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Docket Number:	17-IEPR-09
Project Title:	Climate Adaptation and Resiliency
TN #:	220893
Document Title:	U.S. Department of Energy Guidance on "Cost-Benefit Analyses for Resilience Investments" and "Resilient Utility Roadmap"
Description:	8.29.2017: Presentation by Craig Zamuda of Department of Energy
Filer:	Raquel Kravitz
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	8/25/2017 10:31:11 AM
Docketed Date:	8/25/2017



**U.S. Department of Energy Guidance on
*“Cost-Benefit Analyses for Resilience
Investments” and “Resilient Utility
Roadmap”***

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Supporting the U.S. Department of Energy

Partnership for Energy Sector Climate Resilience

- Membership includes 17 power companies and growing:
 - ❖ Represents approximately 20% of U.S. generating capacity, serving approximately 25% of U.S. customers
 - ❖ Includes broad array of companies geographically dispersed across the Nation

Investor-Owned

- AVANGRID
- Consolidated Edison of New York
- Entergy
- Exelon Corporation
- National Grid
- Pacific Gas and Electric ★
- Pepco Holdings Inc.
- Public Service Electric and Gas
- San Diego Gas and Electric/ Sempra ★
- Southern California Edison ★
- Xcel Energy

Cooperatives

- Great River Energy

State/Municipal

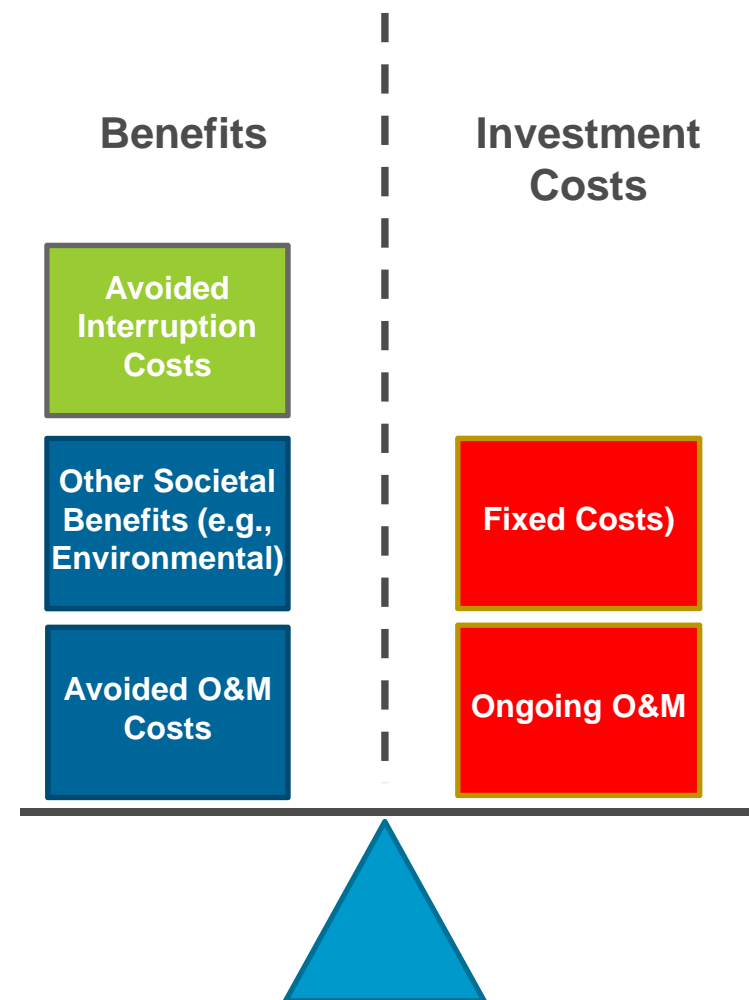
- Austin Energy
- New York Power Authority
- Seattle City Light
- Sacramento Municipal Utility District ★

Federal

- Tennessee Valley Authority

Challenge for Resilience Investments: Key Findings of DOE Analysis

- *Resilience-related cost recovery requests are typically part of the General Rate Case*
- *Costs of investments are generally better understood and easier to monetize*
- *Resilience Benefits are more difficult to monetize (e.g., challenge of estimating probability of future events & magnitude of impacts, externalities, societal benefits, co-benefits)*
- *Economics of resilience investments are important, but other factors are also influential*



Forthcoming “Cost-Benefit Guidebook for Resilience”

Project: Develop a “strawman” cost-benefit guidebook for utilities and regulators that are considering investments in resiliency

Purpose: Provide step-by-step guidance for evaluating the economics of investments in power system resiliency; include compendium of resiliency investment cost and benefit categories and methods that have been considered in a number of jurisdictions

Intended audience: Regulators and staff at utility commissions; long-term planning staff at utilities

Partners: U.S. Department of Energy’s *Office of Energy Policy and Systems Analysis*; Lawrence Berkeley National Laboratory; staff at public utility commissions; electric utility staff (members of Partnership for Energy Sector Resilience); other stakeholders

Direct Costs of Climate & Extreme Weather Impacts: Examples

Extreme Weather/Climate Threat	Direct Cost of Impacts
Nuisance Flooding (Periodic, Temporary)	<ul style="list-style-type: none"> • Restoration and repair costs, including parts and labor • Replacement costs for damaged assets, including parts and labor • Administration of restoration and repair activities, including inspections, procurement, and installation/removal of temporary measures like portable substations
Permanent Inundation due to Sea-Level Rise	<ul style="list-style-type: none"> • Relocation costs, including property, infrastructure, engineering, and installation • Costs to connect relocated assets and supporting infrastructure • Replacement costs for equipment that cannot be relocated
Extreme Storm Surge Event	<ul style="list-style-type: none"> • Restoration and repair costs, including parts and labor • Replacement costs for damaged assets, including parts and labor • Administrative costs
Wildfire	<ul style="list-style-type: none"> • Inspection and repair/replacement costs for assets damaged by smoke exposure • Replacement costs for assets damaged by fire
Warmer Temperatures and Extreme Heat Events	<ul style="list-style-type: none"> • Restoration costs for outages • Replacement costs for equipment needing earlier replacement

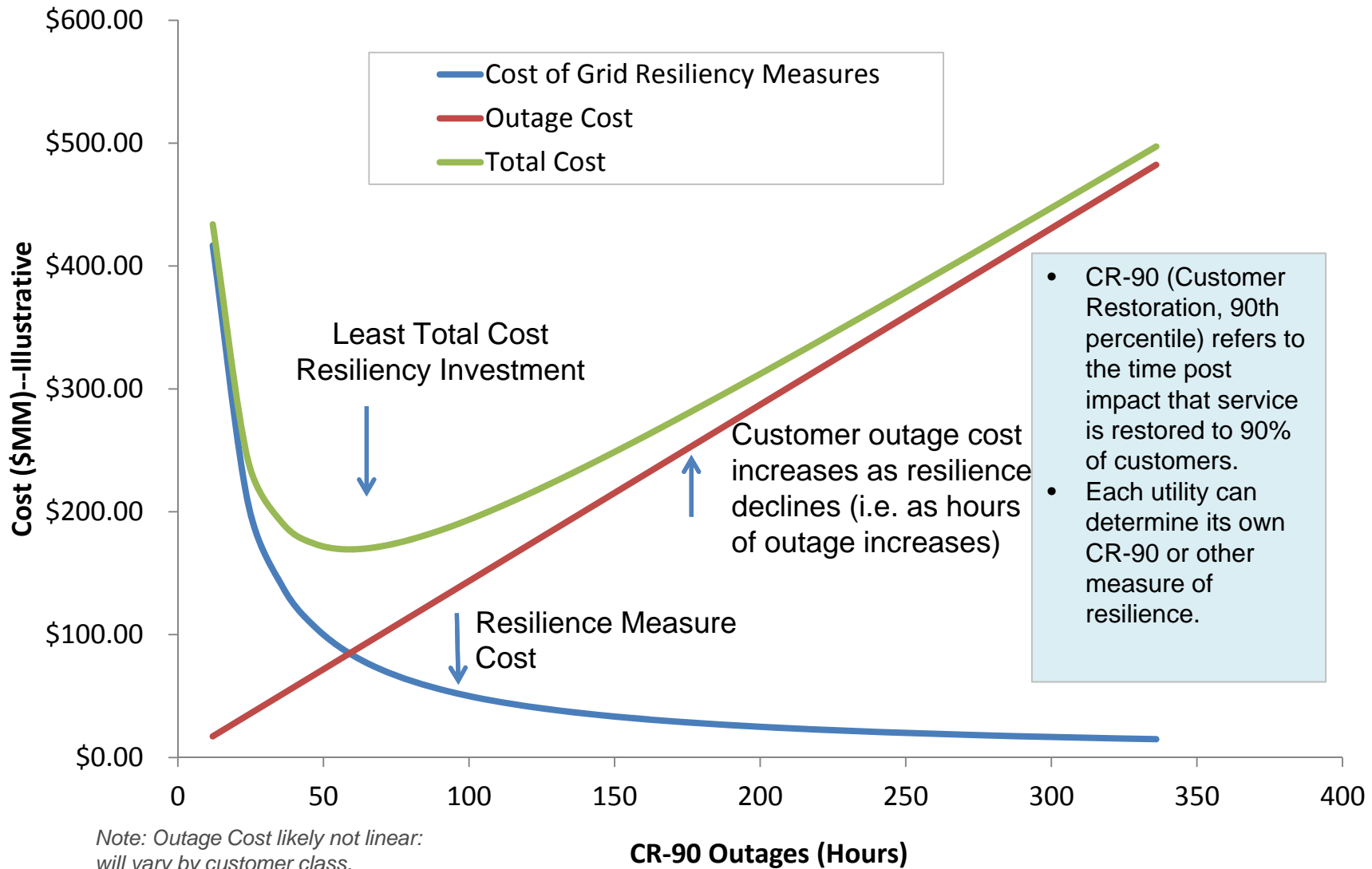
Indirect and Induced Costs: Examples

Consumer Class	Indirect Costs to Rate Payers	Induced Costs to Society or Non-Consumers
Residential	<ul style="list-style-type: none"> • Inconvenience, lost leisure, stress, etc. • Out-of-pocket costs: <ul style="list-style-type: none"> -- Spoilage -- Property Damage • Health and safety effects 	<ul style="list-style-type: none"> • Costs to other households and firms
Industrial, Commercial, and Agricultural	<ul style="list-style-type: none"> • Opportunity costs of idle resources such as labor, land, and capital • Shutdown and restart costs • Spoilage and damage • Health and safety effects 	<ul style="list-style-type: none"> • Cost on other firms that are supplied by impacted firm (multiplier effect) • Costs on consumers if impacted firm supplies a final good • Health and safety related externalities
Infrastructure and Public Service	<ul style="list-style-type: none"> • Opportunity cost of idle resources • Spoilage and damage 	<ul style="list-style-type: none"> • Costs to public users of impacted services and institutions • Health and safety effects • Potential for social costs stemming from looting, vandalism

Categories of Resilience Benefits: Examples

- Reduced/avoided electricity service interruptions and power quality problems
- Reduced/avoided restoration and repair costs, including parts and labor
- Reduced/avoided replacement costs for damaged assets, including parts & labor
- Reduced administrative costs including: inspections, procurement, installation/removal of temporary measures (e.g. portable substations)
- Enhanced energy supply & reduced energy demand, improved energy efficiency, managed demand response, reduced costs
- Enhanced Co-benefits: Societal benefits (e.g., health services, public safety, water treatment, transportation, communication, ecosystems services), GHG mitigation

Solving For “Optimal” Resiliency Investments



Resilient Utility Roadmap

- **DOE's Office of Energy Policy and Systems Analysis** is collaborating with Sandia National Laboratory and Argonne National Laboratory to develop a Resilient Utility Roadmap
- **The Roadmap will:**
 - Characterize the key attributes of a resilient utility & provide illustrative examples from utilities of best practices associated with each key attribute
- **Structured in a framework of progressing maturity** (e.g., initiating, progressing, optimizing, leading, and transforming)
- **Assist regulators, utilities and other stakeholders** in resilience planning and implementation, and making the business case for resilience investments.

Examples of Key Attributes

- **Governance:** Management Oversight and Accountability, Executive Compensation, Corporate Policies and Management Systems
- **Disclosure:** Mechanisms for Disclosure, Scope and Content, Verification and Assurance
- **Stakeholder Engagement:** Focus Engagement Activity, Substantive Dialogue, Senior Level Engagement
- **Risk Management:** Vulnerability Assessments and Resilience Solutions
- **Investments:** Adequate Resilience Investments, Energy Assets and Buildings
- **Supply chains:** Resilient Supply Chains
- **Employees:** Recruitment and Training

Illustrative Example of a Key Attribute: *Governance*

❖ **Management Oversight and Accountability**

- *The CEO and company management – from executives to business unit and functional heads – will be responsible for corporate resilience strategy and performance and will provide oversight and accountability for achieving resilience goals.*
- *Management’s roles, responsibilities and accountability for resilience are clearly defined, communicated and understood.*

❖ **Executive Compensation**

- *Resilience performance results are a core component of compensation packages and incentive plans for all executives.*

❖ **Corporate Policies and Management Systems**

- *Companies will embed resilience considerations into corporate policies and risk management systems to guide day-to-day decision-making.*

Illustrative Example: Potential use of a Maturity Model Approach for Evaluating Progress on Resilience Attributes

1. CORPORATE RESILIENCE GOVERNANCE: Management Oversight and Accountability

	Initiating	Progressing	Optimizing	Leading	Transforming
Attributes	Awareness of vulnerabilities and resilience, with some ad hoc, non-systematic efforts	Systematic structure and formal processes	Advancing internally with continuous improvement	Integrated within company; demonstrates and recognized for some leading industry practices	Developing and implementing innovative practices that transform industry resilience expectations
Management Engagement	There is minimal management support.	Support is visible and clearly demonstrated.	Executive management reviews resilience performance, risks and opportunities, and endorses/sets goals.	The Board of Directors annually reviews resilience performance and sets or endorses goals.	Executive management sponsors transformative change in industry sector and beyond.
Management Roles, Responsibilities and Accountabilities	Roles are not clearly defined, but may be informally recognized.	Key roles are clearly documented and assigned.	Dedicated senior / top management and cross-functional teams manage continuous improvement.	Accountability lies with Board of Directors.	Company leadership actively drives industry innovation. The company serves as a motivator and model for other industries.

NEXT STEPS

- Solicit input from state regulators, utilities, other stakeholders on upcoming draft documents
- We welcome active engagement of California Energy Commission and California Public Utility Commission
- Host U.S. DOE Partnership for Energy Sector Climate Resilience workshop in early November 2017 to discuss documents and opportunities for improvement (identify key gaps, best practices, etc.)

For Additional Information

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➤ Reports

- ❖ ***Climate Change and the Electricity Sector: Guide for Climate Change Resilience Planning;*** <http://www.energy.gov/epsa/downloads/climate-change-and-electricity-sector-guide-climate-change-resilience-planning>
- ❖ ***“Climate Change and the Electricity Sector: Guide for Assessing Vulnerabilities and Developing Resilience Solutions to Sea Level Rise”*** <https://www.energy.gov/epsa/downloads/climate-change-and-electricity-sector-guide-assessing-vulnerabilities-and-developing>
- ❖ ***Climate Change and the U.S. Energy Sector: Regional Vulnerabilities and Resilience Solutions;*** <http://www.energy.gov/epsa/downloads/climate-change-and-us-energy-sector-regional-vulnerabilities-and-resilience-solutions>
- ❖ ***A Review of Climate Change Vulnerability Assessments: Current Practices and Lessons Learned from DOE's Partnership for Energy Sector Climate Resilience;*** <http://www.energy.gov/epsa/downloads/review-climate-change-vulnerability-assessments-current-practices-and-lessons-learned>
- ❖ ***Electricity Sector Resilience Strategies: Current Practices and Lessons;*** <http://www.energy.gov/epsa/downloads/review-climate-change-vulnerability-assessments-current-practices-and-lessons-learned> (Coming Soon!)