State of Kansas
ENERGY SECTOR RISK PROFILE

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

KANSAS STATE FACTS

<table>
<thead>
<tr>
<th>State Overview</th>
<th>Annual Energy Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population: 2.89 million (1% total U.S.)</td>
<td>Electric Power Generation: 44.4 TWh (1% total U.S.)</td>
</tr>
<tr>
<td>Housing Units: 1.24 million (1% total U.S.)</td>
<td>Coal: 28 TWh, 63% [5.5 GW total capacity]</td>
</tr>
<tr>
<td>Business Establishments: 0.07 million (1% total U.S.)</td>
<td>Petroleum: 0.03 TWh, &lt;1% [0.6 GW total capacity]</td>
</tr>
<tr>
<td>Annual Energy Consumption</td>
<td>Natural Gas: 2.9 TWh, 6% [5 GW total capacity]</td>
</tr>
<tr>
<td>Electric Power: 40.3 TWh (1% total U.S.)</td>
<td>Nuclear: 8.3 TWh, 19% [1.3 GW total capacity]</td>
</tr>
<tr>
<td>Coal: 17,800 MSTN (2% total U.S.)</td>
<td>Hydros: 0.01 TWh, &lt;1% [0.007 GW total capacity]</td>
</tr>
<tr>
<td>Natural Gas: 223 Bcf (1% total U.S.)</td>
<td>Other Renewable: 5.2 TWh, 12% [2.7 GW total capacity]</td>
</tr>
<tr>
<td>Motor Gasoline: 35,500 Mbarrels (1% total U.S.)</td>
<td>Coal: 0 MSTN (0% total U.S.)</td>
</tr>
<tr>
<td>Distillate Fuel: 19,800 Mbarrels (1% total U.S.)</td>
<td>Natural Gas: 300 Bcf (1% total U.S.)</td>
</tr>
<tr>
<td>Natural Gas: 300 Bcf (1% total U.S.)</td>
<td>Crude Oil: 43,700 Mbarrels (2% total U.S.)</td>
</tr>
<tr>
<td>Motor Gasoline: 35,500 Mbarrels (1% total U.S.)</td>
<td>Ethanol: 10,100 Mbarrels (3% total U.S.)</td>
</tr>
</tbody>
</table>

NATURAL HAZARDS OVERVIEW

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

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

- According to NOAA, the most common natural hazard in Kansas is Thunderstorm & Lightning, which occurs once every 2.1 days on the average during the months of March to October.
- The second-most common natural hazard in Kansas is Flood, which occurs once every 7.2 days on the average.
- As reported by NOAA, the natural hazard in Kansas that caused the greatest overall property loss during 1996 to 2014 is Tornado at $42.4 million per year.
- The natural hazard with the second-highest property loss in Kansas is Thunderstorm & Lightning at $39.3 million per year.
Electric Power Plants: 147 (1% total U.S.)
- Coal-fired: 8 (1% total U.S.)
- Petroleum-fired: 51 (2% total U.S.)
- Natural Gas-fired: 67 (2% total U.S.)
- Nuclear: 1 (1% total U.S.)
- Hydro-electric: 1 (<1% total U.S.)
- Other Renewable: 19 (1% total U.S.)

Transmission Lines:
- High-Voltage (>230 kV): 1,666 Miles
- Low-Voltage (<230 kV): 3,166 Miles
Electric Transmission

- According to NERC, the leading cause of electric transmission outages in Kansas is Faulty Equipment/Human Error.
- Kansas experienced 14 electric transmission outages from 1992 to 2009, affecting a total of 473,087 electric customers.
- Severe Weather - Thunderstorm affected the largest number of electric customers as a result of electric transmission outages.


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

Electric Distribution

- Between 2008 and 2013, the greatest number of electric outages in Kansas has occurred during the month of August.
- The leading cause of electric outages in Kansas during 2008 to 2013 was Weather/Falling Trees.
- On average, the number of people affected annually by electric outages during 2008 to 2013 in Kansas was 72,415.
- The average duration of electric outages in Kansas during 2008 to 2013 was 852 minutes or 14.2 hours a year.

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

**Petroleum Infrastructure Overview**

- Refineries: 3 (2% total U.S.)
- Terminals: 49 (3% total U.S.)
- Crude Pipelines: 2,672 Miles (6% total U.S.)
- Product Pipelines: 18,480 Miles (3% total U.S.)
- Bio-Refineries (Ethanol): 12 (6% total U.S.)

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**Petroleum Terminals**

- **Storage Capacity (Thousand Barrels):**
  - 50 - 250
  - 251 - 750
  - 751 - 1,500
  - 1,501 - 3,000
  - 3,001 - 6,500+

**Data Sources:** ACE 2012; ANL 2013; EIA 2014; ESRI 2012; NPMS 2011.
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 Kansas during 1986 to 2014 was Incorrect Operation for rail transport and Miscellaneous/Unknown for truck transport, with an average 1.5 and 8.7 incidents per year, respectively.

Petroleum Refinery

- The leading cause of petroleum refinery disruptions in Kansas from 2003 to 2014 was Maintenance/Turnaround. Kansas’ petroleum refineries experienced 133 major incidents from 2003 to 2014. The average production impact from disruptions of Kansas’ refineries from 2003 to 2014 is 24.2 thousand barrels per day.


- Average Production Impact (thousand barrels per day) from Petroleum Refinery Outages in Kansas (2003–2014)
NATURAL GAS

Natural Gas Infrastructure Overview
Gas Wells: 24,844 (5% total U.S.)
Processing Plants: 7 (1% total U.S.)
Storage Fields: 19 (4% total U.S.)
Interstate Pipelines: 15,120 Miles (3% total U.S.)
Local Distribution Companies: 83 (5% total U.S.)
Natural Gas Transport

The leading event type affecting natural gas transmission and distribution pipelines in Kansas during 1986 to 2014 was **Corrosion** for Transmission Pipelines and **Outside Force** for Distribution Pipelines, with an average 0.81 (or one incident every 1.2 years) and 1.06 incidents per year, respectively.

Top Events Affecting Natural Gas Transmission and Distribution in Kansas (1986-2014)

<table>
<thead>
<tr>
<th>Event Type</th>
<th>Transmission</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic Loss</td>
<td>$2,824k</td>
<td>$3,584k</td>
</tr>
<tr>
<td>Corrosion</td>
<td>$2,282k</td>
<td>$3,358k</td>
</tr>
<tr>
<td>Equipment Failure</td>
<td>$104k</td>
<td>$358k</td>
</tr>
<tr>
<td>Excavation Damage</td>
<td>$224k</td>
<td>$2,401k</td>
</tr>
<tr>
<td>Incorrect Operation</td>
<td>$122k</td>
<td>$2,222k</td>
</tr>
<tr>
<td>Material / Weld Failures</td>
<td>$0</td>
<td>$399k</td>
</tr>
<tr>
<td>Miscellaneous / Unknown</td>
<td>$122k</td>
<td>$3,984k</td>
</tr>
<tr>
<td>Natural Forces</td>
<td>$234k</td>
<td>$454k</td>
</tr>
<tr>
<td>Outside Force</td>
<td>$234k</td>
<td>$454k</td>
</tr>
</tbody>
</table>

**Frequency**

<table>
<thead>
<tr>
<th>Event Type</th>
<th>Transmission</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrosion</td>
<td>0.16</td>
<td>0.32</td>
</tr>
<tr>
<td>Equipment Failure</td>
<td>0.00</td>
<td>0.13</td>
</tr>
<tr>
<td>Excavation Damage</td>
<td>0.16</td>
<td>0.26</td>
</tr>
<tr>
<td>Incorrect Operation</td>
<td>0.06</td>
<td>0.55</td>
</tr>
<tr>
<td>Material / Weld Failures</td>
<td>0.00</td>
<td>0.13</td>
</tr>
<tr>
<td>Miscellaneous / Unknown</td>
<td>0.10</td>
<td>0.58</td>
</tr>
<tr>
<td>Natural Forces</td>
<td>0.13</td>
<td>0.65</td>
</tr>
<tr>
<td>Outside Force</td>
<td>0.13</td>
<td>1.06</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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