

#### The Role of Energy Storage in Helping California Meet the State's Future Zero Carbon Energy Goals

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# **California Energy Commission Major Research Programs**



- Electric Program Investment Charge (EPIC)—Administered by the CPUC
  - Ratepayer-funded program to benefit ratepayers
  - Administered by the Energy Commission and three Investor-Owned Utilities (PG&E, SCE, and SDG&E)
  - Energy Commission Program  $\sim$  \$130 M/year for research
  - In 2020 the EPIC Program was extended by the CPUC for an additional 10 years



#### CALIFORNIA'S INVESTMENT IN CLEAN ENERGY INNOVATION

EPIC is California's premier public interest research program investing over \$130 million annually to unleash innovation.



#### **Entrepreneurial Ecosystem** \$143 million invested

Through EPIC, the CEC is building a world-class

ecosystem supporting clean energy entrepreneurship.



#### **Grid Decarbonization & Decentralization** \$154 million invested Improving the cost competitiveness and performance of key technologies.



#### **Resiliency & Safety** \$106 million invested

Helping communities, businesses, and public agencies build a safer, more resilient energy system.



#### Industrial & Agricultural Innovation \$113 million invested Scaling specialized technology solutions to drive energy efficiency without compromising production.



#### **Building Decarbonization** \$170 million invested

Improving the affordability, health, and comfort of buildings.



#### **Transportation Electrification** \$33 million invested

Supporting advances that reduce the cost of electric vehicle ownership and support the grid.

\*Total investment, 2012-2019

#### California Energy Commission has a Long History of Energy Storage Research



## A Decade of Microgrid Research

Deploying the Largest Number of Installed Microgrids (Energy Storage is a Key Component of Each Microgrid)

- 45 microgrids | \$136M invested | \$101M match funding
  - Increasing resiliency
  - Track energy storage performance, reliability and safety
  - Learning best approaches to integrating multiple resources
  - Sharing lessons learned and best practices
  - Driving down costs and establishing deployment norms



# **Diverse Combination of Microgrid Demonstration Projects by End Use**

**Ports** 



#### **Critical Facilities**





**Medical Center** 









**Communities** 

Industrial





**Distribution Center** 



**Fire Stations** 



Waste Water Treatment Plant



City Hall, Police HQ, and **Community Centers** 



Airport















### Growing Need for Energy Storage in California (CPUC Integrated Resource Plan)



#### Table 5. New Resource Buildout of 2019-2020 RSP (Cumulative MW)

Resource Type	2020	2021	2022	2023	2024	2026	2030
Wind	-	34	1,950	1,950	2,737	2,737	2,837
Wind on New Out-of-State	-	-	-	-	-	-	606
Transmission							
Utility-Scale Solar	2,000	4,000	6,000	8,000	8,000	8,000	11,017
Battery Storage	152	2,453	2,453	2,453	3,299	6,127	8,873
Pumped (long-duration)	-	-	-	-	-	973	973
Storage							
Shed Demand Response	-	222	222	222	222	222	222
Natural Gas Capacity Not	-	-	-	-	-	-	(30)
Retained							

# Planning for California's SB-100 Goals Latest Modeling Results: System Resource Adequacy





Demand: High Electrification; Resource Options: All; Year: 2045

### Planning for California's SB-100 Goals To Achieve Clean Energy



- California Energy Commission has invested in a diverse portfolio of energy storage technologies
  - Short- and long-term energy storage technologies
    - Lithium-Ion
    - Advanced battery chemistries
    - Flow batteries
    - Flywheel systems
    - Thermal energy storage
    - Advanced pumped hydro
    - Compress air energy storage
    - Green hydrogen

### 2020 is a Pivotal Year for Critical Energy Storage Research

- Over \$100 Million Invested in Energy Storage in 2020 (EPIC Funds and Awardee Provided Match Funding)
- Evaluating the Performance of Lithium Ion and Non-Lithium-Ion Energy Storage Technologies in a Variety of Microgrid Applications
- Supporting New and Emerging non-Lithium-Ion Technologies
- Field Demonstrations of non-Lithium Ion Longer Duration Energy Storage
- Validating Capability of Second-Life Batteries to Cost-Effectively Integrate Solar Power for Small-Medium Commercial Building Applications
- Assessing Long-duration Energy Storage Deployment Scenarios to Meet California's Energy Goals

































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# Title-24 Building Standards Residential Scale Systems

- +				
	Powerwall	PWRcell 9	eco 10	RESU 10H / StorEdge
Energy Capacity	13.5 kWh	8.6 kWh	10.5 kWh	9.8 kWh
Power Capacity	5 kW	5 kW	7 kW	5 kW
Claimed Efficiency	90 %	96 %	86 %	87 %
Inverter	Tesla	Pika	Outback Power	SolarEdge
Battery	Tesla / Panasonic	Panasonic	Murata / Sony	LG Chem
Integrator	Tesla	Generac	sonnen	Sunrun, etc.
Controller	Tesla	Generac, neurio	sonnen	SolarEdge, etc.

EPC-16-079 EPRI - Impact Assessment & Secure Implementation of California Rule 21 Phase 3 Smart Inverter Functions to Support High PV Penetration

# What is Long Duration Storage?



P. Albertus, J. Manser, and S. Litzelman, "Long-Duration Electricity Storage Applications, Economics and Technologies," Joule, vol. 4,

Department of Energy Long-Duration Energy Storage Workshop March 2021, "BIG" Energy Storage: Priorities and Pathways to Long-Duration Energy Storage

# Assessing Long-duration Energy Storage Deployment Scenarios to Meet California's Energy Goals



- Will consider a variety of specific energy technologies in the categories of storage, generation, and grid structure
- Will utilize cost modeling to forecast the future costs of long duration energy storage



- Will develop a new modeling toolkit to assess the long duration energy storage needs of California.
- Will work with energy storage and microgrid experts from UCSD and long duration energy storage system developers from Form Energy

# Future Energy Storage Grant Opportunities

- California Sustainable Energy Entrepreneur Development (CalSEED)
  - Provided small-scale funding that gives entrepreneurs starting capital to develop their ideas into proof-of-concepts and early prototypes.
- Bringing Rapid Innovation Development to Green Energy (BRIDGE)
  - Provides support to promising technologies and companies that have previously received federal or CEC funding.

#### • Realizing Accelerated Manufacturing and Production for Clean Energy Technologies (RAMP)

 Supports clean energy entrepreneurs transition innovative technologies from prototype development to initial production scale-up. Helps companies advance the Manufacturing Readiness Level of their technology to the Low-Rate Initial Production (LRIP) stage.

#### • Accelerating Tech Transfer

• Seeks to facilitate the accelerated transfer of energy technology related intellectual property (IP) from institutions, such as universities and laboratories, to private entities focused on commercialization.

#### Advanced Battery Manufacturing

• Supports the scale up of advanced battery manufacturing in California focusing on advanced technologies such as Lithium-metal batteries at the component, cell, and battery pack levels.

#### Cost Share

• Provides cost share to California-based entities to leverage private, non-profit, and federal funding opportunities for projects consistent with the goals and objectives of EPIC.

- Optimizing Long-Duration Energy Storage to Improve Grid Resiliency and Reliability in Under-resourced Communities (New Solicitation to be Released in Fall of 2021)
  - Demonstrate increased resiliency and reliability of clean long-duration energystorage systems to critical facilities in under-resourced communities.
  - Demonstrate resiliency during grid outages and public safety power shutoff (PSPS) events.
  - Couple smart inverters, energy management systems, or a microgrid controller with storage, and document performance needs for critical loads while minimizing cost.
  - Clean alternative to back-up diesel generators and ability to "ride out" PSPS events and other grid power-loss events.
  - Operate during grid outages that last 24-36 hours.

- California FY 2021/2022 Budget Clean Energy Investments
  - Incentives for long-duration storage (California Energy Commission)—Current budget \$340 M
  - Green hydrogen: power plant demonstration and grants to scale electrolyzers and end uses (California Energy Commission)—Current budget \$100 M
  - Industrial decarbonization (California Energy Commission)—Current budget \$210 M
  - Food Production Investment Program (California Energy Commission)—Current budget \$85 M

NOTE: Final funding allocations are pending actions by the California State Legislature

# **Open Discussion**