State of Colorado
ENERGY SECTOR RISK PROFILE

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

COLORADO STATE FACTS

<table>
<thead>
<tr>
<th>State Overview</th>
<th>Annual Energy Production</th>
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</thead>
<tbody>
<tr>
<td>Population: 5.27 million (2% total U.S.)</td>
<td>Electric Power Generation: 52.6 TWh (1% total U.S.)</td>
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<tr>
<td>Housing Units: 2.25 million (2% total U.S.)</td>
<td>Coal: 34.5 TWh, 66% [5.9 GW total capacity]</td>
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<td>Business Establishments: 0.15 million (2% total U.S.)</td>
<td>Petroleum: 0 TWh, &lt;1% [0.2 GW total capacity]</td>
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<tr>
<td>Annual Energy Consumption</td>
<td>Natural Gas: 10.5 TWh, 20% [6.9 GW total capacity]</td>
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<tr>
<td>Electric Power: 53.7 TWh (1% total U.S.)</td>
<td>Nuclear: 0 TWh, 0% [0 GW total capacity]</td>
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<tr>
<td>Coal: 19,500 MSTN (2% total U.S.)</td>
<td>Distillate Fuel: 1.3 TWh, 2% [1.1 GW total capacity]</td>
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<tr>
<td>Natural Gas: 327 Bcf (1% total U.S.)</td>
<td>Other Renewable: 6 TWh, 11% [2.4 GW total capacity]</td>
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<tr>
<td>Motor Gasoline: 49,700 Mbarrels (2% total U.S.)</td>
<td>Coal: 28,600 MSTN (3% total U.S.)</td>
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<tr>
<td>Distillate Fuel: 19,100 Mbarrels (1% total U.S.)</td>
<td>Natural Gas: 1,710 Bcf (7% total U.S.)</td>
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NATURAL HAZARDS OVERVIEW

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

- According to NOAA, the most common natural hazard in Colorado is Thunderstorm & Lightning, which occurs once every 2.6 days on the average during the months of March to October.

- The second-most common natural hazard in Colorado is Winter Storm & Extreme Cold, which occurs once every 3.5 days on the average during the months of October to March.

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

- As reported by NOAA, the natural hazard in Colorado that caused the greatest overall property loss during 1996 to 2014 is Thunderstorm & Lightning at $65.6 million per year.

- The natural hazard with the second-highest property loss in Colorado is Wildfire at $51.2 million per year.
ELECTRIC

Electric Power Plants: 141 (1% total U.S.)
- Coal-fired: 16 (1% total U.S.)
- Petroleum-fired: 17 (1% total U.S.)
- Natural Gas-fired: 33 (1% total U.S.)
- Nuclear: 0 (0% total U.S.)
- Hydro-electric: 40 (1% total U.S.)
- Other Renewable: 35 (1% total U.S.)

Transmission Lines:
- High-Voltage (>230 kV): 268 Miles
- Low-Voltage (<230 kV): 914 Miles

Power Plants

Transmission Lines

Data Sources:
- ANL 2013; ESRI 2012;
- EIA 2014; Platts 2014.
## Electric Transmission

- According to NERC, the leading cause of electric transmission outages in Colorado is **Faulty Equipment/Human Error**.
- Colorado experienced **22 electric transmission outages** from 1992 to 2009, affecting a total of **1,558,545** electric customers.
- **Transmission Line Faults and Overloads** 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)

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

- **Faulty Equipment / Human Error**: 8
- **Transmission Line Faults and Overloads**: 4
- **Fuel Supply Deficiency**: 2
- **Unknown Cause**: 2
- **Severe Weather - Lightning**: 2
- **All Other Causes**: 2

Data Source: NERC

## Electric Distribution

- **Between 2008 and 2013**, the greatest number of electric outages in Colorado has occurred during the month of **October**.
- The leading cause of electric outages in Colorado during 2008 to 2013 was **Faulty Equipment/Human Error**.
- On average, the number of people affected annually by electric outages during 2008 to 2013 in Colorado was **217,015**.
- The average duration of electric outages in Colorado during 2008 to 2013 was **3,285 minutes** or **54.8 hours** a year.

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

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


- **Animal**: 30
- **Faulty Equipment / Human Error**: 27
- **Overdemand**: 104
- **Planned**: 66
- **Theft / Vandalism**: 0
- **Unknown**: 11
- **Vehicle Accident**: 2
- **Weather / Falling Trees**: 0
- **# of Incidents**: 1

Data Source: Eaton

**Utility Outage Data (2008–2013)**

- **Total number of people affected by outages**: 3,285
- **Total duration of outages (minutes)**: 360,780

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: 2 (1% total U.S.)
Terminals: 17 (1% total U.S.)
Crude Pipelines: 489 Miles (1% total U.S.)
Product Pipelines: 16,320 Miles (3% total U.S.)
Bio-Refineries (Ethanol): 4 (2% total U.S.)

Data Sources: ACE 2012; ANL 2013; EIA 2014; ESRI 2012; NIPIS 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 Colorado during 1986 to 2014 was Incorrect Operation for rail transport and Incorrect Operation for truck transport, with an average 1.6 and 9.0 incidents per year, respectively.

Petroleum Refinery

The leading cause of petroleum refinery disruptions in Colorado from 2003 to 2014 was Maintenance/Turnaround. Colorado’s petroleum refineries experienced 17 major incidents from 2003 to 2014. The average production impact from disruptions of Colorado’s refineries from 2003 to 2014 is 28.1 thousand barrels per day.
NATURAL GAS

Natural Gas Infrastructure Overview
Gas Wells: 32,371 (7% total U.S.)
Processing Plants: 43 (8% total U.S.)
Storage Fields: 11 (2% total U.S.)
Interstate Pipelines: 17,760 Miles (4% 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 Colorado during 1986 to 2014 was Miscellaneous/Unknown for Transmission Pipelines and Outside Force for Distribution Pipelines, with an average 0.32 and 0.77 incidents per year (or one incident every 3.1 and 1.3 years), respectively.

Top Events Affecting Natural Gas Transmission and Distribution in Colorado (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 Colorado from 2005 to 2014 is Fire and/or Explosion.
- Colorado’s natural gas processing plants experienced 5 disruptions from 2005 to 2014.
- The average production impact from disruptions of Colorado’s natural gas processing plants from 2005 to 2014 is 610 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_produc_wells_s1_a.htm]
- NPMS (2011) Natural Gas Pipeline (Miles of Interstate Pipeline)
- Platts (2014 Q2) Local Distribution Companies (LDCs)

Event Related


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:
Alice Lippert
Senior Technical Advisor
Office of Electricity Delivery and Energy Reliability
U.S. Department of Energy
email: energyanalysis@hq.doe.gov