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

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
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.
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

Development of Training Materials & Presentations

ZNE Schools Recognition Program Support (2016)
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.
“Big Bold” Goals for ZNE in California

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
# Foundational State Policies

<table>
<thead>
<tr>
<th>Policy</th>
<th>Details</th>
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<tbody>
<tr>
<td>AB 32</td>
<td>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.</td>
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<tr>
<td>Energy Efficiency Program for Existing Buildings (2009)</td>
<td></td>
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<td>AB 758</td>
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<tr>
<td>Long Term Energy Efficiency Strategic Plan (2008)</td>
<td>State’s first integrated framework—a single roadmap to achieve maximum energy savings across all major groups and sectors.</td>
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</table>
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.
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**
Time Dependent Value of Energy

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

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

2015 List of Zero Energy Buildings

In 2011 and 2013 NBRI conducted research to identify buildings with tangible or actual outcomes of net zero energy. These researches were published as "ZNE Status Report" by NBRI in early 2011 and 2014. NBRI continues to track and document buildings with low and net zero energy to support the market policy interest in this data. This 2015 list of buildings is an expansion of the ongoing data.

Verified Zero Energy Buildings 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 (electricity, natural gas, steam, etc) is measured and offset. Buildings not on the list are in bold italic.

Verified Zero Energy Buildings

<table>
<thead>
<tr>
<th>State</th>
<th>County</th>
<th>City</th>
<th>Building Name</th>
<th>Type</th>
<th>Source</th>
<th>Energy Use</th>
<th>Net Zero</th>
<th>ZNE Emerging and/or Verified Buildings</th>
</tr>
</thead>
</table>

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

*States with Reach Code Adopted or in Development*
Zero Net Energy Buildings
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
Ownership Type

- Public: 67%
- Private: 26%
- Non-profits: 7%
Existing Building Renovation

- Renovations: 24%
- New Construction: 76%
Performance Range (all projects w/ measured performance data)

National CBEECS average for Commercial Buildings

n=95

Avg. EUI 21
Performance Range - Education

Measured EUIs of Educational Buildings

Average for all verified Education buildings: 24.5 EUI

Zero Net Energy
Richardsville Elementary School

Efficiency Measures:
- Ground source heat pump
- DOAS
- CO2 sensors
- Daylighting
- High performance lighting system with controls
- EMS & Energy Dashboard
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
California ZNE Watchlist

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 (19) as ZNE or emerging (34) toward that target.

The CA ZNE Watchlist tracks commercial buildings (including multi-family) based on information gathered by the 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 our other available ZNE resources, 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.

### ZNE and Ultra Low Energy Buildings by Size

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<thead>
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<th>Size</th>
<th>Total</th>
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### ZNE and Ultra Low Energy Buildings by Type

- Office
- Educational
- Commercial
- Residential
- Mixed Use
- Cultural
- Other

For more resources: [ZNE](http://www.ces.ca.gov/149/149.0/Energy-Efficiency/Zero-Net-Energy-Buildings.html) and NBI [www.newbuildings.org/zne-energy]

nbi new buildings institute

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California Leads in ZNE Schools

### ZNE School Buildings - Top Three States

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<th>State</th>
<th>Verified</th>
<th>Emerging</th>
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<td>North Carolina</td>
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<tr>
<td>Oregon</td>
<td>1</td>
<td>5</td>
<td>6</td>
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</table>

**All North America**: 12 Verified, 65 Emerging, 77 Total

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Number of Buildings and projects (225)

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

States with Peak Code Adopted or in Development
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
- $460/ft^2$
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
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 Yunuff, Freddy Medina, Andy Moo, Mike Edman, Joe Garcia, Mindy Nugent, Greg Whittonone, 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.
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
New library inserted between two existing wings uses existing developed site and existing building fabric.

**Georgina Blach Intermediate School**

**PEOPLE, POLICY & PROCESS**
- Pilot project for the Collaborative for High Performance Schools (CHPS)
- Early adoption of high efficiency goals
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
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%**
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)
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
- 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.
An evolving desire for a higher sustainable agenda

- Interested client with inspiring mission statement
- Amazingly creative design team –
- Wonderful program
- An **evolving** desire for a higher sustainable agenda
- Designed within the cost **budget**
educate children to become exceptional leaders
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
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
Rainwater flows through planters and paving
Greywater is reused for landscape and toilet flushing
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

Lower & Middle School - Site Plan

October 8, 2010
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
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
Excerpt from Zero Net Energy Case Study Buildings book under PGE Pilot project - Ed Dean
PV predicted at 50832 kWh
PV measured 56,811 kWh

Production vs Consumption

PV Production
Measured Energy Consumption

KWh

January February March April May June July August September October November December
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. |

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<th>Mechanical</th>
<th>Measured</th>
<th>Modeled</th>
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<td>903.0</td>
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<td>Aug</td>
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<td>955.0</td>
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<td>Sep</td>
<td>486.5</td>
<td>903.0</td>
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<td>Oct</td>
<td>626.0</td>
<td>955.0</td>
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<tr>
<td>Nov</td>
<td>519.63</td>
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</table>
highs & lows

Better tracking
Constant communication
envelope
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
Stevens Library at Sacred Heart Schools
Modeled Annual Energy Use

- Heating: 14%
- DHW: 19%
- Ventilation: 5%
- Lighting: 37%
- Plug Load: 21%
- Cooling: 4%

Modeled Energy Use
50 MWhr per Year
Modeled EUI = 27.0

37% predicted
4% actual
Approximately 8000 kWh difference

Stevens Library at Sacred Heart Schools
Measured Annual Energy Use

- Heating: 33%
- Ventilation: 22%
- Gray/Rain Water System Pumps: 10%
- Plug Load: 20%
- Lighting: 4%
- Cooling: 11%

Measured Energy Use
31.1 MWhr per Year
Actual EUI = 16.9
People and comfort
modeling site and plugs

Equest 3.64
ZNE Technical Training for School & Building Industry Professionals

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

**EUI of 16.1 or 13.2 including greywater**

<table>
<thead>
<tr>
<th></th>
<th>Fans</th>
<th>Heating</th>
<th>Cooling</th>
<th>Lighting</th>
<th>DHW</th>
<th>Gray/Rain Water System</th>
<th>Misc/Plug</th>
<th>Total Use</th>
<th>PV Generation</th>
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<td><strong>2013 Total</strong></td>
<td><strong>6887</strong></td>
<td><strong>10351</strong></td>
<td><strong>3290</strong></td>
<td><strong>1264</strong></td>
<td><strong>84</strong></td>
<td><strong>2939</strong></td>
<td><strong>6279</strong></td>
<td><strong>31094</strong></td>
<td><strong>53730</strong></td>
</tr>
</tbody>
</table>
Stevens Library at Sacred Heart Schools
Modeled Annual Energy Use

- Heating 14%
- DHW 19%
- Ventilation 5%
- Plug Load 21%
- Lighting 37%
- Cooling 4%

Modeled Energy Use
50 MWhr per Year
Modeled EUI = 27.0

Stevens Library at Sacred Heart Schools
Measured Annual Energy Use

- Gray/Rain Water System Pumps 10%
- Heating 33%
- Ventilation 22%
- Cooling 11%
- Plug Load 20%
- Lighting 4%
- DHW 0%

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 56811 kWh
Demand measured 24394 kWh

Production vs Consumption

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

Excerpt from Zero Net Energy Case Study Buildings book - Ed Dean
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
DO YOU KNOW...
...where the rain goes when it falls?

DO YOU KNOW...
...what’s on the roof of the library?

1 panel = 633 iPhones
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.
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

DEVELOPMENT PROCESS

VISION/GOALS/TARGETS

POLICY

PORTFOLIO

STAKEHOLDERS

ACTIVITIES

MILESTONES

PROJECT
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.
ZERO NET ENERGY BUILDINGS
BACKCASTING TIMELINE

Begin with the End in Mind

- Envelope
- HVAC
- Lighting
- Space Planning

- Finance - Strategies + Opportunities
- Process - Planning, Contracting, Design
- People - Stakeholder Engagement, Education + Outreach

2014 - 1 Year
2015 - 1 Year
2017 - 5 Year
2020 - 10 Year
2025
2030

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. **Identify 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
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**
Establishing Your ZNE Target
Establishing your ZNE Target

The Energy Loading Order
# Two ZNE Building Typologies

<table>
<thead>
<tr>
<th>Renewable-Oriented</th>
<th>Efficiency-Oriented</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimally to moderately sensitive to the grid</td>
<td>Highly grid-integrated and responsive</td>
</tr>
<tr>
<td>Higher gross energy use</td>
<td>Lower gross energy use</td>
</tr>
<tr>
<td>Higher renewable generation</td>
<td>Lower renewable generation</td>
</tr>
</tbody>
</table>

**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)

<table>
<thead>
<tr>
<th>Measure 1: Reduced Building Equipment Energy Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategy 1a. Receptacle Controls</td>
</tr>
<tr>
<td>Strategy 1b. Plug Load Management</td>
</tr>
<tr>
<td>Strategy 1c. Plug Load Equipment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measure 2: Heating and Cooling Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategy 2a. Dedicated Outdoor Air System (DOAS)</td>
</tr>
<tr>
<td>Strategy 2b. HVAC Zone Control</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measure 3: Improved Overall Building Envelope Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategy 3a. Thermal Load Intensity</td>
</tr>
<tr>
<td>Strategy 3b. Air Infiltration Testing</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measure 4: Reduced Lighting Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategy 4a. Luminaire Level Lighting Control</td>
</tr>
<tr>
<td>Strategy 4b. Interior LPDs and Exterior Lighting Efficacies Based on Solid-state Lighting</td>
</tr>
</tbody>
</table>

2016 Prop 39 ZNE School Retrofit Webinar
Establishing your ZNE Target

CHPS, LEED and other green goals
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
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

CBECS Median School
ASHRAE 90.1-1999
Title 24 2001
Title 24 2005 ASHRAE 90.1-2007
Title 24 2008 ASHRAE 90.1-2010
Title 24 2013 ASHRAE 90.1-2013
NREL Maximum Technical Potential (with no renewables). Includes plug load savings.
Net Zero Energy
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.
Integrating ZNE into your Delivery Method

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

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

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

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

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

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

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.
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 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.)
Building to the ZNE Design

Construction delivery methods:
• Design – Bid – Build
• Design – Build
• Guaranteed Maximum Price
• Integrated Project Delivery
• Energy Savings Performance Contract (ESPC)
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.
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)

(a) Traditional Project Delivery Team Communication Structure

Owner

Design Team Lead

Contractor Team Lead

Design Consultants

Subcontractors

(b) Integrated Project Delivery Team Communication Structure

Owner Team

Design Team

Contractor Team

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:

- First Costs (hard and soft)

- Utility Costs

- Ongoing Maintenance

- Repair/Replacement

- Residual Value
## Figure 5.1 ENERGY LIFE CYCLE COST SPREADSHEET

### PROJECT DATA

<table>
<thead>
<tr>
<th>Facility Name</th>
<th>Name</th>
<th>Analyst’s Name</th>
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</thead>
<tbody>
<tr>
<td>ELCCA2005</td>
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### DISCOUNT & ESCALATION

Real Rates as of November 2004

<table>
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<tr>
<th>Enter 1 or 0 for each fuel type</th>
<th>Years</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 = Yes</td>
<td>2005–2040</td>
<td>2.0%</td>
</tr>
<tr>
<td>0 = No</td>
<td>2005–2015</td>
<td>1.0%</td>
</tr>
</tbody>
</table>

| IOU Electricity Source*       | 2005–2015 | 2.0% |
| POU Electricity Source*       | 2005–2040 | 2.0% |

| Natural Gas Fuel?             | 2005–2040 | 2.0% |
| Propane Fuel?                 | 2005–2040 | 2.0% |
| Oil Fuel?                     | 2005–2040 | 2.0% |

| Maintenance                   | 2005–2040 | 2.0% |
| Inflation (Nominal, not used) | 2005–2040 | 3.0% |

* IOU = Investor Owned Utility
** POU = Publicly Owned Utility

### ANNUAL REAL CASH FLOWS

<table>
<thead>
<tr>
<th>Year</th>
<th>First &amp; Replace. Costs</th>
<th>Annual Maint. Costs</th>
<th>Annual Nat.Gas Costs</th>
<th>Annual Electric Costs</th>
<th>Total Annual Costs</th>
<th>Present Worth Factor (1–r)^n</th>
<th>Present Worth of Annual Costs</th>
<th>Present Worth of Cumulative Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,005</td>
<td>$208,000</td>
<td>$1,000</td>
<td>$12,000</td>
<td>$100,000</td>
<td>$113,000</td>
<td>6.28</td>
<td>628</td>
<td>649</td>
</tr>
<tr>
<td>2,006</td>
<td>$208,000</td>
<td>1.020</td>
<td>12,120</td>
<td>101,000</td>
<td>112,120</td>
<td>6.28</td>
<td>628</td>
<td>649</td>
</tr>
<tr>
<td>2,007</td>
<td>$208,000</td>
<td>1.040</td>
<td>12,240</td>
<td>102,010</td>
<td>113,250</td>
<td>6.28</td>
<td>628</td>
<td>649</td>
</tr>
</tbody>
</table>

Total Present Worth of Cumulative Cost: $3,312,896 = 30-year LCC

### Instructions:

1. C14. If electric utility is privately owned enter 1
2. A29: Enter first analysis year
3. B29: Estimated construction cost would be the differential cost between the subject systems.
4. C29: "Annual Maint Cost" includes boiler water and cooling tower water treatment, air filter changes, lubrication, spot replacement of lamps and ballasts, laminar cleaning, boiler tune up, condenser cleaning, controls calibration, and other routine maintenance.
5. D29: "Annual Gas Costs" (or other heating fuel). Enter first year dollar total in this cell.

[http://des.wa.gov/services/facilities/Energy/ELLCCA/Pages/default.aspx](http://des.wa.gov/services/facilities/Energy/ELLCCA/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
“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.”
Building Operation: Post Construction

- Tenants
- Operation
- Design

- Computers and Equipment Schedule Habits
- Layout Integration Installation Components and Features
- Staffing Controls Maintenance Commissioning
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.
ZNE Early Adopters Leadership Network
Support for Schools, Local Governments, Higher Ed & State Agencies

ZNE Trainings

Planning Tools

ZNE Tours

Peer Learning

https://www.linkedin.com/groups/5166071
ZNE & Ultra-Low Energy Case Studies

- CPUC Case Study Briefs & NBI ZNE Case Studies

- PG&E Case Studies

- NBI Registry
  [http://newbuildings.org/share](http://newbuildings.org/share)

- Getting to Zero Database
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.

   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.

www.newbuildings.org/zne-communications-toolkit
Fact Sheets/ZNE Companion Guide

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

2016 Prop 39 ZNE School Retrofit Webinar
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](http://www.newbuildings.org/zne-communications-toolkit)
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
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)
"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
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

October 9, 2015

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.

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 aspect of green building.
ZERO NET ENERGY SCHOOL
RETROFIT WORKSHOPS

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.
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