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

TEXAS STATE FACTS

<table>
<thead>
<tr>
<th>State Overview</th>
<th>Annual Energy Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population: 26.45 million (8% total U.S.)</td>
<td>Electric Power Generation: 429.8 TWh (11% total U.S.)</td>
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<tr>
<td>Housing Units: 10.26 million (8% total U.S.)</td>
<td>Coal: 138.1 TWh, 32% [24.4 GW total capacity]</td>
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<tr>
<td>Business Establishments: 0.54 million (7% total U.S.)</td>
<td>Petroleum: 1.5 TWh, &lt;1% [0.6 GW total capacity]</td>
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<tr>
<td>Electric Power: 365.1 TWh (10% total U.S.)</td>
<td>Natural Gas: 213.9 TWh, 50% [75.1 GW total capacity]</td>
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<tr>
<td>Coal: 98,300 MSTN (11% total U.S.)</td>
<td>Nuclear: 38.4 TWh, 9% [5.1GW total capacity]</td>
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<tr>
<td>Natural Gas: 3,377 Bcf (14% total U.S.)</td>
<td>Hydro: 0.6 TWh, &lt;1% [0.7 GW total capacity]</td>
</tr>
<tr>
<td>Motor Gasoline: 303,100 Mbarrels (10% total U.S.)</td>
<td>Other Renewable: 32.2 TWh, 7% [12.6 GW total capacity]</td>
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<tr>
<td>Distillate Fuel: 164,500 Mbarrels (12% total U.S.)</td>
<td>Coal: 44,200 MSTN (4% total U.S.)</td>
</tr>
<tr>
<td>Natural Gas: 7,480 Bcf (30% total U.S.)</td>
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<tr>
<td>Crude Oil: 725,800 Mbarrels (31% total U.S.)</td>
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<tr>
<td>Ethanol: 8,100 Mbarrels (3% total U.S.)</td>
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NATURAL HAZARDS OVERVIEW

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

- According to NOAA, the most common natural hazard in Texas is Thunderstorm & Lightning, which occurs once every 1.3 days on the average during the months of March to October.
- The second-most common natural hazard in Texas is Flood, which occurs once every 3.7 days on the average.

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

- As reported by NOAA, the natural hazard in Texas that caused the greatest overall property loss during 1996 to 2014 is Drought at $424.7 million per year.
- The natural hazard with the second-highest property loss in Texas is Thunderstorm & Lightning at $212.5 million per year.
Electric Power Plants: 340 (3% total U.S.)
- Coal-fired: 20 (2% total U.S.)
- Petroleum-fired: 17 (1% total U.S.)
- Natural Gas-fired: 162 (5% total U.S.)
- Nuclear: 2 (2% total U.S.)
- Hydro-electric: 25 (1% total U.S.)
- Other Renewable: 114 (4% total U.S.)

Transmission Lines:
- High-Voltage (>230 kV): 15,225 Miles
- Low-Voltage (<230 kV): 10,629 Miles
**Electric Transmission**

- According to NERC, the leading cause of electric transmission outages in Texas is Faulty Equipment/Human Error.
- Texas experienced 76 electric transmission outages from 1992 to 2009, affecting a total of 8,863,707 electric customers.
- Severe Weather - Thunderstorm 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)](image)

Data Source: NERC

**Electric Distribution**

- Between 2008 and 2013, the greatest number of electric outages in Texas has occurred during the month of June.
- The leading cause of electric outages in Texas during 2008 to 2013 was Weather/Falling Trees.
- On average, the number of people affected annually by electric outages during 2008 to 2013 in Texas was 1,328,232.
- The average duration of electric outages in Texas during 2008 to 2013 was 8,363 minutes or 139.4 hours a year.

![Electric-Utility Reported Power Outages by Month (2008–2013)](image)

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: 26 (18% total U.S.)
Terminals: 206 (11% total U.S.)
Crude Pipelines: 12,054 Miles (25% total U.S.)
Product Pipelines: 197,640 Miles (32% total U.S.)
Bio-Refineries (Ethanol): 4 (2% 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 Texas during 1986 to 2014 was Incorrect Operation for rail transport and Incorrect Operation for truck transport, with an average 8.7 and 20.6 incidents per year, respectively.

Petroleum Refinery

The leading cause of petroleum refinery disruptions in Texas from 2003 to 2014 was Equipment Failure or Damage. Texas’s petroleum refineries experienced 3,261 major incidents from 2003 to 2014. The average production impact from disruptions of Texas’s refineries from 2003 to 2014 is 25.5 thousand barrels per day.


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

Natural Gas Infrastructure Overview
Gas Wells: 97,618 (20% total U.S.)
Processing Plants: 164 (32% total U.S.)
Storage Fields: 37 (8% total U.S.)
Interstate Pipelines: 81,000 Miles (16% total U.S.)
Local Distribution Companies: 113 (7% total U.S.)
Natural Gas Transport

- The leading event type affecting natural gas transmission and distribution pipelines in Texas during 1986 to 2014 was Corrosion for Transmission Pipelines and Outside Force for Distribution Pipelines, with an average 7.0 and 10.35 incidents per year, respectively.

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

- Natural Gas Transport

  ![Economic Loss and Frequency Graph]

  **Economic Loss**
  - Corrosion: $5,771,000
  - Equipment Failure: $1,793,000
  - Excavation Damage: $702,000
  - Incorrect Operation: $112,000
  - Material/Weld Failures: $888,000
  - Miscellaneous/Unknown: $2,394,000
  - Natural Forces: $479,000
  - Outside Force: $6,134,000

  **Frequency**
  - Transmission: 7.00
  - Distribution: 10.35

Natural Gas Processing

- According to data derived from DOE’s Energy Assurance Daily, the leading cause of natural gas processing plant disruptions in Texas from 2005 to 2014 is Operational Upset or Process Problem.
- Texas’s natural gas processing plants experienced 1,294 disruptions from 2005 to 2014.
- The average production impact from disruptions of Texas’s natural gas processing plants from 2005 to 2014 is 135 million cubic feet per day (MMcfd).


- Operational Upset or Process Problem: 251 incidents
- Equipment Failure or Damage: 156 incidents
- Loss of Electric Power or Other Utility Service: 49 incidents
- Weather or Natural Disaster: 132 incidents
- All Other Causes: 706 incidents

<table>
<thead>
<tr>
<th>No. of Incidents</th>
<th>Operational Upset or Process Problem</th>
<th>Equipment Failure or Damage</th>
<th>Loss of Electric Power or Other Utility Service</th>
<th>Weather or Natural Disaster</th>
<th>All Other Causes</th>
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<tbody>
<tr>
<td>251</td>
<td>130</td>
<td>138</td>
<td>115</td>
<td>219</td>
<td>15</td>
</tr>
</tbody>
</table>

Average Production Impact (MMcfd) from Natural Gas Processing Plant Disruptions in Texas (2005–2014)

- Operational Upset or Process Problem: 130 MMcfd
- Equipment Failure or Damage: 138 MMcfd
- Loss of Electric Power or Other Utility Service: 115 MMcfd
- Weather or Natural Disaster: 219 MMcfd
- All Other Causes: 15 MMcfd

Data Source: DOE OE
DATA SOURCES

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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