Balancing Risks and Benefits from Grid Modernization Investments

A National Summit on Smart Grid and Climate Change

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Some Thoughts about Grid Modernization from the Dismal Science

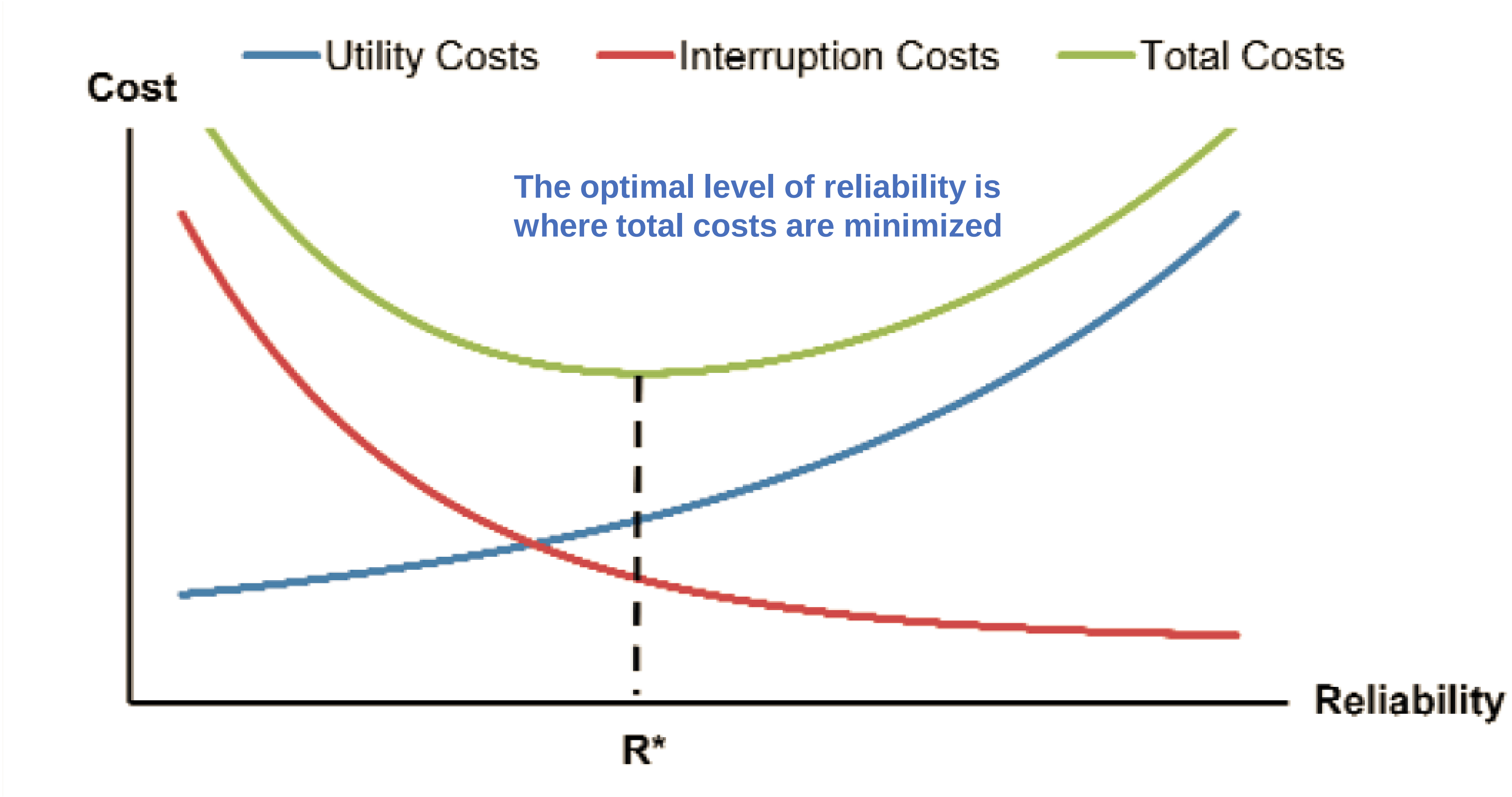
The Emerging Dilemma in Grid Modernization

- Driving forces behind grid modernization?
  - Increasingly strong evidence of vulnerability of society to grid services
  - Aging infrastructure
  - Regulatory intervention changing energy pricing
  - Emerging technologies and businesses
- Key questions about the economics of grid modernization
  - How do centralized delivery systems compare with distributed energy resource plans (cost and performance)?
  - When are grid modernization investments of what kinds cost justified?
  - How can investments in DER, Smart Grid and grid hardening be balanced?
- <u>The bottom line -- How should scarce resources be allocated across investment alternatives?</u>

Types of Grid Modernization Investment Decisions

1. Investment in centralized grid facilities driven by load growth or operating constraints (i.e., air quality regulations)
   - New or updated utility scale generating stations
   - New or upgraded transmission facilities
2. Smart Grid investments (automated switching, self healing topologies, smart meters, VVO, CVR, etc.) to improve grid performance (efficiency, reliability, power quality and resilience)
3. Integration of DER into existing grid in lieu of investment in conventional T&D -- DER (solar, CHP, wind), DR, EE, Storage

VBRP is a well developed and understood methodology for establishing the economic value of "conventional" T&D investments



Valuing Impacts of Grid Modernization on Reliability and Resilience

Impacts on Tangible Customer Outage Costs

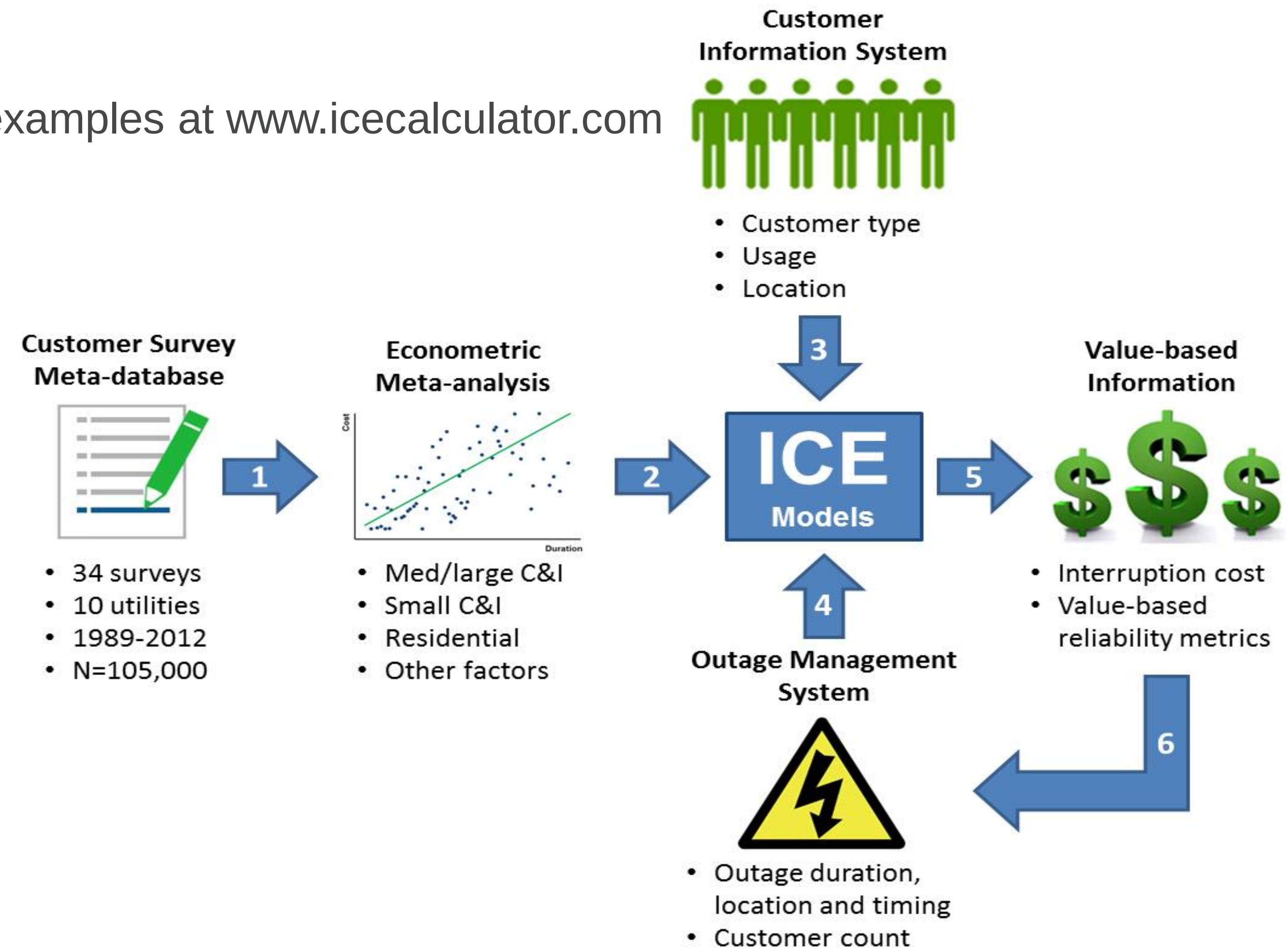
- Costs customers experience as a result of electricity service interruptions and power quality problems.
- Expressed as cost per outage event, cost per unit of time (e.g. hour or minute), cost per kW of demand or cost per un-served or annual kWh
- Measured by surveying representative samples of customers
- A vital element to consider in evaluating risks related to investments

Intangible (but significant) Impacts

- Loss of life
- Disease from water borne illnesses
- Pubic safety
- Migration

ICE Calculator – a Resource for Valuing Reliability

See examples at www.icecalculator.com



Example: Benefits/Costs considered in DER evaluation

Criteria		Definition
Cost per Effective MW		Effective MW is the amount of peak load in MW's that can be carried by a specific resource after taking into account reliability, dispatch constraints, load shapes, etc. Cost per Effective MW is the component Effective MW divided by its total cost to ConEd, including project costs, incentives, and administrative costs.
Other Energy Benefits		Other energy benefits include avoided distribution costs (based on system wide average primary feeder, transformer, and secondary cable costs), avoided generation capacity costs (based on NYISO capacity demand curve), and avoided energy costs (based on NYISO projected LBMPs for NYC). Other known energy benefits can also be included.
Non Energy Benefits	*Resiliency benefits*	Accounts for expected outage costs from major weather events avoided by the resource over its lifetime.
	Avoided CO2 emissions	Benefit of emissions avoided over the lifetime of the resource.
	Health benefits	Benefit of SOx, NOx, and particulate emissions avoided over the lifetime of the resource.
	Economic benefits	GDP and employment impacts resulting from energy savings
	Other non-energy benefits	Other avoided resource costs, such as water conservation, over the lifetime of the resource.
Proposal viability		Estimation of likelihood of proposal success. Factors considered include execution details provided in the RFI, such as marketing plan, customer targets, etc.
Respondent qualifications		Estimation of demonstrated ability of the contractor to successfully execute the proposal. Factors considered include experience in similar past projects.
Reliability of load reduction		Estimation of likelihood the DER technology will deliver stated load reduction. Factors consider include newness of the technology and proven measurement of load reduction.
Flexibility of resource		Estimation of the ability of the resource to be dispatched at any time.
Availability of other funding sources		Degree to which additional funds are provided by outside initiatives (e.g., not utility or participant).

Three approaches to incorporating reliability & resiliency into grid modernization decisions

	Approaches for incorporating reliability & resiliency		
Impacts	**Ignore**	**Maintain**	**Measure & adjust**
Changes in reliability	↓ May inadvertently decrease	→ Keep current level	↓↑ May increase or decrease (aligned with customer value)
Net Benefit Optimization	Excludes reliability	Maintains current reliability as a constraint (assumed to be large but unknown)	Value-Reliability function is an input to optimization
Pro	Takes zero incremental effort	Simpler to implement (only need to model portfolio to maintain current reliability)	Allows more portfolio flexibility for arriving at net benefits due to aligning cost with value
Con	Could lead to unforeseen reliability issues and future costs	Constrains net benefit maximization, resulting in lower net benefits	Can be costly and time consuming to implement
Appropriate use	Never	When implementation resources are constrained	When implementation resources are available

Key need: a common, standardized framework for evaluating grid modernization investments as a portfolio

	Issue	Understand	Quantify
1	**Siloed grid modernization** decisions have potentially resulted in sub-optimal investment	What is the most cost-effective grid modernization **investment portfolio** across Hardening, Smart Grid, DER?	**Comparison of impact across investment options** on utility cost AND customer value
2	**Reliability & resiliency benefits likely substantial** and may outweigh other benefits	How **can customer value be accurately measured** against other more traditional benefits?	**Region / utility specific outage costs** measured using standard survey best practices
3	**DER marginal reliability impacts** have only been considered at low penetration	Is there an **optimal level of DER** investment followed by diminishing returns?	**Influence of DER penetration** level on SAIFI / SAIDI
4	**Interactions / synergies between grid modernization investments** largely unstudied	Which options are **substitutes versus complements**? How do they interact with each other?	**Combined vs. individual impact** of options on SAIFI/SAIDI
5	**Lack of standardized, accepted resiliency benefit evaluation framework**, leading to exclusion from decisions	What is a standardized **economic framework for evaluating resiliency benefits**? What are the missing pieces?	**Likelihood of a catastrophic weather event** (e.g., 50 year storm = 2%) **Quantity and type of customers** likely to get affected

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Discussions