NASEO-NARUC Grid-Interactive Efficient Buildings Working Group:
(1) ASHRAE Grid-interactive Buildings for Decarbonization: Design and Operation Resource Guide and (2) GridOptimal Findings and Experience

September 20, 2023, 3:00 pm ET

Welcome: ***Rodney Sobin***

and **Brief Reminder of** ***NASEO, "State and Local Building Policies and Programs for Energy Efficiency and Demand Flexibility"***

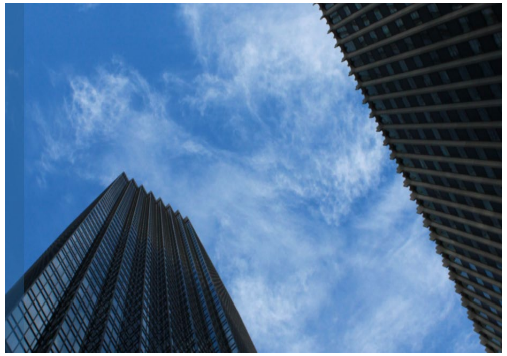
GridOptimal and ASHRAE GEB for Decarbonization Guide

Alexi Miller*, Acting Director of Building Innovation, New Buildings Institute (NBI)*

Jim Edelson*, Senior Climate Advisor, NBI*

State updates and discussion

Wrap-up



+

National Association of State Energy Officials

NARUC
National Association of Regulatory Utility Commissioners

NASEO-NARUC Grid-Interactive Efficient Buildings Working Group:
(1) ASHRAE Grid-interactive Buildings for Decarbonization: Design and Operation Resource Guide and (2) GridOptimal Findings and Experience

September 20, 2023, 3:00 pm ET

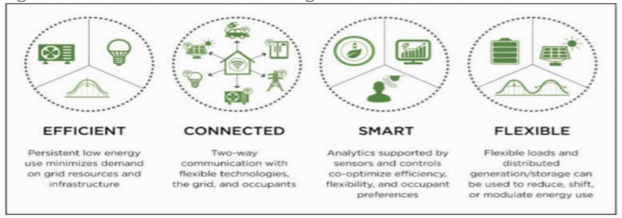
Logistics:

- Please mute when not speaking
- This Forum is meant to be interactive – we encourage discussion. Please use “raise hand” to be recognized. Chat function also available.
- We will record for internal use only; will *not* be disseminated.

NASEO-NARUC Grid-Interactive Efficient Buildings Working Group

https://naseo.org/issues/buildings/naseo-naruc-geb-working-group

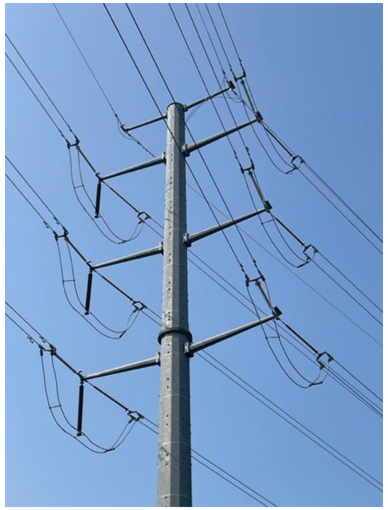
Figure 1. Grid-interactive efficient building characteristics



Source: U.S. Department of Energy

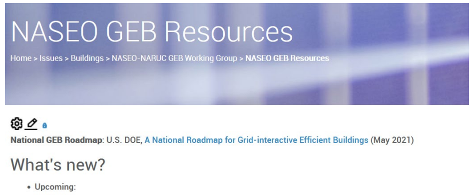
- Working Group co-chairs:
  - Liz Reichart, WA Dept. of Commerce
  - Ashley Norman, Hawaii PUC staff
- Working Group – 28 states:

Arkansas
Arizona
California
Colorado
Connecticut
Florida
Georgia
Hawaii
Idaho
Illinois
Maryland
Massachusetts
Michigan
Minnesota
Mississippi
Nebraska
New Jersey
New York
Pennsylvania
Oregon
South Carolina
Tennessee
Utah
Vermont
Virginia
Washington
Wisconsin
Wyoming



Inquiries: GEB@naseo.org

NASEO-NARUC Grid-Interactive Efficient Buildings Working Group



https://www.naseo.org/issues/buildings/naseo-geb-resources

New/recent:

- LBNL and the Brattle Group, U.S. Building Sector Decarbonization Scenarios to 2050
- NASEO-NARUC Microgrids WG: *State Microgrid Policy, Programmatic, and Regulatory Framework*
- NYSERDA announces $18M NextGen Buildings Innovation Challenge
- **NASEO-NARUC GEB Working Group Forum: Connected Communities - July 26, 2023**
- **California Energy Commission, Workshop on Virtual Power Plants and Demand Flexibility: Identifying R&D Needs - July 18, 2023**
- **DOE Better Buildings and Rocky Mountain Institute webinar: Identifying Cost-Effective Energy Efficiency and Load Flexibility Measures Supporting GEB Strategies - July 12, 2023**

Upcoming:

- NASEO Annual Meeting, Oct. 16-19, Portland, OR – incl. ***Dynamic Loads, Virtual Power Plants, and Connected Communities*** session
- Forum: TBD, November - We welcome topic and speaker suggestions
  - maybe EVs and DF/GEB: V2G, V2X

NASEO-NARUC Grid-Interactive Efficient Buildings Working Group

NASEO, "State and Local Building Policies and Programs for Energy Efficiency and Demand Flexibility"

Table 2. Summary of Demand Flexibility Factors Applicable to Building Policies and Programs

Factor	Factor description	B&T[a]	Rating, labels[b]	BPS[c]	Codes[d]	Appl. stds.[e]	Zoning[f]
Peak Demand[g]	Monthly building peak electricity demand	x	x	x			x
Peak Demand Intensity	Monthly building peak electricity demand per sq. ft.	x	x	x			x
Coincident Peak Demand[h]	Building electricity demand during grid peak periods	x	x	x			
Localized Coincident Peak Demand	Building electricity demand during localized peak periods	x	x	x			x
DR Participation	Participation in demand response (DR) programs	x	x	x			x
DR/DF Capability	Building management system, equipment DR and DF capability	x	x	x	x	x	x
Time-Differentiated Emissions	Emissions calculation considers varied grid generation over time	x	x	x			
Time-Differentiated Cost-Effectiveness	Cost-effectiveness analysis considers time-of-use/time-differentiated utility rates and valuation				x	x	

GridOptimal GEBs Update

Design Guidance, Pilot Project Findings, Policy Developments

JIM EDELSON
Senior Climate Advisor

ALEXI MILLER
Acting Director of Building Innovation

The David and Lucile Packard Foundation Headquarters | Los Altos, CA *Photo: Jeremy Bittermann*

Context:
(Why), What & How
Where We are Coming From

Key Policy Levers Advancing Building Decarb

- Energy Codes
  - Ex: California Title 24 Joint Appx 13 HPWH Demand Mgt.
- Appliance Standards
  - Ex: Oregon water heater CTA-2045 requirement through ODOE EE Standards Rulemaking
  - Ex: State of Washington law (Revised Code of WA) requires CTA-2045 on all electric storage water heaters
- Other Construction Codes
  - Ex: New York State Mechanical and Electrical Codes

GRIDOPTIMAL®
BUILDINGS INITIATIVE

newbuildings.org/gridoptimal

- Launched mid-2018, ongoing
  - *New building-grid interaction metrics*
  - Metrics published (blog, white paper)
  - Design and Operations Guidance Fact Sheets
  - LEED Credit: GridOptimal Building ACP (& soon, v5)
  - Utility program guidance (memo, dashboard)
  - ASHRAE Grid Integrated Buildings Resource Guide
  - Codes, standards, and policy deployments

A Joint Initiative Of:

nbi new buildings institute

U.S. Green Building Council USGBC

Supporting Members:

Southern California Edison

PG&E Pacific Gas and Electric Company

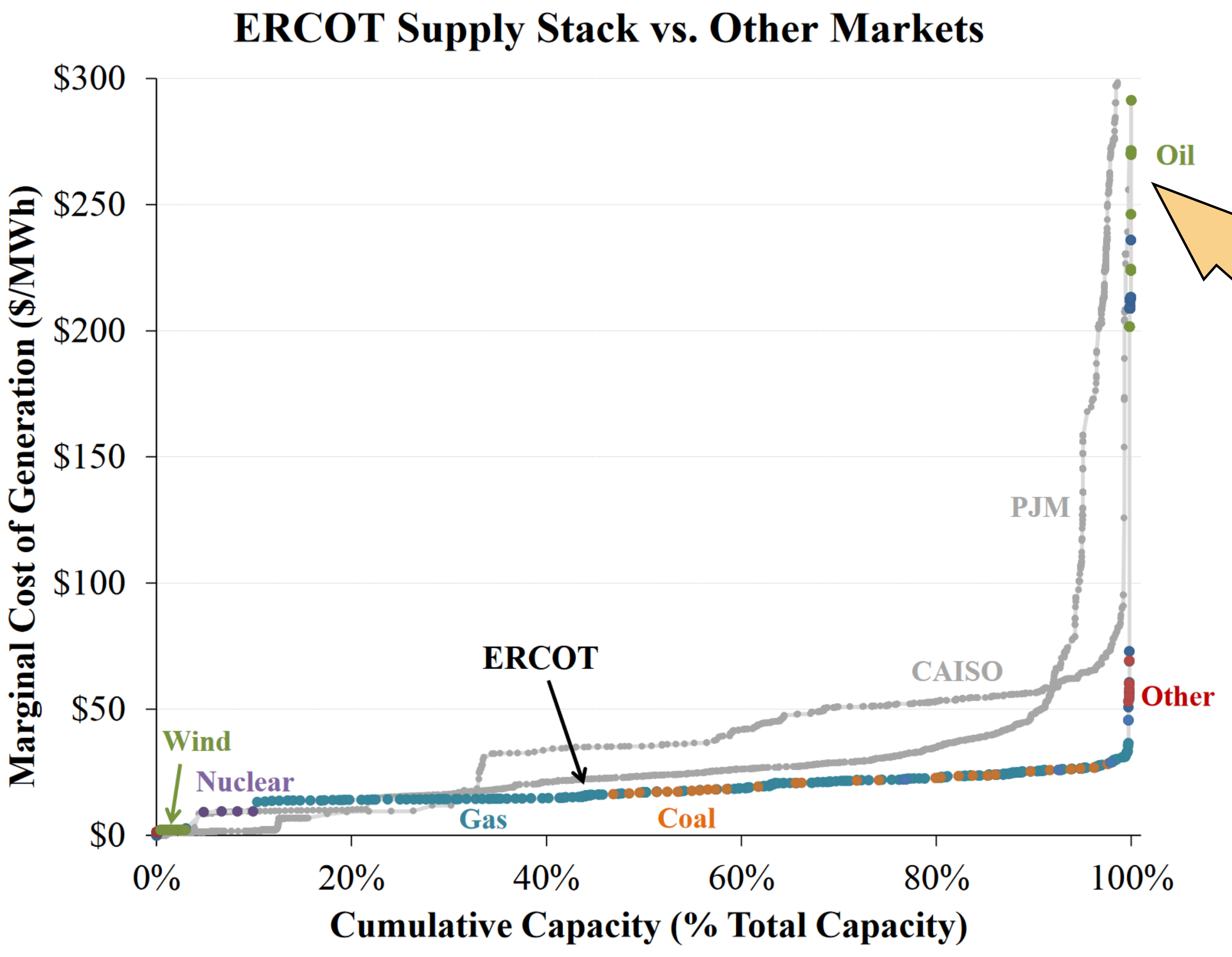
SMUD

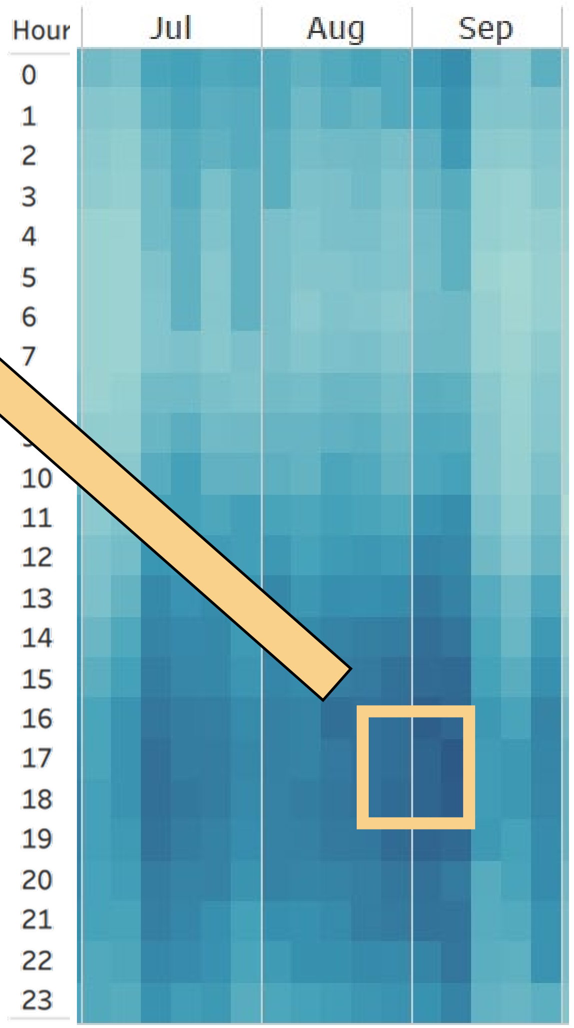
Austin Energy

Efficiency Vermont

Energy Trust of Oregon

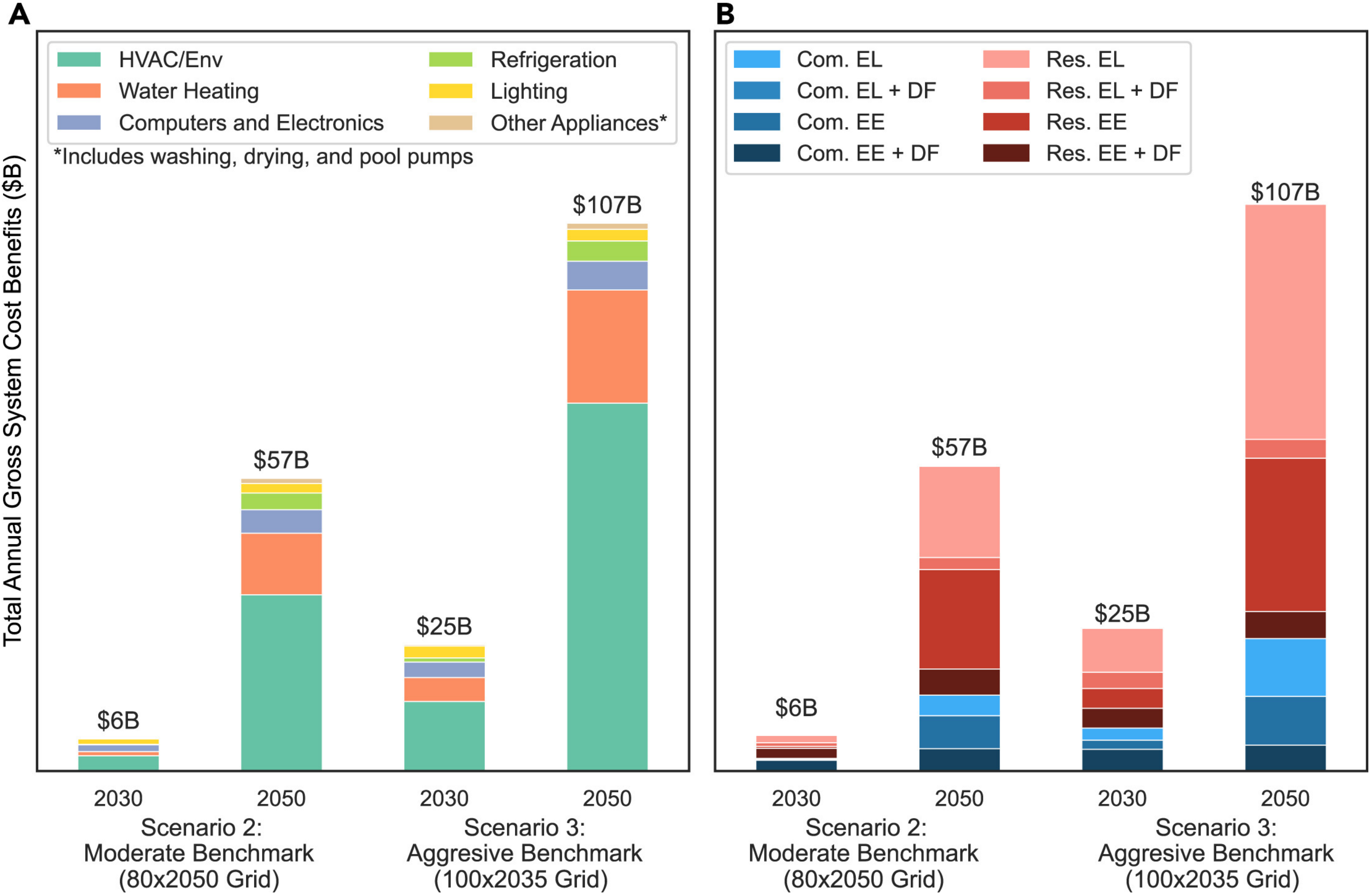
Why Do Utilities Care So Much?





Source: 2012, The Brattle Group [Report]

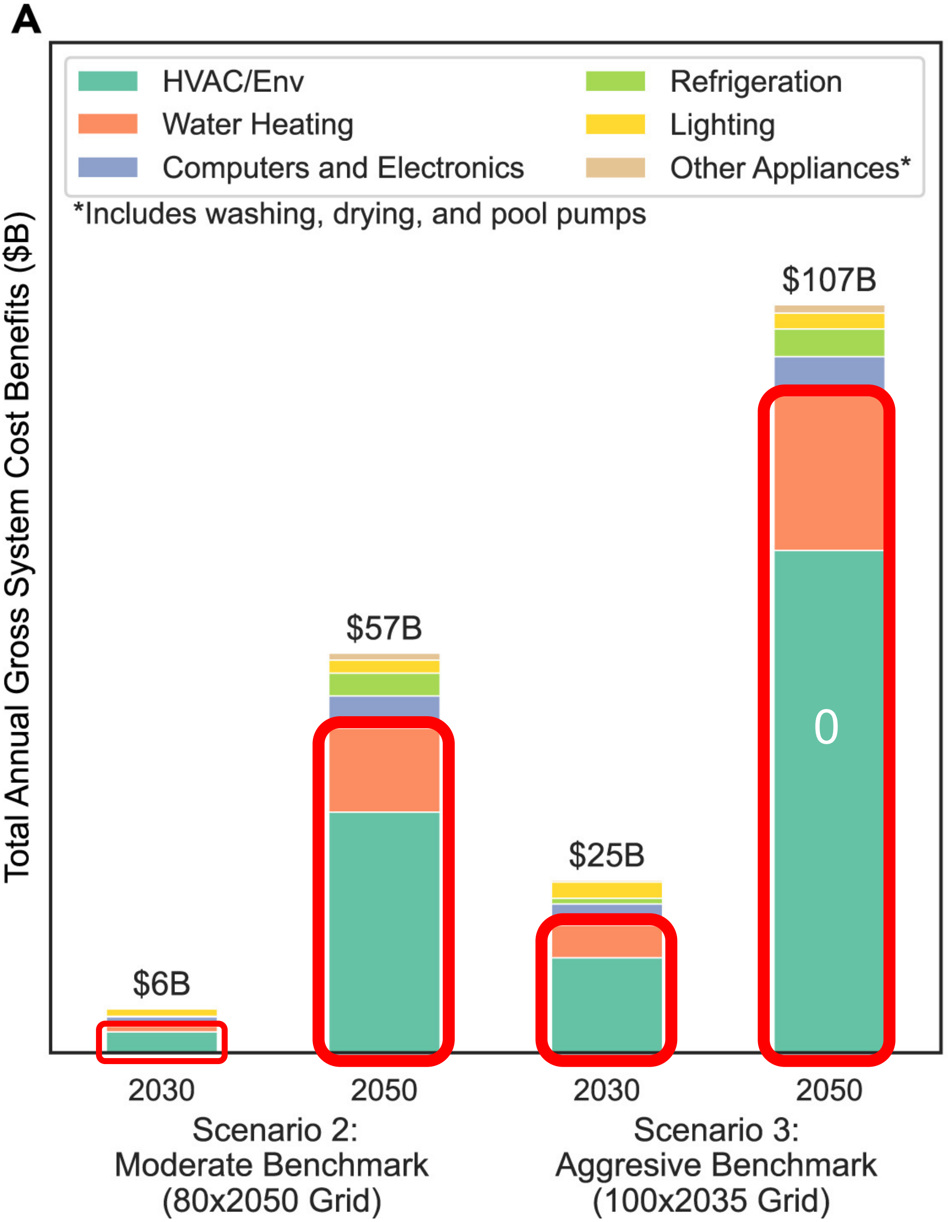
LBNL Study: Future Value of EE, Electrif., & DF

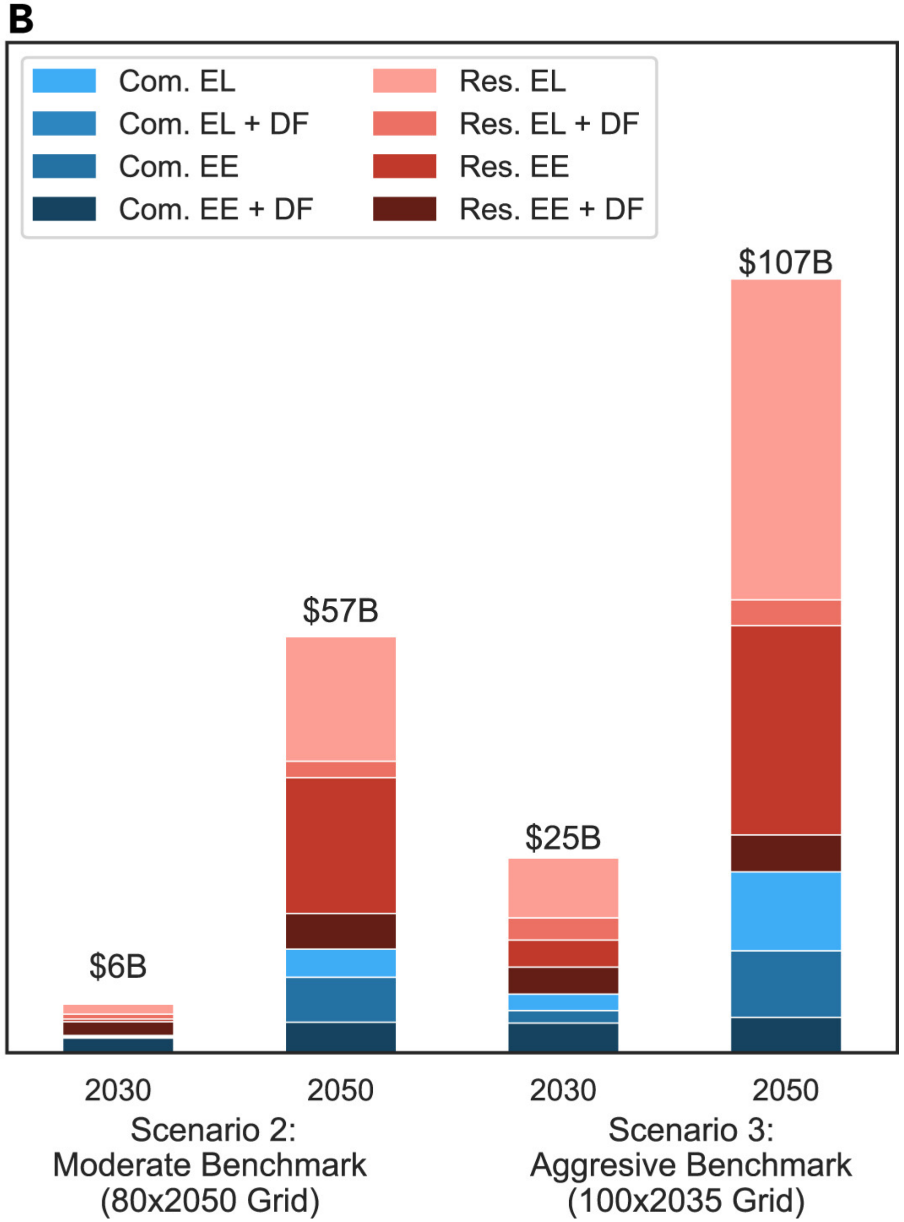


Moderate to aggressive deployment of building efficiency and flexibility measures generates $57–$107 billion in annual power system cost savings by 2050, or 34%–35% of the incremental cost of additional power supply decarbonization before accounting for the cost of the portfolio of demand-side measures.

https://emp.lbl.gov/us-buildings-sector-decarbonization-scenarios-2050

LBNL Study: Future Value of EE, Electrif., & DF





Moderate to aggressive deployment of building efficiency and flexibility measures generates $57–$107 billion in annual power system cost savings by 2050, or 34%–35% of the incremental cost of additional power supply decarbonization before accounting for the cost of the portfolio of demand-side measures.

https://emp.lbl.gov/us-buildings-sector-decarbonization-scenarios-2050

Aldo Leopold Legacy Center | Baraboo, WI *Credit: The Kubala Washatko Architects, Inc*.

What We’ve Learned by Engaging with Buildings On-the-Ground

Sonoma Clean Power HQ, Santa Rosa, CA

Find Simple Ways to Talk Grid-Interactivity

Grid Peak Contribution (GPC)

How much does your building contribute to rush hour on the grid?
→performance-based approach

Demand Flexibility (DF)

What can your building do about it?
→asset-based approach

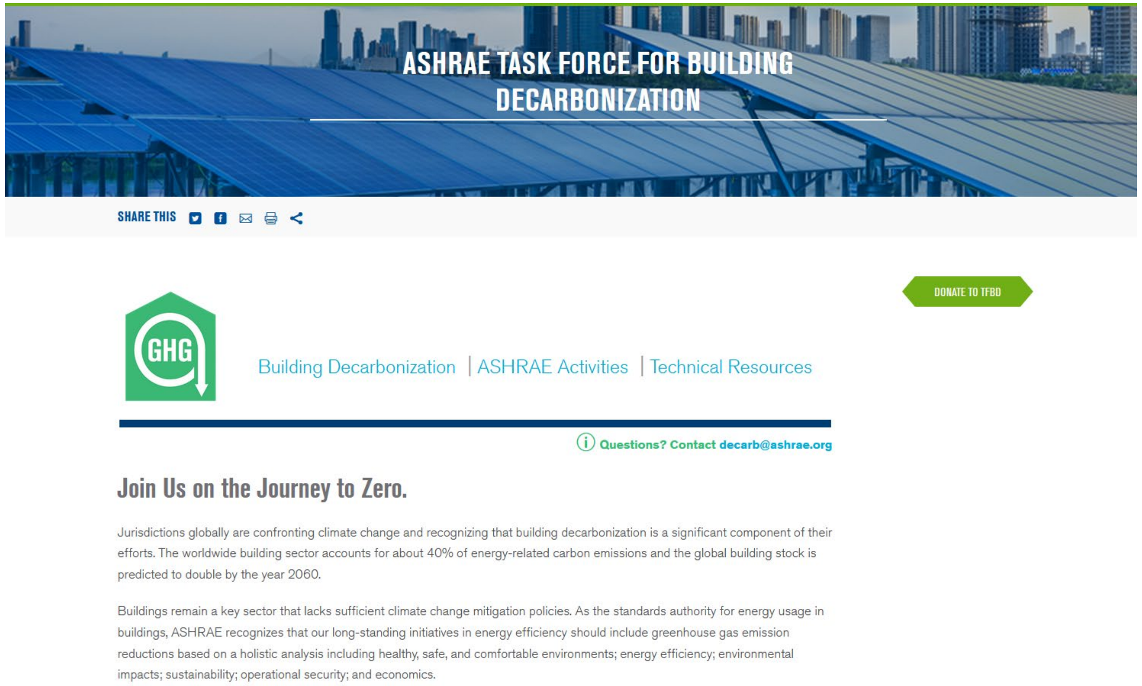
Lovejoy Office Building | Portland, OR
Credit: Opsis Architecture

Focus on the Big Stuff

**Big Now, but also Big Later*

- Passive/Permanent peak load reductions (e.g., GPC savings)
- Building system communications capabilities: key equipment should be able to “talk to the grid”

ASHRAE Task Force for Building Decarbonization



ASHRAE Positions

Eliminating GHG emissions from the built environment is essential to address climate change.

By 2030, the global built environment must halve its 2015 GHG emissions.

1. All new buildings must be net zero GHG emissions in operation,
2. Widespread energy-efficiency retrofits of existing assets must be well underway,
3. Embodied carbon of new construction must be reduced by at least 40%.

By 2050, at the latest, all new and existing assets must be net zero GHG emissions across the whole life cycle.

https://www.ashrae.org/about/ashrae-task-force-for-building-decarbonization

ASHRAE Task Force for Building Decarbonization

SHARE THIS

DONATE TO TFBD

Building Decarbonization | ASHRAE Activities | Technical Resources

Questions? Contact decarb@ashrae.org

Join Us on the Journey to Zero.

Jurisdictions globally are confronting climate change and recognizing that building decarbonization is a significant component of their efforts. The worldwide building sector accounts for about 40% of energy-related carbon emissions and the global building stock is predicted to double by the year 2060.

Buildings remain a key sector that lacks sufficient climate change mitigation policies. As the standards authority for energy usage in buildings, ASHRAE recognizes that our long-standing initiatives in energy efficiency should include greenhouse gas emission reductions based on a holistic analysis including healthy, safe, and comfortable environments; energy efficiency; environmental impacts; sustainability; operational security; and economics.

ASHRAE Positions

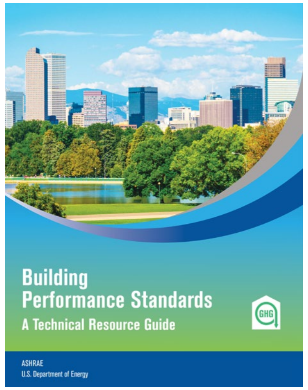
Eliminating GHG emissions from the built environment is essential to address climate change.

By 2030, the global built environment must halve its 2015 GHG emissions.

1. All new buildings must be net zero GHG emissions in operation,
2. Widespread energy-efficiency retrofits of existing assets must be well underway,
3. Embodied carbon of new construction must be reduced by at least 40%.

By 2050, at the latest, all new and existing assets must be net zero GHG emissions across the whole life cycle.

Published Guide



Upcoming Guides

Six additional guides are planned for 2023 and 2024.
> Learn more information

- October 2023 — Grid Interactive Buildings for Decarbonization: Design and Operation Resource Guide
- January 2024 — Whole Life Carbon Guide for Building Systems; Heat Pump Application, Design, and Operation Guide
- February 2024 — CIBSE TM65 for North America
- March 2024 — Decarbonizing Hospital Buildings
- May 2024 — Building Decarbonization Retrofits for Commercial and Multifamily Buildings

https://www.ashrae.org/about/ashrae-task-force-for-building-decarbonization

Grid-Interactive Buildings for Decarbonization: Design and Operation Resource Guide

- *Type of Document:* Resource Guide (informative)
- *Length:* ~130 pages
- *Current Status:* Final layout
- *Estimated Release Date:* October 2023

Contents

Grid-Interactive Buildings for Decarbonization: Design and Operation Resource Guide

- *Type of Document:* Resource Guide (informative)
- *Length:* ~130 pages
- *Current Status:* Final layout
- *Estimated Release Date:* October 2023

Contents

Design and Operations Guidance for Standalone Systems

- Standalone Systems: (equipment controlled at the end-use level)
  - Building Envelope
  - HVAC
  - Water Heating
  - Lighting
  - Solar PV
  - Electric Batteries
  - Electric Vehicle Supply Equipment

- *Covered Topics:*
  - *Basic Requirements and Considerations*
  - *Carbon Impact Drivers*
  - *Grid Communication*
  - *Sizing*
  - *Controlling Flexible Loads*
  - *Specifications (template/ sample language, recommendations)*

HVAC Communications Capability

- Work with local utilities to learn what platforms, standards, etc. will work for them
- Leverage Energy Star Connected Products lists where possible (13 product categories, incl. t-stats, room ACs)
- Example of Specification Grade requirement language:*

  **excerpt from NBI's GSA P100 recommendations, not ASHRAE Guide*

  - **Thermostats**: Specify equipment that can participate in the local utility demand response or peak load management program, or specify thermostats that meet one or more of the following requirements from the Pacific Northwest National Laboratory (PNNL) technical brief "Demand Response in Residential Energy Code":
    - Are certified OpenADR 2.0a, OpenADR 2.0b Virtual End Node (VEN), as specified under Clause 11, Conformance, in the applicable OpenADR 2.0 Specification.
    - Certified by the manufacturer as being capable of responding to a demand response signal from a certified OpenADR 2.0b VEN by automatically implementing the control functions requested by the VEN for the equipment it controls.
    - Certified to be capable of responding to a demand response signal from an OpenADR Virtual Top Node.
    - Comply with IEC 62726-10-1 (2019), an international standard for the open automated demand response (ADR) system interface between the smart appliance, system, or energy management system and the controlling entity, such as a utility or service provider.

Water Heating Communications Capability

- Work with local utilities to learn what platforms, standards, etc. will work for them
- Some states (OR, WA) require CTA-2045
- California T24 JA-13 requires HPWH to have smart grid *capabilities* – but is standard-agnostic
- Example of Specification Grade requirement language:*

  **excerpt from NBI's GSA P100 recommendations, not ASHRAE Guide*

  - **Unitary Water Heating**: All unitary electric water heaters shall be compliant with CTA-2045-B, level 1 (if installed before July 1, 2025) or CTA-2045-B, level 2 (if installed after July 1, 2025).
  - **Central water heating**: All central water heating systems shall include communications capability that can participate in the local utility demand response or peak load management program or that is compliant with one of the following:
    - CTA-2045-B, level 1 (if installed before July 2025) or CTA-2045-B, level 2 (if installed after July 2025)
    - OpenADR2.0b

Design and Operations Guidance for Integrated Systems

- Integrated Systems (equipment controlled by a central system)
  - Building Automation Systems (BAS)
  - HVAC
  - Water Heating
  - Lighting
  - Thermal Energy Storage
  - Electric Vehicle Supply Equipment

- *Covered Topics:*
  - *System Type Selection*
  - *Integration with Other Building Systems*
  - *System Layout*
  - *Sizing*
  - *Carbon Impact Drivers*
  - *Supervisory Control Considerations*
  - *Specifications (template/ sample language, recommendations)*

Major Findings and Key Recommendations

- General Best Practices Include:
  - ❑ Utilize energy efficiency solutions to decrease **overall energy** and **peak electricity** consumption
  - ❑ Decarbonize when upgrading building systems: **go electric**
  - ❑ Enable **demand flexibility via controls** to reduce carbon emissions (and, prefer automated controls)
  - ❑ Co-optimize operations to **minimize carbon** emissions and **energy costs** while **maximizing resiliency**
  - ❑ Evaluate other key objectives relevant to the building (**resiliency, health, equity**)
  - ❑ Make a plan for **cybersecurity**
  - ❑ **Commission** and **maintain** systems properly
  - ❑ Provide owner, operator, and occupant **education**

Photo: ehdd

Advanced controls spotlight:
Sonora Elementary

Costa Mesa, CA

Photo: Orange County Department of Education

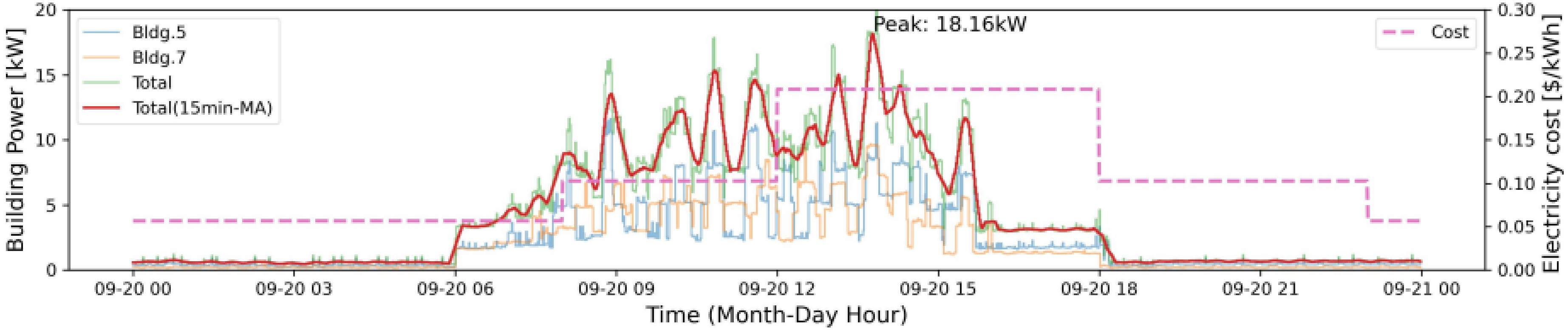
Sonora Elementary – Project Details

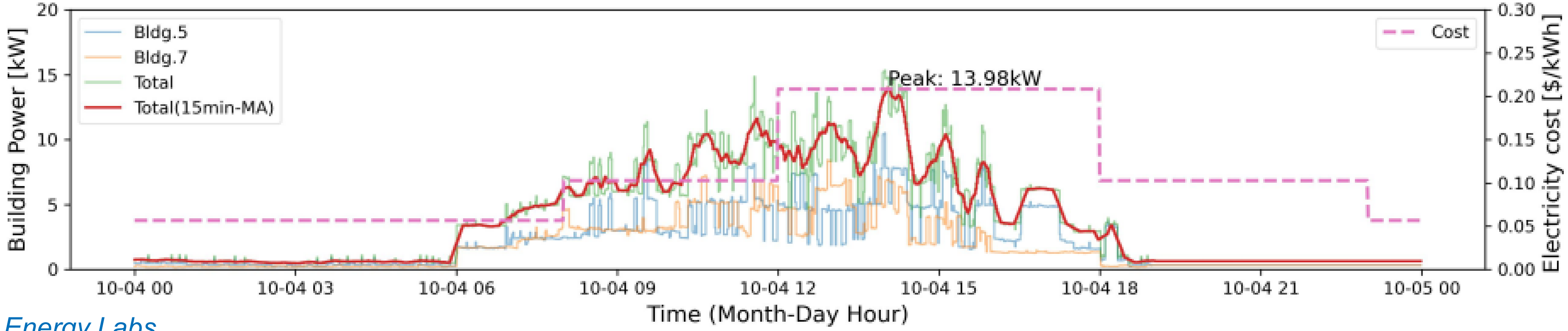
Building Type	Education K-12
Project Type	Retrofit (controls only)
Project Year	2022
Funding	DOE Building Technologies Office
Site description	Two, 6-classroom buildings
Project Team	Community Energy Labs, LBNL, Newport-Mesa Unified School District
Measure	Two-level model predictive control to optimize HVAC

Source: Community Energy Labs

Sonora Elementary - Results

- Reduced peak power by **24%**
- Shifted **16%** of cooling load from on-peak to low price period





Source: [Community Energy Labs]

Grid benefits spotlight:
McKnight Lane Affordable Housing

Waltham, VT

Photo: Clean Energy Group

McKnight Lane – Project Details

Building Type	Affordable multifamily
Project Type	New construction
Year Complete	2016
Project Cost	$3.6 million; $132,156 for storage systems
Site description	14 modular homes @ 925 or 980 s.f. each
Project Team	Addison County Community Trust, Cathedral Square, Clean Energy Group, Clean Energy States Alliance, Green Mountain Power, High Meadows Fund, Sandia National Laboratories, sonnen, US DOE Office of Electricity, VERMOD, Vermont Community Development Program, Vermont Community Foundation Sustainable Future Fund, Vermont Energy Investment Corporation, Vermont Housing and Conservation Board
Measures	• All-electric, high efficiency appliances • 6kWh/4kW AC energy storage systems • 6kW rooftop solar arrays

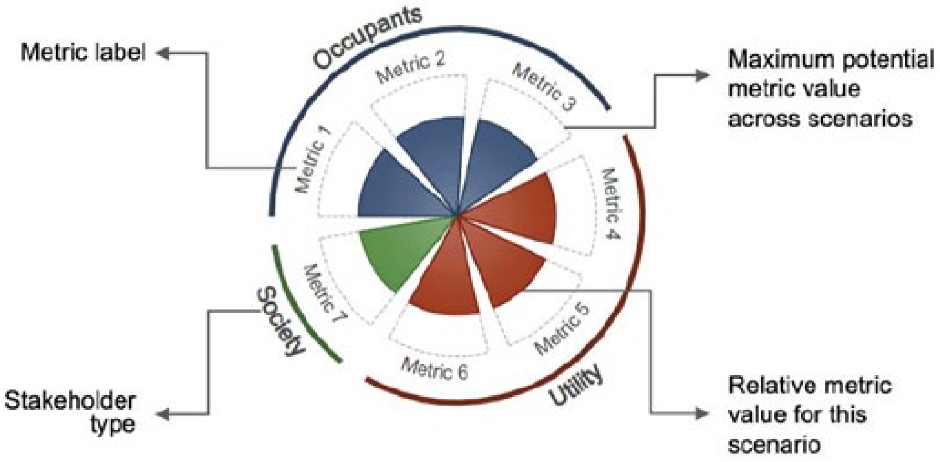
Photo: Clean Energy Group

McKnight Lane - Results

- Benefits of solar plus storage at McKnight Lane:

Occupants	Utility	Society
• $5/month average energy bill • 148 hours of resilience from outages	• **$350-$400/month** transmission charge management savings • **52% lower** coincident grid peak contribution	• GHG emission reduction of 32 metric tons CO_2e every year

- NREL analysis shows that dispatch strategies can be optimized to minimize energy cost, lifecycle costs, or climate costs



Source: NREL

Small Commercial retrofit spotlight: Rincon Consultants HQ Renovation

Ventura, CA

Rincon Consultants HQ – Project Details

Building Type	Office
Project Type	Renovation
Project Year	2023
Funding	Rincon Consultants, Inc.
Site description	1950s single-story medium office building
Project Team	Guttmann & Blaevoet, William Duff Architects, NBI
Measures	Shell, HVAC, Water Heat, BMS Controls, “GridOptimal Ready” PV/Battery infrastructure

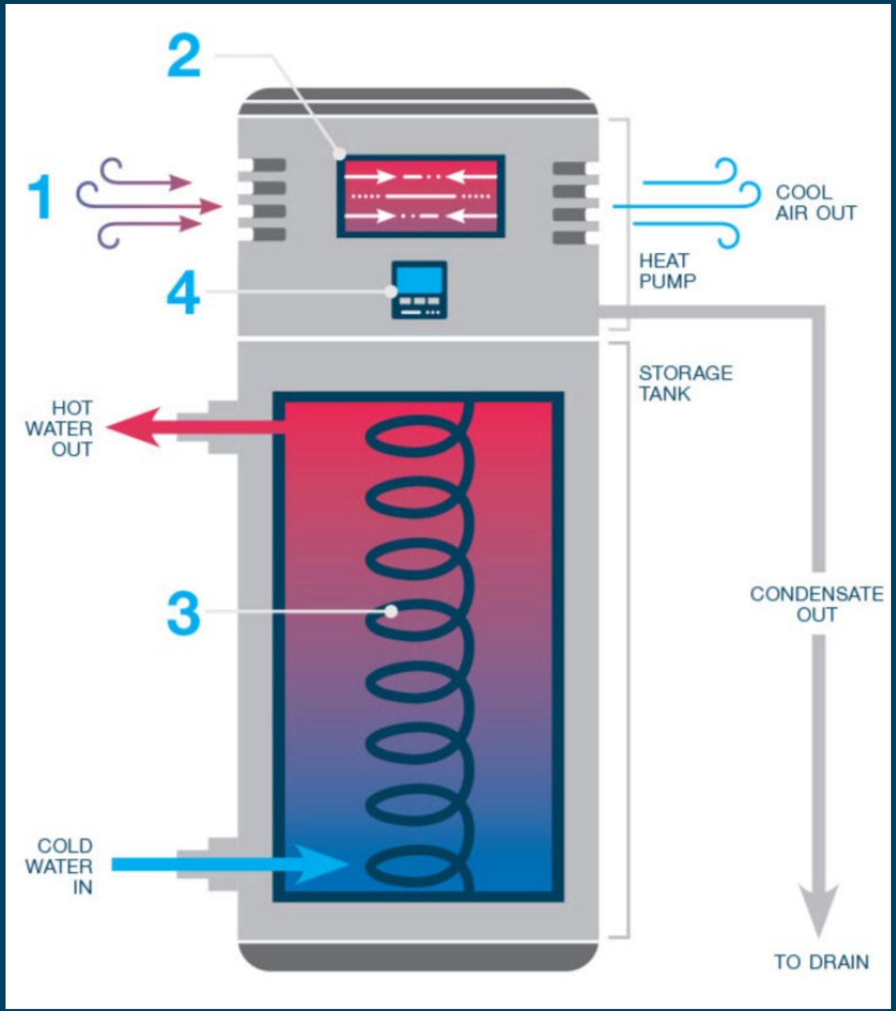
Photo: Google Maps

Rincon Consultants HQ – Simple Design Principles

- Design charrette (clients, architects, engineers, consultants) drove consensus Owners Project Requirements, incl.:

1. ASSETS/COMMUNICATIONS:
   Major mechanical systems (HVAC, DHW, BAS) to include smart grid communications capabilities as described in ASHRAE "Grid-Interactive Buildings for Decarbonization: Design and Operation Resource Guide.
2. SIMPLE 80/20 GOAL GUIDING GRID INTEGRATION DESIGN:
   PV and Battery systems designed and sized (conduit, wiring, panel space, rooftop space and racking, physical space for batteries, etc.) to zero out net building power demand from grid between 4-9 pm on summer design day.

Technology spotlight:
Heat Pump Water Heaters



There are Silver Bullet Technology Options…
Ex: Heat Pump Water Heaters (HPWHs)

- Three Key Value Streams:
  - **High-Efficiency:** 2-3x more efficient than baseline gas or electric resistance equipment: reduces loads during peak hours (also off-peak)
  - **All-Electric:** Zero direct GHG emissions
  - **Smart:** WHs are thermal energy batteries and HPWHs are usually “smart by default,” helping futureproof buildings & support broader grid decarbonization

ADVANCED WATER HEATING INITIATIVE™

https://www.advancedwaterheatinginitiative.org/

Technology Innovation in HPWHs

Plug in retrofit-ready 120V HPWH

NBI now leading the first 120V HPWH demand flexibility field validation

Commercial Grade 120-gallon HPWH

Emerging product class – demand flex potential mostly untested as yet

Skid-mounted, fully packaged central HPWH

Emerging case studies on load shifting starting to come out. Example: BPA-Ecotope Mitsubishi Heat2O Hot Water Load Shift Demonstration and Simulation Analysis, 6/2023

nbi new buildings institute

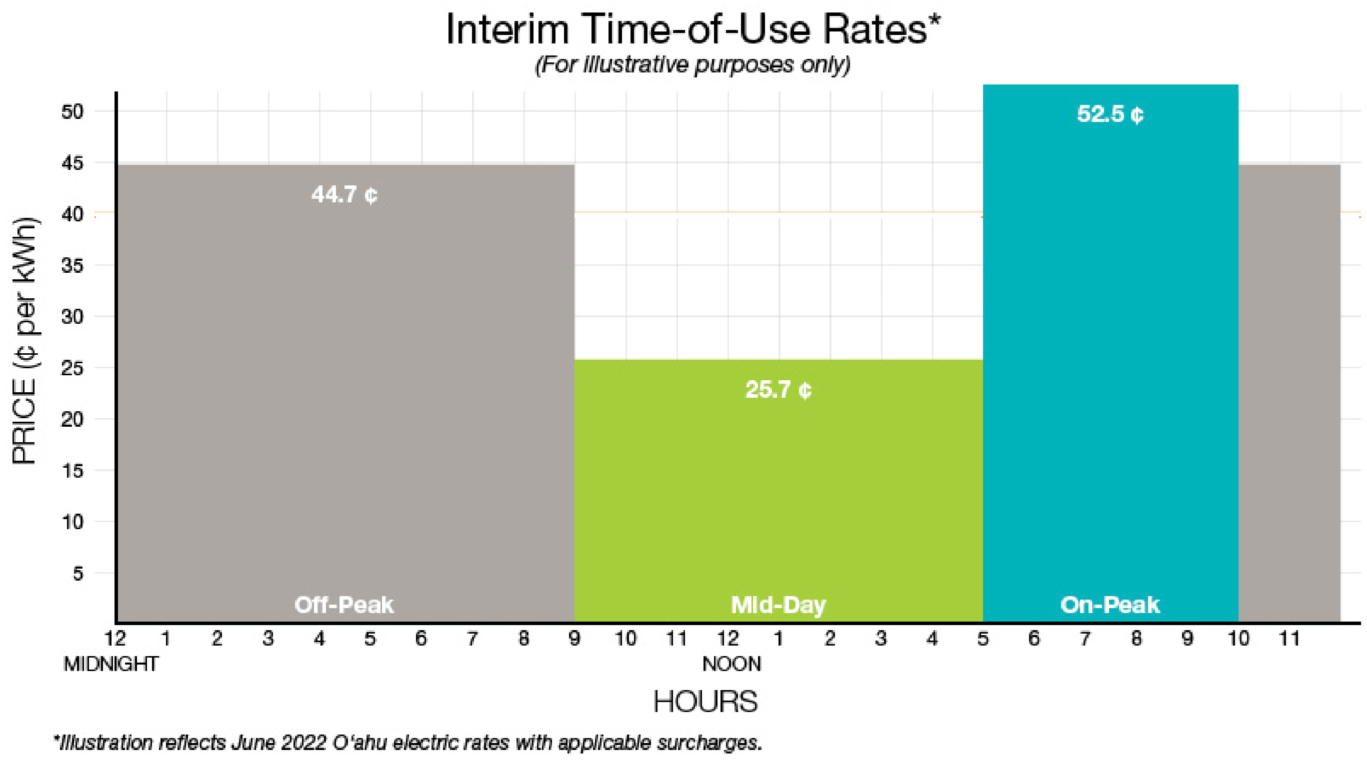
Jurisdictional Case Study: Honolulu, HI Stretch Energy Code Provisions

HVAC/WH Communications*, Grid Peak Contribution, Demand Flexibility

**HVAC communications provisions also in residential base code*

https://hnldoc.ehawaii.gov/hnldoc/measure/2436

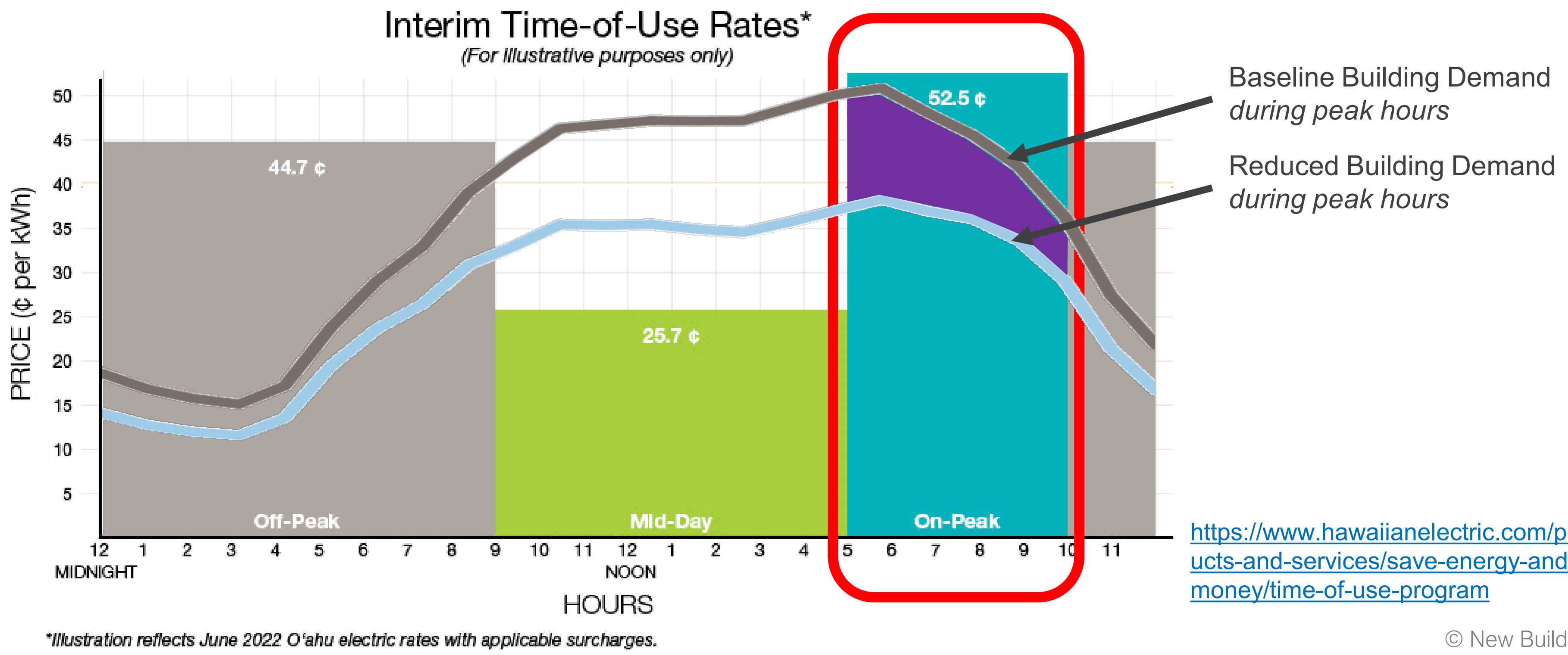
Honolulu: Time of Use Rate Structure



https://www.hawaiianelectric.com/products-and-services/save-energy-and-money/time-of-use-program

Honolulu: Grid Peak Contribution in Stretch Code

Building demand percentage reduction from baseline
during system peak hours (HNL: 5-10 pm, daily)

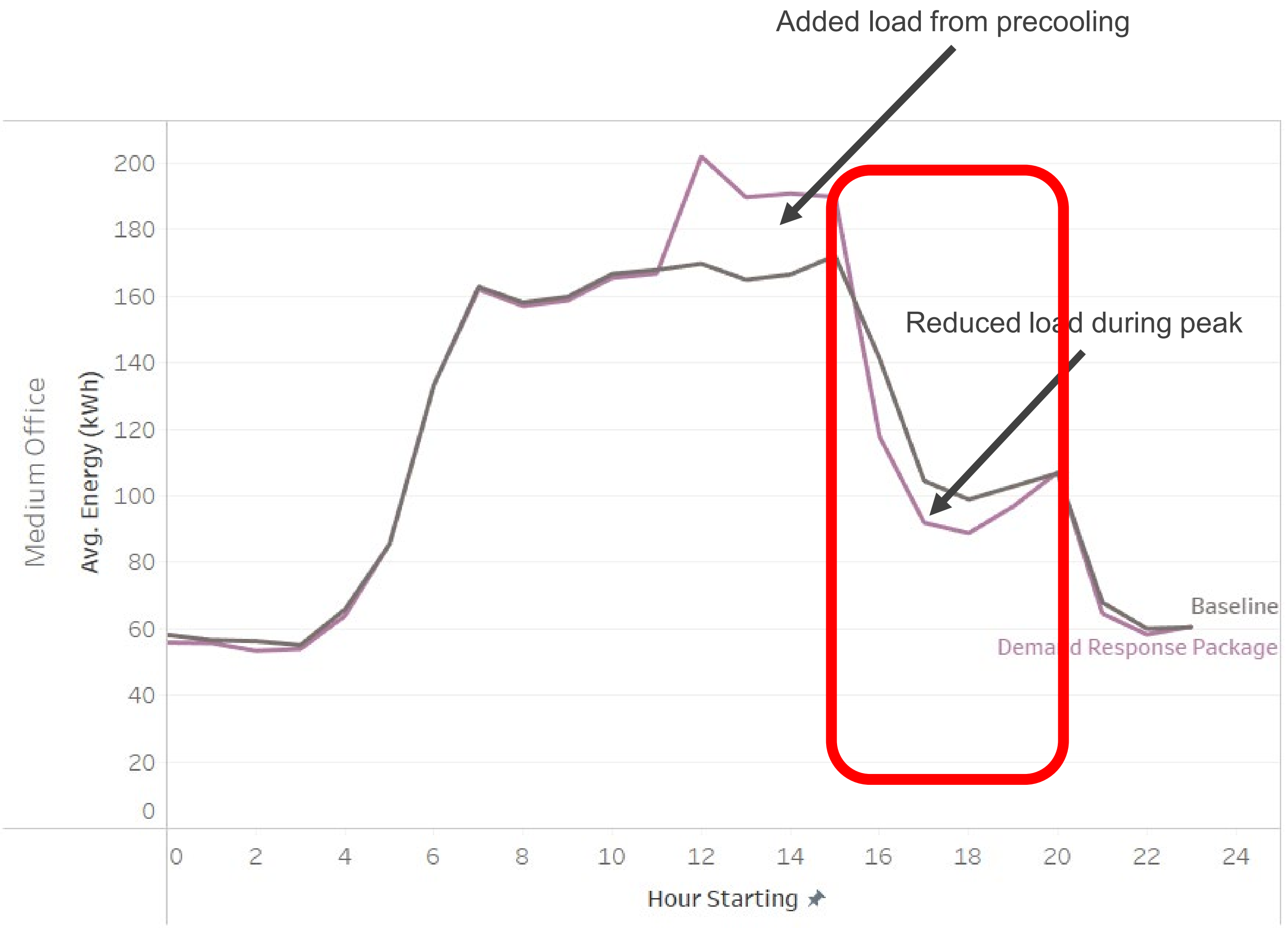


https://www.hawaiianelectric.com/products-and-services/save-energy-and-money/time-of-use-program

Honolulu: Demand Flexibility in Stretch Code

Building's ability to reduce demand (shed)

Shed 10% of load
Averaged over 4 hours
During building peak



West Berkeley Public Library | Berkeley, CA *Credit: Harley Ellis Devereaux*

Policy Progress: Codes and Standards

GEB Adoption Scenarios

	CASE	DESCRIPTION	COMMON ASSUMPTIONS
Main Cases	Low Adoption	EE and DF measure adoption based on lower-end of range of achievable adoption estimates	Main cases use NREL's Standard Scenarios "Mid-Case" for marginal costs
	Mid Adoption	Adoption based on middle of the range of achievable adoption estimates	
	High Adoption	Adoption based on upper-end of range of achievable adoption estimates	
Supplementary Cases	Low Renewables (RE)	System cost forecast based on NREL's High Renewable Energy Cost scenario	Supplementary cases assume Mid Adoption of EE and DF
	High Renewables (RE)	System cost forecast based on NREL's Low Renewable Energy Cost scenario	
	High Capacity Value	System cost forecast based on NREL's Reference case, but modified to assume higher generation capacity value ($75/kW-yr) and to include transmission value ($30/kW-yr)	

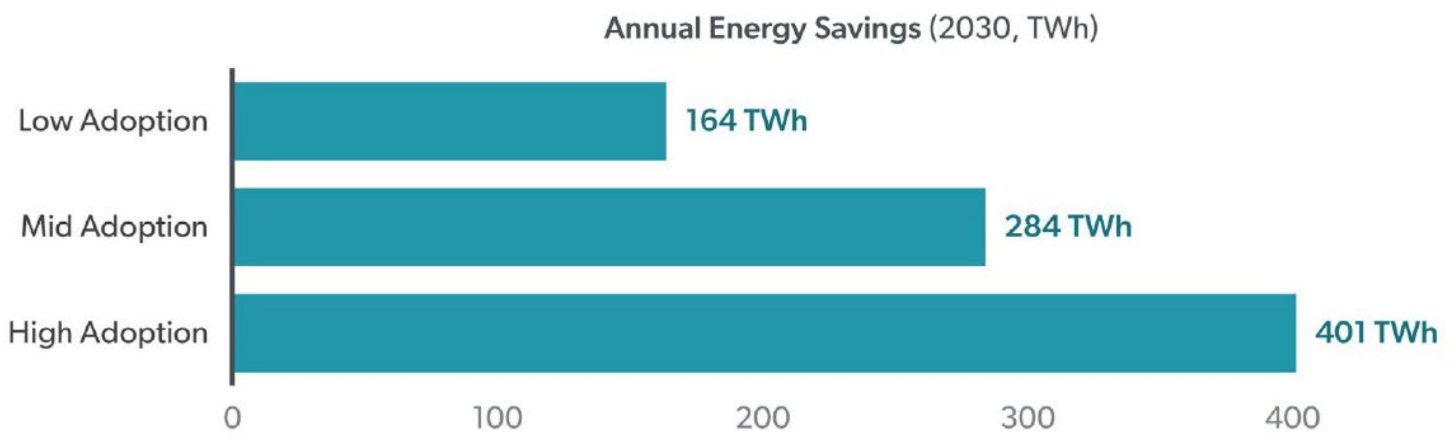
GEB Roadmap

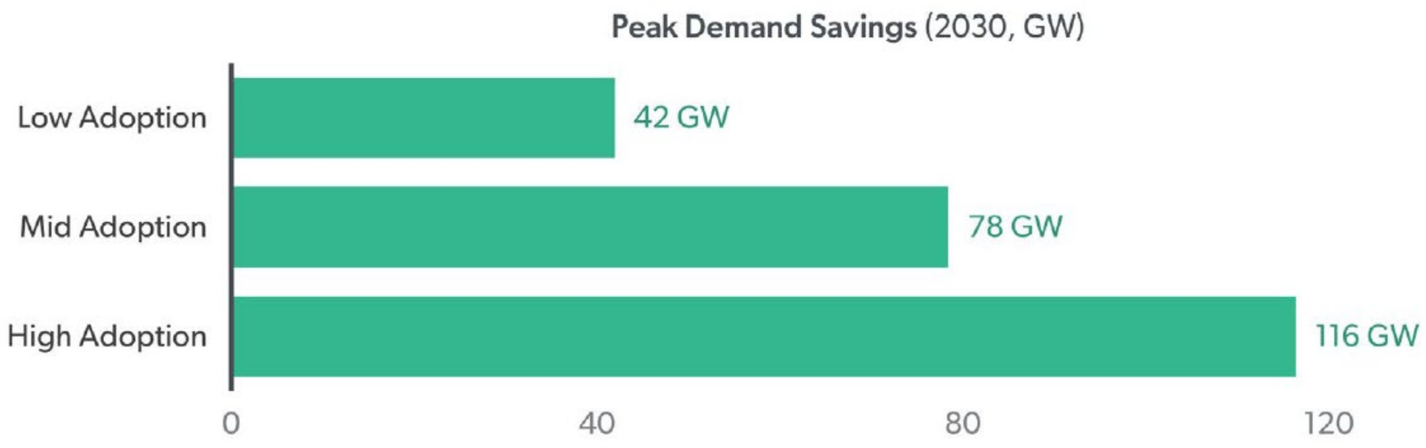
	Low	Mid	High
RESIDENTIAL			
Thermostat[1]	20%	30%	55%
Water heating	20%	30%	55%
Pool Pump	20%	30%	55%
Smart appliances[2]	5%	15%	25%
COMMERCIAL			
HVAC	10%	25%	40%
Lighting	10%	25%	40%
Misc. Electric Loads	5%	15%	20%

TABLE 7: DEMAND FLEXIBILITY CUMULATIVE ADOPTION RATES ASSUMED IN GEB ROADMAP BY END-USE (2021–2030)

Note: Adoption rates are expressed as a percentage of eligible participants.

Adoption Scenarios - energy





Adoption Scenarios - value

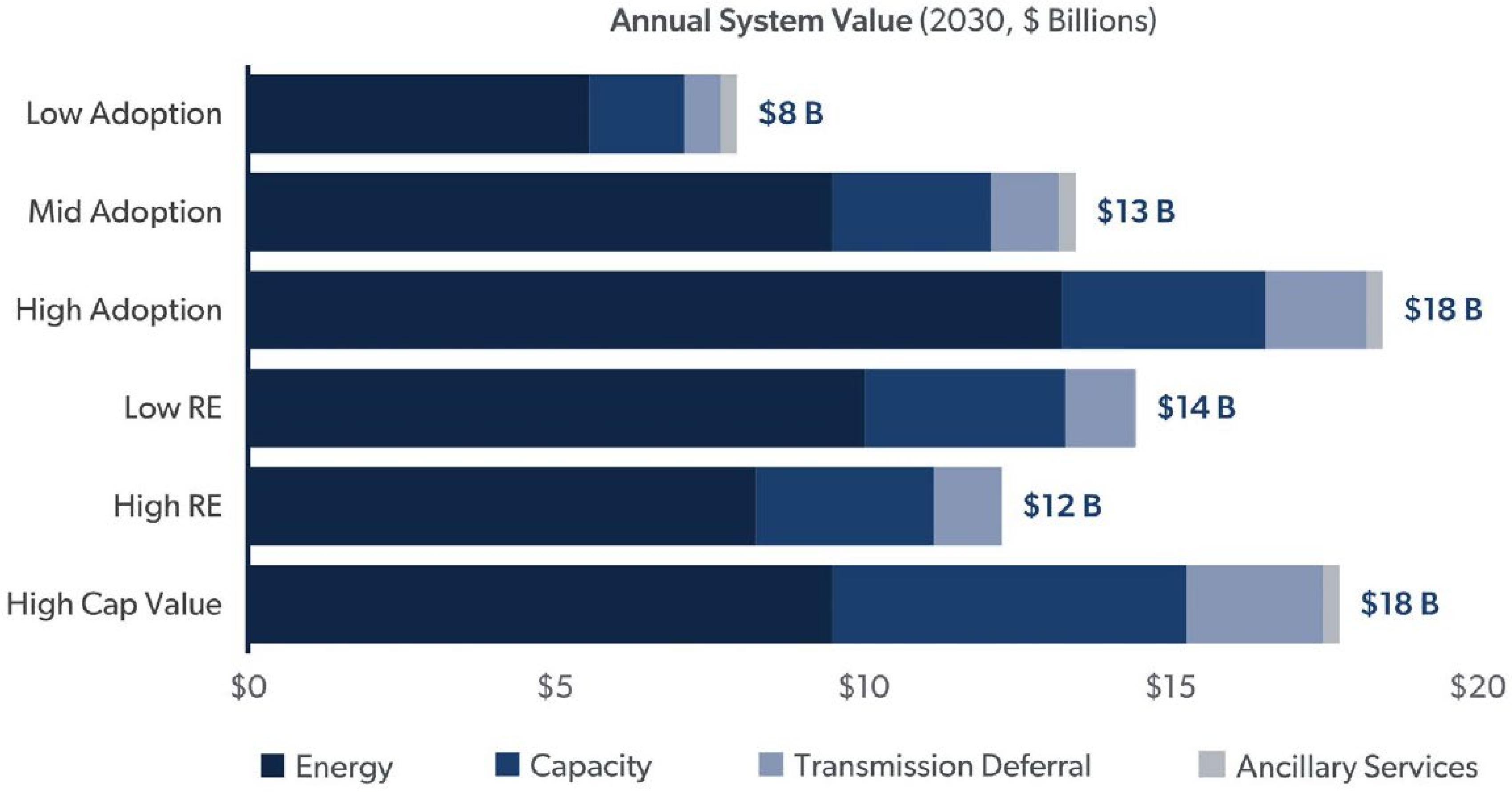


FIGURE 3: THE U.S. POWER SYSTEM VALUE OF PEAK DEMAND AND ENERGY SAVINGS DUE TO ACHIEVABLE LEVELS OF GEB ADOPTION

Notes: All in 2019 dollars. Peak demand savings are computed as the sum of impacts during each region's coincident peak hour. Note that Low RE, High RE, and High Cap Value have the same energy and peak demand savings as the Mid Adoption case.

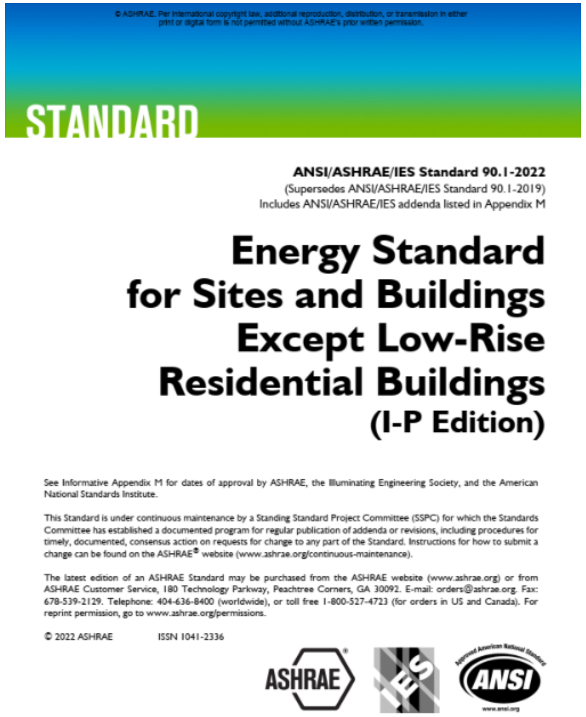
Energy Efficiency precedent (GEB Roadmap)

- States can set EE standards for products sold or installed in their state where federal standards are not in place.
- Many products now covered by national EE standards were first subject to state standards in buildings.
- <u>**Energy codes**</u> are designed to be <u>**cost-effective**</u>
- However, the combination of higher upfront costs and uncertain/unquantifiable benefits complicates the establishment of codes or standards that require demand flexibility in addition to EE.

ASHRAE 90.1 - in Section 11 "Credits"

C406.3 Renewable and Load Management Credits.

- The load management measures in Sections C406.3.2 through C406.3.7 require load management control sequences that are capable of and configured to automatically provide the load management operation specified based on a demand response signal from the controlling entity, such as a utility or service operator.


STANDARD

ANSI/ASHRAE/IES Standard 90.1-2022
(Supersedes ANSI/ASHRAE/IES Standard 90.1-2019)
Includes ANSI/ASHRAE/IES addenda listed in Appendix M

Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings (I-P Edition)

See Informative Appendix M for dates of approval by ASHRAE, the Illuminating Engineering Society, and the American National Standards Institute.

This Standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the Standard. Instructions for how to submit a change can be found on the ASHRAE® website (www.ashrae.org/continuous-maintenance).

The latest edition of an ASHRAE Standard may be purchased from the ASHRAE website (www.ashrae.org) or from ASHRAE Customer Service, 180 Technology Parkway, Peachtree Corners, GA 30092. E-mail: orders@ashrae.org. Fax: 678-539-2129. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

© 2022 ASHRAE ISSN 1041-2336

ASHRAE 90.1 - communications

1. A certified OpenADR 2.0a or OpenADR 2.0b Virtual End Node (VEN), as specified under Clause 11, Conformance, in the applicable OpenADR 2.0 Specification, or

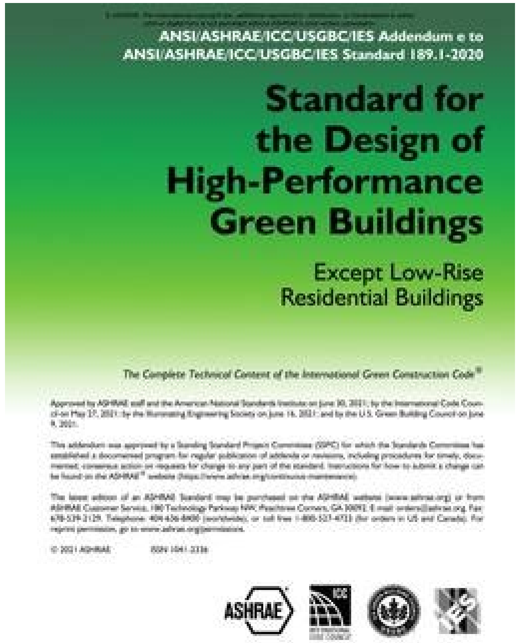
2. A device certified by the manufacturer as being capable of responding to a demand response signal from a certified OpenADR 2.0b VEN by automatically implementing the control functions requested by the VEN for the equipment it controls, or

3. A device that complies with IEC 62726-10-1, an international standard for the open automated demand response system interface between the smart appliance, system, or energy management system and the controlling entity, or

4. An interface that complies with the communication protocol required by a controlling entity, to participate in an automated demand response program, or

ASHRAE 189.1 / IgCC ("green" code)

7.3.4 Automated Demand Response. Where a demand response (DR) program is available to the *building project*, the building controls shall be designed with automated DR infrastructure capable of receiving DR requests from the utility, electrical system operator, or third-party DR program provider and automatically implementing load adjustments to the HVAC and lighting systems.

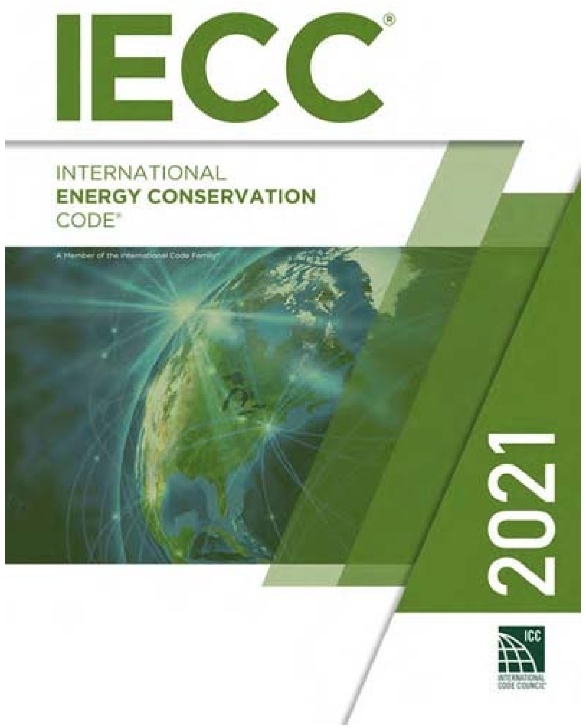


2024 IECC (draft) approach

DEMAND RESPONSE SIGNAL. A signal that indicates a price or a request to modify electricity consumption for a limited time period.

DEMAND RESPONSIVE CONTROL. A control capable of receiving and automatically responding to a *demand response signal*.

C403.4.6 Demand responsive controls Electric heating and cooling systems shall be provided with *demand responsive controls* capable of executing the following actions in response to a *demand response signal.*



Grid-Integrated Thermostat (CEPI-099)

Supports Decarbonization – Not Captured in Progress Indicator

- Demand responsive control capable of automatically adjusting thermal set points
  - Impact assessment of set point setup (summer) and setback (winter) during peak cost periods for the medium office building in all U.S. climate zones.
  - Average reduction in summer peak demand period is 17%
  - Average annual electricity cost savings total 2.5%
  - Some additional electricity costs are incurred during the non-peak period due to the winter pick-up heat load
  - Measure cost savings are higher for buildings with steeper electricity load shapes during summer months.

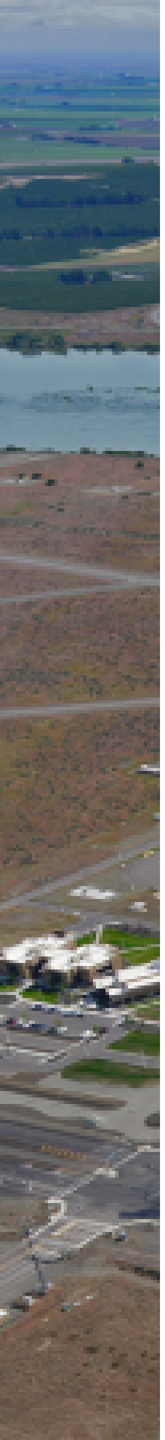
Metric		Units	Min	Average	Max
Demand	Max Demand	(W/sq.ft.)	2.13	2.67	3.10
	Peak Period Demand Reduction	(W/sq.ft.)	0.31	0.45	0.61
		(kW)	16.6	24.4	32.6
		(%)	15%	17%	20%
Cost	TOU Elec Cost	($/sq.ft. year)	0.68	0.82	0.96
	TOU Elec Savings	($/sq.ft. year)	0.01	0.02	0.03
		($/year)	460	1100	1350
		(%)	1.3%	2.5%	2.6%

Pacific Northwest
NATIONAL LABORATORY

Grid-Integrated Water Heating (CEPI-099)
Supports Decarbonization – Not Captured in Progress Indicator

- Demand responsive control capable of automatically adjusting thermal set points
  - Measure preheats SHW above required temperature then shuts of electric SHW equipment during peak energy and demand price periods
  - Average reduction in summer peak demand period is 1.7% for medium office and 10% for small hotel
  - Average annual electricity cost savings total 0.3% for medium office and 2.9% for small hotel
  - Measure cost savings are higher for building types with higher SHW loads

Metric		Units	Medium Office (53,600 sq. ft.)			Small Hotel (43,200 s	
			Min	Average	Max	Min	Avera
Demand	Max Demand	(W/sq.ft.)	2.13	2.67	3.10	1.87	2.63
	Peak Period Demand Reduction	(W/sq.ft.)	0.05	0.05	0.05	0.27	0.27
		(kW)	2.4	2.4	2.4	11.5	11.5
		(%)	1.5%	1.7%	2.1%	6%	10%
Cost	TOU Elec Cost	($/sq.ft. year)	0.68	0.82	0.96	0.53	0.60
	TOU Elec Savings	($/sq.ft. year)	0.003	0.003	0.003	0.017	0.01
		($/year)	157	157	157	756	756
		(%)	0.3%	0.4%	0.4%	2.6%	2.9%



Pacific Northwest NATIONAL LABORATORY

California Title 24 – Overview for DR Provisions

- 110.12 – Mandatory requirements for demand management
  - (a) OpenADR or other communication protocols
  - (b) Zonal HVAC Controls
  - (c) Lighting Controls
  - (d) Electronic Message Center Control
- Qualification Requirements
  - JA12 Battery Storage System
  - JA13 HPWH (citing ANSI/CTA–2045)
- Nonresidential ACM Reference Manual
  - Thermal energy storage

Washington State

RCW **19.260.080** Electric storage water heaters.

(1) An electric storage water heater, if manufactured on or after January 1, 2021, may not be installed, sold, or offered for sale, lease, or rent in the state unless it complies with the following design requirement:

(a) The product must have a modular demand response communications port compliant with: (i) The March 2018 version of the ANSI/CTA–2045-A communication interface standard, or equivalent and (ii) the March 2018 version of the ANSI/CTA-2045-A application layer requirements.

(b) ………..

(2)..........

(3).........

(4) An electric utility supplying electricity to a building in which an electric storage water heater that meets the design requirements established in this section has been installed may not, without first having obtained in writing the customer's affirmative consent to participating in a program that allows such alteration, alter, or require the utility customer to alter, the usage of electricity or water relating to the electric storage water heater on the basis of information collected by the electric storage water heater or any associated device.

Water Heater Communications:

ASHRAE 189.1; 2024 IECC; New York......

TABLE C404.10
DEMAND RESPONSIVE CONTROLS FOR WATER HEATING

Equipment Type	Controls	
	Manufactured before 7/1/2025	Manufactured on or after 7/1/2025
Electric storage water heaters	ANSI/CTA-2045-B Level 1 and also capable of initiating water heating to meet the temperature set point in response to a *demand response signal*.	ANSI/CTA-2045-B Level 2, except "Price Stream Communication" functionality as defined in the standard.

GEB Roadmap Recommendations

01

Determine aspects of demand flexibility that may be considered for codification.

02

Combine grid-interactive requirements and open standards for automated communication with EE requirements.

03

Provide technical assistance to government entities and professional organizations responsible for codes and standards development.

nbi new buildings institute

Summary and Conclusions

- Least-cost path to clean energy integration into U.S. grid can be supported by both **efficiency** AND **demand flex** in buildings
- Communications: We need to drive much more widespread adoption of standardized, smart **HVAC** and **Water Heating** ("80/20")
- Demand Flexibility: Start with **simple systems** that work
- **Building and appliance regulation** drives greater penetration of grid flexibility in both new construction and existing stock
- Early code implementation is focused on communications and demand flexibility capacity

Thank you!

Jim Edelson
jim@newbuildings.org

Alexi Miller

alexi@newbuildings.org

nbi new buildings institute

www.newbuildings.org

Toyota Motor Sales South Campus | Irvine, CA
Credit: LPA Design Studios

NASEO-NARUC Grid-Interactive Efficient Buildings Working Group

Questions:

- How might your state consider using the **ASHRAE Grid-interactive Buildings for Decarbonization: Design and Operation Resource Guide**?
  - To help guide policy and program prioritization?
  - To guide project teams on best practices in state buildings? Public buildings?
- How might your state use of ratings and metrics such as GridOptimal?
  - Encourage use? Require calculation? Require performance thresholds for Grid Peak Contribution or Demand Flexibility?
    - For state buildings? Public buildings? Incentive programs?
- Is your state or are localities in your state considering setting of requirements for grid integration / demand flexibility capabilities in—
  - Public buildings?
  - Construction Codes? Appliance Standards? Building performance standards?
- Is there a greater need for coordination between electricity regulators and building code development to optimize demand flexibility?