SAND2022-14331C

ENERGY STORAGE GRAND CHALLENGE
U.S. DEPARTMENT OF ENERGY

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

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia, LLC., a wholly owned subsidiary of Honeywell International, Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.

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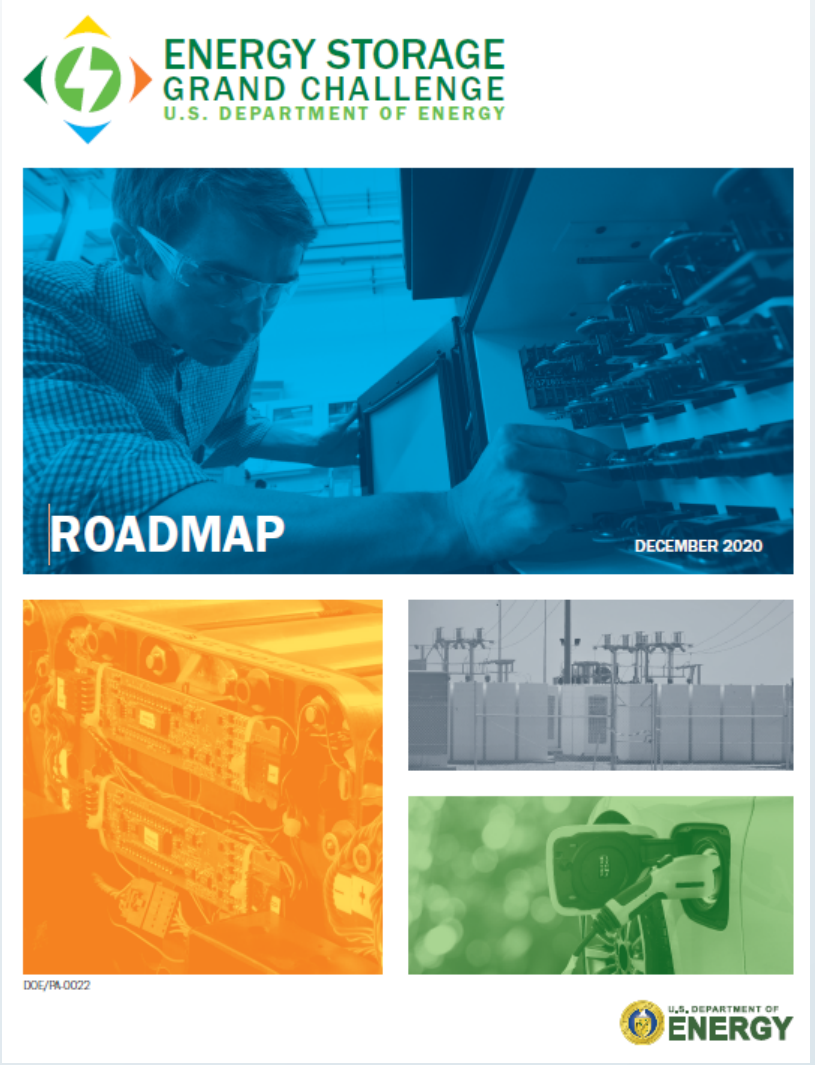
ESGC Presentation Overview

- 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

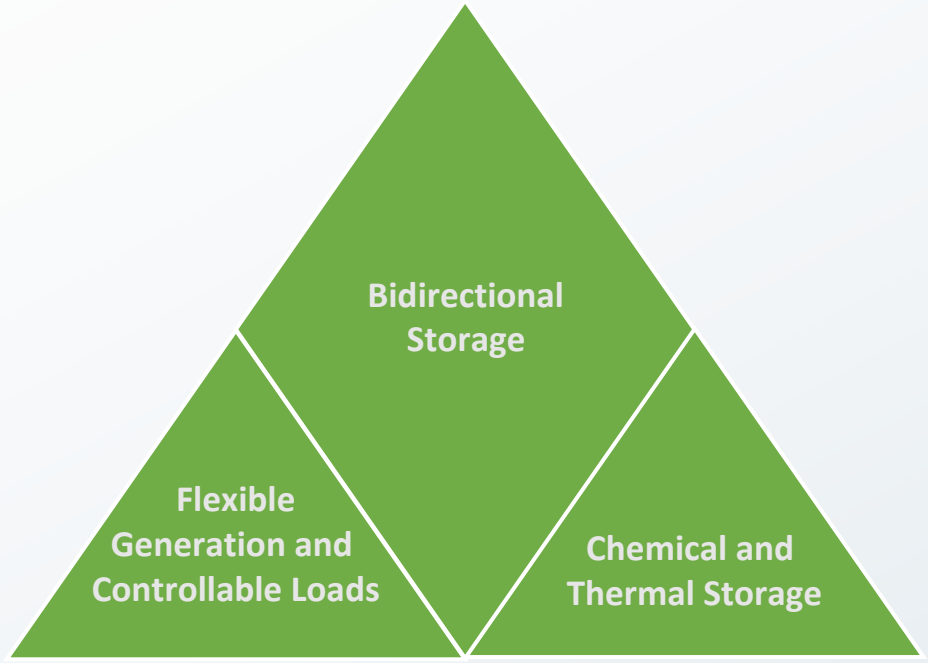
Lab Coordination Team: Comprised of a team from PNNL/ANL/ORNL/SNL

- 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

Basic Science Research & Discovery → Application Driven Materials Development → Applied Device and System R&D → Cost & Performance Metrics, Targets → Demonstration and Performance Validation → Systems Analysis and Valuation → Commercialization Strategy

ESGC Roadmap: Track Structure and Missions

Technology Development

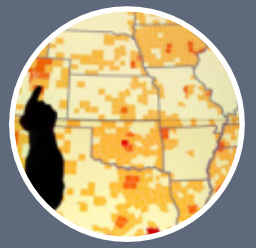
Maximize the pace of storage innovation through by setting ambitious goals and rigorous evaluation metrics, focused on user-centric use cases and promising technology pathways to meet them.

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.

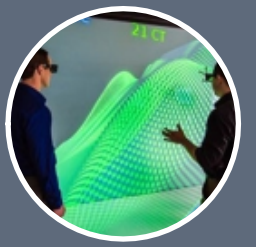
Technology Transition

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.

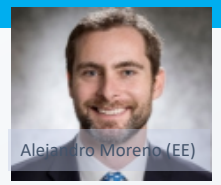


Workforce Development

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

Year 2:
ESGC Lab Coordination

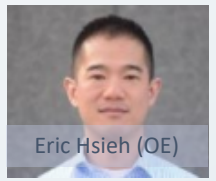
Co-Chairs



ESGC and LDSS Coordination

Coordinators

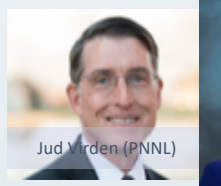
Melissa Monk (EE)

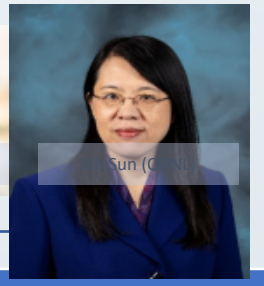


Rachel Pierson (S4)

ESGC Lab Coordination

Leadership Group





Technology Development

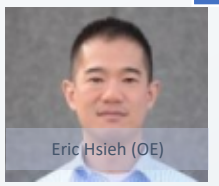
Manufacturing & Supply Chain

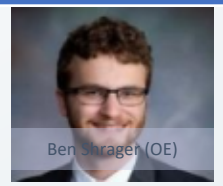
Technology Transition

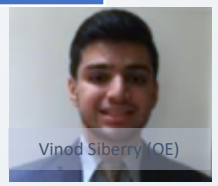
Policy & Valuation

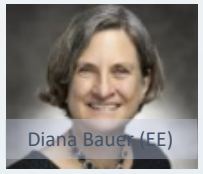
Workforce Development

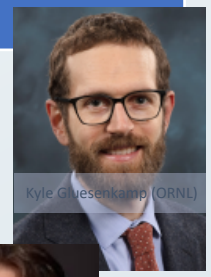
Track Leads

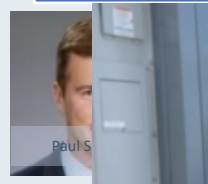


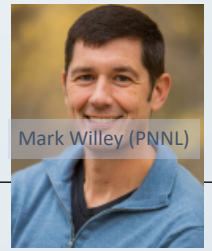


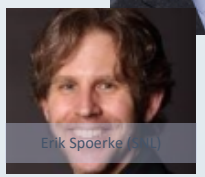


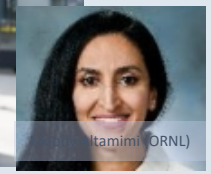












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Expectations

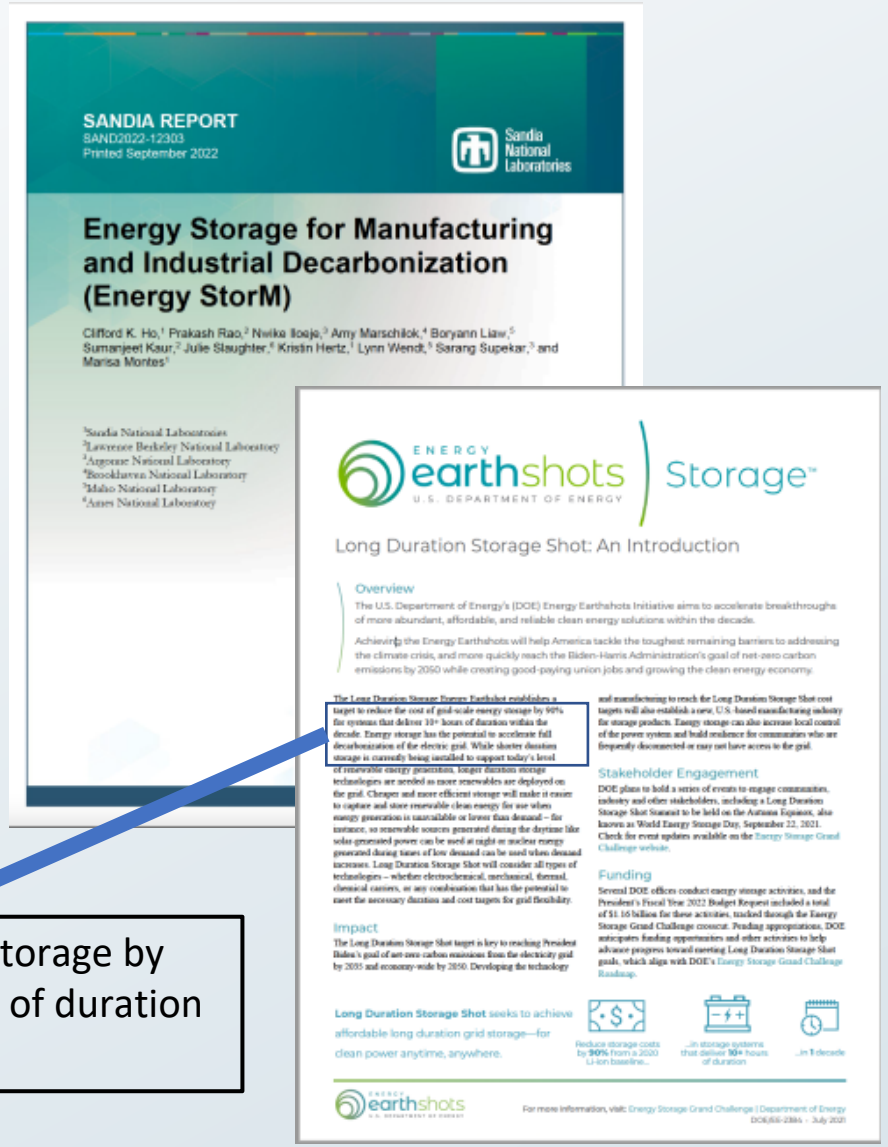
- **Streamlined coordination and communications** – simplify points of contact while empowering the Lab coordination team to develop and implement their own coordination mechanisms with the other Labs.

- **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.

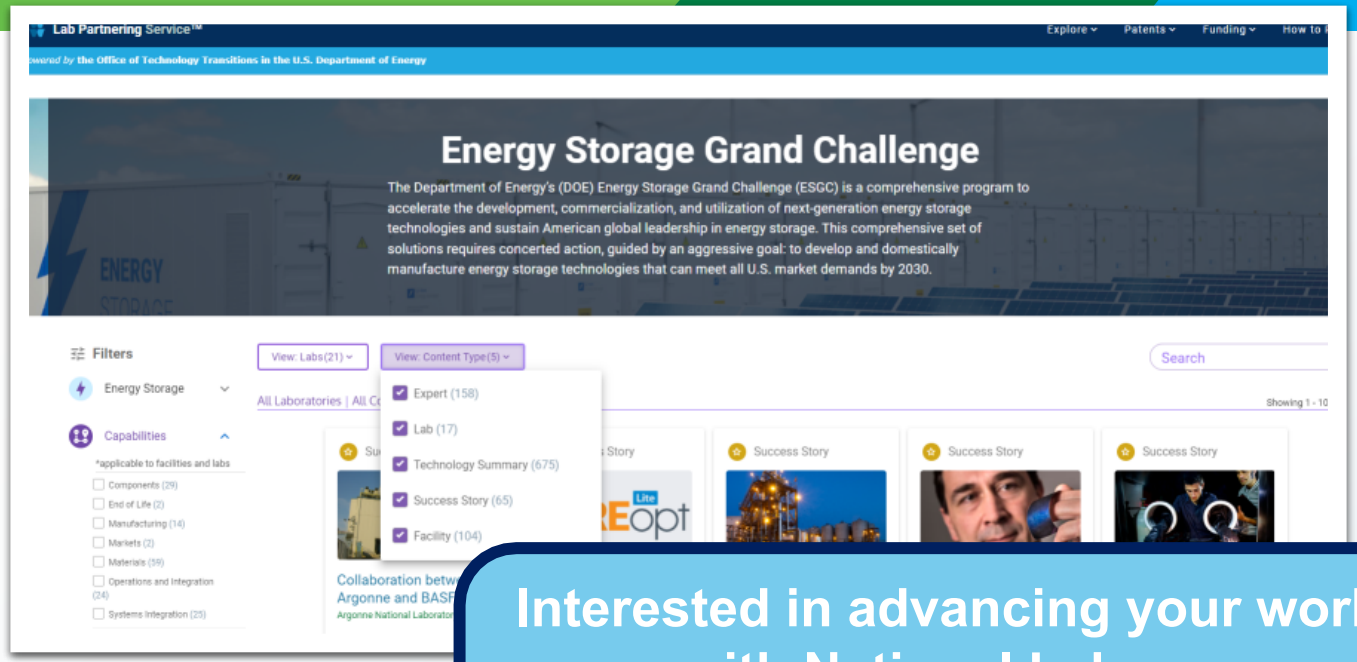
Some ESGC Successes to Date

- **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.

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



ESGC.labpartnering.org

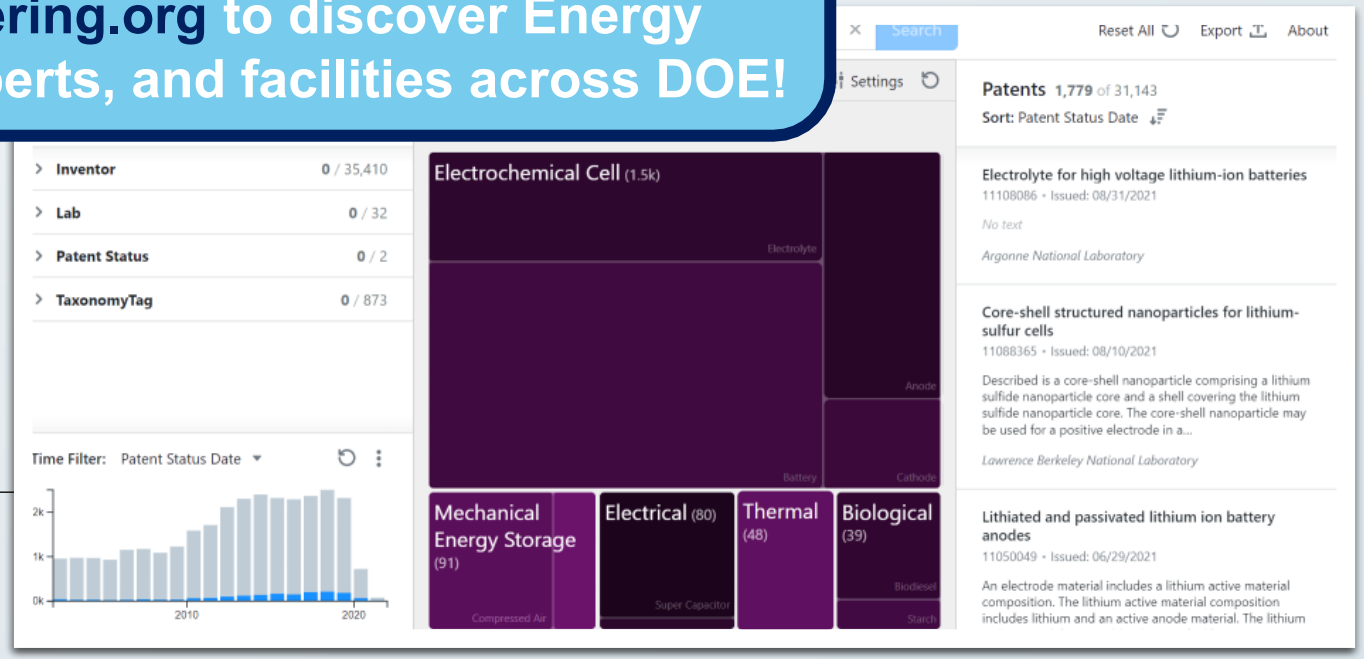
Discover hundreds of Energy Storage technologies, experts, facilities, and success stories across the National Labs. Connect directly with the National Labs on their Energy Storage innovation and expertise.

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.



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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

Strategizing & accelerating the future of energy storage

SI – Flight Paths

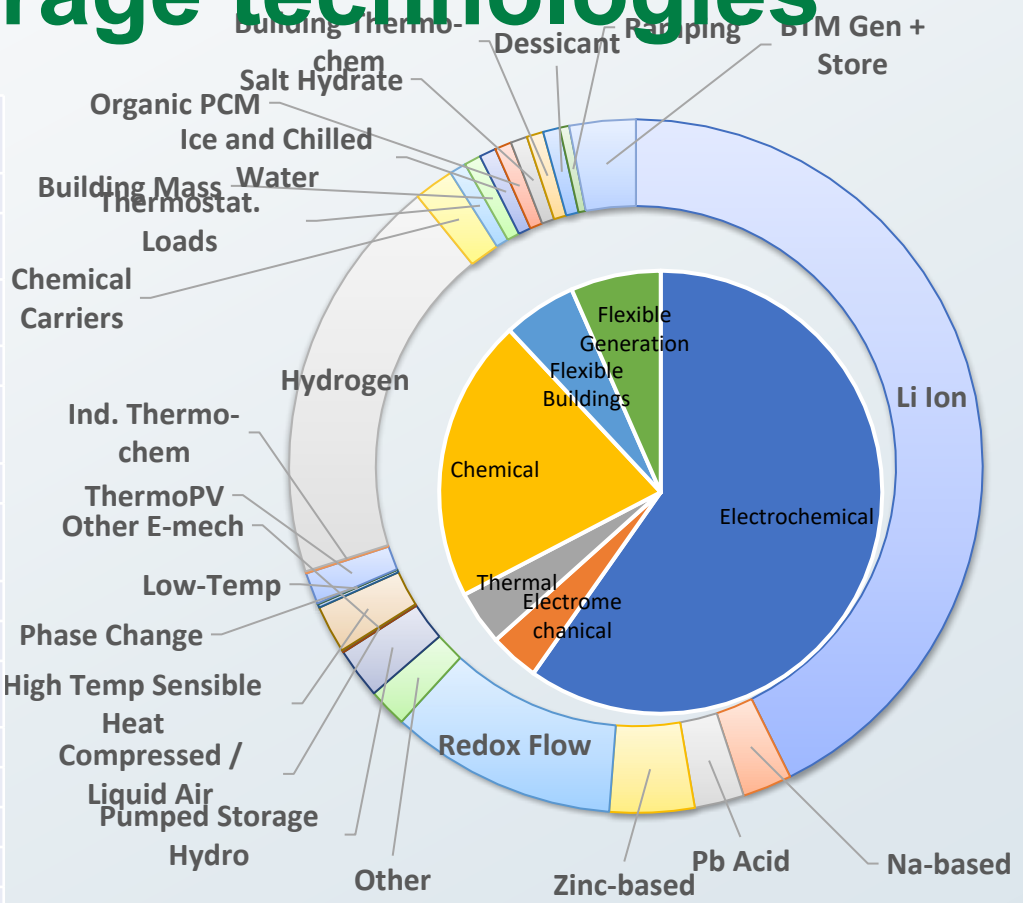
SI - Framework

SI - Prize

DOE has supported 30+ storage technologies

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
	Electromechanical	Pumped Storage Hydro
		Compressed Air
		Liquid Air
		Flywheels
		Geomechanical
		Gravitational
Crosscutting	Power Electronics	Power Electronic Systems

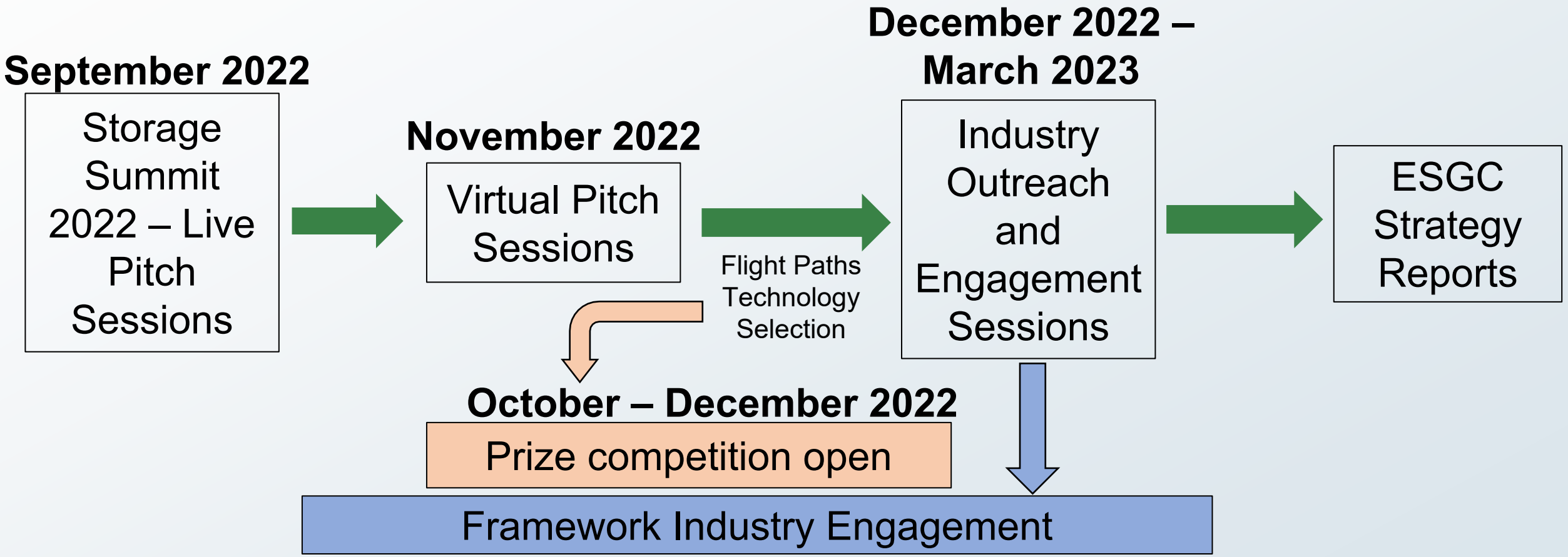
Thermal & Chemical	Thermal	High-Temperature Sensible Heat
		Phase Change
		Low-Temperature Storage
		Thermo-Photovoltaic
		Thermochemical
	Chemical	Chemical Carriers (e.g., Ammonia)
		Hydrogen
Flexible Generation & Loads	Flexible Buildings	Thermostatically Controlled Loads
		Building Mass
		Ice & Chilled Water
		Organic Phase Change Material
		Salt Hydrate
		Thermochemical
		Desiccant
	Flexible Generation	Ramping
		Behind-the-Meter Generation Plus Storage



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

Taken from Energy Storage Grand Challenge Roadmap, Dec. 2020

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?