

# Building-Grid Integration, Zero Energy Buildings, and Strategic Energy Planning

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institute

Photo: Getty Images



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# Today's Topics

- Introductions
- A Status Update on Zero Energy Buildings
- The Grid-Optimal Initiative
- Strategic Portfolio Energy Planning
- Q&A, Next Steps, Opportunities

# nbi: the virtuous cycle

**NBI is a national nonprofit working to improve buildings for people and the environment.** We drive research, uncover solutions, and advance industry practices and policies that deliver positive change in the built environment.

## ***Program Areas:***

- 1. Best practices in new and existing buildings*
- 2. Continuous code and policy innovation*
- 3. Zero net energy leadership and market development*



# *The 2018 Getting to Zero Status Update*



# What is a Zero Energy Building?

A Zero Energy (ZE) building\* is highly energy efficiency and meets  $\geq 100\%$  of its annual energy from renewables.

- » **Energy** = All energy (electric, gas, steam, liquid fuel etc.) consumed on site
- » **Net** = One year or more of on-site renewable energy production minus energy use
- » **Verified** = A year or more of documented performance at net zero
- » **Emerging** = not yet a year or more of data (may be on a path to ZE)
- » **EUI** = Energy Use Intensity in kBtu/sf/yr - metric of energy performance.

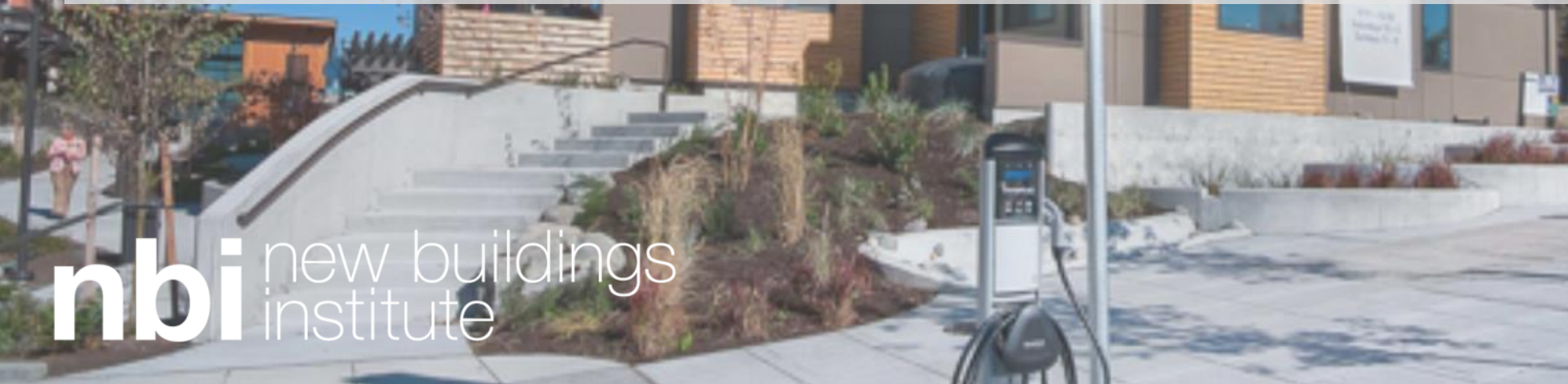


Marin Country Day School (Photo: Michael David Rose)

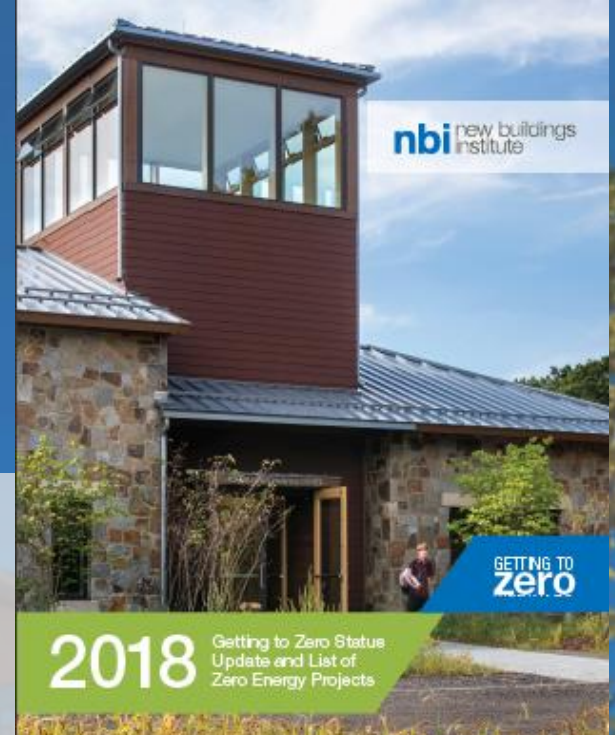
*\*Also known as Net Zero Energy (NZE), or Zero Net Energy (ZNE). Zero Energy Building (ZEB)*



We have a fantastic story to tell about the growing number of ZE projects - **nearly doubling each year** - and maintain the **most comprehensive database** on North America's ZE emerging and verified projects.



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**2018** Getting to Zero Status Update and List of Zero Energy Projects

ZERO ENERGY CERTIFIED												
YEAR	PROJECT NAME	CITY	STATE	BUILDING TYPE	SIZE (SF)	TOTAL SOURCE EUI	NET SOURCE EUI	NET SOURCE PER SF	NET SOURCE PER SF	NET SOURCE PER SF	NET SOURCE PER SF	2018 SCORING
2007	Edin 27 Garage Facility (M)	San Jose	CA	Office	4,927	22.6	71.2	29.2	7.0	-0.6	-1.9	-1
	Chicago Library (M)	Chicago	IL	Public Assembly	2,413	18.7	52.6	17.4	55.0	-0.8	2.4	-1
	Living Learning Center (M)	San Jose	CA	Education	2,368	24.5	77.1	26.4	82.2	-1.9	6.1	2
2009	Chicago Center for Sustainable Living (M)	Riverside	NY	Other	6,200	13.2	41.8	21.5	67.0	4.3	36.0	-2
	Pringle House (M)	Salmon	OR	Public Assembly	3,158	11.1	35.0	15.4	48.4	-4.3	-13.4	-3
	Palmyra Field House (M)	Palmyra	VT	Education	16,800	17	50.6	43.4	32.0	-0.7	2.3	-1
	Bartholdi School Science Wing (M)	Seattle	WA	Education	1,425	48.0	151.2	48.4	152.5	-0.4	-1.3	0
	DPK Construction San Diego Net Zero Office (M)	San Diego	CA	Office	24,000	14.8	46.1	17.1	53.0	2.4	7.8	3
	Energy Lab at Hawaii Preparatory Academy (M)	Honolulu	HI	Education	5,802	11.0	34.9	28.0	88.2	-17.0	-53.4	-15
	Head River Middle School Net-Zero Addition (M)	Head River	OR	Education	5,301	26.8	84.3	27.1	85.4	-0.4	-1.1	3
	Roseville Elementary School (M)	Bowling Green	KY	Education	72,285	19.0	59.0	21.6	68.0	-2.6	-8.1	3
	Quanti Moine Elementary Gardens Storage Family Education Center (M)	Bowling Green	KY	Education	8,200	19.2	60.3	25.5	73.0	4.3	13.0	-4
	Lowell Town Conference Center High School (M)	Laurens	KY	Education	30,000	9.9	31.0	19.6	20.3	-0.7	-2.3	-1
2011	10 Bank Branch - Ft. Lauderdale (M)	Fort Lauderdale	FL	Office	3,070	31.8	289.7	86.6	281.1	-3.8	-11.0	-4
	Shore - Issaquah (M)	Issaquah	WA	Multi-Family	5,813	21.0	66.2	22.0	66.3	-1.0	-3.1	-2
	Ballou Foundation Capital & Center for Leadership Design and Construction (M)	Seattle	WA	Office	51,800	17	50.6	16.6	52.4	-6.9	-21.0	-10
	David and Lucile Packard Foundation (M)	Los Altos	CA	Office	49,161	24.4	76.9	20.0	91.4	-4.6	-14.0	-7
	DPK Construction Phoenix Net Zero Office (M)	Phoenix	AZ	Office	16,533	26.8	84.3	26.0	92.0	-2.7	-8.8	3
2012	Pringle House for Sustainable Living (M)	Pittsburgh	PA	Public Assembly	24,360	18.2	57.3	18.7	58.8	-0.5	-1.5	0
	Second Street School Site new Family Library (M)	Albany	CA	Education	6,800	19.2	41.6	38.8	47.0	-17.6	-55.4	-22
	Smith College Residential Environmental Classroom (M)	Northampton	MA	Education	2,800	11.5	36.1	17.6	55.6	-6.2	-19.6	6
	431 India Ave (M)	San Jose	CA	Multi-Family	21,000	13.5	42.5	28.7	80.2	-15.2	-47.7	-20
	PNC Net-Zero Branch (M)	Fort Lauderdale	FL	Financial (Retail and Office)	4,766	58.1	186.0	64.4	203.0	6.4	-17.0	-5
2013	Sandy Grove Middle School (M)	Lander Bridge	NC	Education	74,000	20.6	64.9	26.7	112.6	-15.1	-42.7	-15
	Wood Shalaby Public Library (M)	Berkeley	CA	Public Assembly	3,300	21.7	68.3	25.5	80.4	-3.8	-12.1	-5
	Smith Environmental Center (M)	Virginia Beach	VA	Education	10,000	14.6	45.9	28.6	80.1	-14.0	-44.2	-14
2014	DPK San Francisco Office (M)	San Francisco	CA	Office	24,010	21.8	68.0	22.1	82.6	-0.5	-1.6	-1
	Wilson School (M)	Chatham	NJ	Education	20,000	21.8	68.9	26.0	119.2	-13.1	-41.4	-12
	Pittsburgh Community Center (M)	Pittsburgh	PA	Education	80	14.5	45.9	28.8	86.6	-6.3	-19.0	-6
2015	Rocky Mountain Institute Innovation Center (M)	Bozart	CO	Office	15,810	16.8	52.9	26.2	82.7	6.4	20.0	-12
	Sumner and Craft (M)	Orlando	FL	Office	3,740	4.8	21.4	8.4	26.5	-1.6	-5.1	-12
	Monty Architects Office (M)	Walden	VT	Office	2,968	22.1	69.5	26.0	78.6	-2.9	-8.1	-2

Building names in boldface new to the List. Buildings with (M) indicate measured data & include LEED Certification.



# Proving Feasibility by Tracking Trends and Growth

Number of Zero Energy Buildings

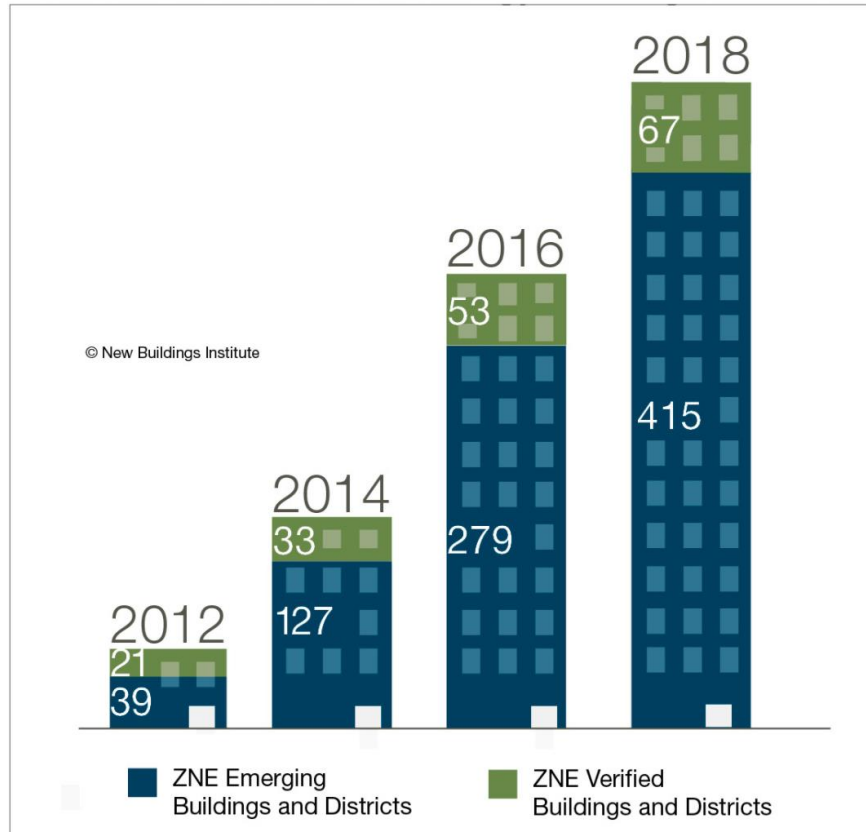


Fig 2. There are now 67 ZE Verified and 415 ZE Emerging projects documented by NBI.

Zero Energy Building Growth

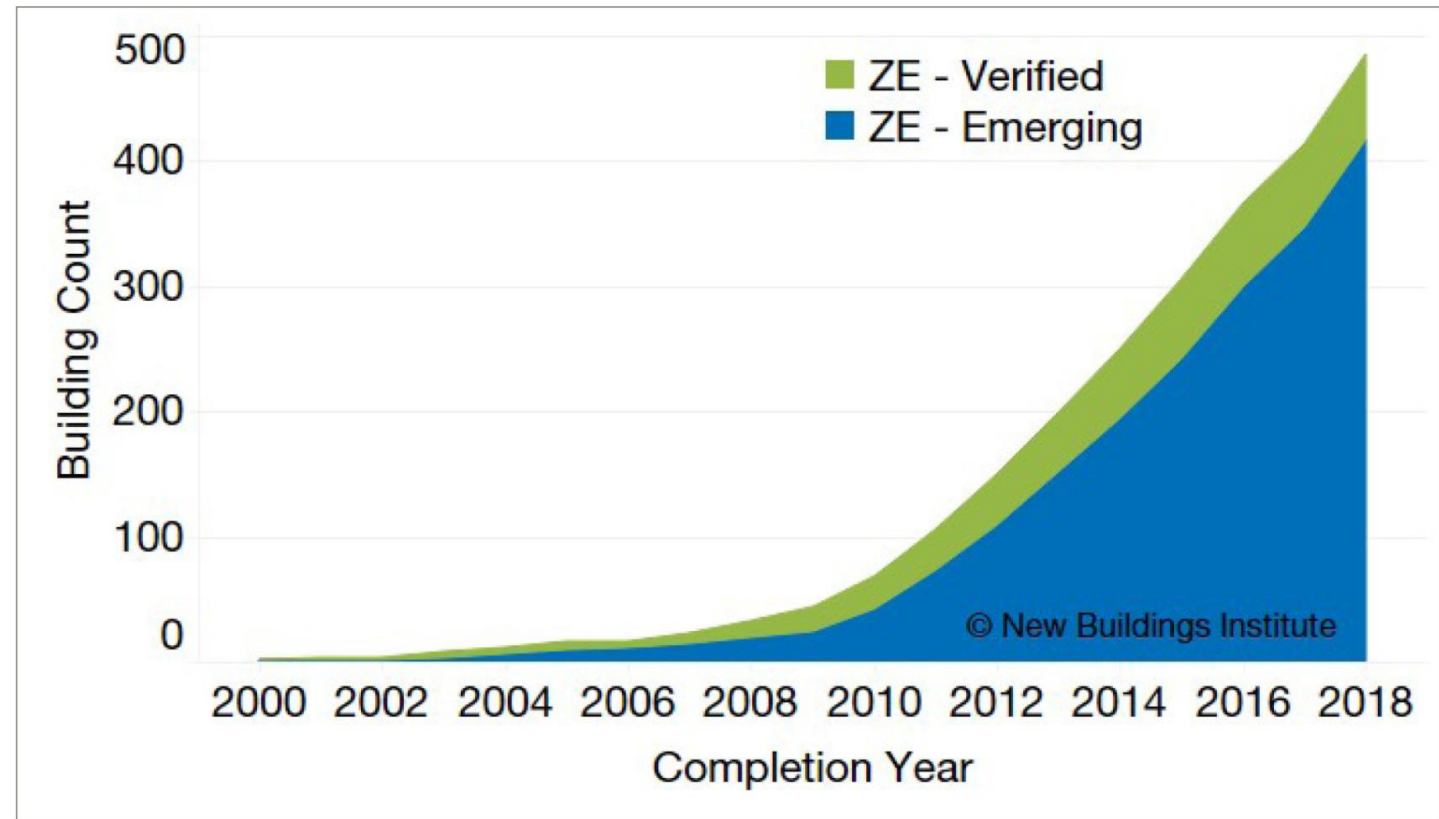


Fig 1. The Buildings List includes nearly 500 projects and is on a steep curve upward, having increased over 700% since 2012.

# Spreading Success

2018 Buildings List Project Locations

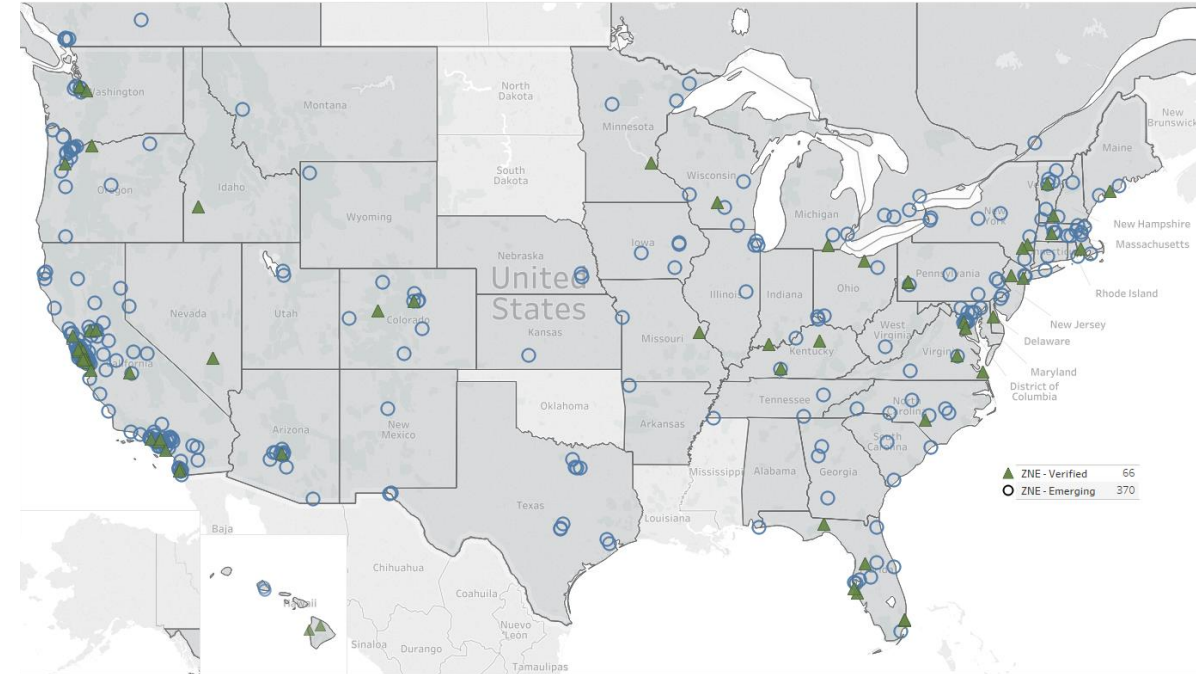
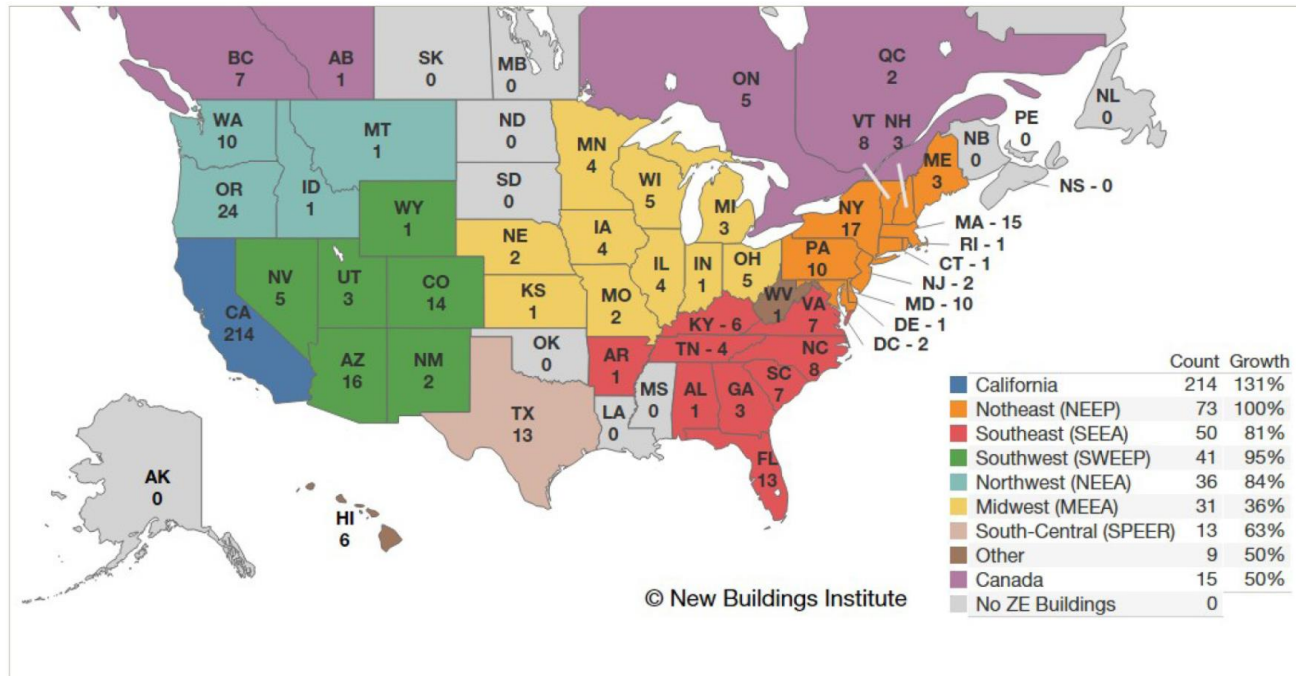


Fig 3. ZE Projects by region and state/province. The legend shows regional growth trends in projects since our 2014 List.

- CA and OR are the top states and together represent ~ 50% of the list...but
- Both the **NE** and **SW** have seen growth of greater than 90% since 2014
- 42 states and 4 providences have documented ZE buildings



# Putting Performance into Perspective

- ZE Verified buildings on average use **60% less energy** than comparable existing U.S. commercial buildings and 46% less than new buildings under one of the most stringent U.S. base code (CA Title 24).

Gross EUI Distribution of ZE Projects

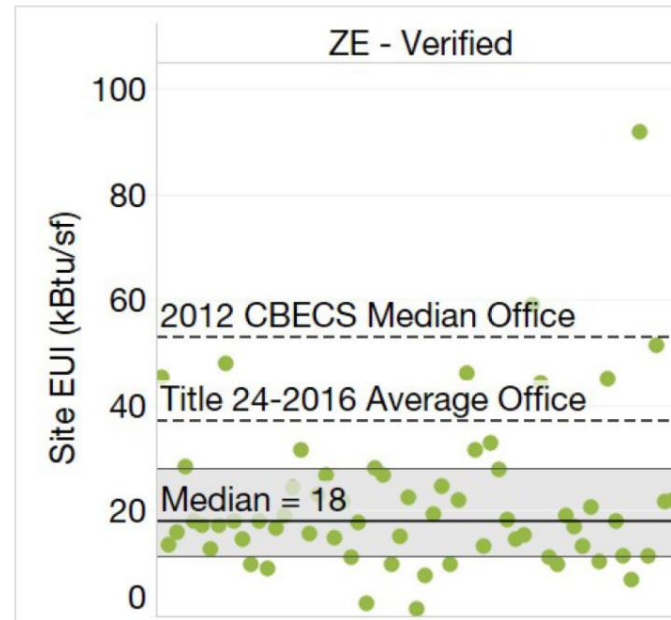


Fig 5. This chart shows the range of energy usage (gross site EUI, not including renewables) for the zero energy projects in this List. The grey band covers the 20<sup>th</sup> to the 80<sup>th</sup> percentile in each group.

# Free Resources

- 2018 Getting to Zero Status Update and List of Zero Energy Projects
- Recorded Webinar Available
- Downloadable Figures & Charts



<https://newbuildings.org/resource/2018-getting-zero-status-update/>



# The GridOptimal™ Initiative

## A New Rating System and Metric For Building-Grid Interactions

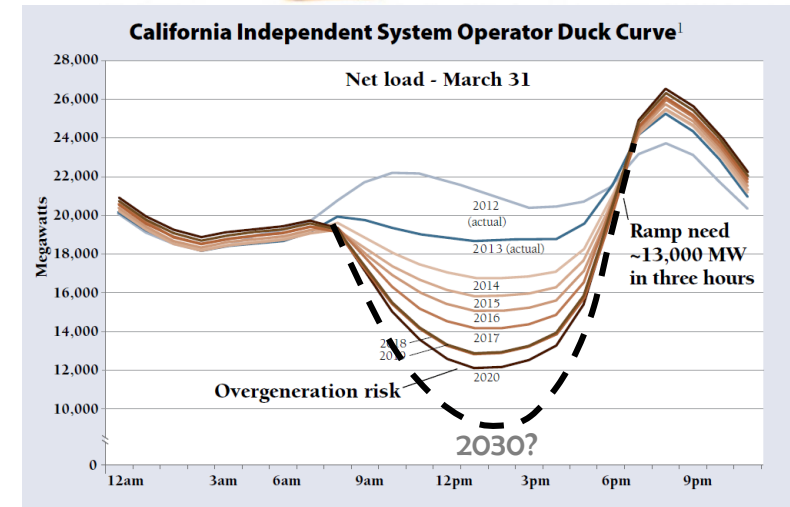
*New Buildings Institute  
U.S. Green Building Council*



# Change is Coming

## What's Next for Buildings and the Grid?

- What is the role of buildings, renewable energy, and storage in the **utility of the future?**
- We are seeking **solutions to today's challenges** and opportunities for **market transformation.**
- We are assembling top experts to help **answer these questions.**



Source: Jim Lazar, 2016

# GridOptimal: Why is it Needed?

**There are currently no metrics that define building-level grid citizenship, or rate building-grid interaction quality**

- Different players have **different language** to discuss the topic
- New technology has introduced new **opportunities and challenges** for building owners and grid operators alike
- Need to catalyze **harmonization** of building design with grid interaction



# GridOptimal: Why is it Needed?

## The GridOptimal Rating System includes a New Quantitative Metric for Building-Grid Interactions

- Defines a building's **“grid citizenship”**
- Credit for **Building Technologies & Strategies**
  - Passive features
  - Dispatchable / Responsive features
- Improves **integration of DERs** onto the grid
- Ensures continued **affordability, safety, reliability, & resilience** for buildings and the grid

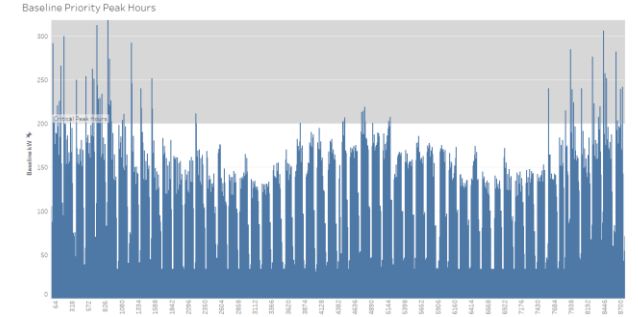




# The GridOptimal Score: Rating Building-Grid Interactions

## ***Start with:*** min. 1 year of Load Profile Data

- 8,760 hrs Net Power Balance (kW Demand and kW Production) for **Rated Building & Baseline Building**



## ***End with:*** Simple, easy-to-understand key number(s)

- GridOptimal Score integrates **an asset and an operational rating** based on building-grid interactions and capabilities

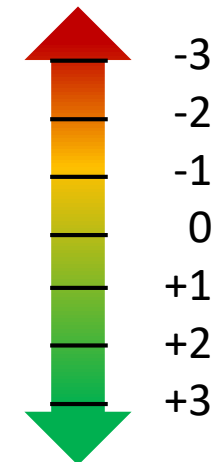


Image: Resnet

# GridOptimal™ : Layering Grid Resources

- Passive Design Elements
- Active Dispatchable Elements (ADR)
- Distributed Energy Resources
- Addressable EV / Storage Technologies



<http://www.lakeland.co.uk>

# Stakeholders and Market Applications

## ***Grid Perspective (Regulators, Utilities, Program Administrators):***

- Incentive Programs: Distributed Energy Resources & Buildings
  - Upfront incentive for GridOptimal design
  - Favorable rates
  - “New Business” charge for connecting a building to grid upon completion
- Target building upgrades for grid operation/stability
- Provide predictable building load reductions to grid managers and for bidding into electricity markets
- Reduced demand ramp up/down leads to greater overall generation efficiency and reliability for grid operator

## ***Building Perspective (Customers, Developers, Designers):***

- Design & Specification Process
- Real Estate & Building Asset Valuation
- Insulation against demand charge changes

## ***Regulatory and Policy Framework:***

- Aligns with ZE Building Goals and Policies
- Regulatory and Policy Frameworks (e.g. CA Title 24, New York REV)
- Model Codes & Standards (e.g. ASHRAE 189.1, IECC, etc.)



# Building Owners & Managers

## *Key Benefits*

- Create a new revenue stream from existing assets
- Enhance access to utility incentives & programs
- Improve building valuation
- Improve Risk Management
  - Insulate against demand charges
  - Reduce bottom-line impacts of rate structure changes
- Meet Sustainability goals/mandates
- Ensure that building staff are engaged in energy performance



# How Can GSA Participate?

- Become a Partner/Sponsor of the GridOptimal Initiative
- Join the Technical Advisory Committee
  - Guide GridOptimal development and implementation
  - Access to leading experts in a collaborative environment
- Participate in Webinars, Workshop(s)
- Pilot the GridOptimal Score in federal buildings

# GRIDOPTIMAL INITIATIVE

SEARCH

## Our Work

- Zero Net Energy +
- Advanced Buildings +
- Outcome-Based Performance +
- Deep Energy Retrofits +

## Newsletter

Sign up to receive updates from NBI.

<https://newbuildings.org/gridoptimal-initiative/>





# ***Strategic Portfolio Energy Planning***

# Strategic Portfolio Energy Planning

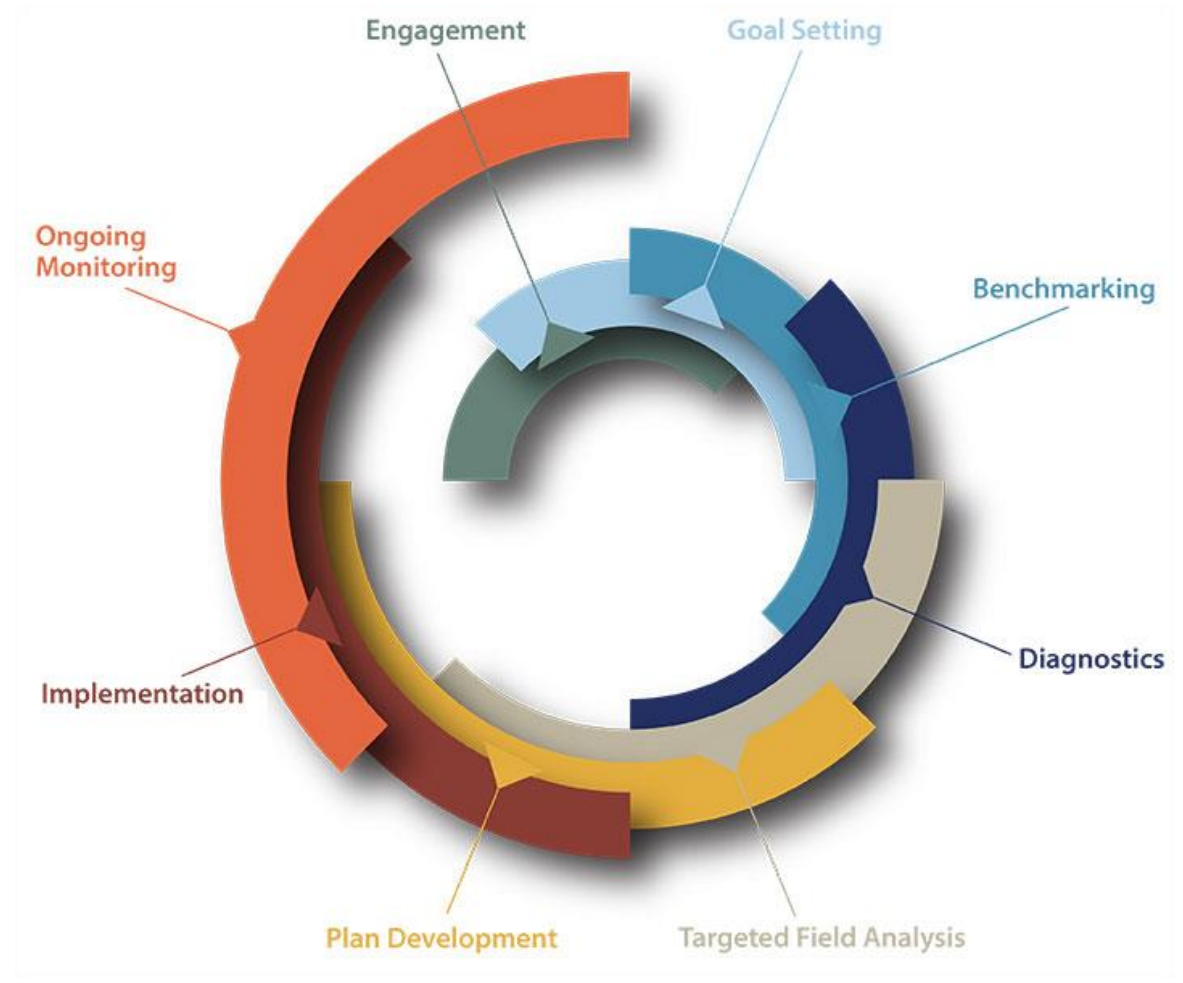
DOE project:

## *Municipal Portfolio Performance and Policy Opportunities*

- Developing **replicable process** and **open-source tools** for public buildings
- Partners: Maalka, EcoEdge, NEEA
- Software platform integrated with Energy Star Portfolio Manager

# Strategic Portfolio Energy Planning

- Replicable process for small to mid size cities and other public portfolio holders
- Long-term, strategic approach to managing energy in public buildings
- Leveraging existing tools, creating new resources



# FirstView: What is it?

## Inputs:

- Aligned with Portfolio Manager

## Outputs:

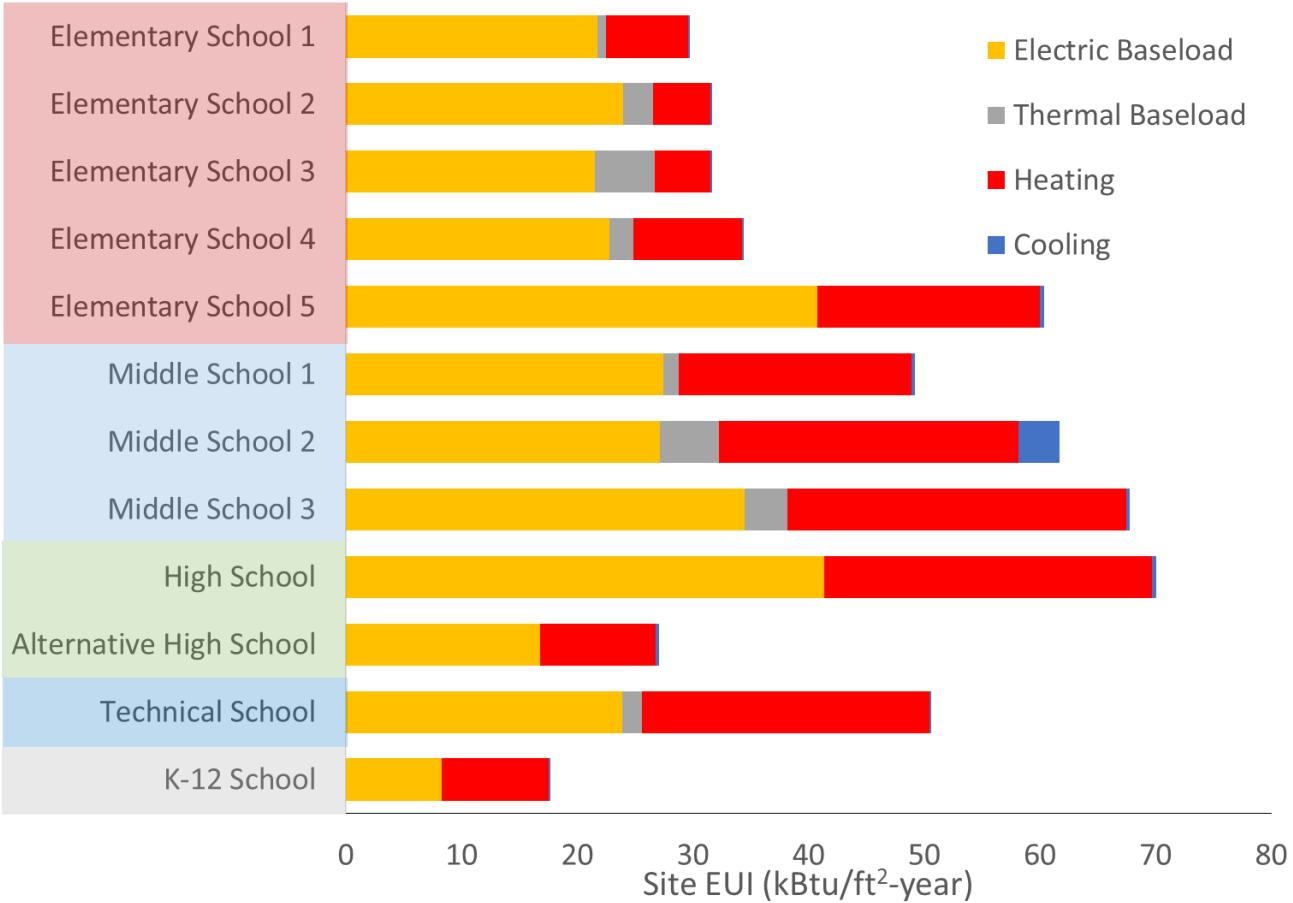
- Disaggregated energy by end-use
- Diagnostics
- Actionable recommendations





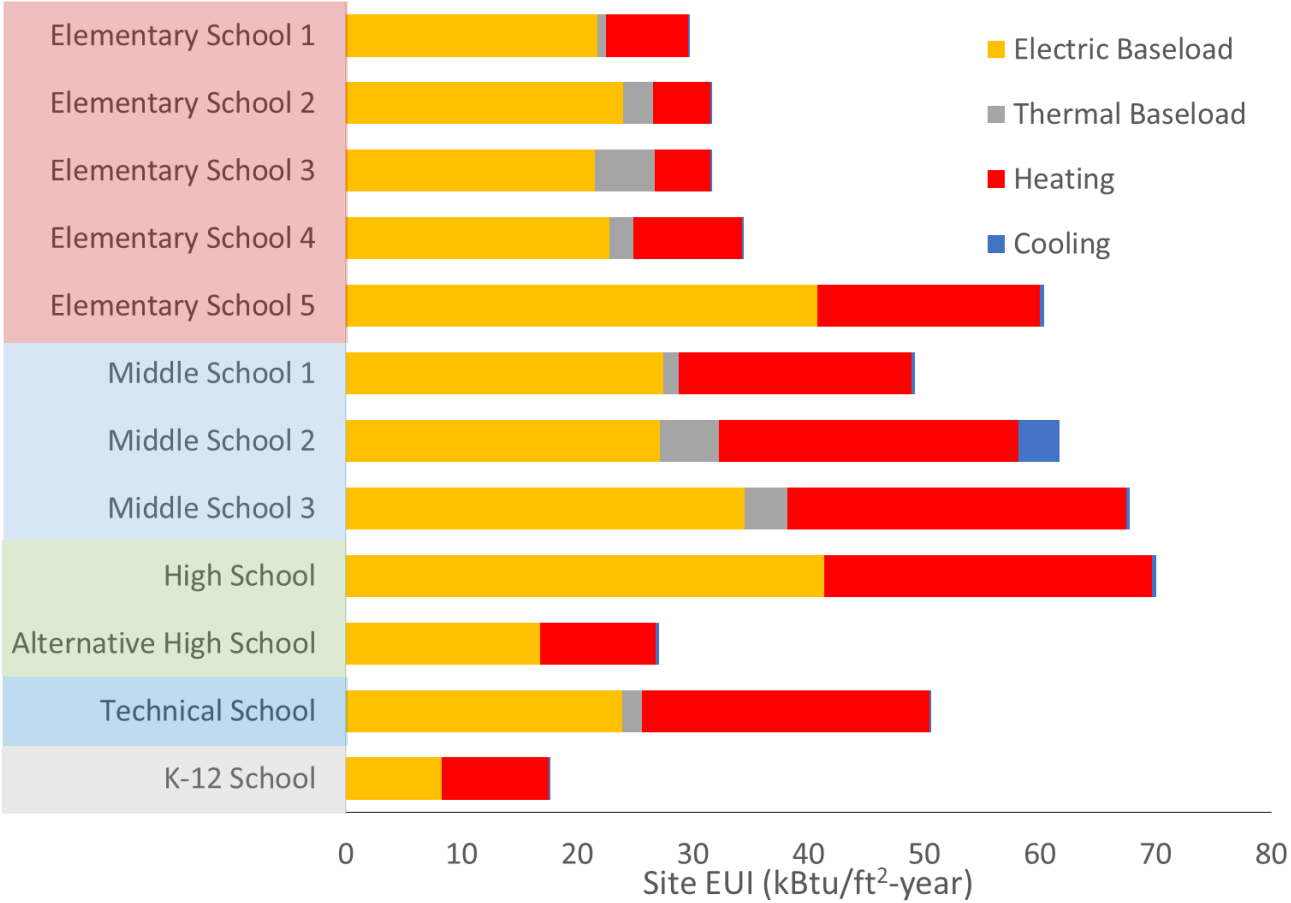
# Portfolio-Level: Disaggregated Energy

Weather Normalized Building EUI by End-Use



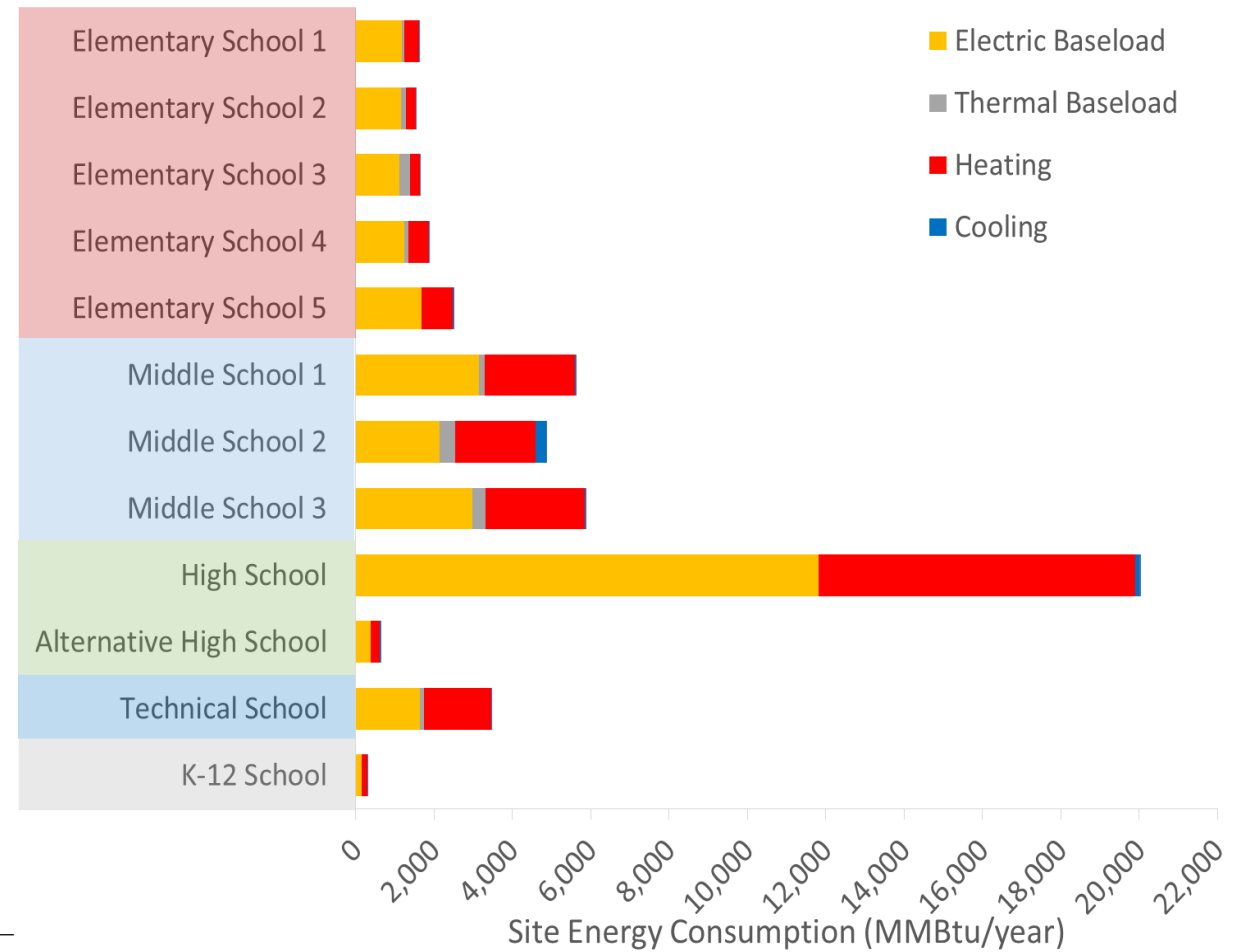
# EUI

Weather Normalized Building EUI by End-Use



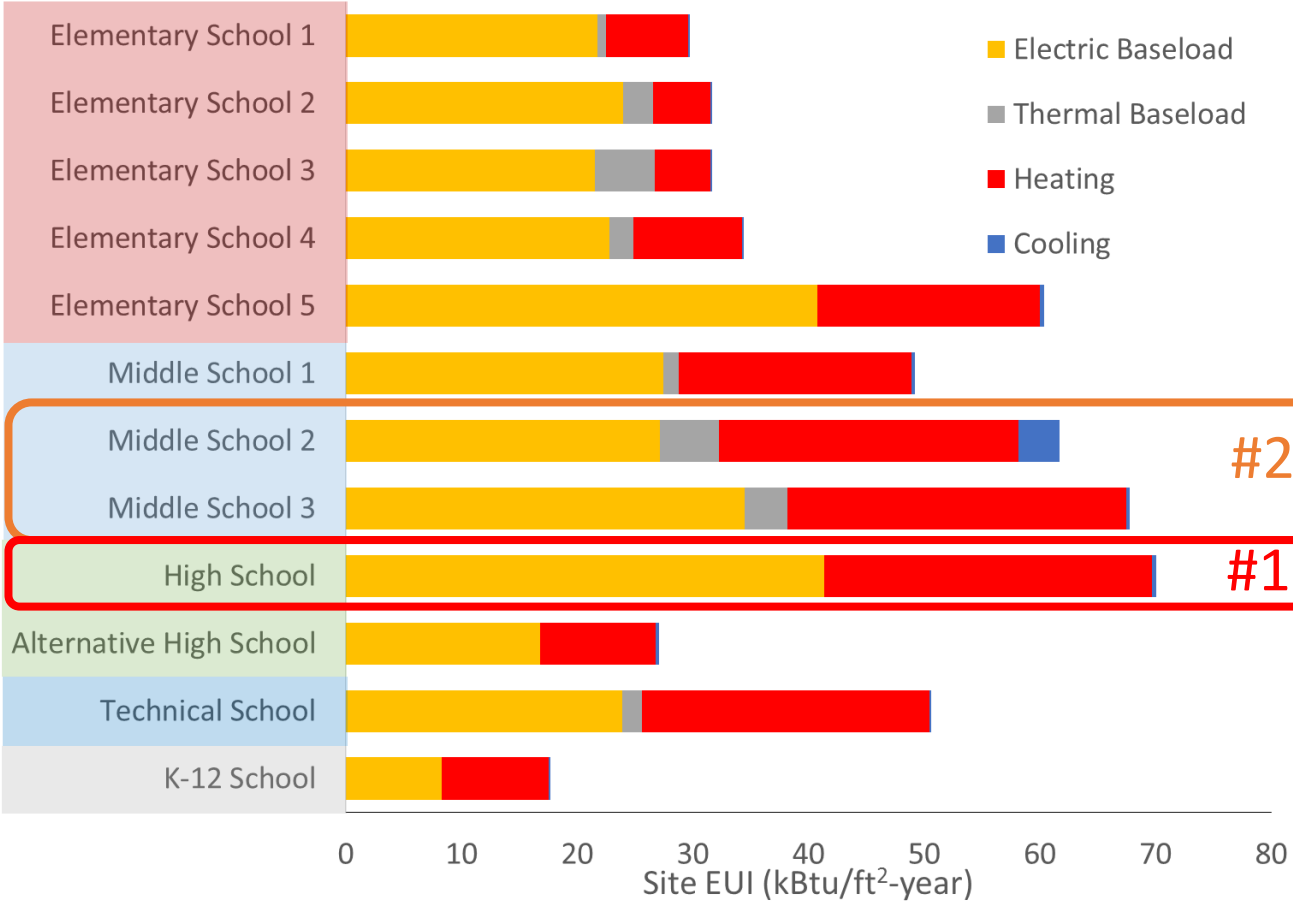
# Total Consumption

Weather Normalized Building Total Energy Usage by End-Use



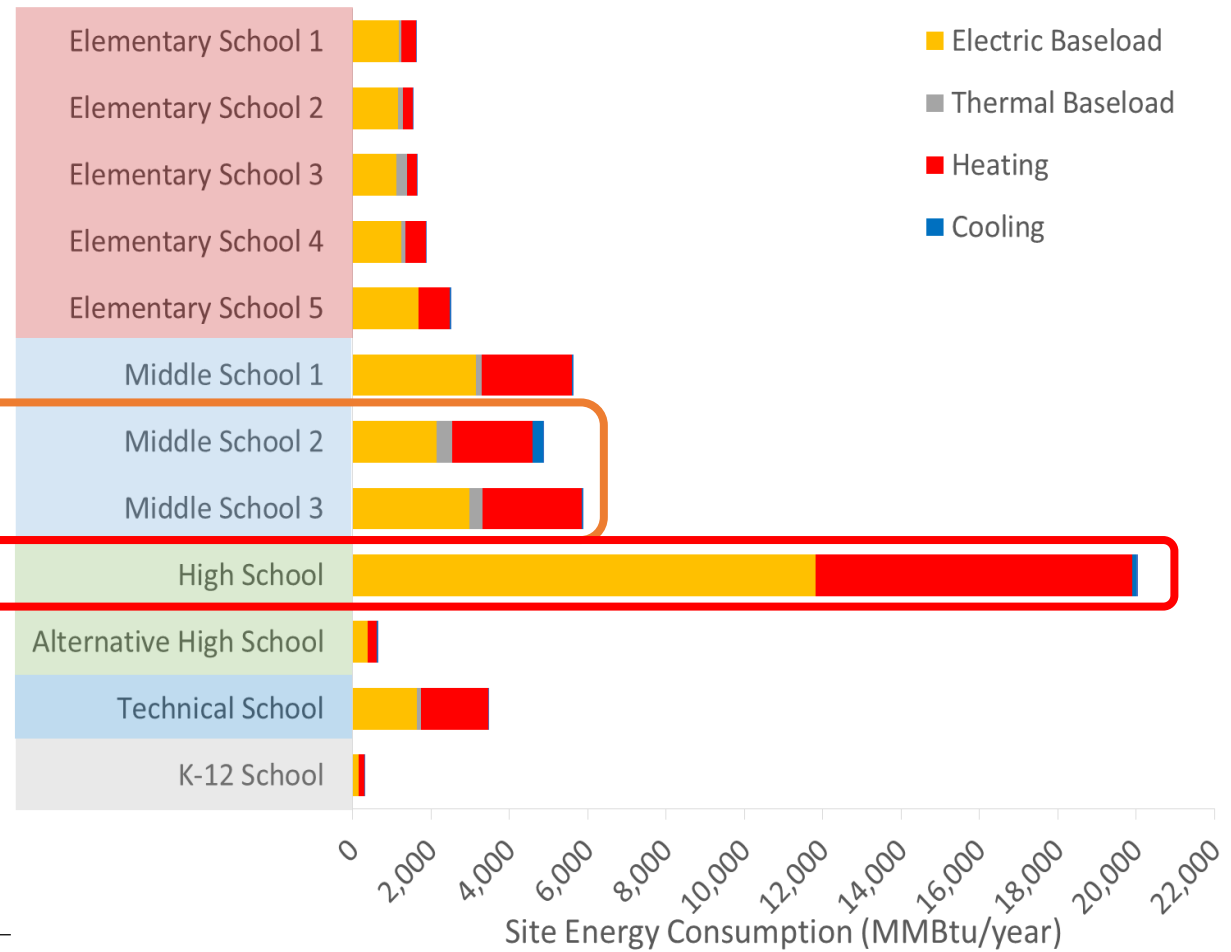
# EUI

Weather Normalized Building EUI by End-Use



# Total Consumption

Weather Normalized Building Total Energy Usage by End-Use



# FirstView Applications: Portfolios

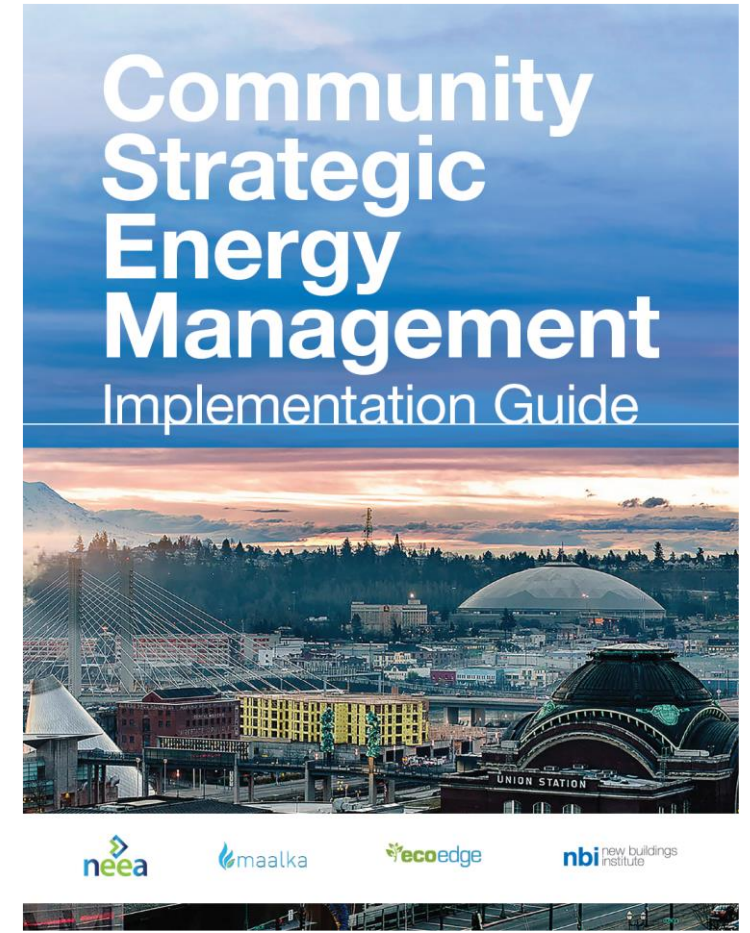
- Cities
  - Past: Seattle WA, Tacoma WA, Boise ID, Emeryville & Berkeley CA, Cambridge MA
  - Current: Providence RI, Eugene OR, Missoula MT, Grand Rapids, MI
- Schools
  - Examples: State of Oregon (all K-12 schools), Eastern WA School Districts
- Private/Public Collaboratives
  - Example: Seattle 2030 District (offices, multifamily, retail, labs...)
- Private Building Owners
  - Examples: Enterprise Community Partners, Emerald Cities (both multifamily)



# Tools and Resources

- Implementation Guide
- Case Studies (participating cities)
- Open-Source Data QC tool
- Master Facilities Tracking Templates
- Public Buildings Strategic Energy Management Plan Template

<https://newbuildings.org/community-sem>





# GETTING TO **zero**

NATIONAL FORUM 2018

April 17-19, 2018  
Grand Wyndam | Pittsburgh

[gettingtozeroforum.org](http://gettingtozeroforum.org)

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*The premier global event dedicated to defining the future of low and zero energy buildings.*

- Share perspectives on the growth of ZE
- Build knowledge on policies driving projects, and design and operation best practices
- Collaborate on opportunities for ZNE to transform the built environment





# Thank You!

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David and Lucille Packard Foundation Building

Courtesy: EHDD