Midwest Region
ENERGY SECTOR RISK PROFILE

This Energy Risk Profile examines the relative magnitude of the risks that the Midwest Region’s energy infrastructure routinely encounters in comparison with the probable impacts. The Midwest Region consists of the State of Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nebraska, North and South Dakota, Ohio, Oklahoma, Tennessee and Wisconsin. 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.

**MIDWEST REGION FACTS**

**Region Overview**
- Population: 82.3 million (26% total U.S.)
- Housing Units: 36 million (27% total U.S.)
- Business Establishments: 2 million (26% total U.S.)

**Annual Energy Consumption**
- Electric Power: 1,113 TWh (30% total U.S.)
- Coal: 411,750 MSTN (48% total U.S.)
- Natural Gas: 5,220 Bcf (22% total U.S.)
- Motor Gasoline: 830,400 Mbarrels (28% total U.S.)
- Distillate Fuel: 434,600 Mbarrels (32% total U.S.)

**Annual Energy Production**
- Electric Power Generation: 1,187 TWh (29% total U.S.)
  - Coal: 707.2 TWh, 60% [157.1 GW total capacity]
  - Petroleum: 4.9 TWh, <1% [95.8 GW total capacity]
  - Natural Gas: 150.7 TWh, 13% [9.5 GW total capacity]
  - Nuclear: 222.0 TWh, 19% [27.1 GW total capacity]
  - Hydro: 26.2 TWh, 2% [12.8 GW total capacity]
  - Other Renewable: 75.8 TWh, 6% [24.6 GW total capacity]

**Coal:** 232,900 MSTN (23% total U.S.)
**Natural Gas:** 2,850 Bcf (12% total U.S.)
**Crude Oil:** 407,500 Mbarrels (22% total U.S.)
**Ethanol:** 286,500 Mbarrels (91% total U.S.)

**NATURAL HAZARDS OVERVIEW**

**Annual Frequency of Occurrence of Natural Hazards (1996–2014)**

- Flood: 610 events
- Tornadoes: 176 events
- Weather Storm & Extreme Cold: 13 events

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

- Flood: $812.9 million per year
- Tornadoes: $595.9 million per year
- Weather Storm & Extreme Cold: $661.0 million per year

- Data Source: NOAA

According to NOAA, the most common natural hazard in the Midwest Region is Flood, which occurs once every 0.6 days on the average during the months of March to October.

The second-most common natural hazard the region is Tornadoes, which occurs once every 2 days on the average.

As reported by NOAA, the natural hazard in the Midwest Region that caused the greatest overall property loss during 1996 to 2014 is Flood at $995.9 million per year.

The natural hazard with the second-highest property loss in the region is Thunderstorm & Lighting at $962.7 million per year.
Electric Power Plants: 2,006 (30% total U.S.)
- Coal-fired: 274 (49% total U.S.)
- Petroleum-fired: 564 (50% total U.S.)
- Natural Gas-fired: 508 (30% total U.S.)
- Nuclear: 22 (33% total U.S.)
- Hydro-electric: 242 (16% total U.S.)
- Other Renewable: 396 (28% total U.S.)

Transmission Lines:
- High-Voltage (>230 kV): 50,250 Miles
- Low-Voltage (<230 kV): 68,400 Miles
Electric Transmission

- According to NERC, the leading cause of electric transmission outages in the Midwest is **Severe Weather - Thunderstorms**.
- The region experienced **298 electric transmission outages** from 1992 to 2009, affecting a total of **20.1 million** electric customers.
- **Severe Weather - Thunderstorms** 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 Outages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe Weather - Thunderstorm</td>
<td>8,124,939</td>
</tr>
<tr>
<td>Faulty Equipment / Human Error</td>
<td>1,886,444</td>
</tr>
<tr>
<td>Severe Weather - Heat Wave</td>
<td>2,871,437</td>
</tr>
<tr>
<td>Severe Weather - Winter Storm</td>
<td>1,130,798</td>
</tr>
<tr>
<td>Severe Weather - High Winds</td>
<td></td>
</tr>
<tr>
<td>All Other Causes</td>
<td>7,758,837</td>
</tr>
</tbody>
</table>

Data Source: NERC

### Number of NERC-Reported Electric Transmission Outages by Cause (1992–2009)

- **Severe Weather - Thunderstorm**: 80 incidents
- **Faulty Equipment / Human Error**: 90 incidents
- **Severe Weather - Heat Wave**: 14 incidents
- **Severe Weather - Winter Storm**: 15 incidents
- **Severe Weather - High Winds**: 40 incidents
- **All Other Causes**: 59 incidents

### Electric Distribution

#### Electric Utility Reported Power Outages by Month (2008–2013)

- Between 2008 and 2013, the greatest number of electric outages has occurred during the month of **June** in the Midwest Region.
- The leading cause of electric outages during 2008 to 2013 was **Weather/Falling Trees**.
- On average, the number of people affected annually by electric outages during 2008 to 2013 was **5.2 million**.
- The average duration of electric outages in the region during 2008 to 2013 was **53,880 minutes or 898 hours a year**.


- **Animal**: 1,741 incidents
- **Faulty Equipment / Human Error**: 1,273 incidents
- **Overload**: 414 incidents
- **Planned**: 241 incidents
- **Theft / Vandalism**: 38 incidents
- **Unknown**: 366 incidents
- **Vehicle Accident**: 775 incidents
- **Weather / Falling Trees**: 5 incidents

Data Source: Eaton

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

### Utility Outage Data (2008–2013)

- **Total number of people affected by outages**:
  - 2007: 5,177,654
  - 2008: 5,584,966
  - 2009: 5,861,062
  - 2010: 8,293,675
  - 2011: 5,382,359
  - 2012: 626,889

- **Total duration of outages (minutes)**:
  - 2007: 147,013
  - 2008: 45,352
  - 2009: 54,896
  - 2010: 36,146
  - 2011: 21,891
  - 2012: 22,963

Produced by Department of Energy (DOE), Office of Electricity Delivery & Energy Reliability (OE)
PETROLEUM

Petroleum Infrastructure Overview
Refineries: 27 (19% total U.S.)
Terminals: 601 (31% total U.S.)
Crude Pipelines: 19,525 Miles (40% total U.S.)
Product Pipelines: 152,160 Miles (25% total U.S.)
Bio-Refineries (Ethanol): 173 (85% 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 during 1986 to 2014 was Incorrect Operation for rail transport and Miscellaneous/Unknown for truck transport, with an average 22.3 and 129.8 incidents per year, respectively.

Petroleum Refinery

The leading cause of petroleum refinery disruptions in the Midwest Region from 2003 to 2014 was Maintenance/Turnaround. The region’s petroleum refineries experienced 1,273 major incidents from 2003 to 2014. The weighted average production impact from all disruptions at the refineries within the region from 2003 to 2014 is 310 thousand barrels per day.


Data Source: DOE OE
NATURAL GAS

Natural Gas Infrastructure Overview
Gas Wells: 127,985 (26% total U.S.)
Processing Plants: 107 (21% total U.S.)
Storage Fields: 197 (45% total U.S.)
Interstate Pipelines: 164,700 Miles (33% total U.S.)
Local Distribution Companies: 770 (45% total U.S.)
Natural Gas Transport

The leading event type affecting natural gas transmission and distribution pipelines in the Midwest Region during 1986 to 2014 was Outside Force for Transmission Pipelines and Outside Force for Distribution Pipelines, with an average 4.9 and 15.45 incidents per year, respectively.

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

Natural Gas Processing

According to data derived from DOE’s Energy Assurance Daily, the leading cause of natural gas processing plant disruptions in the Midwest region from 2005 to 2014 is Fire and/or Explosion.

The region’s natural gas processing plants experienced 3 disruptions from 2005 to 2014.

The weighted average production impact from all disruptions at the natural gas processing plants within the region from 2005 to 2014 is 100 million cubic feet per day (MMcfd).

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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