State of North Carolina
ENERGY SECTOR RISK PROFILE

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

NORTH CAROLINA STATE FACTS

<table>
<thead>
<tr>
<th>State Overview</th>
<th>Annual Energy Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population: 9.85 million (3% total U.S.)</td>
<td>Electric Power Generation: 116.7 TWh (3% total U.S.)</td>
</tr>
<tr>
<td>Housing Units: 4.39 million (3% total U.S.)</td>
<td>Coal: 50.9 TWh, 44% [12.4 GW total capacity]</td>
</tr>
<tr>
<td>Business Establishments: 0.22 million (3% total U.S.)</td>
<td>Petroleum: 0.2 TWh, &lt;1% [0.6 GW total capacity]</td>
</tr>
<tr>
<td>Annual Energy Consumption</td>
<td>Natural Gas: 19.3 TWh, 17% [12.1 GW total capacity]</td>
</tr>
<tr>
<td>Electric Power: 128.1 TWh (3% total U.S.)</td>
<td>Nuclear: 39.4 TWh, 34% [5.4 GW total capacity]</td>
</tr>
<tr>
<td>Coal: 21,500 MSTN (2% total U.S.)</td>
<td>Hydro: 3.7 TWh, 3% [2 GW total capacity]</td>
</tr>
<tr>
<td>Natural Gas: 151 Bcf (1% total U.S.)</td>
<td>Other Renewable: 0 TWh, 0% [0.7 GW total capacity]</td>
</tr>
<tr>
<td>Motor Gasoline: 95,100 Mbarrels (3% total U.S.)</td>
<td>Coal: 0 MSTN (0% total U.S.)</td>
</tr>
<tr>
<td>Distillate Fuel: 28,200 Mbarrels (2% total U.S.)</td>
<td>Natural Gas: 0 Bcf (0% total U.S.)</td>
</tr>
<tr>
<td>Annualized Property Loss due to Natural Hazards in North Carolina (1996–2014)</td>
<td></td>
</tr>
</tbody>
</table>

NATURAL HAZARDS OVERVIEW

- According to NOAA, the most common natural hazard in North Carolina is Thunderstorm & Lightning, which occurs once every 2.4 days on the average during the months of March to October.
- The second-most common natural hazard in North Carolina is Flood, which occurs once every 7.6 days on the average.
- As reported by NOAA, the natural hazard in North Carolina that caused the greatest overall property loss during 1996 to 2014 is Hurricane at $152.2 million per year.
- The natural hazard with the second-highest property loss in North Carolina is Tornado at $34.4 million per year.
**Electric Power Plants**: 174 (1% total U.S.)
- Coal-fired: 19 (2% total U.S.)
- Petroleum-fired: 48 (2% total U.S.)
- Natural Gas-fired: 16 (<1% total U.S.)
- Nuclear: 3 (2% total U.S.)
- Hydro-electric: 42 (1% total U.S.)
- Other Renewable: 46 (2% total U.S.)

**Transmission Lines**:
- High-Voltage (>230 kV): 3,469 Miles
- Low-Voltage (<230 kV): 3,236 Miles
Electric Transmission

- According to NERC, the leading cause of electric transmission outages in North Carolina is **Severe Weather - Thunderstorm**.
- North Carolina experienced **47 electric transmission outages** from 1992 to 2009, affecting a total of **6,251,975 electric customers**.
- **Natural Disaster - Hurricane/Tropical Storm** 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>2,142,000</td>
</tr>
<tr>
<td>Natural Disaster - Hurricane/Tropical Storm</td>
<td>1,795,000</td>
</tr>
<tr>
<td>Faulty Equipment / Human Error</td>
<td>1,280,500</td>
</tr>
<tr>
<td>Severe Weather - Winter Storm</td>
<td>766,977</td>
</tr>
<tr>
<td>Severe Weather - Ice Storm</td>
<td>14,898</td>
</tr>
<tr>
<td>All Other Causes</td>
<td>250,601</td>
</tr>
</tbody>
</table>

Data Source: NERC

### Electric Distribution

- Between 2008 and 2013, the greatest number of electric outages in North Carolina has occurred during the month of **July**.
- The leading cause of electric outages in North Carolina during 2008 to 2013 was **Weather/Falling Trees**.
- On average, the number of people affected annually by electric outages during 2008 to 2013 in North Carolina was **484,300**.
- The average duration of electric outages in North Carolina during 2008 to 2013 was **3,230 minutes or 53.8 hours a year**.

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

- **Animal**: 185
- **Faulty Equipment / Human Error**: 106
- **Overdemand**: 60
- **Planned**: 56
- **Theft / Vandalism**: 10
- **Unknown**: 30
- **Vehicle Accident**: 36
- **Weather / Falling Trees**: 5

### Utility Outage Data (2008–2013)

- Total number of people affected by outages
- Total duration of outages [minutes]

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

**Petroleum Infrastructure Overview**
- Refineries: 0 (0% total U.S.)
- Terminals: 51 (3% total U.S.)
- Crude Pipelines: 0 Miles (0% total U.S.)
- Product Pipelines: 1,440 Miles (<1% total U.S.)
- Bio-Refineries (Ethanol): 1 (<1% total U.S.)

*Data Sources: ACE 2012; ANL 2013; EIA 2014; ESRI 2012; NPMS 2011.*
Petroleum Transport

The leading event type affecting the transport of petroleum product by rail and truck in North Carolina during 1986 to 2014 was Incorrect Operation for rail transport and Miscellaneous/Unknown for truck transport, with an average 1.2 and 10.2 incidents per year, respectively.

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

The leading event type affecting petroleum product pipelines in North Carolina during 1986 to 2014 was Miscellaneous/Unknown, with an average 0.48 incidents per year (or one incident every 2.1 years). There are no crude oil pipelines in the State of North Carolina.

Top Events Affecting Crude Oil and Refined Product Pipelines in North Carolina (1986–2014)
NATURAL GAS

Natural Gas Infrastructure Overview
Gas Wells: 0 (0% total U.S.)
Processing Plants: 0 (0% total U.S.)
Storage Fields: 1 (<1% total U.S.)
Interstate Pipelines: 3,120 Miles (1% total U.S.)
Local Distribution Companies: 23 (1% total U.S.)
Natural Gas Transport

The leading event type affecting natural gas transmission and distribution pipelines in North Carolina during 1986 to 2014 was **Excavation Damage** for Transmission Pipelines and **Outside Force** for Distribution Pipelines, with an average 0.23 and 0.77 incidents per year (or one incident every 4.4 and 1.3 years), respectively.

**Top Events Affecting Natural Gas Transmission and Distribution in North Carolina (1986-2014)**

<table>
<thead>
<tr>
<th>Event Type</th>
<th>Economic Loss</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrosion</td>
<td>$0</td>
<td>0.00</td>
</tr>
<tr>
<td>Equipment Failure</td>
<td>$0</td>
<td>0.00</td>
</tr>
<tr>
<td>Excavation Damage</td>
<td>$32</td>
<td>0.13</td>
</tr>
<tr>
<td>Incorrect Operation</td>
<td>$33</td>
<td>0.16</td>
</tr>
<tr>
<td>Material / Weld Failures</td>
<td>$0</td>
<td>0.00</td>
</tr>
<tr>
<td>Miscellaneous / Unknown</td>
<td>$77</td>
<td>0.39</td>
</tr>
<tr>
<td>Natural Forces</td>
<td>$12</td>
<td>0.03</td>
</tr>
<tr>
<td>Outside Force</td>
<td>$106</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Annual Loss ($ Thousands per Year)

Data Source: DOT PHMSA
DATA SOURCES

Overview Information

› NOAA (2014) Storms Events Database [www.ncdc.noaa.gov/data-access/severe-weather]
› Census Bureau (2012) State and County QuickFacts [http://quickfacts.census.gov/qfd/download_data.html]

Production Numbers

› EIA (2013) Natural Gas Gross Withdrawals and Production [http://www.eia.gov/dnav/ng/ng_prod_sum_a_EPG0_VGM_mmcf_a.htm]

Consumption Numbers

› EIA (2013) Prime Supplier Sales Volumes [http://www.eia.gov/dnav/pet/pet_cons_prim_dcu_nus_m.htm]
› EIA (2012) Adjusted Sales of Fuel Oil and Kerosene [http://www.eia.gov/petroleum/data.cfm#consumption]

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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Bcf – Billion Cubic Feet
GW – Gigawatt
KV – Kilovolt
Mbarrels – Thousand Barrels
Mpdb – Thousand Barrels per Day
MMcfd – Million Cubic Feet per Day
MSTN – Thousand Short Tons
TWh – Terawatt hours