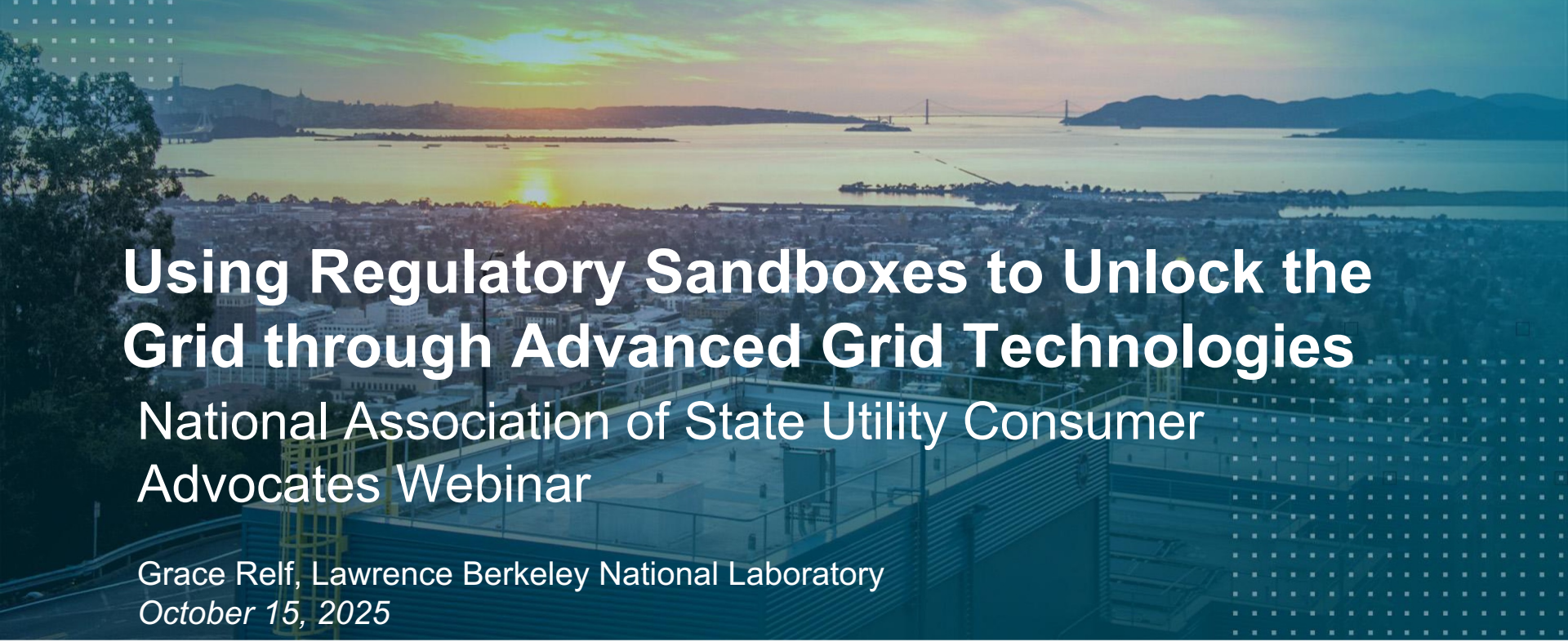

Using Regulatory Sandboxes to Unlock the Grid through Advanced Grid Technologies

National Association of State Utility Consumer Advocates Webinar

Grace Relf, Lawrence Berkeley National Laboratory

October 15, 2025

Energy Technologies Area
BERKELEY LAB

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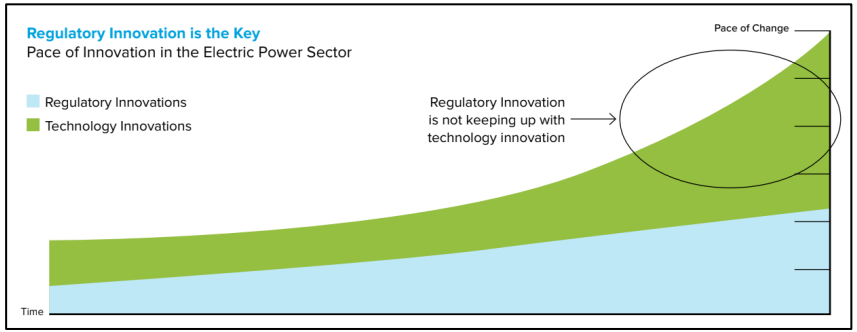
Agenda

- Introduction and Background
  - Project motivation and context
  - Barriers to utility innovation
  - Berkeley Lab's research
- The Landscape of Regulatory Sandboxes
  - Defining regulatory sandboxes
  - Sandbox structures
  - Sandboxes in the U.S. and abroad
- Examples of Specific Project Resulting from Sandboxes
- Wrap up
  - Findings
  - Emerging best practices
  - Complementary toolkit
  - Questions

Introduction and Background

The Need for Regulatory Sandbox Mechanisms

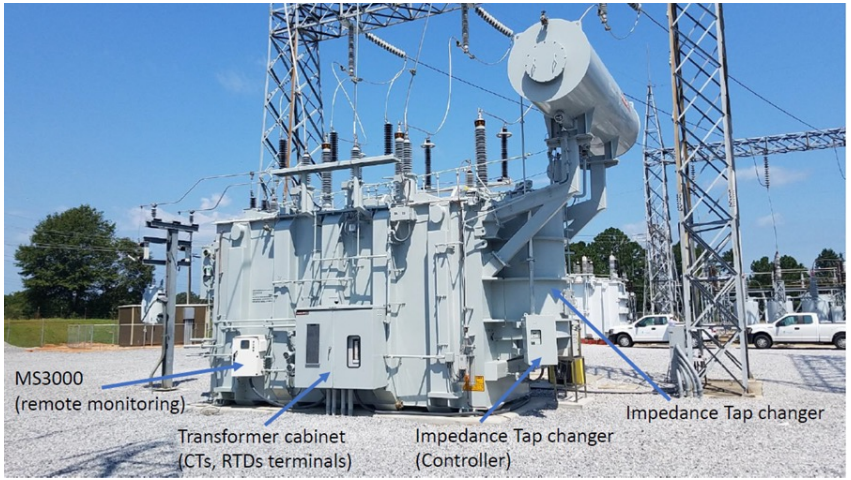
- Load growth, aging assets, variable energy resources, and increasingly severe and frequent weather events are challenging utilities to simultaneously:
  - Expand transmission and distribution (T&D) capacity
  - Improve asset management and utilization
  - Adopt new operational practices
  - Expand resilience programs
  - Maintain energy affordability
- Traditional regulatory processes can discourage utility interest in testing and deploying advanced grid technologies to help meet these challenges.
- ***Regulatory sandboxes*** **aim to bridge the gap between need and opportunity to deliver solutions at scale.**



Source: McDonnell, Gorman, and Field 2022

The Potential for Advanced Grid Technologies

- Advanced grid technologies that are commercially available today, but have not yet reached full market transformation, could be adopted within 3–5 years to increase peak capacity of U.S. T&D systems by 20–100 gigawatts (GW) at lower cost than like-for-like replacements.
- Examples include:
  - Dynamic line rating
  - Advanced flexible transformers
  - Advanced conductors
  - Volt/Var Optimization

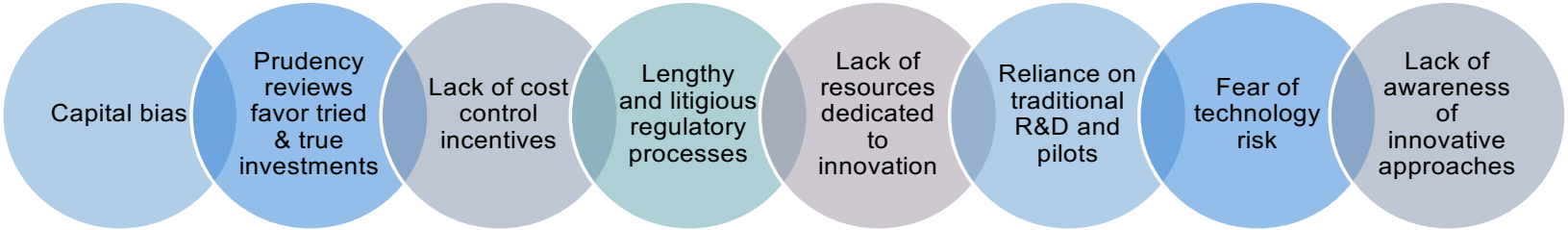


Source: U.S. Department of Energy (DOE)

Barriers to Utility Innovation

- The traditional utility business model and characteristics of the regulated utility sector can impede the desire for utilities to invest in research and development (R&D) and scale successful pilots.
- Pilot programs, for utilities and in other sectors, frequently do not progress to full-scale programs, due to:
  - Lack of, or unclear, terminology
  - Design flaws
  - Lack of process for scaling
  - Lack of information sharing
  - Disputes

Example Barriers to Utility Innovation



Berkeley Lab Research

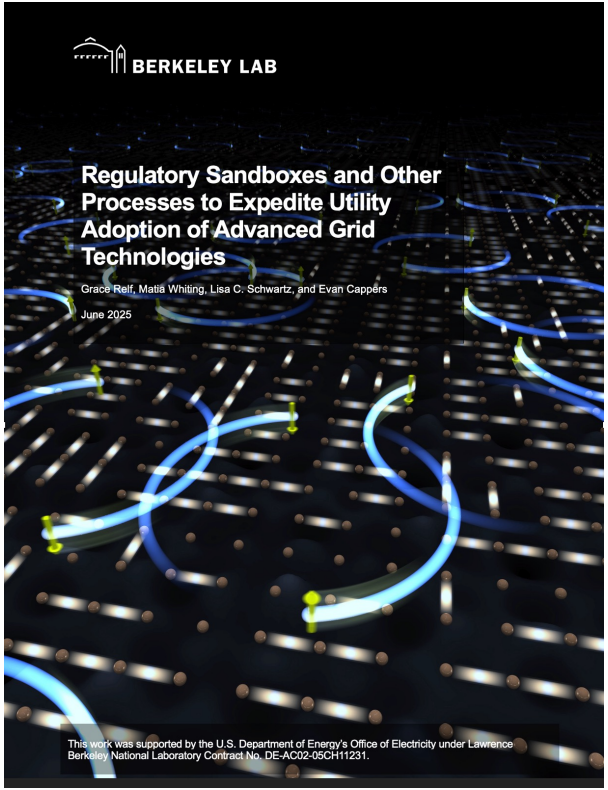
Berkeley Lab published research on regulatory sandboxes and other processes to expedite adoption of advanced grid technologies.

The research:

- Assesses the need for, and barriers to, utility innovation
- Identifies regulatory sandboxes and related processes
- Assesses emerging best practices

Berkeley Lab created an accompanying toolkit to support states looking to develop a sandbox.

Research available at:
https://emp.lbl.gov/publications/regulatory-sandboxes-and-other



Report Methodology

- Literature review & synthesis of common and key findings
- With E9 Insight, comprehensive review of regulatory proceedings & deep-dive into regulatory filings, utility innovation webpages, pilot databases, and other sources
- Structured interviews with utilities, regulators, consumer advocates, industry trade groups, and consultants
- Analysis and synthesis of findings

Organizations Interviewed
American Public Power Association (APPA)
Connecticut Public Utilities Regulatory Authority (PURA)
Current Energy Group
Duke Energy Corporation (via written correspondence)
Hawaiian Electric (HECO)
Hawaii Public Utilities Commission (HPUC)
Green Mountain Power (GMP)
Public Staff – North Carolina Utilities Commission
San Diego Gas & Electric (SDG&E)
United Illuminating
Vermont Public Utilities Commission (VT PUC)
Vermont Electric Power Company (VELCO)
WATT Coalition / Grid Strategies

The Landscape of Regulatory Sandboxes

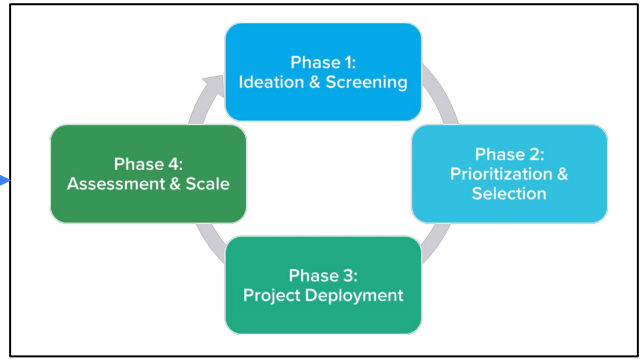
Defining Regulatory Sandboxes

Regulatory Sandboxes

Mechanisms that provide a structured environment for testing new technologies and business approaches under modified rules to increase the speed of adoption

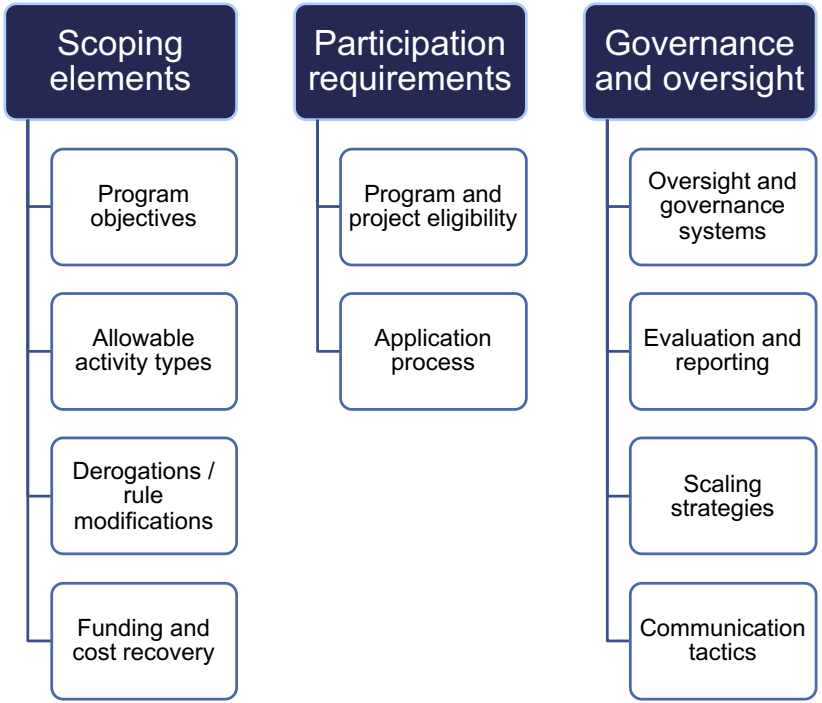
Example

The Connecticut Innovative Energy Solutions (IES) sandbox mechanism selects cutting-edge project proposals to run for a 12- to 18-month trial period before assessing results and quickly determining scaling strategies.

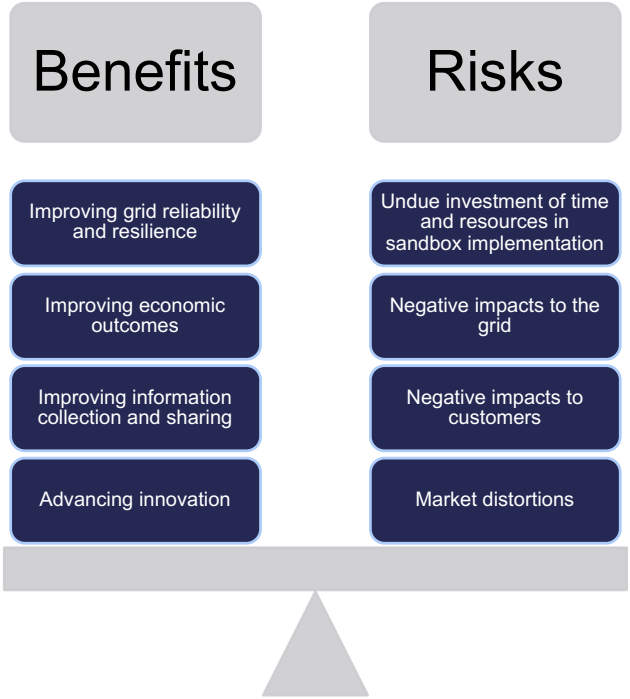


Source: CT PURA

Regulatory Sandbox Design Elements



Potential Benefits and Risks of Sandboxes



Risk Mitigation Tactics

Undue investment of time and resources in sandbox implementation	• Deploy project management tools • Create flexibility to adjust projects in real time or end projects early • Embrace learning/failure as a successful outcome • Deploy best practices for sandbox design and adjust the framework over time • Consider whether a sandbox is the appropriate tool to meet the challenge
Negative impacts to the grid	• Include technological safeguards in eligibility criteria • Deploy best practices for pilot design
Negative impacts to customers	• Include consumer safeguards in eligibility criteria • Deploy best practices for pilot design
Market distortions	• Use transparent eligibility criteria, objectives, selection criteria, and scaling options • Create opportunities for participation by different entities • Create clear and well-implemented knowledge-sharing protocols • Maintain technology neutrality

Taxonomy of Sandbox-Type Mechanisms

Funding Opportunity

Funding carveout for innovative grid transformation projects

Pilot Process

Activities to improve how pilot projects are approved and managed

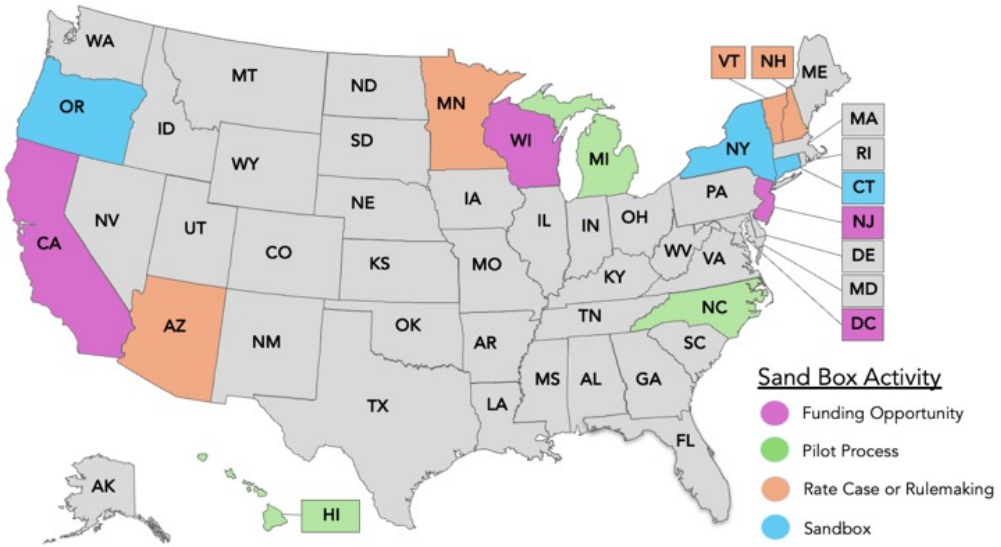
Rate Case or Rulemaking

Vehicles for broader innovation efforts that may include reforms including sandbox-like initiatives

Regulatory Sandbox

Mechanism that provides a structured environment for testing new technologies and business approaches under modified rules to increase the speed of adoption

U.S. States Exploring and Implementing Sandbox-Type Mechanisms



State	Program
National	American Public Power Association (APPA) DEED Program
Arizona (not adopted)	Innovations and Technological Developments
California	EPIC Program
Connecticut	Innovative Energy Solutions
Hawaii	Innovative Pilot Framework
Michigan	New Technologies and Business Models
Minnesota (not adopted)	Rate Case Pilot Projects
North Carolina	Innovation Prototyping Process
New Hampshire (not adopted)	Grid Transformation and Enablement Program
New Jersey	Clean Tech Grant Programs and Future Regulatory Sandbox
New York	Reforming the Energy Vision Demonstration Projects
Oregon	Smart Grid Testbed
Vermont	Innovative Pilot Program
Washington, DC	PowerPath DC Pilot Project Fund
Wisconsin	Energy Innovation Grant Program

Sandbox Examples

Connecticut Innovative Energy Solutions

- Reduces barriers for deploying new technologies and to facilitate collaboration between product innovators and utilities.
- Follows a four-phase process: ideation and screening, prioritization and selection, project deployment, and assessment and scaling.
- Uses thematic program cycles, three participation pathways and an innovation advisory council.

New York Reforming the Energy Vision Demos

- Allows utilities to develop new business models and effectively unlock new revenue streams and private investments.
- Encourages flexibility, innovation, partnerships, customer engagement, market creation, scalability and cost recovery.

Hawaii Innovative Pilot Framework

- Expedites review of pilot proposals for new technologies, programs, and business models that support goals in areas such as resilience.
- Complements elements of a performance-based regulation framework targeted at cost control.

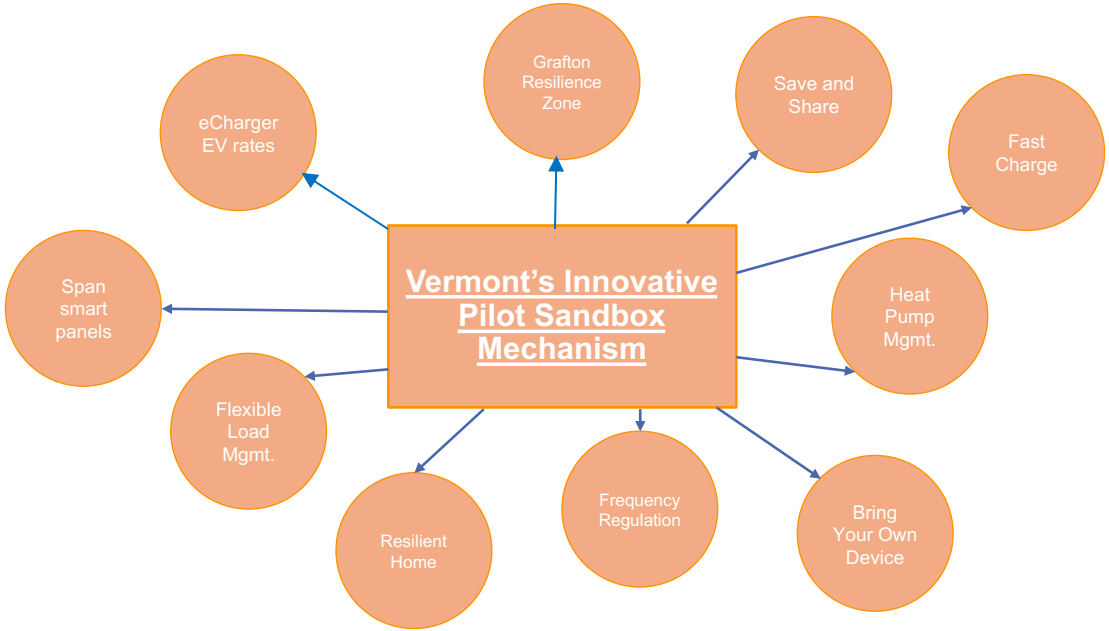
Notable Examples from Abroad

- The U.K's Office of Gas and Electricity Markets (OFGEM) developed an Energy Regulation Sandbox in 2017 as part of its performance-based regulation framework.
  - The sandbox enables demonstrations and trials in the regulated electric and gas sectors, particularly those that may require modified or reduced regulations in order to move forward.
- The Ontario Energy Board established an Innovation Sandbox in 2016 to support achievement of the goals identified in its Strategic Blueprint document.
  - The sandbox aims to better support innovation by introducing a simpler, less adversarial, and quicker way to trial new technologies and services.
- The Singapore Energy Market Authority created a regulatory sandbox in 2017.
  - The sandbox is a means of formalizing a previous effort to identify regulatory barriers to innovation on an ad hoc basis.

Source: OEB

Sandbox Outcomes

Utilities and innovators test specific innovations through regulatory sandboxes.



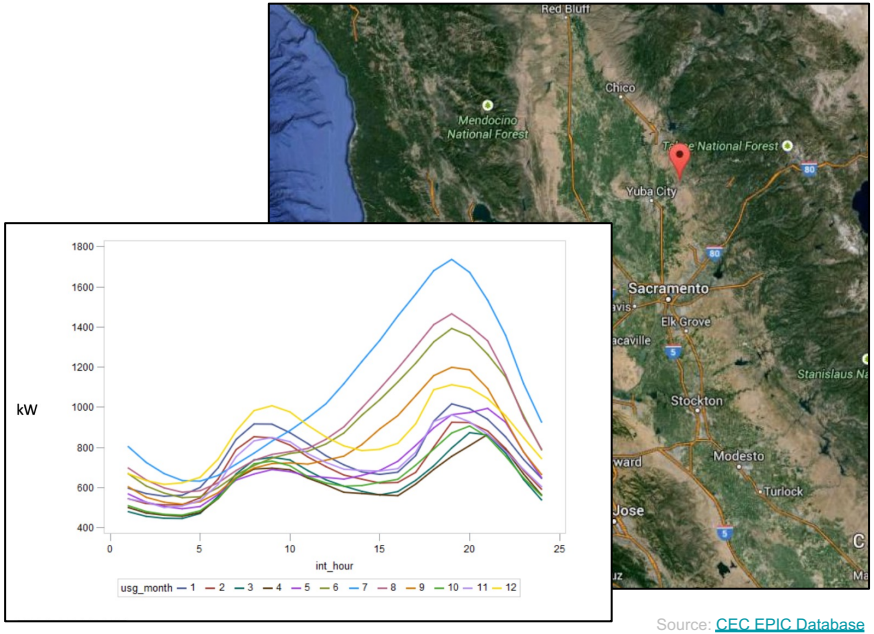
Examples of Specific Projects Resulting from Regulatory Sandboxes

Project Example: Distributed Storage for T&D Cost Reduction

Pacific Gas & Electric deployed energy storage at a substation to deliver autonomous distribution peak shaving.

- The project successfully demonstrated the ability to provide 500 kW of loading relief over 4 hours to delay T&D capacity expansions while maintaining or improving reliability.
- PG&E found that one ~30 MW storage solution can provide $5-15M in cost savings from avoided transmission upgrades.
- The project informed storage procurement practices, operational requirements and practices, and investments in distribution management controls.

Project Location and Average Substation Daily Load By Month



Source: CEC EPIC Database

Project Example: Noteworthy AI

Through the Connecticut IES program, Noteworthy AI is implementing a project that passively collects data on the condition of distribution system assets via smart cameras on utility vehicles.

- The project uses AI to analyze footage.
- Expected outcomes include:
  - Faster broadband deployment and easier pole attachment clearance
  - Improved vegetation management and associated better reliability and resilience
  - Reduced risk of outages by proactive identification of equipment defects
  - Analysis of 20% of the utility's poles within 18 months

Sources: CT PURA, Noteworthy AI

Wrap Up

Findings

Sandboxes have grown over time in the U.S. electricity sector	• 12 ongoing examples of sandbox mechanisms • Sandbox types are varied
Sandboxes have demonstrated value	• Interviewees expressed enthusiasm for sandboxes • Sandboxes are particularly good for creating a willingness to learn and an environment for experimentation
Programmatic focuses are varied	• Sandbox programs most commonly focus on demand-side resources • Sandboxes can enable deployment of customer-sited batteries, distribution management technologies, modeling tools, and microgrids
Sandbox design can be improved to increase impact	• A stronger focus on advanced grid technologies may encourage more sandbox projects • Scaling of programs isn't well documented and may need more focus

Sandboxes can:

- **Advance innovation**
- **Increase information collection and sharing**
- **Improve economic outcomes**
- **Enhance grid reliability and resilience**
- **Better meet customer needs**
- **Expand access to technologies**

Emerging Best Practices (1)

Initiating a Regulatory Sandbox

☐	*Identify barriers to innovation in the jurisdiction and determine which type of sandbox-type mechanism, sandbox design elements, and other innovation vehicles will best address those specific barriers.*
☐	*Solicit buy-in from relevant leadership.*
☐	*Consider establishing an advisory or working group to foster stakeholder buy-in, bring in expertise in new areas, and provide ongoing support for the sandbox.*

Emerging Best Practices (2)

Designing a Regulatory Sandbox	
☐	*Identify clear and ambitious sandbox objectives aligned with state and regulatory goals and in consideration of stakeholder input.*
☐	*Consider learning, speed, and eventual scaling as primary objectives.*
☐	*Clearly define terminology such as "pilot," "demonstration," and "innovative" upfront and with stakeholder input.*
☐	*Develop clear guidelines on project eligibility, application processes, and selection criteria.*
☐	*Consider selection criteria that align with sandbox objectives, reward proposals that follow best practices for pilot design and implementation, are relatively simple in structure, and are responsive to customer needs and desires.*
☐	*Create multiple pathways to participation so that innovators and stakeholders can put ideas forward in addition to or in partnership with utilities.*
☐	*Establish clear reporting and evaluation requirements using metrics that align with desired outcomes.*
☐	*Identify go/no-go checkpoints and criteria for selected projects.*
☐	*Create data and information-sharing requirements as part of reporting by utilities and third party participants.*
☐	*Clearly identify scaling strategies and processes for projects that go through the sandbox mechanism.*

Emerging Best Practices (3)

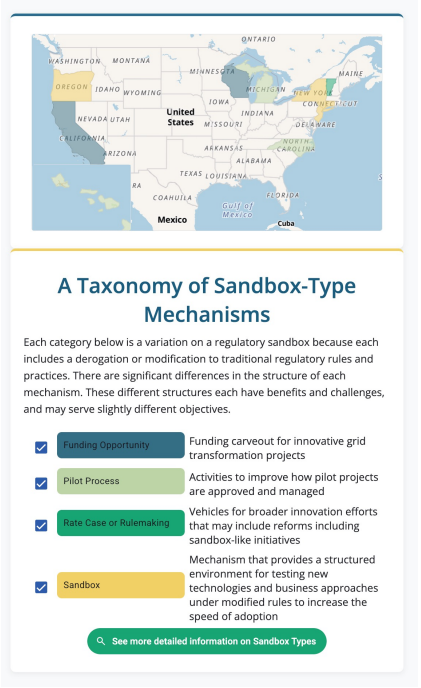
Administering a Regulatory Sandbox

☐	*Establish and clearly communicate a calendar of events or other sandbox timelines and key dates.*
☐	*Design templates or standard format documents for applications and for evaluating proposals to reduce administrative burdens.*
☐	*Dedicate sufficient staff resources to the sandbox, including cross-functional teams with pre-identified roles and processes for quickly reviewing applications (if relevant).*
☐	*Create channels for regular, candid, non-punitive conversations between regulators and utilities, other innovators, and stakeholders, including non-decisional Commission staff.*
☐	*Create processes for continuous learning and checkpoints to adjust the sandbox mechanism over time.*
☐	*Establish and maintain multiple communication channels for sharing information on the sandbox, such as an informational webpage, a library of sandbox project results, an innovation idea exchange portal, or a sandbox newsletter.*

Complementary Toolkit and State Assistance

The Sandbox Navigator provides tactical resources for developing a sandbox.

- Background information on regulatory sandboxes and advanced grid technologies
- Interactive map of sandboxes
  - Detailed and expandable state case studies
  - Examples of specific projects resulting from sandboxes
- Regulatory toolkit – “Setting Up a Sandbox”
  - Walkthrough of key procedural steps
  - Downloadable, model documents
- Checklist of emerging best practices



Questions

Contacts

Grace Relf: gerelf@lbl.gov, 510-926-0943
Lisa Schwartz: lcschwartz@lbl.gov, 510-926-1091

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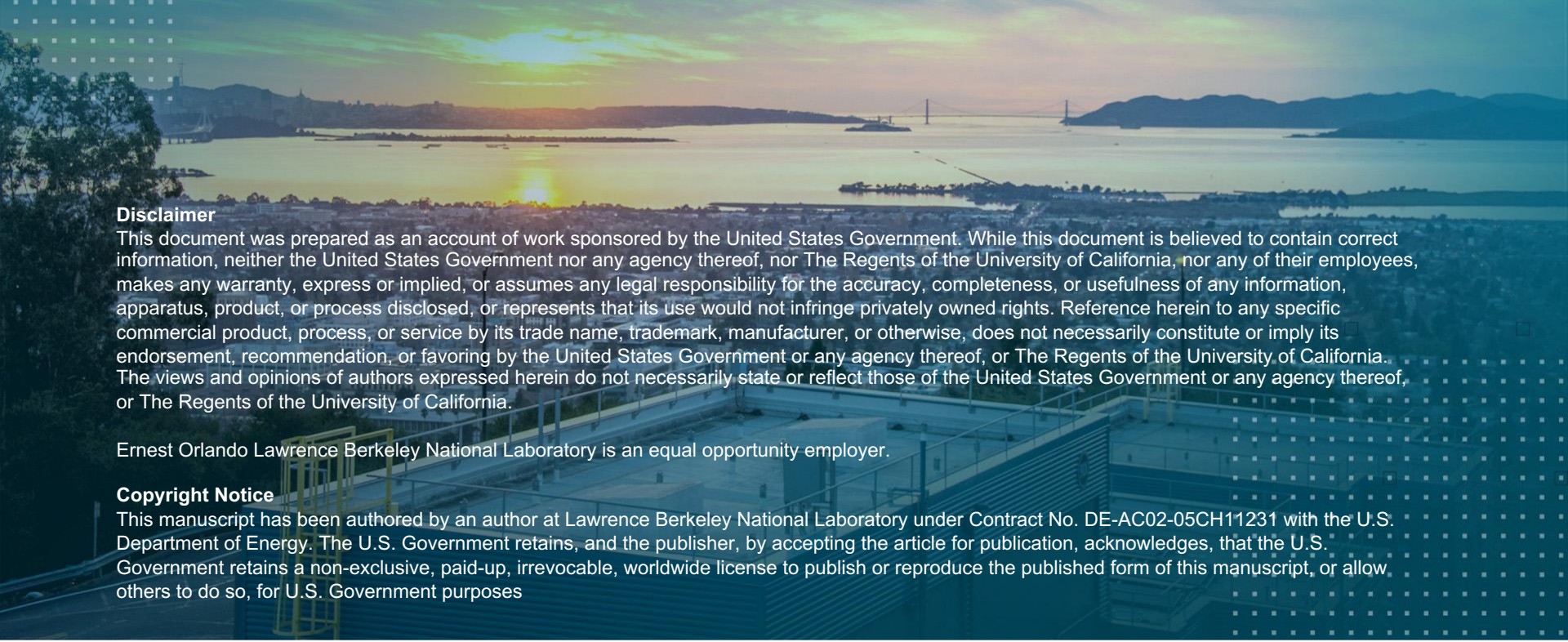

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