INFORMATION BRIEF
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Minnesota's Petroleum Infrastructure: Pipelines, Refineries, Terminals

Minnesota has no indigenous sources of petroleum, so it must import both crude oil and refined oil products for use by its residents. Two crude oil refineries are located here, as well as several pipelines that distribute refined petroleum products throughout the state. In addition, Minnesota serves as the primary route for the nation's importation of Canadian crude oil supplies that travel to refineries on the east coast and the Gulf of Mexico. This information brief describes the state's infrastructure for importing, refining, and distributing crude oil and refined petroleum products.

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Introduction

In addition to serving as the primary shipping route for Canadian crude oil destined for refineries in other states, Minnesota produced or imported more than five billion gallons of petroleum products for use by its own residents in 2017. As a state lacking petroleum deposits, Minnesota must import both the crude oil its refineries process and additional quantities of refined products, such as gasoline and fuel oil.

Minnesota has two petroleum refineries, which produce more than two-thirds of the state's petroleum products. Seventy percent of these products are refined from Canadian crude oil, supplemented by supplies from North Dakota's Bakken field. An extensive system of pipelines brings crude oil to Minnesota's refineries and distributes refined products throughout the state, including products transported from refineries located in other states. Twenty-five major petroleum storage terminals located along the routes of these pipelines, including 15 in Minnesota, store refined petroleum products. The stored products are accessed by rail and truck for delivery to retailers throughout Minnesota.

Crude Oil Pipelines

Enbridge's Mainline/Lakehead System

As a state with no indigenous oil supply situated in a relatively remote and sparsely populated region, Minnesota would not be expected to be more than a minor component of North America's oil supply system. However, the state's strategic location between the oilfields of western Canada and North Dakota and the refining centers of the Midwest, the Gulf of Mexico, and the eastern coasts of the United States and Canada, has greatly magnified the role it plays in meeting America's demand for petroleum products.

Approximately 30 percent of all U.S. crude oil imports flow through Minnesota, the primary route for Canadian oil supplies. Canada's crude oil exports to this country grew by 81 percent between 2007 and 2017, reaching 1.25 billion barrels per year. Canada is by far the largest foreign crude source for the United States, accounting for 43 percent of all imports, more than those of the next six countries combined. Even as U.S. domestic crude production has soared over the past decade, Canadian supplies have become a larger fraction of the total of domestic and imported crude, rising from 11.4 percent of the total in 2010 to 19.8 percent in 2017. Two-thirds of those Canadian imports are shipped through Minnesota, amounting to 847 million barrels in 2015.[1]

[1] U.S. Energy Information Administration, *U.S. Imports by Country of Origin*, www.eia.gov/dnav/pet/pet_move_impcus_a2_nus_ep00_im0_mbbl_m.htm; *Ibid., U.S. Imports from Canada of Crude Oil*, www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=pet&s=mcrimusca1&f=a; *Ibid., U.S. Field Production of Crude Oil*, www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=pet&s=mcrfpus1&f=a; Government of Canada, National Energy Board, *Canada's Pipeline Transportation System 2016*, 2016, p. 34, www.neb-one.gc.ca/nrg/ntgrtd/trnsprttn/2016/cnds-ppln-trnsprttn-systm-eng.pdf.

Canadian crude is transported to Minnesota through five pipelines originating in the tar sands areas of western Canada, and one that gathers oil from North Dakota's Bakken field, transports it north to Cromer in Manitoba, and then south to Minnesota. These pipelines are part of the 3,100-mile Mainline System owned by the Canadian energy company Enbridge, the world's longest crude oil and liquids pipeline system. (The U.S. portion of the Mainline System is known as the Lakehead System.) These lines cross the U.S. border in North Dakota and enter Minnesota's northwest corner. Their destination here is the hub of the state's crude oil supply infrastructure, the Clearbrook Terminal, located north of Bagley in northwestern Minnesota's Clearwater County. Operated by the Koch Pipeline Company, the facility contains 15 oil tanks with an aggregate capacity of 124 million gallons that is used to store, segregate, and blend crude oil.[2]

While the Lakehead System supplies Minnesota's two petroleum refineries (see page 5), the bulk of the oil passing through Clearbrook is destined for refineries in other states. As its export volumes increased, Enbridge sought and obtained access to the vast petroleum refineries on the U.S. Gulf Coast by acquiring, and then reversing the direction of, several midcontinent pipelines.[3] Pipelines that formerly brought petroleum north from the Gulf of Mexico now carry Canadian crude south to that area for refining and for export to other countries.

As shown on the next page in Figure 1, the first stop for Enbridge pipelines exiting Minnesota is Superior, Wisconsin, home to Enbridge's Superior Terminal, whose storage capacity exceeds 10 million barrels.[4] After supplying Superior's local 38,000 barrel per day Husky refinery, the Lakehead System splits into two parts. A southern route travels through Wisconsin to Chicago and Flanagan, Illinois, connecting with Enbridge's Spearhead System heading southwest to Cushing, Oklahoma. Enbridge has over 20 million barrels of storage capacity there, and access to many southbound pipelines, including its own Seaway system, which travels more than 500 miles to refineries in Houston and to ports on the Gulf of Mexico for purposes of export.[5]

[2] Minnesota Pollution Control Agency, *Environmental Assessment Worksheet: Clearbrook Tanks Project*, July 2013 version, pp. 2-3, www.pca.state.mn.us/sites/default/files/p-ear2-69a.pdf.

[3] "Cushing complex key to Enbridge's infrastructure plans," January 15, 2015, www.enbridge.com/stories/great-lakes-to-gulf-coast-part 12.

[4] www.enbridge.com/projects-and-infrastructure/public-awareness/wisconsin/history-and-operations.

[5] "Cushing complex key to Enbridge's infrastructure plans."

Figure 1: Enbridge's Mainline and Lakehead Systems

Source: Government of Canada, National Energy Board, *Canada's Pipeline Transportation System 2016*, https://www.neb-one.gc.ca/nrg/ntgrtd/trnsprttn/2016/cnds-ppln-trnsprttn-systm-eng.pdf, p.32. (This map is a reproduction of a version available on the NEB website. The reproduction has not been produced in affiliation with or with the endorsement of the NEB.)

The eastern leg of the Lakehead system travels through northern Wisconsin and Michigan's Upper Peninsula, then heads south to Sarnia, Ontario, where it connects with other Enbridge pipelines that deliver crude oil as far east as Montreal.

To transport the increased Canadian export volumes, Enbridge has expanded its capacity to move crude oil through Minnesota:

- In 2009, it completed construction of the LSr pipeline, running 313 miles parallel to the Mainline between Cromer, Manitoba, and Clearbrook. It carries 186,000 barrels per day of light- and medium-density crude oil, freeing up Enbridge's other lines to transport heavier Canadian crude.

- Enbridge's Alberta Clipper pipeline began transporting 450,000 barrels per day to Clearbrook in 2010. The construction of additional pumping stations in 2014 and 2015 expanded its capacity to 800,000 barrels per day.

- In June 2018, the Minnesota Public Utilities Commission approved replacement of Enbridge's Line 3 pipeline, built in 1968, which has operated at about half its design

capacity for the last decade because of aging and condition issues. Its proposed capacity is 760,000 barrels per day.[6]

In aggregate, not counting the Line 3 expansion, Enbridge pipelines currently have the capacity to deliver 2.85 million barrels of oil per day through Clearbrook.[7]

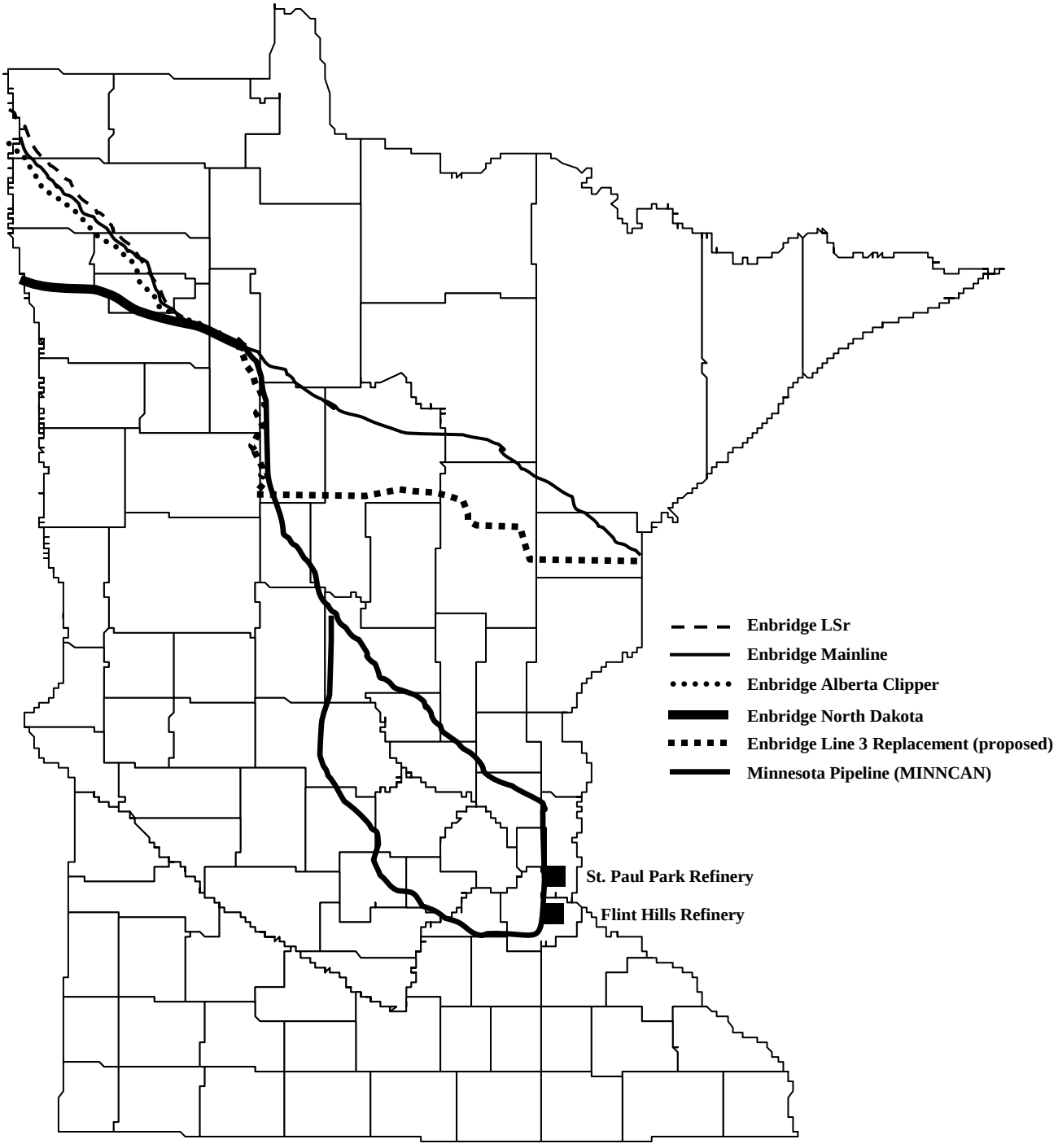
Pipelines Serving Minnesota Refineries

Minnesota's petroleum refineries, both located near St. Paul, obtain both domestic and Canadian crude from the Enbridge pipelines passing through Clearbrook. The oil is transported from Clearbrook to the refineries via four pipelines known as the Minnesota Pipeline. Three parallel lines, constructed in the 1950s, 1970s, and 1980s, have a collective capacity of 300,000 barrels per day, and travel southeast from Clearbrook to access the refineries from the north (Figure 2). A fourth line, known as the MinnCan pipeline, which began service in 2010, splits from the other three lines at Cottage Grove, heading due south before turning east to approach the refineries from the south. The MinnCan pipeline's original capacity of 165,000 barrels per day has been increased to 350,000 barrels per day by constructing additional pumping stations, allowing service to continue when repairs are being made to one of the other three lines.

[6] The commission's decision approving Line 3 has been appealed to the Minnesota Court of Appeals. Mike Hughlett, "4 tribes appeal Enbridge approval to Minnesota appeals court," *Star Tribune*, August 10, 2018, www.startribune.com/4-tribes-appeal-enbridge-approval-to-minnesota-appeals-court/490573361/.

[7] "Pipeline System Configuration," Q1, 2018, www.enbridge.com/~/media/Enb/Documents/Infographics/ENB%20Mainline%20Pipeline%20System.pdf.

Figure 2: Crude Oil Pipelines and Petroleum Refineries



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Crude Oil Transportation by Rail

The successful deployment of advanced oil drilling techniques—hydraulic fracturing (fracking) and horizontal drilling—in the Bakken oil field of North Dakota dramatically increased production in the past decade. Daily production first exceeded 100,000 barrels in 2006; eight years later, daily production passed one million barrels,[8] outstripping the existing capacity of pipelines to transport these supplies to refineries. As a result, large quantities were transported by rail. The proportion of North Dakota oil shipped by rail peaked at about 75 percent in April 2013, while the volume of production using that mode reached its highest level of approximately 870,000 barrels per day in December 2014. By August 2017, it had declined to about 100,000 barrels daily.[9]

To an even greater degree than is true with respect to pipelines, the crude oil moving through Minnesota by rail is destined for refineries located elsewhere, primarily in East Coast states, which received more than 15 percent of their crude supplies by rail in 2016. The percentage of crude oil delivered by rail to 15 Midwestern states, including Minnesota, is insignificant.[10]

Petroleum Refineries

Minnesota Refineries

The Flint Hills Resources refinery in Rosemount and Marathon Petroleum's St. Paul Park facility refined an estimated 138 million barrels of crude oil in 2017.[11]

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[8] State of North Dakota, *North Dakota Drilling and Production Statistics*, "North Dakota Annual Oil Production," www.dmr.nd.gov/oilgas/stats/annualprod.pdf.

[9] North Dakota Pipeline Authority, *Annual Report, July 1, 2016 – June 30, 2017*, Figures 5 and 6, p. 13, www.nd.gov/ndic/pipe/publica/annual-report17.pdf.

[10] U.S. Energy Information Administration, *Refinery Receipts of Crude Oil by Method of Transportation*, www.eia.gov/dnav/pet/pet_pnp_caprec_dcu_r20_a.htm.

[11] This estimate was calculated by multiplying the net input of crude oil to all refineries in Minnesota, North Dakota, and Wisconsin in 2017 (185.3 million barrels) times the proportion of refinery capacity in those states accounted for by Minnesota's capacity (.747). U.S. Department of Energy, Energy Information Administration, *Refinery and Blender Net Input, 2017*, http://www.eia.gov/dnav/pet/pet_pnp_inpt_a_epc0_yir_mbbl_a.htm; U.S. Department of Energy, Energy Information Administration, *Refinery Capacity Report*, Table 1, Number and Capacity of Operating Petroleum Refineries by PAD District and State as of January 1, 2017, http://www.eia.gov/dnav/pet/pet_pnp_cap1_dcu_nus_a.htm.

The Flint Hills facility is owned by Koch Industries, Inc. Northern Tier Energy purchased the St. Paul Park refinery in 2011 from Marathon Oil Corporation, Marathon Petroleum's predecessor. Northern Tier merged with Western Refining in June 2016, which was in turn acquired by Tesoro Corporation in June 2017. In August 2017, Tesoro changed its name to Andeavor. In October 2018, Marathon Petroleum completed its $23.3 billion acquisition of Andeavor, becoming the largest refiner in the United States, with a capacity of 3 million barrels per day. Jon Chavez, "Marathon completes acquisition of rival Andeavor," *The Blade*, October 3, 2018, https://www.toledoblade.com/business/energy/2018/10/02/marathon-petroleum-completes-acquisition-rival-andeavor/stories/20181002180.

The refineries differ significantly in certain respects. Flint Hills is almost three times larger, with a capacity of 290,000 barrels per day, compared with St. Paul Park's 98,515.[12] About 80 percent of the crude processed by Flint Hills comes from Canada, compared with 47 percent at St. Paul Park.[13]

In 2017, the St. Paul Park facility produced 812 million gallons of gasoline, 445 million gallons of diesel, and 107 million gallons of jet fuel.[14] The bulk of the gasoline and diesel is sold in Minnesota through company-operated and franchised SuperAmerica stores.[15]

The Flint Hills Resources refinery supplies about half of Minnesota's motor fuel and 40 percent of Wisconsin's,[16] as well as the bulk of jet fuel for the Minneapolis-St. Paul International Airport.

Minnesota refineries exported about 106 million gallons of gasoline and 74 million gallons of fuel oil to other states in 2017.[17]

Non-Minnesota Refineries

Minnesota also receives refined petroleum products from refineries in other states, including the following:

- Marathon's 73,800-barrel per-day Mandan, North Dakota, refinery, which processes mostly low-sulfur crude from that state. Significant proportions of the gasoline and diesel produced at the refinery are shipped to Minnesota and Wisconsin.

- The 38,000-barrel per-day Husky refinery in Superior, Wisconsin, which receives crude from Canada and North Dakota.

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[12] *Ibid.*, *Refinery Capacity Report*, Table 3, Capacity of Operable Petroleum Refineries by State and Individual Refinery as of January 1, 2017, http://www.eia.gov/petroleum/refinerycapacity/table3.pdf. These figures, and all other measures of refinery capacity in this publication, are based on a "calendar day," 24-hour operation including standard downtime for inspection, maintenance, and repair. The comparable figures for a "stream day"—with no allowances for downtime—are 339,000 and 103,700, respectively.

[13] David Shaffer, "St. Paul Park Refinery increasingly focuses on Bakken oil," *Star Tribune*, June 23, 2015, http://www.startribune.com/st-paul-park-refinery-increasingly-focuses-on-bakken-oil/308916331/; U.S. Securities and Exchange Commission, *Western Refining, and Northern Tier Energy, LP, Form 10-K for the year ended December 31, 2016*, filed March 1, 2017, p. 4, www.sec.gov/Archives/edgar/data/1339048/000133904817000008/wnr12311610k.htm.

[14] U.S. Securities and Exchange Commission, *Andeavor, Form 10-K for the year ended December 31, 2017*, filed February 21, 2018, p. 8, http://phx.corporate-ir.net/phoenix.zhtml?c=79122&p=irol-reportsannual.

[15] *Ibid.*, *Form 10-K*, p. 11.

[16] David Shaffer, "Flint Hills Resources plans $750 million in capital investment at its Minnesota refinery," *Star Tribune*, February 4, 2016, http://www.startribune.com/flint-hills-resources-plans-750-million-in-capital-investment-at-its-minnesota-refinery/367759651/.

[17] Minnesota Department of Revenue, *Petroleum Tax: Petroleum Collections*, January through December 2017, http://www.revenue.state.mn.us/businesses/petroleum/pages/tax-information.aspx.

- British Petroleum's (BP) refinery in Whiting, Indiana, with a capacity of 413,500 barrels per day, which processes crude from Canada, West Texas, and the Gulf of Mexico.

Refined Products Pipelines and Terminals

Refined petroleum products are brought one step closer to consumers via a system of pipelines and some two dozen storage terminals, most of which are located in Minnesota.

The Magellan Midstream Partners pipeline system, the largest common carrier pipeline shipping refined petroleum products in the United States, distributes the largest proportion of the refined products produced in Minnesota's refineries. As shown in Figure 3, Magellan operates six terminals where trucks and, in some cases, rail cars, load these products for distribution to smaller storage facilities and retailers (Alexandria, Mankato, Marshall, Rochester, St. Paul, and Wrenshall).

Refineries in other states also distribute refined products in Minnesota. The Mandan, North Dakota, refinery transports products through its proprietary NuStar Pipeline, which supplies the company's petroleum terminals in Moorhead, Sauk Center, and Roseville.[18] BP's Whiting, Indiana, refinery brings petroleum products to Minnesota through a proprietary pipeline that enters the state in Fillmore County and delivers product to Kinder Morgan's terminal in Spring Valley and to the NuStar terminal in Roseville.

Some Minnesota terminals do not receive supplies through these pipeline systems and are not shown in Figure 3. Both the Flint Hills and St. Paul Park refineries have petroleum product terminals at their facilities. A privately-owned terminal at Newport in Washington County receives product from Flint Hills that is distributed exclusively to Holiday gas stations. A terminal owned by Swissport Fueling, Inc., services airlines at the Minneapolis-St. Paul International Airport, and one in northeast Minneapolis in Burlington Northern Santa Fe's Northtown railyard serves that company's needs. The Husky Refinery in Superior, Wisconsin supplies terminals in Esko, 15 miles southwest of Duluth (whose product is distributed through the Magellan system), and the Duluth Marine Terminal on Lake Superior.

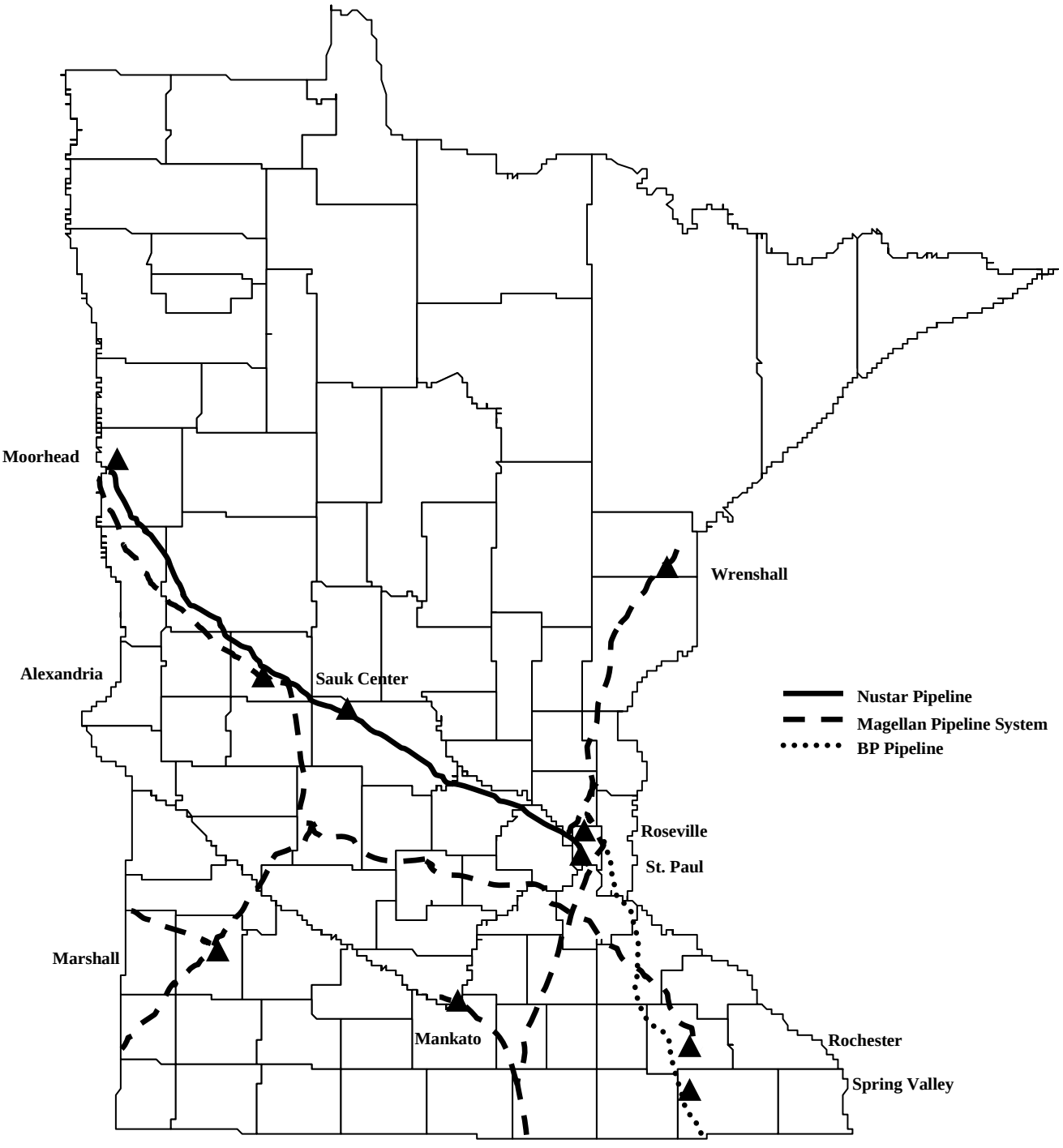
In 2017, the Minnesota Department of Revenue licensed 385 petroleum products distributors—importers, refiners, petroleum storage facilities (bulk plants), and owners of truck and tanker fleets—to distribute these products by truck to retailers and end users.[19] According to the Minnesota Department of Commerce, Minnesota also draws petroleum products from nearly a dozen terminals located near its borders in adjacent states and in Canada.[20]

[18] Some products from the Mandan refinery are also transported to Minnesota by truck from Magellan terminals in the Dakotas.

[19] Minnesota Department of Revenue, Petroleum Tax, Excel spreadsheet, *Petroleum Licensed Distributors*, http://www.revenue.state.mn.us/businesses/petroleum/Pages/Tax-Information.aspx.

[20] Julie Quinn, director, Division of Weights and Measures, Minnesota Department of Commerce.

Figure 3: Refined Petroleum Products Pipelines and Associated Terminals



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