State of Ohio
ENERGY SECTOR RISK PROFILE

This State Energy Risk Profile examines the relative magnitude of the risks that the State of Ohio’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.

The Risk Profile highlights risk considerations relating to the electric, petroleum and natural gas infrastructures to become more aware of risks to these energy systems and assets.

OHIO STATE FACTS

State Overview
- Population: 11.57 million (4% total U.S.)
- Housing Units: 5.12 million (4% total U.S.)
- Business Establishments: 0.25 million (3% total U.S.)

Annual Energy Consumption
- Electric Power: 152.5 TWh (4% total U.S.)
- Coal: 42,200 MSTN (5% total U.S.)
- Natural Gas: 832 Bcf (4% total U.S.)
- Motor Gasoline: 112,000 Mbarrels (4% total U.S.)
- Distillate Fuel: 51,900 Mbarrels (4% total U.S.)

Annual Energy Production
- Electric Power Generation: 129.7 TWh (3% total U.S.)
  - Coal: 85.6 TWh, 66% [20.7 GW total capacity]
  - Petroleum: 1.3 TWh, <1% [1.1 GW total capacity]
  - Natural Gas: 22.7 TWh, 17% [10.9 GW total capacity]
  - Nuclear: 17.1 TWh, 13% [2.2 GW total capacity]
  - Hydro: 0.4 TWh, <1% [0.1 GW total capacity]
  - Other Renewable: 1 TWh, <1% [0.6 GW total capacity]
- Coal: 26,300 MSTN (3% total U.S.)
- Natural Gas: 80 Bcf (<1% total U.S.)
- Crude Oil: 4,900 Mbarrels (<1% total U.S.)
- Ethanol: 10,400 Mbarrels (3% total U.S.)

NATURAL HAZARDS OVERVIEW

Annual Frequency of Occurrence of Natural Hazards in Ohio (1996–2014)

- According to NOAA, the most common natural hazard in Ohio is Thunderstorm & Lightning, which occurs once every 3.8 days on the average during the months of March to October.
- The second-most common natural hazard in Ohio is Flood, which occurs once every 7.3 days on the average.

Annualized Property Loss due to Natural Hazards in Ohio (1996–2014)

- As reported by NOAA, the natural hazard in Ohio that caused the greatest overall property loss during 1996 to 2014 is Flood at $72.8 million per year.
- The natural hazard with the second-highest property loss in Ohio is Tornado at $56.3 million per year.
Electric Power Plants: 148 (1% total U.S.)
- Coal-fired: 29 (3% total U.S.)
- Petroleum-fired: 61 (3% total U.S.)
- Natural Gas-fired: 36 (1% total U.S.)
- Nuclear: 2 (2% total U.S.)
- Hydro-electric: 5 (<1% total U.S.)
- Other Renewable: 15 (1% total U.S.)

Transmission Lines:
- High-Voltage (>230 kV): 6,983 Miles
- Low-Voltage (<230 kV): 112 Miles

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Data Sources: ANL 2013; ESRI 2012; EIA 2014; Platts 2014.
Electric Transmission

- According to NERC, the leading cause of electric transmission outages in Ohio is Severe Weather - Thunderstorm.
- Ohio experienced 31 electric transmission outages from 1992 to 2009, affecting a total of 2,652,102 electric customers.
- Complete Electrical System Failure affected the largest number of electric customers as a result of electric transmission outages.

### Electric Customers Disrupted by NERC-Reported Electric Transmission Outages by Cause (1992–2009)

<table>
<thead>
<tr>
<th>Cause</th>
<th>Number of Customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe Weather - Thunderstorm</td>
<td>1,169,183</td>
</tr>
<tr>
<td>Faulty Equipment / Human Error</td>
<td>1</td>
</tr>
<tr>
<td>Severe Weather - Heat Wave</td>
<td>25,000</td>
</tr>
<tr>
<td>Complete Electrical System Failure</td>
<td>99,118</td>
</tr>
<tr>
<td>Severe Weather - Winter Storm</td>
<td>155,800</td>
</tr>
<tr>
<td>All Other Causes</td>
<td>10</td>
</tr>
</tbody>
</table>

Data Source: NERC

### Electric Distribution

- Between 2008 and 2013, the greatest number of electric outages in Ohio has occurred during the month of July.
- The leading cause of electric outages in Ohio during 2008 to 2013 was Weather/Falling Trees.
- On average, the number of people affected annually by electric outages during 2008 to 2013 in Ohio was 847,785.
- The average duration of electric outages in Ohio during 2008 to 2013 was 9,968 minutes or 166.1 hours a year.

### Causes of Electric-Utility Reported Outages (2008–2013)

<table>
<thead>
<tr>
<th>Cause</th>
<th># of Incidents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal</td>
<td>59</td>
</tr>
<tr>
<td>Faulty Equipment / Human Error</td>
<td>199</td>
</tr>
<tr>
<td>Overdemand</td>
<td>111</td>
</tr>
<tr>
<td>Planned</td>
<td>0</td>
</tr>
<tr>
<td>Theft / Vandalism</td>
<td>20</td>
</tr>
<tr>
<td>Vehicle Accident</td>
<td>6</td>
</tr>
<tr>
<td>Weather / Falling Trees</td>
<td>11</td>
</tr>
<tr>
<td>Unknown</td>
<td>0</td>
</tr>
</tbody>
</table>

Data Source: Eaton

### Utility Outage Data (2008–2013)

- Total number of people affected by outages
- Total duration of outages (minutes)

Data Source: Eaton

NOTE: # of Incidents – The number within each pie slice is the number of event incidents attributable to each cause.
PETROLEUM

**Petroleum Infrastructure Overview**
- Refineries: 4 (3% total U.S.)
- Terminals: 79 (4% total U.S.)
- Crude Pipelines: 538 Miles (1% total U.S.)
- Product Pipelines: 9,600 Miles (2% total U.S.)
- Bio-Refineries (Ethanol): 7 (3% total U.S.)
Petroleum Transport

Top Events Affecting Petroleum Transport by Truck and Rail (1986–2014)

The leading event type affecting the transport of petroleum product by rail and truck in Ohio during 1986 to 2014 was Incorrect Operation for rail transport and Miscellaneous/Unknown for truck transport, with an average 3.1 and 30.8 incidents per year, respectively.

Petroleum Refinery

The leading cause of petroleum refinery disruptions in Ohio from 2003 to 2014 was Maintenance/Turnaround. Ohio’s petroleum refineries experienced 139 major incidents from 2003 to 2014. The average production impact from disruptions of Ohio’s refineries from 2003 to 2014 is 31.3 thousand barrels per day.
NATURAL GAS

Natural Gas Infrastructure Overview
Gas Wells: 32,720 (7% total U.S.)
Processing Plants: 1 (<1% total U.S.)
Storage Fields: 21 (5% total U.S.)
Interstate Pipelines: 11,700 Miles (2% total U.S.)
Local Distribution Companies: 47 (3% total U.S.)
Natural Gas Transport

The leading event type affecting natural gas transmission and distribution pipelines in Ohio during 1986 to 2014 was Outside Force for Transmission Pipelines and Miscellaneous/Unknown for Distribution Pipelines, with an average 0.42 (or one incident every 2.4 years) and 2.06 incidents per year, respectively.

Top Events Affecting Natural Gas Transmission and Distribution in Ohio (1986–2014)

<table>
<thead>
<tr>
<th>Event Type</th>
<th>Economic Loss</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrosion</td>
<td>$814</td>
<td>0.19</td>
</tr>
<tr>
<td>Equipment Failure</td>
<td>$430</td>
<td>0.16</td>
</tr>
<tr>
<td>Excavation Damage</td>
<td>$505</td>
<td>0.06</td>
</tr>
<tr>
<td>Incorrect Operation</td>
<td>$414</td>
<td>0.45</td>
</tr>
<tr>
<td>Material / Weld Failures</td>
<td>$154</td>
<td>0.06</td>
</tr>
<tr>
<td>Miscellaneous / Unknown</td>
<td>$334</td>
<td>0.19</td>
</tr>
<tr>
<td>Natural Forces</td>
<td>$348</td>
<td>0.16</td>
</tr>
<tr>
<td>Outside Force</td>
<td>$776</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Data Source: DOT PHMSA

Natural Gas Processing

Insufficient public data are available on major incidents affecting natural gas processing plants in this state.
Overview Information

- Census Bureau (2012) State and County QuickFacts [http://quickfacts.census.gov/qfd/download_data.html]

Production Numbers


Consumption Numbers


Electricity

- Platts (2014 Q2) Transmission Lines (Miles by Voltage Level)
- Platts (2014 Q2) Power Plants (Production and Capacity by Type)

Petroleum

- Argonne National Laboratory (2012) Petroleum Terminal Database
- Argonne National Laboratory (2014) Ethanol Plants
- NPMS (2011) Petroleum Product Pipeline (Miles of Interstate Pipeline)
- NPMS (2011) Crude Pipeline (Miles of Interstate Pipeline)

Natural Gas

- EIA (2013) Number of Producing Gas Wells [http://www.eia.gov/dnav/ng/ng_prod_wells_s1_a.htm]
- NPMS (2011) Natural Gas Pipeline (Miles of Interstate Pipeline)
- Platts (2014 Q2) Local Distribution Companies (LDCs)

Event Related

*The NERC disturbance reports are not published after 2009.

Notes

- Natural Hazard, Other, includes extreme weather events such as astronomical low tide, dense smoke, frost/freeze, and rip currents.
- Each incident type is an assembly of similar causes reported in the data source. Explanations for the indescribable incident types are below.
  - Outside Force refers to pipeline failures due to vehicular accident, sabotage, or vandalism.
  - Natural Forces refers to damage that occurs as a result of naturally occurring events (e.g., earth movements, flooding, high winds, etc.)
  - Miscellaneous/Unknown includes releases or failures resulting from any other cause not listed or of an unknowable nature.
  - Overdemand refers to outages that occur when the demand for electricity is greater than the supply, causing forced curtailment.
- Number (#) of Incidents – The number within each pie chart piece is the number of outages attributable to each cause.

For more information contact:
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