BAYREN

Local Governments Empowering Our Communities

Energy Target and Benchmark Tool Webinar Demonstration

July 7, 2020

Bay Area Regional Energy Network (BayREN)

BayREN is:

- one of three regional energy networks (RENs) in California
- a collaboration of the nine counties that make up the San Francisco Bay Area
- focused on saving energy, together with protecting climate and health

BAYREN

BayREN Codes & Standards Program

Provides support by and for Bay Area local governments in order to increase energy performance of buildings, through activities such as:

- Quarterly regional forums
- Trainings for local building departments
- Resources to support energy code compliance as well as energy policy and reach code innovation, adoption, and implementation

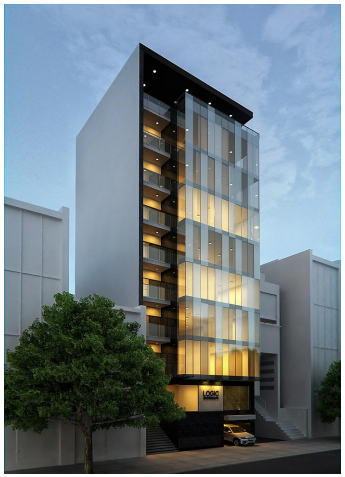
www.bayrencodes.org

BAYREN

Energy Target and Benchmark Tool

To connect energy targets with performance

- Energy Code requirements are based on modeled and estimated future energy use of a building
- Benchmarking requirements look at current actual energy use of a building



BAYREN

BAYREN

Local Governments Empowering Our Communities

Energy Target & Benchmark Tool

July 7, 2020

Energy Target & Benchmark Tool

Objective:

Share the purpose and key uses for the BayREN ETBT

bayrencodes.org/resources/targetbenchmarktool/

BAYREN

Energy Target & Benchmark Tool

Purpose:

Connect design targets to existing building energy performance.

Supports:

- Energy Performance Management
- Outcome-Based Contract or Code

bayrencodes.org/resources/targetbenchmarktool/

BAYREN

Energy Target & Benchmark Tool

ETBT can help put your project's energy budget in context with:

- Typical performance for T24 compliance
- 2030 Challenge
- Zero Net Energy

Free and non-proprietary

bayrencodes.org/resources/targetbenchmarktool/

Energy Target & Benchmark Tool

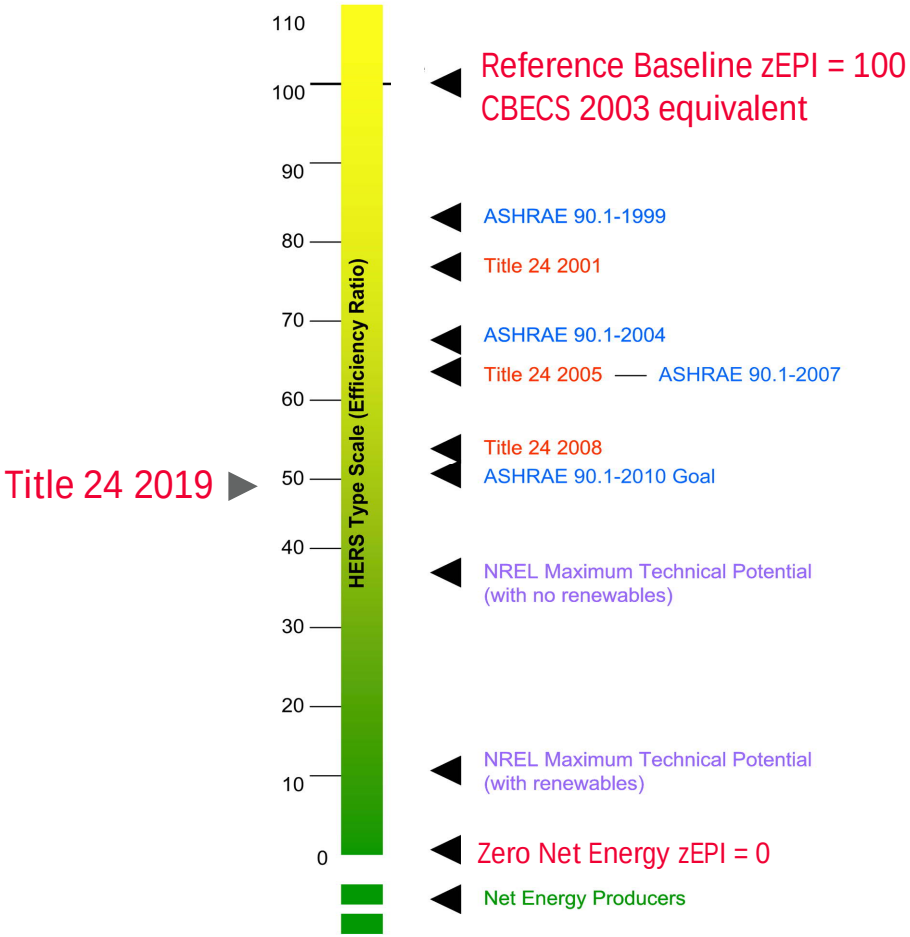
Wonky Bits Ahead

BAYREN

How should energy performance be measured?

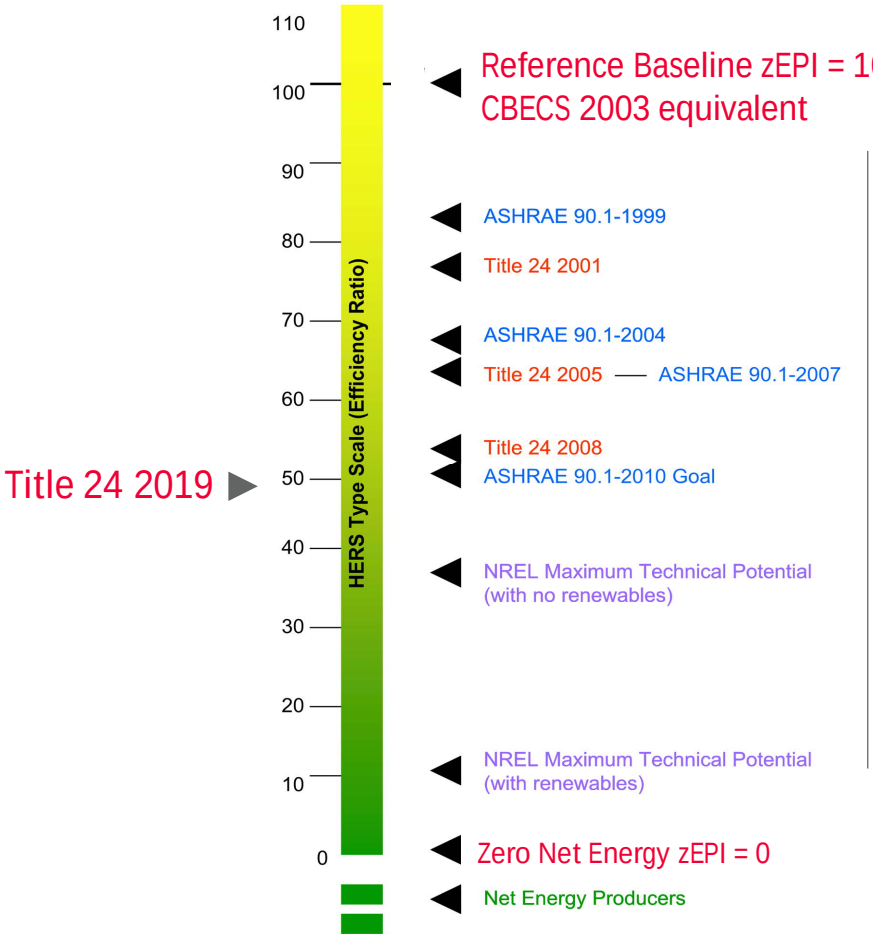
	Pros	Cons
EUI (kBtu/ft^2-yr)	• Simple • Widely recognized	• Difficult to adjust fairly for process loads, building types, climate, etc. • Difficult to baseline against different versions of code
ENERGY STAR Target Finder	• Widely recognized • Integrated with Portfolio Manager	• Relative, not absolute metric • Difficult baseline against different versions of code
Percent Better than Code (?)	• Simple to say	• Meaningless to compare between code vintages
zEPI Zero Energy Performance Index	• Adjusts for process loads, use types, climate • Easy to baseline and scale to code versions • Integrated with Portfolio Manager (somewhat)	• Not widely used (yet)

Zero Energy Performance Index (zEPI)



Reference: SCE & AEC, “Rethinking Percent Savings”, 2009

Zero Energy Performance Index (zEPI)



- Absolute, “Zero = 0”
- Fair
- Stable

Reference: SCE & AEC, “Rethinking Percent Savings”, 2009

Zero Energy Performance Index

$$zEPI = \frac{Building_{EUI}}{Reference_{EUI}} \; x \; 100$$

Zero Energy Performance Index for Title 24

$$zEPI\ Code\ Benchmark = \frac{Reference\ Model_{Title\ 24\ EUI}}{Average\ Operational_{EUI}}\ x\ 100$$

BAYDEN ARUP

Energy Target & Benchmark Tool

(A Bit) Less Wonky From Here

BAYREN

What the Energy Target & Benchmark Tool Does

Before Construction

- Provide context for an energy use target
  - Encourages setting an energy budget between T24 (expected performance by code) and 2030 Challenge (exceptional efficiency)
  - Roughly estimates rooftop PV potential, providing an 'energy budget' for site-ZNE

In Operation

- Determine if target is met

http://bit.ly/bayrenzepi

BAYREN

How the Energy Target & Benchmark Tool Can Be Used

Behavioral program: Set performance target prior to construction, update as design progresses, compare actual performance to target, and facilitate discussion. (Current San Francisco use)

Outcome based contract or code: On either a project or policy level, require setting performance target prior to construction (ZNE, efficient-but-not ZNE or other), compare actuals to target, and provide rewards or corrections based on outcome.

BAYREN

Energy Target & Benchmark Tool

The Tool Supports any Mix of:

Commercial
- Bank
- Hotel/Motel
- Office
- Retail
- Warehouse - refrigerated or non-refrigerated

Education
- Primary and Secondary School
- Adult Education
- Childcare Center

Health Care
- Medical Clinic
- Medical Office

Municipal
- Fire/Police Station
- Library
- Recreation Center

Multifamily Residential

bayrencodes.org/resources/targetbenchmarktool/

BAYREN

BayREN Energy Target and Benchmark Tool

5 Calculate zEPI Scores

Run Analysis

Meets Energy Code

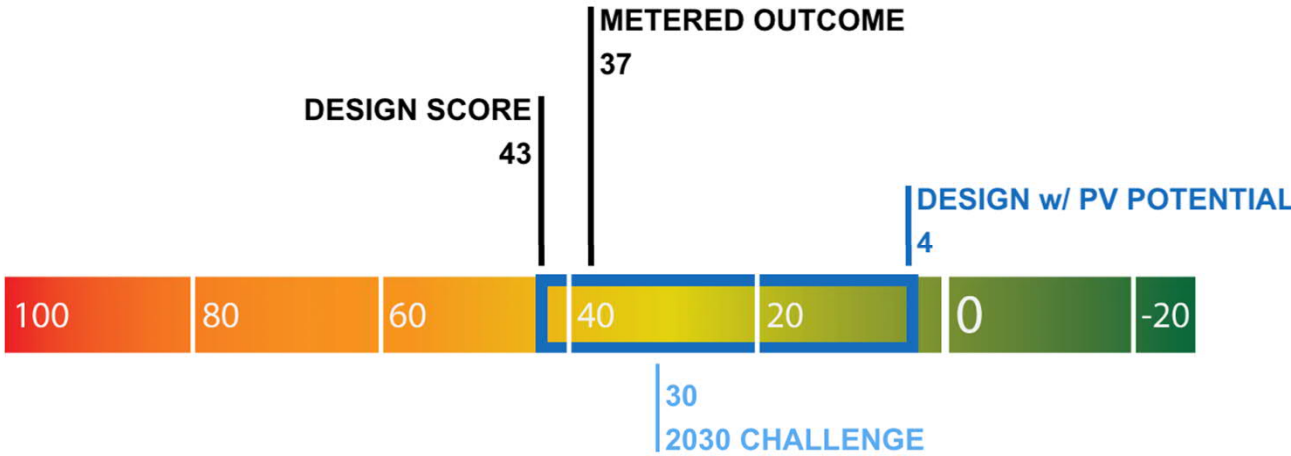
Design: N/A

Metered Outcome: N/A

2030 Challenge

Design: Insufficient

Metered Outcome: Pass



BAYREN

Before Construction

- Set an energy use target
  - Tool suggests energy budget should be between T24 (code minimum) and 2030 Challenge (exceptional efficiency)
- Roughly estimate ZNE feasibility

In Operation

- Determine if target is met

http://bit.ly/bayrenzepi

BAYREN

Energy Target & Benchmark Tool

What Specifically Can I do with ETBT?

BAYREN

Energy Target & Benchmark Tool

New Construction – Set a Goal

BAYREN

San Francisco Municipal Green Building Requirements

New construction and >10k sq ft renovation projects - Env Code Chapter 7

- Set target for annual net energy consumption
- Determine feasibility of ZNE (if ≤ 3 stories)

Municipal Existing Buildings - Env Code Chapter 20

- Annually benchmark & publish energy use

Energy Target & Benchmark Tool

Existing Portfolio – Prioritize

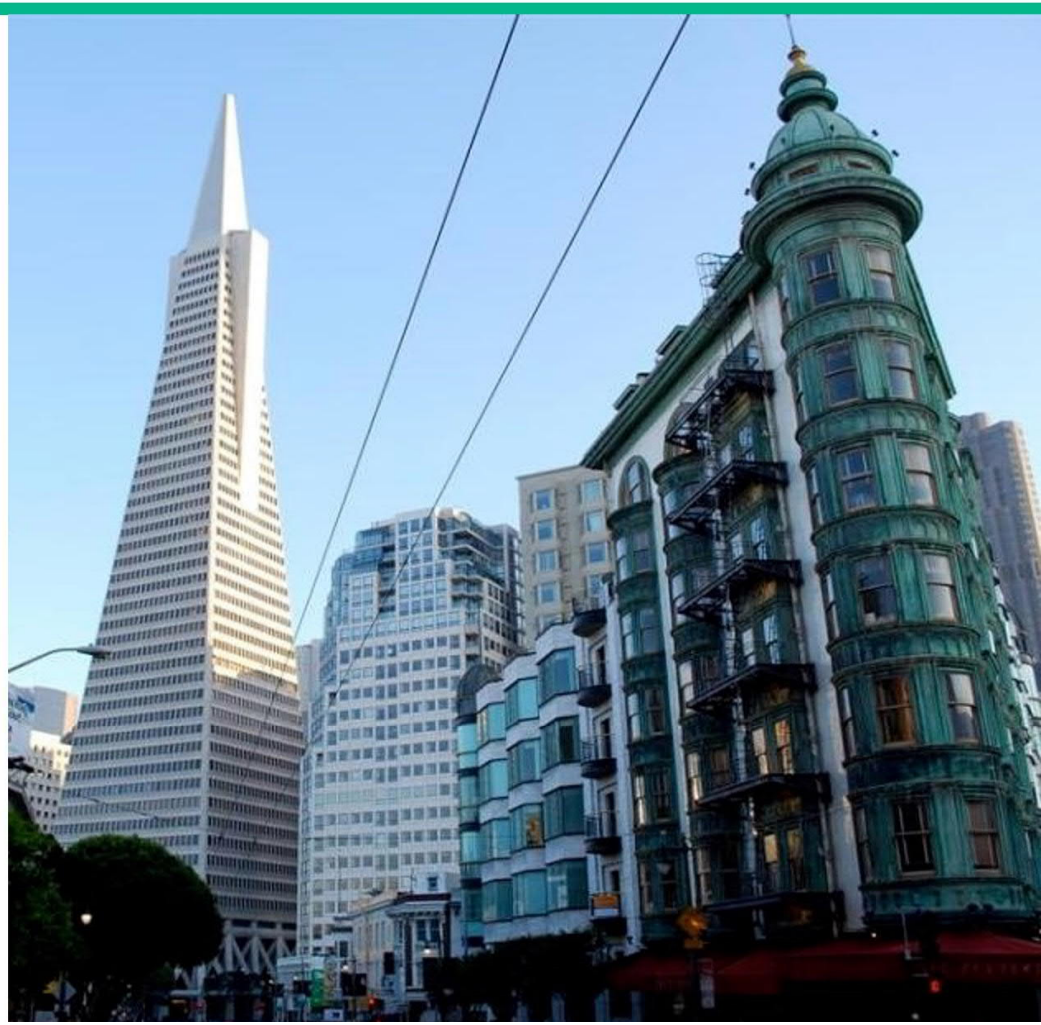
BAYREN

Existing Buildings Ordinance

- Applies to Non-Residential Buildings 10,000 square feet and greater

	# of Buildings	Total Floor Area
Private Sector	1,649	167 Million
Municipal	492	49 Million
Multifamily & Mixed Use	973	110 Million
Total	3,440	326 Million

- Requirements:
  - Annually report energy use
  - Energy audit or RCx every 5 years

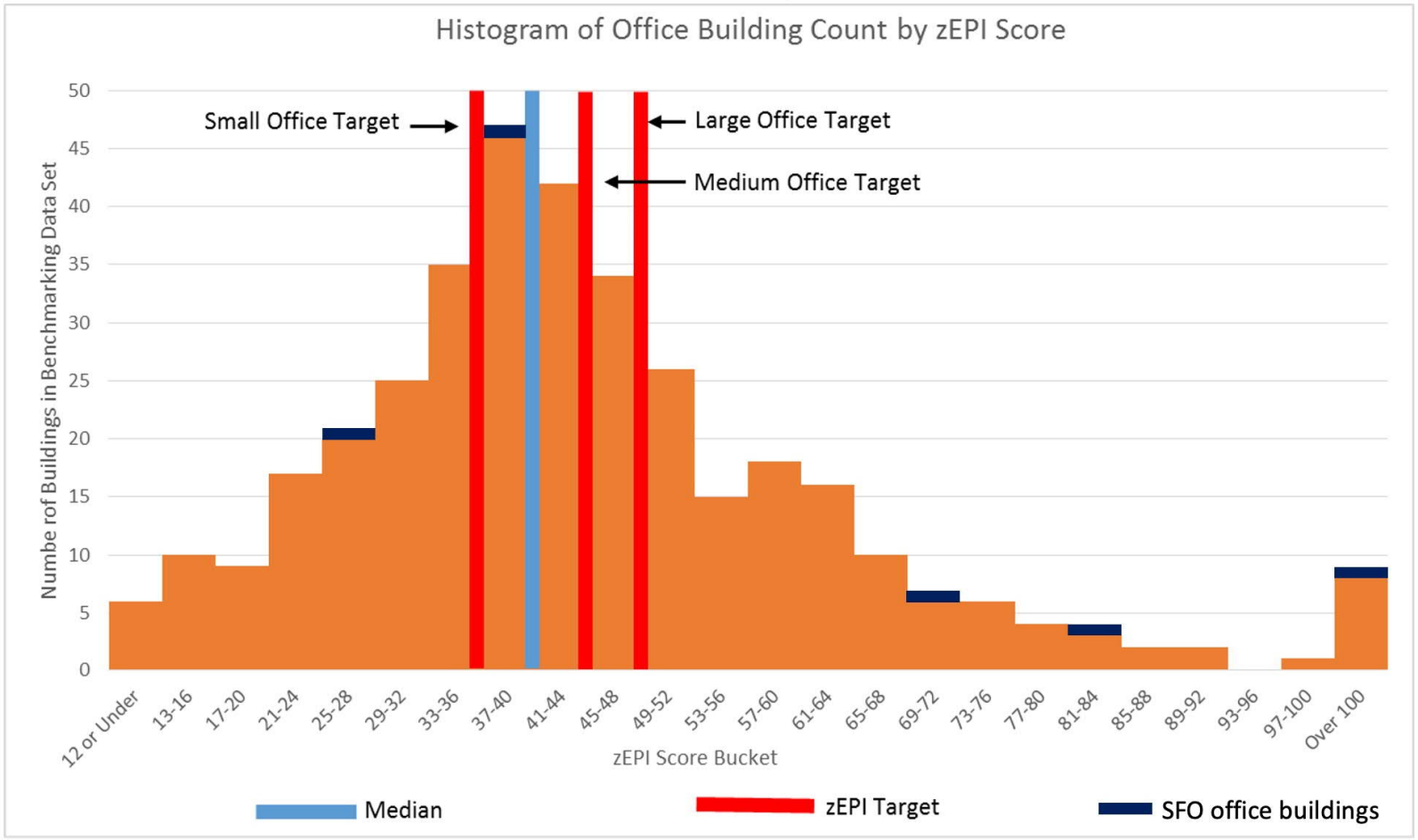


Since Adoption – Municipal Facilities

↓ 25%

CO2e

San Francisco Office Distribution as context for Office Buildings at SFO



ARUP

Results

Building name	Primary Use	T24 Code Benchmark zEPI	Actual zEPI score	Meets 2016 T24 Benchmark?
SFO Business Center	Office	46	108.5	No
Jason Yuen Eng & Arch Bldg.	Office	46	67.9	No
Government Office Bldg. 1	Office	38	38.7	No
Government Office Bldg. 2	Office	38	28.1	Yes
Airfield Ops Services Bldg	Office	38	81.9	No
Airport Museum	Warehouse/ office	51.5	111.1	No
Rental Car Center	Warehouse/ Office	51.8	31.2	Yes
Cargo Bldg. 1	Warehouse	53	6.6	Yes
Cargo Bldg. 2	Warehouse	53	15.3	Yes

Scores calculated from Bay Area Regional Energy Network (BayREN) Outcome Based Code Calculator

ARUP

Energy Target & Benchmark Tool

Municipal ZNE Assistance

BAYREN

BAY AREA Regional Energy Network

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

BAY AREA Regional Energy Network

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

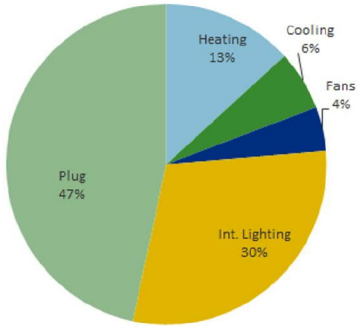


Figure 13: 0-Baseline End Use Breakdown

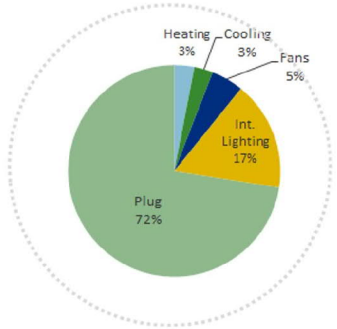
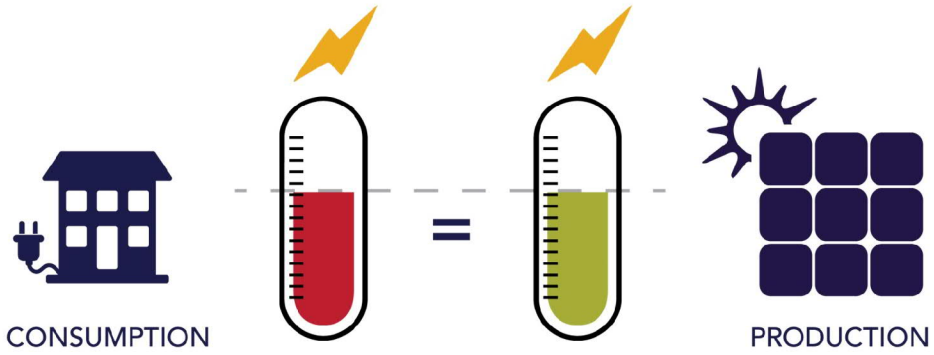


Figure 16: 9-Natural Ventilation End Use Breakdown

BAY AREA Regional Energy Network

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.

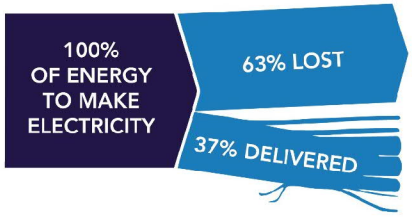


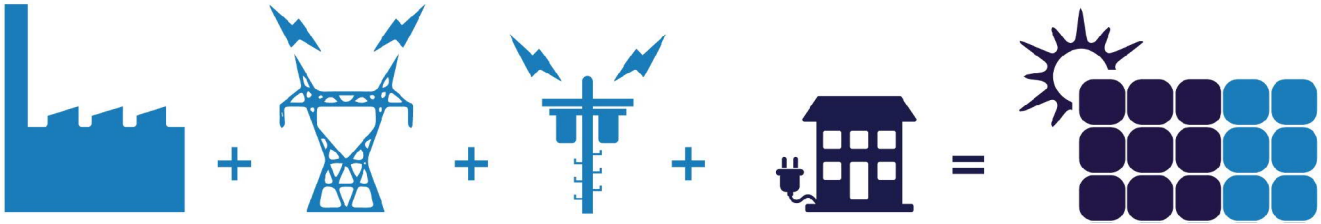
BAY AREA Regional Energy Network

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.

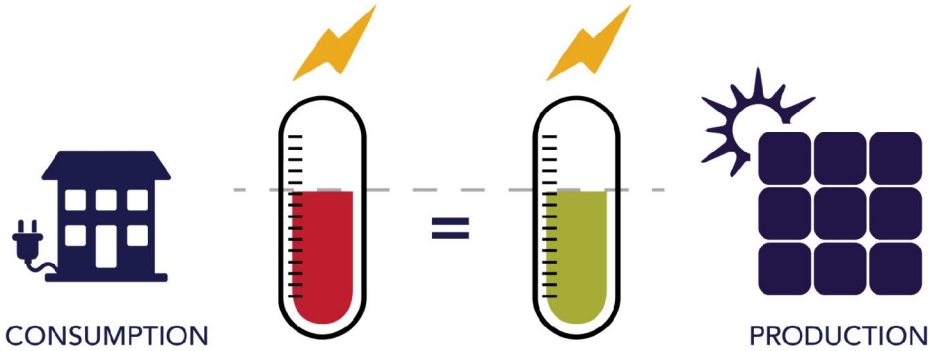




BAY AREA Regional Energy Network

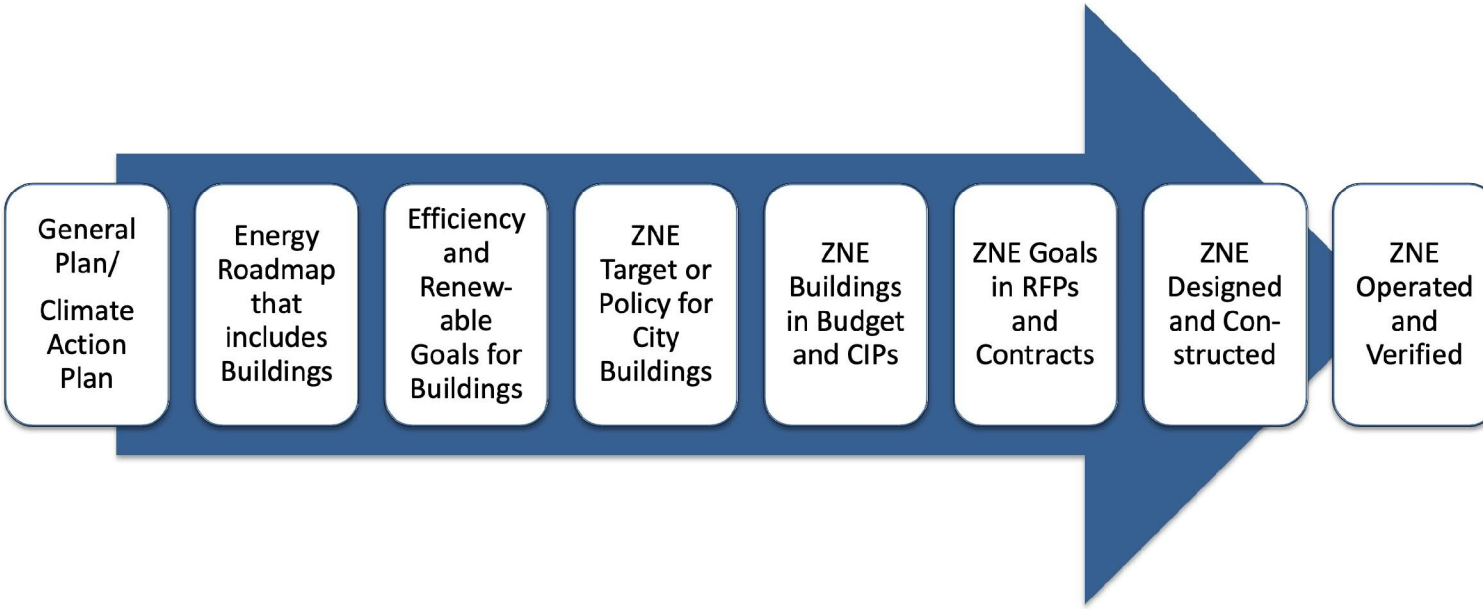
Zero Energy
Definitions and Metrics

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.

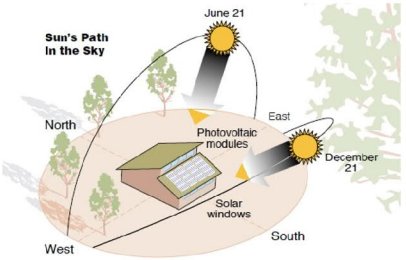


BAY AREA Regional Energy Network

The Path to ZNE Municipal Buildings



BAY AREA Regional Energy Network



Orientation & Shading

Including Daylighting & Natural Ventilation

Envelope

Insulation, Materiality, Window Properties, etc.

Lighting

Add Daylighting/Occupancy Sensors & Reduce Wattage

Plug Load

Energy Star Equipment

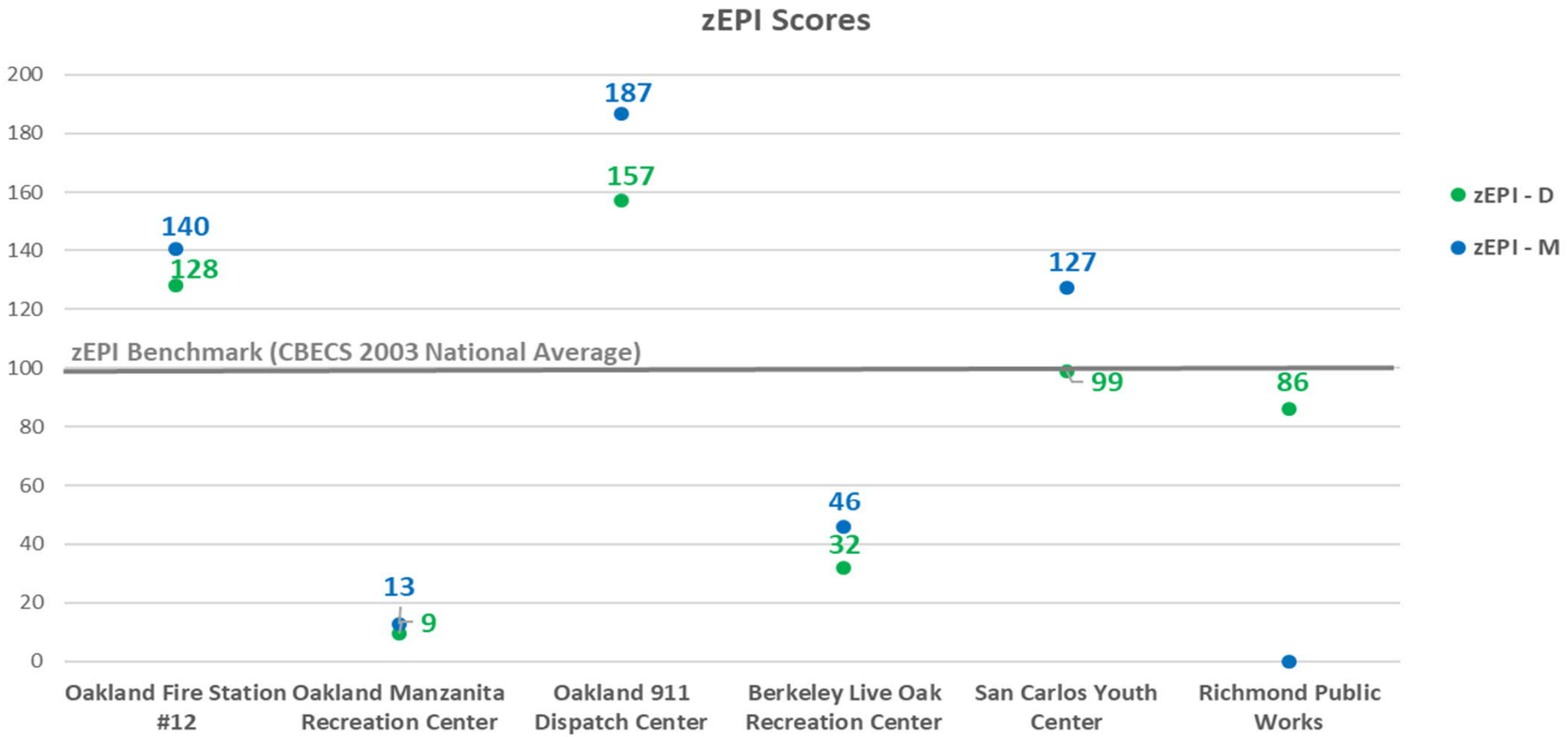
Mechanical Equipment

Size, Energy Source, Efficiency, etc.

Renewable Energy

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

Municipal ZNE Assistance – ETBT Tool for Prioritization



Energy Target & Benchmark Tool

Demo

BAY AREA Regional Energy Network

Energy Target Setting and Performance Verification

Applicant Name	SF Department of Such and Such	Street Address	123 Market St
Building Name	Example Municipal Facility	City	San Francisco

Primary Building Area

Add Building Area

1

Office

Building Gross Area (ft2)	200,000
Computers (#)	1,000
Weekly Operating Hours	120
Workers on Main Shift (#)	1,000

2 Weather Data

Climate Zone	CZ 3: ~Coastal, ~Alam
Heating Degree Days (HDD)	2,885
Cooling Degree Days (CDD)	138

3 12 Month Modeled Energy

(design stage)

Electricity Usage w/o PV (kWh)	2,800,000
Natural Gas Usage (therms)	20,000
Available Roof for PV (ft2)	75,000

4 12 Month Metered Data

(input data once operational)

Electricity Usage (kWh)	0
Natural Gas Usage (therms)	
Billing End Date	

BAYREN

BAY AREA Regional Energy Network

Energy Target Setting and Performance Verification

5 Calculate zEPI Scores

Run Analysis

Meets Energy Code

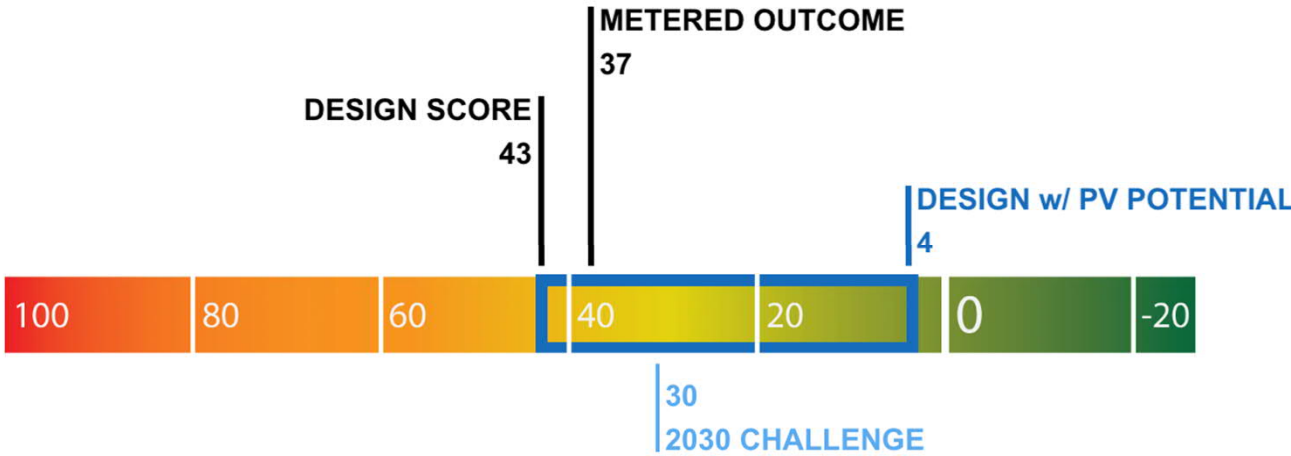
Design: N/A

Metered Outcome: N/A

2030 Challenge

Design: Insufficient

Metered Outcome: Pass



BAYREN

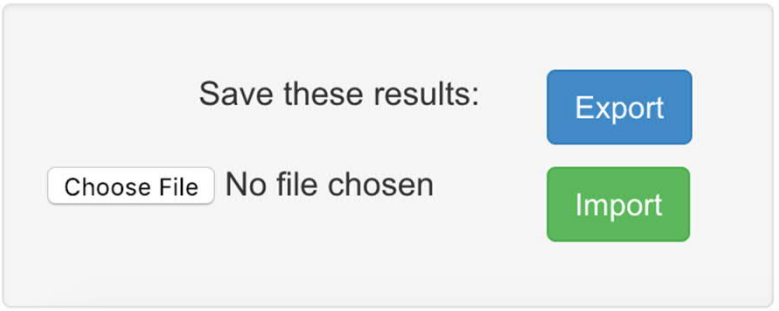
BAY AREA Regional Energy Network

Energy Target Setting and Performance Verification

zEPI Analysis Data

	zEPI	EUI (source)	Therms	kWh	kW
Code Threshold	0	0	N/A	N/A	
Efficient Target	30	49.3	N/A	N/A	
Design Score	43.1	70.8	15000	250000	
Metered Outcome	37.2	61.1	12000	225000	
zEPI Benchmark	100	164.2	N/A	N/A	
Photovoltaic Potential	39.5	65	N/A	364000	244.4

Save or Import Building Data



BAY AREA Regional Energy Network

Energy Target Setting and Performance Verification

BAY AREA Regional Energy Network

Energy Target Setting and Performance Verification

Applicant Name	Bob Ledeveloper	Street Address	1455 Market St, 12th Floor
Building Name	City of Bob Main Library	City	San Francisco

Primary Building Area

1

Library

Building Gross Area (ft2)	60,000
Workers on Main Shift (#)	30
Weekly Operating Hours	120
Refrigerated Book Case?	Yes / No

2 Weather Data

Climate Zone	CZ 3: ~Coastal, ~Al
Heating Degree Days (HDD)	2,885
Cooling Degree Days (CDD)	

Scale document up

3 Design Energy (modeling stage - 12 months)

Electricity Usage w/o PV (kWh)	250,000
Natural Gas Usage (therms)	15,000
Available Roof for PV (ft2)	20,000

4 Metered Energy (input data once operational - 12 months)

Electricity Usage (kWh)	225,000
Natural Gas Usage (therms)	12,000
Billing End Date	12/31/2018

5 Calculate zEPI Scores

Meets Energy Code

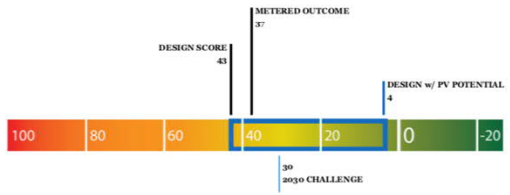
Design:
N/A

Metered Outcome:
N/A

2030 Challenge

Design:
Insufficient

Metered Outcome:
Pass



zEPI Analysis Data

	zEPI	EUI (source)	Therms	kWh	kW
Code Threshold	0	0	N/A	N/A	
Efficient Target	30	49.3	N/A	N/A	
Design Score	43.1	70.8	15000	250000	
Metered Outcome	37.2	61.1	12000	225000	
zEPI Benchmark	100	164.2	N/A	N/A	
Photovoltaic Potential	39.5	65	N/A	364000	244.4

Energy Target & Benchmark Tool

- How has BayREN linked Design with Energy Benchmarking?
- How does it work?
- How can I benefit?

BayREN Energy Target & Benchmark Tool Webinar

July 7, 11 am – 12 pm

Registration link coming soon to:

bayrencodes.org/events/

Or visit:

bayrencodes.org/resources/targetbenchmarktool/

BAYREN