

Resilience planning and valuation framework

Straw proposal for discussion

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Preamble: what the straw proposal does and does not do?

□ It does

- ▣ Offer high level objectives that a VT-specific resilience planning and valuation framework should achieve
- ▣ Outline the core planning practices and components needed to implement this framework
- ▣ Describe with a bit more detail how the core planning practices enable the implementation of a cost benefit analysis

□ It does not

- ▣ Indicate what is the regulatory implementation for the framework
- ▣ Establish any type of resilience target or even how to set such a target
- ▣ Prescribe any technical implementation details; all content is preliminary and designed to motivate a discussion. The major components of the framework are relatively set, but are also open for discussion

□ Straw proposal is structured around the three working groups

- ▣ Resilience metrics
- ▣ Core planning practices
- ▣ Valuation approaches: cost benefit analysis and “budget allocation” methods



An electric distribution system resilience planning framework should enable decision-makers to

1. Characterize the **past, present, and future events** that may challenge system resilience, including extreme weather such as thunder-, wind-, and ice storms.
2. Estimate and/or simulate the **technical impacts of these events** on grid infrastructure, customers, utility processes, and/or non-grid infrastructure.
3. Develop **tractable metrics** that reflect these impacts and can be used for regulation, utility planning, and *ex post* evaluation of resilience investments.
4. Evaluate the **economic and other costs** resulting from these impacts.



An electric distribution system resilience planning framework should enable decision-makers to

5. Identify **solutions that mitigate or avoid costs**, quantitatively characterizing their mitigation potential.
6. **Prioritize and select solutions** using fully documented methods, models, data, and assumptions.
7. Following installation of solutions and subsequent extreme weather events, determine whether **solutions performed as intended** and that resilience of the system is improved based on specific metrics – if not, provide a procedure for updating/correcting ex-ante analyses accordingly.
8. **Transparently and clearly report planning procedures**, including assumptions, data sources, intermediate models, and methodologies. When possible, allow stakeholders to review and use relevant models to reproduce intermediate and final results.



Three components of straw proposal

Resilience metrics and standards

Track and report on the resilience performance of their systems using a prescribed set of resilience metrics

As performance data is assessed, use it to define new resilience standards with metrics' target values

Core planning practices

Utilities have to demonstrate a certain level of technical depth in their resilience planning analysis

Comply with transparent and clear reporting requirements for their data, methods, tools, and results

Valuation and cost-benefit analysis

Adequate ex-ante cost-benefit analysis to demonstrate that the proposed investments will produce benefits in excess of costs

Alternative approach to valuation of resilience and investment decision-making possible



Resilience metrics and standards

- All utilities will collect and report the following data to track and report the following metrics at both the systemwide and, as appropriate, at the circuit or planning zone level, on an annual basis:
 - ▣ “All-in” SAIDI and SAIFI (i.e., including major event days)
 - ▣ Customer minutes interrupted (CMI) and CMI/event
 - ▣ Number of customers without power
 - ▣ Number of customers experiencing multiple (X) interruptions (CEMI-X)
 - ▣ Number of customers experiencing long (X) interruption durations (CELID-X)
 - ▣ Critical facilities experiencing outages - such as hospitals, government facilities (fire, public safety, emergency response), and others that may be utility service territory-specific.
- **Discussion points:** Is this the right set of resilience metrics? Are there any others that you think should be included? Do you foresee any problems collecting and reporting them?



Resilience metrics and standards

- Individual utilities may track additional metrics for their own planning and operations purposes, and regulators may request additional metrics from individual utilities as appropriate.
- In consultation with the Department, the utilities will use the above metrics to assess the performance of resilience measures — i.e., in reducing the vulnerability of their distribution system infrastructures to power interruptions caused by extreme weather.
- As performance data becomes available, the metrics will eventually be used to define resilience standards with target values of the metrics that utilities must achieve.
- **Discussion points:** What do you think about the path we envision that begins with reporting requirements that, after some time, ultimately inform resilience standards?



Questions/feedback on resilience metrics?



Core planning practices

Weather and climate

Ongoing monitoring and measurement of weather variables

Select and report on models, methods, data, and assumptions to project weather event frequency, severity, and type

Risk and vulnerability assessment

Select models, methods, data, and criteria used to identify vulnerable locations and infrastructure

Develop clear processes to estimate risk and vulnerability and report transparently

Resilience measure analysis

Select models, methods, and data to estimate the impact of individual projects and portfolios on resilience improvement

Assess the impacts based on the resilience metrics and standards part of this proposal

Ex post measurement and verification

Develop a process to compare the outcomes of installed resilience measures to ex-ante planning assessments

Select models, methods, and data sources to perform this comparison



Questions/feedback on core planning practices?



Valuation: cost-benefit analysis

- Utilities seeking approval of large investments to enhance system resilience, and/or seeking to achieve a level of resilience beyond the minimum level stipulated by the resilience standards, must provide an adequate ex-ante cost-benefit analysis to demonstrate that the proposed investments will produce benefits in excess of costs.
- **Discussion point:** The idea here is that an ex-ante CBA would be required when certain thresholds are met – i.e., to achieve “stretch” resilience targets and/or make significant investments in new or replacement infrastructure. What criteria should determine whether an ex-ante CBA is required?



Valuation: cost-benefit analysis

- At a minimum, a cost-benefit analysis (CBA) must include the following five components, all adequately described and documented.
 - 1) **Resilience projects:** Characterize the specific project being proposed to enhance electricity resilience, including its estimated cost, useful life, number and type of customers benefited, and expected mitigation potential using resilience metrics, and alternative projects considered
 - 2) **Risks:** Characterize the events (e.g., different types of extreme weather) that may challenge system resilience over the useful life of the project based on historical and/or model-generated data, capturing both their severities and frequencies
 - 3) **Physical Impacts:** Project the physical impacts of risk events on electric infrastructure assets, with and without the proposed resilience intervention
 - 4) **Power Interruptions:** Project the power interruptions that will result from risk events, including their magnitudes and durations, with and without the proposed resilience intervention; ultimately estimate energy not served (ENS) in MWh in both cases



Valuation: cost-benefit analysis

- 5) **Economic Impacts:** At a minimum, the following three benefits must be quantified in monetary units that are directly comparable to estimated project costs (e.g., net present value of benefits in dollars):
- **Avoided customer interruption costs**
 - Multiply estimated reductions in ENS (MWh) due to the proposed resilience project from component (4) by an appropriate value of lost load (VOLL) estimate (\$/MWh) or set of estimates (e.g., those found in the Interruption Cost Estimate Calculator 2.0)
 - **Avoided system restoration costs**
 - Use the information from component (3) on how many fewer electric infrastructure assets would have to be repaired/replaced due to the proposed resilience project, along with estimated repair/replacement costs informed by experience
 - **Avoided costs of implementing alternative reliability/resilience activities**
 - If the proposed resilience project would result in cost savings by reducing needs for existing reliability/resilience activities (e.g., undergrounding that reduces vegetation management needs), then these benefits should be quantified



Valuation: cost-benefit analysis

- Utilities are welcome to identify and estimate other benefits that the proposed resilience project would achieve, beyond the three required benefits described above, and include them in the cost-benefit analysis.
- In addition to providing the CBA described above, a utility that implements a resilience project for which CBA was required should also conduct an ex-post comparison of actual costs and benefits to the planned or estimated costs and benefits.
 - If actual costs or benefits differ significantly from ex-ante estimates, then the utility should attempt to explain the discrepancy and outline how it will modify assumptions in future analyses.
- **Discussion points:** We have designed this CBA blueprint to establish a minimum standard for what an ex-ante CBA must include and how it must be performed, while allowing for flexibility in terms of specific methods, data, and tools. Do you feel that you could feasibly carry out a CBA that satisfies these requirements? Should the framework be more flexible or more prescriptive? Should its minimum requirements entail more or less sophisticated approaches?



Valuation: enhanced budget allocation approach

- For utilities budgeting for “routine” resilience investments and/or as needed to meet required standards, the same previously outlined CBA components could be applied as part of a budget allocation paradigm for choosing which resilience projects to pursue
 - ▣ Essentially, rank resilience projects according to their benefit/cost ratios (calculated using our CBA blueprint), and approve them in descending order until a given capital budget has been exhausted
- We present this alternative implementation because it may balance the desire to incorporate CBA and economic decision-making with existing practices that VT utilities are using to select capital projects without necessitating major increases in revenues and rates
- **Discussion points:** How should the allowable budget for resilience projects be determined (e.g., basing it on CBA vs. revenue/rate considerations)? Should budget setting and project selection for resilience be separated from capital budgeting and project selection for other purposes, or should it be integrated into a general, holistic capital allocation process?



Questions/feedback on valuation?



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