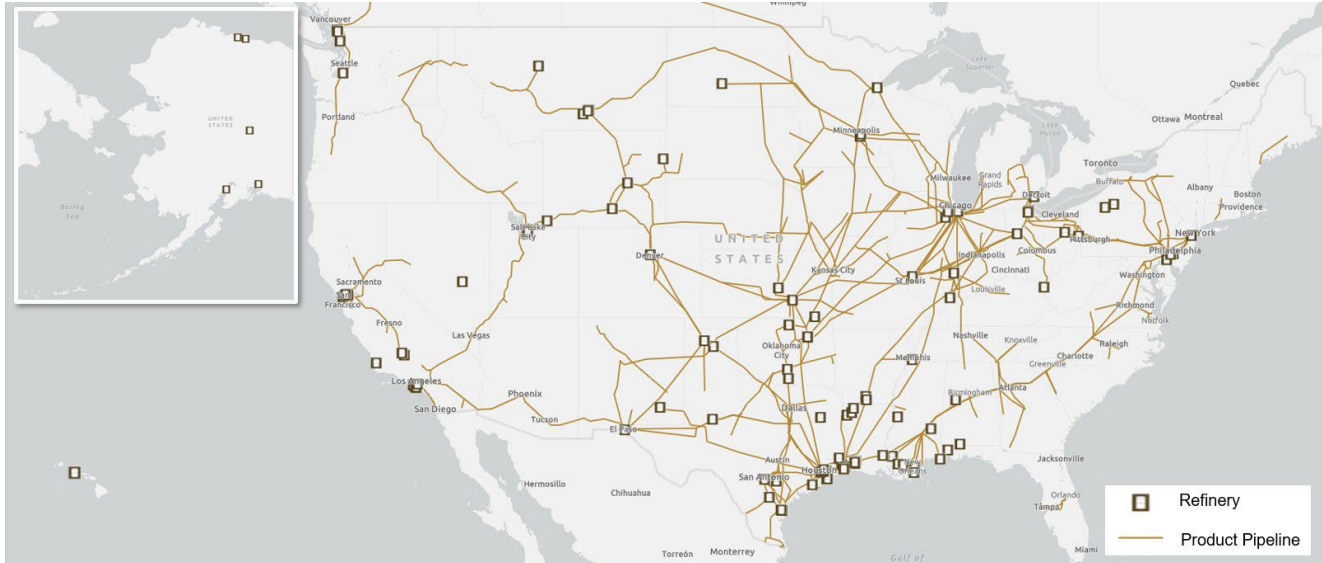


How it Works: Refined Petroleum Product Pipelines

Petroleum product pipelines form the backbone of the U.S. fuel supply chain and are the most efficient and lowest-cost method of transporting fuel from refining centers to end-use markets. There are approximately [64,000 miles](#) of refined product pipelines currently operating in the United States. Refined products include gasoline, diesel, jet fuel, and home heating oil.

Exhibit 1. U.S. Refineries and Refined Product Pipelines



Source: U.S. Energy Information Administration (August 2021)

Refined product pipelines are classified as either proprietary or common-carrier pipelines (with the latter being the most prevalent). Proprietary pipelines are owned and operated by a specific refiner and only ship petroleum products owned by the refiner to terminals owned by the refiner.

Common-carrier pipeline companies do not own the petroleum products shipped on the line and transport products on behalf of their customers, commonly referred to as “shippers” (e.g., refiners, traders, marketing companies, airlines) to multiple terminals.

Common-carrier pipelines that cross state borders—also known as interstate pipelines—are regulated by the Federal Energy Regulatory Commission (FERC), which reviews tariffs for shipping products and ensures shippers receive equal access to pipelines. Generally, pipeline operators are required to move shipper volumes in accordance with FERC’s equal access rules, which prevents pipeline operators from favoring any one shipper, product, or delivery location.

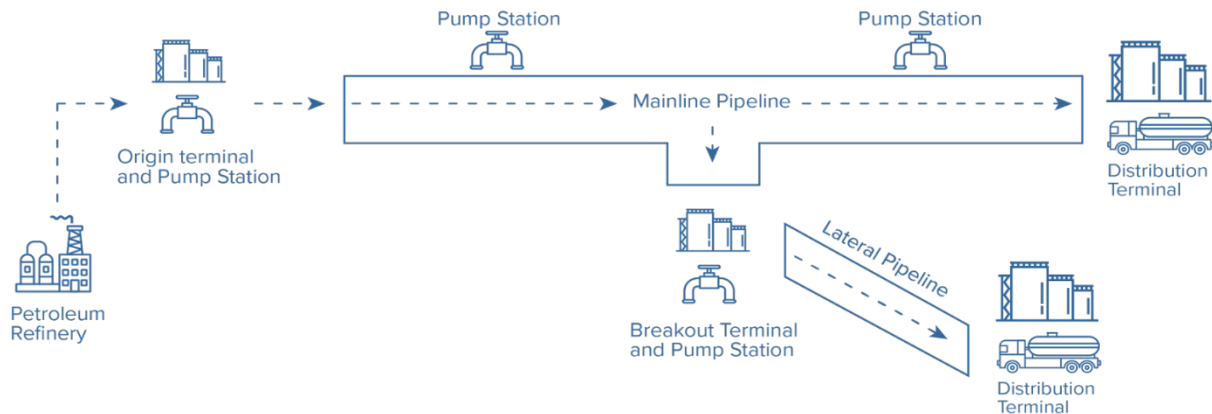
The U.S. Department of Transportation’s Pipeline and Hazardous Materials Safety Administration (PHMSA) regulates the safety of pipeline facilities’ design, construction, testing, operation, maintenance, and emergency response for both common-carrier and proprietary pipelines.

The U.S. Environmental Protection Agency (EPA) manages programs for preventing, preparing for, and responding to oil spills that occur in and around inland waters of the United States, while the U.S. Coast Guard is the lead response agency for oil spills in coastal waters and deep-water ports.

Pipeline Operations

Many large pipeline systems consist of a mainline pipeline, which runs from the origin to the terminus, and lateral lines that break off from the mainline system to deliver fuel to markets further away from the mainline path. Intermediate breakout storage is often required at pipeline junctions to help manage the transfer of products from the pipeline mains to the pipeline laterals. A schematic of these operations is shown in Exhibit 2.

Exhibit 2: Schematic of Pipeline Operations



Source: U.S. Department of Energy

The movement of fuels through product pipelines relies on pumping equipment located at pipeline origins, junctions, and intermediate pump stations along the system. This equipment typically runs on electric power. Disruptions in grid-supplied power can affect pumping operations, potentially forcing lines to operate at reduced rates or to partially or fully close until grid power is restored, or backup power generators are deployed and connected. Electric power is also required for operations at origin and distribution terminals along the pipeline route.

Products move through the pipeline at the same rate that they are pumped into the pipeline, typically [three to eight miles per hour](#), depending on the pipe's size, the line pressure, and the density and viscosity of the fuels. Pipeline product injections occur at origin facilities, located either in refineries or in bulk terminals that gather supply from multiple refineries. Hurricanes and other events that impact refinery production can reduce pipeline injections and slow pipeline transportation rates. If the entire pipeline ceases operation, the product will remain in the pipeline but won't be able to move out of it. Once a pipeline restarts after a shutdown, the product inside is immediately available for downstream delivery.

Pipelines deliver products to distribution terminals located near end-user markets. Distribution terminals typically consist of bulk storage tanks and truck loading infrastructure. Distribution terminals outload product onto trucks for delivery to end-user sites (primarily retail filling stations). Gasoline is typically blended with ethanol and other additives during the truck loading process. Pipeline shipments of jet fuel are often delivered directly to large airports, which store the fuel at their fuel farm. Smaller airports may depend on trucks from distribution terminals for their jet fuel delivery.

Exhibit 3: Petroleum Product Terminal



Source: U.S. Department of Energy

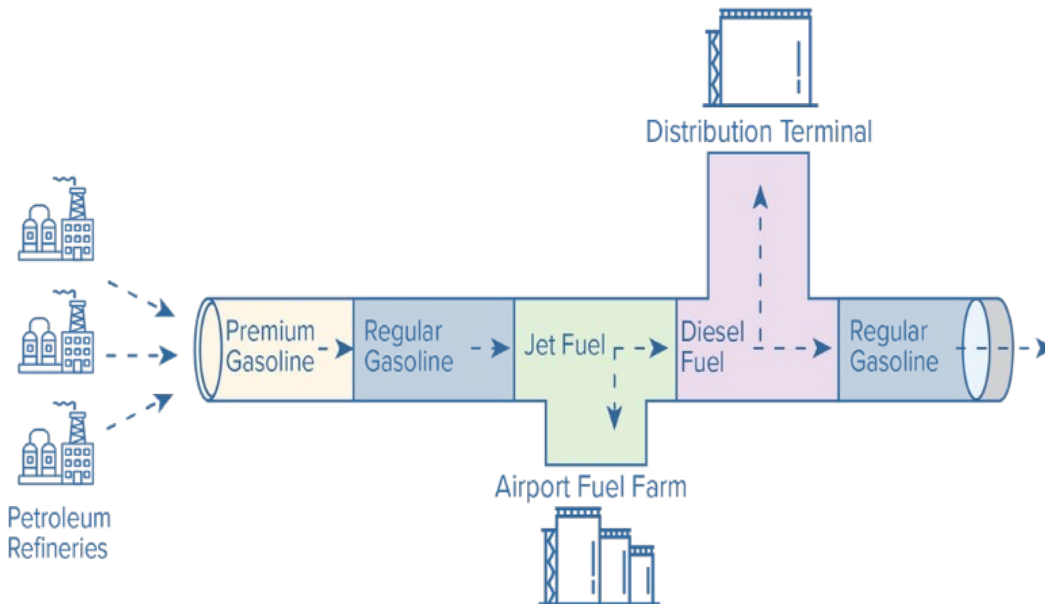
Pipeline Scheduling

Most pipelines transport multiple products (e.g., gasoline, diesel, etc.) of various grades (e.g., premium and regular gasoline) within a single pipeline. “Like products” (i.e., products with identical specifications) from different shippers are often mixed in the pipeline. Products with different specifications are kept separate through a process known as “batching,” where products are injected into the pipeline in a specific order to minimize [mixing](#). Pipeline operators must carefully schedule and batch pipeline shipments from different shippers to ensure shipments are sent at correct quantities, time intervals, and order to delivery locations while maintaining a continuous, uninterrupted flow of products. Exhibit 4 presents an example of how batched volumes flow through a pipeline system.

Pipeline operators schedule shipments on their systems based on the nominations that shippers make. Shippers usually make these nominations one month before the intended delivery period. Pipeline nominations are scheduled over multiday periods known as “cycles.” Colonial Pipeline, for example, has five-day product cycles, which means that shippers assume a new batch of fuel will arrive every five days and must plan for deliveries to their terminals. Olympic Pipeline, in the Pacific Northwest, operates on five- to seven-day product cycles.

Shippers nominate product volumes for movement based on anticipated demands at terminals along the pipeline per the cycle period. Once pipeline operators receive the nominations, they arrange the batches that efficiently move products along the pipeline system. If shipper nominations exceed the available capacity, the pipeline operator will allocate the volume of product in the pipeline, restricting shippers to some percentage of their historical pipeline shipments.

Exhibit 4. Example of Batched Pipeline Shipments



Source: U.S. Department of Energy (DOE)

Under certain circumstances, shippers may opt to redirect shipments already in the pipeline system to new destinations, but this is only possible if the shipment has not already passed the new destination on the pipeline route. FERC has emergency powers pursuant to the Interstate Commerce Act that, when needed, allow them to order pipeline operators to temporarily [prioritize shipments](#) of certain fuels to specific delivery locations to help alleviate supply shortages. For example, in February 2014 when locations in the Midwest and Northeast were experiencing propane shortages, FERC exercised this power by prioritizing propane shipments from Texas to those regions.

For more information on DOE CESER’s State, Local, Tribal and Territorial Program Learning Series, click [here](#).