



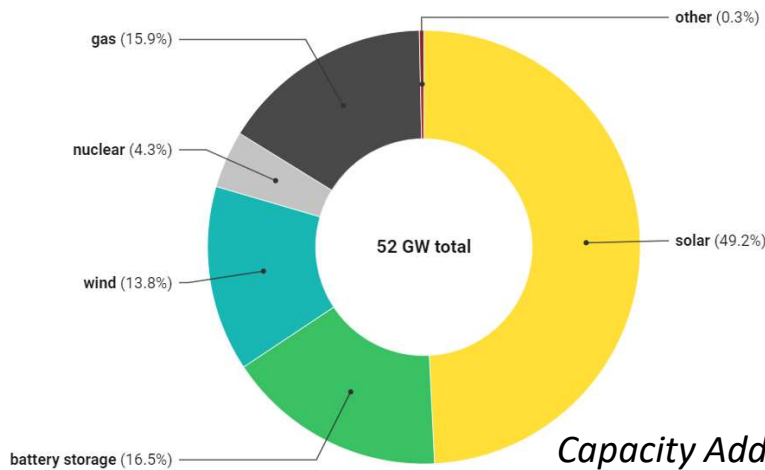
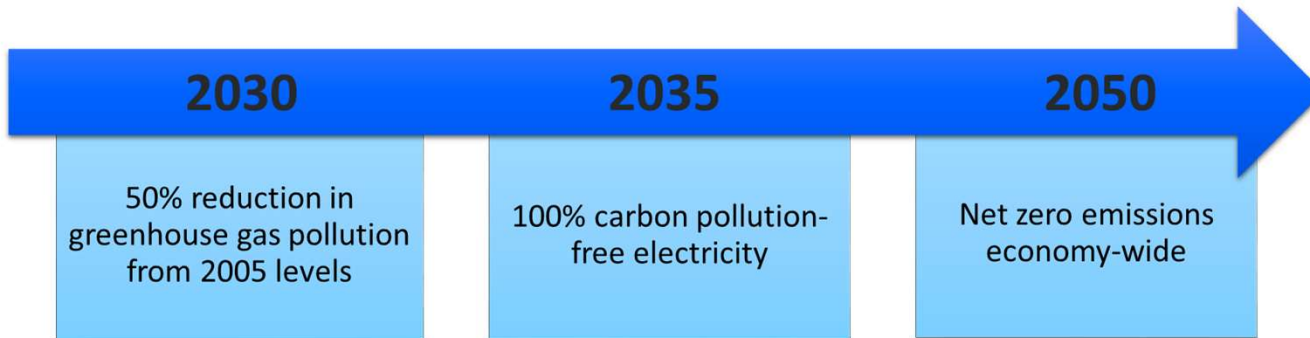
OE-Moderated Discussion on Energy Storage

June 6, 2024

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Acting Director, Storage Analysis

**As the power system evolves,
studies show that we'll need a lot
more LDES, and quickly**

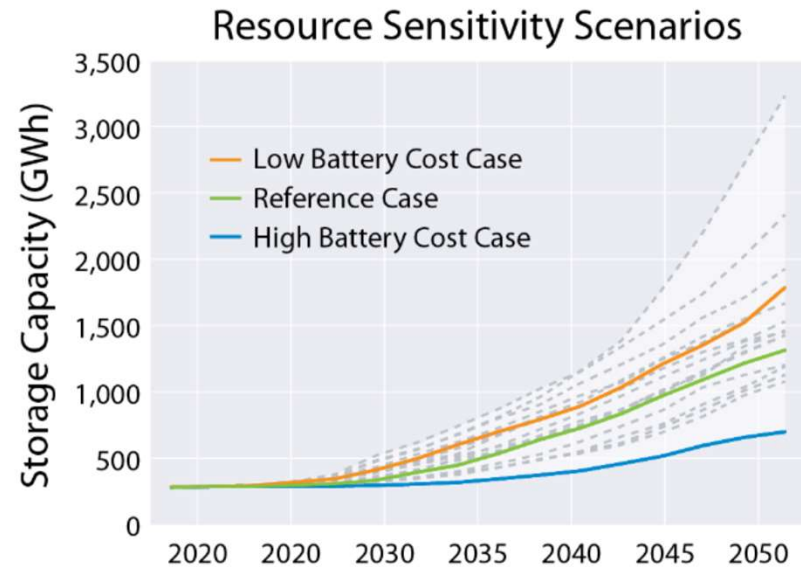
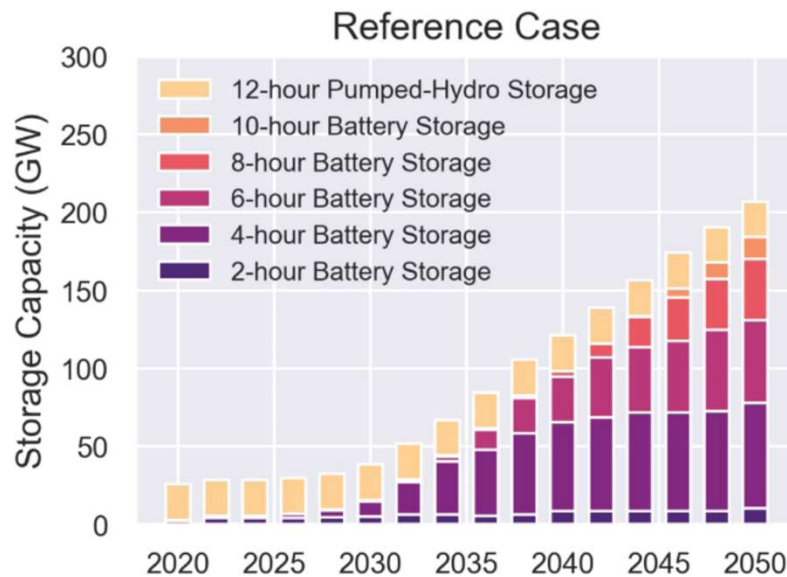
The energy system is transitioning rapidly



- Decarbonization goals require significant shift in generation mix
- Clean energy dominated US added capacity in 2023
- Batteries expected to be even greater share in 2024

Storage Futures Study (NREL/DOE 2022): 2-12 h duration

- 100–650 GW (600 to 3000+ GWh) in 2050, or 5x today's capacity
- Driven by storage costs, natural gas prices, renewable energy cost



LDES Liftoff Report (DOE 2023): Inter-day and multi-day+

- Integrated modelling shows a net-zero U.S. power grid could include ~60-460 GW of LDES by 2050
- The capital investment required is very large (~\$330B), and the applications are diverse resulting in the potential for multiple technologies to scale.

National Storage Capacity, GW

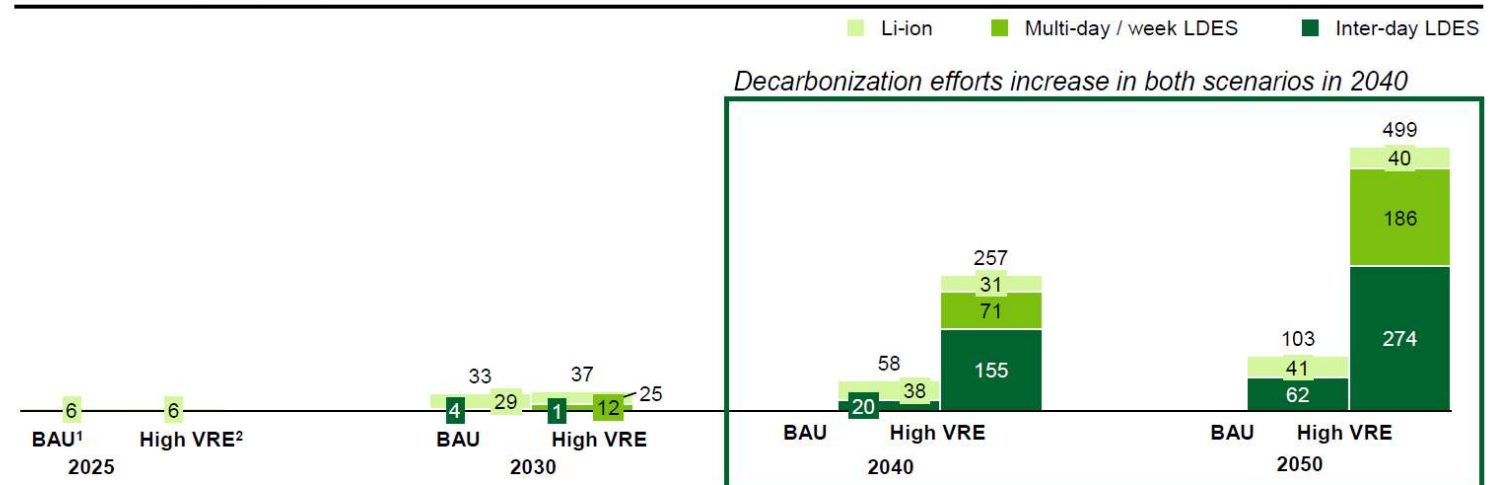
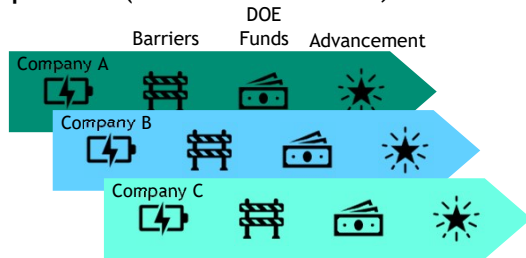


Figure 3: Between 60-460 GW of LDES may be deployed by 2050 to meet decarbonization targets under the BAU and Net-Zero by 2050 with High variable renewables penetration scenarios.¹ BAU stands for Business as Usual; ²Net-zero by 2050 with high renewable penetration.

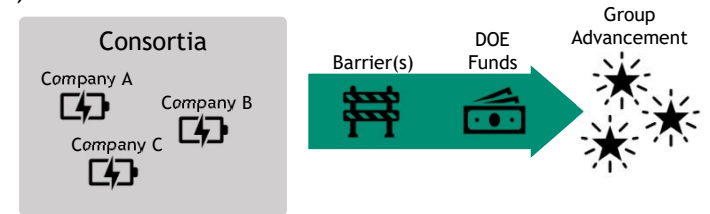
**OE can address this national-scale
need by supporting storage
technology and workforce with
innovative funding mechanisms**

Serial- and consortium-based funding opportunities

Serial Approach (ex. OE FOA 3036; OCED/OE FOA 2867)



Consortia Approach (ex. OE FOA 3020; SC FOA 2923)

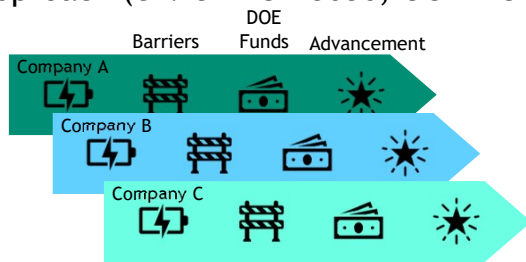


- Company-specific (“Serial”) funding:
 - More “tailored”
 - Easier to ringfence IP
 - Often used for near-commercial technologies

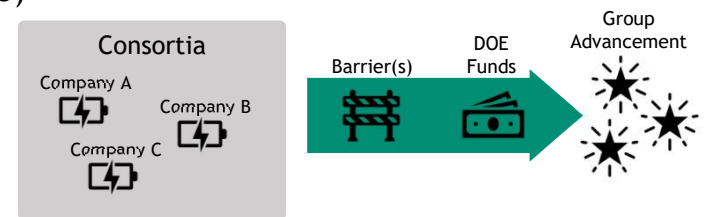
- Multi-partner (“Consortia”) funding
 - Secondary validation of R&D targets
 - Larger beneficiary pool
 - Often used for nascent or fundamental technologies

New awards announced for both FOAs, total of \$30M

Serial Approach (ex. OE FOA 3036; OCED/OE FOA 2867)



Consortia Approach (ex. OE FOA 3020; SC FOA 2923)



DTE Electric Co.

- Project Title: *Fully Hybrid Li-Ion as LDES and Second Life Batteries Demonstration*

CapyBara Energy LLCP

- Project Title: *Empowering Sustainable Community Revival Through Innovative Long Duration Energy Storage and Resource Reclamation (ESTER)*

muGrid Analytics

- Project title: *Project VITALITY: Vanadium Innovation to Advance Long Duration Energy Storage & Impact Tribal Sovereignty*

New Lab, LLC

- Project Title: *Enabling high-capacity zinc utilization through electrode and electrolyte fundamentals*

Battery Council International

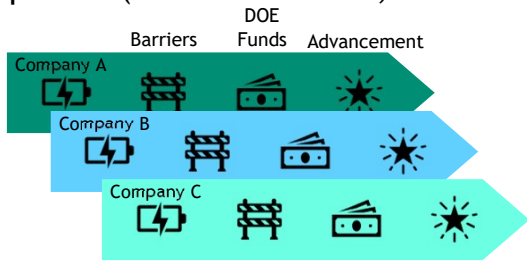
- Project Title: *Consortium for Lead Battery Leadership in LDES*

Clean Tech Strategies LLC

- Project title: *Pre-Competitive Research & Development to Accelerate the Maturation of Flow Battery Technologies into Cost-Effective Long Duration Energy Storage*

New awards announced for both FOAs, total of \$30M

Serial Approach (ex. OE FOA 3036; OCED/OE FOA 2867)



EAC Core Recommendation Addressed:

7. Address barriers and develop use cases for the industry and end users to facilitate timely and efficient interconnection and accelerate the integration of storage assets to maintain stability and promote resilience as the grid transitions.

Consortia Approach (ex. OE FOA 3020; 2923)



EAC Core Recommendation Addressed:

6. Facilitate the cost effective deployment and interoperability of fixed and mobile storage assets by promoting standards that support consistent best practices among the industry and user groups.

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**EAC Core
Recommendation
Addressed:**

4. Improve the resilience of critical services by supporting the deployment of energy storage at critical services and interdependent network infrastructure.

NOI: Critical Facilities Energy Resilience (CiFER)

Overview: Intended FOA is expected to provide up to **\$15 million** for cost-shared demonstration projects to facilitate the deployment innovative long duration storage technologies to support resiliency at critical infrastructures, planned for **August 2024**

- Demonstrate the benefits of innovative LDES technology in the field
- Benefit a host site/critical infrastructure
- Conduct quantitative and qualitative analysis on the value of resiliency provided by LDES

Technology Providers	Critical Facility or Infrastructure Owner	Resiliency Analytics Partner
<ul style="list-style-type: none"> • A private energy storage company • An institution of higher education • Other organizations that develop or deploy energy storage 	<ul style="list-style-type: none"> • A first responder or emergency response facility • Critical service sites such as healthcare, telecommunications, data centers, utilities, financial institutions and government facilities etc. 	<ul style="list-style-type: none"> • Academic or Research Organizations • Consultants • National Labs

RFI: Blue Sky Training Program (BSTP)

Overview: Educate and train first responders, law enforcement agencies, local communities, utilities, authorities having jurisdictions (AHJs), and others on how to respond to unanticipated energy storage system (ESS) failures including those caused by

- Cyber threats
- Physical threats
- Other unanticipated operational failures

Timeline: RFI submission period closes: **Monday, June 3**

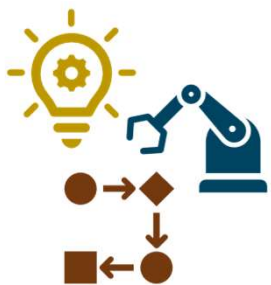
Potential Partners and Roles:

EAC Core Recommendation Addressed:

3. Support local efforts by states and regulators to remove barriers to facilitate markets and remove disincentives for energy storage.

Storage Asset Owner/Operator	Community Partners	Other Partners
Responsible for identifying and gaining an understanding of specific threats to their existing ESS. It is anticipated that they will also be responsible for developing emergency response procedures and conducting tabletop exercises	One or more community training participants that may participate in boots on the ground exercises located at the ESS site to gain an understanding of the threat and their role in ensuring proper response.	Other companies, industry groups, academic institutions, U.S National labs or other organizations that can support development of training programs.

RFI: Manufacturability Pre-Production Design Implications on Energy Storage Technologies



Objectives:

- ✓ Identify pre-production design challenges associated with energy storage technology manufacturability
- ✓ Discover potential R&D innovation opportunities to address these challenges earlier in the design process



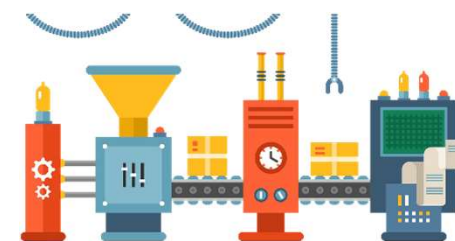
Outcomes:

- Alternative materials & component supply chains?
- Innovative storage designs?
- Manufacturing & assembly efficiencies?
- Improved path to commercialization?



Topic Areas:

- **Key pre-production manufacturability challenges** creating barriers to domestic production
- **Strategies/techniques/tools** to identify and address challenges
- **Metrics** to measure improvement
- The affect on various **system, component, or subcomponent design factors**
- Benefits from **collaboration among stakeholders**
- **Investment levels** required to identify, analyze, and address challenges



<https://www.fedconnect.net> (DE-FOA-0003378) | Issued 5/6/2024, Responses due 6/10/2024

<https://www.energy.gov/oe/articles/doe-seeks-input-energy-storage-manufacturing-challenges>

Contributing to a robust future energy storage workforce through collaboration



Lab Embedded Entrepreneurship Program (LEEP)

- **Opportunity:** OE leveraging EERE's fellowship program to help next-gen entrepreneurs learn to scale early-stage innovations from lab to market at a national lab
- **Fellow:** EarthEn to develop a thermo-mechanical sCO₂ LDES system at ORNL's Innovation Crossroads
- **In the News:**
<https://www.ornl.gov/news/seven-entrepreneurs-join-innovation-crossroads-seventh-cohort>



SJSU SAN JOSÉ STATE
UNIVERSITY



Reaching a New Energy Sciences Workforce (RENEW)

- **Opportunity:** OE, partnered with SC, to fund a minority-serving institution led research project
- **Project:** California State Univ., Chico and San Jose State Univ., with LLNL, are developing novel Li-S materials and preparing future scientists from underrepresented groups
- **In the News:**
<https://today.csuchico.edu/doe-energy-grant-new-battery-tech/>

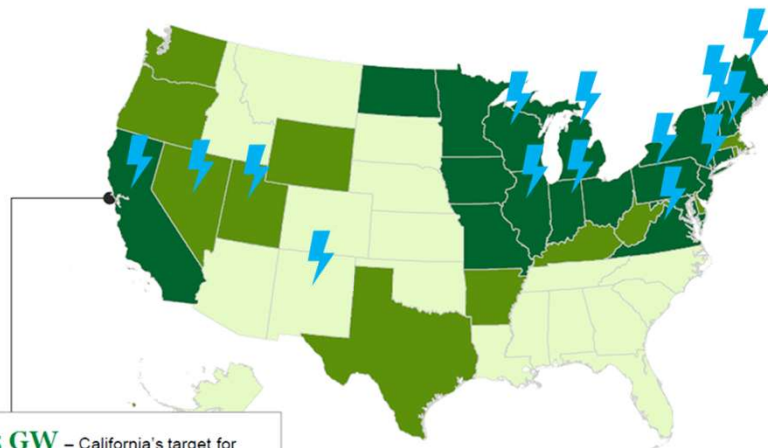
OE can also support states and communities evaluating storage with place-based technical assistance and tools

State- and community-level TA to support energy transition

Policy & market construct

Conditions for LDES deployment are:

■ Favorable
 ■ Emerging
 ■ Unfavorable

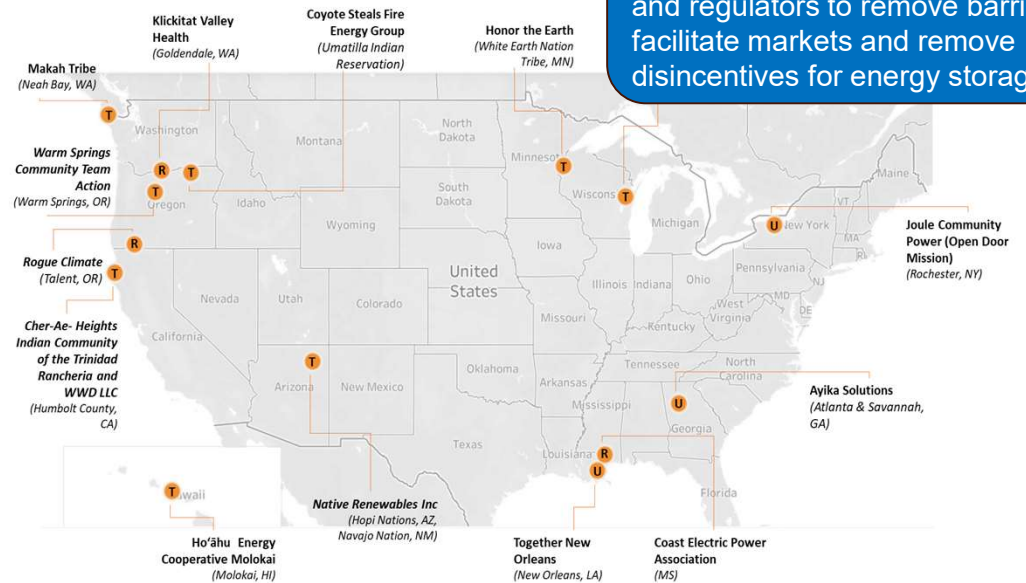


15 GW – California's target for storage by 2030, the highest target in the nation

⚡ States participating in storage-focused, DOE-supported technical assistance (SNL/PNNL)

EAC Core Recommendation Addressed:

3. Support local efforts by states and regulators to remove barriers to facilitate markets and remove disincentives for energy storage.



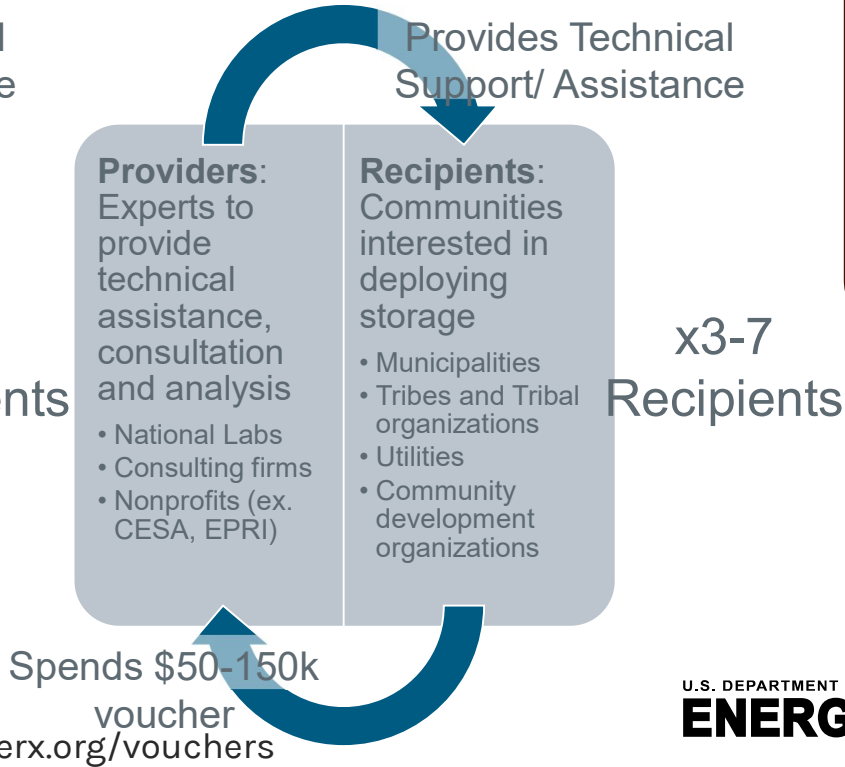
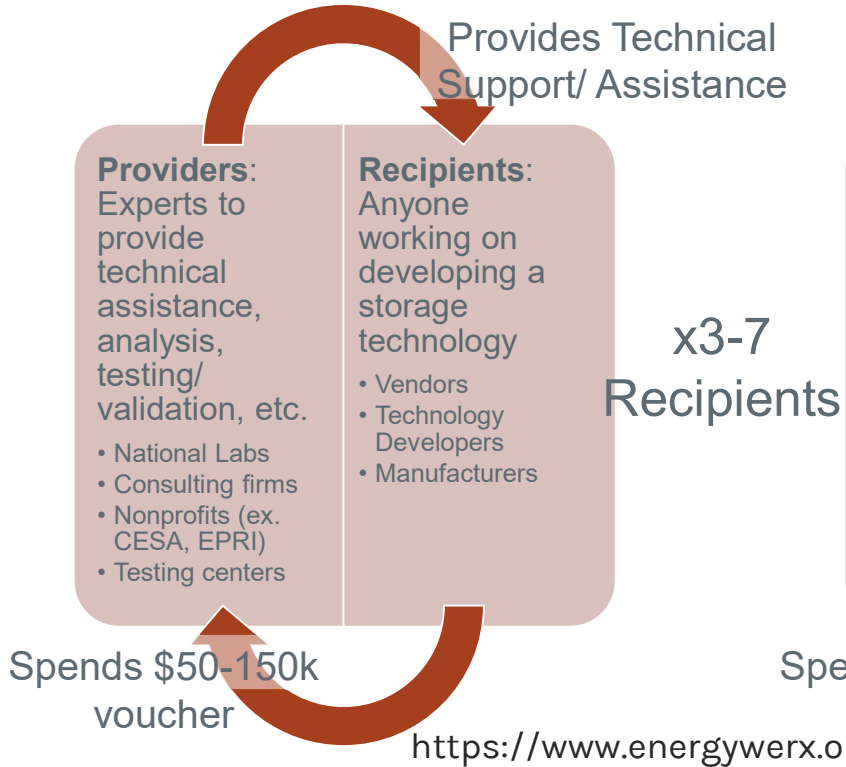
Communities participating in Energy Storage for Social Equity (ES4SE) program (PNNL)

New TA voucher mechanism to match providers with recipients

VO-7: Technology Acceleration (\$500k)

VO-8: Community Adoption (\$500k)

EAC Core Recommendation Addressed:
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Three new ES4SE communities selected for \$1.2M in deployment support

- Together New Orleans
 - Network of resilience hubs (batteries and PV)
 - Various locations in Louisiana
- Open Door Mission
 - Emergency shelter with community services and hot meal provision (batteries and PV)
 - Rochester, NY
- 10Power and 8th Fire
 - Enable school to become emergency shelter (batteries and PV)
 - White Earth Reservation, Ponsford, MN



Ribbon cutting at seventh Community Lighthouse with Together LA leaders & US Energy Secretary Jennifer Granholm

(No



Measuring the impact of ES4SE and other TA programs

- 14 communities across the US chosen in first ES4SE cohort
- \$8.8M in DOE funding, with \$5.2M in cost share by communities
- About \$20M anticipated as leveraged funding from other sources
- Highly active community engagement by PNNL/SNL team throughout the first cohort:
 - Led and supported over 650 community meetings, including 4 program meetings
 - Completed 7 workshop agreements, compensating communities for travel for speaking engagements
 - Conducted 24 community interviews for Program Evaluation and lessons learned
 - Completed 82 individual technical economic analysis and deliverables and 16 final reports

**EAC Core Recommendation
Addressed:**

3. Support local efforts by states and regulators to remove barriers to facilitate markets and remove disincentives for energy storage.

**And coordination across DOE is
critical to leverage resources and
communicate consistently**

OE provides leadership across DOE storage activities

Storage Technology	Materials	Components & Devices	System Design	Grid & System Integration	Supply Chain & Manuf.	Operations	End of Life	Investment & Finance	Markets & Value	Workforce
Electro-chemical	OE , VTO, ARPA E, SC BES	OE , AMO, VTO, ARPA E	OE , VTO, ARPA E, SETO	OE , AMMTO, VTO	AMMTO, MESC	OE , OCED	VTO	OE , LPO, OTT, OCED, AMMTO, LPO, SETO	OE , OTT, EERE SA, GTO, WPTO, SETO, IEDO, BTO	OE , AMMTO, VTO, OP, OTT
Electro-mechanical	ARPA-E, WPTO	ARPA-E, WPTO	ARPA-E, WPTO	OE , WPTO	WPTO, AMMTO	OCED				
Thermal	ARPA-E, SETO, SC-BES, BTO	SETO, BTO	SETO, BTO	SETO, BTO	AMMTO, BTO	OCED, SETO	SETO			
Chemical	HFTO, SC-BES, ARPA-E	HFTO	HFTO	HFTO	AMMTO	OCED				
Power Electronics	OE , SC BES, ARPA E	OE , ARPA E, AMMTO, VTO	OE , AMO, VTO, CESER	OE , VTO, CESER	OE , AMMTO					

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Storage Technology	Materials	Components & Devices	System Design	Grid & System Integration	Supply Chain & Manuf.	Operations	End of Life	Investment & Finance	Markets & Value	Workforce									
Electro-chemical	OE, VTO, ARPA E, SC BES	TA Tech Voucher	Capbara	muGrid	Manufacturing RFI	CiFER NOI	DTE	ES4SE	State TA	RENEW									
Electro-mechanical	ARPA-E, WPTO		ARPA-E, WPTO	OE, WPTO			New Lab, BCI, Clean Tech Strategies							LEEP					
Thermal	ARPA-E, SETO, SC-BES, BTO		SETO, BTO	SETO, BTO										HFTO	HFTO	SETO	TA Community Voucher		Blue Sky RFI
Chemical	HFTO, SC-BES, ARPA-E		HFTO	HFTO															
Power Electronics	OE, SC BES, ARPA E		OE, AMO, VTO, CESER	OE, VTO, CESER															

ESGC tracks and revised structure

How to achieve “Innovate Here, Make Here, Deploy Everywhere”

Technology Development

Develops strategies for DOE’s ongoing and future energy storage R&D around user-centric goals and long-term leadership. It also coordinates execution of storage R&D activities and outreach to the innovation community.

Manufacturing, Supply Chain & Workforce Development

Develops technologies, approaches, and strategies for U.S. manufacturing that support and strengthen American leadership in innovation and increase production across the supply chain; utilizes energy storage to support industrial decarbonization and resilience; and educates members of the workforce.

Investment, Commercialization and Scale-up

Works to ensure that DOE’s R&D investments transition to domestic markets through field validation, demonstration projects, public-private partnerships, and bankable business model development.

Markets & Valuation

Disseminates data, tools, and analysis to support planning, regulatory, market, and policy decision-making in order to maximize the benefits energy storage can provide to the entire system.

- **Structure update:** DOE revised the structure of the ESGC to better strategize, coordinate, and maintain awareness of the ever-expanding universe of storage activities across DOE and its labs. As part of this revision, we created a more formalized working group structure.

ESGC Decadal Challenge to help plan programs

+ Purpose: Leverage the ESGC Lab Coordination team to identify key gaps and opportunities across energy storage that DOE can address over the next decade to achieve roadmap/storage shot goals.

BIG Decadal Idea Generator (BIG-DIG)

- + **WHAT**: Fast Pitch competition to select *needle-moving* seedling ideas for further development
 - + Funding is not to do the research, but to develop the concept into a full program plan
- + **PURPOSE**: Provide fully developed program plans that accelerate progress towards Energy Earthshot™/ESGC goals
- + **PROBLEM BEING SOLVED**: Maximize utilization long-range insights from national lab experts
- + **APPROACH**: Lab-coordinated work aligned with the 4 ESGC tracks
 - + Standardized pitch & 4-page summary format will be provided
 - + Judges are DOE track leads and other SMEs
 - + Subjected to Industry feedback
- + **SCALE**: Total funds \$700K - Concepts can be small/medium/large

Thank you

