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Decision-Making Paradigms for Electricity Resilience Projects

Valuation Working Group
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Motivation

- "More importantly, completing a series of initial ZOI investments will provide meaningful baseline data for conducting **more comprehensive cost-benefit analyses to better assess resilience strategies** that will result in long-term cost savings for GMP's customers"
  - Vermont PUC Case No. 23-3501-PET, October 2024
- Before reviewing specific methodologies and tools that Vermont utilities could employ to carry out analyses, there is a high-level choice that needs to be made about the most appropriate decision-making paradigm for selecting electricity resilience projects
- *What type of analysis should be provided to justify spending ratepayer dollars on a resilience investment?*

Decision-Making Paradigms

I will briefly go over three possible paradigms, the analysis elements that each requires, and their relative strengths and challenges

1. Cost-benefit analysis

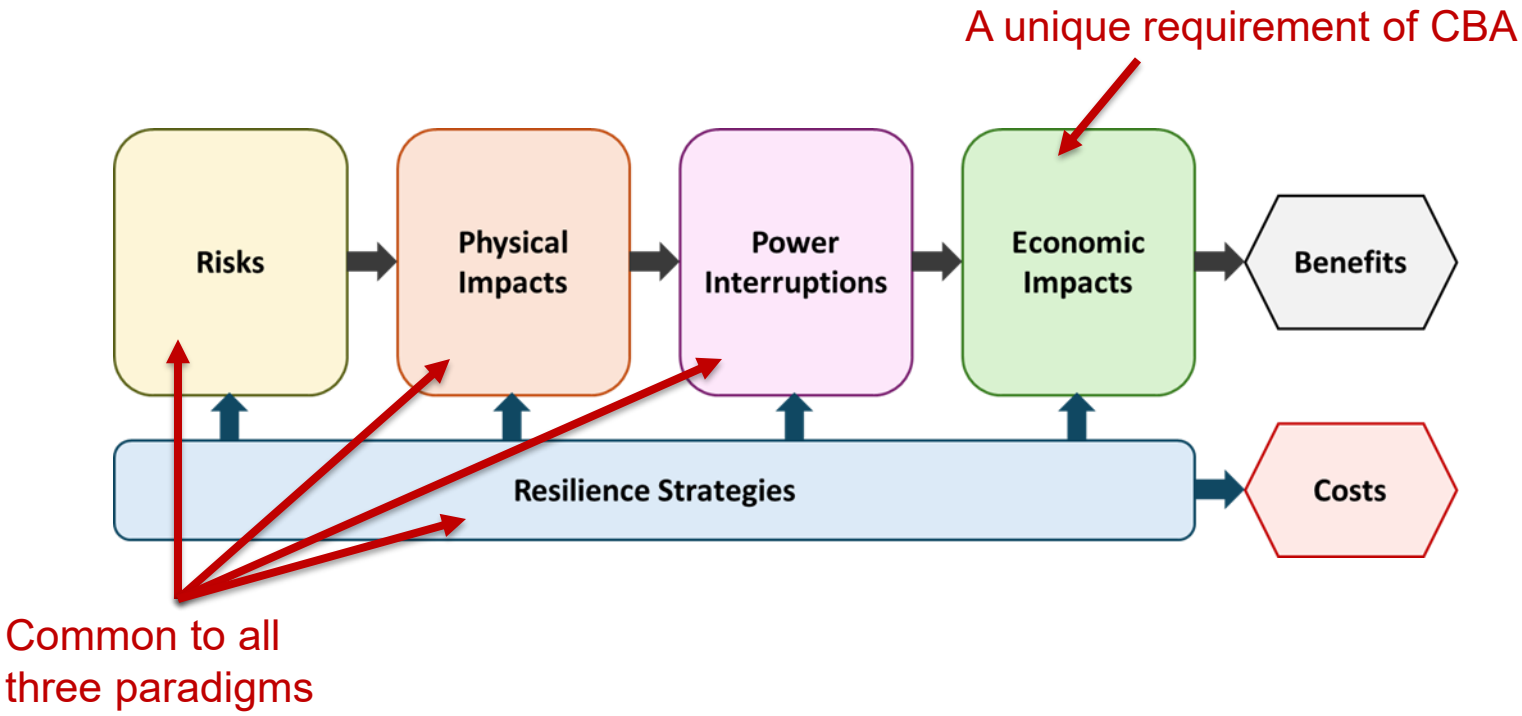
2. Least-cost planning

3. Budget allocation

Cost-Benefit Analysis: General Structure

- Consider a resilience project
- Estimate its costs and benefits, both in dollars
  - Scenario/sensitivity analysis (good idea with any paradigm)
- Do the benefits exceed the costs?
  - If Yes, pursue the project
  - If No, decline the project

Cost-Benefit Analysis: Elements



Cost-Benefit Analysis: Strengths

- The “metric” (net benefits in dollars) is inherently clear and so is the relevant decision-making criterion (are net benefits positive?)

- Provides flexibility to include a wide range of costs and benefits
  - Avoided power interruption costs, avoided system repair and restoration costs, avoided O&M costs, electricity bill savings, aesthetic benefits, avoided impacts to critical facilities, etc.
  - Ability to comprehensively consider all costs and benefits makes project type distinctions (e.g., resilience vs. reliability) less critical

- Should lead to the economically correct level of resilience spending – economically justified projects go forward, unjustified projects do not

Cost-Benefit Analysis: Challenges

- Estimating some categories of benefits in dollars is difficult – this is an extra analysis element that CBA requires
- How should candidate projects be envisioned for CBA, and how narrowly or broadly should a “project” be defined?
- CBA does not make it easy to capture interactions among multiple projects, where benefits are synergistic or cannibalize each other
- Pursuing all net-beneficial projects could entail a large amount of resilience spending, and in this case some prioritization mechanism (e.g., budget allocation based on benefit/cost ratios) could be needed
- A project may be net-beneficial but not part of the least-cost resilience strategy – conflict with regulatory frameworks based on least-cost?

Least-Cost Planning: General Structure

- Define a resilience standard by choosing a resilience metric (or metrics) and setting a target level that utilities must meet
- Utilities determine a set of projects that enable them to satisfy the standard at the lowest possible cost

Least-Cost Planning: Strengths

- Directly corresponds to the goal of making electricity service more resilient by treating the resilience level as a design parameter
- Least-cost planning has been the consensus paradigm for resource planning and reliability planning, so extending this approach to resilience planning would be consistent with those practices
- Does not require monetization of benefits like CBA does
- In principle, least-cost planning involves considering the whole portfolio of resilience projects together, including their interactions

Least-Cost Planning: Challenges

- Agreeing on resilience metrics and target levels is difficult
- Setting target levels too stringently could lead to excessive costs, while setting them too loosely could lead to inadequate resilience
  - Setting appropriate target levels is itself a challenging problem that is best addressed using CBA
- The full space of resilience projects that could be pursued is very large and varied, and they interact with each other – demonstrating that some portfolio is truly the least-cost solution may be impractical

Budget Allocation

- Given a pre-defined budget to allocate to resilience projects
- Choose a resilience metric to measure the effectiveness of the selected projects at improving resilience
- Determine the most effective set of resilience projects whose cost is within the available budget

- Basically the inverse of least-cost planning:

	Least-Cost Planning	Budget Allocation
Fixed by design	Resilience level	Total spending
Outcome of planning	Total spending	Resilience level

Budget Allocation: Strengths

- Caps spending on resilience projects and can directly incorporate budget limitations
- Does not require monetization of benefits like CBA does
- Some flexibility in terms of implementation:
  1. Consider individual projects in isolation, rank them according to some “bang for the buck” metric (resilience improvement per dollar), and invest up to the budget
  2. Determine the maximally effective portfolio of projects within the budget, considering the interactions among them
- Could be combined with CBA to essentially rank projects in terms of their benefit/cost ratios and invest up to the budget

Budget Allocation: Challenges

- Agreeing on resilience metrics for measuring project effectiveness is difficult, as is setting the budget level
  - Can be difficult to predict what level of resilience will result from setting the budget at a given amount
  - Setting an appropriate budget is itself a challenging problem that is best addressed using CBA
- The full space of resilience projects that could be pursued is very large and varied, and they interact with each other – demonstrating that some portfolio truly maximizes resilience may be impractical

Resilience vs. Reliability

- What is *different* about resilience that may favor a different paradigm (e.g., CBA) from the least-cost planning approach used for reliability?

- More costly investments
- Resilience focuses on rare, high-impact events – greater need for thorough ex-ante analysis because benefits are highly stochastic and may take many years to appear in empirical performance data
- There is no consensus on resilience metrics that should be used to define standards, or what their target levels should be

- *For more on resilience vs. reliability, see our technical brief "The concept of resilience and its relationship with reliability in Vermont"*

Preview of What's Ahead

- We have written a technical brief that reviews the research literature on CBA of electricity resilience projects, surveys the available methods and tools, and reflects on their strengths and limitations
- We look forward to discussing these approaches in detail in our upcoming Valuation WG meetings