

NATURAL GAS AND OIL USE IN **MICHIGAN**

ENHANCING THE QUALITY OF LIFE FOR MICHIGANDERS

A photograph of a red archway sign for Bayfront Park. The sign is curved and has the words "BAYFRONT PARK" in white capital letters. In the foreground, there is a white silhouette of the state of Michigan on a red background. The background of the photo shows a large body of water, trees, and a distant shoreline under a clear blue sky.

BAYFRONT PARK

energy **API**[®]

ENHANCING THE QUALITY OF LIFE FOR MICHIGANDERS



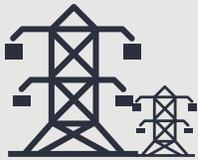


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SUMMARY

From heating homes, schools and hospitals, generating clean and reliable electricity, powering farm and recreational equipment, to providing the building blocks for goods we use daily, petroleum and natural gas touch nearly every aspect of life in Michigan. And the role that petroleum and natural gas plays in our lives is growing. Michigan is currently the **ninth largest consumer of natural gas** in the U.S., generating significant economic and environmental benefits for the state's consumers and manufacturers:



POWER GENERATION

POWER GENERATION: Michigan has grown its use of natural gas for power generation, increasing 130 percent in the last ten years. Increased use of natural gas in generating electricity helped Michigan cut **CO₂ emissions by over 25 percent between 2007 and 2017**, benefits that will continue to rise as Michigan uses more natural gas in its generation mix.



INDUSTRY

INDUSTRIAL: Over the past ten years, natural gas consumption in Michigan's industrial operations has increased 20 percent. Because of falling natural gas prices, industrial **consumers spent \$558 million less** in 2017 than if prices had remained where they were in 2010. Increased use of affordable and reliable natural gas is helping Michigan's companies cut costs and create good-paying jobs.



MILITARY

MILITARY: The Department of Defense is the largest consumer of energy in the U.S., and Michigan has seven significant national security and military installations in the state.



RESIDENTIAL

RESIDENTIAL: One in ten Michigan households rely on propane, kerosene or fuel oil for home heating and more than three-fourths rely on natural gas. Natural gas prices have fallen significantly over the past decade, ranging from a drop of 30 percent for residential consumers to 60 percent for electric power users. For example, if residential and commercial consumers had made their 2017 purchases using 2010 prices, **they would have spent an extra \$1.2 billion.**



COMMERCIAL

COMMERCIAL: Commercial consumption of natural gas has risen 12 percent in the last five years, as both the number of consumers and average consumption has risen. As natural gas prices continue to fall, more facilities will be looking to convert to reliable and affordable natural gas.



TRANSPORTATION

TRANSPORTATION: Natural gas and petroleum products fuel transportation for Michigan's residents. **The state consumed over 113 million barrels of motor gasoline** in 2016, the eighth most in the country, for residents to commute to work, transport loved ones and escape on vacation.

INTRODUCTION

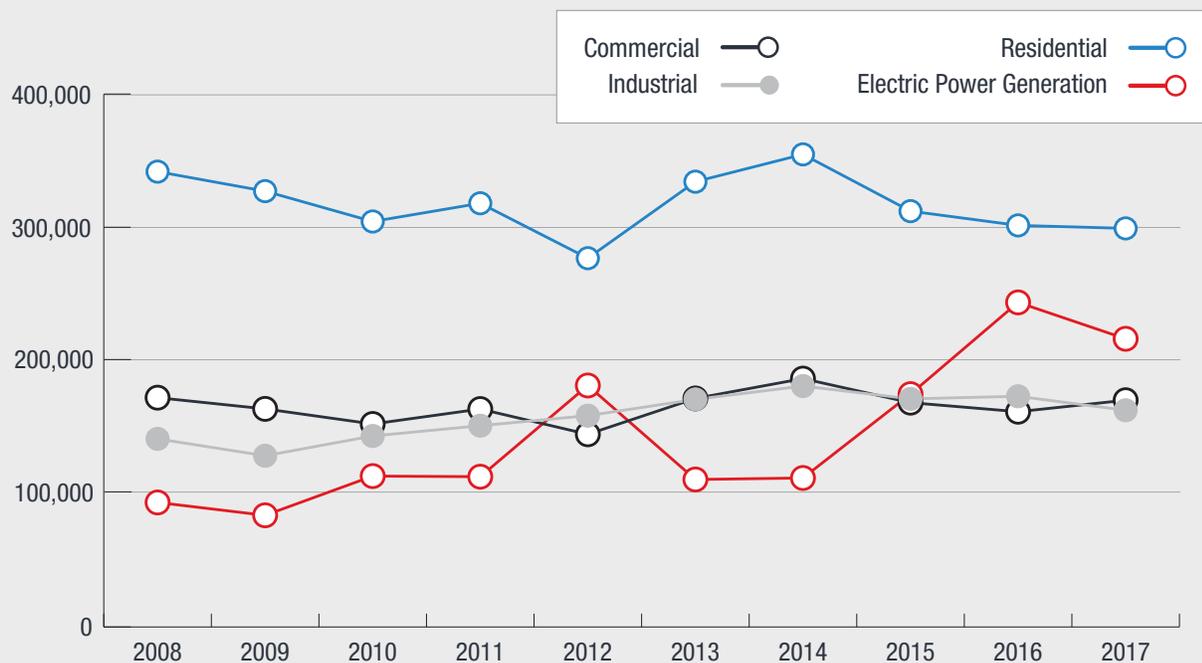
NATURAL GAS CONSUMPTION IN MICHIGAN

Natural gas plays a vital role in providing the quality of life Michigan residents enjoy. Michigan is the tenth largest state in the nation by population, and its residents, businesses and communities rely on safe and reliable energy transportation. The Great Lakes state was in the top ten US states in both natural gas and petroleum consumption in 2016 and routinely ranks in among the top ten in total consumption.¹ This growth is largely attributable to a 130 percent increase in natural gas for low-emissions electricity generation in the last ten years.

The residential sector is the largest user of natural gas in Michigan, accounting for over a third of all natural gas consumed in the state. Residential consumption of natural gas increased nearly 20 percent between 2012 and 2017, and today more than three-fourths of Michigan households use natural gas as their primary source for home heating. The industrial and commercial sectors' use of natural gas have also increased, each accounting for about 20 percent of Michigan's total natural gas consumption in 2017. Average annual consumption per industrial consumer has gone up 30 percent over the same period.² Natural gas as a transportation and vehicle fuel have also increased 40 percent in the last five years.

FIGURE 1: NATURAL GAS CONSUMPTION IN MICHIGAN

Million Cubic Feet (MMcf)



Source: EIA.

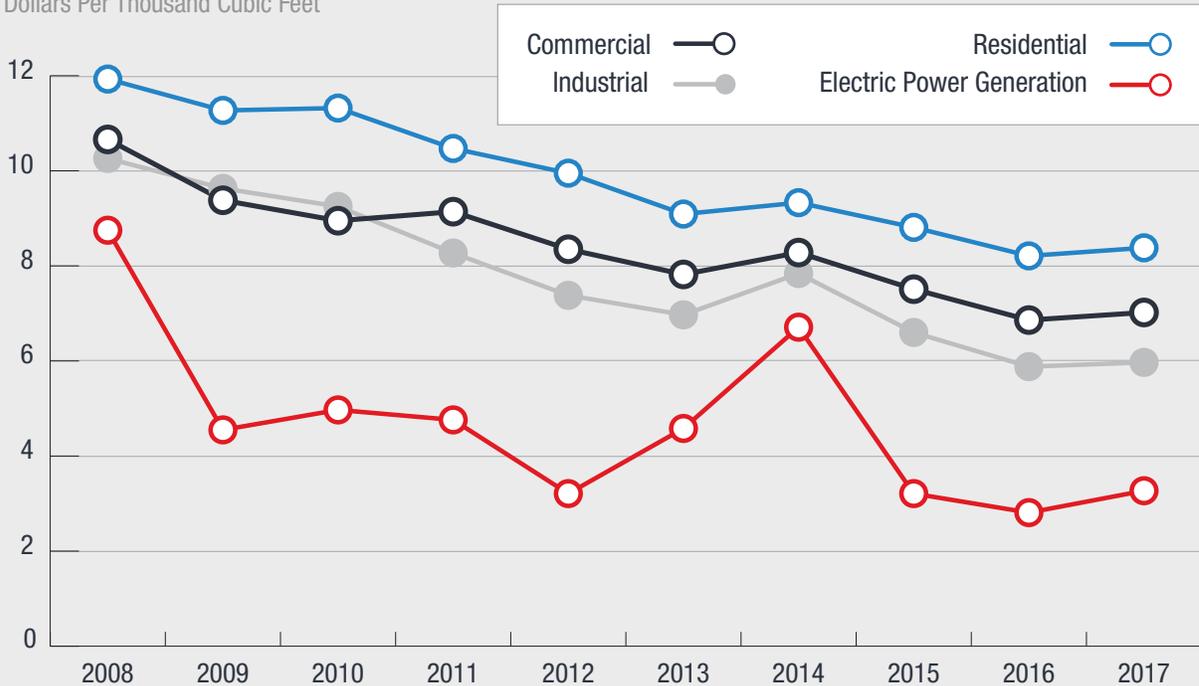


Despite the increase in demand, natural gas prices have remained low for Michigan residents. In fact, natural gas prices have fallen significantly over the past decade, ranging from a drop of 30 percent for residential consumers to 60 percent for electric power users.

This has meant large savings in energy expenditures. For example, if residential and commercial consumers had made their 2017 purchases using 2010 prices, they would have spent an extra \$1.2 billion.³

FIGURE 2: MICHIGAN NATURAL GAS PRICES

Dollars Per Thousand Cubic Feet



Source: EIA.

OIL AND PETROLEUM PRODUCTS' CONSUMPTION IN MICHIGAN

While Michigan's oil production has decreased from 32.6 million barrels per year in 1981 to 5.3 million barrels in 2017, the state relies heavily on petroleum products to power the comforts of modern life its residents enjoy.⁴

Motor gasolines comprises about two-thirds of the petroleum products consumed in Michigan.⁵ During the summer, the state regulates the vapor pressure of motor gasoline sold in eight southeastern counties to reduce emissions. Michigan ranks in the top ten in the nation for miles of public roads, and Michiganders are some of the nation's most avid drivers. In 2016, residents consumed over 113,000,000 barrels of motor gasoline, the eighth most in the country.⁶

Due to its large population and harsh winter, Michigan is the biggest consumer of propane for home heating in the nation and stands among the top ten in the overall use of liquified petroleum gas (LPG).⁷ The Wolverine State is also a top 15 consumer of distillate fuel oil in the U.S. due to high usage in agricultural machinery, trucks and automobiles, using nearly 30 million barrels in 2016.

TRANSPORTATION & STORAGE

NATURAL GAS PIPELINES

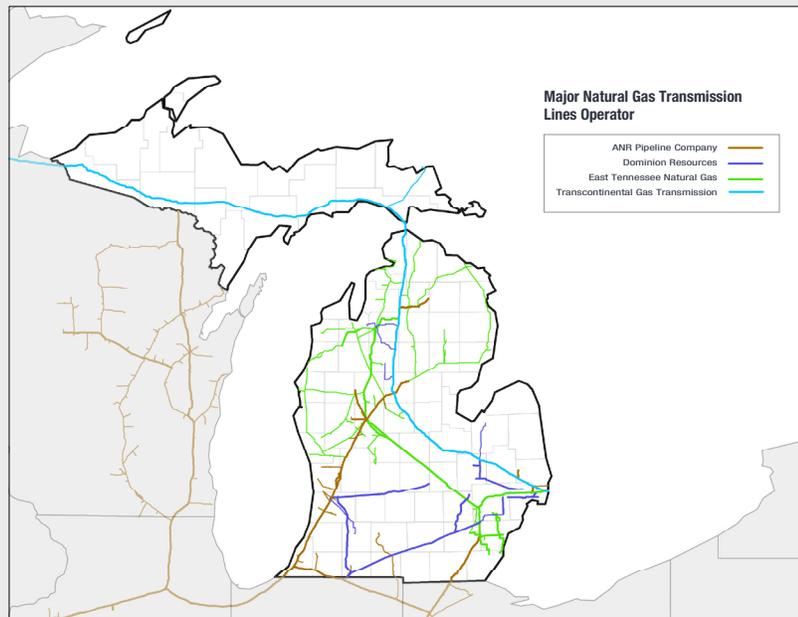
MICHIGAN HAS NEARLY 9,000 MILES OF NATURAL GAS TRANSMISSION LINES AND OVER 3,500 MILES OF PETROLEUM AND REFINED PRODUCTS LINES.

Michigan's crucial pipeline infrastructure transports natural gas produced in the state, mostly in the Lower Peninsula, imports gas from other states, and connects natural gas stored

underground to consumers. As a top ten consumer of natural gas in the U.S., Michigan is largely dependent upon out-of-state production to meet its supply needs.⁸ Approximately 20 percent of the natural gas consumed in Michigan is produced within the state; the remaining 80 percent is imported by interstate pipelines that have access to the major natural gas producing regions in North America.⁹



FIGURE 3: MAJOR NATURAL GAS TRANSMISSION LINES IN MICHIGAN



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MICHIGAN'S INTERSTATE AND INTRASTATE NATURAL GAS PIPELINE NETWORK:¹⁰

- ▶ The Great Lakes Gas Transmission Company is the largest natural gas importing pipeline in the region, transporting 2.9 billion cubic feet (Bcf) per day from the Manitoba/Minnesota border through Minnesota, Wisconsin, and Michigan and to the Michigan/Ontario border.
- ▶ ANR Pipeline Company (ANR) and Natural Gas Pipeline Company of America (NGPLA) transport natural gas produced in Texas, Louisiana, Oklahoma and Kansas to the Midwest. NGPLA carries about 12 percent of the region's natural gas capacity while ANR transports about seven percent.
- ▶ Consumers Energy Company's gas subsidiary serves more than 4.1 million customers in Michigan, operating more than 27,000 miles of transmission and distribution pipelines.¹¹
- ▶ DTE Gas Company operates a network of natural gas storage facilities and transmission pipelines in the state. They also operate a natural gas utility in Michigan, offering a range of gathering, storage and transportation services for the Michigan market.
- ▶ Investing in new infrastructure including two new pipelines in the state will continue to benefit those who rely on access to reliable, affordable natural gas. The Rover Pipeline project, supported by a wide range of groups from farmers to the chemical industry, transfers natural gas from Ohio and West Virginia to Michigan. Currently operational, the \$4.2 billion pipeline transports 3.25 Bcf per day of domestically-produced natural gas, with nearly a third delivered to markets in Michigan.
- ▶ The Nexus pipeline, approved by the Federal Energy Regulatory Commission in 2017, is expected to carry 1.5 Bcf of natural gas per day.¹² The \$2 billion project was completed and placed into service in the fall of 2018. Together, the Rover and Nexus pipelines increase the volume of natural gas entering Michigan by up to 35 percent, helping to meet the state's growing demand for cleaner power generation, industrial and commercial use, and home heating.¹³

Infrastructure development produces a significant and widespread positive impact on the state. A recent ICF study found that natural gas infrastructure in Michigan has already supported almost 25,000 jobs, bringing a total of \$12 billion to state GDP.¹⁴ Investment in infrastructure will continue to have a substantial positive impact on Michigan's economy. ICF estimates that between 2017 and 2035, natural gas infrastructure will support 16,613 jobs per year and add over \$2 billion per year to state GDP. State and local governments will gain over \$6 billion in taxes from investments in natural gas infrastructure. Natural gas infrastructure investment not only supports thousands of jobs and raises billions in state and local taxes, it also fosters the delivery of low cost, reliable energy to consumers throughout Michigan.

UNDERGROUND STORAGE

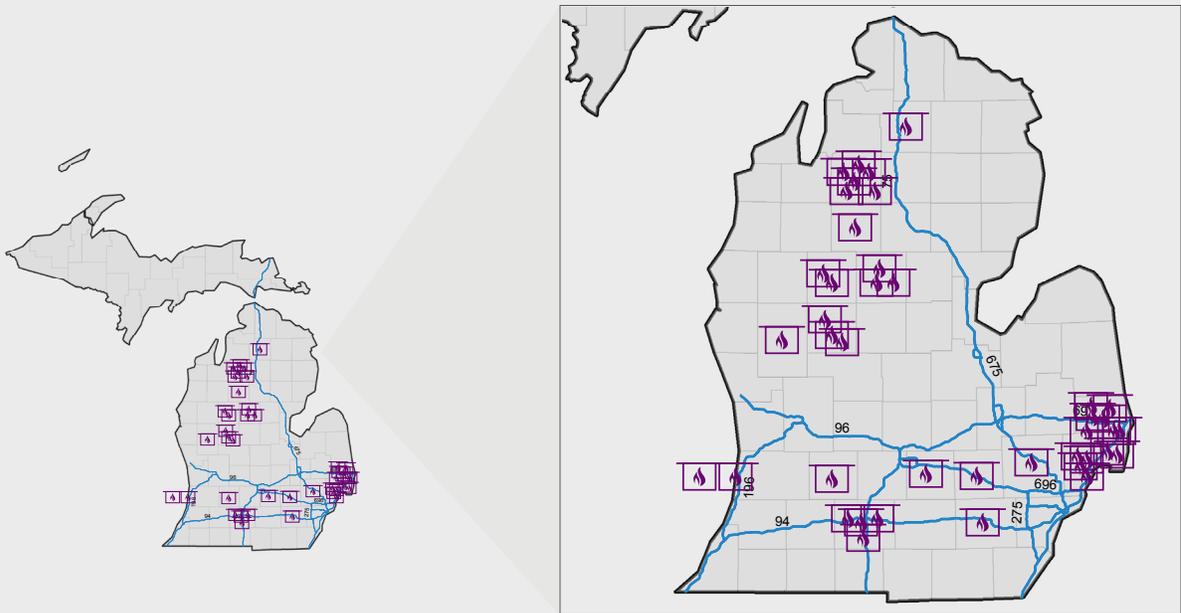
Michigan's 1.07 trillion cubic feet of underground natural gas storage represents one-tenth of U.S. ability and the largest in the nation. Natural gas stored underground in Michigan's 42 depleted natural gas and oil fields is second in number only to Pennsylvania.¹⁵ The state's unique geological features with highly porous fields make them among the best for underground storage in North America.¹⁶

The largest single storage field is DTE Energy's Washington 10 field under Romeo, a 68.5 billion cubic feet field north of a 59-mile natural gas pipeline between Milford and Belle River. Consumers Energy, with 14 sites in Michigan, is the single largest local distribution operator of underground storage fields in the lower 48 States, according to the EIA.¹⁷

Michigan's natural gas storage capacity is a huge asset to both Michigan and surrounding states, benefitting consumers by

helping stabilize prices. Michigan's natural gas demand increases in the winter during extreme cold periods for home heating, and declines during the warm summer months. The Michigan Public Service Commission explains that, "Because of Michigan's excellent underground geological features, supplies of gas can be delivered on a more uniform basis. Michigan's underground natural gas storage facilities can balance receipts and deliveries for Michigan as well as provide winter deliveries to neighboring states."¹⁸ The state's natural gas storage sufficiently provides for Michigan along with neighboring states during high-demand cold weather. In addition to providing needed fuel and smoothing supply in the winter months, Michigan's natural gas storage provides backup energy supply in the event of an emergency, contributing to the resilience of the natural gas system. When floods washed out a section of natural gas pipeline in Kansas in 1951, storage fields near Austin supplied Michigan and Wisconsin's critical natural gas needs for about a week.¹⁹

FIGURE 4: MICHIGAN NATURAL GAS UNDERGROUND STORAGE



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LIQUIDS PIPELINES

As Michigan produces less than one percent of the crude oil it consumes, liquids pipelines play a critical role in providing sufficient energy supplies to Michigan and the surrounding states.²⁰ Pipelines bring crude oil from western Canada through Wisconsin and from the Gulf Coast via Ohio into Michigan. The Mid Valley Pipeline, operated by Sunoco, carries crude oil between Texas and Michigan and connects to refineries in Lima and Toledo. The MarkWest Pipeline gathers crude oil from the Niagaran Reef in Northern Michigan and connects with the Enbridge Lakehead System to transport oil to refineries in the Midwest.²¹ Line 5, part of the Lakehead system operated by Enbridge, transports light crude from the Midwest to refineries in northern Ohio and Detroit.²²

Marathon Petroleum operates a refinery in Detroit that was recently upgraded to process both light, sweet and heavy, sour crude oils and produce gasoline, distillates, asphalt, propane, and other products. The refinery employs approximately 540 people.²³

Even with Michigan's refining sector, refined petroleum demand in Michigan exceeds the state's refined product production. To supply the balance, Michigan has a robust infrastructure

system of liquid pipelines and ports. Petroleum product pipelines, transporting critical gasoline, home heating oil and the raw materials for fertilizer and pharmaceuticals, supply the state mainly from local refineries in the Chicago, Illinois and Toledo, Ohio areas. The majority of petroleum products consumed in Michigan, including diesel, jet fuel and lubricants, are produced at nearby refineries in Ohio, Indiana and Illinois. Marathon's Muskegon pipeline receives product from refineries in Illinois and transports them up the eastern coast. The Wolverine pipeline connects the Chicago supply center to southwestern and eastern Michigan through the Loop system and to south central Michigan through the Mainline system. Buckeye Partners Pipeline transports products from refineries in Northwestern Ohio and Detroit to areas across Eastern Michigan. Sunoco's Toledo North carries product from Toledo refineries to the Detroit area.

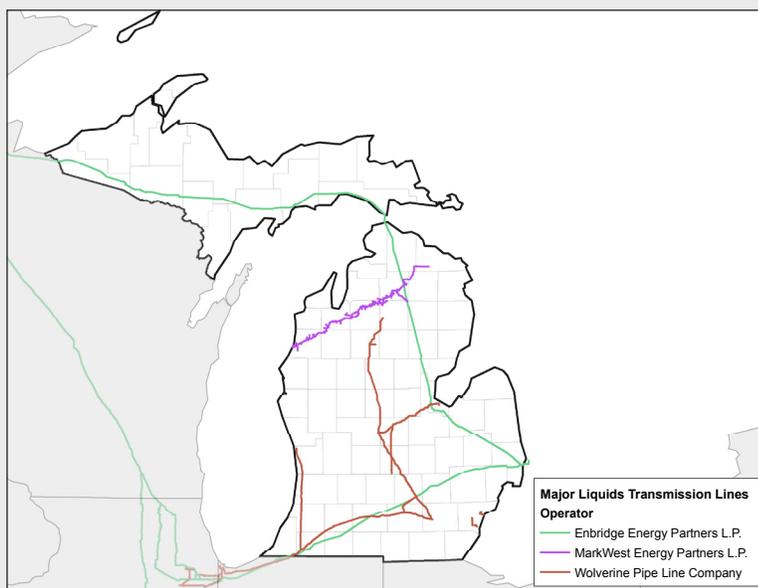
Michigan has 38 petroleum product terminals clustered near urban areas and around airports.²⁴ These terminals, mostly in the southern portion of the state, receive product from nearby refineries, pipelines, and tankers and barges to be redistributed throughout the state. The terminals supply gasoline, heating oil, and diesel fuel to trucks for delivery to retail outlets and local distributors.

Significant volumes of petroleum are also shipped by barge within the Midwest. Michigan received petroleum products from ports in Detroit, Cheboygan Harbor, Manistee Harbor, Gray's Reef Passage and on the Detroit and St Clair rivers. In 2015, the state of Michigan processed over 15.8 million barrels of petroleum products.²⁵ The Detroit River alone handled more than one-third of all petroleum products transported. Asphalt constituted almost 30 percent of the petroleum brought along the Detroit River, with petroleum coke making up another 24 percent of petroleum product movement.²⁶ The Port of Detroit has the largest port freight traffic of petroleum products in the state, transporting 3.2 million barrels of petroleum product in 2015, contributing to almost \$15 million in estimated business revenue.²⁷ The port supports more than 16,000 jobs in southeast Michigan.

Infrastructure development produces a significant and positive impact on the state. In Michigan, natural gas and oil pipelines supported over 14,000 jobs and provided nearly \$1

billion in labor income in 2015.²⁸ Enbridge, a major liquids pipeline operator in Michigan, contributes significantly to the local economy and provides valuable energy supplies to the state. In 2017, the company paid nearly \$8 million in salary to its Michigan-based employees. Enbridge also paid \$60.8 million in property tax in the state for its pipelines and related facilities, and close to \$1 million in sales and use taxes across Michigan that support public schools, hospitals and state outreach programs in 2017.²⁹ Enbridge's 645 mile-long Line 5 runs from Wisconsin to Ontario, bringing products that heat homes and businesses, fuel vehicles and power industry in Michigan. Line 5 adds approximately \$81 million per year to the Michigan economy and supports almost 1,000 direct, indirect, and induced jobs.³⁰ The line has not experienced a leak in more than 60 years of operation. It transports up to 540,000 barrels per day of light crude oil, light synthetic crude and natural gas liquids. About 30 percent of the light crude on Line 5 stays in Michigan.³¹

FIGURE 5: MAJOR CRUDE OIL, NGL, AND REFINED PRODUCT TRANSMISSION LINES IN MICHIGAN

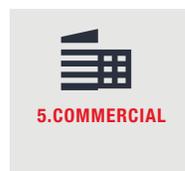
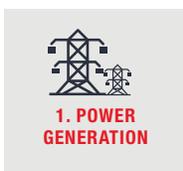


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USE OF NATURAL GAS AND OIL IN MICHIGAN

The remainder of this report examines the major uses of natural gas and oil in Michigan: power generation, industrial, residential, commercial, and transportation.

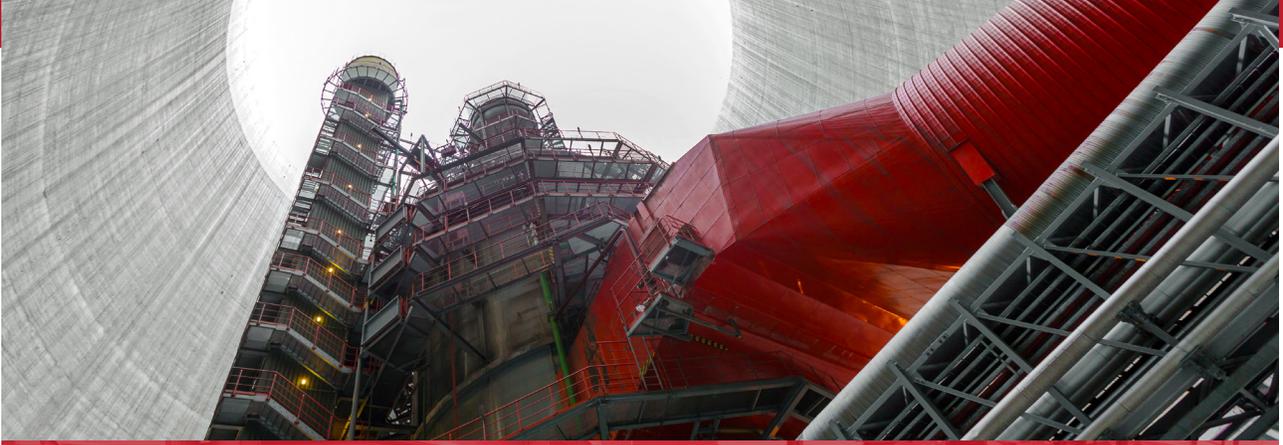


1. POWER GENERATION



Across the U.S., natural gas-fired generation surpassed coal in 2016 as the predominant fuel source for electric generation and is the leading fuel type for capacity additions. In 2014, coal-fired plants generated half of Michigan's electricity, while two years later it had decreased to about a third. In turn, since 2010, natural gas consumption in the power generation sector has doubled.³² There are over 40 natural gas fired power plants currently operating or under construction in the state.³³ Natural gas use is an important part of Michigan's power generation mix for many reasons, including environmental, reliability, and economic benefits. In fact, "by using natural gas for power, utilities have cut Greenhouse Gas Emissions in half compared to emissions from the coal-fired plants which the new combined cycle natural gas plants are replacing." The U.S.' energy-related CO2 emissions are at the lowest levels since 1991.³⁴

While the Holland Energy Park is integrated into, owned and operated by the community itself, other Michigan power plants also work to be good neighbors and contribute to local economies. The Greenwood Energy Center has been operating for close to 40 years, and was designated as a Clean Corporate Citizen by the Michigan Department of Environmental Quality. Owned by Detroit Edison (DTE), "the plant has been an important part of the local community, a significant contributor to the economy and a committed steward of the environment."³⁵ DTE Vice Chairman Steve Kurman described the impact of the Energy Center on the community: "Each day . . . dozens of skilled, dedicated employees have worked diligently to operate the plant efficiently, reliably and responsibly. Through their efforts, Greenwood has been a key contributor to the stability and reliability of the electrical system in Southeast Michigan."³⁶



The increasing use of natural gas in electricity generation is apparent in the city of Holland, MI. Like many other small and mid-size cities, Holland generates electricity through its own municipal utility, the Holland Board of Public Works (BPW). While the city has historically relied on a coal-fired plant, the BPW has constructed the new Holland Energy Park, a \$240 million project that uses clean-burning natural gas. Thanks to the new natural gas facility, Holland's power generation will see a 50 percent reduction in carbon emissions and double the fuel efficiency, while meeting 60 to 65 percent of the BPW's electricity needs.³⁷

Before even beginning operations, the Energy Park received the Institute for Sustainable Infrastructure's Envision Platinum award, the first power plant in the world to receive the honor, which recognizes the sustainability of public infrastructure.³⁸ David Koster, general manager at Holland Board of Public Works, explained that the Energy Park is meant to be integrated into the community, with "an area outside where people can use the trails that will be around this facility and connect to different natural systems and come in to learn about energy. So it's an educational resource also."³⁹

In addition to environmental benefits, natural gas power plants provide significant economic benefits to Michigan's economy, supporting almost 11,000 jobs in the state and adding revenue to local governments.⁴⁰ For example, the New Covert Generating Facility in Covert, MI is "one of the largest taxpayers in Van Buren County, contributing more than \$4.7 million in property taxes for 2011. Each year, the plant injects more than \$8.2 million in salaries and payments to local contractors and vendors into the area economy."⁴¹ In operation since 2004, the facility is an independent natural gas-fueled combined-cycle generating station that sells enough power to meet the needs of more than one million homes.

In Midland, the Midland Cogeneration Venture (MCV) "is the largest natural gas fired combined electrical energy and steam energy generating plant in the United States of America," supplying electricity and steam energy to residents of the state as well as chemical production companies.⁴² The facility "is

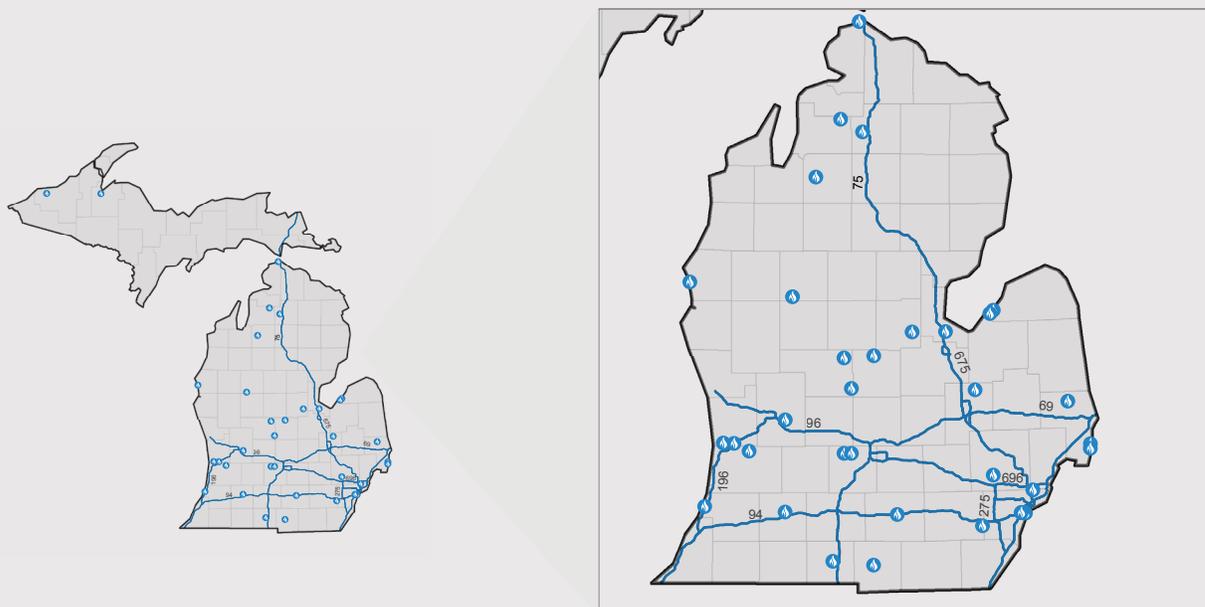
capable of continuously producing 1,633 Megawatts of electrical power, and in parallel, produce process steam at a rate of 1.5 million pounds per hour. This is enough electrical energy output to supply a city the size of over one million households, and at the same time, constantly supply major-sized industrial facilities with all of their process steam."⁴³ The plant's economic benefits are immense, including directly employing 121 people and supporting over 120 contractors, including union laborers. The Midland plant is the second largest taxpayer in Midland and supports regional small businesses by spending about \$15 million per year with over 100 Great Lakes Bay vendors.⁴⁴

With a recently announced natural gas plant in the works, St. Clair County is poised to garner similar environmental and economic benefits. DTE unveiled plans to build natural gas-powered plants worth between \$1 billion by 2022 located in China Township.⁴⁵ Replacing two coal plants, the new combined-cycle natural gas plant will emit 70 percent less carbon emissions.⁴⁶

County Board Chairman Jeff Bohm called the announced plant “arguably the biggest thing in my 44 years of being here. The tax base that these plants generate — if you look at \$1.3 billion (for example). That’s roughly 10 percent of the total (state equalized value on taxes) of all of St. Clair County. That’s how huge these plants are.”⁴⁷ To fully take advantage of these benefits, natural gas power generators like the proposed projects need access to expanded pipeline infrastructure.

The county's existing two major natural gas pipelines and electric transmission lines make St. Clair an ideal place to build the new plant. The county also currently has the largest underground natural gas storage capacity in the Midwest to provide reliable, clean-burning energy even in times of high demand.

FIGURE 6: MICHIGAN INFRASTRUCTURE: NATURAL GAS POWER PLANTS



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MICHIGAN POWER PLANTS USING NATURAL GAS.

PLANT NAME	UTILITY NAME	CITY
491 E 48th Street	City of Holland	Holland
Alpine Power Plant	Wolverine Power Supply Coop	Elmira
Belle River	DTE Electric Company	China Township
Dan E Karn	Consumers Energy Co	Essexville
Dean	DTE Electric Company	East China
Dearborn Industrial Generation	Dearborn Industrial Gen Inc	Dearborn
Delray	DTE Electric Company	Detroit
Greenwood (MI)	DTE Electric Company	Avoca
Hancock	DTE Electric Company	Commerce Township
Holland Energy Park	City of Holland	Holland
Jackson Generating Station	Consumers Energy Co	Jackson
Lansing BWL REO Town Plant	Lansing Board of Water and Light	Lansing
Livingston Generating Station	CMS Generation MI Power LLC	Gaylord
Michigan Power LP	Michigan Power Limited Partnership	Ludington
Midland Cogeneration Venture	Midland Cogeneration Venture	Midland
New Covert Generating Facility	New Covert Generating Company LLC	Covert
Northeast (MI)	DTE Electric Company	Warren
Renaissance Power Plant	DTE Electric Company	Carson City
Sumpter	Wolverine Power Supply Coop	Belleville
Zeeland Generating Station	Consumers Energy Co	Zeeland

SOURCE: EIA; ESRI; DOE; ICF.



2. INDUSTRIAL USERS

MANUFACTURING

Michigan’s industrial sector relies on natural gas as fuel for industrial processes, which could include generating heat and/or electricity and/or feedstocks for products. Industrial consumers of natural gas include manufacturers of chemicals, primary metals, paper, and food and beverage.

A number of industrial facilities in Michigan rely on natural gas and petroleum products for their operations. EIA data indicates that the industrial sector consumes over 30 percent of total state residual fuels.

While the number of industrial natural gas users in Michigan has fallen slightly over the past several years, consumption has risen by nearly 20 percent in the past ten years, and average consumption

per industrial consumer has risen by 30 percent since 2012. Because of falling natural gas prices, industrial consumers spent almost \$558 million less in 2017 than if prices had remained where they were in 2010.⁴⁸

Industrial facilities can use natural gas and petroleum products in several ways. It can be used as a feedstock to make other products such as plastics, pharmaceutical drugs and electronics, to generate heat for industrial processes, to generate electricity for industrial processes, and it can be used to do the latter two together (referred to as co-generation, or cogen, or as combined heat and power, or CHP). The table below lists facilities that have been identified in one of two databases as being cogen facilities using pipeline gas (as opposed to landfill). Some of these facilities, such as the chemical manufacturers, also use natural gas as a feedstock.

INDUSTRIAL	2010	2011	2012	2013	2014	2015	2016	2017
Number of Consumers	9,332	9,088	8,833	8,497	8,156	7,761	7,652	7,314
Consumption (MMcf)	143,351	151,083	158,591	170,833	180,829	171,196	172,010	170,189
Average Consumption Per Consumer (Thousand Cubic Ft.)	15,361	16,624	17,954	20,105	22,171	22,058	22,479	23,269

SOURCE: EIA.

The low cost of natural gas is critical to ensuring industrial businesses can keep energy costs low while still providing good-paying jobs and generating tax revenues for the state and local communities. Michigan is the 13th-largest chemical-producing state in the nation, and the chemical industry is particularly vital here for local economies. At \$15.5 billion, the chemical industry is the third-largest manufacturing sector in the state, providing about 30,000 direct jobs and 90,000 related jobs.⁴⁹

The Michigan Chemistry Council explained that “energy is among the most significant issues of concern for the chemical industry. Our members greatly depend upon reliable and affordable energy sources

– particularly natural gas – not only to produce heat and power, but also as the primary raw input needed to create the chemicals that go into thousands of manufactured goods that Americans use every day. Natural gas is to the chemical industry as flour is to a bakery.”

Michigan is the U.S.’ sixth largest consumer of hydrocarbon gas liquids, also known as natural gas liquids (NGLs), using nearly 12 million barrels in 2016.⁵⁰ NGLs include ethane, propane, butane and isobutane, among others. NGLs are key manufacturing feedstocks used to make propylene and ethylene, which are used to create plastics, toys, pharmaceuticals, paints and tires.

Due to increased domestic production, the relative affordability and abundance of natural gas liquids has fueled the manufacturing and petrochemical industries. Detroit and the surrounding areas of Michigan are known as 'the Automotive Capital of the World' providing the long-time home for General Motors, Ford and

Fiat Chrysler automobile companies. Sixty-three of the top 100 automotive suppliers to North America have their headquarters in Michigan due to its booming manufacturing industry. Michigan leads the nation in automobile manufacturing, accounting for nearly 23 percent of all total U.S. vehicle production in 2013.⁵¹

Founded and based in Midland and with facilities located across Michigan, Dow Chemical is the largest corporate energy consumer in North America. "Dow's operations use energy, primarily naphtha, natural gas and natural gas liquids (such as ethane), as feedstock materials to make a wide array of products. [They] also use energy to drive the chemical reactions necessary to turn our feedstocks into useful products, many

of which lead to net energy savings. Dow's global hydrocarbon and energy use amounts to the oil equivalent of 850,000 barrels per day, approximately the daily energy use of Australia."⁵² Dow operations in Michigan that use natural gas as a feedstock, heating source, or both, include agricultural chemicals and fertilizers, automotive, water and process solutions, pharma and food solutions, and electronic materials manufacturing.⁵³

In the auto manufacturing sector, the Ford Rawsonville Components Plant uses several natural gas fired boilers to provide needed generation for its facilities. Just in the first quarter of 2015, two of the plant's boilers used 60.4 million cubic feet of natural gas, running for a combined 2,100 hours.⁵⁴ The Rawsonville plant employs nearly 800 people and manufactures fuel pumps, carbon canisters, air induction systems, ignition coils, transmission kittings, transmission oil pumps, sequencing, and batteries.⁵⁵ In 2015, the plant was designated a Clean Corporate Citizen by the Michigan Department of Environmental Quality due to exemplifying "corporate environmental responsibility through its efforts to maintain, protect, and enhance Michigan's environmental resources."⁵⁶

The Mastronardi Greenhouse facilities in the city of Coldwater have seven natural gas fired boilers on site which are used for space and hot water heating. Two of the boilers are "equipped with a CO₂ scrubber to capture the gas so it can be sent to the greenhouses for the benefit of the plants."⁵⁷ In addition to using their own boilers, the \$10 million greenhouse has partnered with the city to maximize efficiency. The Coldwater Board of Public Utilities (BPU) and the Michigan South Central Power Agency

installed three natural gas generators to replace the city's outdated diesel units at a plant next door to the greenhouse.

"The trio of generators will expand the BPU's electricity capacity and reliability and in turn produce carbon dioxide and heat that will be captured from the engines and delivered to Mastronardi for heat to help grow the greenhouse's vegetables."⁵⁸ The partnership benefits both the greenhouse and the city, providing needed heat for the greenhouse and shortening the payback time for the city's generators.

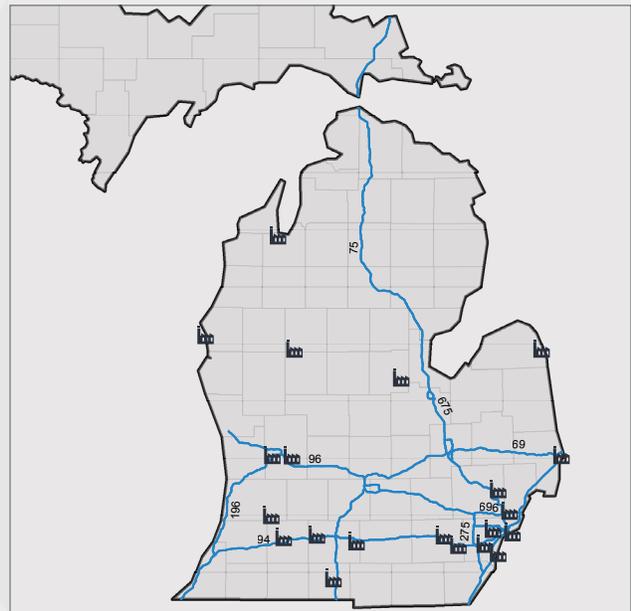
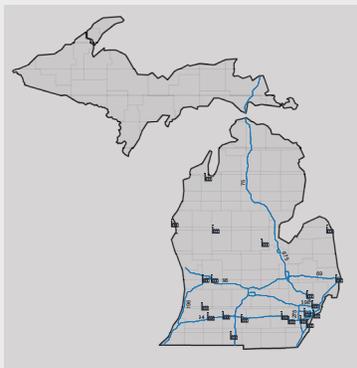
The Michigan Sugar Company has multiple plants located in the state, and has transitioned from coal to natural gas-fired generation in several of them. The company's facility in Tuscola County processes sugar beets to manufacture table quality sugar and liquid sugar. When two aging coal boilers reached the end of their lifecycle, the company replaced them with one natural gas boiler that produced the exact same steam load.⁵⁹ The company's Bay City facility also uses natural gas instead of coal in order to keep emissions down. The company's sugar processing accounts for more than 2,300 local jobs and has an economic impact of more than \$1.5 billion.⁶⁰

CHP FACILITIES USING PIPELINE NATURAL GAS

FACILITY NAME	ORGANIZATION	SECTOR
Country Fresh Dairy Inc	On Site/ Enegrid Ltd.	Agriculture
Amway Corporation	ADA Cogeneration	Chemicals
Anderson Albion Ethanol	Andersons Albion Ethanol LLC	Chemicals
Dow Agro Science	Dow Chemical USA.	Chemicals
Dow Chemical Company	Swedish company EQT Infrastructure and American partner Fortistar	Chemicals
Dow Chemical Plant	Michigan Power, L.P.	Chemicals
IMC Kalium Chemical	IMC Kalium Chemical	Chemicals
Parke-Davis	Parkdale Pharmaceutical Inc.	Chemicals
Warner-Lambert Company	Warner-Lambert Company	Chemicals
Ajax Metal Processing	Ajax Metal Processing, Inc./Hale Enginee	Fabricated Metals
Allied Finishing, Inc.	Allied Finishing, Inc.	Fabricated Metals
CRM Inc.	CRM Inc.	Fabricated Metals
Vosslantz	Voss Industries Aka Mmc Metals	Fabricated Metals
Kraft Foods Inc.	General Foods Corporation	Food Processing
Mastronardi Produce	Coldwater Board of Public Utilities	Food Processing
Detroit Steel Company	Detroit Steel Company	Primary Metals
Voss Steel Project	Voss Industries Aka Mmc Metals	Primary Metals
Domtar Paper	Domtar Paper	Pulp and Paper
Graphic Packaging Corporation	Graphic Packaging Corp	Pulp and Paper
James River Paper-Packaging Papers Mill	Dunn/Seco Partners	Pulp and Paper
USG Paper Mill / Paperboard Division Power Plant	Menasha Packaging Co LLC / Otsego Paper Inc.	Pulp and Paper
Waldorf Corporation	Waldorf Corporation	Pulp and Paper
WestRock	WestRock	Pulp and Paper
Ford & Rouge Steel Company - Severstall	Deanborn Industrial Gen Inc.	Transportation Equipment
General Motors Corp-Warren	Powertrain Warren GMC	Transportation Equipment
Rawsonville Plant	Ford Motor Company	Transportation Equipment

Source: ESRI; Manta.com based on NAICS codes 32531102, Nitrogenous Fertilizer Manufacturing.

FIGURE 7: MICHIGAN INFRASTRUCTURE: INDUSTRIAL FACILITIES



Sources: DOE; EIA; ESRI; ICF; Tele Atlas North America. This map includes information copyrighted by PennWell Corporation, 800-823-6277. This information is provided on a best effort basis and PennWell.



AGRICULTURE

With about 10 million acres of farmland and a total economic impact of \$101.2 billion annually, the food and agriculture industry is vital to Michigan.⁶¹ In fact, total employment in agriculture is 923,000, accounting for about 22 percent of the state's employment.

Access to energy and energy costs are particularly important to Michigan since energy accounts for over 15 percent of farm production expenditures.⁶² Energy costs impact agricultural operations directly through such sources as fuel for farm vehicles, equipment, crop drying, and electricity productions at farm co-ops.⁶³ The Great Lakes state was a top-15 consumer of distillate fuel oil in 2016, using nearly 30 million barrels to power agricultural equipment and machinery.⁶⁴ Michigan farms consume 5.7 percent of total statewide distillate fuel oil, more than the national average, and use both natural gas and propane for crop drying.⁶⁵ Because of this, access to inexpensive natural gas and oil is important to farming communities for direct use (beyond drying) but also for indirect use through fertilizer and pesticides. Indirect uses of energy in represent a larger share of farm expenses than direct uses.

Pesticides, which use natural gas as a feedstock, accounted for slightly less than 50 percent of indirect energy used on U.S. farms in 2010, and slightly less than 15 percent of total energy use.⁶⁶ Use of herbicides has increased over time as the share

of corn, soybeans and wheat, acreage planted with herbicide-tolerant (HT) seed has increased dramatically. For corn, use of HT varieties increased from 11 percent of planted acres in 2002 to 70 percent in 2010.⁶⁷

Fertilizer accounted for over half of all indirect energy consumption on U.S. farms in 2015, and natural gas represents approximately 70 percent of the cost in manufacturing fertilizer.⁶⁸ Michigan's farms use a considerable amount of fertilizer: EPA estimates Michigan farmers purchased 200,393 metric tons of nitrogen in 2011, the 20th most in the country.⁶⁹

With affordable and reliable natural gas and petroleum products playing such an important role in agriculture, energy infrastructure is crucial to accommodate growing demand in the state. In 2015, the Ohio State Grange, an agricultural advocacy group, released a study that found that "two new proposed natural gas pipelines will benefit agricultural producers in Michigan and other states in the Midwest with stable energy prices. . . Building new natural gas infrastructure can reduce costs for farmers by increasing access to affordable natural gas."⁷⁰ The study further determined that "increasing access to affordable and clean natural gas in the eastern Midwest will provide great benefit to farmers, whose agricultural operations face growing concerns from global competition and rising input costs. In order to increase access to gas, the eastern Midwest must invest in new, safe natural gas infrastructures."⁷¹



3. MILITARY USERS

The Department of Defense (DoD) is the largest Federal or private consumer of energy in the United States. The DoD spent \$12.4 billion on energy expenditures in 2016.⁷² The Department's operational and facility energy consumption accounts for about 80 percent of total Federal use.

Facility energy use to heat, cool and power buildings and fixed installations represented \$3.5 billion of total DoD energy expenditures in 2016, with natural gas and electricity constituting over 85 percent of energy consumption. Fuel oil accounted for seven percent and liquified petroleum gas made up one percent in facility energy use.⁷³

DoD fleet vehicles used more than 73 million gallons of gasoline equivalent, made from gasoline and diesel/biodiesel blends, in 2016.⁷⁴ Gasoline represents roughly two-thirds of fleet vehicle fuel consumption, with diesel accounting for 22 percent.

Over 27,000 Active Duty, National Guard, Reserve and civilian personnel call Michigan home.⁷⁵ There are seven significant national security and military installations in Michigan, including two Army bases, Camp Grayling and Fort Custer. Camp Grayling, the main training facility for the Michigan National Guard, is the largest U.S. National Guard camp. The Detroit Arsenal is the prime economic driver of the state's

defense industry and hosts the Army's Tank-automotive and Armaments Command (TACOM), an Army segment that helps manage about two-thirds of all Army equipment.

The Great Lakes state also hosts two Air Force National Guard bases, Selfridge and Battle Creek, as well as the Alpena Combat Readiness Training Center, which provides support, training and airspace to Federal and emergency response personnel. Nearly 5,000 civilian and military personnel are located at Selfridge, including over 1,700 Air Force and over 1,100 Army members.⁷⁶ Operating from Selfridge, the 171st Air Refueling Squadron mans the KC-135T Stratotanker which supported Michigan Army National Guard State Partnership for Peace Operations in Liberia and offloaded 550,000 gallons of fuel to support missions in 2016.⁷⁷

To support the Department of Defense's missions, military installations in Michigan require reliable energy sources to meet its extensive needs. At Camp Grayling, the Michigan Air National Guard uses pipelines to capture natural gas from orphan or abandoned wells to heat buildings and power back up generation units.⁷⁸ Military installations in the state are also developing natural gas power generation facilities to complement solar generation and provide a reliable energy source even when the sun doesn't shine.⁷⁹



4. RESIDENTIAL USERS

The residential sector is the largest consuming sector in the state where approximately 75 percent of Michigan households use natural gas and propane to heat homes, heat water and cook dinner.⁸⁰ Both consumption and the number of consumers have remained relatively stable over the past several years as state residents continue to benefit from the affordability and reliability of using natural gas in their homes. In fact, switching to natural gas can save families up to 50 percent on their home energy bills.⁸¹

Michigan households receive their natural gas from local distribution companies (LDCs), which serve as the primary method for almost all residential and small business consumers. A total of ten natural gas LDCs serve Michigan customers in assigned territories.

RESIDENTIAL	2010	2011	2012	2013	2014	2015	2016	2017
Number of Consumers	3,152,468	3,153,895	3,161,033	3,180,349	3,192,807	3,213,910	3,240,462	3,269,578
Consumption (MMcf)	304,330	318,004	276,778	334,211	354,713	312,098	294,187	299,158
Average Consumption Per Consumer (Million Cubic Ft.)	97	101	88	105	111	97	91	91

SOURCE: EIA.

Pipelines also reliably transport the home heating fuels Michiganders rely on during cold winter months. The Great Lakes state is the nation's largest consumer of propane as a home heating fuel, and one in ten state residents rely on propane, kerosene or fuel oil as their primary heating source.⁸²

Residential consumers utilize almost three-fourths of all kerosene consumed in the state, while commercial users constitute another quarter of consumption. As of June 2016, Enbridge's Line 5 supplies 65 percent of propane demand in the Upper Peninsula and 55 percent of Michigan's overall statewide propane needs for reliable home heating during cold winter months.⁸³



5. COMMERCIAL USERS

LDCs and some interstate pipelines also provide natural gas to commercial facilities such as retail business, hospitals, and schools. Reliable supply of natural gas is helping Michigan's small businesses, schools and hospitals cut energy costs and expand services for state residents. Commercial consumption of natural gas has risen 12 percent in the last five years. While the growth in number of consumers (3 percent) and in quantity consumed by each facility (9 percent) has been small, more facilities will be looking to convert to natural gas to cut energy costs.⁸⁴ Several commercial facilities in the state

have their own combined heat and power (CHP) installations, and many others utilize the benefits of natural gas as well.⁸⁵ For example, the Detroit Arsenal in Warren is the main U.S. laboratory for advanced military automotive technology, serving as the Ground Systems Integrator for all Defense Department manned and unmanned ground vehicle systems.⁸⁶ In an effort to decrease energy consumption and reduce pollution from the facility, the Arsenal uses a natural-gas fired cogeneration system along with multiple boilers.⁸⁷

COMMERCIAL	2010	2011	2012	2013	2014	2015	2016	2017
Number of Consumers	249,309	249,456	249,994	250,994	253,127	254,484	256,368	258,104
Consumption (MMcf)	152,350	163,567	144,609	171,519	186,413	168,360	158,630	162,634
Average Consumption Per Consumer (Million Cubic Ft.)	611	656	578	683	736	662	619	630

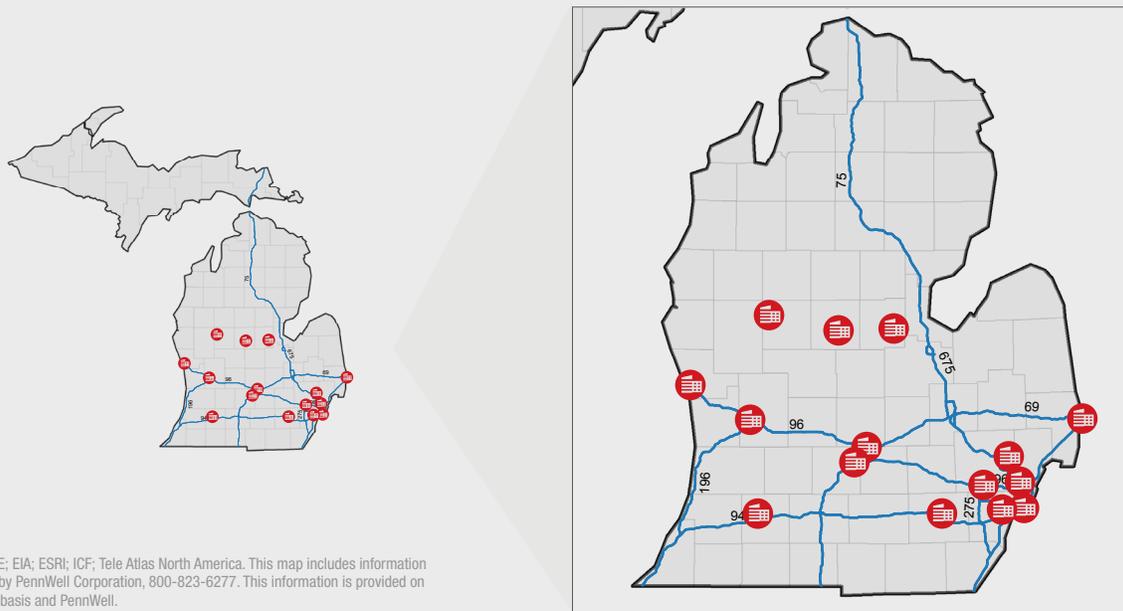
SOURCE: EIA.

COMMERCIAL CHP FACILITIES USING NATURAL GAS

FACILITY NAME	ORGANIZATION	SECTOR
Detroit Metropolitan Airport	Detroit Metropolitan Airport	Air Transportation
Central Michigan University	Central Michigan University	Colleges/Univ.
Central Power Plant	University Of Michigan	Colleges/Univ.
Engineering Center	Oakland University	Colleges/Univ.
FSU Central Heating/Air Conditioning	Ferris State College	Colleges/Univ.
Henry Ford Community College	Henry Ford Community College	Colleges/Univ.
Michigan Alternative and Renewable Energy Center	Grand Valley State Univ	Colleges/Univ.
Northwood Institute	Decker Energy International, Inc.	Colleges/Univ.
University of Detroit Mercy	University of Detroit Mercy	Colleges/Univ.
Washtenaw Community College	GEM Energy	Colleges/Univ.
Western Michigan University	Western Michigan University	Colleges/Univ.
State of Michigan Secondary Complex	State of Michigan Secondary Complex	General Gov't.
Veterans Affairs Hospital	GEM Energy	Hospitals/Healthcare
Clarion Inn Hotel	Royce Ventures	Hotels
Detroit Arsenal	Detroit Arsenal	Military/National Security
Focus Hope Technical School	Focus Hope Technical School	Misc. Education
Metty Drive Project	Stirling Thermal Motors, Inc.	Misc. Services
REO Town Plant	Lansing Board of Water and Light	Utilities
Southeastern Michigan Gas Company	Decker Energy International, Inc.	Utilities

SOURCE: EIA.

FIGURE 8: MICHIGAN INFRASTRUCTURE: COMMERCIAL FACILITIES



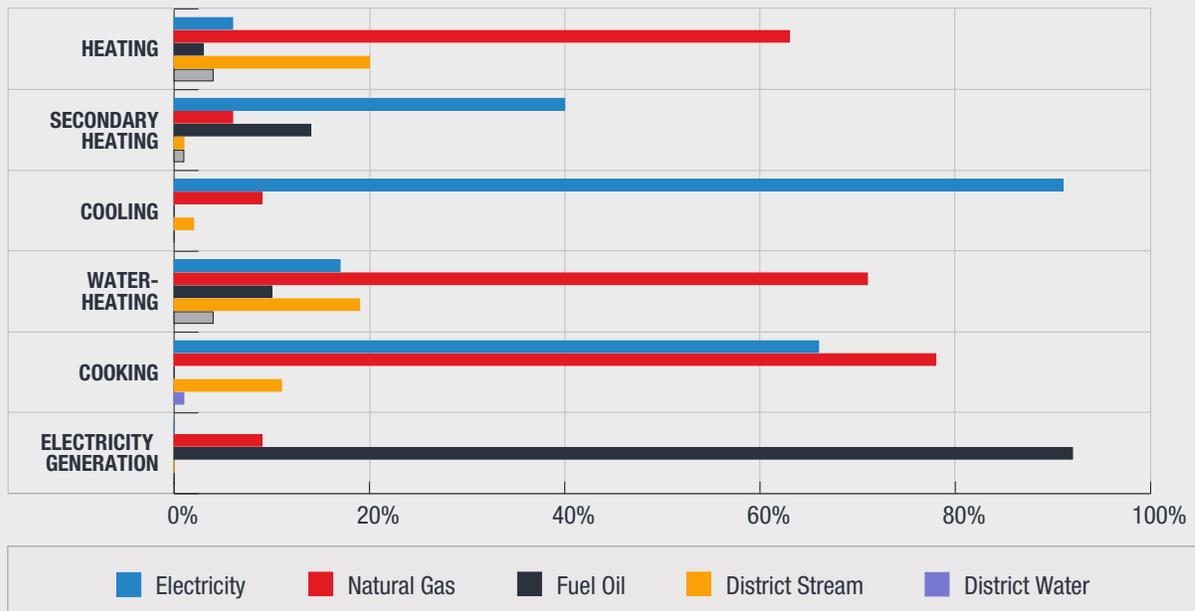
HOSPITALS

Hospitals rely heavily on natural gas to provide consistent, comfortable temperatures, improved air quality when heating and a medically safe environment for all occupants. CHP also helps with energy resilience, since the hospital can remain operating in times of power outages. According to EIA's 2012 Commercial Buildings Energy Consumption Survey (CBECS), natural gas represented 41 percent of all energy consumed at hospitals.⁸⁸ Natural gas was the most common main space heating fuel, used by 63 percent of the buildings. Natural gas was the most common water heating fuel, used by 71 percent of the buildings. Natural gas is not only used by healthcare providers to heat water for showers and baths, but also for dish washing, washing hands, and scrubbing in for surgery.

Cooking was reported in 95 percent of the buildings, with natural gas and electricity the most common cooking fuels. Natural gas is also an efficient energy source for commercial refrigerators, freezers, ovens, stoves, and more.

There are approximately 182 hospitals in Michigan and natural gas' affordable and reliable supply may incentive more hospitals to convert their energy supply and save on costs.⁸⁹

FIGURE 9: ENERGY END USE IN HOSPITALS, 2012



Source: EIA.
 Note: Hospitals may use more than one source for energy



SCHOOLS

Schools are another type of commercial facility that relies on the dependability of natural gas. Data from EIA's 2012 Commercial Buildings Energy Consumption Survey (CBECS) indicates that 72 percent of schools in the survey use natural gas. The majority of schools in the survey use natural gas as the main fuel for heating while a similar percentage use it for water heating. Over a third of schools use natural gas for cooking.⁹⁰ Both school districts and institutes of higher education across the state are increasing their use of natural gas to reduce costs, decrease emissions, and improve reliability.

Nationally, coal consumption by U.S. educational institutions has declined by 64 percent between 2008 and 2015, in part due to increased use of natural gas. Michigan's use of coal in its educational institutions declined by more than 80 percent over this period, adopting natural gas as the major fuel.⁹¹

The University of Michigan's Central Power Plant converted from coal to natural gas in 1963, "putting the University ahead of many peers in reducing pollution and providing strong environmental stewardship."⁹² In addition to the environmental benefits, "the change to a cogeneration plant increased the Central Power Plant's efficiency to 70-80 percent."⁹³ Michigan State University saw similar benefits when it recently switched from coal to all natural gas: "Using natural gas instead of coal to power the campus results in a reduction in CO₂ emissions of

At Western Michigan University (WMU) the Robert M. Beam Power Plant has two 4 mega-watt gas turbines that provide energy to the east and west campuses of the university, as well as the Kalamazoo Psychiatric Hospital. The plant converted from coal to natural gas as its primary heating and cooling source in the 1990s, improving energy efficiency and saving thousands of dollars each year.⁹⁴ The plant has burned only natural gas since 1999.

about 32.4 percent. . . . MSU's use of natural gas has a similar impact to greenhouse gas reduction to planting about a half million trees each year."⁹⁵

Universities are not the only educational institutions benefitting from natural gas use. An IHS Markit study found that Michigan public elementary and secondary schools saved \$21.1 million in electricity costs and \$27.9 million in natural gas expenditures in the 2012/2013 school year due to unconventional oil and natural gas development. That's the cost equivalent of 539 teachers.⁹⁶



6. TRANSPORTATION



Petroleum and natural gas are vital for transportation in Michigan. The transportation sector consumes over four-fifths all of distillate fuel oil and over three-fifths of all residual fuel oil. The Great Lakes state was the ninth largest consumer of motor gasoline in 2016, using over 113 million barrels to help residents commute to work or get away on vacation.⁹⁷ In 2017, on average, over 12.7 million gallons of motor gasoline were supplied per day; highway vehicles, including automobiles, trucks, and buses, use over 75 percent of distillate fuel oil, while railroads consume around 2 percent.⁹⁸ The military uses another 1.6 million gallons of distillate per year. Vessel bunkering, commercial or private boats, consumes nearly all residual fuel oil in the state.⁹⁹ Due to this high usage, Michigan is the 15th largest consumer of distillate fuel oil in the country.¹⁰⁰

Across Michigan, institutions from local governments to commercial companies are increasing their use of natural gas in transportation. In January 2017, the Flint Mass Transit Authority (MTA) received approval to purchase 32 new compressed natural gas (CNG) buses and implement a workforce development training program

for mechanics and drivers. The buses and training will be funded through a federal grant from the Department of Transportation's Federal Transit Authority. Edgar H. Benning, general manager of MTA, explained that "these new vehicles will allow the MTA to avoid the high cost of maintaining a fleet of aged vehicles over 20-years-old. In addition, these alternative fuel vehicles will provide for an environmentally friendly operating system."¹⁰¹

In 2015 Fiat Chrysler Automobiles (FCA) invested \$40 million to convert its Detroit fleet of 179 trucks to run on CNG rather than diesel, giving FCA the largest private fleet of CNG-powered heavy-duty vehicles in the state.¹⁰² The company expected a net fuel cost savings of about 35 percent per year due to the switch—about \$2.5 million each year—and estimated that it would reduce CO emissions by more than 16,000 tons per year.¹⁰³ FCA's \$5 million on-site CNG fueling station is the largest private CNG station in North America.

Michigan is a hub of transportation within the Great Lakes and Midwest regions. The Wolverine State contains 226 public and

private airports, including 15 primary commercial airports and over 60 general aviation airports which provide aviation access to counties, municipalities and military installations. Michigan relies on pipelines to reliably carry jet fuel to the state's commercial and general aviation airports to fuel commerce, tourism and transportation. The state consumed over four million barrels of kerosene-type jet fuel and 12 million barrels of other petroleum products, which includes naphtha-type jet fuel, in 2016.¹⁰⁴

Detroit Metropolitan Wayne County Airport (DTW) is the busiest airport in the state and the 18th busiest in country, completing nearly 17 million commercial passenger boardings in 2016. A study conducted in 2013 found that DTW airport has an economic impact of over \$10 billion through air transportation costs and visitor spending, and accounted for 86,000 jobs and nearly \$300 million in state and local tax revenue.¹⁰⁵ Due to its busy nature, the airport must maintain a reliable fuel supply, hosting a fuel farm with four 20,000-barrel and two 65,000-barrel fuel storage

tanks. The farm's four-million-gallon capacity is enough to fuel the airport for five days.¹⁰⁶ Underground pipelines transport fuel from DTW's tank farm to terminals and planes.

Gerald Ford International Airport is the second largest in the state and provides key access for commerce and tourism for the Western Michigan region. Mackinaw Island Airport transports tourists to the idyllic island where no motorized vehicles are allowed with several specific exemptions. Tourism is the eleventh largest industry in the state and visitor spending totaled \$23.7 billion in 2016, generating \$40.7 billion in total business sales and continuing to grow the state's economy.¹⁰⁷ The state's tourism industry sustained roughly 337,000 jobs, over six percent of all employment, in 2016.¹⁰⁸ State tourists also rely on efficient and affordable access to petroleum products, spending over \$6 billion in air and local transportation costs in 2016. Pipelines carry the energy products that support local communities, grow small businesses and fuel the state's economy.¹⁰⁹

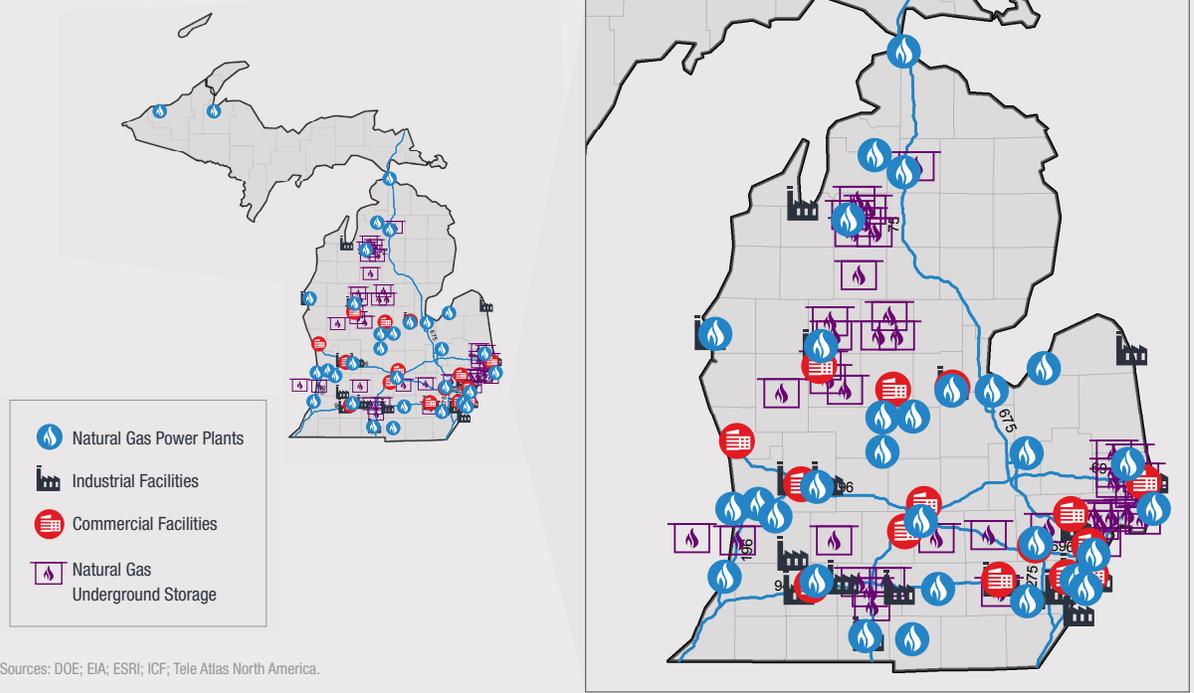


CONCLUSION

Natural gas and petroleum touch nearly aspect of life in Michigan. From generating electricity, lowering energy costs and creating jobs for small businesses to expanding services for Michigan’s educational institutions, natural gas and petroleum are fueling every part of modern life in Michigan.

Expanding energy infrastructure including natural gas, petroleum and liquids pipelines will benefit the environment and save money for residents across the state by providing clean, affordable and reliable supply for years to come.

FIGURE 10: MICHIGAN INFRASTRUCTURE



Sources: DOE; EIA; ESRI; ICF; Tele Atlas North America.

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