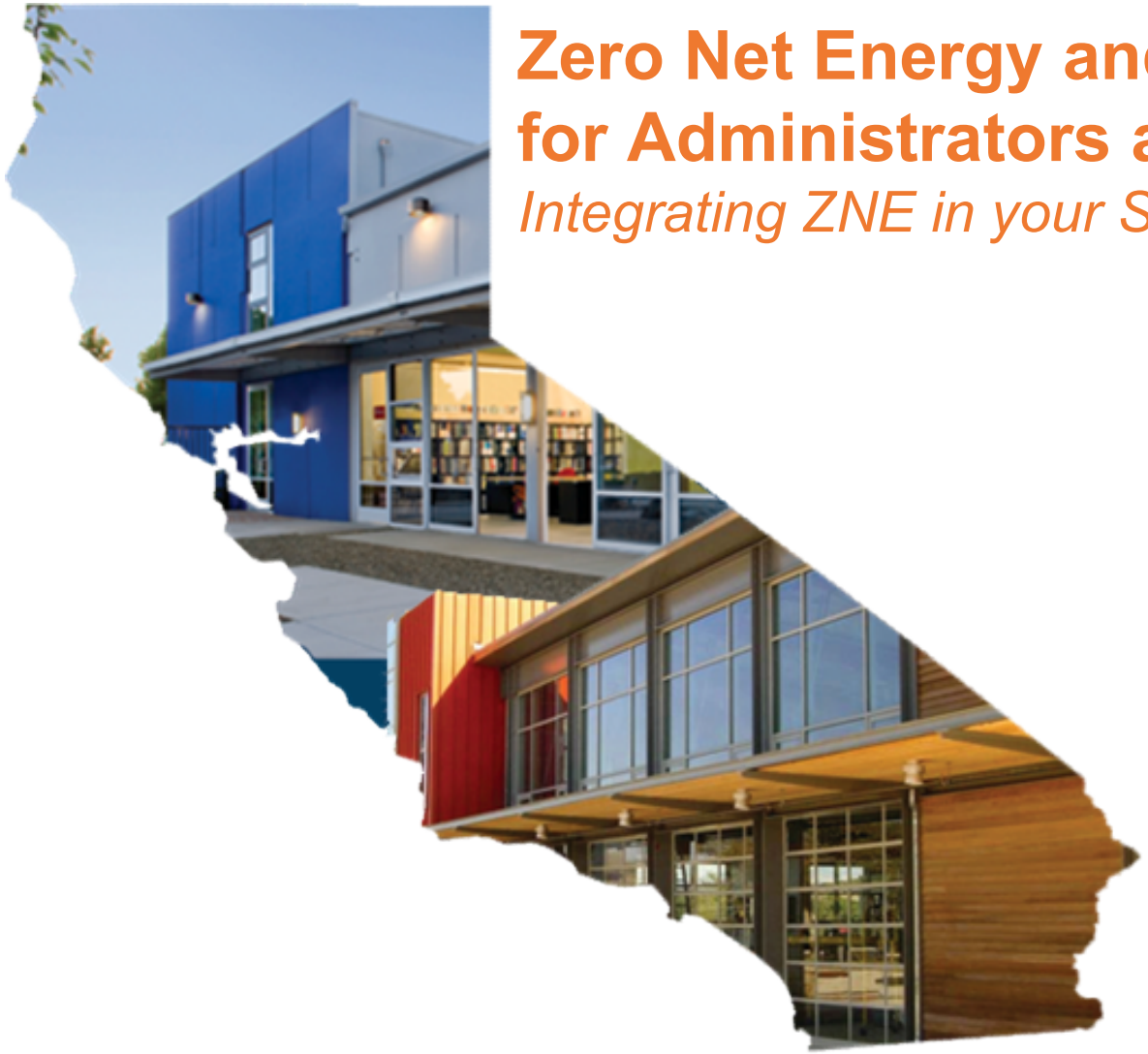
California Proposition 39
Zero Net Energy School Retrofits Webinar



Zero Net Energy and the School Community for Administrators and Stakeholders:

Integrating ZNE in your School Plans & Policies

Tuesday, May 10th, 2016

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California Proposition 39
Zero Net Energy School Retrofits Webinar

The Prop 39 ZNE Pilot Program is funded by California utility customers and administered by Pacific Gas and Electric Company, San Diego Gas & Electric Company, Southern California Edison Company, and Southern California Gas Company under the auspices of the California Public Utilities Commission. The California investor-owned utilities are not responsible for the preparation of this presentation, nor do any of them make any representation concerning the quality, accuracy or suitability of the information set forth herein. As the author of this presentation, the New Building Institute is solely responsible for this presentation and its contents.

California Proposition 39
Zero Net Energy School Retrofits Webinar

Welcome & Introductions

10:00 – 10:10 p.m.

Heather Flint Chatto
ZNE Project Manager

Ralph DiNola
CEO

Our Agenda

10:00 – 10:10	Welcome, Introductions, Expectations
10:10 – 10:30	Prop 39 Schools & Status of ZNE
10:30 – 11:00	Using Case Studies as your Guide
11:00 – 11:10	*Q&A*
11:10 – 11:30	Developing your ZNE Plan
11:30 – 11:40	Incorporating ZNE into your Polices & Delivery Process
11:40 - 11:50	Resources for Engaging & Educating Stakeholders for ZNE
11:50 - 12:00	Group Discussion & Wrap Up

ZNE Workshop Expectations

What questions do you have?

What information do you hope we will share during the webinar?

California Foundational Policies Prop 39 School ZNE Retrofit Pilots Status of ZNE

10:10 – 10:30 p.m.

Introduction to CA ZNE Goals & Policies

Overview of the IOU Prop 39 Zero Net Energy Pilot

Technical Introduction to ZNE – NBI National ZNE Research

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Proposition 39: ZNE / Deep Retrofit Pilot for Schools

D.14-10-046 directs **IOUs to design a new deep retrofit and ZNE pilot for K-12 schools** and community colleges to be run in conjunction with Prop 39

Comprehensive plan that is scalable for the full term of Prop 39

Incorporate best practices from other states and jurisdictions

IOUs to consult and coordinate with stakeholders: state agencies, schools/CCs, ZNE experts, etc.

PHOTO: Turkeyfoot ZNE Middle school, Kentucky

NBI Support for Prop 39 ZNE Schools/Deep Retrofit Pilots

6 Technical Training Workshops

(3 in Northern CA, 3 in Southern CA)

6 Institutional Trainings

(3 in Northern CA, 3 in Southern CA)

5 ZNE School Case Studies

PHOTO: Turkeyfoot ZNE Middle school, Kentucky

Development of Training Materials & Presentations

ZNE Schools Recognition Program Support (2016)

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Round II - Demonstration Projects

Per Utility (Remaining Projects Available):

PG&E	2-4
SCE/SoCalGas	4-6
SDG&E	2-3
Total	8-13

Per School Type:

CCC	3-5
K-12	5-8
Total	8-13

Zero Net Energy – What is it?

A ZNE building is an ultra-efficient building that generates as much energy as it consumes annually. Also known as Net Zero Energy.


Marin Country Day School (Photo: Michael David Rose)

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“Big Bold” Goals for ZNE in California

Exploratorium | San Francisco, CA

1 All new commercial construction will be ZNE by 2030

2 50% of existing buildings will be retrofit to ZNE by 2030

3 All new residential construction in California will be ZNE by 2020

The California Efficiency Strategic Plan (Sep 2008)
californiaenergyefficiency.com/docs/EEStrategicPlan.pdf

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Foundational State Policies

Global Warming Solutions Act (2006)

AB 32 — Reduces statewide greenhouse gas (GHG) emissions to 1990 levels by 2020 and to 20 percent of 1990 levels by 2050.

Energy Efficiency Program for Existing Buildings (2009)

AB 758 — Requires the Energy Commission to develop and implement a comprehensive program to achieve greater energy savings in the state of California's existing residential and nonresidential building stock.

Long Term Energy Efficiency Strategic Plan (2008)

State's first integrated framework–a single roadmap to achieve maximum energy savings across all major groups and sectors.

Leading by Example

California's Policy for Public Buildings

Executive Order B-18-12 requires state buildings to significantly reduce over the next two decades.

- Any proposed new or major renovation of State buildings larger than 10,000 square feet use clean, on-site power generation, such as solar photovoltaic, solar thermal and wind power generation, and clean back-up power supplies

- 50% of new facilities beginning design after 2020 to be Zero Net Energy.
- 100% of new State buildings & major renovations beginning design after 2025 to be ZNE

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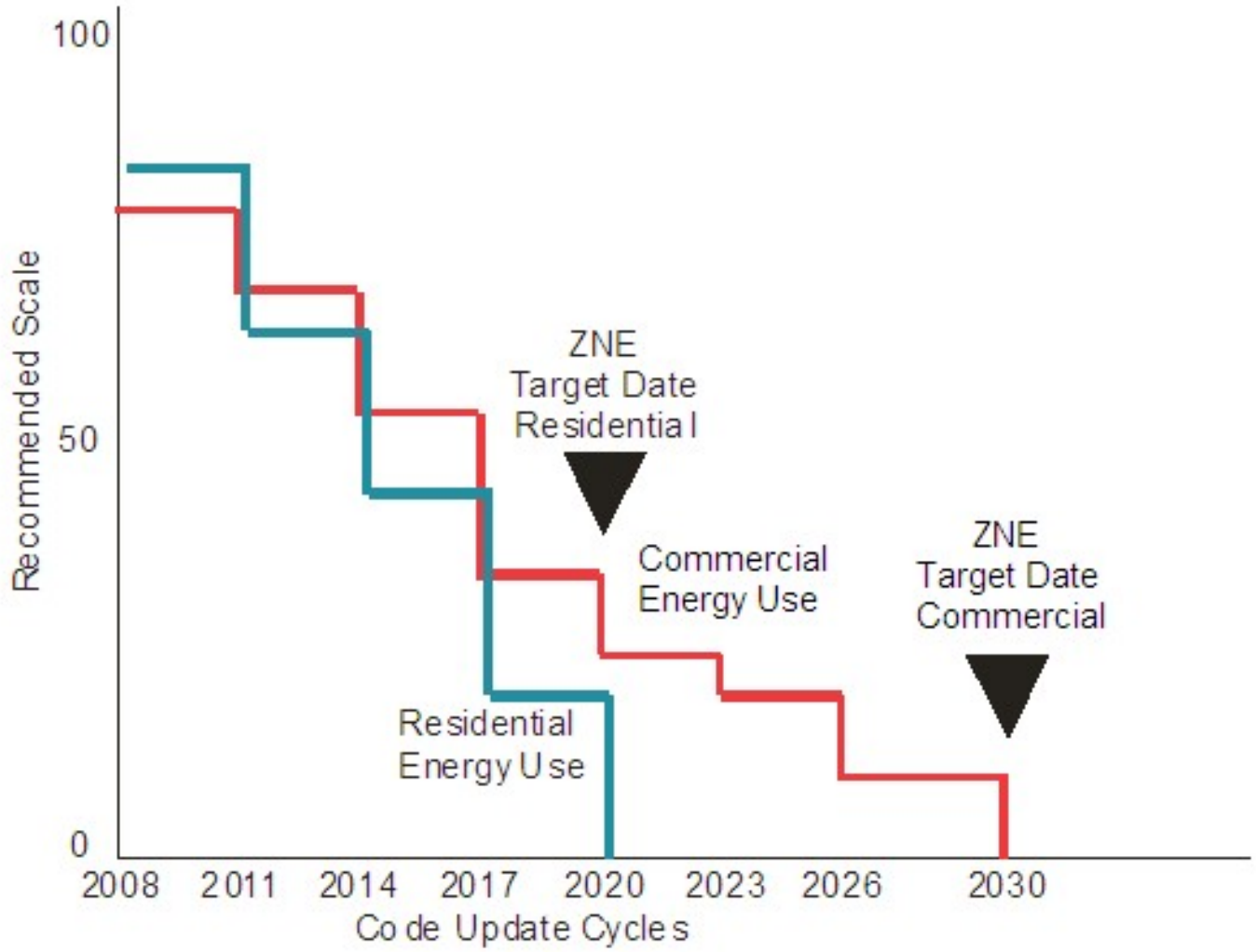
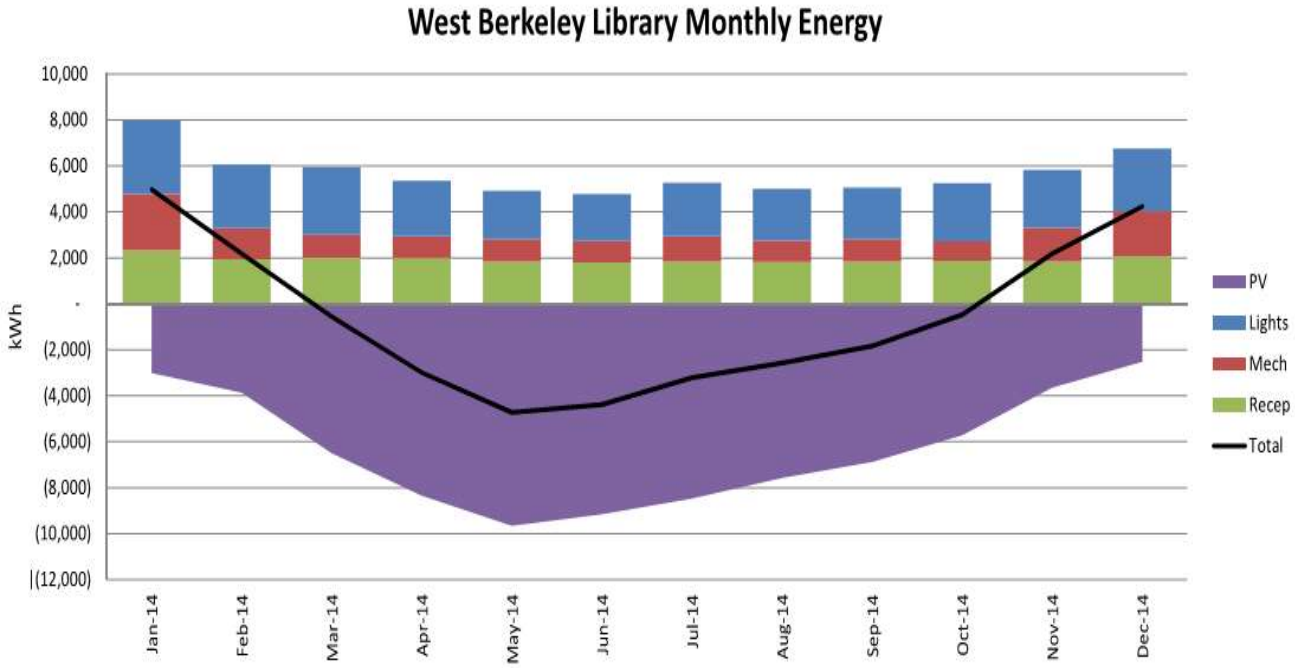
Code Cycles to Net Zero in CA



Code Cycles to ZNE, Source: SCE & AEC, 2009

How do you Measure ZNE?

- ***Energy Use Intensity (EUI)***
- ***Time Dependent Value (TDV)***
- ***ZNE Code Building***



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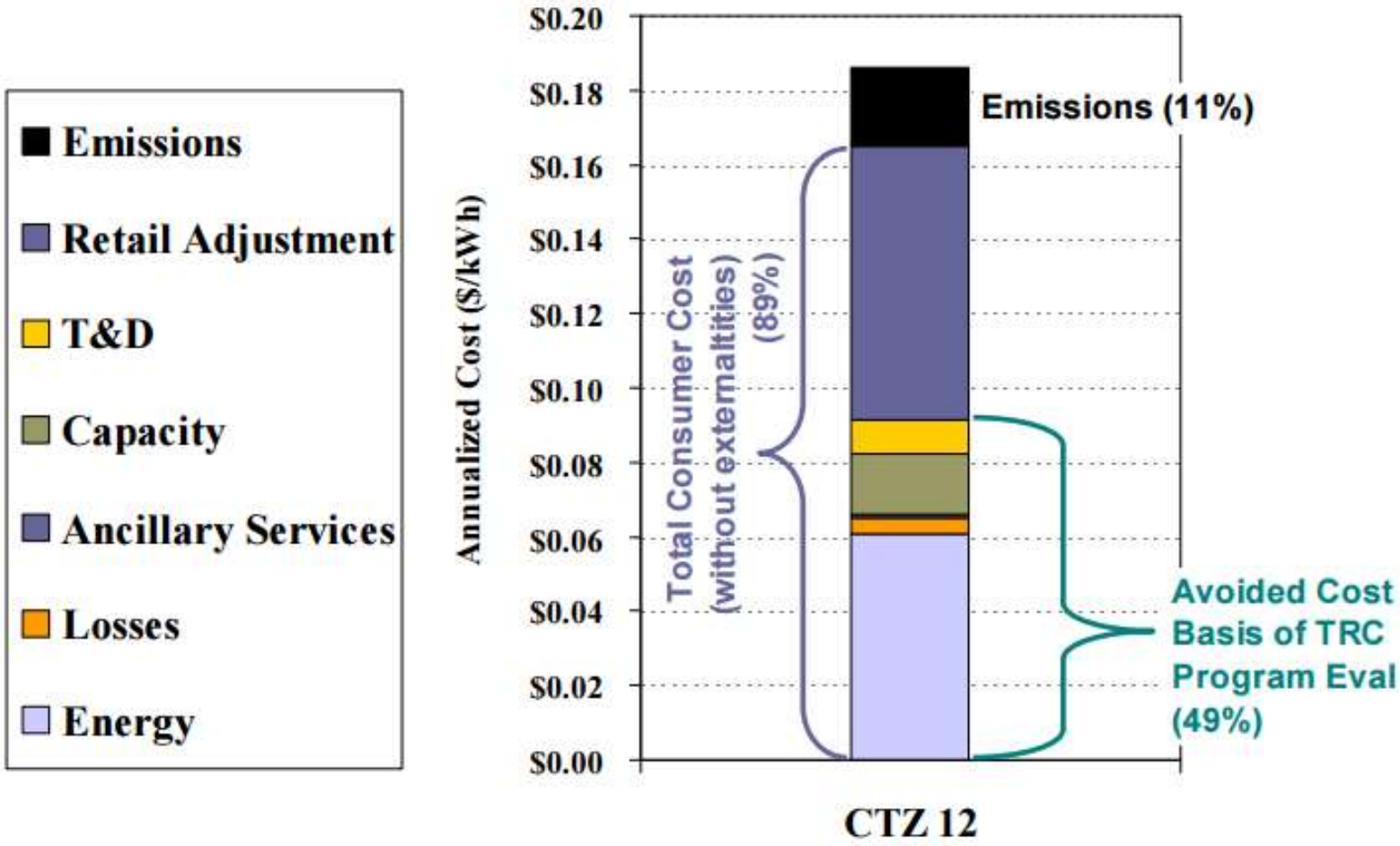
Time Dependent Value of Energy

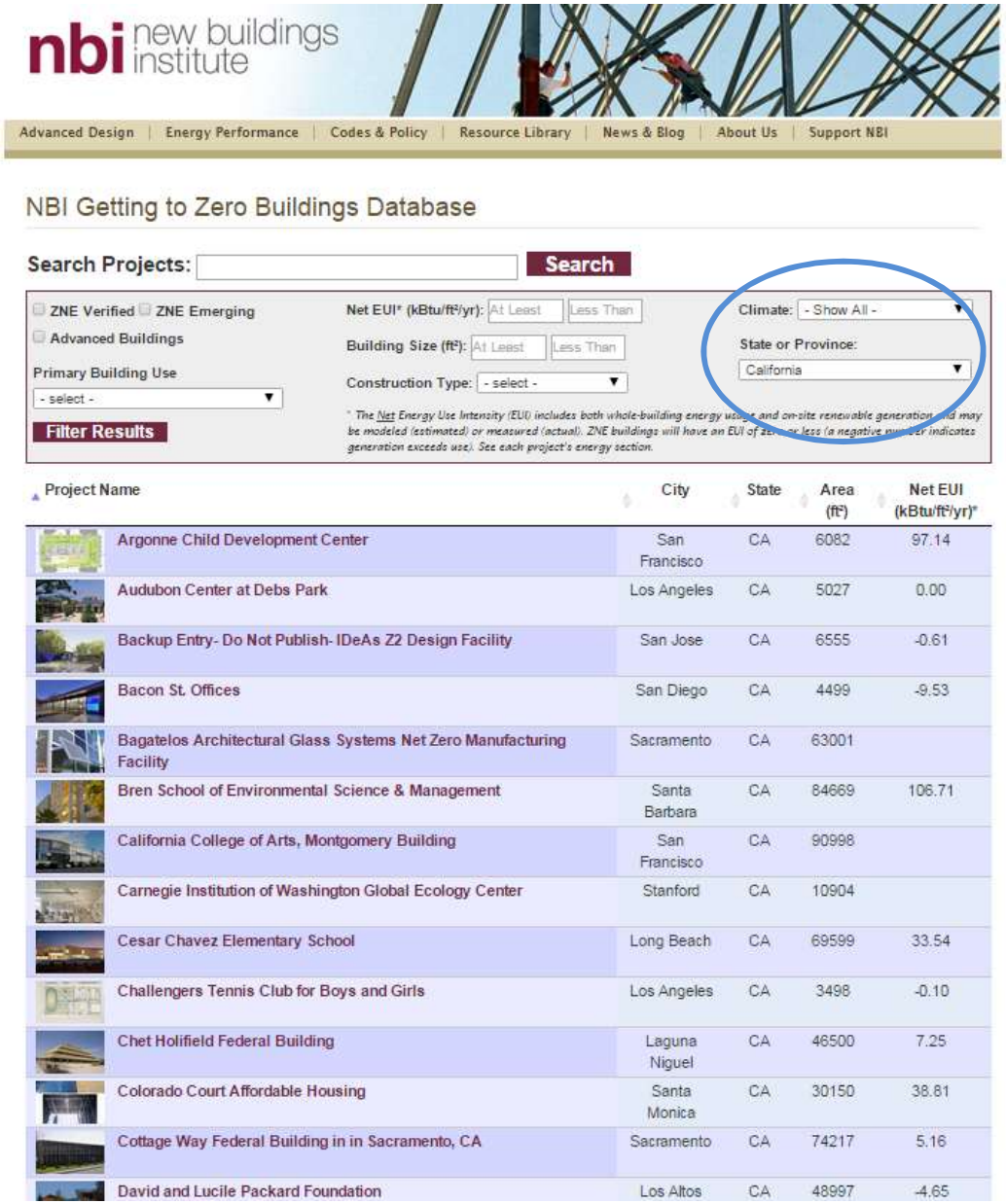


Close approximation of consumer cost with approximately 10% added for emissions

http://www.energy.ca.gov/2011_energypolicy/documents/2011-07-20_workshop/presentations/Revised_Zero_Net_Energy_Definition.pdf

GETTING TO zero BUILDINGS DATABASE

New Buildings Institute is proud to introduce our Getting to Zero Buildings Database.



Project Name	City	State	Area (ft²)	Net EUI (kBtu/ft²/yr)*
Argonne Child Development Center	San Francisco	CA	6082	97.14
Audubon Center at Debs Park	Los Angeles	CA	5027	0.00
Backup Entry- Do Not Publish- IDeAs Z2 Design Facility	San Jose	CA	6555	-0.61
Bacon St. Offices	San Diego	CA	4499	-9.53
Bagatelos Architectural Glass Systems Net Zero Manufacturing Facility	Sacramento	CA	63001	
Bren School of Environmental Science & Management	Santa Barbara	CA	84669	106.71
California College of Arts, Montgomery Building	San Francisco	CA	90998	
Carnegie Institution of Washington Global Ecology Center	Stanford	CA	10904	
Cesar Chavez Elementary School	Long Beach	CA	69599	33.54
Challengers Tennis Club for Boys and Girls	Los Angeles	CA	3498	-0.10
Chet Holifield Federal Building	Laguna Niguel	CA	46500	7.25
Colorado Court Affordable Housing	Santa Monica	CA	30150	38.81
Cottage Way Federal Building in in Sacramento, CA	Sacramento	CA	74217	5.16
David and Lucile Packard Foundation	Los Altos	CA	48997	-4.65

The largest database on ZNE buildings in North America and the only database searchable by ZNE Status & Energy Performance

http://newbuildings.org/getting-to-zero-buildings-database

44 States & Provinces with ZNE Buildings

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2015 List of Zero Energy Buildings

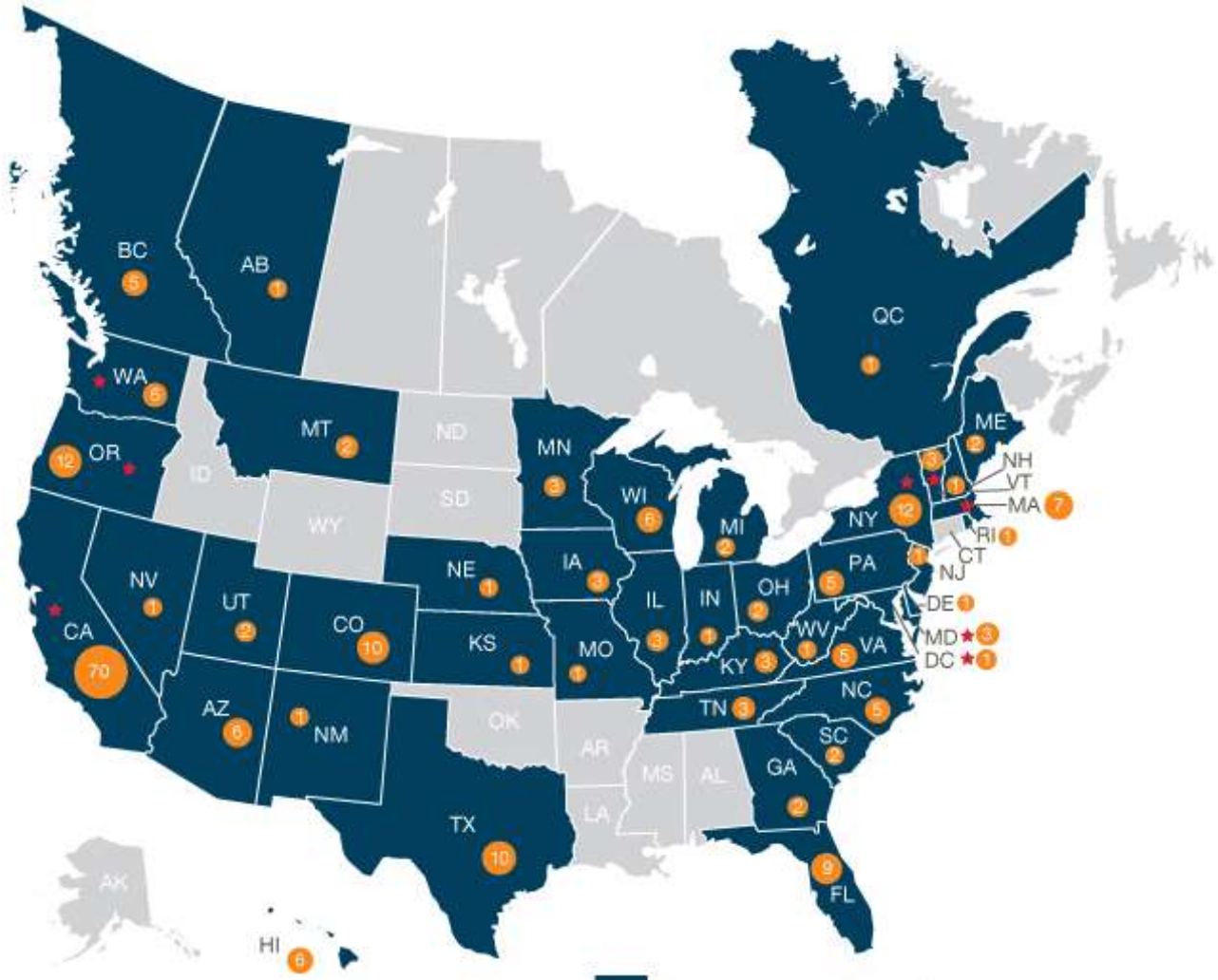
In 2011 and 2013 NBI conducted research to identify buildings with targets or actual outcomes of net zero energy. These results were published in "ZNE Status Reports" by NBI in early 2012 and 2014. NBI continues to track and document buildings with low and zero energy to support the market and policy interest in this data. This 2015 list of buildings is an interim count based on this ongoing work.

Verified Zero Energy Buildings (or Districts) are those with greatly reduced energy loads that have been documented to have met, over the course of a year, all net energy use through onsite renewable sources of energy. The energy use of all fuels (electric, natural gas, steam, etc.) is counted and offset. ***Buildings new to the list are in bold italics.***

Verified Zero Energy 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	1,522	18	18	0
2006	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[L]	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[L]	Eureka	MO	Education- higher	2,968	24	24	0
	Omega Center for Sustainable Living[L]	Rhinebeck	NY	Laboratory	6,200	13	21	-8
	Pringle Creek Painter's Hall[R]	Salem	OR	Public Assembly[R]	3,600	21	21	0

R - Indicates a building renovation project
L - Building is ZNE certified by the International Living Future Institute
*The Net Energy Use Intensity (EUI) includes both whole-building measured energy usage and on-site renewable generation. Buildings will have an EUI of zero or less, with a negative number indicating generation exceeds use.



ZNE Emerging and/or Verified Buildings
(42 states and provinces, and the District of Columbia)

Number of Buildings and projects (225)

States with Reach Code Adopted or in Development

9-21-15

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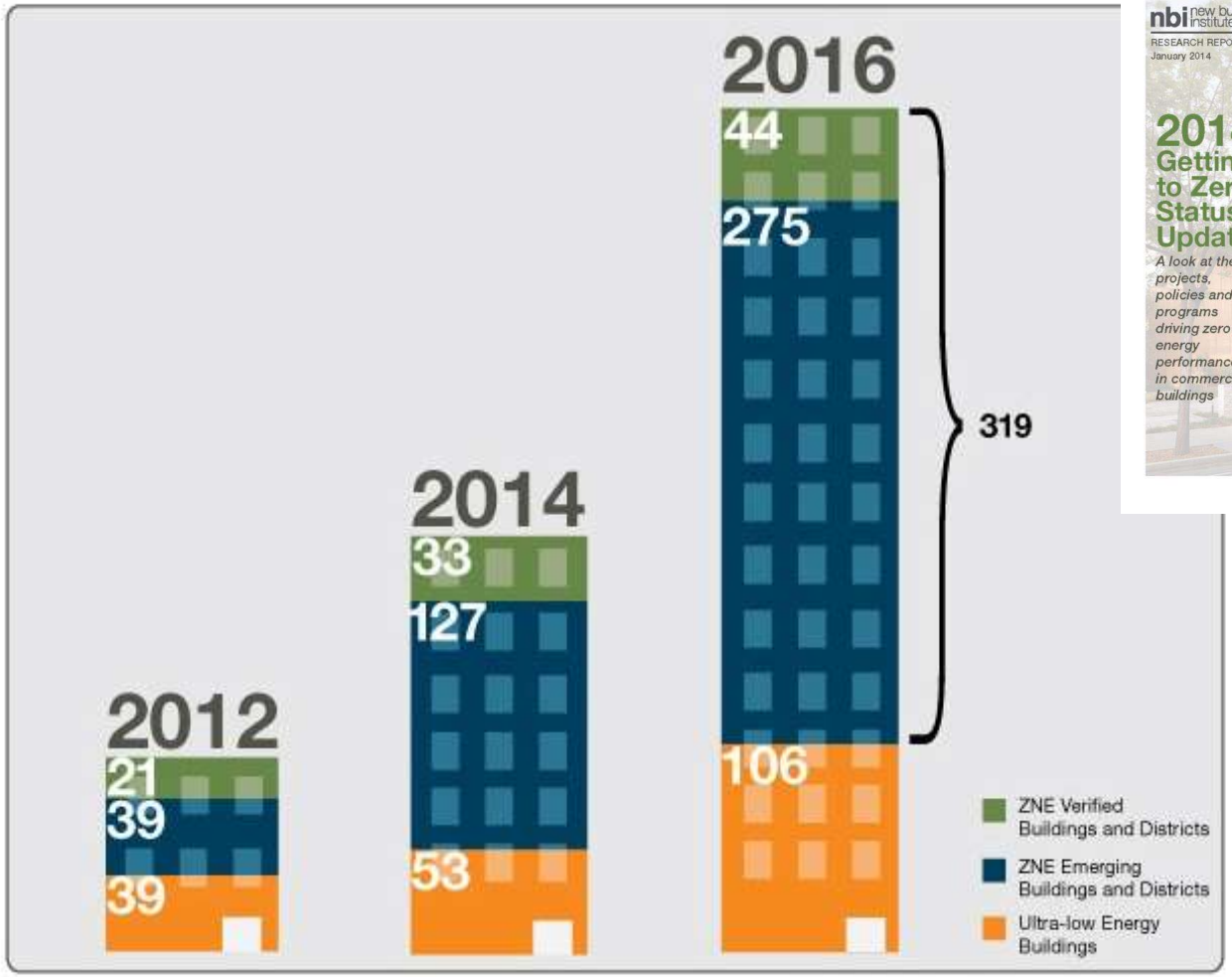
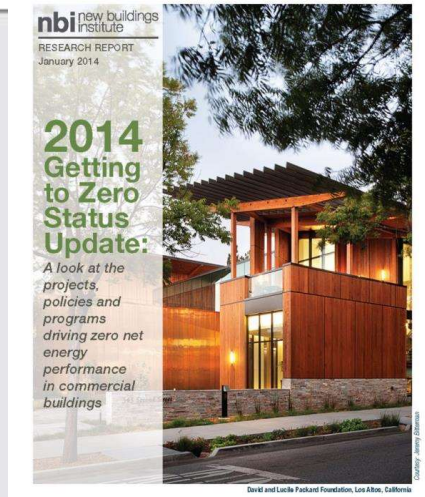
Zero Net Energy Buildings



Courtesy of New Buildings Institute | newbuildings.org



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ZNE and Ultra-Low Buildings are Possible in Many Building Types Across the US

Small-Med Commercial Offices

K-12 Schools

Large Office Facilities

Environmental Centers

Higher Education Institutions

Government Offices

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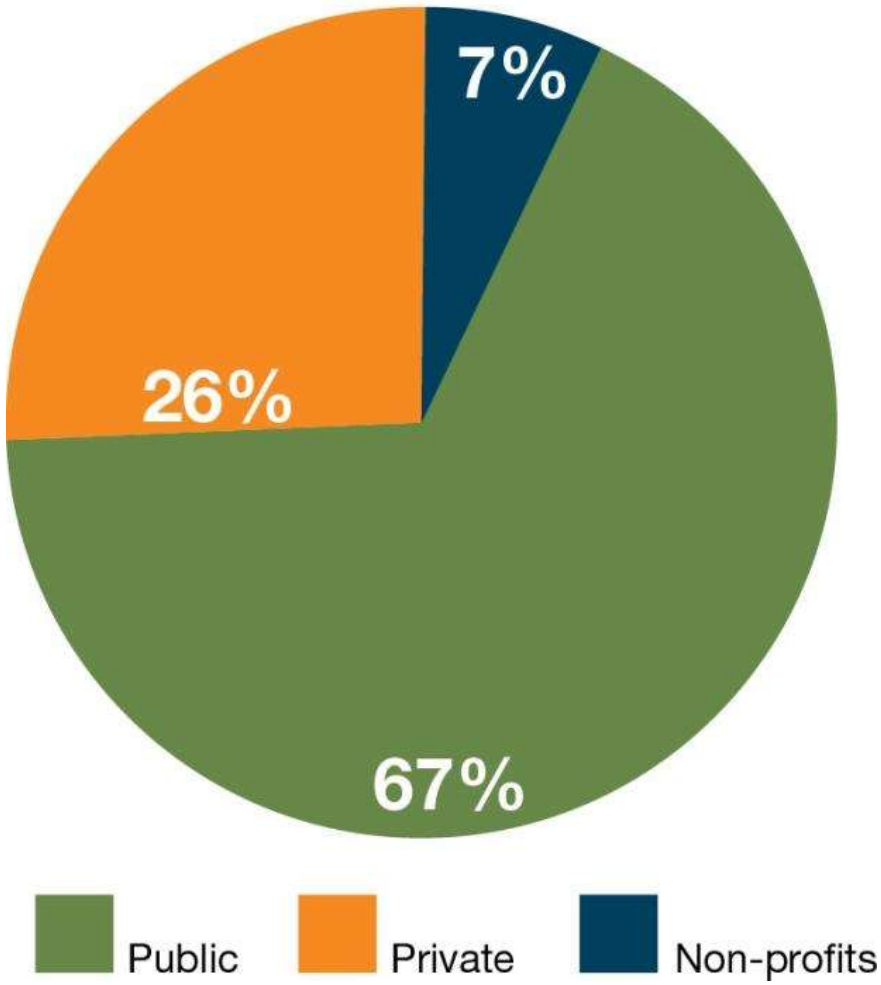
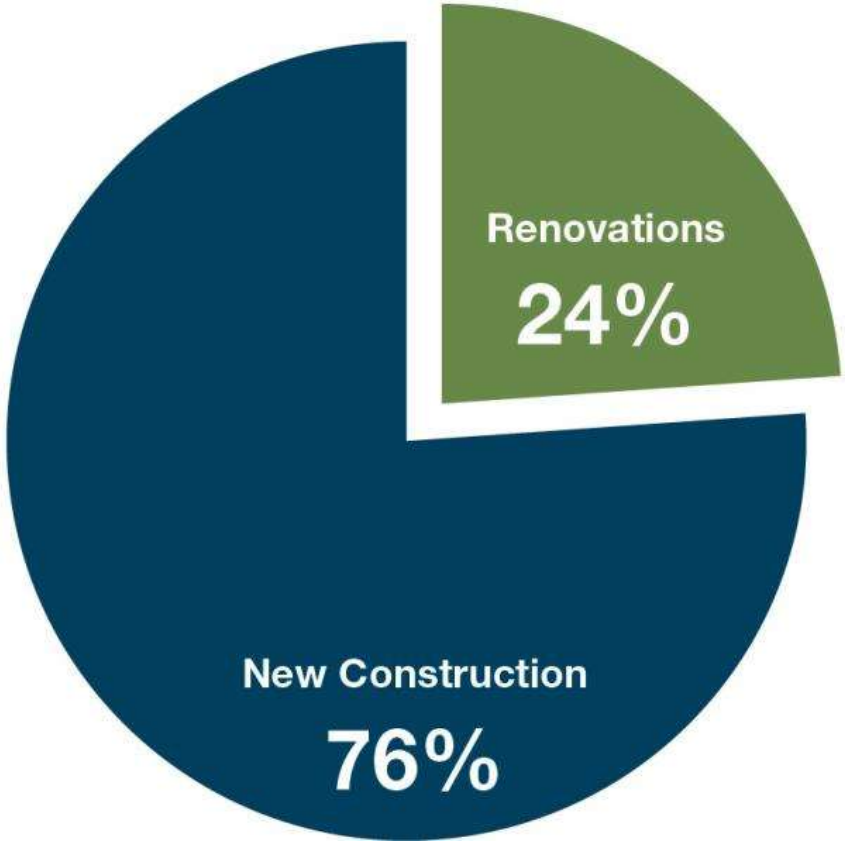
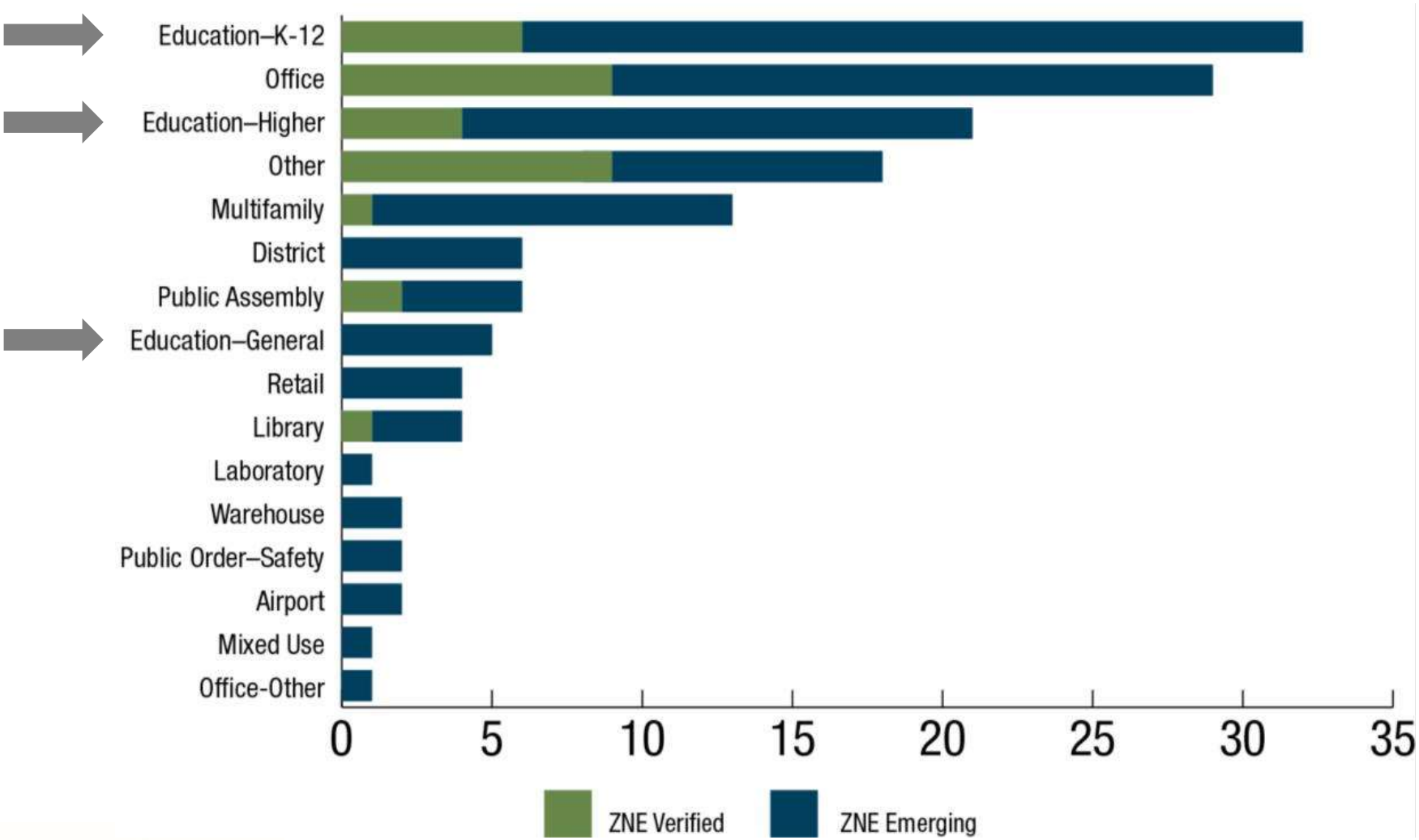
Ownership Type



Existing Building Renovation



Building Types



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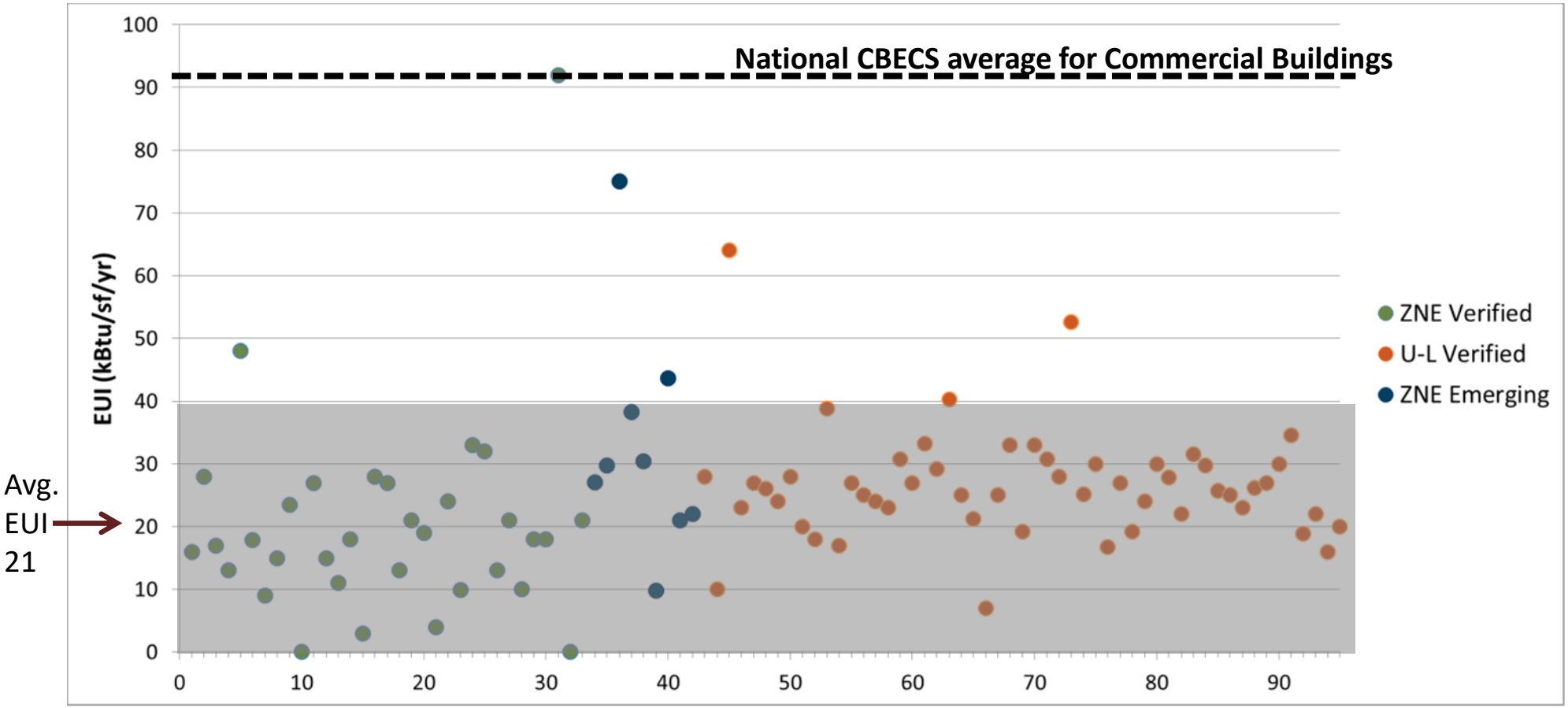
Performance Range
(all projects w/ measured performance data)



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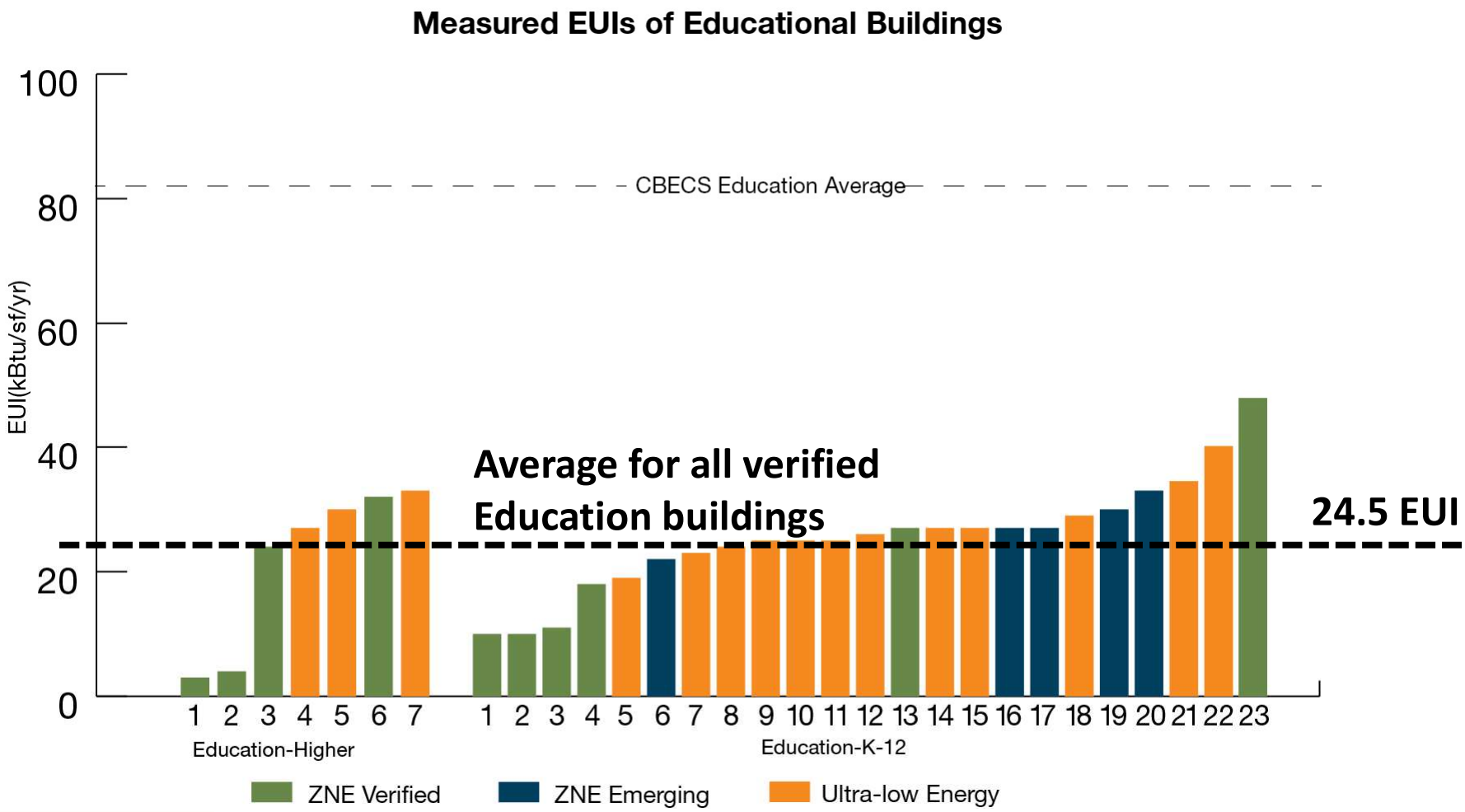
Performance Range - Education



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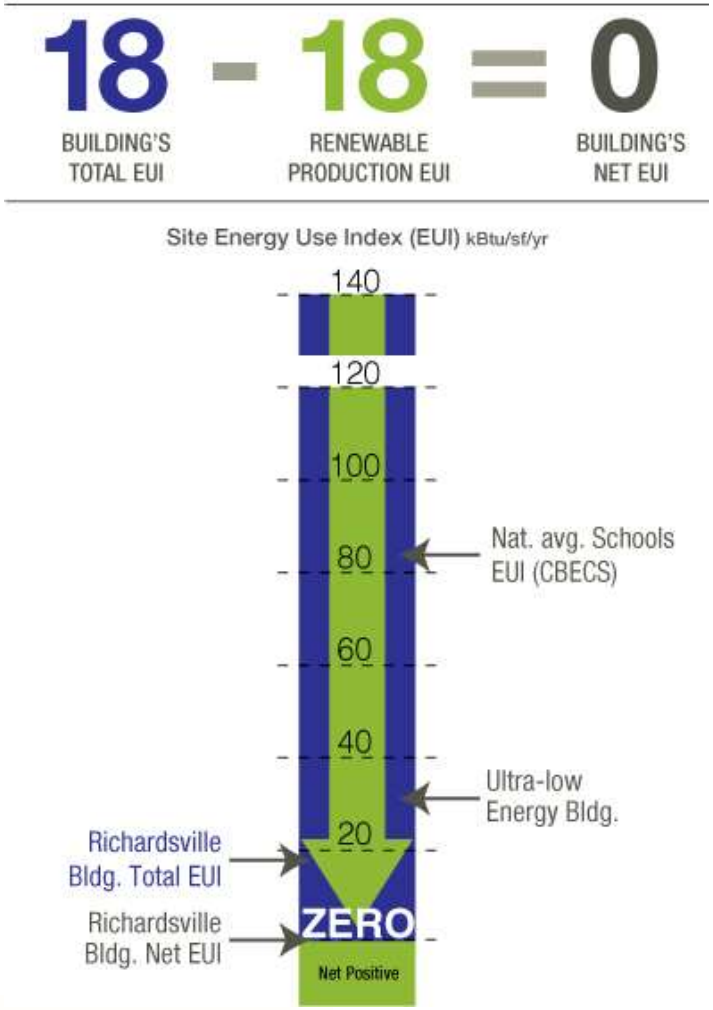
Richardsville Elementary School



Efficiency Measures:

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

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Common Technologies for Ultra-low Energy

- 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 Recovery Systems

Redding School for the Arts, CA

Courtesy : Trilogy Architecture Steve Whittaker Photography

Challenges

- Perception of cost
- PV delayed due to cost
- Getting the metering right
- Using meter data correctly
- Projects not occupied or operated as modeled
- Commissioning – new form of ZNE Cx
- Fear of disclosure - ZNE seen as an end-all

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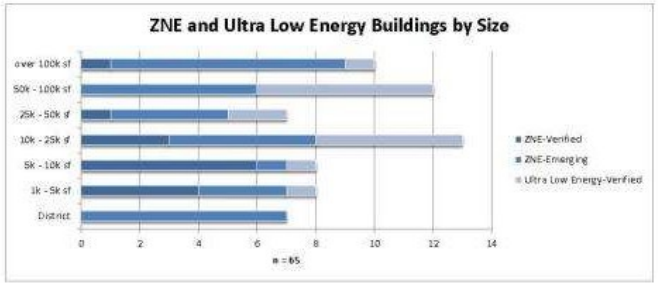
California ZNE Watchlist

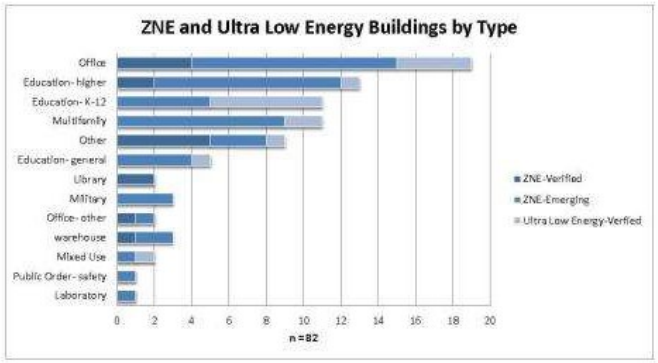
energy upgrade CALIFORNIA

California leads the country in both policy and projects that are laying the path to a zero net energy (ZNE) future. California state agencies have adopted goals for 100% of new and 50% of existing commercial buildings to be ZNE by 2030. Leading design firms and owners have already recognized the real estate and occupancy advantages of these high performance buildings and today California has over 50 commercial buildings either verified (15) as ZNE or emerging (34) toward that target.

This CA ZNE Watchlist tracks commercial buildings (including multi-family) based on information gathered by New Buildings Institute (NBI) from multiple sources including designers, owners, utility programs, private and public organizations, articles, e-news, research, and commercial real estate professionals. It serves, along with other available ZNE resources[1], to support the awareness, acceptance and adoption of ZNE goals and outcomes throughout California and the nation. Buildings with ultra-low energy performance comparable to ZNE are also included.

The graphics below show the trends in location, type and size of the ZNE buildings in California.





Locations of CA ZNE Verified and Emerging ZNE Building. Dot size represents volume of buildings.

[1] **For more resources:** CPUC (http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/Zero+Net+Energy+Buildings.htm) and NBI (www.newbuildings.org/zero-energy)

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List of Zero Energy & Ultra-Low Energy Buildings in California

This ZNE Watchlist provides examples of commercial buildings that have verified zero net energy (ZNE) performance, are emerging toward a ZNE goal or reflect comparable ultra-low energy performance. These are defined as:

- **ZNE Verified** buildings (or districts) have been documented to have met, over the course of a year, all net energy use through onsite renewables. The energy use of all fuels (electric, natural gas, steam, etc.) is counted and offset by production from onsite renewables.
- **ZNE Emerging** buildings (or districts) have a publically stated goal of ZNE but do not yet meet the definition of ZNE verified. These may be in the planning or design phase, under construction or have been in operation for less than a year. Others may have been operating for 12 months or longer, but their measured energy has either yet to achieve net zero or the measured data to document ZNE verified status was not available.
- **Ultra-low Energy Verified** buildings have 12 or more months of metered data that documents energy performance comparable to ZNE buildings (typically 60-80% better than the national industry average). They expand the set of building examples with design strategies and technologies that have resulted in ultra-low energy use. They may have limited renewable resources onsite but do not have a known stated goal of ZNE.

There are, undoubtedly, other projects that belong on this list and/or corrections and updates to this directory. Provide information or add new projects through the NBI Registry located at: http://newbuildings.org/share or email us at info@newbuildings.org.

Building Name	Year Completed	Location	Building Type	Size SF	Total EUI	Site RPI	Net EUI
Verified ZNE							
Audubon Center at Debs Park	2003	E Los Angeles	Other	5,000	17.1	17.1	0.0
Bacara St. Offices	2009	San Diego	Office	4,500	12.7	22.2	-9.5
Challengers Tennis Club							
David and Lucile Packard Fou							
Diamond X Ranch Student In							
DPR Construction, San Diego							
Environmental Nature Center							
Environmental Tech. Center S							
Delta ZZ Design Facility							
Jesse Jackson Sustainable Wi							
Leslie Shao-Ming Sun Field S							
Sacred Heart Schools Stevens							
Vacaville Transportation Cente							
Watsonville Water Resources							
West Berkeley Public Library							

Energy Use Intensity (EUI) is the
EUI meaning the renewable produc
Renewable Production Intensity

energy upgrade CALIFORNIA

Page 2 of 4

Building Name	Year Completed	Location	Building Type	Size SF	Total EUI	Site RPI	Net EUI
ZNE Emerging Buildings							
495 Indio	2013	Sunnyvale	Office	31,600	23.9		
Aquarium of the Pacific Watershed Addition	2008	Long Beach	Education - general	2,500			
Water Place	2012	Eureka	Multifamily	NA			
Bogatkin Architectural Glass Solutions (M)	2008	Sacramento	warehouse	65,000	10.4	6.1	2.5
BSSI Center at Laney College	under construction	Oakland	education - higher	[illegible]			
Blackford School Multi-use Build							
California Department of Motor Ve							
California DOT SFOBB Phase 2 Ve							
Camp Parks							
Church Hill Townhomes							
College of the Desert West Valley F Phase 1							
Conrad N. Hilton Foundation							
DPR San Francisco Office							
exploratorium							
Family Pet Hospital							
Foster Solutions Technology & Dev							
Fort Hunter Liggett							
George W. Lewis Middle School Ad San Jose							
Hanover Page Mill Building							
IBEW Local 595 Zero Net Energy C							
Kaiser Permanente Antelope Valley Medical Office Building							
La Escuela de la Education Center							
La Valentina North							
Los Angeles Harbor College Solenc							
Los Gatos Correctional Facility							
LPL Financial Center at La Jolla Co							
Morphosis Architecture Studio (M)							
Mutual Housing at Spring Lake							
Net Zero Plus (electric) training fa							
Oak Park High School							
Orfalea Campus Core Replacemen							
Pierce College Maintenance & Ope Facility and Net Zero Central Plan							
Plaza Point							
Reaching School for the Arts (M)							
Rio Vista							

Energy Use Intensity (EUI) is the (peak
EUI meaning the renewable production co
Renewable Production Intensity (RPI)

(M) after the name indicates measured energy use. All others are estimated / modeled.

energy upgrade CALIFORNIA

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Building Name	Year Completed	Location	Building Type	Size SF	Total EUI	Site RPI	Net EUI
Senior Village	2013	Ventura	Multifamily	NA			
San Joaquin National Wildlife Refuge Complex Visitor Center and Visitor Center	2012	Los Banos	Education - general	14,000	6	6	0
Sierra Army Depot		Herlong	Military	District			
Sierra Nevada Aquatic Research Lab Multi-use Classroom and Dorm Hall	2015	Mammoth Lakes	Education - higher	2,955			
SMUD Net Zero Complex - Fort Complex - Operations Center	2015	Sacramento	Office	350,000			
Solana Ranch Elementary School	2014	San Diego	Education - K-12	65,000			
Solite Loft Luxury Apartments	2013	San Diego	Multifamily	NA			
Stone Ridge	2014	Escondido	Multifamily	NA			
Student Services Center at Mesa College	2017	San Diego	Education - higher	85,000			
Student Success and Retention Center at Pierce College	2014	Los Angeles	Education - higher	136,000			
UC Davis West Village (eco district)	2012	Davis	Mixed Use	District			
UC Merced	2009	Merced	Education - higher	District			
UC San Diego - Craig Venter Institute	2013	La Jolla	Laboratory	45,000	50		
UC Santa Barbara Recreation Center	under construction	Santa Barbara	Education - higher	NA			
UC Santa Barbara Student Services Buildings		Santa Barbara	Education - higher	District			
W. Building NC	2013	Alameda	Office	100,000			
Ultra Low Energy Verified Buildings							
950 Fifth Street (The Mateo Apartments) Mixed-Use Building	2013	San Francisco	Mixed Use	14,000	0	9	[illegible]
Aventine	2005	La Jolla	Office	250,000	23	0	23
Carlton Hills Modernization	2005	Santee	Education - K-12	55,196	20.0	0.0	20.0
Carlton Oaks Modernization	2005	Santee	Education - K-12	61,875	24.0	0.0	24.0
Center for Children & Families, SBU San Marcos	2007	San Marcos	Education - general	20,206	25.0	0.0	25.0
Cuttone & Cuneffe Winery	1995	Santa Barbara	Office	2,995	20.0	0.0	20.0
Colorado Court Apartments Housing	2002	Santa Monica	Multifamily	29,000	30.0	2.4	35.4
Dunning Elementary Schools	2007	Los Altos	Education - K-12	77,741	35	0	35
Eastlake High - Chula Vista	2009	Chula Vista	Education - K-12	44,370	40.3	14.2	26.1
Kendall Administration of Education	2005	San Ramon	Other	8,200	7.0	0.0	7.0
Mark Clement Building for Technical Careers at Los Angeles College	2005	Los Angeles	Education - higher	21,600	33	10	23
Los Madrones - Multifamily	2009	Chula Vista	Multifamily	61,000	19.2	9.0	10.2
Navy Building 990		Point Mugu	Office	17,000	15	11	15
Hopeleven Office Building	1985	San Diego	Office	70,000	24	0	24
Symonds Degree Modernization	2005	Santee	Education - K-12	57,900	20.0	0.0	20.0
Westmont High School Science Education Facility	2004	Campbell	Education - K-12	12,362	10.0	0.0	10.0

Energy Use Intensity (EUI) is the total annual energy consumption per gross square foot of building. EUI is a measure of how efficiently a building uses energy. The lower the EUI, the more efficient the building. EUI is a measure of how efficiently a building uses energy, regardless of the source of energy.

Renewable Production Intensity (RPI) is the energy production per gross square foot of building. The lower the RPI, the more efficient the building.

(M) after the name indicates measured energy use. All others are estimated / modeled.

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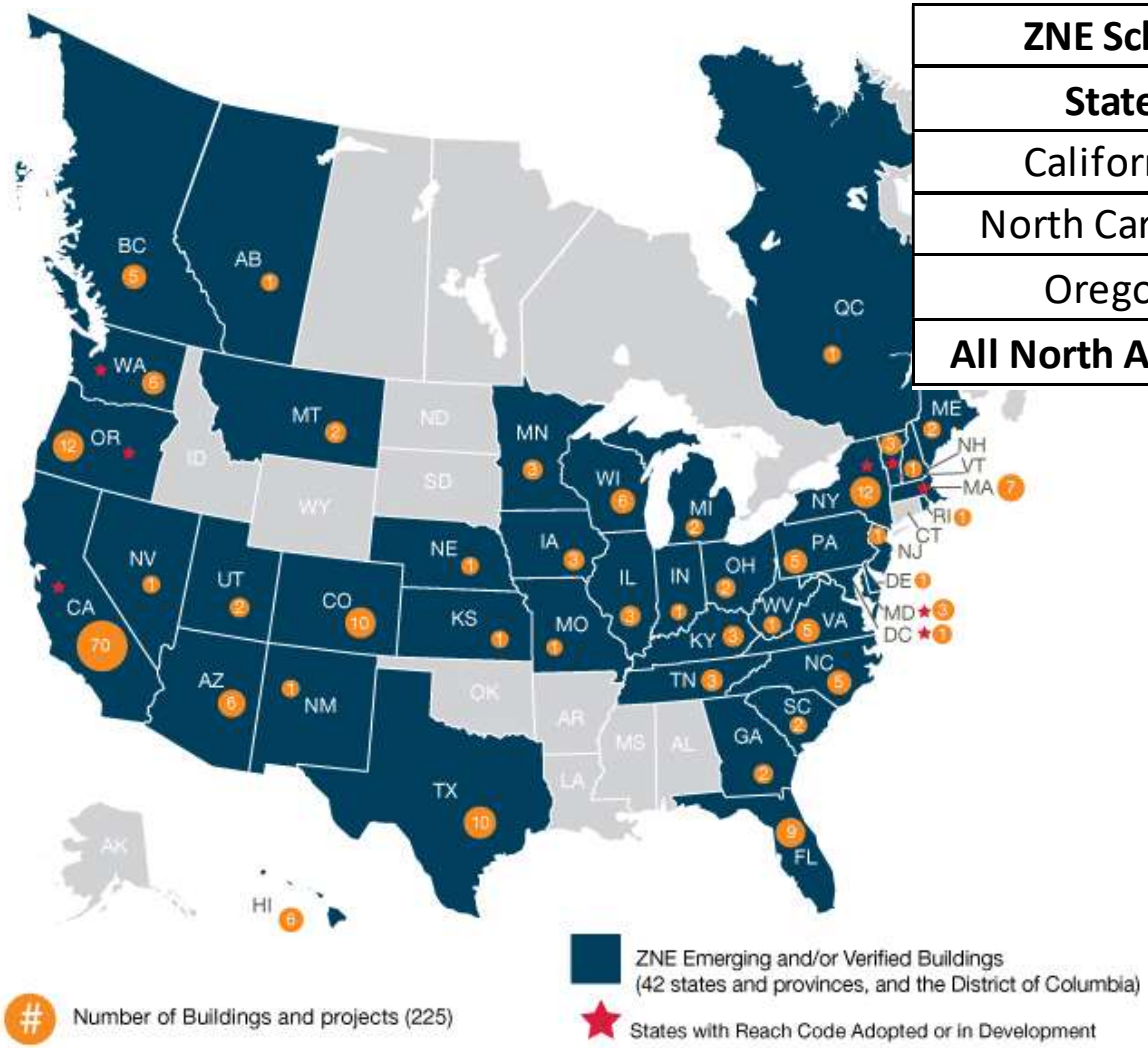
California ZNE Watchlist Spring 2015

California Leads in ZNE Schools



ZNE School Buildings - Top Three States			
State	**Verified**	**Emerging**	**Total**
California	3	20	23
North Carolina	1	5	6
Oregon	1	5	6
All North America	**12**	**65**	**77**

zero net energy

Using Case Studies as your Guide

10:30 – 11:00 p.m.

Using ZNE and Ultra-low Energy Case Studies as your Guide

ZNE and Ultra-low Energy Case Studies

Using Case Studies as a Guide: *The technologies and design approaches that have a proven track record in ZNE projects, including daylighting, radiant heating/cooling, lighting controls, plug load controls, LEDs and beyond*

New Prop 39 Case Studies:

- Berkeley West Branch Library (Net Positive NC)
- Georgina Blach Middle School, Los Altos (Ultra-low Retrofit)
- George V. Leyva Middle School (Emerging ZNE)
- City College of San Francisco (Ultra-Low Energy)
- Jeffrey Trail Middle School, Irvine (Ultra-Low Energy)

City College San Francisco (CCSF)

PROFILE DATA

- Community College
- San Francisco, CA
- 102,000 ft^2
- Climate zone 3
- Completed in summer 2010
- LEED Gold
- \$460/ft^2

City College San Francisco (CCSF)

RESULTS & SUCCESSES

- Ground source central plant will serve up to 5 other buildings
- One of the largest modern buildings fully reliant on natural ventilation

Jeffrey Trail Middle School & Irvine Unified School District

PEOPLE, POLICY & PROCESS

- CHPS High Performance schools resolution
- Irvine pursued a district-wide approach to energy efficiency
- Bonded for solar on all schools
- Power Purchase Agreement (PPA) to fund solar
- Capital outlay=$0

Irvine Unified School District saves money and enriches learning with solar

Located in Orange County, California, the Irvine Unified School District (IUSD) comprises a community of learners, committed to the highest quality educational experience. IUSD educates a diverse population of more than 30,000 K-12 students in 22 elementary schools, six middle schools, four comprehensive high schools and one continuation high school.

Project Profile: Irvine Unified School District	System Type: Roof and Canopy-Mounted Solar Panels
Industry: K-12 Education	System Size: 5 MW over 27 Operational Projects
Location: Irvine, California	Savings: $5-11 million over 20 years
Company: Irvine Unified School District	Capital Outlay: $0

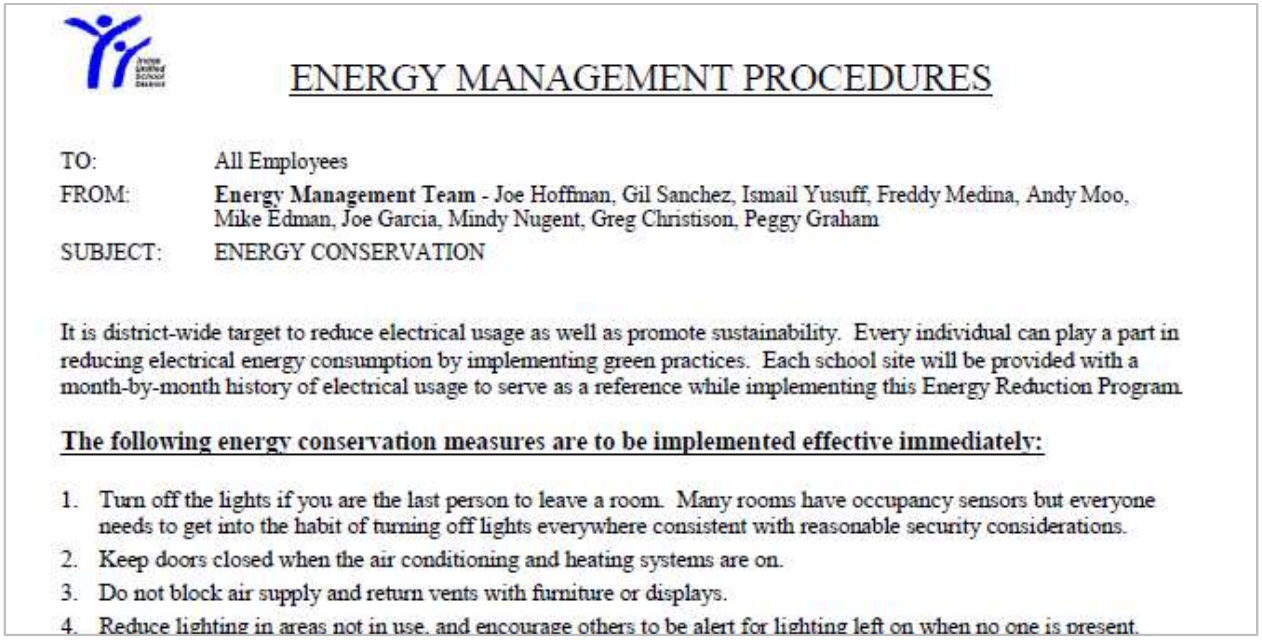
nbi new buildings institute

Jeffrey Trail Middle School & Irvine Unified School District

PEOPLE, POLICY & PROCESS

- Behavior - Energy Conservation/Management Protocols

IUSD set energy-wise guidelines to help make its heating, ventilation, and air conditioning systems (HVAC) more efficient. The District also issued conservation mandates for lighting, thermostat settings, classroom and office equipment, and a variety of other areas. These measures are intended to reduce district-wide electrical usage by 15 percent.



ENERGY MANAGEMENT PROCEDURES

TO: All Employees

FROM: **Energy Management Team** - Joe Hoffman, Gil Sanchez, Ismail Yusuff, Freddy Medina, Andy Moo, Mike Edman, Joe Garcia, Mindy Nugent, Greg Christison, Peggy Graham

SUBJECT: ENERGY CONSERVATION

It is district-wide target to reduce electrical usage as well as promote sustainability. Every individual can play a part in reducing electrical energy consumption by implementing green practices. Each school site will be provided with a month-by-month history of electrical usage to serve as a reference while implementing this Energy Reduction Program.

The following energy conservation measures are to be implemented effective immediately:

1. Turn off the lights if you are the last person to leave a room. Many rooms have occupancy sensors but everyone needs to get into the habit of turning off lights everywhere consistent with reasonable security considerations.
2. Keep doors closed when the air conditioning and heating systems are on.
3. Do not block air supply and return vents with furniture or displays.
4. Reduce lighting in areas not in use, and encourage others to be alert for lighting left on when no one is present.

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Jeffrey Trail Middle School & Irvine Unified School District

PEOPLE, POLICY & PROCESS

Buildings & Technologies inform the district's Curriculum - Science, Technology, Engineering and Math (STEM)

"We have developed our own fifth and sixth grade curriculum that lets students learn about a variety of types of renewable energy. ***We discuss the pros and cons of different types of renewable energy.*** *We are hearing that kids are more aware of things like* ***conservation, recycling, and global warming****. And the community appreciates the* ***nonpartisan way we present the education****."*

– Mark Sontag, UC Irvine Energy Consultant

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Georgina Blach Intermediate School

PEOPLE, POLICY & PROCESS

- Pilot project for the Collaborative for High Performance Schools (CHPS)
- Early adoption of high efficiency goals

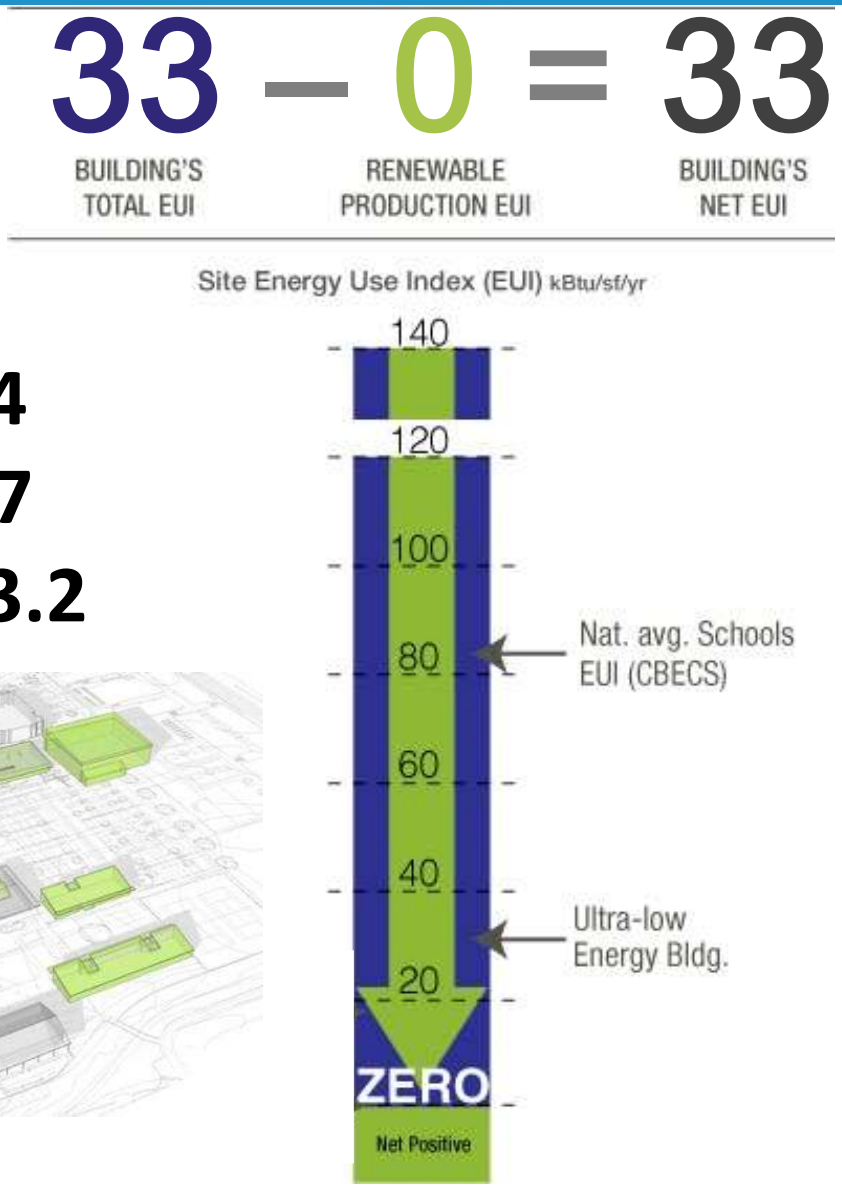
New library inserted between two existing wings uses existing developed site and existing building fabric.

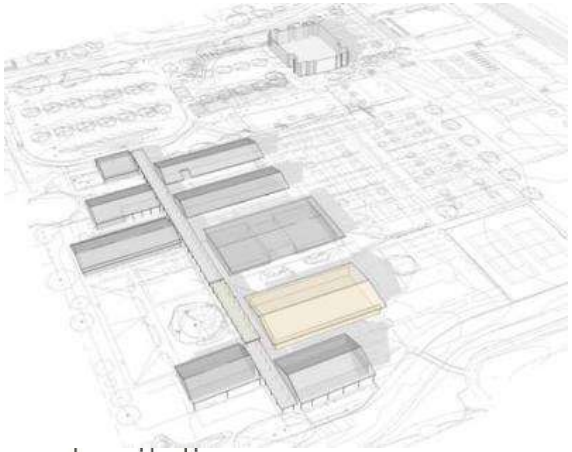
Georgina Blach Intermediate School

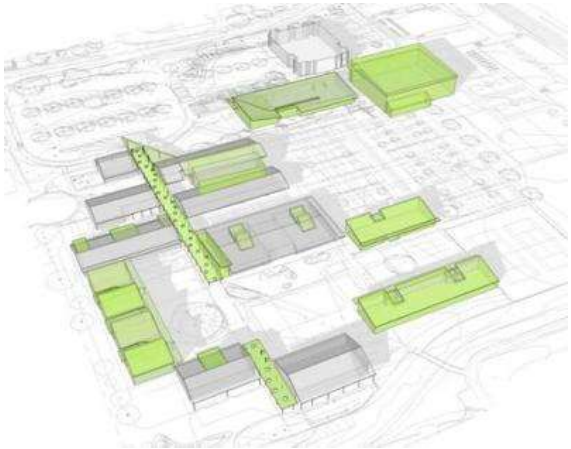
METRICS

Energy performance relative to various benchmarks:

- **38% savings beyond Title 24**
- **Pre-modernization EUI: 55.7**
- **After modernization EUI: 33.2**







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Georgina Blach Intermediate School

RESULTS & SUCCESSES

- Modernization resulted in students viewing school as an entirely new facility
- Daylit classroom
- New Systems
- Model school for district
- **Energy use intensity reduced 45%**

nbi new buildings institute

ZNE and Ultra-low Energy Case Studies

Using Case Studies as a Guide: More CA Examples

- Stevens Library at Sacred Heart Elementary (ZNE Verified)
- Redding School for the Arts (Emerging ZNE)
- Marin Country Day School (Ultra-Low Energy)
- Solano School (Emerging ZNE)
- Blackford (Emerging ZNE as part of Campbell SD's 8 new ZNE schools)
- La Escuelita (OUSD) – (Emerging ZNE)

zero net energy

ZNE Case Study Presentation

Paulina Souza – WRNS Studio

Stevens Library – Sacred Heart Elementary

Case Study :

Sacred Heart Stevens Library Lessons Learned

Pauline Souza

WRNS Studio

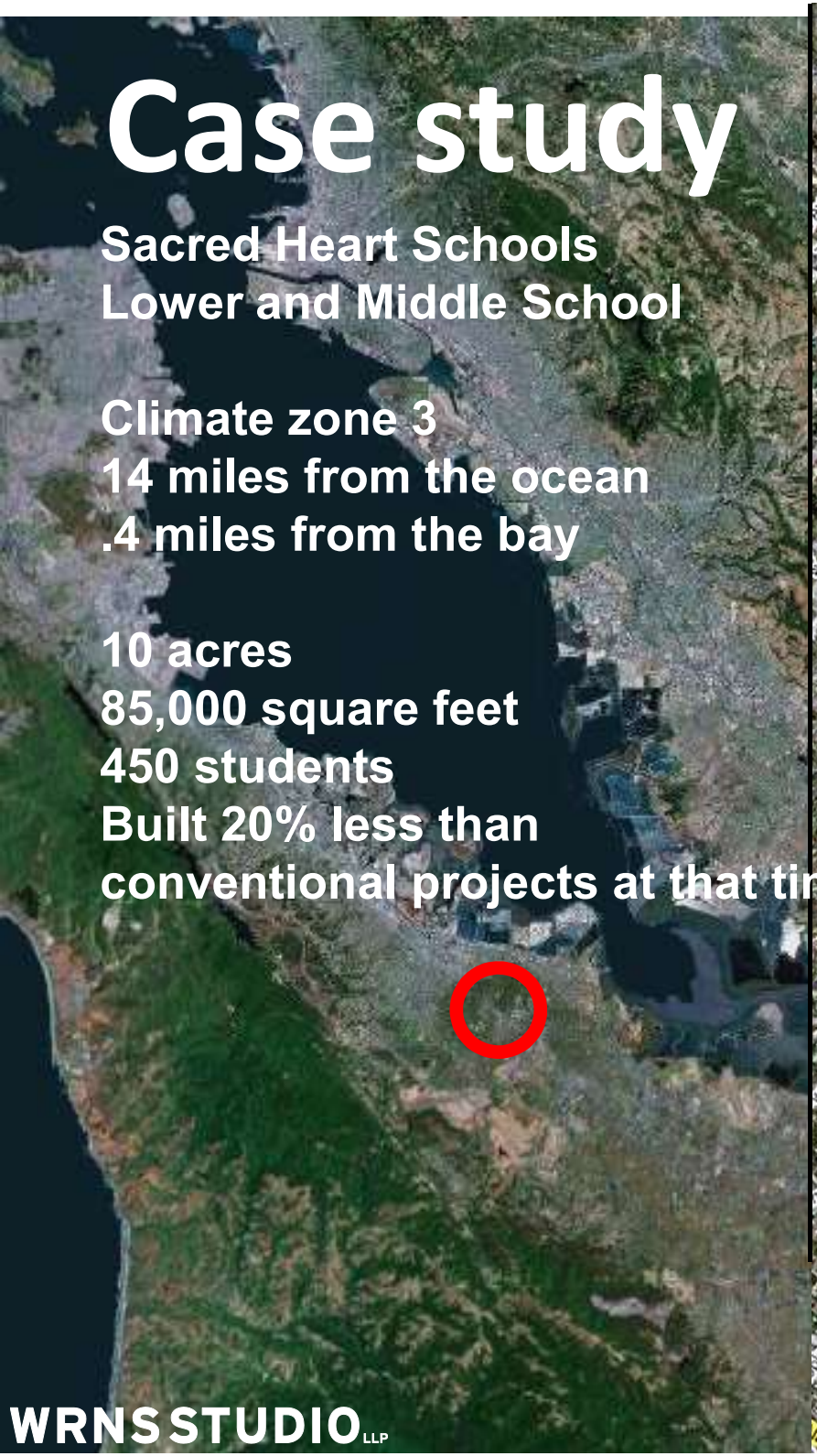
psouza@wrnsstudio.com

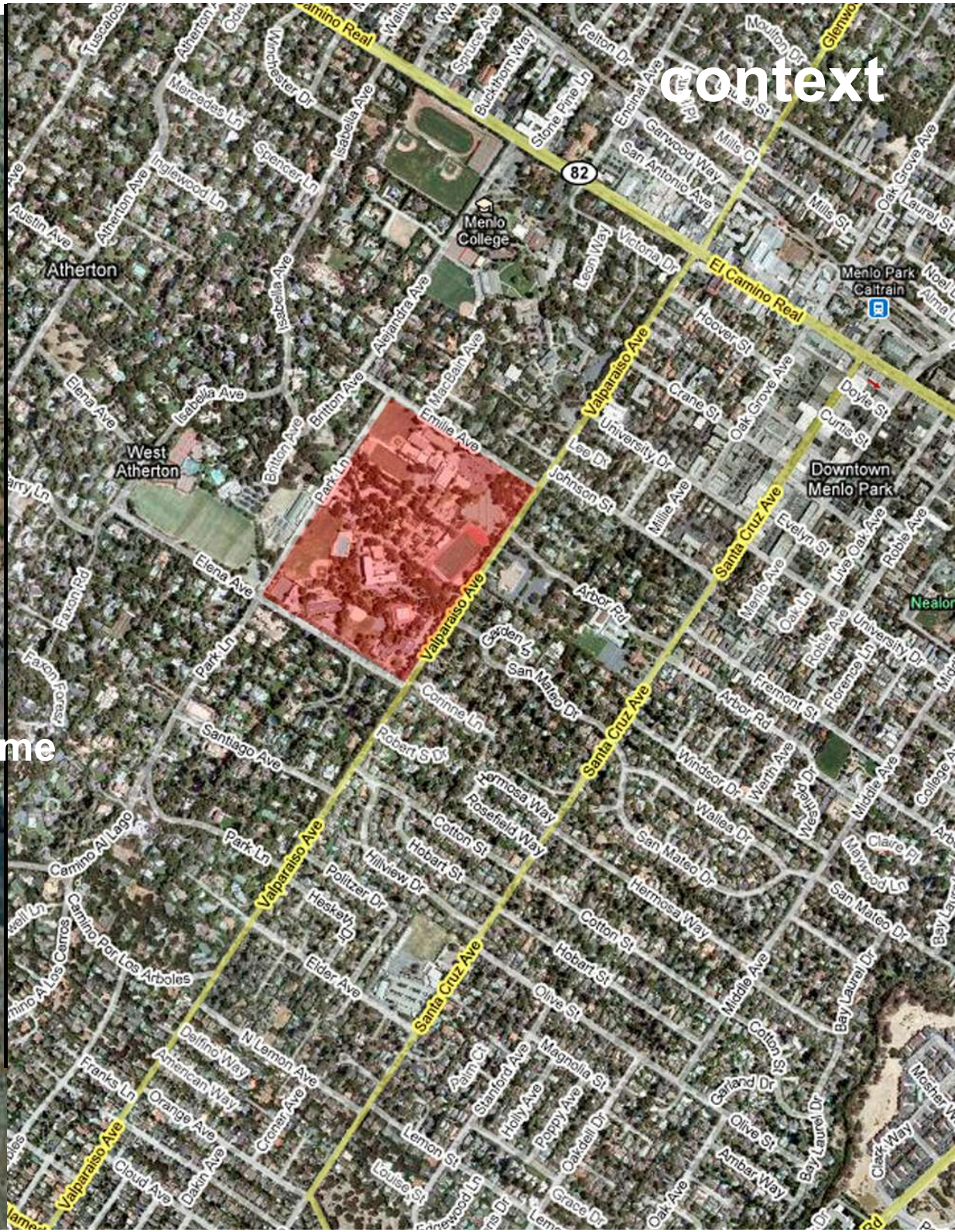
Case study

Sacred Heart Schools
Lower and Middle School

Climate zone 3
14 miles from the ocean
.4 miles from the bay

10 acres
85,000 square feet
450 students
Built 20% less than conventional projects at that time





WRNS STUDIO LLP

- Interested client with inspiring mission statement
- Amazingly creative design team –
- Wonderful program

Starts with the vision and mission

- ***educate children to become exceptional leaders***

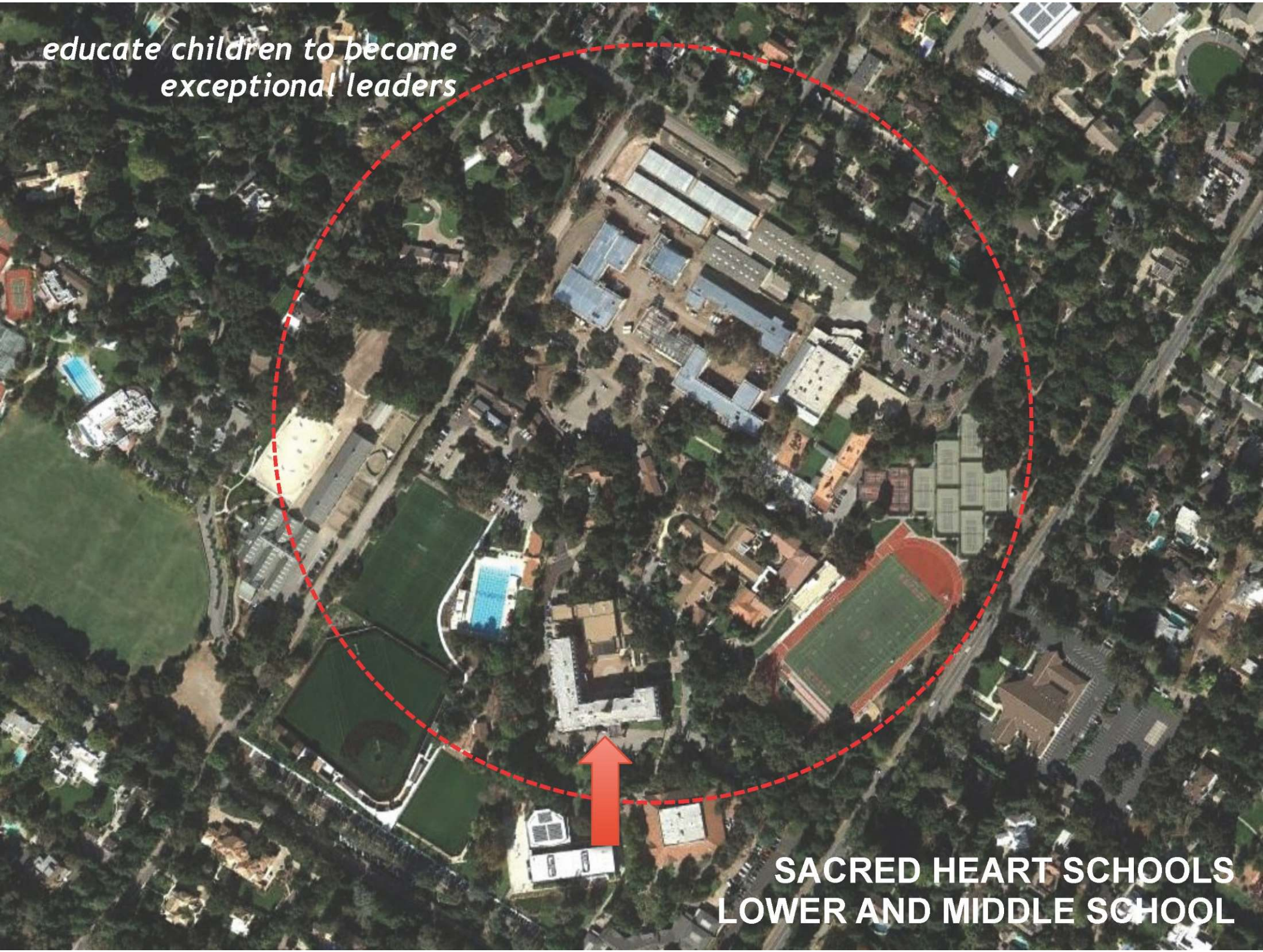
work in partnership with students, parents, and other community members to educate the whole child in a nurturing environment and empower each student to become a contributing member and responsible participant in our changing world.

WRNS STUDIO

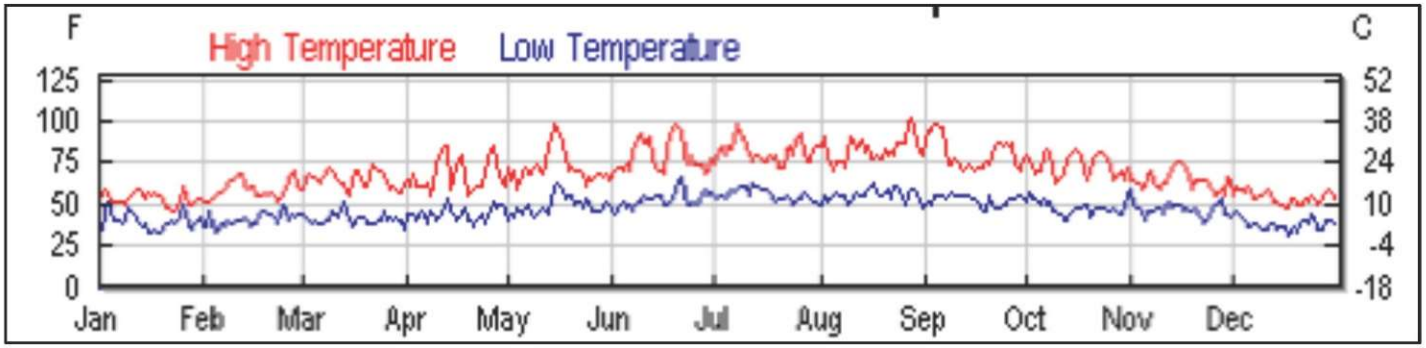
- Interested client with inspiring mission statement
- Amazingly creative design team –
- Wonderful program

❖ **An <u>evolving</u> desire for a higher sustainable agenda**

❖ **Designed within the cost <u>budget</u>**


educate children to become
exceptional leaders
SACRED HEART SCHOOLS
LOWER AND MIDDLE SCHOOL


SHS
XIE
MIDDLE
SCHOOL


F
C
High Temperature
Low Temperature
125
100
75
50
25
0
52
38
24
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-4
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Jan
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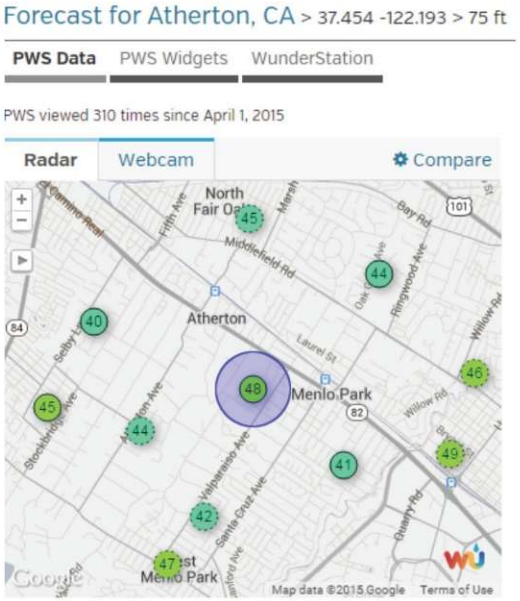
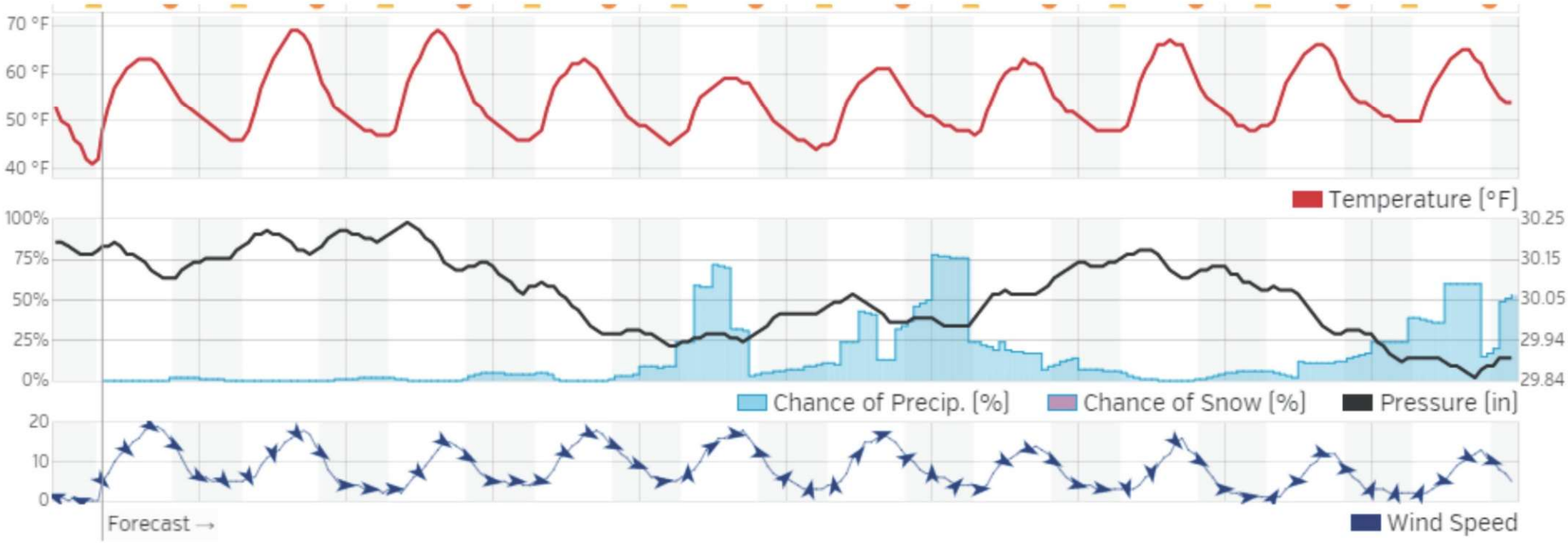
Nov
Dec


Forecast for Atherton, CA > 37.454 -122.193 > 75 ft
PWS Data
PWS Widgets
WunderStation
PWS viewed 310 times since April 1, 2015
Radar
Webcam
Compare
North Fair Oaks
Atherton
Menlo Park
East Menlo Park
Map data ©2015 Google
Terms of Use


70 °F
60 °F
50 °F
40 °F
Temperature (°F)
100%
75%
50%
25%
0%
30.25
30.15
30.05
29.94
29.84
Chance of Precip. (%)
Chance of Snow (%)
Pressure (in)
20
10
0
Forecast →
Wind Speed

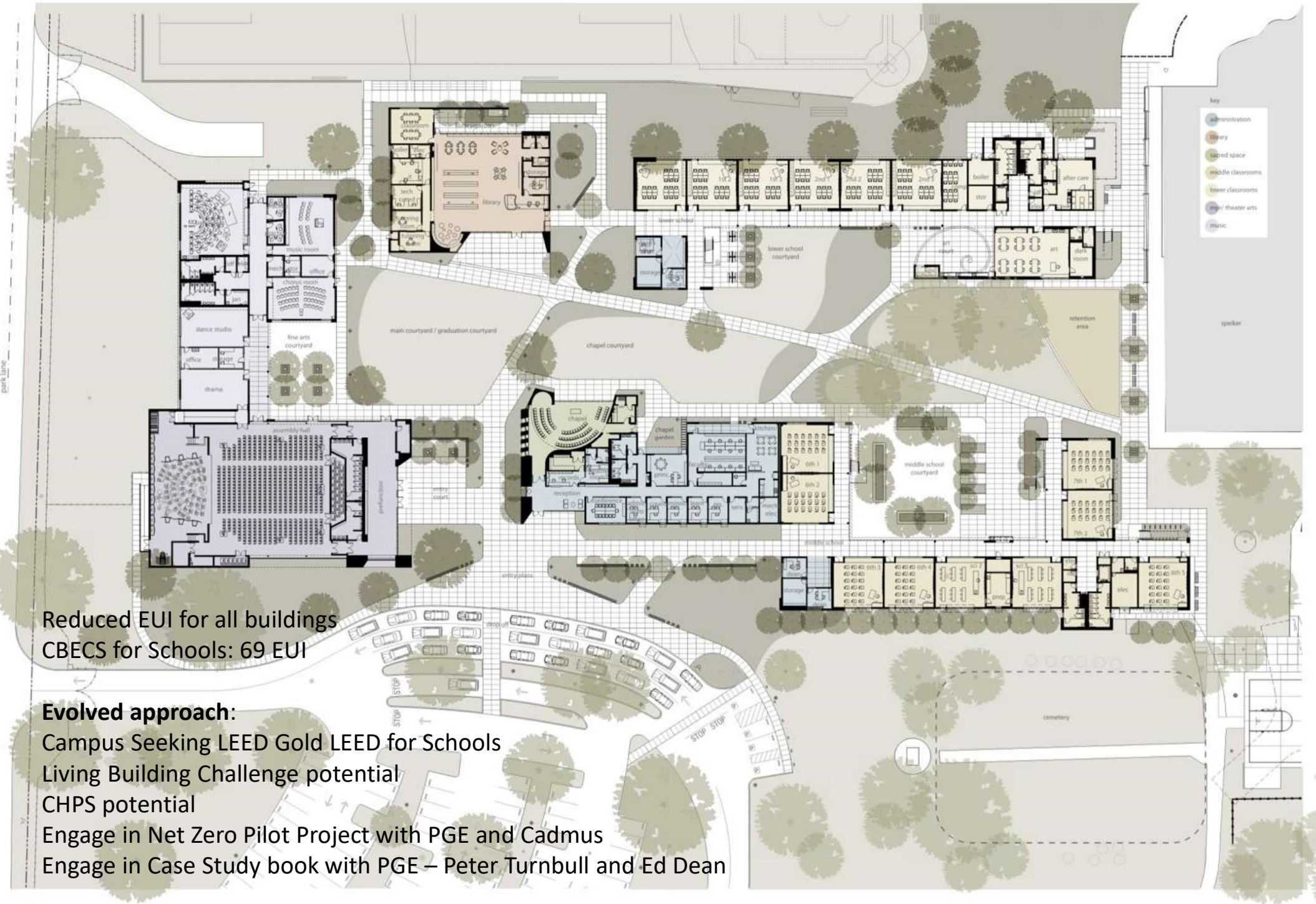
AIA COTE 10 measures

1. Design & Innovation
2. Regional/Community Design
3. Land Use & Site Ecology
4. Bioclimatic Design
5. Light & Air
6. Water Cycle
7. Energy Flows & Energy Future
8. Materials & Construction
9. Long Life Loose Fit
10. Collective Wisdom and Feedback Loops

WRNS STUDIO LLP

Limited dollars - $250 - $300/sf – approximately 20% less than the current construction dollar


NO STORMWATER INFRASTRUCTURE

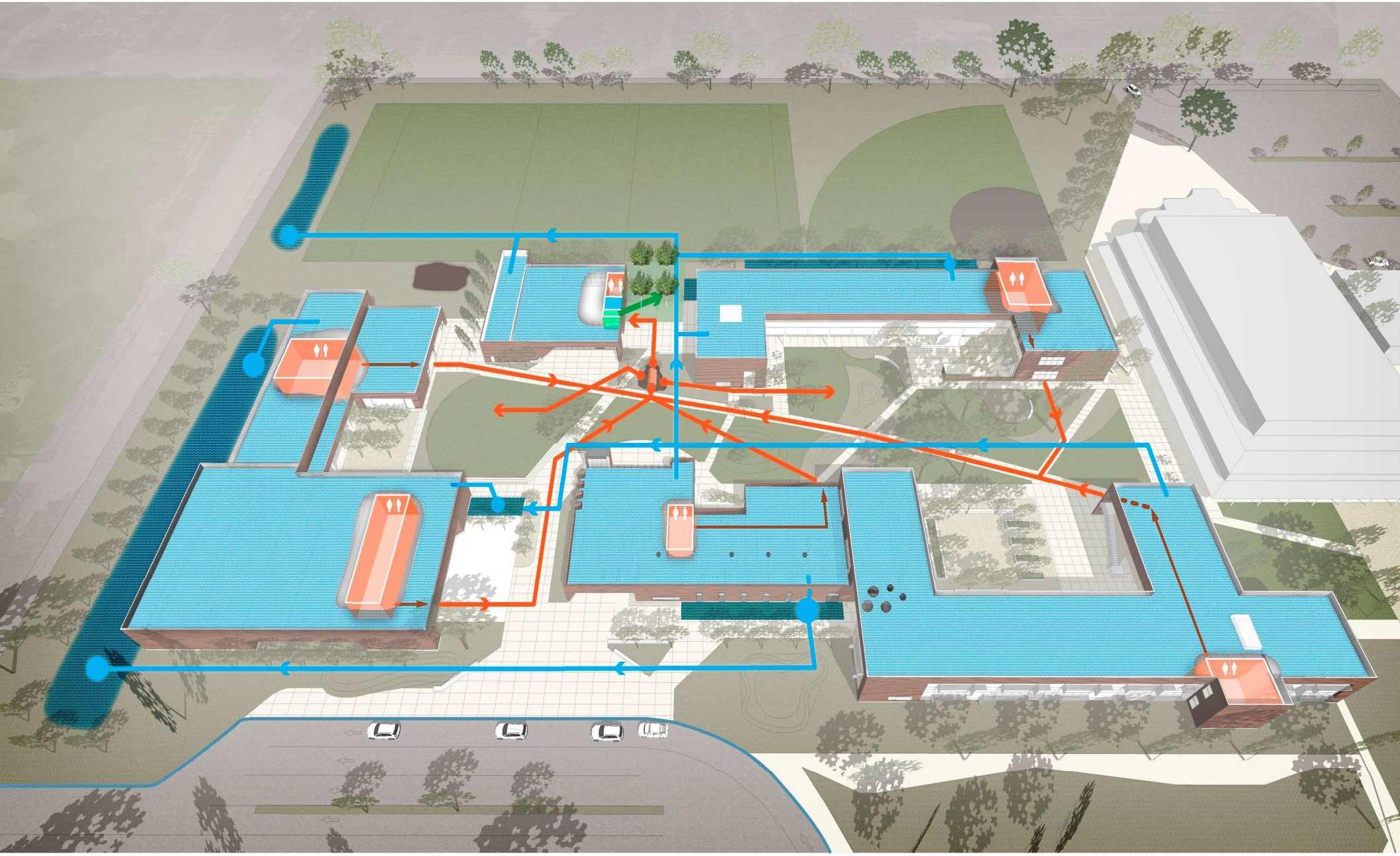


Reduced EUI for all buildings
CBECS for Schools: 69 EUI

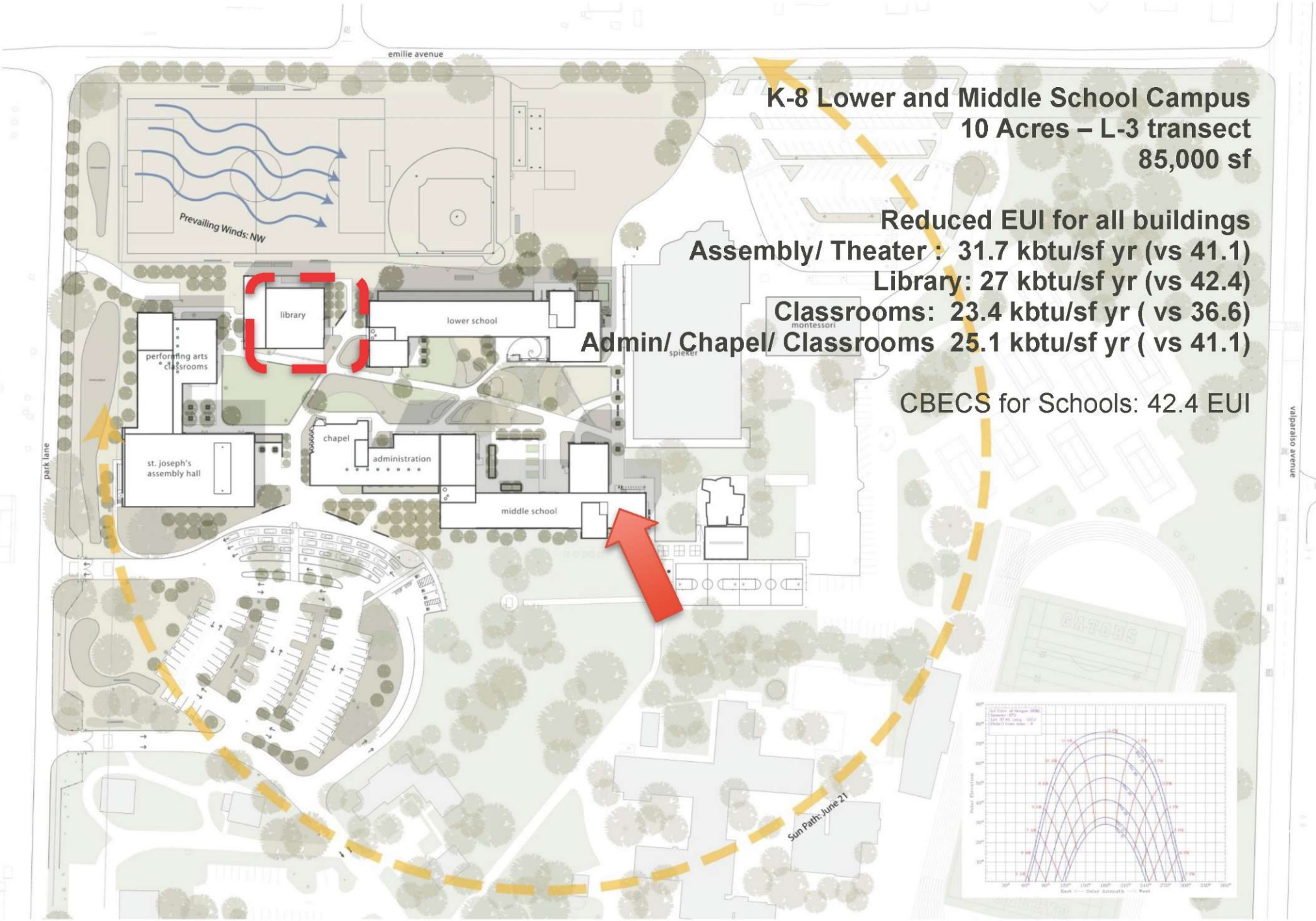
Evolved approach:
Campus Seeking LEED Gold LEED for Schools
Living Building Challenge potential
CHPS potential
Engage in Net Zero Pilot Project with PGE and Cadmus
Engage in Case Study book with PGE – Peter Turnbull and Ed Dean

WRNS STUDIO

Rainwater flows through planters and paving
Greywater is reused for landscape and toilet flushing



WRNS STUDIO



K-8 Lower and Middle School Campus
10 Acres – L-3 transect
85,000 sf

Reduced EUI for all buildings
Assembly/ Theater : 31.7 kbtu/sf yr (vs 41.1)
Library: 27 kbtu/sf yr (vs 42.4)
Classrooms: 23.4 kbtu/sf yr (vs 36.6)
Admin/ Chapel/ Classrooms 25.1 kbtu/sf yr (vs 41.1)

CBECS for Schools: 42.4 EUI

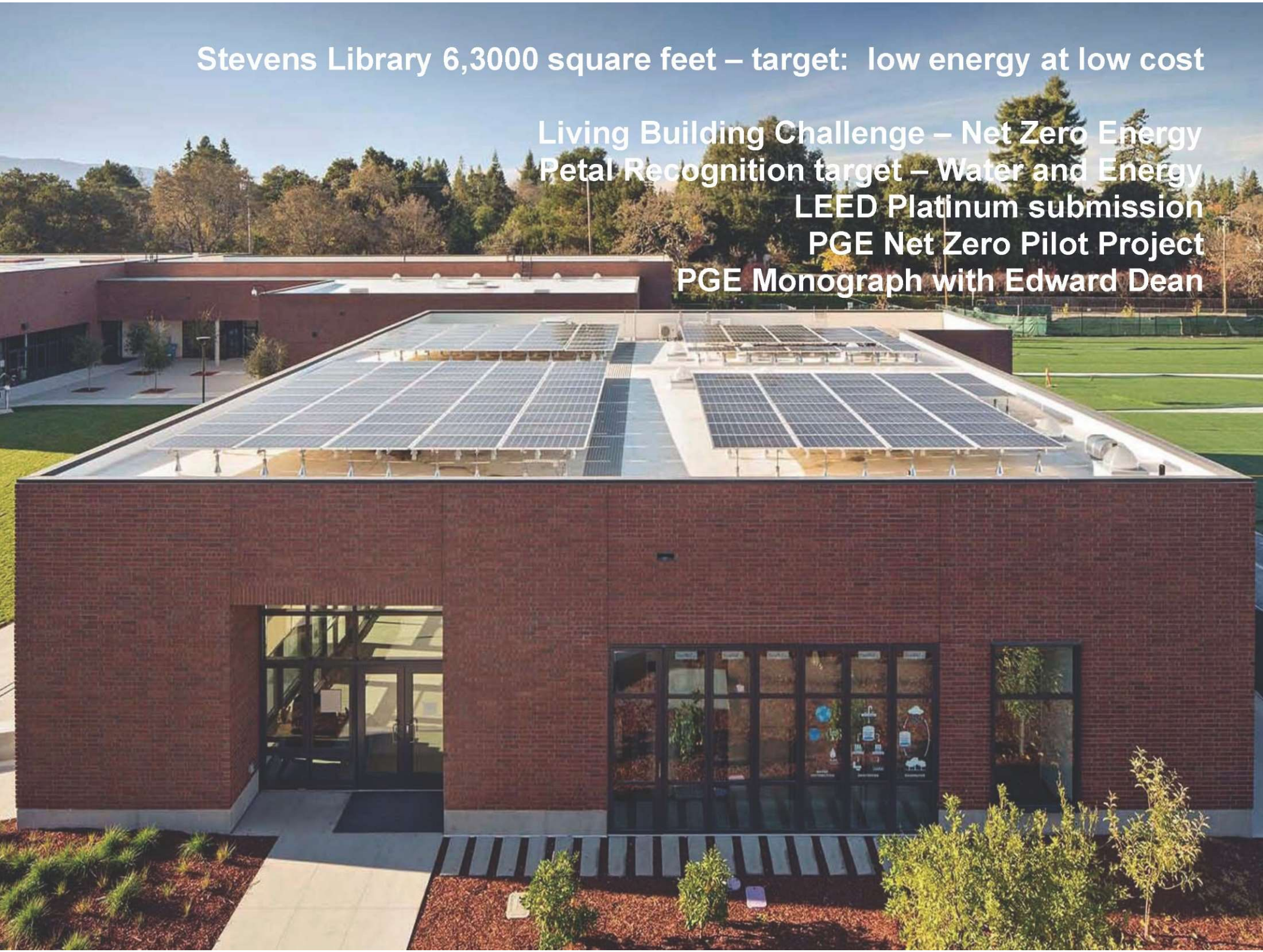
SHS
SACRED HEART SCHOOLS
ATHERTON

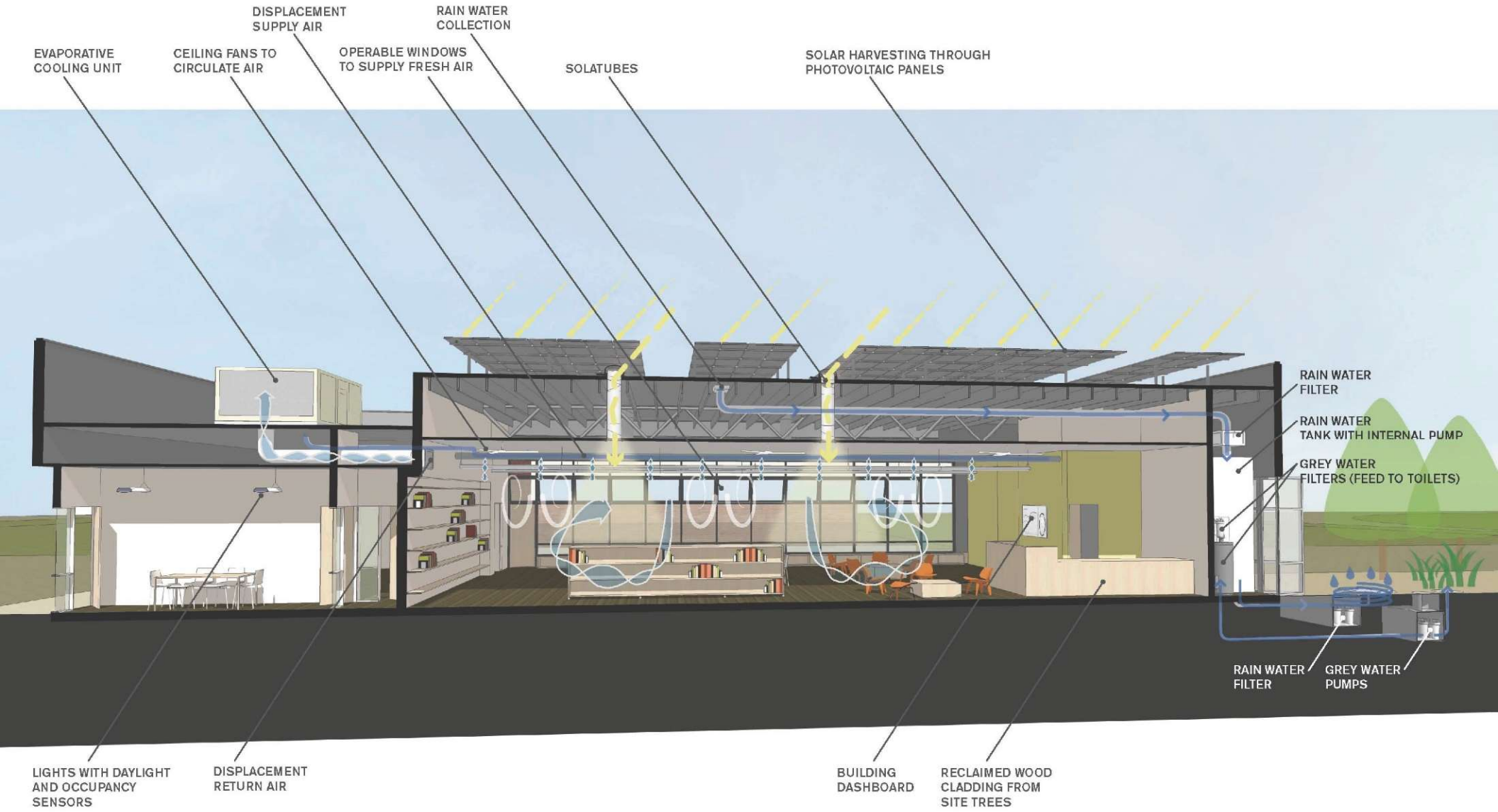
Lower & Middle School - Site Plan

October 8, 2010

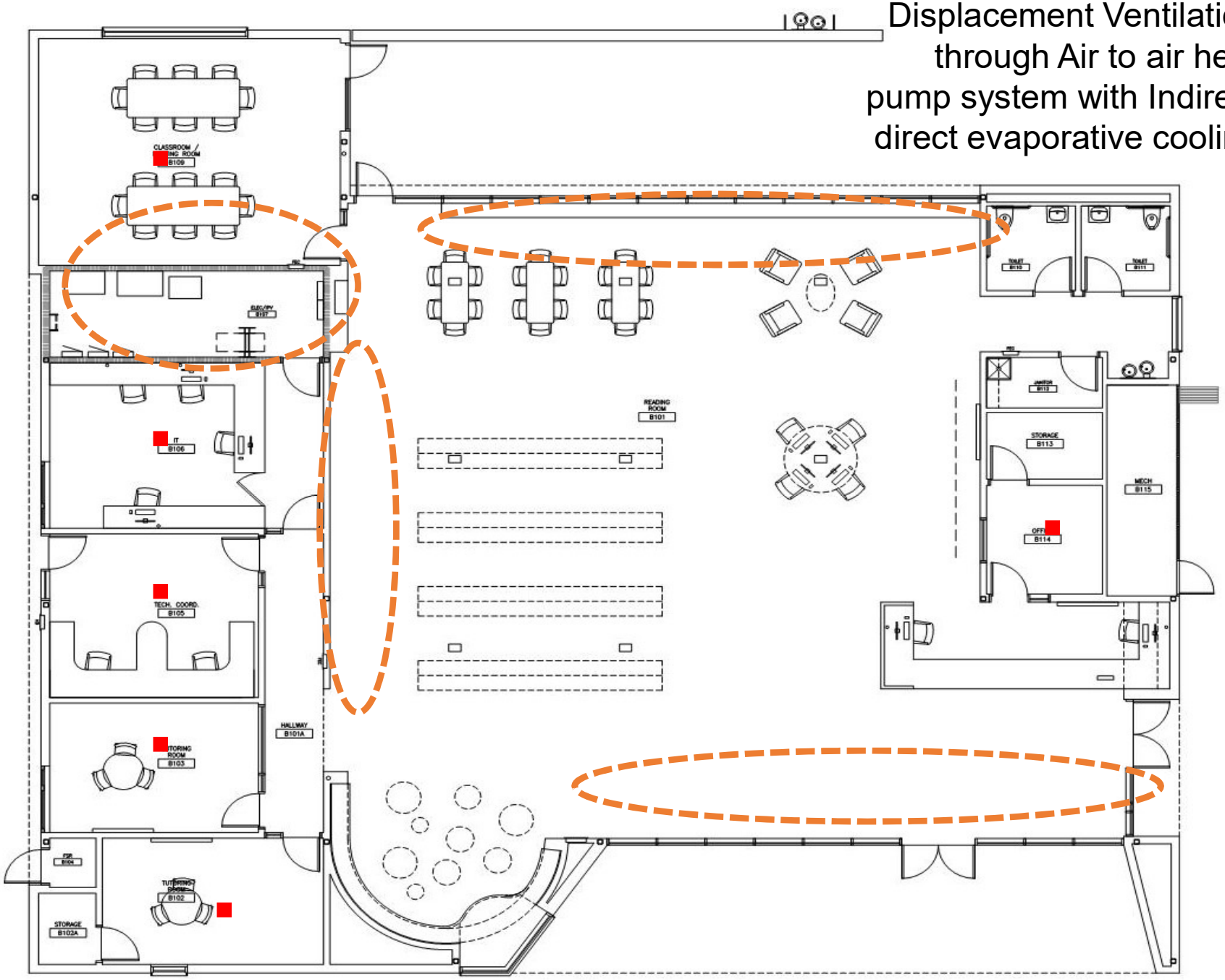
WRNS STUDIO

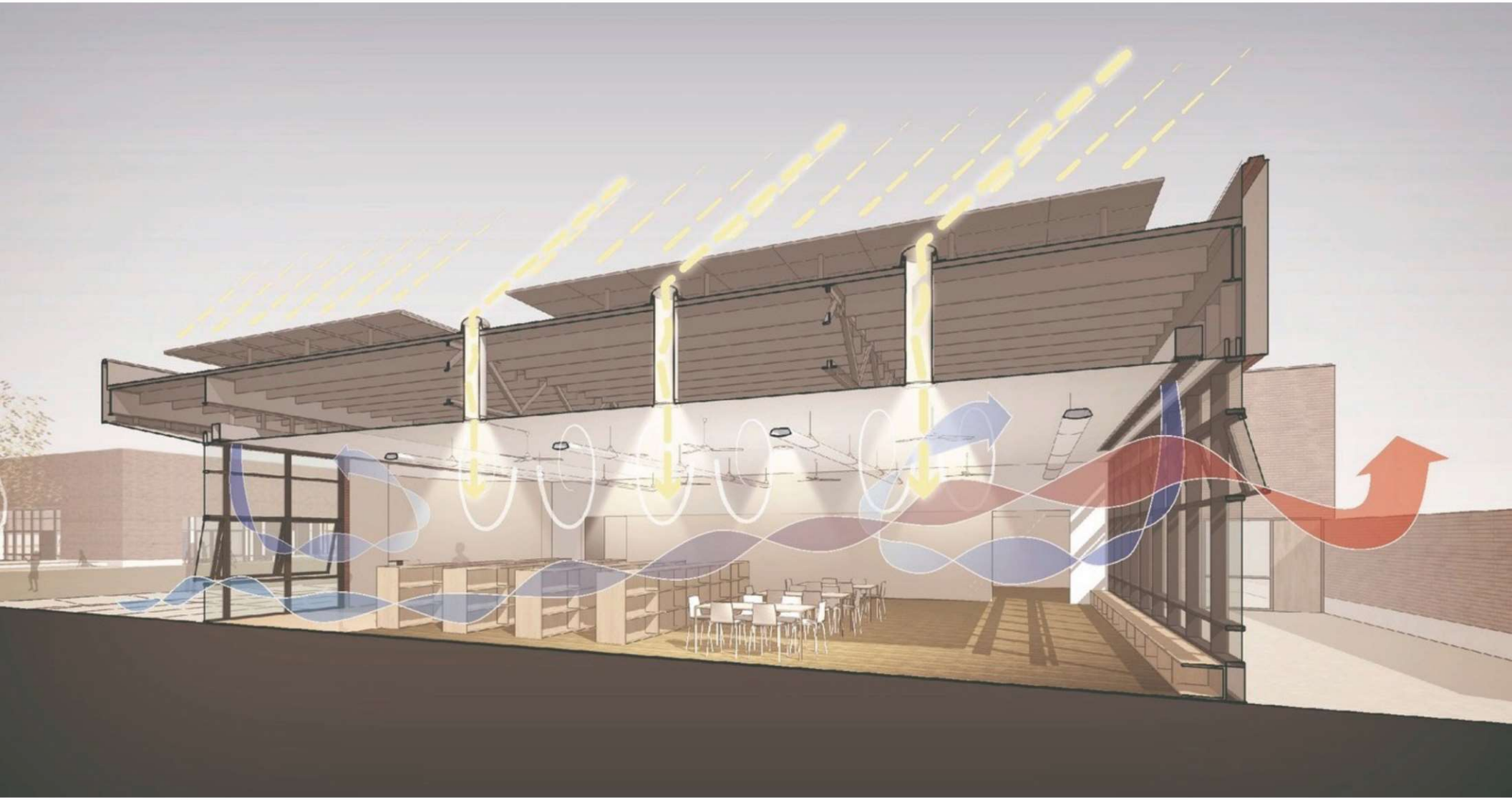

Sacred Heart Schools Lower and Middle School, Atherton CA
450 students


Stevens Library 6,3000 square feet – target: low energy at low cost
Living Building Challenge – Net Zero Energy
Petal Recognition target – Water and Energy
LEED Platinum submission
PGE Net Zero Pilot Project
PGE Monograph with Edward Dean

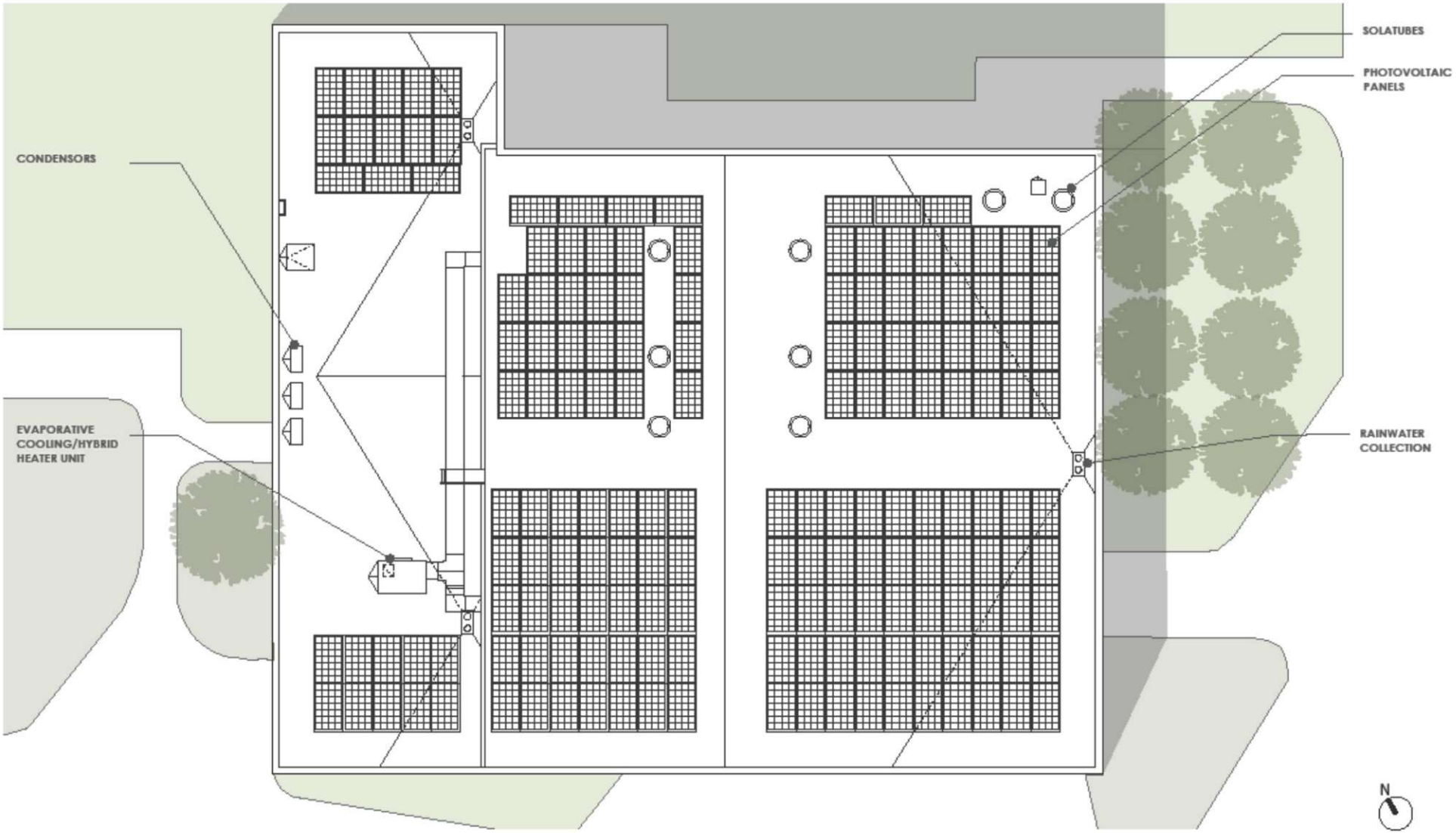

EVAPORATIVE COOLING UNIT
CEILING FANS TO CIRCULATE AIR
DISPLACEMENT SUPPLY AIR
OPERABLE WINDOWS TO SUPPLY FRESH AIR
RAIN WATER COLLECTION
SOLATUBES
SOLAR HARVESTING THROUGH PHOTOVOLTAIC PANELS
RAIN WATER FILTER
RAIN WATER TANK WITH INTERNAL PUMP
GREY WATER FILTERS (FEED TO TOILETS)
RAIN WATER FILTER
GREY WATER PUMPS
LIGHTS WITH DAYLIGHT AND OCCUPANCY SENSORS
DISPLACEMENT RETURN AIR
BUILDING DASHBOARD
RECLAIMED WOOD CLADDING FROM SITE TREES

Displacement Ventilation through Air to air heat pump system with Indirect direct evaporative cooling



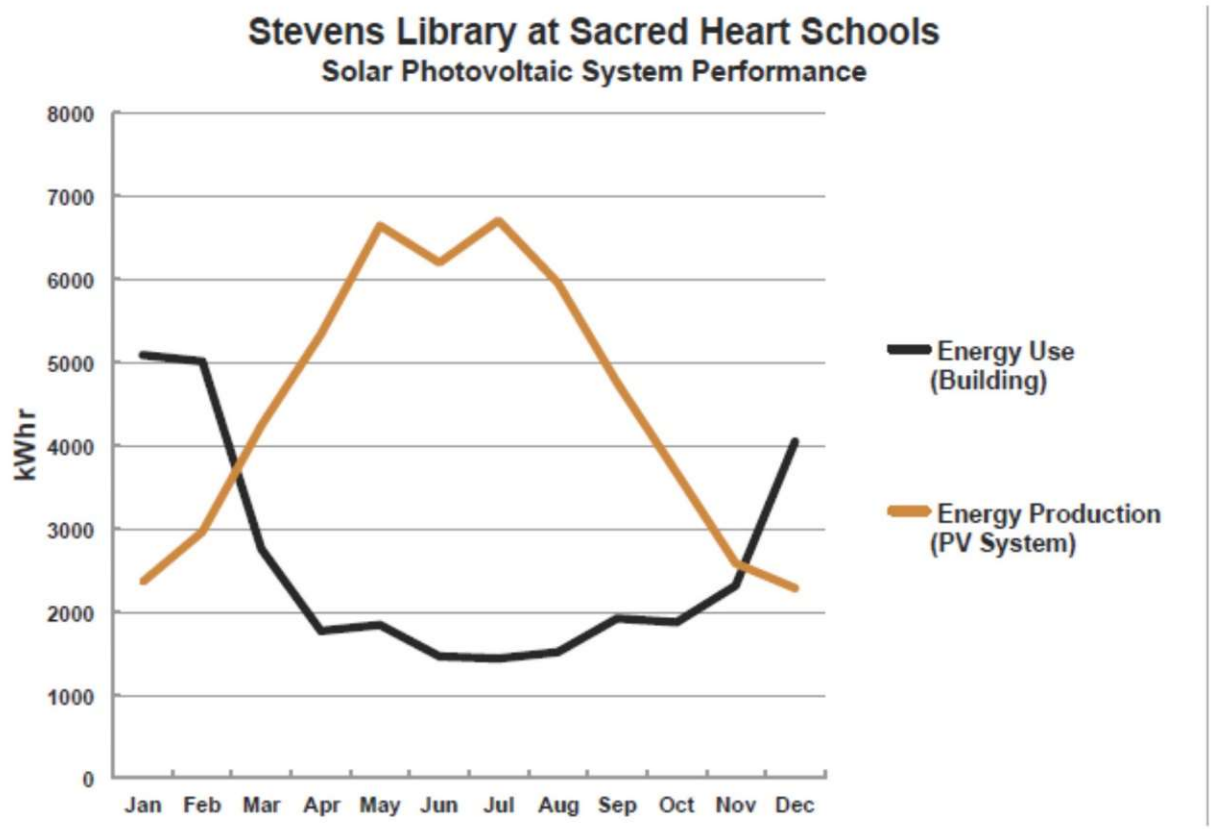


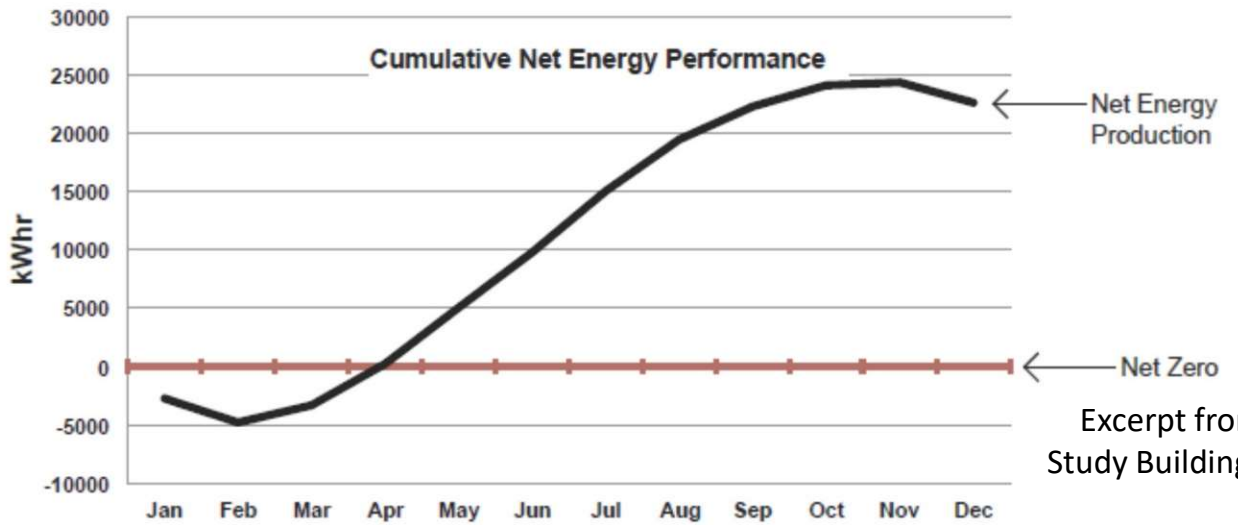
Maximized panels on roof area
170 panels @ 250 w/panel – 40 kw sized 15% over
Flat panels vs tilted resulted in a 13% reduction - required for city planning requirement



SACRED HEART LIBRARY
ROOF PLAN

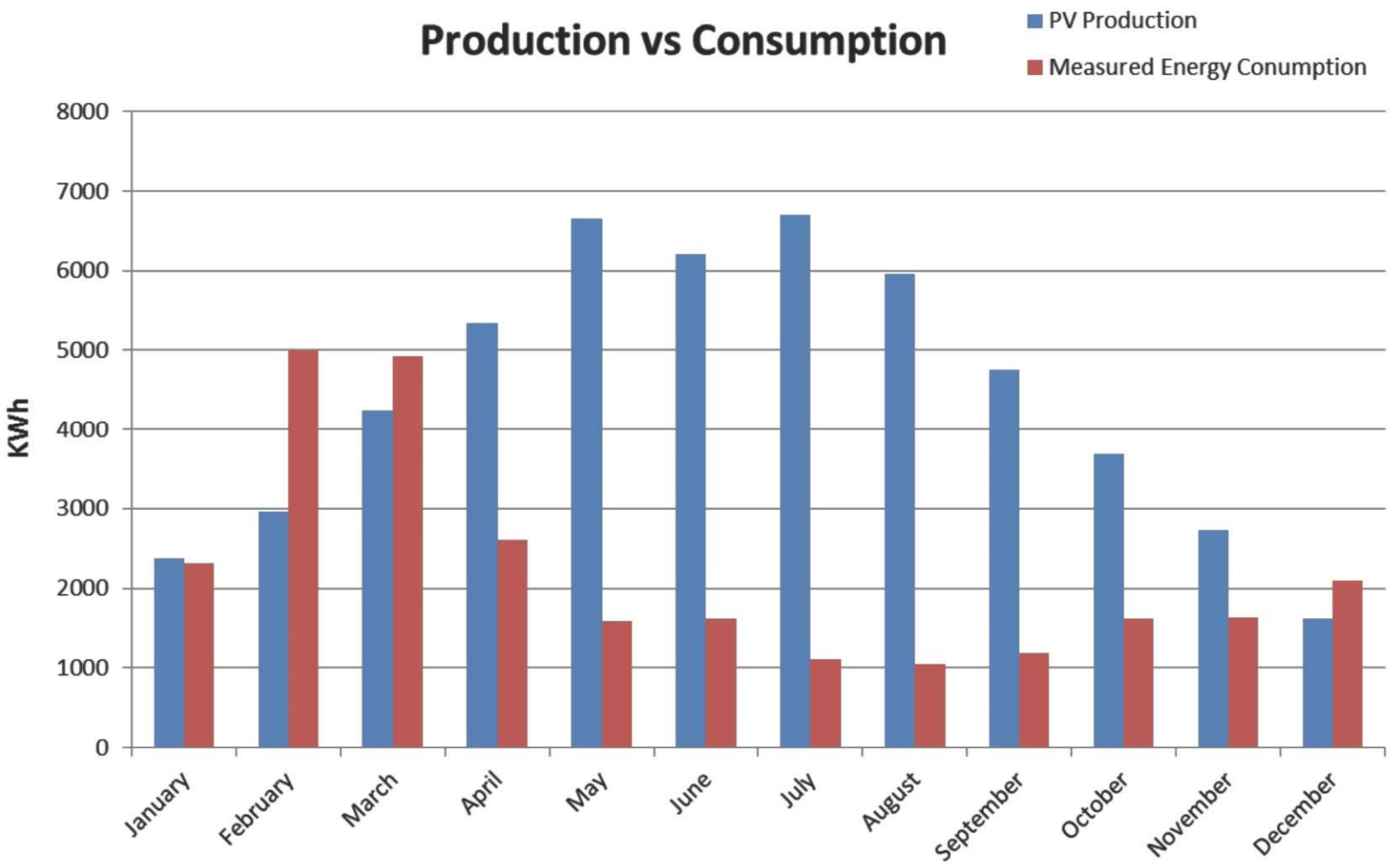
WRNS STUDIO
March 27, 2013

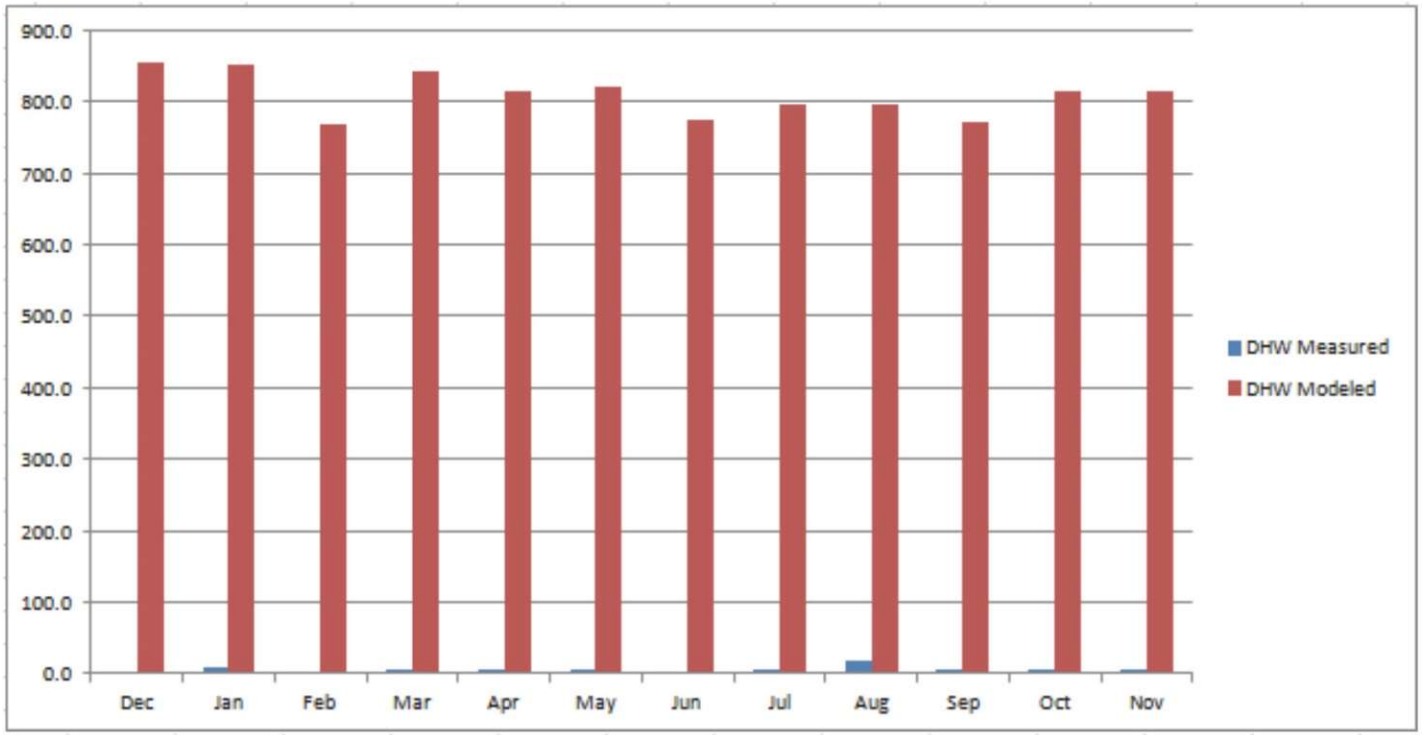




Excerpt from Zero Net Energy Case Study Buildings book under PGE Pilot project - Ed Dean

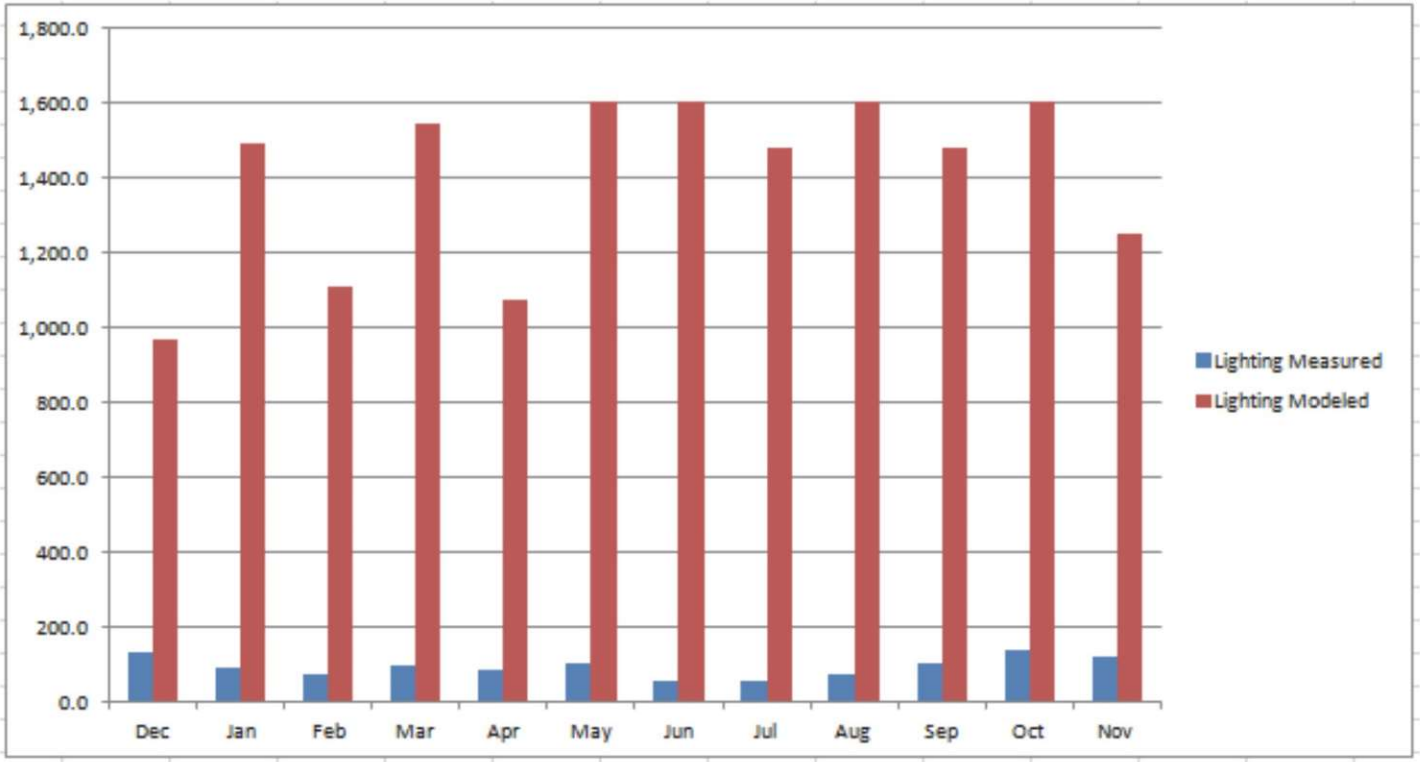
PV predicted at 50832 kWh
PV measured 56,811kWh
x





DHW

	Measured	Modeled
Dec	2.5	856.0
Jan	7.9	853.0
Feb	3.3	768.0
Mar	5.0	842.0
Apr	6.8	815.0
May	7.4	820.0
Jun	1.4	775.0
Jul	5.4	795.0
Aug	17.9	797.0
Sep	7.4	771.0
Oct	6.4	815.0
Nov	5.5	816



Lighting

	Lighting	
	Measured	Modeled
Dec	129.9	969.0
Jan	86.6	1,488.0
Feb	71.5	1,109.0
Mar	94.0	1,546.0
Apr	81.2	1,073.0
May	103.9	1,604.0
Jun	53.9	1,604.0
Jul	54.2	1,477.0
Aug	73.6	1,604.0
Sep	103.0	1,477.0
Oct	135.3	1,604.0
Nov	120	1246

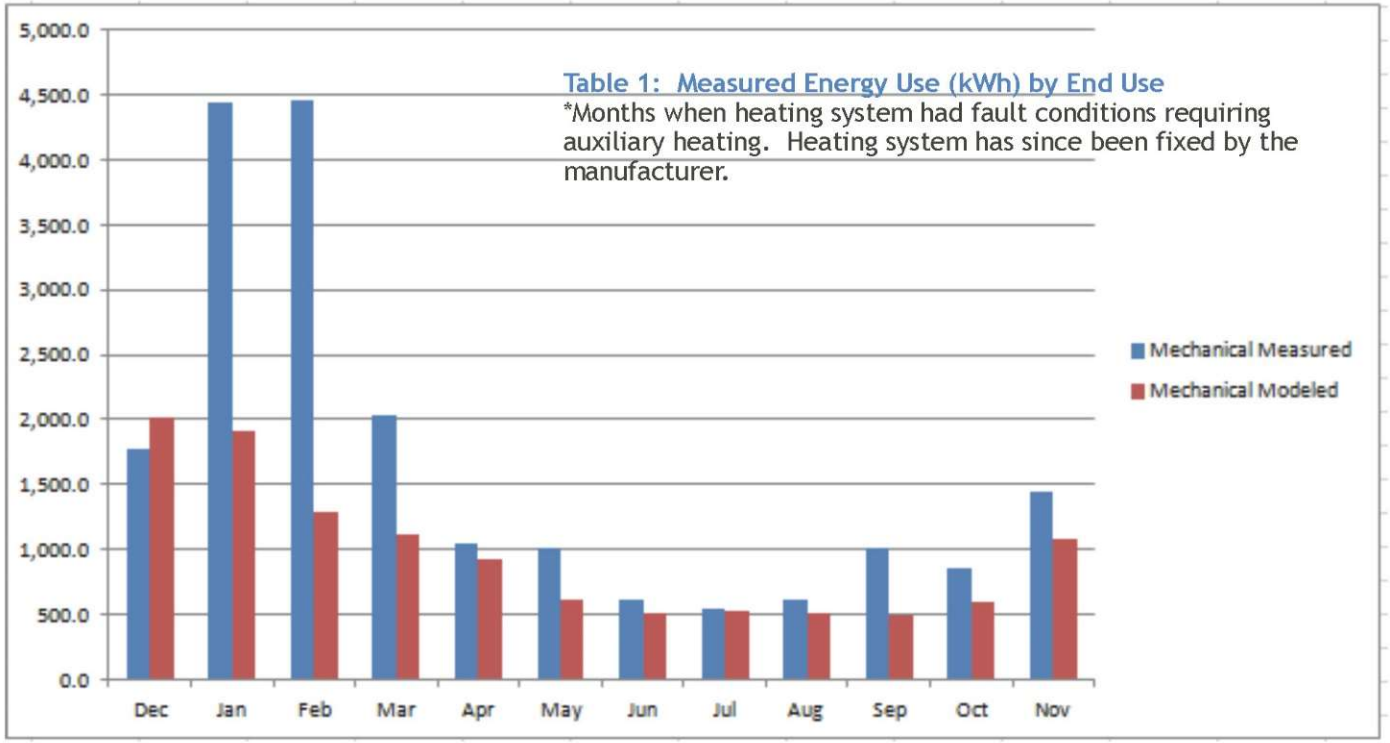
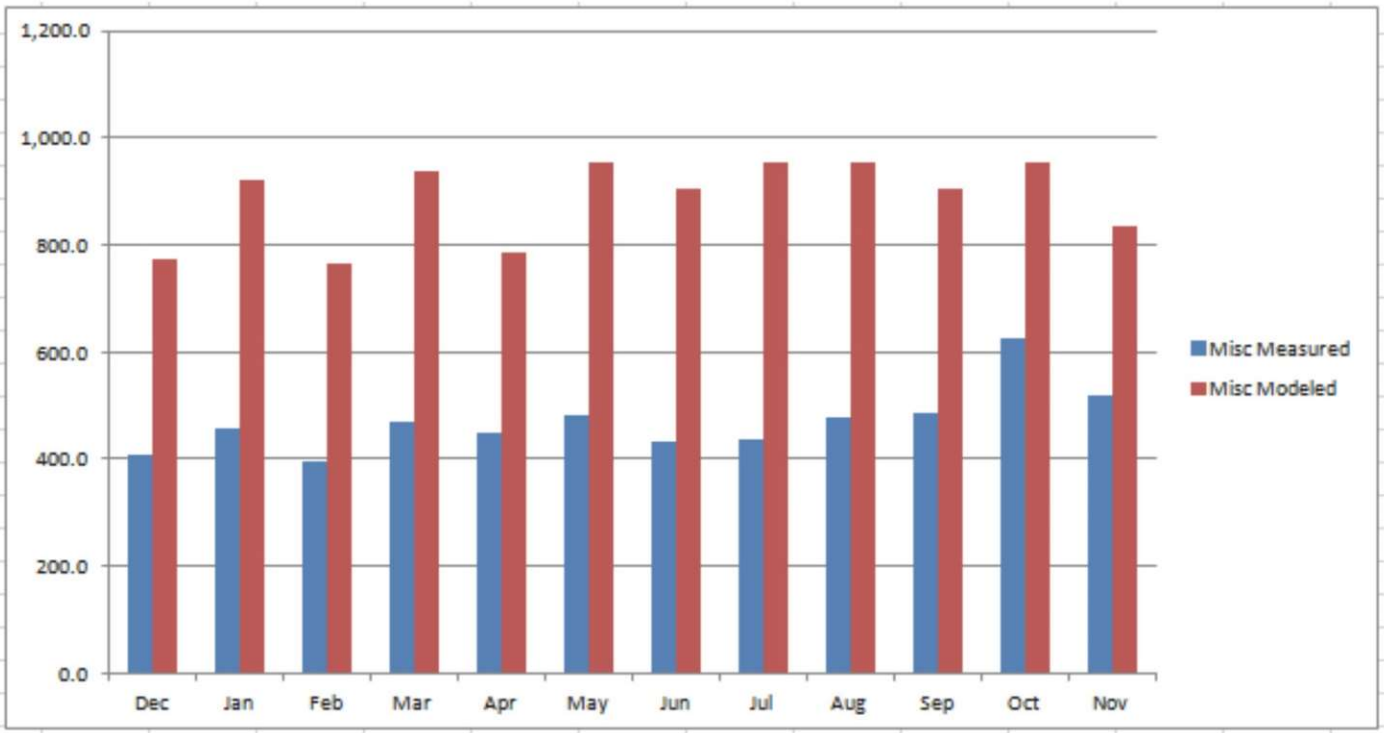


Table 1: Measured Energy Use (kWh) by End Use

*Months when heating system had fault conditions requiring auxiliary heating. Heating system has since been fixed by the manufacturer.

Mechanical

	Mechanical	
	Measured	Modeled
Dec	1,773.9	2018
Jan	4,442.5	1,914.0
Feb	4,457.6	1,283.0
Mar	2,032.1	1,115.0
Apr	1,040.7	928.0
May	1,018.2	617.0
Jun	616.1	506.0
Jul	547.3	527.0
Aug	609.1	520.0
Sep	1,013.8	499.0
Oct	863.3	601.0
Nov	1446.5	1086

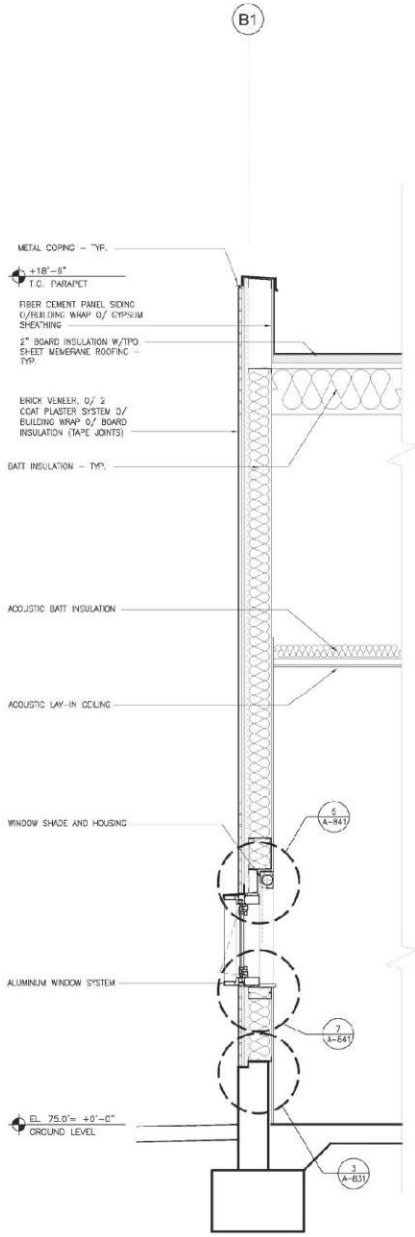


Misc

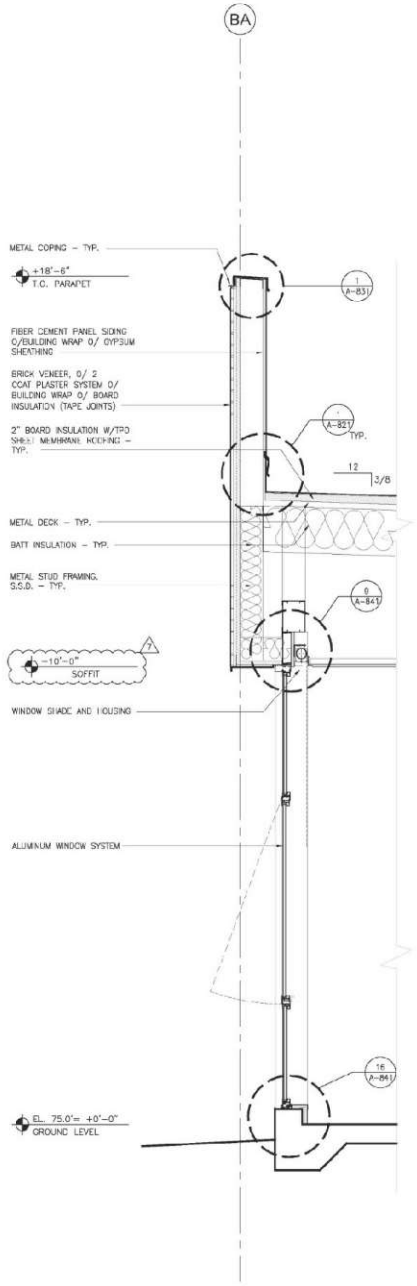
	Measured	Modeled
Dec	407.3	772.0
Jan	455.7	922.0
Feb	396.3	765.0
Mar	469.3	938.0
Apr	450.7	786.0
May	481.4	955.0
Jun	434.4	903.0
Jul	435.1	955.0
Aug	479.2	955.0
Sep	486.5	903.0
Oct	626.0	955.0
Nov	519.63	836


highs
&
lows
Better tracking
Constant communication


envelope



4 WALL SECTION
3/4" = 1'-0"



3 WALL SECTION
3/4" = 1'-0"

Wall Assembly and Roof Assembly

- **WALL R 12.5**

- **¾" Brick Veneer**
- **¾" Exterior Plaster**
- **½" Rigid plus ½" shear board/ 1" Rigid**
- **6" metal studs at 24" oc with R19**

- ***Could go 1" more of rigid to R 17***

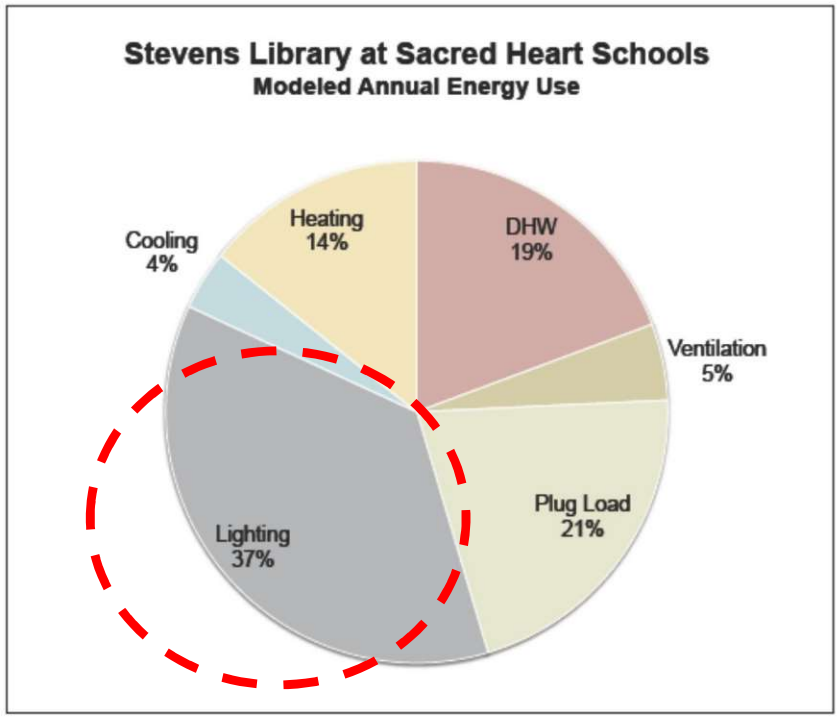
- **ROOF – R 27**

- **TPO Roofing**
- **2" rigid**
- **1-1/2" metal decking**
- **R-40 insulation**

- Change in assembly - Wood would have been R20 with same assembly (vs R12.5)

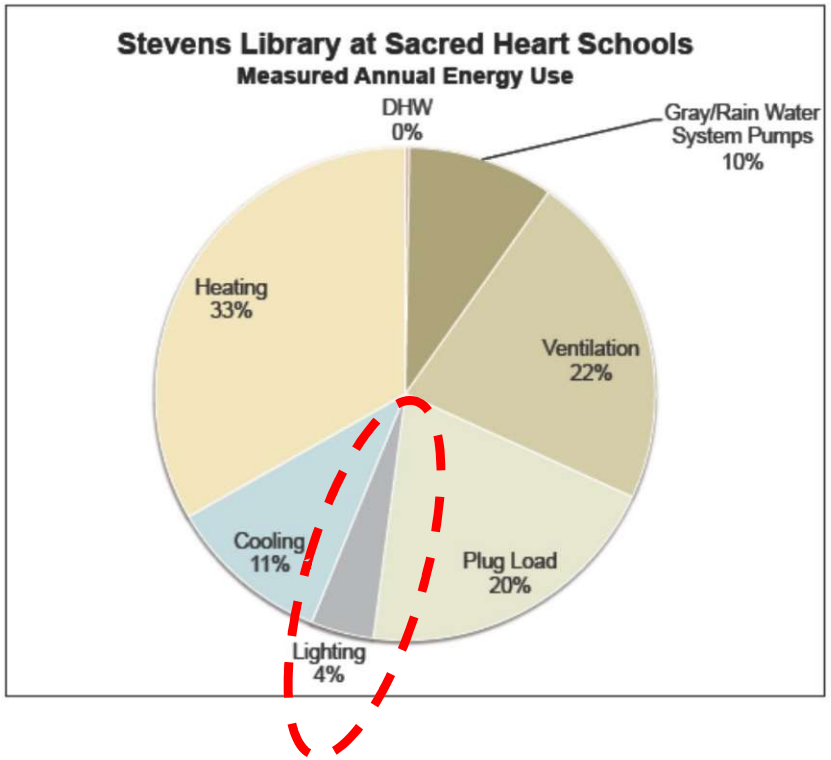
lighting

Daylight modeling and People modeling



Modeled Energy Use

50 MWhr per Year
Modeled EUI = 27.0



Measured Energy Use

31.1 MWhr per Year
Actual EUI = 16.9

37 % predicted

4% actual

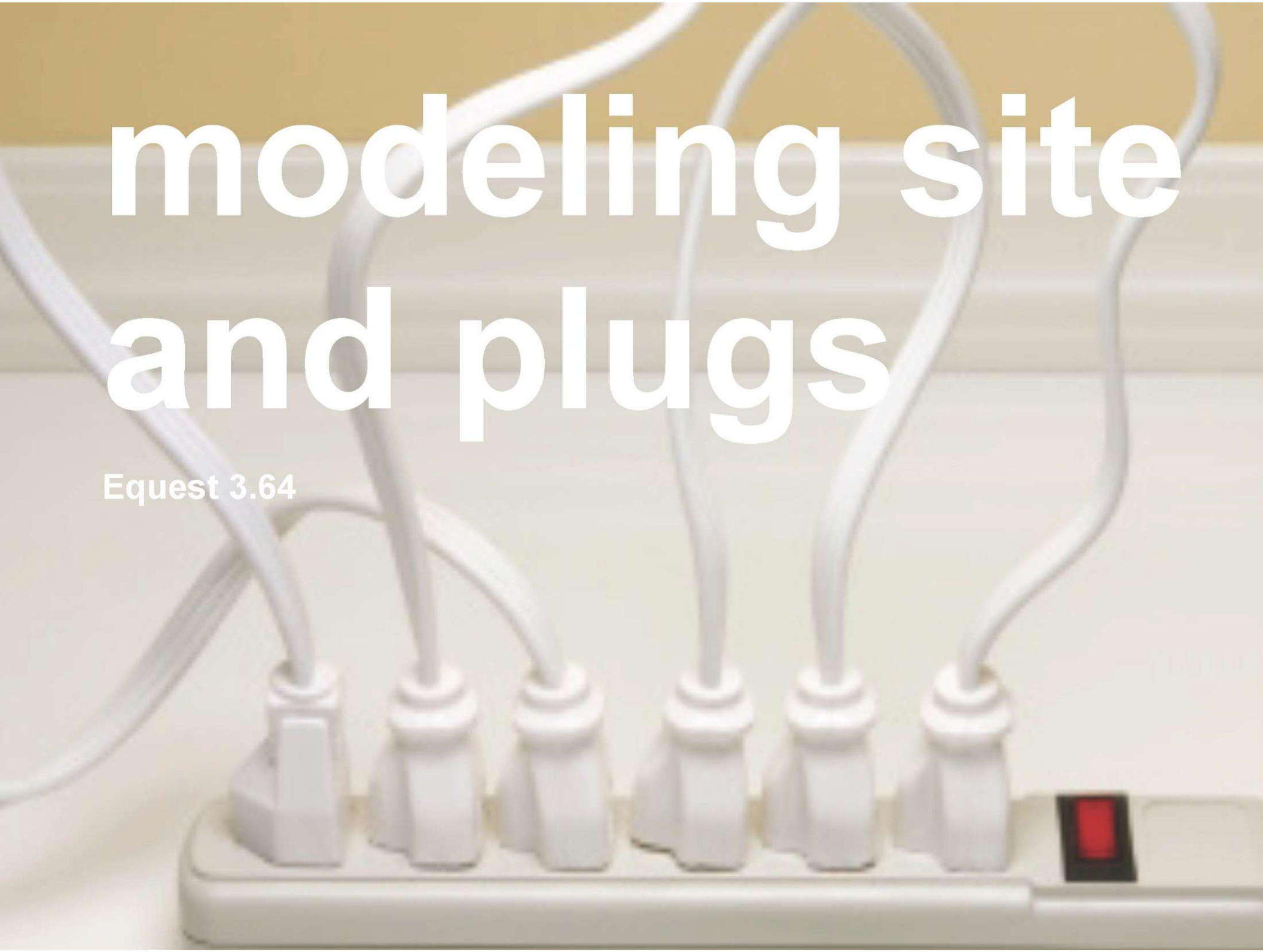
Approximately 8000 kWh difference

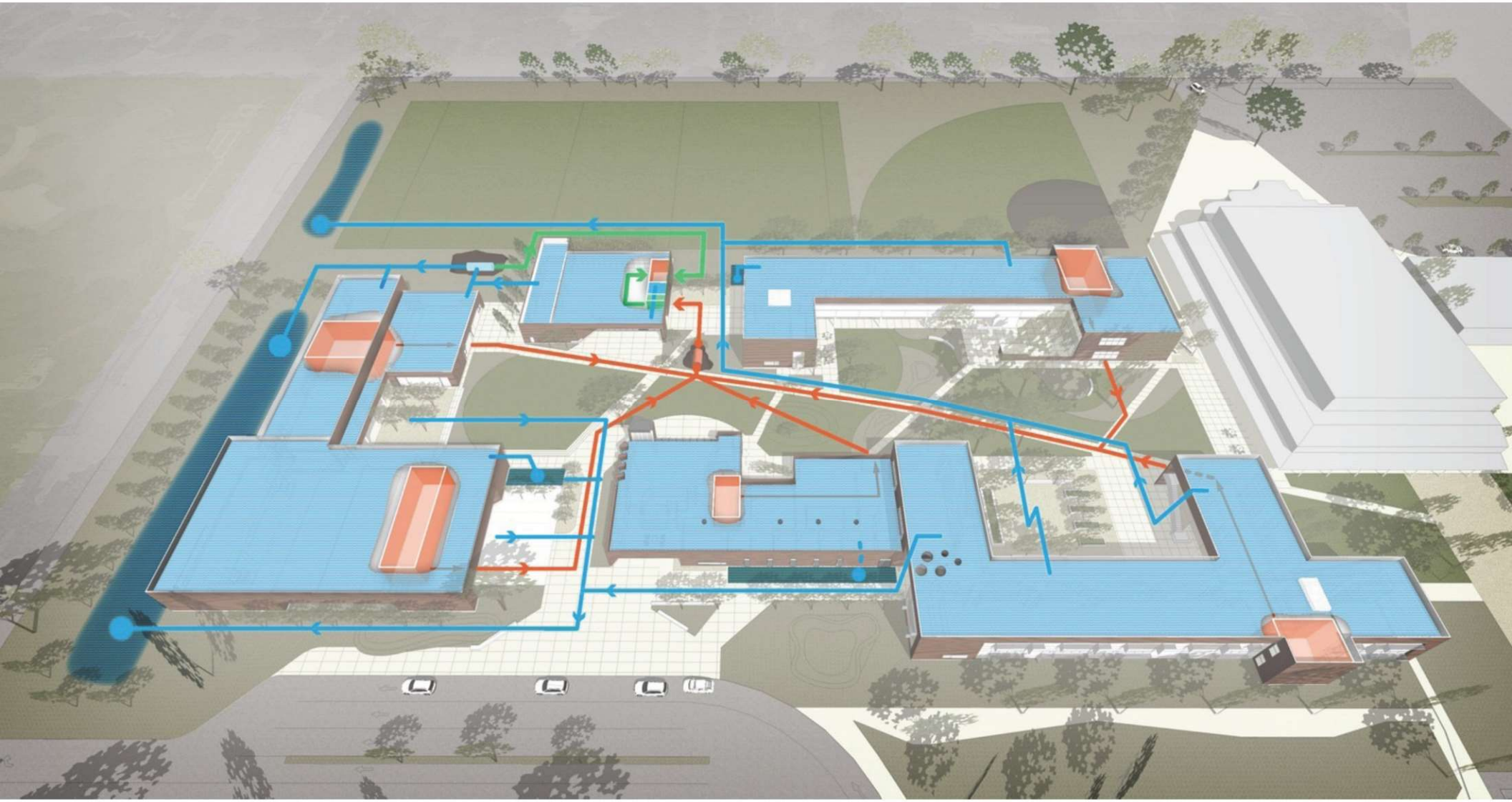
Excerpt from Zero Net Energy Case Study Buildings book under PGE Pilot project - Ed Dean

People and comfort

modeling site and plugs

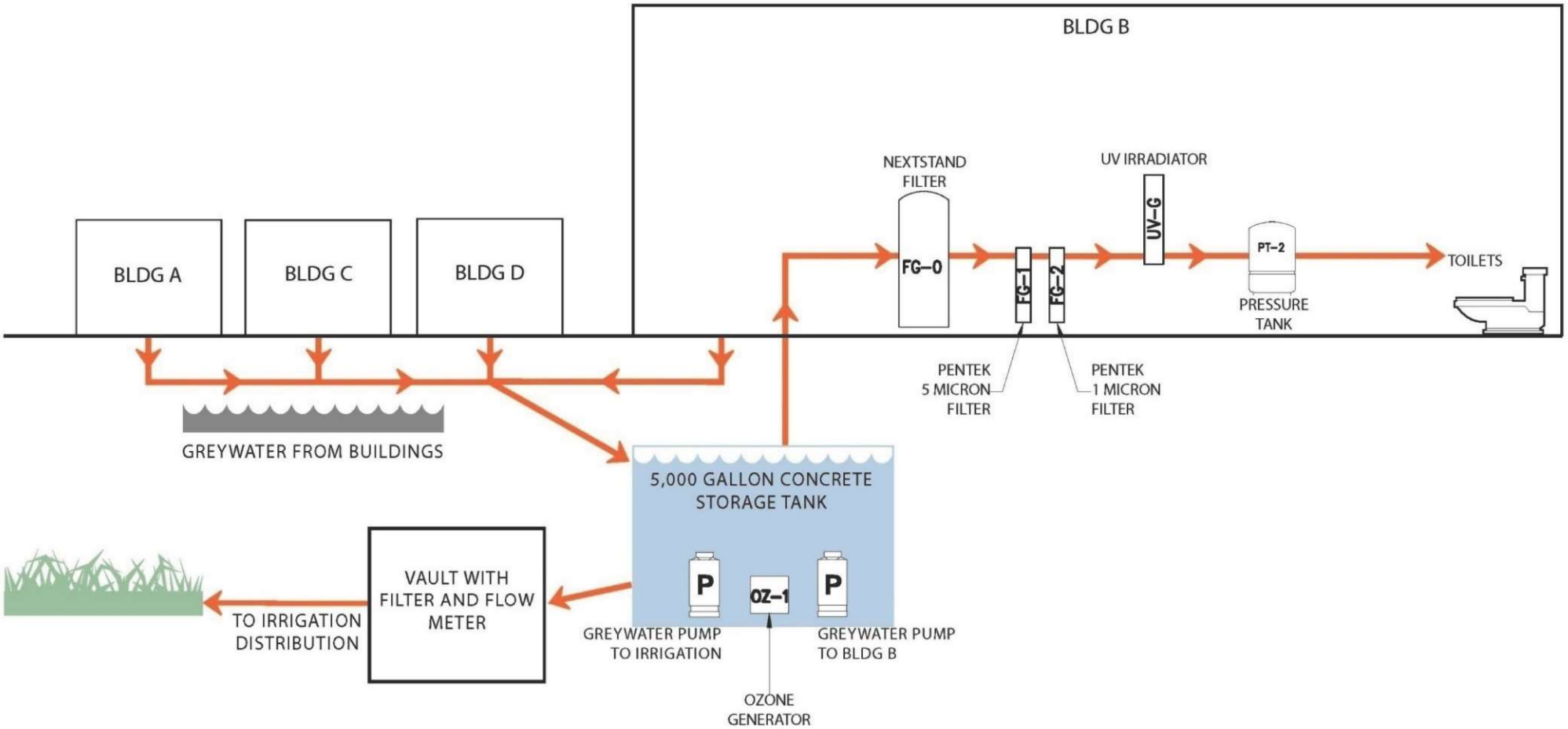
Equest 3.64





ZNE Technical Training for School &
Building Industry Professionals

WRNS STUDIO



SACRED HEART SCHOOLS

ATHERTON, CA

LOWER & MIDDLE SCHOOLS

WRNS STUDIO

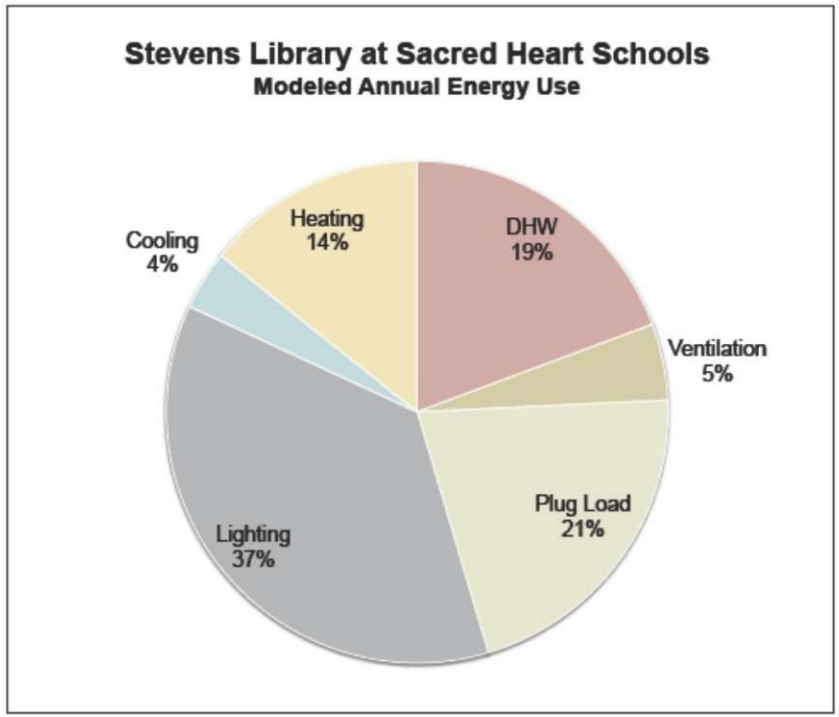

classroom
library garden
it
tech coord
tutoring room
tutoring room
library
jan storage
mech
office
RAINWATER TANK
GREYWATER FILTERS
GREYWATER TANK
1st 1
1st 2
lower school
dean's office
storage
dean's office
practice
practice
music room
mech
stor
office
chorus room
jan
dance studio
fine arts courtyard
storage
LIVING BUILDING CHALLENGE SITE BOUNDARY
main courtyard / graduation courtyard
chapel courtyard


NaturalWall
NaturalWall
NaturalWall
WATER

Greywater added approximately 3000 kWh to the actual metering data – not originally expected

EUI of 16.1 or 13.2 including greywater

	Fans	Heating	Cooling	Lighting	DHW	Gray/Rain Water System	Misc/Plug	Total Use	PV Generation
1/13	952	3030	229	135	7	116	623	5092	2367
2/13	937	2984	226	133	7	114	613	5014	2966
3/13	486	778	459	143	7	269	618	2760	4246
4/13	580	86	313	100	7	228	463	1777	5337
5/13	603	90	326	104	7	237	481	1848	6645
6/13	365	54	197	54	1	364	434	1469	6198
7/13	324	48	175	54	5	401	435	1442	6703
8/13	361	54	195	74	18	340	479	1521	5956
9/13	600	89	324	103	7	316	486	1925	4756
10/13	514	76	278	137	6	237	633	1881	3678
11/13	408	653	386	120	6	225	519	2317	2589
12/13	757	2409	182	107	6	92	495	4048	2289
2013 Total	6887	10351	3290	1264	84	2939	6279	31094	53730

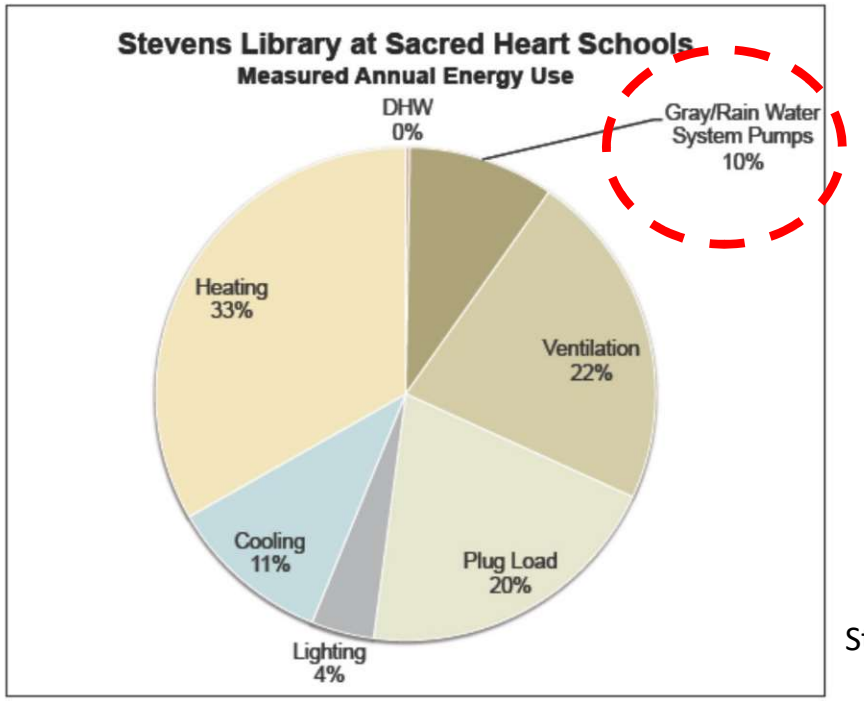


Modeled Energy Use

50 MWhr per Year
Modeled EUI = 27.0

34

Zero Net Energy Case Study Buildings



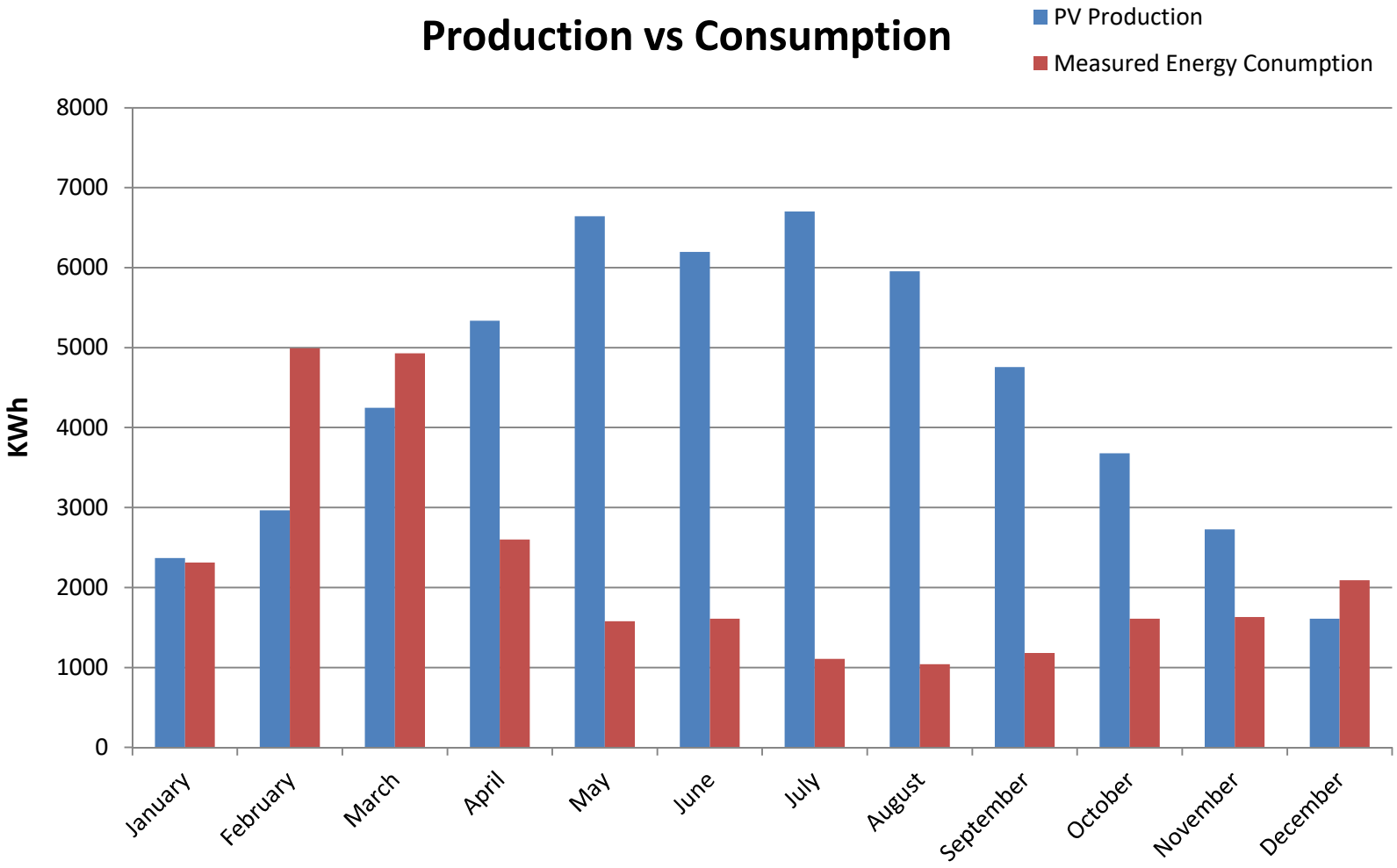
Measured Energy Use

31.1 MWhr per Year
Actual EUI = 16.9

Excerpt from Zero Net Energy Case Study Buildings book under PGE Pilot project - Ed Dean

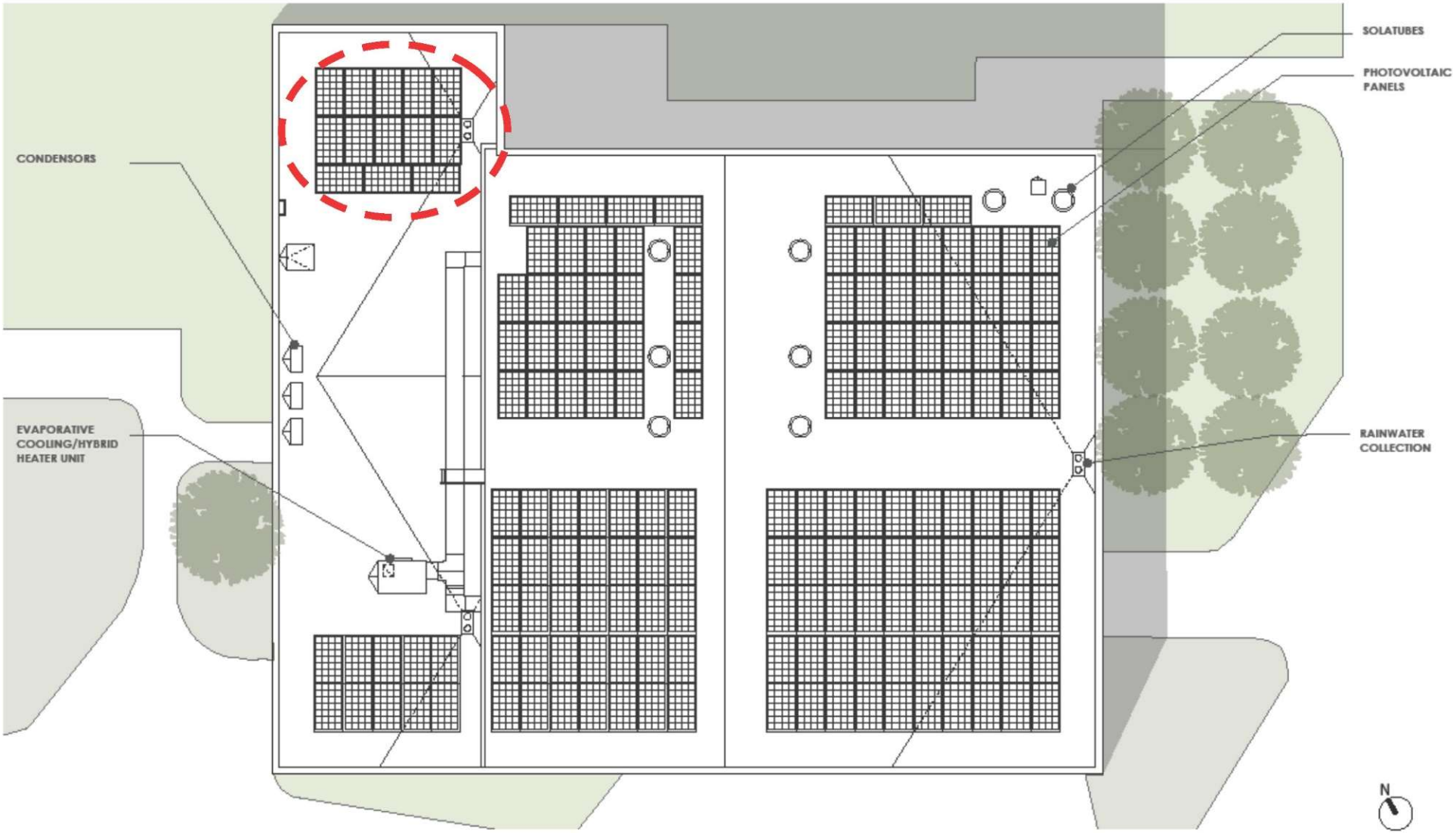
how much

PV predicted at 50832 kWh
PV measured 56811kWh
Demand measured 24394 kWh



Predicted energy back to the grid at 32,417 kWh

170 panels @ 250 w/panel – 40 kw sized 15% over covers graywater system, 4,408 kwh



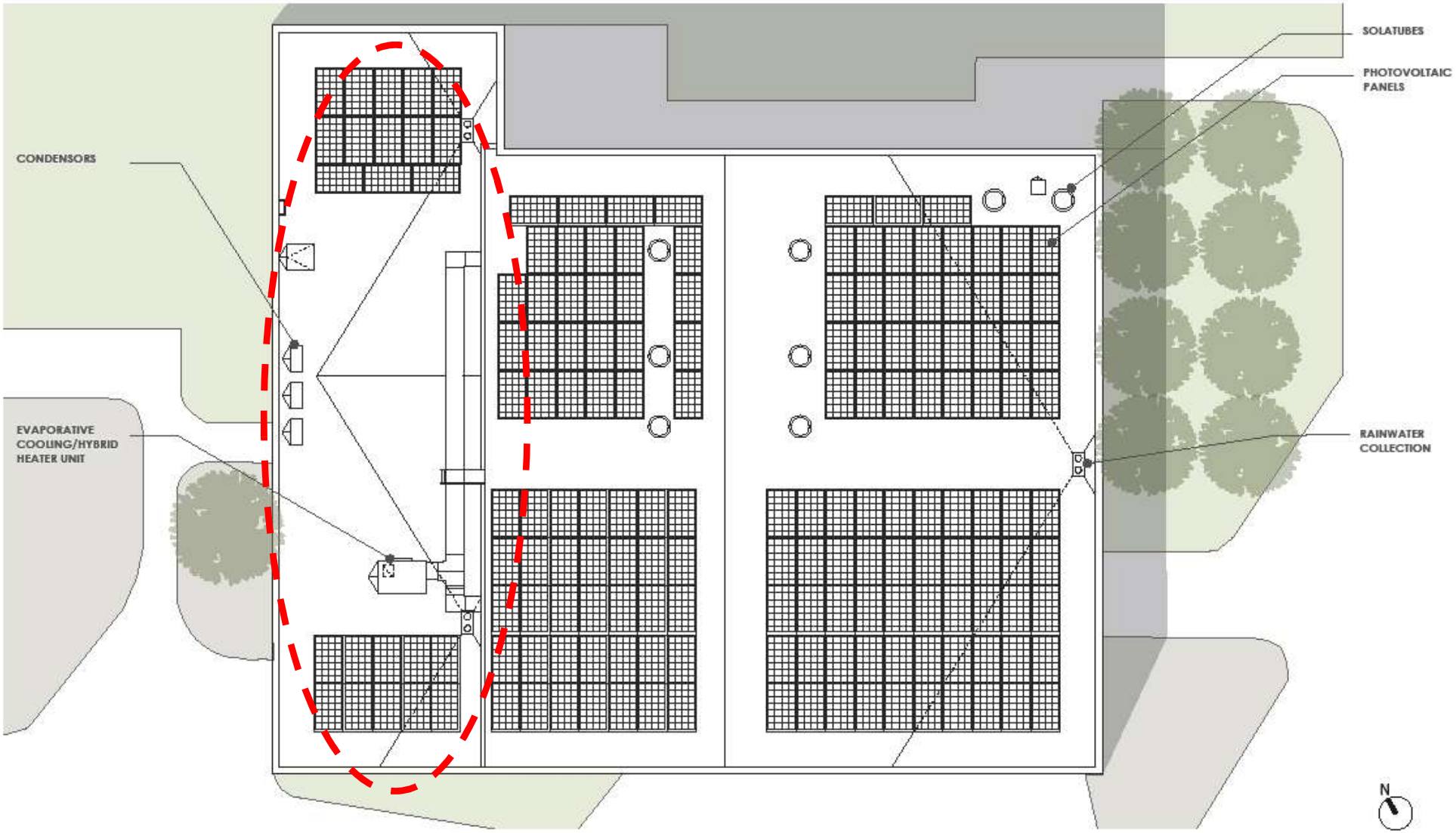
SACRED HEART LIBRARY

ROOF PLAN

WRNS STUDIO

March 27, 2013

Plus the 8000 kW difference for the lighting…..Too much of a difference ?



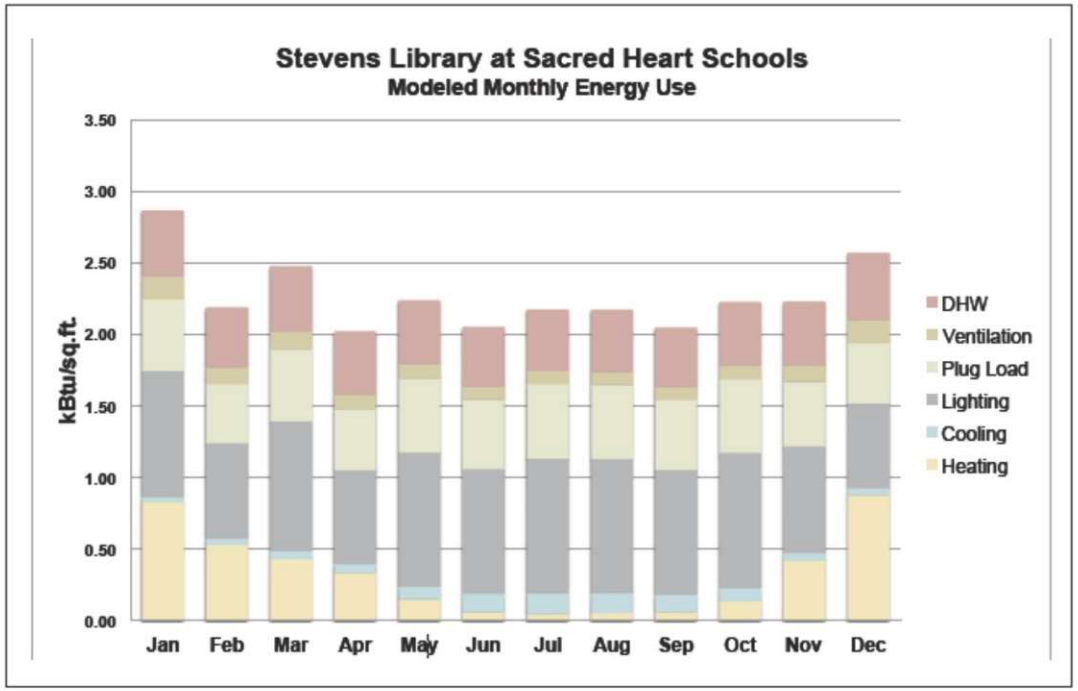
SACRED HEART LIBRARY

ROOF PLAN

WRNS STUDIO

March 27, 2013

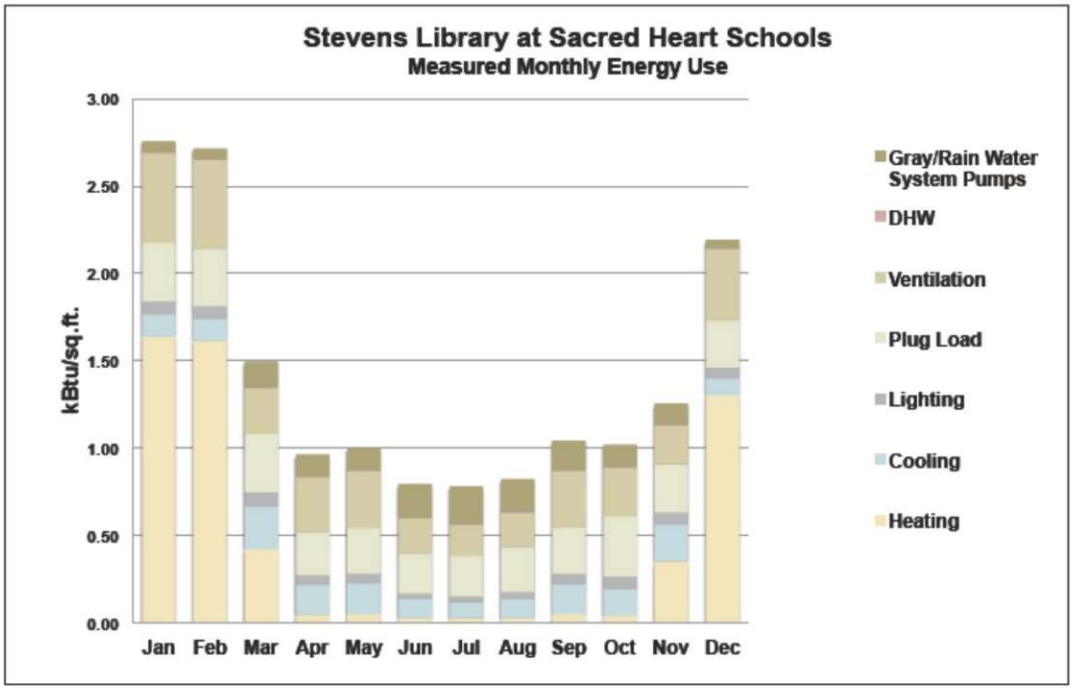

Too Good?



Without added pumps for campus greywater system, library EUI is **16 kBTU/sf**

With added pumps for campus greywater system, library EUI is **19 kBTU/sf**

Energy Use – Actual Measurement and Comparison to Modeling Results

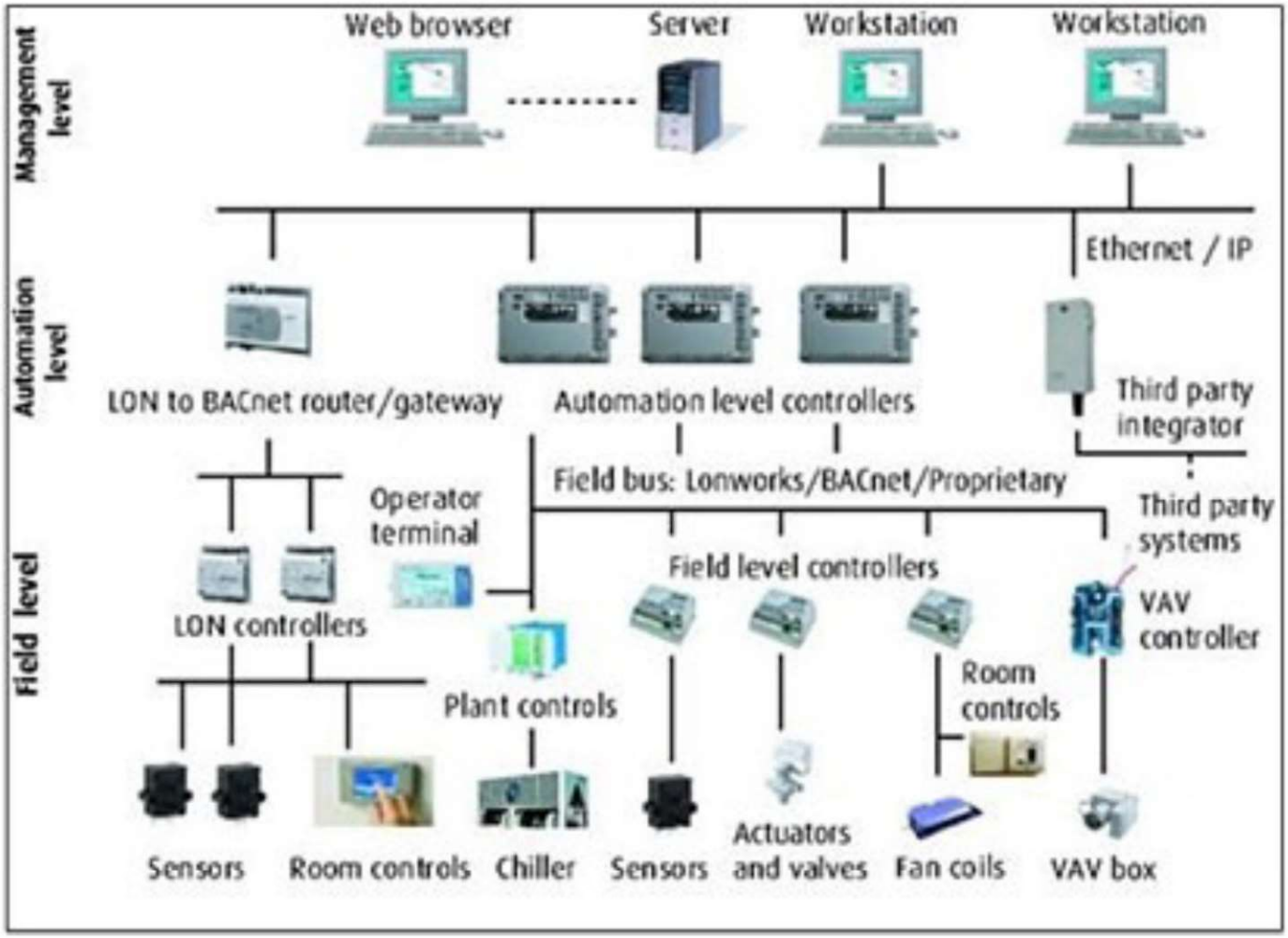


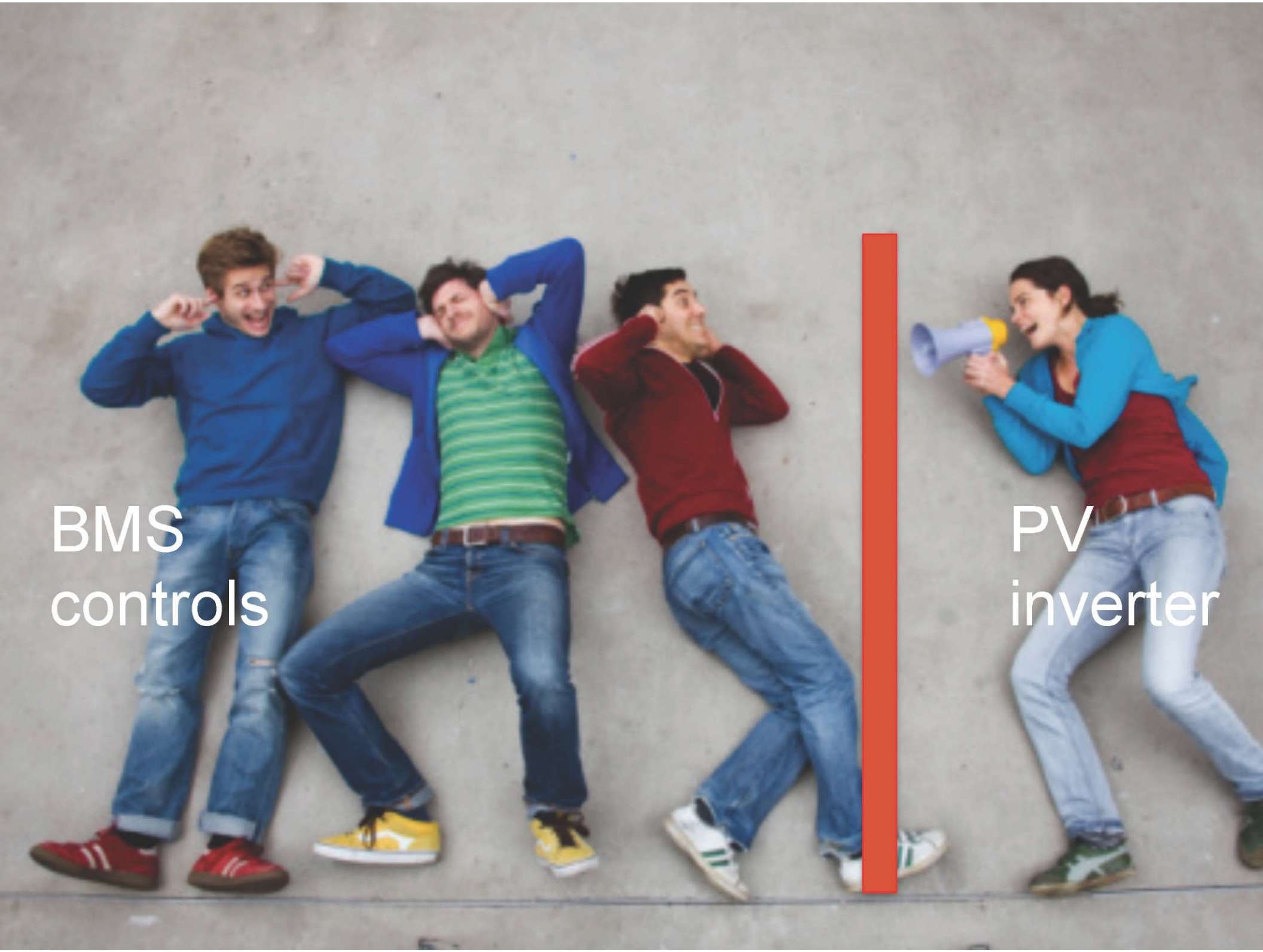
Excerpt from Zero Net Energy Case Study Buildings book - Ed Dean

BMS Controls

A case for Cxg - BMS was not programmed correctly to produce all meaningful data during the measurement period.

A second set of power meters (separate from the BMS) was installed with additional measurement points. This helped uncover a flaw with the BMS recording and provide a more detailed picture of how the building was using energy




BMS
controls
PV
inverter

Additional work to track why the invertor was not communicating with the BMS system

keep up your roadmap

KEEP UP THE BOD – Basis of Design

Update the BOD as part of the deliverable at each phase


highs

First Net Zero Certified Library and first CA School by ILFI and on the road to LEED Platinum

ZNE Technical Training for School &
Building Industry Professionals

WRNS STUDIO

ZNE Technical Training for School & Building Industry Professionals

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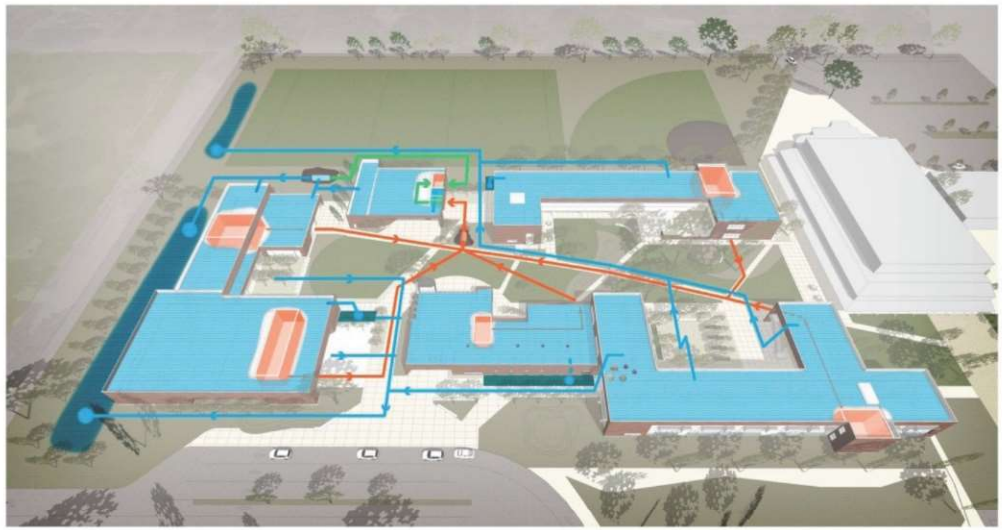
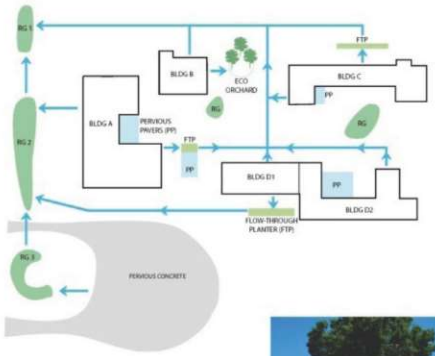
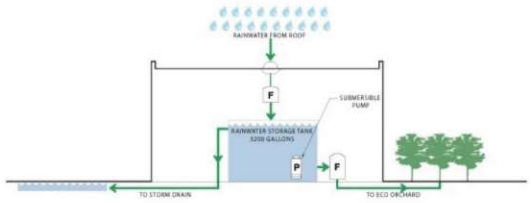
NanoWall
NanoWall
NanoWall
2.5%
GRAYWATER
RAINWATER

DO YOU KNOW...

...where the rain goes when it falls?

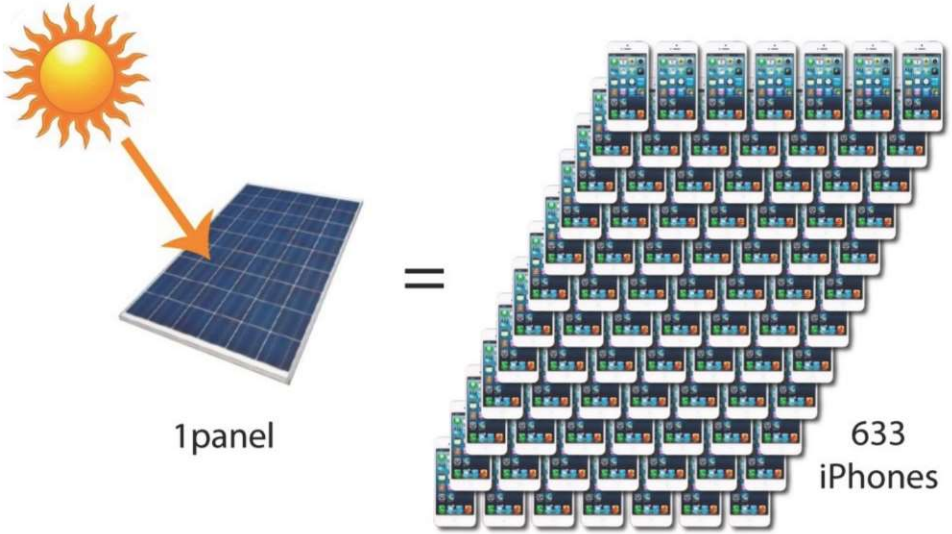


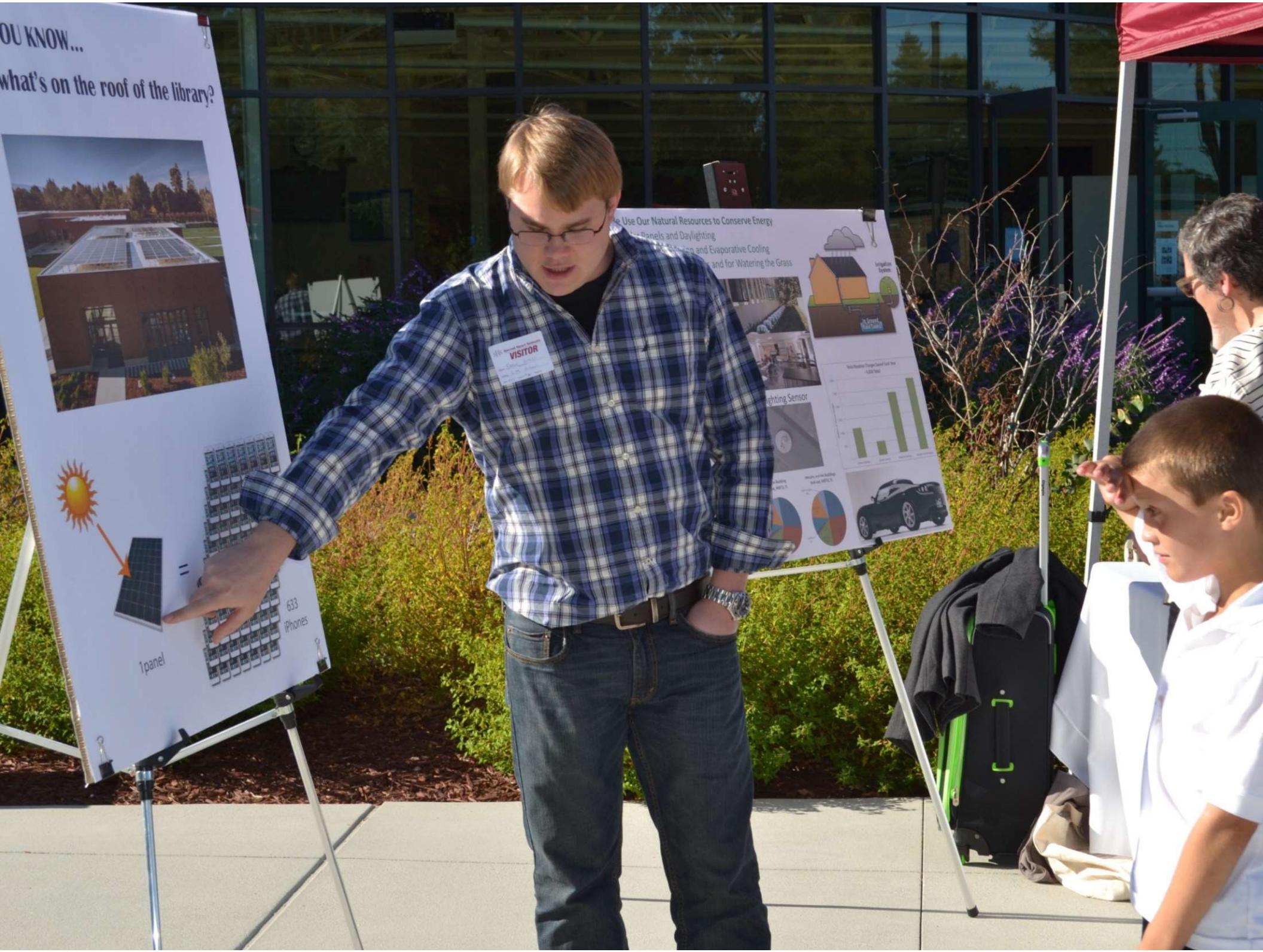




DO YOU KNOW...

...what's on the roof of the library?




OU KNOW...
what's on the roof of the library?
1panel
633
iPhones
VISITOR
Use Our Natural Resources to Conserve Energy
Panels and Daylighting
and Evaporative Cooling
and for Watering the Grass
Irrigation System
At Ground Rain Tanks
ighting Sensor


KNOW...
e the rain goes when it falls?
DO YOU KNOW...
re your counterop is from?


EXIT

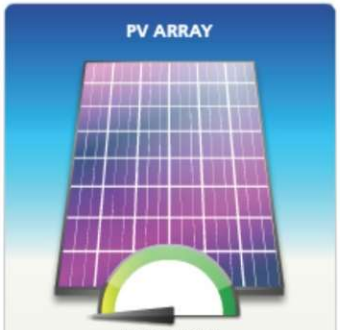
SCHOOL
Sacred Heart

ACADEMIC
Stevens Library

Find buildings

Electricity | Photovoltaic | Water | Rainwater

Homepage | Comparison | PV Array | Green Features



RIGHT NOW:

0 kW

MAX OUTPUT: 0 kW

KILOWATT-HOURS PRODUCED:

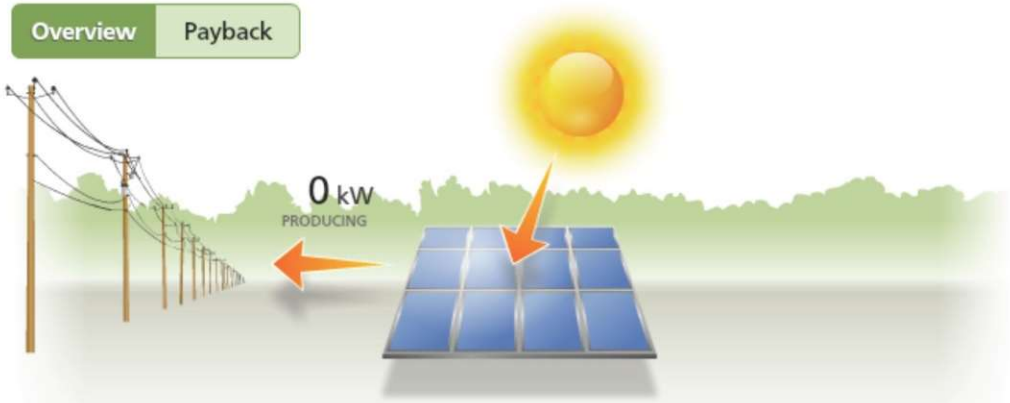
TODAY: 0

THIS MONTH: 1,964

ALL TIME: 28,032

kWh | CO2 | Money

Overview | Payback



Overview

TOTAL SOLAR ENERGY PRODUCED IS EQUIVALENT TO:

1,121,263

Hours of 25-Watt compact fluorescent lightbulb use

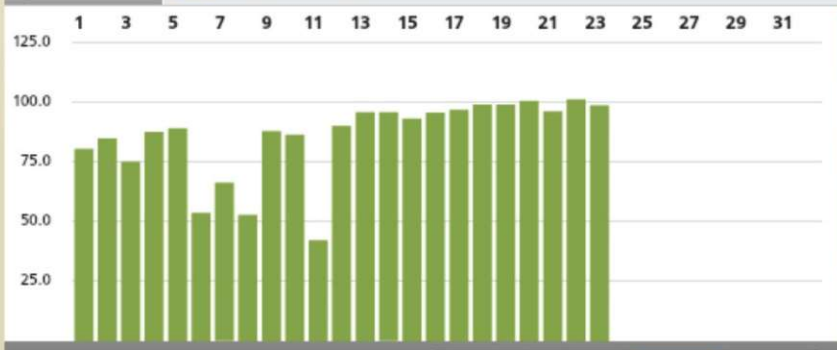
SCHOOL
Sacred Heart

ACADEMIC
Stevens Library

Find buildings

Electricity | Photovoltaic | Water | Rainwater

LAYERS | PV Output Power (kWh)



0.00
Kilowatts

1,963
Kilowatt-hours so far this month

TODAY | WEEK | MONTH | YEAR

kWh

Homepage | Comparison | PV Array | Green Features

PV ARRAY

RIGHT NOW:

0 kW

MAX OUTPUT: 0 kW

KILOWATT-HOURS PRODUCED:

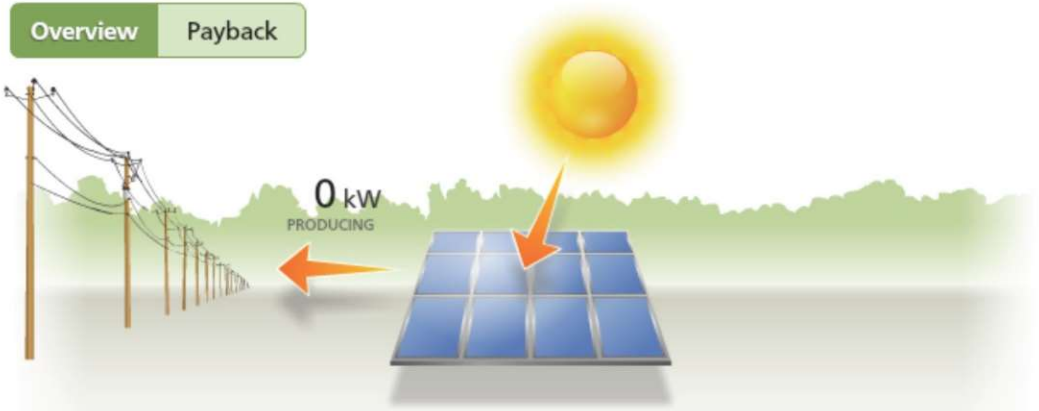
TODAY: 0

THIS MONTH: 1,964

ALL TIME: 28,031

kWh | CO2 | Money

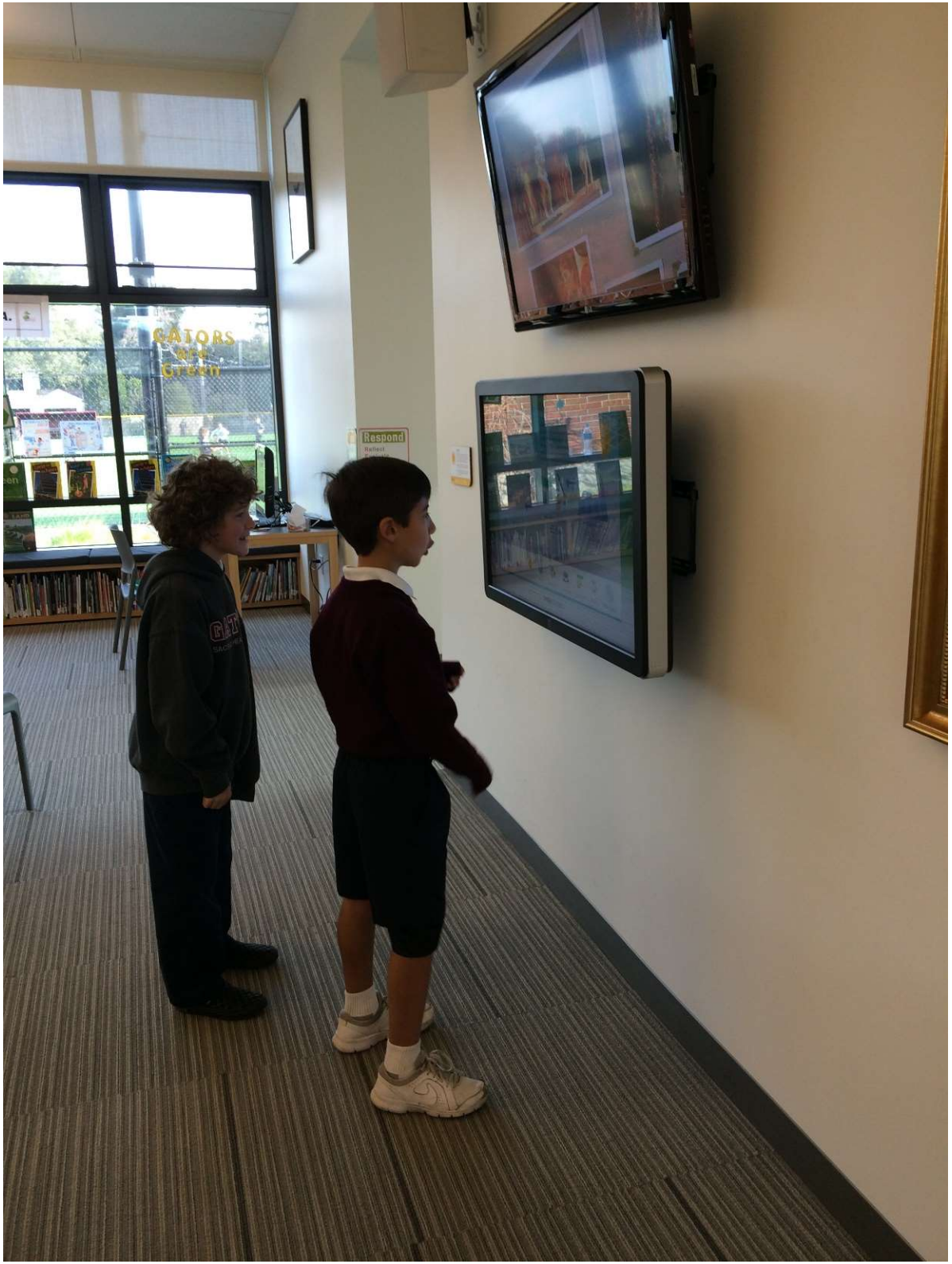
Overview | Payback



Overview

TOTAL SOLAR ENERGY PRODUCED IS EQUIVALENT TO:

1,121,248
Hours of 25-Watt compact fluorescent lightbulb use


GATORS
Respond


EXIT


PROUD to be GREEN.

Lessons Learned AND thoughts

- Use your BOD and OPR as communication tools (your new language) to the team and owner THROUGH EACH PHASE
- BUDGET your energy and water use early. Set targets for project and then each component – backcast to each target
- Talk about SYNERGIES. Discuss comfort modeling as you discuss energy modeling
- RETROCOMMISSION THE USER– every 3 months
- Integrated sustainable elements are TEACHING MOMENTS and inspire the STUDENTS

Questions ?

PAULINE SOUZA
psouza@wrnsstudio.com

Questions & Answers

11:00 – 11:10 a.m.

Developing your ZNE Plan

Introduction, tools and resources

11:10 – 11:30 a.m.

zero net energy

zero net energy

EARLY ADOPTERS NETWORK

TOOLS & RESOURCES FOR

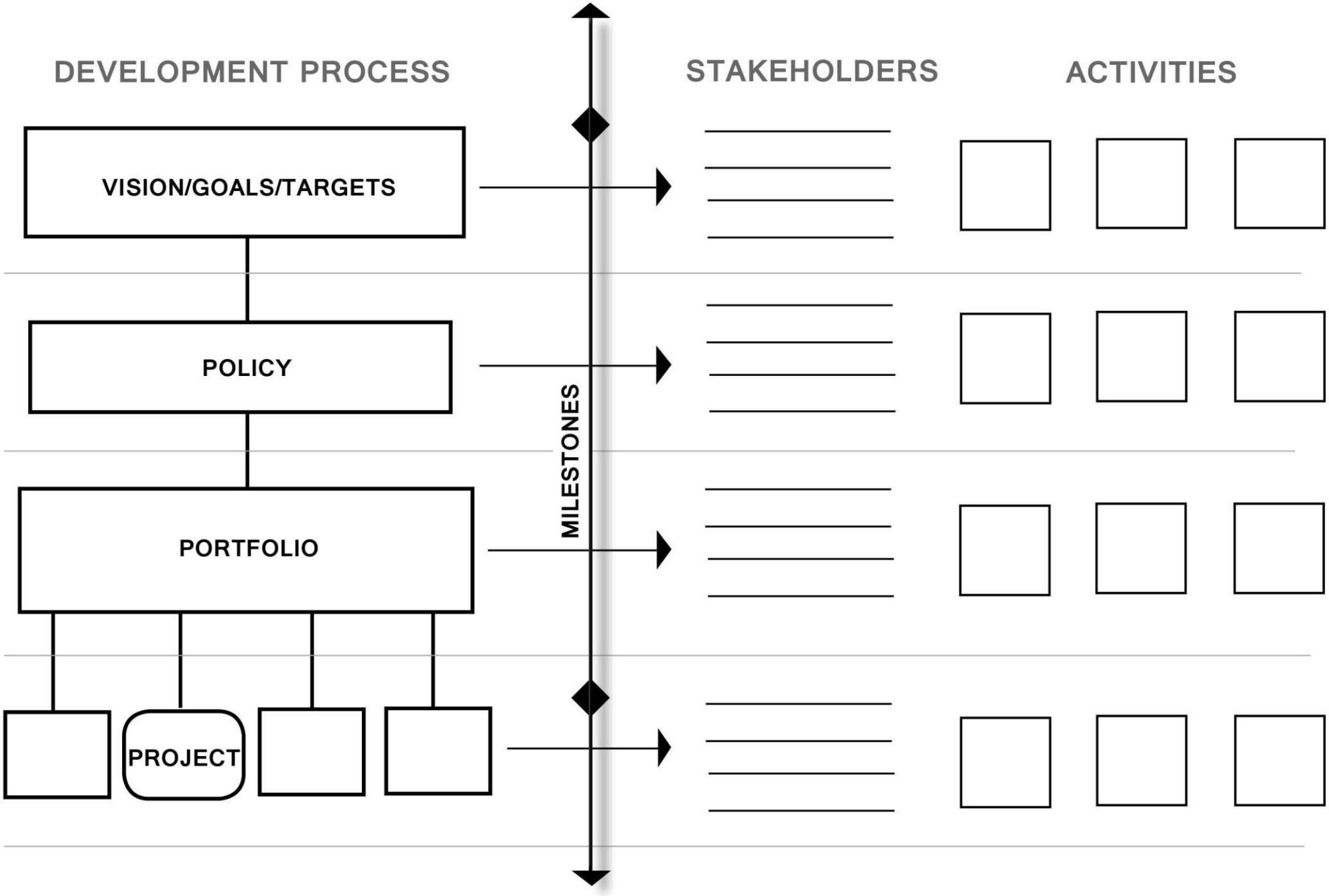
ZNE PLANS

1 Laying the FOUNDATION

2 Orchestrating RESOURCES

3 Developing a ZNE PLAN

BUILDING BLOCKS FOR ZNE PLANNING



ZERO NET ENERGY BUILDINGS
VISION + GOALS + TARGETS

1. Vision: **Articulate your vision for what you would like to create - is it a policy, a single building, a set of buildings or a large portfolio?**

2. Success: **Describe what success would look like, including process**

3. Targets/Milestones: **How do we get there? Think about what key steps will be. How will you know when you have made progress? Note milestones and targets.**

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ZERO NET ENERGY BUILDINGS
BACKCASTING TIMELINE

1 Laying the FOUNDATION

2 Orchestrating RESOURCES

3 Developing a ZNE PLAN

BUILDING SCALE

Begin with the End in Mind

2014 — 1 Year — 2015 — 5 Year — 2017 — 10 Year — 2020 — 2025 — 2030 — ZNE

- *Envelope*
- *HVAC*
- *Lighting*
- *Space Planning*
- *Finance - Strategies + Opportunities*
- *Process - Planning, Contracting, Design*
- *People - Stakeholder Engagement, Education + Outreach*

2015 GOALS	2020 GOALS	2030 GOALS

Assembling the Building Blocks of your ZNE Plan

1. **Set your goals** & milestones (Worksheet)
2. **Backcast** how you will get to ZNE (Worksheet)
3. I**dentify your key stakeholders and communication goals**, then map stakeholder interaction (Worksheet)
4. **Develop your Communication & Outreach Plan**, then engage stakeholders
5. **Conduct a gap analysis** & create a plan for alignment (Worksheets)
6. **Review your current/future building & retrofit plans** for ZNE opportunities and develop criteria for prioritizing

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Assembling the Building Blocks of your ZNE Plan

7. Identify & conduct any **special research/studies** needed
8. **Select a pilot project**
9. **Evaluate available delivery method options** for best likely ZNE result (Worksheet)
10. **Explore alternative financing approaches** to help offset costs
11. **Create RFQ/RFP that sets clear owner requirements and targets for ZNE**
12. Conduct an **integrated design process** and **use proven technologies & design** strategies

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Establishing Your ZNE Target

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Establishing your ZNE Target

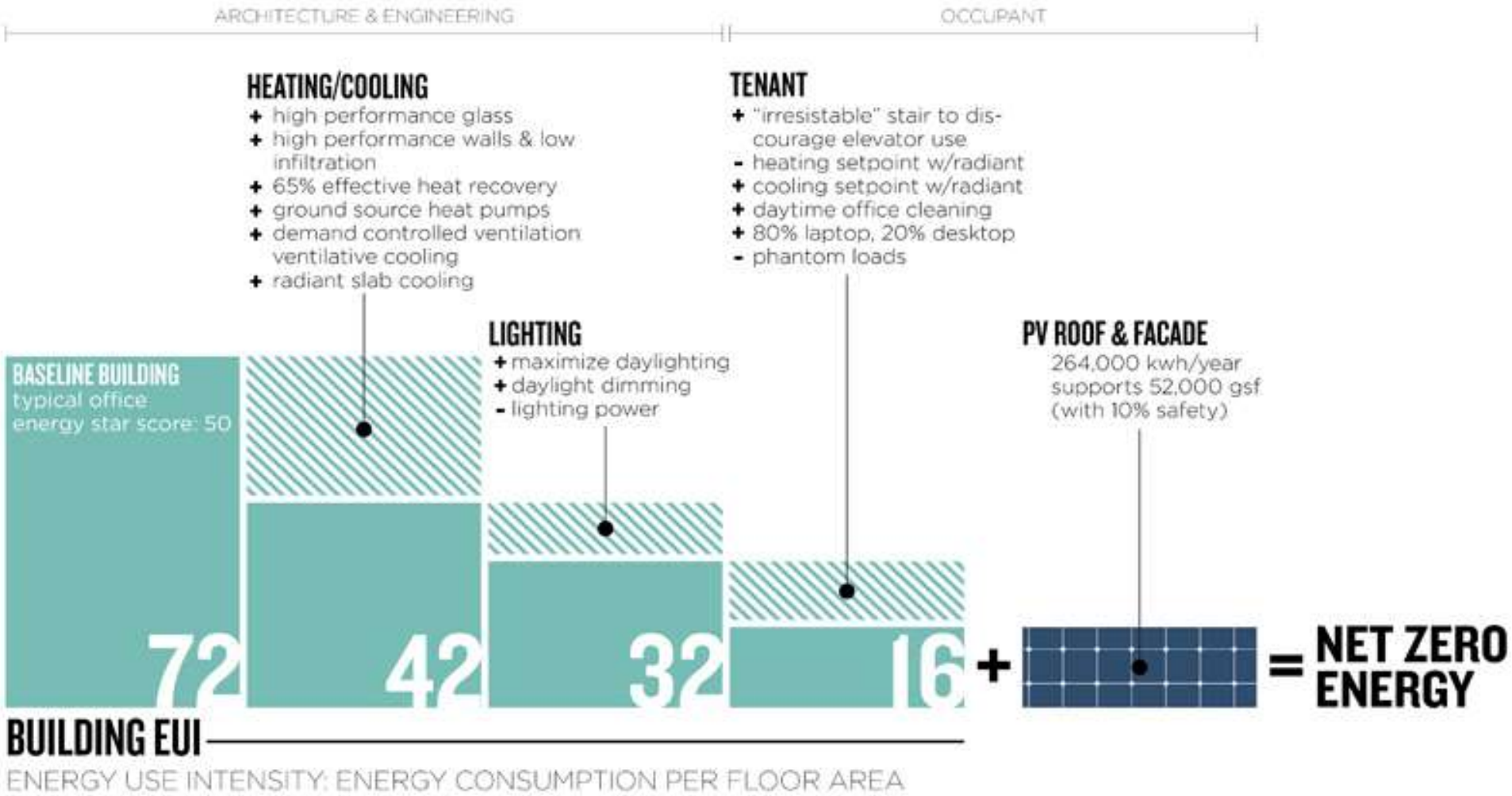
The Energy Loading Order

Two ZNE Building Typologies

Renewable-Oriented	Efficiency-Oriented
Minimally to moderately sensitive to the grid	Highly grid-integrated and responsive
Higher gross energy use	Lower gross energy use
Higher renewable generation	Lower renewable generation
Active Strategies Focus: Mechanical HVAC Systems, Thermal Storage, Night Flush with Fans, Demand Response	**Passive Strategies Focus**: Daylighting, Building Orientation, High Insulation Levels, Passive HVAC, Built-In Shading

Establishing your ZNE Target

Establishing your solar and energy budget



THE PATH TO NET ZERO ENERGY

Establishing your ZNE Target

Defining your EUI Target:

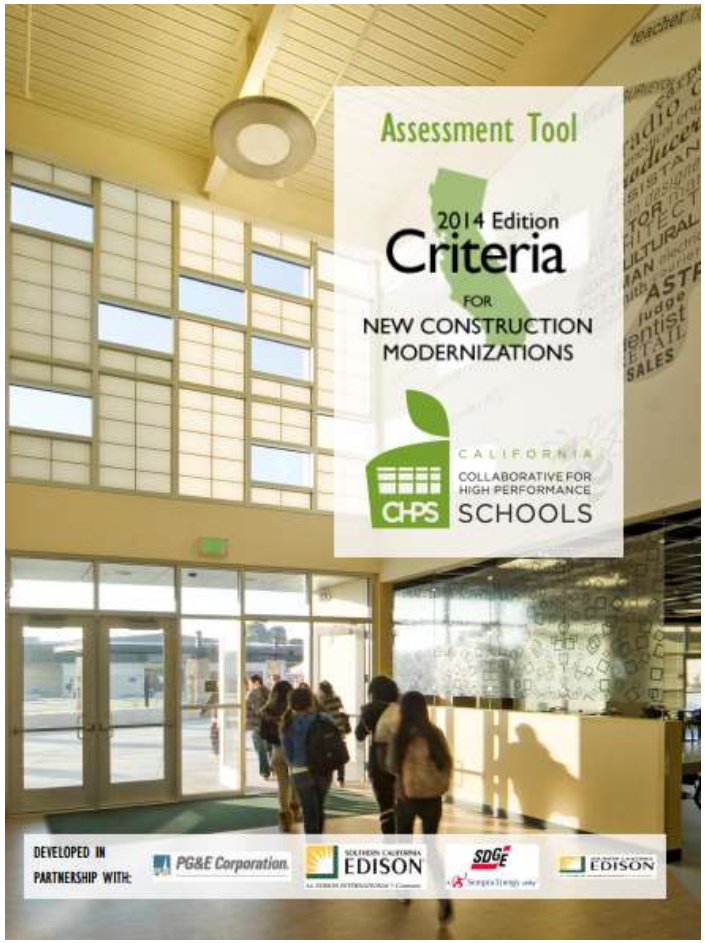
1. Define cost effective EEMs
2. Define your operating schedule compared to annual renewable energy generation
3. Develop iterative energy model (include TDV)
4. Understand PV feasibility
5. Determine solar budget

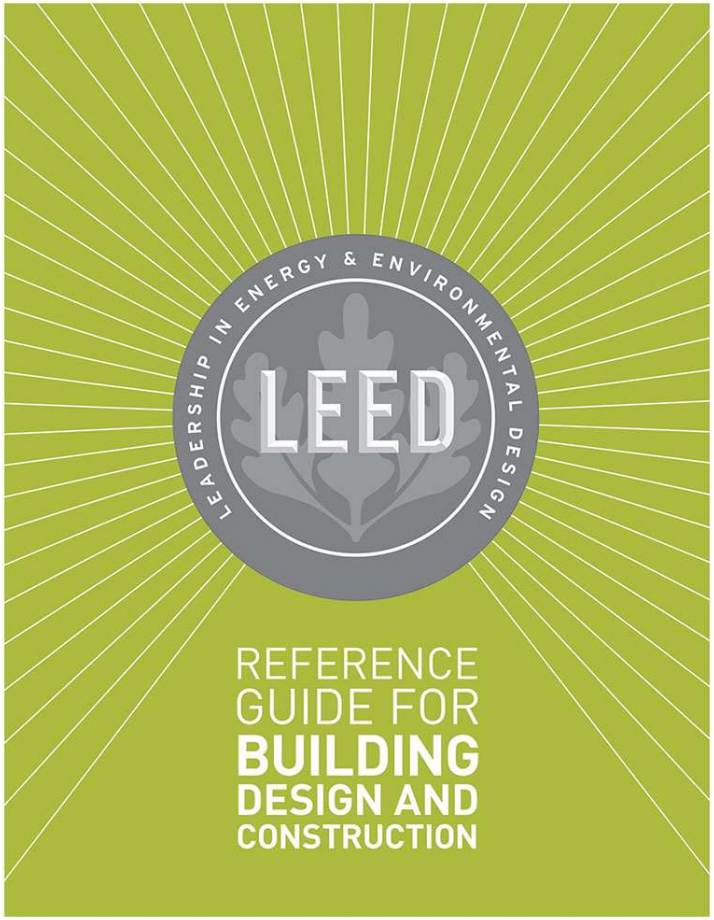
(Example) ZNE Retrofit Energy Efficiency Measures (EEM)

Measure 1: Reduced Building Equipment Energy Use
Strategy 1a. Receptacle Controls
Strategy 1b. Plug Load Management
Strategy 1c. Plug Load Equipment
Measure 2: Heating and Cooling Strategies
Strategy 2a. Dedicated Outdoor Air System (DOAS)
Strategy 2b. HVAC Zone Control
Measure 3: Improved Overall Building Envelope Performance
Strategy 3a. Thermal Load Intensity
Strategy 3b. Air Infiltration Testing
Measure 4: Reduced Lighting Energy
Strategy 4a. Luminaire Level Lighting Control
Strategy 4b. Interior LPDs and Exterior Lighting Efficacies Based on Solid-state Lighting

Establishing your ZNE Target

CHPS, LEED and other green goals





zero net energy

ENERGY

Design Toward Zero Net Energy (ZNE)

- Energy Prerequisite
  - 5% better than Title 24
- Superior Energy Performance
- ZNE Bonus
  - Solar Ready (CALGreen)
  - ZNE Capable
  - ZNE (Innovation)

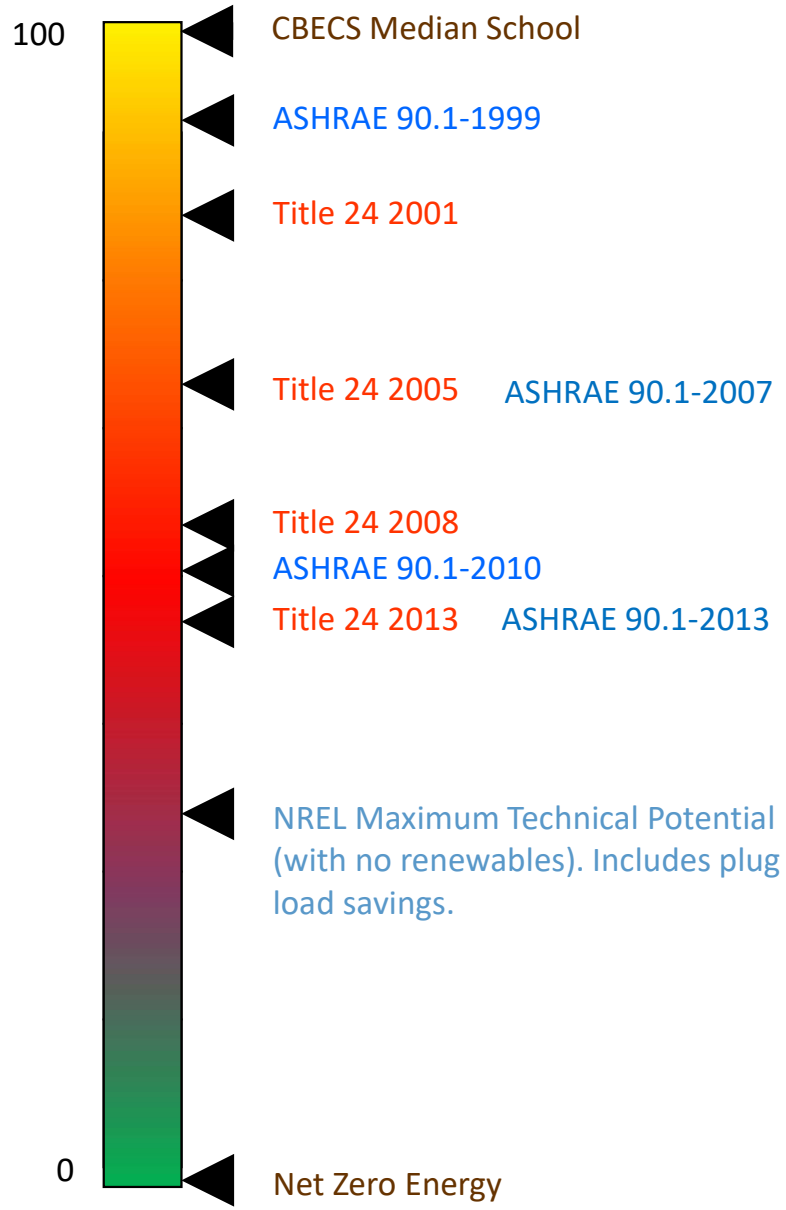
La Escualita Phase I, Oakland, CA

ENERGY

Zero Energy Performance Index "zEPI" Scale

Moving down the scale can be achieved by:

- Code compliance
- More efficient
  - Windows
  - HVAC
  - Lighting
- Integrated design
  - Daylighting
  - Natural ventilation
- Plug load reductions
- Renewables



2014 CA-CHPS POINTS FOR ZNE

- 8 points - Energy Performance Prerequisite
- Up to 40 points - Superior Energy Performance
- 2 points - ZNE Capable
- 4 Innovation points – ZNE

55 possible points for ZNE

- Additional CHPS recognition of ZNE for CHPS Verified Projects

Incorporating ZNE into your Policies & Delivery Process

- *Delivery Models*
- *RFP, RFQs & Contracting*
- *Financing & Fundraising Strategies*
- *Training & Operations*

11:30 – 11:40 a.m.

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Integrating ZNE into your Delivery Method

1 Laying the FOUNDATION
2 Orchestrating RESOURCES
3 Developing a ZNE PLAN

Visioning/Planning

- Engage Stakeholders
- Backcast to ZNE
- Set ZNE goals and milestones
- Map stakeholders
- Develop Communication Plan
- Educate leadership
- Develop training & education plan for planning through -ongoing operation

RFP

- Write contractor requirements and design specs for ZNE
- Consider how integrated design process (IDP) is part of a design firm's regular practice as a proposal evaluation criteria

Design

- Model building performance
- Conduct integrated design process (IDP)
- Set owners project requirements
- Establish basis of design
- Include design requirements to maximizing building performance before integration of

Bid

- Write contractor and construction specifications
- Select contract method – design-bid-build, CMGC, design-build, guaranteed max. price.
- Consider various contract delivery methods will support or hinder an integrated design process – a

Finance

- Choose a lender that values energy performance
- Clearly make valuation argument including benefits of long-terms savings, energy independence, leadership, carbon/climate impacts, marketing, etc.

Build

- Establish quality control mechanism related to energy system calibration, commissioning, and proper installation.

Operate

- Establish actionable feedback loop
- Commissioning/Re-commissioning plan
- Ensure proper handoff of the building includes providing operators and occupants with resources and documentation to operate building including: copy of CD's to building
- Written description of systems and

Educate/Train

- Develop user manual for operators and occupants
- Conduct trainings for operators and users
- Establish training process for new occupants and regular maintenance

Measure/Monitor

- Establish data collection protocols
- Share your data with others
- Provide visible dashboards

Certify/Market/Promote

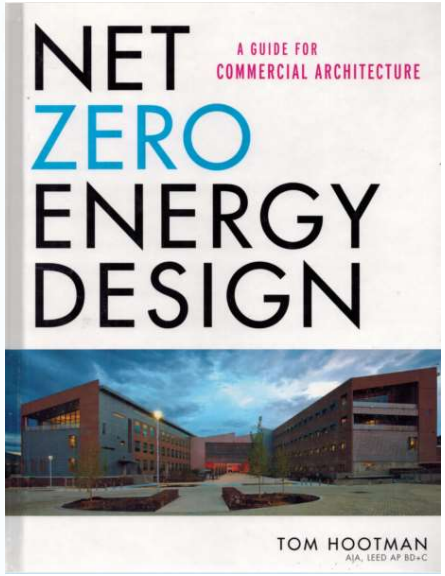
- Verify/certify performance
- Share your data with others
- Tell your story, case studies, news media, websites

nbi new buildings institute

Request for Proposals & Qualifications (RFPs & RFQs)

RFP Guidelines for Net Zero Energy Projects

- Establish net zero energy as one of the key project objectives.
- Set an annual energy use target appropriate for the net zero energy objective.
- Clarify whether or not on-site renewable energy systems will be part of the RFP; in either case, consider how they will be coordinated with building design and construction.
- Provide a well-crafted project definition, one that takes into account the opportunities and challenges of net zero energy.
- If a separate RFQ is not used prior to the RFP, integrate the guidelines for RFQs stated in the previous RFQ section.
- Establish the selection process and delivery method in support of forming a trust-based, integrated delivery team, whose members are aligned with the project objectives.

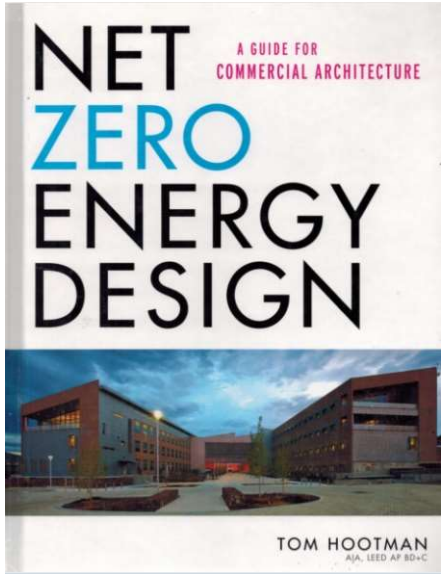


Net Zero Energy Design: Tom Hootman

Budget Guidelines for ZNE

Budget Guidelines for Net Zero Energy Projects

- **Life-cycle value:** Seek long-term, life-cycle value and budget for quality and performance, keeping in mind that net zero energy buildings are all about exemplary energy performance and value.
- **Selection and pricing:** Project team selection and pricing methods used for the project are as important as the budget for overall cost control. (The pros and cons of selection and pricing methods are addressed later in this chapter.)
- **Soft costs:** It is important to budget for additional soft costs, which include the effort and investment in smart design required during the front end of the design phase. Along with the investment in smart design comes the investment in a more rigorous energy modeling process. The additional soft costs also fund participation of all project delivery team members, to ensure an integrated project delivery.
- **Renewable energy:** Consider the cost of renewable energy systems as a separate investment from the construction cost. They can be a sizable investment, but one that virtually buys the future energy for the building up front. In this sense, it is also a financial investment and should be analyzed as such. (Refer to Chapter 9 for more on financial analysis of renewable energy systems.)



Net Zero Energy Design: Tom Hootman

Building to the ZNE Design

Construction delivery methods:

- Design – Bid – Build
- Design – Build
- Guaranteed Maximum Price
- Integrated Project Delivery
- Energy Savings Performance Contract (ESPC)

zero net energy

Design–bid–build

Owner **contracts** with **separate entities for both the design and construction** of a project.

There are three main sequential phases to the design–bid–build delivery method:

- The design phase
- The bidding (or tender) phase
- The construction phase

Design–build

Design and construction services are **contracted by a single entity** known as the design–builder or design–build contractor.

Construction Manager at Risk/Guaranteed Maximum Price

Also known as GMP, Not-To-Exceed Price

A cost-type contract or **open-book contract costs incurred plus a fixed fee subject to a ceiling price**.

The **contractor is responsible for cost overruns**, unless the GMP has been increased via formal change order as a result of added scope by client

zero net energy

Lease-Back

A financial transaction, where one sells an asset and leases it back for the long-term; therefore, one continues to be able to use the asset but no longer owns it.

Integrated Project Delivery (IPD)

Collaborative alliance of people, systems, business structures and practices into a process that harnesses the talents and insights of all participants to optimize project results, increase value to the owner, reduce waste, and maximize efficiency through all phases of design, fabrication, and construction.

There are eight main sequential phases to the integrated project delivery method:

- conceptualization phase [expanded programming]
- criteria design phase [expanded schematic design]
- detailed design phase [expanded design development]
- implementation documents phase [construction documents]
- agency review phase
- buyout phase
- construction phase
- closeout phase
- facilities management

Integrated Project Delivery (IPD)

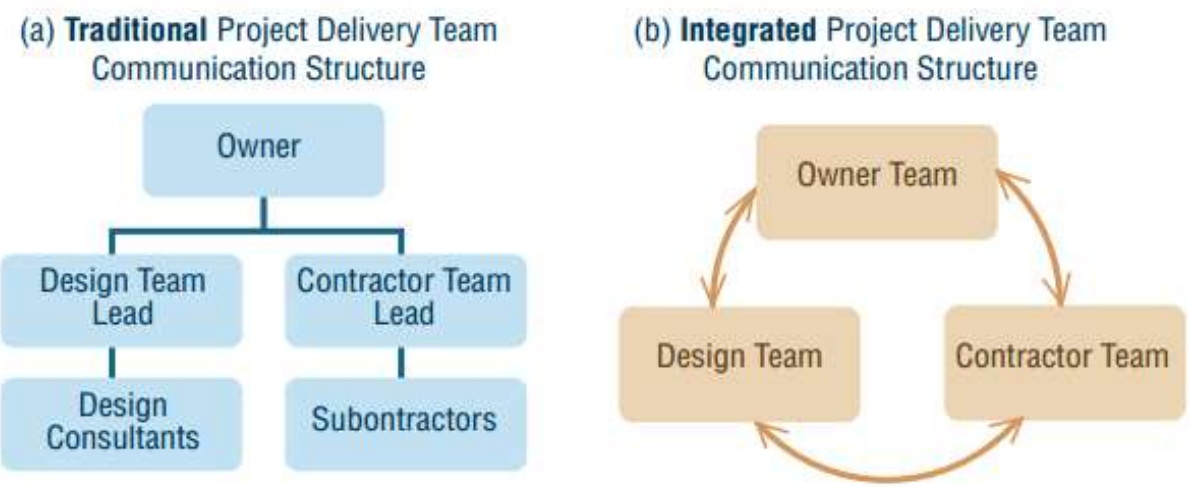
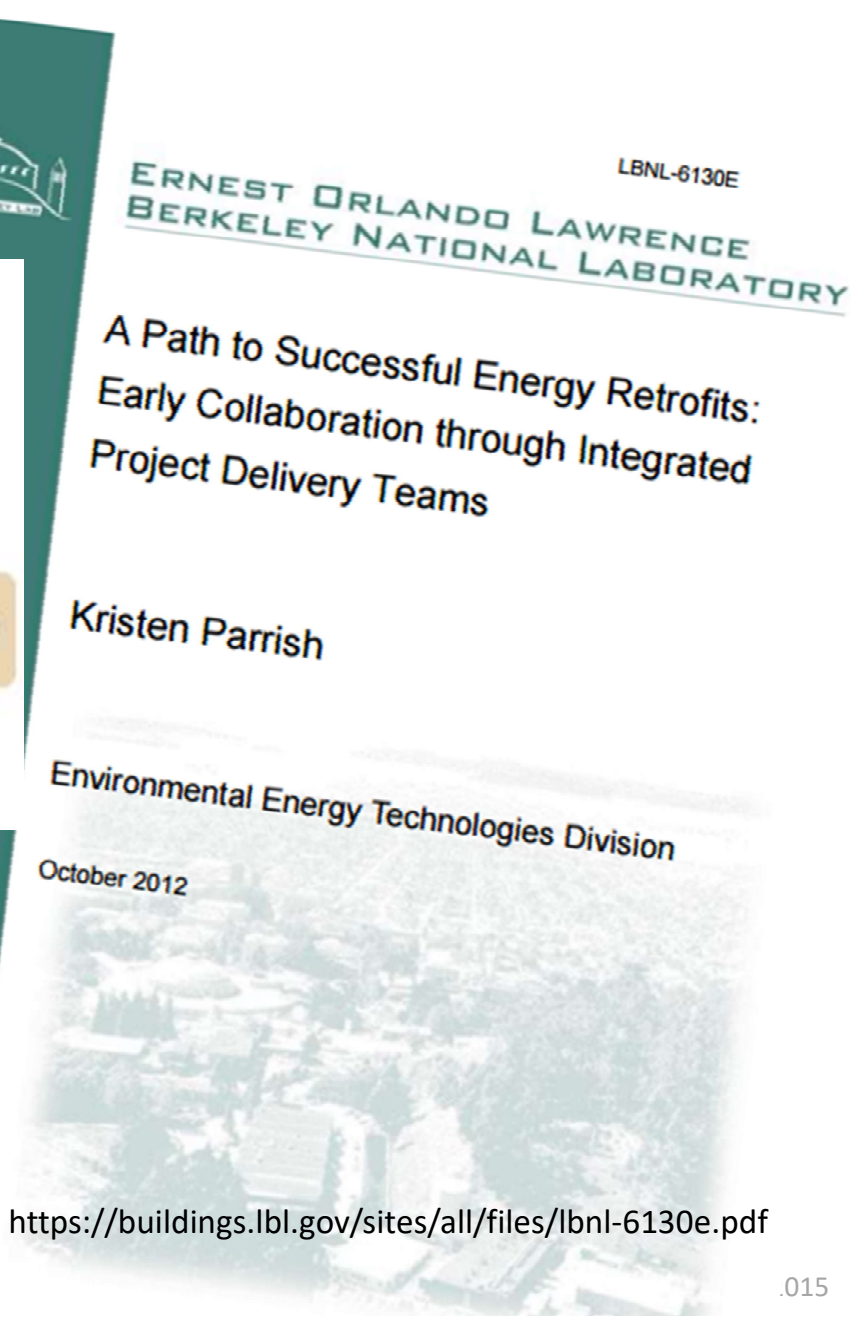


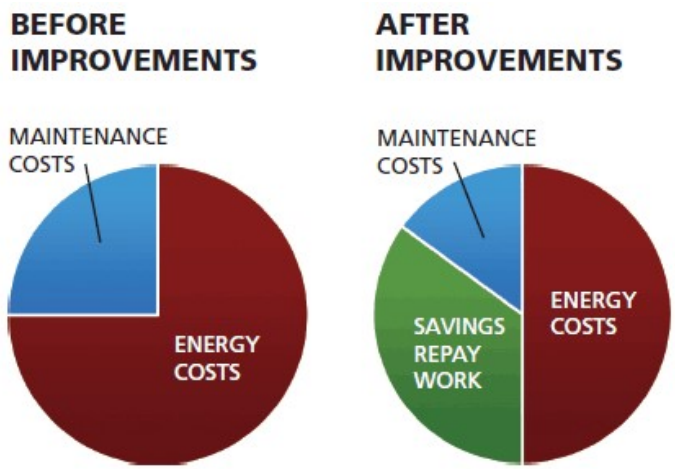
Figure 2: Traditional vs. Integrated Project Team Structure



https://buildings.lbl.gov/sites/all/files/lbnl-6130e.pdf

Energy Savings Performance Contract (ESPC)

- Energy savings performance contracts (ESPCs): Procure energy savings / facility improvements with no up-front capital costs
- An ESPC is a partnership between an owner and an energy service company (ESCO)



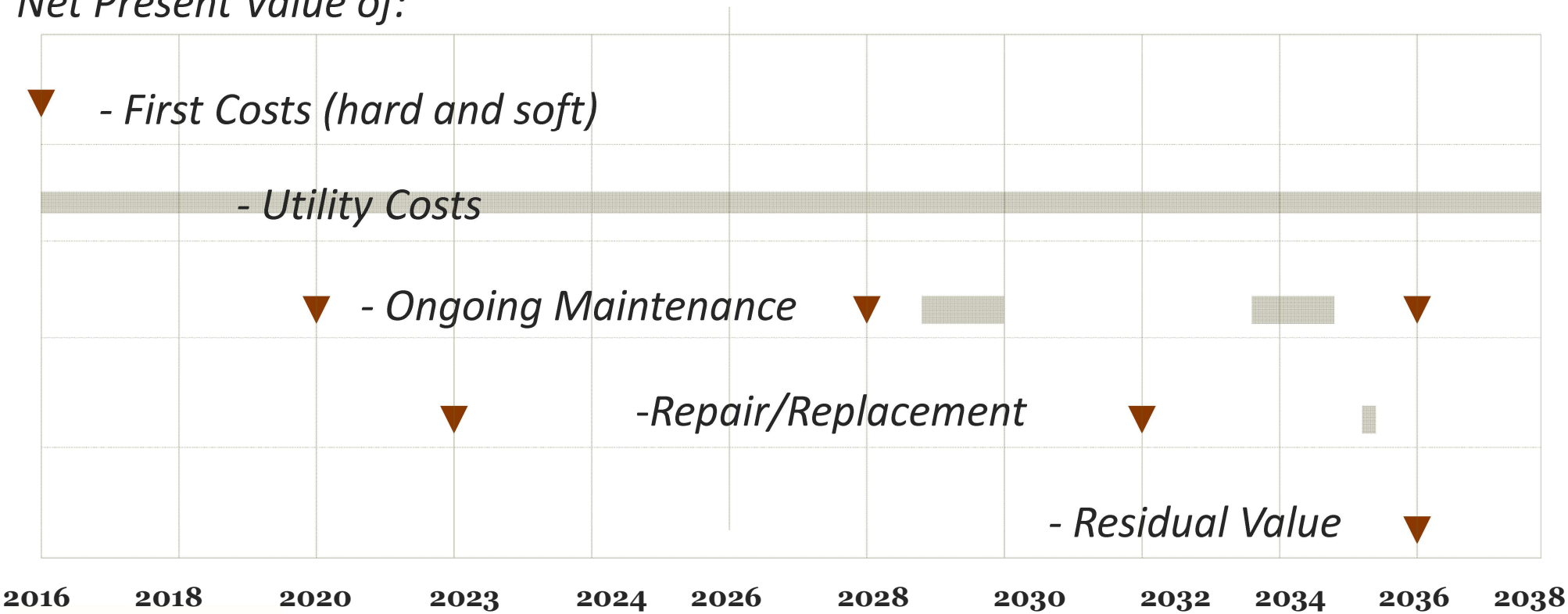
Developing your ZNE Plan & Targeting ZNE

- **Life-Cycle Cost Analysis**
- **Project funding and financing strategies**
- **Budget Guidelines**

Life Cycle Cost Analysis - LCCA

What is the full price of a building?

Life Cycle Cost =
Net Present Value of:



5.1-energy-life-cycle-cost [Compatibility Mode] - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW

Y35

Figure 5.1 ENERGY LIFE CYCLE COST SPREADSHEET

ELCCA2005.xls 18-Apr-16

----------PROJECT DATA----------

PROJECT: Facility Name (Firm Name)

ALT. No.: Description (Analyst's Name)

----------DISCOUNT & ESCALATION Real Rates as of November 2004----------

Enter 1 or 0 for each fuel type:			Years:	Rate:
	1 = Yes	Real Discount Rate (i)	2005 - 2,040	2.0%
	0 = No	Electricity	2005 - 2,015	1.0%
IOU Electricity Source*	1	(Investor Owned Utility)	2,016 - 2,025	2.0%
POU Electricity Source*	0		2,026 - 2,040	2.0%
Natural Gas Fuel?	1	Natural Gas	2005 - 2,015	1.0%
Propane Fuel?	0	And other fossil fuels	2,016 - 2,025	1.0%
Oil Fuel?	0		2,026 - 2,040	1.0%
		Maintenance	2005 - 2,040	2.0%
		Inflation (Nominal , not used)	2005 - 2,040	3.0%

* IOU = Invester Owned Utility

** POU = Publicly Owned Utility

$3,312,896 =30-year LCC

----------ANNUAL REAL CASH FLOWS----------

(Begin) Year	First & Replace. Costs	Annual Maint. Costs	Annual Nat.Gas Costs	Annual Electric Costs	Total Annual Costs	Present Worth Factor (1+i)^-n	Present Worth of Annual Costs	Present Worth of Cumulative Costs
2,005	$200,000	$1,000	$12,000	$100,000	$113,000			
2,005	$200,000	--	--	--	$200,000	1.00	$200,000	$200,000
2,006	0	1,020	12,120	101,000	114,140	0.98	111,902	311,902
2,007	0	1,040	12,241	102,010	115,292	0.96	110,815	422,717

Instructions:

1. C14..C18 plug in 1 if true, 0 if false
   C14 : If electric utility is privately owned enter 1
   C15 : If electric utility is publicly owned (e.g. PUD, municipality, rural electric) enter 1
   C16 : If natural gas escalation factors are desired enter 1
   C17 : If propane fuel is used enter 1
   C18 : If oil fuel is used enter 1
2. A29: Enter first analysis year
3. B29: Estimated construction cost would be the differential cost between the subject systems. (Including overhead & profit, tax, design fees, etc.) (If this was the least cost baseline system, the construction cost would be zero.)
4. C29: "Annual Maint Cost" includes boiler water and cooling tower water treatment, air filter changes, lubrication, spot replacement of lamps and ballasts, luminaire cleaning, boiler tune up, condenser cleaning, controls calibration, and other routine maintenance. e.g. 2% of lighting system construction cost.
5. D29: "Annual Gas Costs" (or other heating fuel). Apply current utility rate structure to monthly consumption from the building computer model. Enter first year dollar total in this cell.

http://des.wa.gov/services/facilities/Energy/ELCCA/Pages/default.aspx

Fundraising & Financing Strategies

1. **Utility Program Support -** Savings By Design
2. **Pilot Research Program**
3. **Technology Demonstrations**
4. **Use an Upgradable Design Strategy** (e.g. Redding School for the Arts)
5. **External Grant Funding**
6. **District Approach to Energy** (FortZED)
7. **Solar Financing District** (e.g PACE)
8. **Prop 39 funding for schools**

Fundraising & Financing Strategies

9. **Prototypical Design for replication of standard buildings** (Campbell School District's 8 new schools)
10. **Reduction of operation costs = increased capital project budgets**
11. **Power purchase agreements** (PPAs)
12. **Energy Service Companies** (ESCo)
13. **Emerging Tech programs** through utilities
14. **Urban development tools** (if they are in local government redevelopment area)
15. **FEMA or hazard mitigation financing** for resiliency planning and critical building upgrades

zero net energy

"The prevailing industry perception is that zero energy is cost prohibitive and suitable only for showcase projects with atypical, large budgets; however, ***there is mounting evidence that zero energy can, in many cases, be achieved within typical construction budgets****."*

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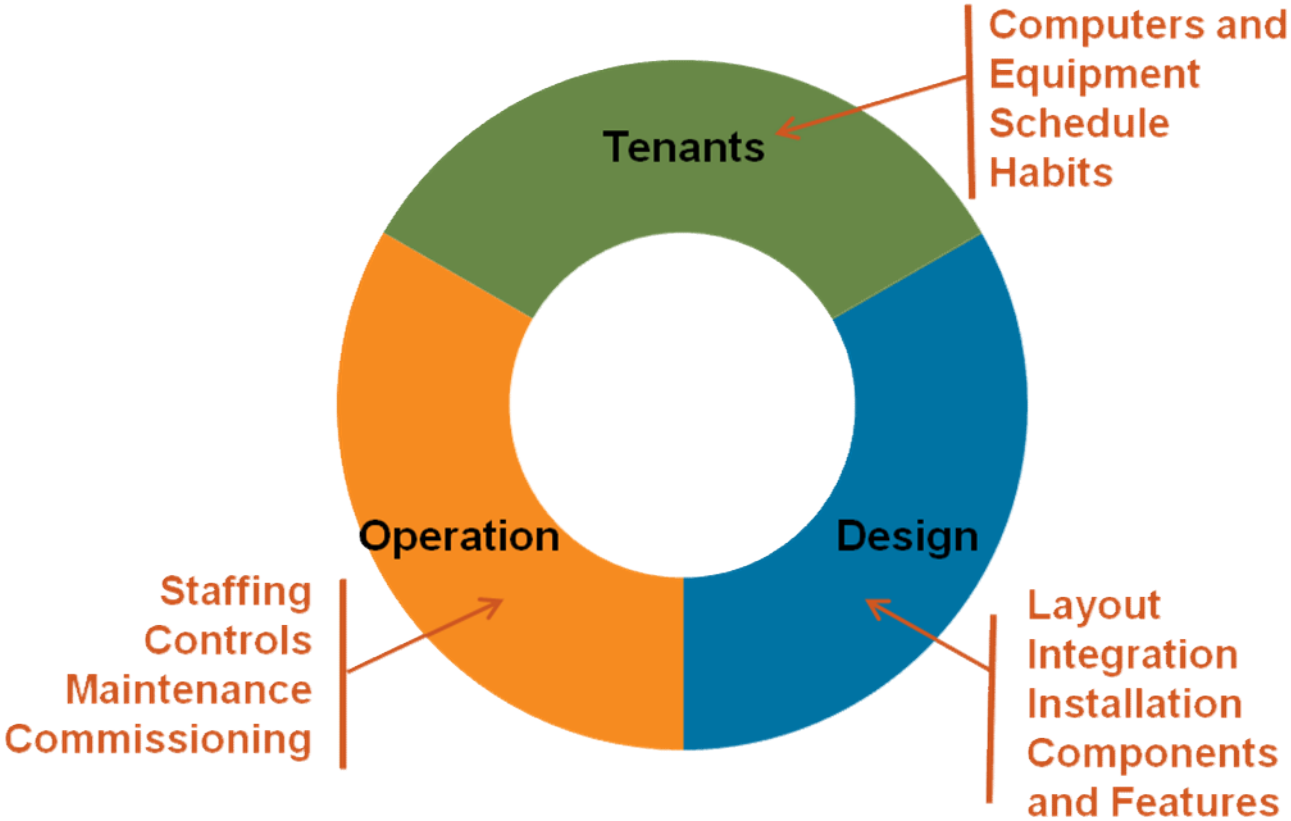
www.nrel.gov/docs/fy14osti/62752.pdf

Building Operation: Post Construction

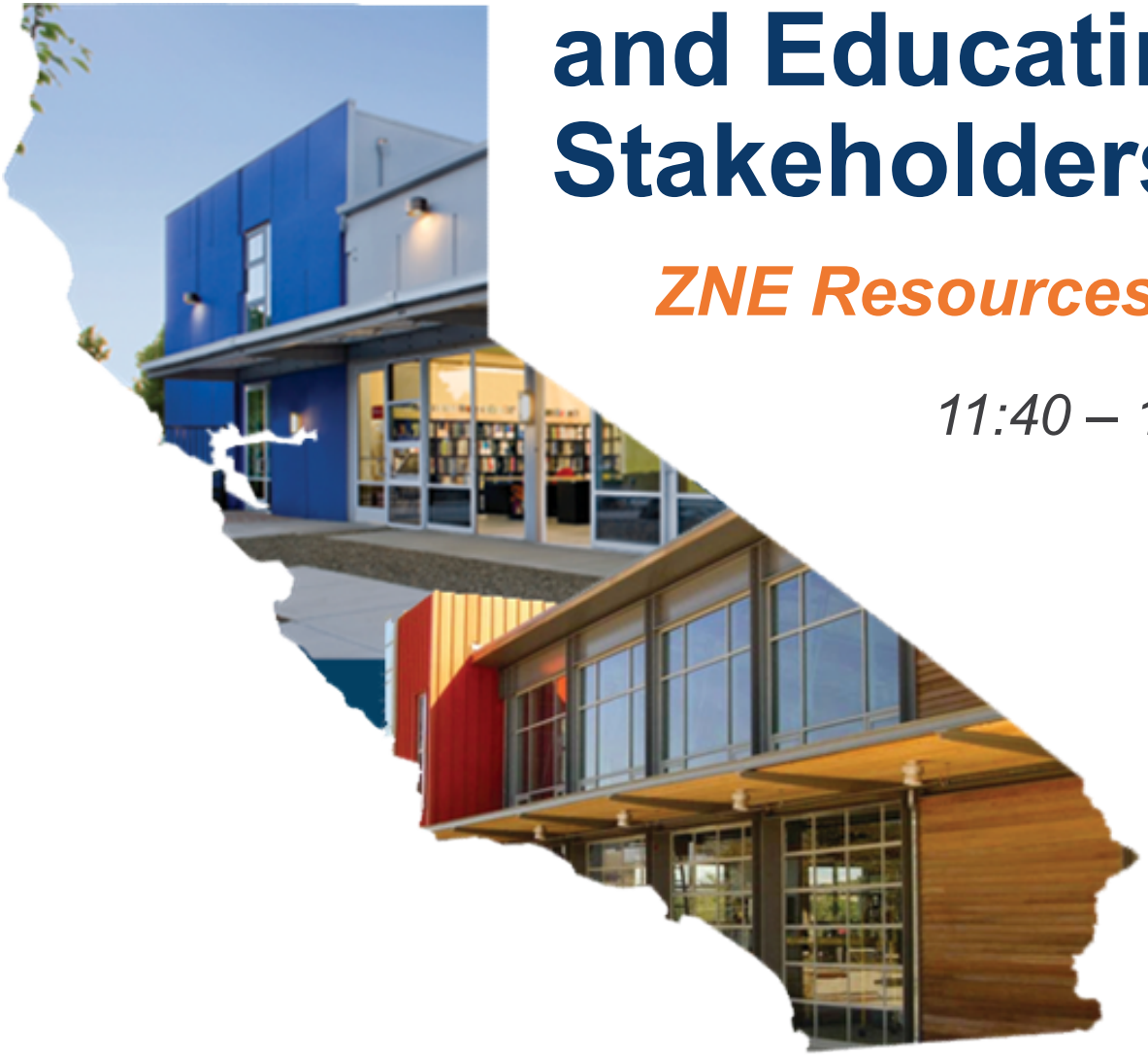


Operating to the ZNE Target: Taking ZNE Design to ZNE Reality

Initiation and training to start building operation on the right track:

- Owner Orientation
- Operator Training
- Metering and Feedback Plan
- Equipment Purchase Standards for Fit-out
- Occupant Training
- Maintenance Plan

Resources for Engaging and Educating Stakeholders



ZNE Resources & Tools

11:40 – 11:50 a.m.

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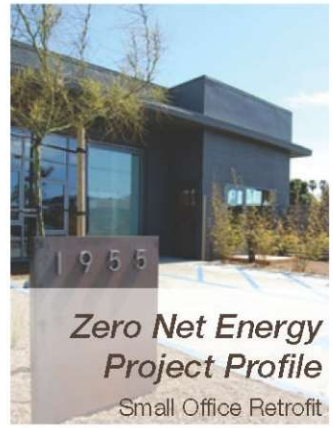
ZNE Early Adopters Leadership Network

Support for Schools, Local Governments, Higher Ed & State Agencies

https://www.linkedin.com/groups/5166071

ZNE & Ultra-Low Energy Case Studies

- CPUC Case Study Briefs & NBI ZNE Case Studies http://newbuildings.org/case-studies-zne-projects
- PG&E Case Studies http://energydesignresources.com/resources/publications/case-studies/case-studies-zne-non-residential-buildings.aspx
- NBI Registry http://newbuildings.org/share
- Getting to Zero Database http://newbuildings.org/getting-to-zero-buildings-database



Photos: ARCHITECTS hannah gabriel wells

OVERVIEW

Site Details

Building Size: 4,500 SF

Location: San Diego, California

Construction Type: Retrofit

Construction Year: 1955, 2009

Building Type: Small Office

CA Climate Zone: 7

Measured Energy Stats

13 - 22 = -9

BUILDING'S TOTAL EUI | RENEWABLE PRODUCTION EUI | BUILDING'S NET EUI

Site Energy Use Index (EUI) kBtu/SF/year

The Energy Equation: **the building energy use** *minus* **the renewables production** *equals* **the net energy of the building.** Buildings may be 'Getting to Zero' and have a net EUI

BACON STREET OFFICES

The Bacon Street Office project is a 4,500 SF retrofit of a single-story, 1950's-era auto repair shop into a high performance office for the firm ARCHITECTS hannah gabriel wells. Through creative design strategies, renewable energy generation and with support from local utilities, including the Savings by Design program, the project has achieved zero net energy goals. In fact, this project is so energy efficient it returns power to the grid.

Planning & Design Approach

The project demonstrates the difference between typical projects and ZNE projects. The following steps were critical to success:

- Start early and use an integrated design process
- Outline goals and benefits
- Structure fees to provide more research and design iterations
- Stay flexible and inclusive with the design process

Energy Efficiency Strategies and Features

Daylighting: A wall of windows along the public street side of the building provides daylight and views of a new landscaped parking court with native vegetation and canopy trees. This light is balanced with toplighting from diffuse skylights at the back of the space. Illuminating walls, ceilings and balancing

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- ZNE Project Profiles
- News & Events
- Policy & Planning Updates
- Upcoming Training & Education
- New Research
- Low Energy Building Innovations

Email heather@newbuildings.org to sign up

5 GREAT NEW TOOLS FOR ZNE BUILDINGS

1 ZNE Message Platform

Key messages for target audiences on the what and why of ZNE.

2 "Intro to ZNE" Presentation

Customizable powerpoint presentation provides an overview of California's goals and policies for ZNE, key strategies, and case study examples.

3 ZNE Companion Guide/Fact Sheets

Collection of FAQs, resources, design strategies, and key messages for designers, commercial building owners, policymakers, and decisionmakers of schools and public buildings.

4 Case Studies: ZNE & Ultra-Low Energy Buildings

Read about ZNE and ultra-low energy building examples, including design strategies, costs, and lessons learned.

5 ZNE Action Bulletin

Sign up for our quarterly e-newsletter for updates on ZNE news, events, trainings, case studies, planning, policy, and research. To sign up, or to get more info about the toolkit, email heather@newbuilding.org.

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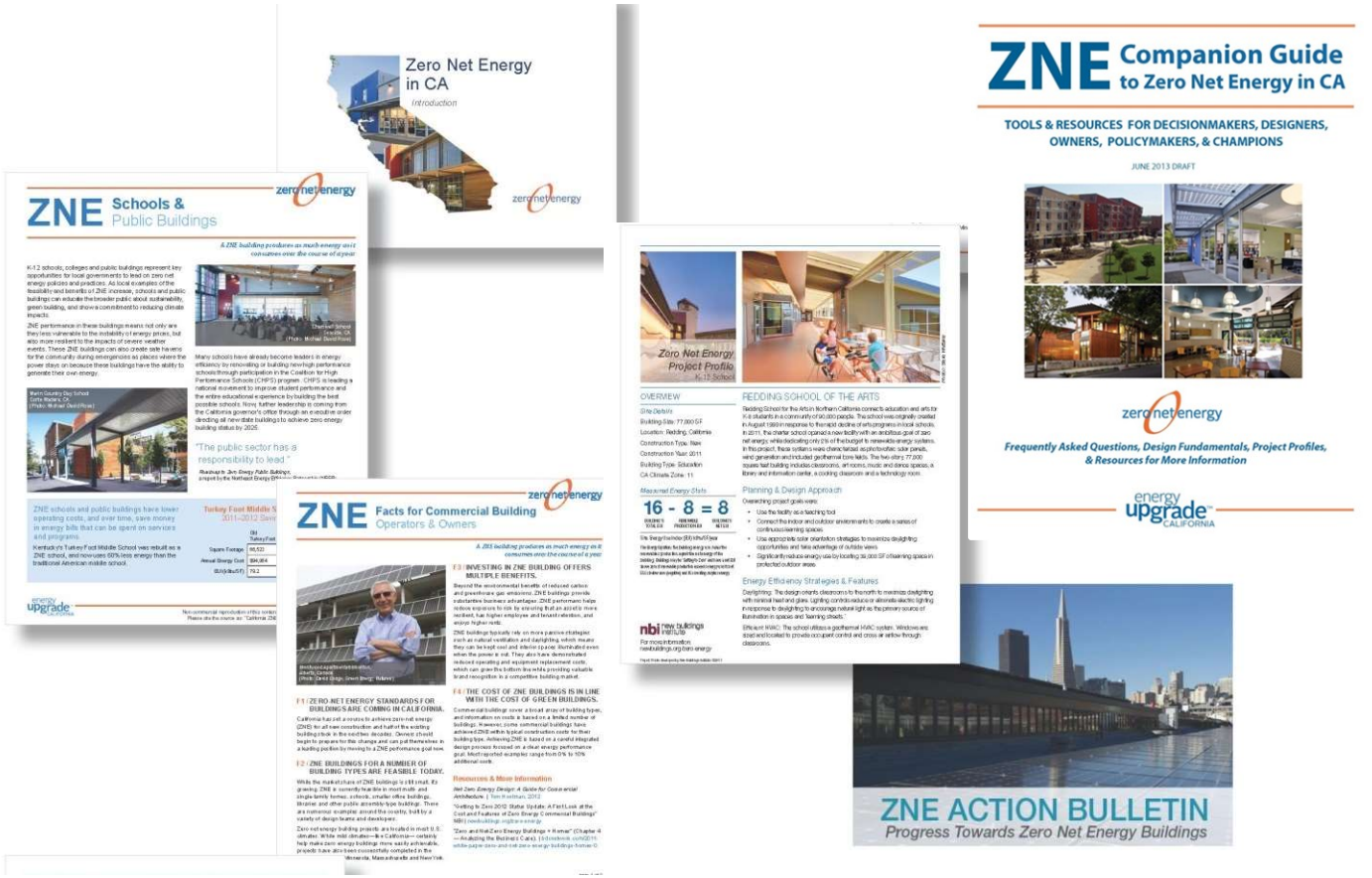
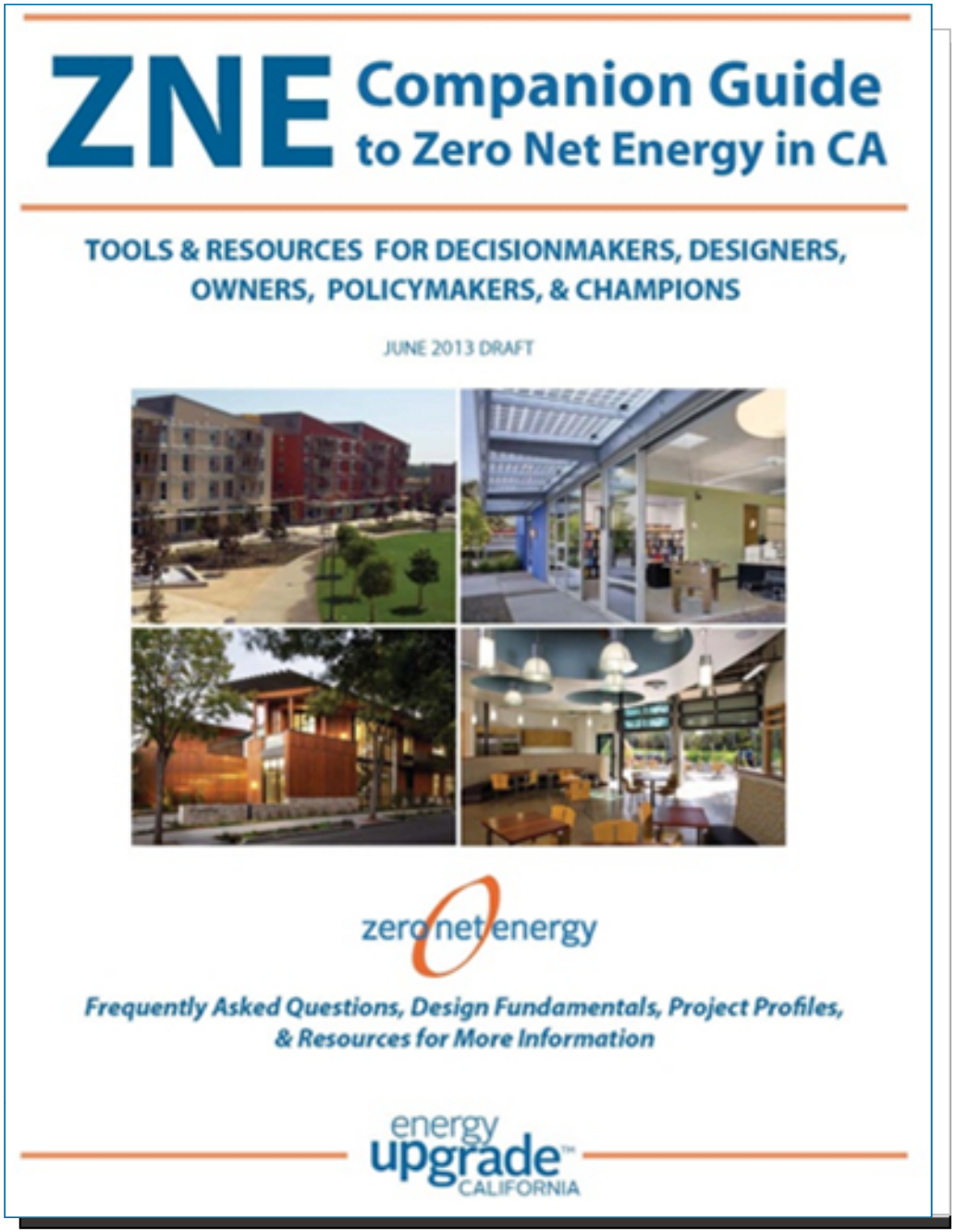
ZNE Communications Toolkit



www.newbuildings.org/zne-communications-toolkit

Fact Sheets/ZNE Companion Guide

- Policymakers
- Decisionmakers of Schools & Public Buildings
- Architecture & Engineering
- Commercial Owners
- FAQ's


ZNE Companion Guide to Zero Net Energy in CA

TOOLS & RESOURCES FOR DECISIONMAKERS, DESIGNERS, OWNERS, POLICYMAKERS, & CHAMPIONS

JUNE 2013 DRAFT

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Frequently Asked Questions, Design Fundamentals, Project Profiles, & Resources for More Information

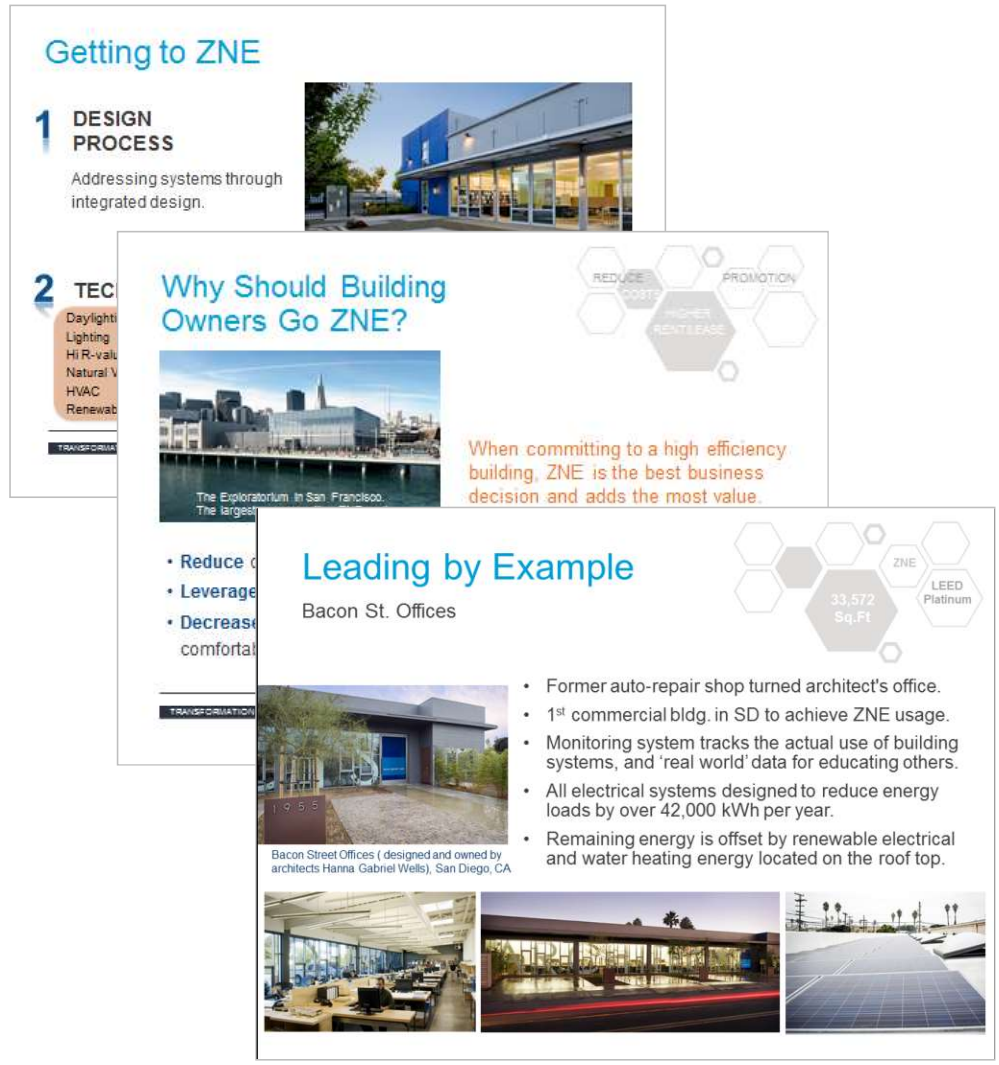
energy upgrade CALIFORNIA

ZNE Presentation Templates

- Primarily commercial
- Carries general messages
- CA Goals for ZNE
- ZNE building examples
- Open source platform! Slide collection will grow as champions and others develop their own ZNE presentations

Users of the Presentation:

- Champions & Early Adopters
- Utilities
- Communications staff



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Ways to Share ZNE

- ✓ Train key staff on ZNE Toolkit and other resources
- ✓ Incorporate Toolkit content into presentations
- ✓ Reuse content for ZNE stories in newsletters and other communications vehicles/announcements
- ✓ Offer materials to stakeholders and members to disseminate
- ✓ Share the ZNE factsheets & case studies as handouts in personal meetings and at events
  - Sample content and details: www.newbuildings.org/zne-communications-toolkit

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Key Takeaways

Getting Started Today: Planning for ZNE

1. Develop your ZNE Plan
2. Create the supporting policy
3. Get & Use the ZNE Communication Tools & Planning Workbook
4. Build capacity through education, collaboration, and convening

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PHOTO: SF PUC, Low Energy Building, San Francisco

Getting Started Today: ZNE Implementation

Set ZNE Goals & Targets

- Engage leadership to adopt a formal policy for ZNE

Assess Existing Performance & Future Capital Projects for Opportunities

- Find opportunities when making major retrofits to get to ZNE in new construction or when significant system or structural upgrades are made

Change Procurement Policies/Requirements

- Amend contract RFP/RFQ Requirements for ZNE performance goals and priorities: for contractors, performance targets, required specifications, documentation and persistence

Engage Stakeholders on ZNE Design & Operations

- Internal staff – faculty, administration, facilities and maintenance need increased operations training– much of ZNE happens downstream
- leadership and public facing staff, especially communication and media
- Students – living classroom for experiential, scientific and climate studies, energy competitions, STEAM programs, etc.

Getting Started Today: Getting ZNE to Scale

Pilot A ZNE building/classroom project

- **New Capital improvement projects** - Look at pipeline of coming up needed
- **Assess existing building stock** to find opportunities & making major retrofits to get to ZNE when significant system or structural upgrades are made

Campus wide ZNE Approach – OUSD high school, Hi-tech High School in Chula Vista

ZNE District or Portfolio-wide Approach – Campbell School District targeting 8 ZNE schools (some taking DMV's approach to skip the pilots and do all ZNE now)

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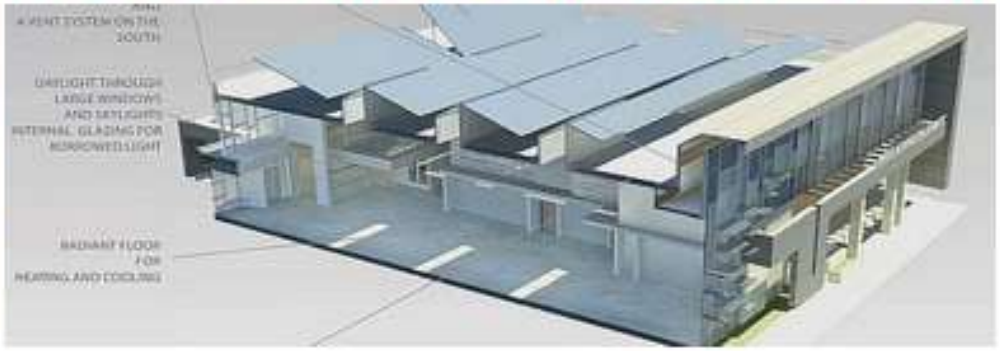
George V. Leyva Middle School Administration Building

*"The **business case** for making the building net zero energy is that it will not just lower our energy bill, but it also will allow us to **put those savings straight back to the top line** of our operations budget for **maintaining programs for kids**." – Assistant Superintendent Kathy Gomez*

nbi new buildings institute

Energy Design Resources is funded by California utility customers under the auspices of the California Public Utilities Commission.

Prop 39 Zero Net Energy Schools - Pilot Program



Proposition 39, the California Clean Energy Jobs Act of 2012 (Prop 39), provides up to $550 million per year to improve energy efficiency and increase the use of clean energy in public schools and community colleges.

The Prop 39 ZNE Schools Pilot will assist schools in retrofitting existing facilities to ZNE by leveraging Prop 39 funding. The Pilot will establish "proof of concept" that ZNE retrofits of schools is feasible across California. The utilities are targeting approximately 13-18 projects in 13-18 school districts or community colleges for the Pilot.

Interested K-12 public school districts and community colleges were invited to respond to the **Opportunity Announcement** posted to this website prior to **May 22nd 2015**. Interested schools are encouraged to revisit this website for updates.

Prop 39 ZNE School Retrofit Workshops

Sort by: Most recent

October 9, 2015 — 0 comments

★★★★☆

A zero net energy (ZNE) building generates as much energy as it consumes annually. With energy bills at California's schools totaling more than $700 million a year, innovative energy solutions for schools like ZNE buildings are being proposed as a way to save energy and put money back into classrooms

Follow EDR on

EDR California — 9 Oct
@edrcalifornia
To help #schools make #ZeroNetEnergy retrofits @SCE @PGE4Me and other CA #utilities offer no-cost #prop39 workshops energydesignresources.com/zneworkshops

Related EDR Resources

Updated - Opportunity Announcement: Prop 39 ZNE Schools Pilot

Phase I Screening Questionnaire: Prop 39 ZNE Schools Pilot

Other Resources

The inclusion of links does not imply endorsement by EDR of any other site, or its contents, or any association with any of its operators.

Advanced Energy Design Guide - Schools: 50% over 90.1-2004
ASHRAE (with AIA/IES/USGBC/DOE)

For K-12 elementary, middle, and high school buildings, with a wide variety of heating and air-conditioning requirements. Options for daylighting, an important

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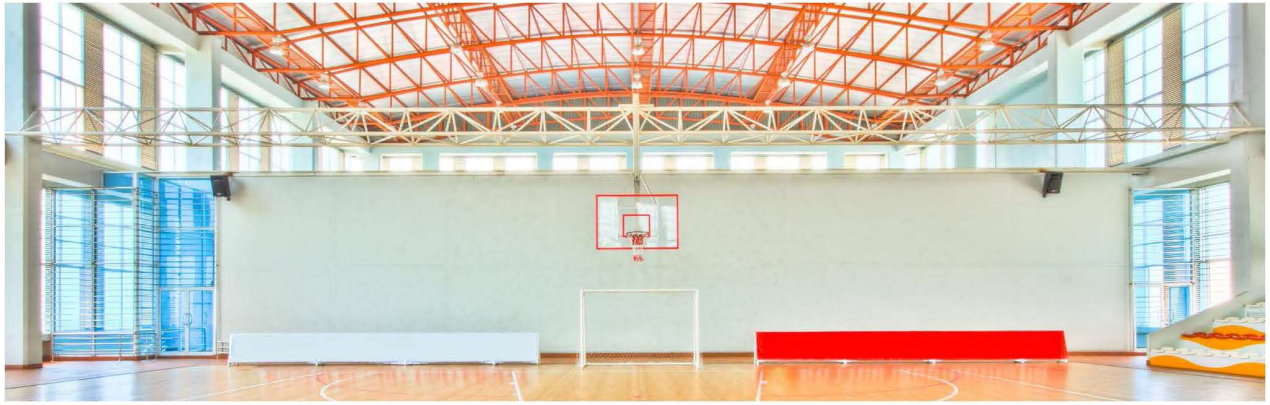
ZERO NET ENERGY SCHOOL RETROFIT WORKSHOPS

Brought you by the Investor-Owned Utilities & Prop. 39 Zero Net Energy Pilot



To help schools achieve successful ZNE retrofits, we're offering the following upcoming no-cost ZNE workshops:

ZNE Technical Training for School & Building Industry Professionals

9:00 am-3:00 pm **May 9, San Diego** | SDG&E Energy Innovation Center
Followed by a tour to Solana Ranch Elementary School, separate registration required.

9:00 am-3:00 pm **June 1, Oakland** | AIA East Bay Offices
Followed by a tour to West Berkeley Library, separate registration required.

9:30 am-4:00 pm **June 17, Newport** | Orange Coast College
A mid-day tour of Orange Coast College included in Workshop registration.

ZNE & the School Community for Administrators and Stakeholders

10:00 am-12:00 pm **April 27, Webinar format,** will also be available on-demand

9:00 am-12:00 pm **May 10, San Diego** | SDG&E Energy Innovation Center
Registrants are invited to join the Solana Ranch Elementary School tour May 9 at 3 pm, separate registration required.

9:00 am-12:00 pm **June 30, Fullerton** | Cal State Fullerton

A zero net energy (ZNE) building generates as much energy as it consumes annually. With energy bills at California's schools totaling more than $700 million a year*, innovative energy solutions for schools like ZNE buildings are being proposed as a way to save energy and put money back into classrooms.

A number of upcoming, no-cost interactive workshops are being offered to explain how California's K-12 schools and community colleges can achieve ZNE through whole-building retrofits.

These workshops are part of an investor-owned utility (IOU) pilot program aimed at leveraging Proposition 39 dollars to test how some of the state's existing K-12 and community college buildings can be transformed into ZNE facilities.

Full-day technical sessions will focus on best practices in design and operations. Half-day school community workshops will cover design approaches, planning and financing.

School administrators, operations managers, business officers, construction managers, community stakeholders, building designers, operations staff and others interested in ZNE are invited to attend. Space is limited, so please register and reserve your spot today at energydesignresources.com/zneworkshops.

* Statistic from the CEC Consumer Energy Center
http://www.consumerenergycenter.org/tips/schools.html

This program is funded by California utility customers and administered by California's investor-owned utilities under the auspices of the California Public Utilities Commission.

energydesignresources

Register or learn more at energydesignresources.com/zneworkshops

GETTING TO zero NATIONAL FORUM 2016

Save the Date

October 12-14, 2016 | Denver, CO

gettingtozeroforum.org/

nbi new buildings institute

Questions & Answers

11:50 a.m. – 12:00 p.m.

Prop 39 ZNE School Retrofit Webinar

Thank you!

For more information, contact:

Ralph DiNola, ralph@newbuildings.org
Heather Flint Chatto, heather@newbuildings.org

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