentane) are transported (in liquid form) from the natural gas processing plants and oil refineries to storage tanks, and then to transportation, commercial, residential, and industrial markets (chemicals, pharmaceuticals and plastics manufacturers) via natural gas liquids (or NGLs) pipelines. NGLs may also be transported by trucks, railcars, and barges, but the cost of these shipping modes tend to be high compared to NGL transmission pipelines.

### D Distribution

**Dry Natural Gas Distribution.** Local gas distribution companies purchase dry natural gas from independent processors and major gas producers to deliver to residential, industrial, commercial customers and power generators, and government consumers. All dry gas is distributed through small-diameter, lower pressure service pipelines.

**Gasoline Distribution.** Several major, integrated oil companies operate retail gas stations and have their own gasoline supplies. Independent fuel retailers, however, purchase motor fuel primarily from third party refiners and major oil companies. The fuel is transported across the U.S. via pipelines and trucks to the independent retailers for the eventual sale into the consumer markets. Gasoline and diesel fuel retailers distribute fuel to their owned and operated fuel stations, affiliated stations, independent fuel retailers, and other fuel outlets for sale to motorists and other end consumers (such as military installations and airports).

#### 31 GAS AND ELECTRIC UTILITIES; LARGE INDUSTRIAL CUSTOMERS

##### 31 DRY GAS DISTRIBUTION UTILITIES (2.19 million miles of gas distribution pipelines)

Selected Local Gas Distribution Companies (AGL Resources, Altagas, CenterPoint Energy Gas Transmission, Chesapeake Operating, Kinder Morgan, KeySpan, Nicor Gas, Pacific Gas & Electric, SEMCO Energy)

##### 32 INDUSTRIAL CUSTOMERS

##### 33 ELECTRIC POWER GENERATORS

Power Generation Companies (Duke Energy, NRG Energy, Southern Companies, NextEra Energy, American Electric Power, Dominion Energy, Exelon)

When natural gas arrives from the large pipelines at the locations where it will be used (primarily gas and electric utility companies), the gas will be liquefied so that it can be more efficiently stored in below-ground storage tanks. Once the liquefied gas is needed for distribution to gas consumers, it will be re-gasified and flow into smaller diameter pipelines called mains and then into smaller service lines that go directly into homes or buildings.

#### 34 CHEMICALS AND PLASTICS PRODUCTION

##### 34 PETROCHEMICAL PROCESSORS

Plastics, Industrial Products and Materials Producers (Dow Chemical, LyondellBasell, ExxonMobil Chemical, Chevron Phillips Chemical Company, Sinopec, Borealis, Royal Dutch Shell, INEOS, Lanxess, NOVA, Saudi Basic Industries Corporation (SABIC))

Chemicals Producers (BASF, DuPont, Dow Chemical, LyondellBasell Industries, Sinopec, SABIC, INEOS, Enterprise Products Partners, Chevron Phillips Chemical Company, Formosa Plastics, Mitsubishi Chemical, Arkema, Celanese, Wacker Chemie, Elkem)

Transport of Finished Petrochemical Products by Railcar

Transport of Finished Petrochemical Products by Truck

Ethane, naphtha and propane are feedstocks used to make chemicals and plastics. They are cracked (i.e., broken down into smaller molecules) and polymerized (i.e., fortified by adding a catalyst that links the molecules together to form polymers/resins). The resins are then melted and cooled into a block. The resin block is chopped into tiny pellets (or nurdles) for distribution to manufacturers.

#### 35 PETROLEUM PRODUCTS DISTRIBUTION

##### 35 PETROLEUM PRODUCTS WHOLESALERS AND RETAILERS

Marketing Companies

Traders
Wholesalers, Resellers, Distributors
Integrated Oil and Gas Companies (Big Oil, the Oil Majors)

Retail Gas Stations

Phillips 66
ExxonMobil
CITGO
Shell
Valero Energy
bp
Chevron/Texaco
Sunoco (Controlled by Energy Transfer)
Marathon / ARCO / Speedway

Convenience, Grocery and Retail Stores

Kwik Trip
Hy-Vee Gas
QuikTrip
Sheetz
Casey's General Stores
Walmart

Retail Sales of Jet Fuel, Residual Fuel Oil, Distillate, Lubricating Oil, Kerosene, Asphalt, and Propane

Retail Sales of Gasoline and Diesel Fuel

### E Consumption

**Multiple End Markets.** Multiple end consumer markets are served by the oil and gas industry. We focus on the three most prominent markets: (a) natural gas primarily for heating residential homes, commercial establishments, and industrial facilities, (b) NGLs for plastics and chemicals producers, and (c) diesel fuel and gasoline for motorists.

#### 36 NATURAL GAS CONSUMER MARKETS

##### 36 END USE NATURAL GAS CUSTOMERS

Electric Utilities (18%)
Residential Consumers (22%)
Industry/Government (43%)
Transportation (3%)
Commercial Establishments (14%)

Retail Electric Power Supply

##### 37 LOCAL ELECTRIC POWER DISTRIBUTION COMPANIES

Investor-Owned Utilities
Electric Cooperatives
Non-for-Profit Municipalities
Retail Power Marketers

#### 38 CHEMICALS AND PLASTICS CONSUMPTION

##### 38 PLASTICS AND CHEMICALS CUSTOMERS

Plastics, Industrial and Materials Markets (Food and Specialty Packaging, Consumer Durables, Health and Hygiene, Infrastructure Caps, Closures, and Pipe Applications, Footwear, Industrial and Consumer Packaging, Bedding, Flooring, Concrete, Roofing)

Chemicals Markets (Home Care (Dishes, Waxes, Polishes, Cleaners), Personal and Baby Care (Skin, Hair, Sun, Cleansing, Powders, Medications), Food Preservation, Building and Construction, Agriculture, Airlines, Transportation, Paint, Ink and Coatings)

Intermediate Petrochemical Products: ethylene, propylene, benzene, butadiene, octene, aromatic co-products

Finished Petrochemical Products: acrylics, elastomers, plasticizers, vinyl, resins, polyethylene (plastic), polypropylene, plastomers, wire and cable insulation, ethers, heat transfer fluids, aircraft deicing fluids, solvents, glycol, isobutyl, drilling fluids, antifoams, surfactants, aniline, caustic soda, oxide, powder, dichloride, diisocyanate, polyols, acrylates, polymers, dispersants, binders, epoxies, dental cement, sealants, adhesives, coupling agents, releasing agents, emollients, oils, opacifiers, reagents, gels, rubber, aerospace composites, Styrofoam cups, lubricants, cosmetics, caps, closures, pipes, crop protection, tiles, glazes, paints, coatings, inks, films and tapes, silicone products

#### 39 PETROLEUM PRODUCTS CONSUMER MARKETS

##### 39 END USE CONSUMPTION (NON-MOTOR FUEL)

Kerosene and Lighting Fuel: Lamps
Asphalt/Bitumen: Road Pavers
Residual Fuel Oil: Oil Tankers, Large Ships, Power Generation Companies
Jet Fuel: Airlines (Delta, American, United Airlines, Southwest)
Heating Oil: Homeowners (Primarily in Northeastern U.S.)
Lubricating Oil: Vehicle Motors, Machines, Cooking

##### 40 MOTOR FUEL CONSUMPTION

Gasoline: Sports and Passenger Vehicles, SUVs, Trucks, Buses, and Lawnmowers
Diesel: Cars, Trucks, Buses, Old-Model Railroad Locomotives, and Power Companies (Peaking Fuel Only)
Aviation Fuel: Military Aircraft, Civilian Aircraft (Commercial, Business, Cargo, General/Recreation, and Aerial Work)