An Inside Look at Electric Reliability
2016 Electric Reliability Report
Welcome

David Meier
Senior Manager, Stockton Division
Agenda

• Overview of our electric system
• Power outages and interruptions
• System-wide and local reliability statistics
• What we’re doing in your community to improve reliability
• Questions
Energizing California for over 150 years

Provides electric service to 16 million people

Spans our diverse 70,000 square-mile service territory

20,000+ employees

Regulated by the California Public Utilities Commission

Together, Building a Better California
Supporting our community

We serve more than 720,000 customers in San Joaquin, Alpine, Amador and Calaveras counties.

• Employ more than 1,170 residents in the area.
• Property taxes - $24.2 million (fiscal year 2016-2017).
• Franchise Fees - $6.69 million (combined city and county totals for 2016).

PG&E supports our local communities through charitable giving and volunteerism.

• Division employees gave more than 2,250 hours of their time to local non profits.
  • Volunteer hours for Stockton events: 1,323 hours.
• Provided more than $220,000 in grants annually to 48 local organizations.

PG&E presented Stephen Boyle from Tokay High School in Lodi with a Better Together Scholarship in 2016.

Students from Stockton’s Mabel Barron School learn about gas and electric safety at the Energy Training Center.
Public safety

Our highest priority is public safety and we engage our customers with a robust communication process.

Personal notifications include:
- In person conversations
- Door hangers
- Letters
- Phone calls
Delivering safe and reliable electric service

Steven Calvert P.E.
Senior Manager, Electric System Reliability
Our electric system

We are committed to delivering safe, reliable, affordable and clean energy.

- Operates and maintains over **107,000 miles** of distribution lines
- 19,000 miles of interconnected transmission lines focused on clean energy
Our electric system

- **Generation**: Power Generated at 13–25 kV
- **Transmission**: Transmission Line 60, 115, 230 or 500 kV
- **Distribution/Customer**: Distribution Line 4, 12, 17 or 21 kV
  - Home or Business 120–480 Volts
Why are there outages and interruptions?

- Weather
- Vegetation
- Animals
- Equipment failure
- Vehicle accidents
- Digging into underground electric lines
Outage classifications

The company classifies outages according to industry definitions, in the Institute of Electrical and Electronic Engineers (IEEE) standards.

Momentary Outage
An outage less than or equal to 5 minutes in duration.

Sustained Outage
An outage greater than 5 minutes in duration.

Planned Outage
Outages which impact customers and when PG&E has notified the customers in advance.

Major Event
A set of outages which occurred during a specific time and location and which combined, exceeds historically expected outage duration (SAIDI) for at least one day (as defined in IEEE 1366-2012)
What we use to measure reliability:

- SmartMeter data
- Information from customer calls
- Information from PG&E’s automated systems

How we track outages:

- Outages are logged in PG&E’s outage databases
- Some data is stored automatically
- Detailed data is gathered by PG&E’s first responders and field crews

What we do with the data:

- Data is grouped into the metrics—SAIDI, SAIFI, CAIDI, MAIFI—so we can learn more about our reliability and how we can improve
Immediate Response
Restoration crews make repairs and improvements to the electric system due to an outage

Daily Reviews
Previous day outages are reviewed and near-term system improvement projects are identified

Weekly and Monthly Reviews
Trends in electric reliability are reviewed and action items are developed for both near- and long-term system improvement projects

Annual Reviews
Long-term (one year or greater) system improvement projects are identified and planned
Reliability is consistently delivering power to our customers

How we define and measure this

**SAIDI** = Total minutes every customer was without power due to sustained outages

\[ \text{SAIDI} = \frac{\text{Total minutes every customer was without power due to sustained outages}}{\text{Total number of customers}} \]

System average cumulative minutes of sustained power interruptions during the year

**SAIFI** = Number of sustained customer outages experienced by all PG&E customers

\[ \text{SAIFI} = \frac{\text{Number of sustained customer outages experienced by all PG&E customers}}{\text{Total number of customers}} \]

System average number of sustained power interruptions during the year

**CAIDI** = System Average Interruption Duration Index (SAIDI)

\[ \text{CAIDI} = \frac{\text{System Average Interruption Duration Index (SAIDI)}}{\text{System Average Interruption Frequency Index (SAIFI)}} \]

Average duration of each sustained power interruptions during the year

**MAIFI** = Number of customers who experience Momentary Outages

\[ \text{MAIFI} = \frac{\text{Number of customers who experience Momentary Outages}}{\text{Total number of customers}} \]

Average number of momentary power interruptions during the year

* **AIDI** — Average cumulative minutes of sustained power interruptions during the year on a specific circuit.

* **AIFI** — Average number of sustained power interruptions during the year on a specific circuit.
PG&E’s electric system performance

What is PG&E’s system-wide reliability story?

- **Shortest outage duration and second fewest annual outage minutes.**
- **23% reduction** in the annual duration customers experience an outage since 2011 - SAIDI
- **18% reduction** in outage duration since 2011 - CAIDI

How will PG&E continue to improve reliability?

- Infrastructure replacement investments
- Implementation of new smart-grid technology
- Special programs targeting poorly-performing areas
- Continued improvements in emergency preparedness and response to outages

Combined Transmission and Distribution System Indices (2011-2016) - Excludes MED and ISO outages, and includes Planned Outages – see page 6 of annual report
Stockton Division’s performance trends show steadily improving electric reliability.
PG&E’s poorly performing electric circuits in 2016, by the amount of time the average PG&E customer on the circuits listed below experienced a sustained outage (an outage that lasts more than five minutes).

Table 33: AIDI Worst Performing Circuit for 2016

<table>
<thead>
<tr>
<th>#</th>
<th>DIVISION</th>
<th>SUBSTATION</th>
<th>CIRCUIT NAME</th>
<th>TOTAL CUSTOMERS</th>
<th>CIRCUIT MILES</th>
<th>% OH</th>
<th>% UG</th>
<th>3 YR AVG MAINLINE OUTAGES</th>
<th>3 YR AVG AIDI</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>CENTRAL COAST</td>
<td>OTTER</td>
<td>OTTER 1102*</td>
<td>530</td>
<td>66</td>
<td>85%</td>
<td>15%</td>
<td>7.0</td>
<td>1224.11</td>
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<tr>
<td>2</td>
<td>KERN</td>
<td>POSO MOUNTAIN</td>
<td>POSO MOUNTAIN 2101*</td>
<td>146</td>
<td>61</td>
<td>100%</td>
<td>0%</td>
<td>4.7</td>
<td>1078.85</td>
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<td>3</td>
<td>NORTH VALLEY</td>
<td>CHALLENGE</td>
<td>CHALLENGE 1101*</td>
<td>690</td>
<td>51</td>
<td>99%</td>
<td>1%</td>
<td>3.3</td>
<td>1017.29</td>
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<td>HUMBOLDT</td>
<td>HOOPA</td>
<td>HOOPA 1101*</td>
<td>1,985</td>
<td>150</td>
<td>93%</td>
<td>7%</td>
<td>5.7</td>
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<tr>
<td>5</td>
<td>FRESNO</td>
<td>TULARE LAKE</td>
<td>TULARE LAKE 2108*</td>
<td>105</td>
<td>57</td>
<td>99%</td>
<td>1%</td>
<td>4.0</td>
<td>823.53</td>
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<td>RISING RIVER</td>
<td>RISING RIVER 1101*</td>
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<td>785.51</td>
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<td>771.58</td>
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<td>BUCKS CREEK</td>
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<td>1.0</td>
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<td>HUMBOLDT</td>
<td>GARBERVILLE</td>
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<td>157</td>
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<td>5%</td>
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<td>SIERRA</td>
<td>ALLEGHANY</td>
<td>ALLEGHANY 1101*</td>
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<td>81</td>
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<td>2%</td>
<td>4.0</td>
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<td>YOSEMITE</td>
<td>INDIAN FLAT</td>
<td>INDIAN FLAT 1104*</td>
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<td>34</td>
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<td>50%</td>
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<td>692.00</td>
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<td>HUMBOLDT</td>
<td>ORICK</td>
<td>ORICK 1101*</td>
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<td>10</td>
<td>92%</td>
<td>8%</td>
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<td>1%</td>
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<td>100%</td>
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<td>2%</td>
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<td>TRINIDAD 1102</td>
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<td>14%</td>
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<td>54</td>
<td>99%</td>
<td>1%</td>
<td>3.0</td>
<td>380.49</td>
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</table>
PG&E’s poorly performing electric circuits in 2016, by the number of times the average PG&E customer on the circuits listed below experienced a sustained outage (an outage that lasts more than five minutes).

**Table 32: AIFI Worst Performing Circuit for 2016**

<table>
<thead>
<tr>
<th>#</th>
<th>DIVISION</th>
<th>SUBSTATION</th>
<th>CIRCUIT NAME</th>
<th>TOTAL CUSTOMERS</th>
<th>CIRCUIT MILES</th>
<th>% OH</th>
<th>%UG</th>
<th>3 YR AVG MAINLINE OUTAGES</th>
<th>3 YR AVG AIFI</th>
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<td>2%</td>
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<td>4.98</td>
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<td>2</td>
<td>STOCKTON</td>
<td>ALPINE</td>
<td>ALPINE 1102*</td>
<td>309</td>
<td>3</td>
<td>0%</td>
<td>100%</td>
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<td>4.33</td>
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<td>3</td>
<td>CENTRAL COAST</td>
<td>OTTER</td>
<td>OTTER 1102*</td>
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<td>85%</td>
<td>15%</td>
<td>7.0</td>
<td>4.29</td>
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<td>88%</td>
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<td>EL DORADO PH 2101*</td>
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<td>161</td>
<td>99%</td>
<td>1%</td>
<td>12.0</td>
<td>3.61</td>
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<td>157</td>
<td>95%</td>
<td>5%</td>
<td>12.7</td>
<td>3.34</td>
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<td>FRESNO</td>
<td>TULARE LAKE</td>
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<td>57</td>
<td>99%</td>
<td>1%</td>
<td>4.0</td>
<td>3.15</td>
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<td>8</td>
<td>STOCKTON</td>
<td>SALT SPRINGS</td>
<td>SALT SPRINGS 2101</td>
<td>393</td>
<td>45</td>
<td>48%</td>
<td>52%</td>
<td>4.7</td>
<td>3.01</td>
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<td>HUMBOLDT</td>
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<td>TRINIDAD 1102</td>
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<td>14%</td>
<td>5.7</td>
<td>2.98</td>
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<td>10</td>
<td>KERN</td>
<td>LAMONT</td>
<td>LAMONT 1104*</td>
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<td>1%</td>
<td>3.7</td>
<td>2.68</td>
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<td>11</td>
<td>DIABLO</td>
<td>ROSSMOOR</td>
<td>ROSSMOOR 1108*</td>
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<td>52%</td>
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<td>2.67</td>
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<td>CAMP EVERS</td>
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<td>3%</td>
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<td>2.63</td>
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<td>DE ANZA</td>
<td>LOS GATOS</td>
<td>LOS GATOS 1106</td>
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<td>78</td>
<td>97%</td>
<td>3%</td>
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<td>2.62</td>
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<td>14</td>
<td>PENINSULA</td>
<td>HALF MOON BAY</td>
<td>HALF MOON BAY 1101</td>
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<td>17%</td>
<td>5.3</td>
<td>2.58</td>
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<td>YOSEMITE</td>
<td>RIVERBANK</td>
<td>RIVERBANK 1711*</td>
<td>1,454</td>
<td>45</td>
<td>81%</td>
<td>19%</td>
<td>3.7</td>
<td>2.55</td>
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<td>16</td>
<td>CENTRAL COAST</td>
<td>ROB ROY</td>
<td>ROB ROY 2105</td>
<td>7,027</td>
<td>105</td>
<td>74%</td>
<td>26%</td>
<td>6.7</td>
<td>2.54</td>
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<tr>
<td>17</td>
<td>KERN</td>
<td>POSO MOUNTAIN</td>
<td>POSO MOUNTAIN 2101</td>
<td>146</td>
<td>61</td>
<td>100%</td>
<td>0%</td>
<td>4.7</td>
<td>2.52</td>
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<td>18</td>
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<td>EIGHT MILE 2106</td>
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<td>2%</td>
<td>3.0</td>
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<td>STOCKTON</td>
<td>SALT SPRINGS</td>
<td>SALT SPRINGS 2102*</td>
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<td>75%</td>
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<td>51</td>
<td>99%</td>
<td>1%</td>
<td>3.3</td>
<td>2.45</td>
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<tr>
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<td>DEVILS DEN</td>
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<td>53</td>
<td>99%</td>
<td>1%</td>
<td>3.7</td>
<td>2.43</td>
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</table>
Improving Stockton’s poor performing circuits

Alpine 1102 (309 customers)
Alpine Substation - Creekside Rd off Hwy 4 and approximately two miles south of Bear Valley Mountain. This is a rural circuit and serves the southern portion of Bear Valley Village. Alpine Substation is a 21kV to 12 kV stepdown from the Salt Springs 2101.
Outages on this circuit are due to snow loading on the conductor and vegetation on the Salt Springs 2101 circuit.
PG&E completed a $1.6 million project to remove primary conductor from tree connect to wood pole on the Salt Springs 2101 circuit. We currently have a Targeted Project planned for Salt Springs 2101 in 2018.

Salt Springs 2101 & 2102 (2393 customers)
Salt Springs Substation is located adjacent to the Salt Springs Power House at Salt Springs Reservoir, approximately 9.5 miles west of Bear Valley Mountain. These are rural circuits and serves Lake Alpine Village, Camp Connell, Dorrington, Mt. Reba and Bear Valley Ski Resort.
Outages on these circuits are primarily due to snow loading on conductor and vegetation.
PG&E recently completed $2.7 million of work on these circuits to remove primary conductor from tree connect to wood pole on the Salt Springs 2101 circuit and targeted reliability work on the 2102. We currently have a Targeted Project planned for Salt Springs 2101 in 2018.

Eight Mile 2106 (189 customers)
Eight Mile Substation is located on Eight Mile Rd and Trinity Parkway on the north west corner of the city of Stockton. Eight Mile 2106 serves the islands to the west of city of Stockton.
Outages on this circuit are primarily due third party car-pole events as well as large birds flying into the line.
PG&E has completed jobs to install Trip Savers and Reclosers to reduce customers impacted when we have an outage.
Local electric reliability

Brian To
Supervisor,
Electric Distribution Reliability Planning

Mydika Redding
Supervisor,
Electric Distribution Project Management
PG&E’s Stockton Division

Key PG&E facilities and office buildings within Stockton Division

1. Channel Street Customer Service Office  
   202 Channel Street, Stockton

2. Stockton Service Center  
   4040 West Lane, Stockton

3. Manteca Service Center  
   10901 East Highway 120, Manteca

4. Jackson Service Center  
   12626 Jackson Gate Road, Jackson

5. Angels Camp Service Center  
   1108 Murphys Grade Road, Angels Camp

6. Stockton Regional Office / Energy Training Center  
   3136 Boeing Way, Stockton

In addition, we have 52 electric distribution substations, 2 electric transmission substations and 3 natural gas transmission stations.

PG&E’s total capital investment in Stockton Division electric distribution and transmission infrastructure:

$131.2 million in 2016 and is forecasted to be $74.3* million in 2017

$150 million in 2018

$160 million in 2019

*adjustment to shift resources due to major emergency response
Customers in Stockton Division have consistently experienced improved reliability with the average customer experiencing **94.0 minutes** of sustained power interruptions in 2016 compared to **111.9 minutes** in 2012.

This is a **16% improvement** in 5 years.

Similarly, the average customer in Stockton experienced **0.866** sustained power interruptions in 2016 compared to **0.971** in 2012.

That’s a **10.8% reduction**.
Key projects recently completed

**East Stockton 402**

As a result of a sustained outage caused by wire down, a preliminary field investigation discovered deteriorated cable and splices. More than a mile (about 5,600 feet) of new overhead wire was installed.

This project was part of the Deteriorated Conductor Replacement Program to maintain or improve safety and reliability of the electrical distribution system.

**Number of customers on the circuit:** 1,158

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**Avena 1701**

7 sustained outages were reported on 36 miles of mainline. This project was part of the Stockton Division Reliability Targeted Circuit Program that addresses all aspects of the mainline.

The work performed is expected to reduce the annual number of customer interruptions by 29% and the customer outage minutes by 16%.

**Number of customers on the circuit:** 891
Planned electric projects

**Stanislaus 1701**

*Planned for 2018*

As a result of 17 cable failures over the past 5 years, this project will replace about 9,500 feet of deteriorated cable.

This project is part of the Proactive Deteriorated UG Cable Replacement Program that will help increase reliability of the electrical distribution system.

**Number of customers on the circuit:**
1,832

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**Tracy 1106**

*Planned for 2018*

10 sustained outages were reported on 37 miles of mainline.

This project is part of the Stockton Division Reliability Targeted Circuit Program that addresses all aspects of the mainline.

The scope of work is expected to reduce the annual number of customer interruptions by 65% and the customer outage minutes by 71%.

**Number of customers on the circuit:**
1,602
Thank you

Annual report and a copy of this presentation
pge.com/ertownhall

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Questions?