State of Tennessee
ENERGY SECTOR RISK PROFILE

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

TENNESSEE STATE FACTS

State Overview
Population: 6.50 million (2% total U.S.)
Housing Units: 2.84 million (2% total U.S.)
Business Establishments: 0.13 million (2% total U.S.)

Annual Energy Consumption
Electric Power: 96.4 TWh (3% total U.S.)
Coal: 19,900 MSTN (2% total U.S.)
Natural Gas: 267 Bcf (1% total U.S.)
Motor Gasoline: 70,800 Mbarrels (2% total U.S.)
Distillate Fuel: 28,900 Mbarrels (2% total U.S.)

Annual Energy Production
Electric Power Generation: 77.7 TWh (2% total U.S.)
Coal: 35.4 TWh, 46% [9.6 GW total capacity]
Petroleum: 0.1 TWh, <1% [0.1 GW total capacity]
Natural Gas: 8.1 TWh, 10% [6.4 GW total capacity]
Nuclear: 25.1 TWh, 32% [3.7 GW total capacity]
Hydro: 8.1 TWh, 10% [4.2 GW total capacity]
Other Renewable: 0 TWh, <1% [0.2 GW total capacity]

TENNESSEE NATURAL HAZARDS OVERVIEW

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

- according to NOAA, the most common natural hazard in Tennessee is Thunderstorm & Lightning, which occurs once every 3 days on the average during the months of March to October.
- The second-most common natural hazard in Tennessee is Flood, which occurs once every 10.2 days on the average.

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

- As reported by NOAA, the natural hazard in Tennessee that caused the greatest overall property loss during 1996 to 2014 is Tornado at $48.2 million per year.
- The natural hazard with the second-highest property loss in Tennessee is Flood at $45.3 million per year.
Electric Power Plants: 63 (<1% total U.S.)
- Coal-fired: 10 (1% total U.S.)
- Petroleum-fired: 3 (<1% total U.S.)
- Natural Gas-fired: 11 (<1% total U.S.)
- Nuclear: 2 (2% total U.S.)
- Hydro-electric: 29 (1% total U.S.)
- Other Renewable: 8 (<1% total U.S.)

Transmission Lines:
- High-Voltage (>230 kV): 141 Miles
- Low-Voltage (<230 kV): 7 Miles
Electric Transmission

- According to NERC, the leading cause of electric transmission outages in Tennessee is Faulty Equipment/Human Error.
- Tennessee experienced 10 electric transmission outages from 1992 to 2009, affecting a total of 491,410 electric customers.
- Severe Weather - Winter Storm 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)

- Faulty Equipment / Human Error: 242,000
- Severe Weather - Thunderstorm: 136,000
- Severe Weather - Winter Storm: 63,410
- Severe Weather - Lightning: 50,000
- Natural Disaster - Tornado: 0
- All Other Causes: 0

Data Source: NERC

Electric Distribution

- Between 2008 and 2013, the greatest number of electric outages in Tennessee has occurred during the month of April.
- The leading cause of electric outages in Tennessee during 2008 to 2013 was Weather/Falling Trees.
- On average, the number of people affected annually by electric outages during 2008 to 2013 in Tennessee was 240,112.
- The average duration of electric outages in Tennessee during 2008 to 2013 was 3,240 minutes or 54.0 hours a year.


- Total number of people affected by outages:
  - Animal: 37
  - Faulty Equipment / Human Error: 115
  - Overdemand: 33
  - Planned: 33
  - Theft / Vandalism: 2
  - Unknown: 14
  - Vehicle Accident: 0
  - Weather / Falling Trees: 37
  - Total number of incidents: 37

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: 1 (1% total U.S.)
- Terminals: 47 (2% total U.S.)
- Crude Pipelines: 249 Miles (1% total U.S.)
- Product Pipelines: 3,360 Miles (1% total U.S.)
- Bio-Refineries (Ethanol): 2 (1% 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 Tennessee during 1986 to 2014 was Incorrect Operation for rail transport and Miscellaneous/Unknown for truck transport, with an average 2.1 and 6.5 incidents per year, respectively.

Top Events Affecting Crude Oil and Refined Product Pipelines in Tennessee (1986–2014)

- The leading event type affecting crude oil pipeline and petroleum product pipelines in Tennessee during 1986 to 2014 was Material/Weld Failure for crude oil pipelines and Outside Force for product pipelines, with an average 0.1 and 0.24 incidents per year (or one incident every 9.7 and 4.1 years), respectively.

Petroleum Refinery

- The leading cause of petroleum refinery disruptions in Tennessee from 2003 to 2014 was Maintenance/Turnaround. Tennessee's petroleum refineries experienced 58 major incidents from 2003 to 2014. The average production impact from disruptions of Tennessee's refineries from 2003 to 2014 is 57.9 thousand barrels per day.
NATURAL GAS

Natural Gas Infrastructure Overview
Gas Wells: 237 (<1% total U.S.)
Processing Plants: 1 (<1% total U.S.)
Storage Fields: 1 (<1% total U.S.)
Interstate Pipelines: 5,520 Miles (1% total U.S.)
Local Distribution Companies: 105 (6% total U.S.)
Natural Gas Transport

The leading event type affecting natural gas transmission and distribution pipelines in Tennessee during 1986 to 2014 was Outside Force for Transmission Pipelines and Outside Force for Distribution Pipelines, with an average 0.23 and 0.84 incidents per year (or one incident every 4.4 and 1.2 years), respectively.


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.

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