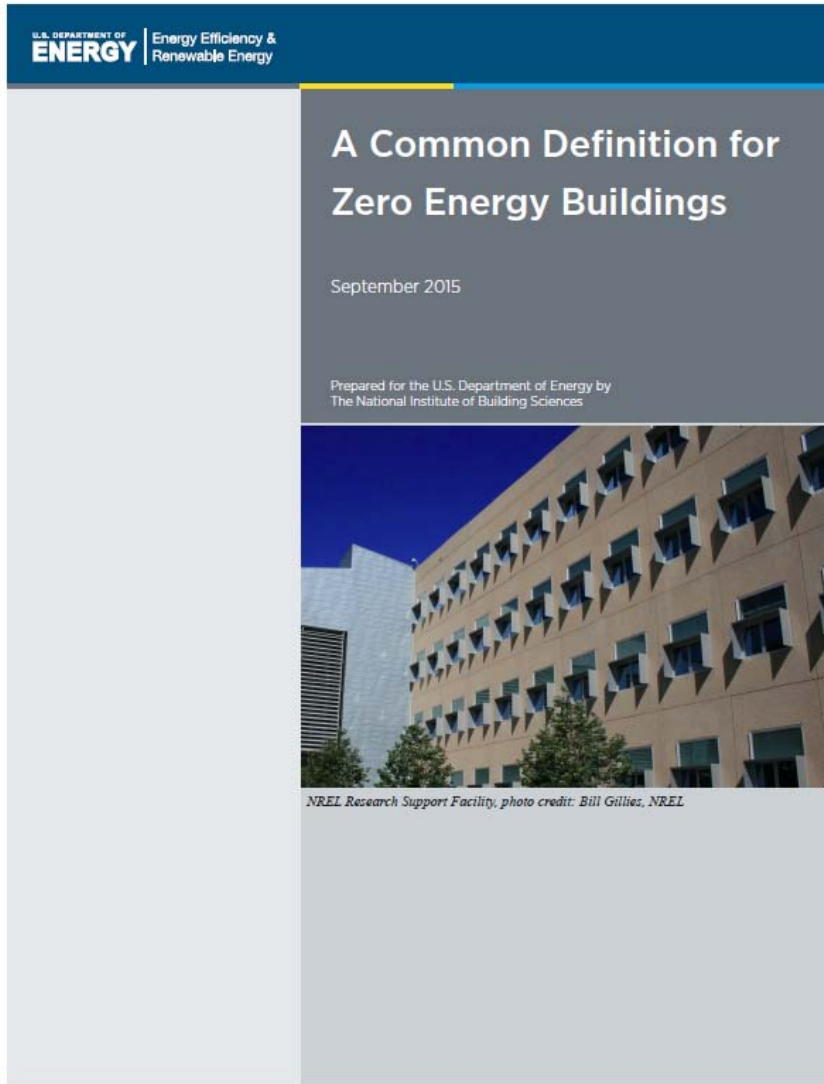


# Introduction to Zero Net-Energy Buildings

Charles Eley, FAIA, PE

# ZNE Definitions

## DOE Common Definition

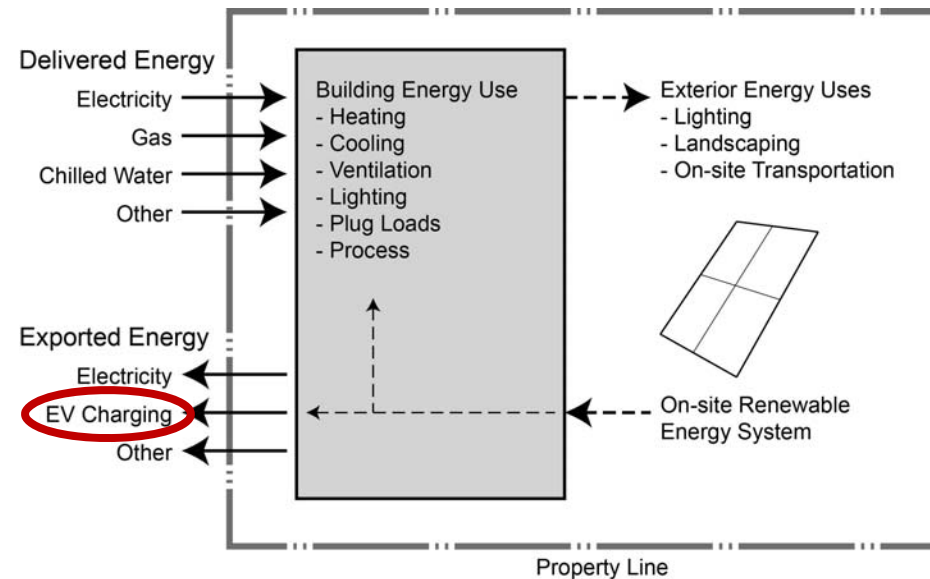


**An energy-efficient building where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy.**

<http://energy.gov/eere/buildings/downloads/common-definition-zero-energy-buildings>

## ZNE Definition

- The sum of all energy that is **delivered** to the property line must be less than the energy that is **exported** from the property.
- All energy use is included.
  - Electricity
  - Gas
  - District energy
- EV charging is considered exported energy.



## Department of General Services Definition

**ZNE Source – Produces as much energy as it consumes over the course of a year, when accounted for at the energy generation source.**

- Executive Order B-18-12, mandates zero net energy (ZNE) for new and existing state buildings
- The California Energy Commission's "ZNE Time-Dependent Valuation (ZNE TDV)" is a code definition for modeling energy based on the utility cost value of energy, and it cannot currently be used to measure existing building compliance.
- Accommodates ZNE campuses, portfolios and communities.
- Consistent with DOE definition.

### Definition of Zero Net Energy (ZNE) for California State Agency Compliance with Executive Order B-18-12

May 19, 2016

#### Executive Summary

With the issuance of Executive Order B-18-12, mandating zero net energy (ZNE) for new and existing state buildings, it has become necessary for the state of California to determine how it will define ZNE for compliance with state targets, and what strategies or prioritization it will encourage.

A focus group of 20 energy professionals representing state agencies, utilities, federal and private sectors, recommended the acceptance of one definition, which was accepted by the governor's office as the primary definition for use by state agencies in achieving and reporting on ZNE status for new and existing state buildings, and to be consistent with federally adopted definition as follows:

***ZNE Source – Produces as much energy as it consumes over the course of a year, when accounted for at the energy generation source.***

By adopting this definition, the state of California will require 39 percent less renewable energy generation capacity, and save the state over \$1.9 billion over the next nine years while still achieving the requirements of the executive order, as compared with the "ZNE site" definition, which only accounts for energy within the site. "ZNE source" can effectively be measured for existing as well as new buildings, whereas the California Energy Commission's "ZNE Time-Dependent Valuation (ZNE TDV)" is a code definition for modeling energy based on the utility cost value of energy, and it cannot currently be used to measure existing building compliance.

In order to enable attainment of ZNE on site-constrained or challenging state sites, additional variations of ZNE source are acceptable to allow various boundaries for defining ZNE for buildings, campuses, portfolios and communities, to accommodate the wide variety of state facilities and locations and to provide a more feasible path to achieve ZNE at new and existing state buildings. The focus group also emphasized energy efficiency, energy storage, renewable orientation and other important strategies to reduce long-term operating costs to the state, and reduce impacts to the energy grid.

#### Background

Zero Net Energy was introduced into state policies as a strategy to reduce greenhouse gas emissions, conserve state energy resources, and lead the state by example.

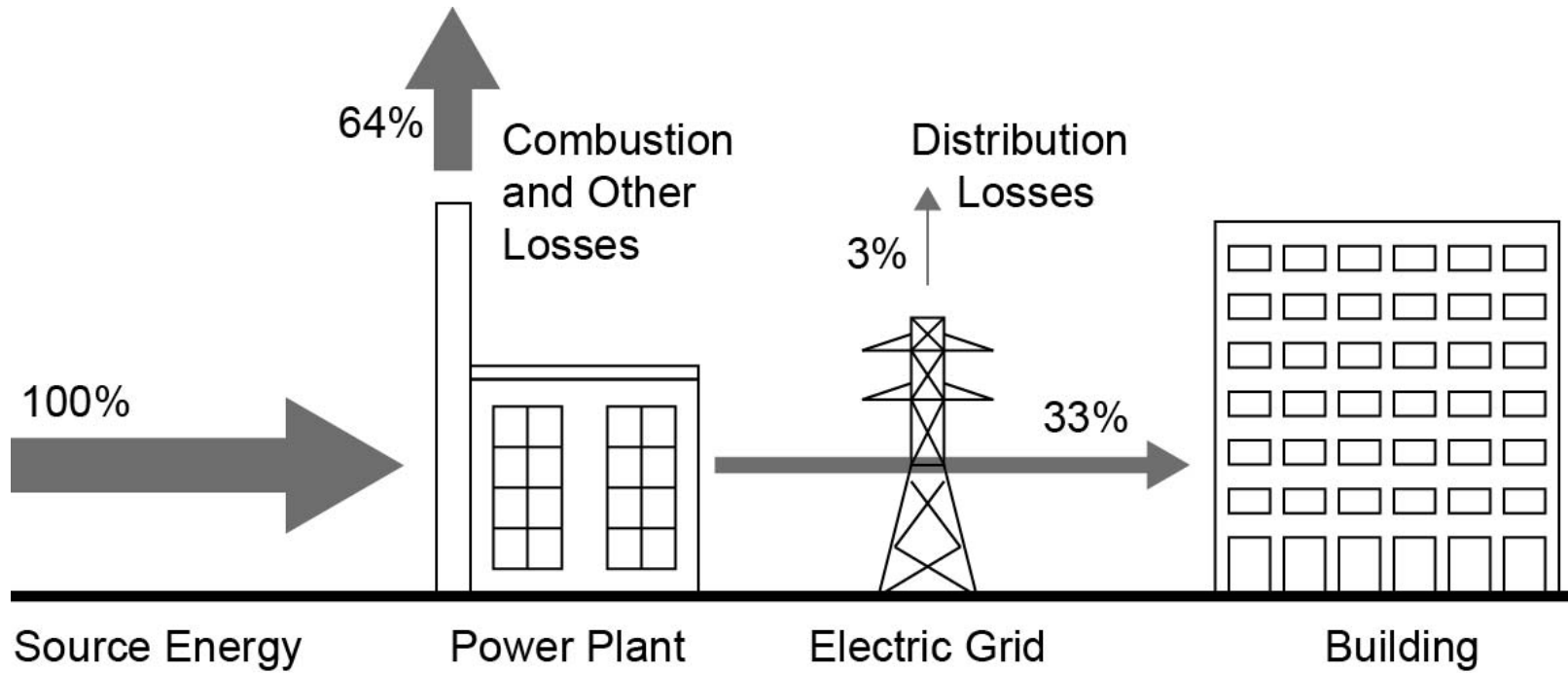
1. AB 32 Scoping Plan  
AB 32 was signed into law in 2006, with a [Scoping Plan](#) and

# Energy Accounting

## Site Energy

British Thermal Unit (Btu)		kiloWatt-hour (kWh)		kiloJoule (kJ)
1 Btu	=	.000293 kWh	=	1.055 kJ
3,412 Btu	=	1 kWh	=	3,600 kJ
0.948 Btu	=	.000278 kWh	=	1 kJ

## Source Energy





## Site Source Multipliers

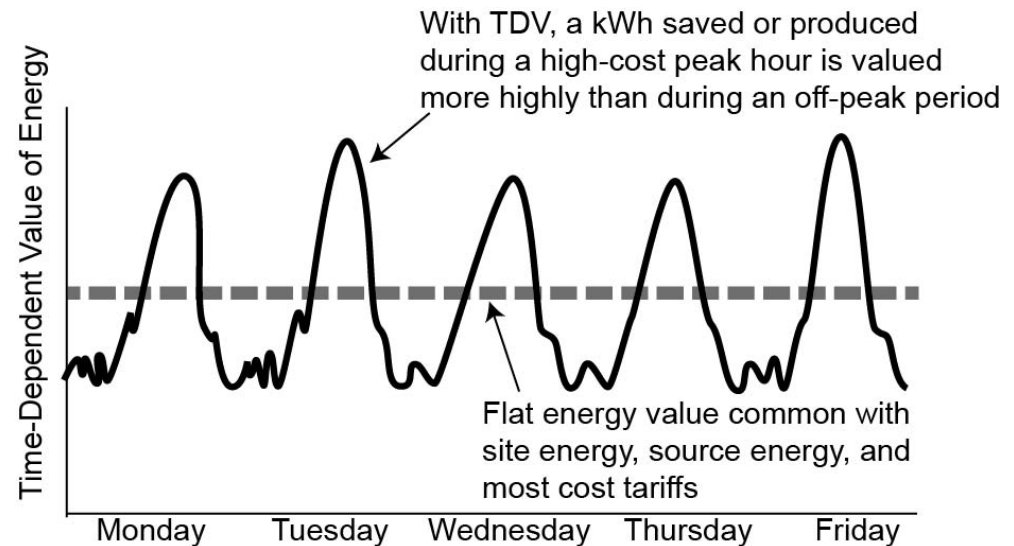
Energy Type	Source Multiplier	Common Units	Site Btu / unit	Source Btu / unit
Imported Electricity	3.15	kWh	3,412	10,751
Exported Renewable Electricity	3.15	kWh	3,412	10,751
Natural Gas	1.09	Therms	100,000	109,000
Fuel Oil (1,2,4,5,6,Diesel, Kerosene)	1.19	Gallons	138,000	164,220
Propane & Liquid Propane	1.15	Gallons	91,000	104,650
Steam	1.45	lb	1,000	1,450
Hot Water	1.35	millions Btu	1,000,000	1,350,000
Chilled Water	1.04	millions Btu	1,000,000	1,040,000
Coal or Other	1.05	short ton	19,210,000	20,170,000

Notes: The Btu per lb of steam will vary depending on how much the steam is superheated.

**Source: DOE Common Definition and ASHRAE Standard 105**

## Time Dependent Valued Energy

- Used by the California Energy Commission for performance calculations.
- Proposed as the metric for meeting the code-based ZNE requirement.



## Comparison of Metrics

	All Electric Buildings	Mixed Fuel Buildings
Site Energy	Equal difficulty in achieving ZNE	Most difficult to achieve ZNE
Source Energy (recommended)		Easier to achieve ZNE
Energy Cost (flat rate)		
TDV or Energy Cost (time-of-use)	Easiest to achieve ZNE	

Table: Design Professionals Guide to Zero Net Energy Buildings, Charles Eley, Island Press, 2016

# Operational vs. Asset Assessments

## Comparison

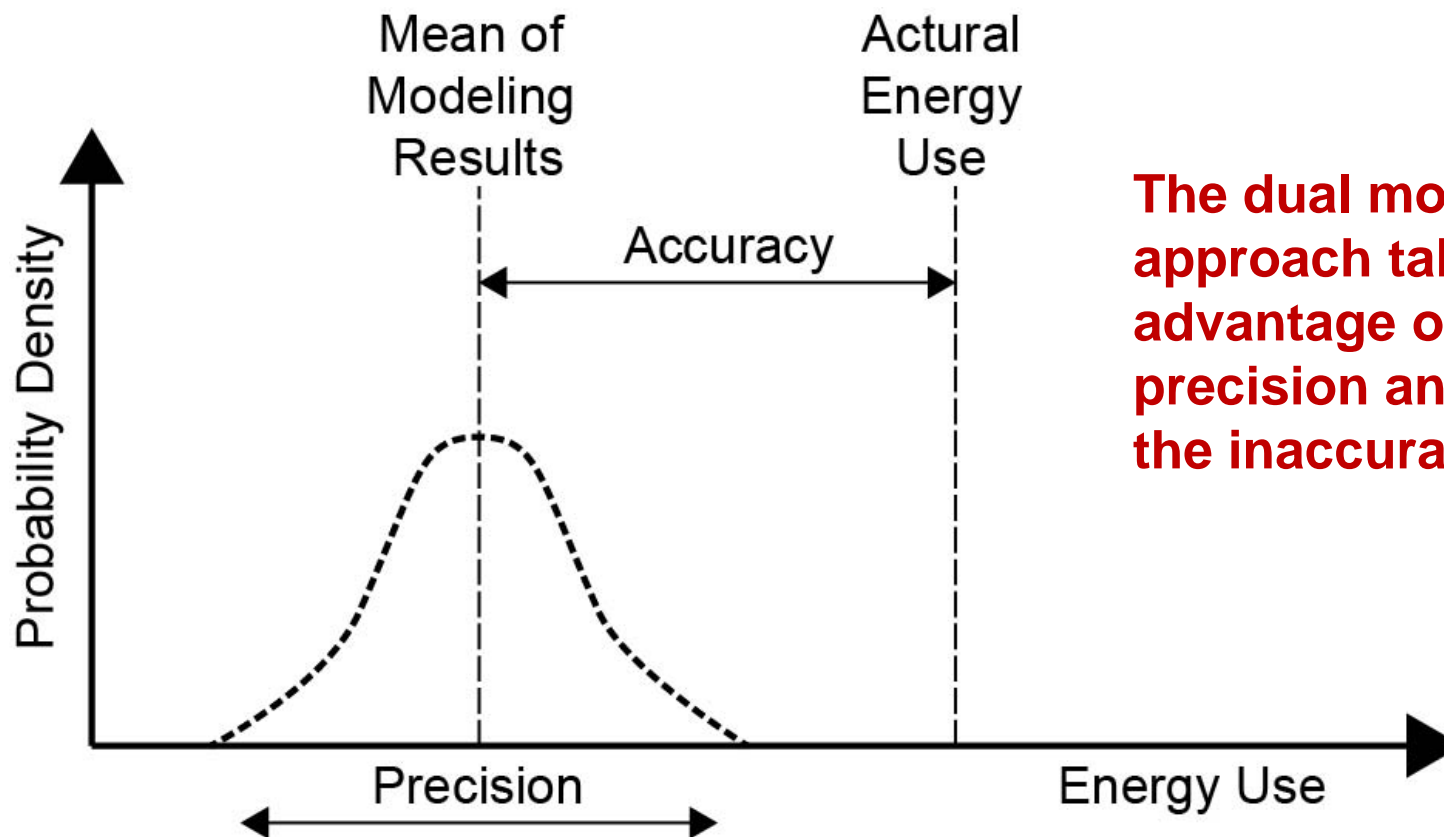
### Operational Assessment

- Based on utility bills
- Actual building operation
- Based on actual weather
- DGS uses source energy

### Asset Assessment

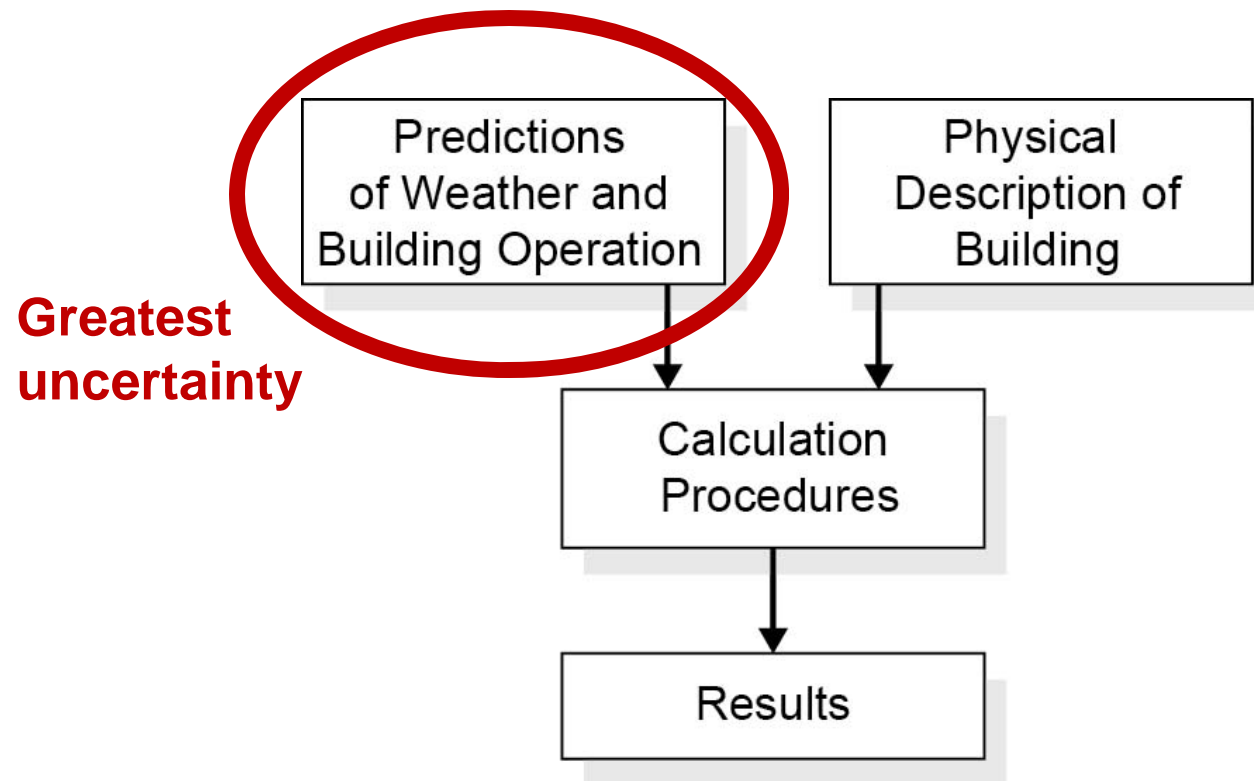
- Based on energy model
- Standard modeling assumptions
- Standard weather file
- CEC uses TDV as metric

## Accuracy vs. Precision

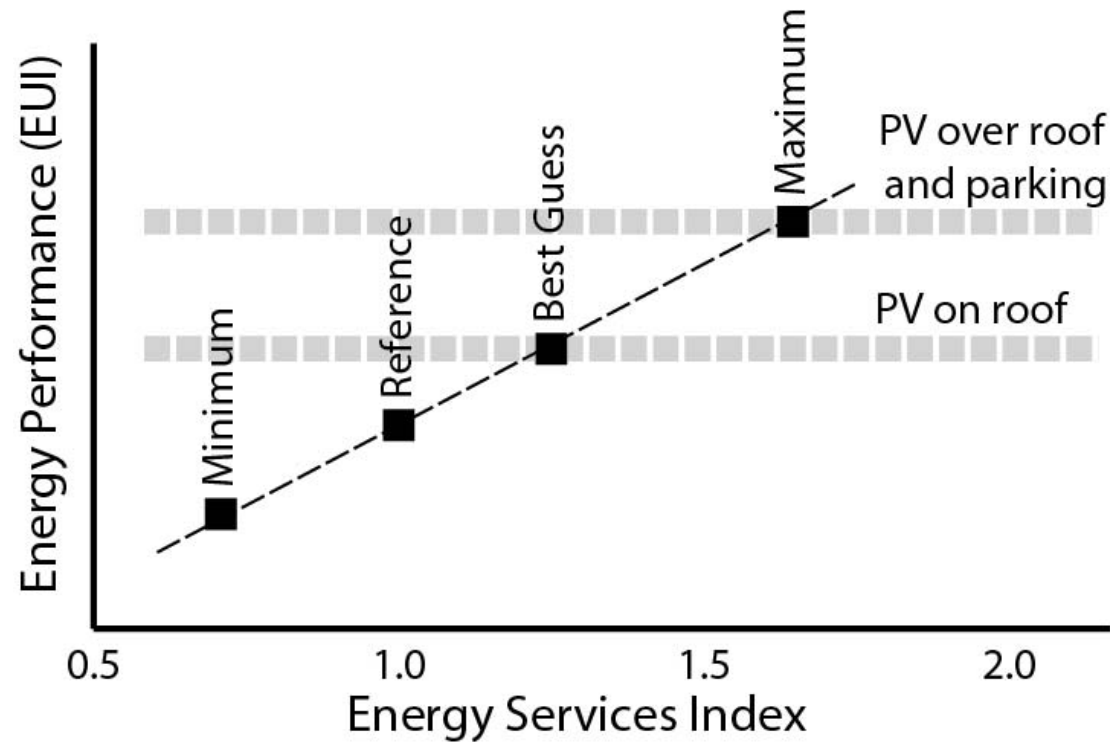


**The dual model approach takes advantage of modeling precision and manages the inaccuracy**

## Energy Model Uncertainties



## Scenario Analysis

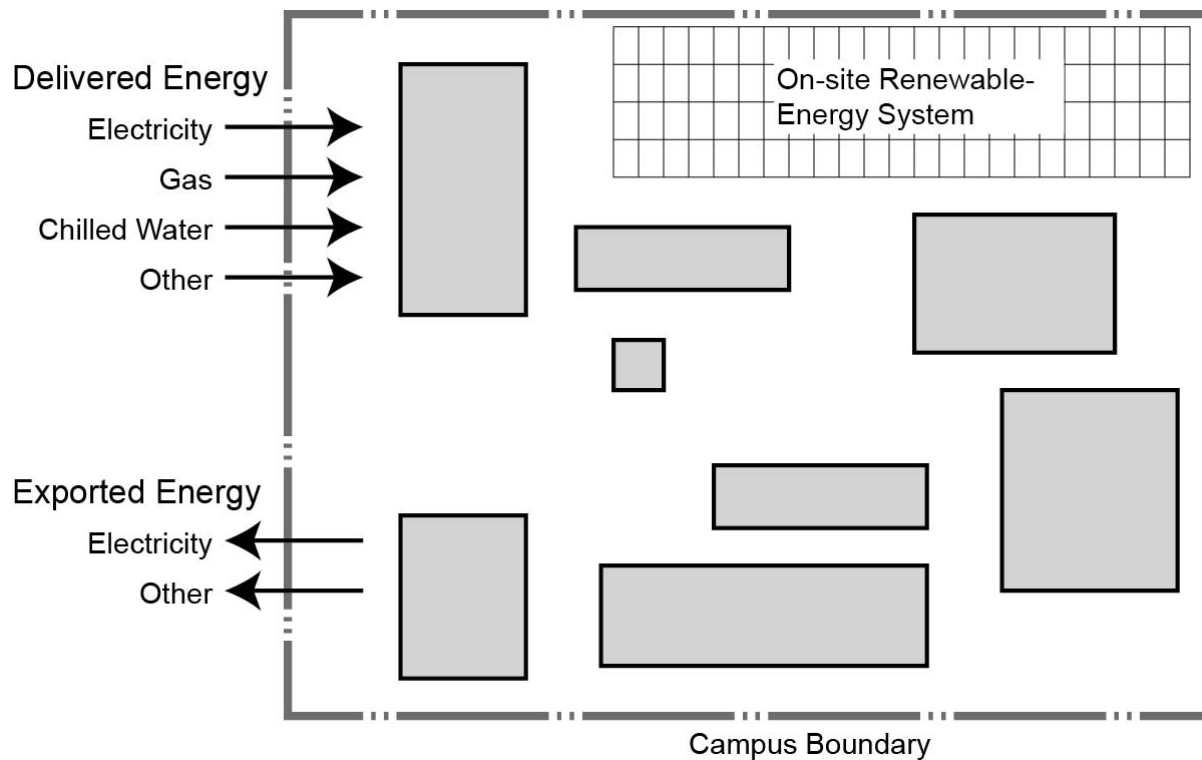


**Accuracy is critically important when the target is ZNE.**

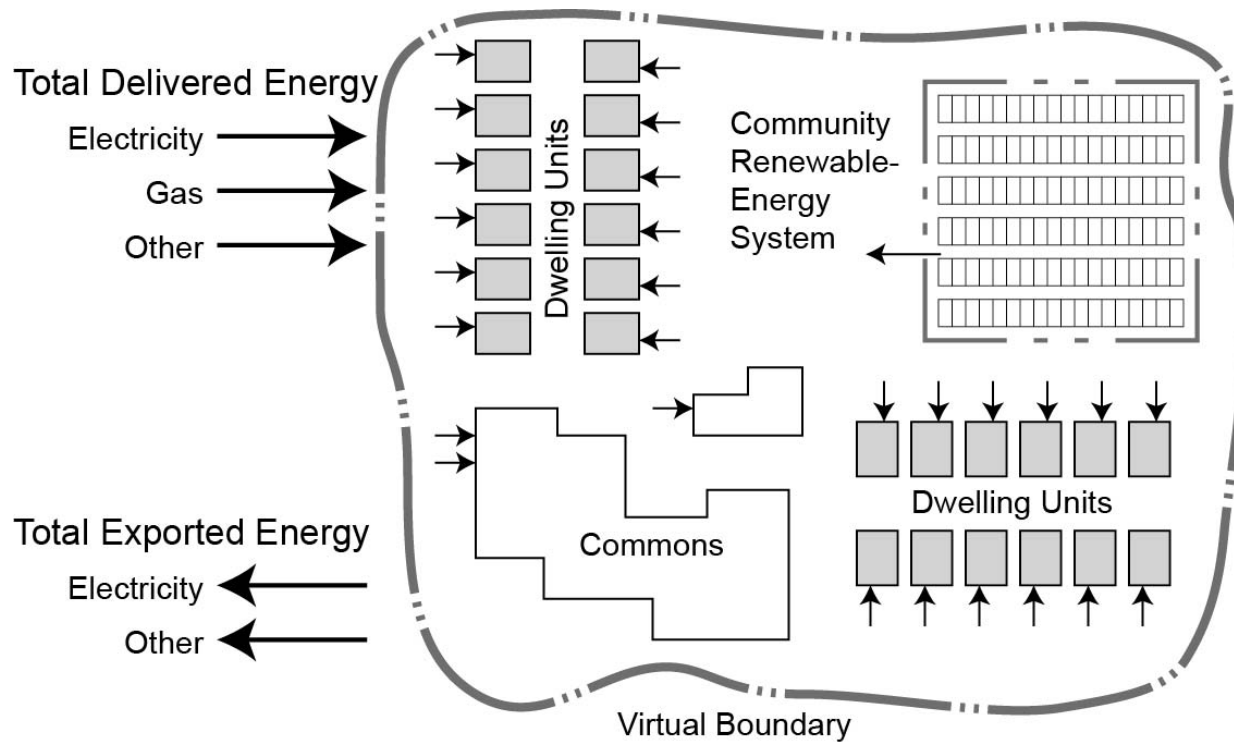


# Campuses, Communities and Portfolios

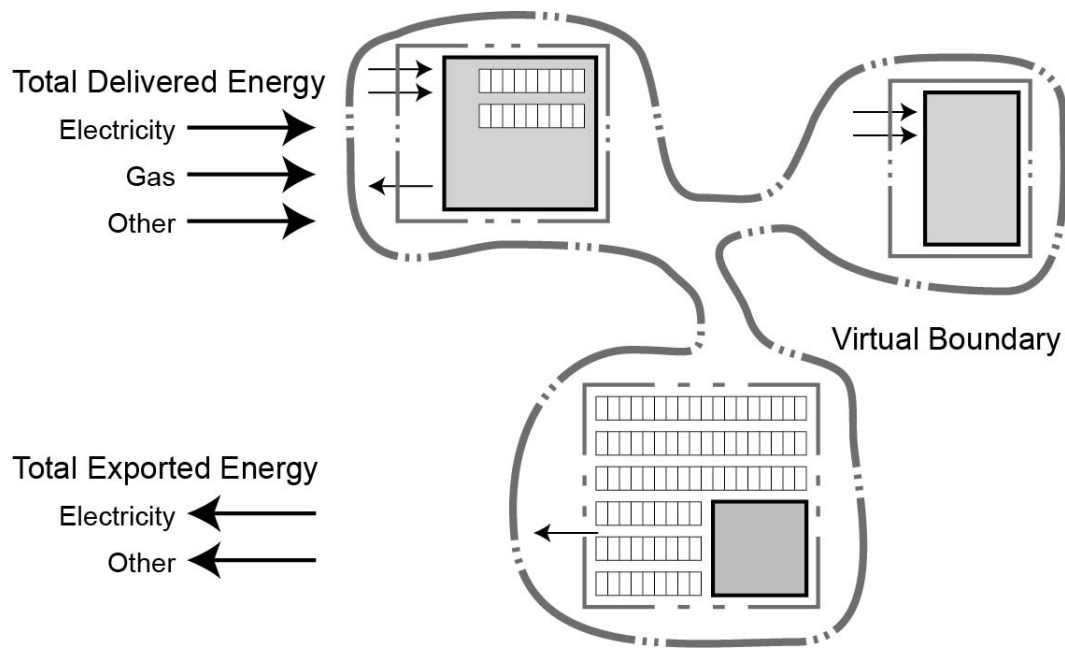
## ZNE Campus



## ZNE Communities

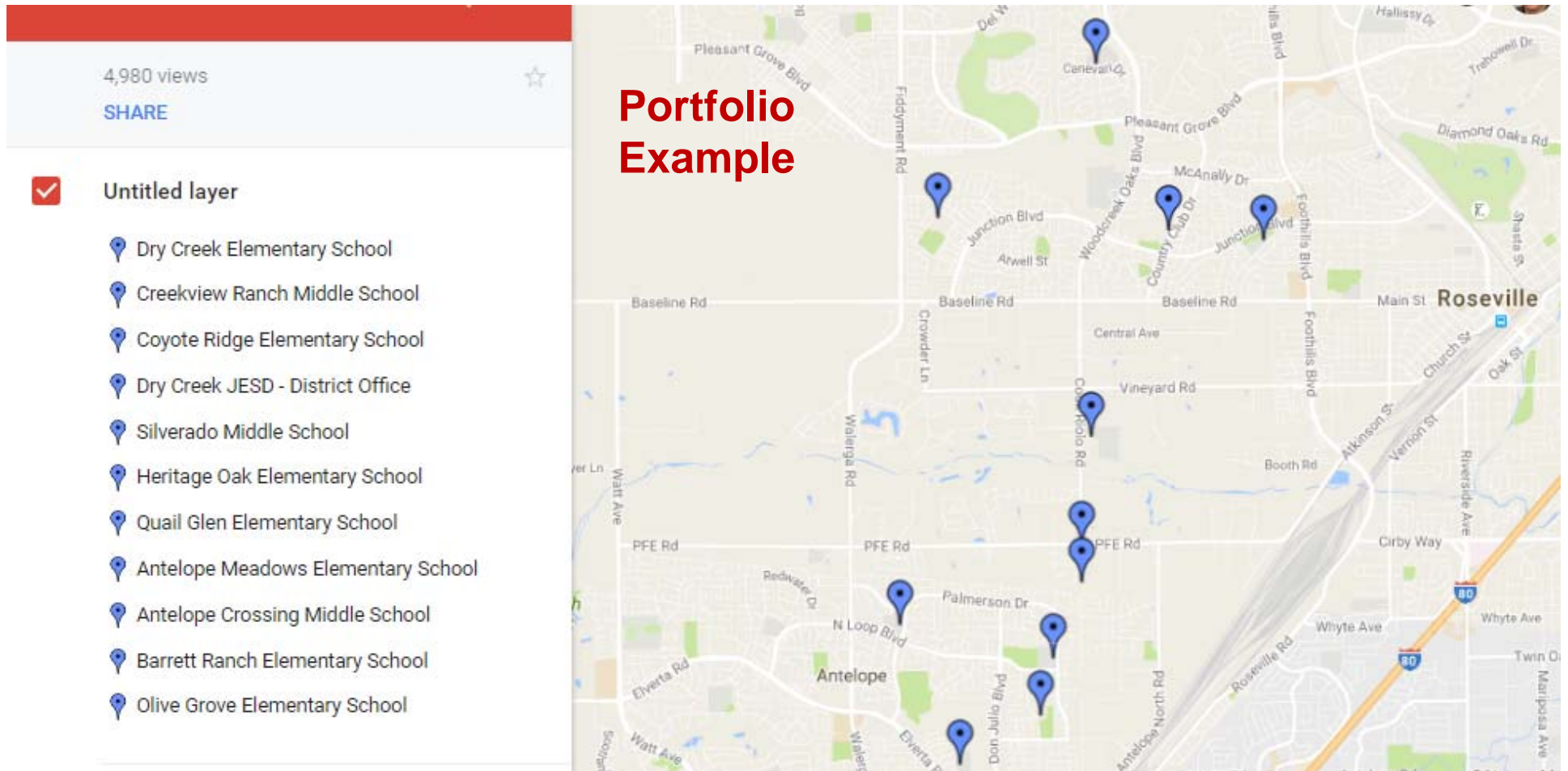


## ZNE Portfolio



## Combining Buildings within a School District

### Dry Creek Elementary School District



## Combining Supermarkets with Distribution Centers



**Portfolio  
Example**



# Smart Building Design



## Long Life, Loose Fit



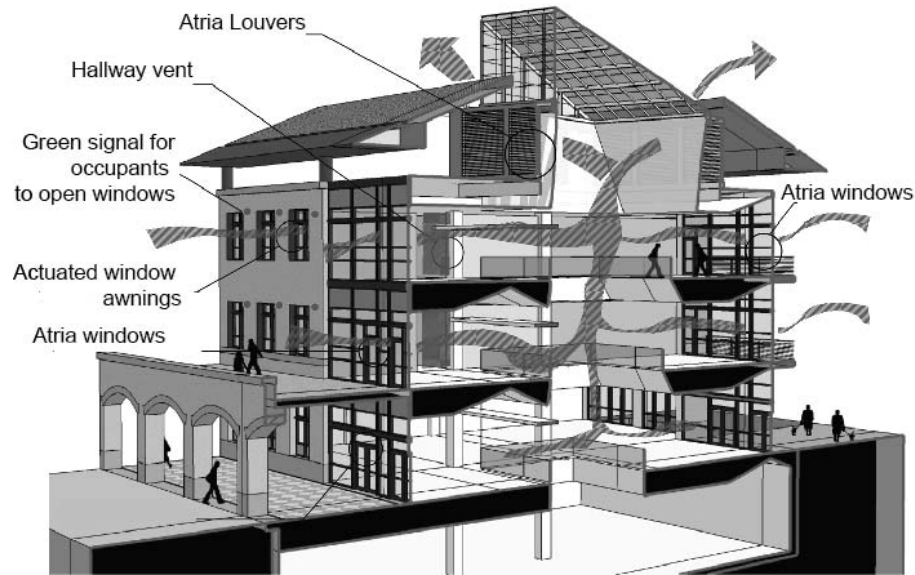


# Smart Building Design

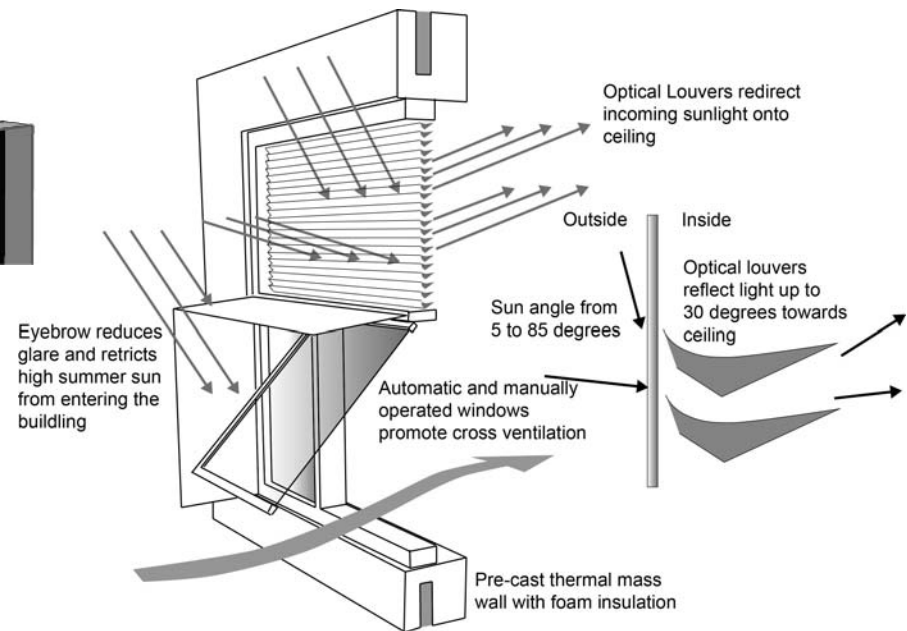
## Form and Configuration



## Building Envelope



**Y2E2 Stanford**



**NREL RSF South Window**

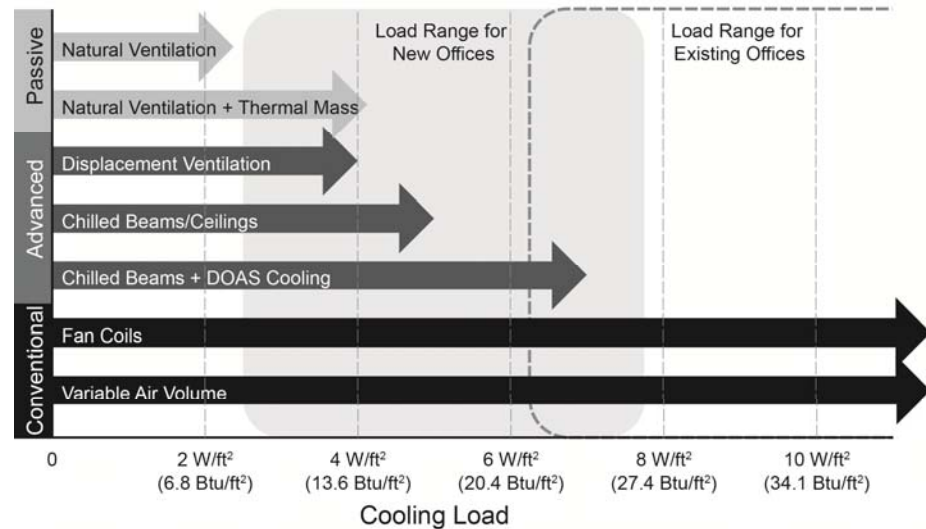
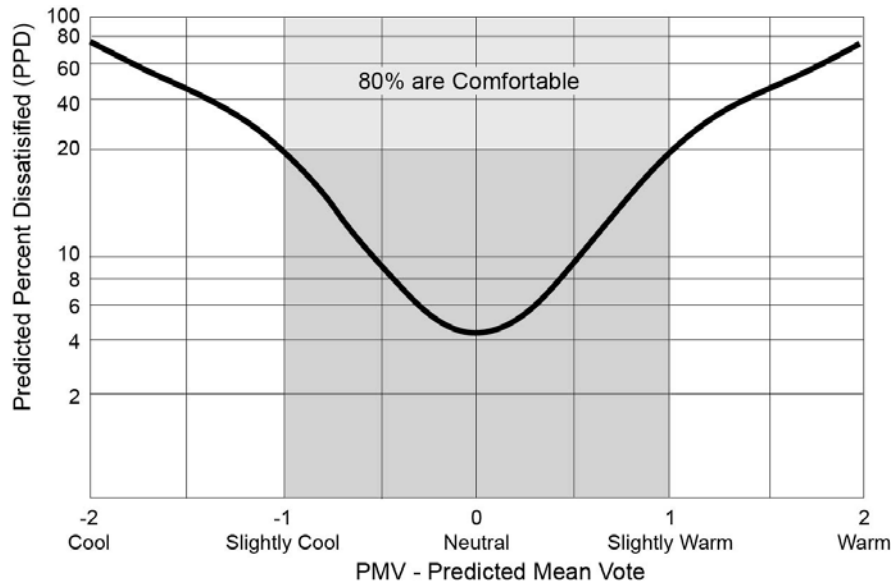


# Smart Building Design

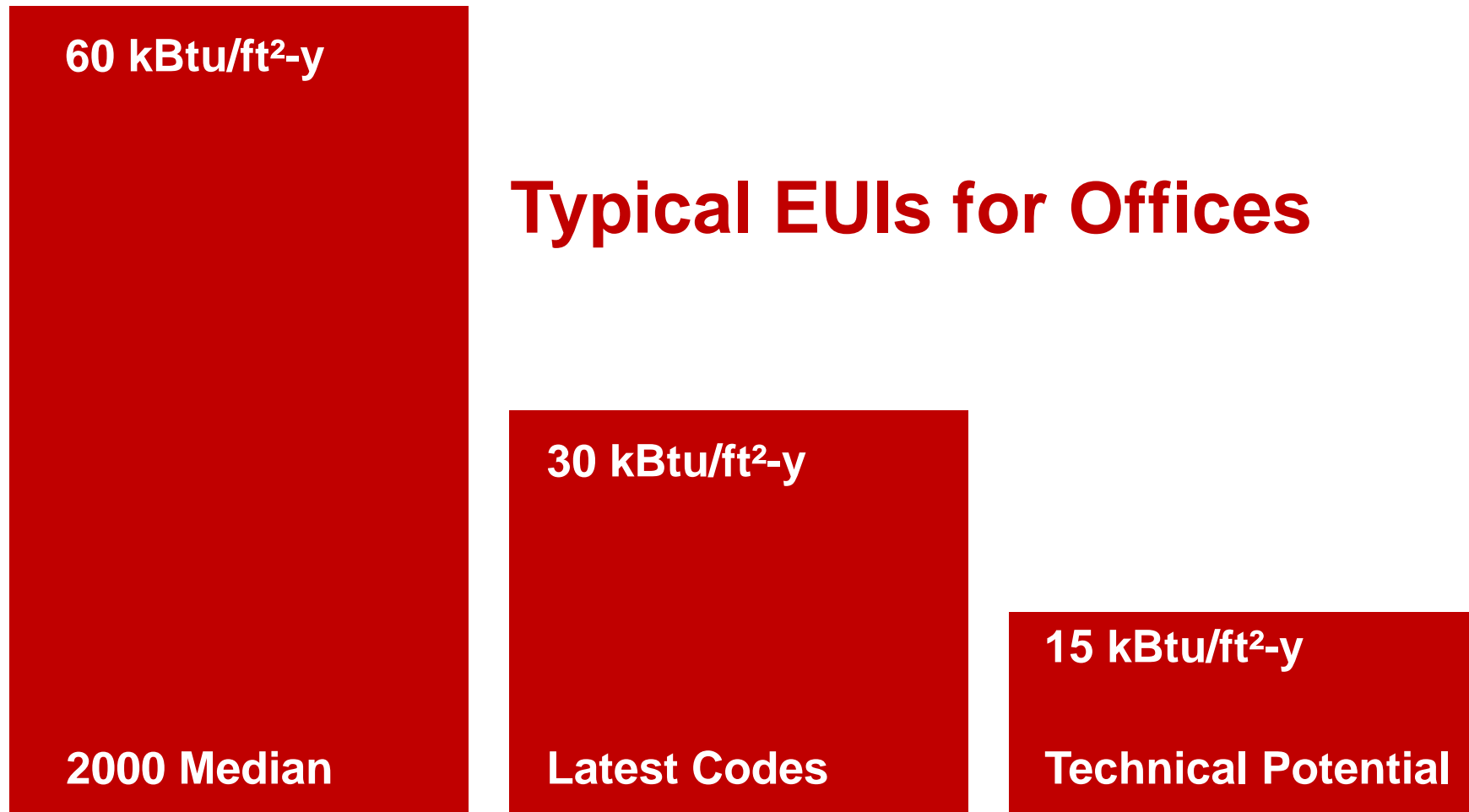
## Lighting and Visual Comfort



## HVAC and Thermal Comfort



## How Low Can We Go?



# Here Comes the Sun



## Solar



**Primary source of  
on-site renewable  
energy for ZNE  
buildings**



## Wind



- **Limited on-site potential for ZNE buildings**
- **More potential is at the utility scale**





## Hydro



**Limited or no on-site  
renewable energy  
potential**



## Geothermal



**Limited or no  
on-site renewable  
energy potential**



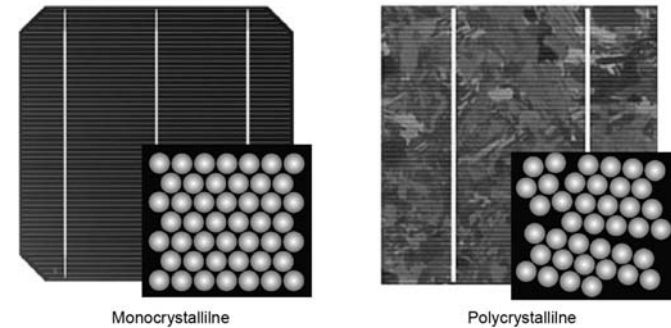
## Biomass

**Regenerative, but not renewable in the same sense as wind and solar.**

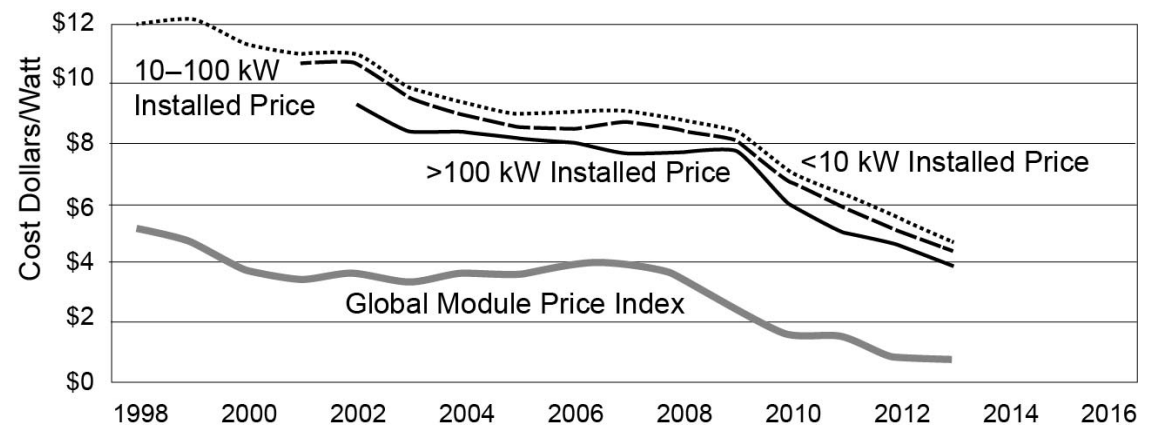


# Here Comes the Sun

## Solar PV is Affordable



**Costs are less than  
\$4/W before tax  
credits or incentives**



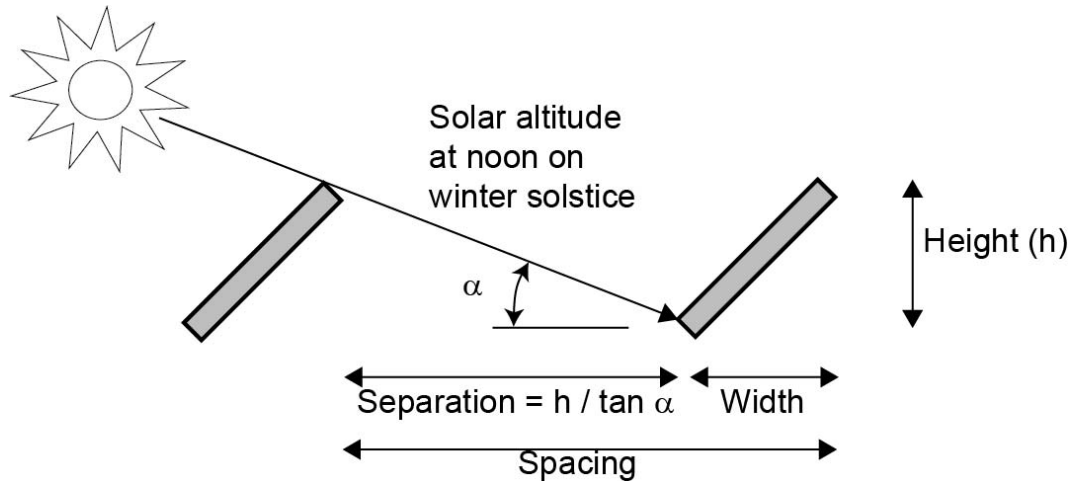
## Renewable Energy Production (kWh/y)/kW<sub>stc</sub>

<i>Climate</i>	<i>Orientation</i>	<i>0° Tilt</i>	<i>10° Tilt</i>	<i>20° Tilt</i>	<i>30° Tilt</i>	<i>40° Tilt</i>	<i>50° Tilt</i>	<i>60° Tilt</i>
Warm and Dry	East	1,414	1,385	1,336	1,269	1,191	1,105	1,013
	Southeast	1,414	1,470	1,493	1,486	1,450	1,383	1,292
	South	1,414	1,518	1,581	1,605	1,594	1,540	1,451
	Southwest	1,414	1,498	1,545	1,560	1,537	1,483	1,399
	West	1,414	1,425	1,409	1,368	1,310	1,236	1,149
”								
Pacific Coast	East	1,378	1,353	1,304	1,244	1,172	1,092	1,010
	Southeast	1,378	1,437	1,467	1,466	1,434	1,373	1,289
	South	1,378	1,485	1,553	1,582	1,571	1,523	1,436
	Southwest	1,378	1,464	1,518	1,534	1,518	1,466	1,389
	West	1,378	1,389	1,372	1,336	1,282	1,213	1,132

Source: Design Professionals Guide to Zero Net Energy Buildings, Charles Eley, Island Press, 2016



## The Benefit of (near) Horizontal Tilt



Source: Design Professionals Guide to  
Zero Net Energy Buildings,  
Charles Eley, Island Press, 2016



## Production per Square Foot

	Pacific Coast	Warm and Dry	Hot and Humid	Warm and Humid	Cold and Dry	Cold and Humid	Artic
	(3c, 4c)	(2b, 3b, 4b)	(1a, 2a)	(3a, 4a)	(5b, 6b)	(5a, 6a, 7)	(8)
Horizontal Production (kWh/y)/kW (stc)	1,378	1,414	1,359	1,316	1,311	1,138	748
Horizontal Production (kBtu/y)/kW (stc)	4,702	4,825	4,637	4,490	4,473	3,883	2,552
kBtu/ft <sup>2</sup> -y of Collector Area	72	74	71	69	69	60	39

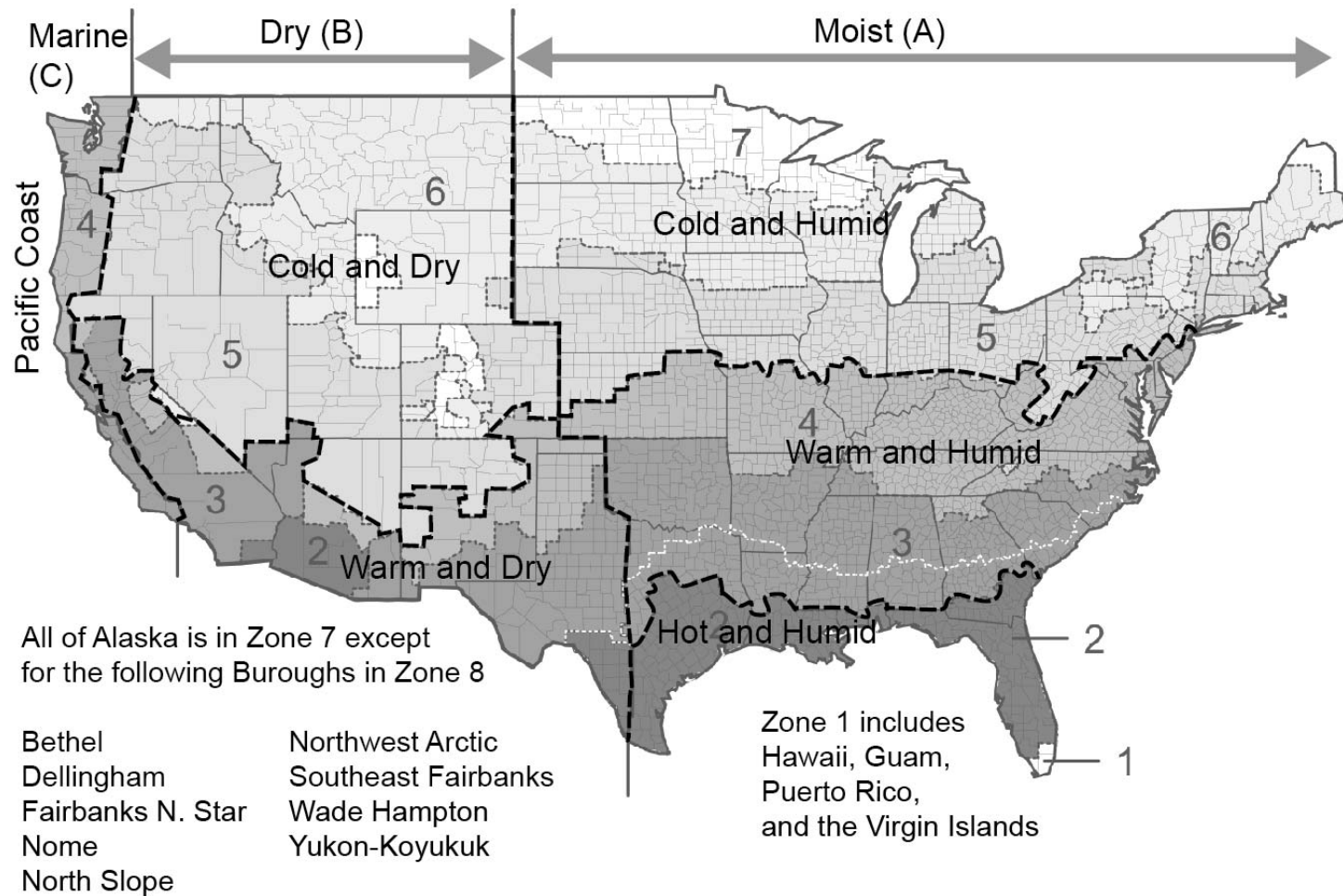
**Maximum site EUI to achieve ZNE for a one story building with the roof covered with PVs.**

Source: Design Professionals Guide to Zero Net Energy Buildings, Charles Eley, Island Press, 2016

# Challenging Building Types and Climates



## Climate Zones and Regions



# Challenging Building Types and Climates

## Turn-of-the-Millennium Buildings (site kBtu/ft<sup>2</sup>-y)

	Pacific Coast	Warm and Dry	Hot and Humid	Warm and Humid	Cold and Dry	Cold and Humid	Arctic
	(3c, 4c)	(2b, 3b, 4b)	(1a, 2a)	(3a, 4a)	(5b, 6b)	(5a, 6a, 7)	(8)
<b>Warehouses</b>	34	20	23	40	53	65	161
<b>Offices</b>	58	62	69	69	69	77	126
<b>Retail</b>	101	86	99	114	122	142	249
<b>Schools</b>	70	59	71	78	77	91	165
<b>Apartments</b>	62	42	52	69	73	86	153
<b>Hotels</b>	122	99	119	126	126	134	151
<b>Healthcare</b>	232	202	232	242	218	238	281
<b>Restaurants</b>	558	497	522	569	598	660	965

**California**

Source: Design Professionals Guide to Zero Net Energy Buildings,  
Charles Eley, Island Press, 2016

# Challenging Building Types and Climates

## Standard 90.1-2013 (site kBtu/ft<sup>2</sup>-y)

**Title 24 is similar**

	Pacific Coast	Warm and Dry	Hot and Humid	Warm and Humid	Cold and Dry	Cold and Humid	Artic
	(3c, 4c)	(2b, 3b, 4b)	(1a, 2a)	(3a, 4a)	(5b, 6b)	(5a, 6a, 7)	(8)
<b>Warehouses</b>	16	15	12	17	20	26	33
<b>Offices</b>	22	31	33	32	31	34	41
<b>Retail</b>	35	49	48	50	53	59	81
<b>Schools</b>	35	46	49	47	48	50	68
<b>Apartments</b>	35	48	48	51	53	61	76
<b>Offices/Data Center</b>	62	69	71	70	72	77	88
<b>Hotels</b>	57	75	80	78	77	83	100
<b>Healthcare</b>	101	108	117	116	111	120	140
<b>Restaurants</b>	360	431	414	471	513	574	759

**California**

Source: Design Professionals Guide to Zero Net Energy Buildings,  
Charles Eley, Island Press, 2016

# Challenging Building Types and Climates

## Maximum Technical Potential (site kBtu/ft<sup>2</sup>-y)

	Pacific Coast	Warm and Dry	Hot and Humid	Warm and Humid	Cold and Dry	Cold and Humid	Arctic
	(3c, 4c)	(2b, 3b, 4b)	(1a, 2a)	(3a, 4a)	(5b, 6b)	(5a, 6a, 7)	(8)
<b>Warehouses</b>	6	6	5	6	7	8	7
<b>Offices</b>	8	10	11	11	11	11	12
<b>Retail</b>	13	18	18	17	18	19	27
<b>Schools</b>	16	21	23	22	21	23	26
<b>Apartments</b>	24	30	29	31	32	34	35
<b>Offices/Data Center</b>	43	47	47	44	47	46	47
<b>Hotels</b>	40	49	49	51	51	54	58
<b>Healthcare</b>	62	64	68	67	66	68	70
<b>Restaurants</b>	265	323	324	336	343	353	377

**California**

**Study did not look at comprehensive measures to reduce cooking and refrigeration energy.**

Source: Design Professionals Guide to Zero Net Energy Buildings,  
Charles Eley, Island Press, 2016

# Challenging Building Types and Climates

## Collector Area to Floor Area Ratio Maximum Technical Potential

	<i>Pacific Coast</i>	<i>Warm and Dry</i>	<i>Hot and Humid</i>	<i>Warm and Humid</i>	<i>Cold and Dry</i>	<i>Cold and Humid</i>	<i>Arctic</i>
Warehouses	0.08	0.08	0.07	0.09	0.10	0.13	0.19
Offices	0.11	0.14	0.15	0.15	0.15	0.18	0.30
Retail	0.18	0.24	0.25	0.25	0.26	0.32	0.67
Schools	0.22	0.28	0.32	0.32	0.31	0.38	0.66
Apartments	0.33	0.40	0.41	0.44	0.45	0.57	0.90
Off/Data Center	0.59	0.63	0.66	0.64	0.68	0.77	1.19
Hotels	0.55	0.66	0.69	0.74	0.75	0.90	1.48
Healthcare	0.87	0.86	0.96	0.96	0.95	1.15	1.83
Restaurants	3.66	4.35	4.53	4.87	4.99	5.91	9.51

ZNE feasible for four stories or more

ZNE feasible for two-story buildings

ZNE feasible for one-story buildings

PV on roof not enough

**California**

Source: Design Professionals Guide to Zero Net Energy Buildings,  
Charles Eley, Island Press, 2016

# Challenging Building Types and Climates

## Maximum Technical Potential

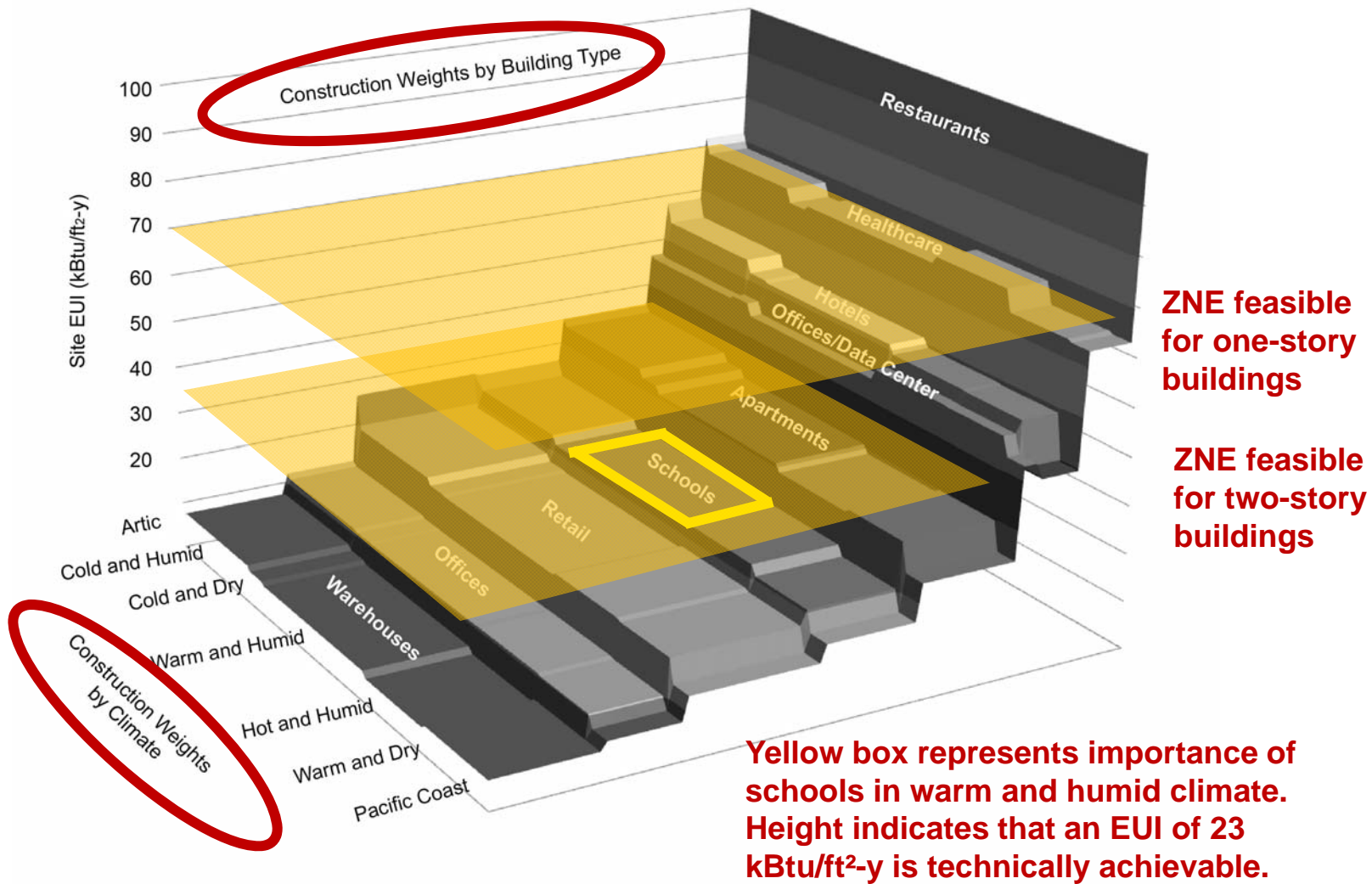


Image from Design Professionals Guide to Zero Net Energy Buildings, Charles Eley, Island Press, 2016



# Off-Site Renewable Energy

## Off-Site Renewable Energy





# Off-Site Renewable Energy





# Off-Site Renewable Energy

## Stanford University

### Palo Alto Campus



All Electric Central Plant



## 73 MW Solar System in California Desert



### **RESBCT (Renewable-Energy Self-Generation Bill Credit Transfer)**

- Program of **California IOUs**
- Allows **municipal governments and school districts** to install an eligible renewable-energy generator on property located within its geographic boundary and under its ownership or control
- The exported energy is **automatically credited to up to fifty separate electricity accounts** located within the local government's geographic boundaries, and on property that the government entity owns, operates, or controls
- This program is limited to renewable-energy generators that are **no larger than five megawatts**

# Community Solar



## Definition


A **community solar farm** or **garden** is a **solar power** installation that accepts capital from and provides output credit and tax benefits to individual and other investors. In some systems you buy individual solar panels which are installed in the farm after your purchase. In others you purchase kW capacity or kWh of production. The farm's power output is credited to investors in proportion to their investment, with adjustments to reflect ongoing changes in capacity, technology, costs and electricity rates. Companies, cooperatives, governments or non-profits operate the farms.<sup>[1]</sup>



**In many instances, the renewable energy is credited to your utility bill on a monthly basis, just as if the system were located on your roof.**


**Source: [https://en.wikipedia.org/wiki/Community\\_solar\\_farm](https://en.wikipedia.org/wiki/Community_solar_farm)**

## One of the first examples . . .

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### Environment

- Greenergy®
- ▶ Solar for Your Home
- ▶ Smart Homes
- SolarShares®
- Carbon Offsets
- ▶ Shade Trees
- ▶ Electric Vehicles




### SolarShares®: Solar for Everyone!

Solar energy should be available and affordable for everyone, but putting a solar system on your roof is not always an option. SMUD's SolarShares gives everyone the opportunity to benefit from the sun's power whether you rent or own your home. Plus, SolarShares is 100% local with the solar farm located in our service area, providing local environmental benefits in Sacramento County.



Locally-grown solar power  
Buy your electricity fresh off the farm.

[Watch video](#)



Energy savings begin here  
See where your energy dollars may be going.

**“SolarShares gives everyone the opportunity to benefit from the sun’s power whether you rent or own your home”**

## Electric Utilities are Embracing the Concept

Google Calendar - Ever... x | in Cameron Scott | Linked... x | in Capitalizing on Trends | x | trobey | Drupal.org x | W Community solar farm x | G stanford campus - G

nation-are-embracing-community-solar/354164/

Charles | Enlighten | CHPS | Sustainability Diction... | AIA IgCC | COMNET Standing Co... | Pandora Radio - Liste... | UTC Gateway | Microsoft Answers | Foothill

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The shared renewables movement is catching on from coast to coast

By [Herman K. Trabish](#) | January 22, 2015 [print](#)

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## Significant Growth is Expected

The screenshot shows a web browser window with multiple tabs open. The active tab is the Greentech Media article. The browser's address bar shows the URL: [www.greentechmedia.com/articles/read/us-community-solar-market-to-grow-fivefold-in-2015-top-500-mw-in-2020](http://www.greentechmedia.com/articles/read/us-community-solar-market-to-grow-fivefold-in-2015-top-500-mw-in-2020). The page features a dark sidebar on the left with the 'gtm.' logo and navigation links for SOLAR, GRID EDGE, ETC., Videos, The Energy Gang, Webinars, White Papers, About, Advertising, Careers, Contact, Newsletters, Terms & Conditions, and Privacy Policy. The main content area has a search bar and navigation links for GTM RESEARCH and GTM EVENTS. Below these are three featured articles: 'Donald Trump's Energy Delusion', 'EVs Will Reduce US Gasoline Demand by 300,000 Barrels per Day by 2035', and 'Watch the Video-On-Demand From New York Future 2016'. The main article is titled 'US Community Solar Market to Grow Fivefold in 2015, Top 500MW in 2020' under the 'MARKETS & POLICY' category. It includes a large image of solar panels in the foreground and a city skyline in the background. The text states: 'California, Minnesota, Colorado and Massachusetts will pave the way.' by Mike Munsell, dated June 23, 2015. A photo credit to shutterstock.com is at the bottom of the image.

**US Community Solar Market to Grow Fivefold in 2015, Top 500MW in 2020**

California, Minnesota, Colorado and Massachusetts will pave the way.

by Mike Munsell  
June 23, 2015

Photo Credit: shutterstock.com

<http://www.greentechmedia.com/articles/read/us-community-solar-market-to-grow-fivefold-in-2015-top-500-mw-in-2020>

### **Additionality**

"Additionality" means that a project introduces new renewable energy onto the electricity grid beyond what would have happened without the project or "business as usual".

**Important concept for  
zero net-energy buildings**

## Participation Models

### Capacity Model

A participant pays money up front (or arranges financing) to lease a certain number of panels

**High** additionality probability

Likely included in **capital improvement budget**

### Subscription Model

A participant contracts to purchase output from the system on a monthly basis

**Low** additionality probability

Likely included in **operating budget**

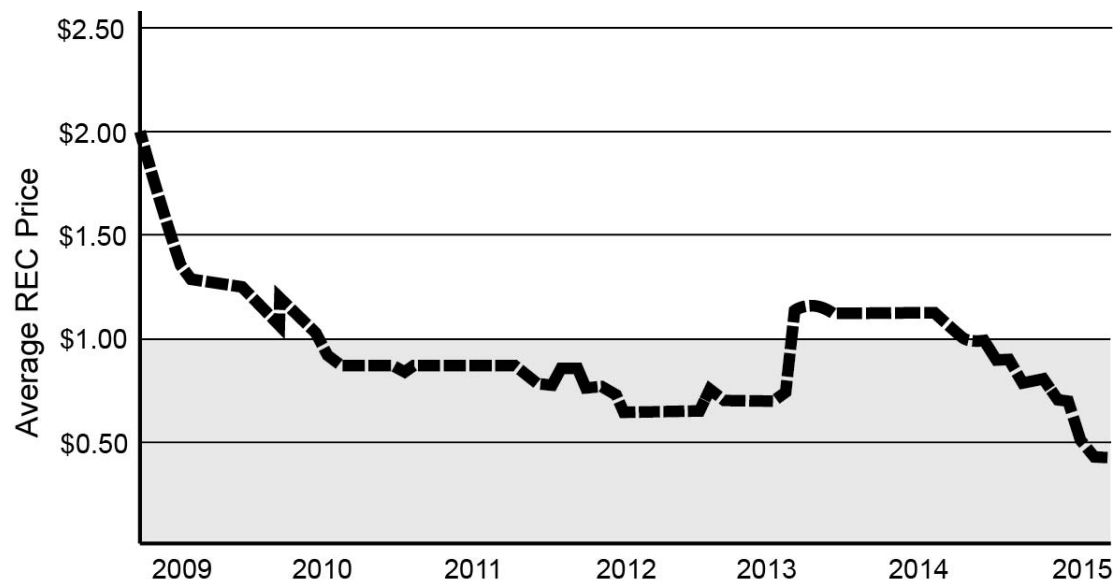


# Renewable Energy Credits (RECs)

# Renewable Energy Credits (RECs)

## RECs

Per Year			
Annual Revenue/Cost	=	Electricity Sales/Cost	+ Renewable Energy Certificate Sales/Cost
For the Life of the System			
Value of Renewable Generation Asset	=	Net Present Value of Electricity Production	+ Net Present Value of Future RECs



**National average  
price for RECs**

**\$/MWh**

# Renewable Energy Credits (RECs)

## Solar Providers Often Retain RECs

Berkeley Blog






Culture & humanities Economics Environment Mind & body Politics & law Science & technology Other

Economics

### Feeling smug about your solar rooftop? Not so fast



Severin Borenstein, professor of business | January 21, 2016

[10 comments](#) | [Leave a comment](#)     

If you installed solar panels on your roof and feel aglow with environmental virtue, you may be in for a rude awakening. There's a good chance someone else has purchased your halo and is wearing it right now.

In most states (including California) power generated by rooftop solar panels earns [Renewable Energy Certificates](#), which quantify how much clean electricity they produce. But if panels are leased or installed under a power purchase agreement, it's the "third-party owner" — not the homeowner — who gets those certificates. Most then turn around and sell the RECs, which magically turns some other brown electrons green.

Here's how it works: Joe's Solar puts panels on your roof that produce 7,500 kilowatt-hours a year, and Joe sells you the electricity under a power purchase agreement. Because Joe still owns the panels, he gets credit — in the form of RECs — for that renewable electricity. Meanwhile, Bob's all-fossil utility wants to "green up" so it buys the RECs from Joe. That allows Bob to relabel 7,500 kilowatt-hours of its coal or gas-fired power generation as "renewable energy."



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- 3 Marginal Revolution
- 2 Marketplace
- 2 Medium
- 3 Planet Money (NPR)

## Federal Trade Commission

Federal Register / Vol. 77, No. 197 / Thursday, October 11, 2012 / Rules and Regulations 62131

(a Möbius loop) without explanation. By itself, the symbol likely conveys that the packaging is both recyclable and made entirely from recycled material. Unless the marketer has substantiation for both messages, the claim should be qualified. The claim may need to be further qualified, to the extent necessary, to disclose the limited availability of recycling programs and/or the percentage of recycled content used to make the package.

**Example 9:** In an office supply catalog, a manufacturer advertises its printer toner cartridges “65% recycled.” The cartridges contain 25% recycled raw materials and 40% reconditioned parts. The claim is deceptive because reasonable consumers likely would not know or expect that a cartridge’s recycled content consists of reconditioned parts. It would not be deceptive if the manufacturer claimed “65% recycled content including 40% from reconditioned parts.”

**Example 10:** A store sells both new and used sporting goods. One of the items for sale in the store is a baseball helmet that, although used, is no different in appearance than a brand new item. The helmet bears an unqualified “Recycled” label. This claim is deceptive because reasonable consumers likely would believe that the helmet is made of recycled raw materials, when it is, in fact, a used item. An acceptable claim would bear a disclosure clearly and prominently stating that the helmet is used.

**Example 11:** An automotive dealer, automobile recycler, or other qualified entity recovers a serviceable engine from a wrecked vehicle. Without repairing, rebuilding, re-manufacturing, or in any way altering the engine or its components, the dealer attaches a “Recycled” label to the engine, and offers it for sale in its used auto parts store. In this situation, an unqualified recycled content claim likely is not deceptive because reasonable consumers in the automotive context likely would understand that the engine is used and has not undergone any rebuilding.

**Example 12:** An automobile parts dealer, automobile recycler, or other qualified entity purchases a transmission that has been recovered from a salvaged or end-of-life vehicle. Eighty-five percent of the transmission, by weight, was rebuilt and 15% constitutes new materials. After rebuilding<sup>31</sup> the transmission in accordance with industry practices, the dealer packages it for resale in a box labeled “Rebuilt Transmission,” or “Rebuilt Transmission (85% recycled content from rebuilt parts),” or “Recycled Transmission (85% recycled content from rebuilt parts).” Given consumer perception in the automotive context, these claims are not deceptive.

### **§ 260.14 Refillable claims.**

It is deceptive to misrepresent, directly or by implication, that a

package is refillable. A marketer should not make an unqualified refillable claim unless the marketer provides the means for refilling the package. The marketer may either provide a system for the collection and refill of the package, or offer for sale a product that consumers can purchase to refill the original package.

**Example 1:** A container is labeled “refillable three times.” The manufacturer has the capability to refill returned containers and can show that the container will withstand being refilled at least three times. The manufacturer, however, has established no collection program. The unqualified claim is deceptive because there is no means to return the container to the manufacturer for refill.

**Example 2:** A small bottle of fabric softener states that it is in a “handy refillable container.” In the same market area, the manufacturer also sells a large-sized bottle that consumers use to refill the smaller bottles. The claim is not deceptive because there is a reasonable means for the consumer to refill the smaller container.

### **§ 260.15 Renewable energy claims.**

(a) It is deceptive to misrepresent, directly or by implication, that a product or package is made with renewable energy or that a service uses renewable energy. A marketer should not make unqualified renewable energy claims, directly or by implication, if fossil fuel, or electricity derived from fossil fuel, is used to manufacture any part of the advertised item or is used to power any part of the advertised service, unless the marketer has matched such non-renewable energy use with renewable energy certificates.

(b) Research suggests that reasonable consumers may interpret renewable energy claims differently than marketers may intend. Unless marketers have substantiation for all their express and reasonably implied claims, they should clearly and prominently qualify their renewable energy claims. For instance, marketers may minimize the risk of deception by specifying the source of the renewable energy (e.g., wind or solar energy).

(c) It is deceptive to make an unqualified “made with renewable energy” claim unless all, or virtually all of the significant manufacturing processes involved in making the product or package are powered with renewable energy or non-renewable energy matched by renewable energy certificates. When this is not the case, marketers should clearly and prominently specify the percentage of renewable energy that powered the significant manufacturing processes involved in making the product or package.

(d) If a marketer generates renewable electricity but sells renewable energy certificates for all of that electricity, it would be deceptive for the marketer to represent, directly or by implication, that it uses renewable energy.

**Example 1:** A marketer advertises its clothing line as “made with wind power.” The marketer buys wind energy for 50% of the energy it uses to make the clothing in its line. The marketer’s claim is deceptive because reasonable consumers likely interpret the claim to mean that the power was composed entirely of renewable energy. If the marketer stated, “We purchase wind energy for half of our manufacturing facilities,” the claim would not be deceptive.

**Example 2:** A company purchases renewable energy from a portfolio of sources that includes a mix of solar, wind, and other renewable energy sources in combinations and proportions that vary over time. The company uses renewable energy from that portfolio to power all of the significant manufacturing processes involved in making its product. The company advertises its product as “made with renewable energy.” The claim would not be deceptive if the marketer clearly and prominently disclosed all renewable energy sources. Alternatively, the claim would not be deceptive if the marketer clearly and prominently stated, “made from a mix of renewable energy sources,” and specified the renewable source that makes up the greatest percentage of the portfolio. The company may calculate which renewable energy source makes up the greatest percentage of the portfolio on an annual basis.

**Example 3:** An automobile company uses 100% non-renewable energy to produce its cars. The company purchases renewable energy certificates to match the non-renewable energy that powers all of the significant manufacturing processes for the seats, but no other parts, of its cars. If the company states, “The seats of our cars are made with renewable energy,” the claim would not be deceptive, as long as the company clearly and prominently qualifies the claim such as by specifying the renewable energy source.

**Example 4:** A company uses 100% non-renewable energy to manufacture all parts of its product, but powers the assembly process entirely with renewable energy. If the marketer advertised its product as “assembled using renewable energy,” the claim would not be deceptive.

**Example 5:** A toy manufacturer places solar panels on the roof of its plant to generate power, and advertises that its plant is “100% solar-powered.” The manufacturer, however, sells renewable energy certificates based on the renewable attributes of all the power it generates. Even if the manufacturer uses the electricity generated by the solar panels, it has, by selling renewable energy certificates, transferred the right to characterize that electricity as renewable. The manufacturer’s claim is therefore deceptive. It also would be deceptive for this manufacturer to advertise that it “hosts” a renewable power facility because reasonable consumers likely interpret this claim to mean


**Example 5:** A toy manufacturer places solar panels on the roof of its plant to generate power, and advertises that its plant is “100% solar-powered.” The manufacturer, however, sells renewable energy certificates based on the renewable attributes of all the power it generates. Even if the manufacturer uses the electricity generated by the solar panels, it has, by selling renewable energy certificates, transferred the right to characterize that electricity as renewable. The manufacturer’s claim is therefore deceptive.

<sup>31</sup> The term “rebuilding” means that the dealer dismantled and reconstructed the transmission as necessary, cleaned all of its internal and external parts and eliminated rust and corrosion, restored all impaired, defective or substantially worn parts to a sound condition (or replaced them if necessary), and performed any operations required to put the transmission in sound working condition.



# Renewable Energy Credits (RECs)

## Additionality and RECs

 CRS center for resource solutions

### Additionality and Renewable Energy Certificates

Understanding the value of REC claims

Updated March 7, 2016

Additionality is a term used in markets for tradable greenhouse gas (GHG) emissions reductions (carbon offsets). It means that a project or activity that reduces GHGs would not have happened without the offset buyer or collective buyers in the market. In a business-as-usual scenario—where the market for offsets didn't exist—the project would not have taken place. So, additionality enables offset buyers to claim to be reducing emissions.

While it is one of the most important qualities for carbon offset projects, additionality is not required for renewable electricity generators to create Renewable Energy Certificates (RECs), which embody the generation attributes of one megawatt-hour of renewable energy generation. Additionality is not required in order for REC buyers to claim use of renewable electricity, or the reduced carbon footprint that comes from switching to renewable electricity. Even without additionality, REC buyers are still impacting the development of new renewable resources.

They enable suppliers and utilities to deliver renewable electricity to specific customers (both through state programs and in response to voluntary demand) and they allow grid customers to claim use of renewable electricity.

RECs and renewable electricity may be sourced from new or existing renewable energy generators that were built for a variety of reasons without affecting a consumer's claim to be using that generation or to the benefits of that generation, which is nevertheless proved with RECs. An individual renewable energy purchase may not result in the creation of new renewable generation or a new renewable plant to supply that renewable electricity. Nonetheless, the purchaser may legitimately claim to have changed their usage and reduced their environmental impact, regardless of additionality.

In 2015, The Greenhouse Gas Protocol, a joint initiative of the World Resources Institute (WRI) and World Business Council on Sustainable Development (WBCSD), released new guidance on how companies should calculate and report their GHG emissions from purchased electricity—Scope 2 GHG emissions.<sup>1</sup> The guidance "does not require that contract instruments claimed [...] fulfill criteria such as offset 'additionality' or prove the overall market impact of individual purchases or supplier programs result in direct and immediate changes in overall supply" in order for RECs to be used to reduce a consumer's Scope 2 emissions (p. 90). It says: "[a]ll energy has a direct emissions factor associated with generation, and the use of that emissions factor does not depend on whether the generation facility is existing or new, or why the generation has occurred. [...] [R]egardless of what causes the project to be built, the energy attribute certificate still serves as the instrument conveying claims about the attributes of the underlying energy generation for consumers purchasing that generation" (p. 91).

Since RECs are the way to purchase and use renewable energy, they are also the way for consumers to affect

#### Why Isn't Additionality Required To Claim Use Of Renewable Energy Using RECs?

A consumer can purchase and use renewable energy without having to demonstrate that their purchase caused that renewable energy to be created. The consumer gets the benefits of using that clean energy. Their choice still affects their own usage and may still have an impact in the electricity market by increasing demand for renewable energy. This is how consumers affect demand-side change in any market for any product.

Because all electricity is identical and electrons can't be tracked, use of renewable electricity generation on a shared distribution grid is determined contractually. In the U.S., RECs are the legally enforceable contractual instrument for verifying use and delivery of renewable electricity on the grid. RECs demonstrate the use of a clean electricity product.

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## Off-Site Priorities

1 On-Site Test		The Zero Net-Energy Criteria
$[ Q_{\text{Delivered}} - Q_{\text{Exported}} ]$		$\leq 0$
Description	Basic definition of on-site zero net-energy building	
Additionality	New renewable energy is added as part of the construction project	
Funding	Capital Improvement Budget	



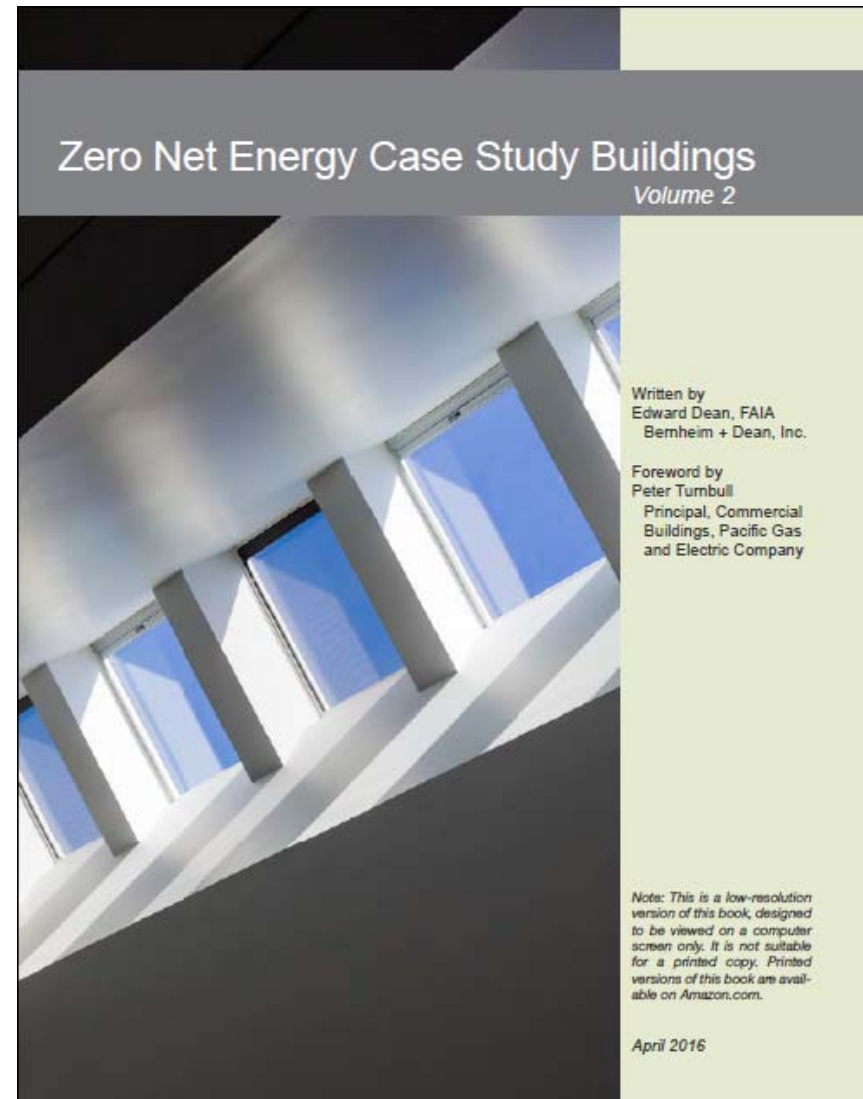
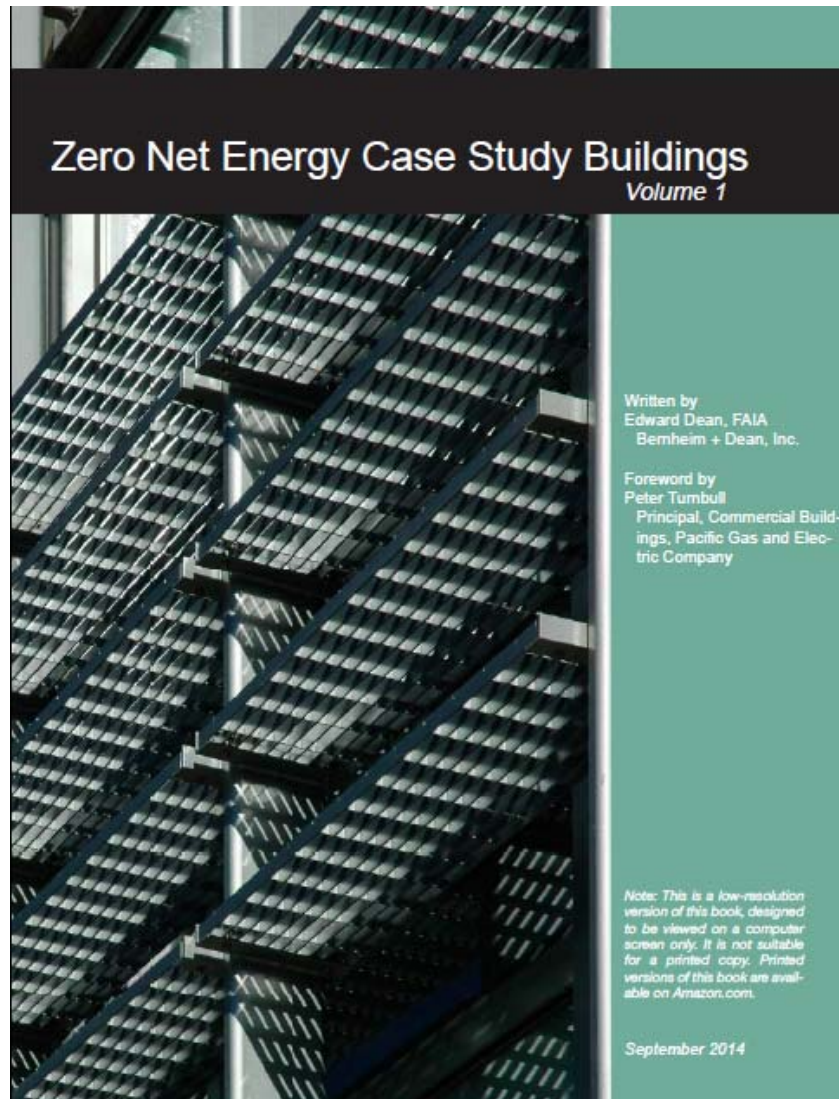
# Resources and Wrapup

### Significant ZNE Drivers

- Title 24 and Standard 90.1 are requiring energy efficient buildings low enough in many instances to achieve ZNE.
- PV can be installed through Innovative power purchase agreements and solar leases at little or no capital cost.

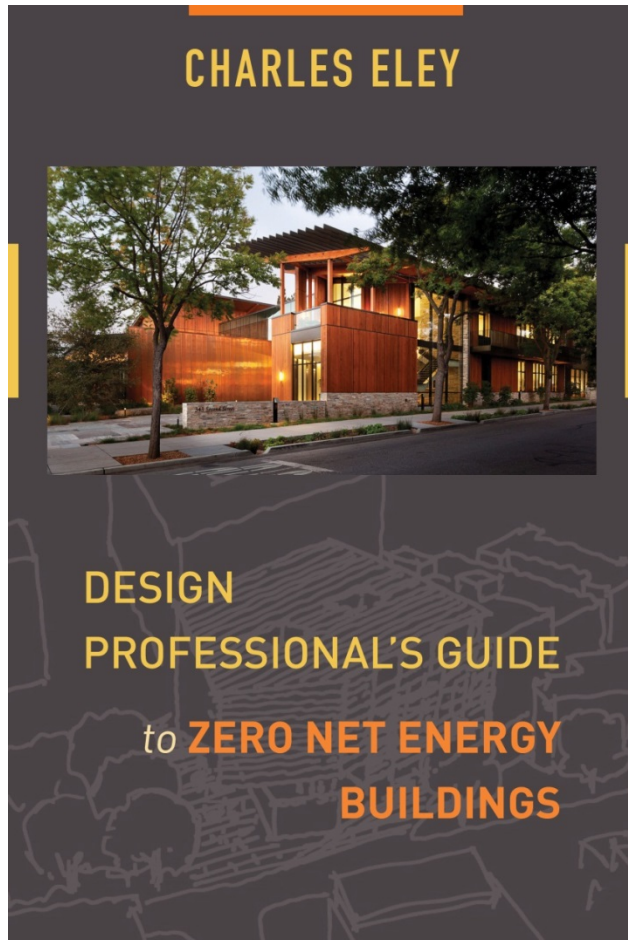


## Pacific Gas and Electric Case Studies





## Design Professionals Guide



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**Much of the material in this presentation is adapted from this book to be published by Island Press, November 2016.**