NARUC

Winter Committee Meetings

Staff Subcommittees on Electricity & Electric Reliability

Welcome!

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The Cost of Power Interruptions to Customers

And…

Early Findings from State PUC Reviews of Utility Investments in Reliability & Resilience

Moderator: *Kimberly Duffley*, Vice Chair, Staff Subcommittee on Electricity

Speakers from Lawrence Berkeley National Laboratory:

- *Joseph Eto*
- *Peter Larsen*

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Lawrence Berkeley National Laboratory

Energy Technologies Area   Lawrence Berkeley National Laboratory

National Cost of Power Interruptions to Customers

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Evaluating Proposed Investments in Power System Reliability and Resilience

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February 12, 2017

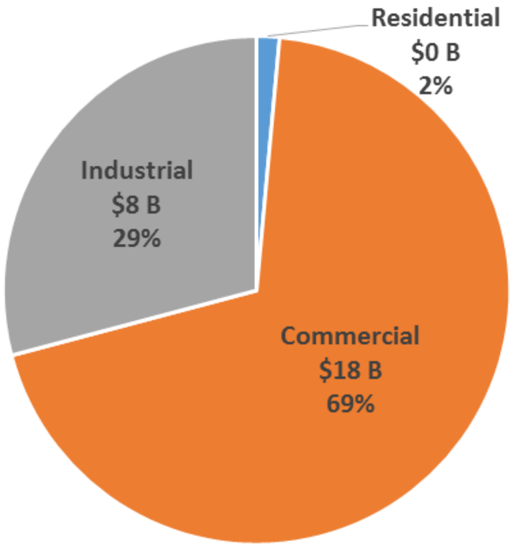
NARUC Winter Meeting Washington, D.C.

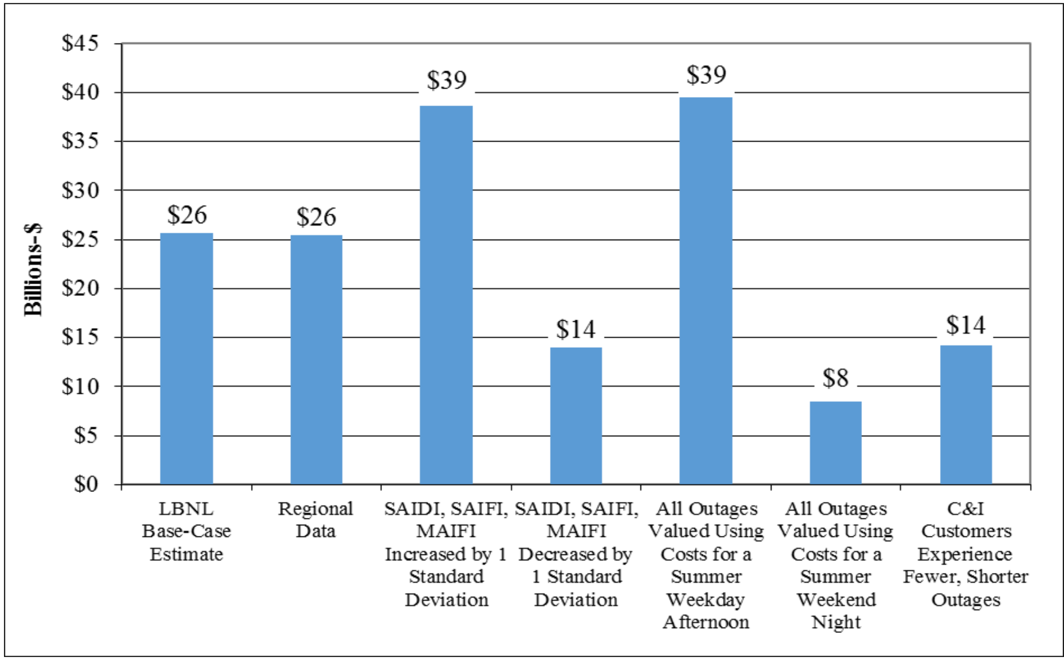
National Cost of Power Interruptions to Customers

This research project is funded by the U.S. Department of Energy's
Office of Electricity Delivery and Energy Reliability.
The opinions and views expressed are those of the authors, not DOE.

In 2004, LBNL estimated that sustained power interruptions cost the US $26 billion/year (2002-$)

LBNL's research was the first and remains the only peer-reviewed analysis *based entirely on public data*





LBNL also documented significant uncertainties in its analysis, ranging from $8-39 billion

Sources: Hamachi LaCommare, K. and J. Eto. 2006. "Cost of Power Interruptions to Electricity Consumers in the United States." *Energy, the International Journal*. 31:1509-1519. LaCommare, Kristina H., and J. H. Eto. 2004. Understanding the Cost of Power Interruptions to U.S. Electricity Consumers. LBNL-55718. Accessible at: https://emp.lbl.gov/sites/all/files/REPORT%20lbnl%20-%2055718.pdf.

LBNL's customer-focused framework for estimating the national cost of power interruptions

$$\text{Cost of Power Interruptions} = \sum_{i=1}^{m}\sum_{j=1}^{n} C_{i,j} \times E_{i,j} \times O_{i,j} \times V_{i,j}$$

where,

C = total number of electric power customers in each region and customer class sector

E = the frequency of power interruption events in one year for each region and customer class sector

O = the cost per interruption as a function of outage duration by customer class for each region

V = vulnerability factor

m = the number of customers in each customer class

n = the number of regions

i,j = indices for customer class and region, respectively

U.S. Energy Information Administration now collects and publishes utility reliability information annually

Independent Statistics & Analysis
U.S. Energy Information Administration

FORM EIA-861

ANNUAL ELECTRIC POWER INDUSTRY REPORT

OMB No. 1905-0219
Approval Expires xx/xx/xxxx
Burden Hours: 10.97

Entity Name: *ABC Company*

Entity ID: *00000*

Data Year: 2013

SCHEDULE 3. PARTS B and C.
DISTRIBUTION SYSTEM RELIABILITY DATA

Who is required to complete this schedule?

This schedule collects System Average Interruption Frequency Index (SAIFI) and System Average Interruption Duration Index (SAIDI) statistics. If your organization does not compute these indexes, answer 'no' to Question 1 and then skip to Schedule 4A. You do not have to complete any other part of this schedule 3B or 3C.

Should you complete Part B or Part C?

If your organization computes the SAIFI and SAIDI indexes and determines Major Event Days using the IEEE 1366-2003 or the IEEE 1366-2012 standard, answer 'YES' to Questions 1 and 2, and complete Part B. Then skip to Schedule 4A. (You do not complete Schedule 3, Part C.)

If your organization does not use the IEEE 1366-2003 or the IEEE 1366-2012 standard but calculates SAIDI and SAIFI indexes via other method, answer 'yes' to question 1 and 'no' to question 2 and complete Part C. Then go to Schedule 4A.

1 Do you calculate SAIDI and SAIFI by any method? If Yes, go to Question 2. If No, go to Schedule 4, Part A. Yes [ ] No [ ]

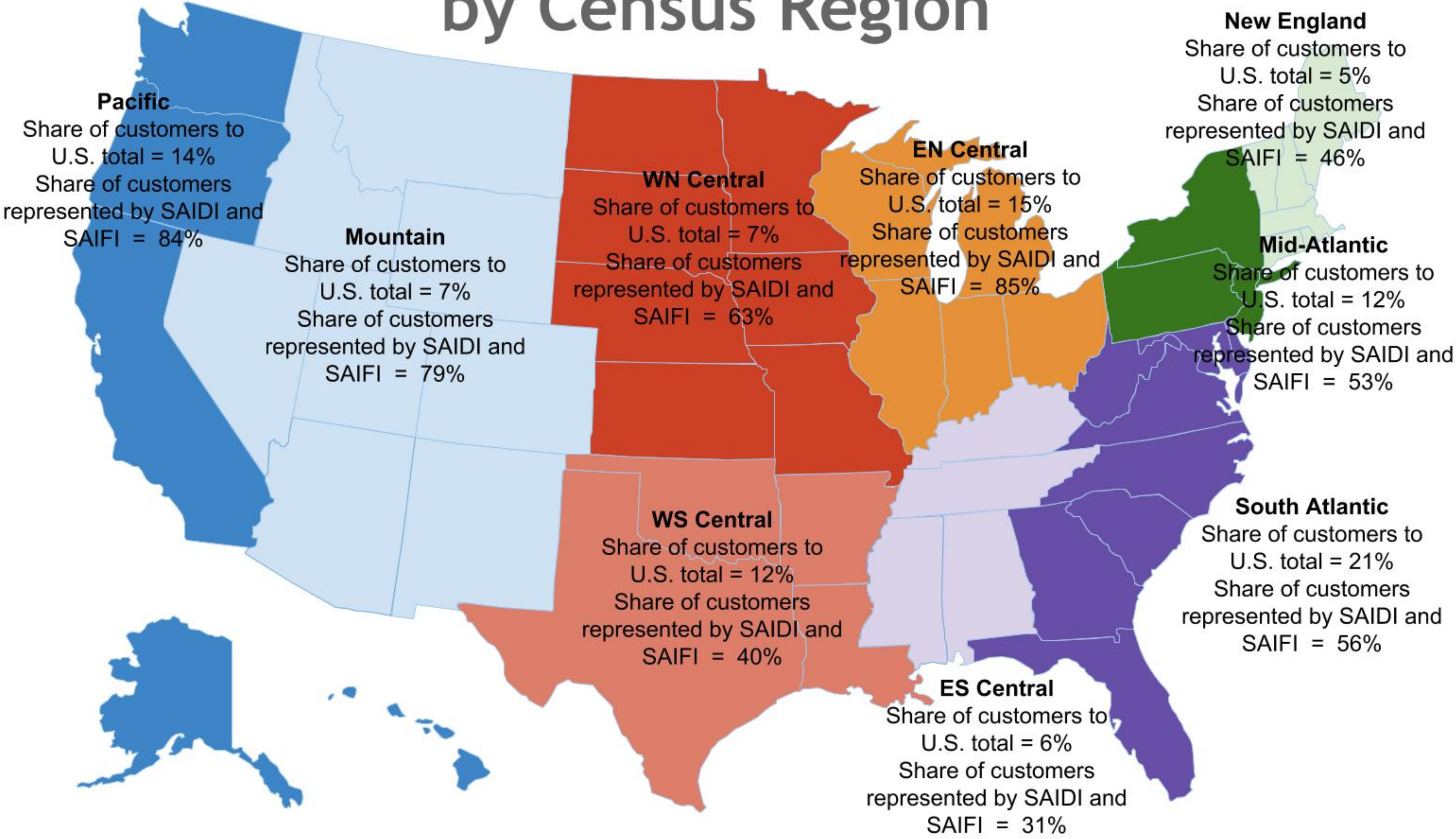
2 Do you calculate SAIDI and SAIFI and determine Major Event Days using the IEEE 1366-2003 standard or IEEE 1366-2012 standard? If Yes, complete Part B. If No, complete Part C. Yes [ ] No [ ]

Part B: SAIDI and SAIFI in accordance with IEEE 1366-2003 standard or IEEE 1366-2012 standard

State

		Including Major Event Days	Excluding Major Event Days
3	SAIDI Value for the Year		
4	SAIDI Value: Major Event Days Included minus loss of supply		
5	SAIFI Value for the Year		
6	SAIFI Value: Major Event Days Included minus loss of supply		

Representation of SAIDI and SAIFI by Census Region



DOE's Interruption Cost Estimate (ICE) Calculator

ICECalculator.com

Interruption Cost Estimate Calculator

U.S. DEPARTMENT OF ENERGY

The Interruption Cost Estimate (ICE) Calculator is a tool designed for electric reliability planners at utilities, government organizations or other entities that are interested in estimating interruption costs and/or the benefits associated with reliability improvements.

- Home
- About the Calculator
- Disclaimer
- Relevant Reports
- Contact Us

Use the ICE Calculator to:

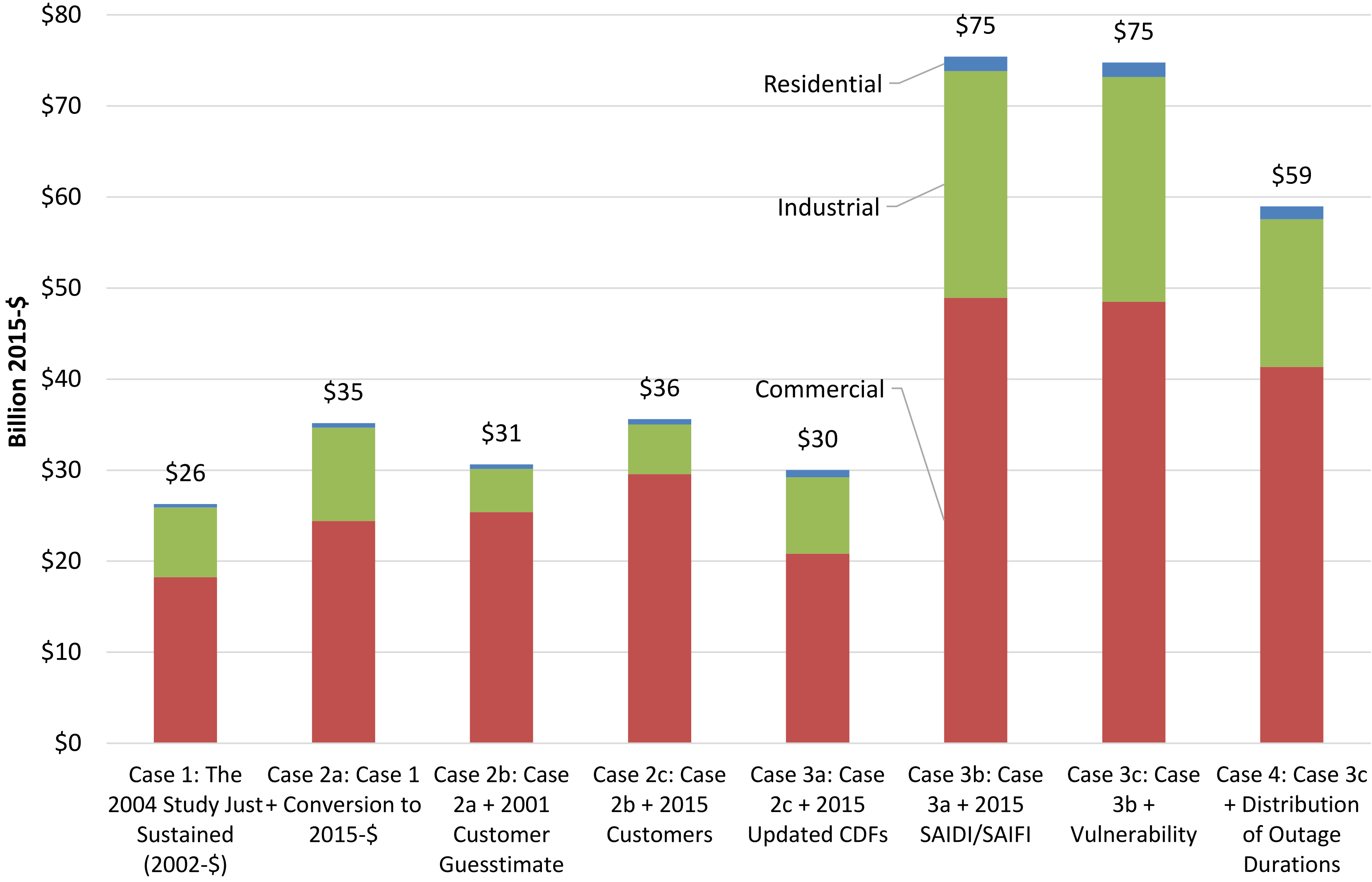
- Estimate Interruption Costs
  Estimate the cost per interruption event, per average kW, per unserved kWh and the total cost of sustained electric power interruptions.
- Estimate Value of Reliability Improvement in a Static Environment
  Estimate the value associated with a given reliability improvement. The environment is "static" because the expected reliability with and without the improvement does not change over time.
- Estimate Value of Reliability Improvement in a Dynamic Environment
  Estimate the value associated with a given reliability improvement. The environment is "dynamic" because the expected reliability with and without the improvement changes over time based on forecasts of SAIFI, SAIDI and CAIDI.

This tool was funded by the Lawrence Berkeley National Laboratory and Department of Energy. Developed by Freeman, Sullivan & Co.

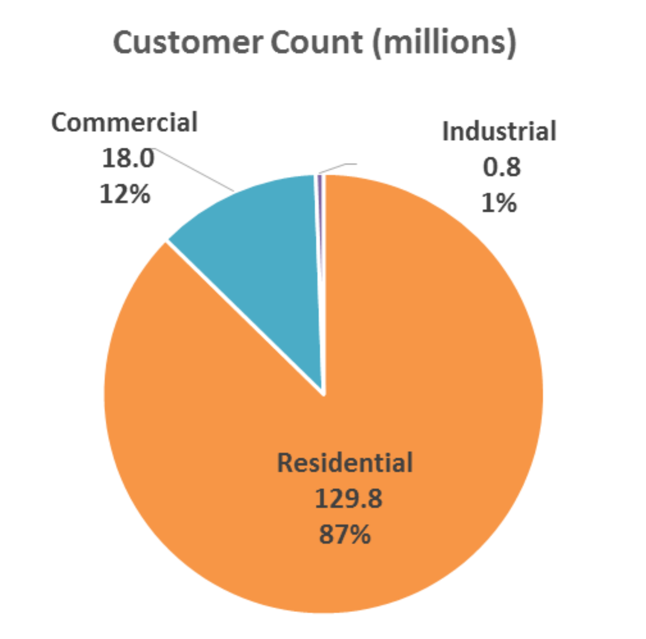
Learn more about the federal initiatives that support the development of the technologies, policies and projects transforming the electric power industry on SmartGrid.gov.

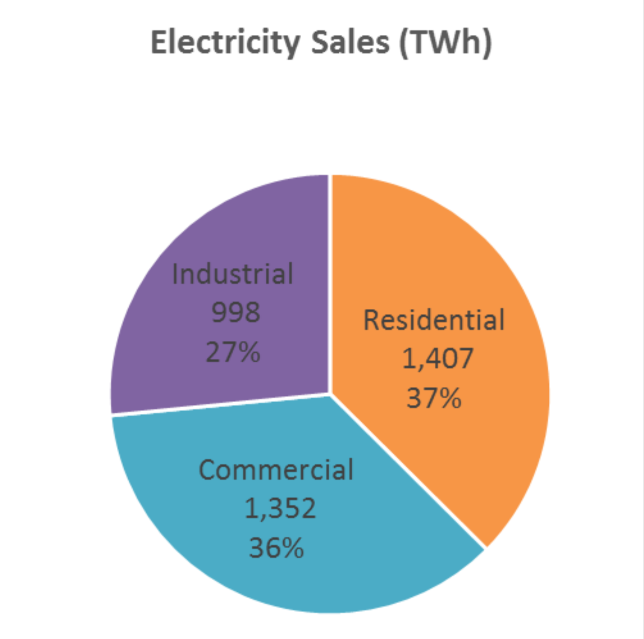
http://icecalculator.com

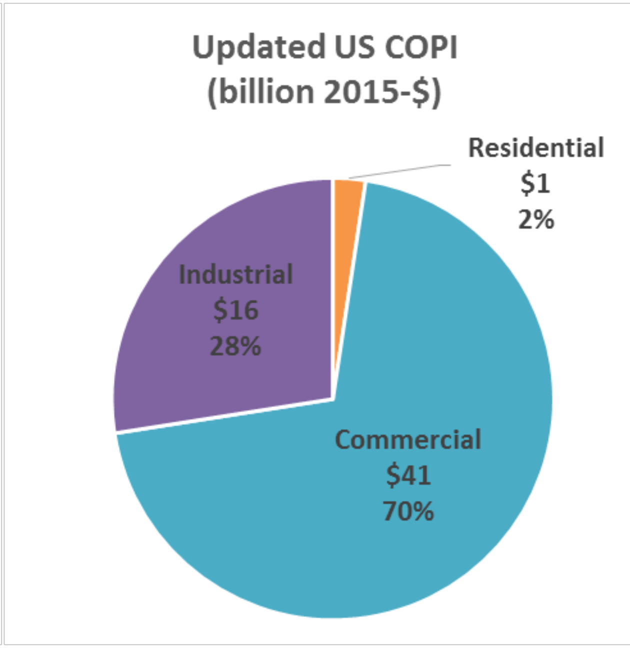
Step by step development of a revised national cost of sustained power interruptions



A closer look at the numbers





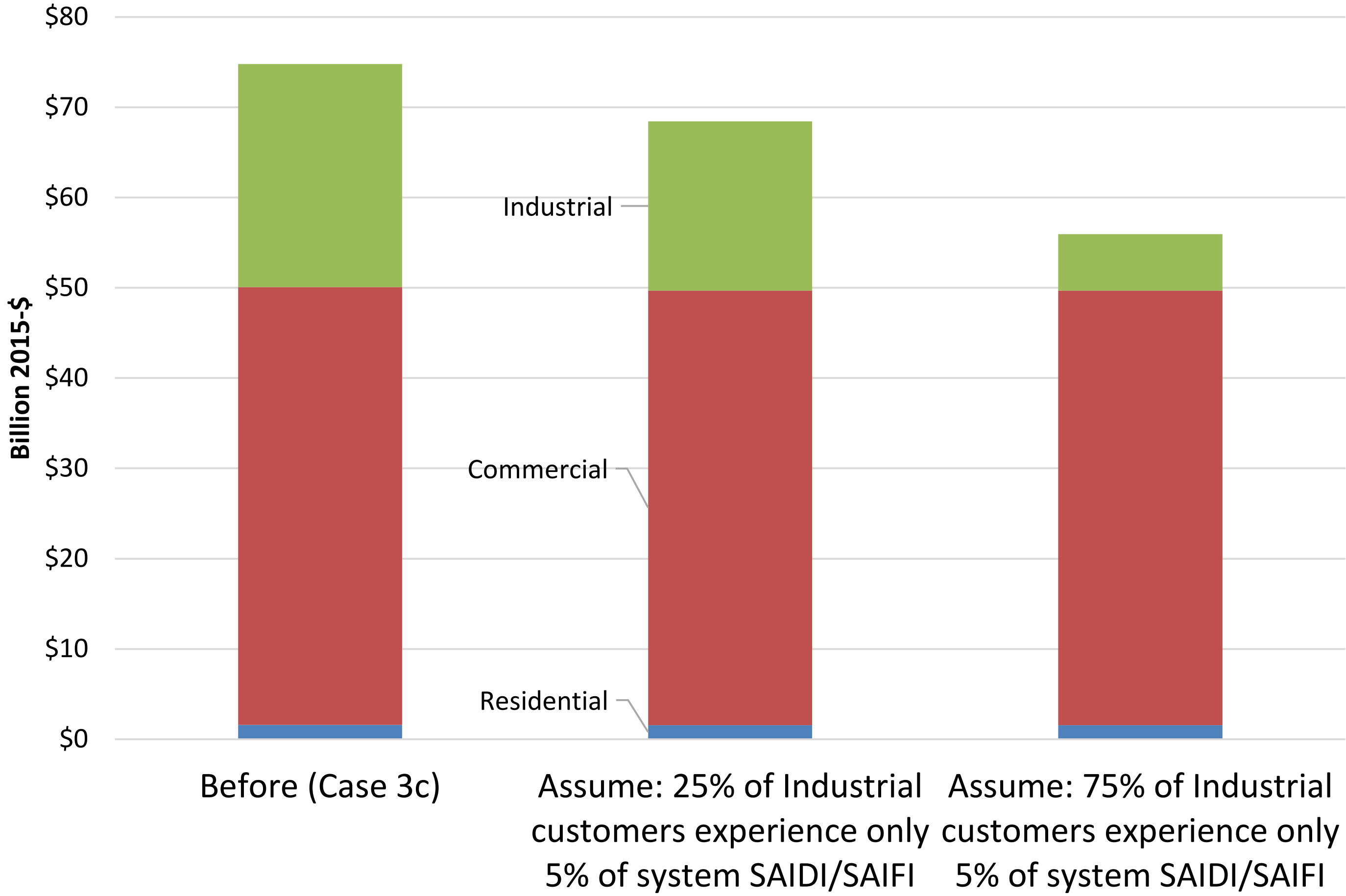


	Residential	Commercial	Industrial
Cost per customer (2015-$/customer)	$11	$2,299	$19,391
Cost per MWh annual sales (2015-$/MWh)	$1	$31	$16

Source: U.S. Energy Information Administration, Form EIA-861, "Annual Electric Power Industry Report.", Form EIA-861S, "Annual Electric Power Industry Report (Short Form)" and Form EIA-923, "Power Plant Operations Report“ for Year 2015

A sensitivity study on the national cost of power interruptions to industrial customers

Industrial customers are often served at sub-transmission and transmission voltages



Source: Assumption of 5% of interruptions due to LOS taken from findings in:
Eto, J., K. H. LaCommare, H. C. Caswell, and D. Till, *Distribution System vs. Bulk Power System: Identifying the Source of Electric Service Interruptions*, submitted to IEEE Transactions on Power Systems, January 2017.

Summary of *Preliminary* Findings

- LBNL is updating its 2004 study of the national cost of power interruptions
- The update is based on a number of improvements in the reliability information that is now publicly available, in part due to research sponsored by DOE
- LBNL currently estimates that sustained power interruptions cost $59 billion per year (2015-$), an increase of more than 68% since our initial, 2004 study
- There remain important uncertainties in
  - Applicability of utility-wide metrics to different customer classes
  - Cost of long-duration, widespread power interruptions
  - Customer's adoption of stand-by generation and UPS

Concluding Remarks

- Power interruptions have economic consequences for customers
- Addressing these consequences is a responsibility that is shared primarily between the customer and its utility, but also in some cases the government at large
- Managing sustained interruptions is a long-standing responsibility of the utility
- Managing severe major events is a responsibility that is shared with government
- Customers always have the option to secure (and pay for) higher levels of reliability

Evaluating Proposed Investments in Power System Reliability and Resilience


Helena Independent Record (October 2015)


P. Larsen (May 2015)

Study motivation

- Renewed interest in the reliability/resilience of the U.S. power system due to growing recognition of challenges posed by extreme weather events, cyber security, and other emerging threats

- Little/no consolidated information in the public domain describing how public utility/service commission (PUC) staff evaluate the economics of proposed reliability investments

New York Magazine (November 2012)

Project goal

Consolidate information to give policymakers and regulators a better understanding of how different state regulatory entities across the U.S. make economic decisions pertaining to reliability/resiliency

Research method

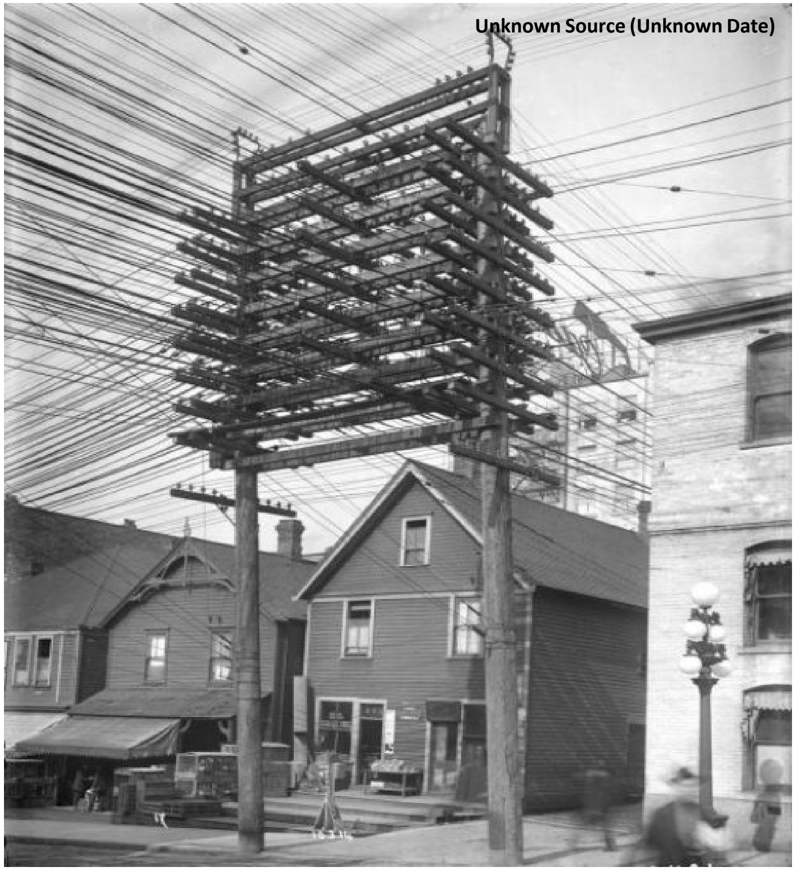
- LBNL staff conducted one-hour, structured discussions with regulatory commission staff from three jurisdictions:

  (1) California
  (2) Florida
  (3) District of Columbia

- Asked same 10 questions related to the economic factors considered when making complex decisions regarding proposed utility investments in reliability/resiliency

- Summarized relevant information in publicly-filed dockets for each jurisdiction

Important disclaimer



Opinions provided by public utility commission staff are their own and do not necessarily represent the positions of the public utility commissions….

Key findings

1. ***PUC staff make no distinction between the terms reliability and resiliency when evaluating the economics of utility investments***

- Efforts to develop metrics for energy sector resilience may provide basis for making distinctions between these two related concepts

2. ***Reliability (resiliency)-related cost recovery requests are typically part of the General Rate Case***

- Reliability investment decisions occasionally involve a separate docket or case number

Key findings (cont.)

3. ***Costs of investments are well-understood and easy to monetize***

- Costs generally include the installation cost, the cost of capital, and operations and maintenance (O&M) costs

4. ***Limited number of benefit categories considered and difficult to monetize***

- DC: Cited saving mature trees and ensuring federal government continues to operate by monetizing interruption costs
- CPUC: Looking to quantify benefits of risk reduction and helping disadvantaged communities
- Florida: Focused on valuing physical losses to infrastructure

Key findings (cont.)

5. ***Need for improved customer interruption cost estimation***

- Regulatory staff indicated the need for better customer interruption cost tools, especially for residential and government customers

6. ***Improve tracking of historical utility investments in reliability/resiliency***

- Interviewees generally indicated that PUCs have the necessary staff in-house to evaluate cost-recovery requests
- Some concern about limited amount of information available detailing past utility investments—and this issue goes beyond investments made exclusively for reliability and resiliency

Key findings (cont.)

7. ***Economics of reliability/resiliency investments are important, but there are other factors, including politics***

- Political environment may be equally (or more) influential in the decision-making process than purely economic considerations
- DC: $1 billion undergrounding initiative gained momentum after major storm in 2012
- Florida: Extremely active hurricane years (2004-2005) prompted state to take aggressive actions to prepare for future severe weather

Recommendations

1. Conduct additional interviews with other regulatory commissions to better understand:

- How and why some PUCs do (or do not) distinguish between reliability and resiliency
- The economic factors considered when evaluating reliability/resiliency investments—including confidence in existing data sources and methods
- The non-economic factors that influence decisions related to reliability/resiliency investments

Recommendations (cont.)

2. ***Develop and pilot a reliability investment tracking system with one or more utilities***

P. Larsen (October 2015)

3. ***Develop and administer a national survey of customer interruption costs***

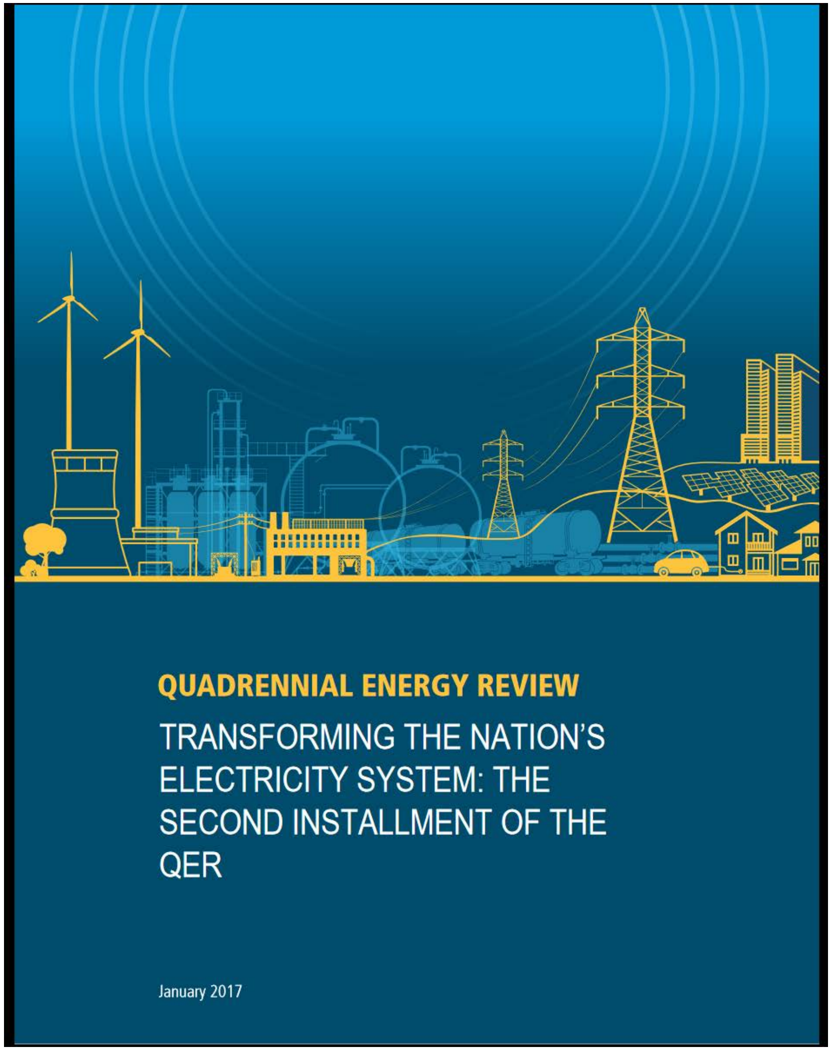
Related recommendation (cont.)

4. ***"Develop uniform methods for cost-benefit analysis of security and resilience investments for the electricity system"***

- "Could be implemented in part through the establishment of a 'community of practice' for valuation of electricity-sector reliability and resilience, providing a stakeholder forum for sharing current practices and developing uniform valuation methods"

QER Recommendation #47

https://energy.gov/epsa/quadrennial-energy-review-qer



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- Study would not have been possible without key insights from staff at **Florida Public Service Commission**, **Washington, D.C. Public Service Commission**, and **California Public Utilities Commission**.

Thank you

LBNL- 1006971

Evaluating Proposed Investments in Power System Reliability and Resilience: Preliminary Results from Interviews with Public Utility Commission Staff

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https://emp.lbl.gov/publications/

Ten questions

1. Do you distinguish between utility investments in grid resiliency from utility investments in so-called "blue-sky" reliability investments? If so, how do you distinguish between them?

2. Can you give examples of specific dockets when utilities filed for cost recovery on grid resilient (reliability) investments?

3. Were any of the dockets indicated earlier part of a general rate case or a special rate case dedicated exclusively to utility investments in reliability (resiliency)? If part of a general rate case, how much weight was given to the utility request for cost recovery on grid resilient/reliable investments relative to other requests for cost recovery?

4. How influential were economic analyses in a past commission's decision to approve/reject proposed utility investments in reliability/resiliency?

5. What resources (e.g., staff, PSC/PUC consultants, analysis techniques) did you use to independently evaluate the merits of utility investments in reliability (resiliency)? Were the economic merits evaluated from the perspective of society/ratepayers/utility shareholders?

Ten questions (cont.)

6. What types of economic benefits were considered when evaluating utility investments in grid reliability (resiliency)? Are there other types of benefits that the commission might have considered if the information was readily available?

7. What types of economic costs were considered when evaluating utility investments in grid reliability (resiliency)?

8. What cost (or benefit) category was the most influential in a specific commission's decision to approve (reject) a utility filing related to grid reliability (resiliency) investments?

9. Have there been any examples of utilities attempting to "gold plate" infrastructure under the guise of making the grid more reliable and/or resilient to extreme weather/climate change?

10. What are the common barriers that you have had to overcome when making decisions on reliability/resiliency improvements? What recommendations do you have for new research products in order to improve your decision-making process in the future?

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