
Pennsylvania Energy Storage Consortium

MEETING #3

MARCH 1, 2022

Welcome & Overview

Tech notes:

- Please mute your mic/video unless indicated otherwise during Q&A
- Enlarge PPT screen by going to the ellipses icon and clicking “focus on content” and/or “full screen”

Forum Overview:

- PA DEP Energy Storage website: <https://www.dep.pa.gov/Business/Energy/OfficeofPollutionPrevention/Pages/Energy-Storage.aspx>
 - (Registration and link to download “*Pennsylvania Energy Storage Assessment: Status, Barriers & Opportunities*”)
- Steering Committee serving as content advisors
- Review of Meeting #1 and #2 outcomes
- Next meeting: **Tuesday, May 17, 1-3pm ET**

Mission Statement: *To engage stakeholders on policy and market topics that identify the opportunities to deploy energy storage for a modern, resilient, cleaner, low-carbon grid for all Pennsylvanians.*

Agenda – Meeting #3, March 1

- I. Welcome & Overview**
- II. Opportunities for Federal Funding for Energy Storage: Infrastructure Bill Analysis**
- III. State Policy Levers for Energy Storage Deployment: Lessons Learned for Pennsylvania**
- IV. Developer Perspectives on Optimizing Storage Policies & Programs for Pennsylvania**
- V. Stakeholder Discussion**
- VI. Wrap-Up & Next Steps**

Opportunities for Federal Funding for Energy Storage: Infrastructure Bill Analysis

Presented by: Dr. Imre Gyuk, Director Energy Storage Research
with the Department of Energy's Office of Electricity

Wrap-Up & Next Steps

Next Consortium Meeting Date:

- *May 17, 1:00-3:00 PM EST*

Stakeholder Engagement & Feedback:

- PA_energystorage@strategen.com

Energy Storage at DOE and Elsewhere in the U.S.

IMRE GYUK, DIRECTOR,
ENERGY STORAGE RESEARCH, DOE-OE

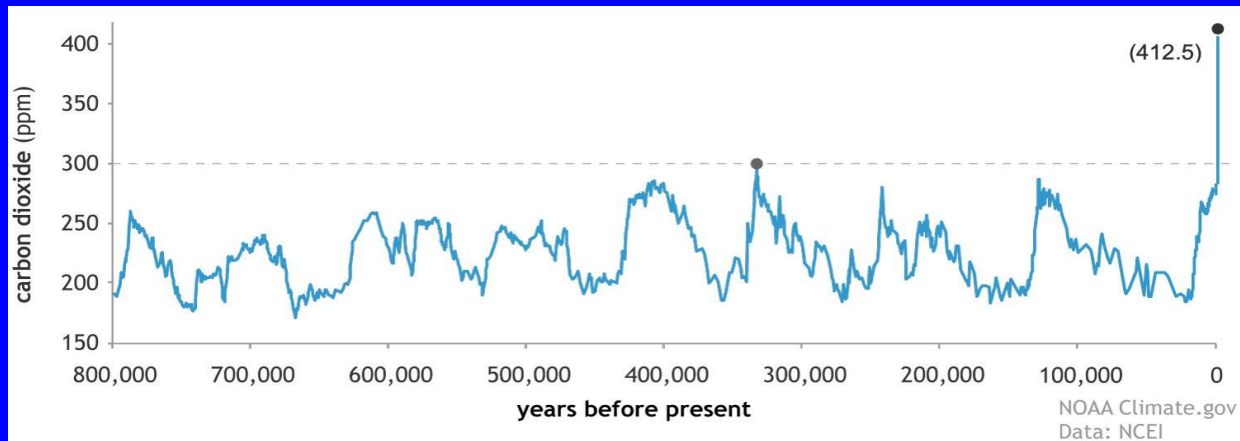
Global Warming is Real!



NY, Hurricane Ida, Aug. 2021



West Coast: 400 year Drought



800,000 years Atmospheric Carbon Dioxide

Burning Coal, Oil, Natural Gas:
for our Electric Grid,
Transportation, and Industry

Meanwhile
Extreme Weather Events
are becoming more Frequent
and more Severe!

Floods and Droughts,
but also
Sea Level Rise, Coastal Erosion,
Reduced Crop Yield, Wild Fires,
and Health Impacts

Global Warming has Emerged
as a Paramount Issue - World Wide!

To reduce CO2 emission
we must Decarbonize,
we must change
to Renewable Energy!

And we have to do it soon!

Unfortunately
Carbon Emission has
increased by 7% in 2021!

While 6% more Electricity
is being generated
with increased use of coal.

(IEA)

Decarbonization
will need to encompass;

Electricity Generation
Transportation
The Building Sector (HVAC)
Industrial Production

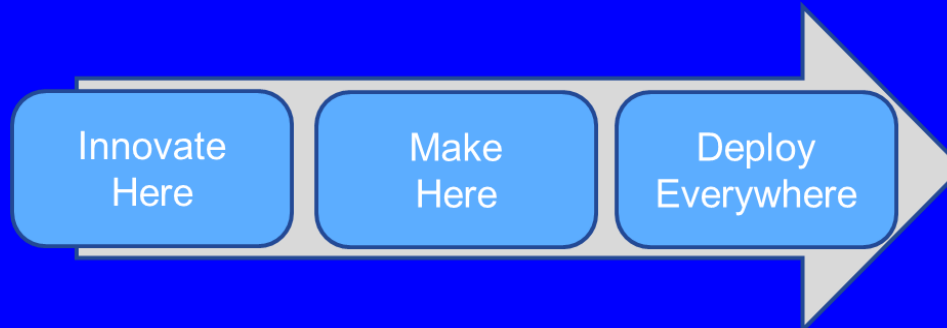
Vast amounts of Renewable Electricity
will be required in Future!

And correspondingly
Vast Amounts of Energy Storage
will be required.

This represents a Huge Investment!
and somebody
will have to Finance it!

Energy Storage Grand Challenge (ESGC)

*Vision: Leveraging **all** DOE resources to create and sustain global leadership in energy storage by 2030*



Earth-shot goal - Levelized Cost: \$ 0.05/kWh

In Actuality,
the Storage Industry is
Running into Serious Supply Chain Issues.
e.g. 9 months wait time for
an overseas Li-ion Battery!

Raw materials need to be assured
at the source!

We must emulate the L/A Industry
and create circular Economies!

One Company's supply chain
Is another Company's Export!

We must think Globally.

To achieve real Sustainability
we would Ultimately like
to have a Circular Technology
Based on
Earth Abundant and Inexpensive
Materials!

Supply Chain and Waste Stream
Must be part of the design!

Storage of Various Durations will be Needed: Short, Medium, and Long

15 min – 4 hrs: smoothing renewables. Li-ion

4 – 12 hrs: day/night PV storage. Flow Batteries

12h – 3 days: bad weather backup. Thermal/Gravity

We will need some 1200-2300 GWh
of Energy Storage!

Scaling up American Manufacturing of Flow Batteries

AMO \$18M

Largo Clean Energy (MA) - Vanadium

TreadStone Technologies (NJ) - Electrodes

Otoro Energy (CO) – Metal Chelate

Quino (CA) – Aqueous Organics

OE will fund Prototype Testing and Validation

Need for Social Equity
is becoming widely recognized

e.g. CA targets \$227M
for Equity in SG Incentive

DOE Initiative ES4SE:
Energy Storage for Social Equity

Office of Electricity \$9M

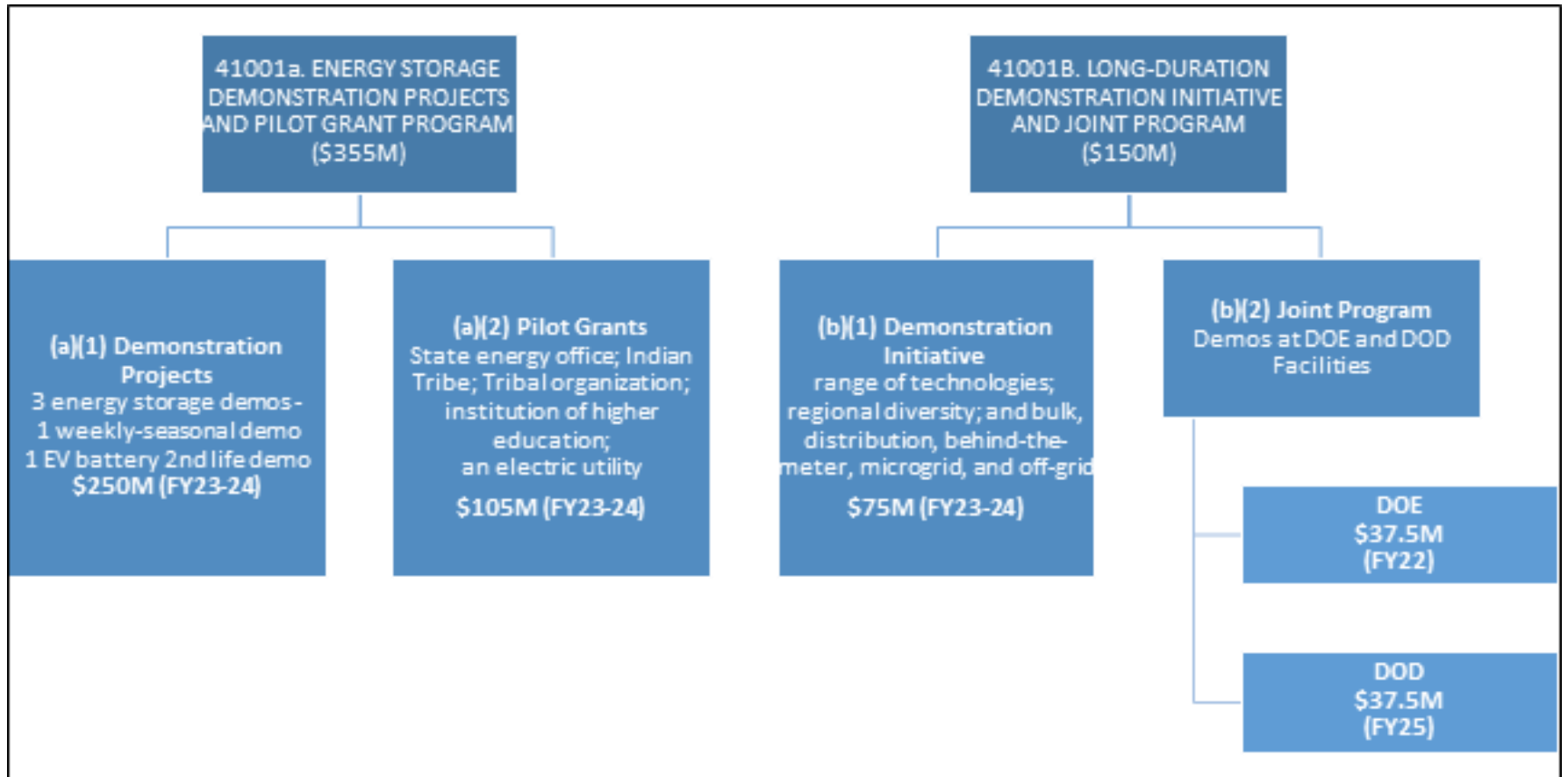
14 communities selected
to receive detailed Technical Assistance

5 communities will be chosen
to partner in constructing
an energy storage facility.

<https://www.pnnl.gov/projects/energy-storage-social-equity>

The Infrastructure Investment and Jobs Act
sets aside \$6 billion for
grant awards to expand Capabilities of
U.S. based Battery Research and Development,
bolster Domestic Battery Production
and shore up the American Supply Chain
in an industry often reliant on
Foreign Metals and Raw Materials.

Infrastructure Investment and Jobs Act (IIJA)



Energy Storage Deployment Provision Structure (Program Funds Subject to Change)

Invest over \$7 billion in Battery Supply Chain,

\$550 million in Energy Efficiency and Conservation Block Grant Program (EECBG)

\$500 million in the State Energy Program to provide grants to communities, cities, states, territories, and tribes to develop and implement clean energy programs

\$1.5 billion for clean hydrogen manufacturing and advancing recycling RD&D

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and advancing recycling RD&D

\$750 million in grants for advanced energy technology
manufacturing projects in coal communities.

Expand DOE's Loan Program Office (LPO)
to invest in projects that increase
the domestic supply of critical minerals

Meanwhile at OE,
Building and Validating
Novel Business Cases:
Resilience, Sustainability,
Grid Stability, and Social Equity

We need much more Energy Storage!
And we need it bigger, and safer,
less expensive, and longer in duration.
And we need to apply it in equitable ways.
If we don't do this, we are in very deep Trouble.



Energy Storage: State Policies and Emerging Uses

March 1, 2022

Jeremy Twitchell

Pennsylvania Energy Storage Forum



PNNL is operated by Battelle for the U.S. Department of Energy



Acknowledgment

The work described in this presentation is made possible through the funding provided by the U.S. Department of Energy's Office of Electricity, through the Energy Storage Program under the direction of Dr. Imre Gyuk.

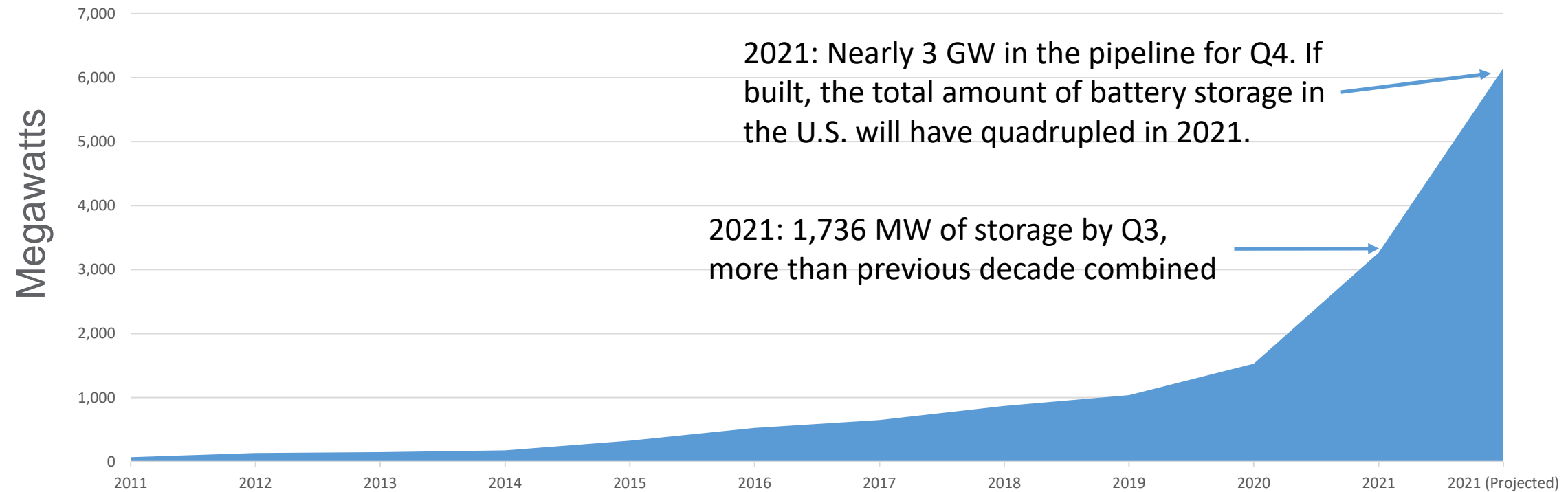
Agenda

- ▶ **Overview of State-Level Policies**
- ▶ **Case Studies: Multi-Faceted State Programs**
 - ▶ California
 - ▶ Virginia
 - ▶ Maine
 - ▶ Connecticut
 - ▶ States without a procurement target (Arizona and North Carolina)
- ▶ **Emerging Uses**
 - ▶ Energy Storage for Social Equity
 - ▶ Energy Storage for Resilience
 - ▶ Energy Storage as a Transmission / Dual-Use Asset

Overview of State-Level Policies on Energy Storage

Storage deployment and policy activity are accelerating

Cumulative Utility-Scale Battery Energy Storage (U.S.)

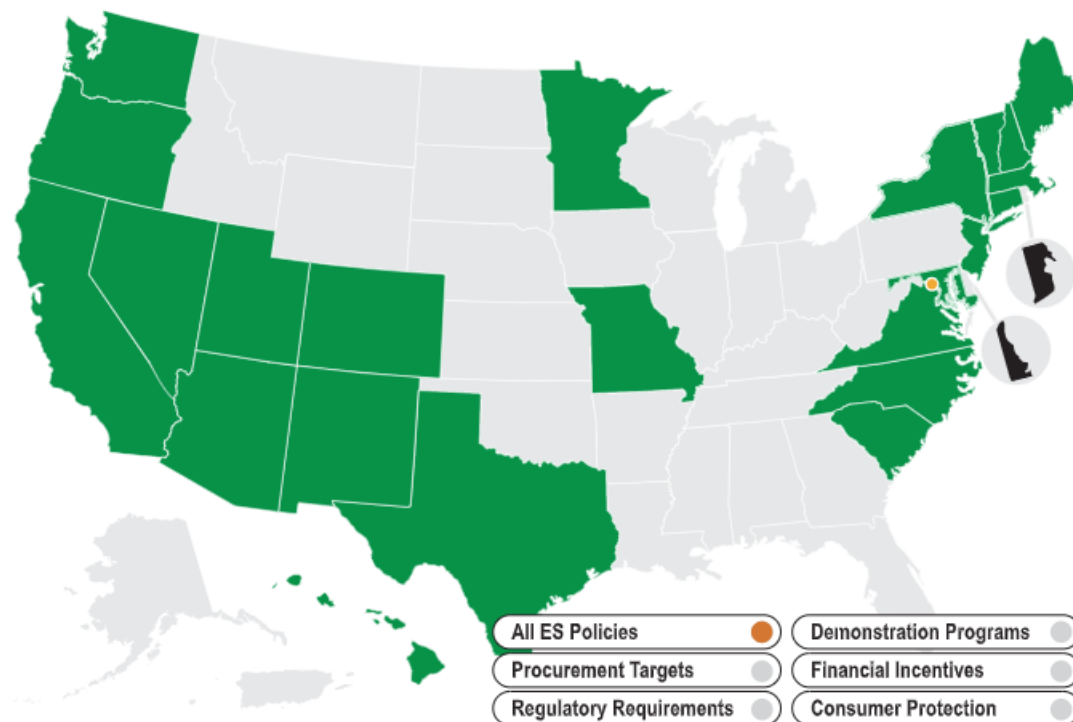


2011	2013	2015	2016	2017	2018	2019	2020	2021
<ul style="list-style-type: none"> • FEREC: Order 755 	<ul style="list-style-type: none"> • CA: 1,325 MW Target • WA: \$14m demo fund • HI: MPR mechanism 	<ul style="list-style-type: none"> • OR: 10 MWh target • NY: REV demo project • HI: Inter-connection changes 	<ul style="list-style-type: none"> • CA: SGIP storage focus • CA: 500 MW target increase • AZ: \$4m aggregation pilot • UT: Demo project 	<ul style="list-style-type: none"> • MA: 200 MW target • MA: \$20m demo fund • NV: Target legislation, incentives, storage as a right • NY: Target legislation • WA: Policy statement on storage in IRPs • NM: Storage in IRPs rule • AZ: \$2m BTM pilot • MD: Tax credit • VT: Study, demonstrations 	<ul style="list-style-type: none"> • FEREC: Order 841 • MA: 1,000 MWh target, planning requirements • NJ: 2,000 MW target • NY: 1,500 MW incremental target • CA: Planning requirements • CO: Storage as a right • VA: Planning requirements, demo projects 	<ul style="list-style-type: none"> • OR: Solar + storage rebates • MA: Storage in retrofits • NY: Resilience incentives • CO: Storage in dist. plans • MD: Ownership pilot • SC: Storage in net metering • NH: Property tax exemptions • MN: Storage in IRPs; storage study; pilots • DE: Storage in cooperatives • MT: Storage in net metering • NC: End of life management • ME: Storage study; non-wires coordinator • MO: Storage in IRPs 	<ul style="list-style-type: none"> • Federal: BEST Act • VA: 3,100 MW target; plan requirements • AZ: BTM aggregation • MA: Clean peak implemented • NV: 1,000 MW target • WA: Storage in PACE • PR: Storage for backup power • OR: Resolution on long-term storage • MD: Storage as economic dev. • CA: Storage for local RA and equity • CT: Storage interconnection • NH: Storage for T&D avoidance • RI: Tax credit for solar+ storage 	<ul style="list-style-type: none"> • Federal: Infrastructure Investment and Jobs Act • VA: 3,000 MW target • AZ: Expedited interconnection for solar + storage • VA: Sales tax exemption • ME: 400 MW target, critical load pilot • CT: 1,000 MW target; planning guidance; financial incentives • IL: Climate and Equitable Jobs Act (target, incentives, consumer rights)

Energy Storage Policy Database

In recent years, several states have begun to identify and address barriers to energy storage. PNNL tracks these policies in an interactive database available at <https://energystorage.pnnl.gov/regulatoryactivities.asp>:

Energy Storage Policy Database



The policy database tracks five types of state-level energy storage policies:

- ▶ Procurement targets
- ▶ Regulatory adaptation
- ▶ Demonstration programs
- ▶ Financial incentives
- ▶ Consumer protection

Related article: [A Review of State-Level Policies on Electrical Energy Storage.](#)

Procurement Targets

Generally adopted where a state identifies specific issues that energy storage is expected to address, and current practices that may prevent storage from adoption in the normal course of business. Currently adopted in 10 states:

- ▶ **California:** [1,325 MW](#) by 2020; [500 MW](#) (distribution-connected) by 2020
- ▶ **Oregon:** [10 MWh](#) by 2020
- ▶ **Massachusetts:** [200 MW](#) by 2020; [1,000 MWh](#) by 2025
- ▶ **New Jersey:** [600 MW by 2021; 2,000 MW by 2030](#)
- ▶ **New York:** [1,500 MW by 2025; 3,000 MW by 2030](#)
- ▶ **Nevada:** [1,000 MW by 2030](#)
- ▶ **Virginia:** [3,100 MW by 2035](#)
- ▶ **Maine:** [300 MW by 2025; 400 MW by 2030](#)
- ▶ **Connecticut:** [1,000 MW 2030](#)
- ▶ **Illinois:** [Pending](#)

Regulatory Adaptation

Several states have adapted regulations to account for the unique capabilities of energy storage and other flexible, scalable technologies:

- ▶ **California:** CPUC adopts [11 rules](#) covering energy storage in planning
- ▶ **Connecticut:** PURA develops [six points of guidance](#) for utility investments in energy storage.
- ▶ **Washington:** WUTC issues [policy statement](#) guiding storage modeling in IRPs
- ▶ **Hawaii:** HPUC changes to [interconnection requirements](#) encourage storage; [streamlined proceedings](#) for review of flexible resource investments
- ▶ **[New Mexico](#):** NMPRC amends IRP rule to require storage analysis
- ▶ **[Virginia](#):** Legislature requires distributed energy integration report
- ▶ **Maine:** Legislature creates [nonwires alternative coordinator](#) to make recommendations for non-wire investments in transmission and distribution systems
 - Legislature directs PUC to [design rates to incent BTM storage](#) usage during peak periods
- ▶ Target legislation in OR, MA, NJ also requires PUC to develop processes for evaluating, siting storage

Demonstration Programs

Demonstration programs are state-directed initiatives in which the state authorizes, and often assists in funding, energy storage projects intended to assist utilities in gaining operational understanding of energy storage:

- ▶ **Massachusetts:** [ACES program](#) provides \$20 million to 26 projects
- ▶ **New York:** REV initiative includes an [open call](#) for demonstration project proposals; four projects developed
- ▶ **Washington:** [CEF](#) provides \$14.3 million for five demonstration projects
- ▶ **Virginia:** [Legislation](#) authorizes 40 MW of storage demonstration projects
- ▶ **Utah:** [Legislation](#) authorizes energy storage demonstration project
- ▶ **Maryland:** [Legislation](#) requires utilities to conduct demonstration projects testing various ownership models
- ▶ **Illinois:** [\\$280.5M to support storage](#) deployments at retiring coal plants
 - **PNNL Memo:** [Energy Storage for Social Equity: Capturing Benefits from Power Plant Decommissioning](#)

Financial Incentives

Many states offer state-funded programs that provide incentives, either as direct payments or tax rebates, to customers who install energy storage:

- ▶ **Maryland:** [30% state income tax credit](#) for residential and commercial energy storage systems
- ▶ **California:** [Self-Generation Incentive Program](#) set aside \$378M for customer-sited energy storage projects from 2017-2021
- ▶ **New York:** [The New York State Energy Research and Development Authority](#) provides multiple grant programs to support energy storage developments
- ▶ **Nevada:** [Legislation](#) expands solar incentive program to include energy storage
- ▶ **Arizona:** Regulators authorize [\\$2M incentive program](#) to assist large commercial customers in deploying behind-the-meter storage for peak management
- ▶ **Vermont:** Legislation makes storage eligible for [Clean Energy Development Fund](#)
- ▶ **Virginia:** Sales tax exemption for energy storage equipment; property tax flexibility
- ▶ **Washington:** [Commercial Property Assessed Clean Energy and Resilience \(C-PACER\)](#) program includes energy storage

Consumer Protection

Three states have adopted legislation that guarantees certain protections to customers who install energy storage:

- ▶ **Nevada**: Legislation establishes a right for customers to install energy storage in a timely manner, subject to reasonable standards
- ▶ **Colorado**: Legislation establishes a right for customers to install energy storage and directs the Colorado PUC to develop interconnection rules
- ▶ **Illinois**: Climate and Equitable Jobs Act establishes a right for customers to use energy storage at their residence, and directs utilities to allow for the interconnection of customer-sited storage in a timely manner

Case Studies: Multi-Faceted State Programs

Target Establishment:

- ▶ Legislature authorized the California Public Utilities Commission to establish a target if the CPUC determined that doing so would be in the public interest (2010)
- ▶ CPUC set a target of 1,325 MW, allocated across utilities and point of interconnection (transmission, distribution, BTM)
- ▶ Legislature required additional 500 MW of BTM storage in 2016

Additional steps taken:

- ▶ **Procurement rules:** The CPUC's [target order](#) also identified priority use cases and where energy storage fit in the "Loading Order" used to guide utility resource procurement
- ▶ **Incentives:** [Self-Generation Incentive Program](#) focus shifted from distributed generation to energy storage; \$378M for customer-sited energy storage projects from 2017-2021
 - Incremental changes have prioritized funding for projects in overburdened communities and areas affected by public safety power shutoffs
- ▶ **Planning guidelines:** In 2018, the CPUC adopted [guiding principles](#) for how utilities should account for the various values of energy storage in the planning process
- ▶ **Interconnection:** [Rule 21](#) establishes transparent, streamlined interconnection processes as well as a discussion forum
- ▶ **IRP reforms:** California's statewide resource planning process has received several storage modeling enhancements

Additional steps taken:

- ▶ **Breaking down the target:** [SCC's rules](#) establish interim targets for 2025 and 2030
- ▶ **Procurement guidelines:** The rules require annual competitive, transparent solicitations
- ▶ **Financial incentives:** The rules authorize utilities to propose incentive programs for BTM storage
- ▶ **Use case prioritization:** The rules identify specific uses for storage projects, including infrastructure deferral and peak reduction
- ▶ **Aggregators:** The rules authorize energy storage aggregators to register with the commission, market to customers, and sell services to utilities (final order noted that Order 2222 may supersede these regulations)

Target Establishment:

- ▶ Legislature established a target of 3,100 MW and outlined broad procurement and cost allocation principles, but assigned the Virginia State Corporation Commission with figuring out the details
- ▶ SCC adopted implementation rules in Dec. 2020

Target Establishment:

- ▶ In June 2021, the Maine Legislature established a target of 400 MW by 2030 with an incremental target of 300 MW by 2025.
- ▶ After 2030, the Governor's Energy Office will update the target every two years.

Other things the target legislation did:

- ▶ **Financial incentives:** Added load shifting to the mission of the Efficiency Maine Trust and authorized the use of incentives for customer-sited energy storage systems
- ▶ **Resilience demonstration program:** Also directed the Efficiency Maine Trust to develop a 15 MW pilot program to deploy BTM storage at critical facilities
- ▶ **Rate design:** Directs the PUC to implement time-of-use rates as an incentive for customers to reduce usage during peak
- ▶ **Market assessment:** Directs the Governor's Energy Office to prepare a report identifying obstacles to the achievement of the target and options for addressing them

Additional measure in place:

- ▶ **Non-wires alternative coordinator:** 2019 legislation created an independent arbiter of utility resource plans to identify opportunities for non-wires alternatives

Connecticut

PURA's Electric Storage Program (July 2021):

- ▶ **Program objectives:** Identifies seven distinct objectives for program investments to achieve, including net positive economic benefits, resilience, reducing financial barriers, and emissions reduction
- ▶ **BTM Target Disaggregation:** Determined that the 580 MW BTM target should be used for peak management and broke it down by customer class and timing:

Table 1: Electric Storage Deployment Targets

CUSTOMER CLASS	2022-2024	2025-2027	2028-2030	TOTAL
Residential	50 MW	100 MW	140 MW	290 MW
Commercial and Industrial	50 MW	100 MW	140 MW	290 MW
Total	100 MW	200 MW	280 MW	580 MW

- ▶ **Financial incentives:** Established up-front and performance-based incentive for BTM systems participating in the program
 - Adder incentives for low-income and underserved customers

Target Establishment:

- ▶ In June 2021, the Connecticut Legislature established a requirement of 1,000 MW by 2030, with incremental targets of 300 by 2024 and 650 MW by 2027.
- ▶ Of the final target, 580 MW must be connected to the distribution system
- ▶ Authorizes the Public Utilities Regulatory Authority (PURA) to develop programs to facilitate the target's achievement.

Procurement Targets Not Required

Arizona:

- ▶ **Demonstration Programs:** Arizona Corporation Commission authorized a \$4 million program to deploy utility-owned, customer-sited energy storage
- ▶ **Financial Incentives:** \$2 million pilot incentive for commercial customers to deploy BTM storage evolved into a bring-your-own-device program
- ▶ **Regulatory Adaptation:** Arizona is the only vertically integrated state to require utilities to work with independent distributed energy resource aggregators
- ▶ **Customer Protection:** Clearly defined, streamlined interconnection processes for customers wanting to install energy storage

North Carolina:

- ▶ **Regulatory Adaptation:** NC appears to be the only state that has end-of-life requirements in place for batteries
- ▶ **Regulatory Adaptation:** NC Utilities Commission simplified the process for retrofitting existing generators with energy storage
- ▶ **Financial Incentives:** Utility contracts with third-party renewable energy generators create clear price signals to add energy storage
- ▶ **Regulatory Adaptation:** NC Clean Energy Plan recommends rate design and load management practices that incent the use of energy storage for peak management

Case Study Takeaways

- ▶ **Breaking targets into more digestible components facilitates planning and program design**
 - Use case approach: What do we want the storage to do? (Peak reduction, T&D referral, decarbonization, etc.)
 - Point of interconnection approach: Where do we want the storage? (Transmission, distribution, BTM, etc.)
 - Assignment responsibility: Who will be responsible for acquiring storage
- ▶ **Customer-owned and -sited storage is a growing area of focus**
 - Can be facilitated with state incentives or ratepayer-funded utility programs
 - Aggregation allows for leveraging of private investments to achieve grid benefits that flow to all customers
 - Order 2222 will greatly facilitate aggregation in ISO regions, but implementation is realistically several years away
- ▶ **Planning and modeling guidelines increase transparency and help utilities/LDCs identify cost-effective opportunities for deploying storage**
 - With or without a target
- ▶ **Technical details still matter**
 - Interconnection standards, codes and safety necessary for streamlined, safe deployment of energy storage

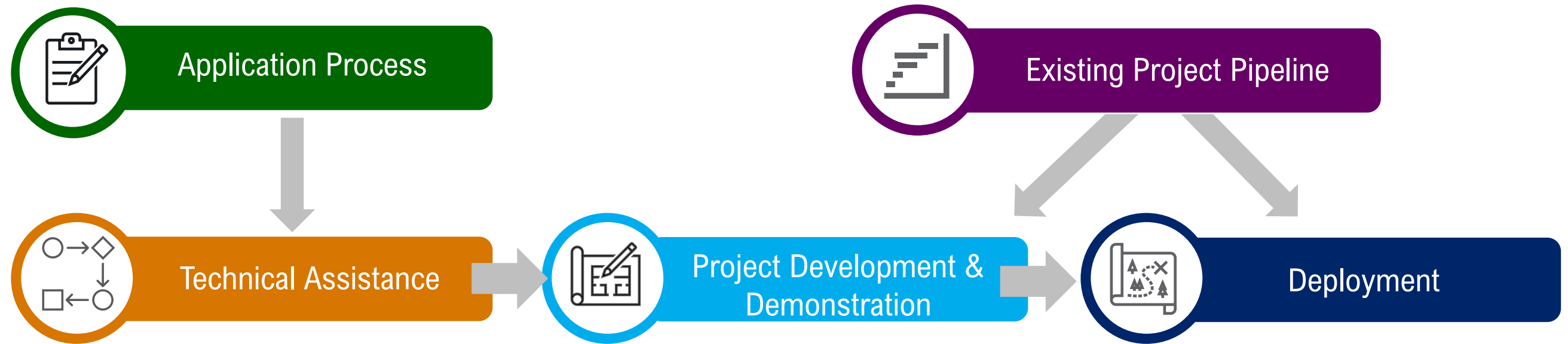
Emerging Uses

Energy Storage Offers Non-Energy Benefits that Can Drive More Equitable Outcomes

Benefit Title	Benefit categories	Description
Emissions reduction	Environmental	Storage facilitates the removal of fossil fuels from the grid through decommissioning strategies and renewable energy expansion.
Energy costs	Economic, Social	Storage creates a resource to manage peak demand and reduce cost.
Equity enhancement	Social, Economic	Storage systems can provide targeted benefits to underserved communities including revenue generation and energy independence.
Increased property value	Economic	Storage provides the capability to keep heating and cooling systems reliably operational and may decrease energy costs leading to an increased property value.
Job creation	Economic, Social	Storage creates job opportunities across the asset's lifecycle, including battery manufacturing, operation, maintenance, and management.
Less land use	Environmental, Social	Storage decreases the need to build new or maintain existing power plants.
Resilience benefits	Social, Economic	Storage mitigates energy outages and disruption costs (financial and otherwise).

New Program: Energy Storage for Social Equity (ES4SE)

Goal: support disadvantaged communities affected by unreliable and expensive energy systems. Through this program, eligible communities have access to direct, non-financial technical assistance and potential support for new energy storage project development and deployment.



OUTCOMES

Connect disadvantaged communities with energy solutions that support equitable outcomes

Demonstrate the role of energy storage in energy equity

Develop methods and metrics to analyze impact of investment on equity

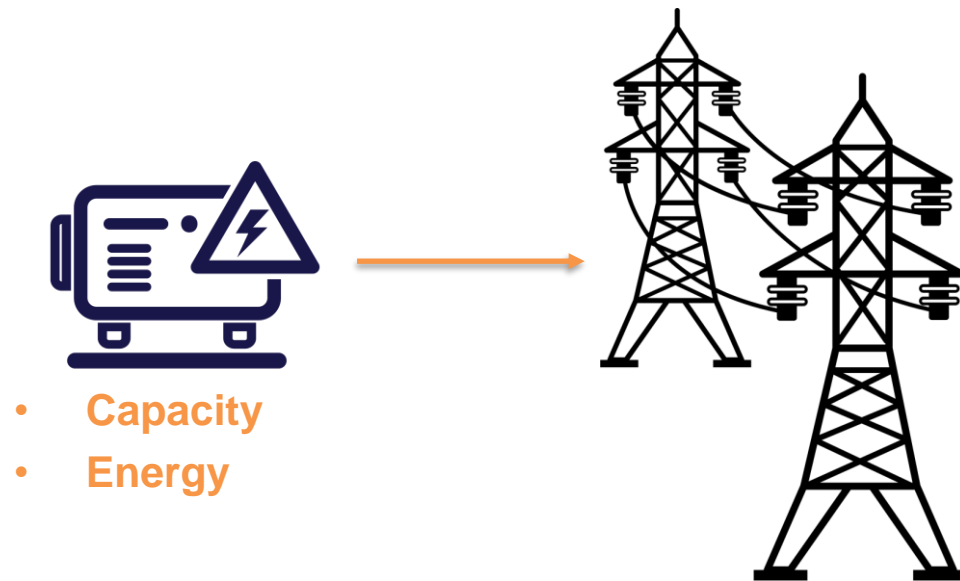
Report on lessons learned and best practices to support future work across DOE

Grow and strengthen DOE project pipeline

Energy Storage Enables Cost-Effective Resilience

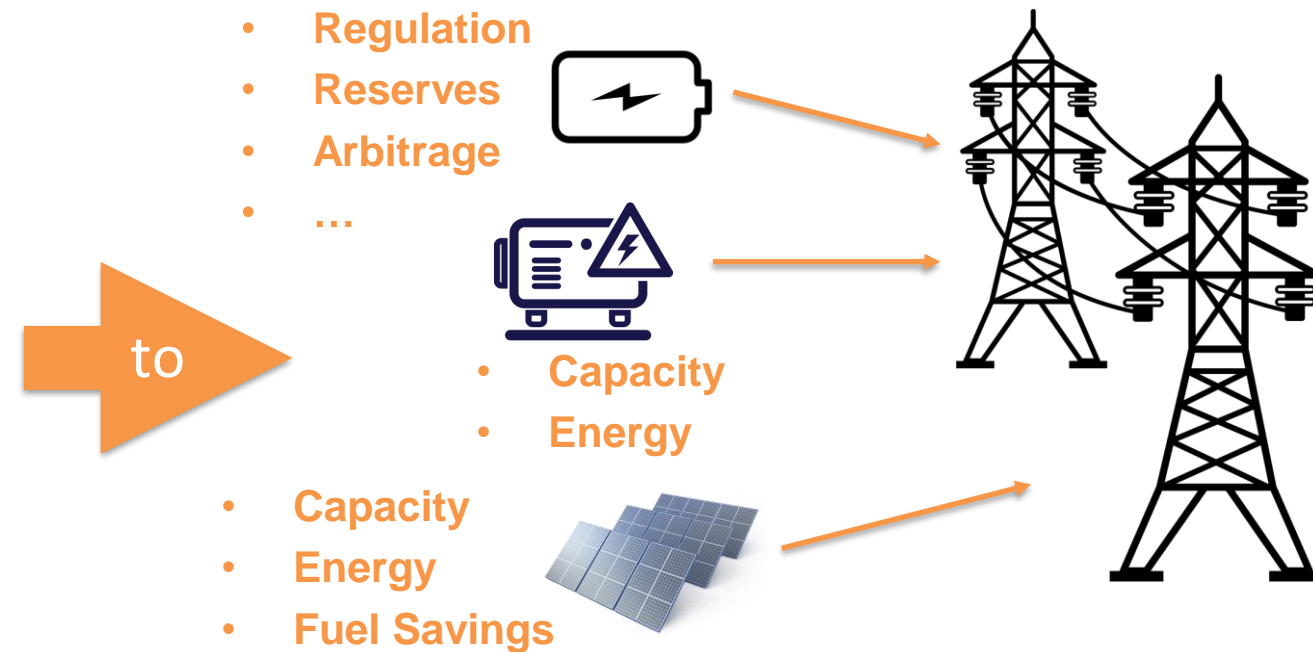
The advent of cost-competitive energy storage options has enabled us to go from:

Mission-critical resilience



- Limited opportunities for grid participation
- High cost
- Limited to facilities in which resilience is mission critical

Economic Resilience



- Increased opportunities for grid participation
- Offsetting revenues reduce system costs
- Viable resilience for broader range of facilities

Full report: [Planning Considerations for Energy Storage in Resilience Applications](#)

FERC Policy Statement on Dual-Use Storage (2017)

- ▶ **Policy Statement**: Once deployed as a transmission asset, energy storage will likely have significant opportunities to provide energy services in the market, thereby generating offsetting revenue that can be shared with customers to reduce system costs.
- ▶ Therefore, energy storage can be a dual-use (transmission and generation) asset, subject to three clarifying principles:
 - ▶ Avoid double recovery of costs
 - ▶ Minimize adverse impacts on markets
 - ▶ ISO/RTO independence must not be compromised
- ▶ **A policy statement is a nonbinding document; no action required**
 - ▶ The California Independent System Operator (CAISO) and Midcontinent Independent System Operator (MISO) are the only entities to initiate a direct response to the statement
 - ▶ CAISO's proceeding was suspended after a year of development; timeline for revisiting is uncertain
 - ▶ MISO's initial proceeding refocused on storage as a transmission asset only; dual-use proceeding re-launched in January 2022

Project Overview

Generic Example of Revenue Sharing Impacts

Year	Transmission Revenue Requirement	Market Revenue Credit	Net Transmission Revenue Requirement
1	(\$1,250,000)	\$50,000	(\$1,200,000)
2	(\$1,225,000)	\$50,000	(\$1,175,000)
3	(\$1,200,000)	\$50,000	(\$1,150,000)
...			
38	(\$325,000)	\$50,000	(\$275,000)
39	(\$300,000)	\$50,000	(\$250,000)
40	(\$275,000)	\$50,000	(\$225,000)
Total	(\$30,500,000)	\$2,000,000	(\$28,500,000)
		0	
Net Present Value	\$10,000,000		\$9,511,047



Project Structure:

- ▶ Two-year, joint project between PNNL and Argonne National Laboratory
- ▶ Funded by DOE's Water Power Technologies Office, through the HydroWIRES initiative.

Project Objectives:

- ▶ Identify a participation mechanism by which energy storage may be deployed as a transmission asset, but also earn offsetting revenue through market participation, then quantify the resulting benefits.
- ▶ Objectively inform future proceedings on dual-use storage.

First Paper: [Enabling Principles for Dual Participation by Energy Storage as a Transmission and Market Asset](#)



Thank you

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