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

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Executive Summary

Policymakers and regulatory agencies are expressing renewed interest in the reliability and resilience of the U.S. electric power system in large part due to growing recognition of the challenges posed by climate change, extreme weather events, and other emerging threats. Unfortunately, there has been little or no consolidated information in the public domain describing how public utility/service commission (PUC) staff evaluate the economics of proposed investments in the resilience of the power system. Having more consolidated information would give policymakers a better understanding of how different state regulatory entities across the U.S. make economic decisions pertaining to reliability/resiliency. To help address this, Lawrence Berkeley National Laboratory (LBNL) was tasked by the U.S. Department of Energy Office of Energy Policy and Systems Analysis (EPSA) to conduct an initial set of interviews with PUC staff to learn more about how proposed utility investments in reliability/resilience are being evaluated from an economics perspective. LBNL conducted structured interviews in late May-early June 2016 with staff from the following PUCs: Washington D.C. (DCPSC), Florida (FPSC), and California (CPUC). Results from the interviews with PUC staff indicated the following:

- In most cases, requests for cost recovery of reliability (resiliency) investments are included as part of the utility General Rate Case (GRC) proceedings.

- Commission staffers interviewed for this study make little or no distinction in the characterization of investments in reliability versus investments in resiliency when evaluating the economics of proposed projects.[i] *Recommendation: Conduct additional interviews with other regulatory commissions to better understand what proportion of PUCs do or don't distinguish between reliability and resiliency.*

- The costs of investments in reliability (resiliency) are well-understood and relatively easy to monetize.

- The benefits of these investments are generally difficult to monetize and a limited number of categories are considered (e.g., avoided customer costs of power interruptions). *Recommendation: Conduct additional interviews with other regulatory commissions to better understand the benefits (and costs) associated with reliability and resiliency investments.*

- There is a desire for improved tracking of historical utility investments in reliability/resiliency vis-à-vis utility representations made during the rate case approval process. *Recommendation: Develop and pilot a reliability investment tracking system with one or more utilities*

[i] Please note this finding is limited to the information obtained from the three states considered in this study. The authors acknowledge that some states, e.g., New Jersey and Maryland, specifically address resiliency, but our findings do not reflect this.

- Commission staff indicated the need for improved interruption cost estimation, especially for residential and government customers. *Recommendation: Develop and administer a national survey of customer interruption costs.*

- Economic analyses of reliability/resiliency investments are important for both customers and regulated utilities, but there are other factors—including political momentum in response to power interruptions from extreme weather—that have been influential in the decision-making process. *Recommendation: Conduct additional interviews with other regulatory commissions to better understand the various factors that influence decisions related to reliability/resiliency investments.*

I. Introduction

Policymakers and regulatory agencies are expressing renewed interest in the reliability and resilience[ii] of the U.S. electric power system large in part due to growing recognition of the challenges posed by climate change, extreme weather events, and other emerging threats. Recent large-scale weather events including catastrophic hurricanes together with aging transmission and distribution (T&D) infrastructure have resulted in some notable investments to improve reliability and resiliency of the grid. With the support of the U.S. Department of Energy, Lawrence Berkeley National Laboratory (LBNL) is investigating how staff at regulatory agencies evaluate the economics of proposed utility investments in reliability and resilience, including resilience to climate change. The purpose of this research project is to develop findings that could be used to (1) share information with other jurisdictions and policymakers who are interested in the decision-making process around investments in the resilience of the power sector; and (2) identify new DOE research products that could improve decision-making in response to climate change.

It is important to note that the findings presented here are limited to what has been learned to-date from only three case studies. And what has been learned during these one-on-one interviews may not necessarily represent the official policy positions of the respective PUCs. The findings presented are not likely to represent the broad range of practices or experiences of regulatory commissions across the U.S. In fact, it is more likely that these three cases represent practices undertaken at states and/or the regulated utilities that are already actively trying to improve reliability/resilience, including climate resilience across their respective jurisdictions. Nevertheless, we hope the findings from this project and any future research can serve as a useful reference for other state regulatory agencies and policymakers as they navigate the complex decision-making process around utility investments in reliability/resiliency. This report is organized as follows. We discuss the research approach in section two and section three describes high-level findings from our interviews with staff from the three PUCs. Section four concludes with a brief summary of the findings and initial recommendations for future research. This paper includes more specific information that discuss each of the three commissions' decision-making process in more detail as presented in appendices C-E.

II. Approach

LBNL conducted one-hour, structured interviews with regulatory commission staff from three jurisdictions – California, Florida, and the District of Columbia. The commissions (also sometimes known as public utility commissions, public service commissions, among other names) typically have regulatory authority over utilities pertaining to electricity/gas tariffs and services. As a result, the individuals we sought out are inherently familiar with the decision-making process associated with investments in reliability/resiliency and are therefore well-positioned to answer questions related to such improvements. In the case of the California Public Utilities Commission, we were able to interview two

[ii] See Appendix A for a definition of the terms reliability and resiliency.

different staffers: one from the Office of Ratepayer Advocates and another from the Infrastructure Planning and Permitting Branch of the Energy Division.

For each of the interviews, LBNL asked the same set of ten questions related to the economic factors considered by regulators in making complex decisions regarding proposed utility investments in reliability/resiliency. Appendix B contains the complete list of the questions that were asked of each commission staffer. This report focuses on an initial, high-level summary of information learned during the interviews. The plethora of information found in the docket filings that were provided to us—or accessible online are summarized for each of the three jurisdictions in each of the appendix write ups.

In the next section, we highlight findings from each of the interviews and then, in section four, synthesize these findings into general themes that policymakers and regulators should consider when making decisions about reliability/resiliency.

III. Findings

Based on the information collected, LBNL was able to make some preliminary statements regarding general practices that appear to take place during the regulatory decision-making process.

Reliability (resiliency)-related cost recovery requests are part of General Rate Case
Generally speaking, most of the cost recovery requested are included as part of the utility's General Rate Case (GRC). The GRC is a mandatory proceeding conducted by the utility commission to request changes to the utility's operations and costs. In some instances, however, reliability investment decisions involve a separate docket or case number.[1]

No distinction between reliability and resiliency when evaluating the economics of utility investments
In general, we did not find a distinction in terms of how regulatory staff view reliability versus resilience when evaluating economic analyses. Instead, issues of reliability or resiliency appear to be handled collectively or as needed, either under the GRC or in certain cases in separate dockets. While economic regulators have yet to make a distinction between reliability and resilience[2], ongoing efforts to develop metrics for energy sector resilience could provide a basis for making qualitative and quantitative distinctions between these two related concepts in the future. See Appendix A for further discussion.

Costs of investments are well-understood and easy to monetize
In assessing the costs versus benefits associated with investments designed to improve reliability or resiliency, we find the costs to be straightforward to identify, yet the benefits are more challenging to quantify, as they are often characteristically specific to the state/jurisdiction. Generally, the costs considered include the installation cost of the infrastructure, the cost of capital (i.e., financing charge), and the ongoing operations and maintenance (O&M) costs.

Limited number of benefit categories considered and difficult to monetize

In terms of the benefits, the DCPSC cited ensuring the federal government continues to safely operate and saving mature trees as a primary benefit from undergrounding lines and implementing other reliability/resiliency investments in the Washington, D.C. area. The DCPSC uses the ICE calculator to monetize each minute of lost operation of the federal government, but according to the DCPSC this valuation assumes a simplistic inflator to the most costly customer class in the calculator, the industrial sector. In California, the CPUC is looking to quantify benefits associated with risk and helping disadvantaged communities as part of their investments in reliability/resiliency with no current practice of monetizing these benefits. In Florida, the main driver is reducing the number of outage events and their associated restoration time. In this state, monetization is limited to valuing physical losses such as utility poles and generators, with too much skepticism of customer valuation estimates like the ICE calculator. The commissions we interviewed are typically using standard reliability metrics like SAIDI and SAIFI, which provide a foundation for quantifying the benefits of reliability/resiliency investments.[iii] One interviewee indicated that there was interest in developing a power quality metric that could better track momentary interruptions or more subtle, yet disruptive frequency events. These findings suggest additional interviews with other state regulatory commissions are needed to better understand the benefits associated with reliability/resiliency investments. More information is needed beyond these three case studies in order to develop a general practices guideline that can be applied to all states.

Improve tracking of historical utility investments in reliability/resiliency

PUC interviewees generally indicated that they have the necessary staff in-house to evaluate cost-recovery requests. One interviewee did suggest that the utilities may be in need of such tools/metrics in order to help them justify their requests to the commission. During two of the interviews, commission staff expressed concern about the limited amount of information available detailing past investments made by the utilities—and this issue goes beyond investments made exclusively for reliability and resiliency. Staff would like to be able to identify the spending associated with reliability/resiliency improvements, because this additional information could improve their understanding of how spending can be directly tied to reliability gains. It is likely that utilities have this information available, but it might not be organized in a format that is readily accessible for analysis by commission staff. Future research might involve learning more about how utilities track these investments internally and whether there are ways of organizing and providing this information to commission staff. A reliability/resiliency investment tracking system should be promoted or, if it does not already exist, could be developed and piloted with one or more utilities.

Need for improved customer interruption cost estimation

During two of the interviews, regulatory staff indicated the need for better customer interruption cost tools, especially for residential and government customers. Both believe the residential costs estimated by the DOE-funded ICE calculator are too speculative to use, as it is too difficult to discern the interruption costs experienced by, for example, a stay-at-home parent versus a day trader. One staffer

[iii] It is important to note that DOE-EIA requests that utilities report SAIDI and SAIFI both without the inclusion of major events (typically extreme weather) and with the inclusion of major events.

indicated that they simply "scale up" the ICE Calculator large commercial and industrial (C&I) interruption cost estimates to account for interruption costs at critical government facilities. Gaining a better understanding of interruption costs by customer type is therefore a recommended area of improvement. U.S. DOE and its partners should consider supporting the development and administration of a national survey of customer interruption costs.

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

Our interviews revealed that the economics of assessing costs and benefits are an important factor when contemplating investment decisions to improve reliability/resiliency, but the political environment may be equally (or more) influential in the decision-making process. In an example of political momentum in Washington D.C., the $1 billion undergrounding legislation (Docket 1116) was a priority of district leadership who sought to harden grid infrastructure to withstand more severe storms after experiencing widespread interruptions following a 2012 storm. In Florida, large-scale hurricanes in 2004-2005 prompted the state to take aggressive actions to prepare for the next severe weather event. In some states, these actions may be described as distinctly resilience, however our interview findings suggest that in these states that distinction is not currently made. The weather has been relatively mild in Florida in recent years so regulators find themselves waiting to assess whether their storm hardening efforts were adequate and cost-effective. It was stated that the main objectives of the FPSC include reducing outages and improving restoration times. Future research could involve a literature review of notable historic weather events that led to significant investments in reliability/resiliency. The outcome of this research might help other jurisdictions learn from FPSC's experiences.

IV. Conclusion

We were able to identify some, albeit initial, general practices that are evident across states. Investments in reliability/resiliency are typically part of the mandatory GRC proceedings and PUC staff make no substantive distinction when evaluating investments in reliability and resiliency. From an economic perspective, the investment costs in reliability/resiliency are much easier to identify and monetize, whereas the associated benefits of these investments—to customers, utilities, and society as a whole—can be challenging to identify, monetize, and include in the economic evaluation. There may be limited information available for commission staff to be able to track utility spending on reliability/resiliency. There is also a need to better understand the economic costs associated with power interruptions, especially for residential and government customers. Although economics are an important factor in the decision-making process, other factors can overshadow the results of cost-benefit analyses.

Through our discussions with regulatory staff, we have a better appreciation for the complex relationship between the utility commissions and regulated utilities. Given the broad goal of the PUC to ensure the safe and reliable delivery of electric power, the utilities are often able to justify their cost recovery requests if these requests are made in the name of ensuring reliability.

We believe that interviewing a broader number of PUCs, will produce findings that can inform a comprehensive set of best practices in the evaluation of investments in reliability/resiliency. Developing and piloting a system to track past utility investments in reliability/resiliency is another research product that could help regulators make more informed decisions. LBNL and our partners have conducted research into the economic cost of power interruptions to U.S. electricity customers (e.g., LaCommare and Eto 2004).[3] We intend to conduct additional research into the economic cost of power interruptions that can serve as a more credible and reliable source for utilities, regulatory staffers, and policymakers.

Appendix A. Definition of reliability and resiliency

It was shown that public utility commission staff interviewed for this study make little or no distinction between the definitions of reliability and resiliency. There is a significant amount of literature that, when compared, shows that there are similarities between these two terms, especially within the context of power systems.

Mann et al. (1974) generally define *reliability* as the "probability of a device performing its defined purpose adequately for a specified period of time under the operation condition encountered".[4] Specific to the power sector, the North American Electric Reliability Corporation (NERC) defines power system reliability based on two concepts: (1) adequacy and (2) operating reliability: "Adequacy is the ability of the electric system to supply the aggregate electric power and energy requirements of the electricity consumers at all times, taking into account scheduled and reasonably expected unscheduled outages of system components. Operating reliability is the ability of the electric system to withstand sudden disturbances such as electric short circuits or unanticipated loss of system components." [5]

Alternatively, Keogh and Cody (2013) indicate that there are numerous ways that the term *resilience* has been defined within the context of regulated utilities.[6] Stockton (2014) notes that many of the definitions of utility resilience are similar to what is discussed in Presidential Policy Directive 21 (PPD-21).[7] PPD-21 broadly defines the term resilience as the "ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions. Resilience includes the ability to withstand and recover from deliberate attacks, accidents, or naturally occurring threats or incidents".[8] Furthermore, Stockton (2014) notes that the metrics typically used to measure electric utility reliability, including the System Average Interruption Duration Index (SAIDI), are consistent with the PPD-21 definition of resilience.[9] SAIDI, for example, is an average measure of the total duration of time that customers are without power, typically over the course of one year.

However, use of SAIDI and other reliability statistics as a credible measure of resiliency is not without its limitations due to inconsistencies in how utilities have historically reported metrics like SAIDI (see LaCommare and Eto 2008).[10] For example, some utilities include data associated with "major events" in their public reporting to PUCs, while others do not.[11] Furthermore, utilities use different approaches when defining what constitutes a "major event."[12] These inconsistencies illustrate some of the limitations of using reliability metrics to evaluate system performance during disruptive events. It should be noted, however, that the IEEE 1366 Standard represents an effort to define in a consistent manner how metrics such as SAIDI should be calculated and also includes a method for categorizing major events. Although still voluntary, the IEEE 1366 Standard is now incorporated into the annual EIA reporting form 861.[13]

One subtle difference between these two terms involves the notion that utilities have the ability to "prepare for and adapt to changing conditions." In other words, reliability appears to be the general ability of an electric system to supply power at all times and withstand sudden disturbances.

Alternatively, resiliency describes the capacity of the utility to withstand and recover from disruption, but also *prepare* for the possibility of disruptions.

Appendix B. Interview 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?

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?

Appendix C. California Public Utilities Commission (CPUC)

Key Events and Background: Response to the 2007 California Wildfires

Drought conditions in California helped make the 2007 California wildfire season one of the most destructive in state history. In October 2007, Southern California experienced a series of large wildfires fed by strong Santa Ana winds with gusts over 100 mph. Referred to as a "fire siege" in the Cal Fire overview report,[14] the wind-fueled fires burned over a half a million acres of land and destroyed over 3,000 homes and other buildings. A total of 17 significant fires plus dozens of smaller ones that burned from Santa Barbara south to the Mexican border destroyed portions of the electrical power distribution network, telecommunication systems, and impacted water sources. A total of 17 people died as a result of these fires, hundreds were injured, and as many as 900,000 people were evacuated. A state of emergency was declared by Governor Schwarzenegger with a major disaster declared by President Bush. Total insurance claims were estimated at $1.8 billion.

In response, the Commission initiated an Order Instituting Rulemaking (OIR) on November 13, 2008 to revise its rules regarding potential hazards including fires, which may be caused by electric transmission, distribution, or communication infrastructure.[15] The ruling was aimed at reducing the risk of fires in California in preparation for the 2009 fire season. Some of the measures adopted include:

- Changing the term "tree trimming" to "vegetation management" to broaden the definition (Clarification to Rule 35).
- Expanding the minimum radial vegetation clearances for certain electric lines in "Extreme and Very High Fire Threat Zones" in Southern California (Rule 37 of General Order 95).
- Developing a new rule to address public safety issues concerning pole overloading and the resulting increased fire hazard (new rule General Order 95, Rule 44.2).
- Increasing the frequency of patrol inspections in "Extreme and Very High Fire Threat Zones" in Southern California (Modification to General Order 165).
- Considering fire hazards in high speed wind areas, especially with conductor separation (Clarification to Rule 38 of General Order 95).

Furthermore, the CPUC has adopted fire maps to identify areas in California more susceptible to ignition and rapid spread resulting from power line fires due to strong winds, which were conditions that led to the October 2007 fires across Southern California.

In recent years, the drought conditions have continued to fuel fires across the state. In southern Lake County of Northern California, the Valley fire of September 2015 was one of the most damaging wildfires in California history. This fire was responsible for four deaths and burned over 76,000 acres and 2,000 structures. Around this same time, the Butte fire in Amador County killed two and burned 70,000 acres and over 900 structures. Interestingly, the cause of this fire was ignited powerlines due to vegetation interference, which was addressed, at least in Southern California, under the 2008 OIR.[16] Together, it was estimated that these two fires caused an estimated $2 billion in losses.[17]

Research Method

LBNL interviewed two staffers at the CPUC: one from the Infrastructure Planning and Permitting Branch (May 25, 2016) and the other from the Division of Ratepayer Advocates (June 9, 2016). As stated earlier, each interview was limited to one hour in an effort to keep responses at a high-level in this initial phase of research. In this appendix, we present information specific to the interviews with the two CPUC staffers. Based on recommendations from these interviews, we investigated pertinent reliability/resiliency aspects of regulatory docket proceedings and report them below.

High-level Findings, Relevant Dockets, and Additional Insights

We highlight the broader sub-set of findings presented in the main report that were, at least in part, informed by specific information provided by the CPUC during the interviews. Below is the detailed information provided by the CPUC as well as supplemental information from publicly-available sources:

Report Finding:
Reliability (resiliency)-related cost recovery requests are part of the General Rate Case

Relevant Dockets:

- Pacific Gas & Electric (PG&E) 2014 General Rate Case (GRC), Proceeding# A1211009, http://www.ora.ca.gov/general.aspx?id=2034
- Cornerstone Improvement Project, Proceeding# A0805023, http://www.pge.com/includes/docs/pdfs/b2b/purchasing/suppliers/cornerstone_project.pdf.
- Southern California Edison (SCE) 2015 GRC, Proceeding# A1311003, http://www.ora.ca.gov/general.aspx?id=2107.
- Southern California Edison (SCE) 2012 GRC, Proceeding# A1011015, http://www.ora.ca.gov/general.aspx?id=2524.
- San Diego Gas & Electric (SDG&E) 2016 GRC, Proceeding# A1411003, http://www.ora.ca.gov/general.aspx?id=2897.
- CPUC Rule 20, D73078 (1929), D.06-12-039 (2006), D.14-01-002 (2014), http://www.cpuc.ca.gov/General.aspx?id=4403.

Additional Insight:
We evaluated the content of the filed documents related to select CPUC proceedings to better understand what has recently been done to address reliability/resiliency. Our interviews with CPUC staff indicated that much of the cost-recovery requests for reliability/resiliency improvement are

accounted for in the cycle of the General Rate Cases[iv] for each regulated utility. The information below highlights what we found from recent GRCs submitted by utilities operating in California.

The PG&E 2014 GRC decision granted $250 million over 3 years for distribution reliability. This included funding to expand the current SCADA system to improve monitoring capabilities, overhead line and pole inspections and replacements, and vegetation management, among other improvements. It also includes funds for electric mapping and records management to create new maps, record and archive electric distribution maps, and incorporate details in the maps that can be viewed when planning new services or providing maintenance. In some instances, reliability/resiliency proceedings are separate from the GRC, as with the Distribution Reliability Improvement Program (DRIP), also known as the Cornerstone Improvement Project.[18] This program granted PG&E over $350 million in funding to install numerous reclosers, fuses and upgrading circuits throughout the service territory—while acknowledging that subsequent funding should be included as part of future GRC requests.

The SCE 2015 GRC decision included $72 million for inspection and replacement of deteriorating poles, $85 million for the Worst Circuit Replacement (WCR) program, and $57 million and $17 million, respectively, for distribution capital and O&M expenditures.

As part of the reliability component titled "Reliability/Improvement" in the settlement agreement of the SDG&E 2016 GRC, SDG&E requested about $259 million over the next three years (2016-2018) for 20 projects that would improve: underground and overhead infrastructure; replace underground cables; rebuild various substations; install new emergency transformer and switchgear; upgrade security systems at 59 substations; improve controls; install advanced storage on circuits with high PV; install new microgrid systems and distribution circuits; among other things (pg. 75, section 6.2.2.1.4). Included in this request—under the Distribution Capital Expenditures for Electric Operations section—are dedicated funds for capital projects like upgrading meters and distribution substations; replacing/reinforcing poles and underground cables (pg. 69, section 6.2.2). SDG&E also received approval to develop standards and distribution reliability functions in response to said declines in reliability under section titled "O&M Distribution costs for Electric Operations" (pg. 45, section 6.2.1). The SDG&E 2012 GRC requested $55 million to install smart grid technologies for monitoring the electric grid in year 2012. These improvements are intended to address challenges associated with increased PV deployment in the service territory.

Report Finding:
No distinction between reliability and resiliency when evaluating the economics of utility investments

Relevant Dockets:
None found.

[iv] According to a presentation by the CPUC's Office of Ratepayers Advocates (ORA) on the rate making process, the purpose of the GRC is to provide the utility with an adequate amount of revenue that balances the expected utility costs with allowances for unexpected circumstances while still allowing the utility to earn a reasonable profit (http://www.dra.ca.gov/general.aspx?id=393).

Additional Insight:
The CPUC does not distinguish between reliability and resiliency, acknowledging that such investments have largely been part of the GRC (e.g., Worst Circuit Replacement program).

Report Finding:
Limited number of benefit categories considered and difficult to monetize

Relevant Dockets:
San Diego Gas & Electric (SDG&E) 2016 GRC, Proceeding# A1411003, http://www.ora.ca.gov/general.aspx?id=2897

Additional Insight:
In addition to the commonly reported reliability metrics of SAIDI and SAIFI, CPUC staff indicated that it is more challenging to identify the "soft benefits," but efforts have been made to look at the benefits of reducing impacts from greenhouse gases, helping disadvantaged customers, and avoiding other risks. For example, the 2016 SDG&E GRC Proposed Decision includes a section that discusses planned costs for assessing—and ultimately avoiding—risks associated with the basic operation of this combined gas-electric utility. According to the Proposed Decision, avoiding operational risk—through the use of risk assessment modeling—was a direct result of the 2010 San Bruno pipeline explosion which killed eight people. The Proposed Decision does not make a clear distinction between (or specify) costs to avoid operational risks (i.e., benefits) to the power system versus the gas distribution system.

Report Finding:
Improve tracking of historical utility investments in reliability/resiliency

Relevant Dockets:
- SCE 2012 GRC, Proceeding# A1011015, http://www.ora.ca.gov/general.aspx?id=2524.
- Rule 20, D73078 (1929), D.06-12-039 (2006), D.14-01-002 (2014), http://www.cpuc.ca.gov/General.aspx?id=4403.
- PG&E 2017 GRC, Proceeding# A1509001, http://www.ora.ca.gov/general.aspx?id=2034.
- San Diego Gas & Electric (SDG&E) 2016 GRC, Proceeding# A1411003, http://www.ora.ca.gov/general.aspx?id=2897

Additional Insight:
The CPUC staffer interviewed acknowledged that the utilities typically do not spend all of the funding that they receive for specific projects requested as part of the GRC, which makes it difficult to assess the full economic benefit of these investments. For example, if the utility asks for and receives $70 million for a specific reliability improvement, the utility report submitted to the CPUC typically shows underspending for that reliability improvement. This is a common business practice among the regulated utilities across the U.S. as investor-owned utilities balance the need to provide safe and reliable electric service while prioritizing any unforeseen issues that may require attention. The SCE

2012 GRC, which noted underspending, was ultimately approved to increase spending by $62M (2011-2012) to encourage more undergrounding conversions. Interestingly, the CPUC granted less than what SCE requested, because previous proceedings had provided significant funding to underground and SCE had yet to spend those earlier funds. Perhaps in response, the SCE 2015 GRC's approval for the Reliability Investment Incentive Mechanism (RIIM) Program required SCE to spend certain funds on reliability or else provide refunds to ratepayers should the targets not be met. It should be noted that SCE requested $32 million per year under Rule 20A (underground conversion) as part of the 2015 GRC, but did not receive approval because of historic underspending. Interestingly, the Proposed Decision of the 2016 SDG&E GRC includes a section containing accountability reports that review whether the actual expenditures made by the IOU aligned with what was approved as part of the GRC.

Report Finding:
Economics of reliability/resiliency investments are important, but there are other factors

Relevant Dockets:

- PG&E 2014 GRC, Proceeding# A1211009, http://www.ora.ca.gov/general.aspx?id=2034
- Cornerstone Improvement Project, Proceeding# A0805023, http://www.pge.com/includes/docs/pdfs/b2b/purchasing/suppliers/cornerstone_project.pdf.
- SCE 2015 GRC, Proceeding# A1311003, http://www.ora.ca.gov/general.aspx?id=2107.
- SCE 2012 GRC, Proceeding# A1011015, http://www.ora.ca.gov/general.aspx?id=2524.
- SDG&E 2016 GRC, Proceeding# A1411003, http://www.ora.ca.gov/general.aspx?id=2897.
- CPUC Rule 20, D73078 (1929), D.06-12-039 (2006), D.14-01-002 (2014), http://www.cpuc.ca.gov/General.aspx?id=4403.
- CPUC Fire Threat Maps, Rule 15-05-006 (2015), http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M162/K498/162498284.PDF, http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=162550016
- CPUC PG&E Substation Attack, Incident Number E20140827-01 (2014), http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Safety/Electric_Safety_and_Reliability/Facility_Safety/Citations/Enclosure%205%20-%20Response%202%20Supplement%20Redacted.pdf

Additional Insight:
Decisions regarding reliability/resiliency in California are largely driven by economics. Primary factors include how much was spent historically and why additional cost recovery is being requested by the utility. This is the general approach for justifying the requests of cost recovery by the utilities in the GRCs.[19]

As discussed earlier, there has been a recent focus by the CPUC to evaluate the benefits from reduced risk and improved safety. The CPUC took action to address risk from wildfires in response to the October 2007 Santa Ana fires that swept through Southern California. In May 2016, the CPUC adopted a fire map (Decision 16-15-036 as part of Rule 15-05-006) of the state showing areas with the greatest hazard for ignition and rapid spread of power line-related fires due to strong winds, dry vegetation, and

other environmental conditions. Shortly after this decision, SDG&E received a "Permit to Construct" from the CPUC, approving safety enhancements to fire-harden electricity facilities near the Cleveland National Forest. In another example, an attack at the Metcalf substation in PG&E's service territory resulted in a $100 million investment by PG&E to upgrade security at substations, including 24/7 on-site guard coverage.[20] These decisions represent examples of a non-economic influence on decision-making regarding reliability/resiliency.

Appendix D. Public Service Commission of Washington, DC (PSCDC)

Key Events and Background: Response to the 2012 Derecho Storm

On June 29, 2012, one of the most destructive derechos in U.S. history made its way across the Ohio Valley and Mid-Atlantic regions covering 11 states and the District of Columbia. Characterized as a land-based wind storm, the derecho traveled over 700 miles in just 10 hours, resulting in 4.2 million customers without power for up to one week. This event resulted in 13 deaths, many of whom were killed by falling trees due to the extreme winds or through contact with live downed power lines. In total, this event was estimated to cost $3 billion in losses.[21]

According to Johns and Hirt (1987)[22], a derecho is defined as a severe storm possessing all four of the following conditions:

- There must be a concentrated area of convectively induced wind damage or gusts greater than or equal to 58 mph occurring over a path length of at least 250 miles.
- Wind reports must show a pattern of chronological progression in either a singular swath (progressive; this event was a classic example) or a series of swaths (serial).
- There must be at least three reports separated by 64 kilometers (km) or more of Enhanced Fujita 1 (EF1 damage) and/or measured convective wind gusts of 74 mph or greater.
- No more than 3 hours can elapse between successive wind damage/gust events.

Due to the widespread damage from this storm, the NOAA's NWS issued a report to the Department of Commerce assessing the forecasts and warnings leading up to the event.[23] According to this report, the weather models generally did not do a good job of forecasting this storm. Numerous forecast models from 3-days prior and leading right up to the event showed little to no measurable accumulation of precipitation, while others did not show any convective activity until the day of the event. As a result, forecast watches and warnings were issued without time to adequately prepare.

The severe impacts from the derecho also prompted the Department of Energy to issue a report reviewing the power outage and restoration efforts of this storm in relation to other major storms in recent history.[24] The 4.2 million customers affected by the 2012 derecho were higher in total number of customers affected than five other spring and summer storms from 2007-2011. For context, the number of customers without power during this event was almost 25% higher than the 3.3 million customers affected by Hurricane Irene and more than two times higher than the 1.6 million customers affected by Hurricane Ike. In terms of restoration, the 2012 derecho exhibited a slower restoration time when compared to Hurricane Ike or Irene. Several factors were attributed to this slow recovery of power, including the fact that the strong winds caused significant damage to all types of electricity infrastructure including transmission and distribution lines, substations, and utility poles. To further complicate the situation, a severe heat wave occurred around the same time as the derecho event resulting in 34 heat-related deaths. Several affected utilities reported needing to take extra precautions

due to the excessive heat conditions as temperatures remained above 95F for the next eight days following the derecho storm.[25] In a news release issued by Pepco, the predominant utility serving the DC metropolitan area, the headline read "300,000 crew man-hours estimated, 3,000 personnel mobilized for eight-day restoration, 19,000 cases of water and energy drinks supplied to keep crews hydrated, 260 poles and 760 transformers delivered – more than Hurricanes Isabel or Irene." At one point in time, more than 440,000 Pepco customers were without power.[26]

The 2012 derecho event resulted in an immediate call for action by Washington, D.C. Mayor Vincent Gray. The Mayor ordered the formation of a Power Line Undergrounding Task Force to assess the feasibility of undergrounding new and existing overhead power lines to avoid possible future recurrences (Order 2012-130). In May 2014, a piece of legislation—specifically related to undergrounding—was then enacted in May 2014 in the form of the $1 billion Electric Company Infrastructure Improvement Financing Act of 2013 (FC 1116). According to an information fact sheet published by Pepco, the approximately $1 billion cost to underground the Washington, D.C. area will be made possible with $500 million in traditional cost-recovery by Pepco, $375 million in District-securitized bonds, and roughly $100 million in D.C. Department of Transportation funding.[27]

Research Method

LBNL interviewed staff from the PSCDC on May 23, 2016. As was the case with the other interviews, this discussion was limited to one hour in an effort to keep responses at a high-level in this initial phase of research. In this appendix, we present information specific to the interview with the PSCDC staffer. Based on the report findings, we also reviewed pertinent reliability/resiliency aspects of regulatory docket proceedings and discuss them below.

High-level Findings, Relevant Dockets, and Additional Insights

In this appendix we highlight the sub-set of findings presented in the main report that were informed by specific information provided by the PSCDC during the staff interviews. Below is the detailed information provided by the PSCDC as well as supplemental information from publicly-available sources:

Report Finding:
Reliability (resiliency)-related cost recovery requests are part of the General Rate Case

Relevant Dockets:

- FC No. 1103 Order 17141 PEPCO Revenue Rate Increase Request (2013)

http://www.opc-dc.gov/index.php/consumer-topics-a-z/consumer-alert/930-public-input-sought-on-pepco-s-rate-increase-request-formal-case-no-1103

Additional Insight:
On March 2014, the PSCDC approved $23 million of the $52 million Pepco request to increase revenue

(FC No. 1103).[28] It appears that the PSCDC uses the term Formal Case (FC) in lieu of General Rate Case to represent a request for an increase in distribution service rates for Pepco customers. Only one section of the FC pertains to reliability (resiliency)—Rate-Making Adjustment (RMA) No. 22. This specific section increases O&M expenses related to storm restoration efforts, to improve response time. This RMA appears to be a response to the lengthy restoration times following the 2012 Derecho event.

However, the section of FC No. 1103 directly pertaining to reliability improvements, Issue No. 15b, was not approved citing additional information necessary as it relates to the proposed reliability improvement projects. This section requested $964 million over 5 years (2013-2017) to replace or upgrade equipment, add necessary infrastructure, and reduce outage restoration times. These reliability investments were to include a continued focus on upgrading the worst performing feeders in an effort to significantly improve reported reliability metrics (SAIDI and SAIFI).

Report Finding:
No distinction between reliability and resiliency when evaluating the economics of utility investments

Relevant Dockets:
None.

Additional Insight:
The PSCDC does not distinguish between reliability and resiliency, acknowledging that reliability is measured using the IEEE 1366 Standard, but that resiliency is not explicitly considered.

Report Finding:
Limited number of benefit categories considered and difficult to monetize

Relevant Dockets:

- FC 1116-2014-E-153, Order No. 17697 (2014)

http://opc-dc.gov/index.php/consumer-topics-a-z/dc-undergrounding-updates

Additional Insight:
The interviewee indicated that the Commission relies on the IEEE 1366 Standard definitions for SAIDI and SAIFI for tracking reliability impacts and assessing the benefits of investments in reliability/resiliency.

As with the other Commissions we interviewed, the PSCDC expressed a desire to be able to measure the benefit of a reliability (resiliency) investment, which is information that the Commission finds difficult to monetize.

The PSCDC staff person mentioned the importance of seeing more information on momentary interruptions (i.e., power quality) to help them better understand how to proactively manage these short, but potentially costly disruptions.

Report Finding:
Improve tracking of historical utility investments in reliability/resiliency

Relevant Dockets:
FC No. 1103 Order 17424 (2013)
http://www.opc-dc.gov/index.php/consumer-topics-a-z/consumer-alert/930-public-input-sought-on-pepco-s-rate-increase-request-formal-case-no-1103

Additional Insight:
As we learned from the other interviews, tracking the benefits of an approved reliability/resiliency project is an area where regulatory agencies could potentially benefit from greater transparency by the regulated utility (utilities). The PSCDC staff expressed some concern that it is difficult to obtain reliability performance improvement information from the utility to help inform the costs and benefits of past or proposed investments. Currently, the PSCDC is not able to track the economic benefits associated with reliability investments as it is not clear how much the utility actually spends on reliability/resiliency projects that they have been approved for in earlier regulatory proceedings. The latest request for a utility rate increase mentions this specific issue of not being able to track past investments (pg. 38). For this reason, establishing a reporting process for reliability/resiliency project investments together with the corresponding reliability metric(s) will help stakeholders more accurately assess the benefits of past and future expenditures. The interviewee stated they have difficulty getting the utility to provide requested information, citing reasons related to data sensitivity or an inability to track specific expenditures.

Report Finding:
Need for improved customer interruption cost estimation

Relevant Dockets:

- FC 1116-2014-E-153, Order No. 17697 (2014)

http://opc-dc.gov/index.php/consumer-topics-a-z/dc-undergrounding-updates

Additional Insight:
The PSCDC uses the Nexant/LBNL ICE Calculator to assess the estimated cost of lost service for the federal government operating in this jurisdiction. More specifically, staff use the cost per interruption values from the large commercial and industrial (C&I) sector plus some assumed, but undisclosed, adder as a proxy for interruption cost to the U.S. federal government. It was also noted that the residential interruption cost estimate for residential customers is too speculative as the loss to a day-trader is very different from the loss perceived by a stay-at-home parent. The interviewee believes that improving the ability to better capture the interruption cost to the federal government, residential

customers, and other customers is an important area for future work.

Interestingly, the undergrounding case (FC 1116) contains criticism by the Apartment and Building Association of Metropolitan Washington (pg. 23) of Pepco's "inappropriate" use of the Nexant/LBNL ICE Calculator as not based on relevant input assumptions to value the undergrounding benefit at $24 million per year.

Report Finding:
Economics of reliability/resiliency investments are important, but there are other factors

Relevant Dockets:

- FC 1116-2014-E-153, Order No. 17697 (2014)

http://opc-dc.gov/index.php/consumer-topics-a-z/dc-undergrounding-updates

Additional Insight:
For the most part, the decision making regarding investments in reliability/resiliency at the PSCDC is driven by the economic analysis provided by the in-house staff. However, one notable exception is the $1 billion undergrounding legislation (FC 1116) that was not exclusively driven by economics.[29] The tipping point came in the form of a widespread outage in the Washington, D.C. area (2012) resulting in a call for action by Mayor Vincent Gray under Mayor's Order 2012-130. This resulted in the establishment of the Power Line Undergrounding Task Force, which analyzed the technical feasibility of undergrounding new or existing overhead power lines. The Task Force concluded that undergrounding was feasible. Accordingly, legislation known as the Electric Company Infrastructure Improvement Financing Act of 2013 was enacted in May 2014. The main focus of this legislation involved saving older trees from aggressive vegetation management practices. To help pay for the undergrounding project, Pepco was permitted to apply a surcharge to its ratepayers to cover the cost of this project. A key priority for the PSCDC and the local utility, Pepco, is ensuring that the federal government continues to function. For this reason, the national security implications of maintaining reliable power in Washington, DC area may supersede any economic considerations.

Appendix E. Florida Public Service Commission (FPSC)

Key Events and Background: Hurricane Preparation and Response

Response to the 2004-2005 Hurricane Seasons in Florida

The 2004-2005 hurricane seasons were two of the most destructive on record for the state of Florida and the neighboring Gulf Coast region. In 2004, Florida was severely impacted by four major hurricanes—Charley, Frances, Ivan, and Jeanne. These storms caused an estimated $17.5 billion in insurance-claimed damages and forced nearly 10 million people to evacuate. In 2005, another four major hurricanes impacted the state—Dennis, Katrina, Rita, and Wilma. These storms resulted in an estimated $7.2 billion in insurance-claim damages and forced over 5 million people to evacuate, wreaking havoc on an already weakened state.[30] Following these storms, the state took major steps to improve the condition of the electric distribution system in preparation for future severe weather events.

As a first step, the Commission held a workshop on January 23, 2006 convening representatives from local government, utilities, universities, and industry and topic experts to gather information regarding lessons learned from the devastating hurricanes.[31]

Second, the Commission convened what would become an annual meeting in mid-2006 to assess the level of hurricane preparedness from all Florida utilities, municipals and rural electric cooperatives[v] in advance of that year's upcoming hurricane season. From this meeting, the Commission was able to determine where improvements were needed across all utility service territories.[32]

Outside of the general rate case, the FPSC now requires that all investor-owned utilities and local exchange telephone companies to file an annual report that adheres to an 8-year wooden pole inspection cycle. Each subject utility is required to show how they complied with the National Electric Safety Code (NESC) guideline for pole strength and integrity, detailing any pole failures and how they will be addressed (Docket Nos. 060078-EI & 060077-TP).

In the spring of 2006, the Commission also required each of the regulated utilities to file storm preparedness plans and associated costs that are specifically designed to address a number of storm hardening initiatives including[33]:

- Three-year vegetation management cycle for distribution circuits
- Audit of joint-use attachment agreements

[v] FPSC Order No. PSC-06- 00351-PAA-EI on April 25, 2006 (Order 06-0351) to increase collaborative research between the IOUs, municipals, and rural electric cooperatives;
The Public Utility Research Center University of Florida. 2007. "Report on Collaborative Research for Hurricane Hardening." February 26.
http://www.floridapsc.com/Files/PDF/Utilities/Electricgas/EnergyInfrastructure/UtilityFilings/docs/PURC_Hurricane_Hardening_Report.pdf#search=PSC-06-%2000351-PAA-EI

- Six-year transmission structure inspection program
- Hardening of existing transmission structures
- Transmission and distribution geographic information system
- Post-storm data collection and forensic analysis
- Collection of detailed outage data differentiating between the reliability performance of overhead and underground systems
- Increased utility coordination with local governments
- Collaborative research on effects of hurricane winds and storm surge
- Natural disaster preparedness and recovery program

In subsequent years, each of the IOUs is required to address these initiatives in their annual distribution reliability reports to the Commission (FPSC Order No. PSC-06-0351-PAA-EI, in Docket No. 060198-EI).

Under the requirements of Chapter 2006-230, Sections (19)2 and (3), at 2615, Laws of Florida, enacted by the 2006 Florida Legislature (Senate Bill 888), the Florida Public Service Commission was required to submit a report by July 1, 2007 that recommended what actions the state should take to enhance electricity reliability during extreme weather events. In this report, the Commission formally recommended the ten storm hardening initiatives stipulated as part of the annual filing requirement for storm preparedness plans from each IOU.

Since 2005, it was reported that FPL has spent $1.5 billion on strengthening its transmission and distribution system in preparation for the next big storm.[34] In late 2015, the Commission released a report reviewing the 2014 reliability reports by the IOUs, comparing them to one another and assessing storm hardening activities, including the 8-year wooden pole inspection program and the Storm Preparedness Initiatives. The report suggested reliability across the IOUs in Florida was mixed over the last five years (2010-2014).[35]

Resilience Measures Taken Before Hurricane Matthew Expedited Power Restoration

Hurricane Matthew began impacting the Southeast United States on Thursday October 6, 2016 and the flooding caused by the storm continued to affect North Carolina and South Carolina. The initial effects of the storm were felt from Florida to Virginia with increased rain and wind causing damage to energy infrastructure. Efforts to restore damaged infrastructure involved mutual assistance from utilities from across the country. More than 99% of customers who lost power were restored within 8 days, by 11am on October 14, 2016. [36, 37]

Florida Power and Light (FPL) has invested $2 billion over the last 10 years, leveraging $200 million in Federal investment through the 2009 American Recovery and Reinvestment Act (ARRA), to advance smart grid functionalities with technologies such as advanced smart meters, distribution automation, and advanced monitoring equipment for the utility's transmission system. FPL suggested that investments in these resilience measures helped to expedite FPL's restoration timeline. They suggest that restoration efforts before these upgrades would have been longer and more costly. FPL reports that 98% of the 1.2 million customers who lost power were restored within 2 full days.[38]

Research Method

LBNL interviewed FPSC staff on May 26, 2016. In this appendix, we present information specific to the interview with the FPSC staff person. Based on the recommendations, we then investigated pertinent reliability/resiliency aspects of regulatory docket proceedings and report them below.

High-level Findings, Relevant Dockets, and Additional Insights

Florida represents a unique state when it comes to reliability/resiliency. With a largely sub-tropical climate and an abundance of coastline, the state is vulnerable to hurricane activity from both the Atlantic Ocean and Gulf of Mexico. This was especially true from 2004 to 2005 when Florida was significantly impacted by numerous devastating hurricanes. The state legislature took immediate action to identify improvements that could be made to ensure that Florida was better prepared for future severe weather events. Actions were then taken by both regulators and investor-owned utilities to proactively harden the distribution system in an effort to reduce power interruptions as the result of these severe storms.

Below is the detailed information provided by staff at the FPSC as well as supplemental information from publicly-available sources:

Report Finding:
Reliability (resiliency)-related cost recovery requests are part of the General Rate Case

Relevant Rate Increase Dockets:

- Docket 130140, Gulf Power Request for Rate Increase (2013), http://www.psc.state.fl.us/library/filings/13/02585-13/02585-13.pdf
- Docket 120015, FPL Request for Rate Increase (2013), http://www.psc.state.fl.us/library/filings/12/00293-12/00293-12.pdf
- Docket 140025, FPUC Request for Rate Increase (2014), http://www.psc.state.fl.us/library/filings/14/01949-14/01949-14.pdf
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- Docket 080677, FPL Request for Rate Increase (2009), http://www.psc.state.fl.us/library/filings/08/10711-08/10711-08.pdf

Additional Insight:
The FPSC acknowledged that reliability/resiliency cost recovery is sometimes filed as part of the General Rate Case. However, in recent years due to extraordinary circumstances, the FPSC has largely addressed reliability/resiliency in separate dockets that are aimed at storm-hardening the state for the next severe storm.[39]

Although we list some recent requests for rate increases, in general, we found little or no information detailing specific requests for reliability/resiliency cost recovery in these most recent filings. Interestingly, in 2009, Florida Power and Light (FPL) was only granted $75 million of the $1.3 billion it requested as part of a rate increase. This request did not make mention of projects related to reliability/resiliency. The focus, instead, was on inflation adjustments that FPL claimed were long overdue. The Commission's approval of less than 6% of the total FPL request caused a significant controversy. In the months after the decision, the Florida Senate did not renew numerous commissioner seats.[40] FPL submitted another rate increase request of $690 million (2013) and the Commission approved a $350 million rate increase.[41]

Report Finding:
No distinction between reliability and resiliency when evaluating the economics of utility investments

Relevant Dockets:
None.

Additional Insight:
The FPSC staff person did not distinguish between the terms reliability and resiliency. It was acknowledged that there is some discrepancy in how resiliency is defined even within the Commission—some refer to resiliency as storm hardening and others believe that deployment of smart meters is considered resiliency.

Report Finding:
Limited number of benefit categories considered and difficult to monetize

Relevant Dockets:

- Chapter 2006-230, Sections 19(2) and (3), at 2615, Laws of Florida, Enacted by the 2006 Florida Legislature (Senate Bill 888)
- FPSC Rule 25-6.0455 (2006)
- FPSC Order No. PSC-06-0643-FOF-EI, Docket 060512-EI (2006)

Additional Insight:
Annual reliability reports are submitted pursuant to Rule 25-6.0455 and involve reporting reliability metrics such as SAIDI and SAIFI. These performance metrics were modified after the 2004-2005 hurricane season to include reliability data for extreme weather events. This change involved reporting both adjusted and unadjusted reliability metric information. Prior to this, the IOUs were only required to report SAIDI and SAIFI without the inclusion of major events. This change enabled the Commission to assess the contribution of severe weather to the overall reliability of each reporting utility. Over the past decade, the focus of the FPSC has been on two priorities—reducing the number of outages and improving restoration times, both of which are informed by the SAIDI and SAIFI metrics in helping assess economic investments in reliability/resiliency.

Report Finding:
Need for improved customer interruption cost estimation

Relevant Dockets:

- FPSC. 2007. Chapter 2006-230, Sections 19(2) and (3), at 2615, Laws of Florida, Enacted by the 2006 Florida Legislature (Senate Bill 888). July 1. http://www.psc.state.fl.us/Files/PDF/Utilities/Electricgas/EnergyInfrastructure/UtilityFilings/docs/stormhardening2007.pdf

Additional Insight:
The FPSC was asked whether they use the ICE Calculator to assess the cost of interruptions in Florida. The staff person indicated that they do not use the ICE Calculator because there are concerns about the accuracy of the results from this tool, especially with respect to the costs to residential customers. Instead, the FPSC focuses on the cost from physical losses (e.g., flooded generators, downed utility poles). In 2007, the Commission reported to the legislature insurance claims as the basis for estimated economic damages from each major hurricane that hit the state during the 2004-2005 seasons.

Report Finding:
Economics of reliability/resiliency investments are important, but there are other factors

Relevant Dockets:

- PSC-07-1023-FOF-IE http://www.psc.state.fl.us/ClerkOffice/ShowDocket?orderNum=PSC-07-1023-FOF-EI

Additional Insight:
After the state of Florida was hit with significant hurricane activity in 2004-2005, the FPSC—and the IOUs—faced political pressure to improve the infrastructure of the state's distribution system to better withstand severe storms. As noted earlier, severe weather events motivated the state legislature to address reliability/resilience in Florida.

The Commission reports produced after the 2004-2005 hurricane events acknowledge that the actions it took to strengthen the electric power system in Florida were not economically favorable. This passage highlights the desire to invest in storm-hardening efforts despite the fact they were not shown to be cost-effective in terms of realized net-positive benefits.

"Assuming a hurricane frequency of once every 3-5 years, FPL estimates a storm restoration cost savings, on a net present worth basis, of approximately 70% to 45% of the hardening costs over a 30 year period. FPL's assumptions regarding the average frequency of hurricanes is based on statements from the National Hurricane Center and the historical frequency of storms impacting FPL." (FPL Plan, Docket 070301, pp. 14-15)

According to the FPSC staffer we interviewed, the motivation was to ensure the state could significantly improve its restoration efforts in preparation for the next big storm, which at the time of the interview, still had yet to arrive.

As a possible non-economic influence, the FPSC stated they rely entirely on their in-house staff to conduct the cost-benefit analyses necessary to assess requests for cost-recovery from reliability/resiliency efforts. The Commission does consider comments submitted by consultants hired by the utility or ratepayer advocacy groups, economic or not, as part of the proceeding, but the Commission does not hire third-party consultants to perform economic analyses.

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