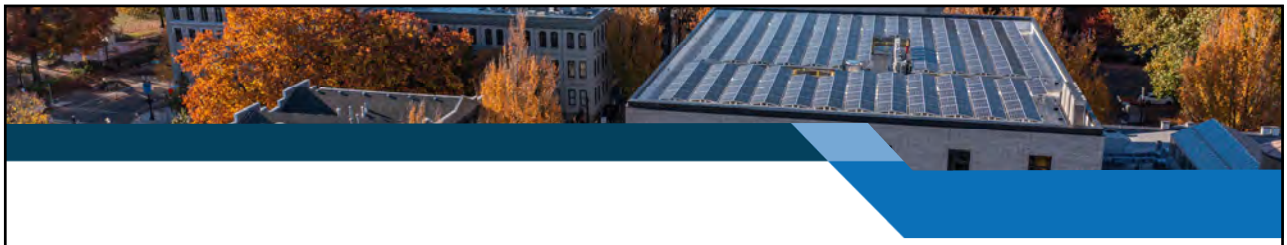

Net-Zero Energy Buildings—Now and What's Next

Webinar – March 4, 2025

nbi new buildings institute

1

SAN DIEGO LEARN

This webinar was developed in partnership with the LEARN Program.

The LEARN Program is a San Diego-based workforce education and training program that has partnered with New Buildings Institute to offer free energy efficiency and electrification webinars. Please visit the LEARN website for more information: www.sandiegolearn.com

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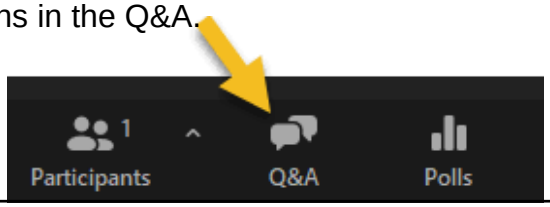
2

Net-Zero Energy Buildings—Now and What's Next

In today's webinar we'll discuss:

- Net Zero Energy (NZE)
- How it compares to other building labels
- Their relevance today
- Why building owners choose this approach
- NZE commercial buildings, including affordable housing

Links to our slides and presentations will be sent to you. Feel free to chat with each other and ask presenters questions in the Q&A.



3

Today's Panelists

Karina Hershberg
PAE

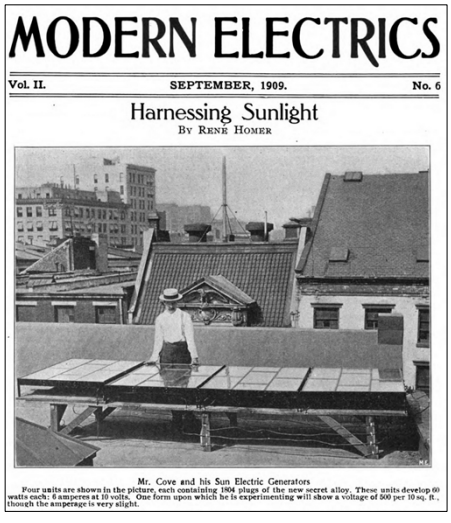
Sean Armstrong
Redwood Energy

4

Net Zero Energy: Then, Now and the Future!

5

EVs in 1900, Rooftop PV in 1909, and Electrification in 1916!



MODERN ELECTRICS

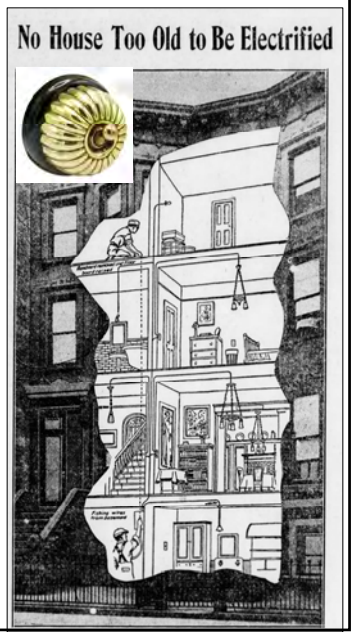
Vol. II. SEPTEMBER, 1909. No. 6

Harnessing Sunlight

By René Homer

Mr. Cove and his Sun Electric Generators

Four units are shown in the picture, each containing 1806 plugs of the new secret alloy. These units develop 60 watts each; 8 amperes at 10 volts. One form upon which he is experimenting will show a voltage of 500 per 10 sq. ft., though the amperage is very slight.



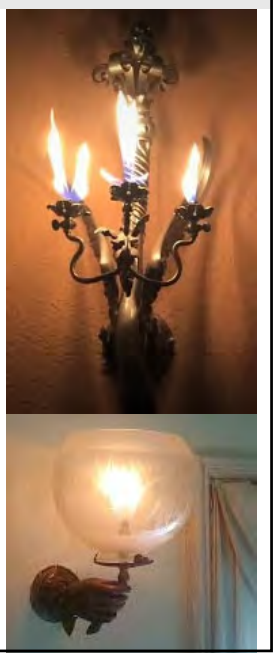
No House Too Old to Be Electrified

6

1920: One Million DC Microgrids In Rural America, where half of Americans lived and had no grid electricity.

7

1923 Berkeley Blaze Triggers First All-Electric Houses



8

2019 East Bay Electrification Exposition Kicks Off Berkeley Gas Ban and 80 Others

9

1st Net Positive Apartments in N. America in 2012. Arcata, California.

1st Net Positive Housing Development in in N. America in 2014. Free EV Charging. Fort Bragg, California.

10

Vertical PV in High Rise ZNE: 2011-2027

Bullet Center, Seattle. 2011

303 Battery, Seattle. 2024

Radia, Silver Spring, MD. 2024

11

2010s-2020s: R&D For Power Efficient Products

700sf Garage Conversion to 1 Bed House

1400sf, 1973 "Double Wide" Electrification

12

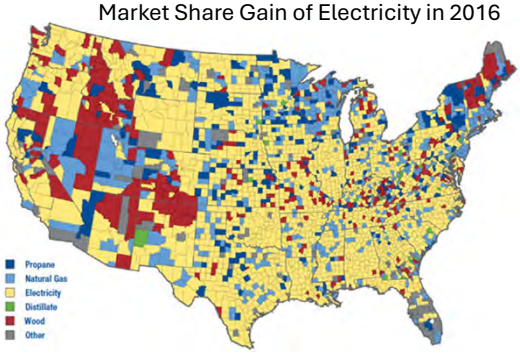
2018: New Smart Panels Balance An Abundance of Loads

Span Panels Can Support 50A-100A Services

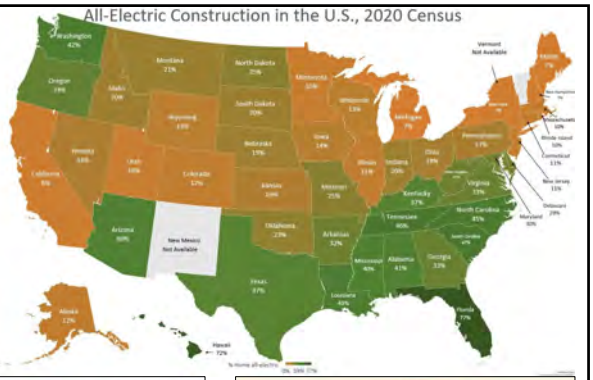
Lumin Panels Can Support 30A

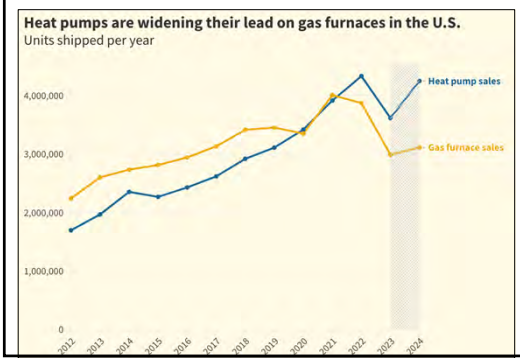
13

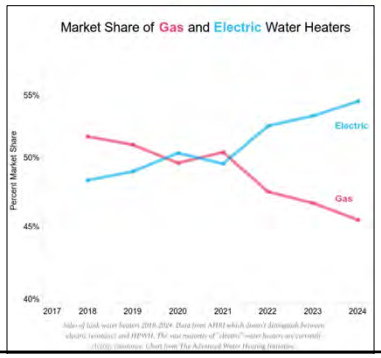
Market Share Gain of Electricity in 2016

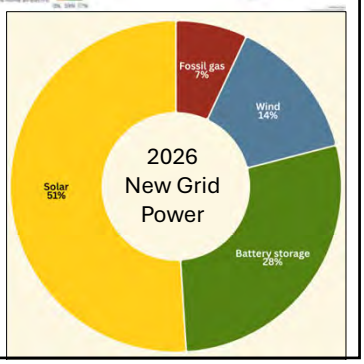


All-Electric Construction in the U.S., 2020 Census









14

EVs and Bidirectional Chargers: 2011 Tsunami

15

Bidirectional Bus Chargers!

An app allows fleet managers to monitor and schedule charging

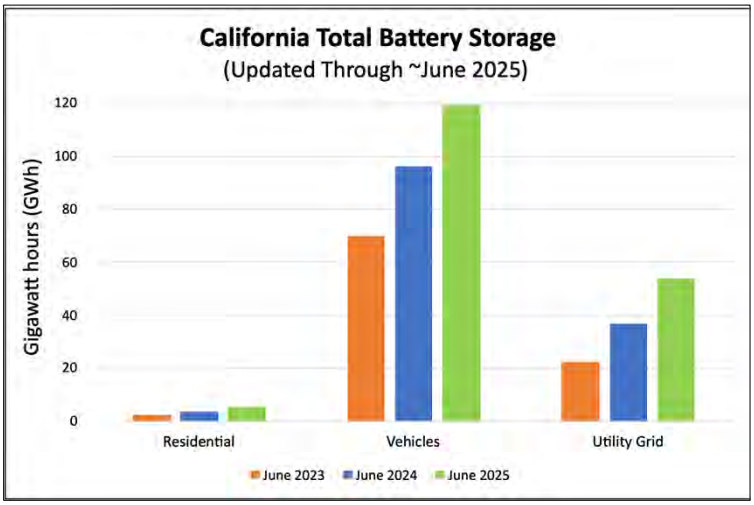
16

Emergency Services: Vehicle-to-Vasectomy?

Using V2L from his Rivian electric truck, Dr. Yang powered the vasectomy clinic—lights, electrocautery equipment, and fans while the power was out in Austin, TX.

17

California Has More Than Twice As Much EV Battery as Grid Battery! 2.24M and Growing Fast!



18

2021: ”Next EPIC Challenge” from CEC requires 4pm-9pm Off-Grid. Owners asks for 100% Off-Grid!

“Can you make it off-grid? PG&E delays are the #1 problem for all our developments.”- Dan Johnson, Danco

19

Power Efficient Appliances For Winter

Rheem 120V HPWH indoors vs $SanCO_2$

COP 3.1 vs. 3.5

<u>$3800/apt vs. $14,700</u>

Ephoca Pro 120V PTHP vs. multihead minisplit

COP 3.5 vs. COP 3.2

<u>$11,000/apt vs. $15,000</u>

120V Induction Range vs. Resistance

COP 0.85 vs. 0.60

<u>$1500 vs. $700</u>

Induction is just $400 with rebate

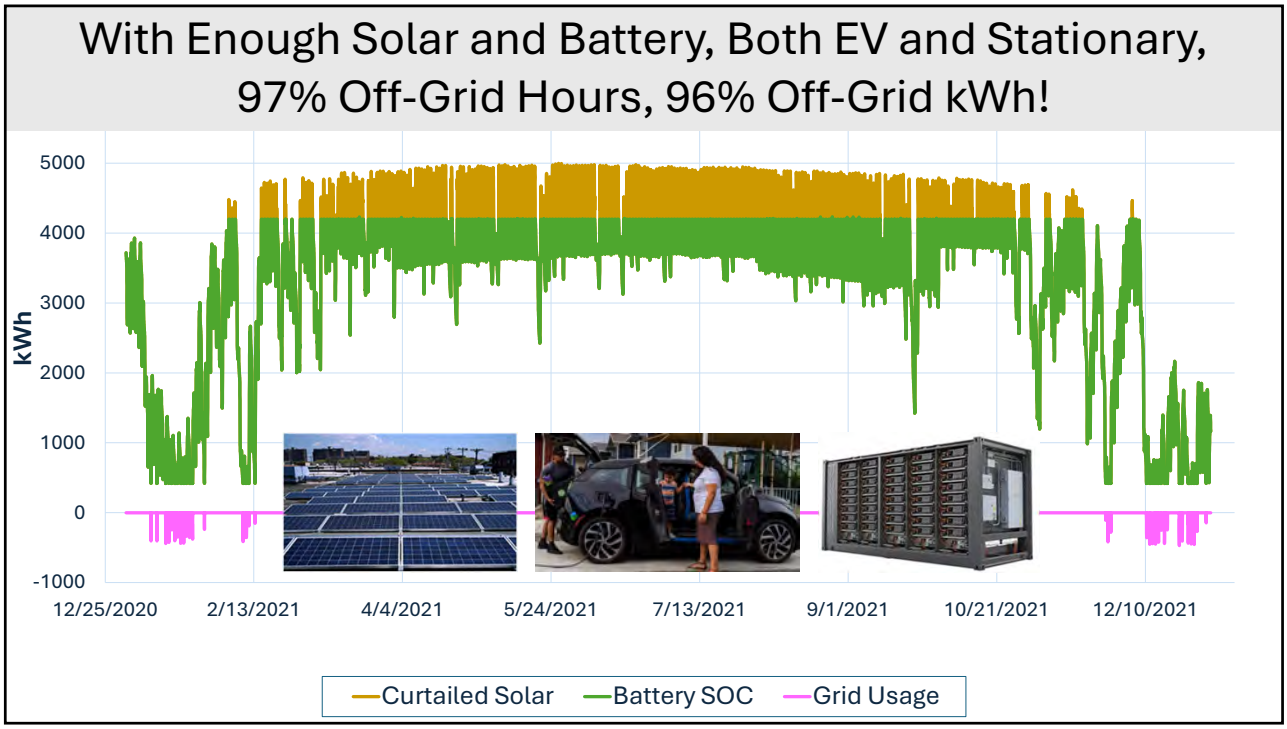
Miele Commercial HP Dryer vs. Resistance

CEF 9.7 vs. CEF 2.0

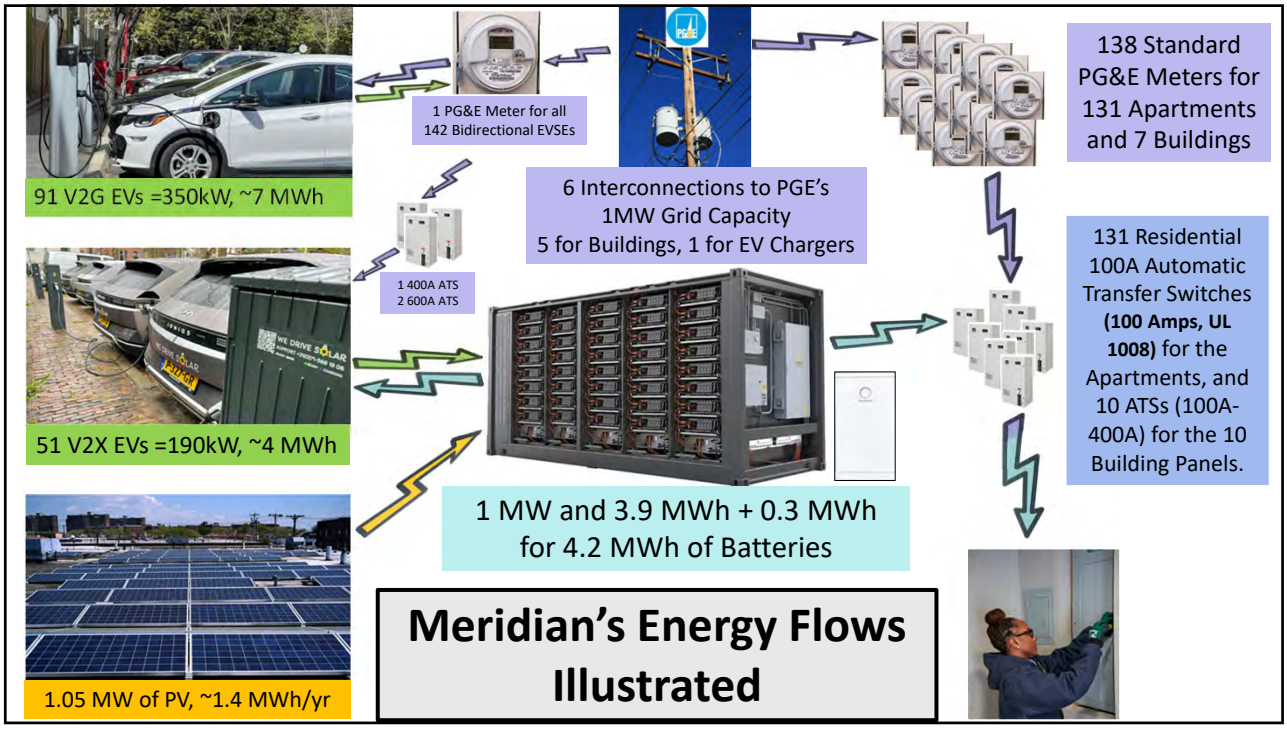
<u>$4,500 vs. $2200</u>

7-year payback

20


With Enough Solar and Battery, Both EV and Stationary, 97% Off-Grid Hours, 96% Off-Grid kWh!
kWh
5000
4000
3000
2000
1000
0
-1000
12/25/2020
2/13/2021
4/4/2021
5/24/2021
7/13/2021
9/1/2021
10/21/2021
12/10/2021
Curtailed Solar
Battery SOC
Grid Usage

21


91 V2G EVs =350kW, ~7 MWh
1 PG&E Meter for all 142 Bidirectional EVSEs
138 Standard PG&E Meters for 131 Apartments and 7 Buildings
6 Interconnections to PGE's 1MW Grid Capacity 5 for Buildings, 1 for EV Chargers
1 400A ATS
2 600A ATS
131 Residential 100A Automatic Transfer Switches (100 Amps, UL 1008) for the Apartments, and 10 ATSs (100A-400A) for the 10 Building Panels.
51 V2X EVs =190kW, ~4 MWh
1 MW and 3.9 MWh + 0.3 MWh for 4.2 MWh of Batteries
1.05 MW of PV, ~1.4 MWh/yr
Meridian's Energy Flows Illustrated

22

For $12M: An Electric “Silent 120” Luxury Yacht, Jet Ski and Submarine
100% Off-Grid 100 miles/day on 40kW of Solar + 800kWh Battery

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Thank you for your attention!

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The Future of Net Zero Energy
NEW SOLUTIONS FOR A NEW ERA
pae-engineers.com | March 4, 2026
PAE

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Engineering
that matters
PAE

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Leaders in Sustainable Design

20 LIVING BUILDINGS
6 ACHIEVED | 14 PURSUING

18 CARBON NEUTRAL
8 ACHIEVED | 10 PURSUING

56 NET ZERO ENERGY
15 ACHIEVED | 41 PURSUING

13 PASSIVE HOUSE
6 ACHIEVED | 7 PURSUING

112 LEED PLATINUM
60 ACHIEVED | 52 PURSUING

100 ALL ELECTRIC
47 ACHIEVED | 53 PURSUING

PAE **PAE Living Building**| Portland, OR

27

Net Zero Energy

28

WHAT IS A NET ZERO ENERGY BUILDING?
NREL DEFINITION:

Zero energy buildings produce at least as much energy as they consume on an annual basis.

It's so easy to say and understand…
…who wouldn't want one?

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"Net Zero Energy" means...

Annualized

(i.e. compounded across the year)

Energy is made when the sun is shining

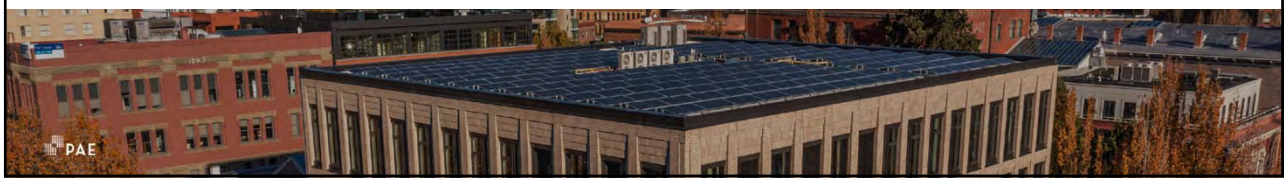
(for solar)

"Hey Utility! Take all the clean energy I make and find a good use for it."

(if you can)

When my building is not producing surplus renewable energy, it's buying energy from the grid...

whatever energy is flowing on the grid at that time.



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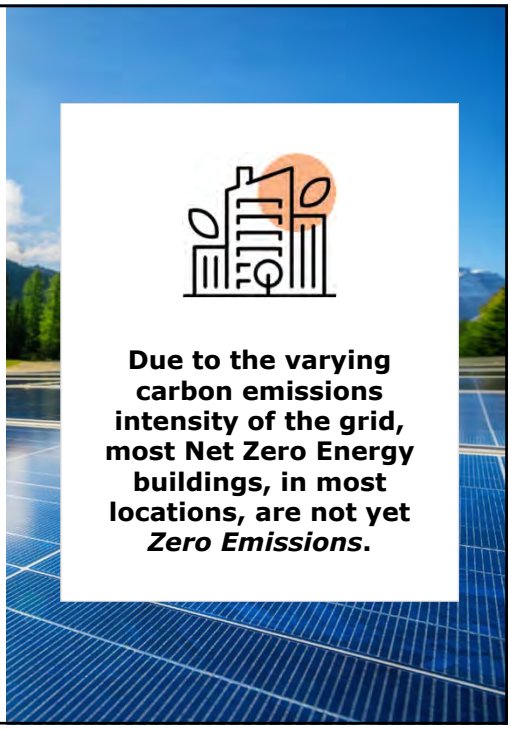
"Net Zero Energy" is not...

Fully addressing operational carbon emissions

"Zero Carbon"

The end game in Green Building...

But it is an important step along the way.



Due to the varying carbon emissions intensity of the grid, most Net Zero Energy buildings, in most locations, are not yet *Zero Emissions*.

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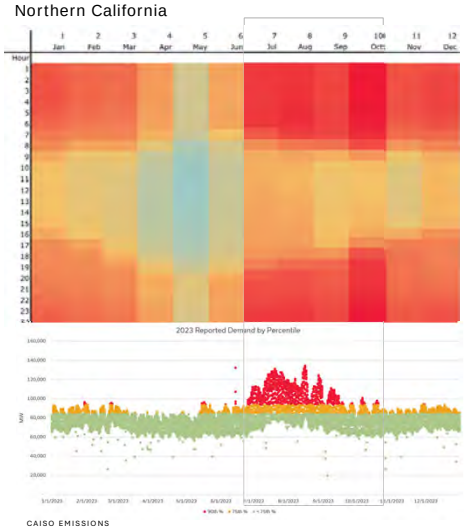
Load Shifting

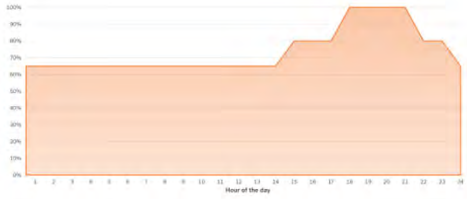
Cost Reductions, Emissions Avoidance, and Grid Resilience

Northern California

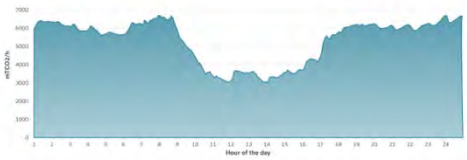


CAISO EMISSIONS

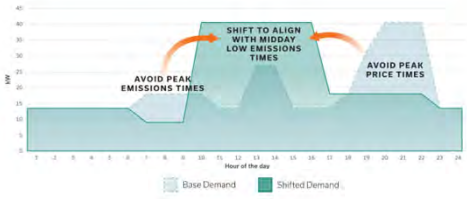
TOU PRICING



AVOIDED EMISSIONS



DEMAND SHIFT



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The Future is Now

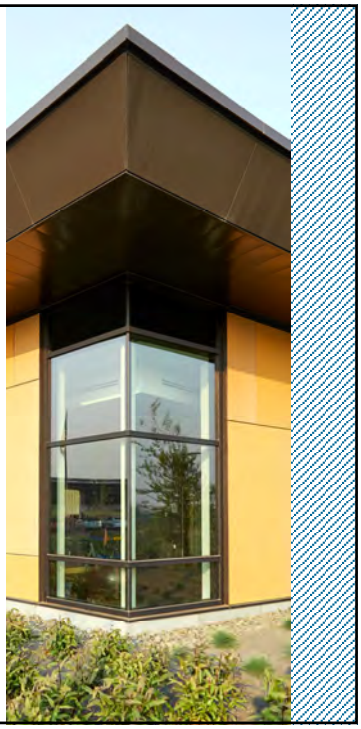
33

Introducing: Future Ready Buildings

A Future Ready Building is an energy-efficient building that flexibly and strategically adapts when and how it uses energy to reduce operating costs, function efficiently during disruptive events, and minimize carbon emissions.

Benefits:

- Energy savings
- Cost savings
- Increased building resilience
- Decarbonization benefits



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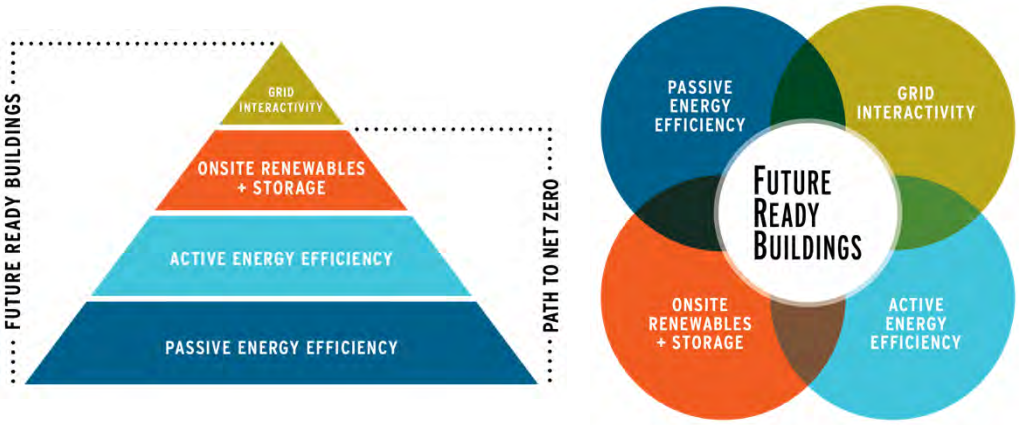
What Makes a Building Future Ready?

A Future Ready Building has features that help make its energy use efficient and flexible.



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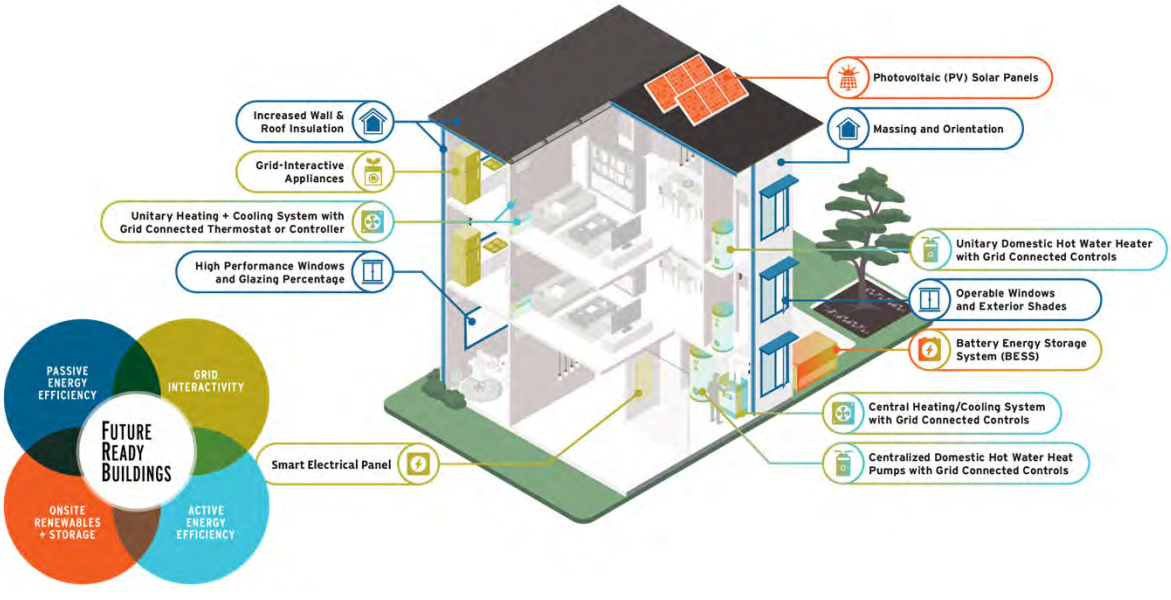
What Makes a Building Future Ready?



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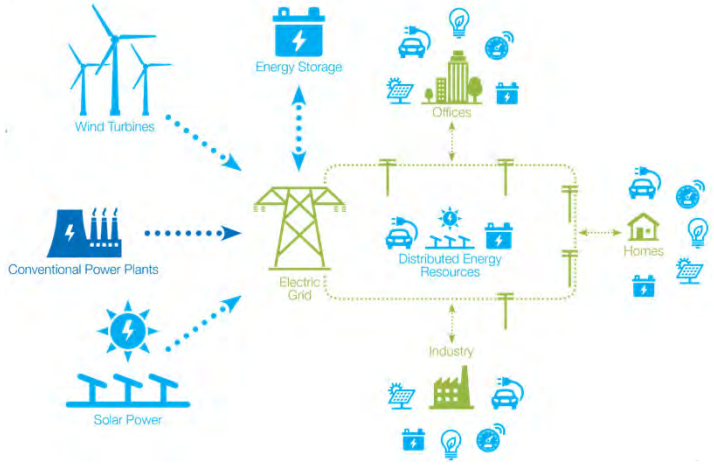
GridOptimal empowers players on both sides of the meter to actively support the transition to a carbon-free grid.



GridOptimal Technologies and Strategies

renewable energy · energy efficiency · electric vehicle · energy storage · smart connected controls

GRIDOPTIMAL BUILDINGS INITIATIVE

https://newbuildings.org/resource/gridoptimal/

EnergyTrust of Oregon

www.energytrust.org/future-ready-buildings

CONTACT US TO ENROLL YOUR PROJECT:

newbuildings@energytrust.org
or call 1.877.467.0930

SCAN THE QR CODE TO LEARN MORE:

OR VIEW THE LINK BELOW

https://register.gotowebinar.com/register/4124185006287033690

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CASE STUDY

The PAE Living Building

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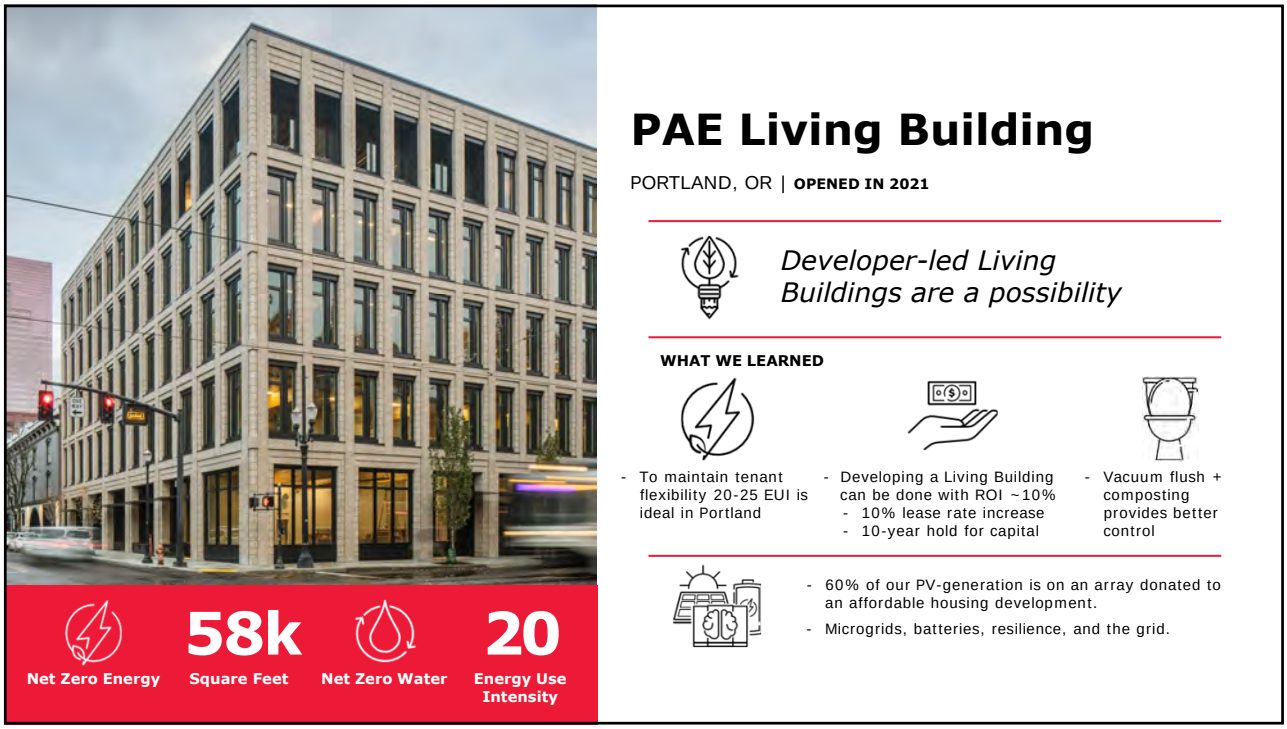


PAE Living Building

PORTLAND, OR | **OPENED IN 2021**

Developer-led Living Buildings are a possibility

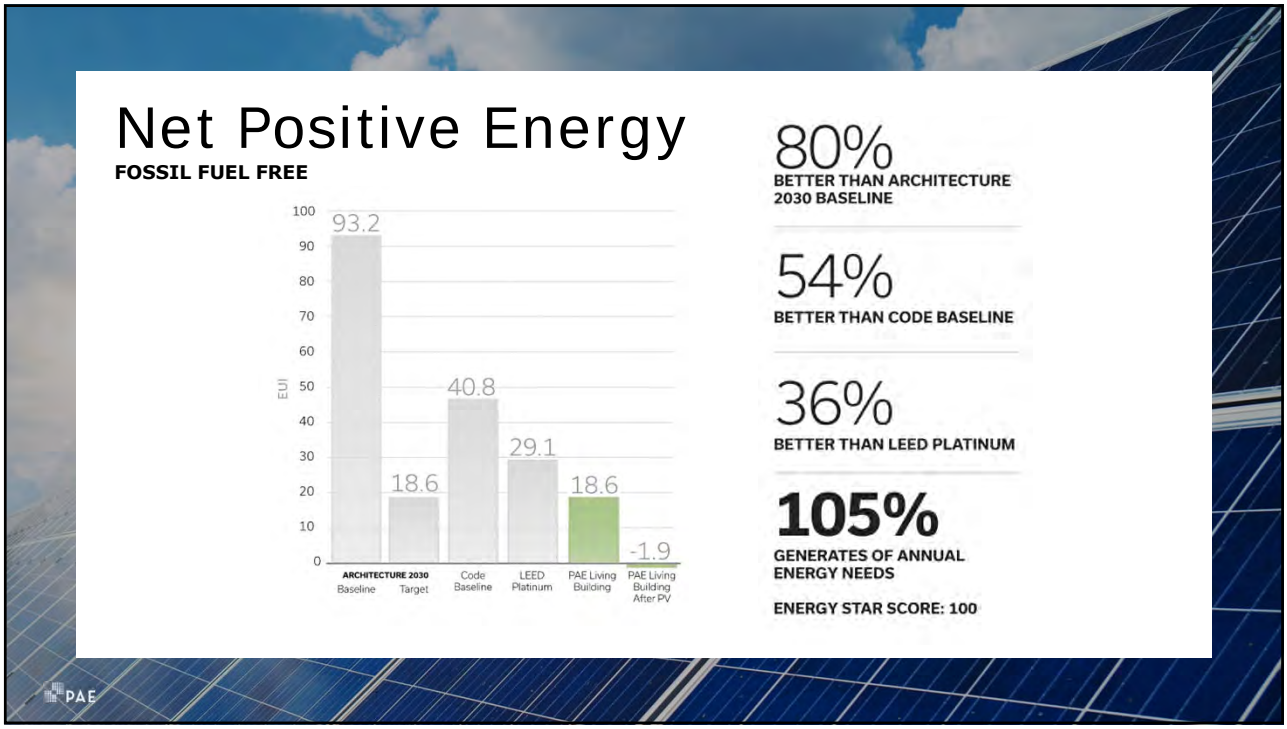
WHAT WE LEARNED

- To maintain tenant flexibility 20-25 EUI is ideal in Portland
- Developing a Living Building can be done with ROI ~10%
  - 10% lease rate increase
  - 10-year hold for capital
- Vacuum flush + composting provides better control

- 60% of our PV-generation is on an array donated to an affordable housing development.
- Microgrids, batteries, resilience, and the grid.

Net Zero Energy | **58k** Square Feet | **Net Zero Water** | **20** Energy Use Intensity

39



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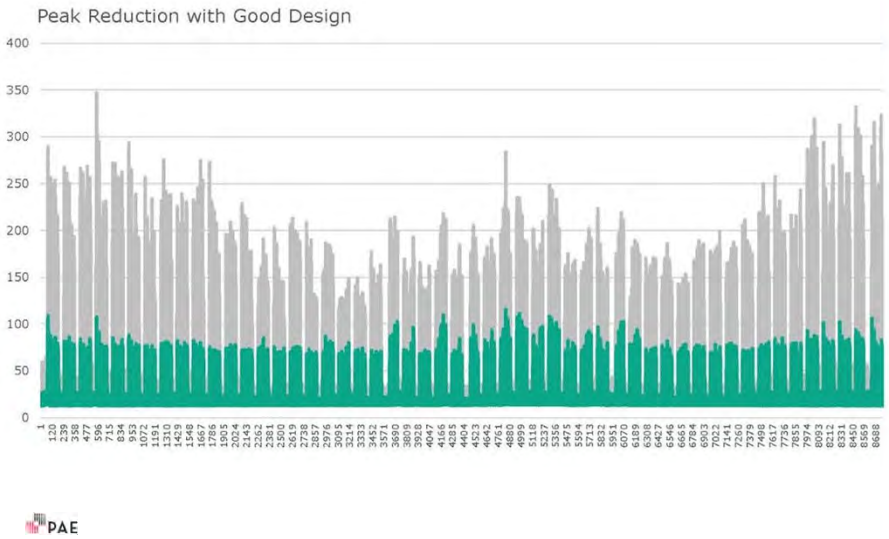
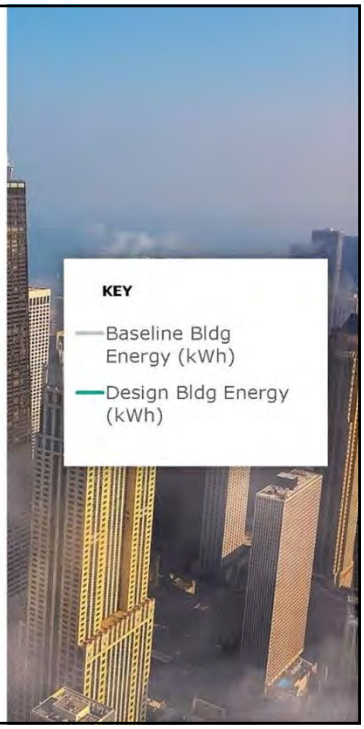
Stop Peaks Before They Start





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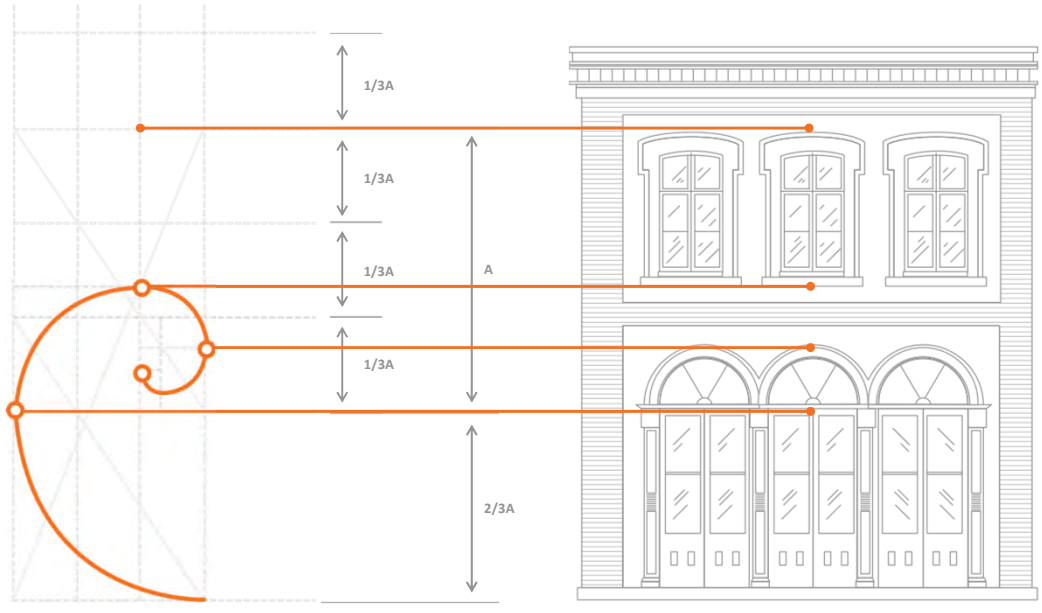

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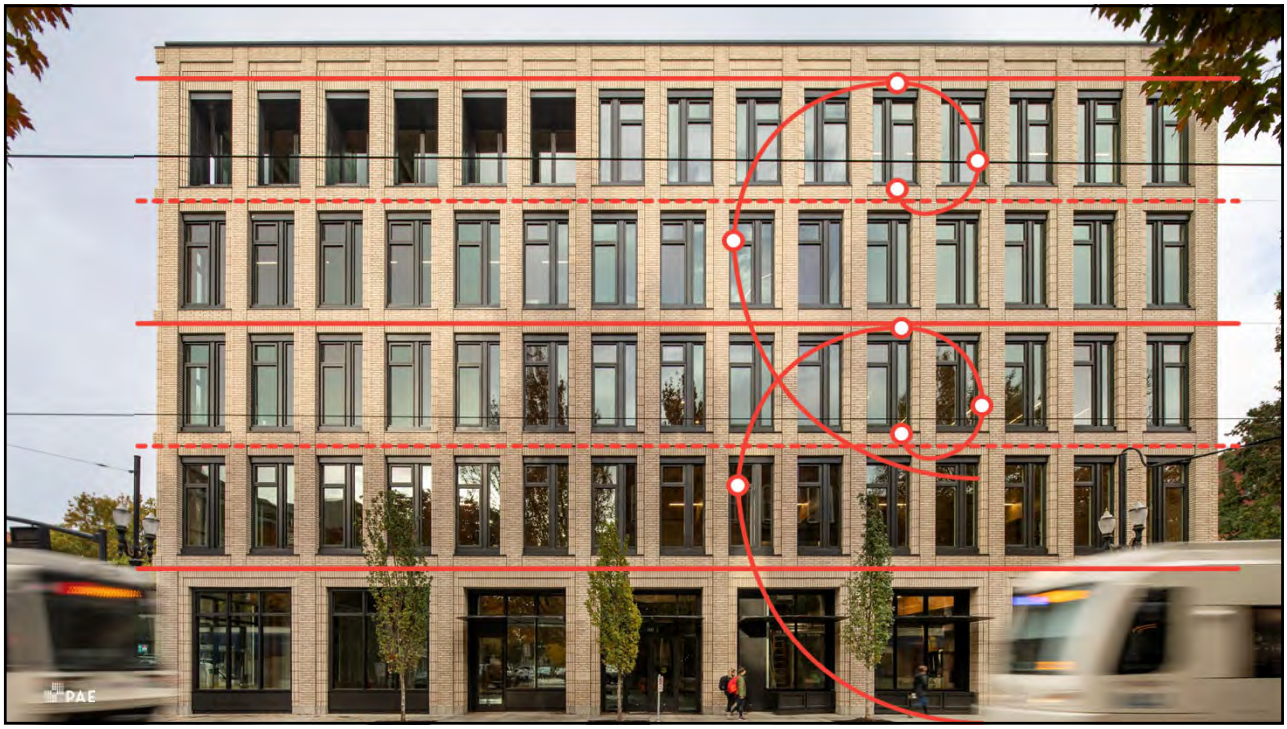

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Reduce Peaks Through Design

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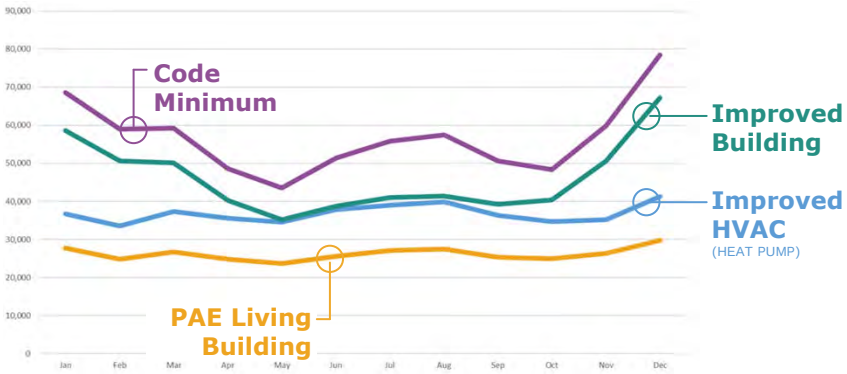

PEAK REDUCTION THROUGH DESIGN:

Improved Building = Summer Peak Reductions

Heat Pump = Winter Peak Reduction

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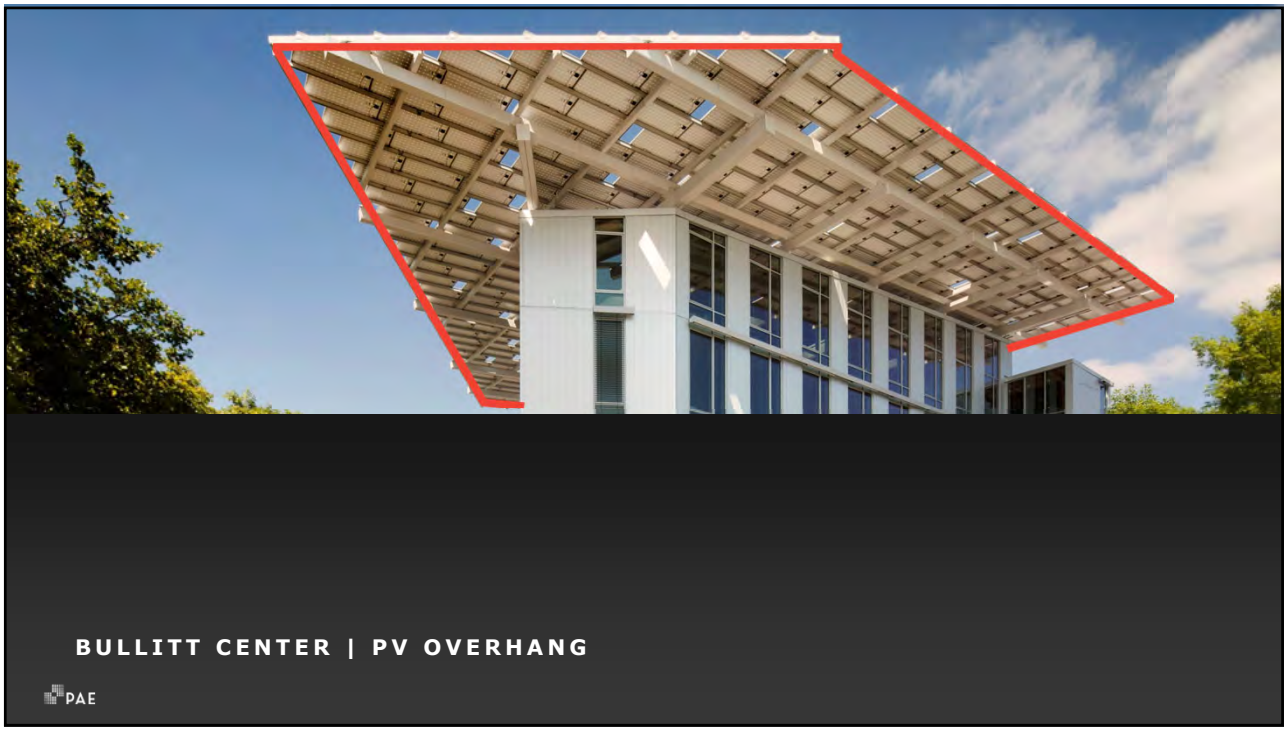

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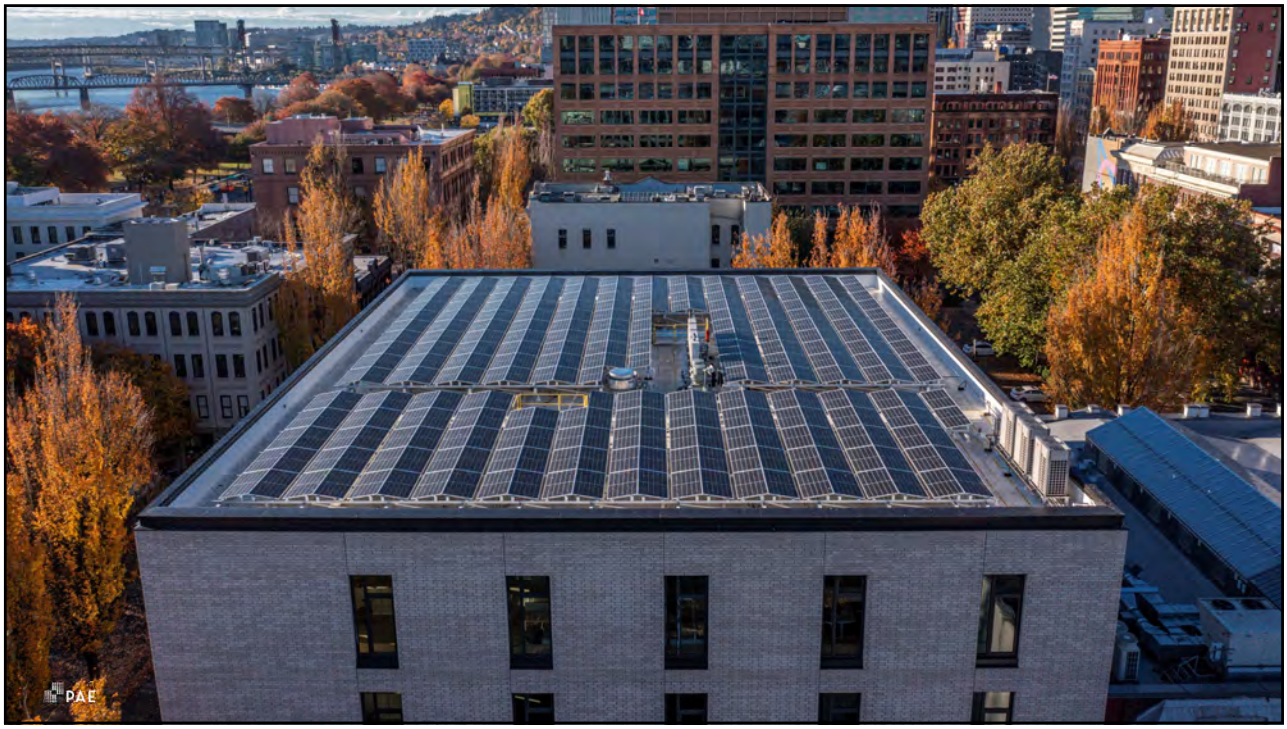

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PAE Living Building
PHOTOVOLATIC ARRAY
SUPPORTS
Affordable Housing
RENAISSANCE COMMONS
PHOTOVOLATIC ARRAY
SUPPORTS
GRID
PAE

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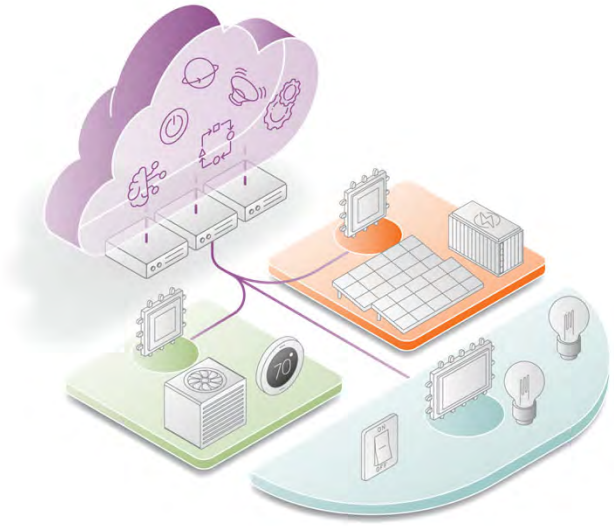

Ongoing Research

— Continued optimization of grid-interactivity of the microgrid with PGE

— Pilot project exploring the future of building controls. External partners:

SkyCentrics · ONUMA · CSB FOUNDATION · THE LINUX FOUNDATION · IBB Interoperable Building Box

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PE, LEED AP | ASSOCIATE PRINCIPAL
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151 SW 1st Avenue, Suite 300
Portland , OR 97204

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Questions?

Thank you for your interest and joining us today!

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Want to go deeper?

BESF webinar on Future Ready Buildings - Modeling Tools, Resources and Incentives

Attend the webinar that follows next

https://register.gotowebinar.com/register/4124185006287033690

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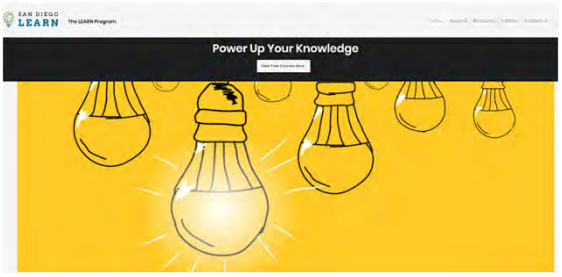
Share your feedback in this short survey

Power up your electrification knowledge with the San Diego LEARN program: www.sandiegolearn.com



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Other LEARN courses of interest:

Batteries Hidden in Plain Sight: HPWHs with Thermal Storage

Using HPWHs to conserve space while storing more energy.

Net Zero Energy

Essentials of Zero Net energy buildings, campuses, and communities, and the "passive house."

Microgrids for a Resilient, Renewable Future

How microgrids are playing a role in modernizing the power grid and strengthening community resilience.

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