



(G09) Decarbonization and Resiliency in Affordable Multi-Family Housing: Emerging Practices, Research and Case Studies

THURSDAY, SEPTEMBER 28, 2023
11:15 AM – 12:15 PM US EDT
LOCATION: ROOM 204BC

PRESENTED BY:



David Baker Architects



AGENDA

11:15am

Overview

11:20am

Presentations

Christian J. Agulles, PE
PAE Consulting Engineers



Christian J. Agulles

Katie Ackerly, AIA, CPHC
David Baker Architects



Katie Ackerly

Matt Roberts, PhD
CBE, UC Berkeley



Matt Roberts

11:55am

Discussion and Q&A

David Lehrer, LEED, RA
CBE, UC Berkeley (moderator)



David Lehrer

Tackling the Affordable Housing Crisis in America and Helping to Fix the World Along the Way



**Affordable
Housing Crisis**



**Decarbonize
the Grid**



**Passive Grid,
Interactive Buildings**



**PAE Living
Building Lessons**



**Energy Poverty and
Virtual Net Metering**



**Case
Study**

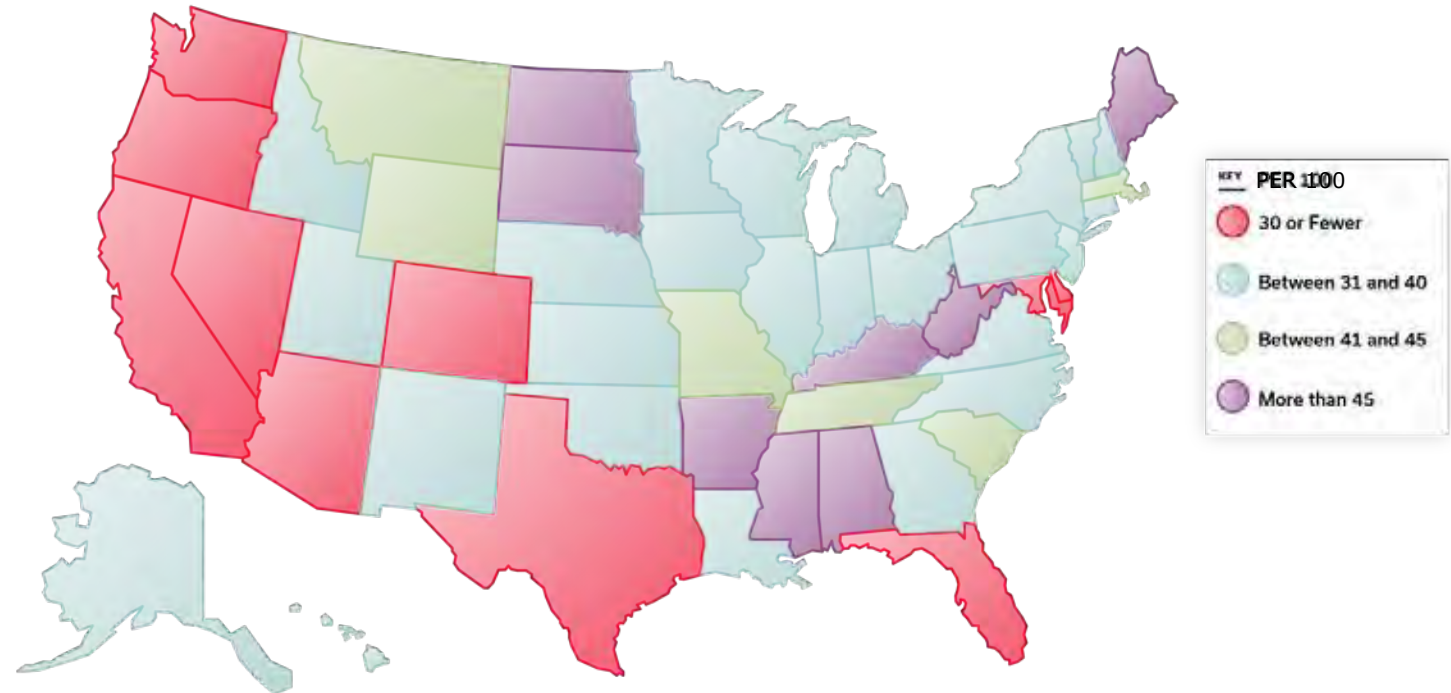


Affordable Housing Crisis



NATIONAL SHORTAGE OF AFFORDABLE RENTAL HOUSING

The U.S. has a shortage of **7.3 million** affordable housing units available to renters with extremely low incomes.



NATIONALLY

33

Per 100 households

Note: Extremely low-income (ELI) renter households have incomes at or below the poverty level or 30% of the area median income.

Source: NLIHC tabulations of 2021 1-year ACS PUMS Data.

Why it Matters?

Housing is the key to reducing intergenerational poverty and increasing economic mobility

Safe, clean, affordable housing addresses:

- **Mental Health**
- **Family Stability**
- **Health and Education Disparities**
- **Energy Poverty**

**DID YOU
KNOW?**

“There is no state or county in America where a renter working full-time earning minimum wage can afford a two-bedroom apartment.”

Source: NLIHC.org

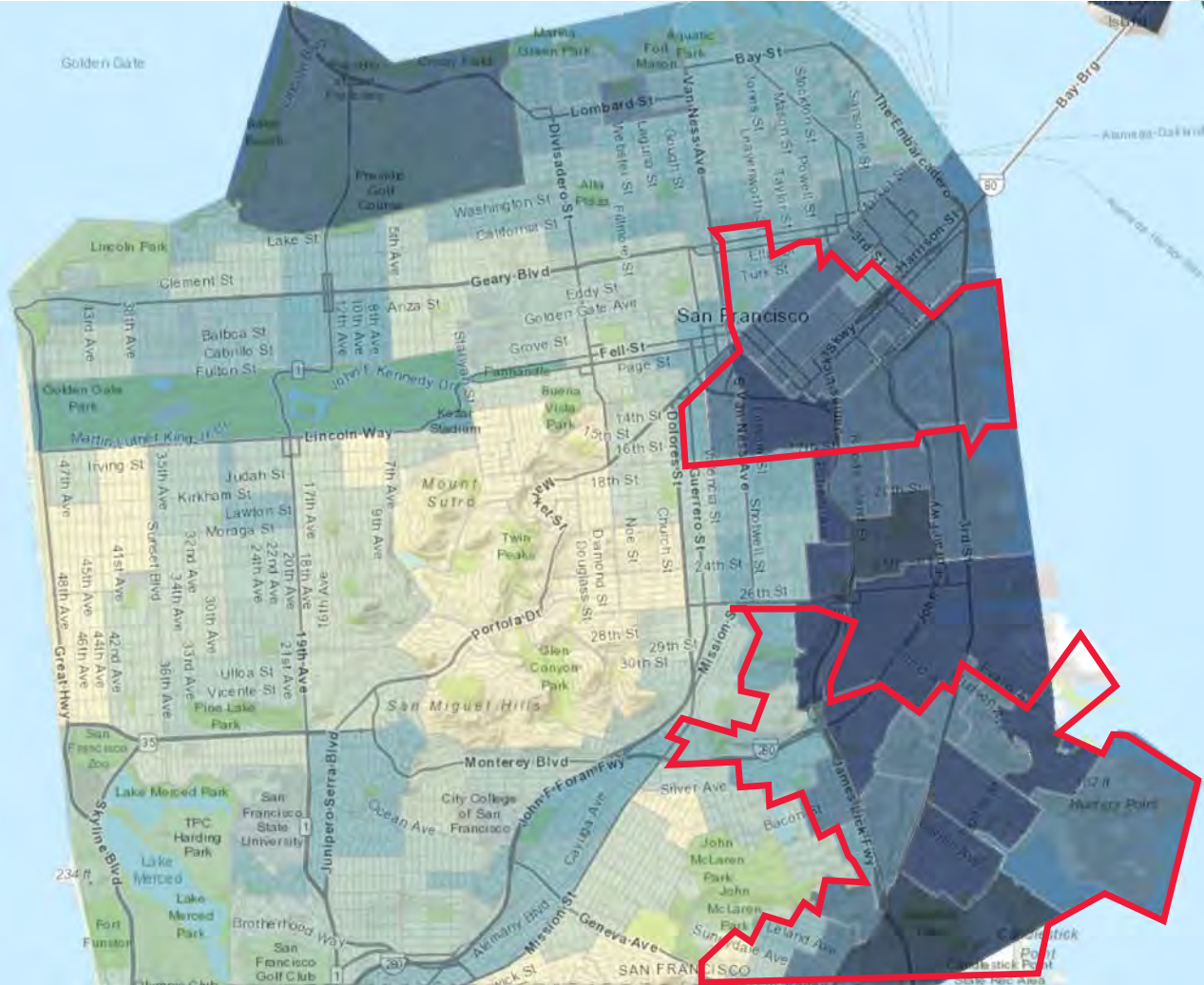
Air Pollution-Poverty Correlation

Environmental Injustice

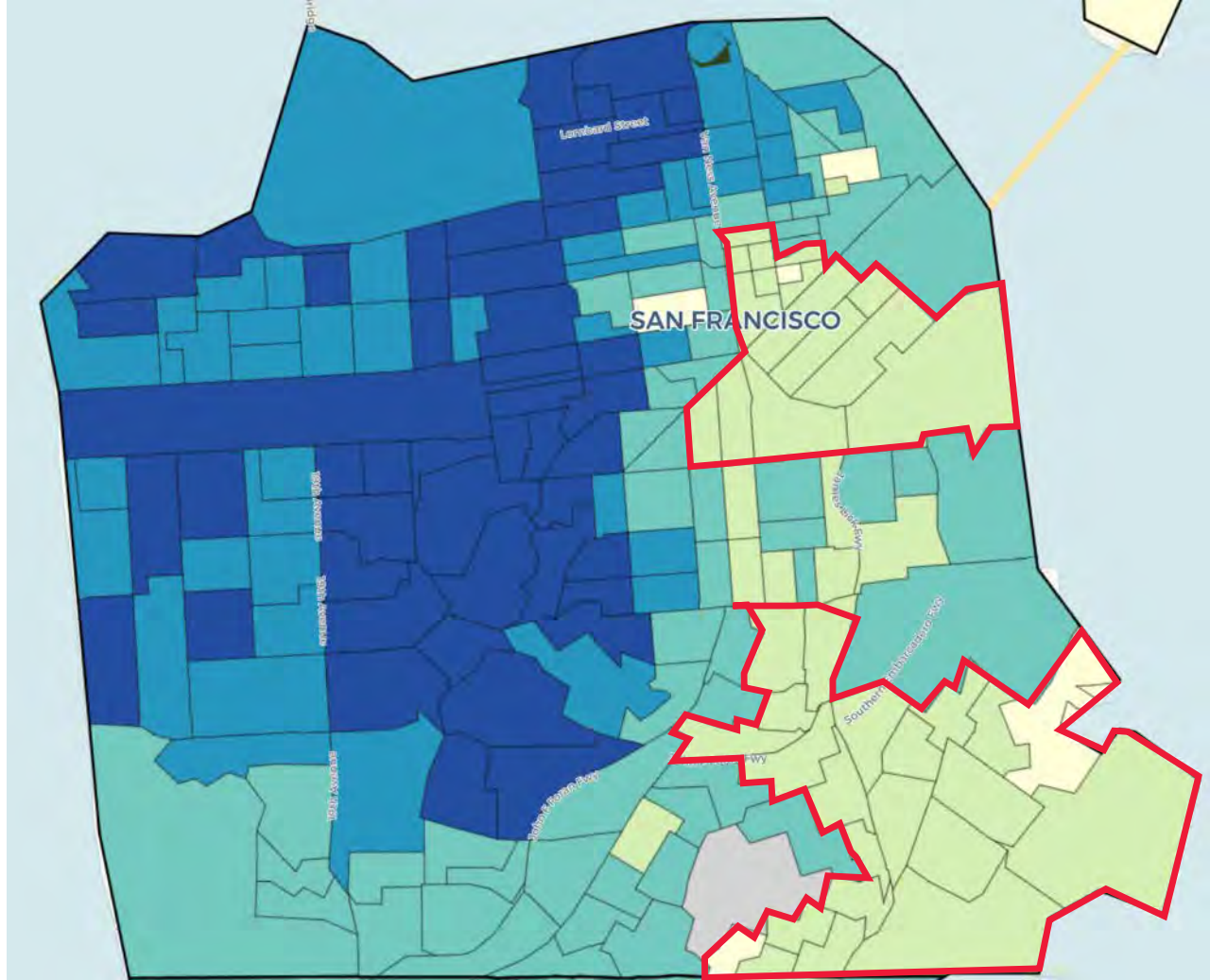
Socioeconomic factors often play a role in determining who bears the brunt of environmental degradation

Disproportionate Exposure

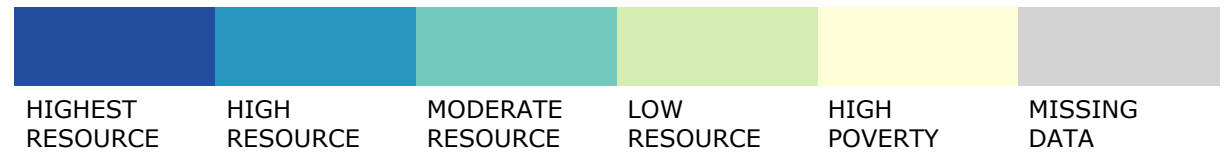
Low-income communities are more likely to be located near pollution sources

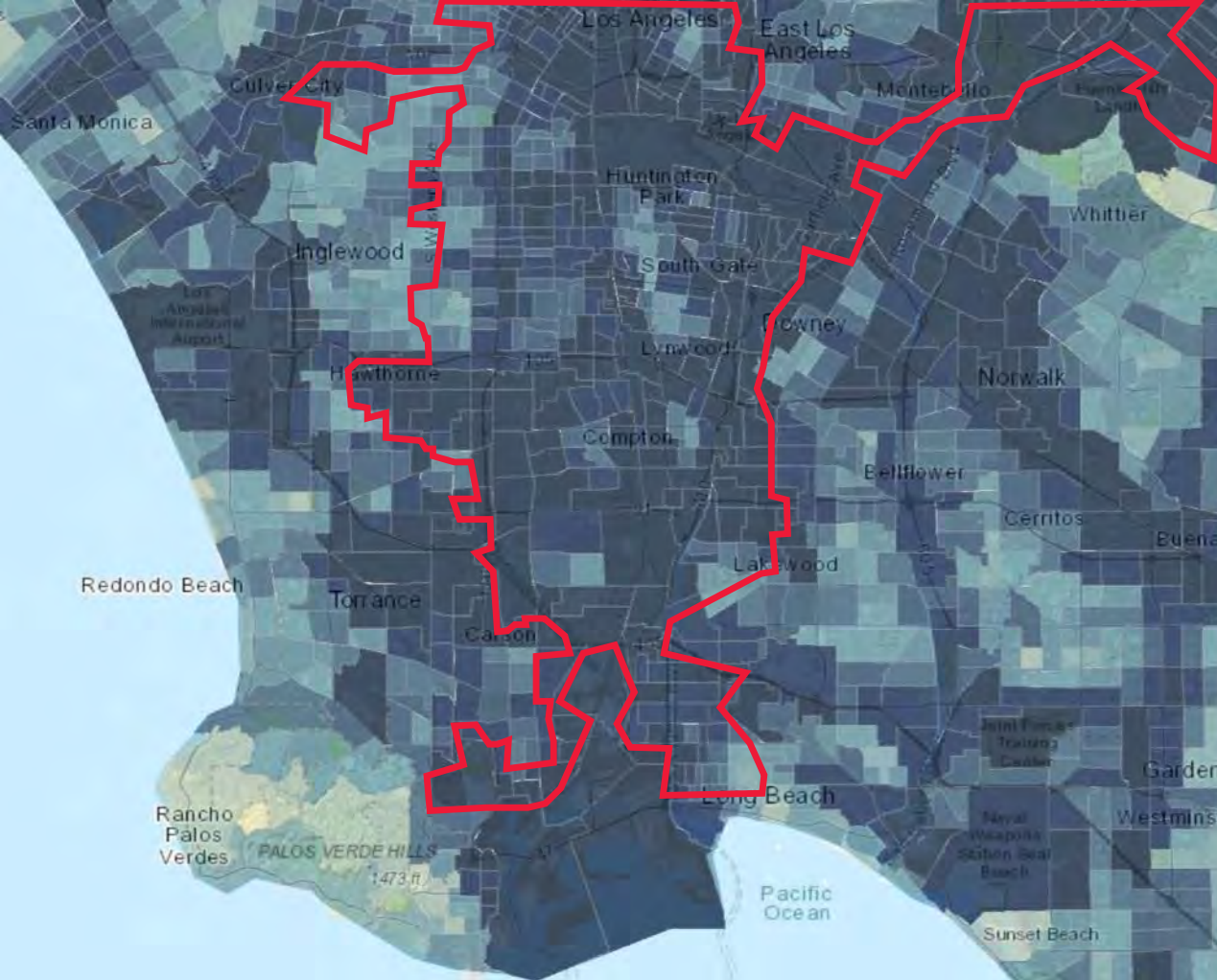


2021 Results
Air Pollution Map | SAN FRANCISCO

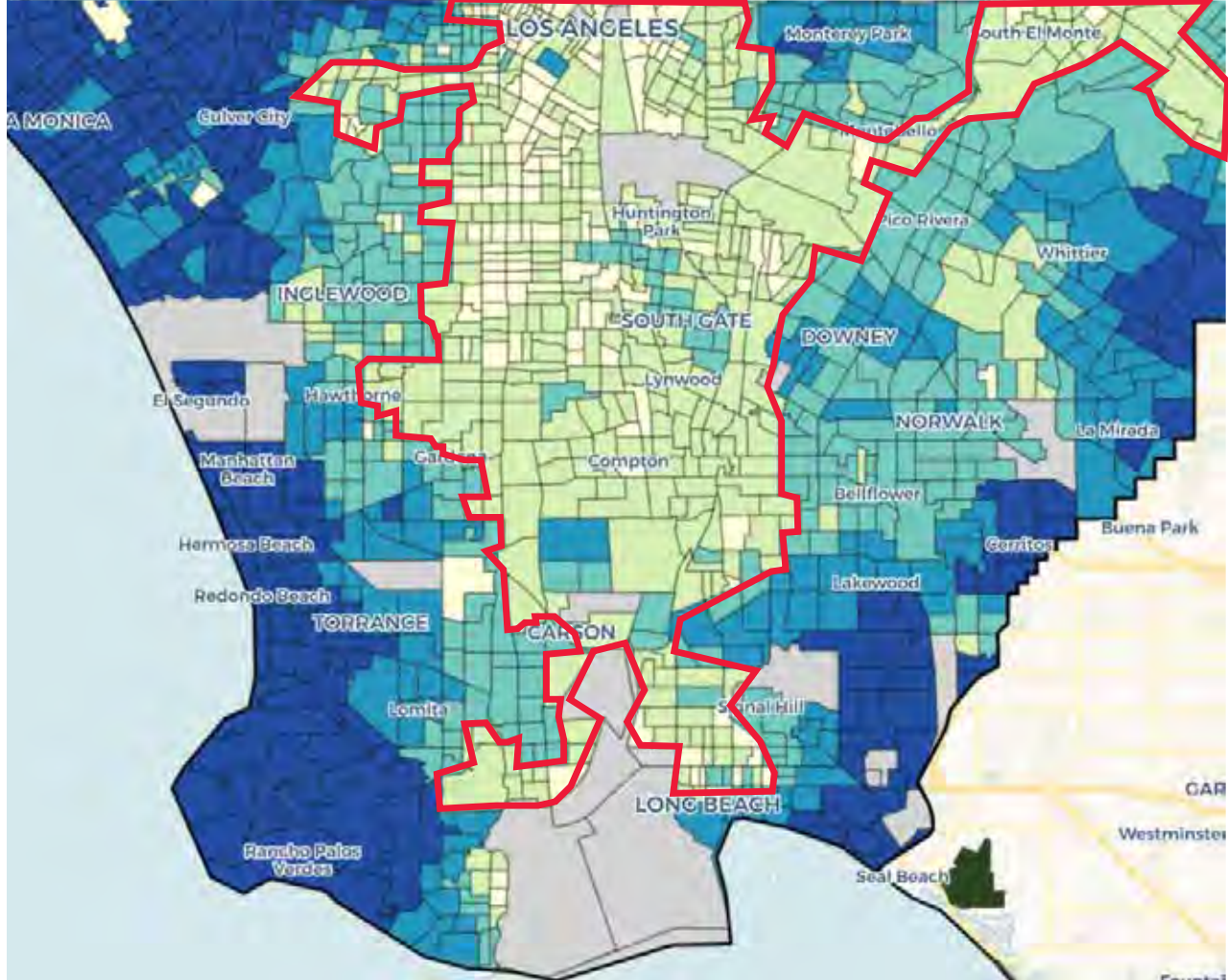


2023 Results
Opportunity Map | SAN FRANCISCO





2021 Results
Air Pollution Map | LOS ANGELES



2023 Results
Opportunity Map | LOS ANGELES





How can Equitable, Sustainable, and Resilient Affordable Housing Help Fix the World?

Combat racial and economic inequality by reducing intergenerational poverty and increase economic mobility

- **Mental Health**
- **Family Stability**
- **Health and Education Disparities**
- **Energy Poverty**

Decarbonize: Reduce emissions to mitigate the worst impacts of climate change

Why Decarbonize?

The background of the slide features several black silhouettes of oil pumpjacks (jack-o'-lanterns) against a warm, orange and yellow sunset sky. The pumpjacks are positioned at various heights and angles, creating a sense of depth and industrial activity. The overall mood is somber and urgent, reflecting the theme of decarbonization.

To avoid the most severe effects of climate change we need to limit global temperature rise to 1.5°C above pre-industrial levels. To achieve this goal developed countries need, by 2050, to have reduced their Greenhouse Gas emissions to 20% of what they were in 1990.

How can we Decarbonize?

- More Renewable Energy Production
- Distributed Energy Resources
- Electrify Buildings and Transportation

THE PROBLEM

- Increases Electrical Demand
- Imposes More Burden on the Grid

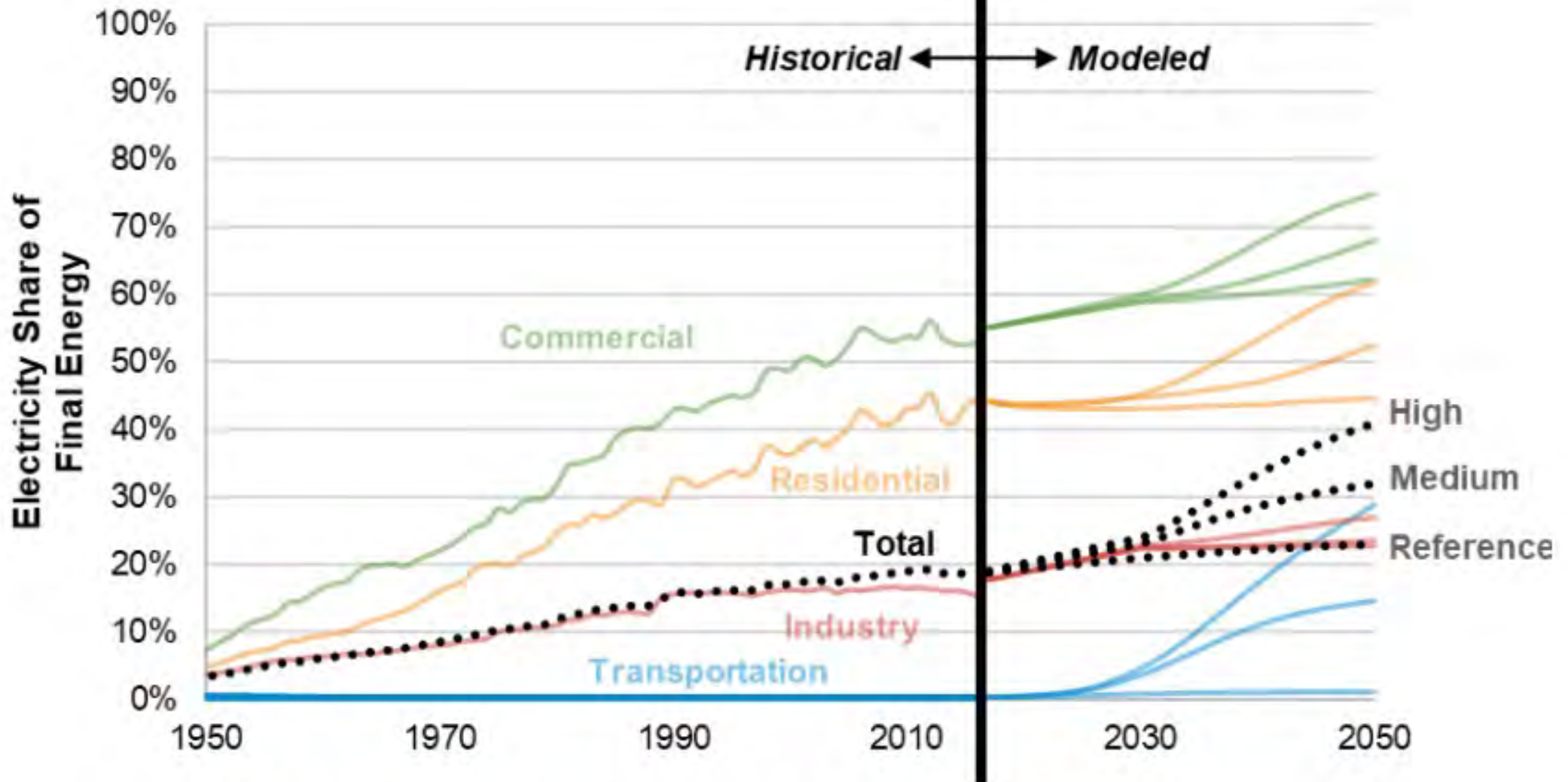


Figure ES-5. Electricity share of final energy consumption

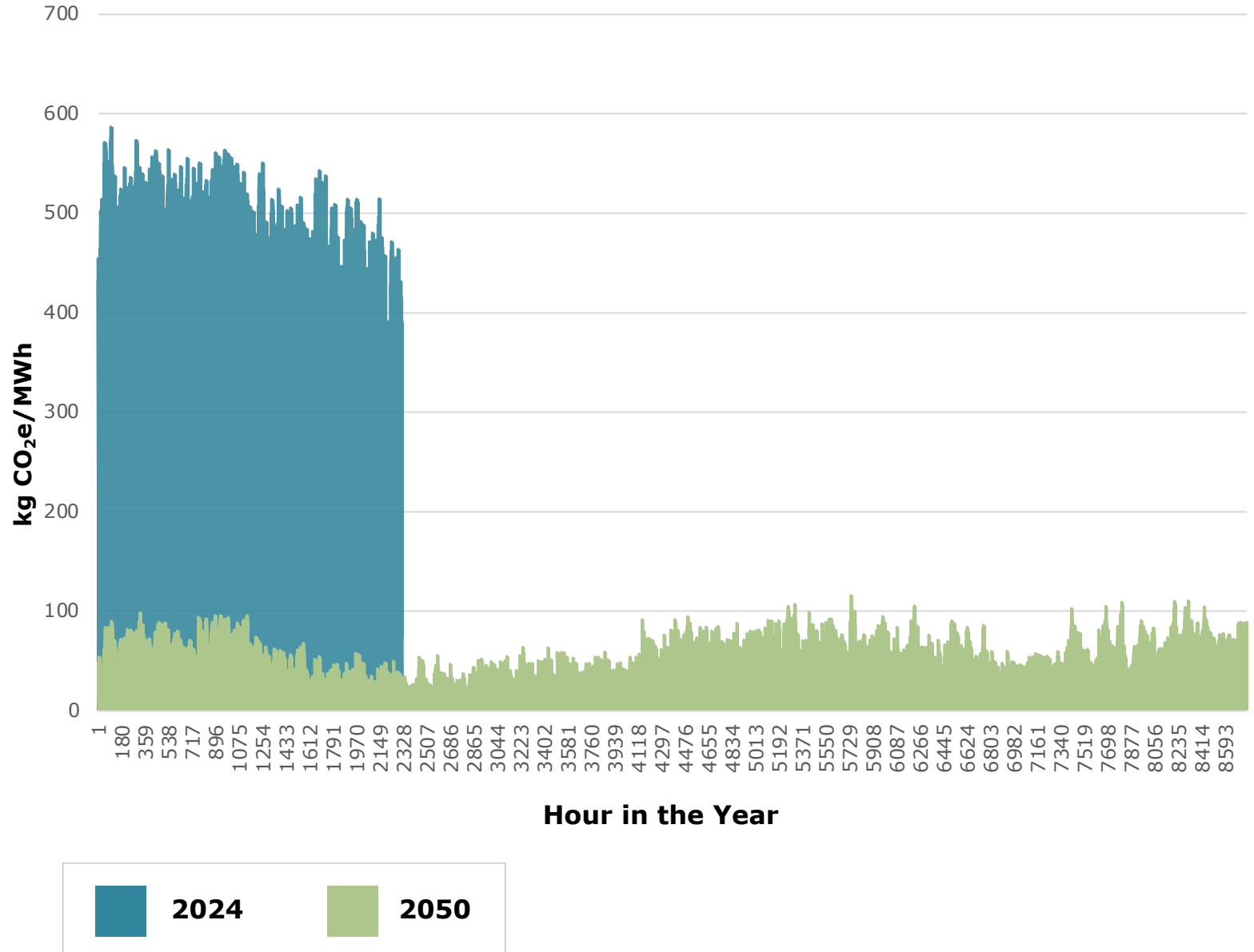
Source: NREL, Electrification Futures Study: Scenarios of Electric Technology Adoption and Power Consumption for the United States

20% to 40% Increased Burden on the Grid



**The utilities
can't solve
this alone**

US NATIONAL HOURLY GRID EMISSIONS

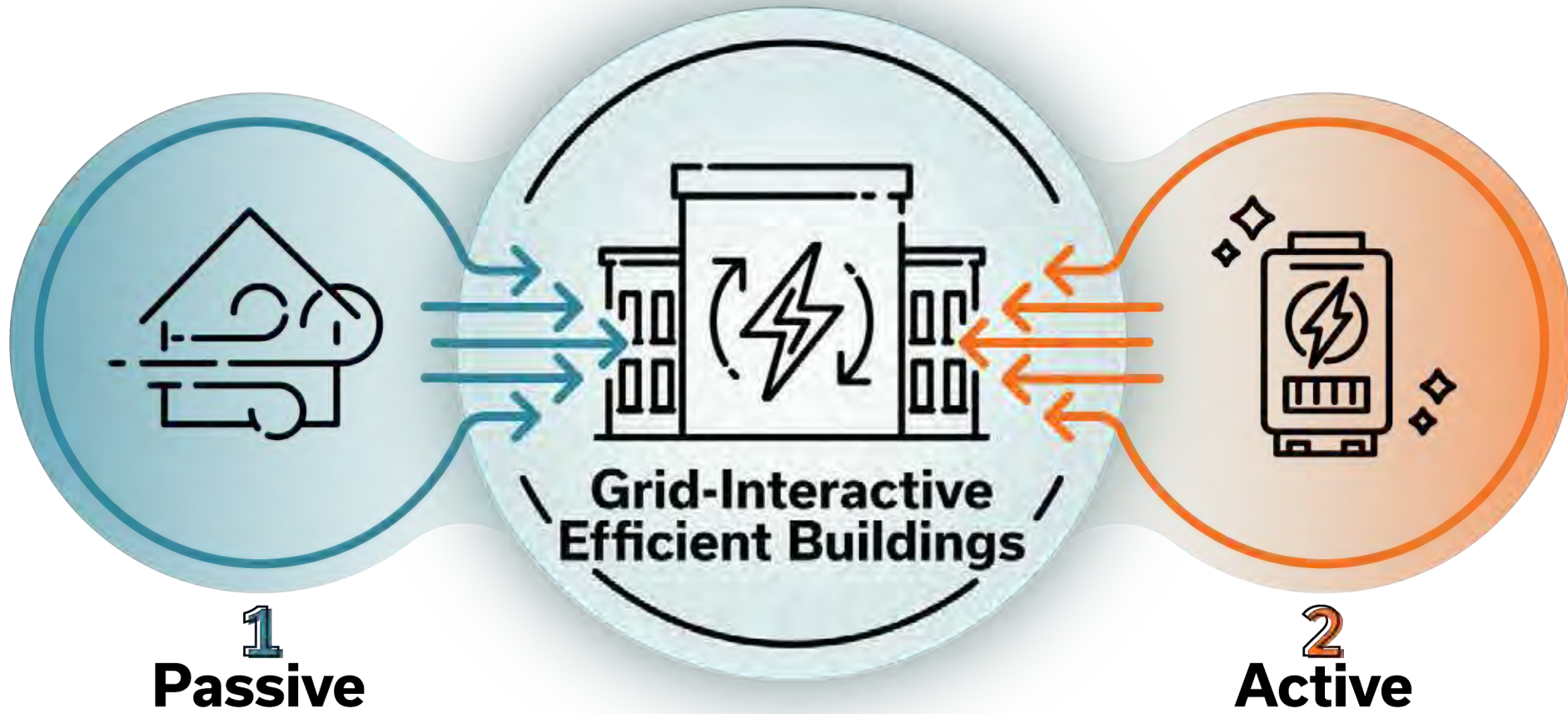


Source: Cambium 2022, Low-Cost Renewables Scenario



We Can Help!

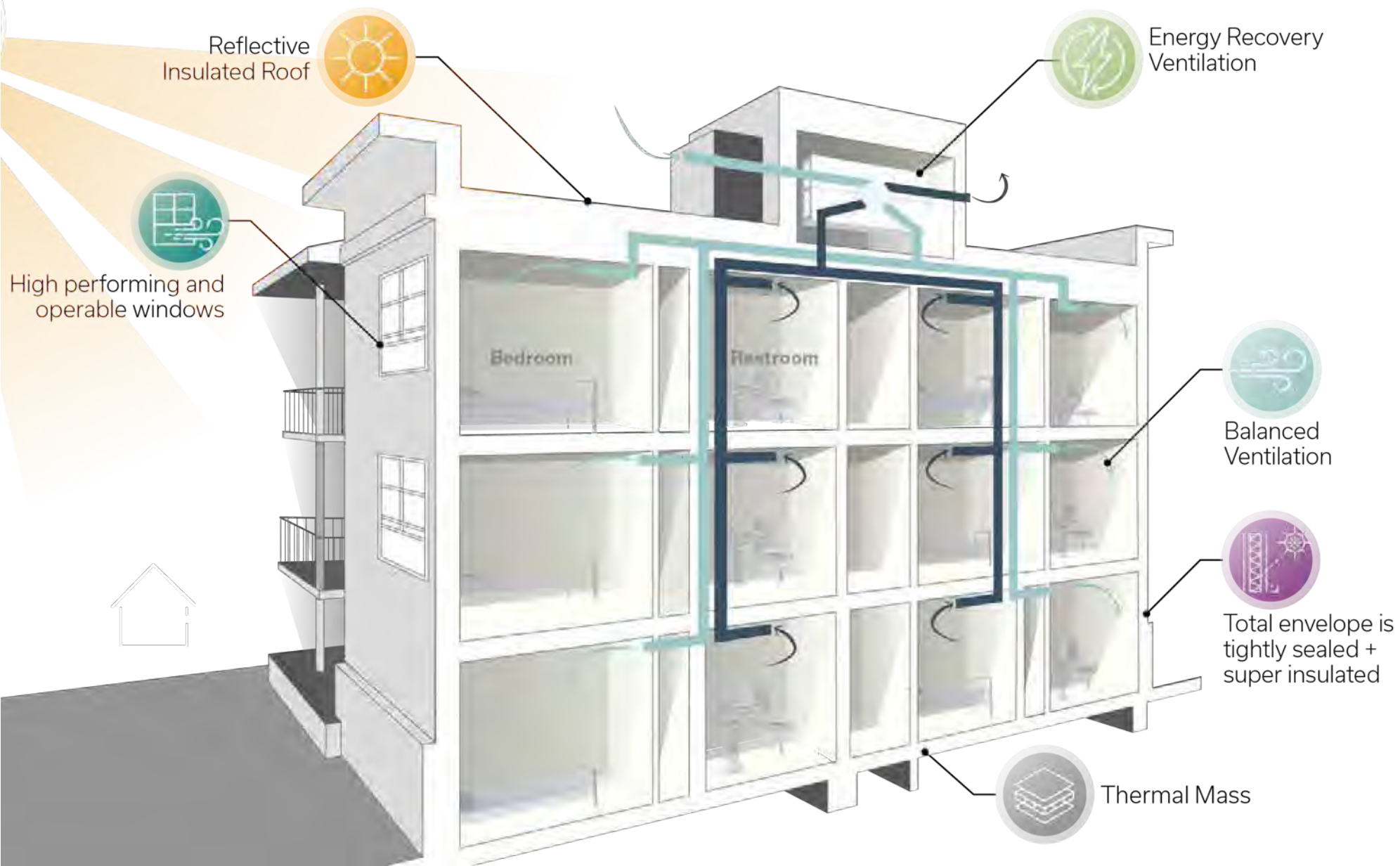
- Energy Efficient Building Strategies**
 - Install Renewables**
 - Distributed Energy Resources**
 - Grid-Interactive Efficient Buildings (GEBs)**
 - Building-Grid Integration**
-



PLACE-BASED BUILDING SOLUTIONS

ELECTRIC, EFFICIENT AND ABLE TO SHAPE LOADS

Passive Building Principles | Thermal Control





Design Efficient Buildings

- Drive Down EUI
- Reduce Total Loads
- Take Advantage of Heat Recovery
- Peak Load Reduction

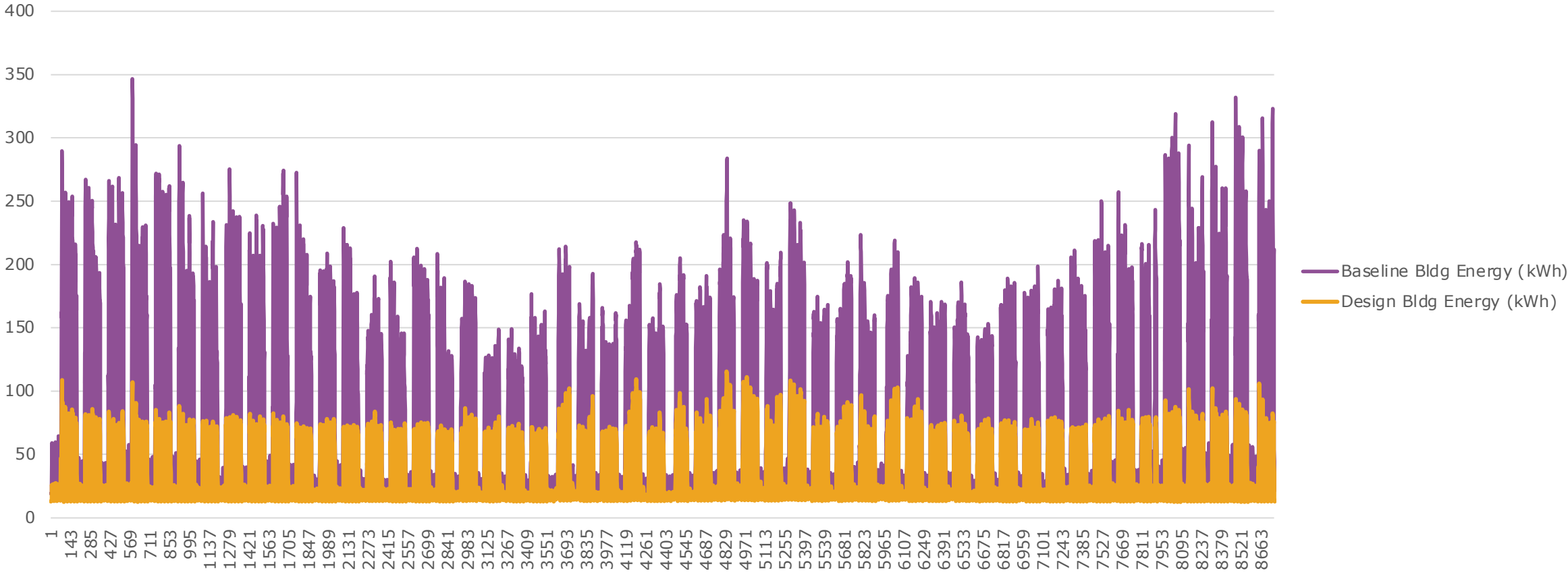


Electric and Able to Shape Loads

- Air-Source Heat Pumps
- Controls for Smart Thermostat Setpoint Adjustment
- Onsite Renewables
- Microgrids
- Distributed Energy Resources
 - Batteries
 - Domestic Hot Water Load Shift
 - Electric Vehicle Charging
- Grid Interactive Efficient Buildings

GOOD DESIGN = PEAK REDUCTION

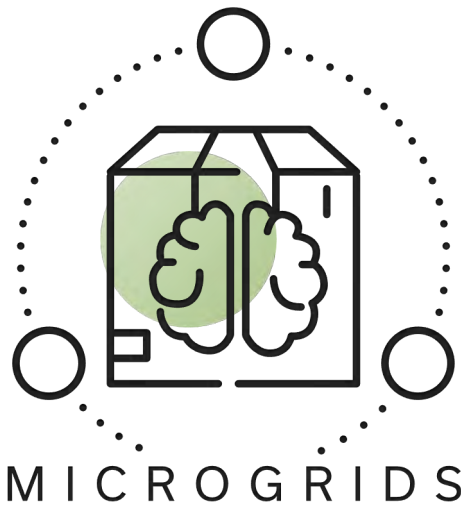
Peak Reduction with Passive Design



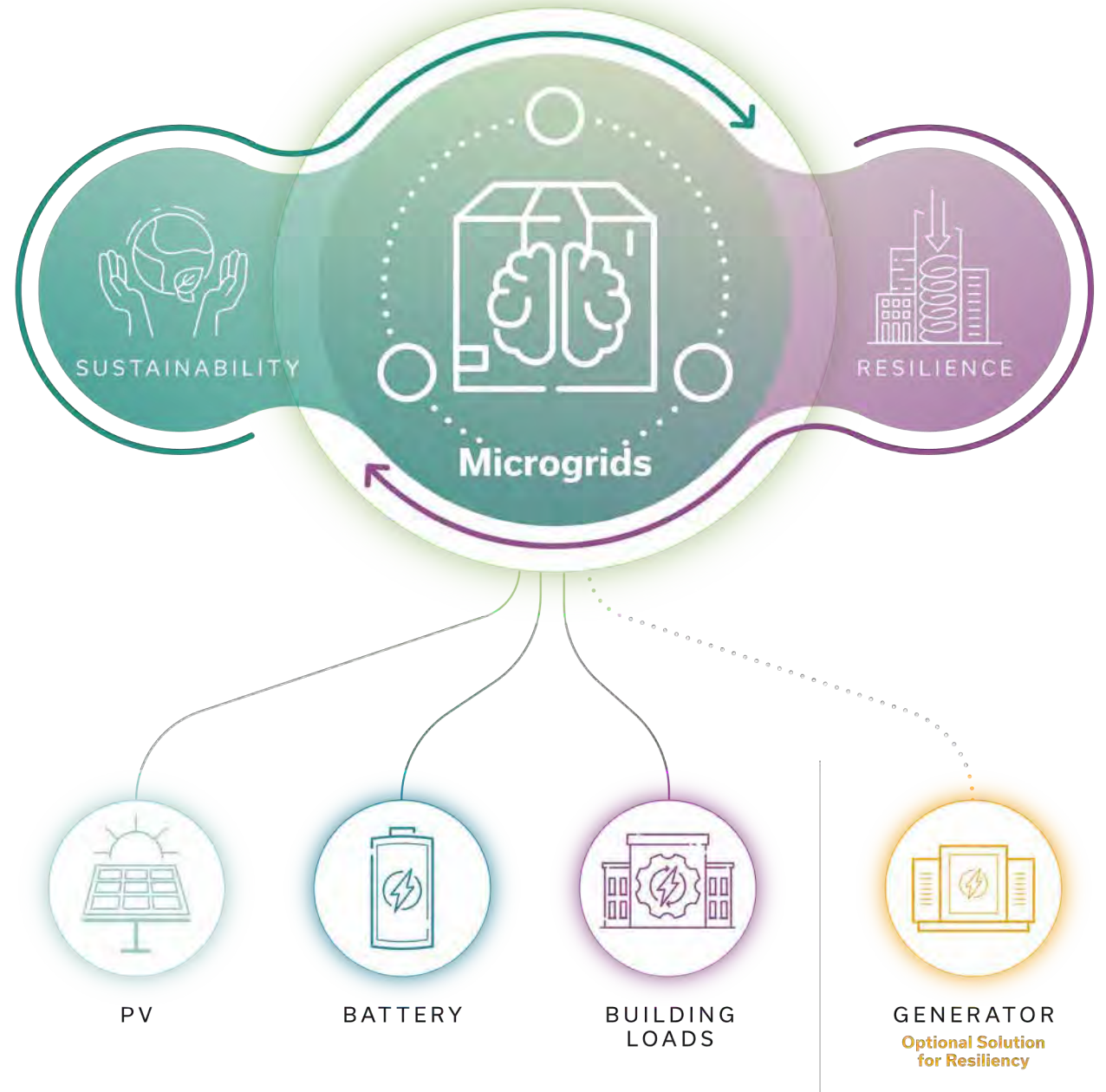


Microgrids for Resiliency in Affordable Housing

What is a Microgrid?



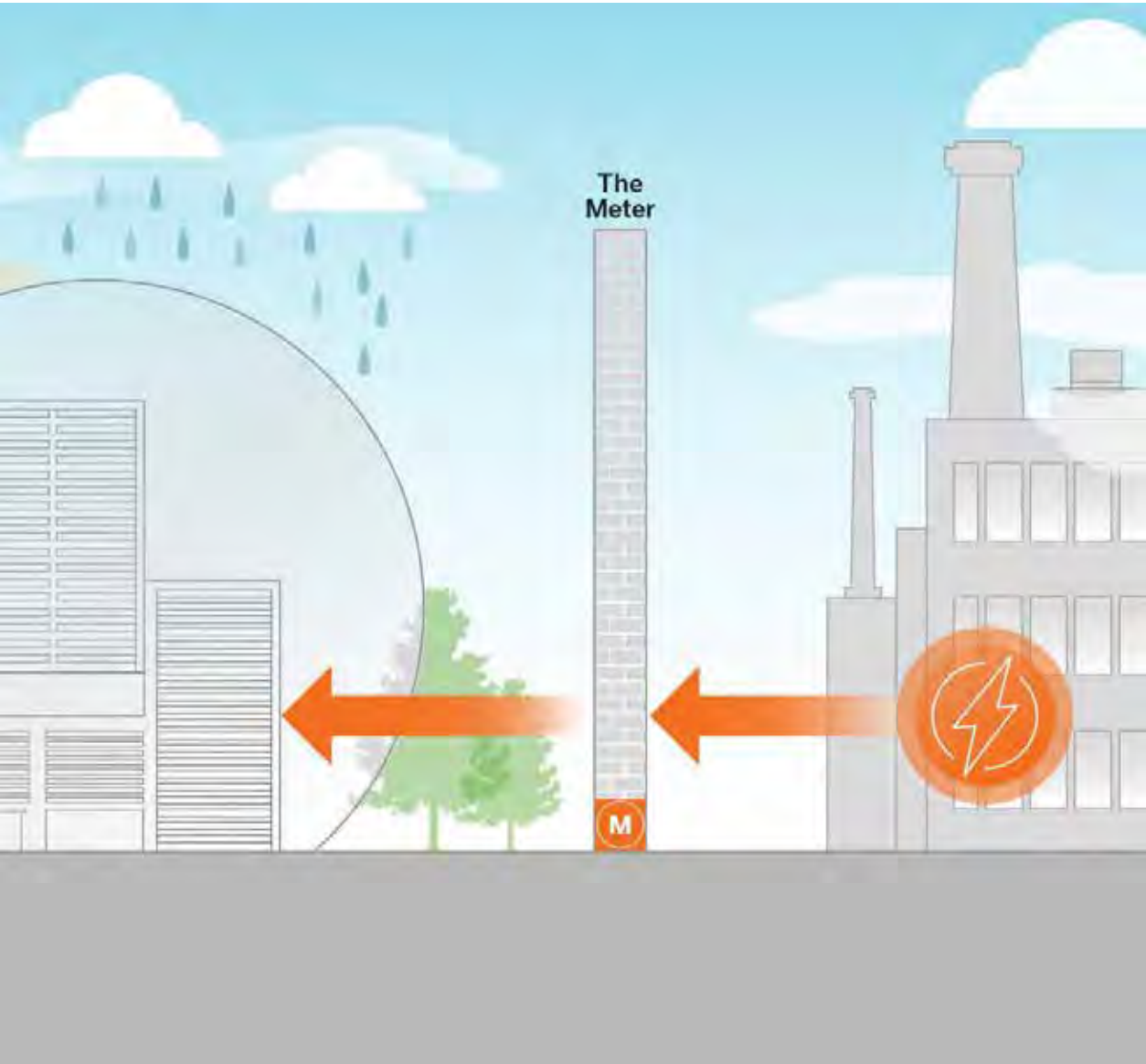
**Dynamically
operate a
building with or
without a grid.**



Standard Building + Electric Grid

vs.

Grid-Interactive Efficient Buildings



Grid Interactive Building

There are 3 key components in reaching a zero emissions energy sector:



Quantity



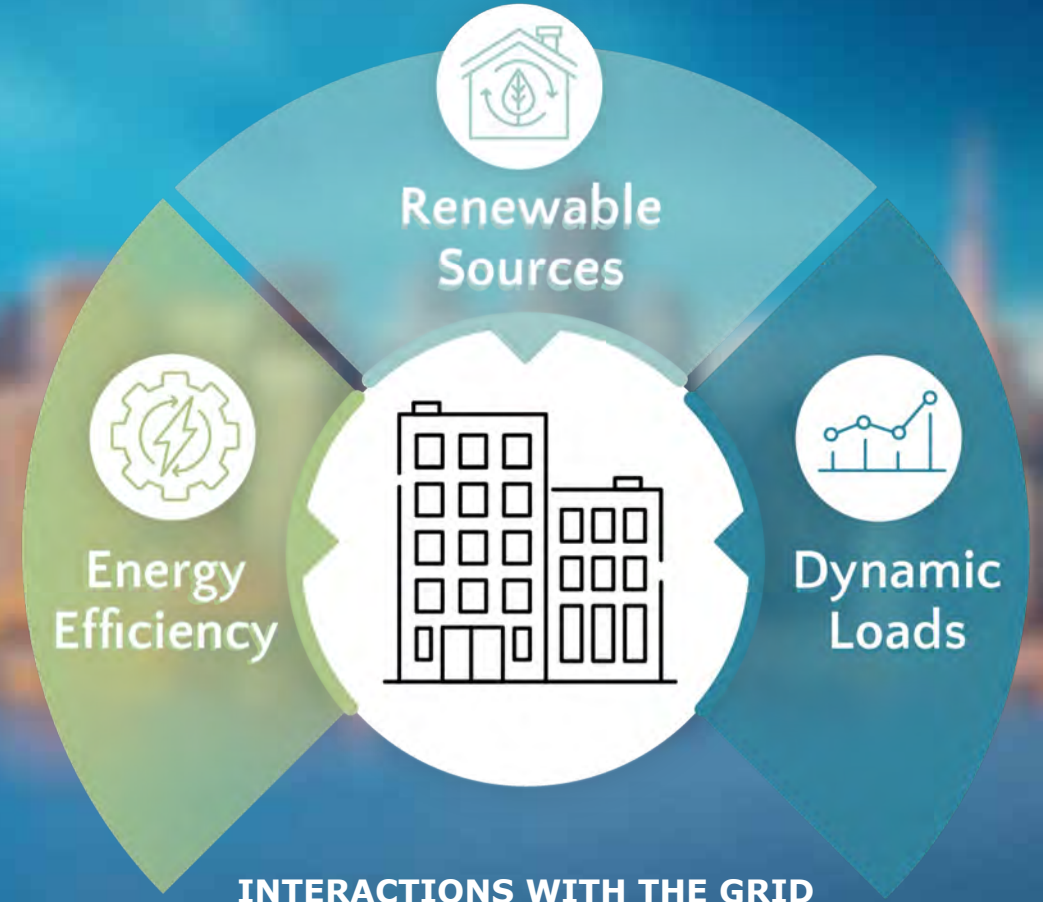
Source

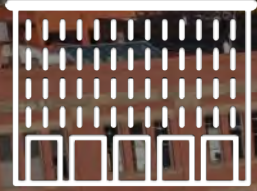


Time



A Grid-Interactive building is electric, efficient, and **able to shape its loads.**





PAE Living Building Lessons

THE CHALLENGE

- Mid-Rise Building with Net Zero Energy Goal
- Historic District Limitations
- Not Enough Available Roof Space for Net Zero Energy
- Find a Place for 12,000 sf of PV Panels
- Hard to Find Someone to Donate PV Panels to



**REACH Renaissance
Commons Affordable
Housing Project**

\$20,000/yr
Total Energy Generated

215 kW
PV Array

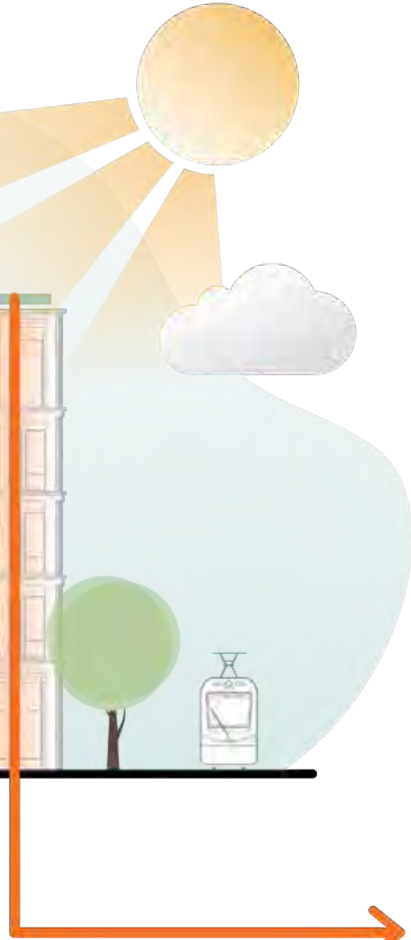
12,200
Square Feet of Area

PAE Living Building

PHOTOVOLATIC ARRAY



SUPPORTS



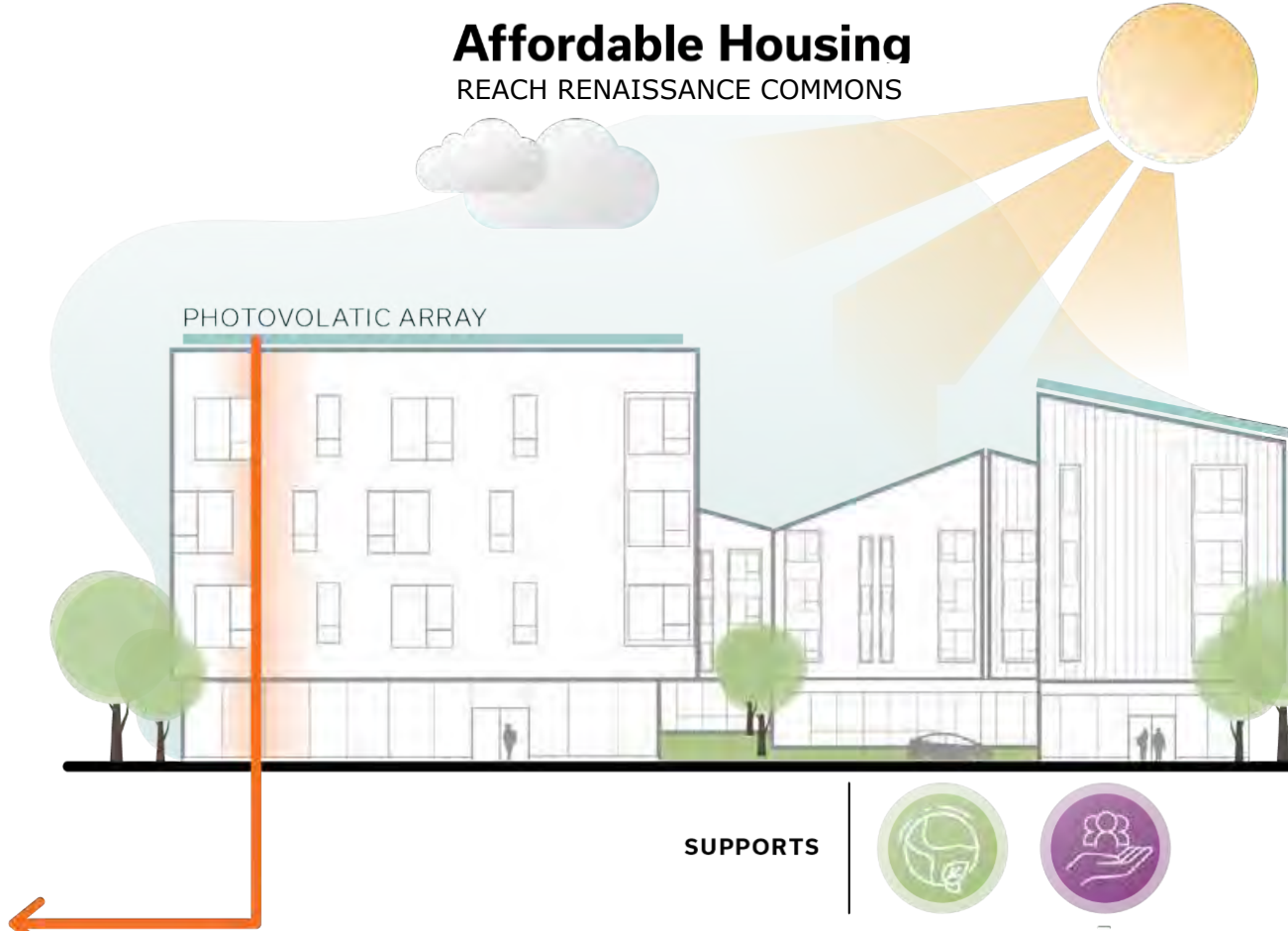
Affordable Housing

REACH RENAISSANCE COMMONS

PHOTOVOLATIC ARRAY



SUPPORTS



GRID

Who Benefited?



PAE

Achieved Net-Zero Energy



CITY

Progress toward Sustainability Goals



REACH

Free Energy



UTILITY

Progress toward Renewable Goals



What if...

There was an incentivized municipal framework that benefits everyone?

- Developers **achieve net-zero energy** goals
- Affordable housing **tenants get free power**
- Cities make progress to their **sustainability goals**
- Utilities make progress toward their **renewable portfolio targets.**



**Create a sustainable and equitable
energy model that brings together
multiple stakeholders**

What Could it Look Like?

Municipality

- Host a 'matchmaker' platform to list corporate real estate owners interested in donating solar panels
- Pair with suitable affordable housing projects
- Provide tax incentives for participating property developers and utilities.

NZE Building Owner

- Donate remaining PV panels required to achieve NZE to affordable housing project.

Utility Companies

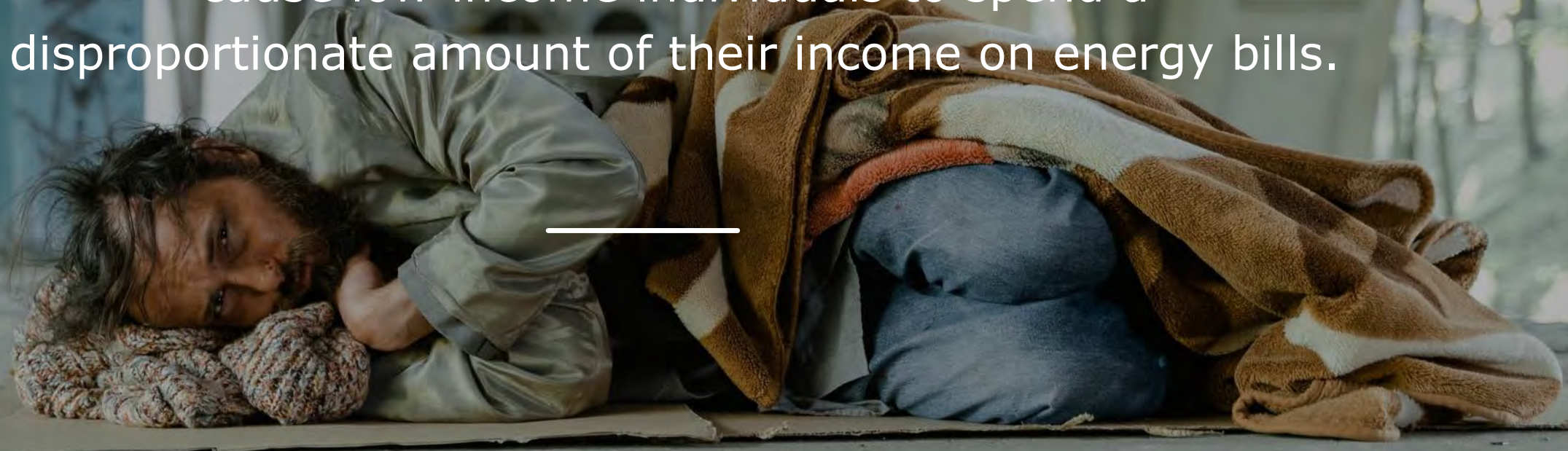
- Incentivize PV Panel donation by property developer.
- Provide grants for Distributed Energy Resources such as batteries

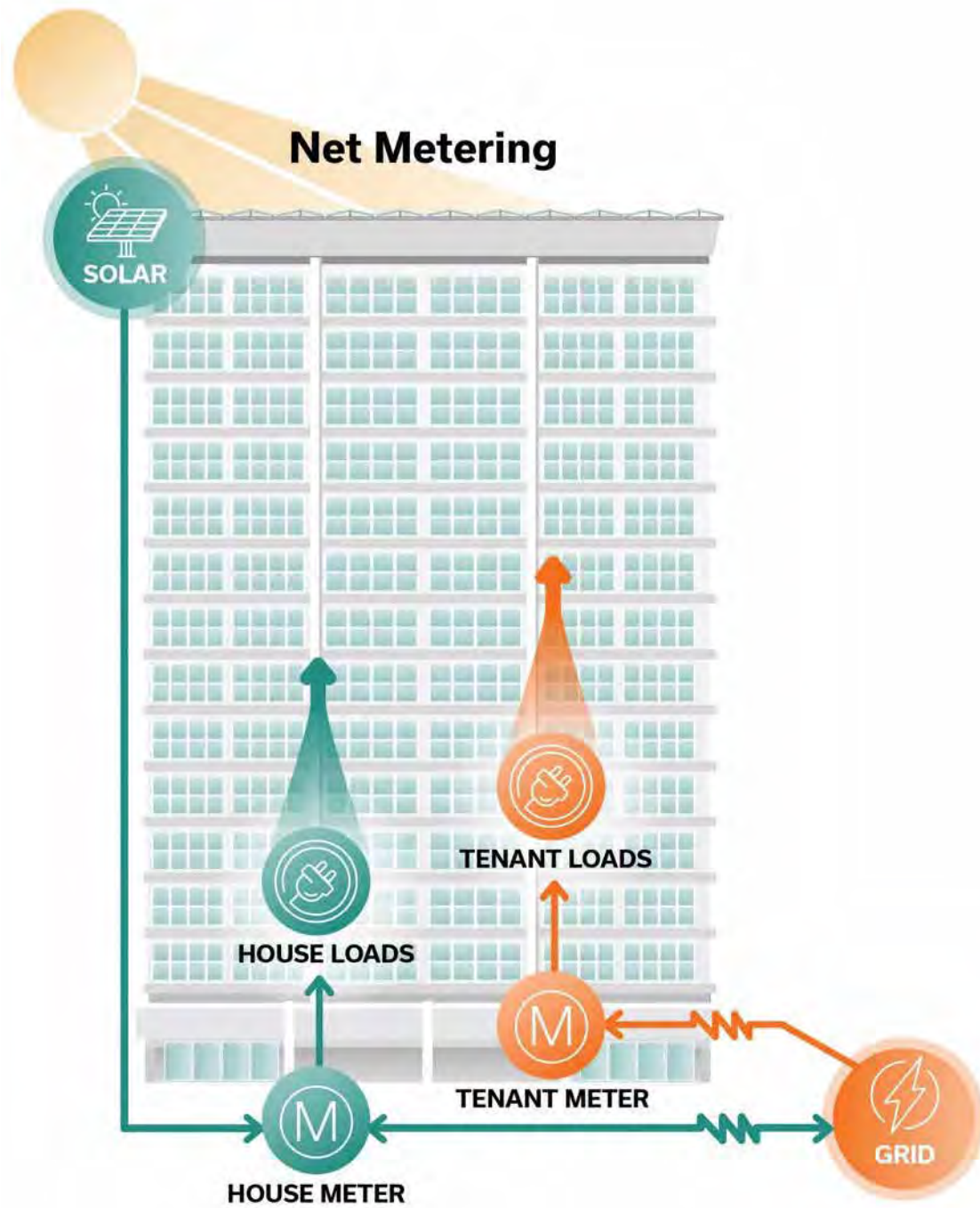
Affordable Housing Project (Non-profit)

- Maintain the PV panels and batteries in exchange for free energy.

Energy Poverty

High first costs and lack of access to solar energy that cause low-income individuals to spend a disproportionate amount of their income on energy bills.



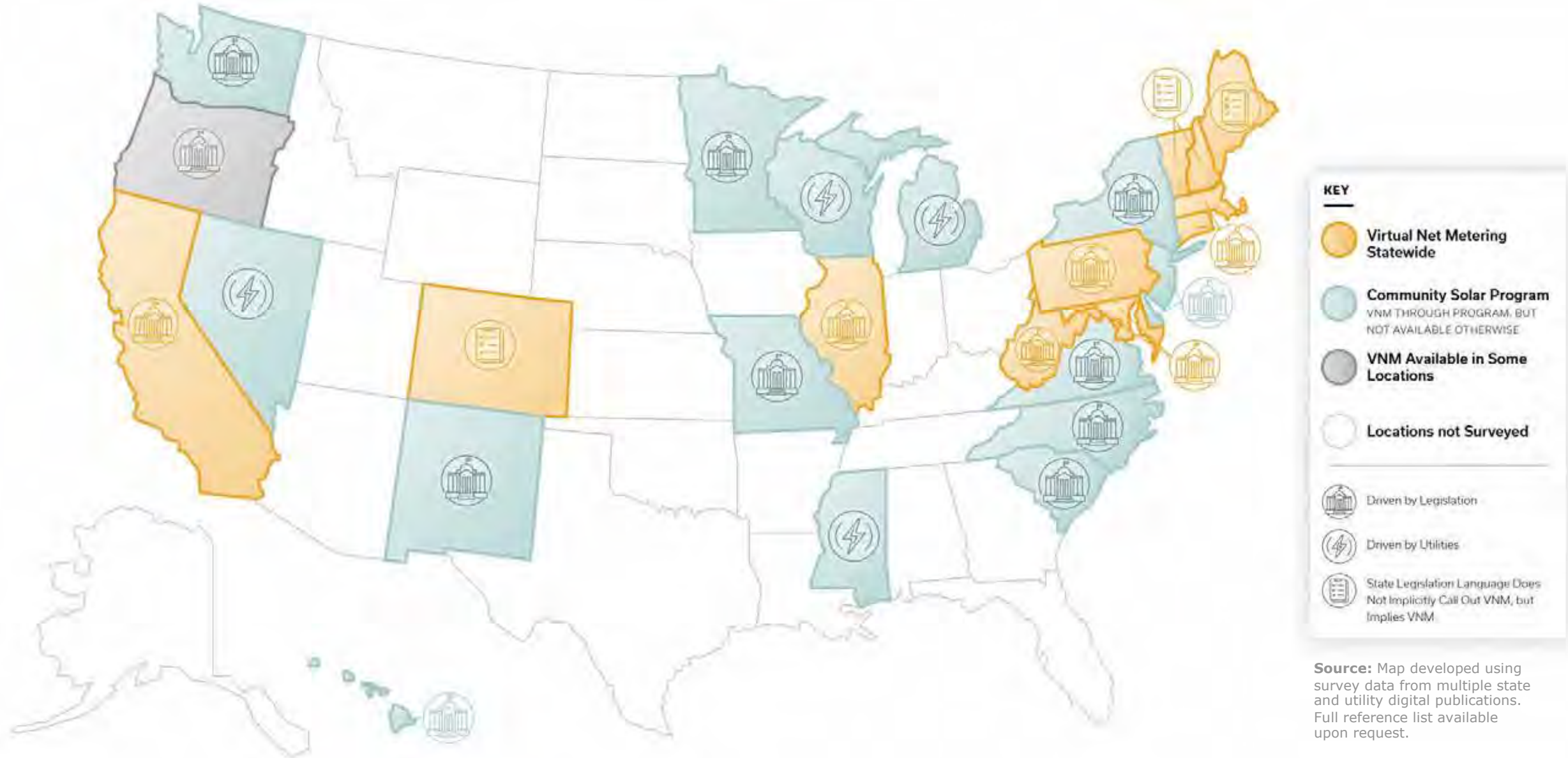


Virtual Net Metering



Virtual net metering allows multiple electricity consumers to share the benefits of renewable energy systems.

Virtual Net Metering by Location



Source: Map developed using survey data from multiple state and utility digital publications. Full reference list available upon request.



Case Study



EDLEN & CO.

Wynne Watts Commons

GRESHAM, OR

23.25

EUI

48%

Energy Reduction



Designed to be Net Zero Energy

96,000

Square feet on 2.5 acres

150

Units

for those earning less than 30% AMI up to 80% AMI





FLOOR
3







LUXER

← COMMUNITY ROOM
← RESTROOM
← LEASING →
▼ 102-118
▼ 120-136
← 142-176

★1





**Net Zero
Energy**

Wynne Watts Commons: Enhanced Passive House Strategies

—



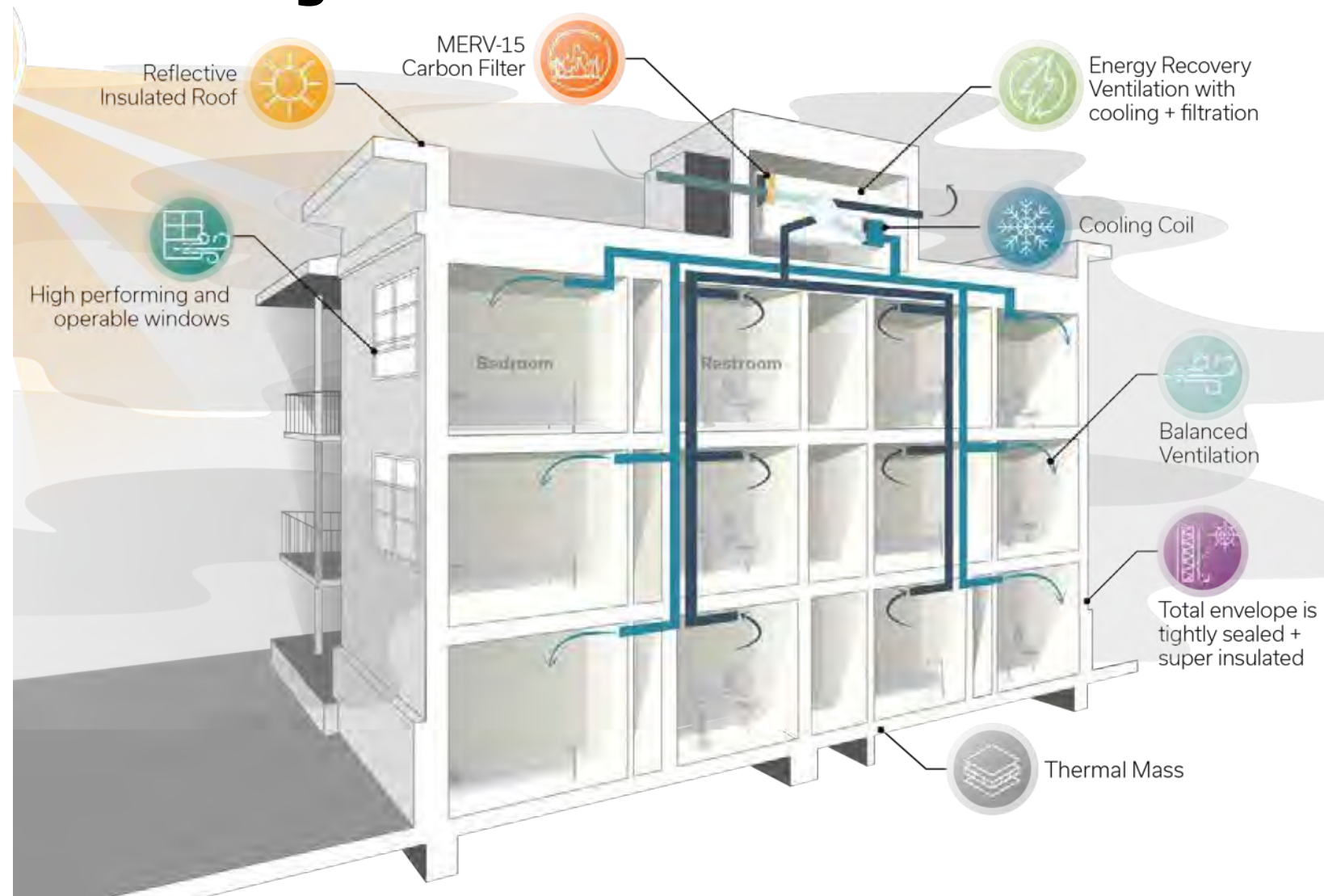
Improved Thermal Comfort



Enhanced Filtration and Improved IAQ

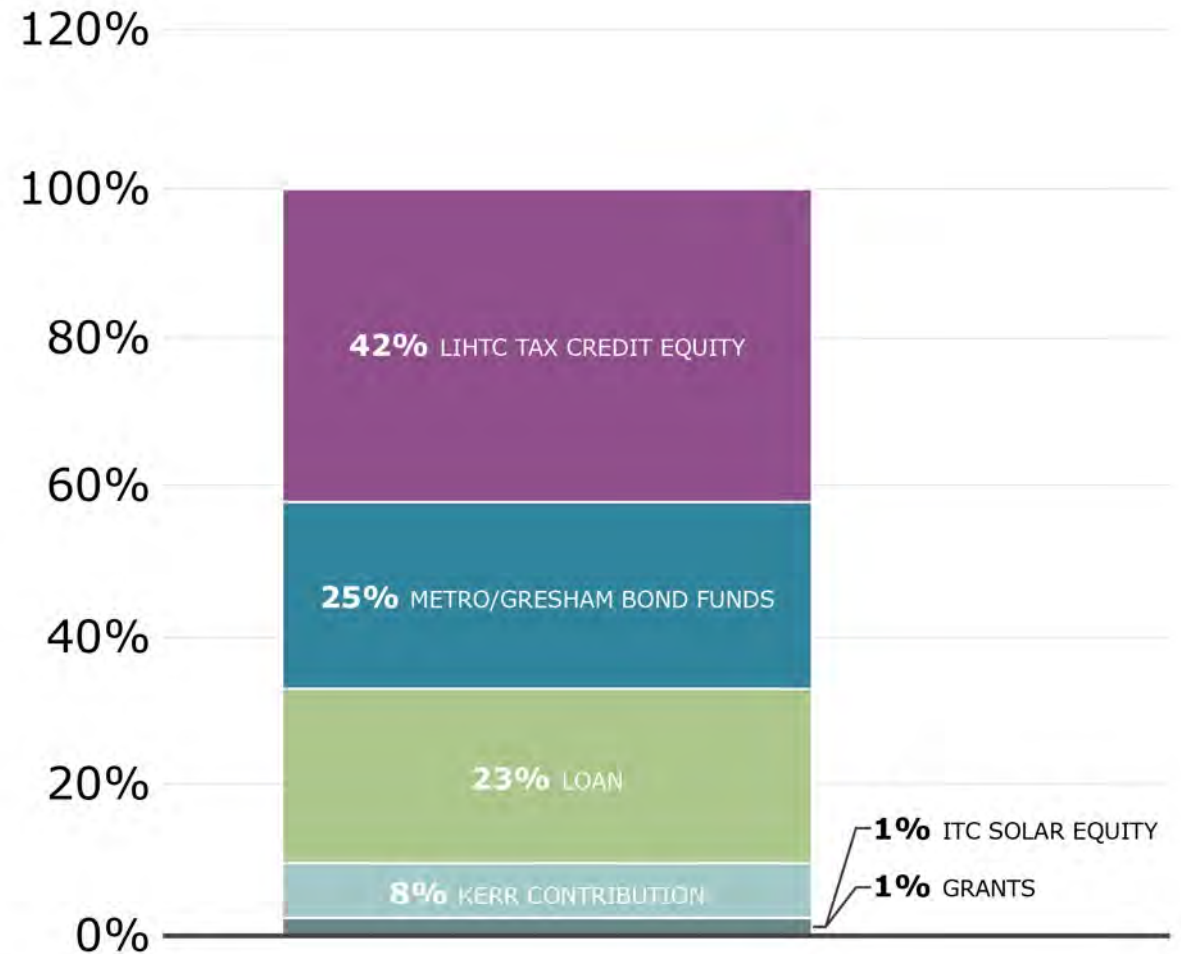


Reduced Ambient Noise



Affordable Housing Financing

- NZE Utility Bill Savings Allowed Developer to Carry a Higher Debt Service
- NZE Attracted Additional
 - LIHTC Equity
 - Loan Amount
 - ITC (Solar Tax Credit) Equity
- Initial NZE Cost Premium was 12%
- **NZE Premium was Almost Entirely Offset by Tax Credit Equity and Additional Loan Amount**



Takeaways

- We have an **affordable housing crisis**
- We have a **climate crisis**
- **We can tackle the Affordable Housing Crisis in America and Help Fix the World Along the Way**
- Design Buildings that are Passive, Efficient, Electric, Resilient, and Able to Shape Loads
- Design Buildings with Microgrids
- Design Buildings to be Grid Efficient Interactive Buildings
- Advocate for municipal frameworks that enable these innovations, and push for lower private activity bonds test percentage to channel more funding towards affordable housing



**TOGETHER, WE CAN BUILD
A BETTER TOMORROW**

We are not just engineers, architects, developers, builders, and policymakers—we are stewards of a better tomorrow.

By aligning our skills and passions, we can create affordable housing solutions that also combat the climate crisis.

This is not just a vision; it's a call to action.