CALFLEXHUB SYMPOSIUM

SEPTEMBER 24 | 8am-6pm PT

ANDREW MCALLISTER

MARY ANN PIETTE

RAM NARAYANAMURTHY

SVEN MUMME

ACHINTYA MADURRI

KEYNOTE SPEAKERS: Andrew McAllister, Commissioner, California Energy Commission;
Mary Ann Piette, Associate Lab Director, Berkeley Lab;
Ram Narayanamurthy, Deputy Director, Building Technologies Office, U.S. Department of Energy;
Sven Mumme, Supervisor and Technology Manager, U.S. Department of Energy;
Achintya Madurri, Senior Regulatory Analyst, CPUC

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MOMENTUM

2024

U.S. DEPARTMENT OF ENERGY | *Office of* ENERGY EFFICIENCY & RENEWABLE ENERGY

Innovating at the edge of the grid

Ram Narayanamurthy

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An ambitious but achievable vision for the buildings sector in 2050

The National Blueprint is a plan to **reduce U.S. building GHG emissions 65% by 2035 and 90% by 2050** vs. 2005 while enabling net-zero emissions economy-wide and centering equity and benefits to communities.

Increase building energy efficiency
Reduce onsite energy use intensity in buildings 35% by 2035 and 50% by 2050 vs. 2005

Accelerate on-site emissions reductions
Reduce onsite GHG emissions in buildings 25% by 2035 and 75% by 2050 vs. 2005

Transform the grid edge
Reduce electrical infrastructure costs by tripling demand flexibility potential by 2050 vs. 2020

Minimize embodied life cycle emissions
Reduce embodied emissions from building materials and construction 90% by 2050 vs. 2005

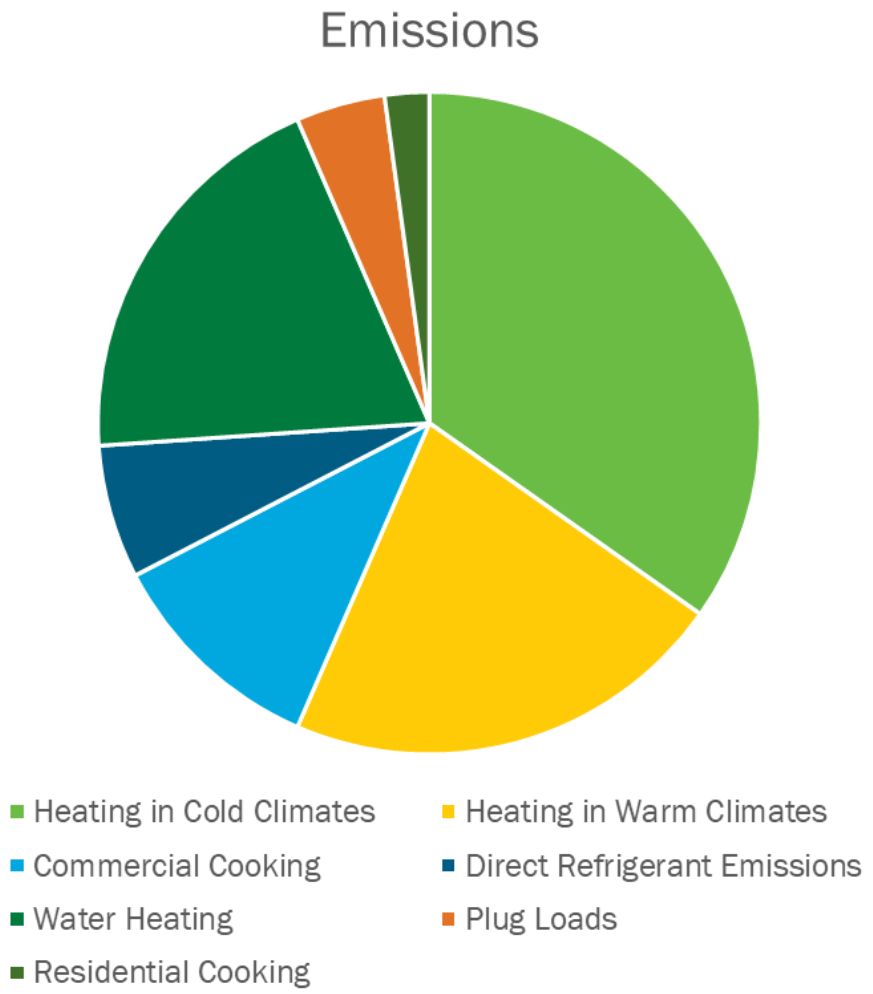
Cross Cutting Goals: Equity, Affordability, and Resilience

BTO Priorities aligned to Buildings Blueprint

75% onsite emissions reduction	**1. Scale cold climate residential heat pumps and accelerate rooftop RTU adoption** **2. Innovate on thermal system designs for large buildings (with IEDO and GTO)** **3. Leverage Better Climate Challenge to scale commercial building technologies** **4. Reduce electrification soft costs** **5. Help 25C tax credits and IRA rebate programs succeed** **6. Support DECARB with standard building scenarios**		
Doubling EE by 2050	1. Support owners and jurisdictions in adoption of Building Performance Standards 2. Accelerate envelope retrofits through innovations. 3. Reduce energy use in all climates through better dehumidification. 4. Focus on latest code adoption in states with greatest opportunity 5. Leverage standards to advance innovative products (e.g., air to water heat pumps)		
Grid Integration – 3x Demand Flexibility	**Reduce Embodied Emissions**	**Focus on advancing equity**	**Support Customer Resilience**
1. Support EERE grid edge work through Supercharged 2. Connected Communities National Demo Coordinator.	1. Advance ultra-low GWP refrigerant adoption in HVAC and other industries in partnership with EPA and Codes.	1. Launch technology development and products in support of Affordable Homes Earthshot.	1. Expand R&D on dehumidification, and heat resilience. 2. Resilient envelopes. 3. CC and V2B demonstrations.

Priority R&D areas

- **Accelerating Grid Edge Innovation**
- Commercial HVAC
- Enabling ultra-low GWP refrigerants
- Innovating building envelope retrofits
- Scaling equity focused R&D
- Leveraging end user partnerships
- Advancement of BPS



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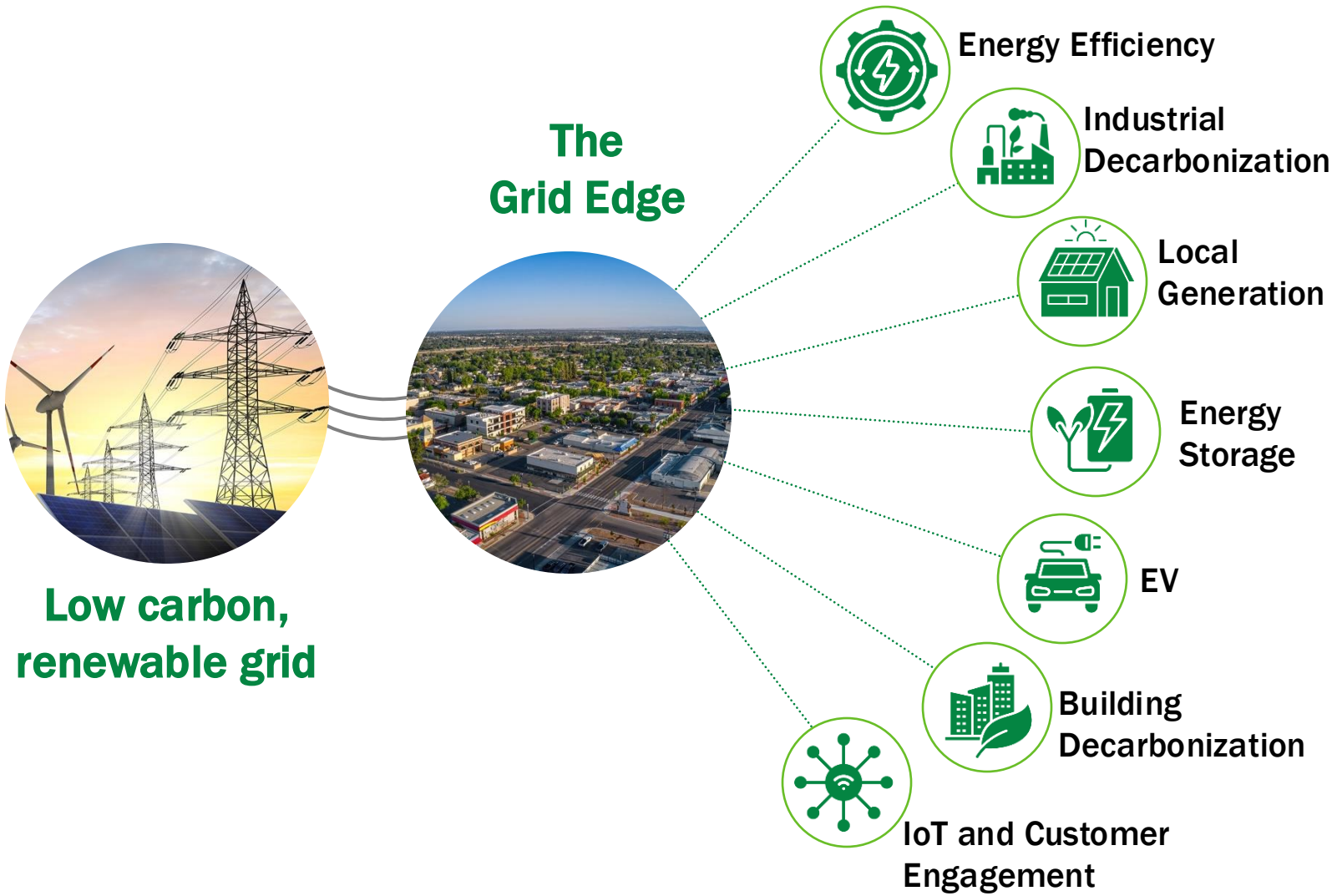
Accelerating grid edge innovation

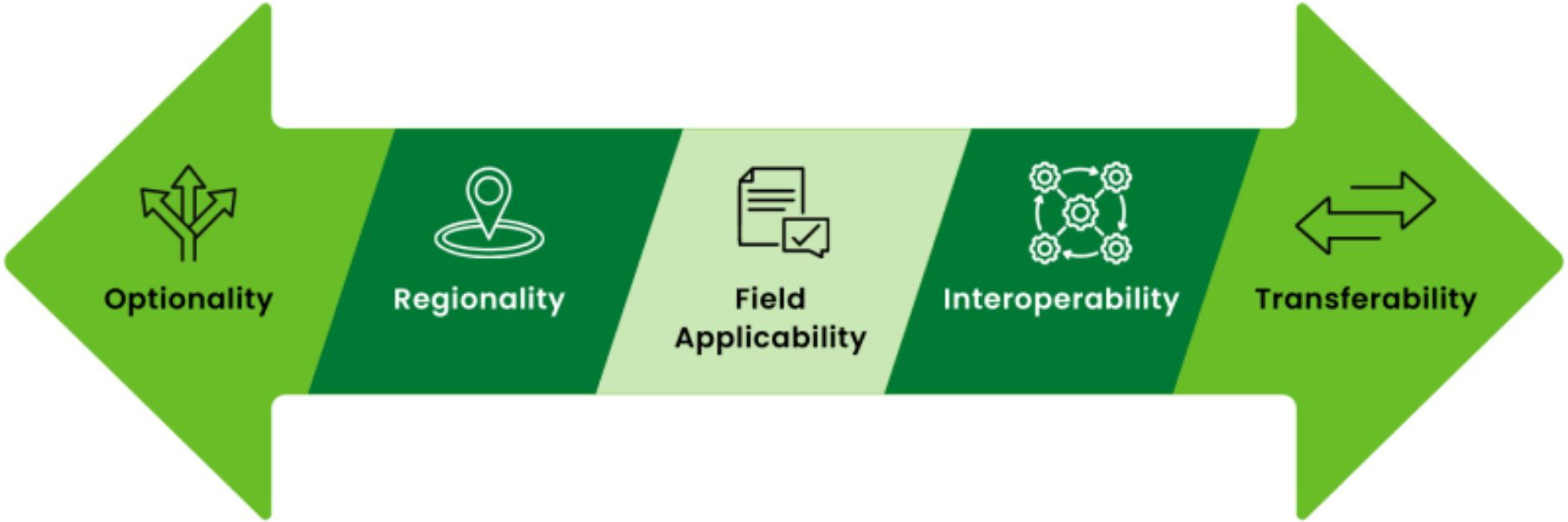
What is the Grid Edge?



The grid edge is where buildings, industry, transportation, renewables, storage, and the electric grid come together. More specifically, it's the area where electricity distribution transitions between the energy utility and the end user, broadly the space between feeder and the plug.

DOE efforts - Supercharged

- A flexible approach to accelerate the move to a modern grid edge
- Increased engagement with industry, policy makers, regulators, and technology developers



Grid Innovation Focus Areas

Grid Edge management	• Strategies to reduce grid edge impact including DERs and stochastic planning
Distribution system optimization	• Reducing grid edge impact from electrification
Gas-Electric transitions and thermal energy networks	• Reducing grid impact with dual fuel, geothermal networks, etc.
Policy analysis and training incl. rates	• Addressing the imbalance of rates and bill impacts from electrification

Our nation's transition to a decarbonized, clean energy future requires concurrent technology and business model transformations across our electricity system.

Utilities are facing a challenge they have not faced in decades—significant load growth.

This load growth comes from disparate drivers, including the increase AI and computing needs, the re-industrialization of America, and the electrification of transportation, buildings, and industry.

Technologies that will help address these challenges include managed electric vehicle charging, low-power appliances, smart panels, energy storage, energy efficiency, and rooftop solar. We also need innovative distribution and grid planning strategies.

Connected Communities 2.0 is designed to drive innovation to manage growing building, transportation, and industrial electrical loads on the grid.

Projects will validate grid-edge technology innovations in real-world situations and provide new tools for utilities, grid planners and operators, automakers and smart-charge management service providers, and the communities they serve.

[Funding Notice: Connected Communities 2.0 | Department of Energy]

DOE is targeting four focus areas for research, development, and demonstration.

- Field validation of grid-edge technical measures that reduce the necessary level of investment into distribution infrastructure.
- Field validation of smart charge management for electric vehicles that can be deployed at large scale.
- Demonstration of increased customer benefits and community/grid resilience using grid-edge technical measures, both in front of and behind the meter.
- Data collection to assess system readiness for new loads.

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The Stor4Build Building Energy Storage Consortium

Keynote: Scaling Flexibility: Federal Initiatives for the Future Grid, September 24, 1:20-1:30PM

Sven Mumme, Department of Energy

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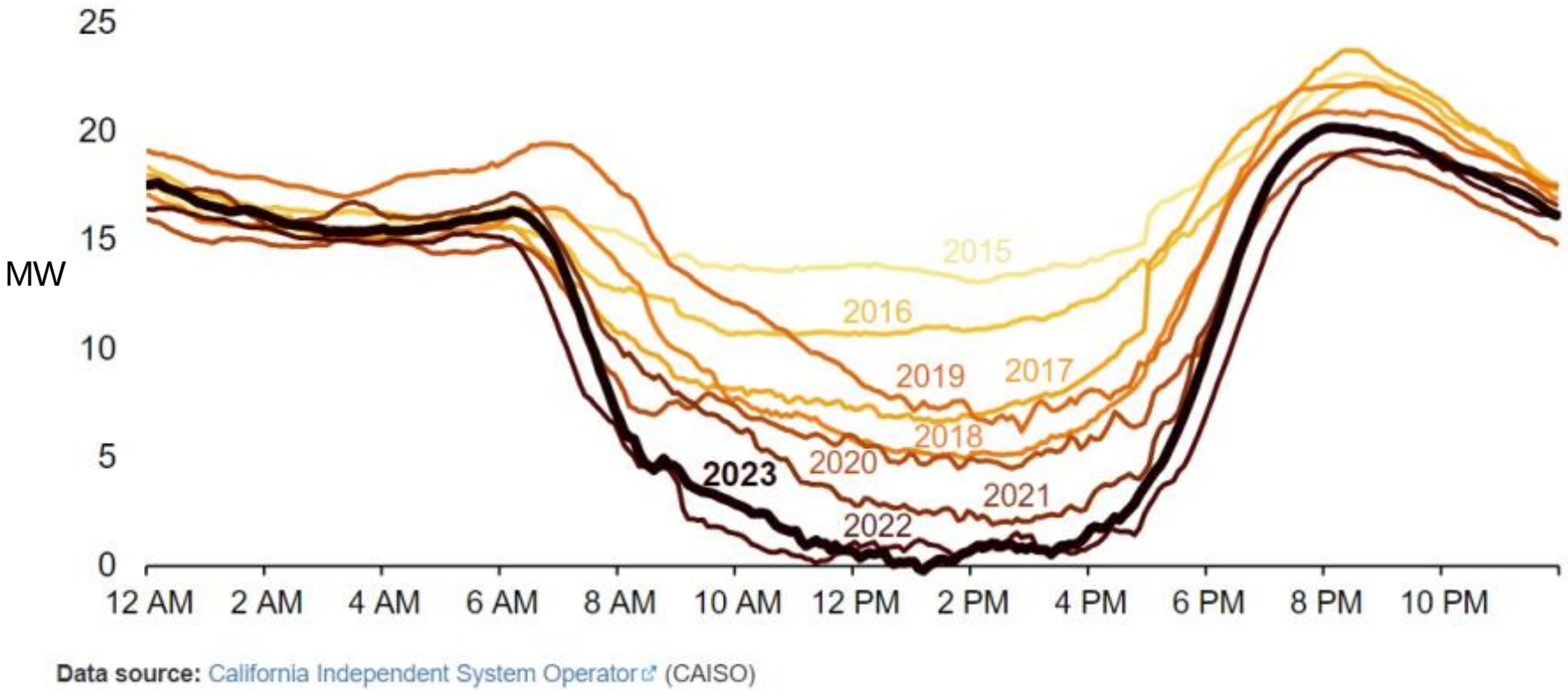
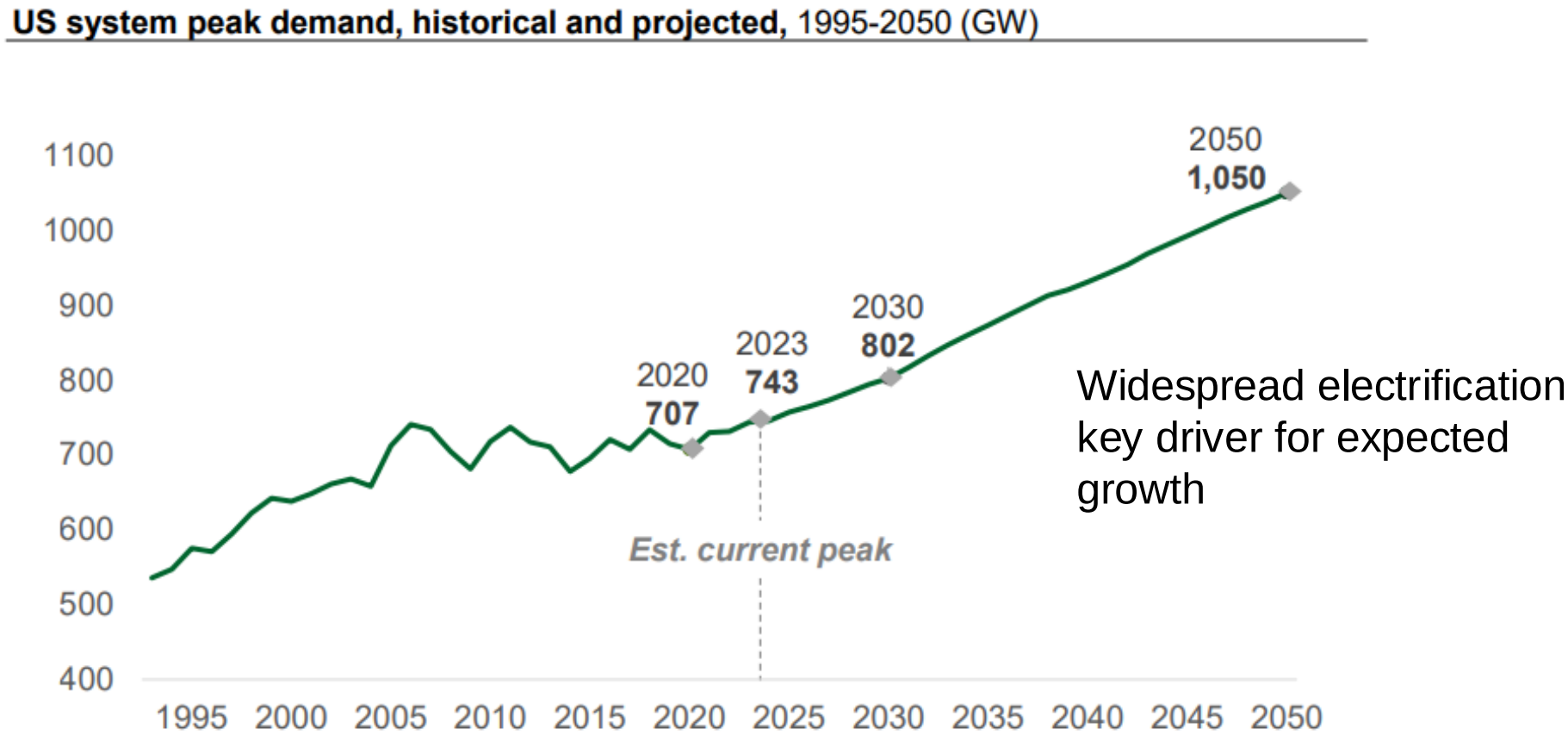
Neet to Address the Duck Curve



Data source: California Independent System Operator (CAISO)

Courtesy: US Energy Information Administration

US peak demand is expected to grow by ~60 GW between 2023 and 2030



Widespread electrification key driver for expected growth

Source: Historical energy demand sourced from AEO; forecasted energy sourced from OP-NEMS mid-case scenario

Energy Storage in Buildings

Energy storage makes buildings more resilient and significantly contributes to managing and shifting their peak electrical demand.

Thermal and electrical energy storage are main types of storage used in buildings

Thermal energy storage

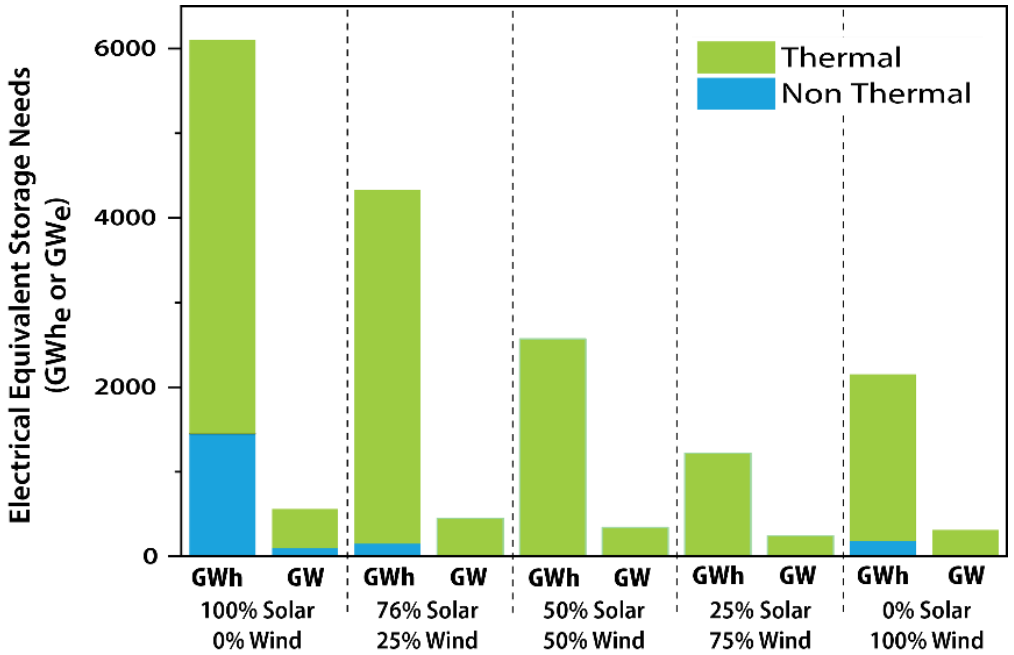
- TES systems provide storage capability for heating or cooling loads.
- TES can lower heating and cooling equipment costs while increasing thermal system effective capacity.

Electrical energy storage

- EES can handle a wide range of end loads to provide backup electrical power.
- Useful for buildings that frequently experience power disruptions and need backup for critical loads.

Strategic investments to reduce TES and EES costs can be traded off with investments in electrical distribution system and service upgrades.

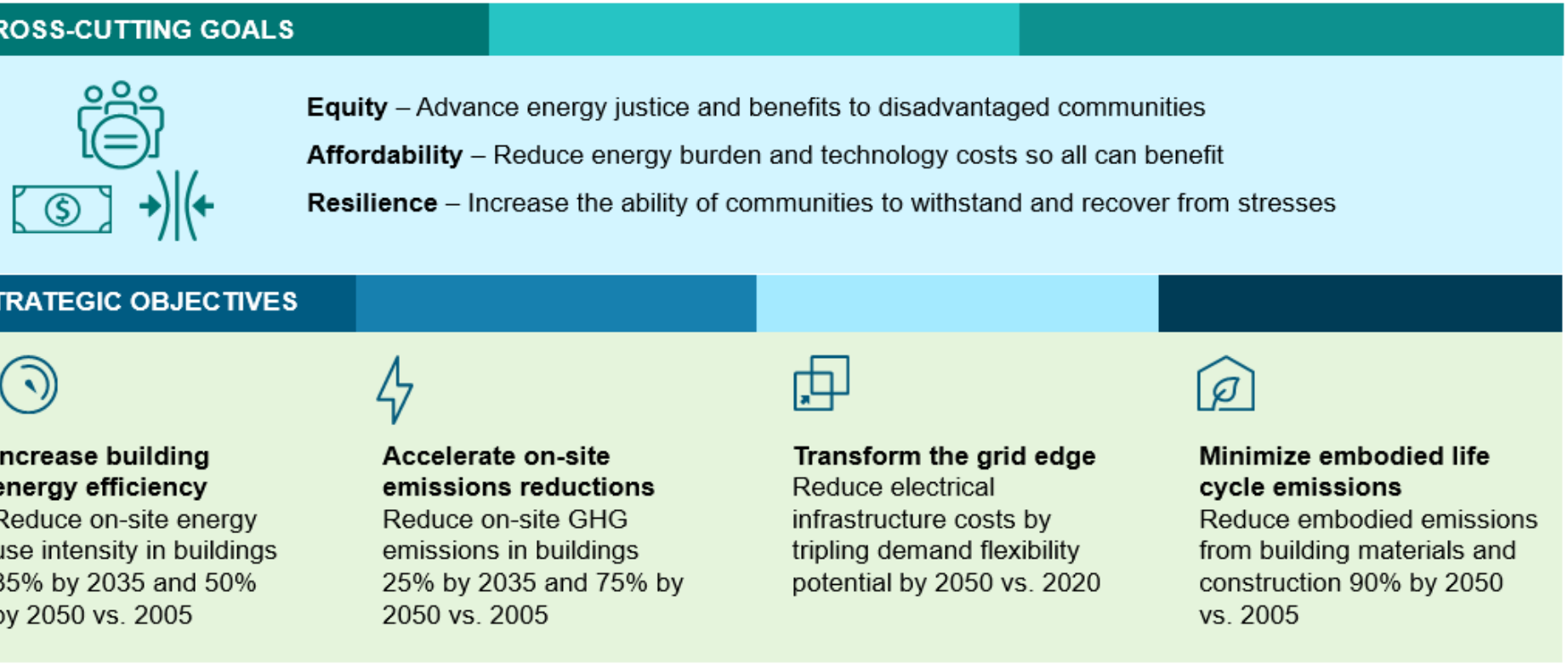
Energy storage required to support commercial and residential buildings in the United States for a 2050 grid with 100% renewable energy, disaggregated into thermal and nonthermal storage, assuming electrified heating with ASHPs.



Source: Odukomaiya 2021

National Buildings Blueprint

Reduce U.S. building emissions 60% by 2035 and 90% by 2050 vs. 2005 while enabling net-zero emissions economy-wide and centering equity and benefits to communities



Decarbonizing the U.S. Economy by 2050: A National Blueprint for the Buildings Sector

Blueprint Alignment – TES

Reduce U.S. building emissions 60% by 2035 and 90% by 2050 vs. 2005 while enabling net-zero emissions economy-wide and centering equity and benefits to communities

Prioritize equity – Foster equitable and sustainable electrification by lowering upgrade costs for electrical distribution system components like panel, service, and transformers by reducing system peaks and equipment rating and footprint.

Prioritize affordability – Thermal energy storage can be more cost-effective for buildings than Li-ion batteries. Strategic storage integration can avoid costly upgrades and downsize HVAC systems. TES can reduce energy costs by cutting peak demand and taking advantage of time-of-use (TOU) rates and lower energy burden in LMI communities.

Prioritize resilience – Potential to improve resilience by maintaining end-use service delivery and extend acceptable indoor condition duration during brief grid outages and extreme weather events (heat waves, cold snaps).

Blueprint Alignment – TES

Reduce U.S. building emissions 60% by 2035 and 90% by 2050 vs. 2005 while enabling net-zero emissions economy-wide and centering equity and benefits to communities

Increase building energy efficiency	TES can improve HP efficiencies or harness free heating and cooling by taking advantage of daily variations in ambient temperature.
Accelerate onsite emissions reductions	TES makes electrification far more viable by reducing the need for electrical upgrades and right-sizing equipment. TES can increase the effective capacity of heat pumps, making them higher perfuming in cold climates.
Transform the grid edge at buildings	Energy storage can reduce peak demand providing a "non-wires" solution to substantially reduce required investments in distribution system upgrades that would otherwise be needed to support widespread electrification.
Minimize building life cycle emissions	By utilizing low embodied carbon materials, TES technologies have the potential to lower life cycle carbon impacts relative to conventional battery EES.

Stor4Build
U.S. DEPARTMENT OF ENERGY

Stor4Build Overview

A Multi-Lab Building Energy Storage Consortium

Unlocking Demand Flexibility: Leveraging TES for Decarbonization and Grid Resilience

Stor4Build is a multi-lab consortium designed to accelerate the development and deployment of affordable thermal energy storage technologies for buildings.

Funded By:

U.S. DEPARTMENT OF ENERGY | Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Co-Directors:

BERKELEY LAB

NREL Transforming ENERGY

OAK RIDGE National Laboratory

Supported By:

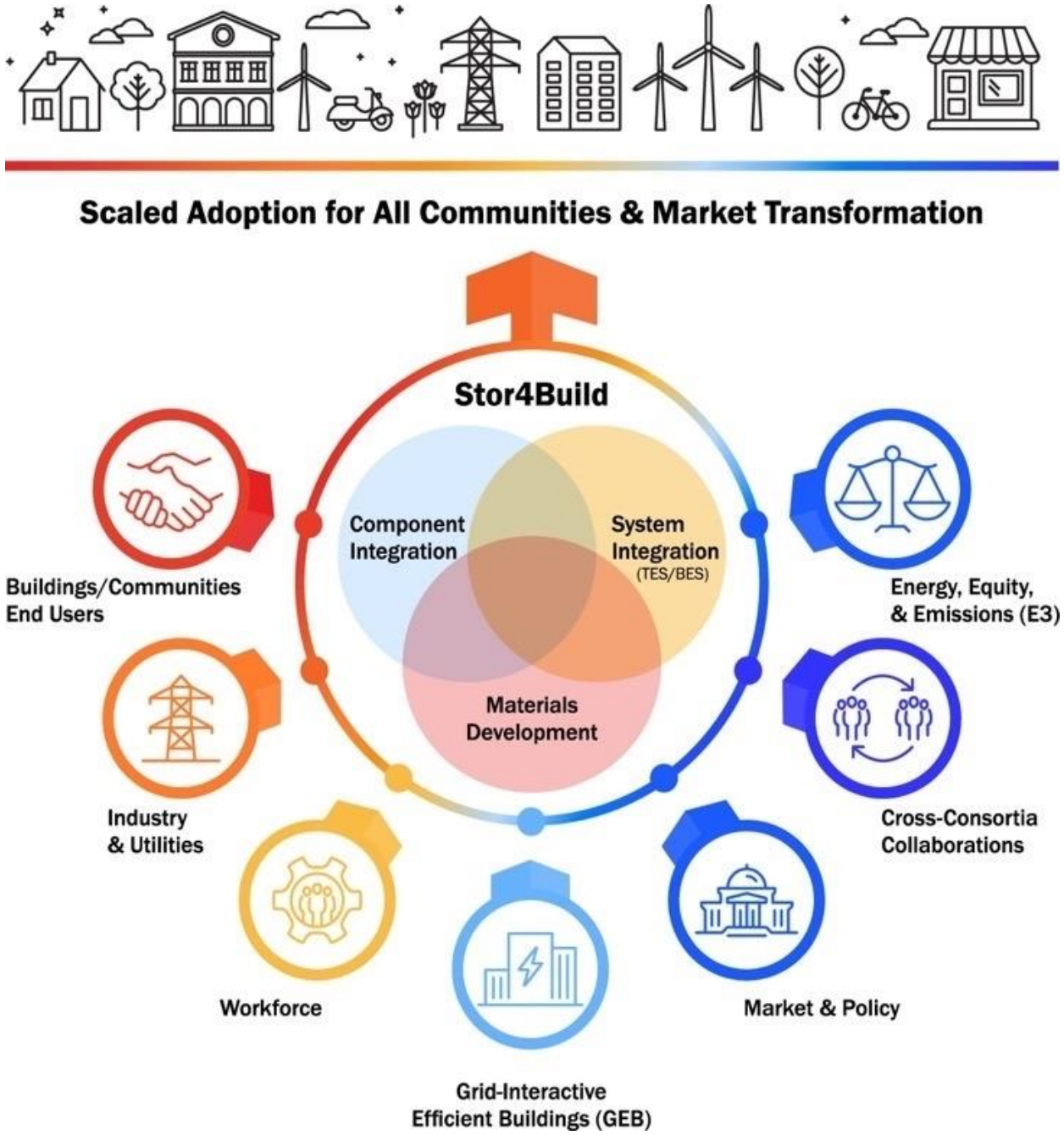
ACEEE American Council for an Energy-Efficient Economy

Pacific Northwest NATIONAL LABORATORY

Objectives

Stor4Build is working to:

- Advance and accelerate TES solutions from development to market adoption
- Develop metrics for identifying optimal performance targets
- Conduct field evaluations of novel packaged/integrated TES solutions
- Support equity-centric scaled adoption and market transformation
- Facilitate synergistic collaboration among stakeholders



Research Areas

Stor4Build has identified five key areas of focus to accelerate the growth, optimization, and deployment of cost-effective thermal energy storage technologies.

Systems Centric Materials Optimization

Systems Centric Controls + Aggregation

Modeling & Analysis

TES Sizing, Benefits and Decision

Systems Development

Standard Test Procedures & Performance Standards

R&D Steering Council

- R&D gap analysis
- Technology readiness map
- R&D technology screening
- Key performance indicators

Market Adoption Steering Council

- Market structures, policies, and market transformation activities
- TES standards gap analysis
- Application use case evaluation

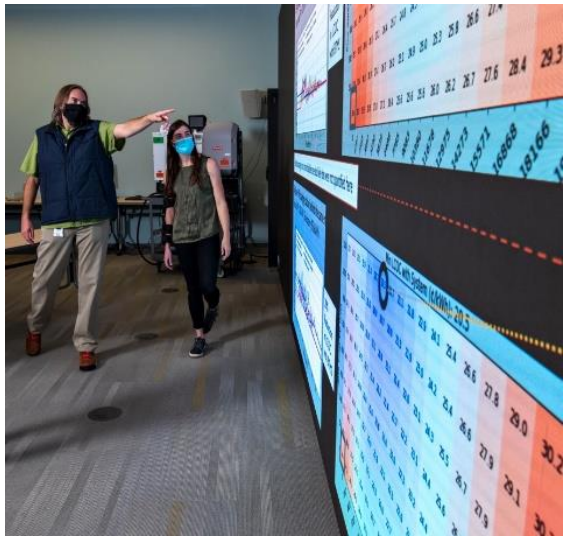



Photo by Werner Slocum, NREL 73692

Get Involved

Stor4Build welcomes participants from industry, utilities, nonprofit organizations, communities, building owners, academia, government, and other research institutions.

Contact Stor4Build@ee.doe.gov for more information on ways to collaborate.

Learn more on Energy.gov or to receive the latest Stor4Build news.

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Thank you!

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