Municipal Zero Net Energy

Project Engineering as Reach Code Technical Assistance

June 14, 2016

StopWaste: Energy Council

BAY AREA Regional Energy Network

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Agenda

1. **Introductions & Project Overview**
2. ZNE Primer and Regional Context
3. Municipal ZNE Offer
4. Jurisdictions' Service Request
5. Next Steps

Introductions

- Name
- Role
- Jurisdiction
- *Please share a Zero Energy question, comment or concern you have*

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Welcome
Goals and Expectations

Meeting Objectives

- Introduce the Municipal Zero Net Energy Technical Assistance Program in the context of reach-codes
- Prioritize services to support Municpal ZNE
- Discuss project opportunites and constraints

Desired Outcomes

- Confirm candidate projects to participate in the first-round

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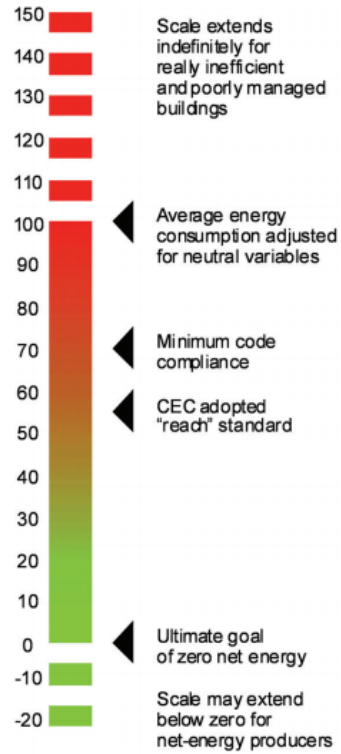
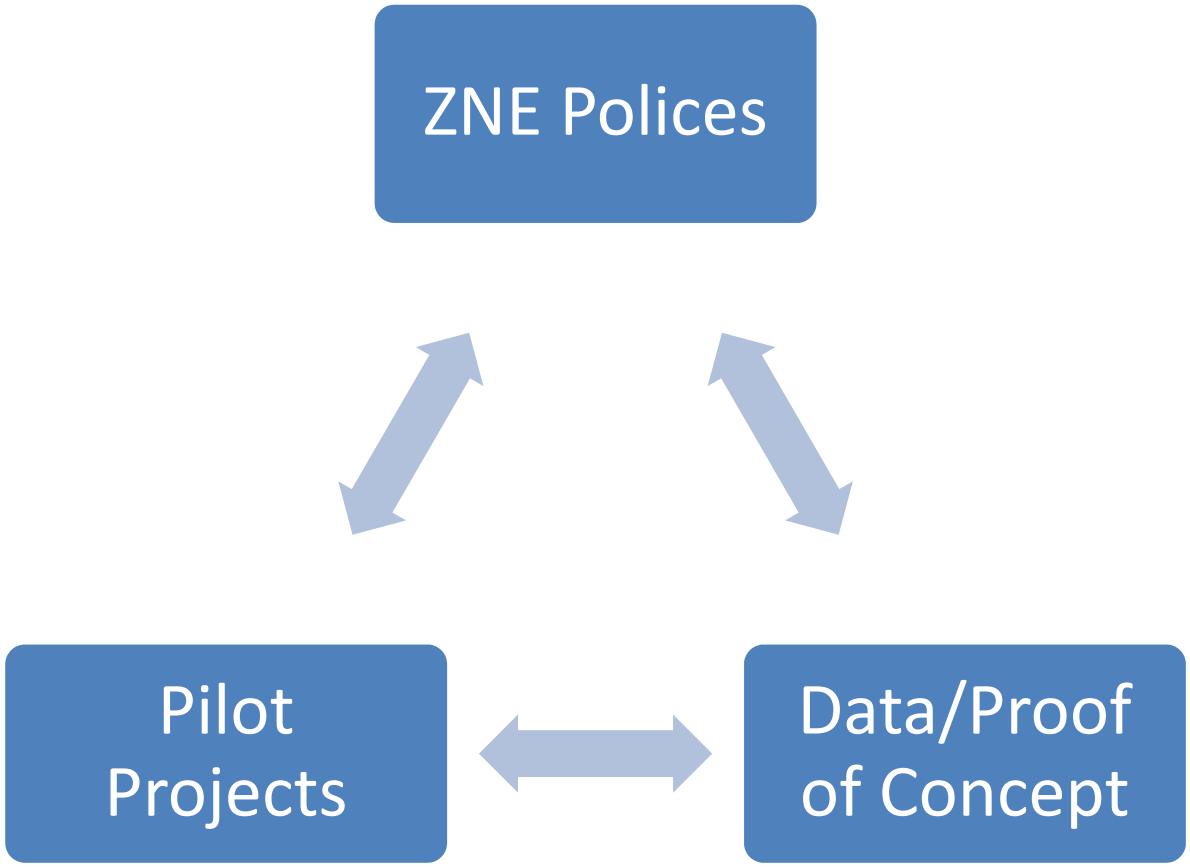
2016 ZNE Reach Code projects led by 3 counties

- San Francisco
  - ZEPI Non-Residential Definition
- San Mateo
  - ZNE policy templates & City engagement
- **Alameda**
  - Municipal ZNE Technical Assistance
    - Engineering
    - Cost estimating
    - Portfolio review
    - Policy threshold analysis



Approach to reach codes



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Lead by Example on own buildings to Prime the market for ZNE policies

Develop Municipal ZNE pilot project scopes of work

- Engineering specifications, energy savings & cost estimates
- System design comparisons
  - Gas vs. Electric system evaluation to optimize GHG/$
- Procurement and financing

Community Scale Municipal ZNE Planning

- Energy Efficiency as a component of plans to off-set jurisdiction's municipal energy load/bills

Develop policy recommendation from pilot project analysis

- Definition threshold feasibility

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Bay REN
Municipal ZNE Scale-up 2017?

- Stipends to project engineers for replicable services on Municipal projects
- Municipal ZNE Policy Adoption
- Municipal Carbon Neutral project implementation
  - Energy
  - Waste
  - Electric Fleets

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Zero Energy
How is a Zero Energy building different?

Mindset

- Begin with the goal in mind

Process

- Integrated team, iterative modelling

Tools

- Performance and economics modeling to inform decisions at all stages

Factors to Consider

- Resulting energy use is about behavior
- Invest in the life-cycle

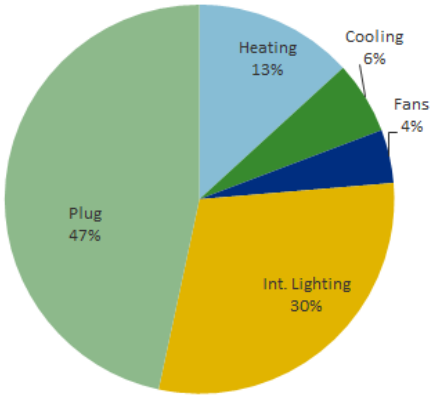


Figure 13: 0-Baseline End Use Breakdown

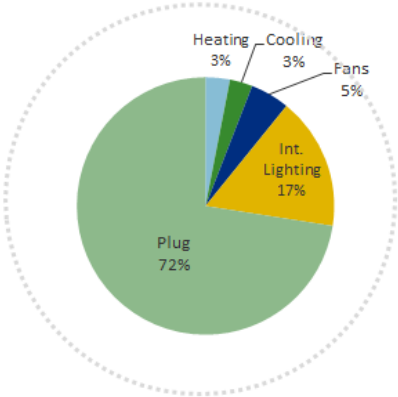
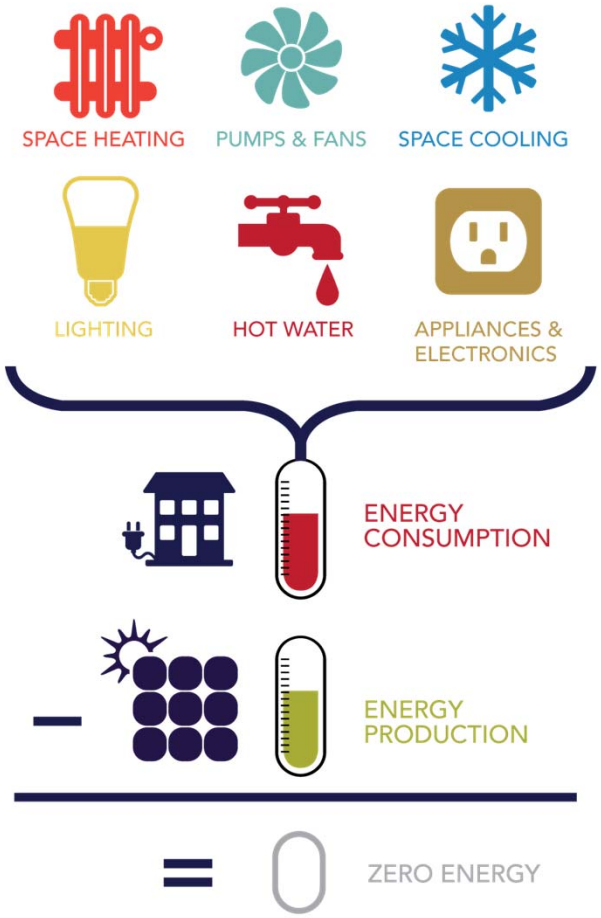


Figure 16: 9-Natural Ventilation End Use Breakdown

Zero Energy Definitions and Metrics

- Common Terms
- ZNE TDV
- DOE ZEB
- Site energy ZEB
- Source energy ZEB
- Zero Energy Cost Building
- Zero Emissions Building



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Zero Energy
Definitions and Metrics

Greenhouse Gas Emissions (GHG):

GHG emission (factor) is a measure of the pounds of carbon dioxide (CO2) equivalent emitted per megawatt-hour of electricity or per therm of natural gas. It is common to approximate emissions from electric usage through the use of an average emissions rate such as the California Public Utilities Commission (CPUC) approved ClimateSmart electric emissions rate of 0.524 lbs CO2 per kWh. The CPUC-approved ClimateSmart natural gas emissions rate is 13.446 lbs CO2 per therm.

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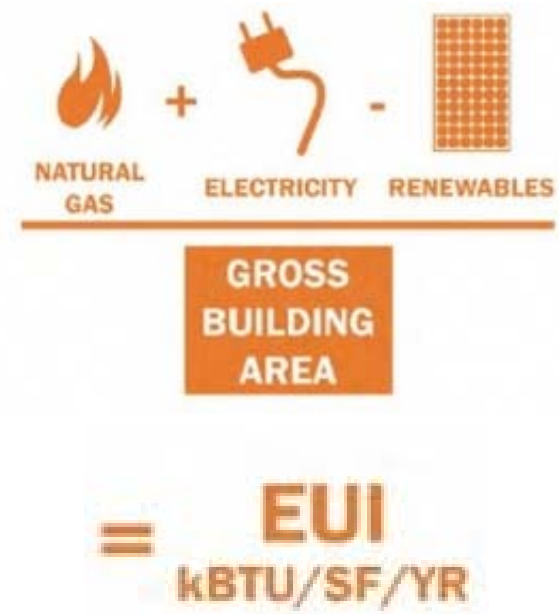
Zero Energy Definitions and Metrics

Energy Use Intensity (EUI):

is a measure of annual energy consumption (kBtu) divided by the area (square feet) of the building. EUI is one of the key metrics used to express and compare a building's energy use as a function of its size.



$$\frac{Natural\ Gas\ (Therms * 100) + Electricty\ (kWh * 3.412) - Renewables\ (kWh * 3.412)}{Gross\ Building\ Area\ (square\ feet)}$$

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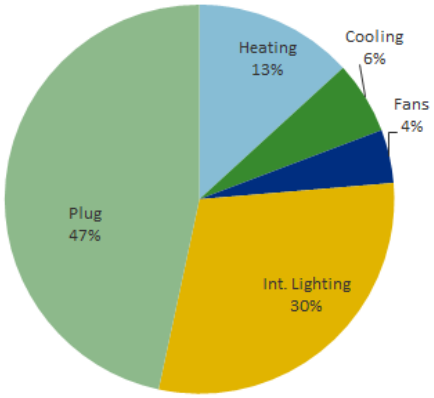
Zero Energy
Definitions and Metrics

Regulated Energy

Regulated Energy includes heating, cooling, ventilation, hot water, and interior lighting and is the basis of current energy codes. Process energy, plug loads, commercial refrigeration, are examples of non-regulated energy uses. Regulated Energy in buildings is between 30-75 percent of energy based on building type and use.



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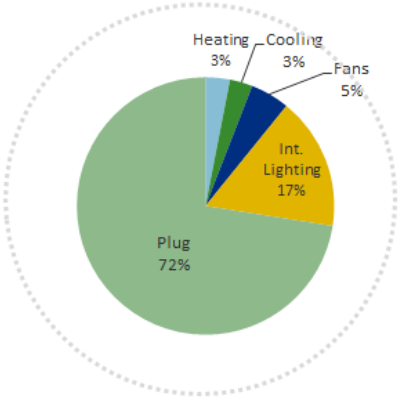

Figure 16: 9-Natural Ventilation End Use Breakdown

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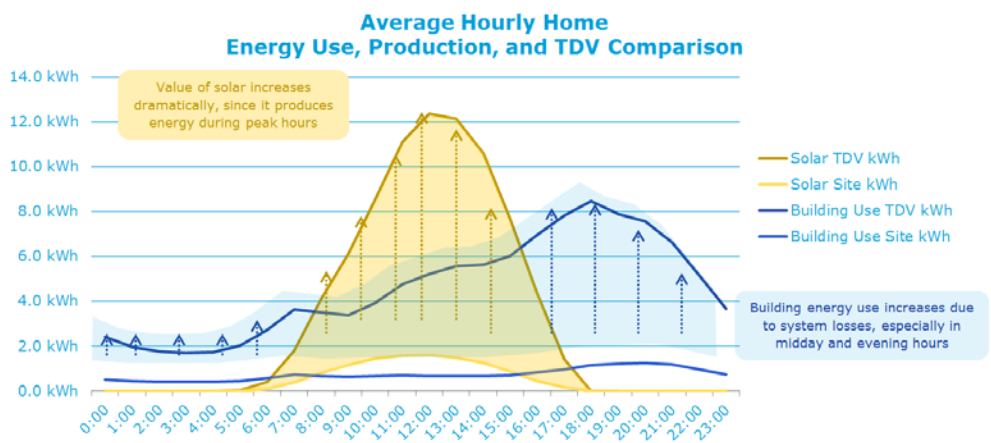
Zero Energy
Definitions and Metrics

Time Dependent Value (TDV):

California Utilities use TDV to apply different energy valuation to every hour of the year with an understanding that energy reduction or solar production during total system peaks have more value than energy reductions at non-peak times.



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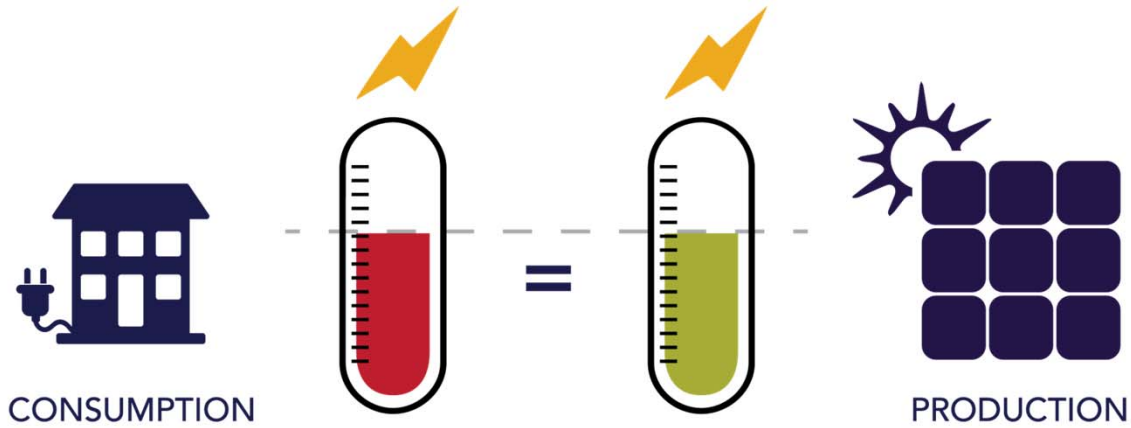
Zero Energy Definitions and Metrics

Site Energy ZEB A building where the actual annual delivered energy ≤ on-site renewable exported energy as measured at the site.



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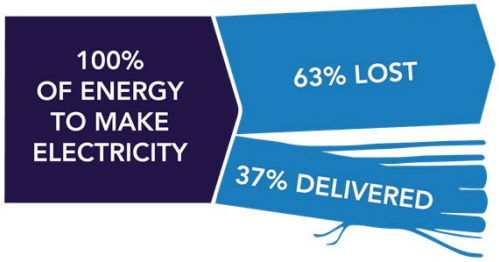
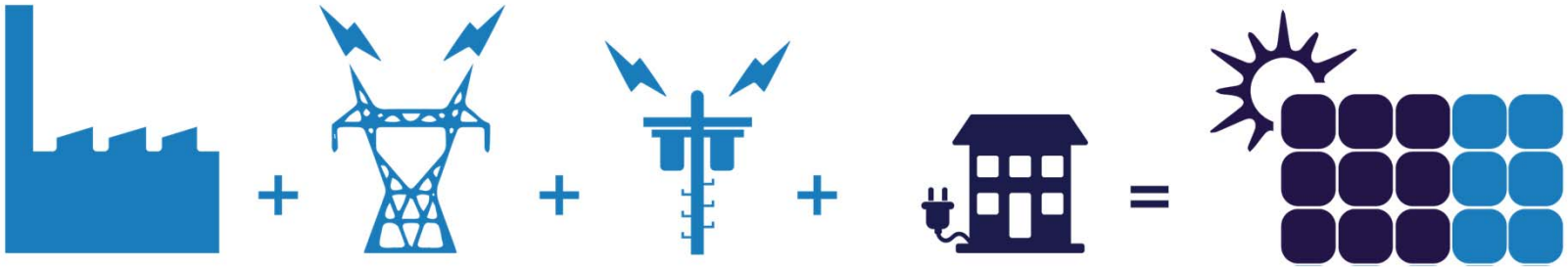
Zero Energy Definitions and Metrics

Source Energy ZEB

A building where the actual annual delivered energy ≤ on-site renewable exported energy as measured at the building site and converted to source energy.





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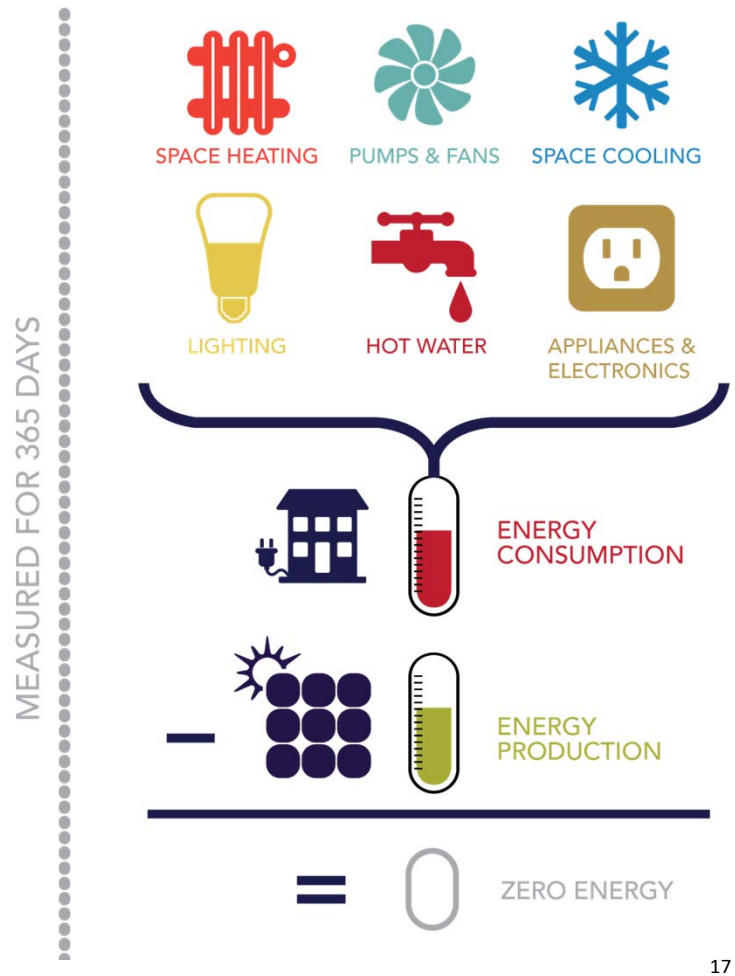
Zero Energy Definitions and Metrics

Zero Energy (DOE):

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

**Community, Portfolio, Campus*



Zero Energy
Definitions and Metrics

Zero Energy Cost Building

A building where the actual annual energy costs are zero.

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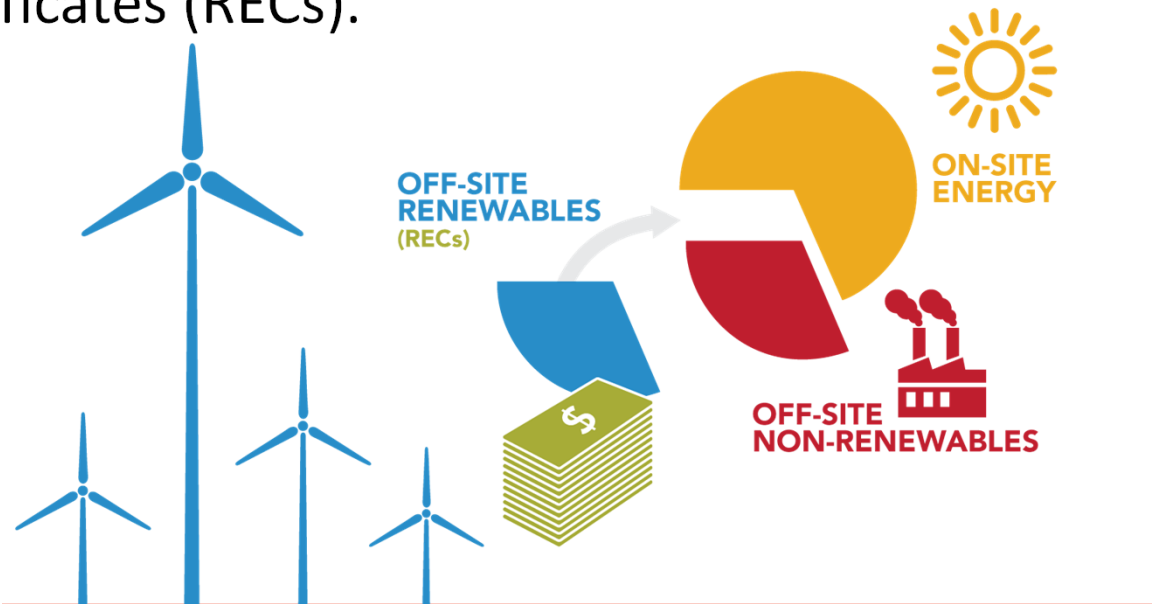
Zero Energy Definitions and Metrics

Zero Emissions Building A building where the actual annual delivered energy ≤ on-site renewable exported energy + renewable energy certificates (RECs).



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Zero Energy
Definitions and Metrics

City of Hayward

"A Zero Net Energy building is one that produces as much energy, based on the value of the energy produced, as it consumes over the course of a year."

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of Hayward that all new City buildings that begin design after January 1, 2017, shall be zero net energy; and

BE IT FURTHER RESOLVED that all existing City buildings for which renovations exceeding 50% of the building's value and that begin design after January 1, 2017, be zero net energy; and

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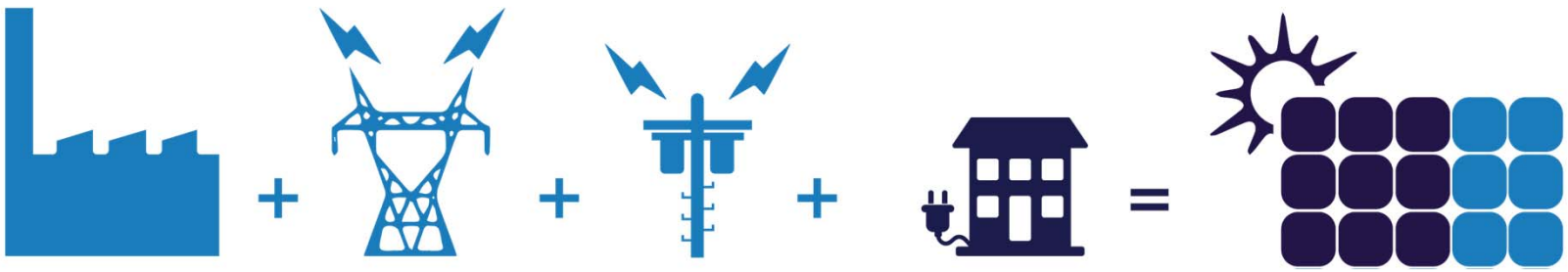
Zero Energy
Definitions and Metrics

Zero Net Energy Source (CA State Agency compliance with Exec. Order B-18-12): ZNE Source (building) produces as much energy as it consumes over the course of the year, when accounted for at the energy generation source



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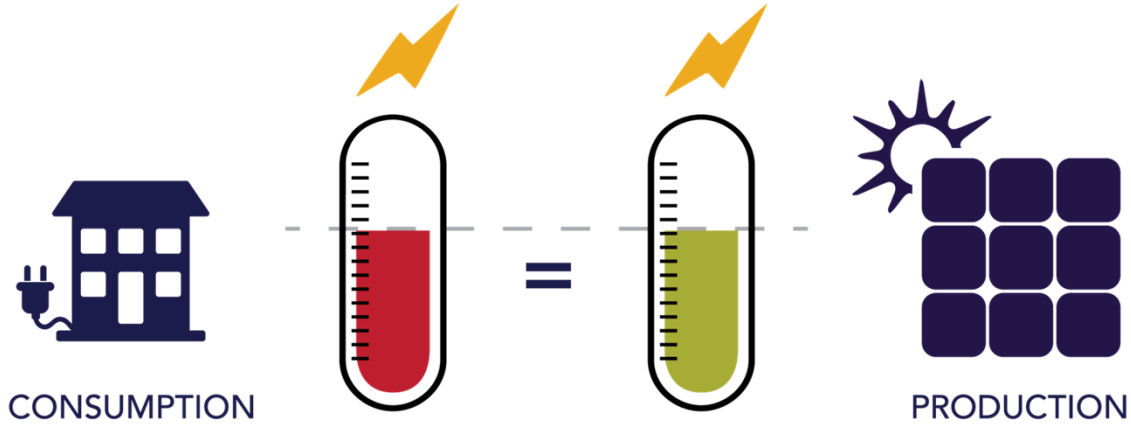
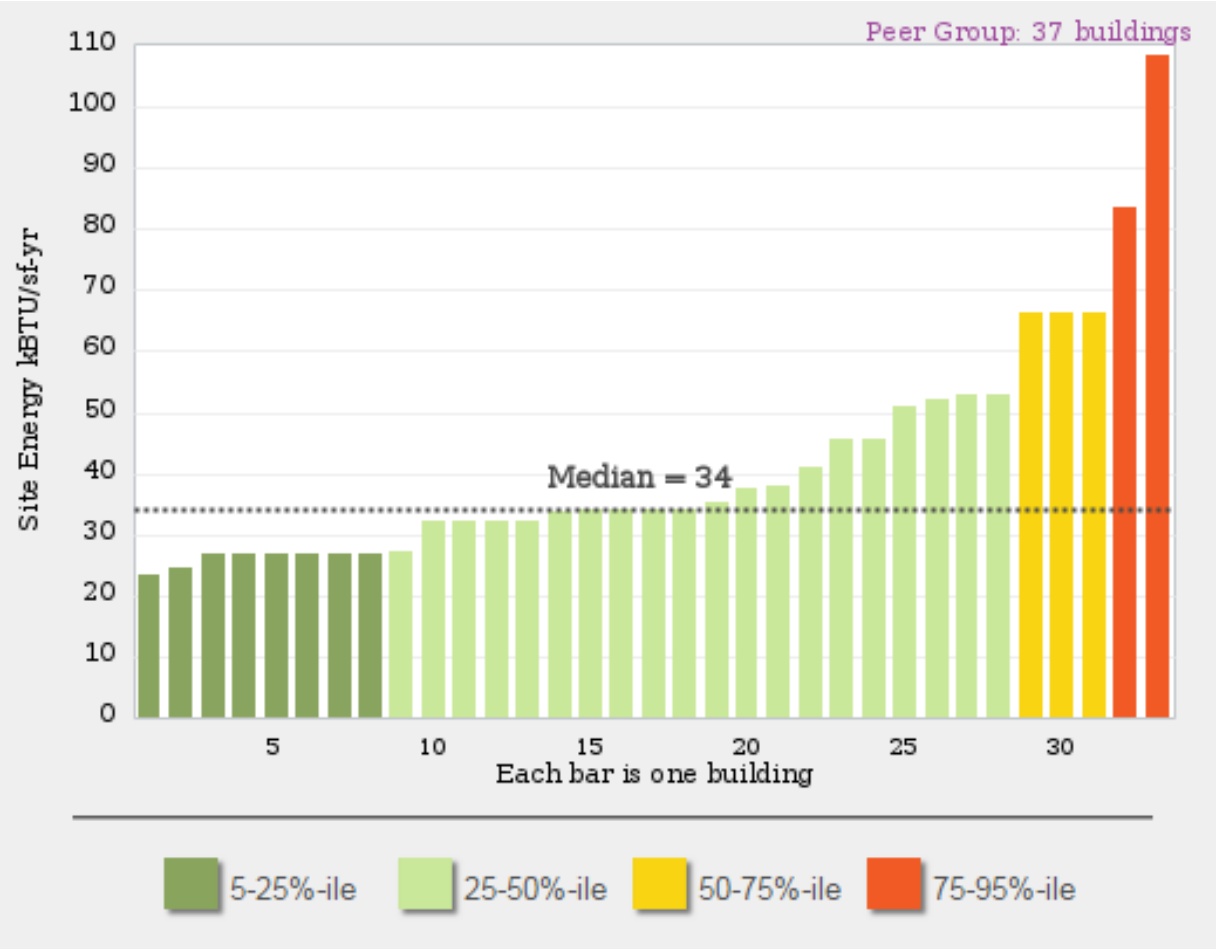
Zero Energy
Definitions and Metrics

Zero Net Energy (ZNE) A Zero Net Energy building or community produces as much, or more, energy as it uses in a given year, still requiring a grid connection for power supply during times when its on-site renewables are not generating power.



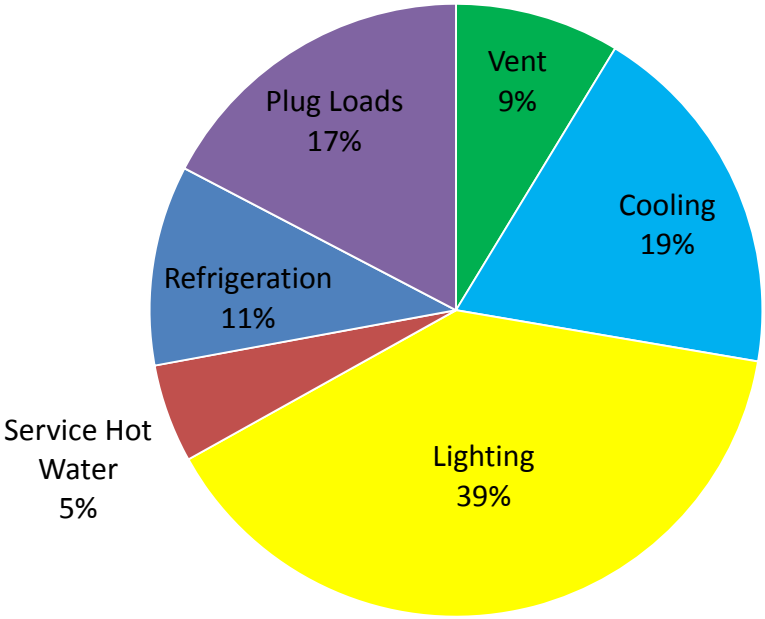
Benchmarking California Government Buildings

- **Median EUI is 34 kBtu/sf/year**
- **Target for ZNE is 20-24 kBtu/sf/year**

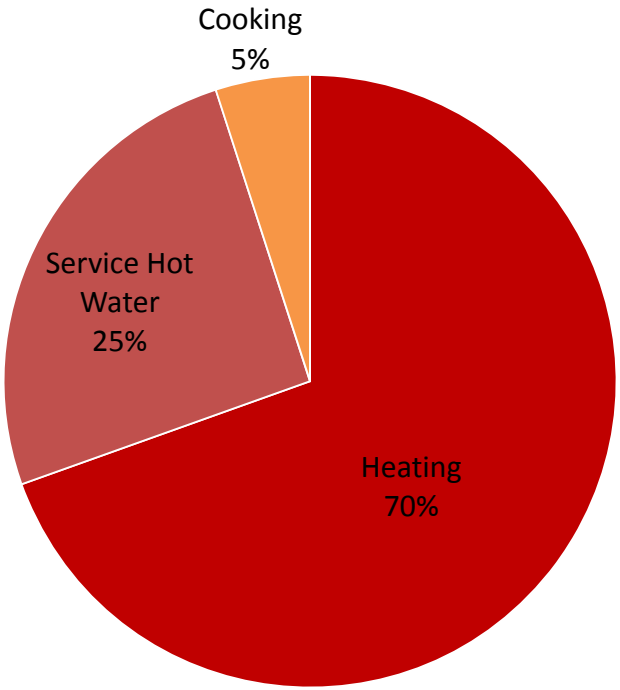


Benchmarking California Government Buildings

Electricity End Use Breakdown



Gas End Use Breakdown



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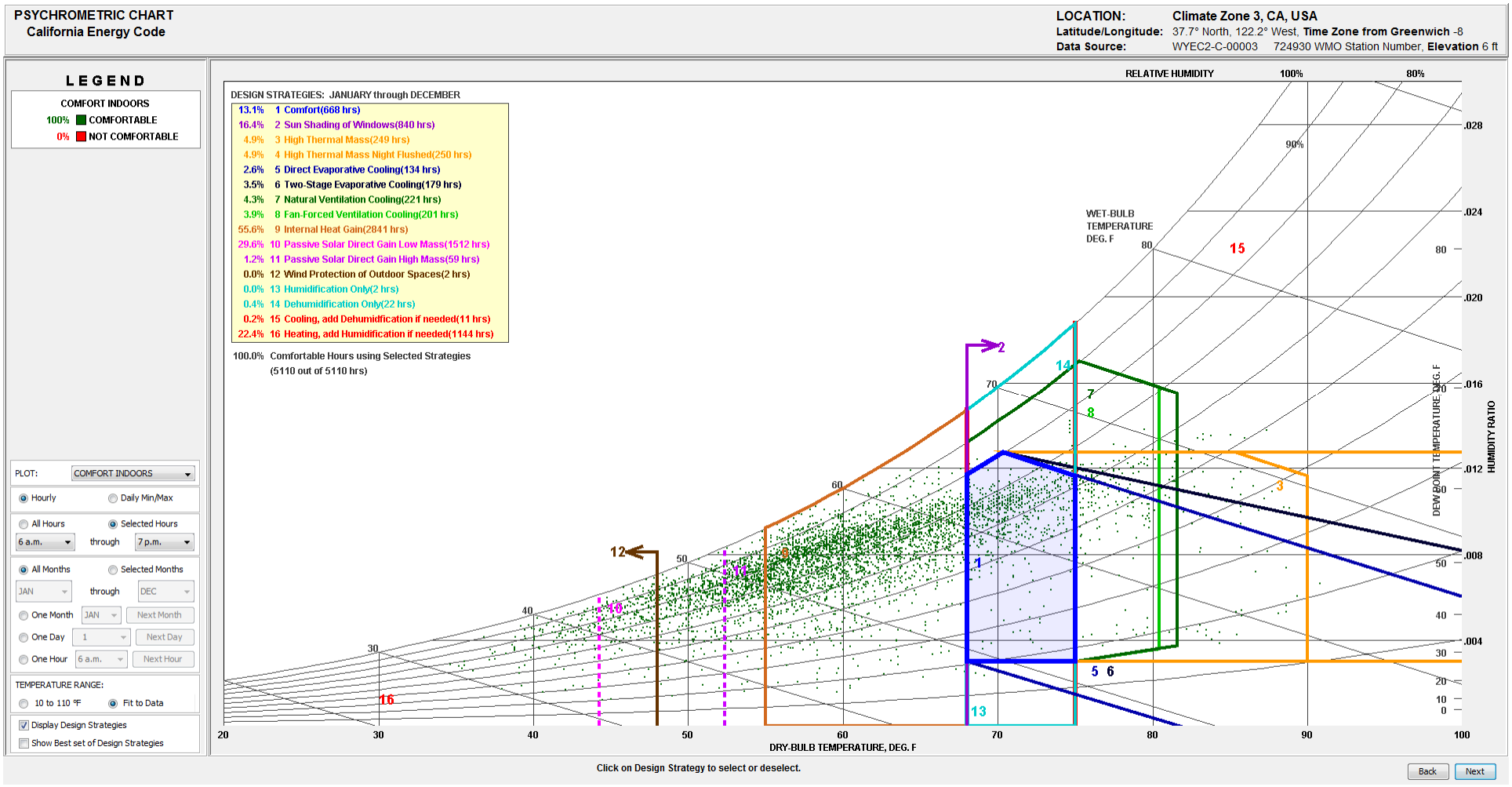
Climate Responsive Design



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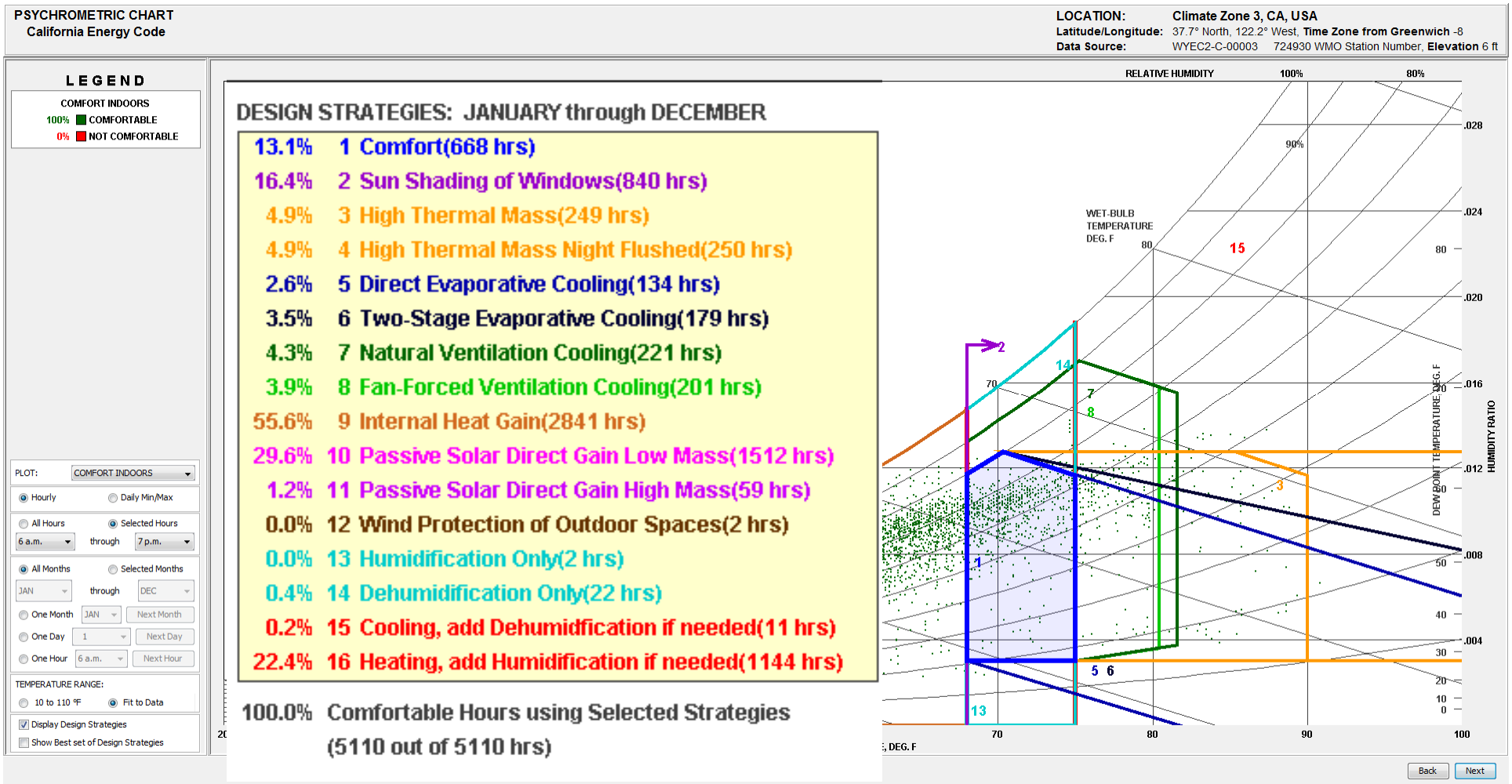

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State Agency Compliance
ZNE Application Strategies

- Energy Efficiency
- Share Excess Generation
- Install Energy Storage
- PV Array Orientation
- Use Over Generation for Electric Vehicle Service Equipment

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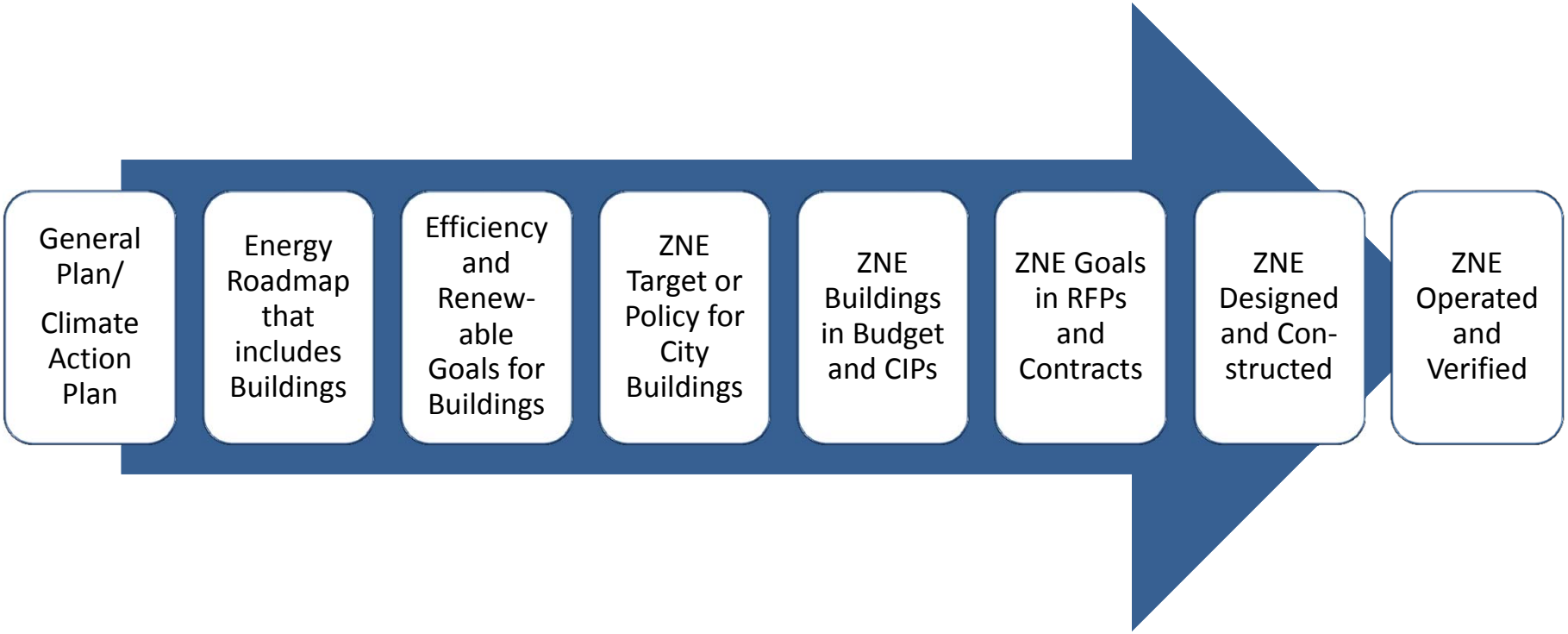
The Path to ZNE Municipal Buildings



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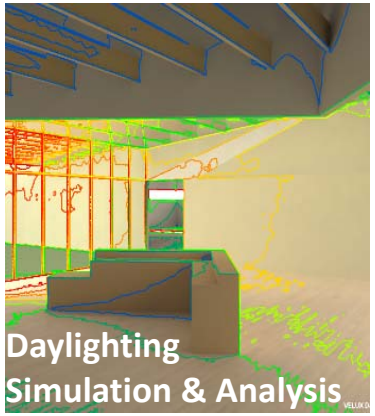
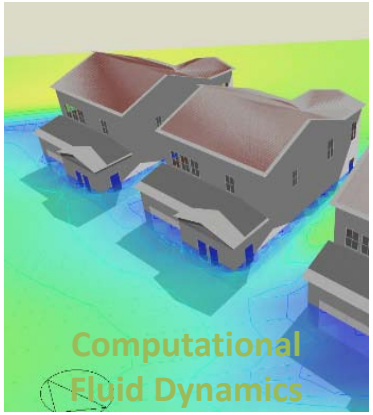
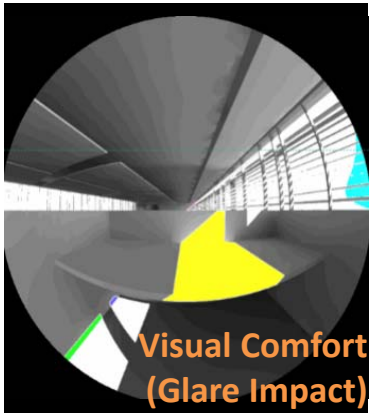
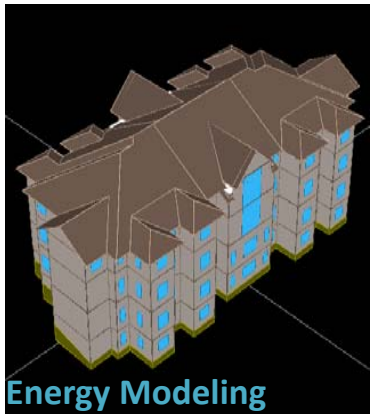
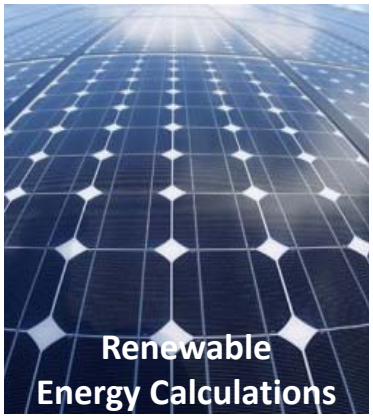
Program Approach
Technical Assistance











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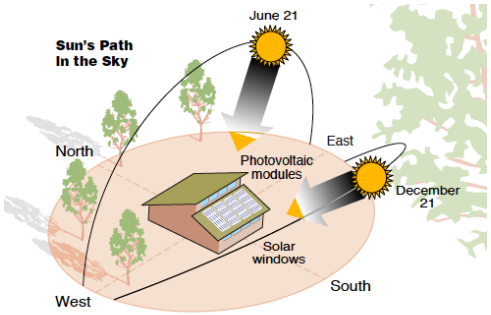


Orientation & Shading

Including Daylighting & Natural Ventilation

Envelope

Insulation, Materiality, Window Properties, etc.

Lighting

Add Daylighting/Occupancy Sensors & Reduce Wattage

Plug Load

Energy Star Equipment

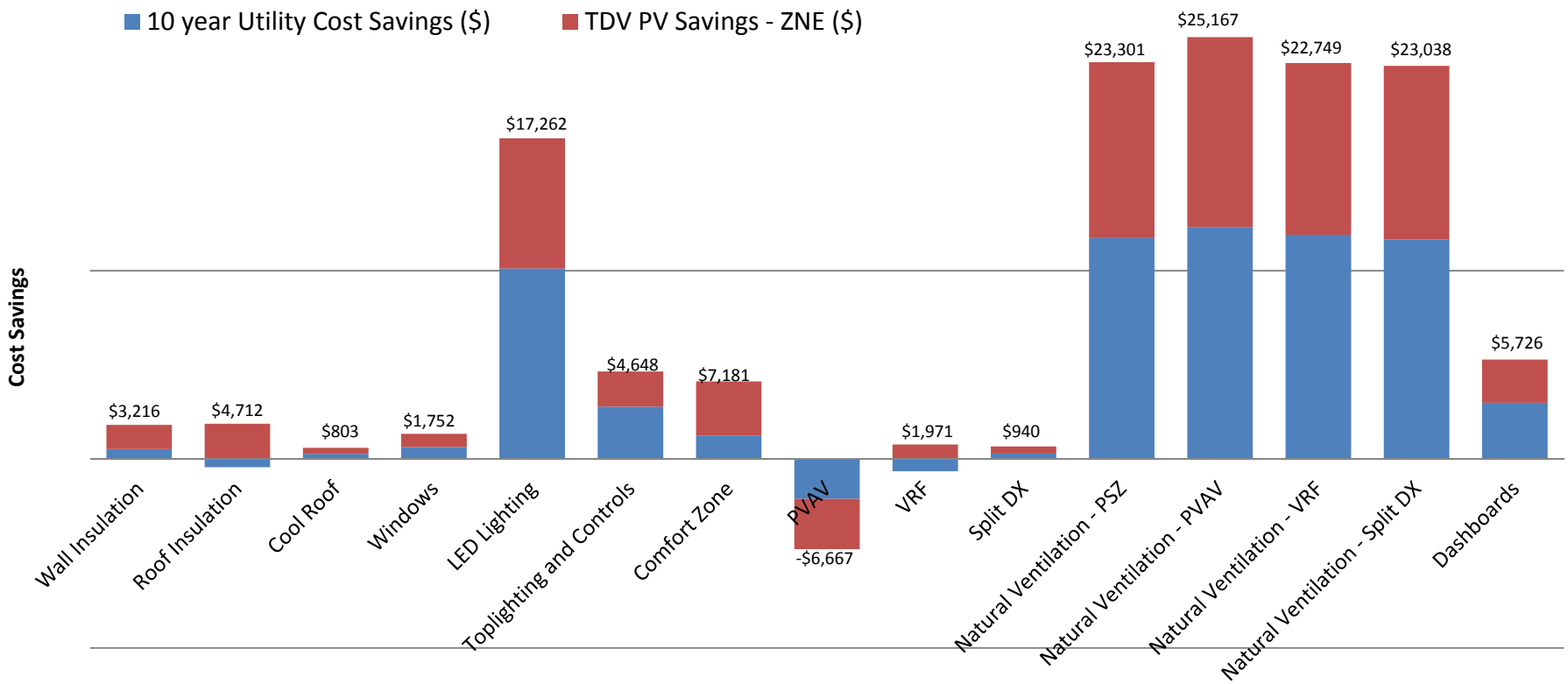
Mechanical Equipment

Size, Energy Source, Efficiency, etc.

Renewable Energy

Photovoltaic Panels, Solar Hot Water Heaters, Wind Energy, etc.

Program Approach
Measure-based Economic Modeling



Efficiency First: the value of efficiency doubles for zero energy buildings

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Program Approach
Technical Assistance Intake Form

Check if interested	ZNE Services	Provide notes on areas of interest
City-level Services		
	Policy Development Assistance	
	Review municipal building portfolios and select buildings	
	Comprehensive plans for off-setting municipal energy load	
	Staff trainings related to ZNE strategies or policies	

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Program Approach
Technical Assistance Intake Form

Building-specific Services		
	Zero Net Energy Engineering and Design Assistance and Cost Estimation	
	RFP Assistance / Team Formation	
	Eco-Charrettes	
	System-Specific Specification and Cost Analysis	
	Other:	

Municipal ZNE Pipeline

See Handout, Jurisdictions Include:

- Alameda County
- Berkeley
- Dublin
- Fremont
- Hayward
- Oakland
- Marin County
- Sonoma County

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Wrap-up
Action Items

1. Intake form completion
2. Schedule follow-up meetings
3. _____
4. _____
5. _____

June

Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

July

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

August

Sun	Mon	Tue	Wed	Thu	Fri	Sat
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7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

September

Sun	Mon	Tue	Wed	Thu	Fri	Sat
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4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

Question?

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