ENERGY CODES 2024

May 6-8, 2024 | Sacramento, CA

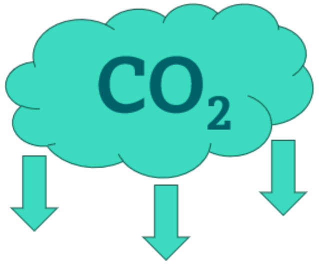
2024 NATIONAL ENERGY CODES CONFERENCE

HOSTED BY THE U.S. DEPARTMENT OF ENERGY

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

Building Energy Codes

Grid Edge Modernization and the Energy Code: How Codes Can Support a Transition to a Clean and Resilient Grid



The Big Picture

Randall Higa, PE, LEED BD+C
Southern California Edison
May 7, 2024

SOUTHERN CALIFORNIA EDISON

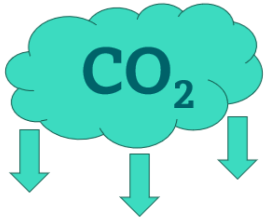
Agenda

- What is a clean and resilient grid?
- Why do we need to transition to it?
- Why should buildings support the grid?
- How can buildings support the grid?
- How is the grid transitioning?
- What is the role of codes?
- What is the role of SCE?

What is a Clean and Resilient Electric Grid?

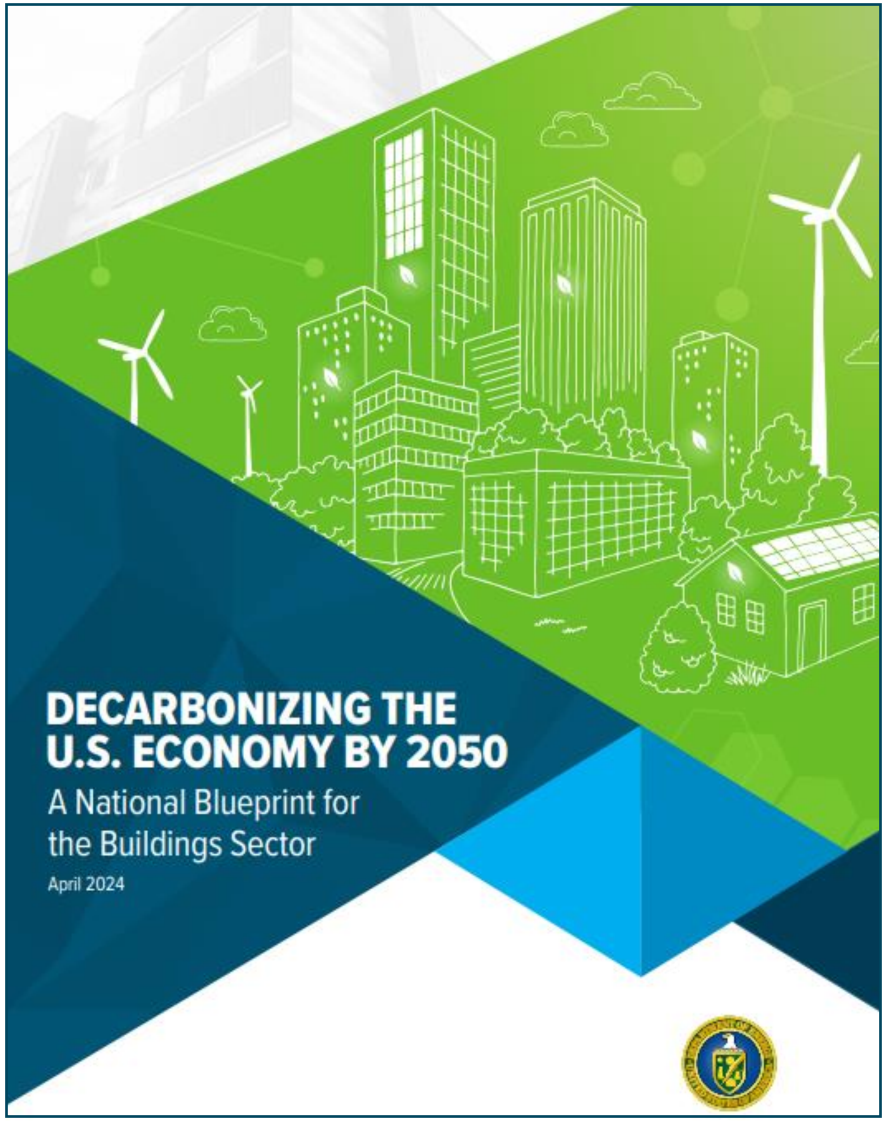
- Renewable and clean generation resources
- Storage
- Smart
- Reliable
- Safe
- Minimal environmental impact
- Supported by behind-the-meter DERs (Distributed Energy Resources)
- 2-way flow of power

Why a Clean and Resilient Electric Grid?



- Reduce the *causes* of climate change by reducing GHG emissions
- Defend against the *impacts* of climate change such as wildfires, sea level rise, extreme weather, etc.
- Reduce criteria pollutants to allow for clean breathable and healthy air
- Provide reliable power to buildings to keep them safe from the effects of climate change

Why Should Buildings Support the Grid?



Building upgrades **improve lives** by increasing high-quality jobs, economic security, equity, health, and community resilience

Enable fast, secure, and interactive distributed energy resources like EVs, onsite generation, and storage

Why Should Buildings Support the Grid?

Reduce U.S. building emissions 65% by 2035 and 90% by 2050 vs. 2005 while enabling net-zero emissions economy wide and centering equity and benefits to communities

CROSS-CUTTING GOALS

Equity – Advance energy justice and benefits to disadvantaged communities

Affordability – Reduce energy burden and technology costs so all can benefit

Resilience – Increase the ability of communities to withstand and recover from stresses

STRATEGIC OBJECTIVES

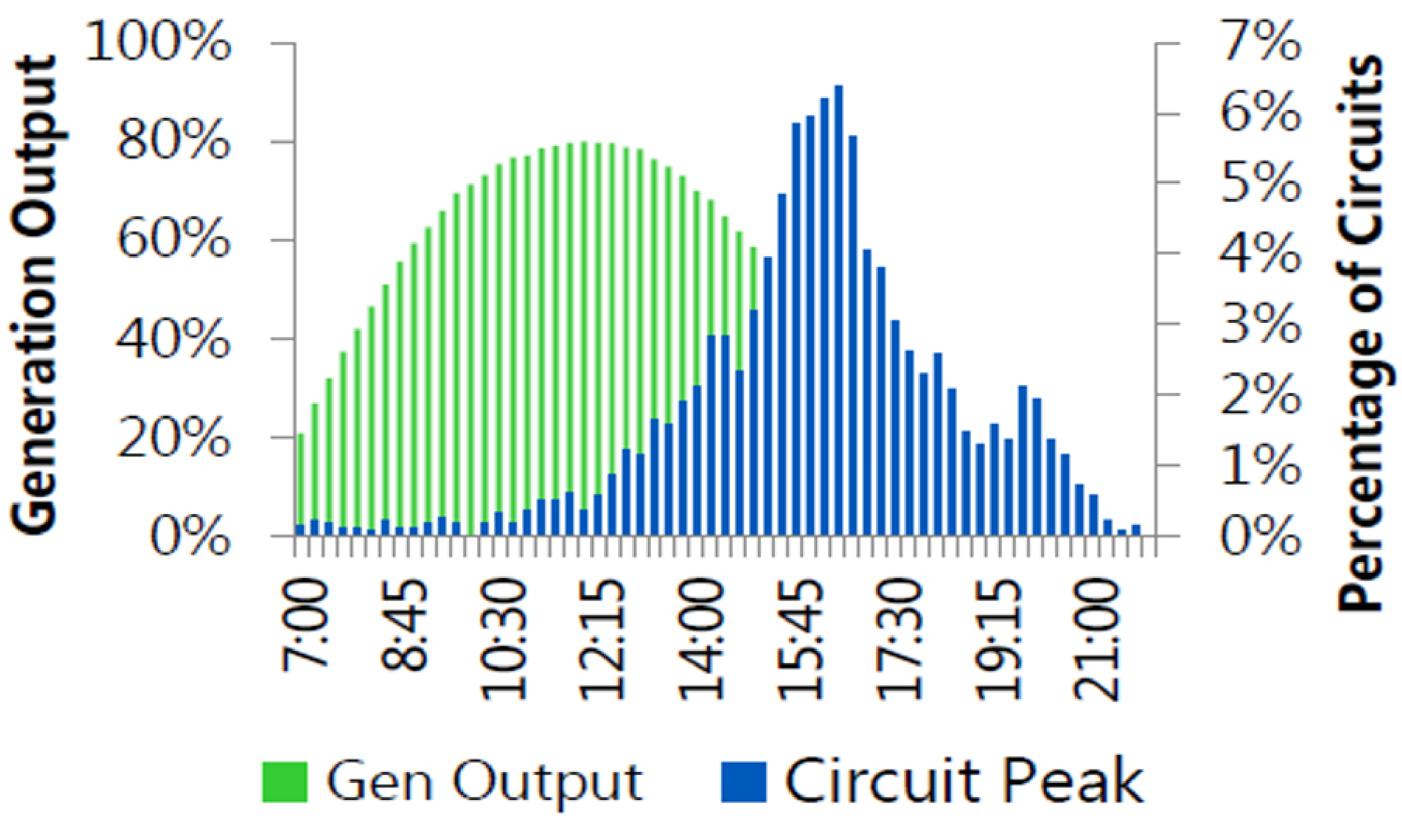
Increase building energy efficiency
Reduce on-site energy use intensity in buildings 35% by 2035 and 50% by 2050 vs. 2005

Accelerate on-site emissions reductions
Reduce on-site 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

Why Should Buildings Support the Grid?

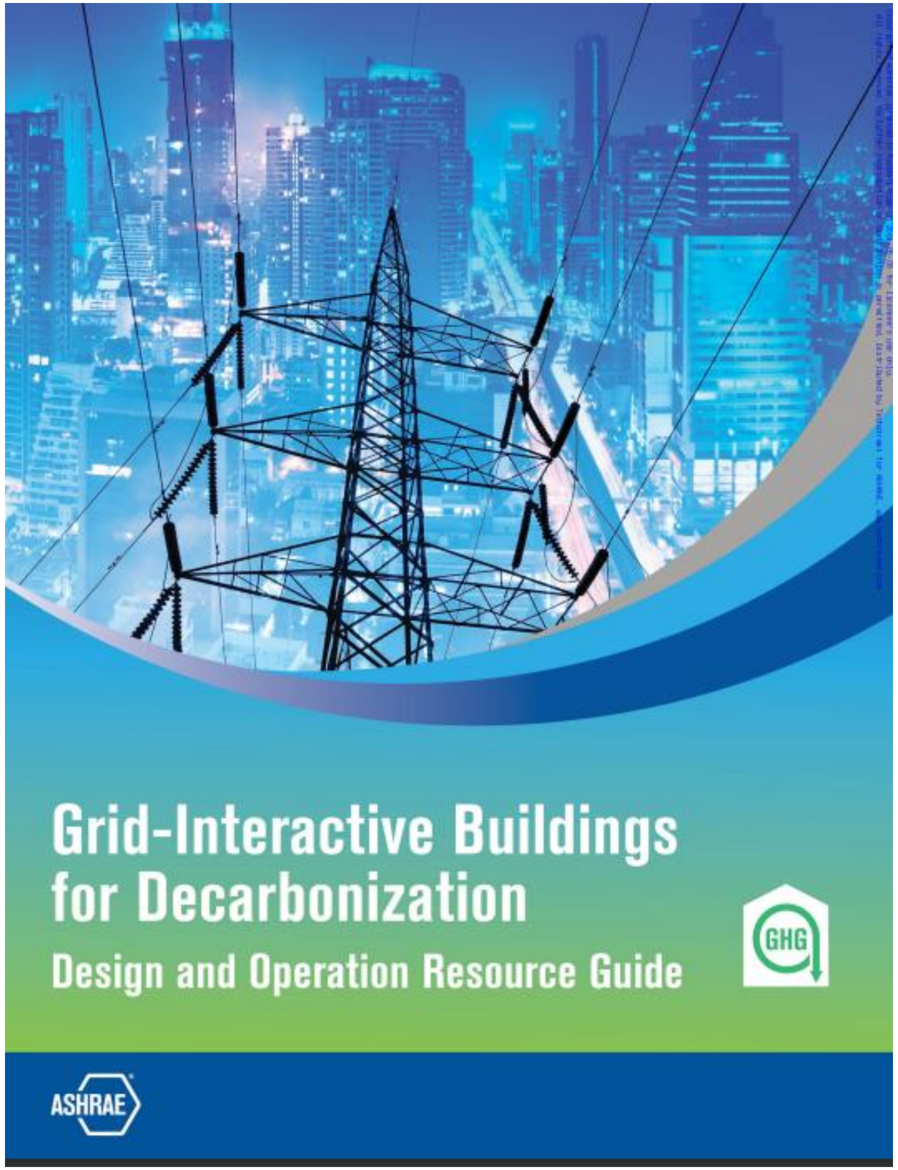


Peak time for distribution circuit load and PV do not typically coincide

The grid needs to accommodate this available power for the benefit of the customer and the grid

Jordan Wirfs-Brock | Inside Energy

How Can Buildings Support the Grid?



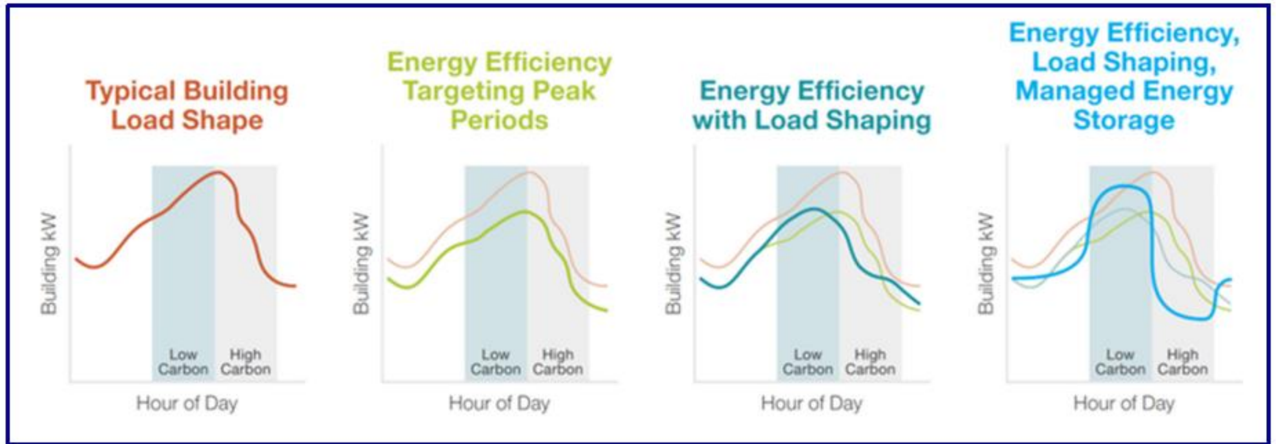


Figure 2.1 Daily load profile impacts of various levels of grid-interactive building design and operation.

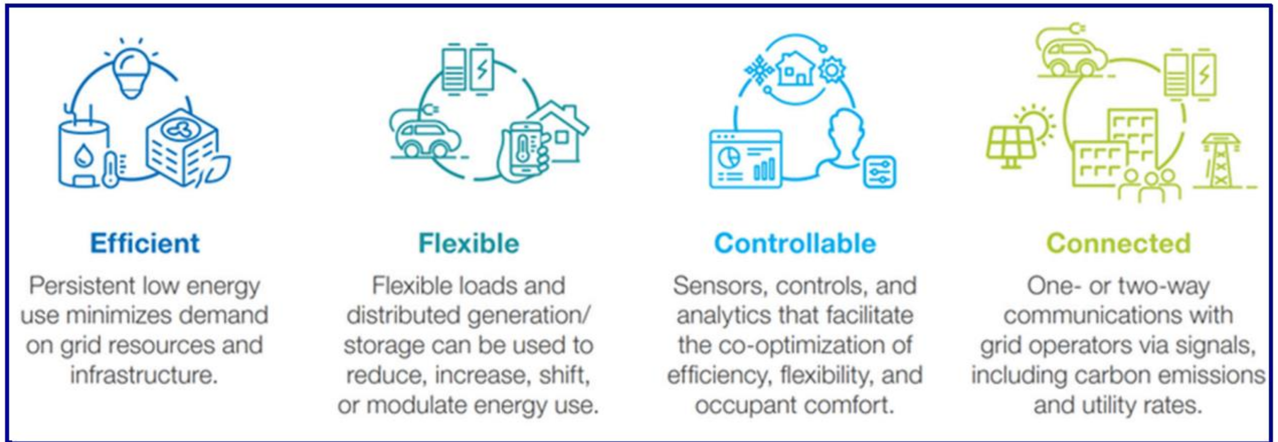
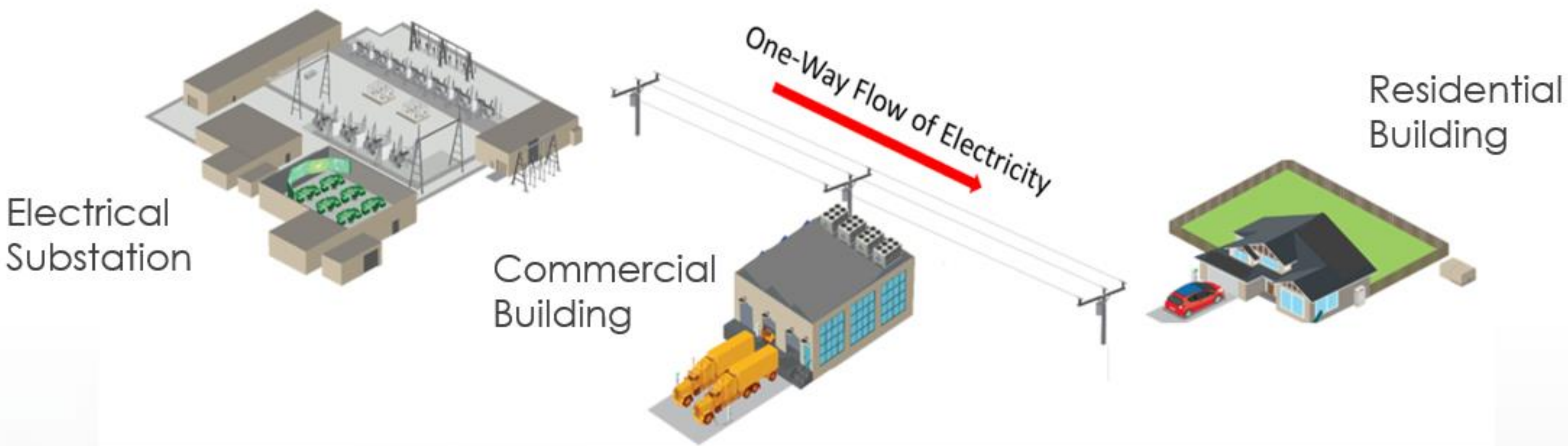


Figure 3.1 Key characteristics of a grid-interactive building.

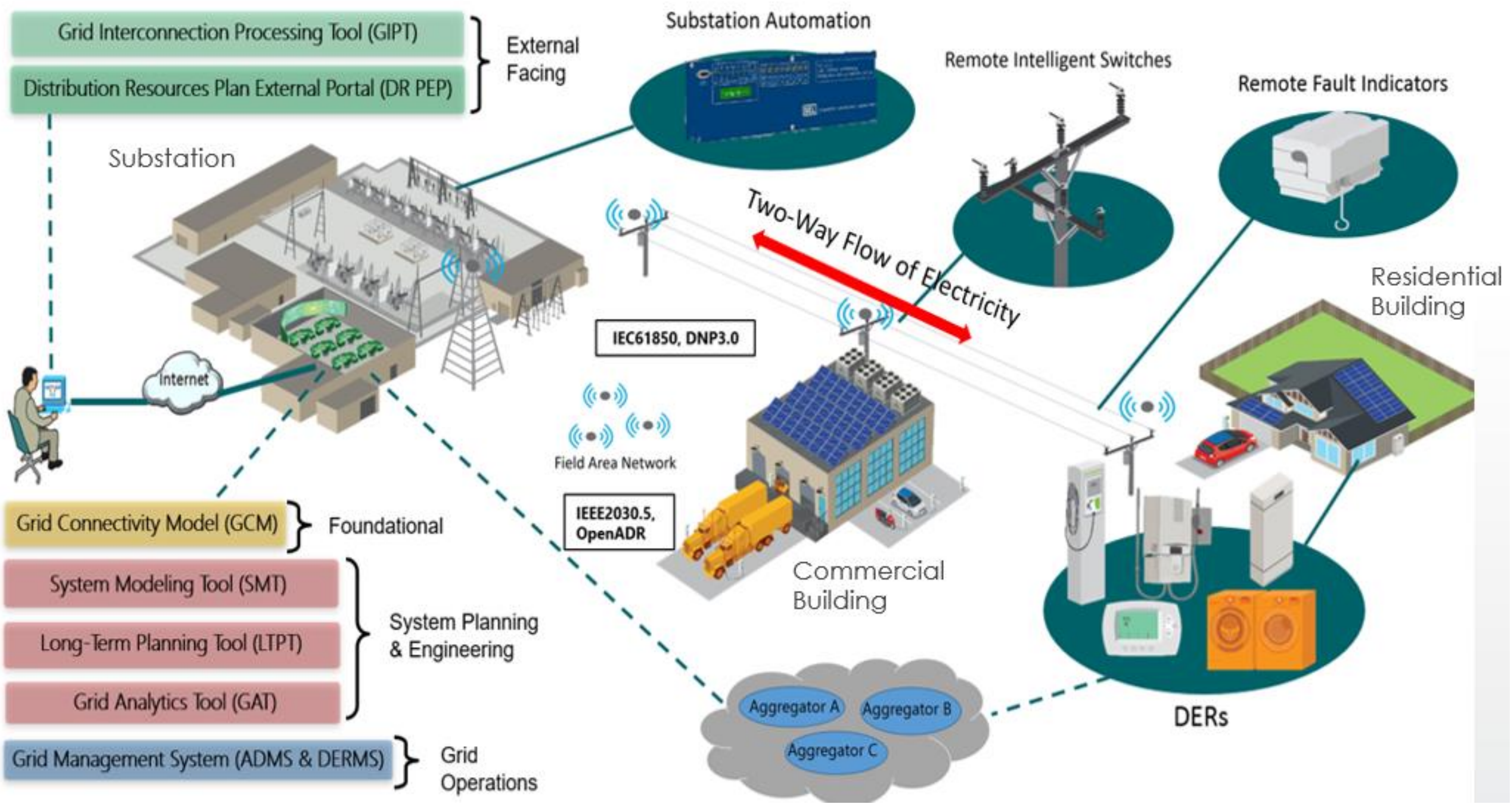
How is the Grid Transitioning?

"Traditional" Electric Grid Intersection with Buildings



How is the Grid Transitioning?

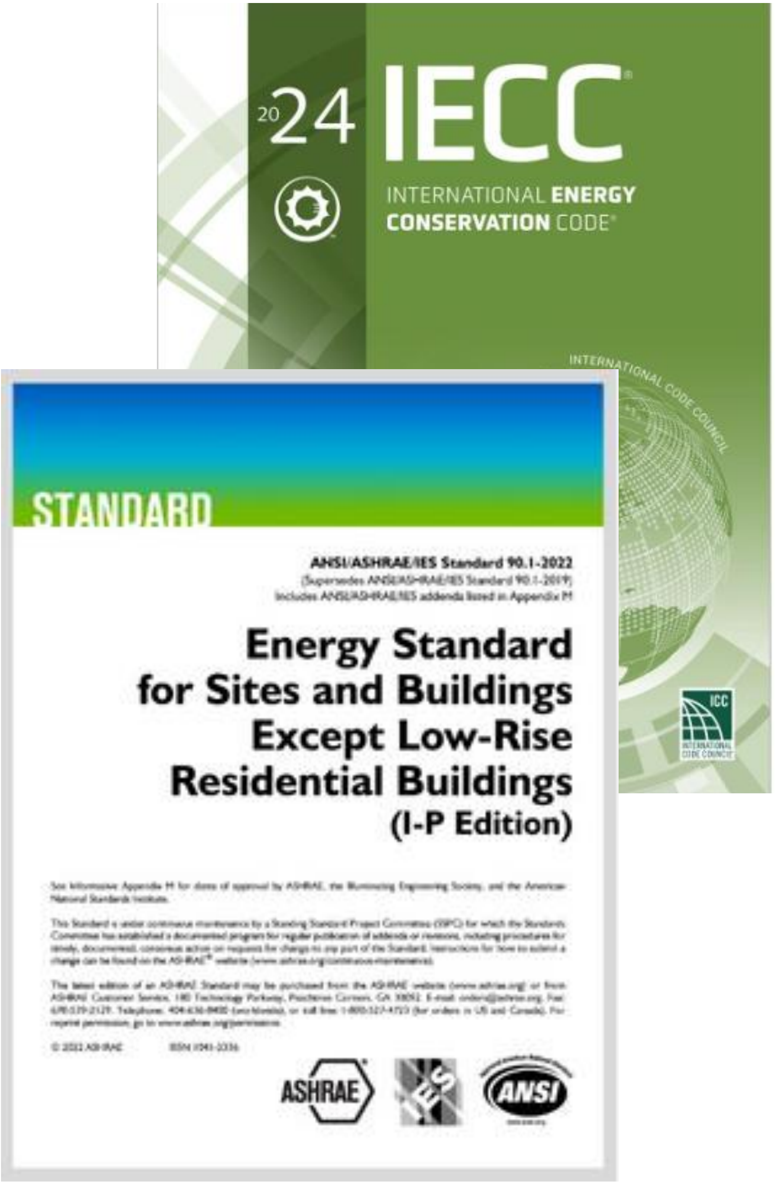
Future Electric Grid Intersection with Buildings with Distribution Energy Resources (DERs)



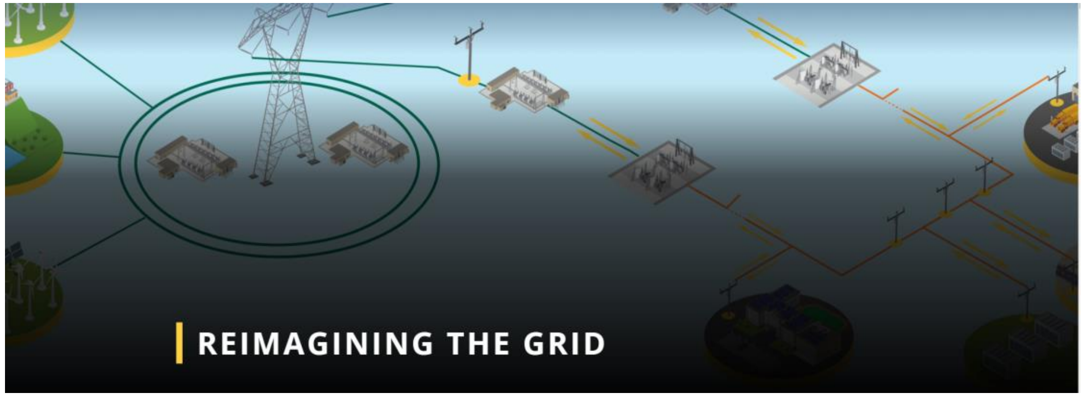
What is the Role of Codes?

- Building energy codes purpose and scope are expanding beyond "traditional" energy efficiency to address CO_2 reduction and facilitate the grid's transition
- To achieve this, building codes need to include,
  - On-site generation,
  - Energy storage,
  - Load shifting/reduction capabilities

  That can be optimally controlled in communication with the grid, energy pricing signals, and carbon emission levels



What is the Role of SCE?



Reimagining the Grid

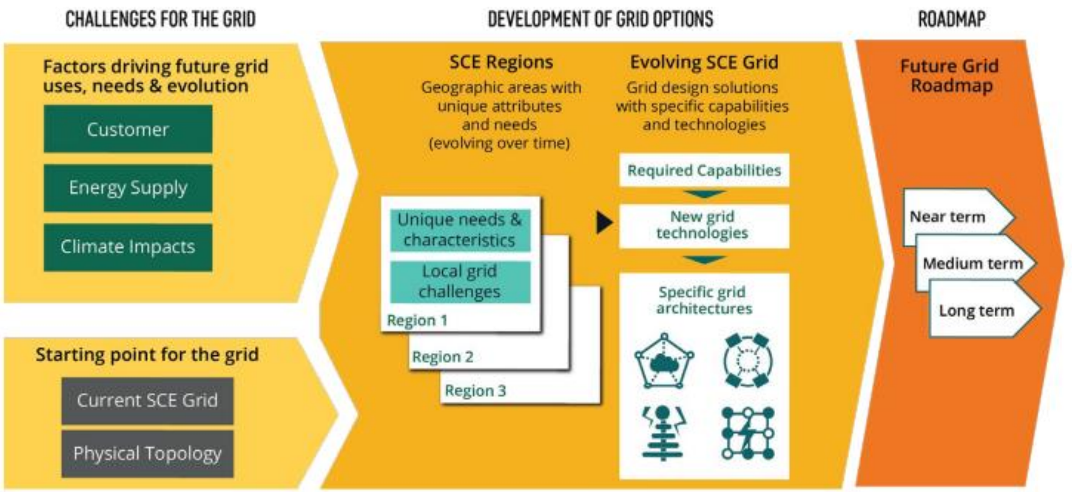
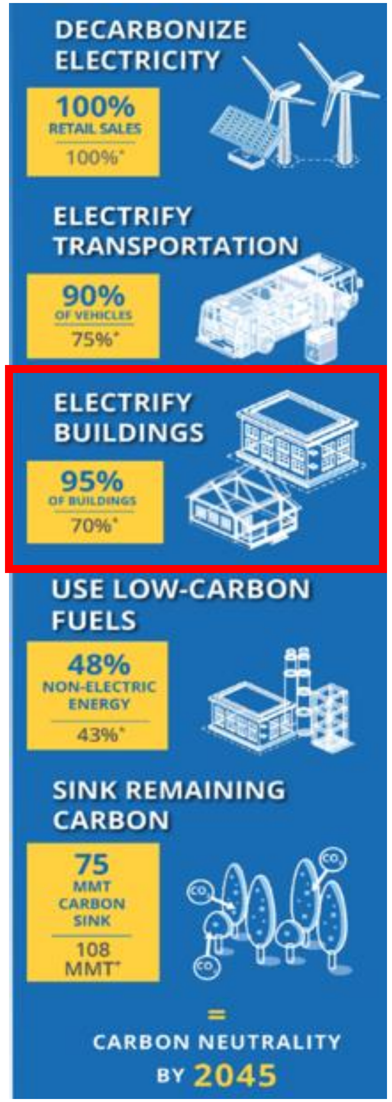
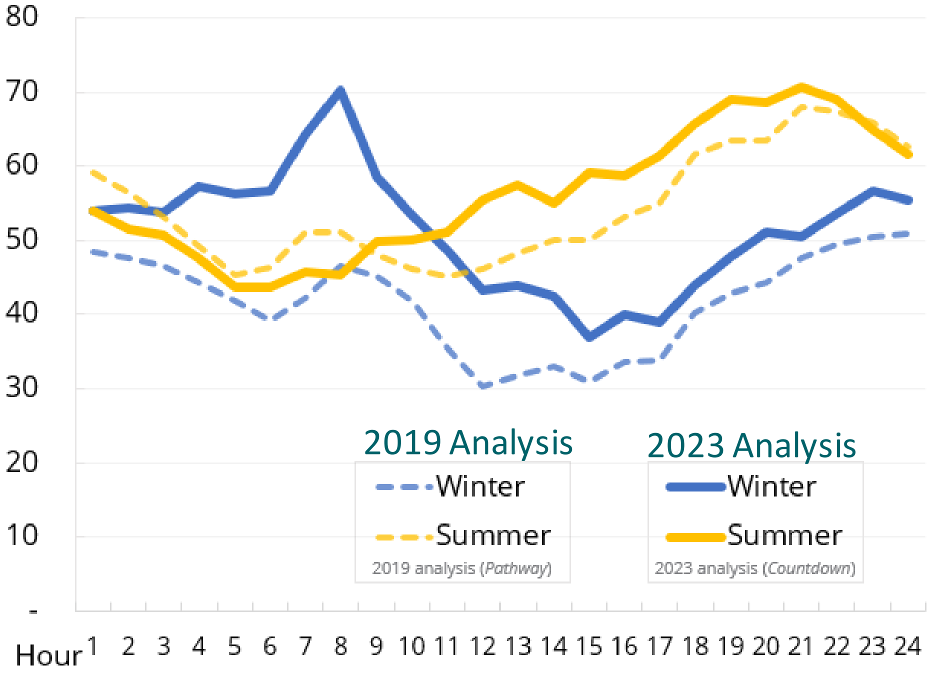


Figure 2: Overview of SCE's Reimagining the Grid methodology



2045 CAISO peak load day forecast, gigawatts (GW)



What is the Role of SCE?

Fontana Meritage ZNE Homes

- Project location 60 miles east of Los Angeles
- CEC Climate Zone 10 (3B -- warm and dry)
- Annual peak temperatures ~114.8, Winter Design: 31 degrees
- Electric space and water heating
- Average PV size at 4 kW
- 9 homes on 1 transformer (T1) w/ 6.5 kW battery storage

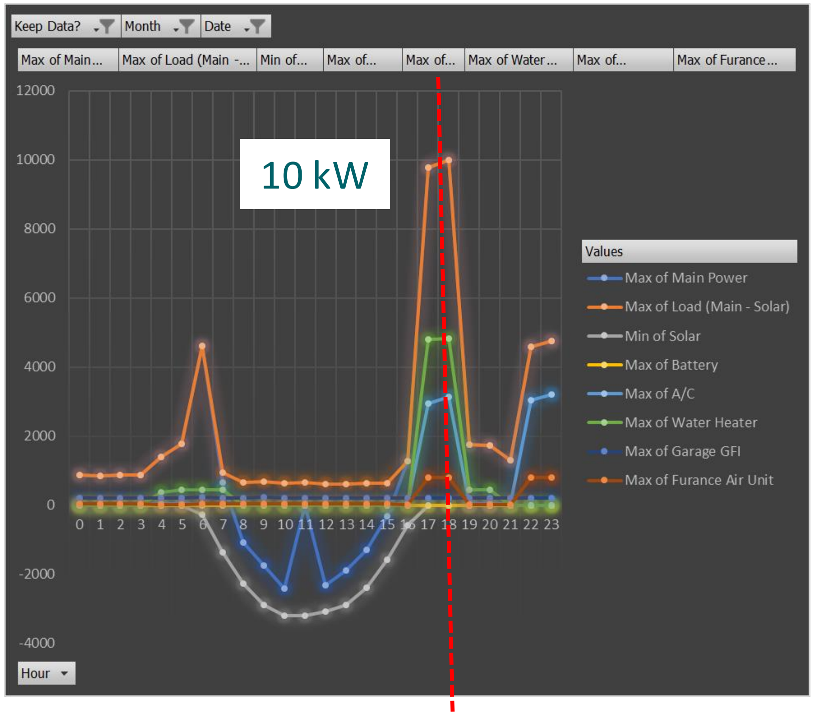
Control Group: 11 homes w/ partial solar, no storage, mixed-fuel

What is the Role of SCE?

Transformer Level Analysis

Key research questions: peak demand, demand factor, coincident factor of homes with electric space and water heating

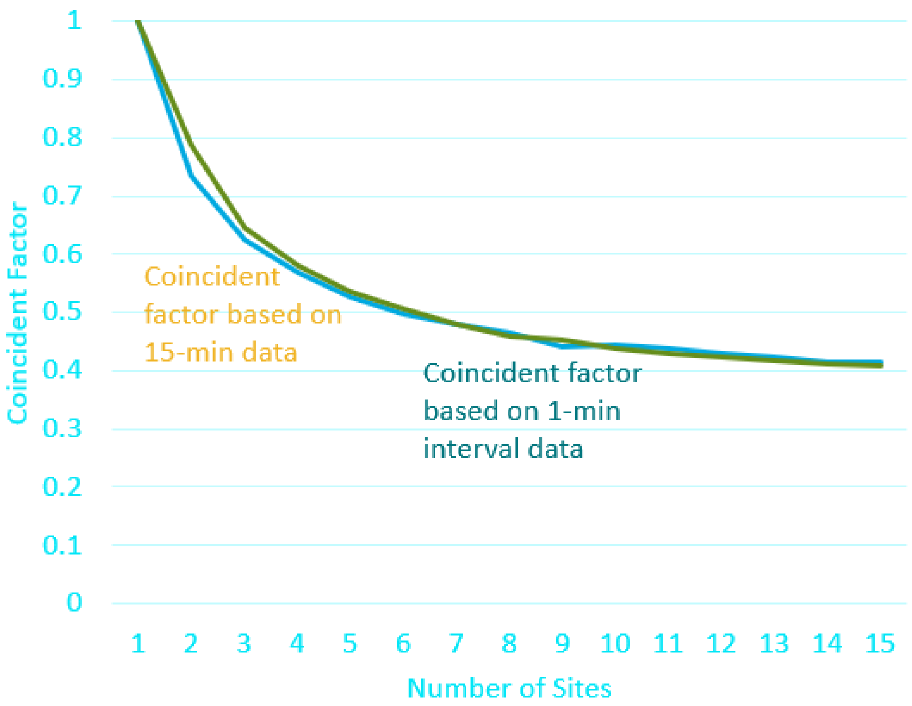
Demand Factor Analysis



Individual home exhibits **high** peak demand

What / When is the peak?
What is contributing to the peak?

Coincident Factor Analysis



What is the diversity factor among multiple customers?

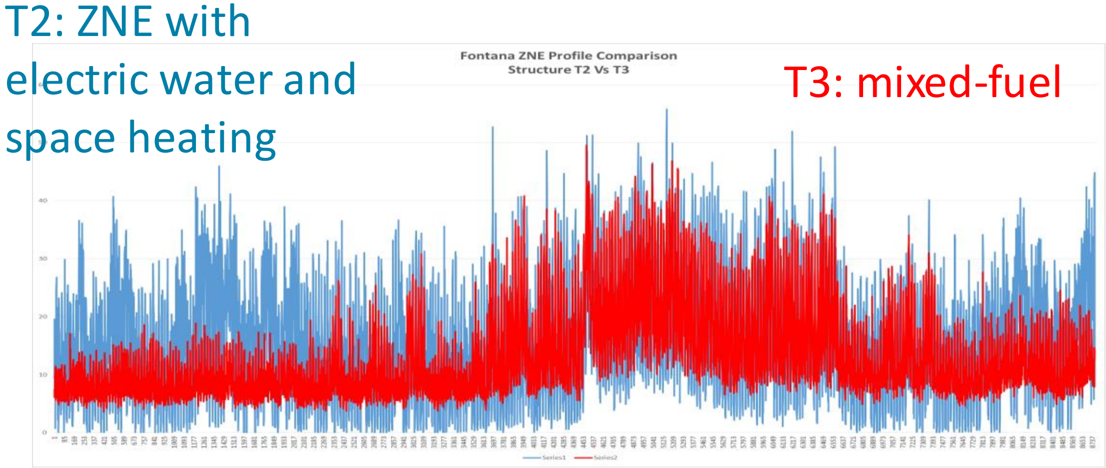
- Weather-driven loads have high coincidence, dominating community-level / transformer-level peaks
  - HVAC in the summer
  - Water heater in the winter
- PV creates equal or slightly larger negative peaks at the transformer-level

What is the Role of SCE?

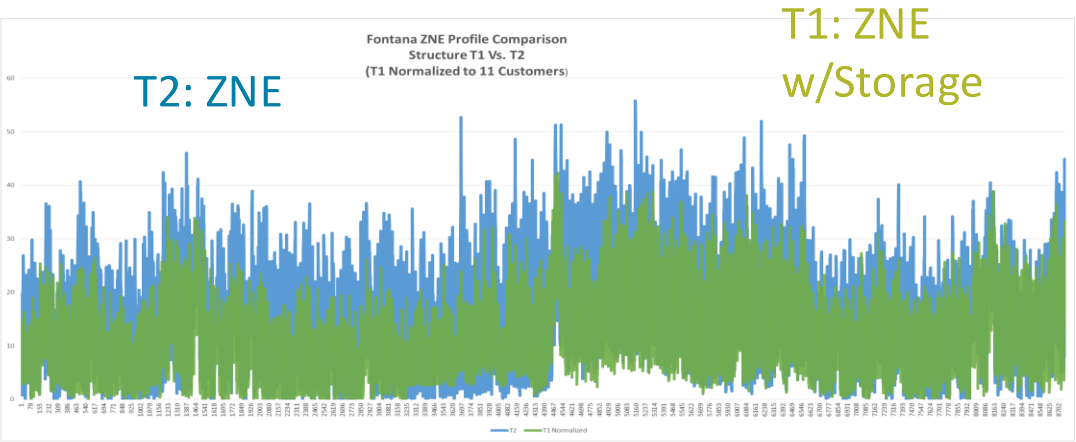
Transformer Level Analysis

Similar transformer level peaks when compared with the ones with mixed-fuel homes

- The transformer level peak demand with partial/all-electric is **comparable to** the ones with mixed-fuel but shows higher winter demand, and hence better utilization of grid assets.
- The transformer for homes with battery storage shows **lower** demand than the one without



8760 Fontana transformer load profiles



8760 Fontana transformer load profiles

Thank you!

Randall Higa, PE, LEED BD+C
Southern California Edison
randall.higa@sce.com

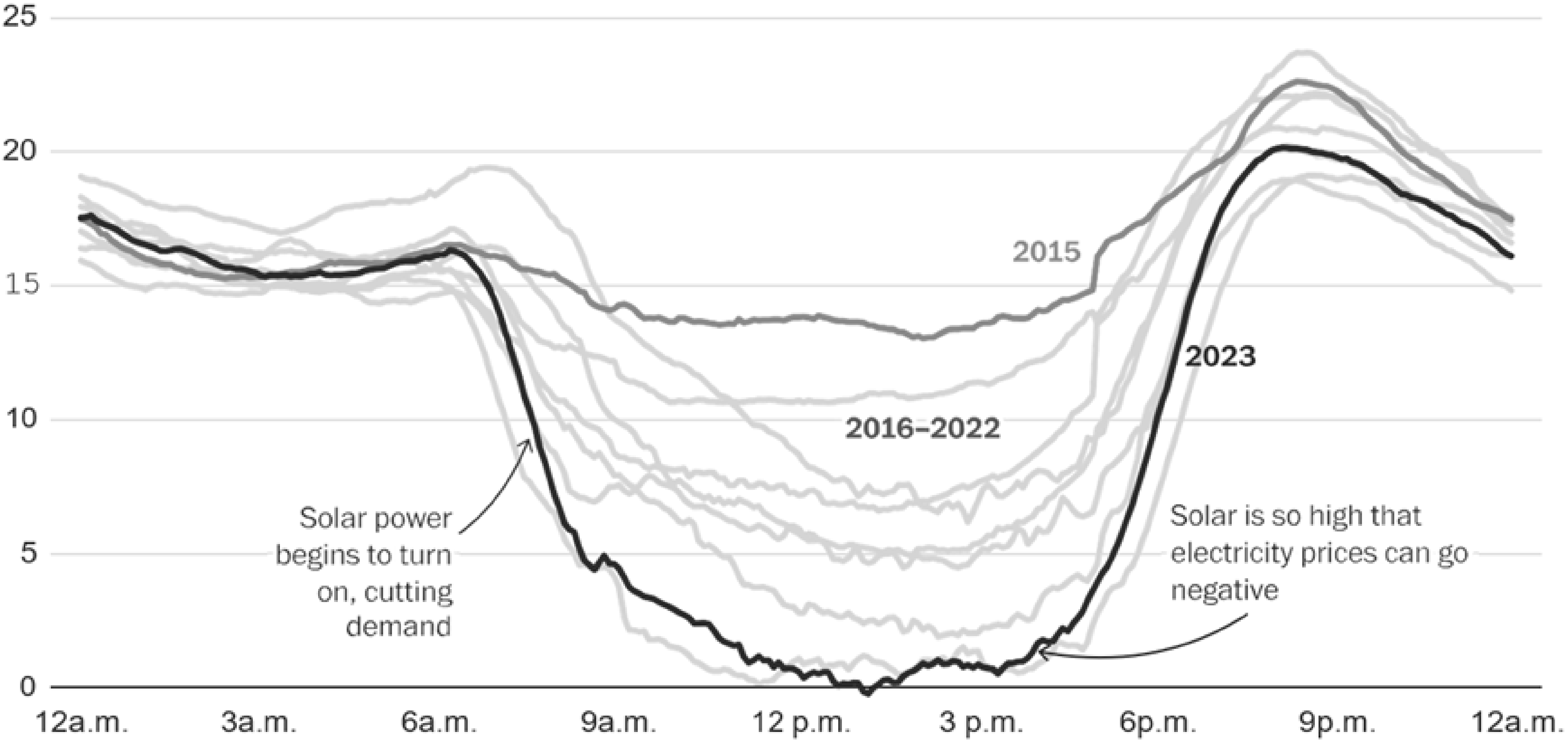
California Energy Commission

May 7, 2024

Presented by: Scott Blunk

In California, ample solar power floods the grid in the middle of the day

Net load (electricity demand minus solar and wind) on the grid, in gigawatts



Data is for the lowest net load day in the spring (between March and May) each year.

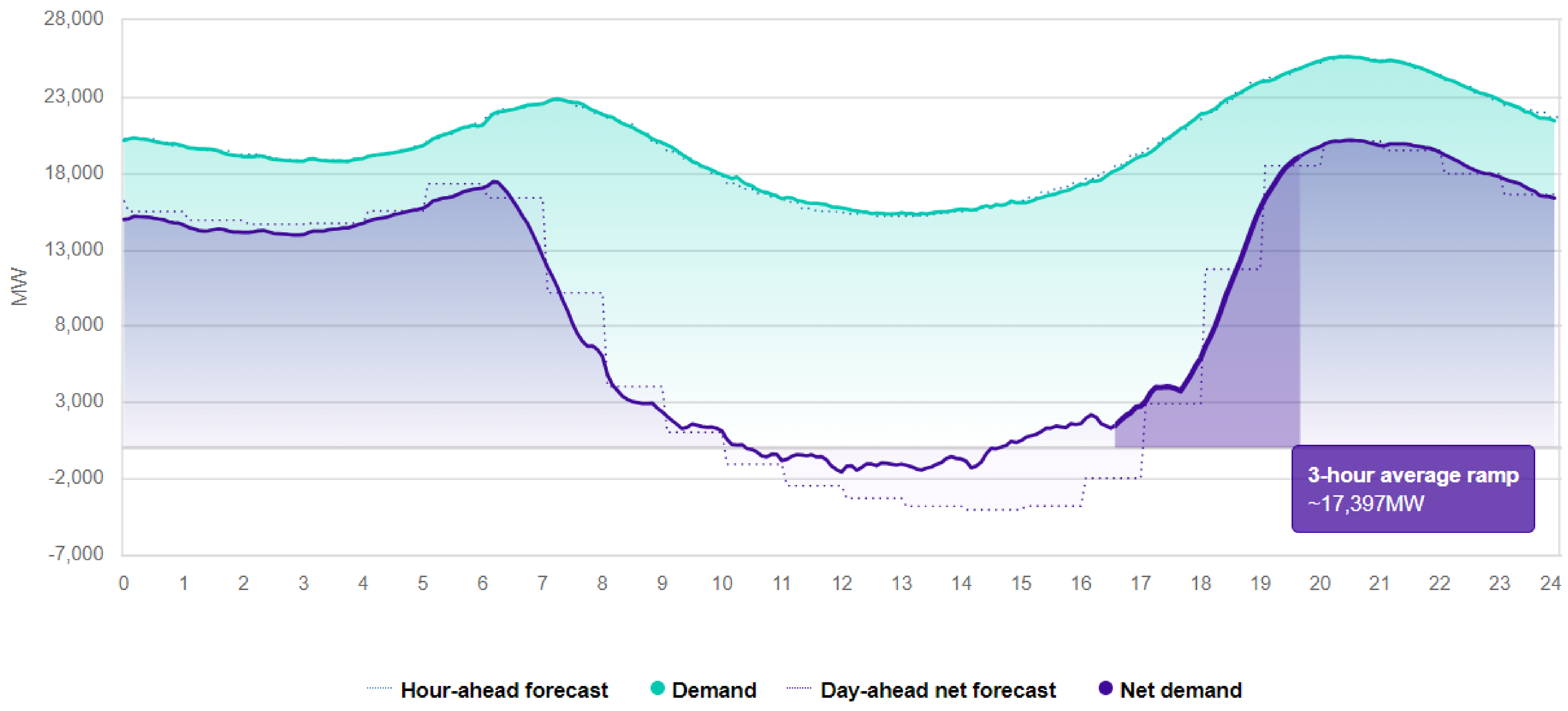
Source: Energy Information Administration, California Independent System Operator

SHANNON OSAKA/ THE WASHINGTON POST

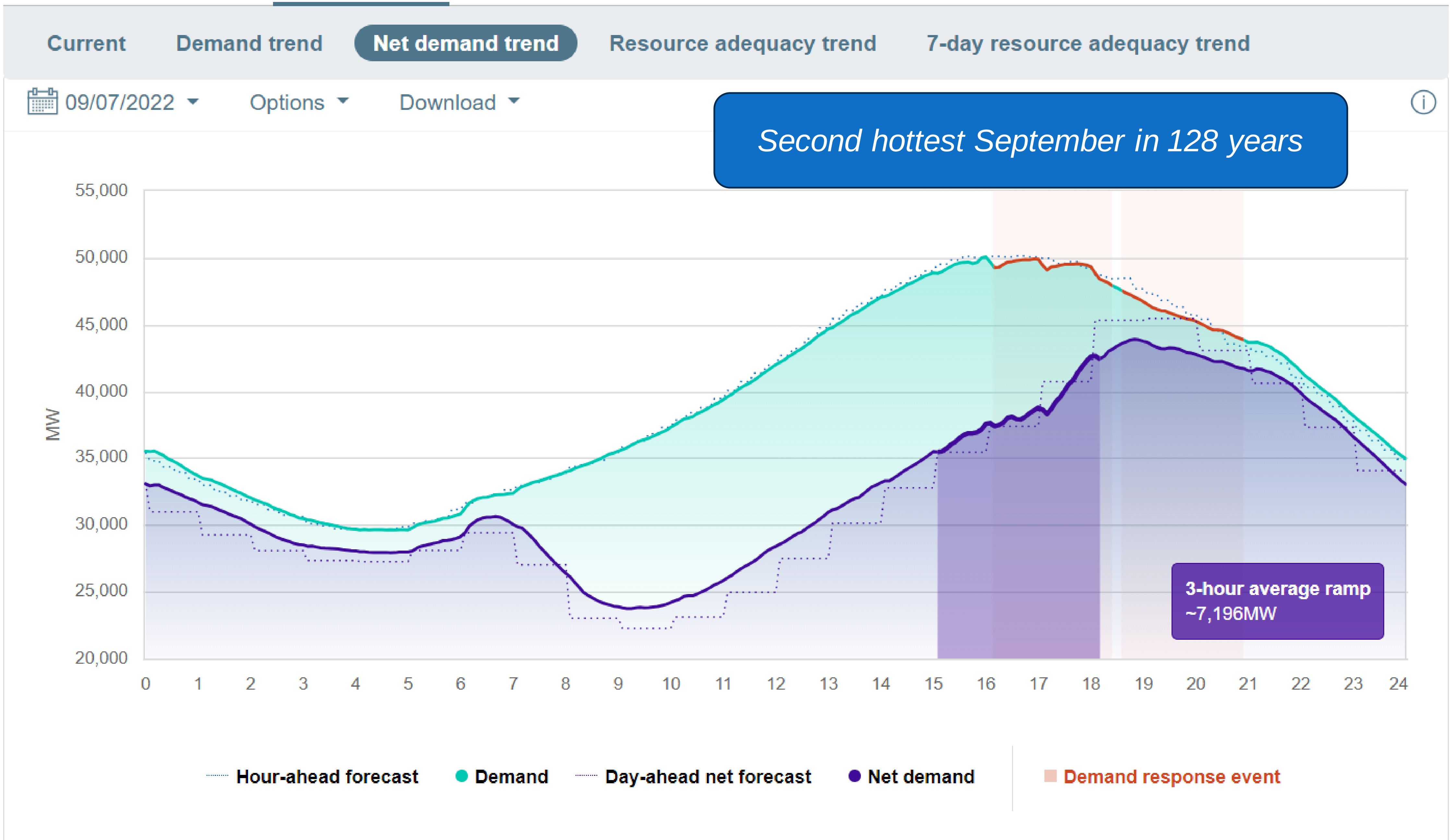
Current | Demand trend | **Net demand trend** | Resource adequacy trend | 7-day resource adequacy trend

05/06/2024 | Options | Download

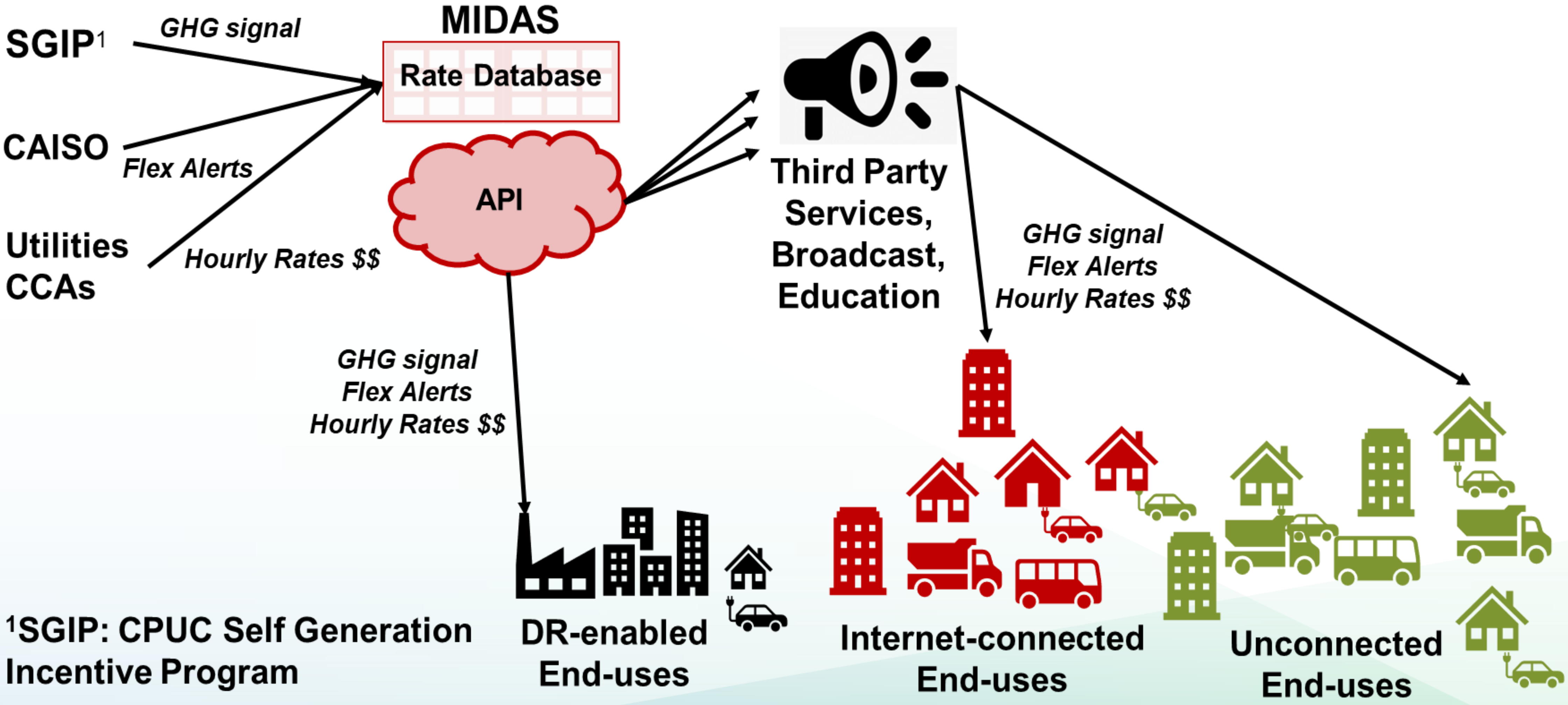
Yesterday



Second hottest September in 128 years



Load Flexibility Ecosystem



[1]SGIP: CPUC Self Generation Incentive Program

Load Management Standards

Benefits

- Enhanced Grid reliability
- Reduced electricity cost
- Increased Customer choice
- Reduced GHG emissions

Regulated Parties

- Large IOUs
- Large POUs
- Large CCAs

Authority: Warren-Alquist Act (1974)

- PRC §25403.5

Rulemaking for Updated Standards

- Adopted October 2022
- Effective April 2023

Compliance Timeline & Milestones

- 2025 - utilities apply for marginal cost rates that vary hourly
- 2026-2027 - rates are available for customers to opt-in

Load Flexibility Resource Target

Table ES-1: Proposed Statewide Load-Shift Goal

2022 Load Shift Estimate	2030 Load-Shift Goal	2030 Goal (Incremental)
3,100–3,600 MW	7,000 MW	3,400–3,900 MW

Megawatts shown are measured at the customer meter.
Source: CEC staff

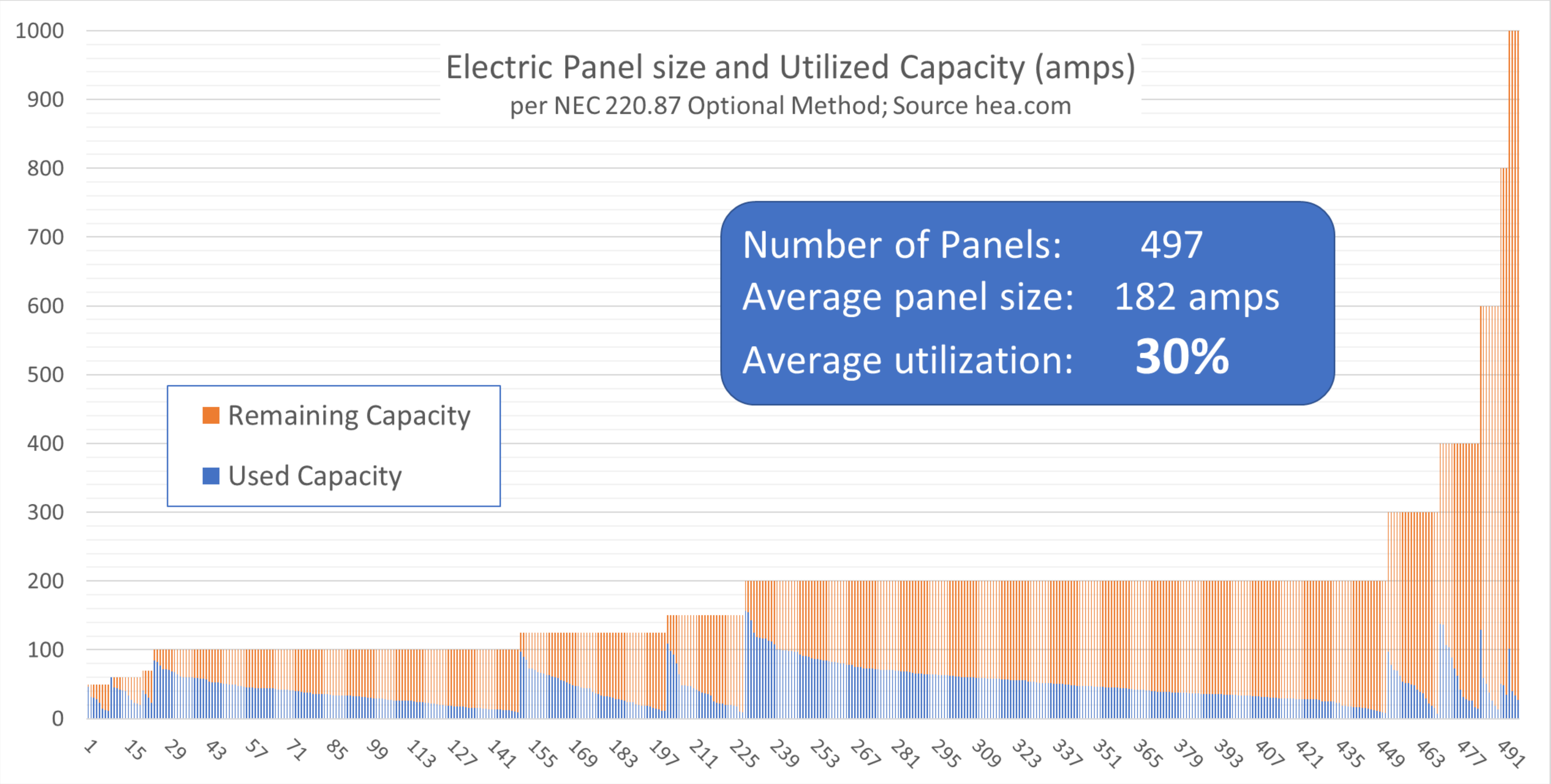
	Pool Controls during 7:00 p.m. hour	Electric Storage Water Heater 8:00 p.m. hour	Low-Voltage Thermostat 8:00 p.m. hour	Dishwashers During the 7:00 p.m. hour	Electric Clothes Dryer during 7:00 p.m. hour
Load Shift Potential (MW)	564	301	989	339	376

FDAS Current Staff Proposals Total Load Shift Potential: 2,560 MW

MIDAS Data

Data Source	Data Type	Update Frequency	Availability
Large IOUs, POUs, and CCAs	Bundled All-in Prices and Generation Prices	Hourly	Available
Large IOUs	Unbundled Delivery Prices	Hourly	Available
CAISO	Flex Alert	5 minute	Available
	Energy Emergency Alert (Watch, 1-3)	5 minute	In process
	Restricted Maintenance	5 minute	In process
	Transmission Emergency	5 minute	In process
WattTime (SGIP)	Marginal GHG Emissions (Regional)	5 minute	Available
	Marginal GHG Emissions (Statewide)	5 minute	In process

Distribution Upgrades



Electric Panel size and Utilized Capacity (amps)
per NEC 220.87 Optional Method; Source hea.com
Number of Panels: 497
Average panel size: 182 amps
Average utilization: 30%
Remaining Capacity
Used Capacity
1000
900
800
700
600
500
400
300
200
100
0
1 15 29 43 57 71 85 99 113 127 141 155 169 183 197 211 225 239 253 267 281 295 309 323 337 351 365 379 393 407 421 435 449 463 477 491

Questions?

Scott Blunk
scott.blunk@energy.ca.gov

Electrical Load Management Strategies in Commercial Energy Codes

Michael Tillou, PE

May 7th, 2024

PNNL is operated by Battelle for the U.S. Department of Energy

Pacific Northwest
NATIONAL LABORATORY

DOE Building Energy Code Program (BECP)

Development

- ASHRAE Standard 90.1
- International Energy Conservation Code (IECC)
- DOE Determinations on code energy savings

Model Energy Codes

Implementation

- State technical assistance
- State-specific energy, cost and benefit analyses
- Compliance software tools & resources
- User Support
- Trainings
- Field study guideline and methodology

COMcheck REScheck

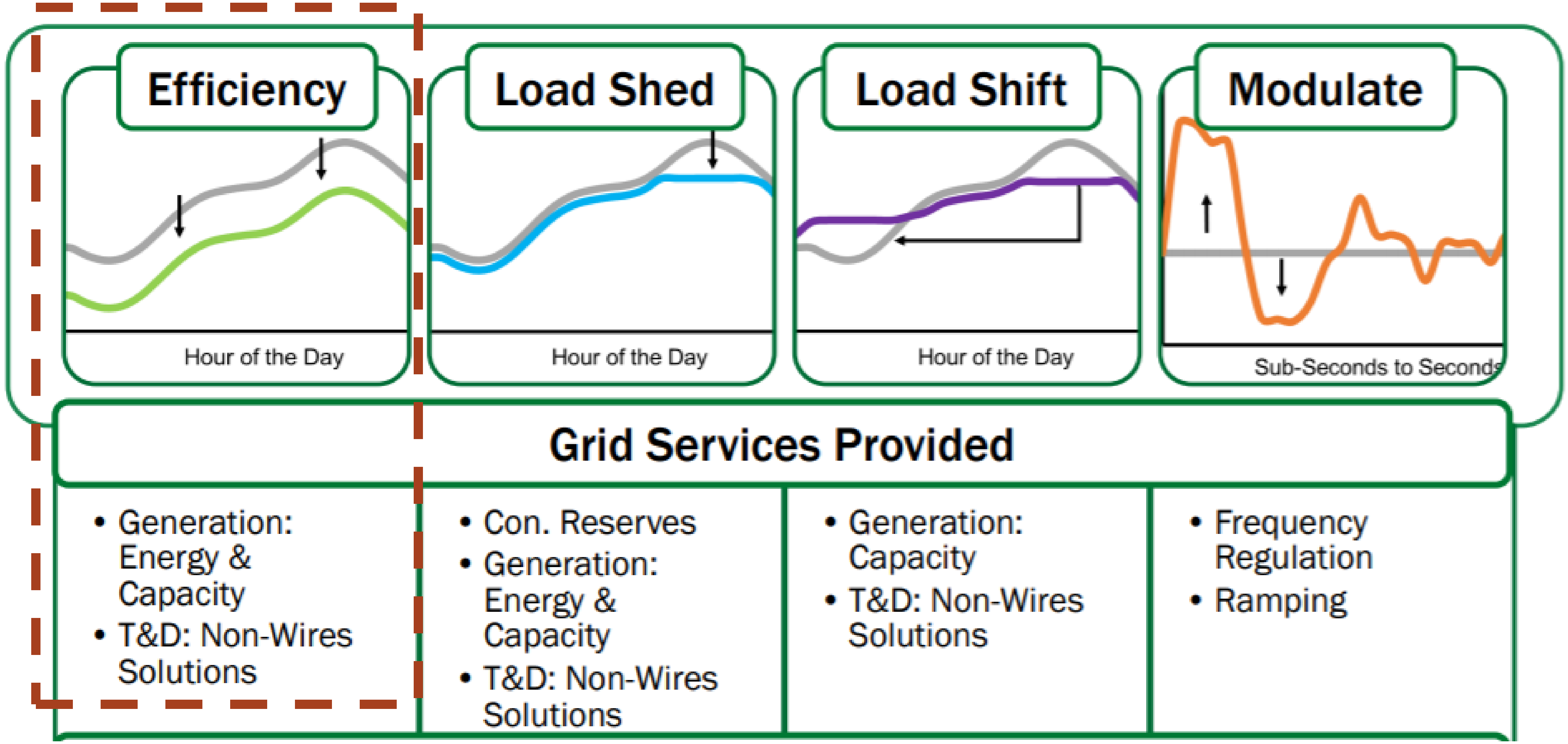
DOE BECP Advancing Energy Codes
With Code Change Proposals and Informative Technical Briefs

Topic	Description
Load Management	Informative analysis to encourage states to incentivize or establish code requirements for load management measures
Energy Credits	Code language for additional energy efficiency and grid-interactivity measures that go beyond the prescriptive code
Demand Response	Code language for thermostats and water heaters requirements to include demand response capability
PV Required	Code language for on-site solar photovoltaic requirements
EV Charging	Code language for requirements for electric vehicle installed, ready, and/or capable infrastructure
Electric Readiness	Code language for requirements electric outlets installed near fossil fuel water heaters, dryers, and cooking equipment
Zero Emissions	Optional residential and commercial code language for a performance-based path to achieve zero emissions

Cost Effectiveness Considerations in Energy Code Development and Compliance Demonstration

Grid-Interactive Efficient Buildings (GEBs) can provide added value beyond efficiency

The development of energy codes has historically focused on efficiency impacts with cost effectiveness based on a flat $/kWh cost



Source: DOE BTO 2019 PEER Review, Grid-Interactive Efficient Buildings Portfolio (Lighting GEB Technical Report)

Load Management Strategies in Energy Codes

Load Management measures are included with Energy Efficiency and Renewable measures as part of the comprehensive suite of credit measures introduced into both ASHRAE 90.1-2022 and the Commercial IECC 2024.

G01: Lighting load management – 20% light dimming during peak periods

G02: HVAC load management - reset thermostat setpoints during peak periods

G03: Automated shading - reduce SHGC by 50% during peak periods

G04: Electric energy storage – install a minimum of 1.5Wh/ft2 electric storage capacity

G05: Cooling energy storage – install a minimum of 0.5 ton-hours per design day ton

G06: SHW energy storage – preheat SHW prior to peak and suspend heating during peak period

G07: Building thermal mass – provide additional passive interior mass and night flush control of the HVAC systems

Load Management Strategies in Energy Codes

ASHRAE 90.1-2022 requires a total of 46-50 Energy, Renewable and Load Management credits (based on occupancy and climate zone). No more than 60% of credits can be from Renewable and Load Management credits.

IECC 2024 has separate requirements for Energy and Renewable/Load Management credits.

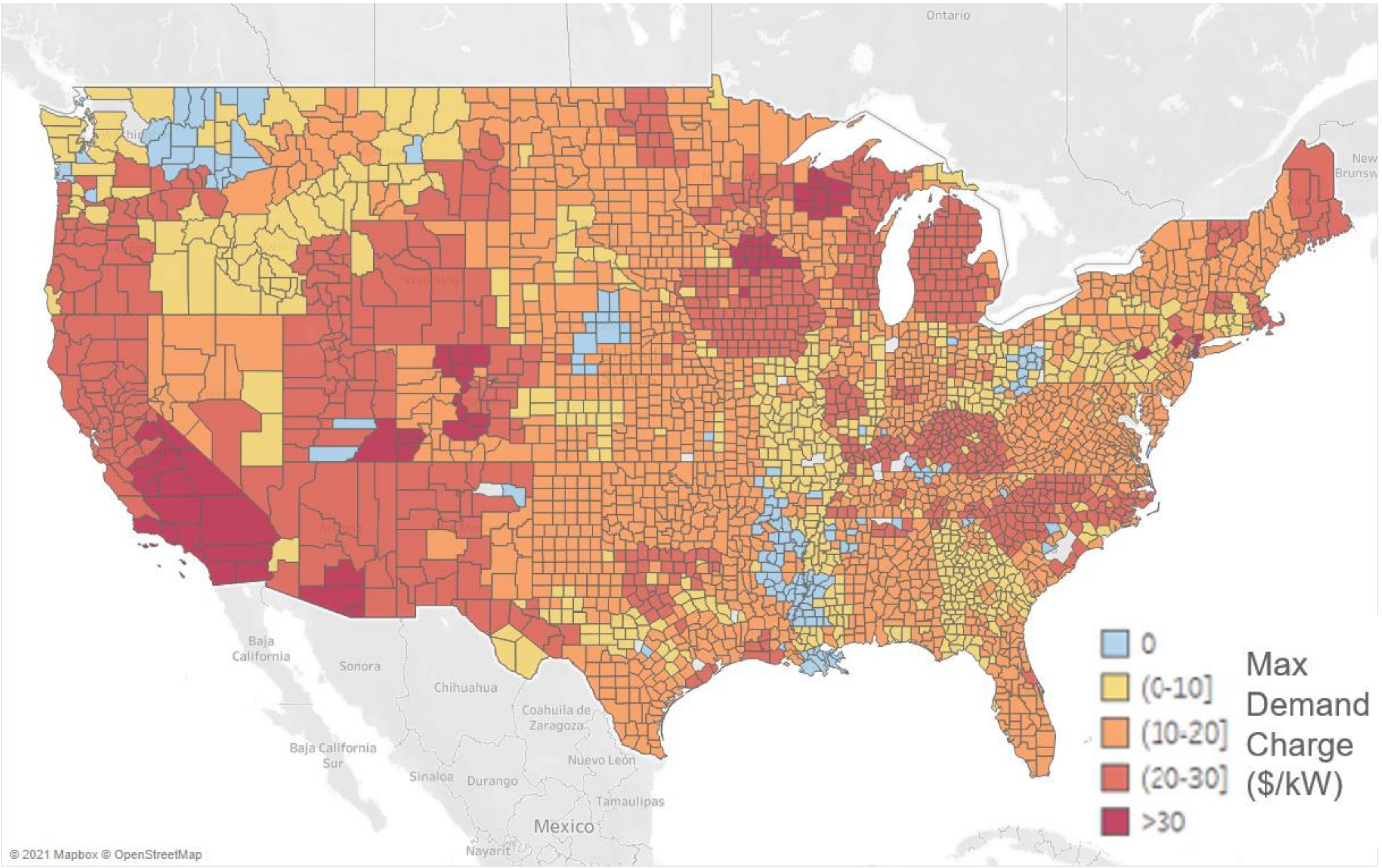
IECC 2024 Renewable and Load Management Credit Requirements by Building Occupancy

BUILDING OCCUPANCY GROUP	CLIMATE ZONE																		
	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R-2, R-4 and I-1	34	37	31	46	48	56	49	56	38	31	42	32	26	33	34	23	27	25	25
I-2	23	24	25	25	25	28	26	30	22	25	32	24	25	28	29	26	28	22	20
R-1	30	28	35	30	34	36	34	37	41	32	37	27	28	33	32	25	29	22	18
B	38	39	45	42	45	49	47	56	57	44	55	42	38	47	46	38	45	38	31
A-2	8	8	9	9	8	9	9	11	13	8	11	9	8	10	9	8	9	8	3
M	32	32	42	37	39	47	44	58	57	42	54	46	38	48	5	42	45	38	34
E	27	34	38	37	39	47	44	58	57	42	54	46	38	48	50	42	45	38	34
S-1 and S-2	89	90	90	90	90	90	90	90	90	90	90	90	70	90	90	84	86	71	54
All other	35	39	46	42	46	52	49	56	56	40	52	42	37	44	44	36	39	32	28

Load Management Strategies in Energy Codes

- Load management measure cost savings are not achieved by direct energy use reductions at the building.
- Cost effectiveness of load management measures is calculated separately from energy efficiency measures.
- Savings are based on cost savings achieved from the load time shifts impacting a time-of-use (TOU) electric pricing schedule.

Published TOU Tariffs Are All Over the Map



- Variable electricity pricing encourages building owners to invest in load management technologies.
- Many different Time-of-Use (TOU) electricity tariffs are available across the U.S.

Source: PNNL; mapping of max demand charges in published commercial building utility rates as indicated in the OpenEI utility rate database (https://openei.org/apps/USURDB)

Development of a Representative National TOU electric rate

- PNNL helped establish a U.S. representative time-of-use (TOU) rate for ASHRAE 90.1.
- In 2020 a representative TOU rate (a.k.a. the ASHRAE TOU Rate) was approved as an optional rate for evaluating cost effectiveness.
- The rate was developed based on data published in the OpenEI Utility Rate Database
  - https://openei.org/wiki/Utility_Rate_Database
  - Extracted average base and peak period demand tariff based on 1700 rates that include a demand charges

ASHRAE TOU Rate

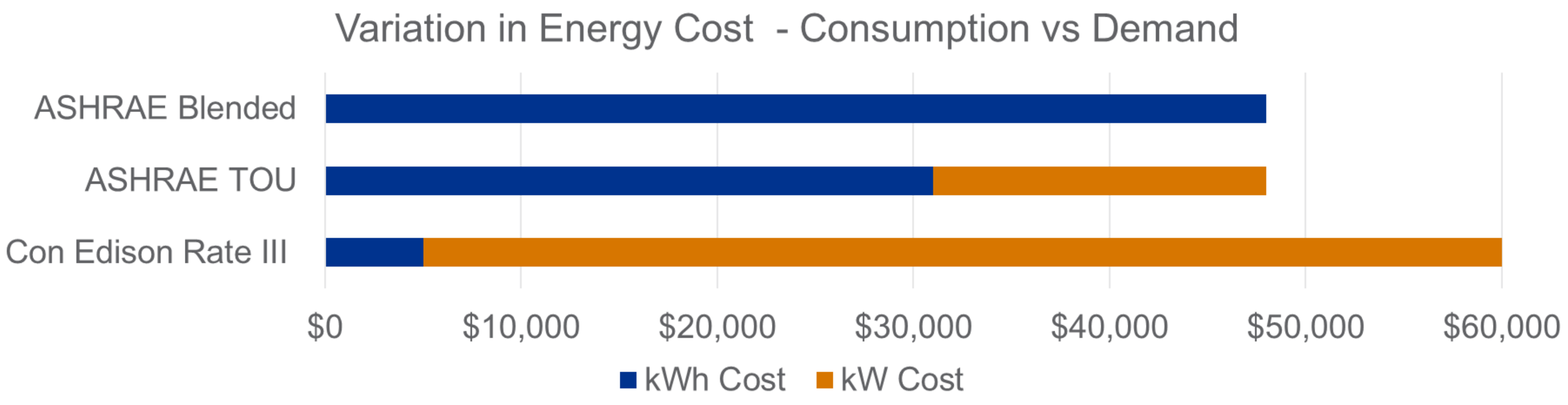
Winter (October through May)
- $0.0876 per kWh, peak hours
- $0.0528 per kWh, off-peak hours
- $5.18 per kW, base
- No peak kW charges
- Peak: Monday–Friday, 6 AM to 10 AM and 5 PM to 9 PM

Summer (June – September)
- $0.1023 per kWh, peak
- $0.0543 per kWh, off-peak
- $ 5.18 per kW, base
- $10.18 per kW, peak
- Peak: Monday-Friday, 1 PM to 9 PM

Development of a Representative National TOU electric rate

- The rate was fine-tuned to align with the approved, blended electric cost per kWh ($0.11/kWh)

Annual Cost Comparison	Average	2A	4A	6A
Blended rate	$ 48,619	$ 52,024	$ 45,342	$ 48,490
Adjusted TOU rate	$ 48,543	$ 50,212	$ 45,707	$ 49,709
Adjusted TOU rate vs Blended rate	-0.2%	-3.5%	0.8%	2.5%



The Impact of Electricity Rate on the Cost Effectiveness* of EE, DR, and DER measures

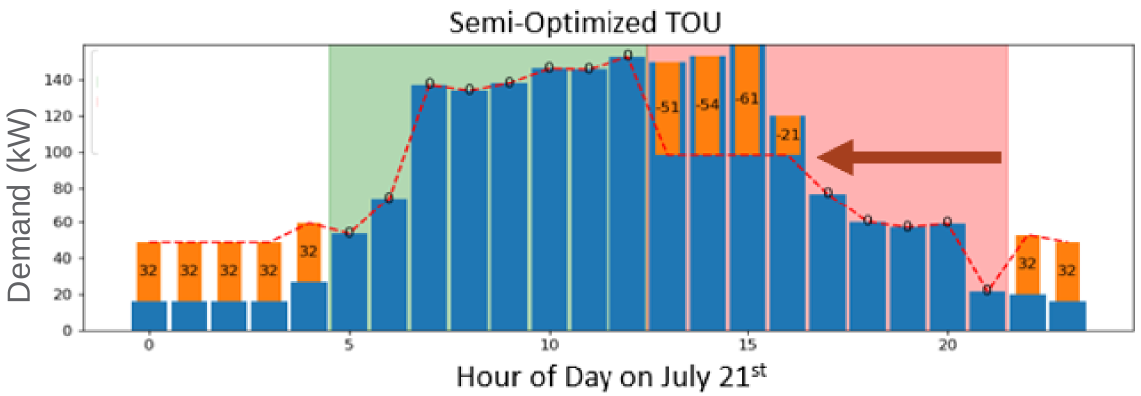
Measure		Annual Energy Savings ($/year)			Net LCC ($)		
		ASHRAE Blended	ASHRAE TOU	ConED TOU	Blended Rate	ASHRAE TOU	ConEd TOU
Climate Zone 4A -JKF Airport, NY	SHGC decreased by 10%	128	197	340	5,588	4,470	2,159
	EER increased by 20%	179	495	1,092	48,415	43,315	33,670
	Setup cooling w/ pre-cooling	(618)	(87)	(7,328)	10,498	1,921	118,961
	Setback heating w/ pre-heating	186	653	838	(2,248)	(9,801)	(12,782)
	OA ventilation ramp down	101	275	198	(4,293)	(7,117)	(5,863)
	20% light power reduction	344	701	1,282	(4,999)	(10,769)	(20,156)
	Battery Storage - Monthly 2018	(1,140)	5,756	10,031	241,419	129,953	60,856
	Battery Storage - Daily 2018	(434)	5,267	10,027	230,018	137,853	60,913
	Battery Storage - Monthly 2025	(1,140)	5,756	10,031	178,403	66,937	(2,160)
	Battery Storage - Daily 2025	(434)	5,267	10,027	167,002	74,837	(2,103)

The impact of factoring in TOU energy costs is evident when evaluating Load Management Measures.

Encouraging Investment in Load Shifting

Prototype Building Simulation Analysis **+** Load Management Semi-Optimized Operation Strategy **+** Justified First Cost Analysis

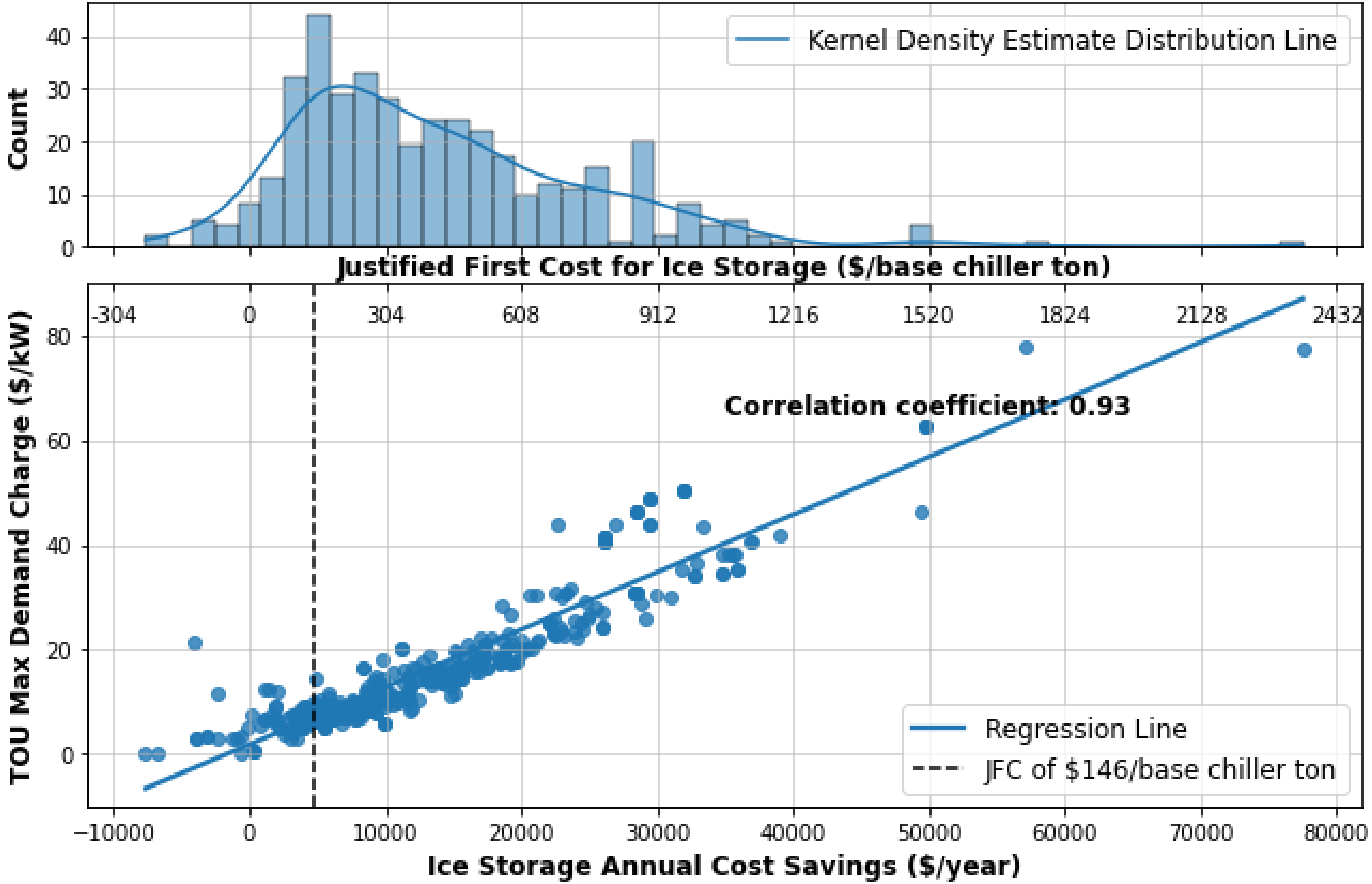
Medium Office Prototype	
Floor Area	4,980 m^2 (53,600 ft^2)
Floors	3
Weekday Occupied Hours	9 AM – 6 PM
Mechanical System	Packaged VAV roof-top air conditioning system with forced-air gas furnace
Other	VAV zone terminal units with electric reheat, gas service hot water



Parameter	Value
Study period – years	30
Nominal discount rate	6.00%
Real discount rate	4.05%
Electricity and natural gas Price escalation	Uniform PV factors: Electric 14.12, Gas 17.28
Loan interest rate	6.00%
Federal corporate tax rate	21.00%
State corporate tax rate	6.50%

Ice Thermal Storage Analysis

Large office building prototype in New York City, CZ 4A



Ice thermal storage cost savings and justified first costs determined for the prototype large office building in climate zone 4A. Supplemental monetary incentives are needed for tariffs that fall to the left of the cost point.

DOE BECP Resources supporting Grid-Integrated Efficient Buildings

- ***Energy Credits:*** Supports additional energy efficiency and load management measures for prescriptive energy codes.
- ***Electric Readiness:*** supports electric readiness for residential buildings.
- ***GEB (Demand Response)*:** supports demand responsive equipment and controls for residential buildings.
- ***EV Charging***: supports minimum EV infrastructure requirements for commercial and residential new construction.
- ***Zero Code Plug-In****:* supports achievement of net zero energy (NZE) or NZOEE in newly constructed buildings with options for prescriptive and performance path compliance..

Load Management Strategies in Energy Codes

- Building load management strategies are becoming increasingly important to the achievement of resilient electricity grids, building decarbonization and building energy resilience.

- The cost effectiveness of load management measures is aligned with TOU peak demand costs rather than a flat or blended electricity cost per kilowatt hour.

Thank you

New York's Pioneering Regulatory Strategies for a Clean and Resilient Grid

May 7, 2024

NYSERDA

The New York State Energy Research and Development Authority (NYSERDA)

MISSION

Advance clean energy innovation and investments to combat climate change, improving the health, resiliency, and prosperity of New Yorkers and delivering benefits equitably to all.

Building an Inclusive Clean Energy Economy

Supporting Clean Energy Jobs and New York State's Economic Recovery

Accelerating the Transition to a Low-Carbon Future

Fostering Healthy and Resilient Communities

Roadmap

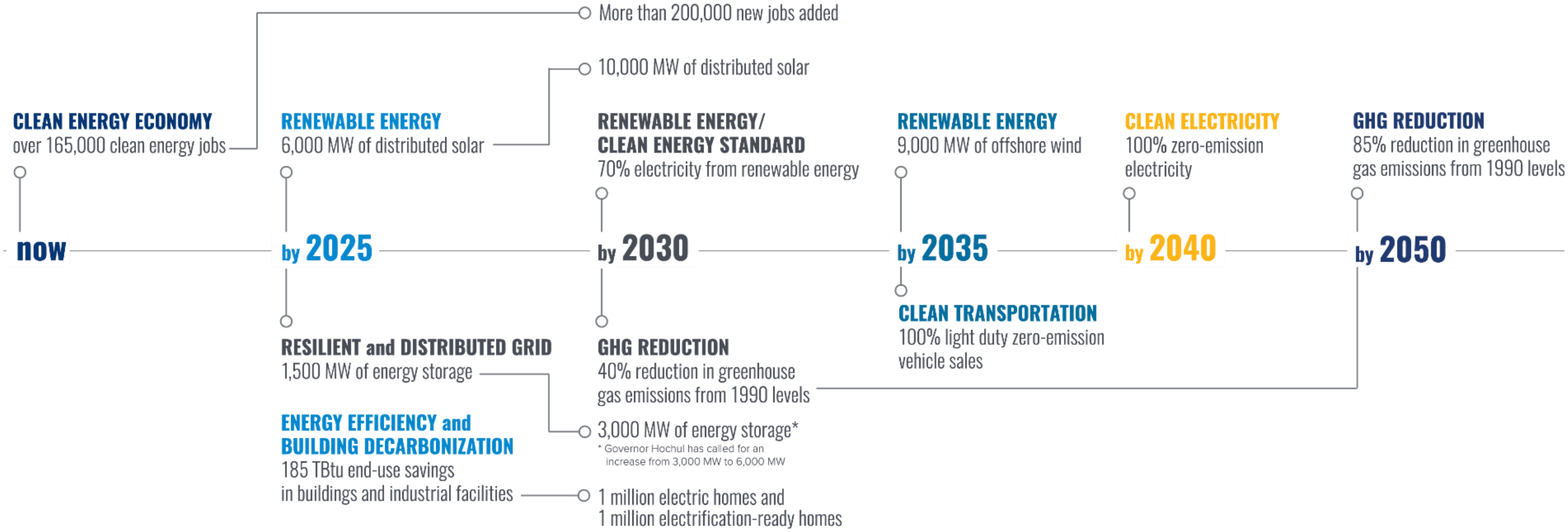
Topics covered in this presentation

- New York's trailblazing laws to confront climate change
- New York's building stock and emissions profile
- New York's climate agenda's impact on the grid
- New York's regulatory authority to mitigate demand (hint: increase efficiency)
- New York's innovative cost effectiveness methodology
- New York's approach to EV and solar

NOT covered in this presentation

- Details on New York's grid transformation
- Sneak peeks of New York's imminent Energy Code update

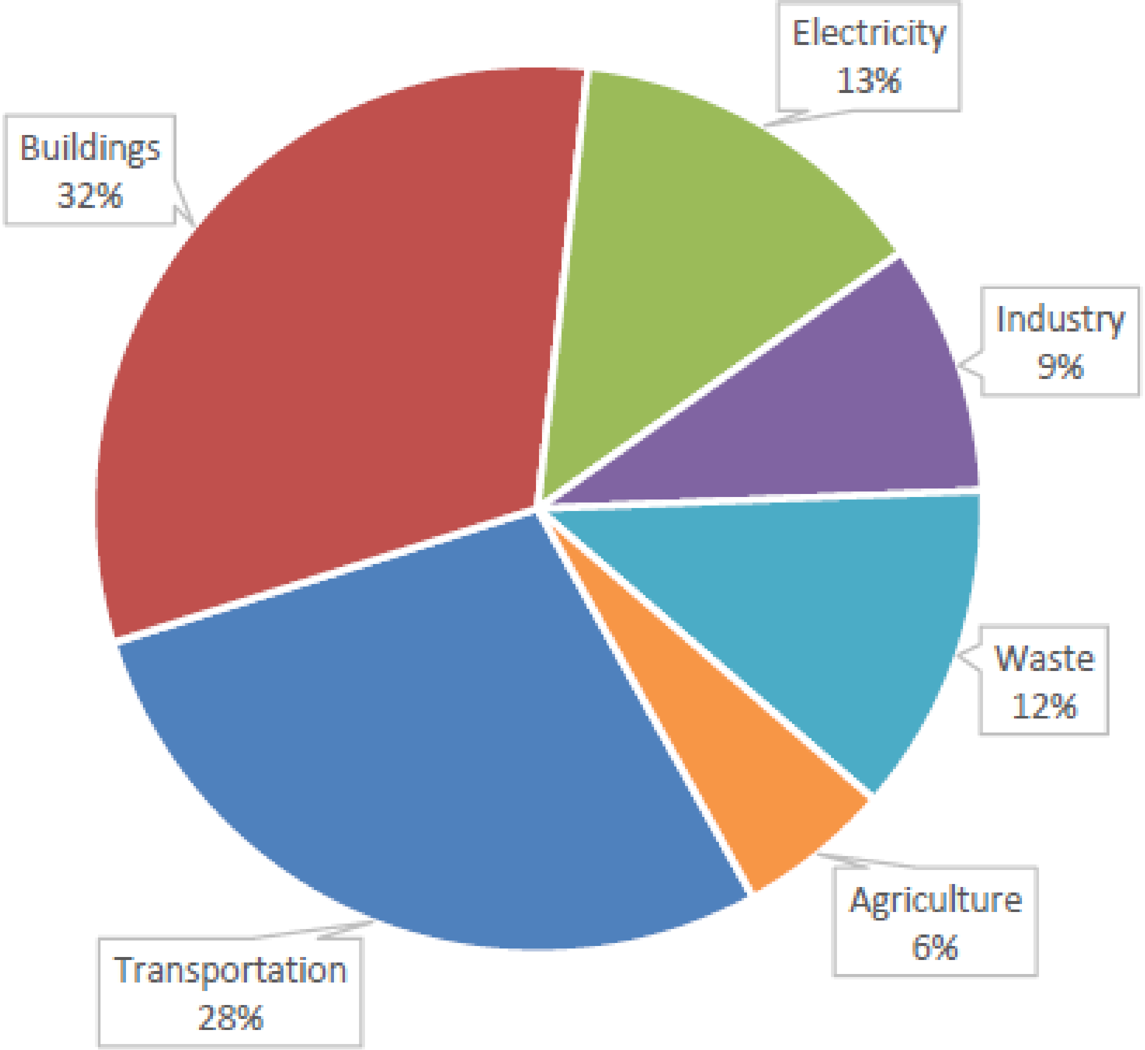
Climate Leadership and Community Protection Act (2019)



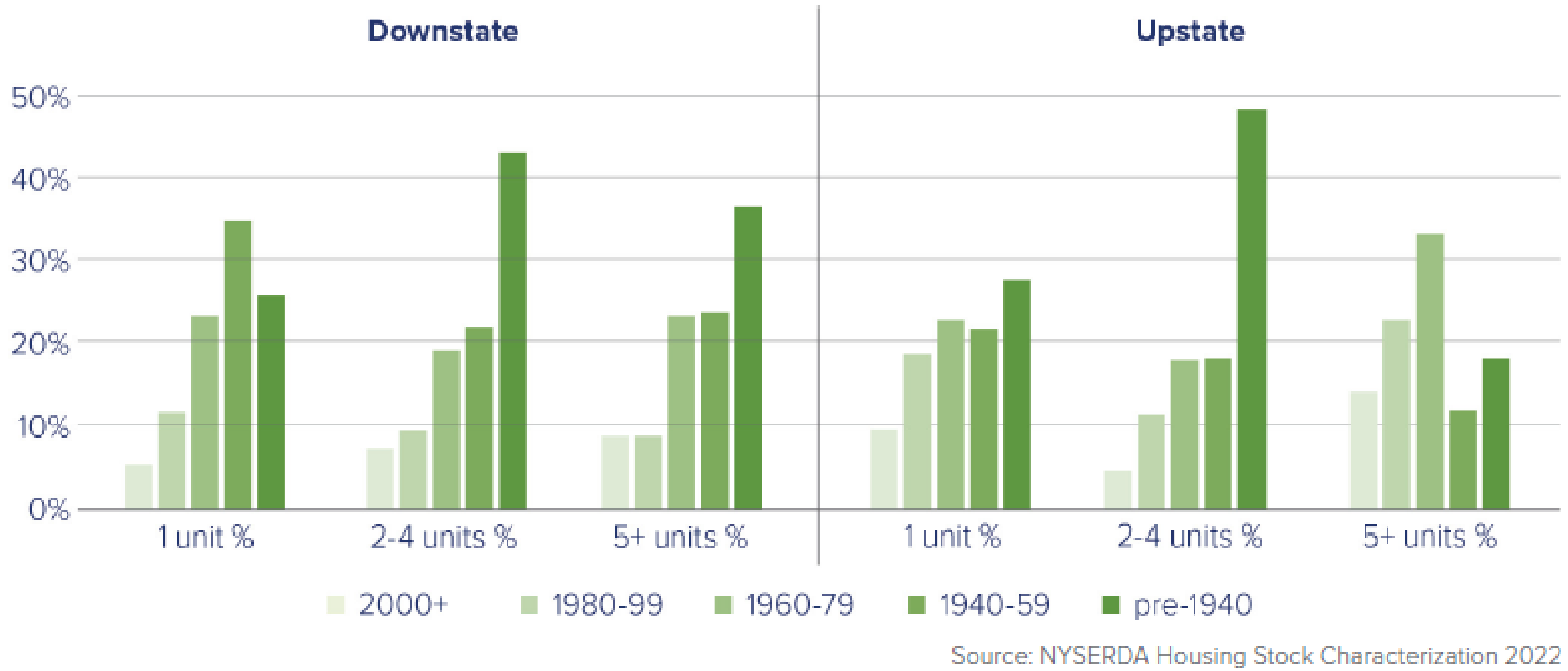
New York's GHG Emissions Profile

New York's 6+ million buildings are responsible for approx. one-third of statewide GHG emissions

Emissions Overview
The buildings sector was the largest source of emissions in 2019, responsible for 32% of emissions statewide, which includes the combustion of fossil fuels in residential (34%) and commercial buildings (19%), emissions from imported fuels (33%), and hydrofluorocarbons released from building equipment and foam insulation (14%). The fuels used in buildings today include fossil natural gas, distillate fuel (e.g., heating fuel oil #2), wood, propane, kerosene, and residual fuel.



New York's Building Stock



- The **older** and **taller** building stock make it more difficult to scale building retrofits and to transition from gas to renewable electricity.
- The large proportion of **leased space** in New York makes valuing decarbonization a more complicated proposition for owners and tenants.
- New York has a **diverse geography** spanning multiple climate zones and **regional fuel mixes**. Significant variations exist among building types and their respective mechanical systems.

Electrification's Impact on the Electrical Grid

NEW YORK STATE | NYSERDA

Annual electricity demand anticipated to grow 100% to 110% by 2050

EV Charging

- 3 Million EVs anticipated by 2030, from 175k today

Existing Buildings

- Statewide: 85% of Buildings using clean heating & cooling by 2050
- NYC: existing buildings >25k sq ft must achieve net zero emissions by 2050 (Local Law 97)

New Construction

- Statewide: New buildings required to be all-electric by 2026 for buildings < 7 stories* and 2029 for all others
- NYC: Local Law 154 – already in effect – requires the phasing out of FF for heating and hot water for new construction

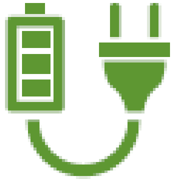
Attributes of a Carbon Neutral Building

These attributes focus upon the building, the impact of that building on the electric grid, and the value of infrastructure as an investment. A carbon neutral building in New York should focus on the following attributes:

Maximizes **energy efficiency,** especially to reduce thermal needs.

No fossil fuel combustion for building services or other appliances onsite (all-electric end uses).*

Produces or procures **zero-emission electricity** consistent with the Climate Act.



Designed with flexible loads and real-time control strategies and/or storage that can respond to grid conditions.

Features **resiliency measures** that protect buildings and occupants.

Designed and operated with the **health, wellness, comfort, and productivity** of occupants as a priority.

Code and Standards Act of 2022

- Energy Code required to achieve efficiency equivalent to most recent IECC and ASHRAE 90.1
  - Best efforts to achieve greater savings than IECC and ASHRAE 90.1 (subject to cost effectiveness test)
- Scope of the Energy Code expanded to include "clean energy features"
- Cost effectiveness of Energy Code updates revised to allow for the consideration of "societal effects"
- NYSERDA given authority to establish efficiency standards for appliances not already regulated by the federal government

Mitigating against increased demand: Appliance Standards

Code and Standards Act authorizes NYSERDA to develop state appliance standards

Efficiency standards promote energy reduction, water conservation, GHG reduction, and/or increase demand flexibility associated with the regulated product categories.

Appliance standards should be coordinated with similar efforts by other states.

NYSERDA required to conduct public meetings to provide meaningful opportunities for public comment from the population that would be impacted, including persons living in Disadvantaged Communities

June 2023, NYSERDA established efficiency standards for 21 appliances

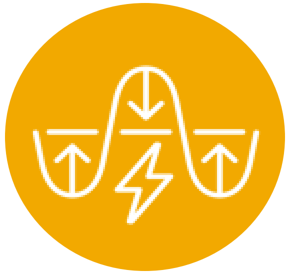
- Energy Reduction
- Water Conservation
- GHG Reduction
- Demand Flexibility

Managing the Loads

As NYS brings more renewable generation online, which introduces more variability in production, and that requires matching flexibility on loads.

New York is also investing in storage capacity and is planning for 6000 MW of storage by 2030.

NYSERDA recognizes that Demand Response and FDAS are important tools in load management.



Demand Flexibility

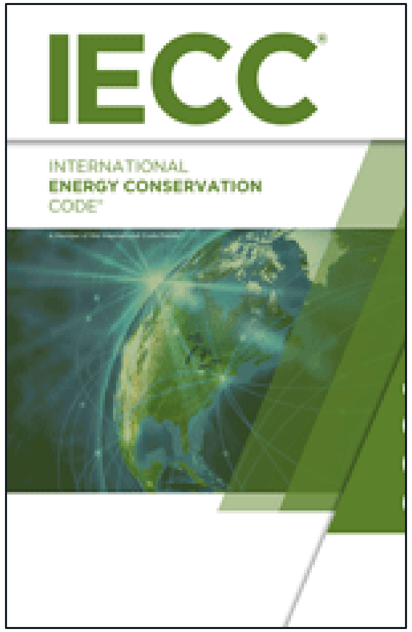
Mitigating against increased demand: Building Efficiency

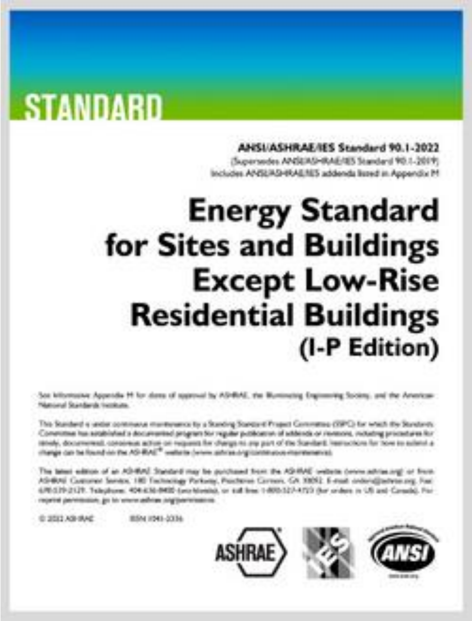
NEW YORK STATE | NYSERDA

NY plans to mitigate the burden on the grid by increasing efficiency through regulations

NYECCC
***At least** as*
efficient as most recent IECC and ASHRAE 90.1

Best efforts to achieve **greater** energy savings*





New York is updating its Building Codes this year. The Energy Code update will be IECC 2018 → 2024

Cost Effectiveness Rule

New York State Codes & Standards Act of 2022 established a two-pronged cost effectiveness approach that includes life-cycle cost methodology and defined societal effects developed by NYSERDA.

Proposed Cost Effectiveness Rule is based on DOE's Commercial and Residential Methodologies.

	NYSERDA's Proposed Cost Effectiveness Rule	Previous Process
Cost Evaluation	**30-year life-cycle cost analysis of full-range of incremental costs and energy cost savings associated with an Energy Code update** Based on U.S. DOE Building Energy Codes Program Methodology for Evaluating Cost-Effectiveness of Energy Code Changes	Simple payback of incremental first costs and energy cost savings
Societal Effects	**Quantify the monetized value of incremental GHG emissions that are avoided over 30 years associated with an Energy Code update** Based on DEC's *Establishing a Value of Carbon: Guidelines for Use by State Agencies*	Not included
Cost Effectiveness Presumption	**Life Cycle Cost Savings + Societal Effects ≥ 0**	10-year simple payback

EV Charging and Solar

The Code and Standards Act put amended the authority of the Energy Code to include both energy conservation features and **clean energy features** applicable to the construction of any building

Solar and EV charging requirements can distort the cost effectiveness analysis

- No increase in energy efficiency

Future solutions under consideration

- Include GHG reductions from EVs into the societal effects

The End


Thank you!
Please feel free to reach out to me at:
Tomi.Vest@nyserda.ny.gov

DOE Codes Conference

Grid Edge Modernization

Heidi Werner

May 7, 2024

Energy Solutions

Agenda

1 **Example: Load Management**
Considerations for load management codes and standards

2 **Cost Effectiveness Considerations**
California's Title 24 cost effectiveness methodology

Load Management Requirements

Code Requirements that Support Grid Modernization

Requirement	How it supports the modern grid
Energy Efficiency	Reduces building load, minimizing need to increase grid capacity
Solar	Reduced amount of grid-provided electricity a site needs, provides cleaner electricity, potentially minimizes need to increase grid capacity
Storage	• Adjusts when grid-supplied electricity is used, reduces peak • Allows buildings to actively support grid reliability
Load Management (DR)	• Adjusts when grid-supplied electricity is used, reduces peak • Allows buildings to actively support grid reliability
Electric Vehicle Infrastructure	• Increased electricity use – which needs to be managed • Controls can enable managed charging including charging when it is advantageous to grid operations (off-peak)
All-Electric & Electric Readiness	Enables buildings to transition to all-electric in the future with lower investment costs

Stakeholders Collaboration Is Especially Important for Grid Modernization Requirements

- Technologies are evolving
- Grid is evolving
- Align requirements with regional needs
- New stakeholders (e.g., solar, storage, EV manufactures)

Demand Responsive Controls – Residential Water Heaters

Example - 2024 IECC Residential Demand Responsive Water Heating Requirements

Electric storage water heaters (40 – 120 gallons) must have DR controls that meet the following:

TABLE R403.5.5
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	AHRI Standard 1430-2022 (I-P) or 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.	AHRI Standard 1430-2022 (I-P) ~~ANSI/CTA-2045-B Level 2, except "Price Stream Communication" functionality as defined in the standard.~~

Key Elements:

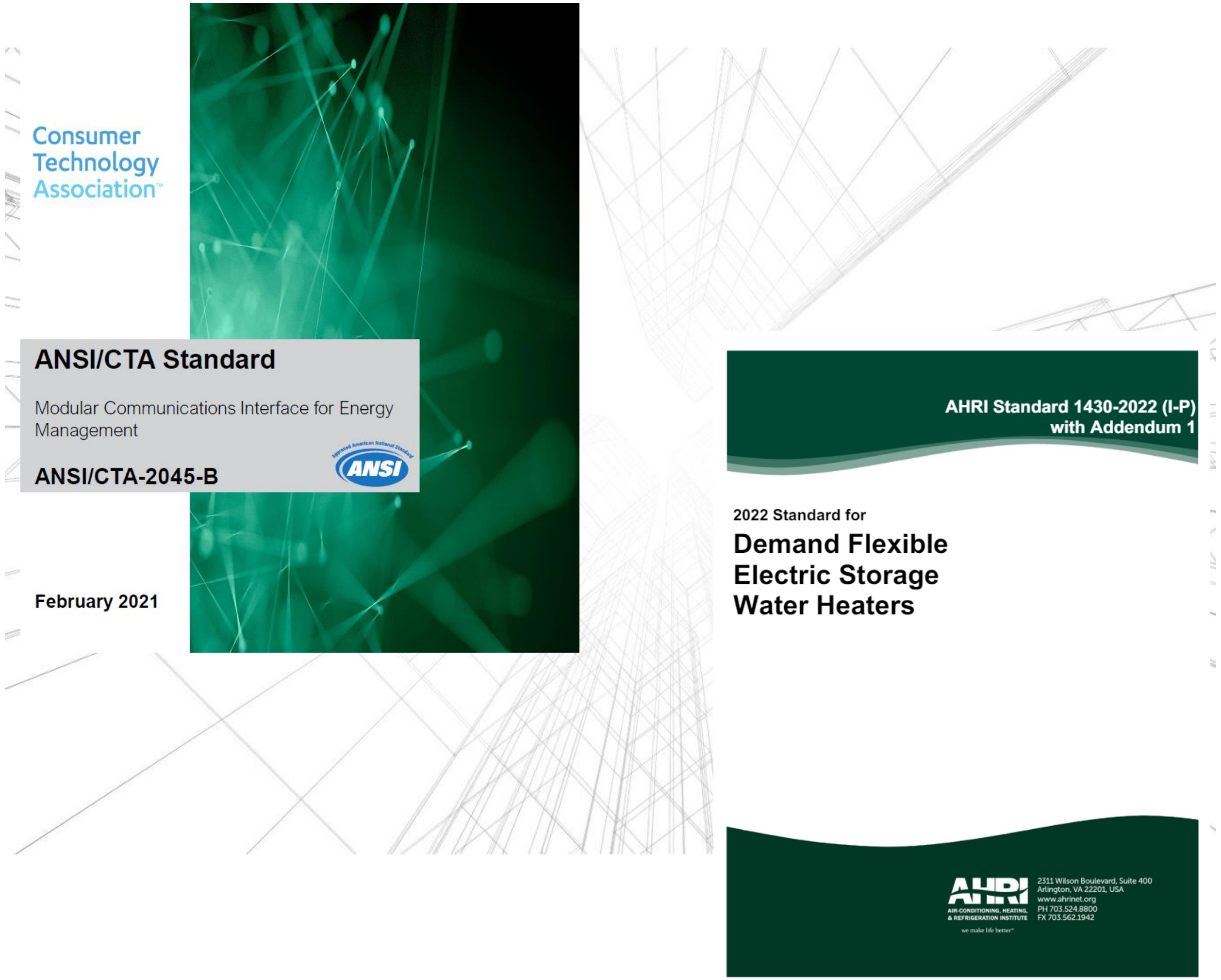
- Trigger – when required
- Communication requirements
- Controls requirements

Covered by referencing industry standards

Communications Protocols are Critical

Ensure controls in the building can communicate effectively with utility or authorized third party

- Open standards support interoperability
- Uncertainty on which protocols will prevail
- Proprietary communications are still allowed
- Communication links occur outside of the building site (e.g., the cloud)
  - Outside scope of building codes or appliance standards?



Industry Standards

Allow for clear and concise code language and more thorough communication and controls requirements

Title 24, Part 6: Qualification Requirements Reside in Joint Appendices (22 pages)

Appendix JA5 – Technical Specifications For Occupant Controlled Smart Thermostats

Appendix JA11 – Qualification Requirements for Photovoltaic System

Appendix JA12 – Qualification Requirements for Battery Energy Storage System

Appendix JA13 – Qualification Requirements for Heat Pump Water Heater Demand Management Systems

Appendix JA15 – Qualification Requirements for Central Heat Pump Water Heater Ready

IECC language is less than ½ page, but references standard that has > 175 pages of specifications in AHRI 1430 and CTA-2045

Use **appliance standards** instead of building codes to regulate load management

Load Management in Appliance Standards v. Codes

- Appliance standards apply to all products sold – broader reach than codes
- Manufacturers are more familiar with compliance process for appliance standards
- Appliance standards are typically easier to enforce than building codes

California Flexible Demand Appliance Standards (FDAS) Timeline

Senate Bill 49:
S.B. 49 (2019) is finalized, requiring the CEC to adopt standards to facilitate flexible demand technology deployment.
Senate Bill 49 (2019)

CEC Releases FDAS RFI:
CEC Request for Information focused on:
- thermostats
- pool controls
- dishwashers
- electric clothes dryers
- electric storage water heaters
- behind-the-meter battery systems
- electric vehicle supply equipment

Pool Controls FDAS Adopted:
After several drafts and rounds of stakeholder comment, the first CA FDAS is adopted for pool controls.

Pool Controls FDAS Effective:
Pool controls FDAS will go into effect in Sep. 2025, about 2 years after adoption.

Oct. 2019	Dec. 2020	Sep. 2021	Jun. 2022	Oct. 2023	2024	Sep. 2025

Initial CEC Workshop:
CEC holds workshop on FDAS and releases Staff Paper on "Introduction to Flexible Demand Appliance Standards"
CEC Docket: 20-FDAS-01

First Pool Control FDAS Proposal:
CEC releases the initial pool control FDAS draft staff report and proposal for stakeholder comment. Proposal was revised in response to comment and formal rulemaking opened in Feb. 2023.
CEC Docket: 23-FDAS-01

CEC Working on Next FDAS:
CEC staff are working on the next FDAS regulation, expected to be for electric storage water heaters. Draft proposal will likely be released this year.

Potential Appliances to be Covered by CA FDAS

- Thermostats
- Pool controls - **completed**
- Dishwashers
- Electric clothes dryers
- Electric storage water heaters
- Behind-the-meter battery systems
- Electric vehicle supply equipment

Source: CEC Request for Information on Flexible Demand Appliance Standards, Docket 20-FDAS-01, September 2021

Cost Effectiveness Considerations

Cost Effectiveness Considerations

for Proposals that Support Grid Modernization

- Account for **hourly costs and benefits**
- Evaluate impacts of **entire code**
- Use an **appropriate period of analysis**
- Consider how **electricity and gas supply will evolve** over time
- Account for **societal benefits**

California Cost Effectiveness

Statutory Requirements

> The standards … shall be cost-effective when taken <u>in their entirety</u> and when <u>amortized over the economic life of the structure</u> compared with historic practice. When determining cost-effectiveness, the commission shall consider the value of the water or energy saved, the impact on product efficacy for the consumer, and the life-cycle cost of complying with the standard.
>
> *California Public Resources Code Section 25402(b)3*
> *Excerpt from Warren Alquist Act*

- **Energy code must be cost effective**
- **The whole code must be cost effective**
  - Each unique requirement does not need to be cost effective on its own
- **Determined based on economic life of structure (30 years)**

California Energy Savings and Cost Effectiveness Methodology

1

Calculate site energy impacts

2

Apply Long-term Systemwide Cost (LSC) Factors

California Energy Commission. 2025 Energy Code Accounting Methodology 2025 Energy Code Rulemaking Docket Number 24-BSTD-01. March 2024 | CEC-400-2024-004.

https://efiling.energy.ca.gov/GetDocument.aspx?tn=255318-1

California Cost Effectiveness

1. Calculate Energy Impacts

- Calculate energy impacts on an hourly basis
- Simulate impacts in 16 California climate zones
- Use approved California compliance software
  - Weather files updated regularly
- Use prototypical buildings
  - Updated each code cycle

California Cost Effectiveness

2. Long-term Systemwide Costs

"The LSC represents hourly long-term costs to the energy system over 30 years and does not represent annual utility bill savings from a measure."

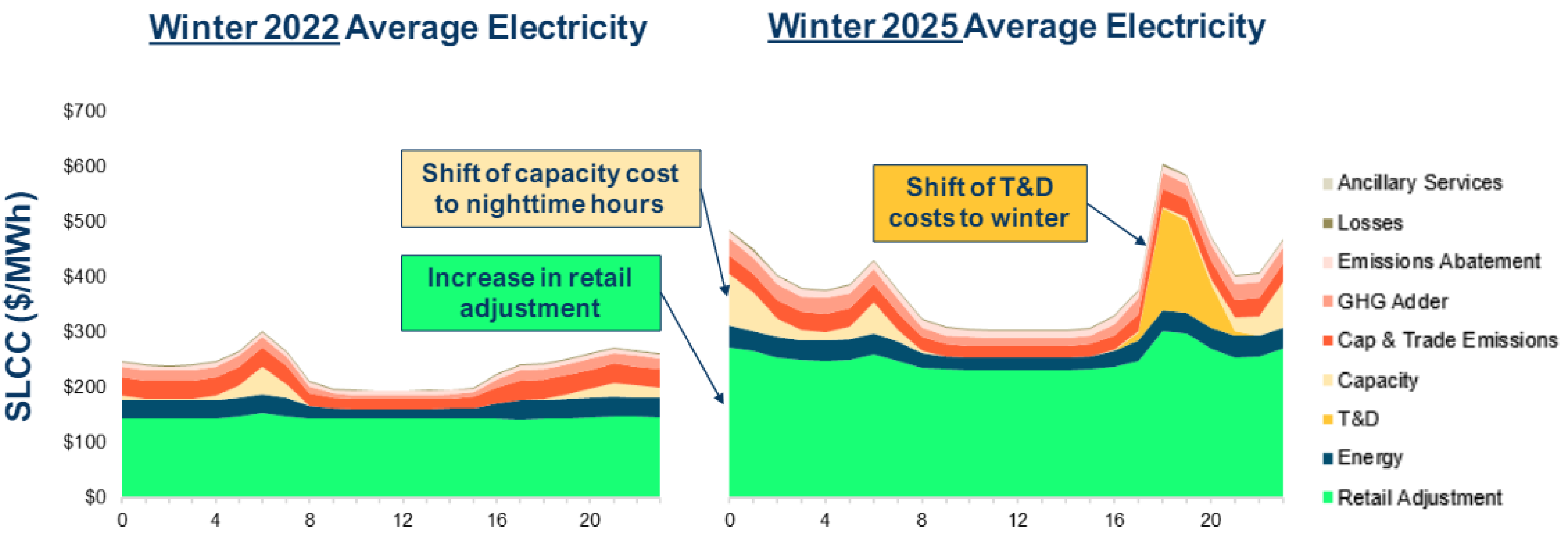
- Hourly LSC factors for each California climate zone
- Unique LSC factors for residential and nonresidential
- Accounts for energy cost over 30 years
- Costs are built-up with each component of the cost adjusted independently
- Updated every code cycle

Result

Energy cost savings over 30 years

Winter Electricity

Winter electric factors higher than 2022 cycle, mainly due to increases in retail adjustment and winter capacity cost (**36-75% increase** in winter electric factors)



California Energy Commission. Presentations Combined - Revised November 10, 2022 Energy Accounting Workshop.
https://efiling.energy.ca.gov/GetDocument.aspx?tn=248216&DocumentContentId=82524

Thank you

Heidi Werner

hwerner@energy-solution.com

510.482.4420 x219