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

**CALIFORNIA STATE FACTS**

### State Overview
- Population: 38.33 million (12% total U.S.)
- Housing Units: 13.79 million (10% total U.S.)
- Business Establishments: 0.86 million (12% total U.S.)

### Annual Energy Consumption
- **Electric Power**: 259.5 TWh (7% total U.S.)
- **Coal**: 1,900 MSTN (<1% total U.S.)
- **Natural Gas**: 2,337 Bcf (10% total U.S.)
- **Motor Gasoline**: 337,400 Mbarrels (11% total U.S.)
- **Distillate Fuel**: 87,200 Mbarrels (6% total U.S.)

### Annual Energy Production
- **Electric Power Generation**: 199.5 TWh (5% total U.S.)
  - Coal: 1.4 TWh, <1% [0.4 GW total capacity]
  - Petroleum: 0.3 TWh, <1% [0.5 GW total capacity]
  - Natural Gas: 119.7 TWh, 60% [45.6 GW total capacity]
  - Nuclear: 18.5 TWh, 9% [4.6 GW total capacity]
  - Hydro: 27.4 TWh, 14% [13.5 GW total capacity]
  - Other Renewable: 9.8 TWh, 5% [7.5 GW total capacity]
- **Coal**: 0 MSTN (0% total U.S.)
- **Natural Gas**: 250 Bcf (1% total U.S.)
- **Crude Oil**: 197,200 Mbarrels (8% total U.S.)
- **Ethanol**: 4,200 Mbarrels (1% total U.S.)

**NATURAL HAZARDS OVERVIEW**

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

- Drought: 3
- Earthquake (≥3.5 M): 93
- Event: 8
- Fire: 49
- Hurricane: 0
- Landslide: 2
- Other: 32
- Tornado: 7
- Wildfire: 75

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

- **Drought**: $0.1
- **Earthquake**: $29.1
- **Event**: $19.3
- **Fire**: $72.7
- **Hurricane**: **$0.2**
- **Landslide**: **$6.9**
- **Other**: **$1.8**
- **Tornado**: **$53.3**
- **Wildfire**: **$10.7**
- **Winter Storm & Extreme Cold**: **$164.1**

- **Drought**: **$101.7**

- **Data Source: NOAA**

- According to NOAA, the most common natural hazard in California 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 California is Earthquake (≥3.5 M), which occurs once every 3.9 days on the average.

- As reported by NOAA, the natural hazard in California that caused the greatest overall property loss during 1996 to 2014 is Wildfire at $164.1 million per year.

- The natural hazard with the second-highest property loss in California is Winter Storm & Extreme Cold at $101.7 million per year.
Electric Power Plants: 833 (7% total U.S.)
- Coal-fired: 7 (1% total U.S.)
- Petroleum-fired: 12 (1% total U.S.)
- Natural Gas-fired: 274 (8% total U.S.)
- Nuclear: 2 (2% total U.S.)
- Hydro-electric: 261 (9% total U.S.)
- Other Renewable: 277 (10% total U.S.)

Transmission Lines:
- High-Voltage (>230 kV): 4,428 Miles
- Low-Voltage (<230 kV): 10,320 Miles
Electric Transmission

- According to NERC, the leading cause of electric transmission outages in California is **Faulty Equipment/Human Error**.
- California experienced **118 electric transmission outages** from 1992 to 2009, affecting a total of **19,772,487** electric customers.
- **Transmission Line Faults and Overloads** affected the largest number of electric customers as a result of electric transmission outages.


- Faulty Equipment / Human Error: 4,894,850
- Transmission Line Faults and Overloads: 1,030,646
- Natural Disaster - Wildfire: 3,653,293
- Severe Weather - High Winds: 1,271,894
- Severe Weather - Heat Wave: 2,131,580
- All Other Causes: 6,790,225

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

- Faulty Equipment / Human Error: 40
- Transmission Line Faults and Overloads: 42
- Natural Disaster - Wildfire: 8
- Severe Weather - High Winds: 8
- Severe Weather - Heat Wave: 10
- All Other Causes: 10

**Electric Distribution**

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

- Between 2008 and 2013, the greatest number of electric outages in California has occurred during the month of **December**.
- The leading cause of electric outages in California 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 California was **3,810,855**.
- The average duration of electric outages in California during 2008 to 2013 was **36,025 minutes or 600.4 hours a year**.


- Animal: 540
- Faulty Equipment / Human Error: 163
- Overdemand: 12
- Planned: 236
- Theft / Vandalism: 4
- Unknown: 916
- Vehicle Accident: 116
- Weather / Falling Trees: 447

**Utility Outage Data (2008–2013)**

**NOTE:** # of Incidents – The number within each pie slice is the number of event incidents attributable to each cause.
Petroleum Infrastructure Overview
Refineries: 20 (14% total U.S.)
Terminals: 130 (7% total U.S.)
Crude Pipelines: 3,072 Miles (6% total U.S.)
Product Pipelines: 71,280 Miles (11% total U.S.)
Bio-Refineries (Ethanol): 6 (3% 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 California during 1986 to 2014 was Incorrect Operation for rail transport and Miscellaneous/Unknown for truck transport, with an average 8.2 and 21.8 incidents per year, respectively.

Petroleum Refinery

The leading cause of petroleum refinery disruptions in California from 2003 to 2014 was Operational Upset or Process Problem. California’s petroleum refineries experienced 1,331 major incidents from 2003 to 2014. The average production impact from disruptions of California’s refineries from 2003 to 2014 is 18 thousand barrels per day.
NATURAL GAS

**Natural Gas Infrastructure Overview**

- Gas Wells: 1,346 (<1% total U.S.)
- Processing Plants: 24 (5% total U.S.)
- Storage Fields: 14 (3% total U.S.)
- Interstate Pipelines: 28,080 Miles (6% total U.S.)
- Local Distribution Companies: 12 (1% total U.S.)
Natural Gas Transport

- The leading event type affecting natural gas transmission and distribution pipelines in California during 1986 to 2014 was Excavation Damage for Transmission Pipelines and Outside Force for Distribution Pipelines, with an average 1.29 and 6.19 incidents per year, respectively.

Top Events Affecting Natural Gas Transmission and Distribution in California (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 California from 2005 to 2014 is Fuel Supply Problem.
- California’s natural gas processing plants experienced 1 disruption from 2005 to 2014.
- The average production impact from disruptions of California’s natural gas processing plants from 2005 to 2014 is 350 million cubic feet per day (MMcfd).

Top Cause of Natural Gas Processing Plant Disruptions in California (2005–2014)

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

Data Source: DOE OE

Data Source: DOT PHMSA
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


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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