



ESGC Overview and Recent Events

**Presented to
NM Renewable Energy Transmission Authority
20 October, 2022**

**DOE/OE Electricity Advisory Committee
26 October, 2022**

**By Charles Hanley, Sandia National Labs
On behalf of the Lab Coordination Team:
ANL, ORNL, PNNL, SNL**



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ESGC Presentation Overview

- Overview of ESGC
- Some key accomplishments from national lab interactions
- Highlights from ESGC Summit: Sept 27-28
- Path Forward



December 2020

Bottom Line Up Front: ESGC is...

A means of better coordinating all energy storage-related activities

- Across DOE offices and programs
- Across National Labs

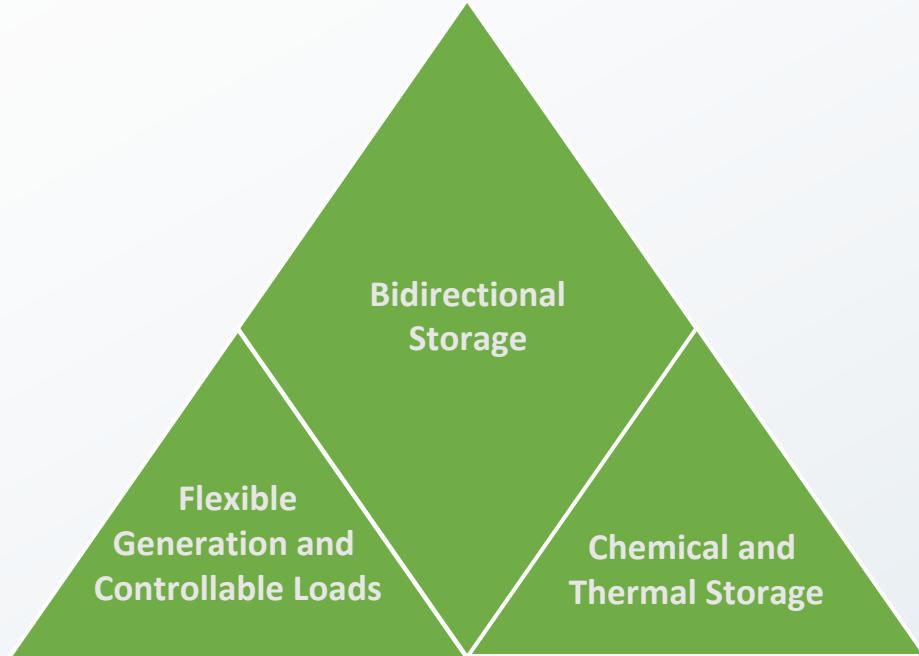
Lab Coordination Team: Comprised of a team from PNNL/ANL/ORNL/SNL

- not intended as a funding mechanism
- a way to recognize gaps and opportunities for DOE/Lab research and new collaborations

Energy Storage Grand Challenge

Unifying Efforts Across Technologies and Functions

Technologies



Offices

- Office of Electricity
- Energy Efficiency and Renewable Energy
- Office of Science
- Office of Technology Transitions
- Nuclear Energy
- Fossil Energy and Carbon Management
- Office of Policy
- ARPA-E
- Loan Programs Office

Functions



ESGC Roadmap: Track Structure and Missions



Technology Development

Maximize the pace of storage innovation through by setting ambitious goals and rigorous evaluation metrics, focused on user-centric use cases and promising technology pathways to meet them.



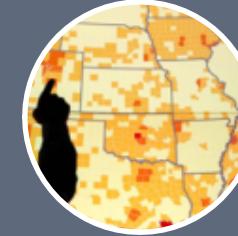
Manufacturing & Supply Chain

Address major challenges to lowering manufacturing costs, accelerate scale up of manufacturing innovations, and enable reliable sourcing of critical materials and components across supply chains.



Technology Transition

1. Enhance external access to experts, facilities, and IP
2. Industry and market analysis
3. Industry and interagency collaboration and engagement
4. Develop real-world projects to demo and validate tech



Policy & Valuation

Develop a coordinated, DOE-wide analysis and technical assistance program to support effective energy storage policies, planning and regulation across the United States.



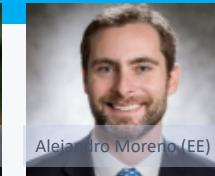
Workforce Development

Develop the broad workforce required for research, development, design, manufacture, and operation.



Year 2: ESGC Lab Coordination

Co-Chairs



ESGC and LDSS Coordination

Coordinators

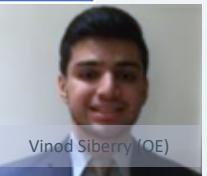


ESGC Lab Coordination

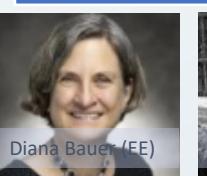
Leadership Group



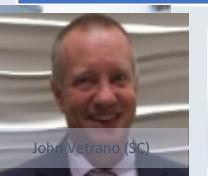
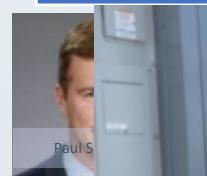
Technology Development



Manufacturing & Supply Chain



Technology Transition

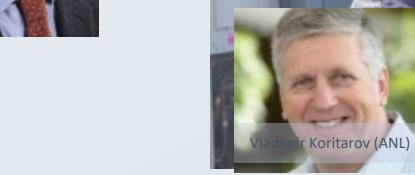


Policy & Valuation

Track Leads



Workforce Development



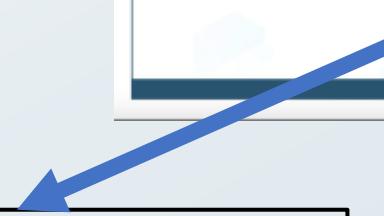
Expectations

- **Streamlined coordination and communications** – simplify points of contact while empowering the Lab coordination team to develop and implement their own coordination mechanisms with the other Labs.
- **Inclusion of expertise across the labs** – Labs not acting as coordinators have extremely valuable expertise that needs to be represented in all of the ESGC's work.
- **Help develop strategy and fill in gaps** – we want the Lab coordinators to help us identify where we have research gaps and provide input on potential solutions.

Some ESGC Successes to Date

- **Rapid Operational Validation Initiative:** accelerate lifetime determinations for new storage technologies
- Storage-focused web pages on DOE's **Lab Partnering Service** and **Visual Patent Search** tools
 - Stakeholders can ID and access SMEs and IP to help their causes.
- Numerous **workshops, webinars, and listening** sessions around advanced manufacturing, policy and valuation of energy storage, and equitable workforce development
 - Publishing stakeholder guides as outputs
- DOE released the **Long Duration Energy Storage Earthshot** in July, 2021, with the intent to aggressively enhance the role of storage technologies in our electric grid system

...reduce the cost of grid-scale energy storage by 90% for systems that deliver 10+ hours of duration within the decade.



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Sandia National Laboratories

Energy Storage for Manufacturing and Industrial Decarbonization (Energy StorM)

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U.S. DEPARTMENT OF ENERGY

Long Duration Storage Shot: An Introduction

Overview
The U.S. Department of Energy's (DOE) Energy Earthshots Initiative aims to accelerate breakthroughs of more abundant, affordable, and reliable clean energy solutions within the decade. Achieving the Energy Earthshots will help America tackle the toughest remaining barriers to addressing the climate crisis, and more quickly reach the Biden-Harris Administration's goal of net-zero carbon emissions by 2050 while creating good-paying union jobs and growing the clean energy economy.

The Long Duration Storage Project establishes a target to reduce the cost of grid-scale energy storage by 90% from a 2020 Li-ion baseline by 2030. Energy storage has the potential to accelerate the decarbonization of the electric grid. While shorter duration storage is currently being installed to support today's level of renewable energy generation, longer duration storage technologies are needed as more renewables are deployed on the grid. Cheaper and more efficient storage will make it easier to use solar and wind power when the sun is out and the wind is blowing, and to store energy when generation is unavailable or lower than demand – for instance, as renewable sources generated during the daytime like solar-generated power can be used at night when demand increases. Long Duration Storage Shot will consider types of technologies, including batteries, compressed air, pumped hydro, chemical batteries, or any combination that has the potential to meet the necessary duration and cost targets for grid flexibility.

Stakeholder Engagement
DOE plans to hold a series of events to engage communities, industry, and other stakeholders, including a Long Duration Storage Shot Summit to be held on the Autism Equation, also known as World Energy Storage Day, September 22, 2021. Check for event updates available on the Energy Storage Grand Challenge website.

Funding
Several DOE offices conduct energy storage activities, and the President's Fiscal Year 2022 Budget Request included a total of \$1.18 billion for these activities, funded through the Energy Storage Grand Challenge construct. Pending appropriations, DOE anticipates funding opportunities and other activities to help advance progress toward meeting Long Duration Storage Shot goals, which aligns with DOE's Energy Storage Grand Challenge Roadmap.

Impact
The Long Duration Storage Shot target is key to reaching President Biden's goal of net-zero carbon emissions from the electricity grid by 2050 and economy-wide by 2055. Developing the technology will also enable the grid to be more reliable, flexible, and efficient.

Long Duration Storage Shot seeks to achieve affordable long duration grid storage—for clean power anytime, anywhere.

Reduce storage costs by 90% from a 2020 Li-ion baseline...
...in storage systems that deliver 10+ hours of duration
...in 10 years

For more information, visit: Energy Storage Grand Challenge | Department of Energy
DOI/EIS-2384 - July 2021

<https://www.energy.gov/energy-storage-grand-challenge>

Energy Storage Grand Challenge

The Department of Energy's (DOE) Energy Storage Grand Challenge (ESGC) is a comprehensive program to accelerate the development, commercialization, and utilization of next-generation energy storage technologies and sustain American global leadership in energy storage. This comprehensive set of solutions requires concerted action, guided by an aggressive goal: to develop and domestically manufacture energy storage technologies that can meet all U.S. market demands by 2030.

Filters

View: Labs (21) ▾ View: Content Type (5) ▾

Energy Storage Capabilities

Applicable to facilities and labs

- Components (29)
- End of Life (2)
- Manufacturing (14)
- Markets (2)
- Materials (59)
- Operations and Integration (24)
- Systems Integration (23)

All Laboratories | All Content

Expert (158)

Lab (17)

Technology Summary (675)

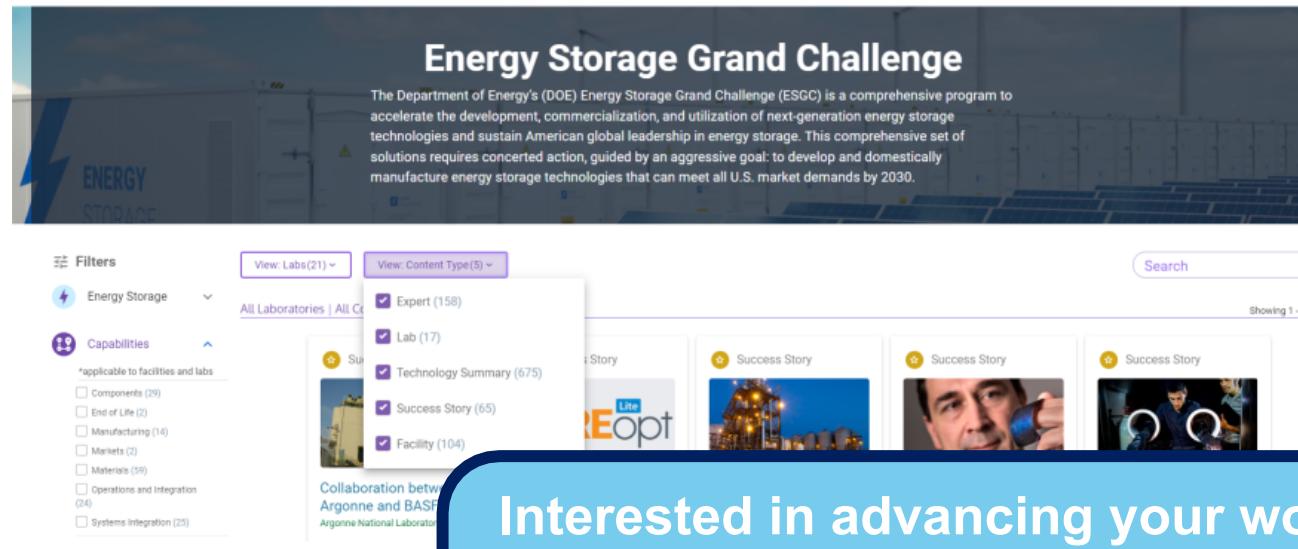
Success Story (65)

Facility (104)

Showing 1 - 10

Search

Collaboration between Argonne and BASF Argonne National Laboratory



ESGC.labpartnering.org

Discover hundreds of Energy Storage technologies, experts, facilities, and success stories across the National Labs. Connect directly with the National Labs on their Energy Storage innovation and expertise.

Interested in advancing your work through partnership with National Lab resources and experts?

Visit **ESGC.Labpartnering.org** to discover Energy Storage innovations, experts, and facilities across DOE!

Energy Storage Grand Challenge Visual Patent Search

Quickly explore nearly 2,000 Energy Storage patents and patent applications using the Visual Patent Search tool.

Reset All Export About

Patents 1,779 of 31,143
Sort: Patent Status Date

Electrochemical Cell (1.5k)

Electrolyte

Anode

Battery

Cathode

Electrolyte for high voltage lithium-ion batteries
11108086 • Issued: 08/31/2021
No text
Argonne National Laboratory

Core-shell structured nanoparticles for lithium-sulfur cells
11088365 • Issued: 08/10/2021
Described is a core-shell nanoparticle comprising a lithium sulfide nanoparticle core and a shell covering the lithium sulfide nanoparticle core. The core-shell nanoparticle may be used for a positive electrode in a...

Lawrence Berkeley National Laboratory

Mechanical Energy Storage (91)

Electrical (80)

Thermal (48)

Biological (39)

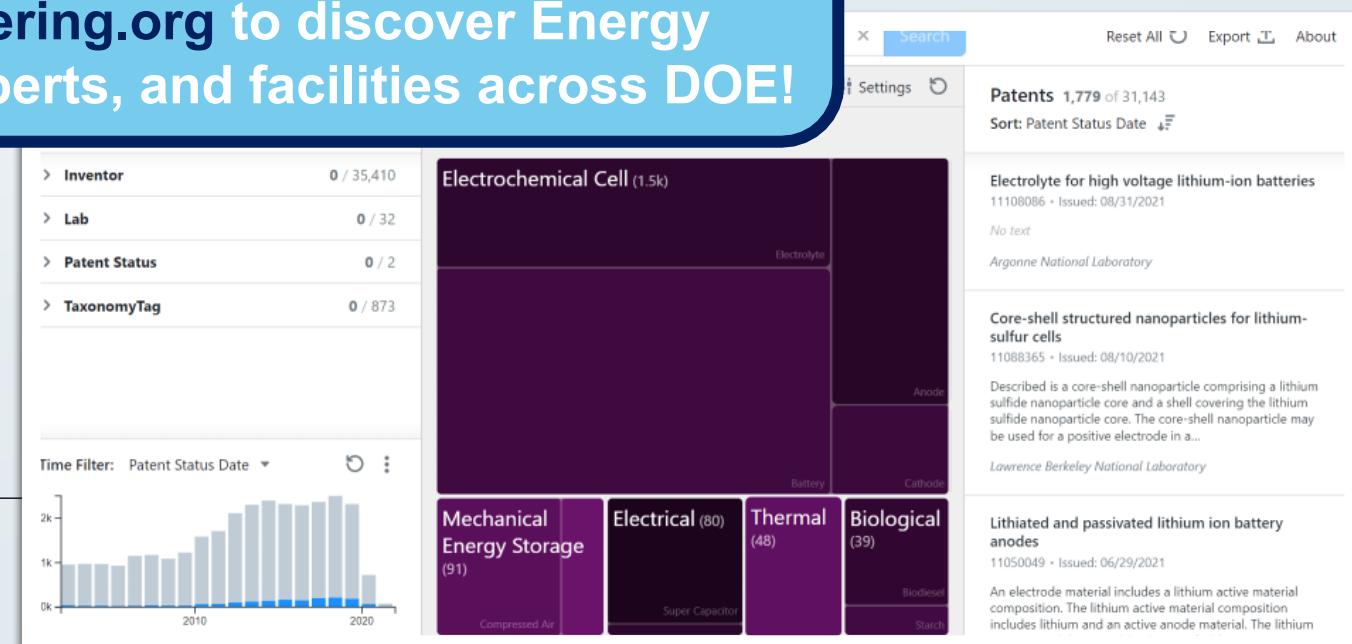
Compressed Air

Super Capacitor

Biodiesel

Starch

Lithiated and passivated lithium ion battery anodes
11050049 • Issued: 06/29/2021
An electrode material includes a lithium active material composition. The lithium active material composition includes lithium and an active anode material. The lithium



2nd Annual ESGC Summit: Sept 28-29

- 175 in-person, 250 virtual attendees (425 total)
- Focus on stakeholder input to DOE and labs
 - What can DOE provide to help address gaps?
 - How can we help to catalyze inter-disciplinary partnerships
- High-level DOE-led discussions
 - Numerous opportunity spaces discussed across offices
 - Emphasis on decarbonization, equity, partnering
- Sessions and breakouts based on 5 ESGC tracks
 - Excellent integration with SolarPaces around valuation of LDES
- (10 of ~90) Pitch sessions for technology pathways to LDES

Some Key Summit Takeaways

- Biggest commercialization barriers varied significantly by technology, but included **new business models** to monetize new storage, workforce availability, policy/regulations (particularly beyond Li), and technology readiness.
- **Access to financing is limiting**, either to enable large-scale demonstrations (50-100MW scale) or to enable collaborative development efforts.
- **Inadequate market rules and mechanisms** for LDES- Not compensated
- Need for DOE to help make **connections across development cycle**.
- In developing a sustainable workforce: lack of career awareness, connecting industry to academia and creating a **workforce development network**.
 - It is difficult to sustain a workforce when clean tech is consistently evolving, which creates a disconnect between the new technologies coming from R&D, training happening in academia, and the implementation by industry and deployment in local communities.
- Project **pre-development documentation** and validation, economic studies, cost and performance data entries, etc.
- Need for increased access to and awareness of **DOE/lab capabilities** that they can use.

Storage Innovations 2030

Strategizing & accelerating the future of energy storage

Developing industry consortia and enhancing collaboration

Quantifying the benefits of RD&D activities for mature technologies

Enabling emerging technologies

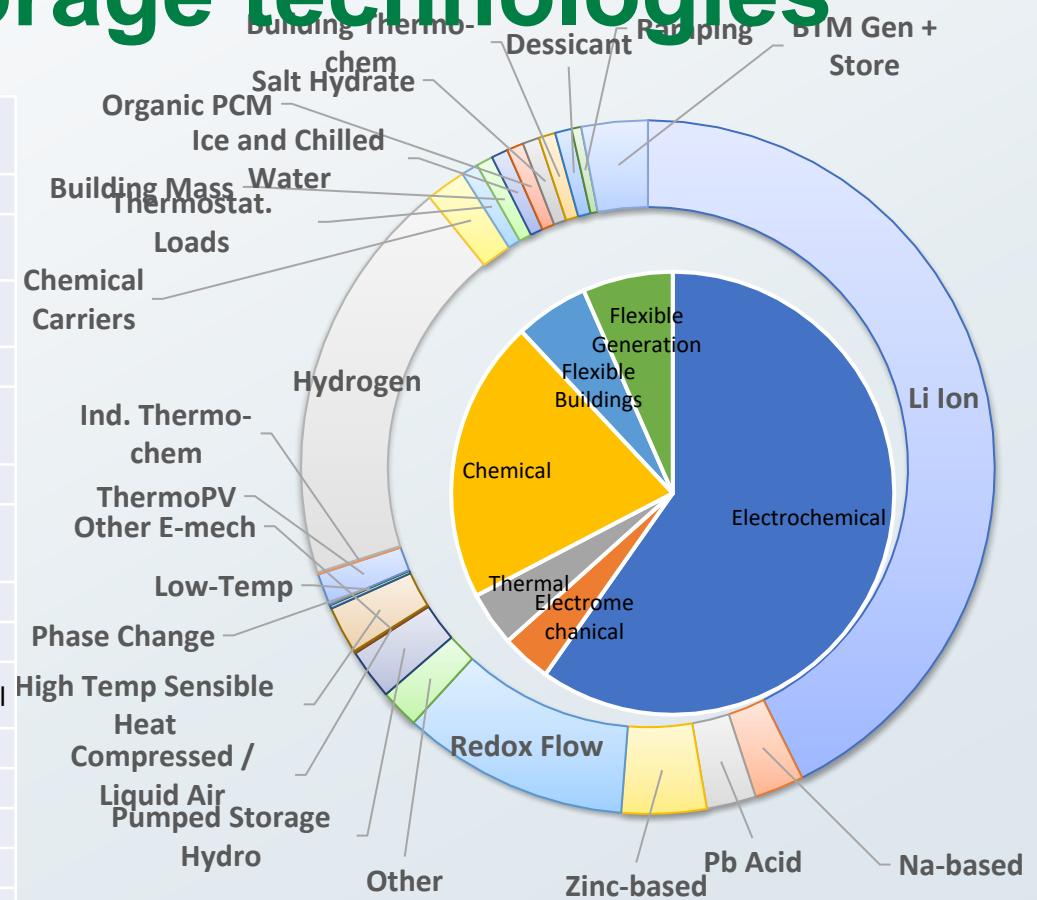
Storage Innovations 2030



DOE has supported 30+ storage technologies

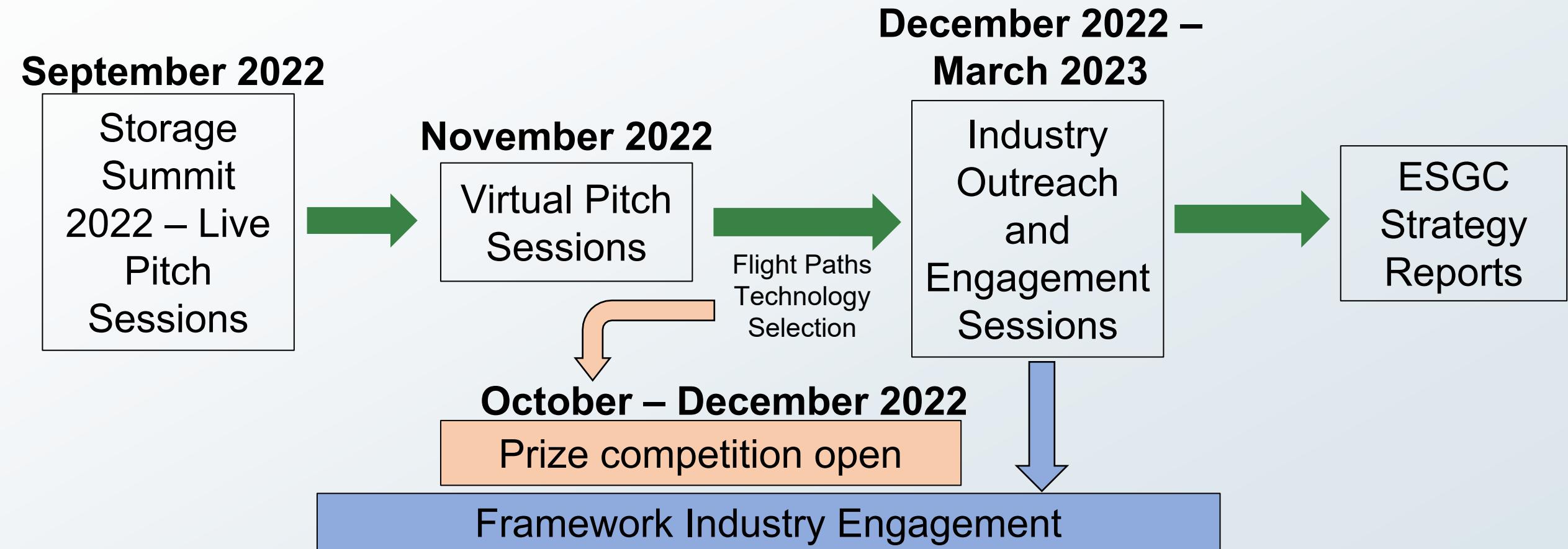
Crosscutting	Power Electronics	Power Electronic Systems
Bidirectional Electric Storage	Electrochemical	Li-Ion & Li-Metal Na-Ion Na-Metal Lead Acid Zinc Other Metals (Mg, Al) Redox Flow Reversible Fuel Cells Electro-Chemical Capacitors
		Pumped Storage Hydro Compressed Air Liquid Air Flywheels Geomechanical Gravitational
Flexible Generation & Loads	Flexible Buildings	High-Temperature Sensible Heat Phase Change Low-Temperature Storage Thermo-Photovoltaic Thermochemical Chemical Carriers (e.g., Ammonia) Hydrogen Thermostatically Controlled Loads Building Mass Ice & Chilled Water Organic Phase Change Material Salt Hydrate Thermochemical Desiccant Ramping Behind-the-Meter Generation Plus Storage

Taken from Energy Storage Grand Challenge Roadmap, Dec. 2020



Needed: a unified strategy for how technologies contribute to top-level objectives

Flight Paths & SI Timeline



Technologies Pitched at Summit (~10 of ~90)

- Flow
 - Zinc-Bromine
 - Vanadium
- Undersea Pumped Hydro
- Thermal – Rock packed bed
- Electrochemical
 - Liquid metal
 - Sodium

Characteristics discussed

- Technology readiness
- Commercial viability
- US manufacturing
- Supply chain
- Cost projections

Grid-based energy storage – so much going on...

- Infrastructure Investment and Jobs Act
- Inflation Reduction Act
- Long-Duration Energy Storage Earthshot
- Energy Storage Grand Challenge
- Storage Innovations 2030
- DOE-led National Lab Initiatives
 - Rapid Operational Validation Initiative
 - Long-Duration Energy Storage Demonstrations
- *****Energy Storage for Social Equity*****

We are paving the way for new energy storage technologies to meet our electric grid goals:
decarbonization, resilience, equity, stability...

Thank you...Questions?