Michigan Energy Overview

Prepared by the Michigan Public Service Commission
Department of Licensing and Regulatory Affairs
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The Michigan Energy Overview is an assessment of Michigan's energy markets prepared by the MPSC Energy Data and Security Section. The overview provides a snapshot of the State's energy supply and expenditures as well as a discussion of key infrastructure. While national trends are touched upon, the primary focus is the State's energy profile with comparisons to historical trends. Graphs are prepared utilizing data from the Energy Information Administration (EIA) and sources within the MPSC. Data from outside sources is often not immediately available; therefore there is a two year time lag with data used in most figures. Despite this time lag, the data is comprehensive and provides valuable insight into Michigan's energy profile.

Background

Michigan is relatively limited in most energy resources and imports 97 percent of its petroleum needs, 82 percent of its natural gas and 100 percent of coal and nuclear fuel from other states and nations. These imports account for about 72 cents of every dollar spent for energy by Michigan's citizens and businesses. Michigan spent a total of $31.3 billion on all forms of energy in 2009 and of that amount $22.6 billion was for the energy resources imported from other states and nations.

Michigan's total energy consumption is relatively high, due in part to the State's large population, northern climate and industrial sector. Energy-intensive activities in the State include durable goods manufacturing, such as by the automotive, glass, metal castings, chemical industries, mining and pulp and paper manufacturing/production.

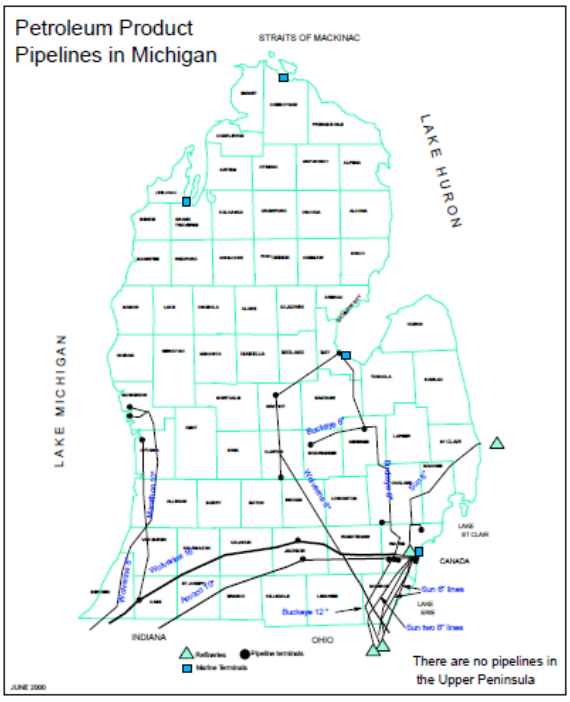
- Michigan Population – 9.9 million, U.S. Rank 8th (2010)
- Michigan Gross Domestic Product - $368.4 billion in 2009, U.S. Rank 12th
- Crude Oil Reserves – 33 million barrels, 0.2 percent of U.S. total reserves, with 3,800 producing wells (2009)
- Natural Gas Reserves – 2,763 billion cubic feet, share of U.S. 1.0 percent, producing wells 10,600 (2009)
- Natural Gas Use - 746.8 trillion British Thermal Units[1] (BTU) per year, U.S. Rank 9th (2009)
- Propane Use – 42.1 trillion BTU per year, U.S. Rank 11th (2009)
- Retail Electricity Sales – 334.8 trillion BTU per year, U.S. Rank 12th (2009)
- Michigan End-Use Sectors as a percent of the total for each U.S. sector (2009):
  - Residential 3.6 percent
  - Commercial 3.3 percent
  - Industrial 2.1 percent
  - Transportation 2.7 percent

[1] Energy consumption figures are shown in British Thermal Units (BTU). This allows the energy content of various fuels to be compared on a common basis. A BTU is about the same amount of energy as contained in a common kitchen match, and is defined as the amount of energy required to raise the temperature of 1 pound of water by 1 degree Fahrenheit. For example 1 kWh of electricity has 3,412 BTU, a cubic foot of natural gas contains 1,027 BTU, and a gallon of gasoline contains about 124,000 BTU.

Michigan Resources

Petroleum

Michigan has limited crude oil production from small wells scattered across the Lower Peninsula. Michigan oil production peaked in 1979 at 35 million barrels per year and has since declined to 6.5 million barrels in 2010.[2] As a result, the vast majority of crude oil is imported through two major pipelines which cross Michigan from western Canada. These are part of the Enbridge Pipeline System. One enters Michigan from the northwest, crossing the Upper Peninsula and then heading south through the Lower Peninsula before turning east into Canada. The other runs from Canada to the Chicago area and then heads northeast across the Lower Peninsula and back into Canada. This pipeline supplies both Michigan and eastern Canada.



Once the crude oil has been refined, several petroleum product pipelines are used to transport the product to Michigan's Lower Peninsula markets. The Wolverine and BP Amoco pipelines run from Chicago area refineries to the Detroit area. The Buckeye system runs north into Michigan from refineries in Toledo and other parts of Ohio. These pipelines serve the areas of highest use in southern and southeastern Michigan where the majority of the state population resides. In 2009, Michigan consumed an estimated 163.6 million barrels of petroleum products.[3]

The Marathon oil refinery in Detroit is the State's only refinery and is currently undergoing an expansion slated for completion by late 2012. The Detroit Heavy Oil Upgrade Project will add $2.2 billion in new equipment to process additional heavy crude oils, such as those from Canada. The project will increase the refinery's capacity from approximately 106,000 barrels per day (bpd) to 120,000 bpd, an increase of more than 400,000 gallons per day. Most of the refined petroleum products used in Michigan, however, are currently produced at refineries in Ohio, Indiana and Illinois.

Biofuels

Michigan has substantial ethanol production capacity with five operating ethanol plants and a combined capacity of 268 million gallons per year. This number has remained steady despite the effects of the recession and volatility in the commodity markets. Plans for the construction of new plants in 2008, however, were abandoned due in part to difficulties with financing. While ethanol blending is not mandated in Michigan, it is widely used as an oxygenate substitute for Methyl Tertiary Butyl Ether (MTBE) in unleaded gasoline. Until recently, the EPA limited ethanol blending in gasoline to 10 percent, but the limit was raised to 15 percent in January, 2011. Higher level blends such as E85 are also available with 96 stations currently dispensing the fuel. In 2010, 9.9 million gallons of E85 were sold.

[2] EIA-Crude Oil Production - http://www.eia.gov/dnav/pet/pet_crd_crpdn_adc_mbbl_m.htm
[3] EIA-Michigan Data - http://www.eia.gov/state/state-energy-profiles-data.cfm?sid=MI#Economy

In contrast, the state has gone through a transition with biodiesel plants and currently has three operational. This compares to four operating plants in 2007. The past several years have been a challenge for the biodiesel industry due to the high price of soybeans and the need to diversify into lower cost feedstocks. Annual production capacity is approximately 37 million gallons per year.

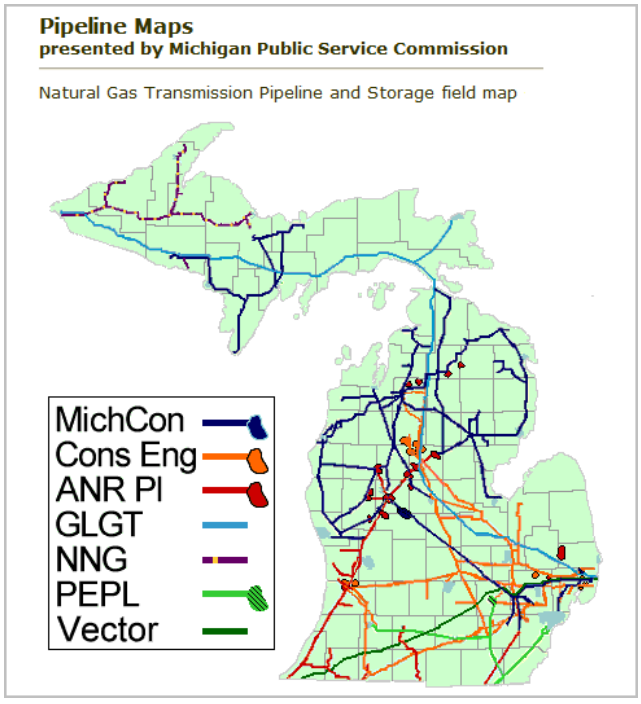
Natural Gas

Natural gas production in Michigan is substantial and supplies about 18 percent of the State's demand for natural gas. Natural gas wells are concentrated in the Antrim geological formations in the northern portion of the Lower Peninsula. In-state production peaked in 1997 at 280 billion cubic feet per year, but has since declined to 141 billion cubic feet in 2010 due to decreased well productivity.

Additional natural gas reserves are also being explored. A significant new gas discovery took place in Missaukee County, where a recently drilled exploration well in the Collingwood Shale formation flowed 2.5 million cubic feet per day of gas. In May 2010, auctioned oil and gas lease rights brought in $178 million for the Michigan Natural Resources Trust Fund, which in one day earned as much as the fund has taken in over the past 81 years of leasing. A year later, however, interest has decreased dramatically with only $772,000 raised in the most recent land lease auctions. Since the Missaukee County well, several more Collingwood Shale wells have been drilled, but additional infrastructure and production data is required to know the full potential of this play.

Several major pipelines, including the Vector Pipeline from Illinois and the Great Lakes Gas Transmission line from western Canada satisfy the remainder of the State's natural gas demand. These pipelines cross Michigan on the way to northeastern U.S. and eastern Canadian markets.

An additional feature of the natural gas market is storage, where capacity in Michigan leads the nation. With over 10 percent of U.S. natural gas storage capacity, Michigan cycles more natural gas through underground storage than any other state. During the summer months, when natural gas use is at its lowest, large quantities of natural gas are delivered to Michigan and placed into underground storage in specifically suitable geological formations. During the winter months when natural gas demand tends to be highest, gas from Michigan's 649[4] billion cubic feet of storage can be withdrawn to supply users both in-state and in neighboring states. Driven largely by use for space and water heating in the residential sector, Michigan's natural gas consumption is high. Nearly 80 percent of Michigan households use natural gas as their primary energy source for home heating. The total consumption of natural gas in Michigan was 765 billion cubic feet in 2010.



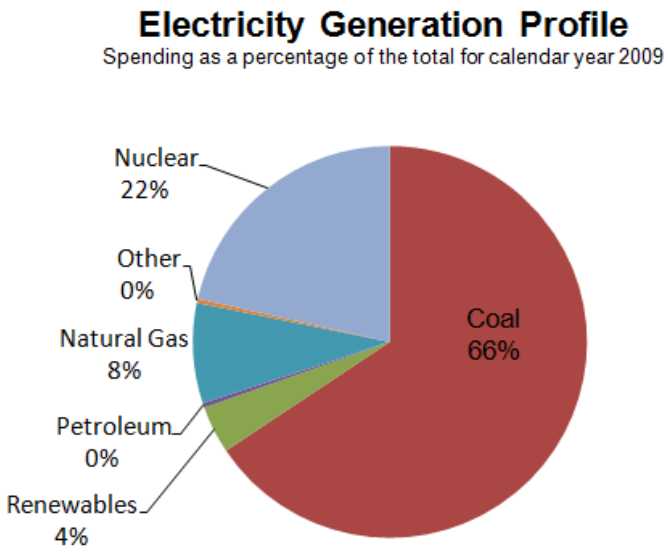
[4] EIA-Regional Underground Natural Gas Storage -http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications /ngpipeline /UGTable.html?title=&product=&submit2=A-Z+List+of+publications and or Nat Gas on MPSC website

Electricity and Coal

Michigan power plants can generate a total of 30,308 Megawatts (net summer capacity).[5] These range from the largest, Detroit Edison's 3,129 MW coal-fired power plant in Monroe, to smaller distributed generators run by hydro and wind.

Michigan coal-burning power plants generated 66 percent of the electricity used in Michigan in 2009 (Figure 1). The total coal use in Michigan in 2009 was 37.4 million tons, of which 94 percent was used to generate electricity. The annual cost of coal used to produce electricity for Michigan is presently estimated to be $1.39 billion[6] per year, of which 100 percent is imported. About 82 percent of the coal burned in Michigan power plants is supplied from the Powder River Basin in Wyoming and Montana.[7] A large portion of that coal is transported by rail to the western end of Lake Superior, where it is loaded onto freighter ships for delivery to power plants largely located along Great Lakes shorelines. Michigan also obtains coal by rail, from both western and eastern sources, including West Virginia, Kentucky and Pennsylvania.

Figure 1



Data Source: State Energy Expenditures Report, Energy Information Administration, DOE

Michigan's three nuclear power plants, D.C. Cook Units 1 and 2, Fermi 2 and Palisades, supply 22 percent the State's electricity generation; natural gas fired generation provides about 8 percent, and 4 percent is provided by renewable energy. Petroleum generation is used primarily to meet peak load demand and represents less than one percent of total generation.

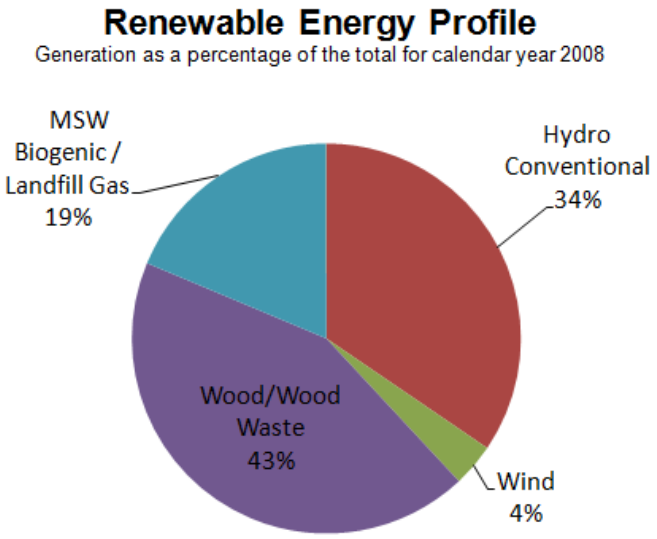
[5] Michigan Electricity Profile, EIA; http://www.eia.doe.gov/cneaf/electricity/st_profiles/michigan.html.
[6] Expenditures to Electric Power Sector http://www.eia.gov/state/seds/hf.jsp?incfile=sep_prices/eu/pr_eu_MI.html&mstate=Michigan
[7] Domestic Distribution of U.S. Coal by Origin State, Consumer, Destination and Method of Transportation, EIA; http://www.eia.doe.gov/cneaf/coal/page/coaldistrib/2005/o_05state.pdf.

Renewable Energy

Michigan has significant potential for energy from renewable resources, particularly from: biomass; hydroelectricity, liquid fuels from agricultural and forestry feedstock; wind, generally near the Great Lakes shorelines and in the Thumb region; and solar. In 2009, about 4 percent of the electricity production in Michigan was derived from renewable energy sources. This percentage has been steadily increasing as a result of Public Act 295 (PA 295) of 2008 which established a 10 percent Renewable Energy Standard (RPS) based on retail sales by the end of 2015.

By the end of 2012, a total of approximately 700 MW of new generation is planned to become commercially operational. Based on current contracts, the majority will be from wind (93%) followed by landfill gas (3%), anaerobic digesters/biomass (3%), and solar (1%). In April, 2009, five commercial wind farms were in operation with a total of 83 turbine units.[8] This compares to only 35 operational turbines in 2008. Michigan has significant wind energy potential and ranks 14th in the nation among states with wind potential.[9] When comparing the state's current renewable portfolio in 2008, however, wood and wood waste was the largest generator of electricity (Figure 2). A majority of the power is produced from seven wood-burning power plants. The newest is a 20 MW plant owned by L'Anse Warden Electric Company, LLC which began commercial operation in 2009. A small amount of wood is used for space heating, although a dramatic drop in natural gas prices is likely to dampen demand for wood as a heating fuel. Michigan also has many small hydroelectric plants which account for approximately 34 percent of Michigan's renewable portfolio. Electricity from landfill gas, anaerobic digesters and municipal waste incinerators are also significant sources. Residential solar and small wind[10] represent very small but growing contributions, fueled largely by Michigan's improved net metering policy and utility pilot programs.

Figure 2

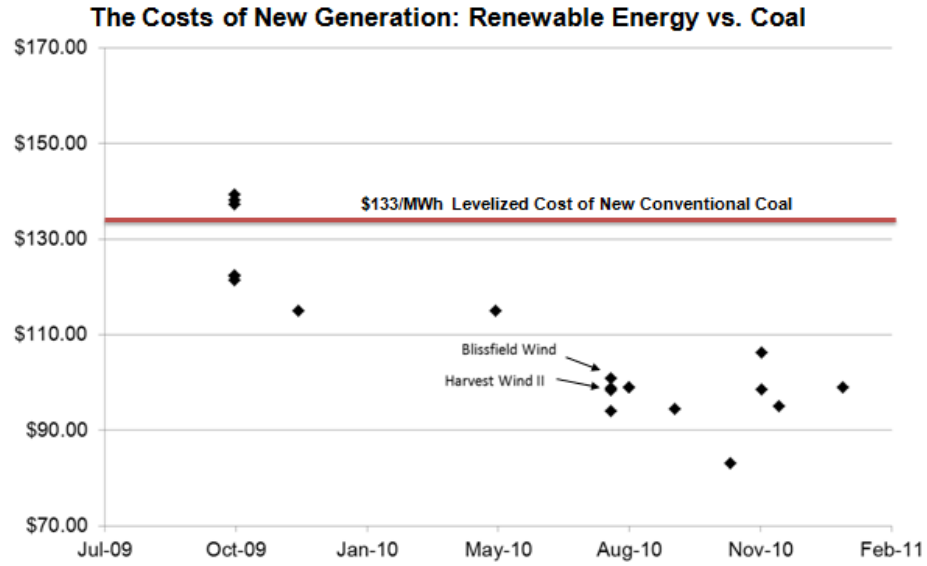


Data Source: State Energy Data Report, Energy Information Administration, DOE

[8] Final Report: http://www.dleg.state.mi.us/mpsc/renewables/windboard/werzb_final_report.pdf
[9] DOE EERE Michigan Energy Summary http://apps1.eere.energy.gov/states/energy_summary.cfm/state=MI
[10] Contributions from solar energy were not large enough to show on Figure 1.

In terms of cost, renewable energy in Michigan has been cheaper than new conventional coal in recent years. With the exception of three contracts established shortly after the signing of PA 295, new renewable generation costs have been significantly lower than anticipated by the utility companies and show a downward sloping pricing trend (Figure 3). This is evident with new wind farm contracts such as Blissfield Wind and Harvest II Wind which came in at costs significantly less than estimated in Consumers Energy's Renewable Energy Plan.[11] In Figure 3, each point represents a renewable energy contract submitted to the MPSC as part of PA 295.

Figure 3



- 20 year levelized costs of MPSC approved contracts which include all plant fixed costs, fuel, operation and maintenance, emissions (i.e., CO2), interconnection and transmission system upgrade costs.

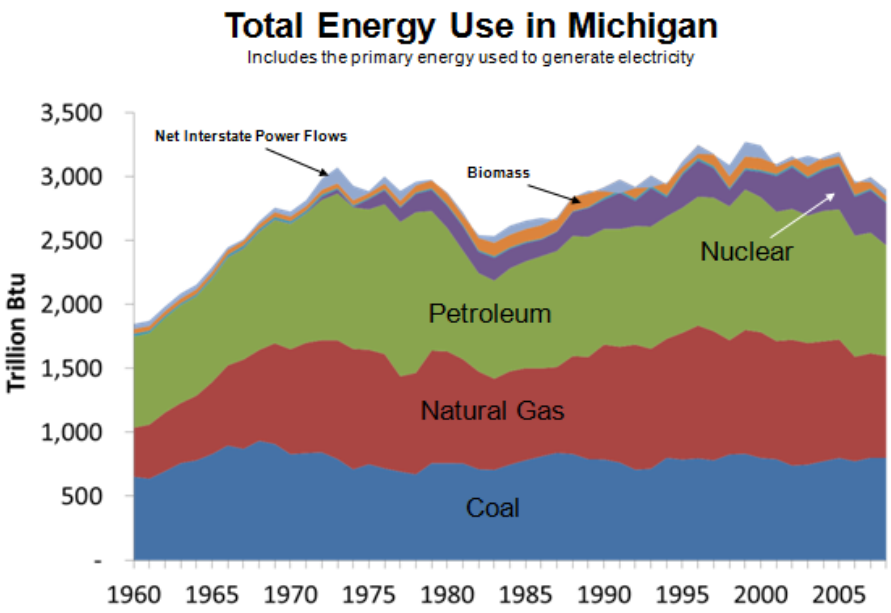
Source: Report on the Implementation of the P.A. 295 Renewable Energy Standard and the Cost-Effectiveness of the Energy Standards, Michigan Public Service Commission

[11]Report on The Implementation of the P.A. 295 Renewable Energy Standard and the Cost-Effectiveness of the Energy Standards

Michigan Energy Use and Expenditures[12]

Michigan has a diversified energy supply with coal, natural gas and petroleum products each contributing similar amounts to meeting the State's total energy needs. A smaller amount comes from nuclear power (Figure 4). Biomass began making a contribution in the mid-1970's but still only represents a small share of the total supply. The economic recession beginning in 2008 caused a drop in demand and expenditures for most energy sources used in the state. This change was most pronounced with petroleum, which experienced an 11 percent reduction in use and a 22 percent decrease in expenditures between 2007 and 2009. In contrast, renewables such as hydropower and biomass both saw approximately a 6 percent increase in use.

Figure 4



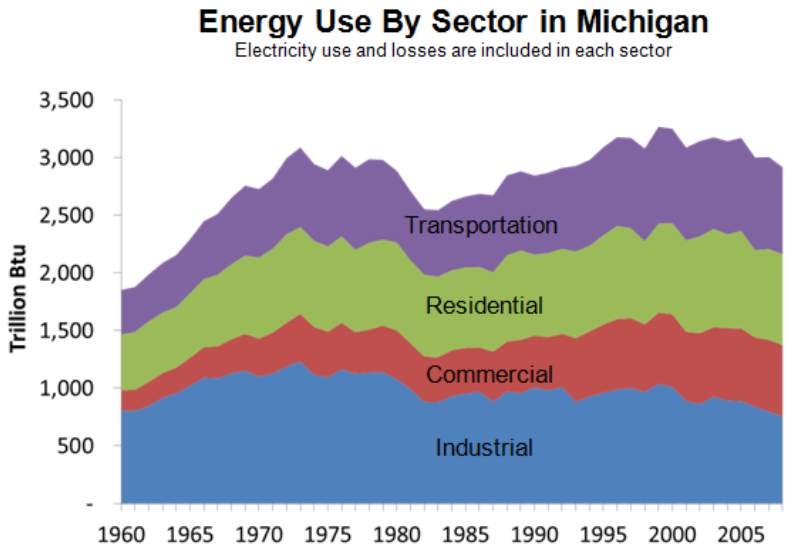
Data Source: State Energy Data Report, Energy Information Administration, DOE

Over time, one can see the rapid growth in energy use from 1960 to1973 due in large part to increased industrial production. The Arab Oil Embargo beginning in the fall of 1973, however, resulted in a sharp jump in oil prices and triggered a recession. This caused a leveling out of energy demand and helped encourage the development of nuclear energy which saw increased use beginning in this period. The Iranian Revolution in 1979 resulted in another sharp increase in the cost of crude oil and triggered a significant drop off in demand for petroleum products. In 2008, problems with the housing mortgage industry, rising oil prices and a massive recession contributed to yet another significant decrease in energy use. The rise in energy prices was particularly difficult for Michigan's durable goods manufacturing. This sector suffered with the loss in buying power as consumers and businesses had to spend more to meet their energy needs.

Energy use by sector is displayed in Figure 5. While all sectors show a drop in demand after 2005, industrial is the most pronounced with a decrease of 39 percent between 2000 and 2009. This is due to an overall decrease in manufacturing in the state.

[12] The following series of graphs show energy consumption and expenditures for the State as a whole and by sector. The 2009 data is based on the State Energy Data Reports, EIA, February 2011. http://www.eia.doe.gov/emeu/states/sep_use/total/pdf/use_mi.pdf

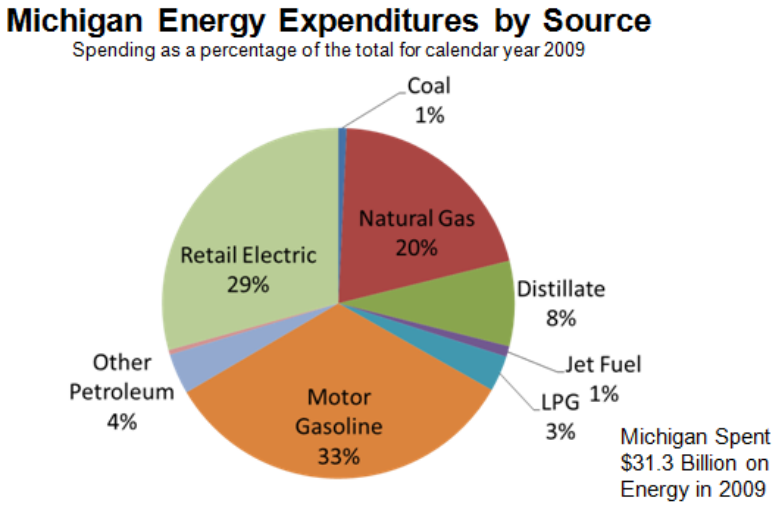
Figure 5



Data Source: State Energy Data Report, Energy Information Administration, DOE

Energy expenditures in Michigan in 2009 totaled $31.3 billion,[13] compared to $37 billion in 2007. This change in expenditures reflects both the prices of energy and how much was used. Petroleum products were used to meet 32 percent of the State's energy needs at a cost that was just over 50 percent of total expenditures (Figure 6).[14] Natural gas accounted for 28 percent of use, but only 21 percent of expenditures. Fuels used to generate electricity are included in the electricity usage numbers, so as a result only a small amount of coal use is seen in the Figure 6. This represents industrial uses of coal and not what is used for electricity generation.

Figure 6



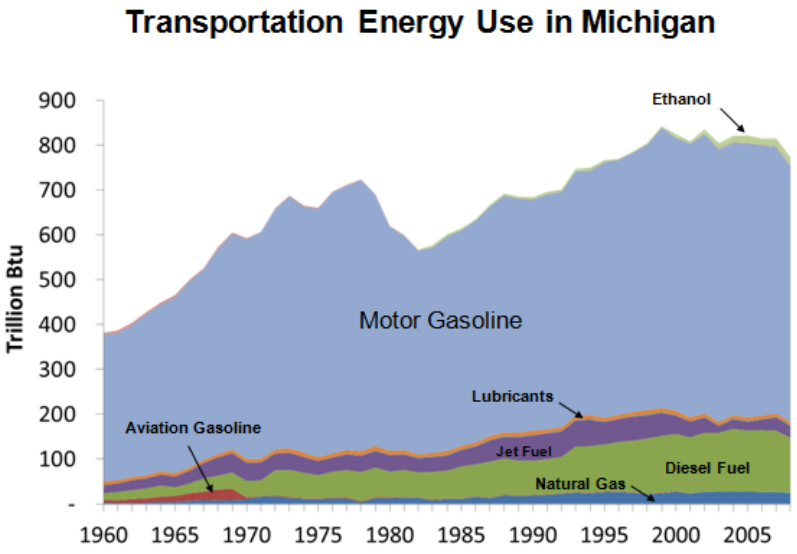
Note: the cost of fuels used to generate electricity are included in the retail electric costs. Coal use is non-utility industrial costs; Other petroleum products is comprised of residual fuel oil, lubricants, asphalt and road oil, kerosene, etc.

Data Source: State Energy Data Report, Energy Information Administration, DOE

[13] This data represents the dollar value in 2009, not adjusted for inflation.
[14] Petroleum products expenditures include figures for distillate fuel, jet fuel, LPG, motor gasoline, and other petroleum products (i.e., residual oil and lubricants)

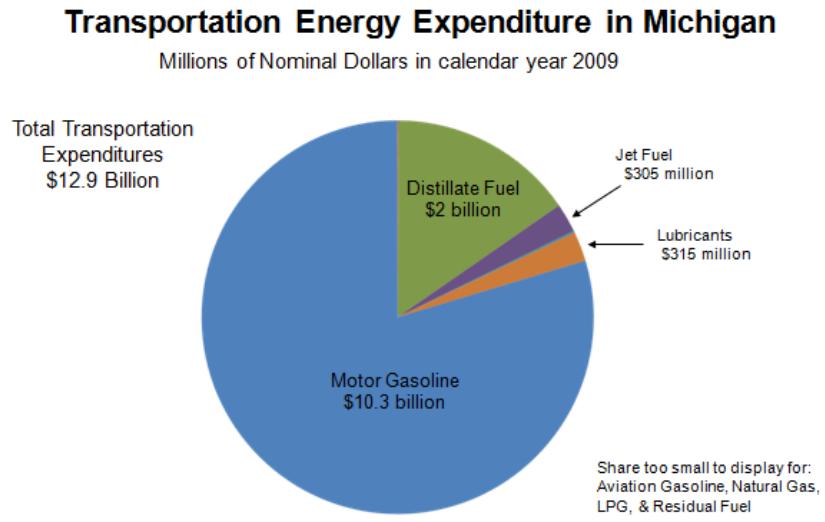
Transportation sector: [15]
This clearly shows the predominance of gasoline used for transportation and the nearly exclusive use of petroleum to meet the State's transportation needs.[16] In 2007, gasoline cost Michigan motorists and businesses $13 billion which is estimated to have decreased slightly to $12.9 billion in 2009 due to lower gasoline prices and reduced consumption. In 2009, Michigan used about 4.6 billion gallons of gasoline. Since then, a slow and steady rebound in the U.S. economy has modestly increased demand. This upward trend will be highly dependent on the price of crude oil and the level of economic activity.

Figure 7



Data Source: State Energy Data Report, Energy Information Administration, DOE

Figure 8



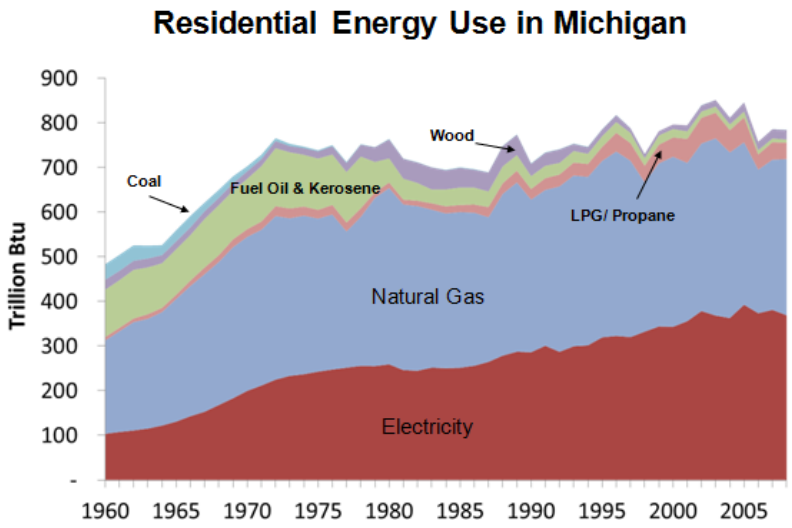
Data Source: State Energy Expenditures Report Energy Information Administration, DOE

[15] Transportation energy use is not included in the residential, commercial, or industrial sector data.
[16] Gasoline for all uses is included in the transportation sector unless it is used for other industrial processes.

Residential sector:

Natural gas and electricity are the principal fuels used in Michigan homes. Fuel oil and kerosene has shown a steady decline because of its relatively high cost compared to other fuels. Although LPG/propane remains a modest share of residential use, Michigan uses more LPG/propane in the residential sector than any other state. Wood for home heating has declining significantly since its high point in the 1980's, however recent usage appears to be on the upswing.

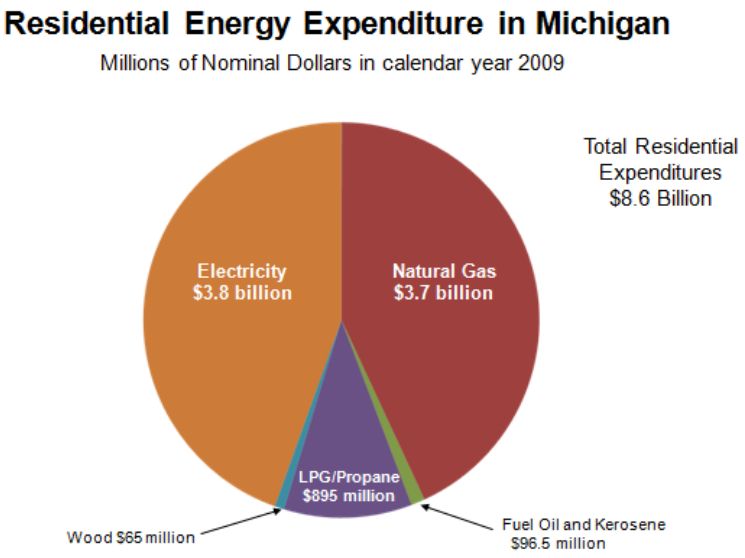
Figure 9



Data Source: State Energy Data Report, Energy Information Administration, DOE

A total of $8.6 billion was spent in Michigan to meet residential energy needs in 2009, most of which went for electricity and natural gas. Due to its much higher cost per BTU compared to natural gas, Michigan's 2009 total spending for LPG/propane reached nearly 900 million dollars, even though it represents less than 10 percent of residential usage (Figure 10).

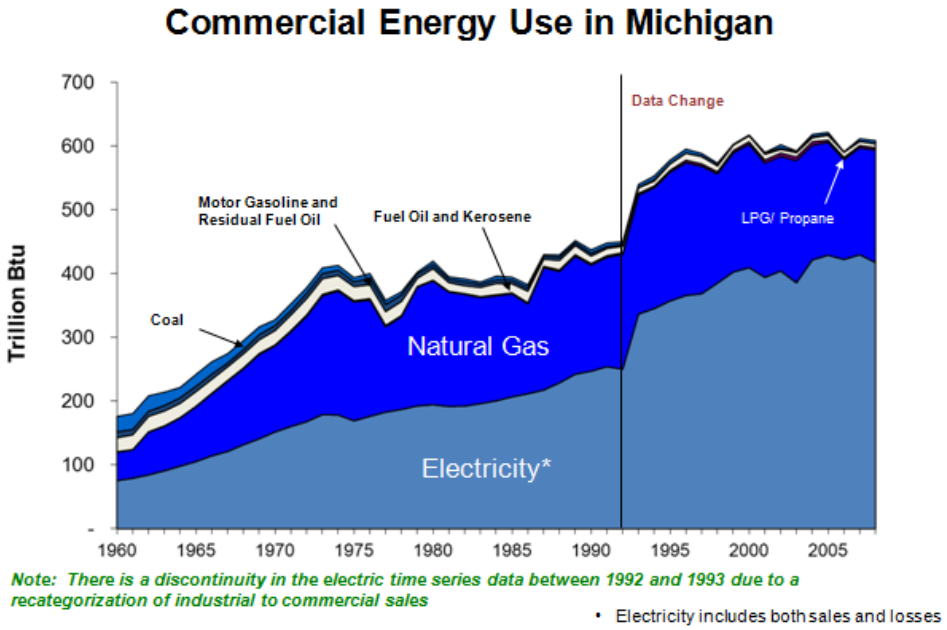
Figure 10



Data Source: State Energy Expenditures Report Energy Information Administration, DOE

Commercial sector:
Like the residential sector, use is dominated by natural gas and electricity. In 1992, a change in how commercial use was defined in reporting by industry caused a shift which reflects a re-categorization and not growth. On the expenditure side, the dominance of electricity costs can be seen. Spending in the commercial sector totaled $5.3 billion in 2009.

Figure 11

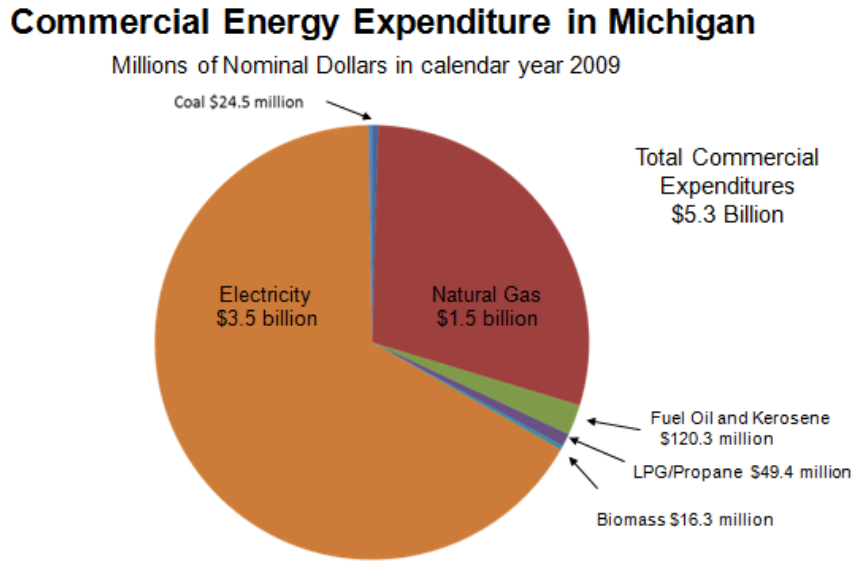


Note: There is a discontinuity in the electric time series data between 1992 and 1993 due to a recategorization of industrial to commercial sales

• Electricity includes both sales and losses

Data Source: State Energy Data Report, Energy Information Administration, DOE

Figure 12

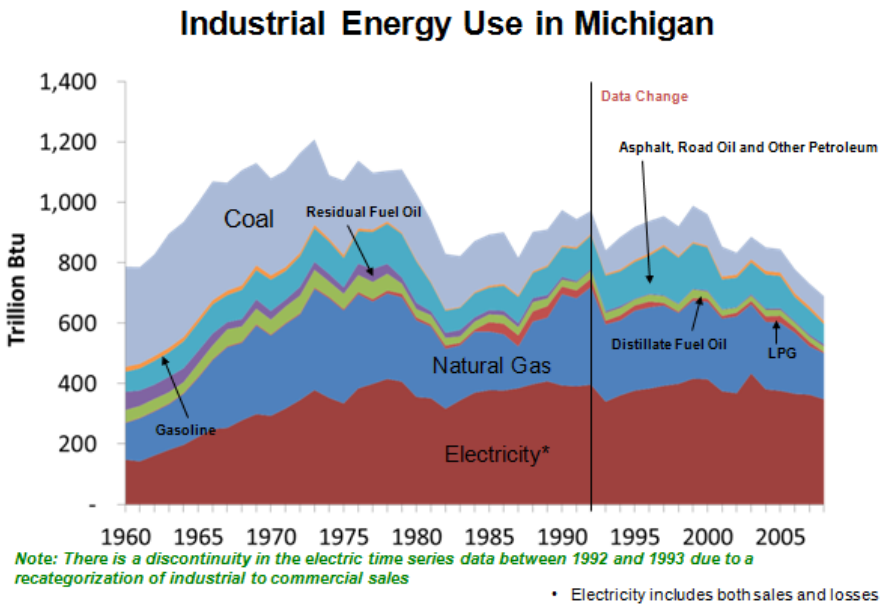


Data Source: State Energy Expenditures Report Energy Information Administration, DOE

Industrial sector:

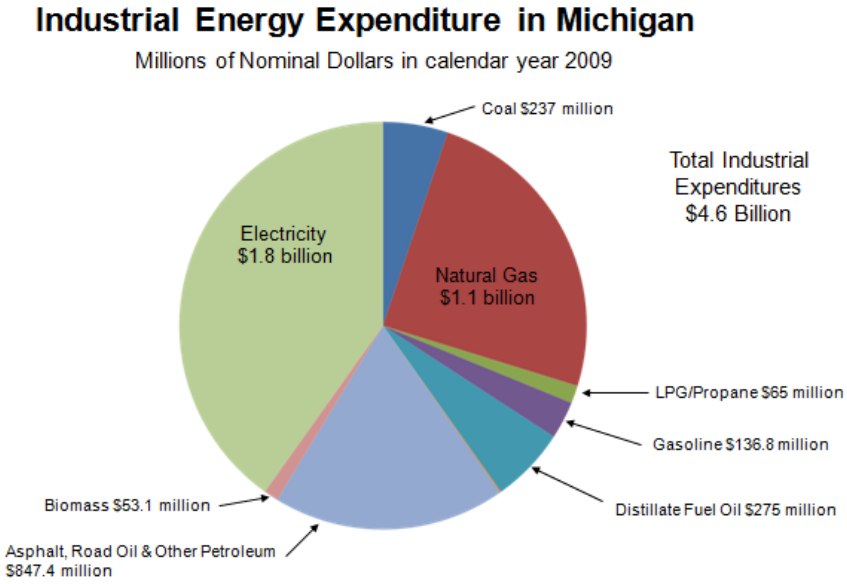
The diversity of the energy supply used by the industrial sector is clear in these graphs. The sharp reduction in industrial coal use from the 1960's is the result of a combination of reduction in heavy energy intensive manufacturing like steel mills, coupled with environmental regulations that made alternative energy sources more attractive. The effects on the industrial sector of the economic recession that took place in the early 1980's and again in 2008/09 are clearly evident in industrial energy use. Spending in the industrial sector totaled $4.6 billion in 2009 which is a significant reduction from the $5.8 billion spent in 2005.

Figure 13



Data Source: State Energy Data Report, Energy Information Administration, DOE

Figure 14



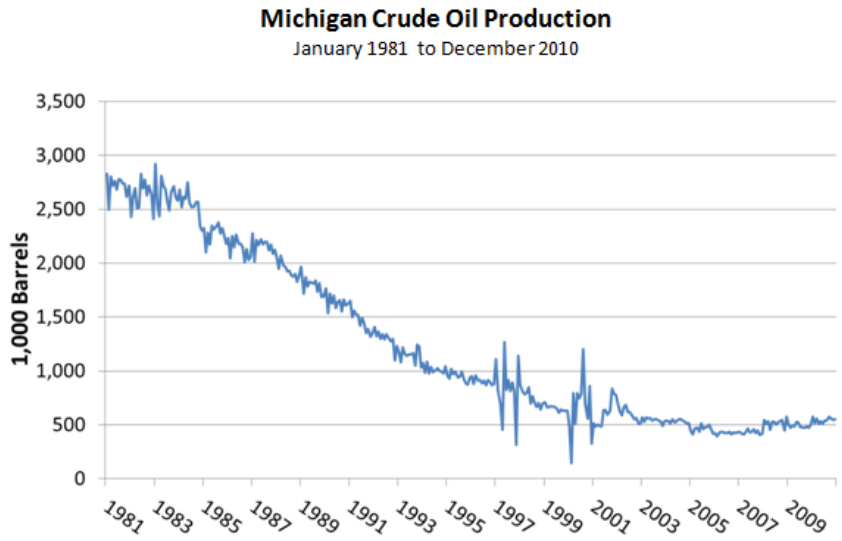
Data Source: State Energy Expenditures Report, Energy Information Administration, DOE

*Other petroleum" is comprised of aviation gasoline, kerosene, lubricants, etc.

Petroleum and Natural Gas Trends and Analysis

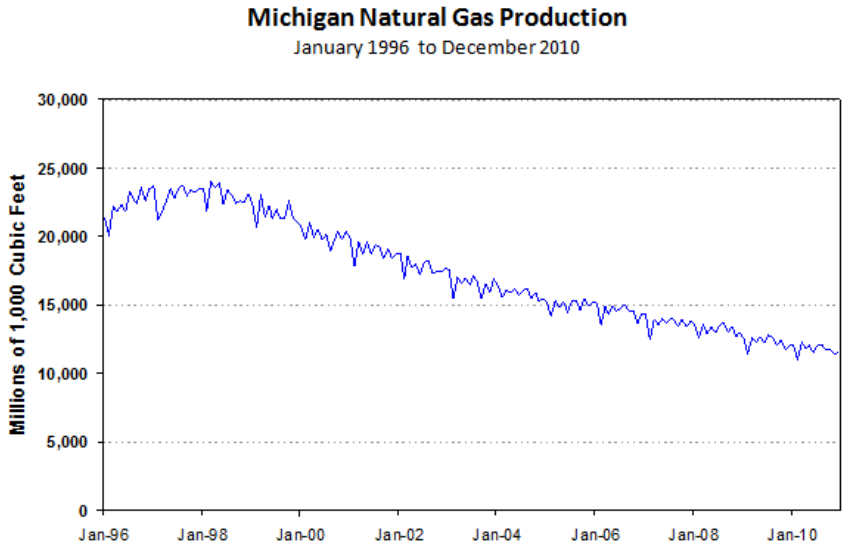
Oil and natural gas production in Michigan is shown in Figures 15 and 16. This graph shows the overall decline in Michigan crude oil production which currently is 6.5 million barrels annually; down from 1979 when it peaked at 35 million barrels. With a trend toward higher crude prices, however, production has increased and was 25 percent higher in 2010 than in 2007. Natural gas production in Michigan peaked in 1997 at 280.7 billion cubic feet and has since declined due to decreased well productivity. In 2010, yearly production was at 166.9 billion cubic feet, down 41 percent from 2000. In-state production in 2010 equaled about 18 percent of the State's annual total natural gas use.

Figure 15



Data Source: Energy Information Administration, DOE

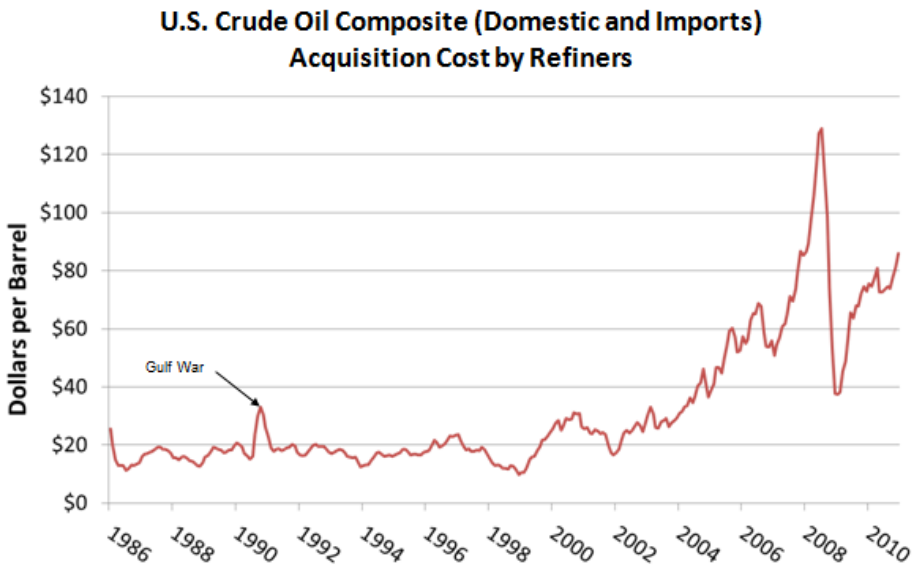
Figure 16



Data Source: Gas Operations, Operations and Wholesale Markets, MPSC

Crude oil and natural gas prices are shown in Figures 17 and 18. Crude oil prices are a major factor in the price of all refined petroleum products such as gasoline, diesel fuel, jet fuel, etc. From the mid-1980's to the mid-1990's crude oil prices were relatively stable with the exception of the spike in prices that occurred just before the 1991 Gulf War. In December 1998, crude oil prices bottomed out at $9.81 per barrel. Following this, OPEC members asserted greater discipline over production levels. This was the beginning of the major upward price trend that led to prices above the $100 per barrel level by the end of 2007 and record highs in 2008.[17] More recently in 2010/11, decreasing non-OPEC oil production and reduced supply from Libya has contributed to a tightening of markets and raised crude prices. Market speculation in response to political unrest in the Middle East Region has also contributed to the upward trend.

Figure 17

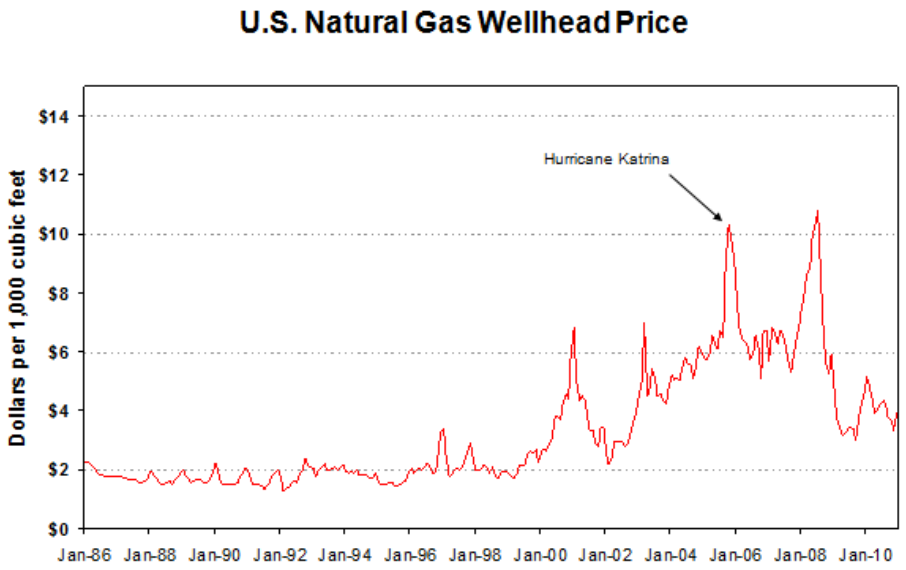


Data Source: Energy Information Administration, DOE

Traditionally, natural gas prices have followed a similar pattern as crude oil with relative stability from the mid-1980's to the mid-1990's. Since then, the markets have seen increased volatility. Some of this volatility has been the result of natural disasters and/or unexpected supply disruptions. For example, the peak price in October 2005 was a direct result of the 2005 hurricanes that shut-in a substantial share of natural gas production from the Gulf of Mexico which did not fully recover until the first part of 2006 (Figure 18). Beginning around 2009, however, this trend appears to have eased as natural gas prices have remained stable despite increased price volatility in the crude oil market (Figure 19). This change in trend can be attributed in part to the popularity of horizontal drilling techniques which have made shale gas accessible on a larger scale in recent years. This method is in contrast to vertical drilling which only allows gas extraction at the point of entry.

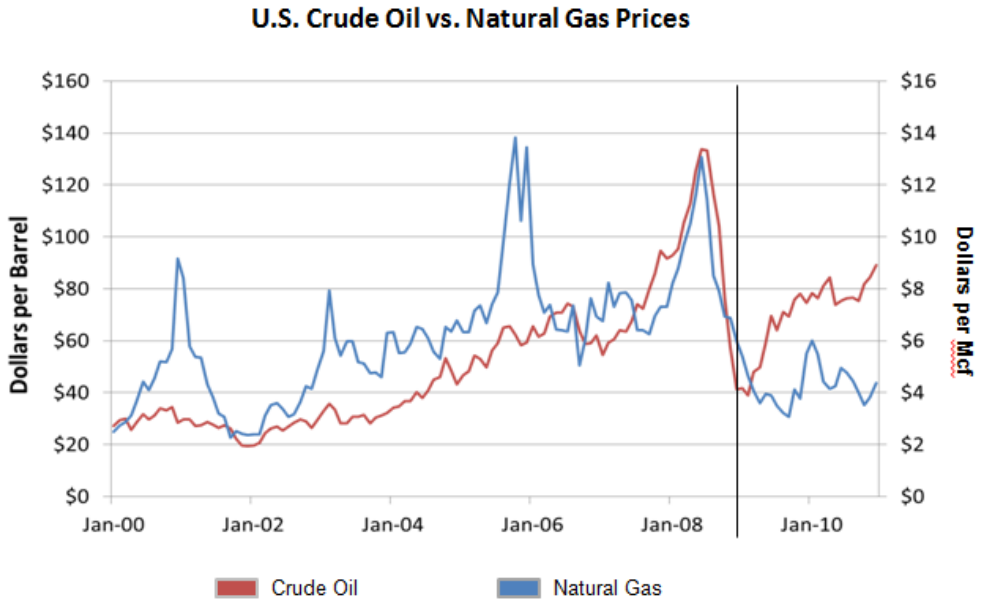
[17] For a detailed history of crude oil prices and factors that effected prices see: http://www.eia.doe.gov/emeu/cabs/AOMC/Overview.html.

Figure 18



Data Source: Energy Information Administration, DOE

Figure 19



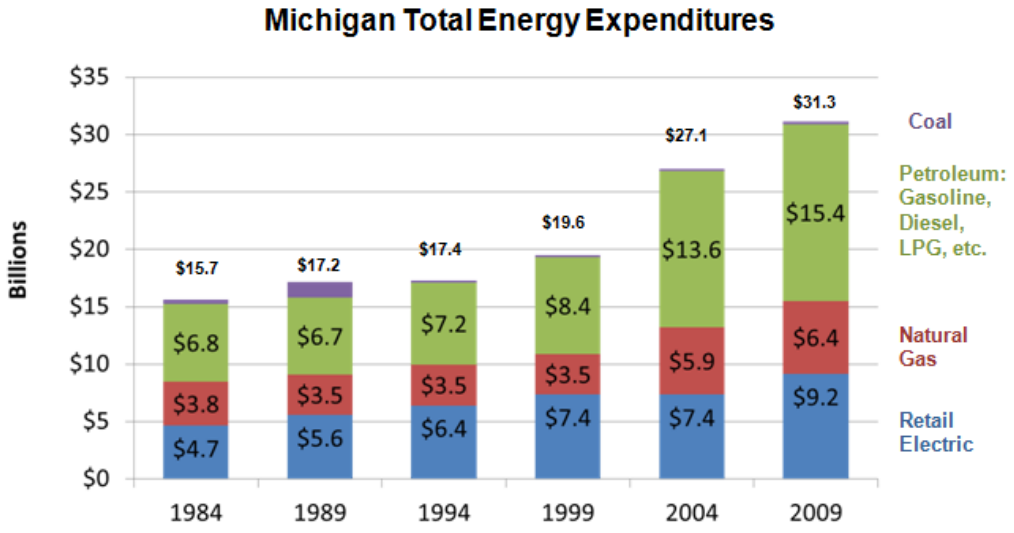
Data Source: Energy Information Administration, DOE

Conclusion

Due in part to the State's large population, northern climate and industrial sector, Michigan's total energy consumption is relatively high. Michigan is limited in most energy resources and imports 97 percent of its petroleum needs, 82 percent of its natural gas and 100 percent of coal and nuclear fuel from other states and nations. These imports account for about 72 cents of every dollar spent for energy by Michigan's citizens and businesses. Michigan citizens and businesses spent an estimated $31.3 billion on energy in 2009.

Most notable is the change in spending over time. A decade ago, in 1999, Michigan spent nearly $20 billion compared to the $31.3 billion spent in 2009 (Figure 19). While petroleum costs in this period nearly doubled, natural gas increased 81 percent and electricity 24 percent.

Figure 20



Data Source: Energy Information Administration, DOE

Despite Michigan's reliance on imported energy sources, the State does have substantial natural gas production which supplies about 18 percent of the State's demand. Natural gas wells are concentrated in the Antrim geological formations in the northern portion of the Lower Peninsula. Well productivity has steadily decreased, however, since its peak in 1997.

When examining market trends over time, one can see increased volatility in the oil and natural gas markets beginning in the mid-1990's. Natural disasters (i.e., Hurricane Katrina), wars and unrest in the Middle East have contributed to this volatility by creating short term supply disruptions and fear in the energy trading markets. While historically trending with the price of crude oil, natural gas prices have broken this pattern in recent years. In 2010, the average spot price for natural gas was the lowest since 2002 despite increasing crude oil prices. This trend change can be attributed in part to the expansion of horizontal drilling techniques which have made shale gas accessible on a larger scale and increased the supply available to markets.

Michigan also has significant potential for renewable energy development, specifically in the area of wind. In April, 2009, five commercial wind farms were in operation with a total of 83 turbine units.[18] This compares to only 35 operational turbines in 2008. The majority of renewable energy, however, is still generated by wood/biomass (43 percent) and hydro power (34 percent).

In a state with relatively high energy use and a dependence on imports such as Michigan, assessing energy supply, consumption and expenditures is vital. This in-depth understanding of the State's energy baseline helps inform decision making for business leaders, researchers, community action groups and emergency response personnel and will help assure future energy reliability and availability.

For additional Michigan energy statistics go to the Michigan Energy Profiles found at: http://tonto.eia.doe.gov/state/state_energy_profiles.cfm?sid=MI.

[18] Final Report of the Michigan Wind Energy Resource Zone Board
http://www.dleg.state.mi.us/mpsc/renewables/windboard/werzb_final_report.pdf