This State Energy Risk Profile examines the relative magnitude of the risks that the state of Michigan’s energy infrastructure routinely encounters in comparison with the probable impacts. Natural and man-made hazards with the potential to cause disruption of the energy infrastructure are identified. Certain natural and adversarial threats, such as cybersecurity, electromagnetic pulse, geomagnetic disturbance, pandemics, or impacts caused by infrastructure interdependencies, are ill-suited to location-based probabilistic risk assessment as they may not adhere to geographic boundaries, have limited occurrence, or have limited historic data. Cybersecurity and other threats not included in these profiles are ever present and should be included in state energy security planning. A complete list of data sources and national level comparisons can be found in the Data Sources document.

**Michigan Risks and Hazards Overview**

- The natural hazard that caused the greatest overall property loss between 2009 and 2019 was **Flooding** at $232 million per year (leading cause nationwide at $12 billion per year).
- Michigan had 26 Major Disaster Declarations, 1 Emergency Declaration, and 0 Fire Management Assistance Declarations for 5 events between 2013 and 2019.
- Michigan registered 8% fewer Heating Degree Days and 28% greater Cooling Degree Days than average in 2019.
- There are 2 Fusion Centers in Michigan. The Primary Fusion Center is located in Lansing.

### Annualized Frequency of and Property Damage Due to Natural Hazards, 2009 – 2019

<table>
<thead>
<tr>
<th>HAZARD</th>
<th>FREQUENCY – Annualized</th>
<th>PROPERTY DAMAGE – Annualized ($Million per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drought</td>
<td>&lt;1</td>
<td>$0</td>
</tr>
<tr>
<td>Earthquake (≥ 3.5 M)</td>
<td>&lt;1</td>
<td>$0</td>
</tr>
<tr>
<td>Extreme Heat</td>
<td>1</td>
<td>$0</td>
</tr>
<tr>
<td>Flood</td>
<td>13</td>
<td>$232</td>
</tr>
<tr>
<td>Hurricane</td>
<td>0</td>
<td>$0</td>
</tr>
<tr>
<td>Landslide</td>
<td>0</td>
<td>$0</td>
</tr>
<tr>
<td>Thunderstorm &amp; Lightning</td>
<td>85</td>
<td>$109</td>
</tr>
<tr>
<td>Tornado</td>
<td>8</td>
<td>$11</td>
</tr>
<tr>
<td>Wildfire</td>
<td>1</td>
<td>$2</td>
</tr>
<tr>
<td>Winter Storm &amp; Extreme Cold</td>
<td>62</td>
<td>$12</td>
</tr>
</tbody>
</table>

Data Sources: NOAA and USGS
Electric Infrastructure

- Michigan has 66 electric utilities:
  - 4 Investor owned
  - 11 Cooperative
  - 40 Municipal
  - 11 Other utilities
- Plant retirements scheduled by 2025: 46 electric generating units totaling 4,672 MW of installed capacity.

Electric Customers and Consumption by Sector, 2018

<table>
<thead>
<tr>
<th>Sector</th>
<th>CUSTOMERS</th>
<th>CONSUMPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>89%</td>
<td>34%</td>
</tr>
<tr>
<td>Commercial</td>
<td>11%</td>
<td>37%</td>
</tr>
<tr>
<td>Industrial</td>
<td>&lt;1%</td>
<td>29%</td>
</tr>
<tr>
<td>Transportation</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>

Data Source: EIA

Electric Utility-Reported Outages by Cause, 2008 – 2017

- In 2018, the average Michigan electric customer experienced 1.4 service interruptions that lasted an average of 7.4 hours.
- In Michigan, between 2008 and 2017:
  - The greatest number of electric outages occurred in June (2nd for outages nationwide)
  - The leading cause of electric outages was Weather or Falling Trees (leading cause nationwide)
  - Electric outages affected 1,264,206 customers on average

Electric Utility Outage Data, 2008 – 2017

Note: This chart uses a logarithmic scale to display a very wide range of values.

Data Source: Eaton

Produced by Department of Energy (DOE), Office of Cybersecurity, Energy Security, and Emergency Response (CESER)
Natural Gas Transport

Top Events Affecting Natural Gas Transmission and Distribution, 1984 – 2019

<table>
<thead>
<tr>
<th>Event Type</th>
<th>Transmission</th>
<th>ECONOMIC LOSS – Annualized Loss $Thousands per year</th>
<th>FREQUENCY – Annualized Frequency Average incidents per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrosion</td>
<td>$295</td>
<td>0.08</td>
<td>0.47</td>
</tr>
<tr>
<td>Equipment Failure</td>
<td>$282</td>
<td>0.17</td>
<td>0.58</td>
</tr>
<tr>
<td>Excavation Damage</td>
<td>$365</td>
<td>0.17</td>
<td>0.92</td>
</tr>
<tr>
<td>Incorrect Operation</td>
<td>$1,015</td>
<td>0.19</td>
<td>0.25</td>
</tr>
<tr>
<td>Material/Weld Failure</td>
<td>$787</td>
<td>0.28</td>
<td>1.39</td>
</tr>
<tr>
<td>Miscellaneous/Unknown</td>
<td>$151</td>
<td>0.08</td>
<td>0.36</td>
</tr>
<tr>
<td>Natural Force</td>
<td>$330</td>
<td>0.11</td>
<td>0.22</td>
</tr>
<tr>
<td>Outside Force</td>
<td>$74</td>
<td>0.28</td>
<td>2.28</td>
</tr>
<tr>
<td></td>
<td>$3,072</td>
<td></td>
<td>1.39</td>
</tr>
<tr>
<td></td>
<td>$4,180</td>
<td></td>
<td>2.28</td>
</tr>
</tbody>
</table>

Data Source: DOT PHMSA

- As of 2018, Michigan had:
  - 8,774 miles of natural gas transmission pipelines
  - 59,730 miles of natural gas distribution pipelines
- 65% of Michigan’s natural gas transmission system and 25% of the distribution system were constructed prior to 1970 or in an unknown year.
- Between 1984 and 2019, Michigan’s natural gas supply was most impacted by:
  - **Material Failures** when transported by transmission pipelines (leading cause nationwide at $28.43M per year)
  - **Outside Forces** when transported by distribution pipelines (leading cause nationwide at $76.59M per year)

Natural Gas Processing and Liquefied Natural Gas

Natural Gas Customers and Consumption by Sector, 2018

<table>
<thead>
<tr>
<th>Sector</th>
<th>Customers</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>93%</td>
<td>35%</td>
</tr>
<tr>
<td>Commercial</td>
<td>7%</td>
<td>19%</td>
</tr>
<tr>
<td>Industrial</td>
<td>&lt;1%</td>
<td>19%</td>
</tr>
<tr>
<td>Transportation</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Electric Power</td>
<td>&lt;1%</td>
<td>27%</td>
</tr>
<tr>
<td>Other</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>

- Michigan has 9 natural gas processing facilities with a total capacity of 101 MMcf/d.
- Michigan has 0 liquefied natural gas (LNG) facilities.

Data Source: EIA
Petroleum Transport

Top Events Affecting Petroleum Transport by Truck and Rail, 1986 – 2019

- **Corrosion**
  - ECONOMIC LOSS
    - $0
  - FREQUENCY
    - 0
- **Derailment or Collision / Rollover**
  - ECONOMIC LOSS
    - $0
  - FREQUENCY
    - 0
- **Equipment Failure**
  - ECONOMIC LOSS
    - $1,121
  - FREQUENCY
    - 0.09
- **Incorrect Operation**
  - ECONOMIC LOSS
    - $0
  - FREQUENCY
    - 0
- **Material / Weld Failure**
  - ECONOMIC LOSS
    - $197
  - FREQUENCY
    - 0.12
- **Miscellaneous / Unknown**
  - ECONOMIC LOSS
    - $13
  - FREQUENCY
    - 0.09
- **Natural Force**
  - ECONOMIC LOSS
    - $1,448
  - FREQUENCY
    - 0.26
- **Outside Force**
  - ECONOMIC LOSS
    - $2,407
  - FREQUENCY
    - 0

Data Source: DOT PHMSA

Top Events Affecting Crude Oil and Refined Product Pipelines, 1986 – 2019

- **Crude Pipelines**
  - **Corrosion**
    - ECONOMIC LOSS
      - $76
    - FREQUENCY
      - 0.09
  - **Equipment Failure**
    - ECONOMIC LOSS
      - $71
    - FREQUENCY
      - 0.32
  - **Excavation Damage**
    - ECONOMIC LOSS
      - $43
    - FREQUENCY
      - 0.15
  - **Material / Weld Failure**
    - ECONOMIC LOSS
      - $197
    - FREQUENCY
      - 0.21
  - **Miscellaneous / Unknown**
    - ECONOMIC LOSS
      - $13
    - FREQUENCY
      - 0.09
  - **Natural Force**
    - ECONOMIC LOSS
      - $14
    - FREQUENCY
      - 0.09
  - **Outside Force**
    - ECONOMIC LOSS
      - $400
    - FREQUENCY
      - 0.21

Data Source: DOT PHMSA

Petroleum Refineries

- **Michigan has 1 petroleum refinery with a total operable capacity of 140 Mb/d.**
- Between 2009 and 2019, the leading cause of petroleum refinery disruptions in Michigan was:
  - **Loss of Containment or Flaring** (leading cause nationwide)

Causes and Frequency of Petroleum Refinery Disruptions, 2009 – 2019

- As of 2018, Michigan had:
  - 1,564 miles of crude oil pipelines
  - 1,422 miles of refined product pipelines
  - 0 miles of biofuels pipelines
- 61% of Michigan’s petroleum pipeline systems were constructed prior to 1970 or in an unknown year.
- Between 1986 and 2019, Michigan’s petroleum supply was most impacted by:
  - **Outside Forces** when transported by truck (2nd leading cause nationwide at $60.45M per year)
  - **Equipment Failures** when transported by rail (7th leading cause nationwide at $0.02M per year)
  - **Material Failures** when transported by crude pipelines (leading cause nationwide at $41.36M per year)
  - **Equipment Failures** when transported by product pipelines (6th leading cause nationwide at $4.66M per year)
- Disruptions in other states may impact supply.