Grid Modernization Investment Economics

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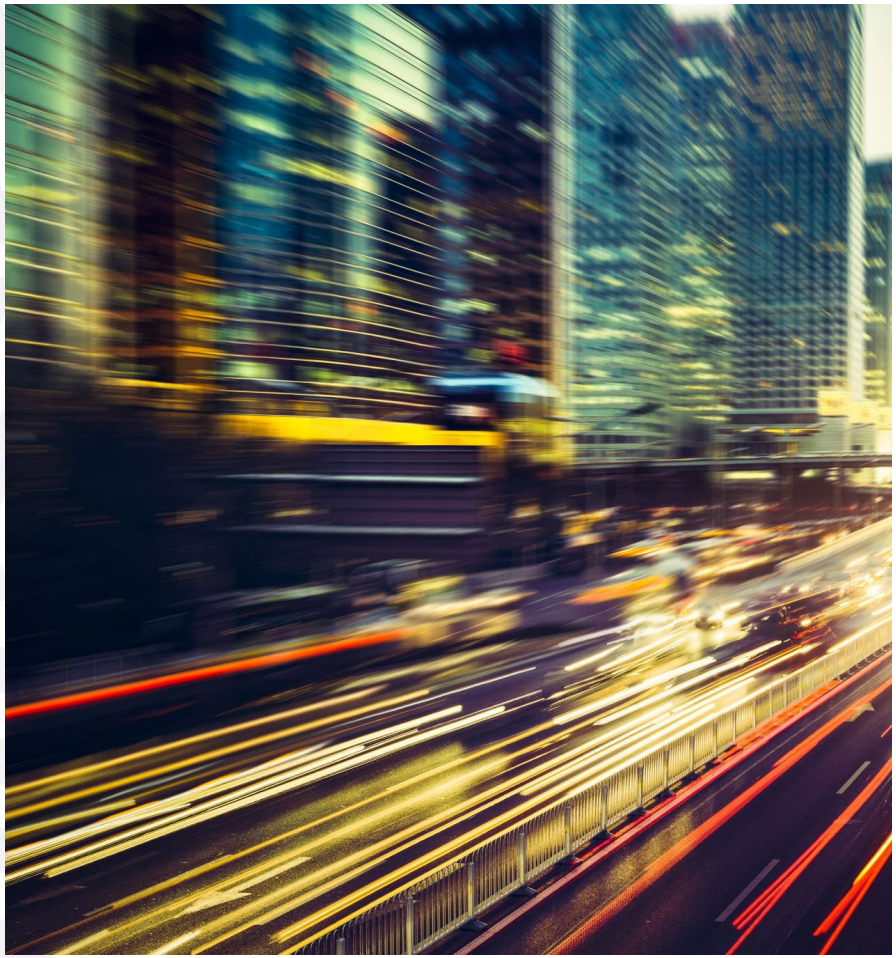
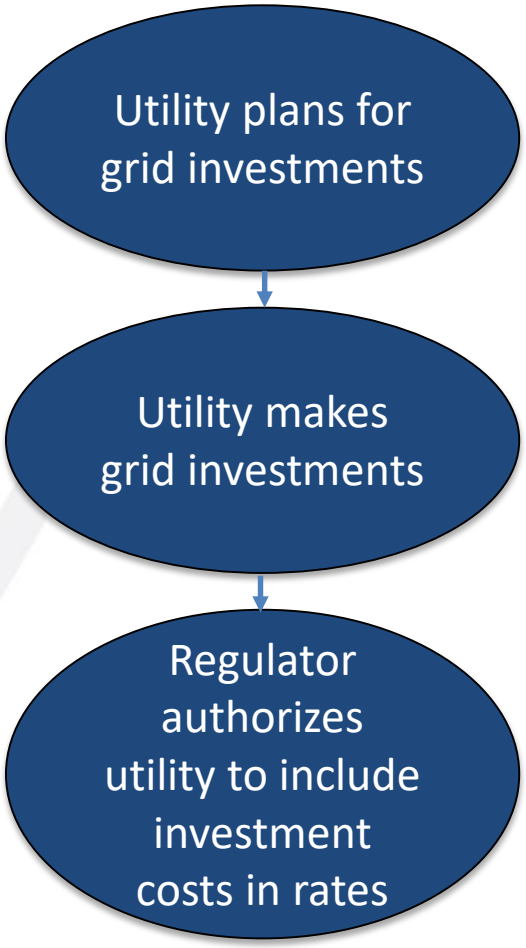
Grid modernization investment economics

- Consensus on the vision of a modern electric grid: information-rich, automated, flexible, secure, reliable, resilient
- Less consensus on the focus and timing of investments to achieve that vision
- Managing costs and risks is an important obstacle to grid modernization



Utility regulation and grid modernization

- Regulated utility investments in the grid are shaped by federal and state regulation — most importantly for utility rates and cost recovery.
- Regulators must balance consumer protections and utility risks and incentives:
  - Cost-of-service regulation gives utilities a built-in incentive to over-invest
  - Regulators conduct after-the-fact review to determine if utility investments were "used and useful" and costs prudently incurred
  - To mitigate risk, utilities may ask regulators for pre-approval of investments, shifting risks onto ratepayers.
- Getting incentives right is a central challenge in grid modernization.



Key regulatory issues for grid modernization

Transmission system: The high voltage ("bulk power") transmission system is regulated by the Federal Energy Regulatory Commission (FERC). States regulate siting and inclusion of transmission costs in retail rates.

Key regulatory issues: Growing need for transmission to integrate renewables, impacts of declining loads and distributed energy resources (DERs) on transmission needs, siting and interstate coordination, wildfire risk

Distribution system: The lower voltage distribution system is regulated by state public utility commissions (PUCs).

Key regulatory issues: Encouraging demand flexibility, improving reliability, increasing resilience to extreme events, encouraging efficient DER investments, mitigating impact of high PV levels on system reliability and costs, beneficial electrification

Why is evaluating grid modernization costs and risks complex and challenging?

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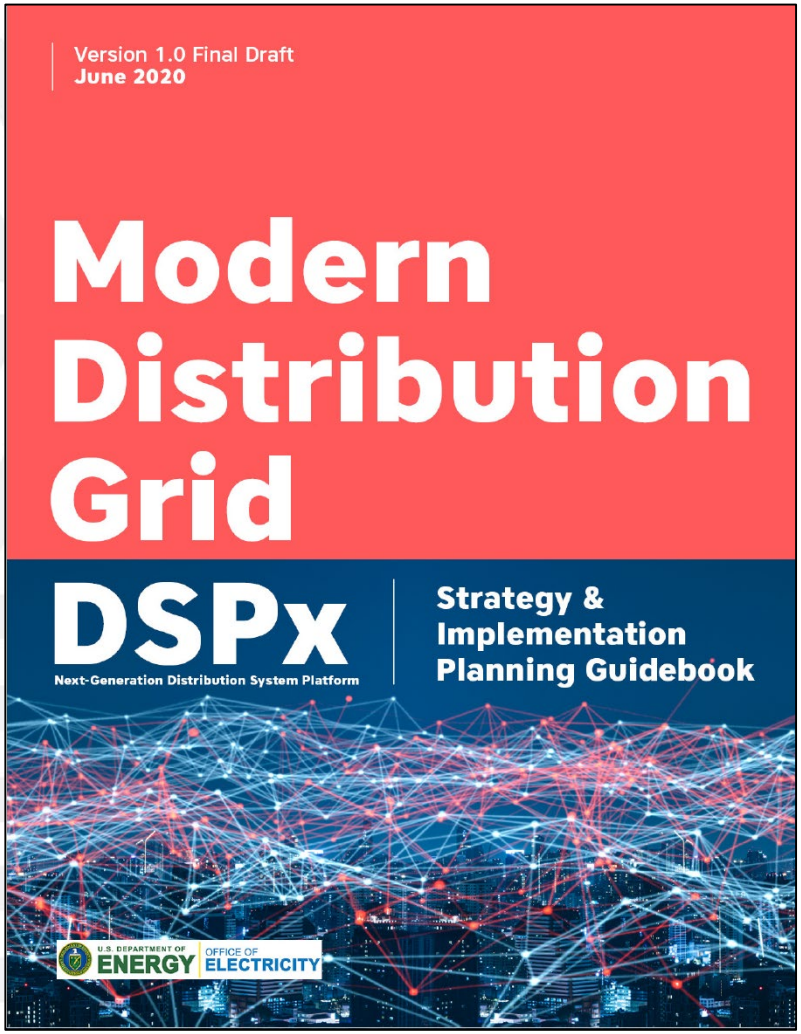
Whole vs. Parts	Grid modernization will ideally be supported by a holistic vision and investment strategy, but component investments may support different objectives and have different evaluation methods.
Resources vs. Grid	Grid modernization investments may support distribution-level resources, but resource and grid investments often have different evaluation methods.
Joint & Inter-dependent Benefits	Grid modernization investments often have benefits that are hard to isolate and depend on other investments.
Uncertainty	Grid modernization technologies are subject to significant uncertainty — e.g., over costs, timing of need, technology maturity, deployment challenges.

DOE's Modern Distribution Grid guidebook

- Volume IV includes an economic evaluation framework for grid modernization investments
  - Aims to inform approaches to evaluating economics and managing costs and risks of grid modernization investments
- No textbook approach — multiple reasonable paths to achieving the same broad goals



U.S. Department of Energy. *Modern Distribution Grid Volume IV: Guidebook (final draft)*

Economic evaluation framework

- Framework has three basic stages:

Planning

Deployment

Evaluation

- Stakeholder input throughout the process can help regulators reduce information asymmetry, improve outcomes

Develop/prioritize objectives, set spending limits

Coordinate regulatory processes

Identify investment needs, priorities, timelines

Link needs to objectives, develop performance metrics

Evaluate investments using targeted approach

Make investments

Evaluate investments, adapt investment strategies

See "Example performance metrics" in extra slides.

Prioritizing objectives

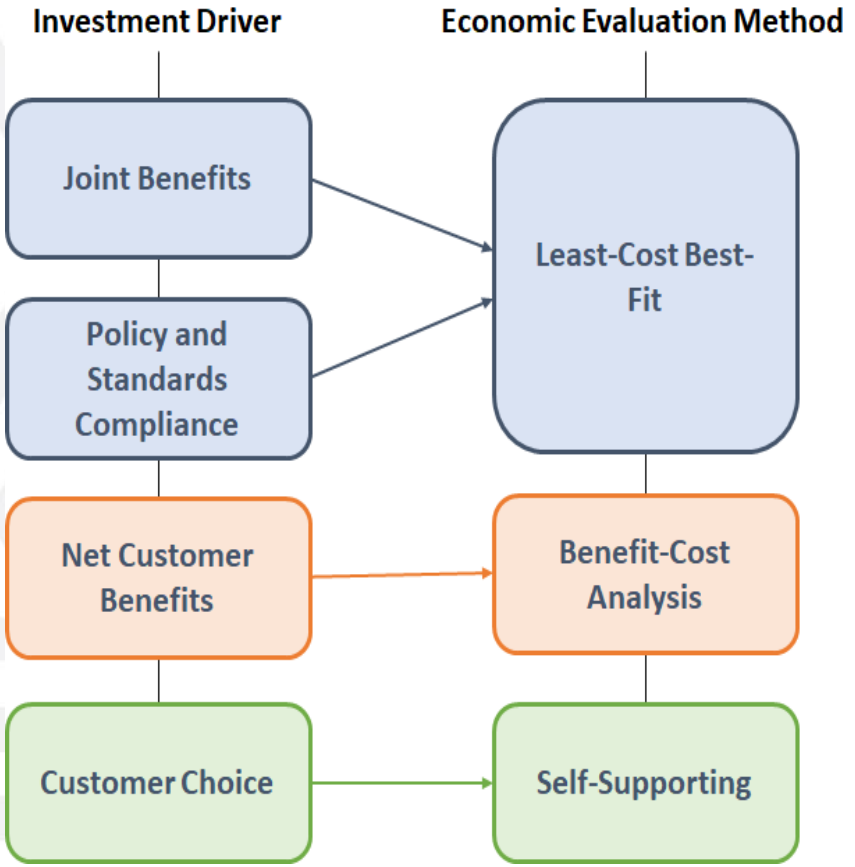
- Different jurisdictions will identify and emphasize different objectives for modernizing distribution grids
- Priorities will shape economic evaluation frameworks

Priority objective	Customer choice	Distributed energy resource integration	Reliability and resilience
Investment priority	Advanced metering infrastructure that enables full retail competition	Monitoring, sensing, and control systems that enable higher DER penetration	Feeder upgrades, distribution automation, outage management systems that reduce outages and improve response time
Example priority investments and functionality	Communications network, data management, advanced meters	Communications network, ADMS, GIS, VVO	Communications network, ADMS, GIS, OMS, FLISR

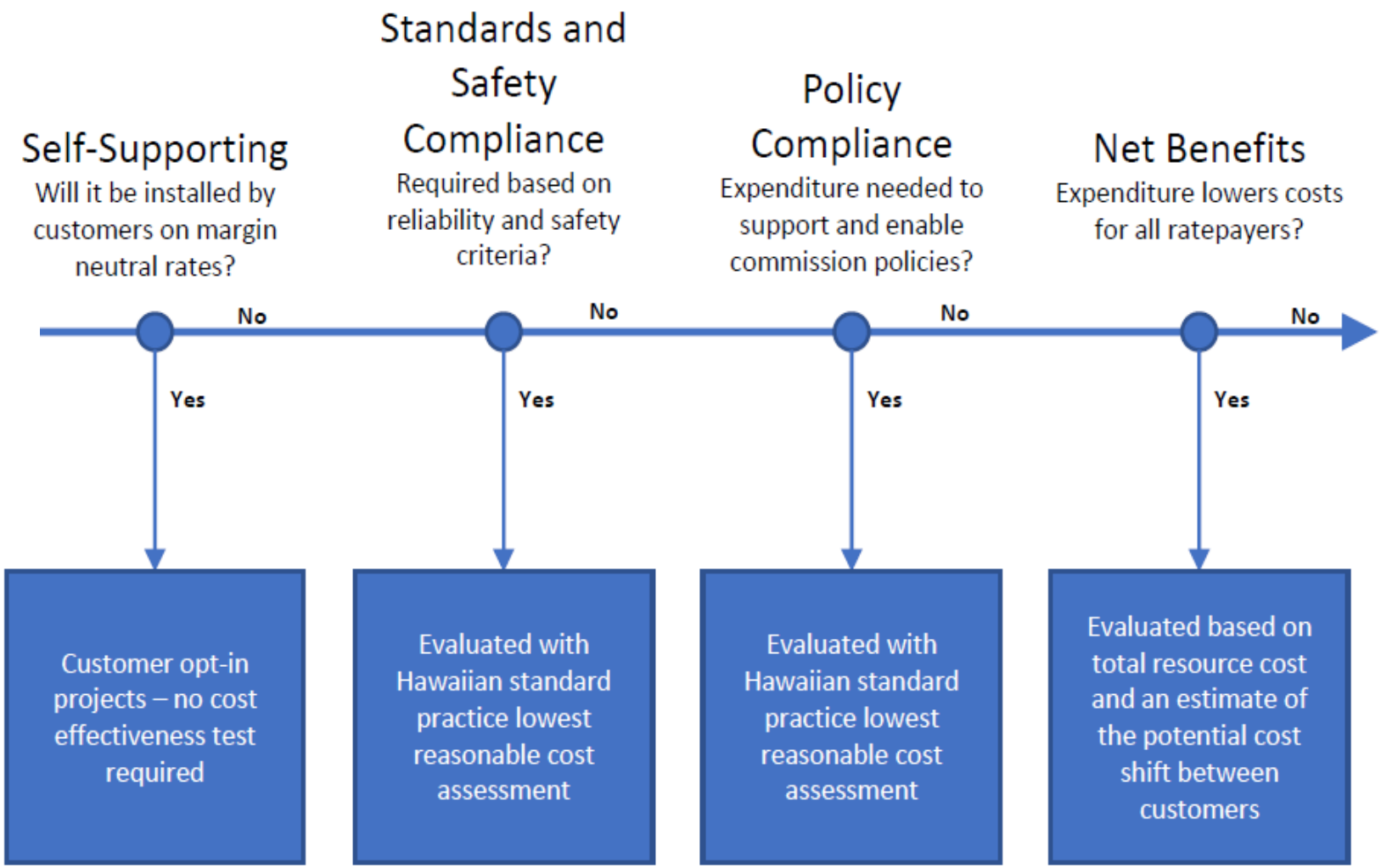
ADMS - Advanced Distribution Management Systems; GIS - Geographic Information System; VVO - Volt-var optimization; OMS – Outage Management System; FLISR - Fault location, isolation, and service restoration

Targeting economic evaluation

- **Joint and interdependent benefits** — core platform investments that are needed to enable new capabilities and functions in the distribution grid
- **Standards compliance and policy mandates** — utility investments that are needed to comply with safety and reliability standards or to meet policy mandates for proactive investments to integrate DER
- **Net customer benefits** — utility investments from which some or all customers receive net benefits in the form of bill savings
- **Customer choice** — utility investments triggered by customer interconnection, opt-in utility programs, and customer-driven reliability improvements, paid for by individual customers



Using decision trees to aid categorization: Hawaii example



Source: Hawaiian Electric Companies, 2017, *Modernizing Hawaii's Grid for Our Customers,* https://www.hawaiianelectric.com/Documents/about_us/investing_in_the_future/final_august_2017_grid_modernization_strategy.pdf

Strategies for managing costs and risks: stakeholder initiatives and utility planning

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- *Developing objectives and priorities for grid modernization through stakeholder initiatives*
  - Examples: Maryland (PC44), Michigan (MI Power Grid), New York (Reforming the Energy Vision), Ohio (PowerForward), Rhode Island (Power Sector Transformation)
- *Providing greater transparency on needs, priorities, costs, and risks by requiring utilities to develop long-term grid modernization plans, with nearer-term action plans*
  - Examples: California (Grid Modernization Plans), Hawaii (Grid Modernization Strategy), Massachusetts (Grid Modernization Plans), Minnesota (Integrated Distribution Plans)

Strategies for managing costs and risks: analysis, pilots, metrics, and incentives

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- *Requiring utilities to conduct alternatives analysis and risk scoring for investments*
  - Example: Minnesota PUC required Xcel Energy to conduct alternatives analysis and risk-ranking of investments in its Integration Distribution Plans (Docket 18-251, Order Accepting Report and Amending Requirements)
- *Encouraging and approving well-designed grid modernization pilots*
  - Examples: Austin Energy (advanced distribution management system), Xcel Minnesota (advanced metering and time-of-use pricing), Rocky Mountain Power Utah (customer-sited solar + battery demand response), Oregon (storage), New York State Electric & Gas (flexible interconnection)
- *Using budget caps to limit potential rate impacts*
  - Example: Massachusetts DPU pre-authorized specific categories of grid-facing utility investments for three-year term, subject to a budget cap
- *Designing performance metrics and linking these to utility incentives*
  - Examples: Illinois ICC created performance metrics for grid modernization that are linked to utility earnings; Minnesota PUC (Docket 17-401) required Xcel Energy to develop performance metrics and a reporting schedule

Potential roles of legislators

- State legislators can play several potential roles in managing the costs and risks of grid modernization — for example:
  - Affirm or set grid modernization objectives and priorities
  - Provide guidance or policy on desired levels of grid resilience
  - Proactively address issues that may require legislative intervention (e.g., equity issues, data privacy and access, interoperability and cybersecurity standards, facilitate DER aggregation by third parties, encourage performance-based incentives for utilities)
  - Provide state funding where there are broader public benefits of grid modernization (e.g., resilience, environment)

Questions state legislators and regulators can ask

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- What types of grid modernization investments support the state's objectives and priorities for grid modernization?
- How do regulated utilities' grid modernization plans support the state's objectives and priorities?
  - For each planned investment, which objectives and priorities does it support?
- What are the drivers of different investments and how should they be evaluated?
- What are reasonable levels of spending and rate impacts for grid modernization investments?
- What performance metrics should be used to evaluate investments?
- How should risk management be incorporated into investment prioritization and decision-making?
- How should the different regulatory processes affected by grid modernization be coordinated — e.g., for utility planning, procurement, programs, cost recovery, rate design?

For more information

- Background reading:
  - DOE's Modern Distribution Grid project
  - Berkeley Lab, *Benefit-Cost Analysis for Utility-Facing Grid Modernization Investments: Trends, Challenges, and Considerations*
  - IREC and GridLab, *A Playbook for Modernizing the Distribution Grid*
  - NCCETC, *The 50 States of Grid Modernization*
- Public Utility Commission documents
  - California PUC, Decision on Track 3 Policy Issues, Sub-Track 2 (Grid Modernization)
  - New Hampshire PUC, *Staff Recommendation on Grid Modernization*
  - Minnesota PUC, *Staff Report on Grid Modernization*

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Extra Slides

Example performance metrics

- Performance metrics will vary across jurisdictions, according to differing objectives and priorities

Example category	Example performance metrics
Deployment	Extent of planned deployment or number of installations
Customer satisfaction	Customer experience ratings, customer engagement metrics
Reliability	System-wide or targeted SAIDI, SAIFI, CAIDI, CAIFI
Resilience	Service interruptions and restoration time after extreme events
Safety	Emergency events and response times, accidents and injuries
Economic efficiency	Investment and operating cost savings
Network and data access	Interconnection times, data access times, developer satisfaction
Retail competition	Number of customers choosing a competitive retail option
Program or rate participation	Customers enrolled in EV and other time-of-use rates, utility programs