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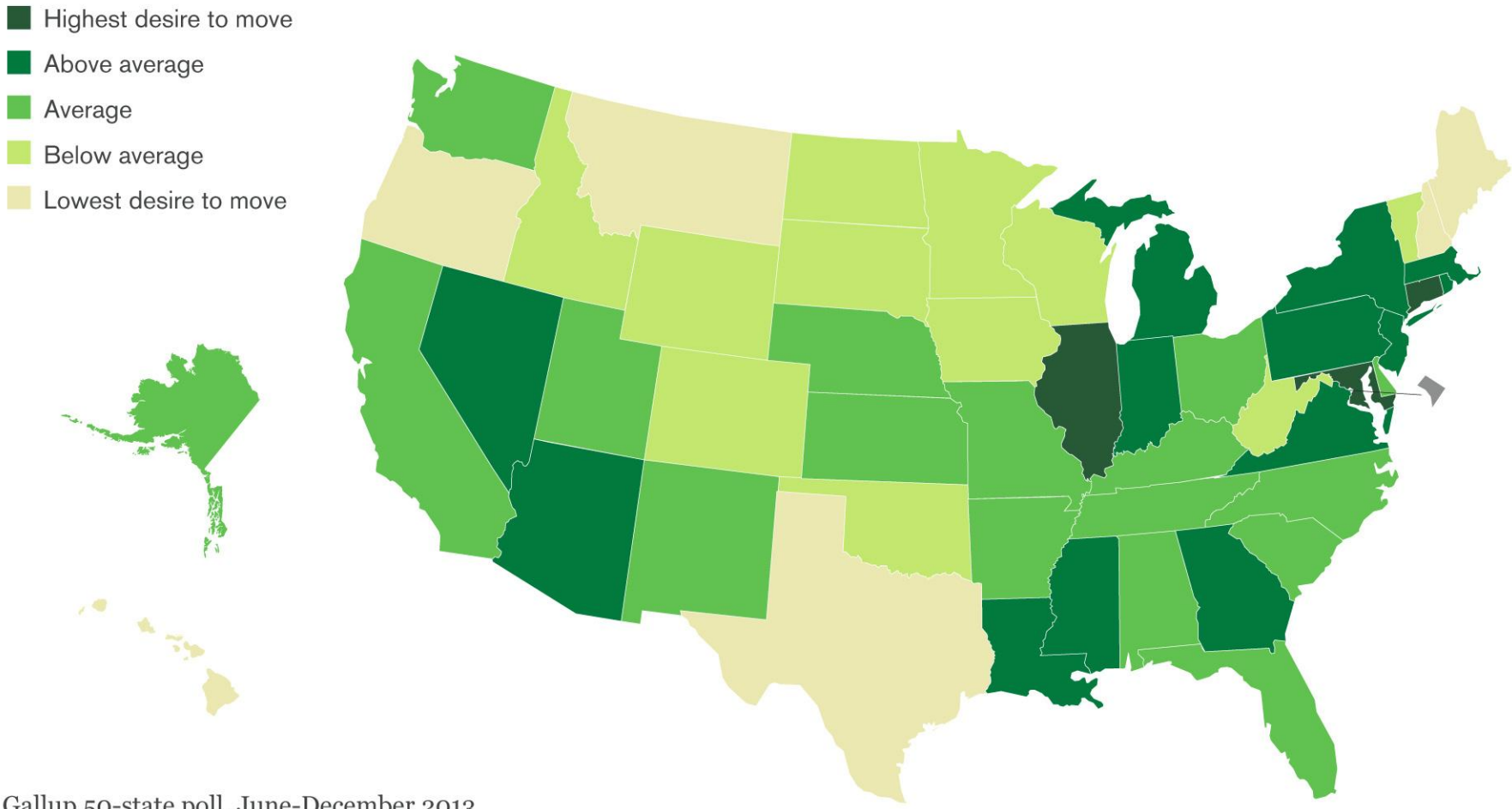
Getting to Zero in Hawaii

Ralph DiNola
Executive Director, NBI

14th Annual Hawaii Build & Buy Green Conference
May 7th, 2014
Honolulu, HI


MENITIES
r for your devices.
737-800/900
some with life rafts and life vests
Airlines®
FETY INFORMATION

State Residents' Desire to Move to a Different State



Gallup 50-state poll, June-December 2013

Note: No data available for the District of Columbia

GALLUP®

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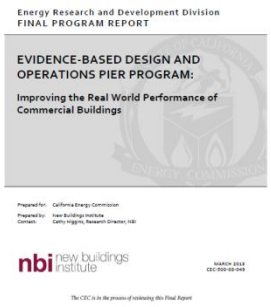
New Buildings Institute

NBI's mission is to promote and accelerate the adoption of next practices for improving energy performance throughout the built environment

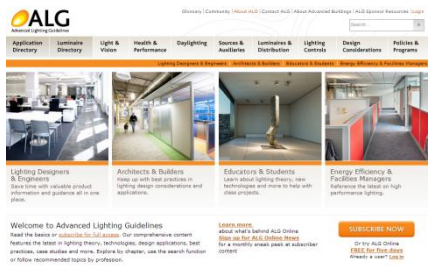
NBI...

the virtuous cycle

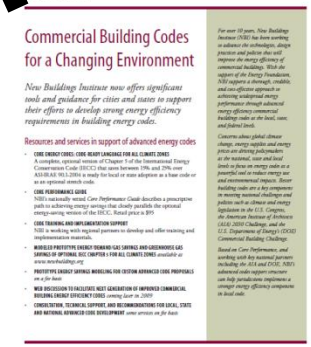
Thought Leadership



Research



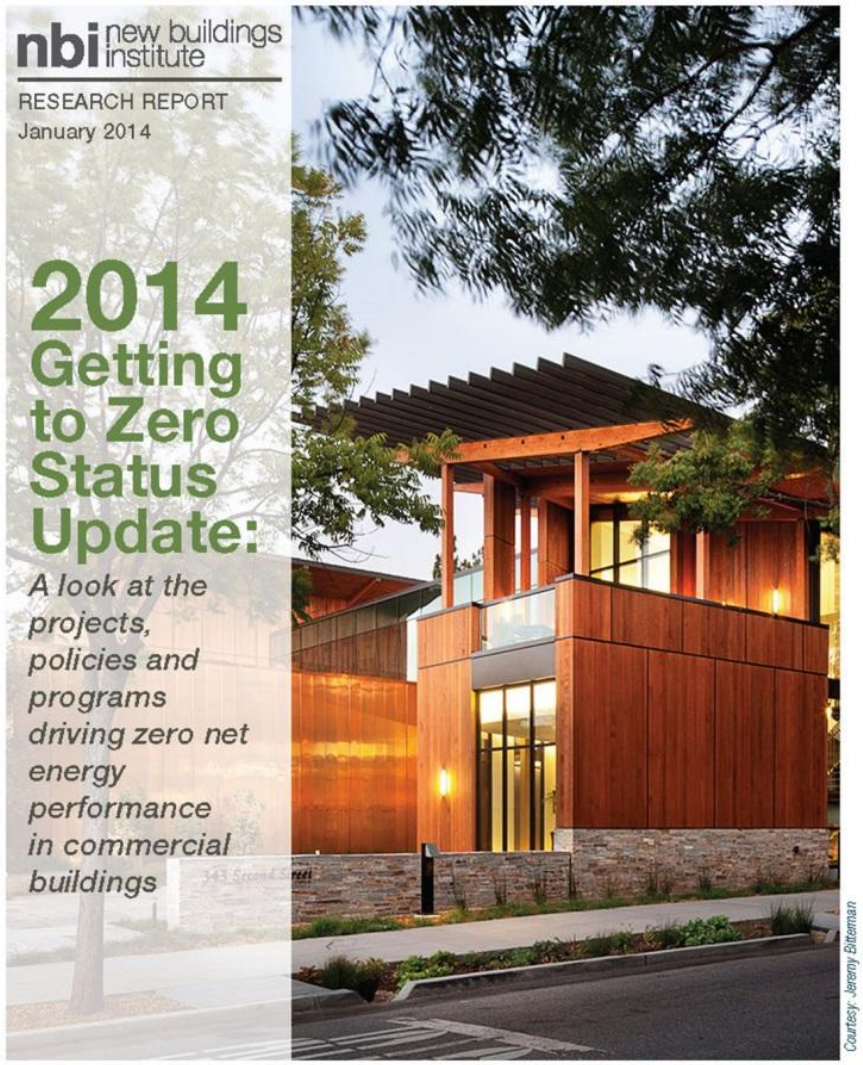
Solutions



Code & Policy

Vision

Research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RESEARCH REPORT
January 2014
2014
Getting to Zero Status Update:
A look at the projects, policies and programs driving zero net energy performance in commercial buildings
Courtesy: Jeremy Bitterman
David and Lucile Packard Foundation, Los Altos, California

Forbes · New Posts · Most Popular: Snapchat's Future · Lists: The 2014 30 Under 30

ENERGY | 6/05/2013 @ 5:36PM | 4,986 views

Building The Capacity To Increase Net Zero Construction

4 comments, 2 called-out + Comment Now + Follow Comments

The net zero building movement (where buildings produce as much or more energy than they co
remains a nascent phenom
As of this time last year, th
Buildings Institute – the
organization that tracks s
– had recognized only 2
as net zero structures.
these exceeded 15,000
The concept of net zer

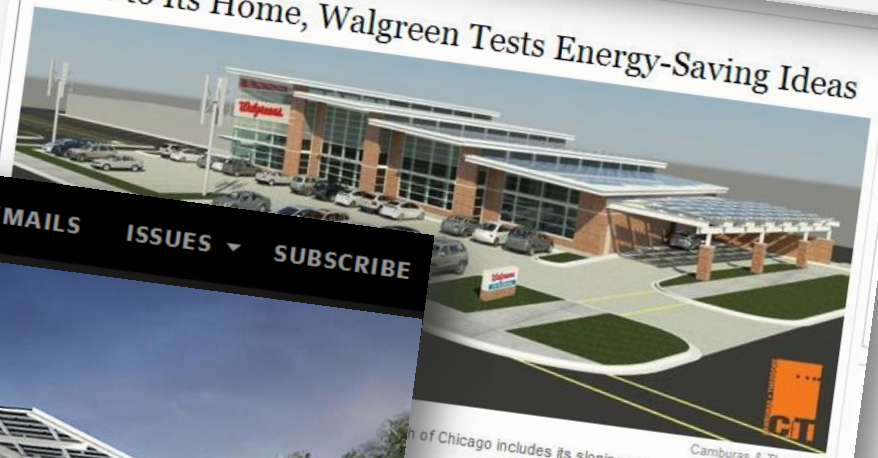
The New York Times

WORLD | U.S. | N.Y. / REGION | BUSINESS | TECHNOLOGY | SCIENCE | HEALTH | SPORTS | OPINION
NEIGHBORHOODS | GREAT HOMES AND DESTINATIONS | COMMERCIAL

Commercial

SQUARE FEET

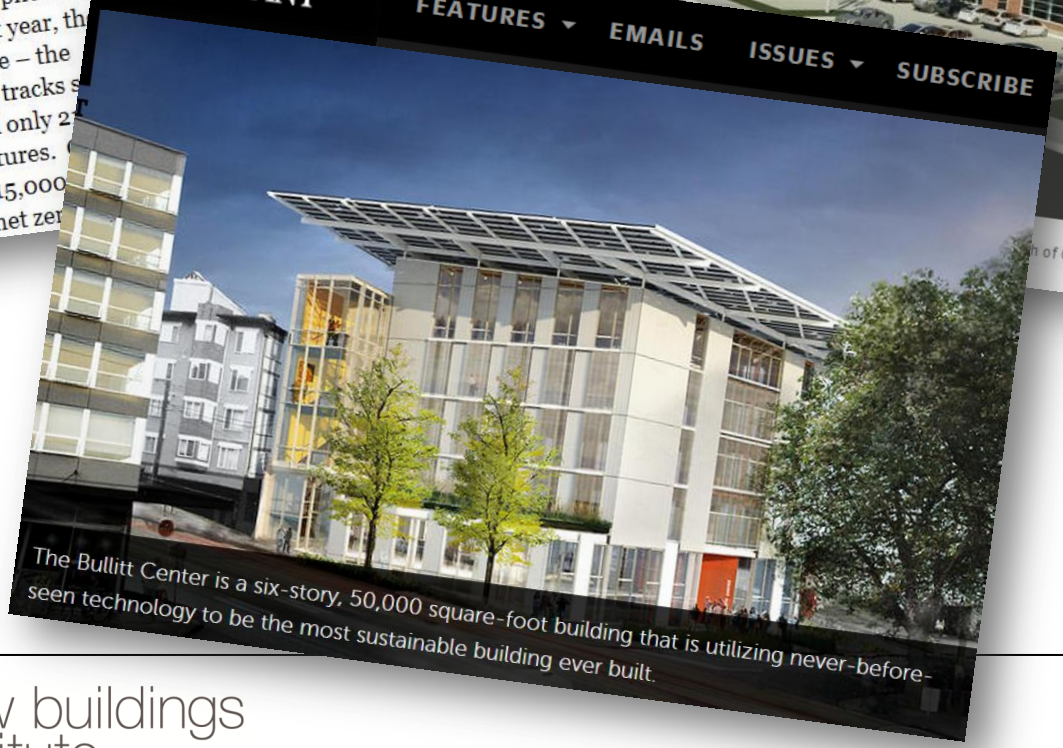
Close to Its Home, Walgreen Tests Energy-Saving Ideas



h of Chicago includes its sloping roof, which is to contain

Camburas & Theodore.

FAST COMPANY · FEATURES · EMAILS · ISSUES · SUBSCRIBE

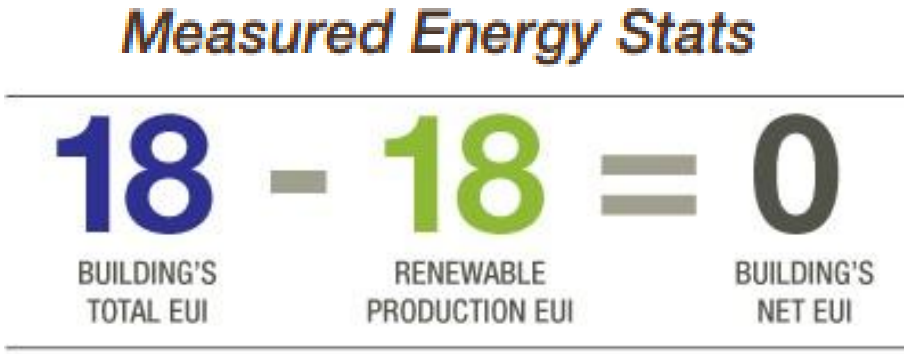


The Bullitt Center is a six-story, 50,000 square-foot building that is utilizing never-before-seen technology to be the most sustainable building ever built.

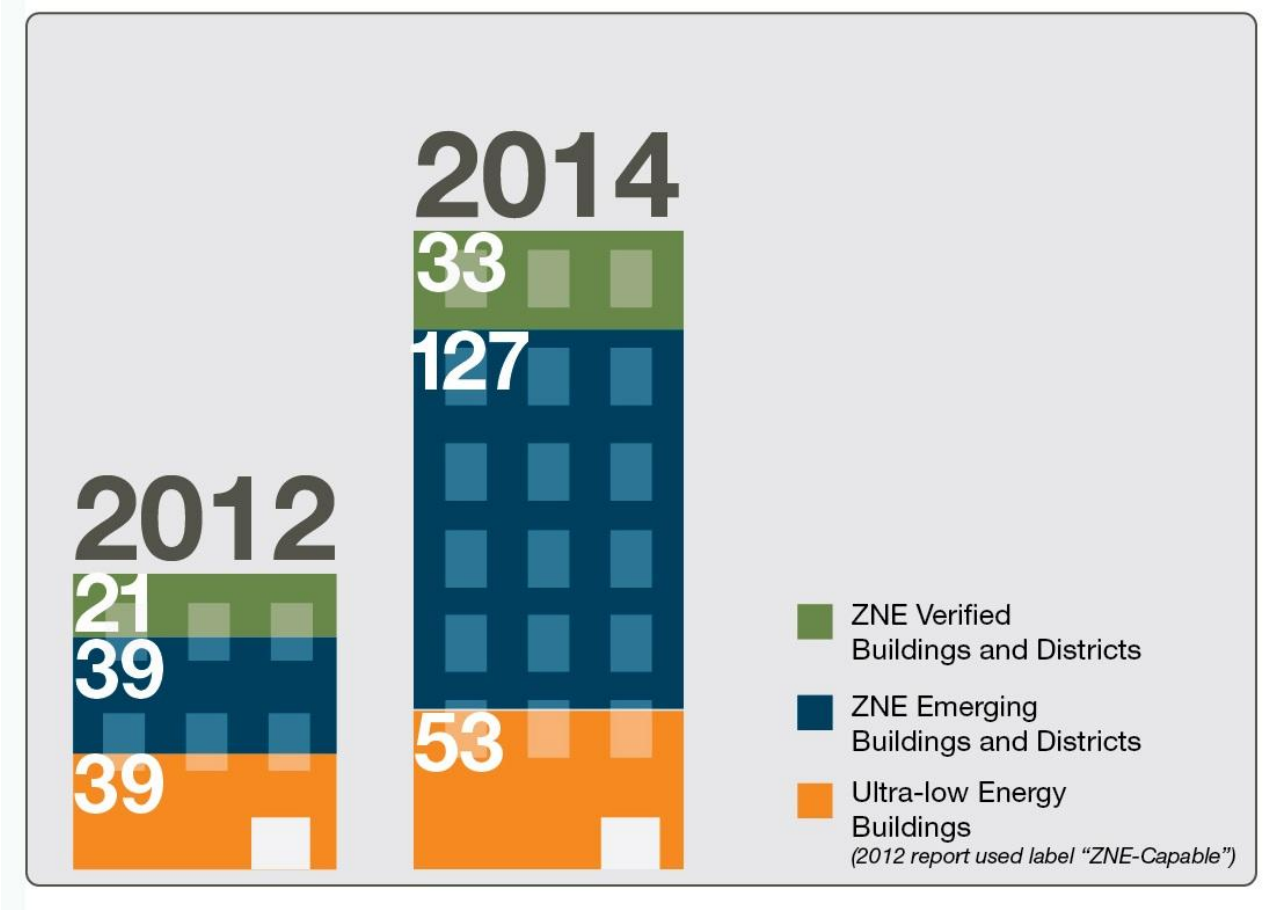
Zero Net Energy

Defined…

Zero Net Energy buildings are buildings with greatly reduced energy load such that, averaged over a year, **100% of the buildings energy use can be met with onsite renewable energy technologies**. *Also known as Net Zero Energy.*



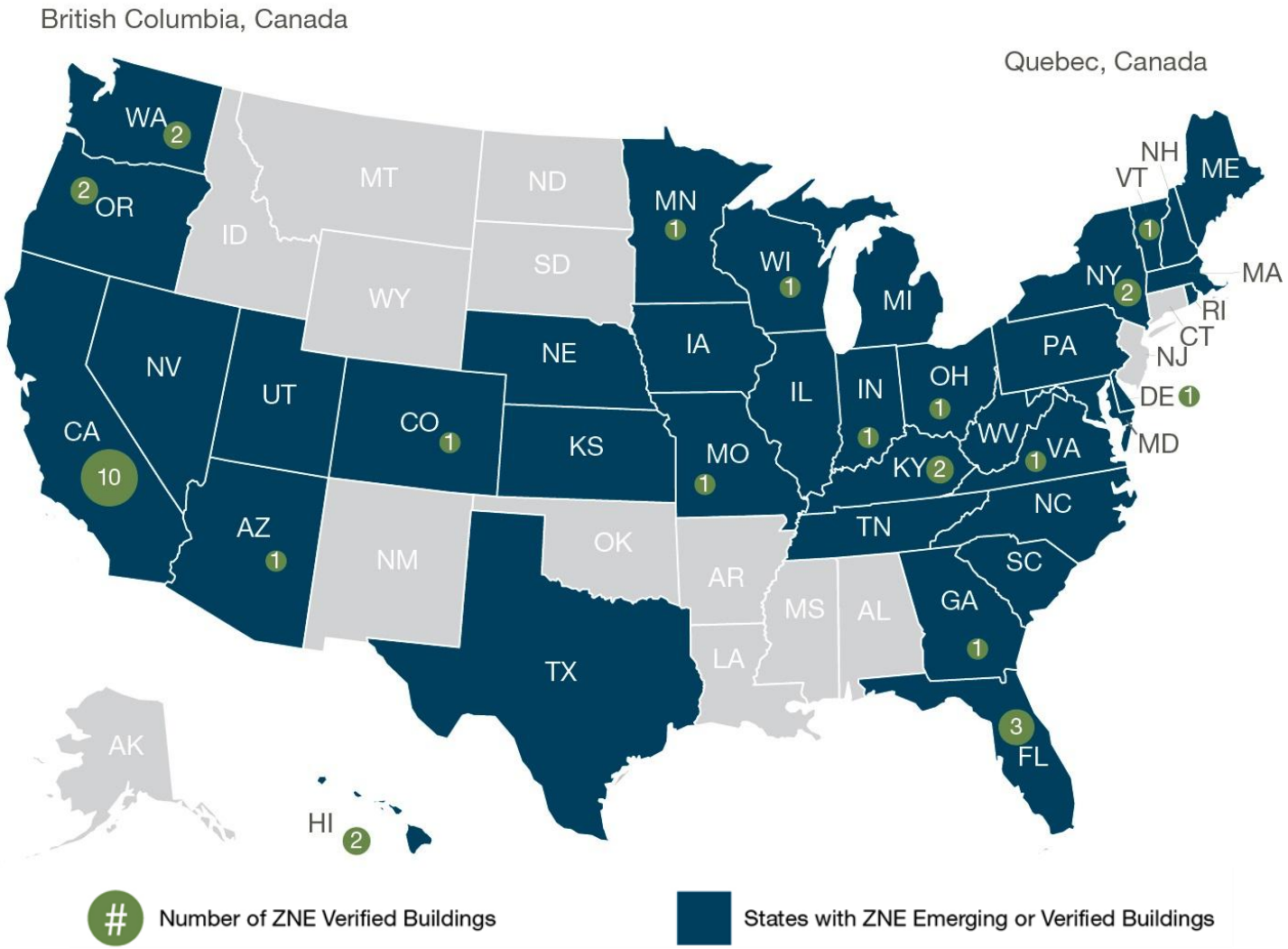
Number of Projects from 2012 to 2014



2014 List of Zero Net Energy Verified Buildings

Year Completed	Name	Location	State	Building Type	Size (sf)	Total Building Actual EUI	Site Renewable EUI	Net Building EUI
2000	Oberlin College Lewis Center	Oberlin	OH	Education- higher	13,600	32	36	-4
2001	Environmental Technology Center Sonoma State	Rohnert Park	CA	Education- higher	2,200	3	4	-1
2002	Challengers Tennis Club	Los Angeles	CA	Other	3,500	9	9	0
	Leslie Shao-Ming Sun Field Station	Woodside	CA	Education- higher	13,200	4	6	-2
2003	Audubon Center at Debs Park	E Los Angeles	CA	Other	5,020	17	17	0
	Science House	St. Paul	MN	Other	1,532	18	18	0
2005	Hawaii Gateway Energy Center	Kailua-Kona	HI	Other	5,600	28	31	-3
2007	Aldo Leopold Legacy Center	Baraboo	WI	Office	11,884	16	18	-2
	IDeAs Z2 Design Facility (1)	San Jose	CA	Office (R)	6,557	21	25	-4
2008	Camden Friends Meeting Social Hall	Camden	DE	Public Assembly	2,864	18	20	-2
	Environmental Nature Center	Newport Beach	CA	Other	8,535	18	28	-10
	Hudson Valley Clean Energy Headquarters	Rhinebeck	NY	Other	5,470	13	13	0
2009	Bacon Street Offices	San Diego	CA	Office (R)	4,500	13	22	-9
	Chrisney Library	Chrisney	IN	Library	2,400	15	18	-3
	Living Learning Center at Tyson Research Center (1)	Eureka	MO	Education- higher	2,968	24	24	0
	Omega Center for Sustainable Living (1)	Rhinebeck	NY	Other	6,200	13	21	-8
	Pringle Creek Painter's Hall (1)	Salem	OR	Public Assembly (R)	3,600	21	21	0
	Putney Field House	Putney	VT	Education- K-12	16,800	10	10	0
2010	Bertschi School Science Wing (1)	Seattle	WA	Education- K-12	1,425	48	48	0
	Dovetail Construction Headquarters Barn	Richmond	VA	Office (R)	6,800	UA	UA	0
	DPR Construction San Diego Net Zero Office	San Diego	CA	Office (R)	24,000	15	17	-2
	Energy Lab at Hawaii Preparatory Academy (1)	Kamuela	HI	Education- K-12	5,902	11	11	0
	Hood River Middle School Net-Zero Addition	Hood River	OR	Education- K-12	5,331	27	27	0
	NREL Research Support Facility	Golden	CO	Office	222,000	33	33	0
	Richardsville Elementary School	Bowling Green	KY	Education- K-12	72,285	18	18	0
2011	Anna Maria Historic Green Village	Anna Maria	FL	District (R)	District	28	35	-7
	Locust Trace AgriScience High School Campus	Lexington	KY	Education- K-12	70,000	10	11	-1
	TD Bank Branch - Ft Lauderdale	Fort Lauderdale	FL	Other	3,970	92	96	-4
	Vacaville Transportation Center	Vacaville	CA	Other	261,360	0.1	0.2	-0.1
	ZHome - Issaquah (1)	Issaquah	WA	Multifamily	5,813	21	22	-1
2012	David and Lucile Packard Foundation	Los Altos	CA	Office	49,161	24	28	-4
	DPR Construction Phoenix Regional Office (1)	Phoenix	AZ	Office (R)	16,533	27	30	-3
	Leon County Cooperative Extension	Tallahassee	FL	Office (R)	13,000	19	19	0

Where Are They?



Hawaii ZNE Projects

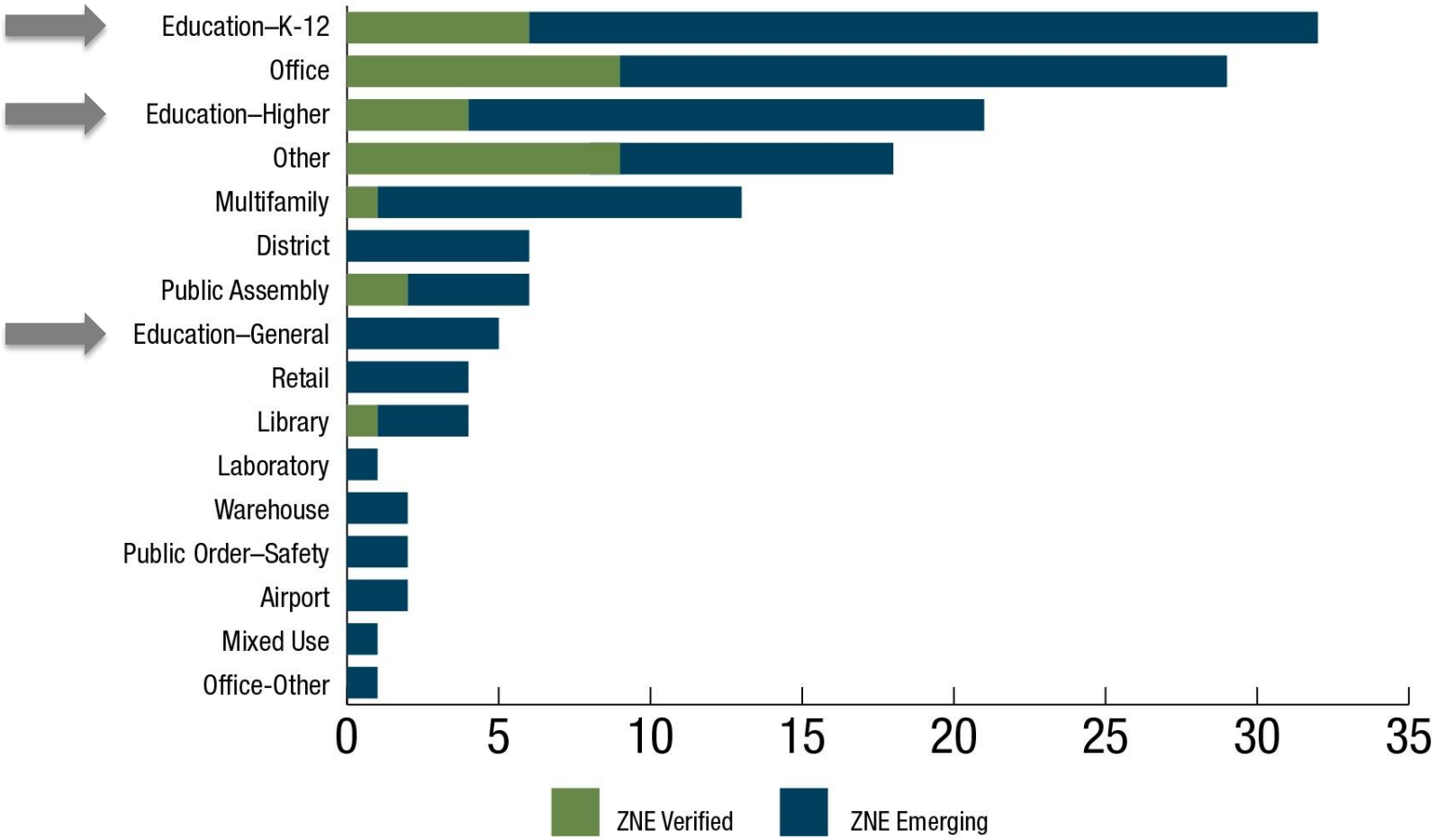
ZNE Verified:

- Energy Lab at Hawaii Preparatory Academy
- Hawaii Gateway Energy Center

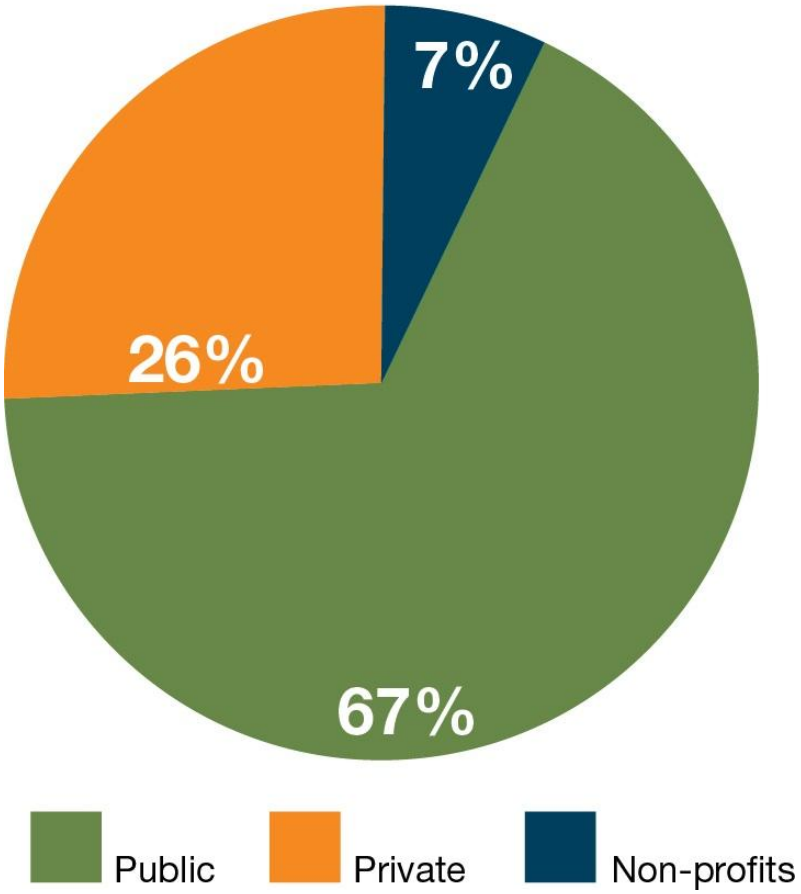
ZNE Emerging:

- Ewa Elementary School Portable Classroom – Oahu
- Kalaeloa NZE Community
- Kaupuni Village

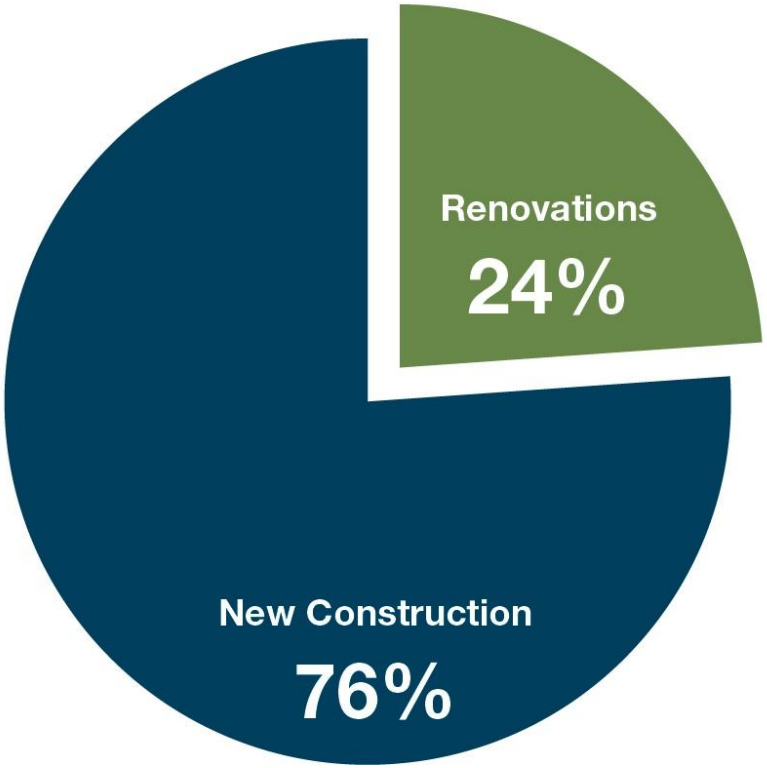
Building Types



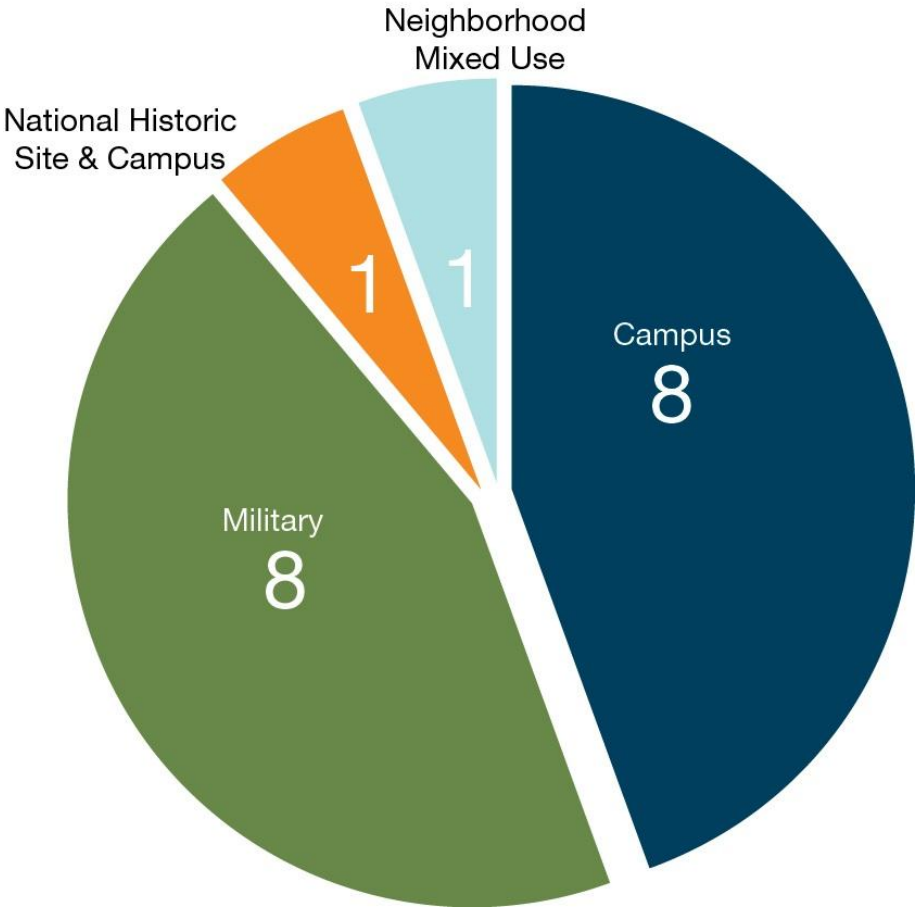
Ownership Type



Existing Building Renovation



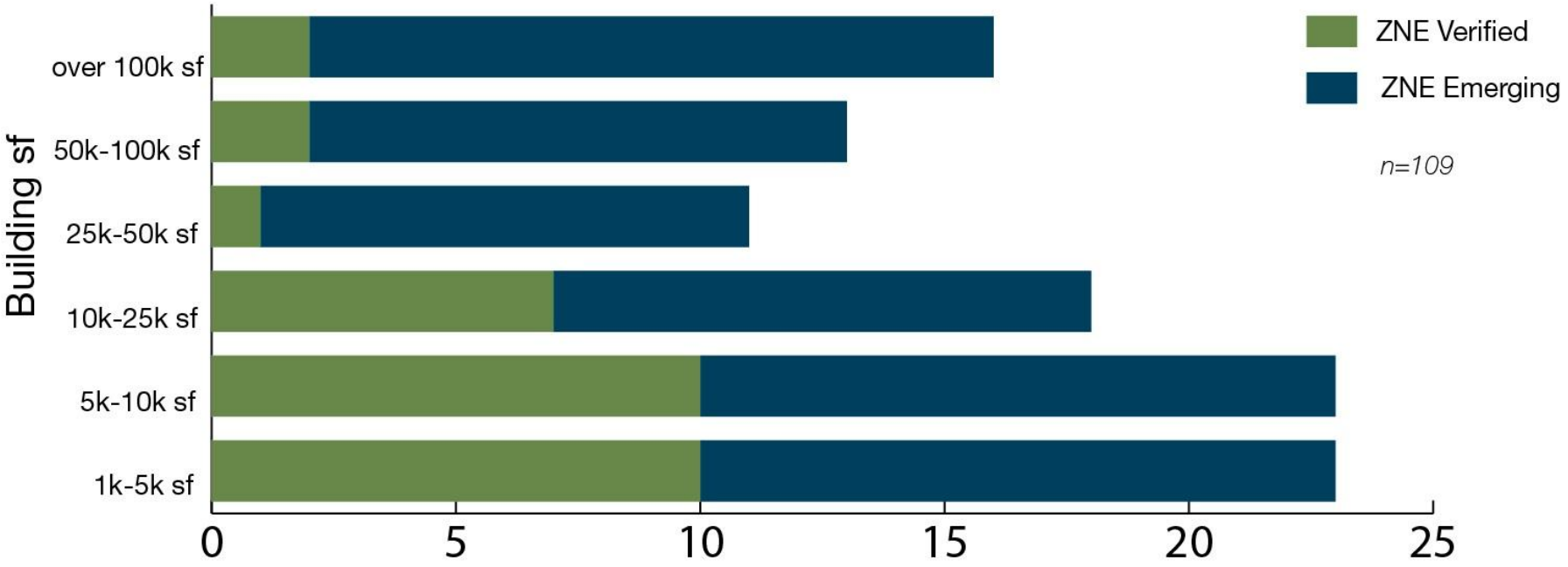
18 ZNE Districts



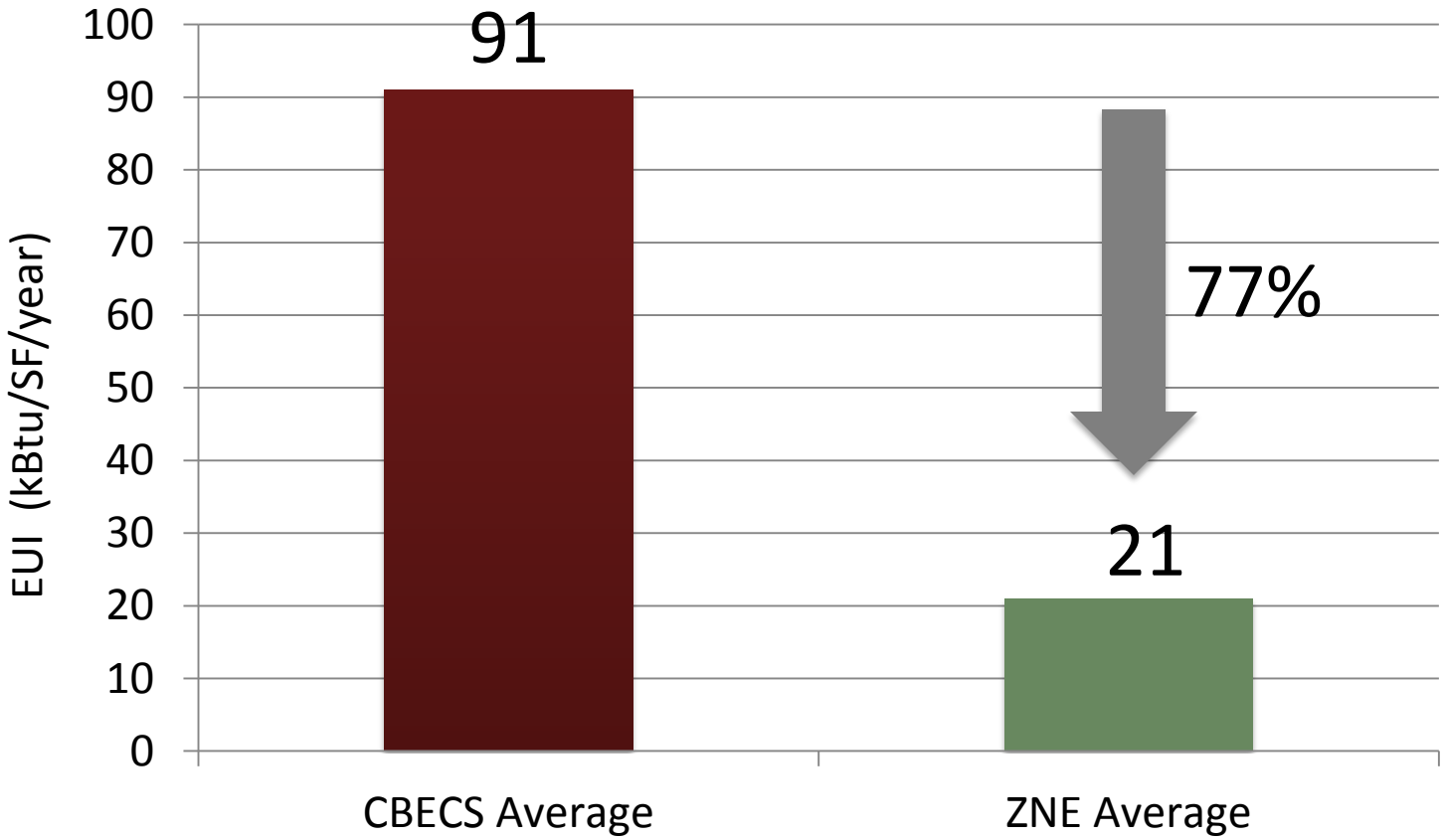
TD Bank Prototype

Photos courtesy of Turner Construction

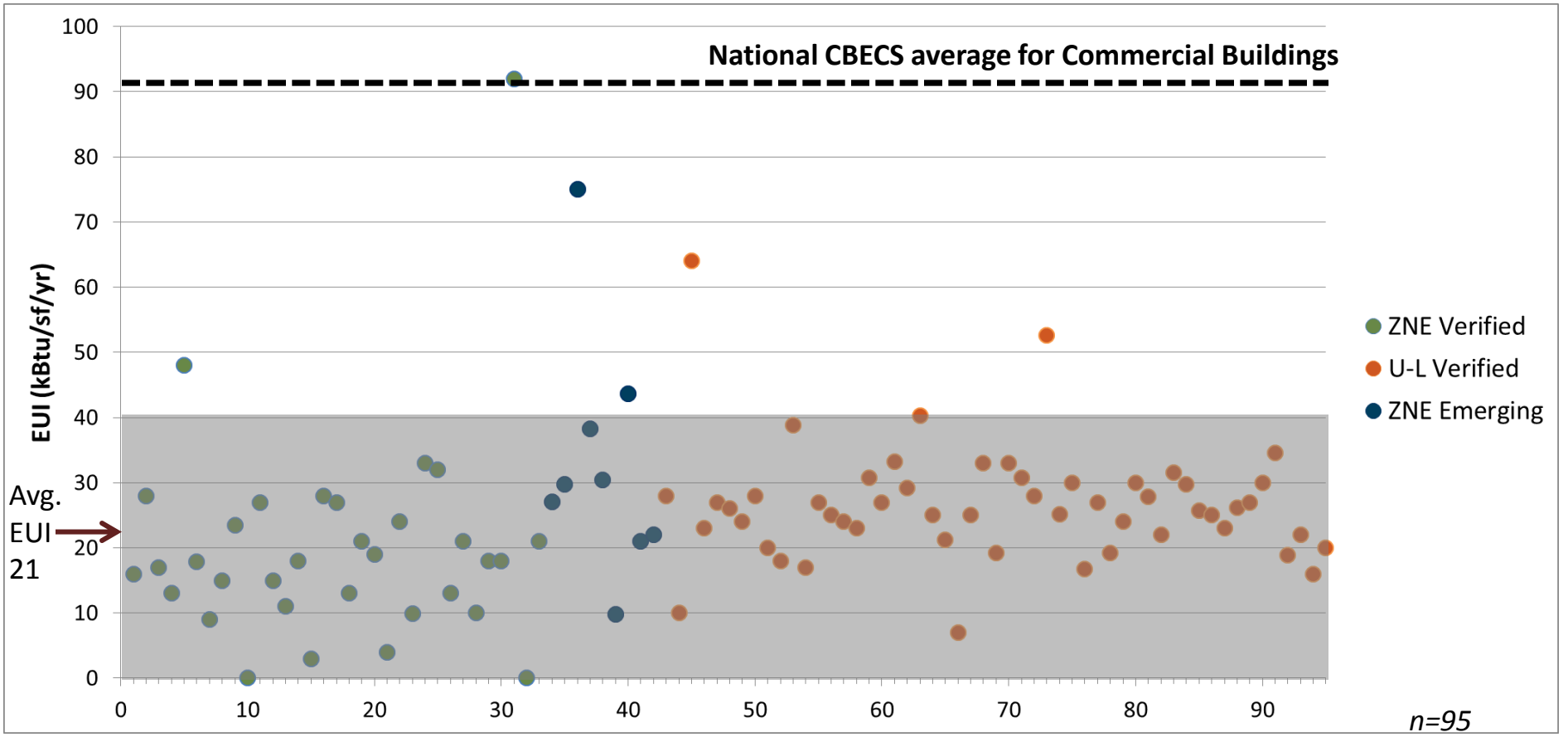
Building Size



Energy Use Index of ZNE Buildings



Performance Range
(all projects w/ measured performance data)

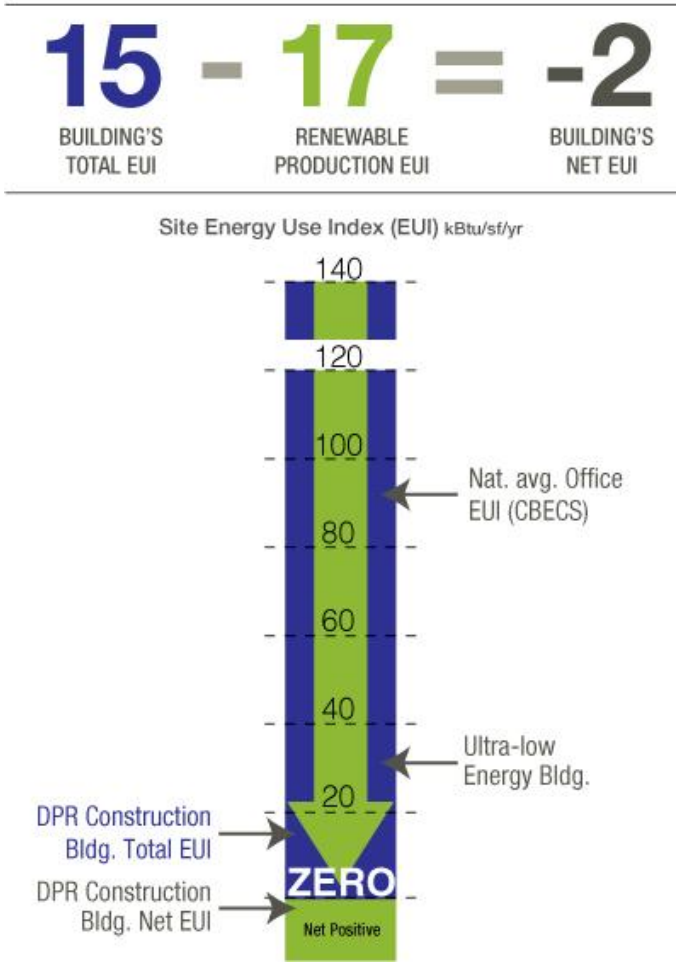


DPR Construction San Diego

- San Diego, CA
- 24,500 SF
- Office
- LEED NC Platinum
- ILFI Zero Energy Building Certified
- Callison Architecture
- DPR Construction, Owner, Design/Builder

Photo: DPR Construction

DPR Construction San Diego



Efficiency Measures:

- Natural ventilation
- Daylighting
- Roof monitors
- Efficient HVAC
- Solatubes and high performance lighting
- 64 kW PV

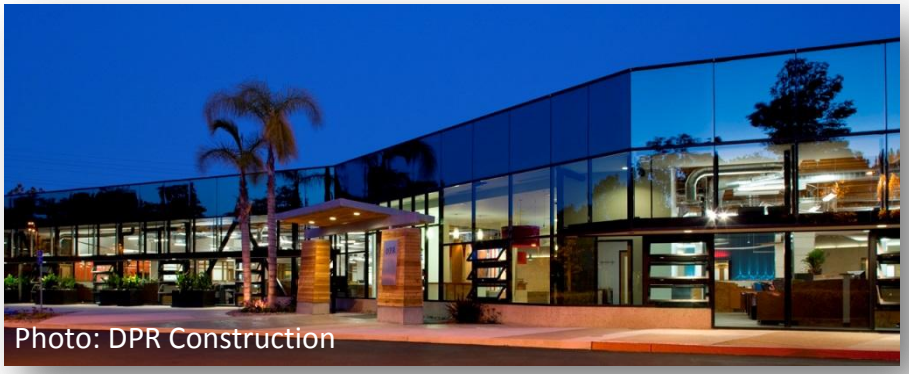


Photo: DPR Construction

Richardsville Elementary School

- Bowling Green, KY
- 72,300 SF
- Education K-12
- Completed in 2010
- LEED Gold
- $206/SF
- Warren County Public Schools
- Sherman Carter Barnhart, Architect
- CMTA, Mechanical and Electrical

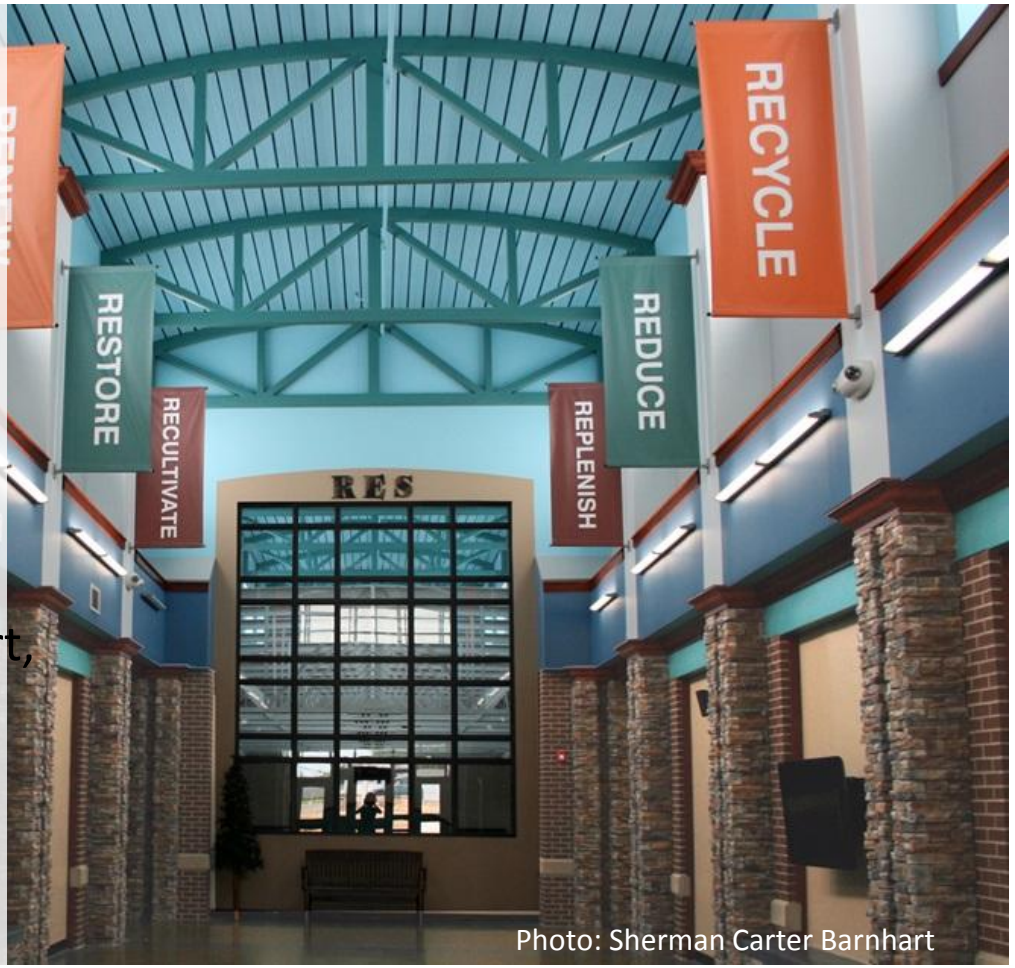
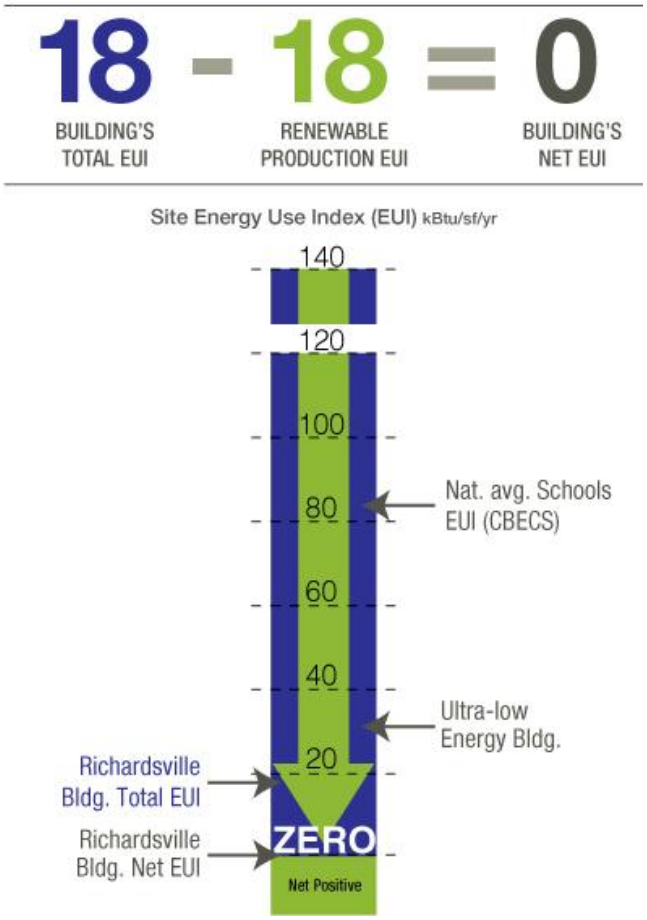


Photo: Sherman Carter Barnhart

Richardsville Elementary School



Efficiency Measures:

- Ground source heat pump
- DOAS
- CO2 sensors
- Daylighting
- High performance lighting system with controls
- EMS & Energy Dashboard


Photo: Sherman Carter Barnhart

Overall Trends

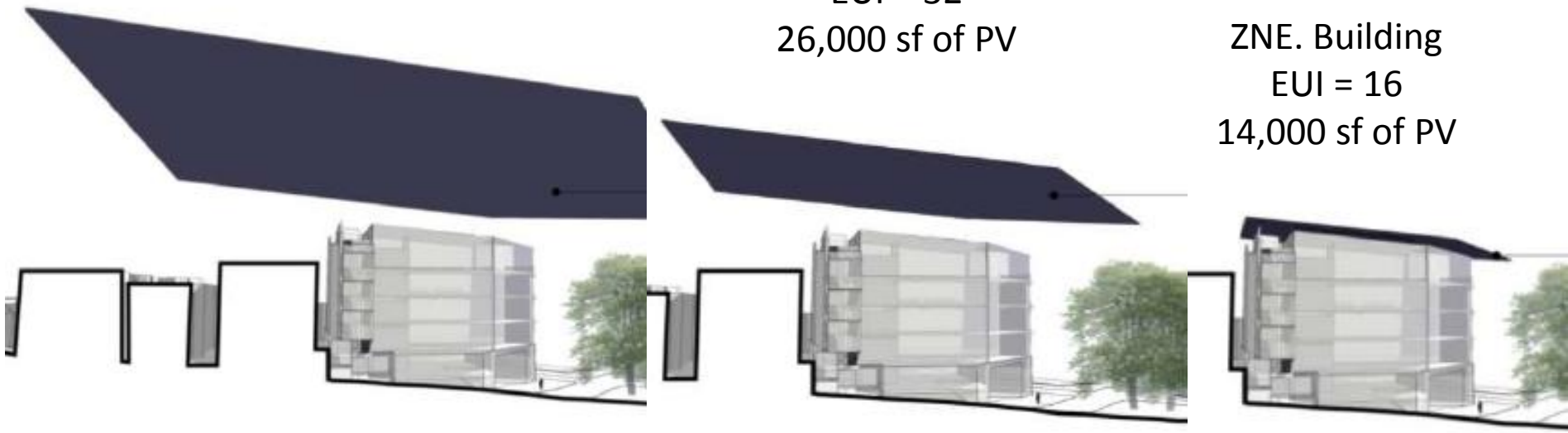
- ZNE is achievable in a **wide variety of regions** and **climate zones**
- ZNE works for **many building types and sizes**
- ZNE is achievable during **existing buildings renovations**
- **Private sector** is increasingly embracing ZNE
- ZNE **districts** are a growing trend
- Large proportion ZNE buildings are in the **educational sector**

Bullitt Center: begin with a Solar Budget

Typical U.S. Building
EUI = 92
64,000 sf of PV

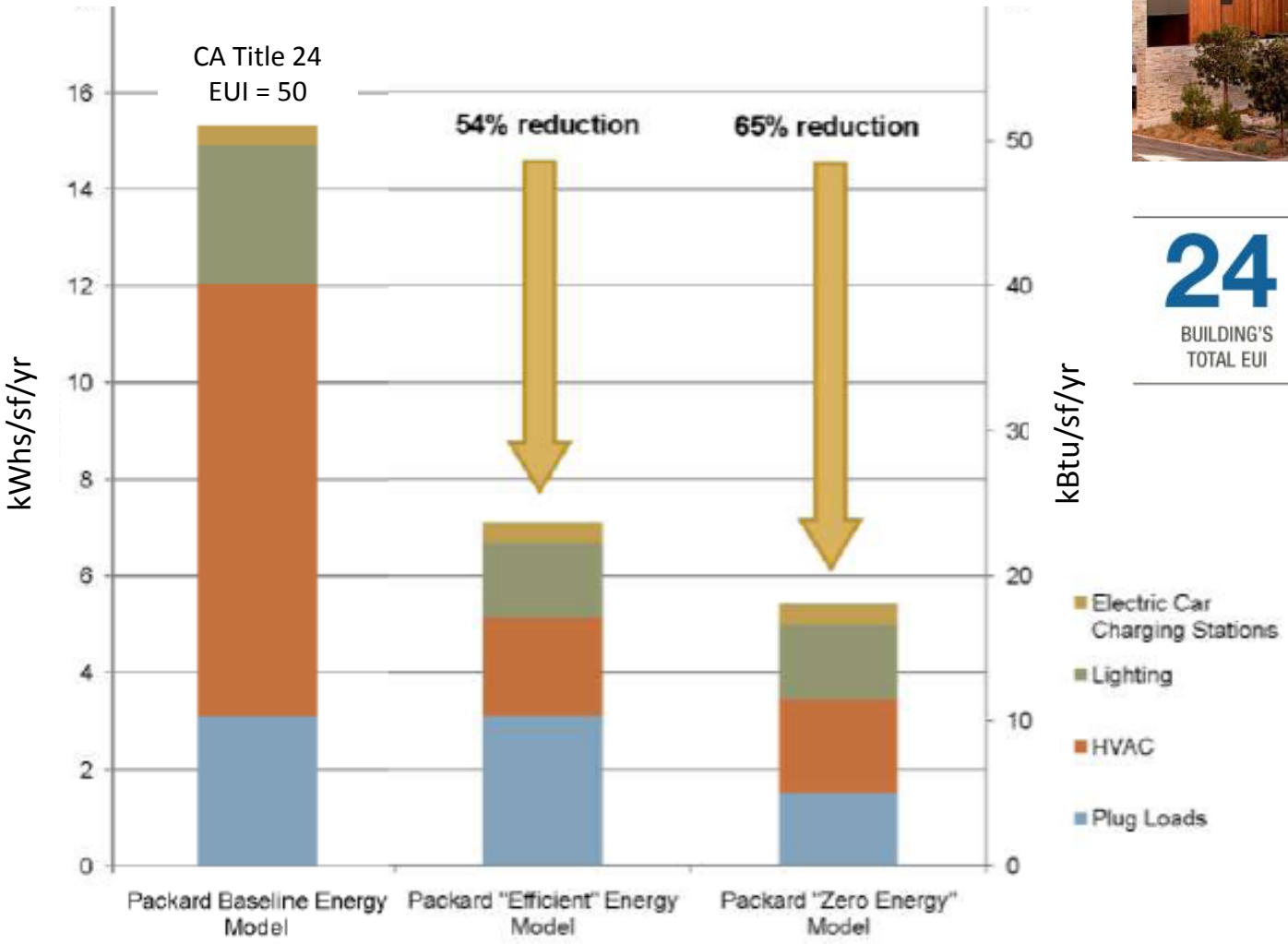
High Performance Building
EUI = 32
26,000 sf of PV

ZNE. Building
EUI = 16
14,000 sf of PV



Courtesy: PAE Consulting Engineers

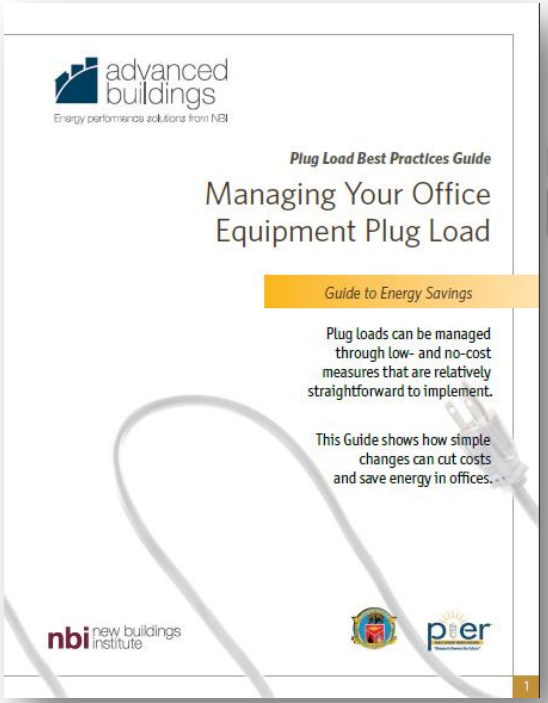
Packard Building Energy Model

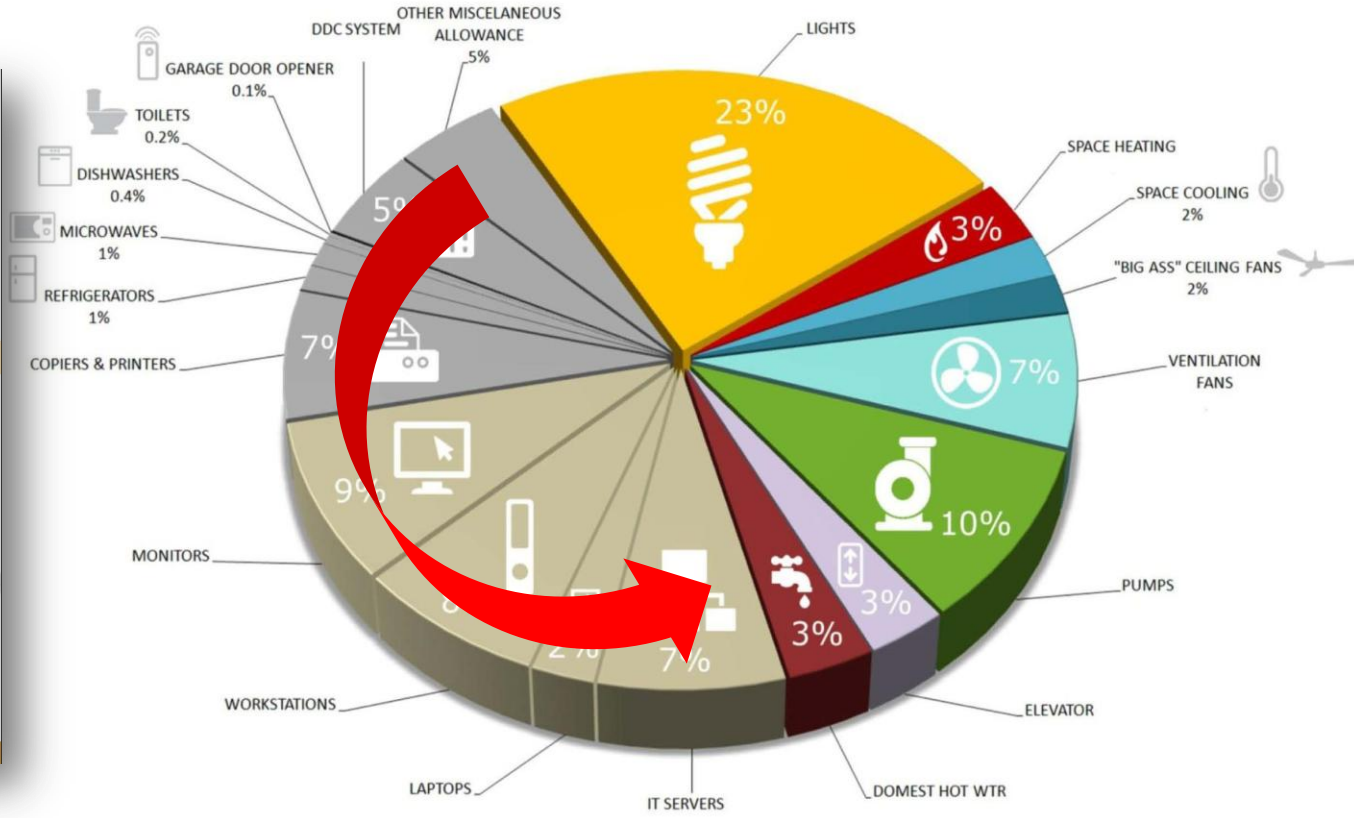


Courtesy: EHDD

Bullitt Center Modeled EUI: 16

Focus on Occupancy and Plug Loads





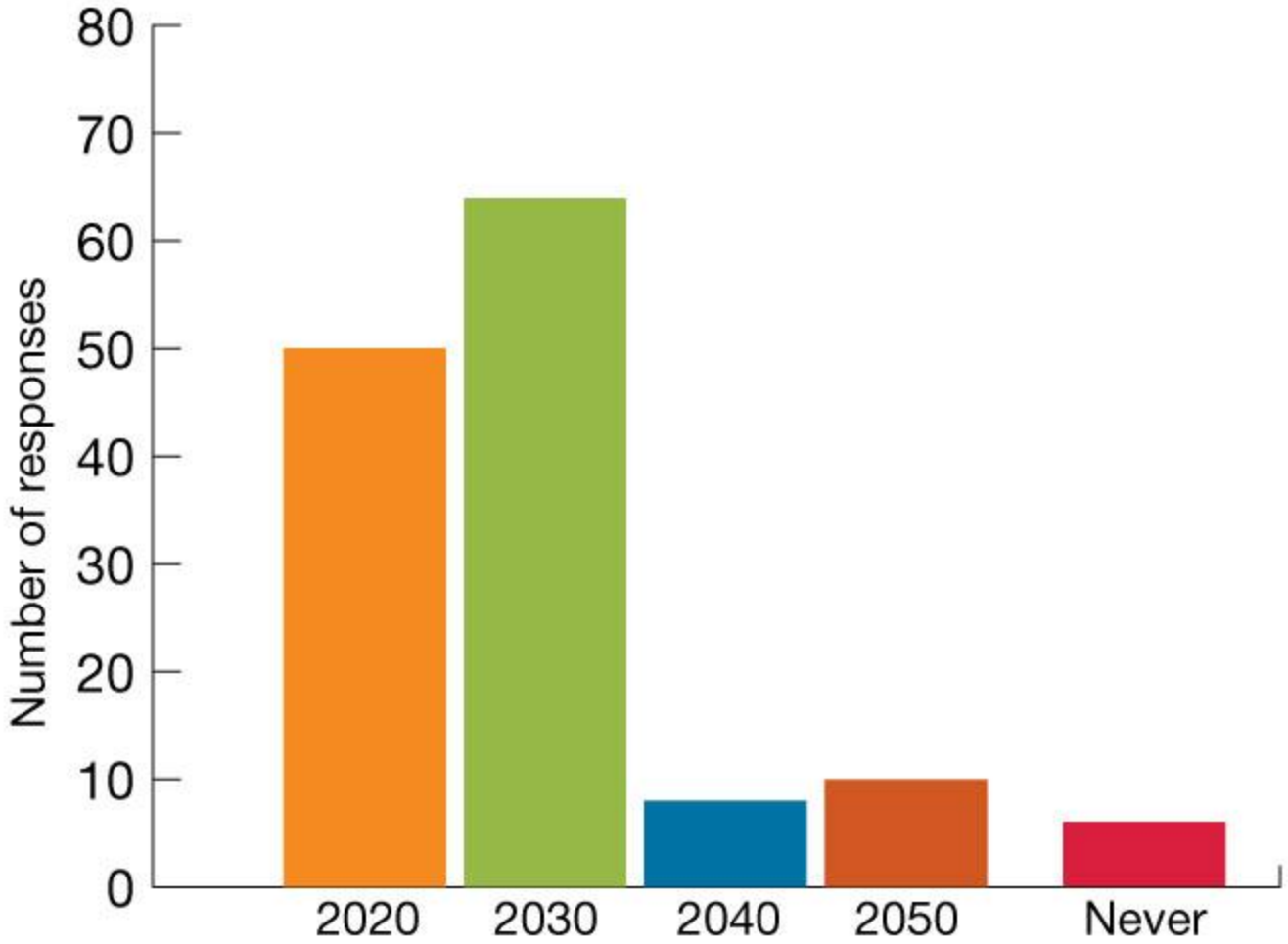
Courtesy of PAE Consulting Engineers

Ultra-low Energy Technologies and Strategies

- Ground Source Heat Pumps
- Ventilation: Natural, Dedicated Outdoor Air Systems (DOAS), Demand Control Ventilation (DCV)
- Highly Efficient Thermal Envelope
- Building Orientation & Glazing ratio
- Solar Control - shading
- Daylighting Access and Controls
- Energy Management Systems
- Building Dashboards
- Radiant Heating / Cooling & Chilled Beams
- Plug load Reductions
- Energy Recover Systems

NASA Sustainability Base, CA
Courtesy: Cesar Rubio Photography, McDonough & Partners

Given your knowledge of and experience with ZNE buildings, when do you think ZNE will be considered a mainstream approach?



Based on a survey conducted by NBI of 140 leading practioners in the sustainable buildings industry

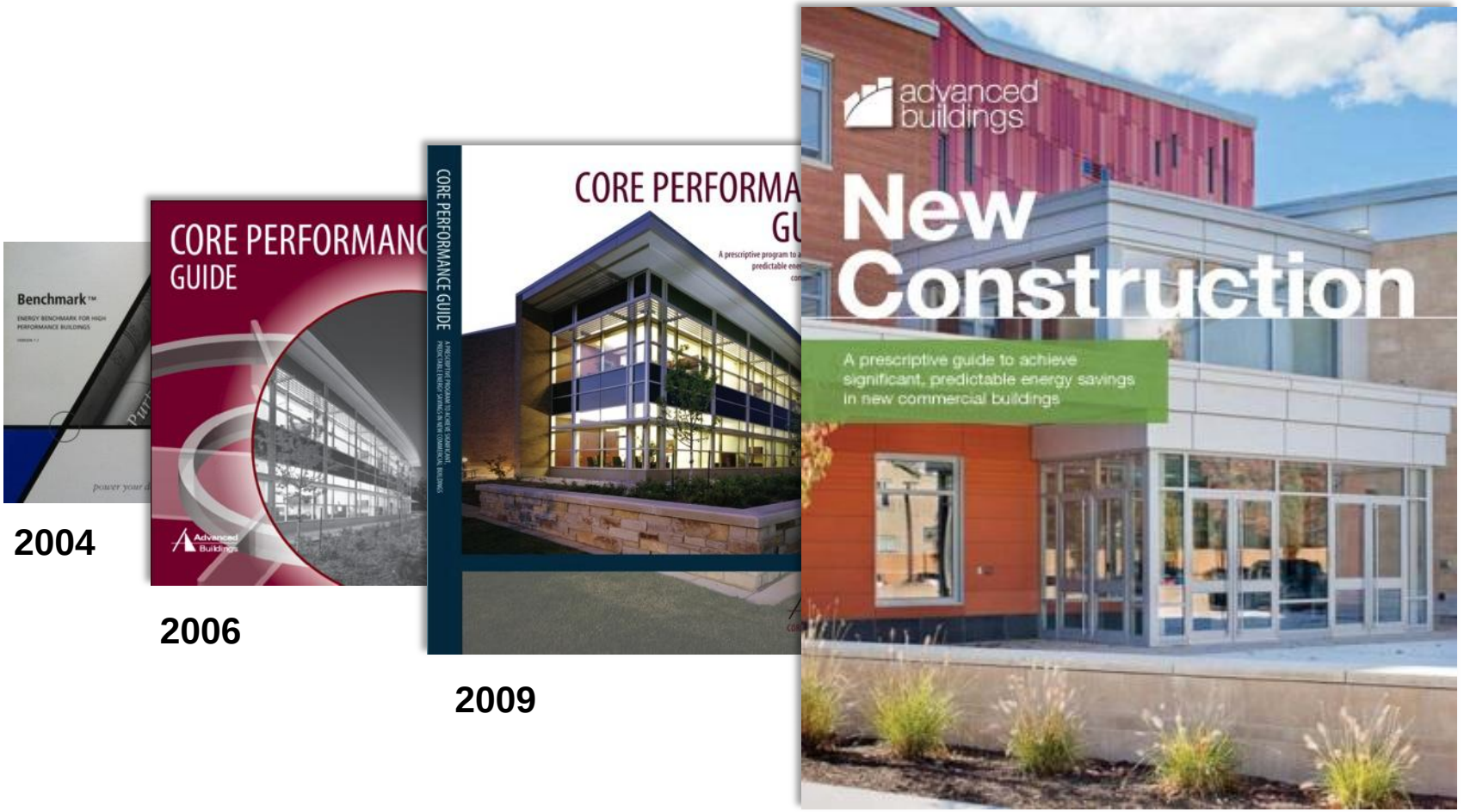
Solutions

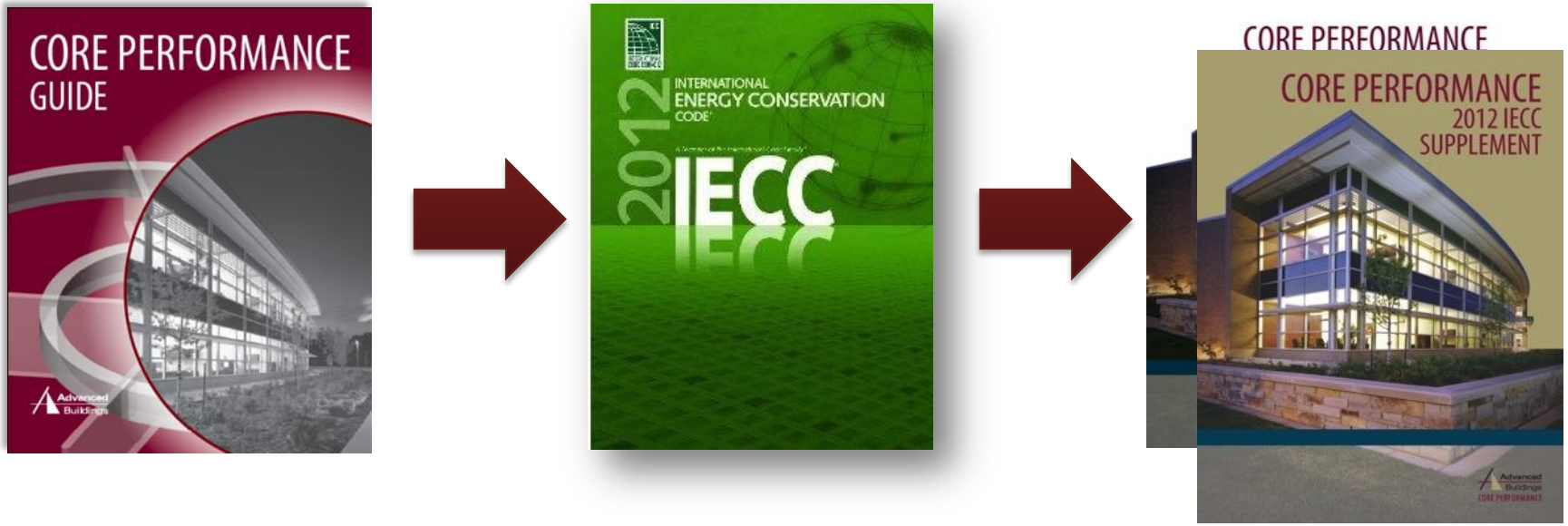
Advanced Buildings New Construction Guide

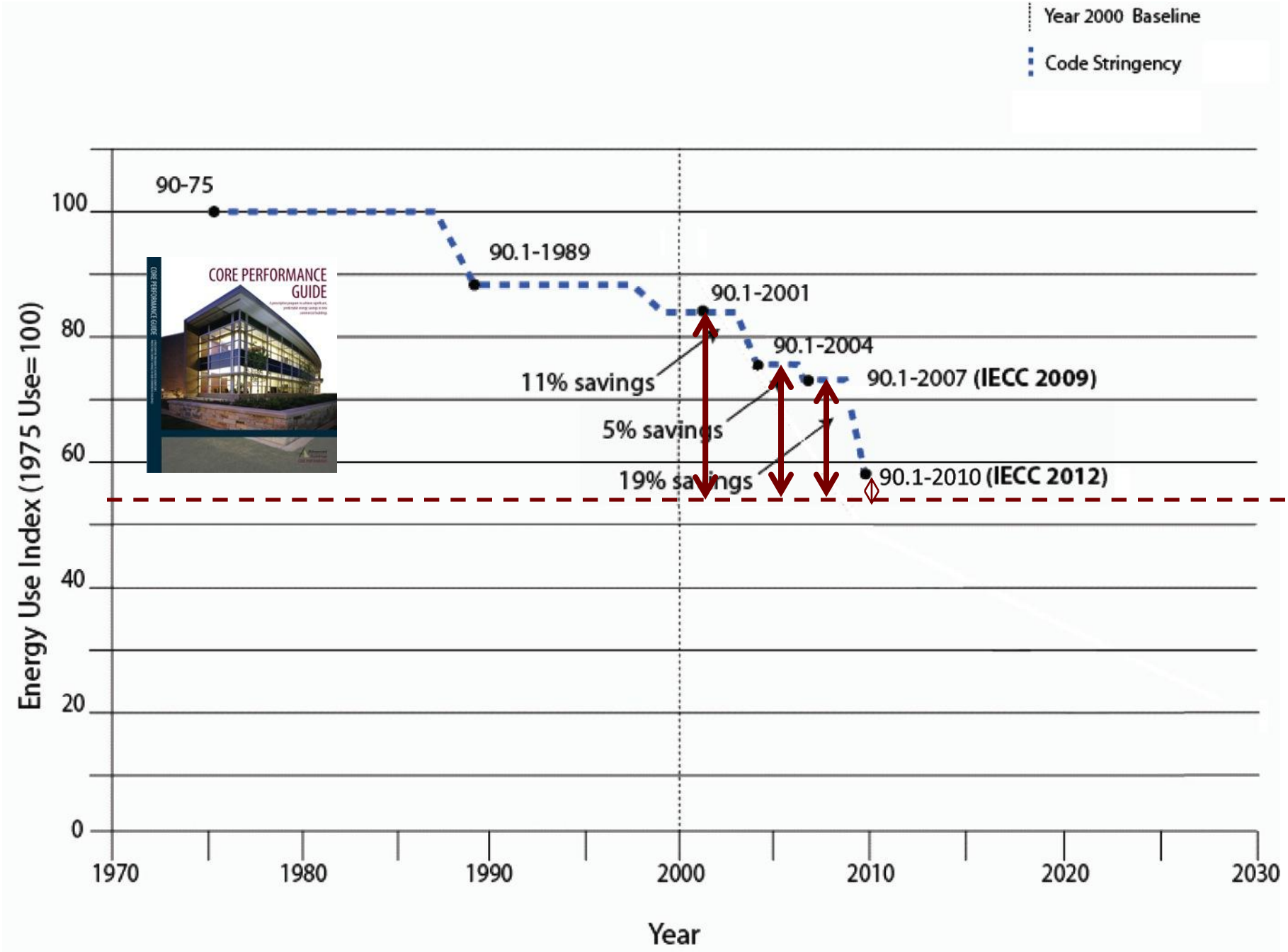
Commercial Buildings under 100,000 sf

- Office
- Retail
- Elementary & private schools
- Town Halls, Fire & Police Stations

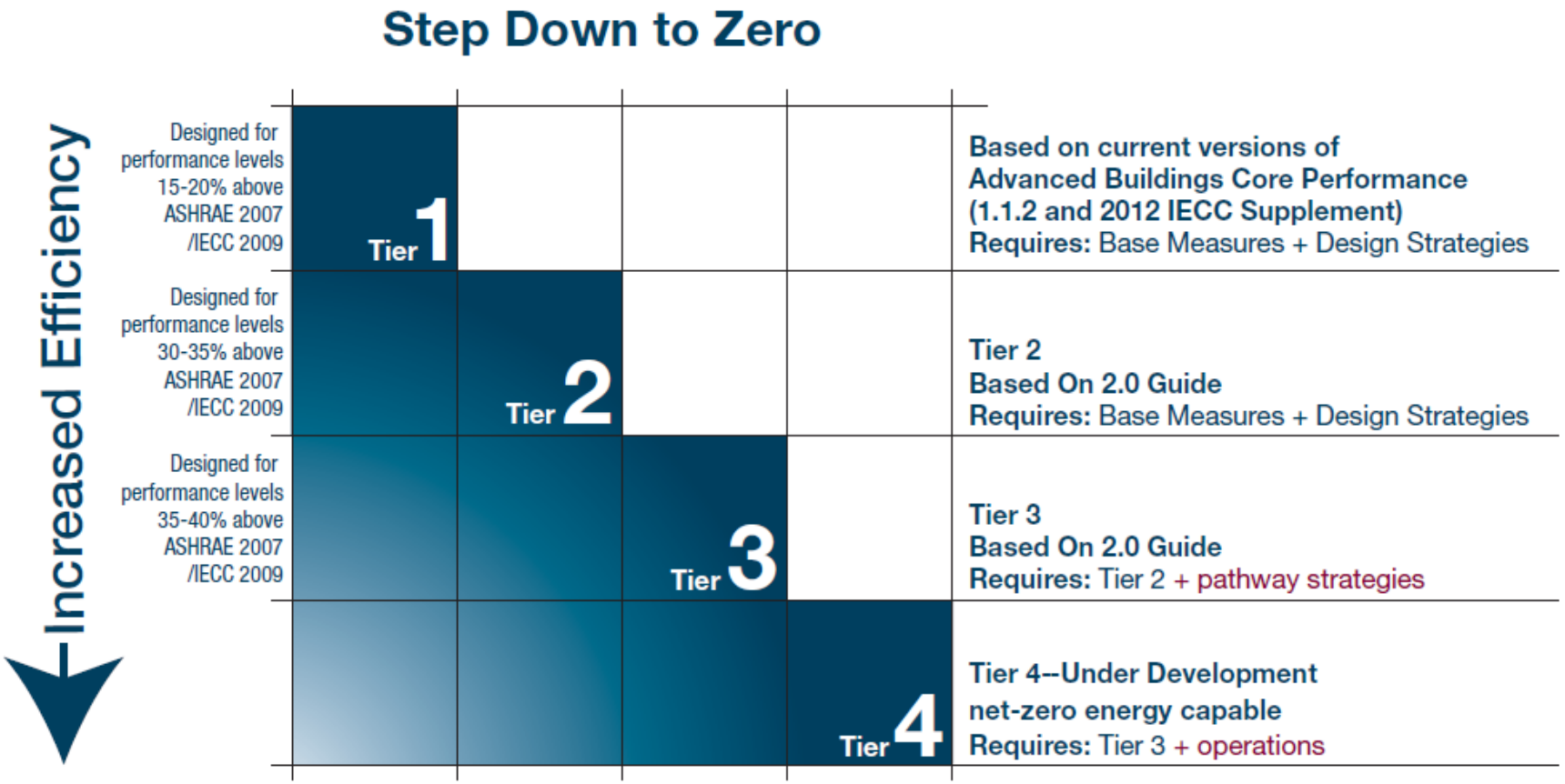
Guide Evolution




CORE PERFORMANCE
GUIDE
Advanced Buildings
2012
INTERNATIONAL
ENERGY CONSERVATION
CODE
IECC
CORE PERFORMANCE
CORE PERFORMANCE
2012 IECC
SUPPLEMENT
Advanced Buildings
CORE PERFORMANCE


Year 2000 Baseline
Code Stringency
90-75
90.1-1989
90.1-2001
90.1-2004
90.1-2007 (IECC 2009)
90.1-2010 (IECC 2012)
11% savings
5% savings
19% savings
CORE PERFORMANCE GUIDE
Energy Use Index (1975 Use=100)
100
80
60
40
20
0
1970
1980
1990
2000
2010
2020
2030
Year

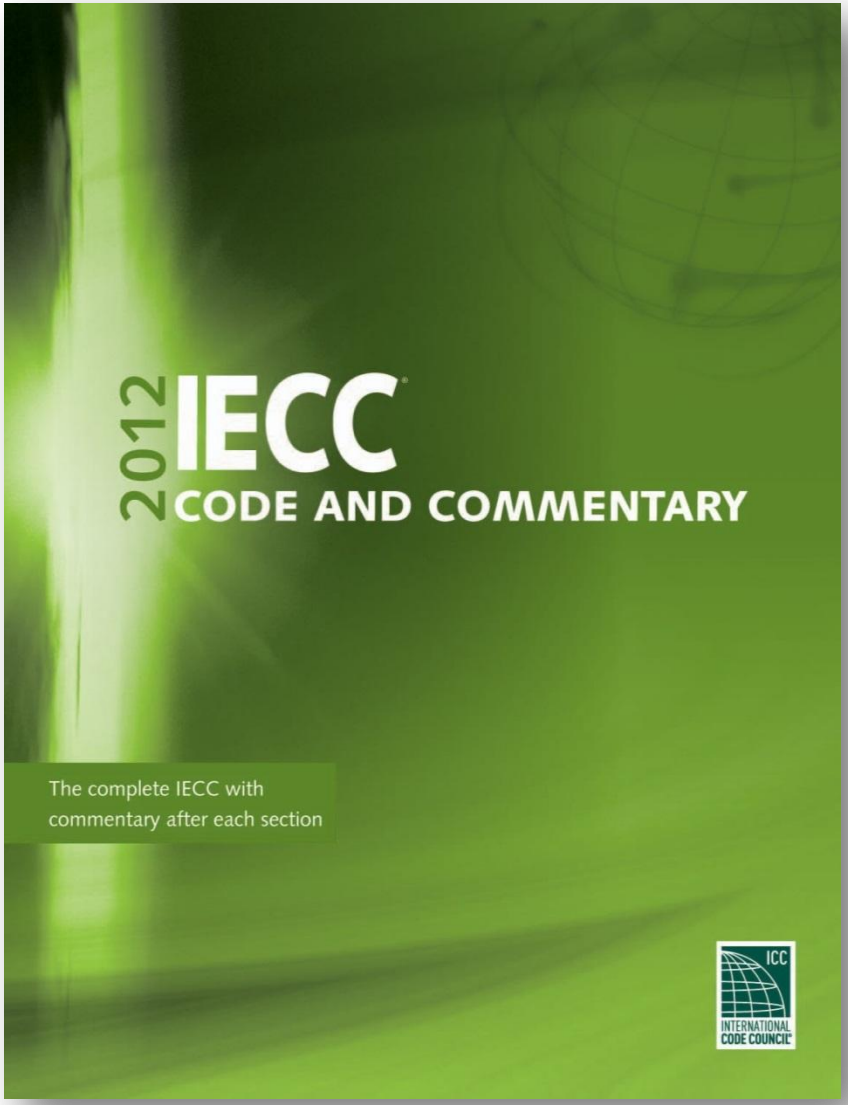
AB Energy Performance Tiers



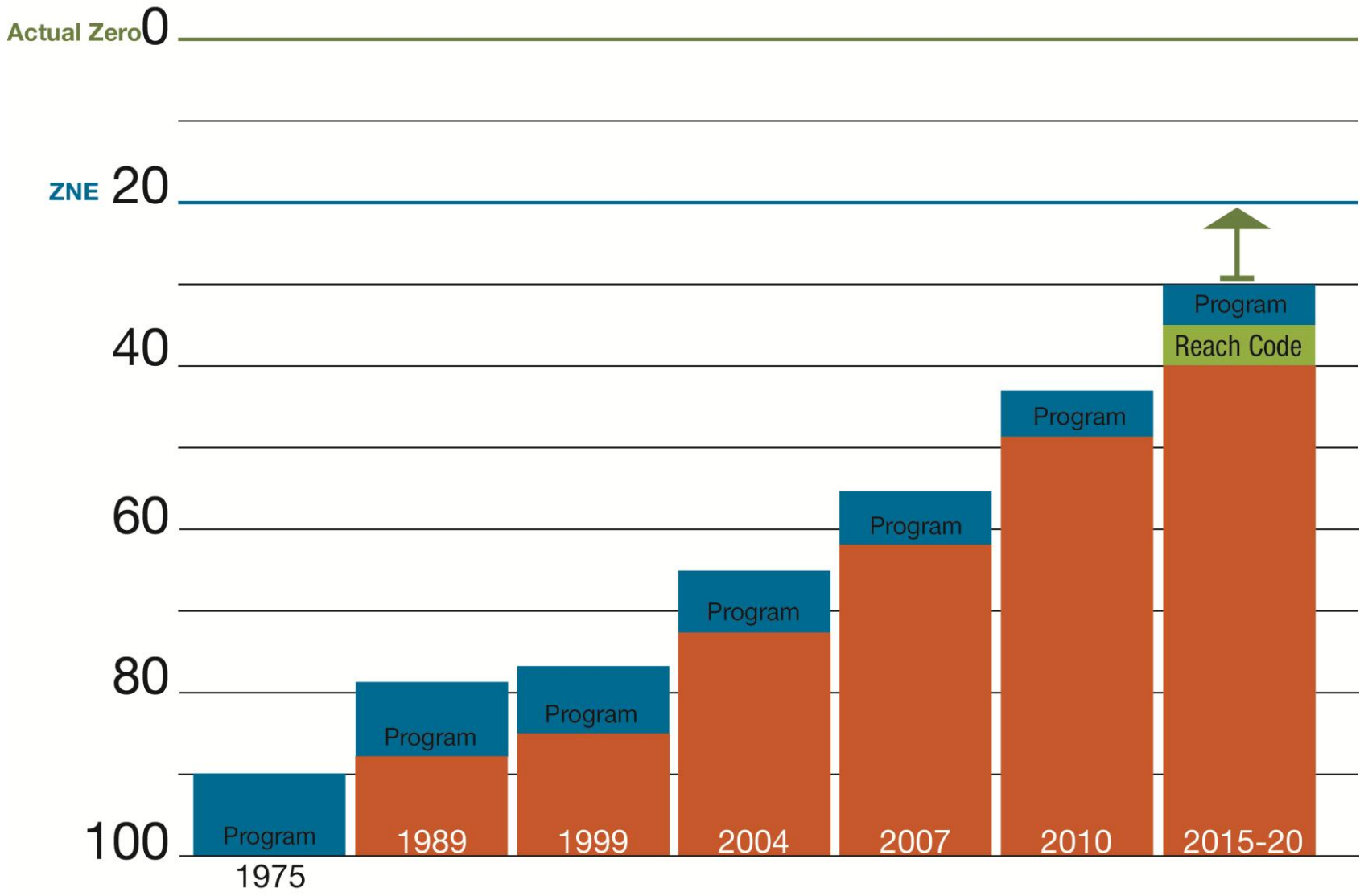
Approximate Range of Savings from Advanced Buildings Requirements

Base Code and Year		Range of Savings		
ASHRAE 90.1	IECC	Tier 1	Tier 2	Tier 3
2004	2006	20-30%		
2007	2009	15-25%	25-35%	>40%
2010	2012	n/a	15-25%	>30%

Codes and Policy



45 Years of Codes and Programs



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advanced buildings

State Buildings ZNE goals-
Adopted by Executive Order in 2012

- All new state buildings and major renovations starting design in 2025 shall be ZNE
- 50% of new state facilities beginning design after 2020 shall be ZNE

- State agencies shall strive towards ZNE for 50% of existing state-owned building area by 2025.

Code Cycles to ZNE

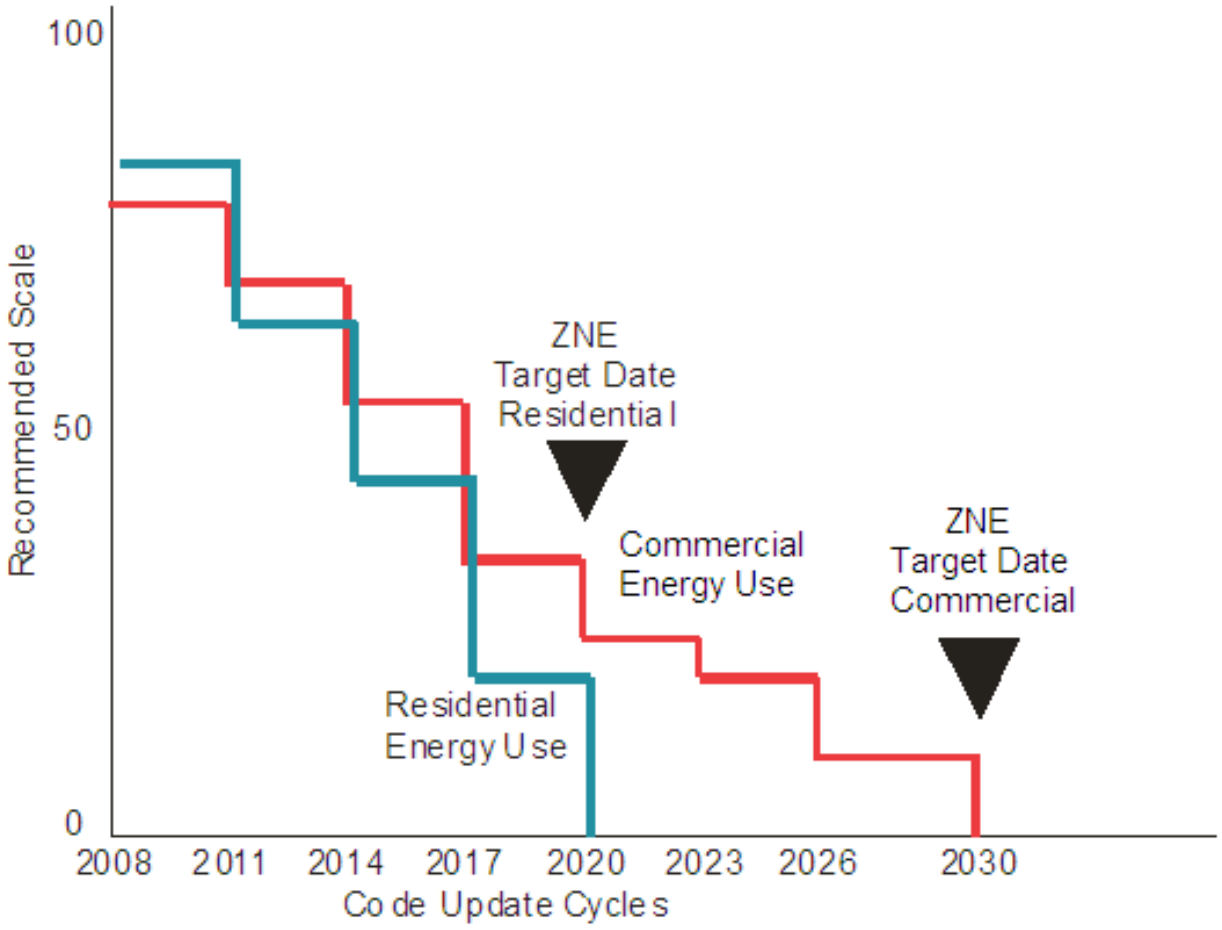

Figure 2. Code Cycles to ZNE, Source: SCE & AEC, 2009

Boulder Energy Conservation Code

Commercial Buildings

C401.1 Scope. The requirements contained in this chapter are applicable to new commercial buildings and additions to or remodels of commercial buildings. Commercial buildings shall exceed the energy efficiency requirements of ASHRAE/IESNA Standard 90.1 Energy Standard for Building Except for Low-Rise Residential Buildings by at least 30 percent or other approved equivalent design criteria.

30% Better ASHRAE/IENSA Standard 90.1

CITY OF BOULDER

City of Boulder Commercial Energy Code

A Prescriptive Pathway to Compliance for Buildings Less Than 20,000 Square Feet Using the *Advanced Buildings: New Construction Guide*

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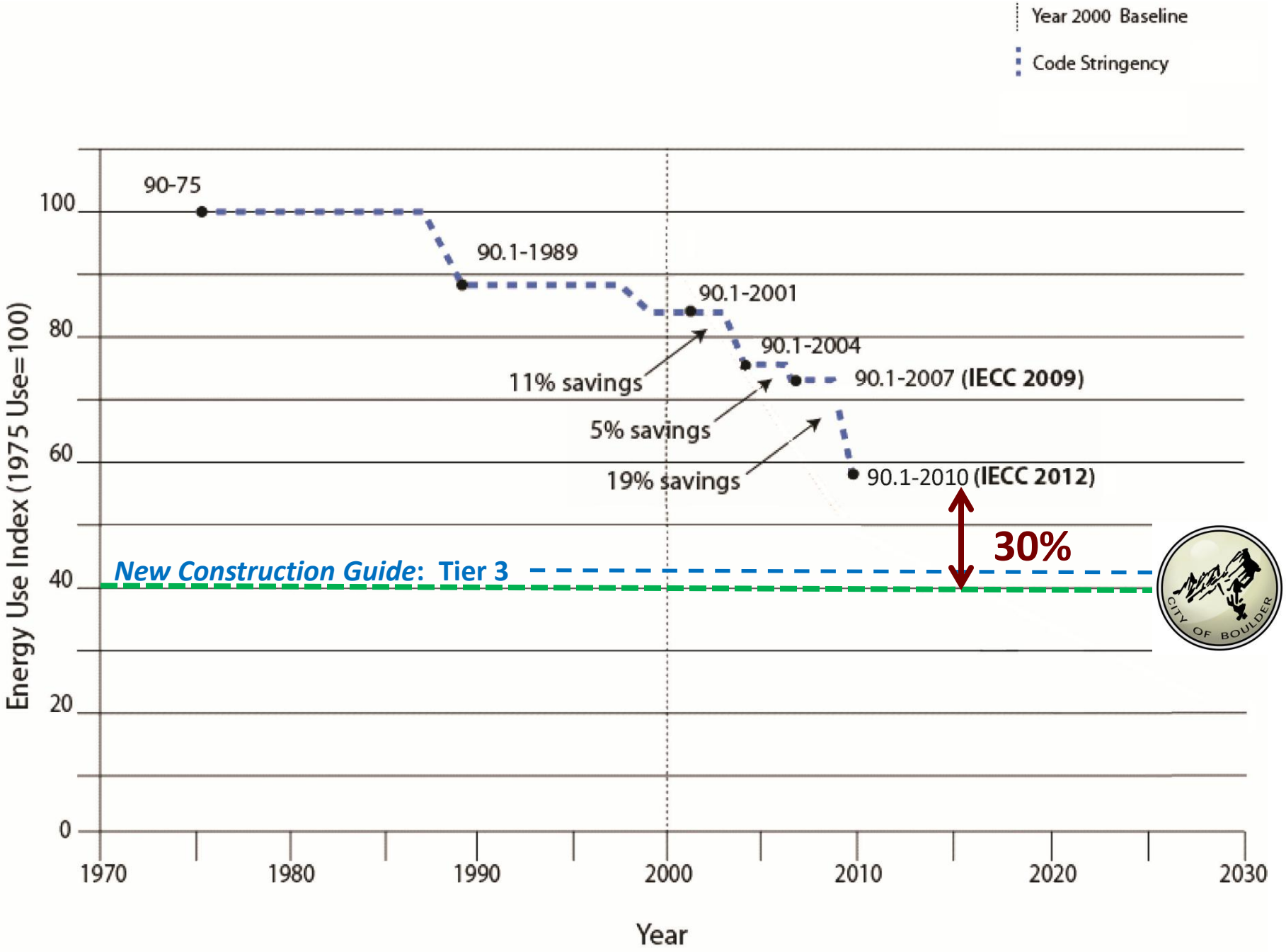

Year 2000 Baseline
Code Stringency
90-75
90.1-1989
90.1-2001
90.1-2004
90.1-2007 (IECC 2009)
90.1-2010 (IECC 2012)
11% savings
5% savings
19% savings
30%
New Construction Guide: Tier 3
CITY OF BOULDER
Energy Use Index (1975 Use=100)
100
80
60
40
20
0
1970
1980
1990
2000
2010
2020
2030
Year

What does this have to do with Hawaii?


Hawaii State Archives

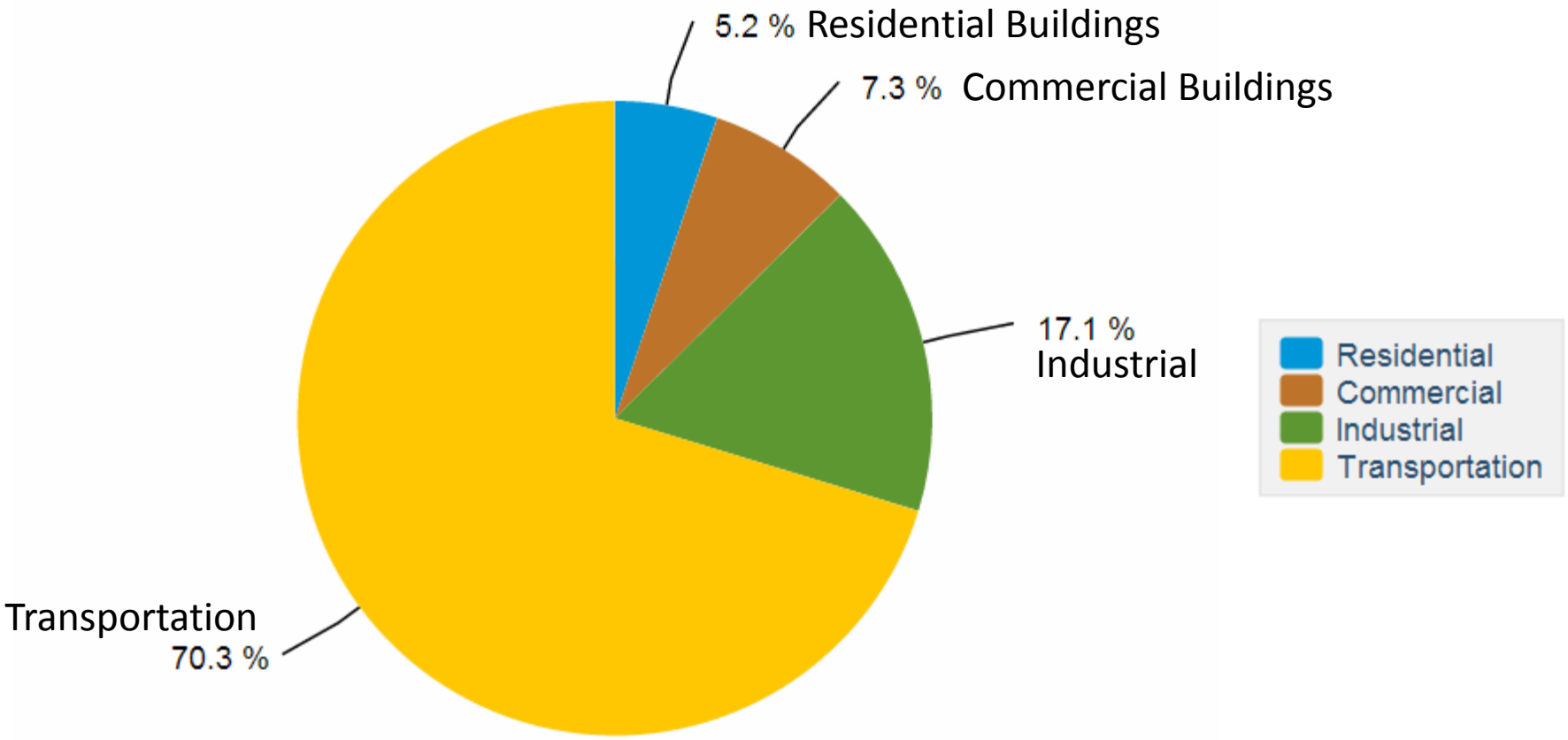
Hawaii Climate Change Policies

- Initially developed a Climate Action Plan in 1998.
- In 2007, Global Warming Solutions Act, mandates that GHG emissions reach 1990 levels by 2020
- In 2008, The Hawaii Clean Energy Initiative goal of 70% energy reductions through efficiency and renewables by 2030

Hawaii Quick Energy Facts

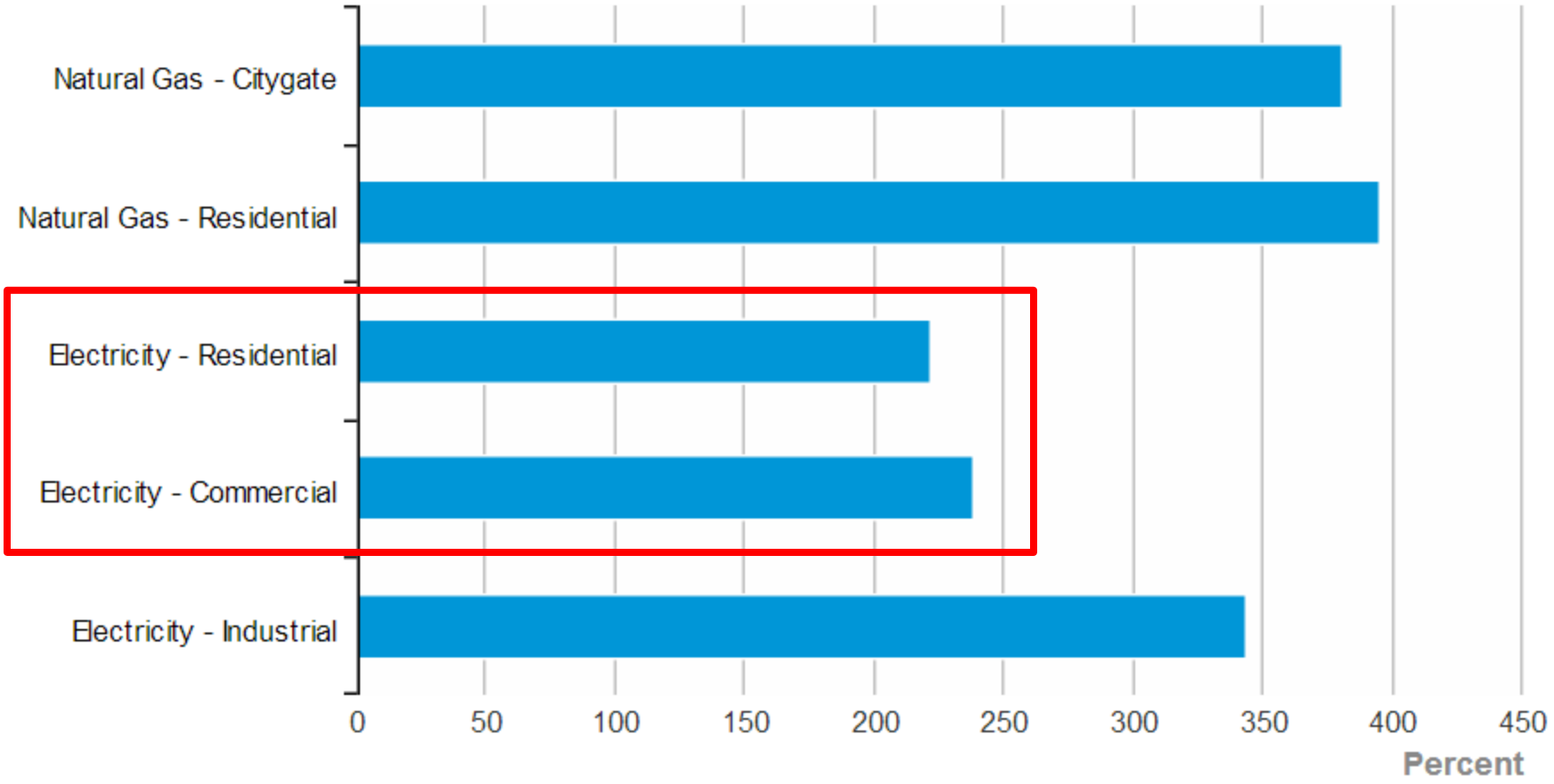
- Fourth lowest per capita energy use in the nation in 2011
- In 2011, imported 93% of its energy
- In 2013, had the highest electricity prices in the nation
- World's largest commercial biofuel electricity generator
- In 2013, 23% of its renewable electricity from geothermal energy
- In 2013, utility-scale electricity solar energy increased nearly six-fold. Now ranked third in solar generation per capita.

Hawaii Energy Consumption by End-Use Sector, 2012




United States
North Pacific Ocean
Gulf of Mexico
Mexico
Solomon Sea
Coral Sea
Google

Hawaii Price Differences from U.S. Average, Most Recent Monthly

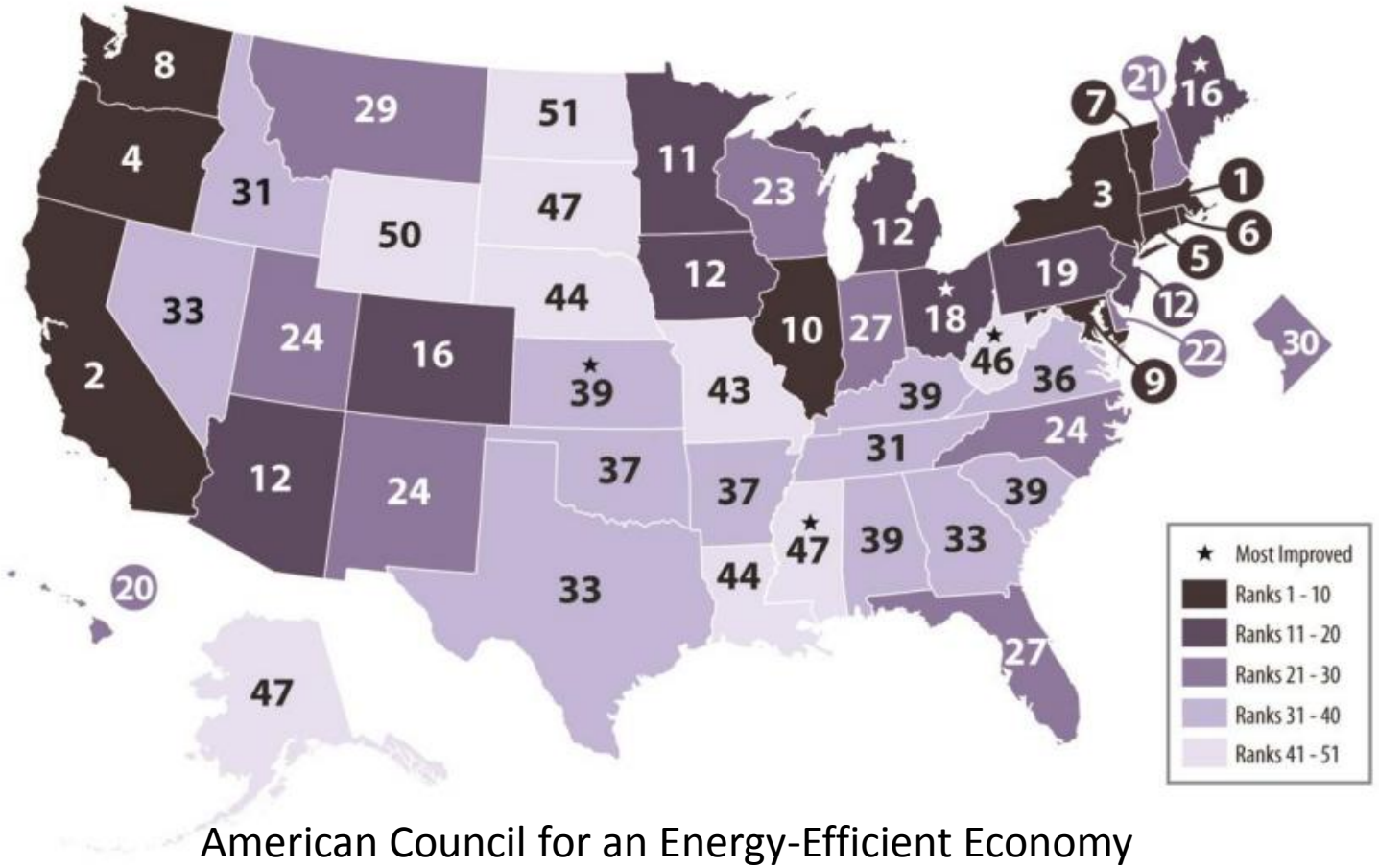


How Does HI Rank?

State	Production		Consumption per Capita		Expenditures per Capita	
	U.S. Share	Rank	Million Btu	Rank	Dollars	Rank
Wyoming	13.3%	2	975	1	9,529	3
Louisiana	5.1%	3	886	2	10,237	2
Hawaii	0.0%	48	208	48	5,521	8
Rhode Island	0.0%	50	175	51	3,634	46

ACEEE 2013 State Energy Efficiency Scorecard

Figure ES-2. *2013 State Scorecard* Rankings Map



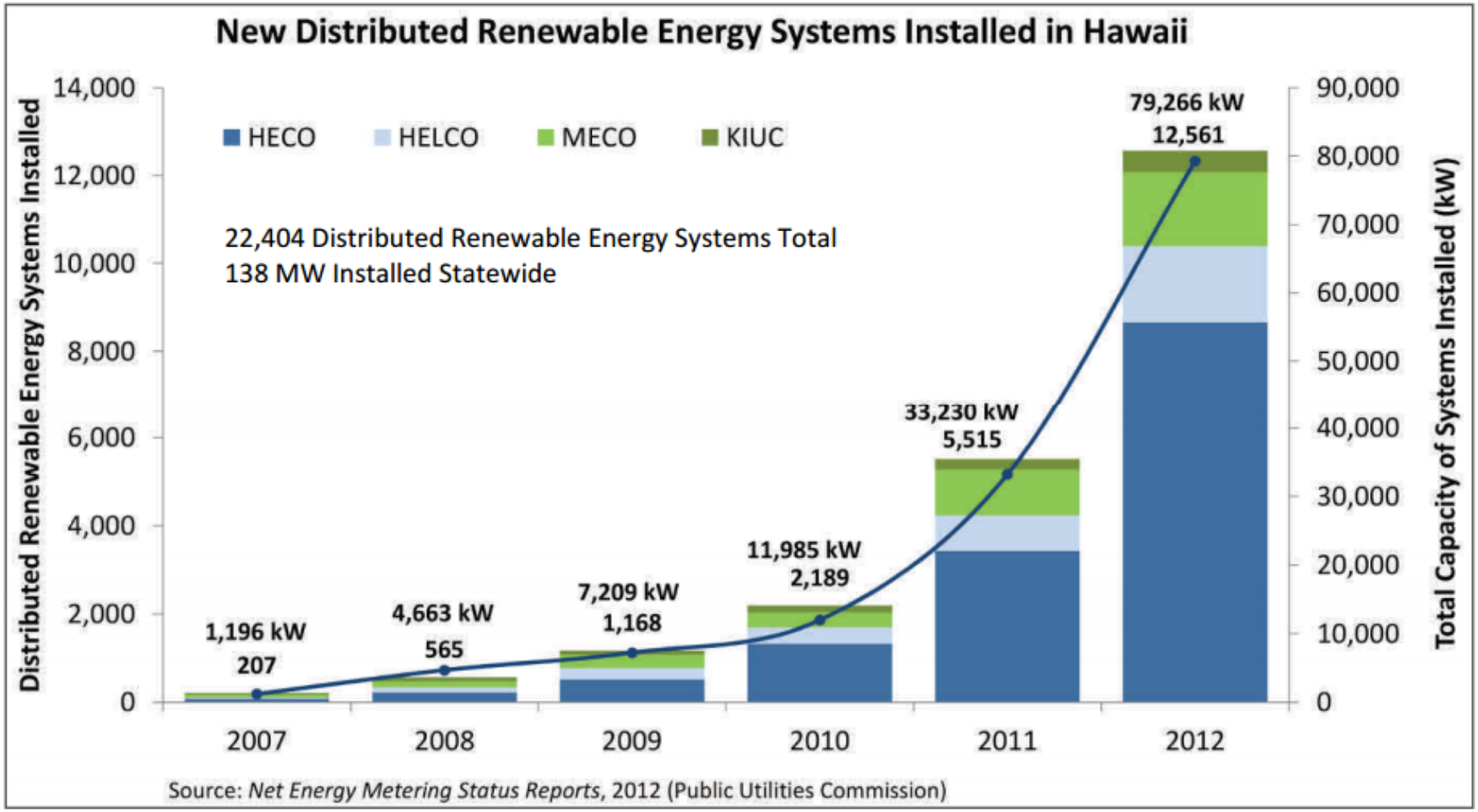
American Council for an Energy-Efficient Economy

ACEEE 2013 State Energy Efficiency Spending

State	2012 Budget ($million)	% of Statewide Utility Revenues	Score (5 pts.)
Rhode Island	61.4	7.61%	5
Massachusetts[1]	515.7	6.78%	5
Washington[2]	344.8	5.37%	5
Vermont[3]	39.3	5.20%	5
Oregon[4]	153.0	3.98%	4.5
Hawaii[18]	35.6	1.09%	1
Wisconsin[19]	78.7	1.08%	1
Louisiana	3.7	0.06%	0
Virginia	0.2	0.00%	0
Alaska	0.0	0.00%	0
North Dakota	0.0	0.00%	0
US Total	5988.9	1.63%	
Median	40.5	1.09%	

New Distributed Renewable Energy Systems Installed in Hawaii (2007-2012)

2012 was a banner year for distributed renewable energy systems in Hawaii with installations more than doubling from 5,515 in 2011 to 12,561 in 2012. At the end of 2012, the cumulative number of systems statewide totaled 22,404 with a total capacity of 138 MW.



Mar 31, 2014, 1:19pm HST

http://www.bizjournals.com/pacific

Ala Moana Center completes one of Hawaii's largest rooftop solar energy projects

Duane Shimogawa
Reporter-
Pacific Business News
Email | Google+ | Twitter | LinkedIn

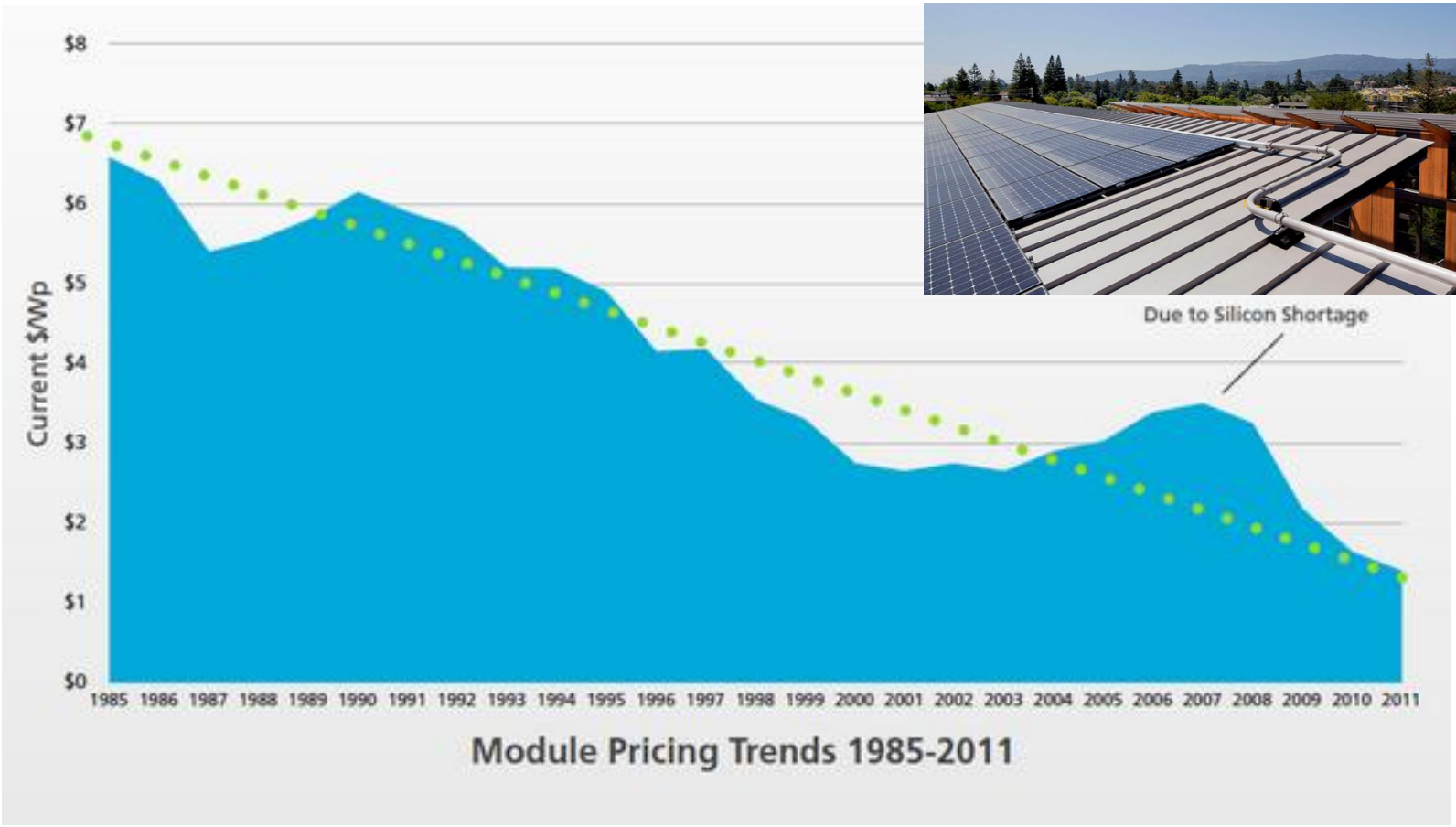
Ala Moana Center recently completed one of Hawaii's largest rooftop solar energy projects, which includes more than 4,730 panels covering 85,000-square-feet of previously unused roof space, the state's largest shopping mall said Monday.

The new 1.17-megawatt solar project began generating power for the common areas of Ala Moana Center at the

Courtesy Ala Moana Center

Ala Moana Center recently completed one of Hawaii's largest rooftop solar energy projects, which includes more than 4,730 panels covering 85,000-square-feet of previously unused roof space atop the state's largest shopping mall.

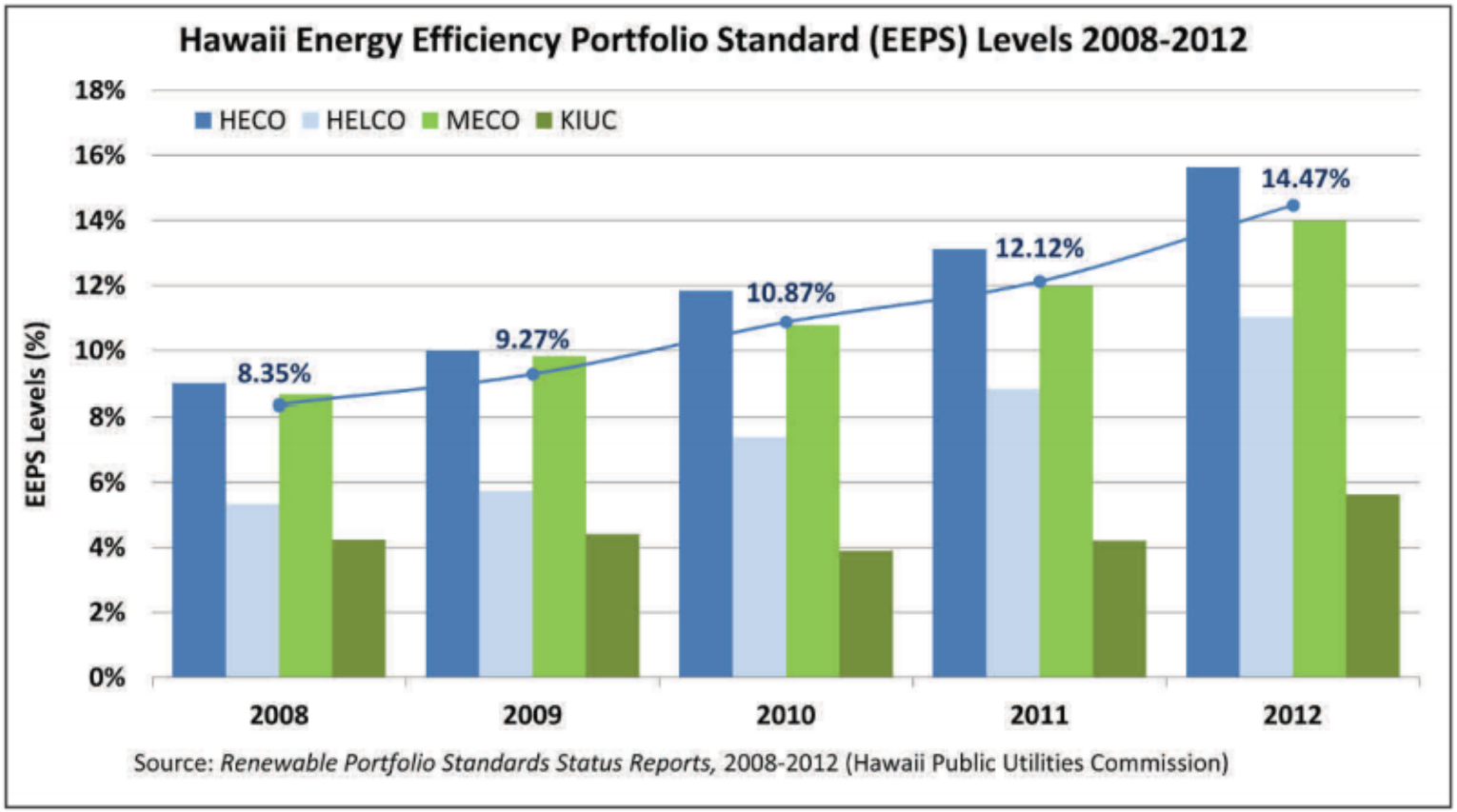
PV cost trend makes ZNE accessible



Source: P. Mints, Navigant Solar Services Program, 2011

Hawaii Energy Efficiency Portfolio Standard (EEPS) Levels (2008-2012)

This chart shows Hawaii's Energy Efficiency Portfolio Standard (EEPS) levels from 2008 (the year the Hawaii Clean Energy Initiative was established) through 2012. In 2012, the state's EEPS level was 14.47%. The state is required to reduce energy consumption through efficiency measures by 30% by the end of 2030.



Goal of achieving 4,300 GWh of energy savings by 2030.

Feature Article

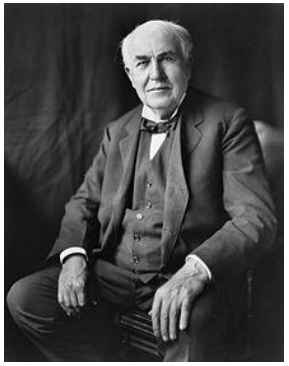
Why utilities will soon be obsolete in HI and CA (and then in your state)

Mar 4, 2014 Talk Back Free Alerts More On This Topic SHARE

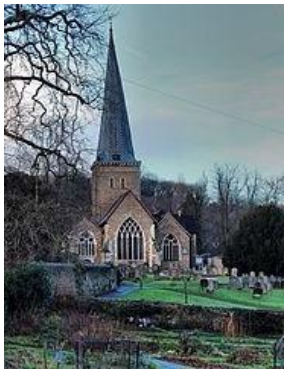
Existential threat to Utilities: Grid Defection? http://www.smartgridnews.com/

One Minute History of Utilities

1878 Thomas Edison Incandescent Bulb



1881 The world's first public electricity supply Godalming in the UK



1882 Edison opened the Pearl Street Power Station in New York City

One Minute History of Utilities

1935 Federal Power Act and the
Public Utility Holding Company Act (PUHCA)

"Regulatory Compact."
The Regulatory Compact is a covenant -
essentially a contract between the utility and the public

Hawaiian PUC orders state utilities to take action

May 2, 2014 | By Barbara Vergetis Lundin

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The Hawaiian Public Utilities Commission has made four major decisions and orders requiring the Hawaiian Electric Companies (HECO) to: develop and implement major improvement plans to aggressively pursue energy cost reductions, proactively respond to emerging renewable energy integration challenges, improve the interconnection process for customer-sited solar photovoltaic systems, and embrace customer demand response programs.

Hawaiian Electric Industries' electric utilities, including Hawaiian Electric Company, Hawaii Electric Light Company and Maui Electric Company, are all affected by the four PUC decisions and orders.

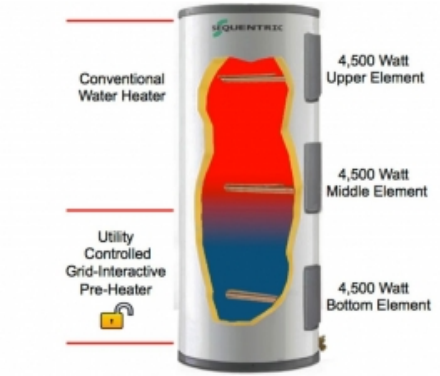
The decisions and orders include Integrated Resource Planning, Reliability Standards

Demand Response

Code hearings last week: 2015 IgCC supports greater DR participation by **simplifying** and **standardizing** the Auto-DR HVAC

- Energy Management Systems
- Direct Digital Control
- Smart Thermostats

The Water Heater as Grid Battery, Version 2.0



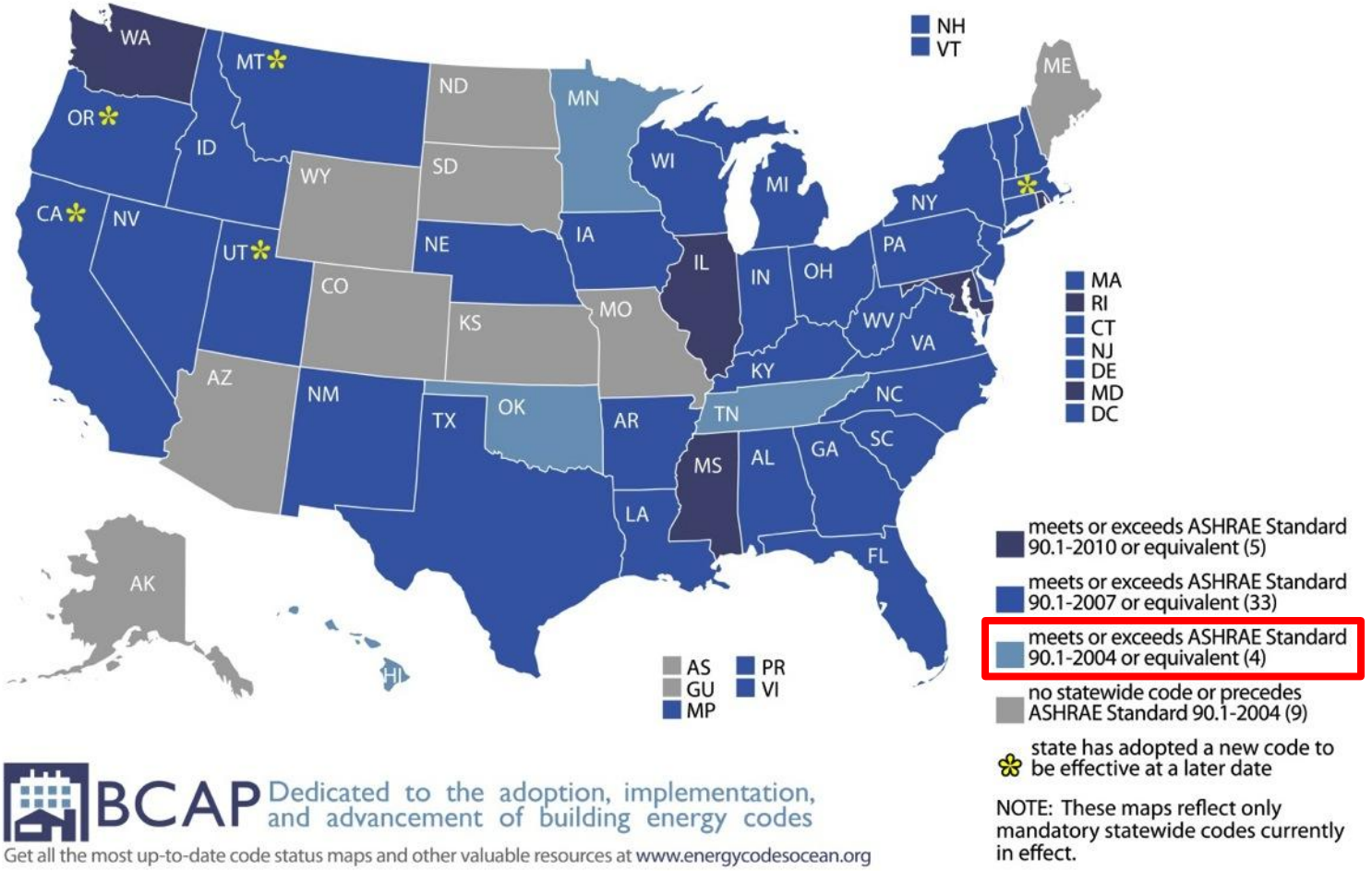
Could a simple redesign turn basement water tanks into real-time utility assets?

Jeff St. John
November 8, 2013

http://www.greentechmedia.com/

Commercial State Energy Code Status

AS OF FEBRUARY 1, 2014



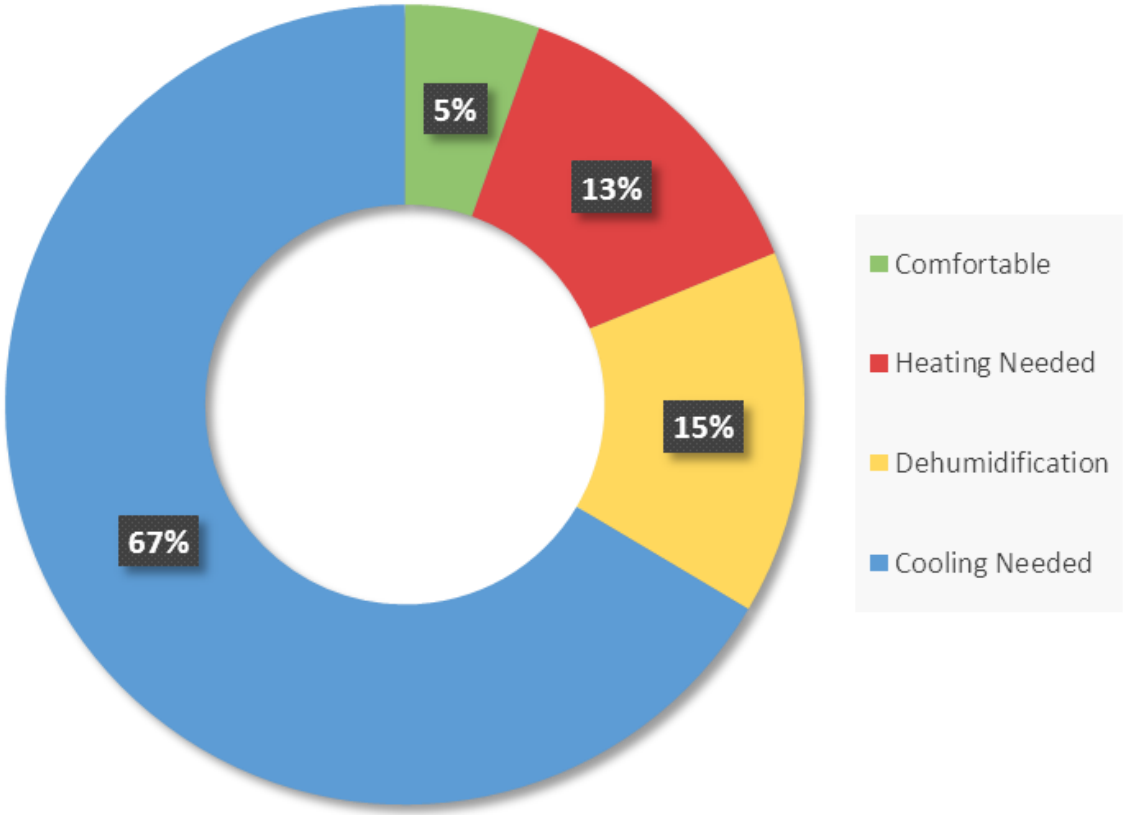
BCAP Dedicated to the adoption, implementation, and advancement of building energy codes

Get all the most up-to-date code status maps and other valuable resources at www.energycodesocean.org

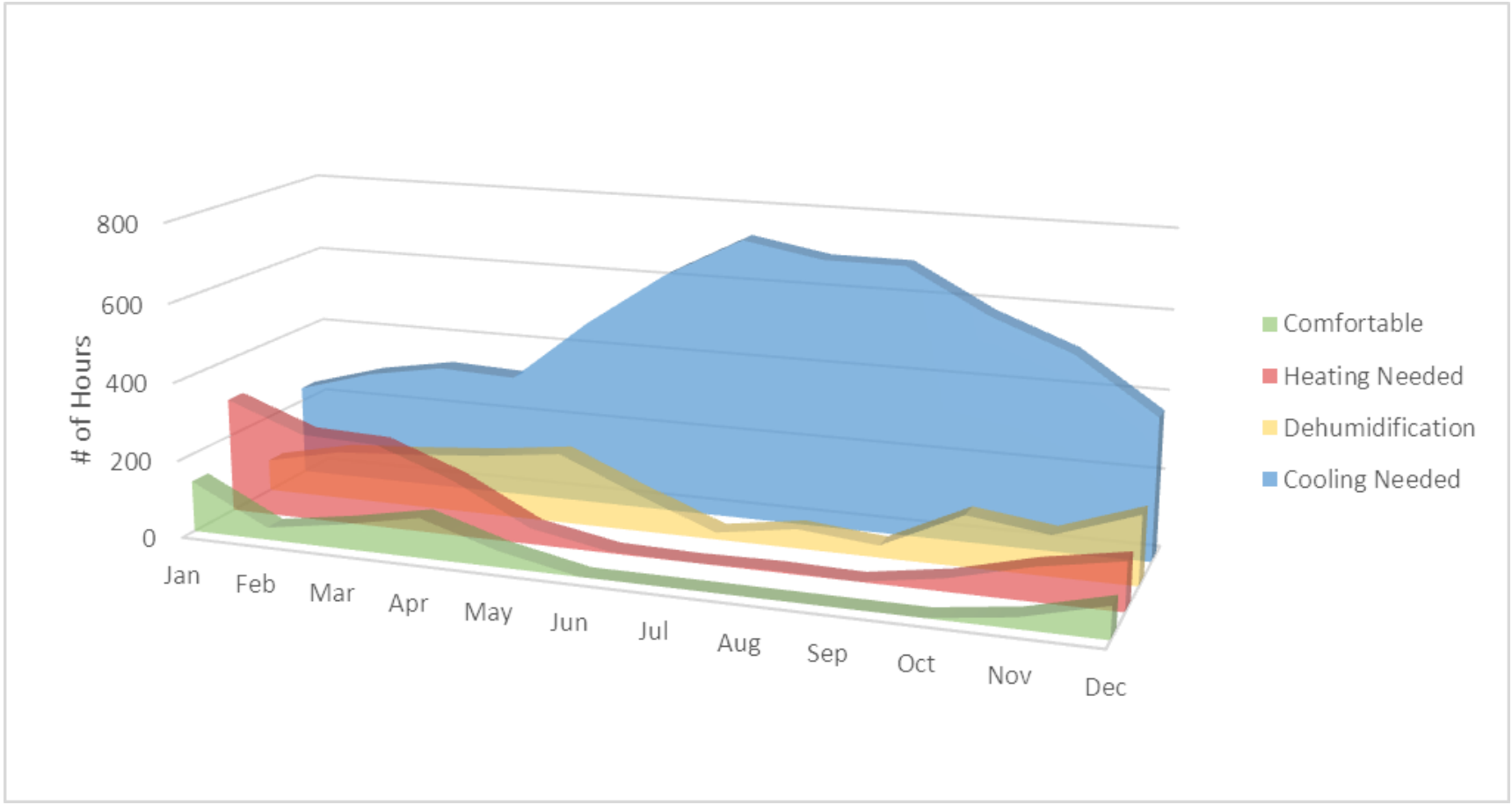
By David Howard Hitchcock (1861-1943), via Wikimedia Commons

Robert C. Barnfield - 'Hawaiian Homes', watercolor, c. 1885.jpg

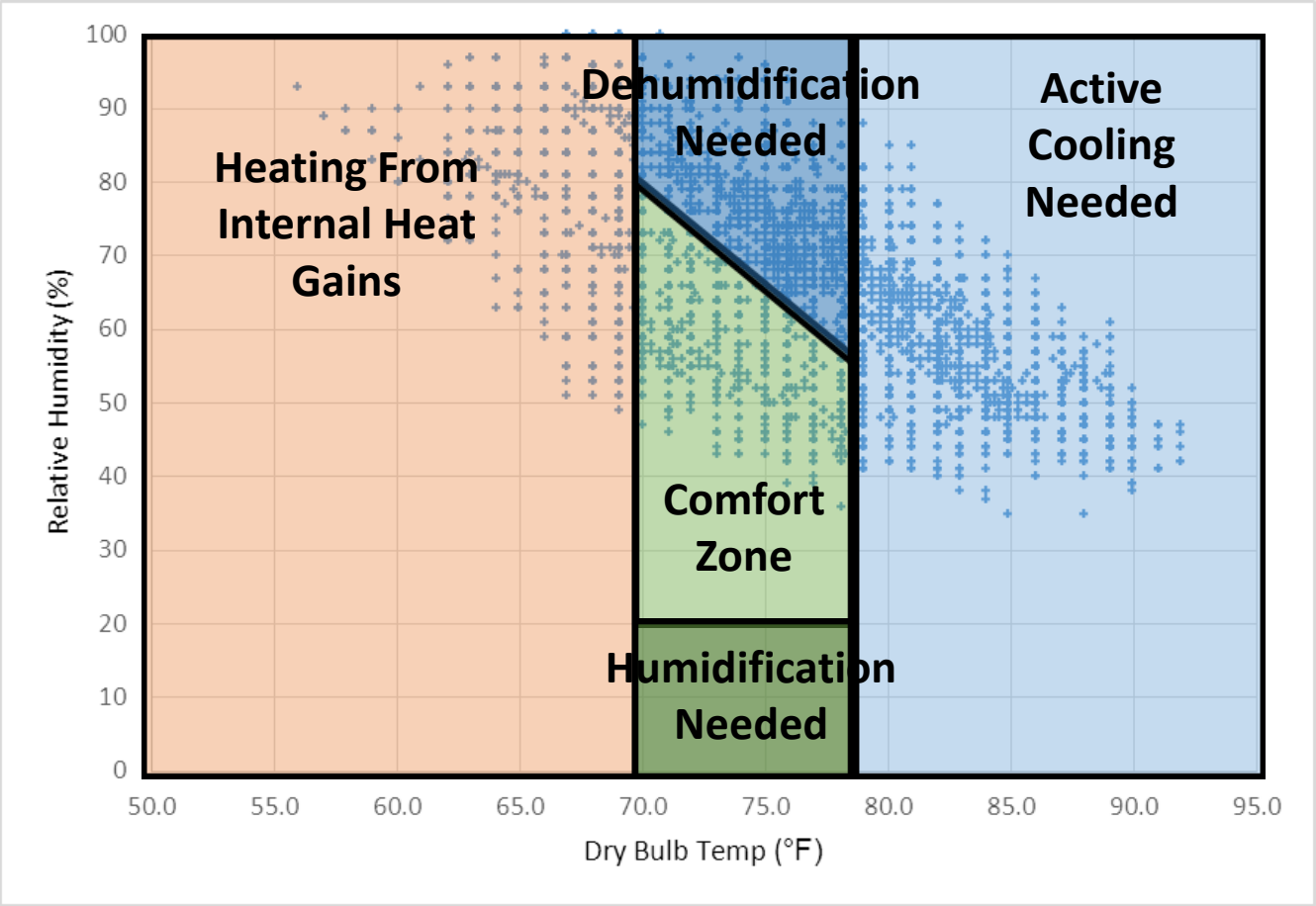
Comfort Profile - Honolulu



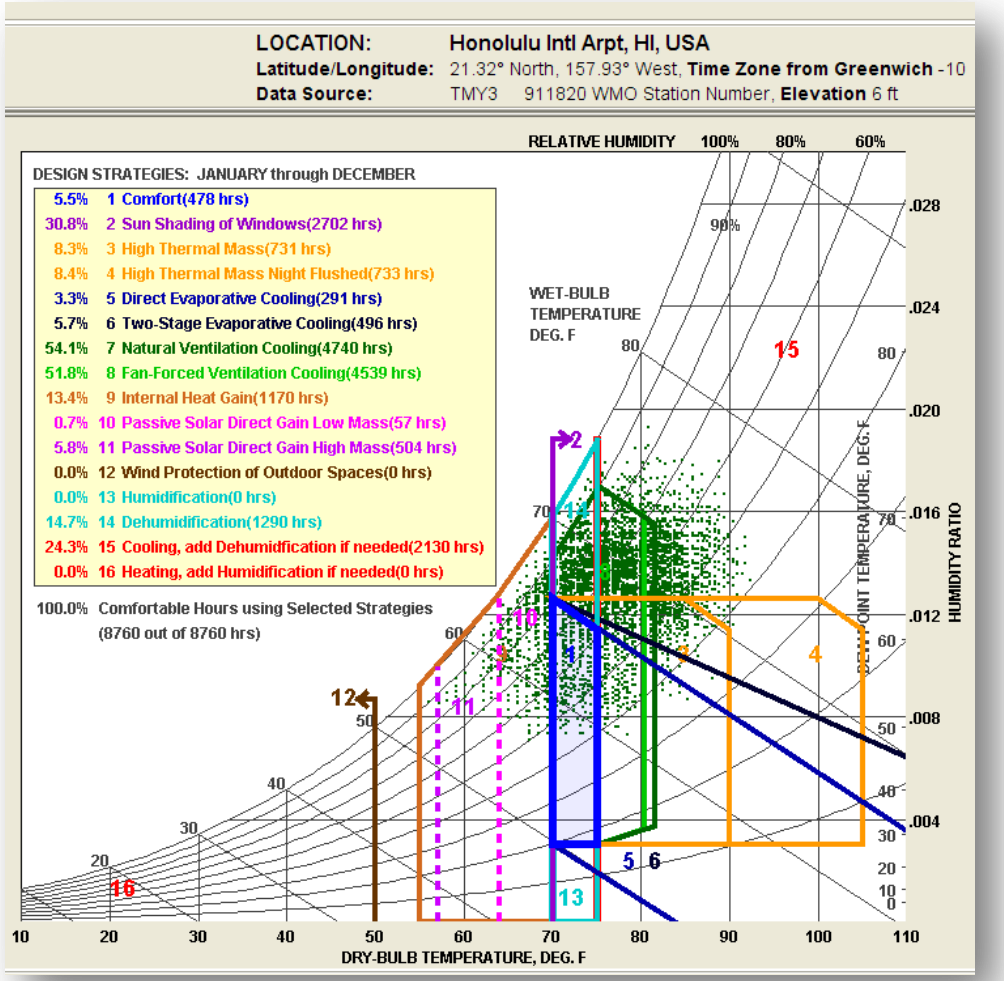
Monthly Comfort Chart



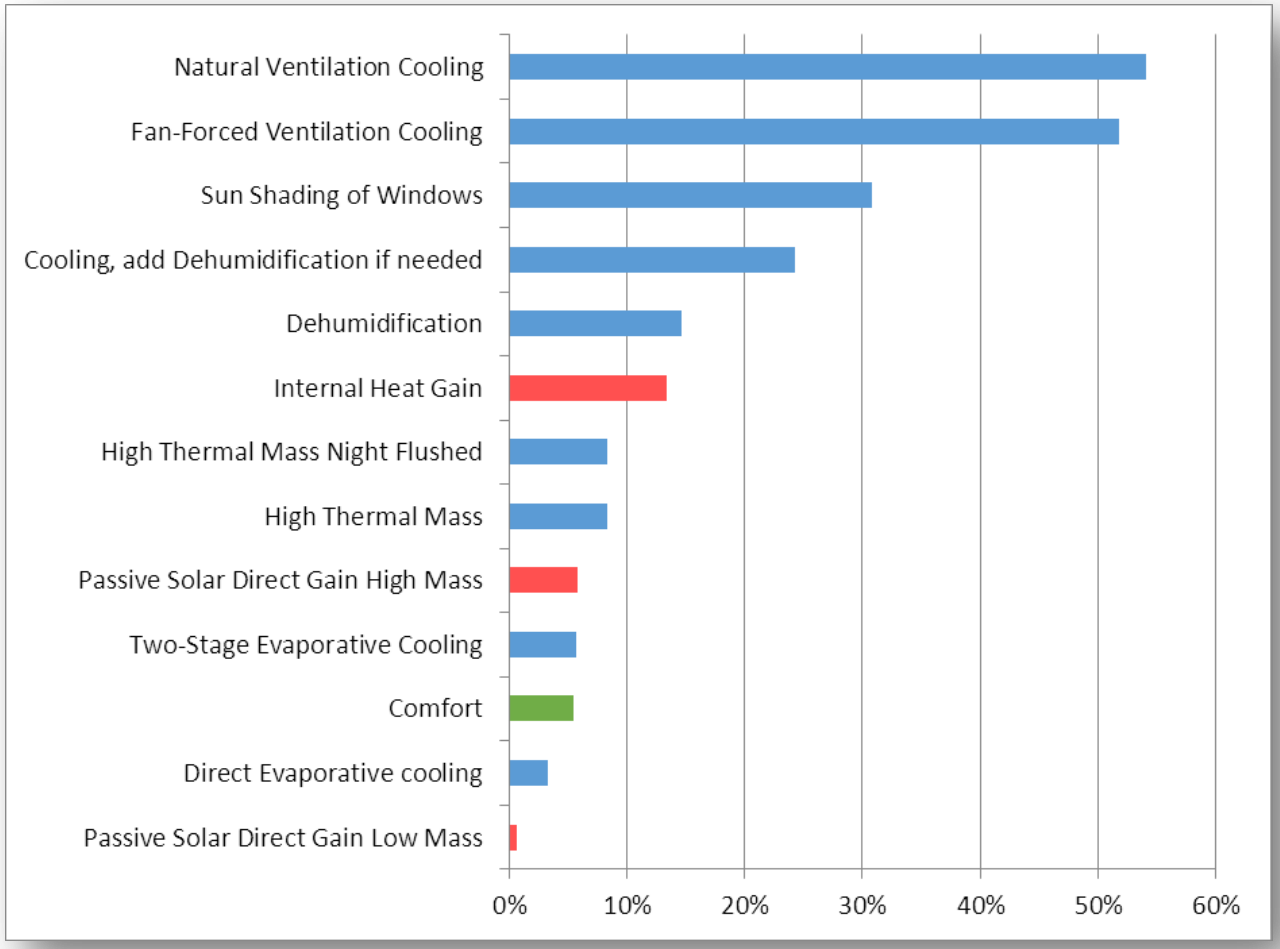
Temperature/RH Scatter



Design Strategies



Design Strategies



Where do you go from here?

Where do you go from here?

- Orchestrate Harmony & Synergies Among Stakeholders
- Define Effective Technologies and Strategies for ZNE
- Align Incentives with ZNE and Whole Building Solutions
- Take ZNE to scale with District and Community approach
- Develop an Energy Code Roadmap to ZNE by 2030 and foster adoption of advanced codes across Hawaii

Learn more about NBI

http://newbuildings.org/support-nbi

Thank You!

Ralph DiNola
Executive Director, NBI
ralph@newbuildings.org

David and Lucille Packard Foundation Building
Courtesy: EHDD