Using Regulatory Sandboxes to Unlock Advanced Grid Technologies

Technical Assistance for the Maryland Energy Administration

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Energy Technologies Area
BERKELEY LAB

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Objectives

- Introduce regulatory sandboxes as a tool for innovation to Transmission Modernization Workgroup members.
- Provide foundational, detailed information on how sandboxes function, why sandboxes are a useful tool, including what challenges they help solve and how they test and scale advanced grid technologies, and best practices for establishing and implementing a sandbox.
- Discuss how regulatory sandboxes can support Maryland's specific objectives of relieving transmission constraints, accelerating grid upgrades, and improving affordability and reliability, among others.

Source: EO

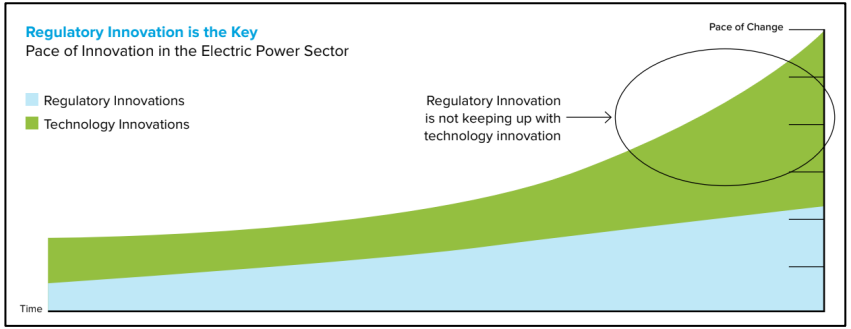
Agenda

- Introduction and Background
  - Barriers to utility innovation
  - Regulatory sandboxes – definitions, benefits, and risks
  - Building an ecosystem of innovation
- Designing and Implementing a Sandbox
  - Sandbox structures
  - Risk mitigation and best practices
- Sandbox Designs to Facilitate Desired Outcomes
  - Elements to support focus areas
  - Examples
- Wrap Up
  - Findings
  - Considerations for Maryland

Introduction and Background

The Need for Regulatory Sandbox Mechanisms

- Load growth, aging assets, grid-edge energy resources, and increasingly severe and frequent weather events are challenging utilities to simultaneously:
  - Update and make grid planning processes more accessible
  - Expand transmission and distribution (T&D) capacity
  - Improve asset management and utilization
  - Adopt new operational practices
  - Expand resilience programs
  - Maintain energy affordability

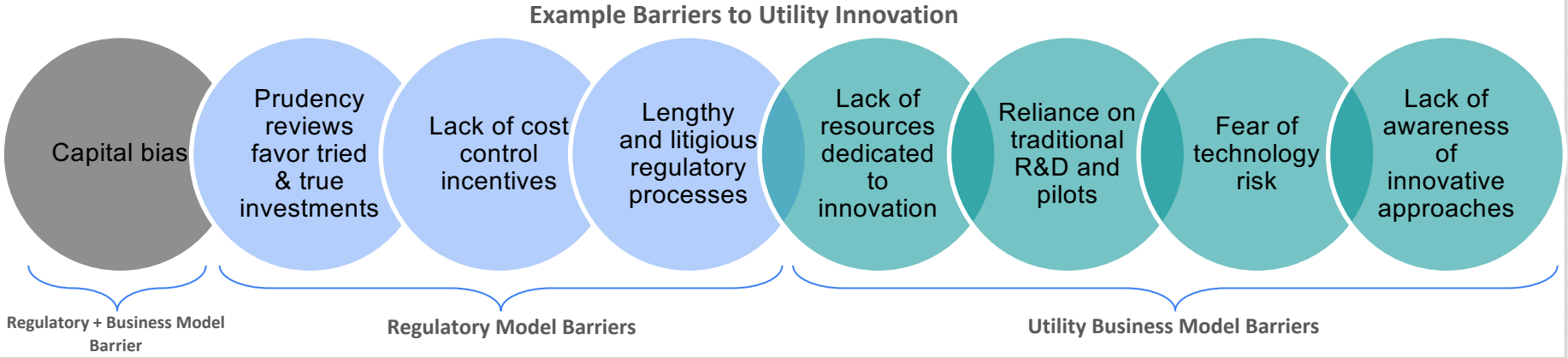


Source: McDonnell, Gorman, and Field 2022

***Regulatory sandboxes* aim to bridge the gap between need and opportunity to deliver solutions at scale.**

Barriers to Utility Innovation

- The traditional utility business and regulatory models are designed to ensure safe and reliable electric service and, thus, encourage risk aversion, which can extend to innovation.
- Regulatory models and processes can also be misaligned with advancing innovation.
- This has resulted in limited research and development (R&D) investments, proliferation of one-off solution designs, and infrequent scaling of successful pilots.

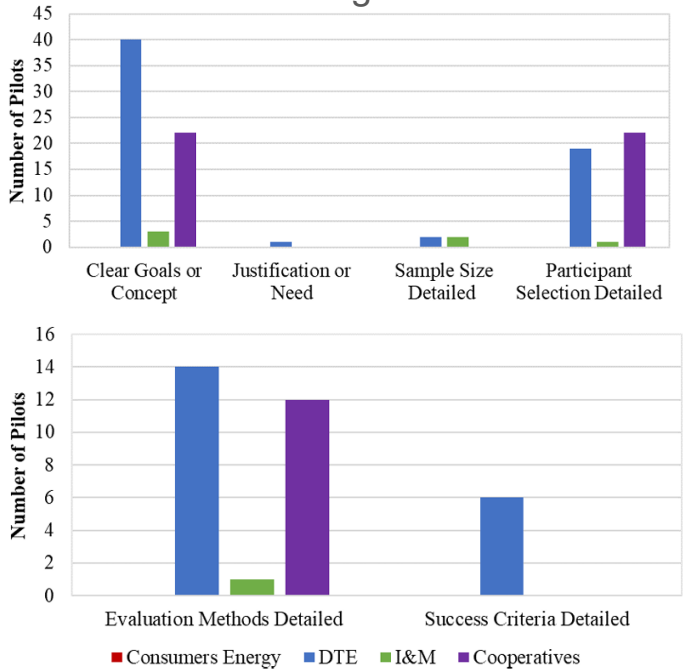


Source: Berkeley Lab

Challenges with Traditional Pilots

- Utility pilot programs, as in other sectors, frequently do not progress to full-scale programs, due to:
  - Lack of, or unclear, goals
  - Lack of, or unclear, terminology
  - Design flaws
  - Lack of process for scaling
  - Lack of information gathering / sharing
  - Disputes
- Sandboxes differ from traditional pilots by explicitly modifying existing processes, rules, or regulations.
- Sandboxes are also often designed with explicit expectations around data gathering and scaling.

Michigan Energy Waste Reduction Pilot Design Data



Source: MI PSC, 2020

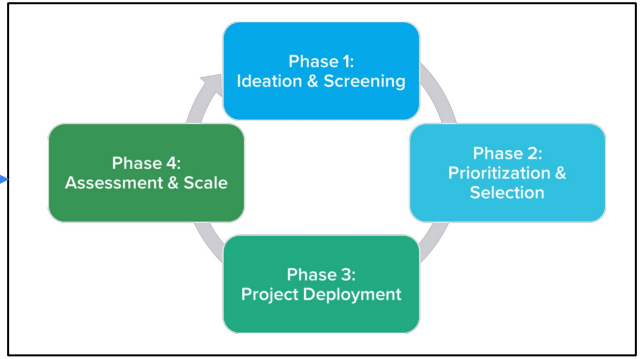
Defining Regulatory Sandboxes

Regulatory Sandboxes

Mechanisms that provide a structured environment for testing new technologies and new customer and businesses uses of existing technologies 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

Sandbox Outcomes

Utilities and innovators test specific innovations through regulatory sandboxes.

Vermont's Innovative Pilot Programs Sandbox Mechanism

Pilot examples

- Resilience Zones
- Fast Charge
- Heat pump management
- Bring your own device
- Frequency regulation
- Resilient home
- Flexible load management
- Span smart panels

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 (PBR) 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 PBR framework.
  - The sandbox enables demonstrations in the regulated electric and gas sectors, particularly those that may require modified or reduced regulations.
- 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

Creating an Ecosystem of Innovation

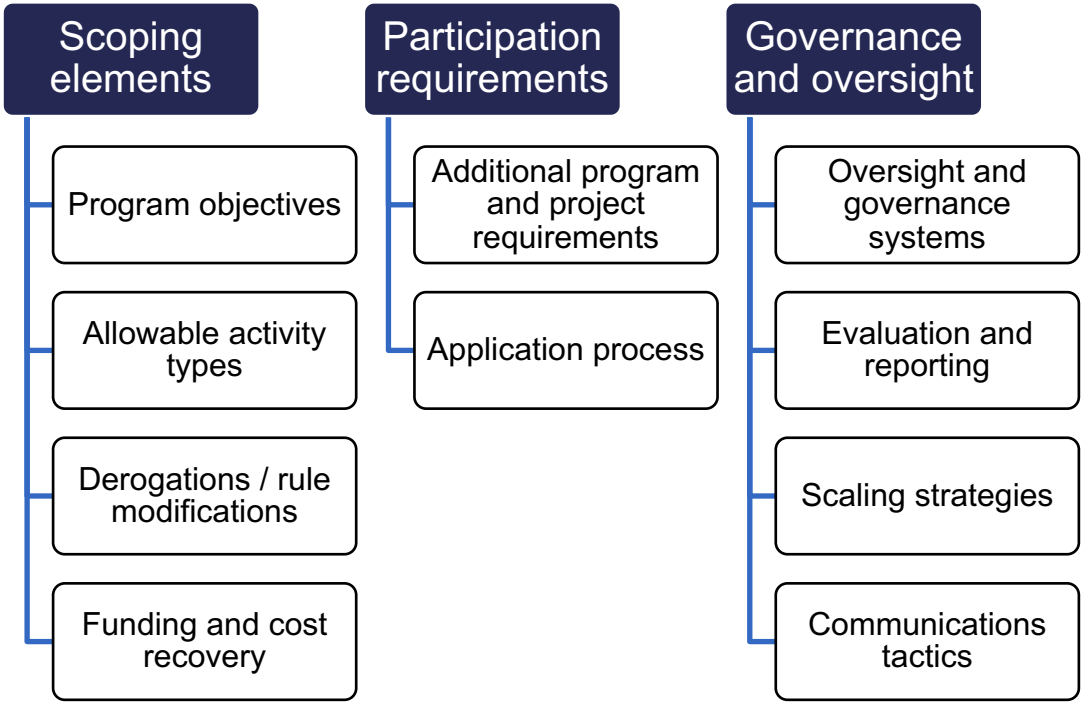
- Regulatory sandboxes do not address every barrier to innovation.
- Deployment of multiple innovation vehicles creates a supportive environment and robust innovation ecosystem within a state.
  - Innovators require some level of certainty that there will be demand for their product or service to confidently invest in development, and a supportive ecosystem can help build this confidence.
  - Different vehicles can support innovation at different stages.
- Common innovation vehicles in states with sandbox-type mechanisms include PBR frameworks, policy directives and vision statements, and information sharing platforms.

Other Innovation Vehicles

Utility-driven approaches	• R&D • Demonstrations • Pilot programs • Organizational changes that focus on innovation
Legal- or regulatory-driven approaches	• Topical explorations and information-gathering processes • PBR • Changes to legislative policies and utility regulations • Track-then-act approach
Economy-wide and broader approaches	• Policy directives and vision statements • Information sharing platforms and communication tools • Grant and financing programs • Innovation hubs and incubators • Forums to bring together innovators and investors (“pitch fests”) • Technical assistance

Designing and Implementing a Sandbox

Regulatory Sandbox Design Elements



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

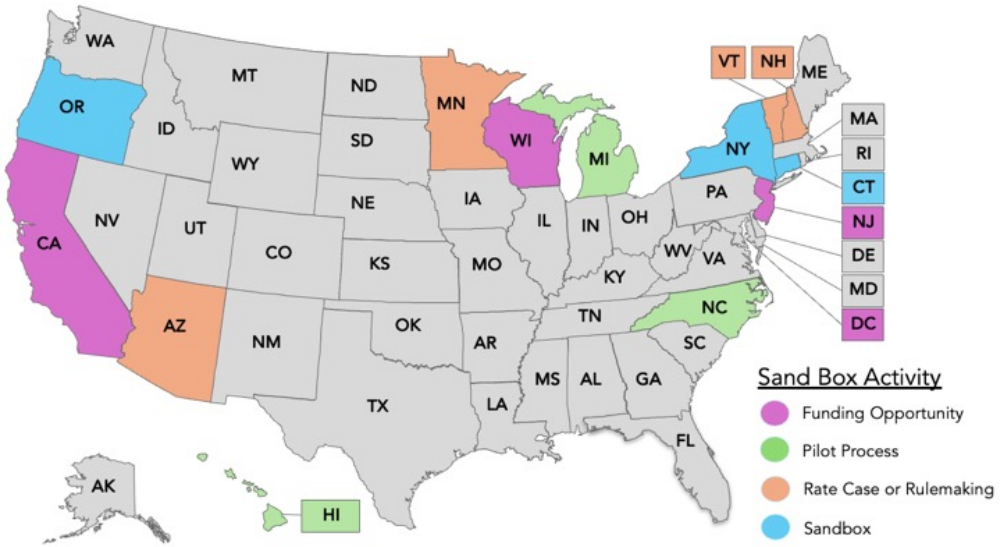
Rate Case or Rulemaking

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

Regulatory Sandbox

Mechanisms that provide a structured environment for testing new technologies and new customer and businesses uses of existing technologies 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

Data as of June, 2025.

Potential Benefits and Risks of Sandboxes

Benefits	Risks
Improving grid reliability and resilience	Undue investment of time and resources in sandbox implementation
Improving economic outcomes	Negative impacts to the grid (e.g. technologies reduce reliability)
Improving information collection and sharing	Negative impacts to customers (e.g. increased costs)
Advancing innovation	Market distortions

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 • Employ program and project budget caps • Establish scaling plans early in the process • Set contractual milestones that balance providing sufficient funding with demonstrated pilot progress
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

Emerging Best Practices

- Emerging best practices focus on all stages of sandbox implementation:
  - Initiation
  - Sandbox design
  - Administration and continuous improvement
- Approaches aim to reduce administrative burden, improve transparency, maximize success, and mitigate risks.
- A checklist is available here.

Checklist of Emerging Best Practices

Regulatory Sandbox Design and Implementation for Advanced Grid Technologies

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Following are emerging best practices for use when designing and implementing a regulatory sandbox or similar mechanism. These are adapted from Berkeley Lab's report, *Regulatory Sandboxes and Other Processes to Expedite Utility Adoption of Advanced Grid Technologies*.

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.*

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.*

Sandbox Designs to Facilitate Desired Outcomes

Supporting Specific Focus Areas

- Sandboxes can support specific desired outcomes such as affordability or advanced transmission technologies (ATTs).
- Approaches include:
  - Use thematic program cycles to encourage applications in specific areas.
  - Design eligibility and assessment criteria to reward specific outcomes.
  - Include a variety of external stakeholders on advisory councils to supplement existing expertise, including for specific technology or focus areas.
  - Consider proposals that include shared savings mechanisms (SSMs) or performance incentive mechanisms (PIMs) to gain real-world experience.
- Examples:
  - The Connecticut IES program uses cycle themes such as demand-side flexibility and residential energy affordability.
  - Washington DC uses weighted screening criteria to score applications in line with desired outcomes.

Source: CTC Global

Project Example: Pacific Gas & Electric (PG&E) T-Flex

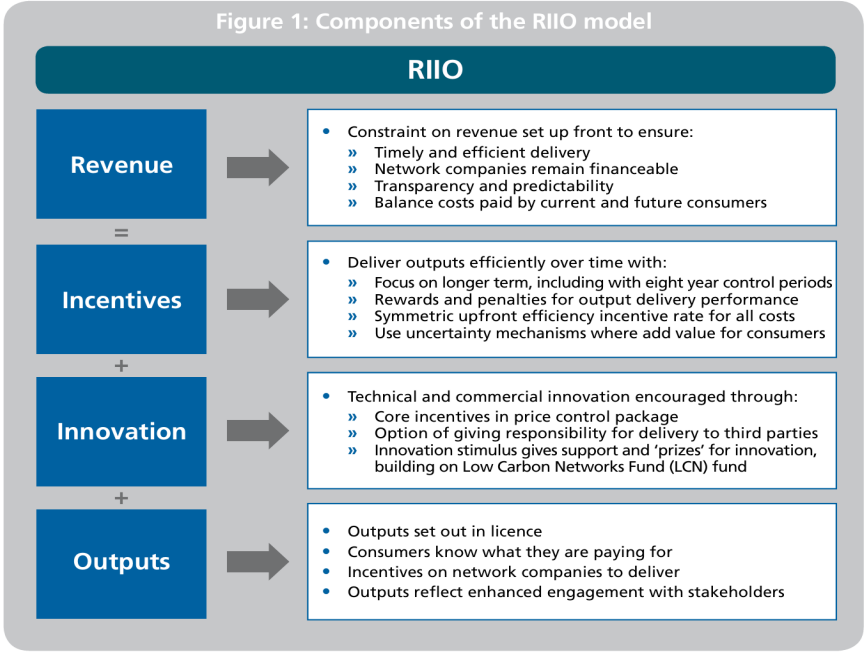
PG&E is conducting a speed to power trial to “energize large load customers prior to the completion of transmission upgrades”.

- The project will allow customers to enter a flexible service agreement with curtailment on PG&E’s signal.
- PG&E will provide customers with a heatmap of expected frequency, duration, and timing of curtailments.
- PG&E will use a transmission energy management system for grid needs forecasting and signaling.
- The project is ~$3.5M and runs through 2027.

Source PG&E

Innovation in the U.K.'s PBR Framework

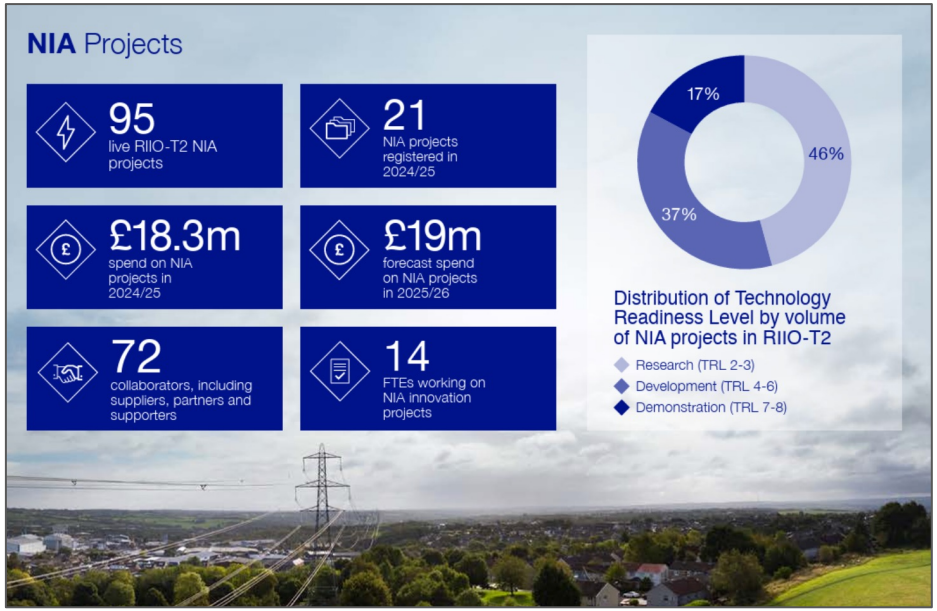
- The U.K.'s PBR framework is called RIIO – Revenue = Incentives + Innovation + Outputs.
- A review of the predecessor to RIIO found that it disincentivized innovation due to the focus on operating cost efficiency that discouraged long-term thinking and investment.
- RIIO includes multiple innovation mechanisms including an innovation stimulus, expedited review of certain programs, and a regulatory sandbox.

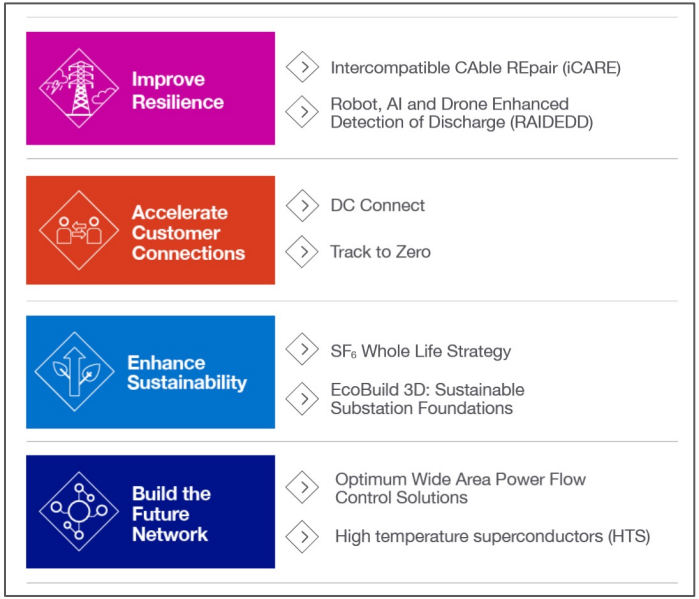


Sources: Mandel, ND; OFGEM, 2010

Project Examples: National Grid Electricity Transmission U.K.

Transmission-focused National Innovation Allowance (NIA) reporting





Source National Grid

Wrap Up

Berkeley Lab Resources

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

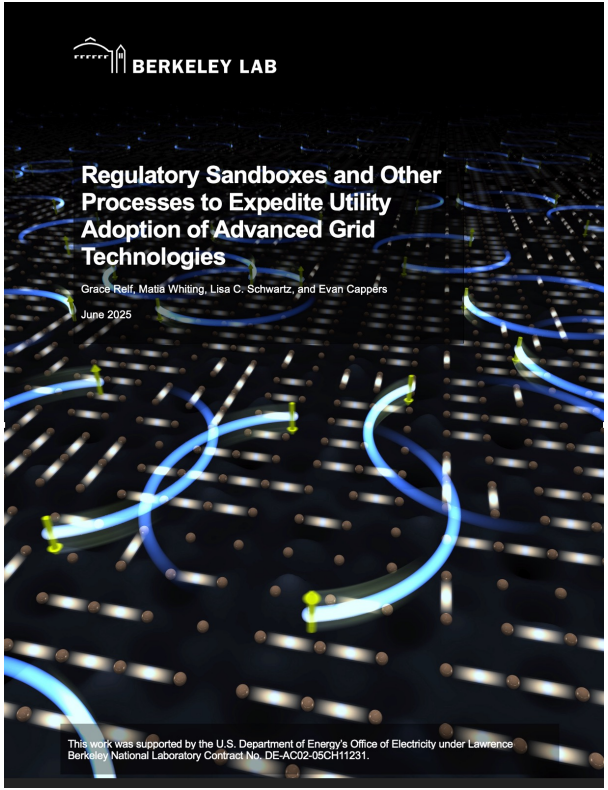
The research:

- 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

Toolkit available at: http://sandbox-navigator.lbl.gov/



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**

Findings on how a Sandbox Could support Maryland

Objective	Sandbox Applications
"Demonstrate how ATTs were evaluated … and provide transparent justification when ATTs are not deployed"	• Data from trials support reporting • Real-world experience with ATT implementation enables better prioritization of opportunities
Identify "a process for selecting candidate projects"	• A sandbox could serve as part of the process for selecting projects • Data from trials helps identify selection criteria
"Create shared savings mechanisms"	• Data from trials informs baselines to set and calculate savings levels • Sandboxes can allow experimentation with specific SSM designs
"Propose fast-track permitting workflows"	• Sandboxes are explicitly designed to support faster workflows and identify appropriate circumstances for modifications to regulations
"Regulatory de-risking"*	• Sandboxes can include consulting services to pre-vet projects or help third-parties navigate regulatory requirements

*The EO includes this in reference to power plants, but it could apply in other circumstances. Sources: EO, MEA 2026

Considerations for Maryland

- Explicitly identify the unique aspects of Maryland's transmission context that hinder or promote innovation, and identify whether mitigations to barriers are necessary or whether there are opportunities to support innovation
- Solicit information from utilities / transmission owners (TOs) on R&D and pilot approaches, budgets, and achievements
- Evaluate historical pilot projects and assess challenges and successful practices
  - Use existing evidence and share results going forward to determine when a pilot is necessary vs. when a phased roll-out or full-scale program may be acceptable
- Solicit ideas and perspectives and, where necessary, buy-in from external stakeholders on innovation and opportunities to scale ATTs, including PJM and the TOs
- Consider whether a sandbox is an appropriate tool for Maryland and develop a specific sandbox proposal for consideration

Questions

Extra Slides

Legal Frameworks for Sandboxes

- Commissions cite their broad regulatory authority and obligations as justification to establish a sandbox.
  - The District of Columbia cited its obligation to take meaningful steps to achieve its energy objectives.
  - Connecticut cited its broad statutory powers and obligations to oversee electric distribution companies and requirements to partner with third parties for enhanced demand-side management programs.
- Some states have more explicit legal authority for sandboxes.
  - California preserved an expiring funding carve-out under a Public Goods Charge statute for the EPIC program.
  - Hawaii cited statutes requiring implementation of PBR.
- Commissions may have existing frameworks to draw on in the design of regulatory sandboxes.
  - Hawaii mimicked an existing Commission process for expedited approval of programs.

PBR and Innovation

PBR tools may either promote or discourage innovation.

Multi-year rate plans (MYRPs)	• MYRPs can promote cost control • Utilities may either innovate to lower costs or may cut costs related to innovation
Revenue decoupling	• Decoupling de-links utility profits and electricity sales • It can remove a disincentive to pursue innovative programs that may reduce sales
Capex/Opex equalization	• Allowing utilities to earn a return on operational and other non-capital expenditures can promote investment in new technologies and services, regardless of ownership
Performance incentive mechanisms (PIMs)	• PIMs can focus on areas that promote innovation • When designed well, PIMs can incentivize creative thinking and reduce customer costs
Performance tracking	• Public reporting is a simple tool that can drive utility focus on certain outcomes such as annual R&D outcomes, particularly if specific metrics are established

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For more information

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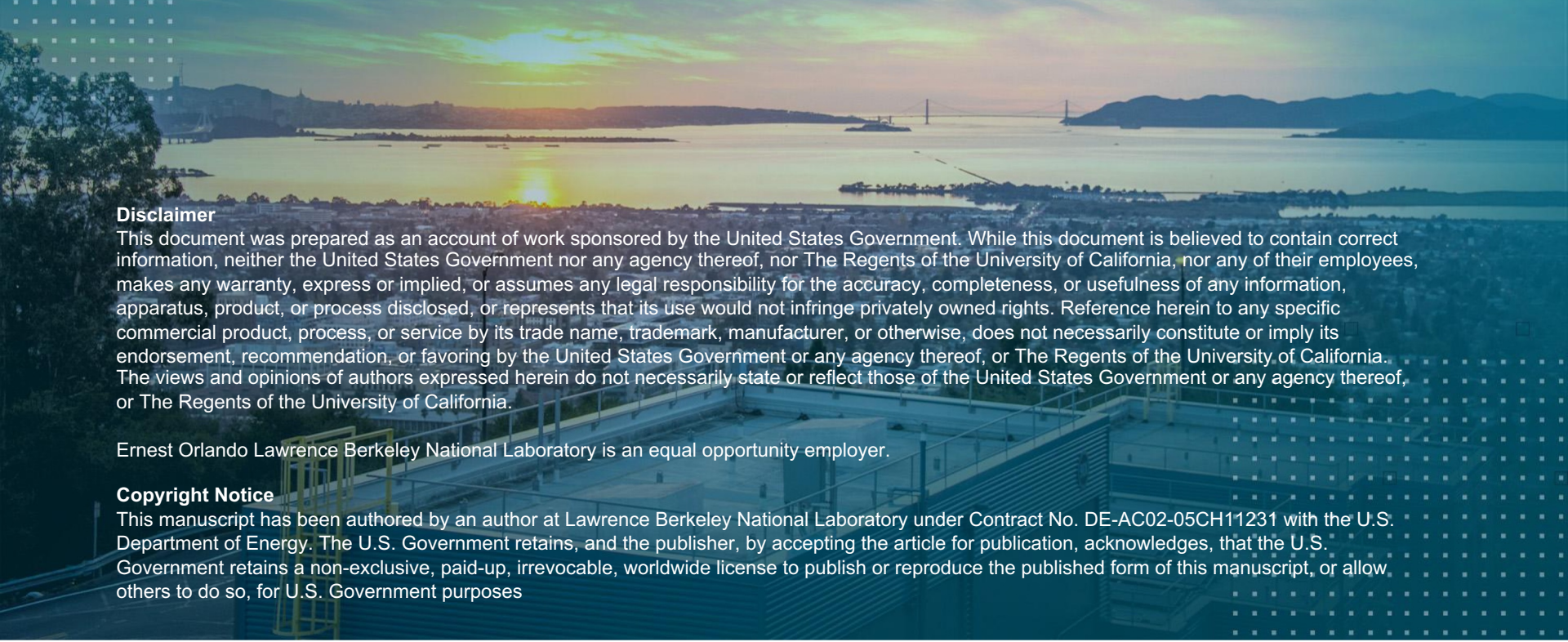

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