BUILDINGENERGY BOSTON

Decarbonizing Affordable Multifamily Housing: All-in REALIZE Retrofits & Zero Over Time

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Northeast Sustainable Energy Association (NESEA)
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Agenda

- REALIZE Overview
- Zero Over Time
- Concepts In Practice
- 1,000 Apartment Challenge

REALIZE Overview

To address the climate crisis buildings must be:

- Low embodied carbon
- Efficient and properly ventilated
- All electric with low GWP refrigerants
- Grid interactive
- Powered by renewable energy

Construct all new buildings to a zero-carbon standard

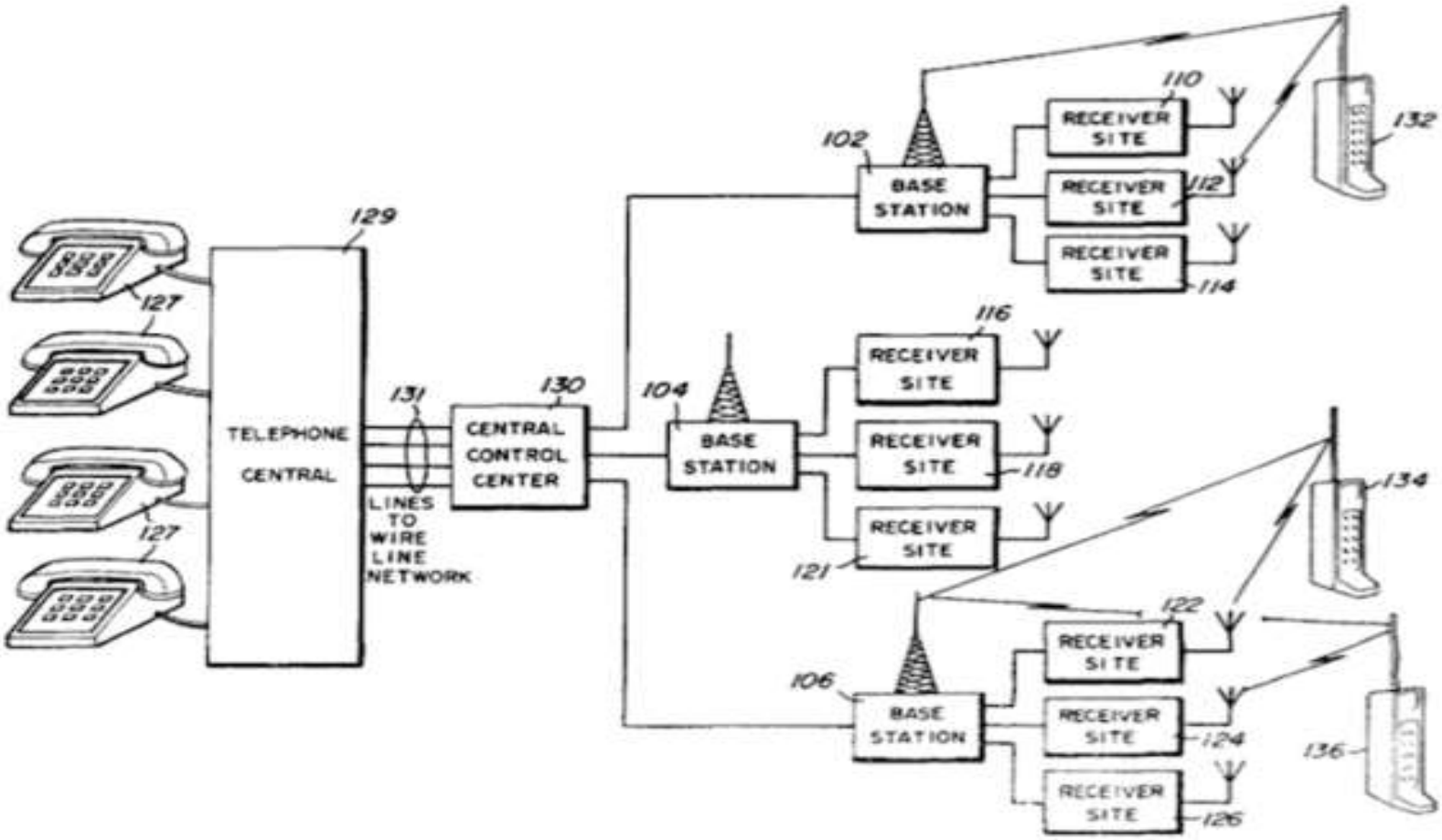
Ensure all appliance sales are electric, efficient and grid-interactive

Retrofit 4% buildings stock/year (4M/year in US alone) – 4x current rate

MISSION:

REALIZE aims to accelerate building decarbonization by developing affordable streamlined solutions that make buildings healthier for people and the planet.

A Service Analogy



REALIZE Theory of Change

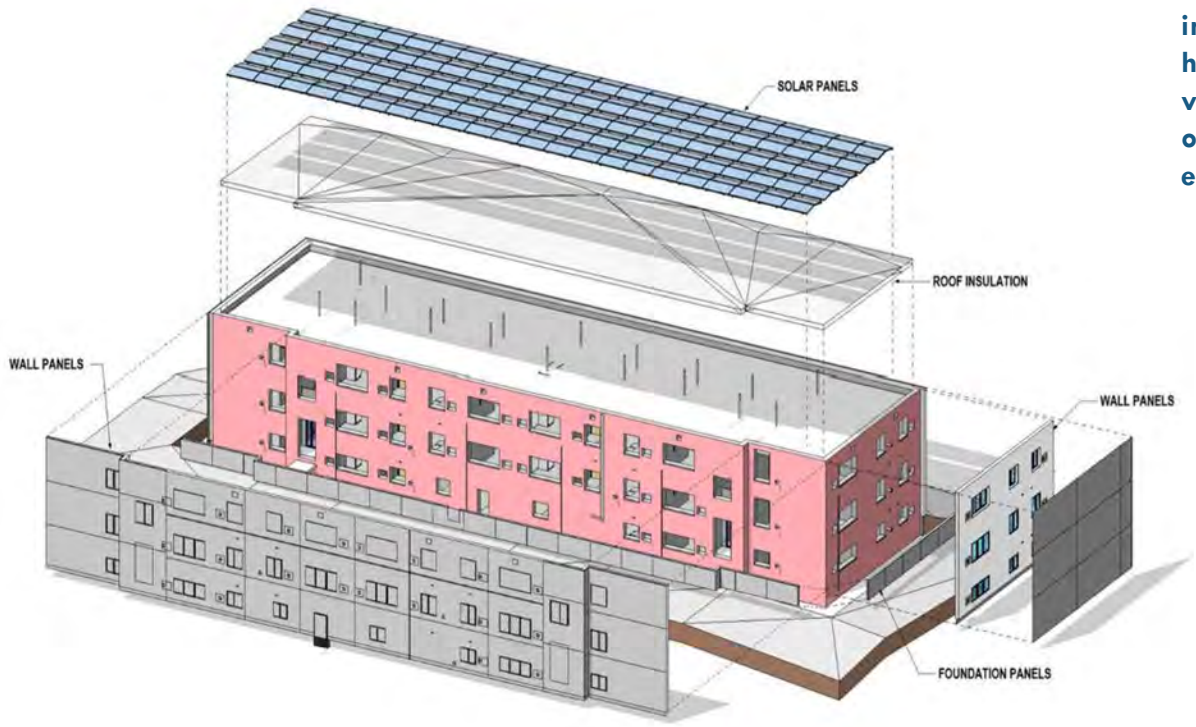
STANDARDIZED RETROFIT PACKAGES + STREAMLINED & STANDARDIZED FINANCING + AGGREGATED DEMAND = SCALABLE SOLUTIONS

RMI

Standardize Retrofit Packages

High-performance roof system including integrated solar

Integrated mechanicals including domestic hot water, heating, cooling, and ventilation, with controls and option for smart inverter and energy storage

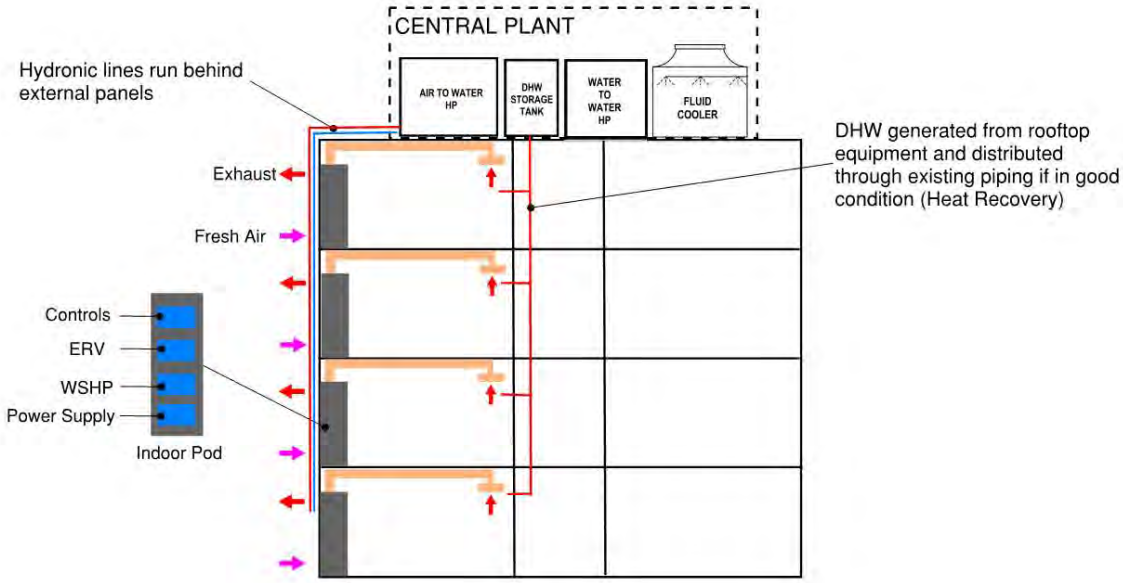


All-electric appliances

Prefabricated wall panel including high-performance windows and doors

RMI

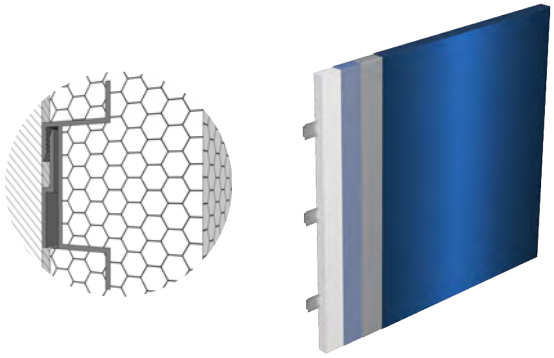
Integrated Mechanical Systems



ERV with Boost | Heating/Cooling | Economizer | Central DHW
Requires 1 30A, 115V connection plus central plant electrical

Envelope Systems

Stick-frame solution



- 2-4 lb/sqft
- Non-structural
- Windows and doors not integrated (rough opening connections prefabbed)
- Streamlined scan → CAD → CAM process

Masonry solution

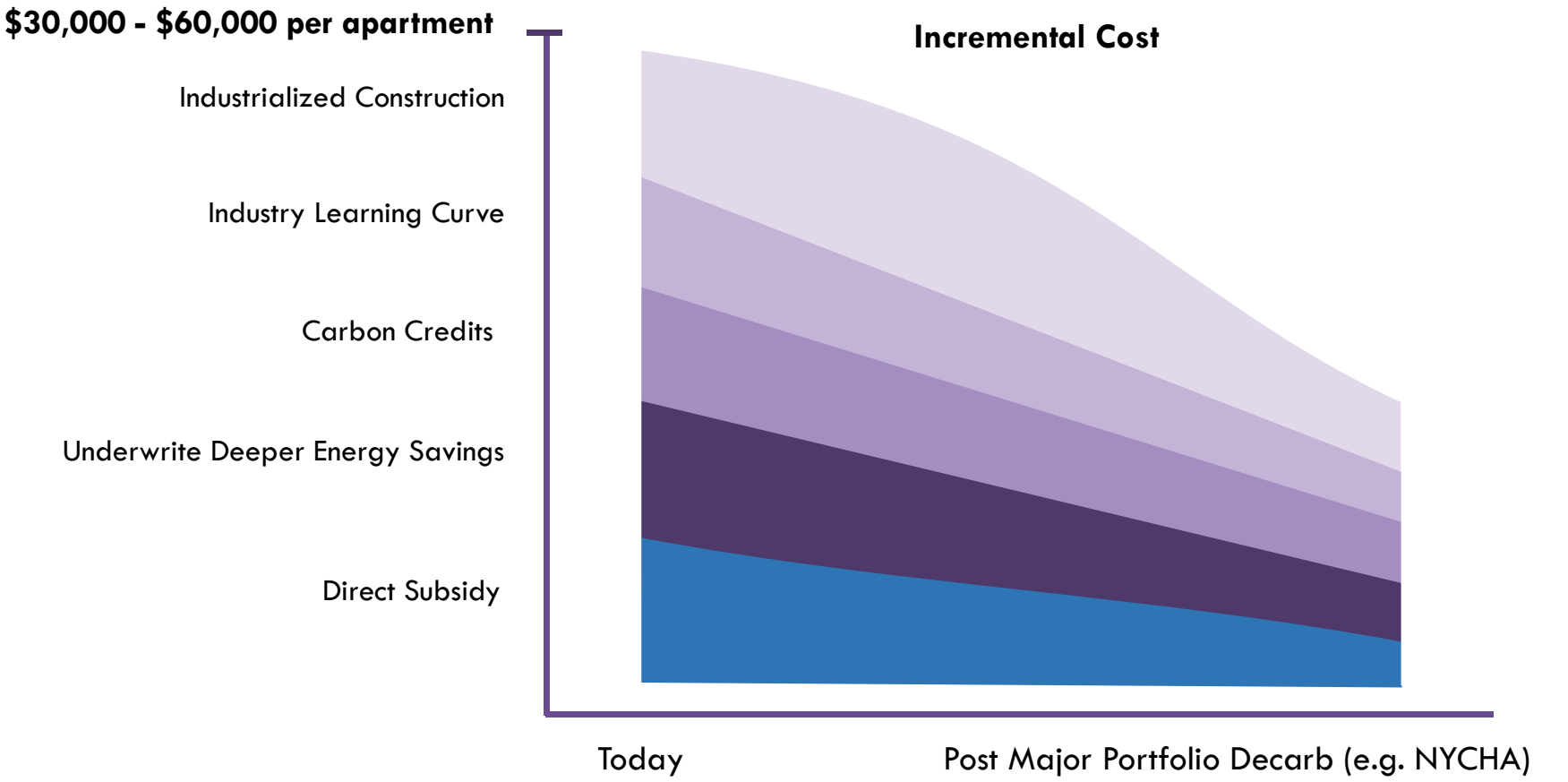
- 8-12 lb/sqft
- Structural
- Windows and doors integrated
- Streamlined scan → CAD → CAM process

Roof solution

- Insulated metal roof panels
- 2-3 lb/sqft
- Streamlined scan → CAD → CAM process

Streamline and Standardize Financing

First solve the incremental cost gap



Aggregate Demand

RetrofitNY Pledge

4,395 Buildings
404,485 units

+

REALIZE CA Pledge

35,598 units

+

REALIZE MA 1,000 Apartment Challenge

starting construction 2023

=

Pathway to Scaling Zero Carbon Retrofits

Regional REALIZE Program Vision

DEMAND PIPELINE

ZERO OVER TIME TOOL

STANDARDIZED RETROFIT PACKAGE

MINIMAL DISRUPTION

FINANCING SOLUTION

PERFORMANCE GUARANTEE

INCLUSIVE ECONOMY

Zero Over Time

ZERO OVER TIME TOOL

DEMAND AGGREGATION AND

Portfolio Energy Optimization
Physics Based Analytics

Financing
Discounted
Cash Flow Model

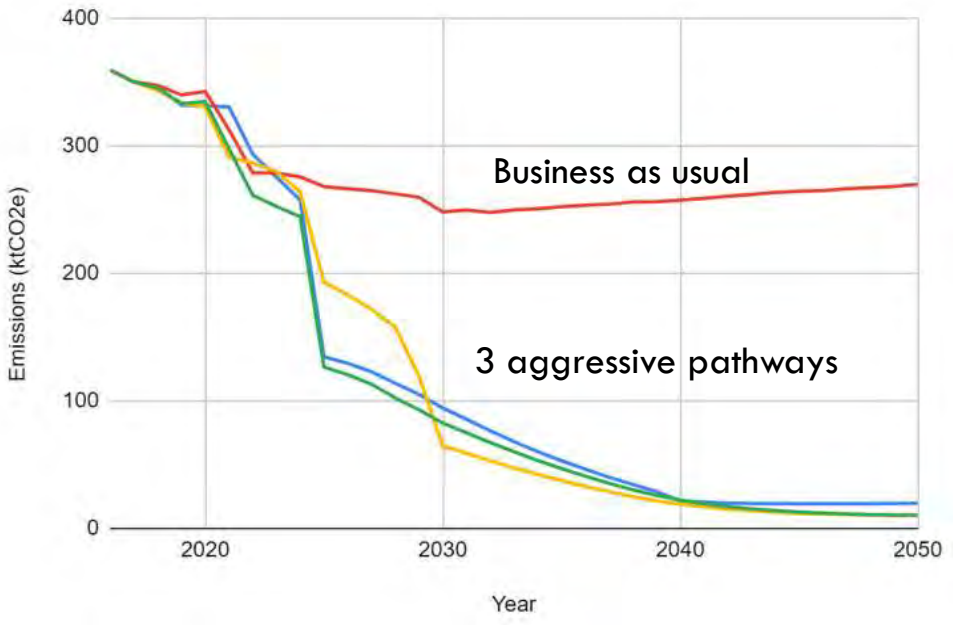
Retrofit Packages
based on typology & climate zone

Optimized timing
with trigger events

ZOT Component 2

Physics-based analysis with Portfolio Energy Optimization

PEO evaluated a large portfolio of federal buildings in Canada.



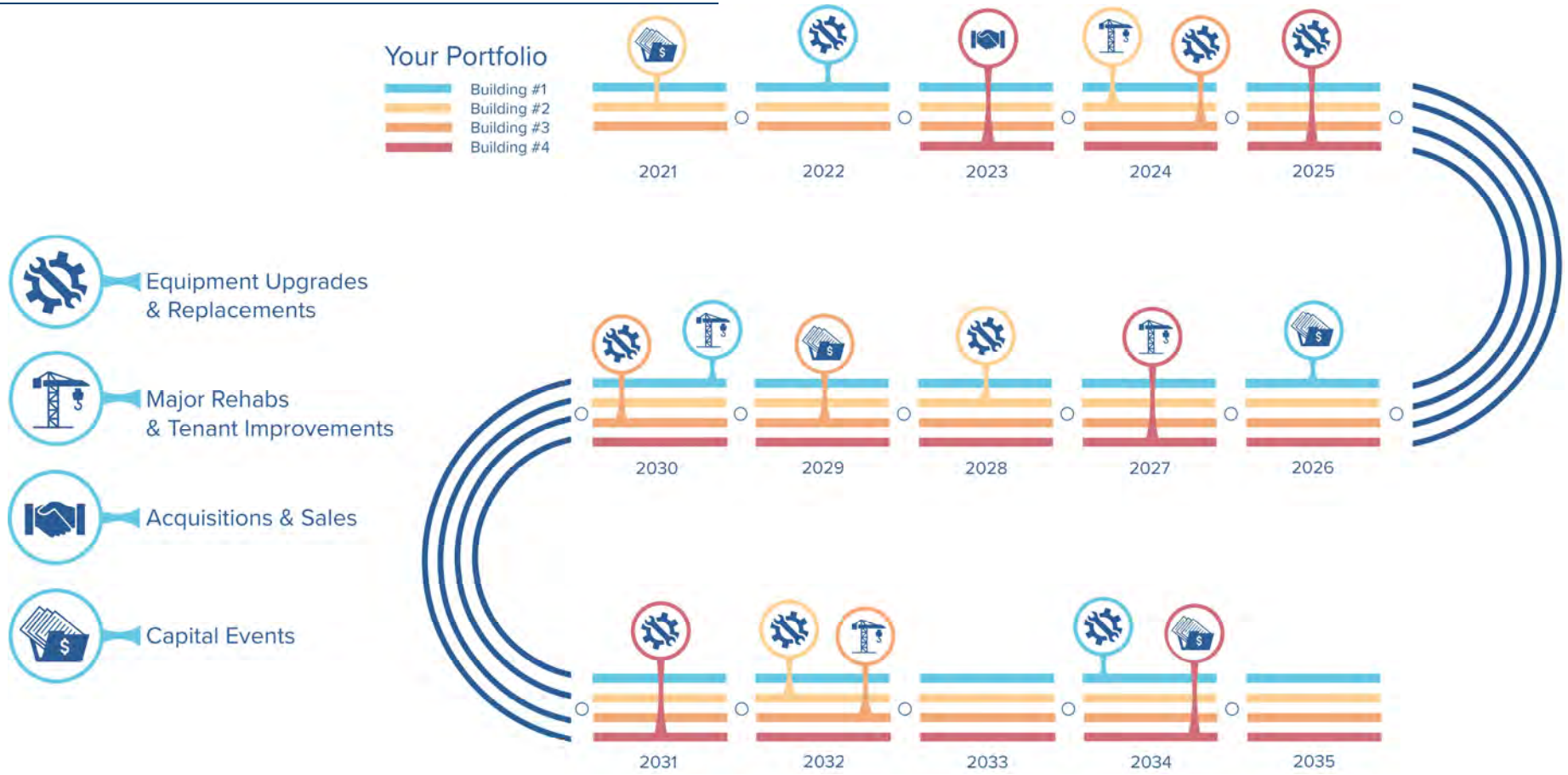
Collect reasonably comprehensive data on each portfolio asset

Analyze historical performance to establish a baseline

Generate multiple project scenarios for each property

ZOT Component 3

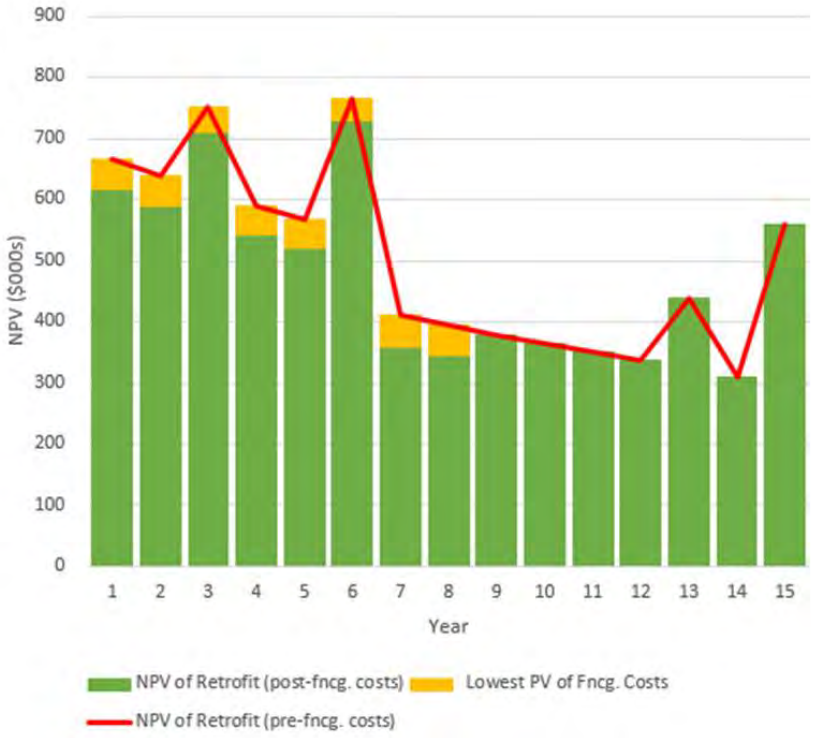
Trigger Events

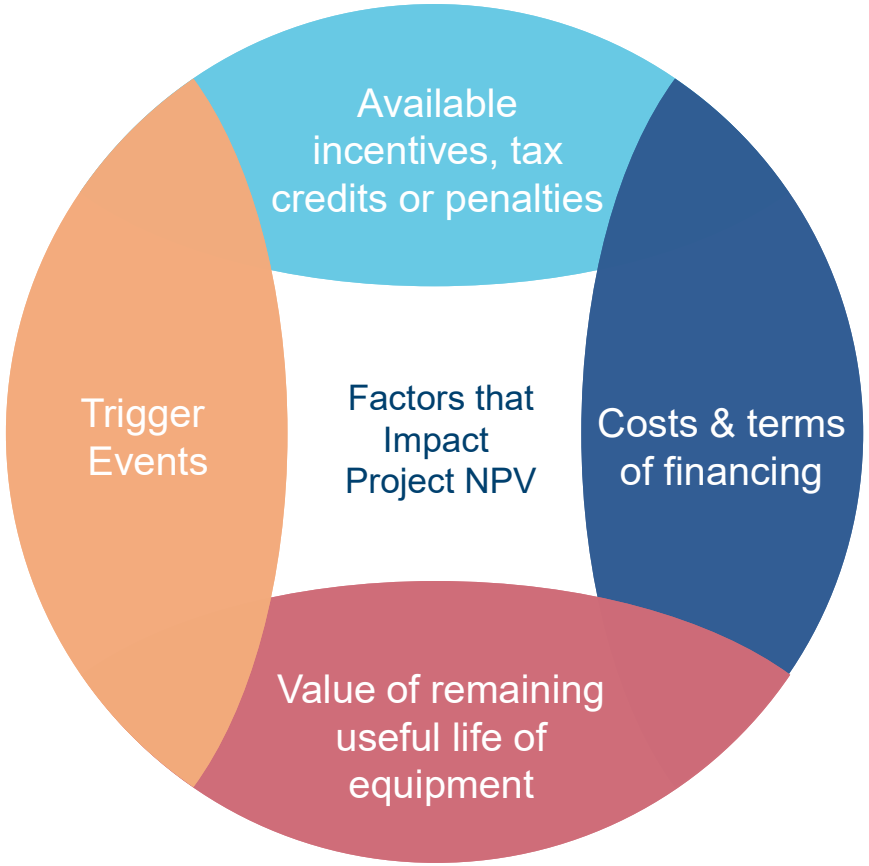


ZOT Component 4

Discounted Cash Flow Model

Present value of a project, modeled if done in different years.





Source: NYCEEC

Examples of Measures

Category	Measures	Measure Description
Demand Flexibility	Battery storage	Either maximize kW shed/shifted or IRR
	Central ice storage	Ice storage
	Light dimming	Shed measure, not shifting load.
	Staging heating and cooling coils	Stage coils and cycling fans to reduce peak demand every month
	Peak demand curtailment-Temperature setback	Setback temperatures in appropriate zones to reduce demand during TOU times or peak demand events
Energy Efficiency	Improved thermal envelope – Roof and wall insulation	Within each measure, there are several different scenarios with different R-values (e.g. R20, R30 and R40) and different types of insulations
	Roof membrane	Dark or Light roof membrane
	Improved fenestration	Replacing current windows (curtain walls, load windows and storefront windows) with high performance windows; Adding window films
	Unitized wall panels	**REALIZE style pre-fabricated insulated panels on the exterior of the building**
	Exterior door upgrades	Door air-curtains, revolving doors and fast acting dock doors to reduce infiltration
	HVAC upgrades	Where applicable adding VFDs, high efficiency motors and pumps, energy recovery, economizer control, demand-controlled ventilation, and heat recovery
	Smart Thermostat	Installing smart thermostats in apartments (non-BMS)
	LED lighting upgrades	LED lamp retrofit; LED fixture upgrade with integrated sensors
	Ceiling fans	Increased temperature setpoints while maintain comfort by increased air velocity using BAS integrated ceiling fans
Electrification	Heat pumps	Replace natural gas boilers for heating and DHW with GSHP, ASHP, VRFs or distributed WSHP where applicable
	REALIZE Pods	**Pre-fabricated heating and cooling pods installed in each apartment. Central heat pumps supplies DHW and neutral water to in-unit Pods**
Renewable Energy	Rooftop PV	New PV array or augment existing PV array with more capacity
Plug Loads	High efficiency appliances	Install high efficiency refrigerators, dish washer, in-unit washer/dryer where applicable

Concepts in Practice

WinnCcompanies Overview

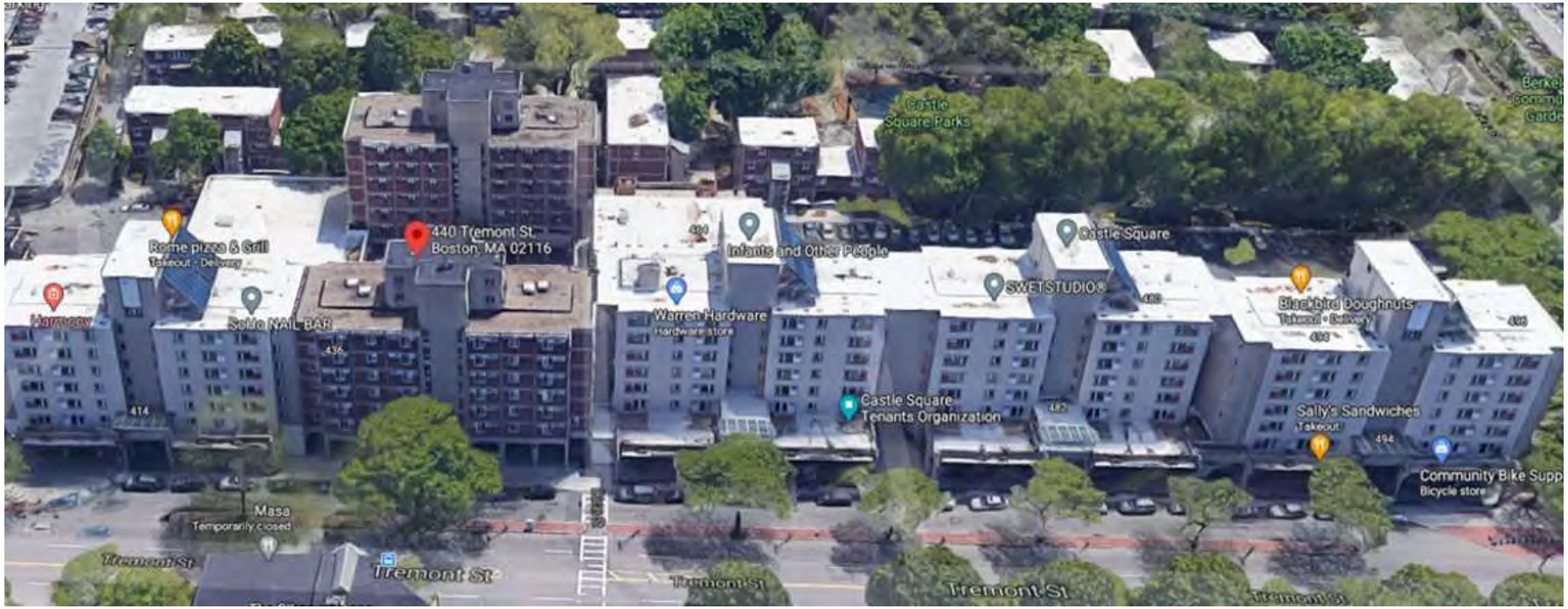
- WinnCompanies is a **50-year-old** mixed income multifamily property developer, owner, and manager
- Employs more than **3,500** team members
- Manages **121 Million** square feet, including housing, condos, commercial, retail, and parking;
- Provides homes to **330,000** residents;
- Has created or preserved **more than 15,000 units of mixed-income housing** across the Mid-Atlantic and Northeast
- A **Commitment to Sustainability** has been one of 8 Guiding Principles for over a decade.

WinnCcompanies
Development | Residential | Military

Eva White Apartments, Boston

- **REALIZE-MA** Case Study
- **DOE Advanced Building Construction**
- **Key Partners:**
  - Castle Square Tenant Organization
  - Boston Housing Authority
  - Reisen Design Associates
  - Petersen Engineering Inc.

Eva White Apartments, Boston



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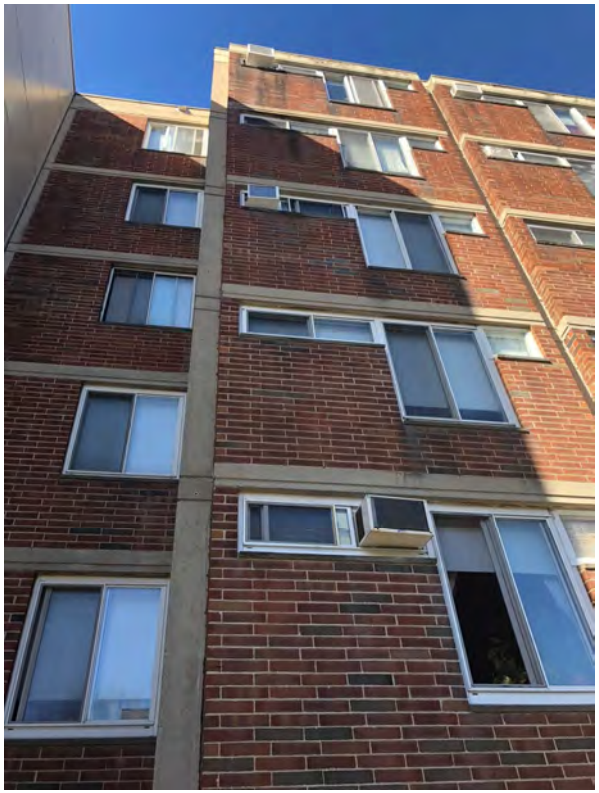
Existing Conditions



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Existing Conditions

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“Business as Usual” Rehab

- **Moderate, Occupied Rehab**
  - Capital Needs Assessment
  - Critical Repairs
  - No Energy Performance Requirements
- **Scope of Work:**
  - Kitchen reno: flooring, cabinets, appliances, lighting, paint
  - Bathroom reno: flooring, vanity, plumbing fixtures, lighting, paint
  - Common area finishes
  - In-kind HVAC upgrades: condensing boilers, MAU, exhaust fans
  - Roof replacement
  - Window replacement
  - Misc. structural repairs to parapet, brick & concrete

Eva White Apartments: REALIZE

Performance Specs:

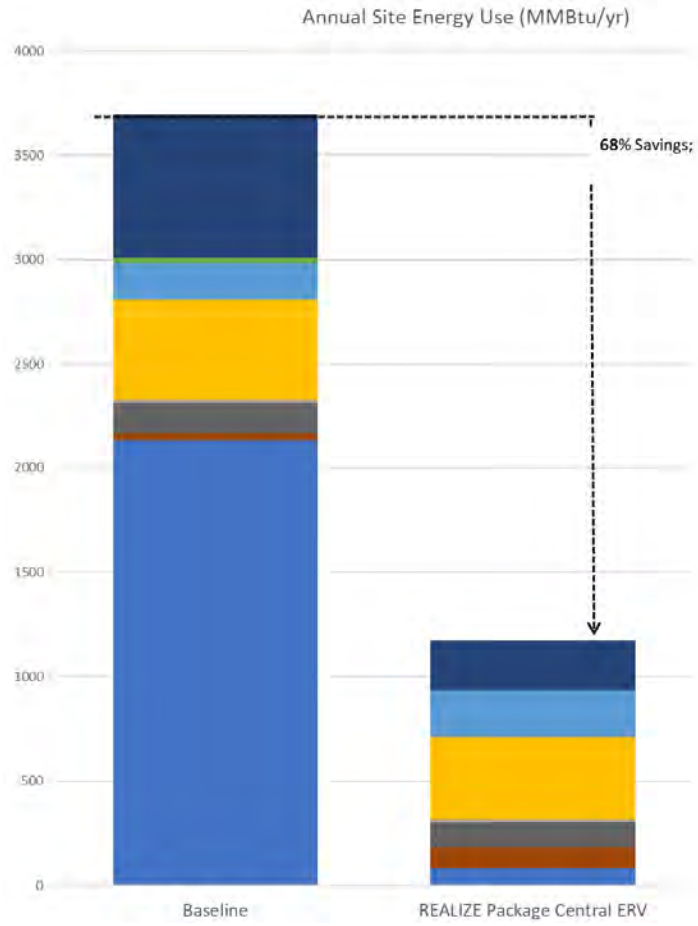
- R-25 Continuous Insulation
- R-40 Roof
- 0.20 ACH50
- Limited thermal bridging
- U-0.26 Windows
- Full Electrification

ABC ADVANCED BUILDING CONSTRUCTION Collaborative

REALIZE

OpenMarket ESCO Energy Innovation

WinnCompanies Development | Residential | Military



Modeled savings:

- 68% site energy savings
- EUI 96 → EUI 31
- $70k/year utility cost savings

Eva White Retrofit Package

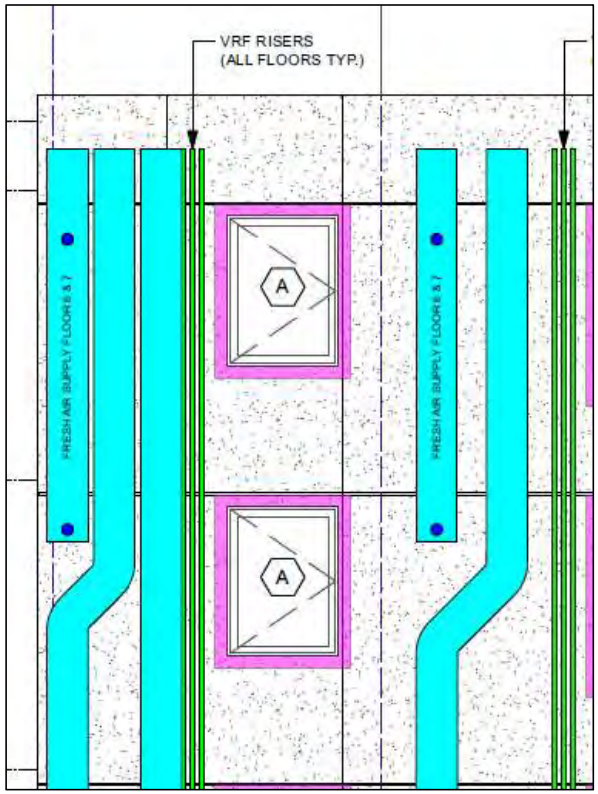
Envelope: Prefabricated Wall Panel System

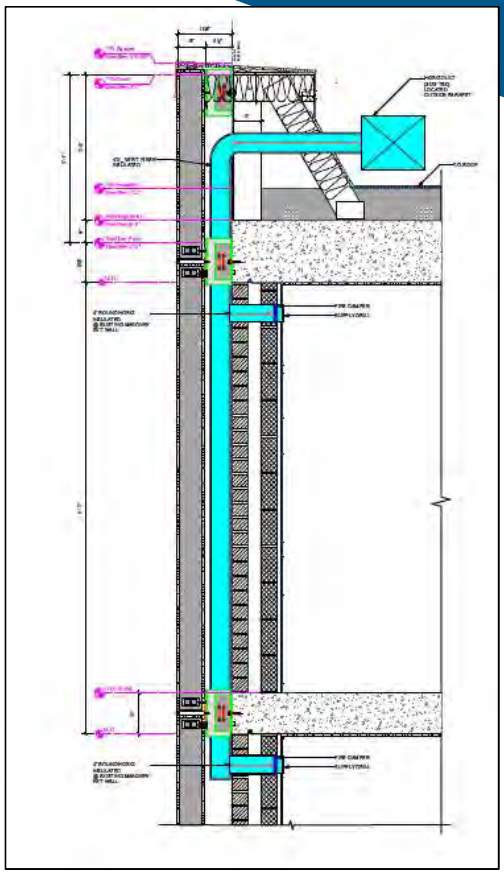
- R&D by Tremco → "Revitalite" System
  - Prefabricated, Lightweight, Structural, Insulated Façade
  - 6" thick, EPS or GPS core and EIFS finish
  - uPVC Amberline Window
  - Patented connection assembly
- Performance Testing Ongoing
  - Fire, thermal, air, water, structural
- Warranty & Insurance Discussions

Eva White Retrofit Package

HVAC: All Electric

- Standard systems
  - VRF, Mitsubishi Y-series
  - ERV, Annexair
  - HPWH, Mitsubishi QAHV
- Master metering required
- Central systems preferred for maintenance
- Utilizing new cavity space





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Eva White DER

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Reisen Design Associates

Eva White DER

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Reisen Design Associates

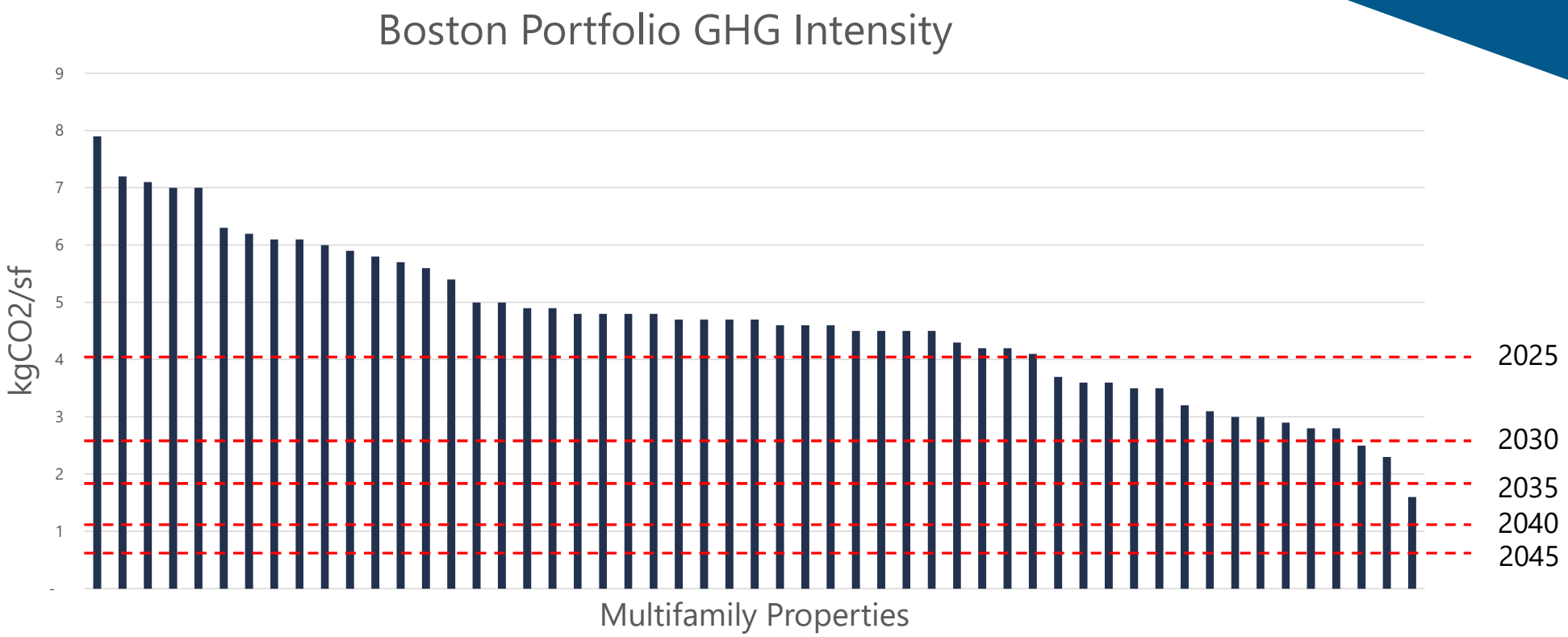
Eva White Key Takeaways (pre-construction!)

- **Leveraging existing rehab and capital needs can reduce incremental cost**
  - BAU: $150k/unit
  - DER: $250k/unit
- **New sources needed to support added costs**
  - MassSave LEAN (ABCD Inc.)
  - Proportionally higher LIHTC equity
  - RAD/Section 18
- **Customized vs. "Standardized"**
  - Creativity, Demonstrations, and further R&D still needed
  - Learn as you go → Integrated Design & Project Delivery

Scaling a New BAU

- How can we re-define the "BAU" rehab and capital planning process?
  - It costs more…
  - It's harder to do…
- **REALIZE** and **ZOT Frameworks** offer solutions for building owners and policy makers
- Carrots & Sticks will continue being primary drivers
  - **Sticks:**
    - BERDO 2.0
    - Building Energy Performance Standard ("BEPS", Washington DC)
    - NYC Local Law 97
  - **Carrots:**
    - Energy Cost Savings (not enough)
    - Non-economic: aesthetics, comfort, etc. (not enough)

Taking Inventory



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Zero Over Time

- Subset of 29 Properties being evaluated across 6 states and 3 climate zones
  - Extensive and Ongoing Data Collection Process
- The buildings in scope include 4,526 units
- Average Energy Use Intensity of 68 kBTU/SF
  - Data requires further QA/QC
  - Tenant paid utilities often excluded

PEO Analysis

29
Properties

5.3 million
Square Feet

100+
Measures & variations

3000+
Energy Simulations

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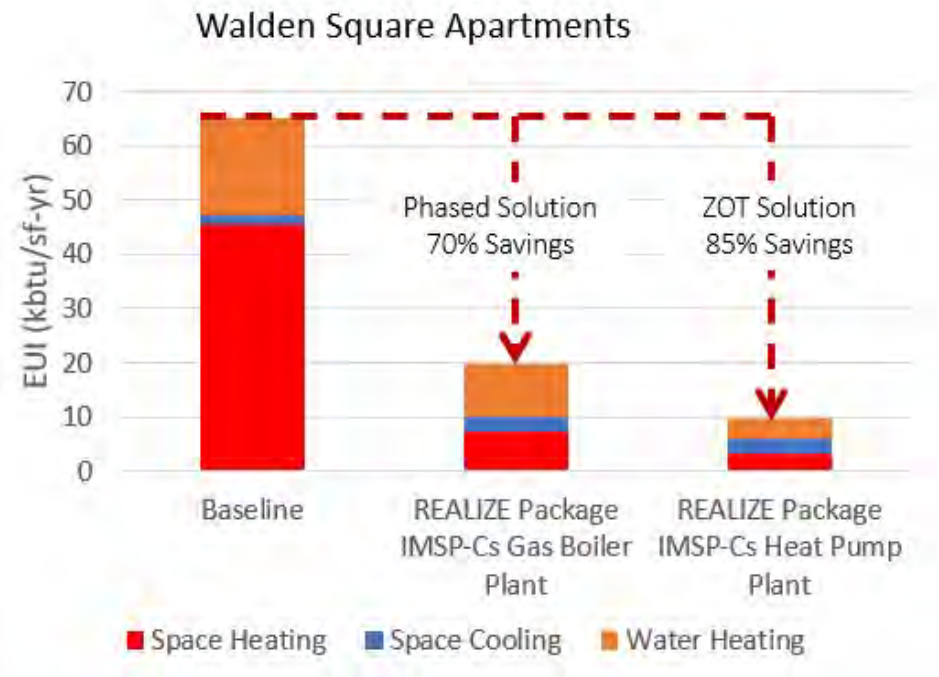
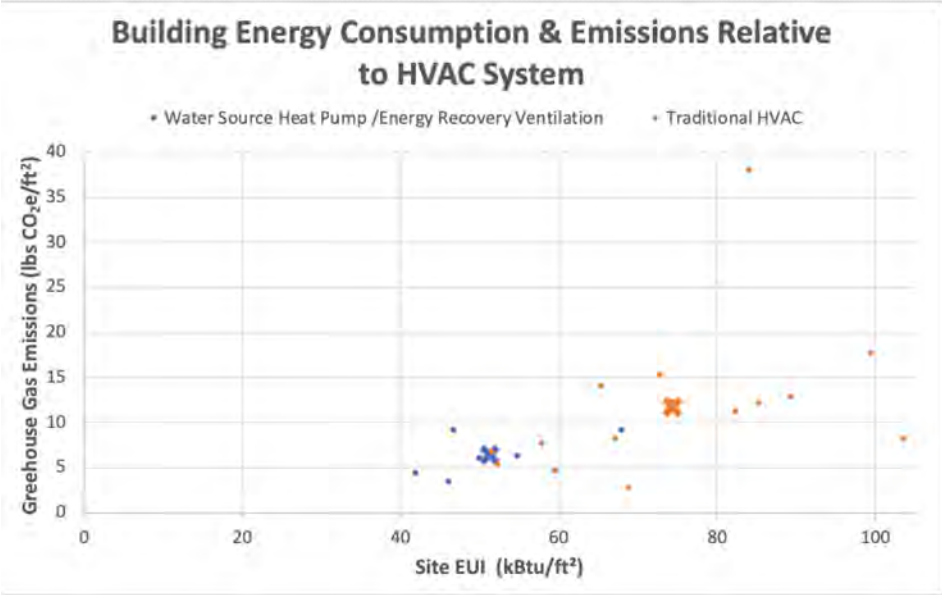
Zero Over Time





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Looking Ahead

- Strategic Planning
- Leverage capital needs and major recapitalization events

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1000 Apartment Challenge

1,000 apartment challenge

1,000 deep energy retrofits under construction in Massachusetts by 2023

LISC BOSTON

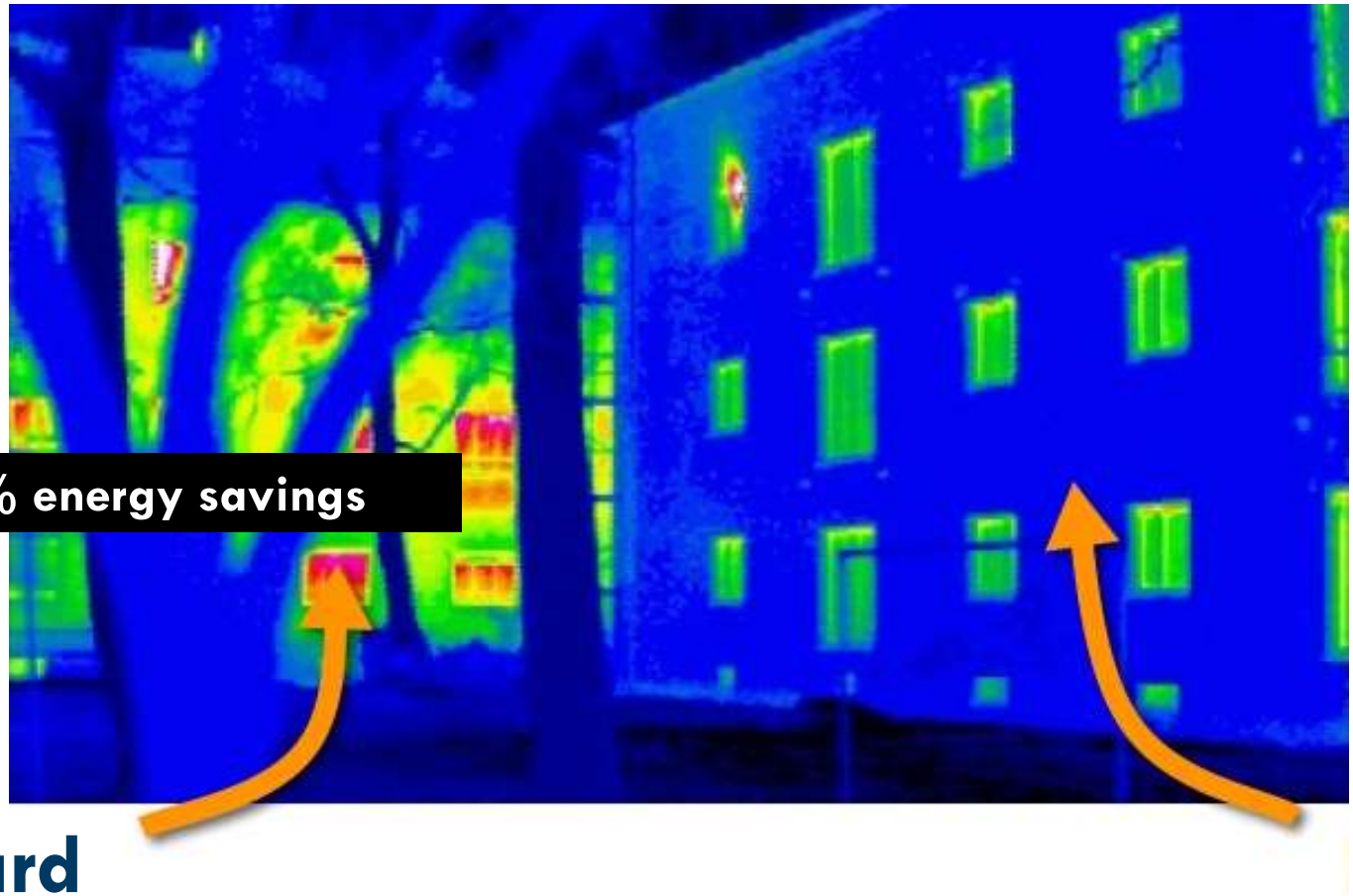
RMI

CHAPA

MACDC
Massachusetts Association of Community Development Corporations

MASSACHUSETTS CLEAN ENERGY CENTER®

Market Transformation



Standard Weatherization

15 – 20% energy savings

50%+ energy savings

All electric

Grid Interactive

Renewables

Heat Recovery Ventilation

Low Embodied Carbon

Standard Weatherization

Zero Carbon Retrofit

Energie Sprong – 50% Cost Compression in 5 Years

The ideal candidate building(s)

1) Scheduled for a **major rehab**

2) **Funds** allocated for major rehab

3) **Planned scope of work** (at least 3 of the following): new windows, roofs, mechanicals, new siding

4) **Simple architecture**

5) **Not historic or architecturally significant building**

1,000 Apartment Challenge

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Thank You

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