

Decarbonizing Affordable Multifamily Housing

All-in REALIZE Retrofits & Zero Over Time

May 2022

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Agenda

- REALIZE Overview
- Zero Over Time
- Concepts In Practice



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



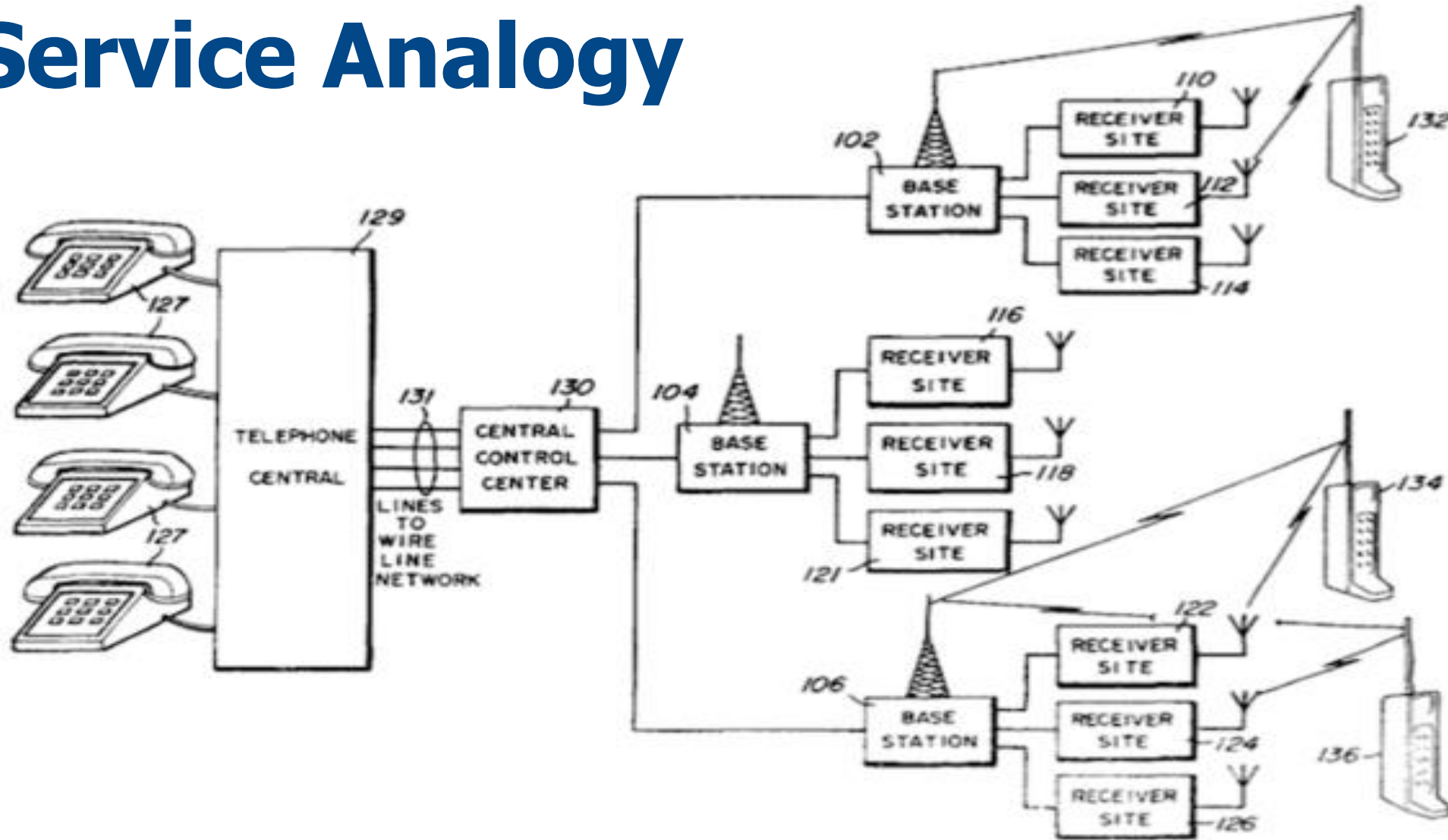
Retrofit 4% buildings stock/year
(4M/year in US alone) – 4x current rate



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



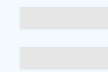
**Standardized
Retrofit Packages**



**Streamlined &
Standardized
Financing**



**Aggregated
Demand**



**Scalable
Solutions**

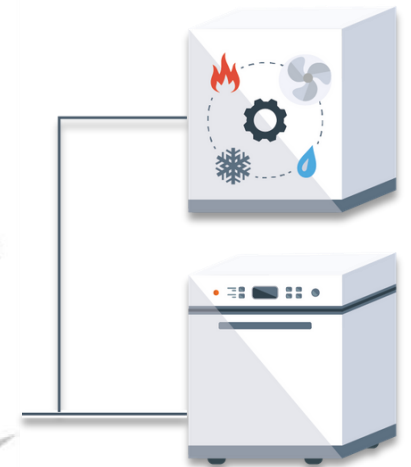
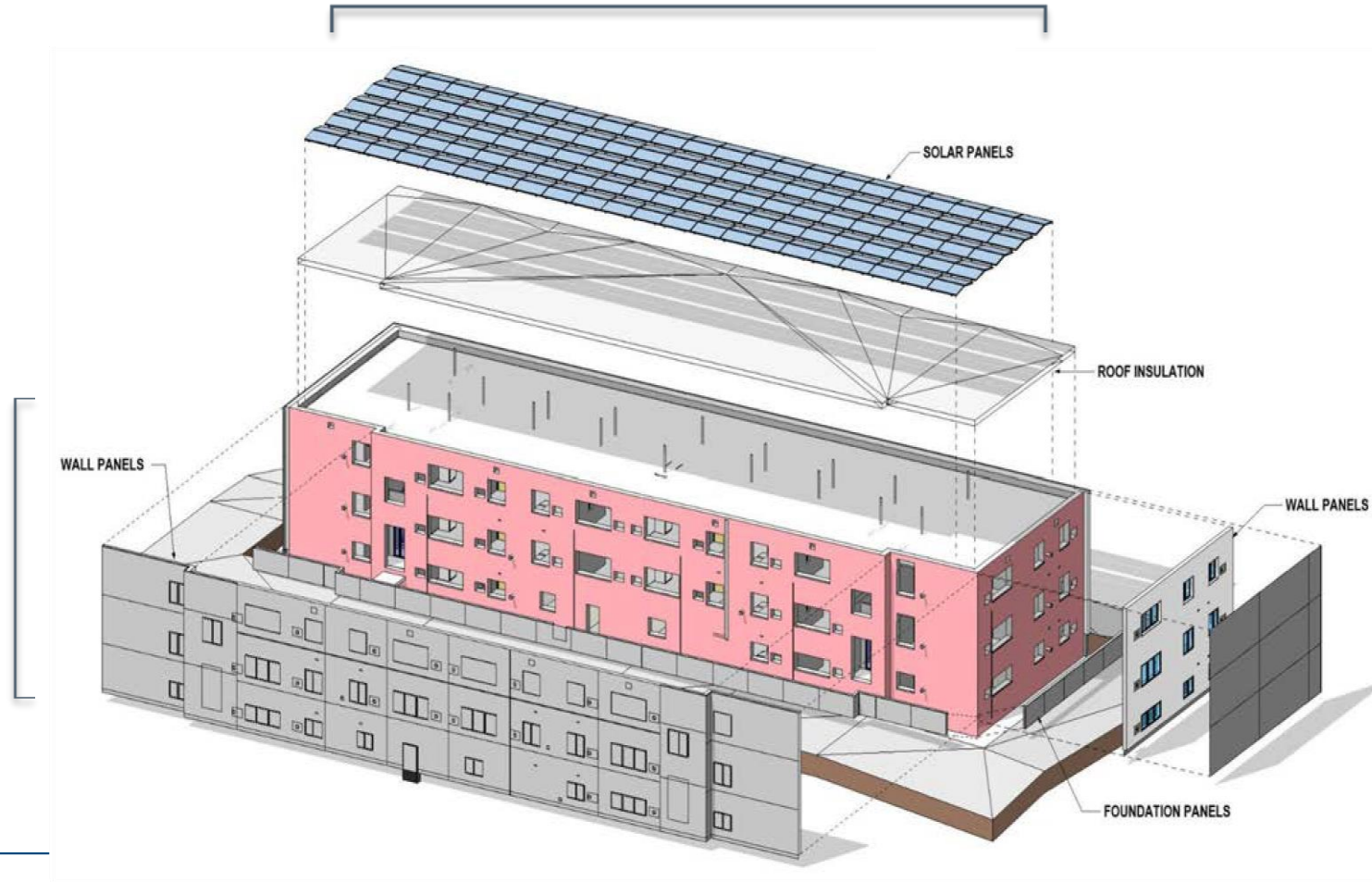
Standardize Retrofit Packages



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

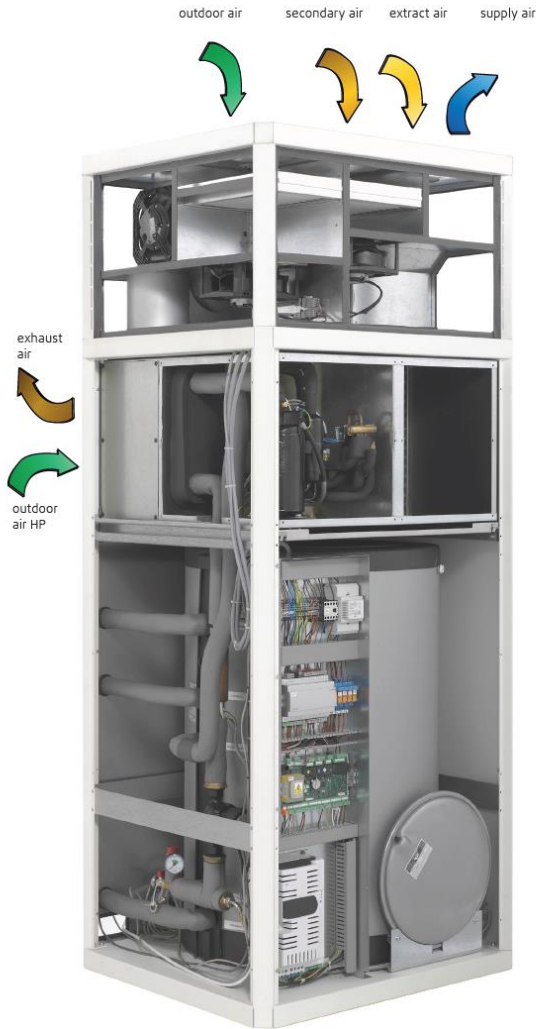
Prefabricated wall panel
including high-performance
windows and doors



All-electric appliances

Mechanical Systems

All-in-one solution



Ventilation module

- Rotating heat exchanger with humidity recovery
- Heating and cooling through supply air ducts (recirculation air)

Heat pump module

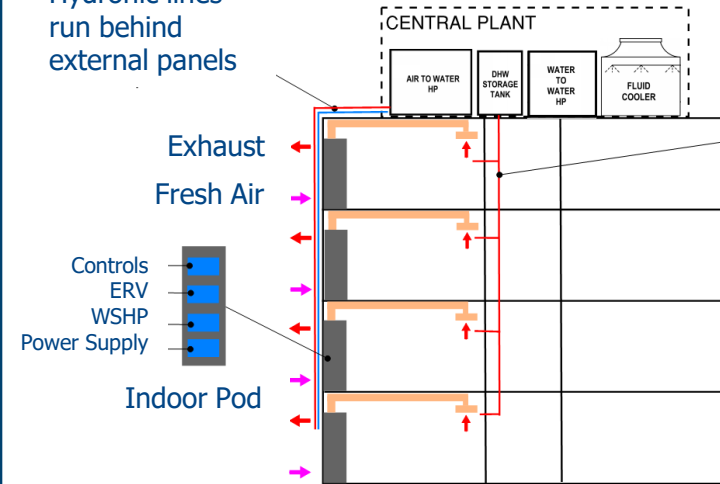
- Reversible air to air and air to water heat pump for heating, cooling and hot water
- Steplessly controlled compressor to modulate the power exactly to the need of heating and cooling energy

Hot water module

- 150 litres storage tank for hot water
- Hot water production parallel to heating and cooling
- Electric heater with 3 kW power
- Control box

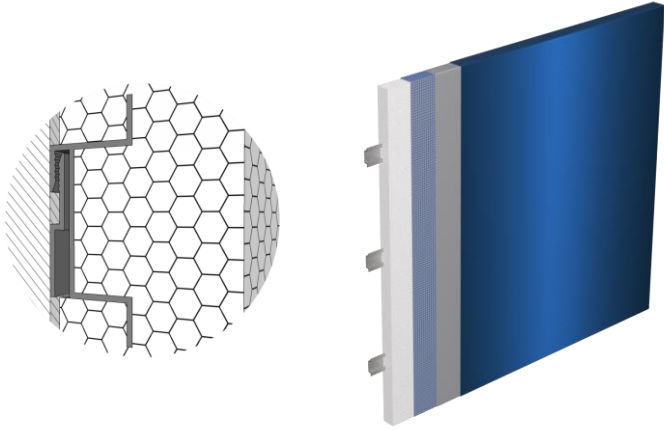
Central plant solution

Hydronic lines run behind external panels



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

Concrete solution



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

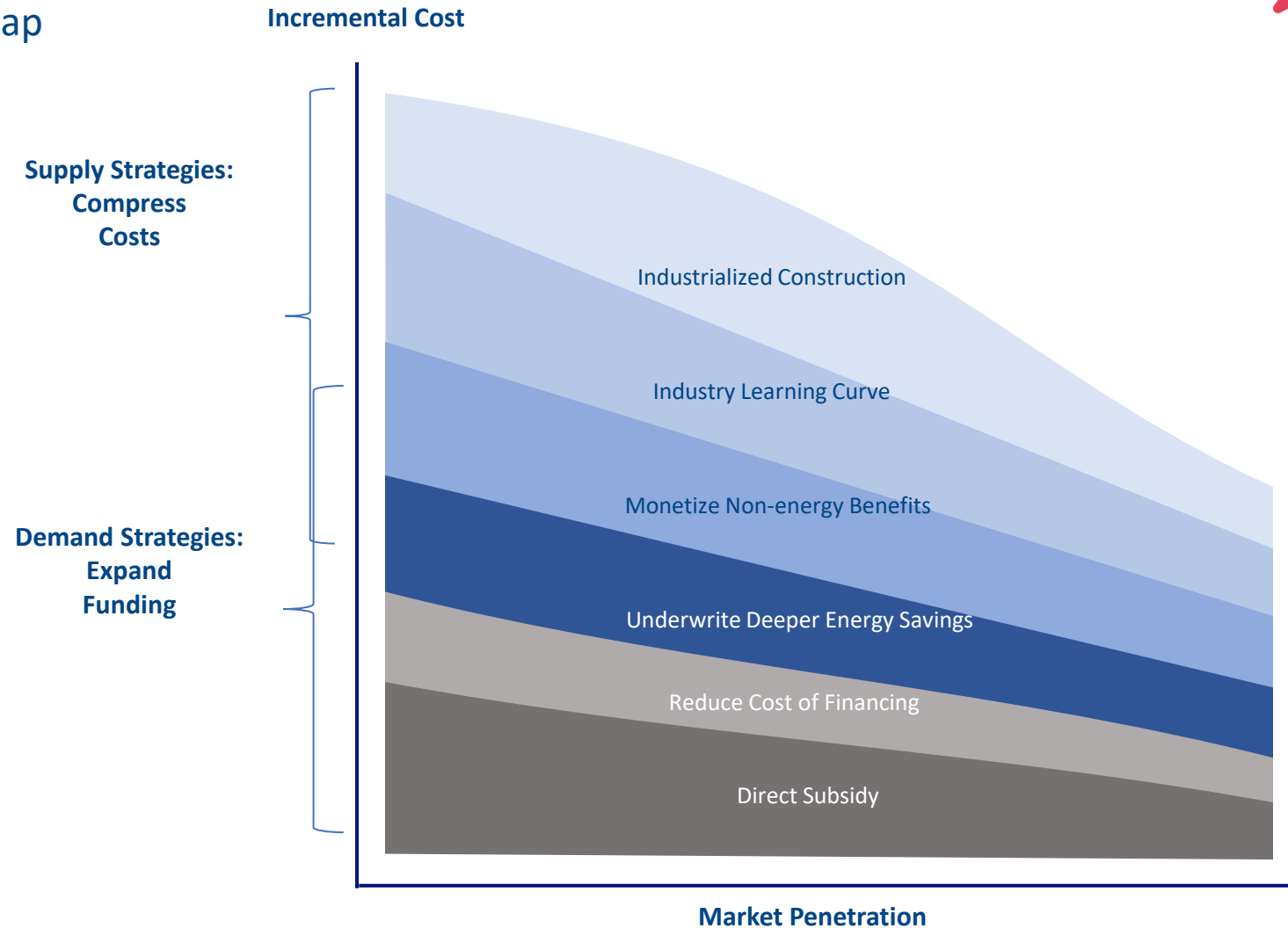
Roof solution



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

Enable & Standardize Funding & Financing

First solve the incremental cost gap



Aggregate Demand



Pledges signal
Future demand



Challenges and demonstrations serve to
test hypothetical packages and build
sector knowledge



Organize discreet typology
& climate zone combinations
in volume



Pathway to scaling building
decarbonization projects

RetrofitNY & REALIZE-CA
Pledges
450,000 units

**RetrofitNY,
REALIZE-MA & REALIZE-
CA Demonstrations**

**REALIZE MA 1,000
Apartment Challenge**
starting construction 2023

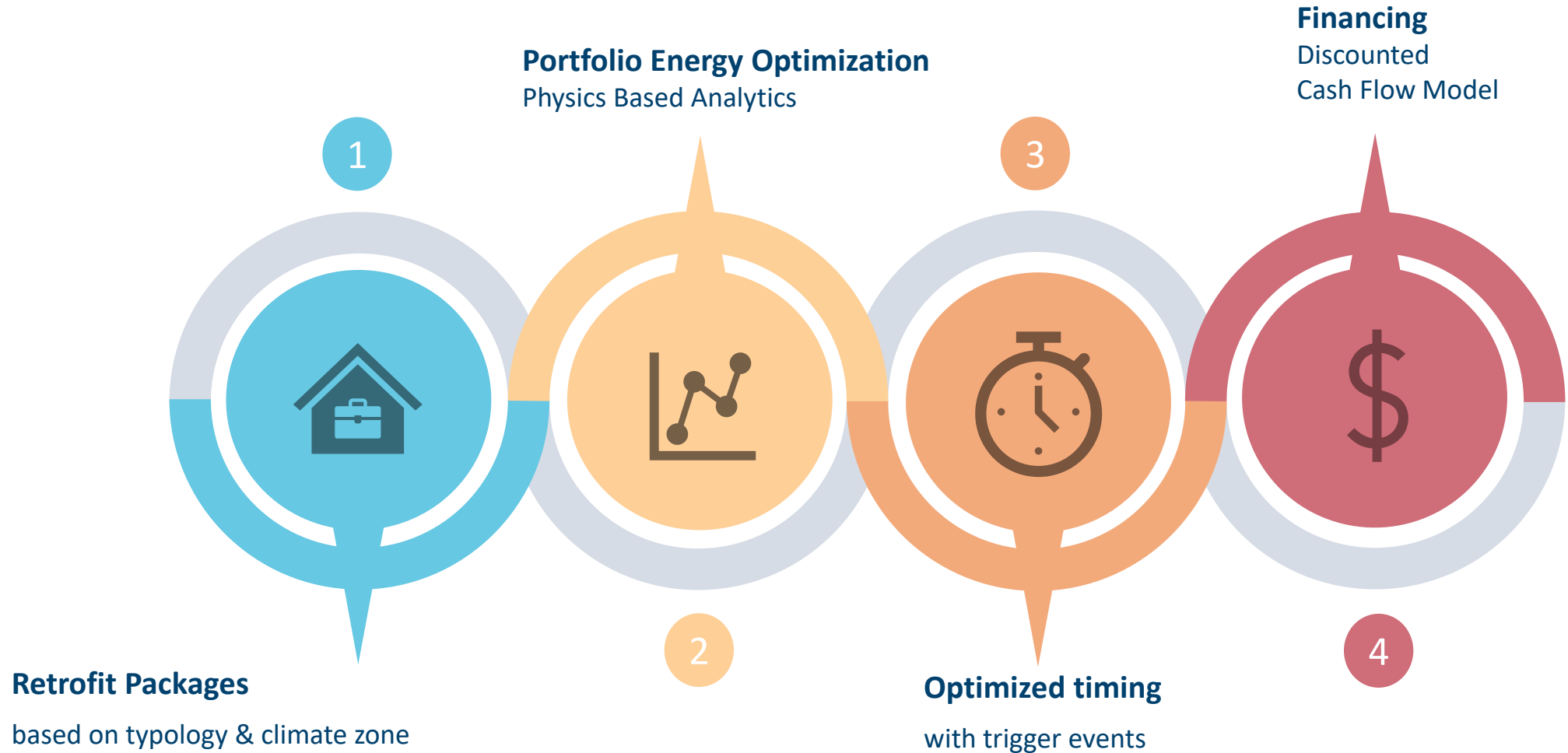


Zero Over Time



ZERO OVER TIME TOOL

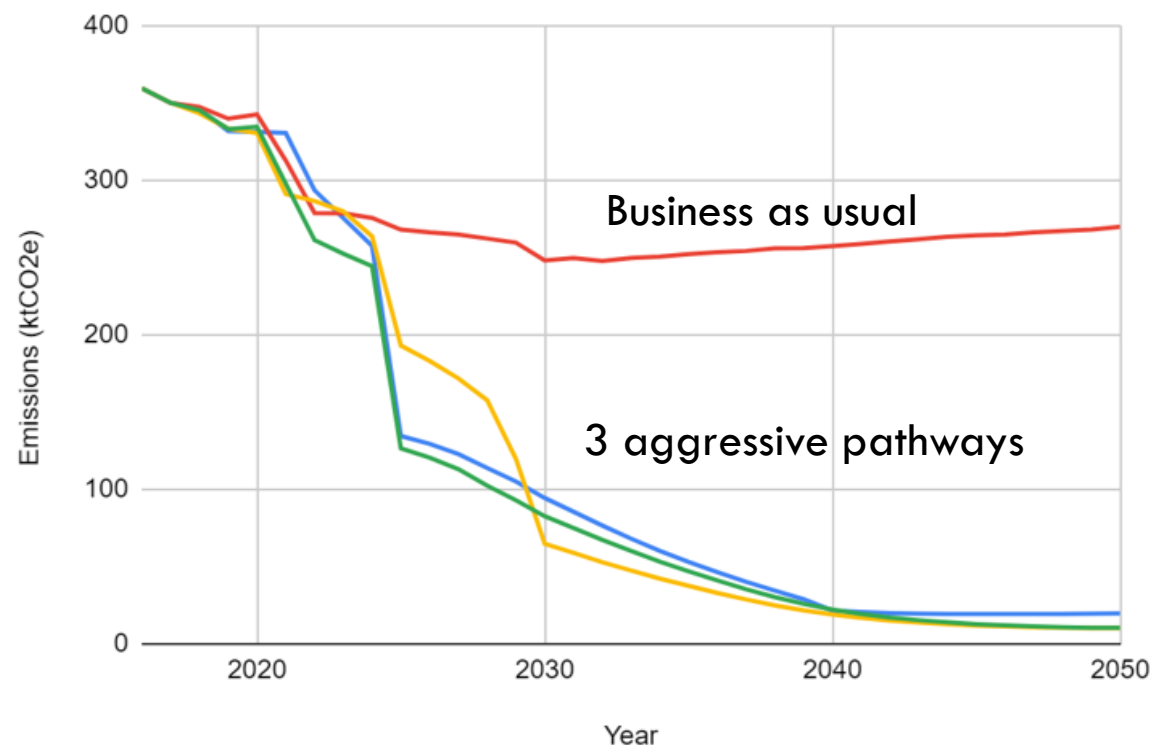
DEMAND AGGREGATION AND PIPELINE



Physics-based analysis with Portfolio Energy Optimization



PEO evaluated a large portfolio of federal buildings in Canada.

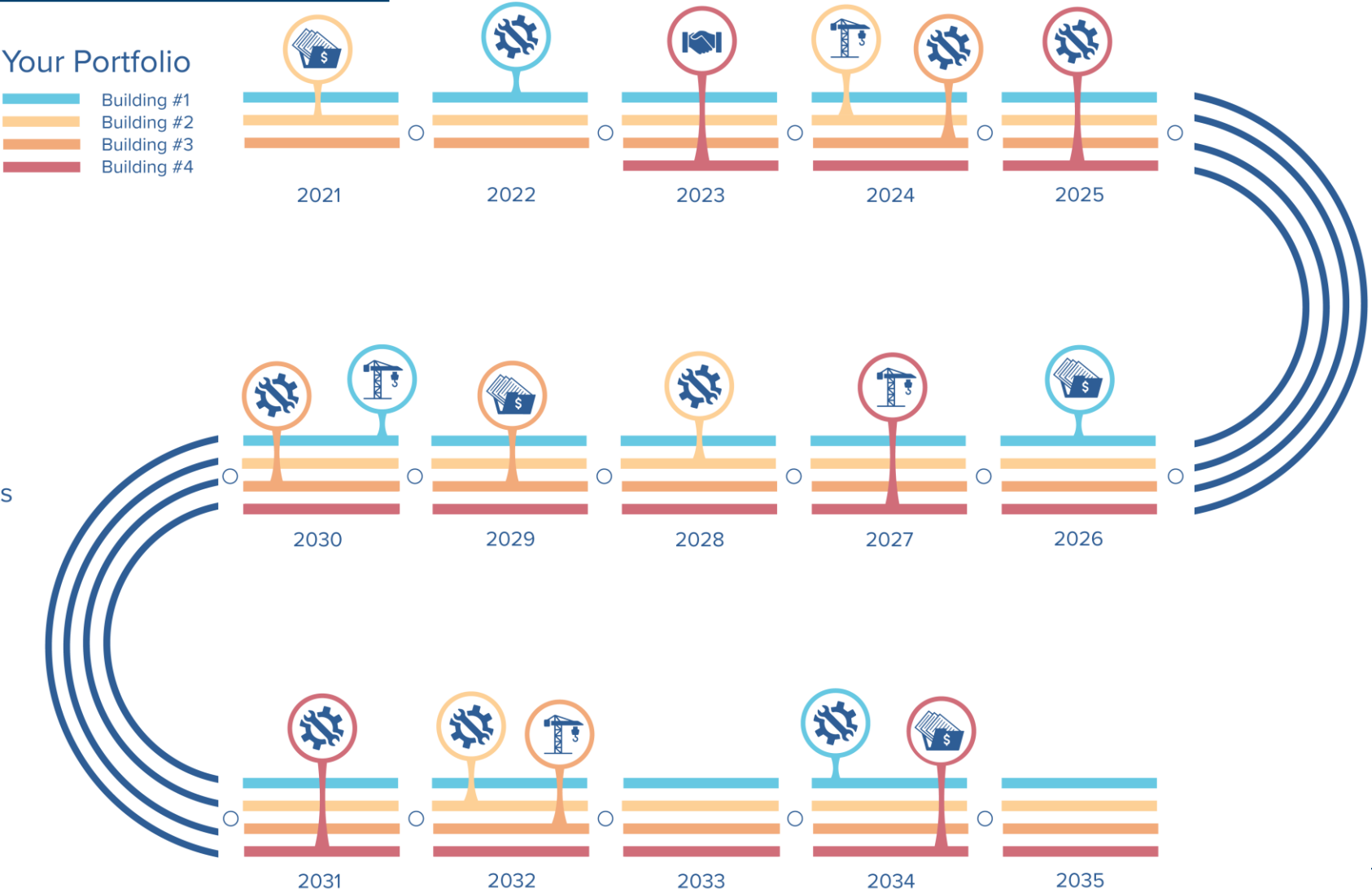


Collect reasonably comprehensive data on each portfolio asset

Analyze historical performance to establish a baseline

Generate multiple project scenarios for each property

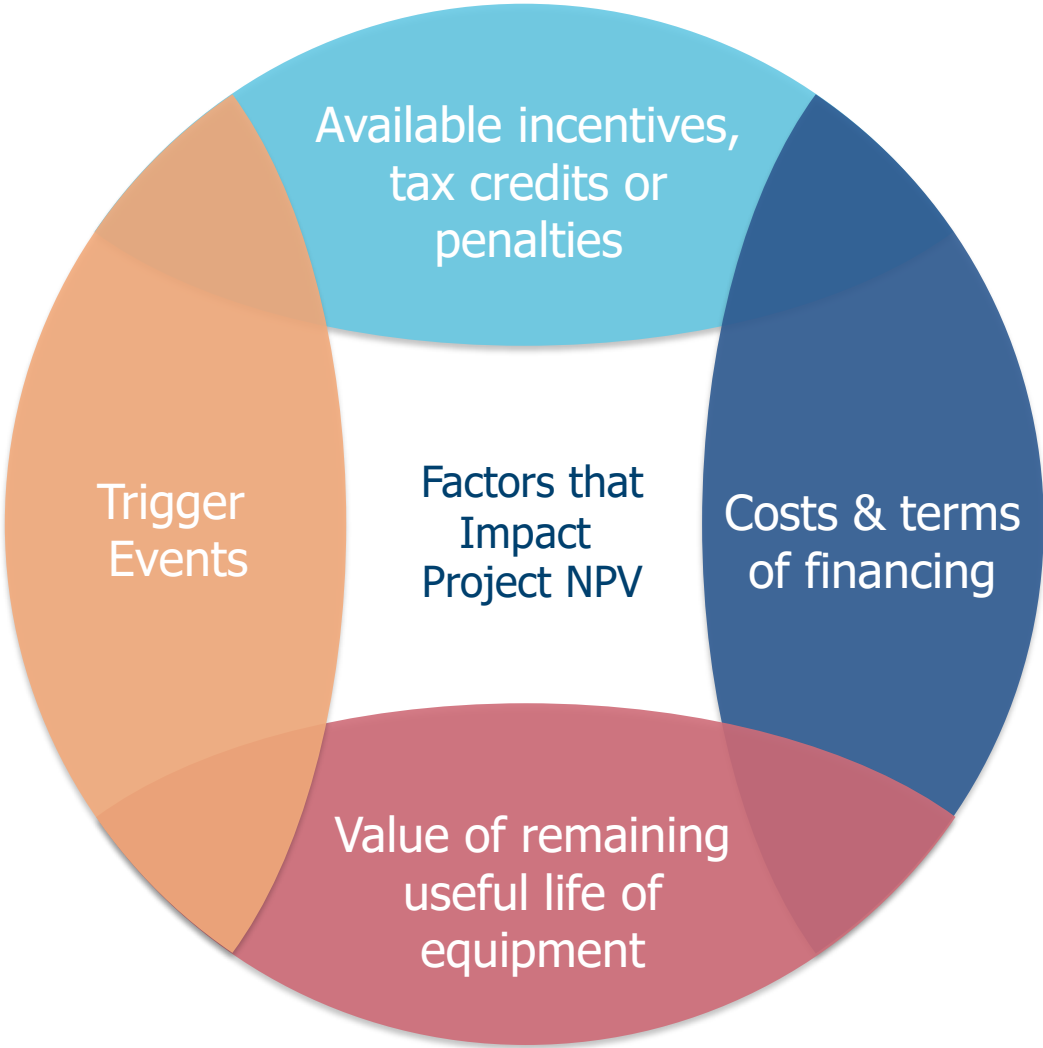
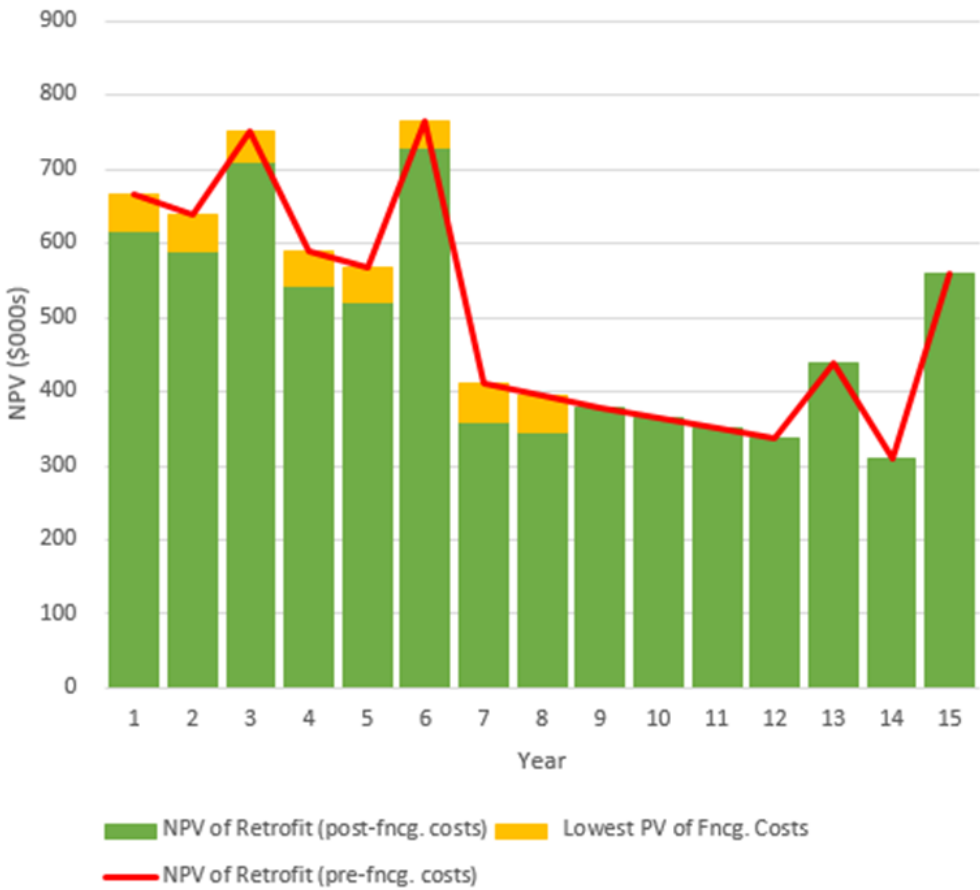
Trigger Events





Discounted Cash Flow Model

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





Eva White Apartments

440 Tremont Street, Boston, Massachusetts



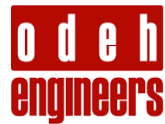
Eva White Apartments



Reisen Design Associates



Petersen
Engineering



Structural Design
Consulting
Investigation



Passive House Institute US



REALIZE Retrofit Package Summary

Comparison with
Existing Building

	Baseline	REALIZE Package
Wall	Uninsulated masonry (R-1)	R-30 panel with no thermal bridging
Roof	Some insulation (R-9)	R-40
Floor	Some insulation with thermal bridging (R-7.6)	R-21.5 accounting for thermal bridging at columns
Infiltration	0.2 ACHn	0.11 cfm75 / ft2 enclosure (0.013 ACHn)
Window	Metal single pane U-1.02, SHGC 0.82	Whole window U-0.26, SHGC 0.4
Space heating	85% boiler; derated to 55% overall	Ducted VRF fan coil in each apt based on Mitsubishi R2 series N Generation
Space cooling	29 window AC units	
Water heating	Condensing boilers derated to 73% overall efficiency	CO2 Central Heat Pump Water Heater
Ventilation	Central exhaust 50-100 cfm	84% central ERV; supply to bedrooms and living
Appliances	Electric cooking	Induction cooktop, other appliances unchanged
Lighting	LED in common areas, mixed in-unit	LED upgrade in kitchens and baths
Water use	103 gal / bedroom / day	67 gal / bedroom / day

Existing Building



Ventilation supply ductwork and VRF line sets run along the exterior



Fire stopping around window openings and panel perimeter



Envelope panels with new windows pre-installed



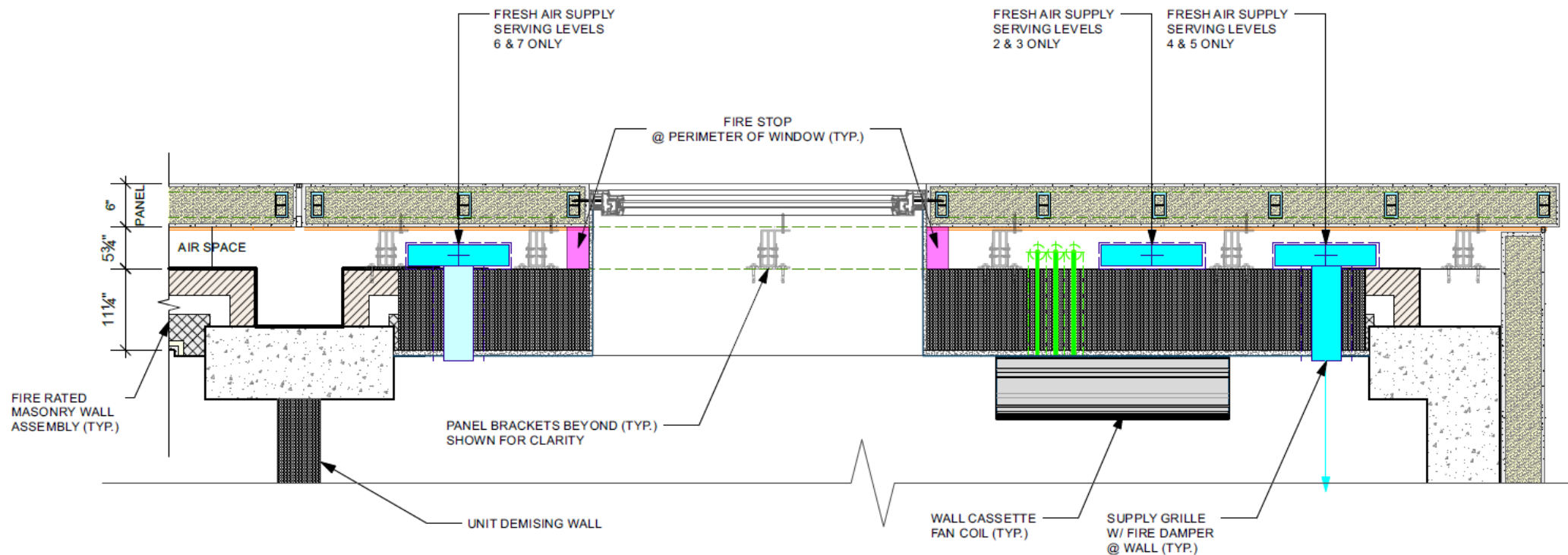
Finished Product



Design Detail

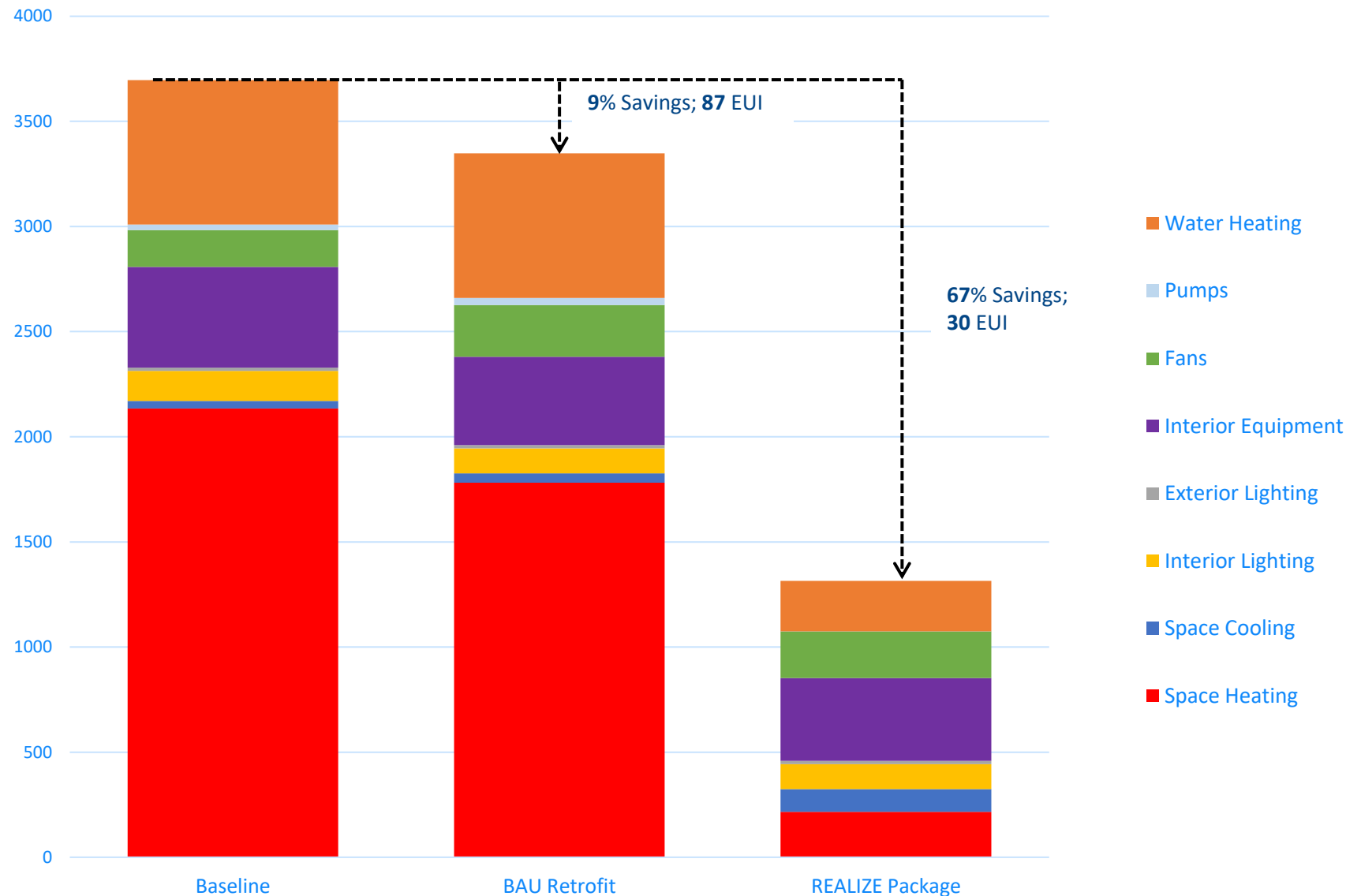


- **Enclosure:** Tremco Revitalite System, uPVC Amberline windows
- **MEP:** Gas to electric conversion | Central: VRF, HPWH, ERV



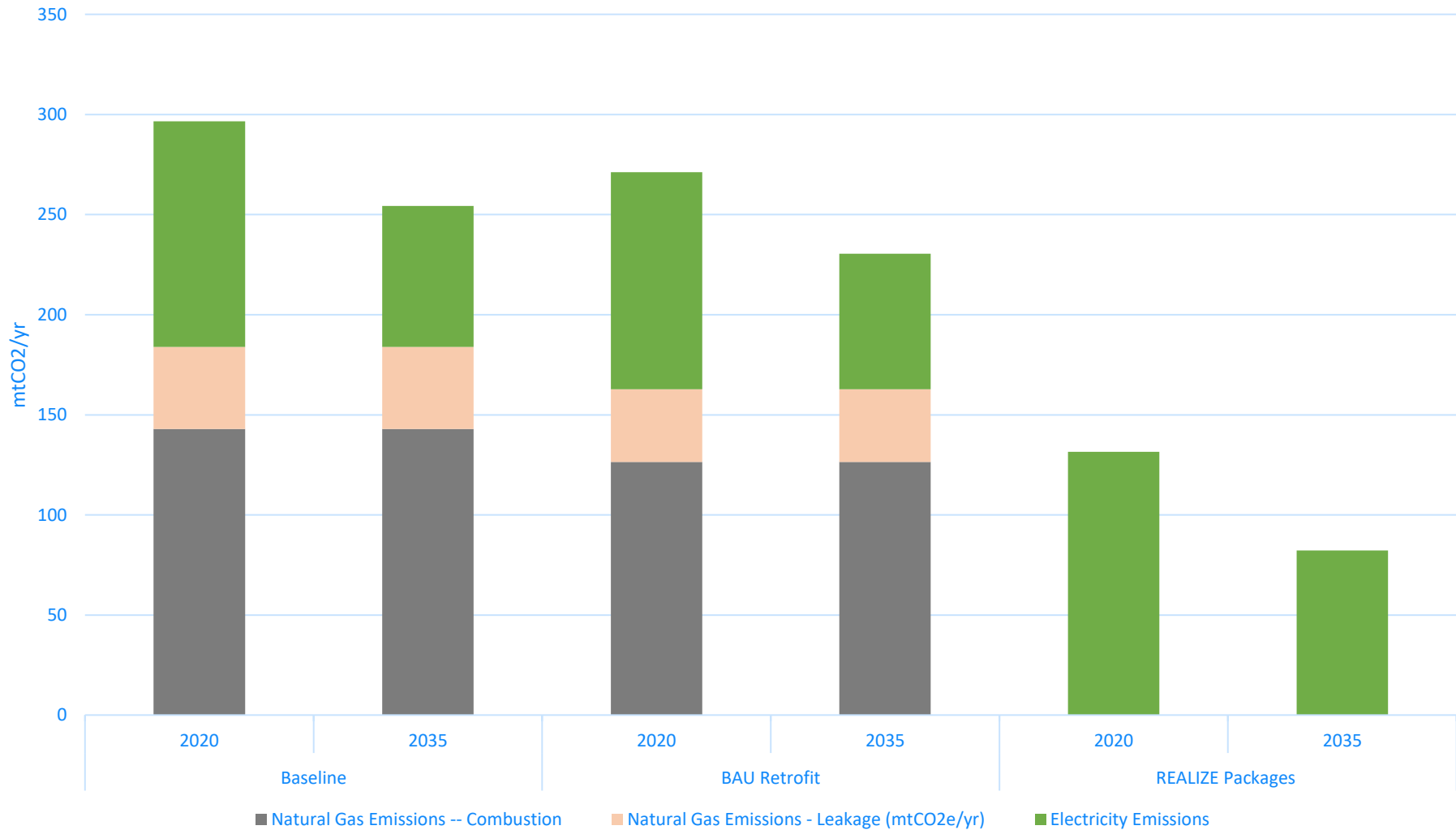
REALIZE Retrofit Package Results

Modeled Site Energy Savings (mmbtu/yr)



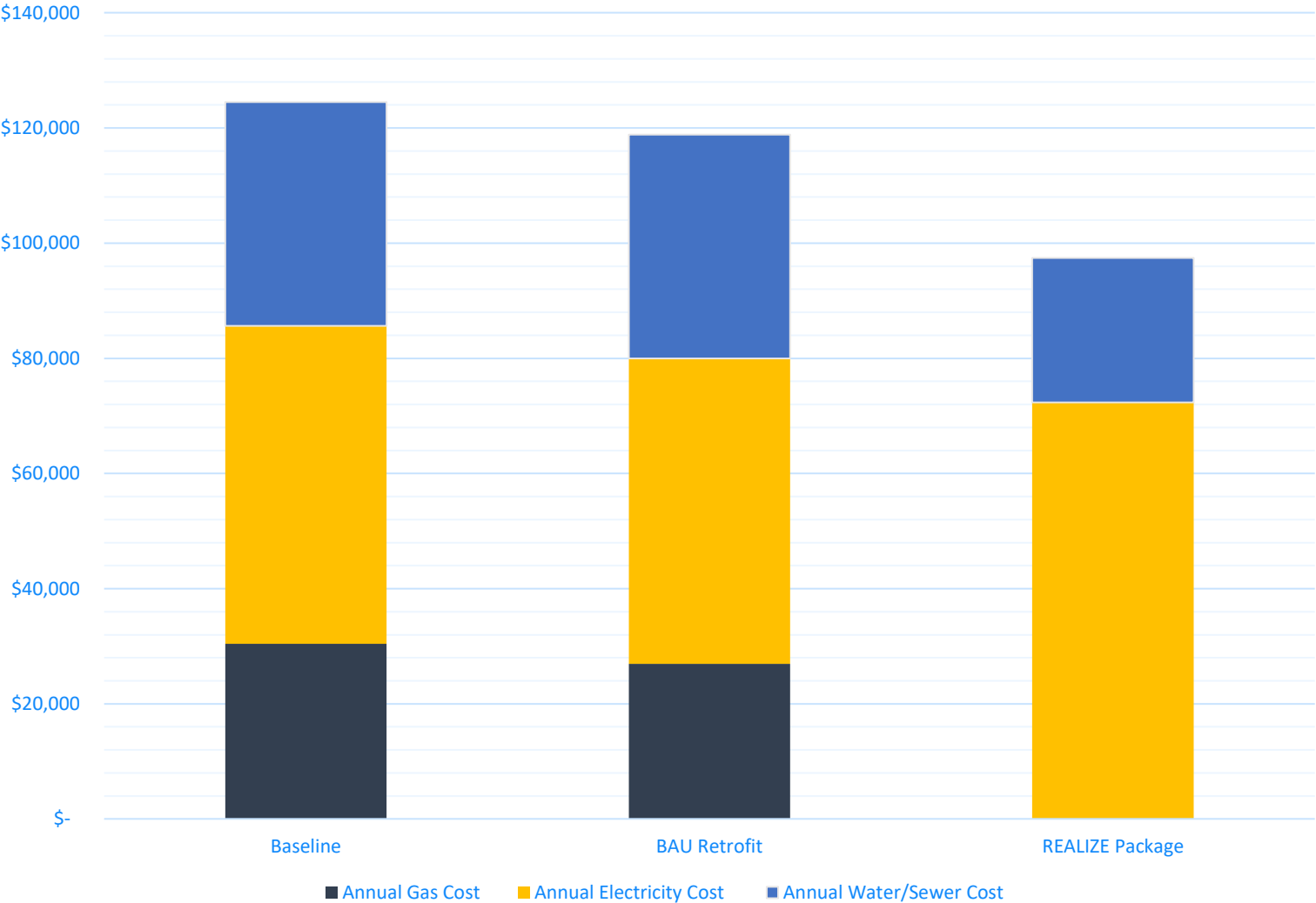
REALIZE Retrofit Package Results

GHG Emissions Over Time



Estimated Utility Savings

Annual Utility Costs (\$/yr)



Eva White Lessons Learned (So Far!)

- **Leveraging existing rehab and capital needs can reduce incremental cost (ZOT)**
 - BAU: \$150k/unit
 - Deep Energy Retrofit: \$250k/unit
- **New sources are needed to support additional costs**
 - MassSave LEAN incentives
 - LIHTC
 - RAD/Section 18
- **Customized vs. “Standardized”**
 - Further R&D is needed
 - Integrated design and project delivery models need to evolve with new retrofit ‘products’

Thank you!

Questions?

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