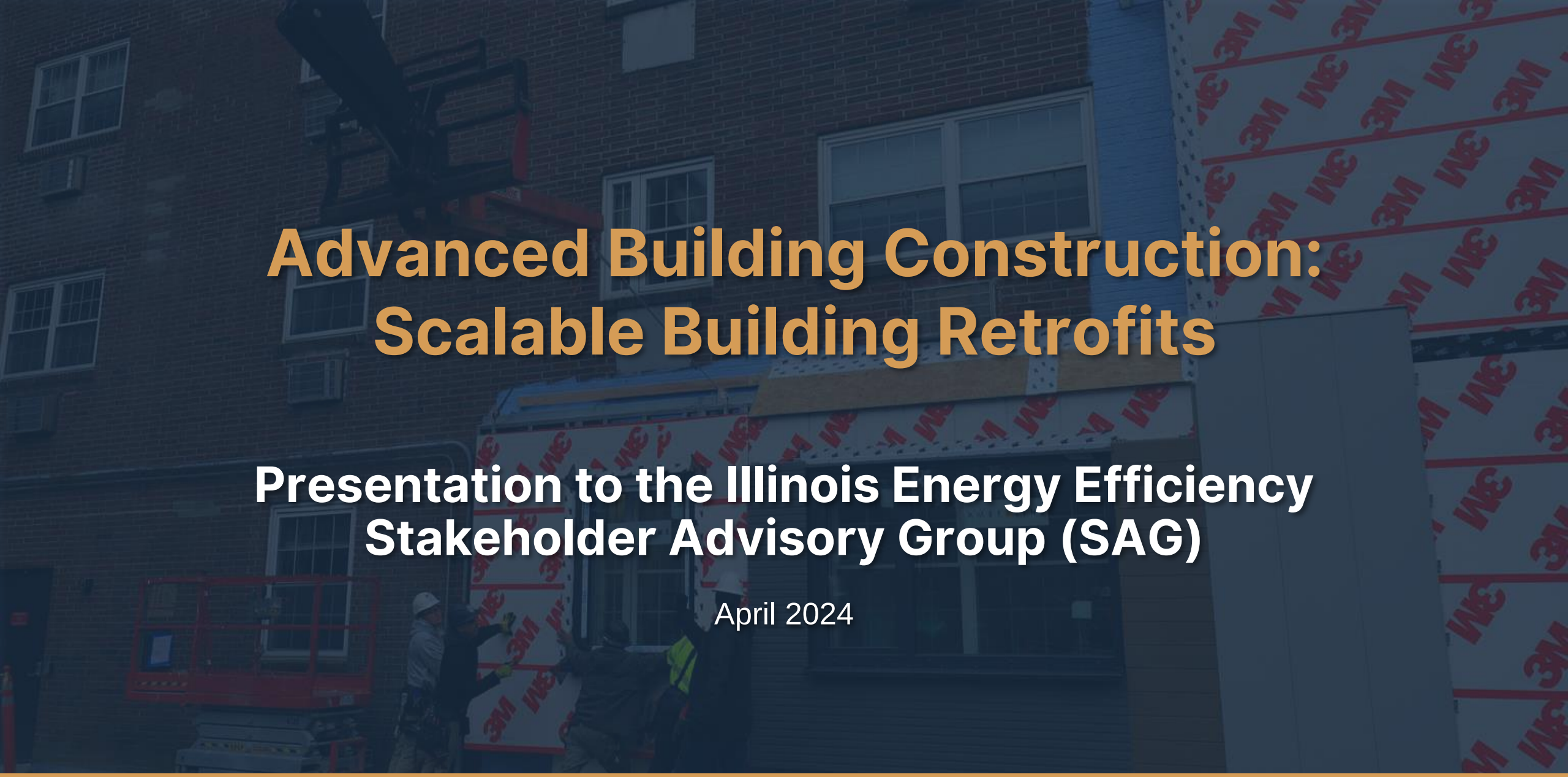


Advanced Building Construction: Scalable Building Retrofits

Presentation to the Illinois Energy Efficiency Stakeholder Advisory Group (SAG)

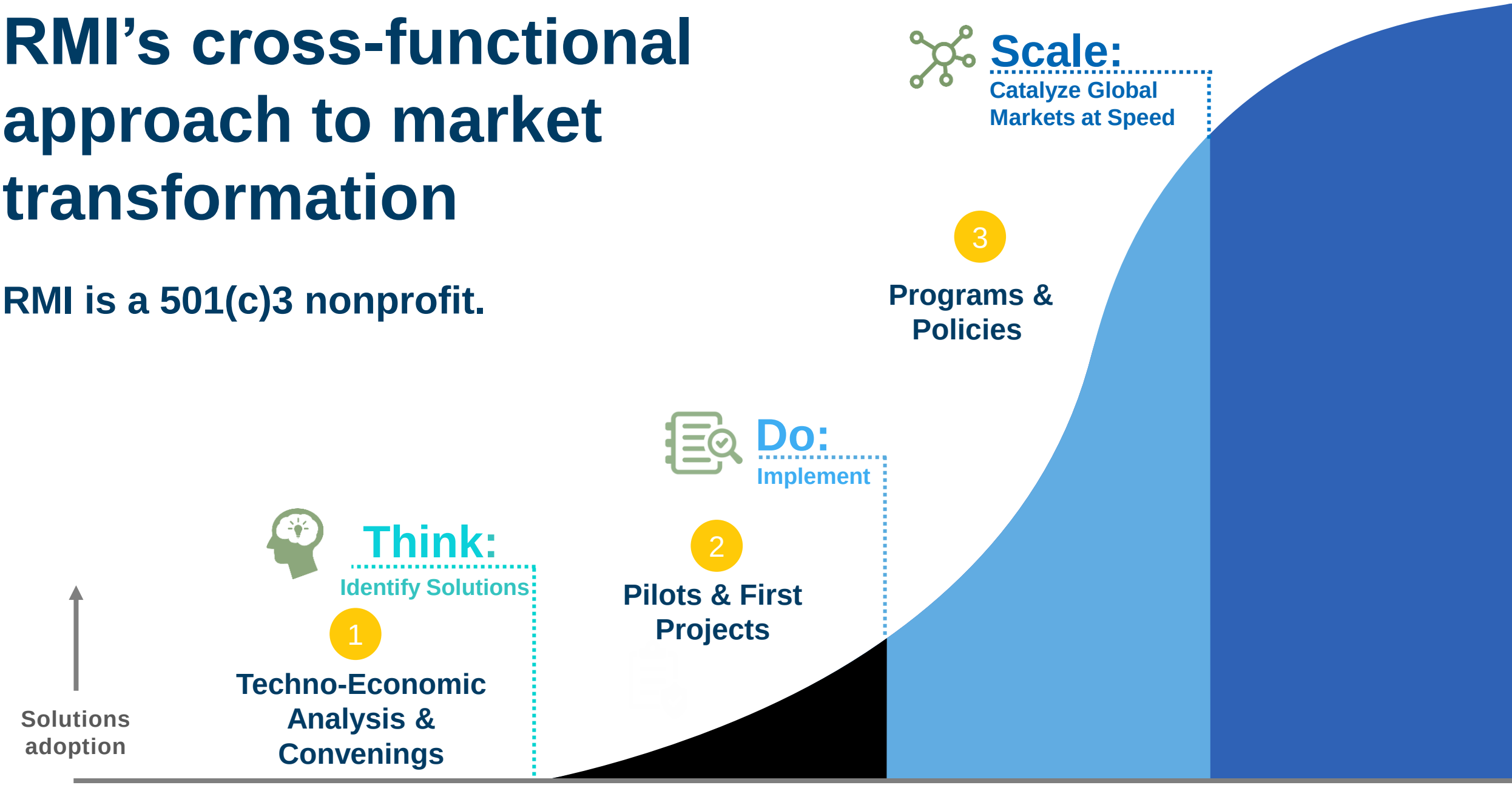
April 2024

RMI
ENERGY. TRANSFORMED.

ABC
ADVANCED BUILDING CONSTRUCTION
Collaborative

RMI's cross-functional approach to market transformation

RMI is a 501(c)3 nonprofit.



The incumbent market is struggling to meet a confluence of buildings sector challenges.

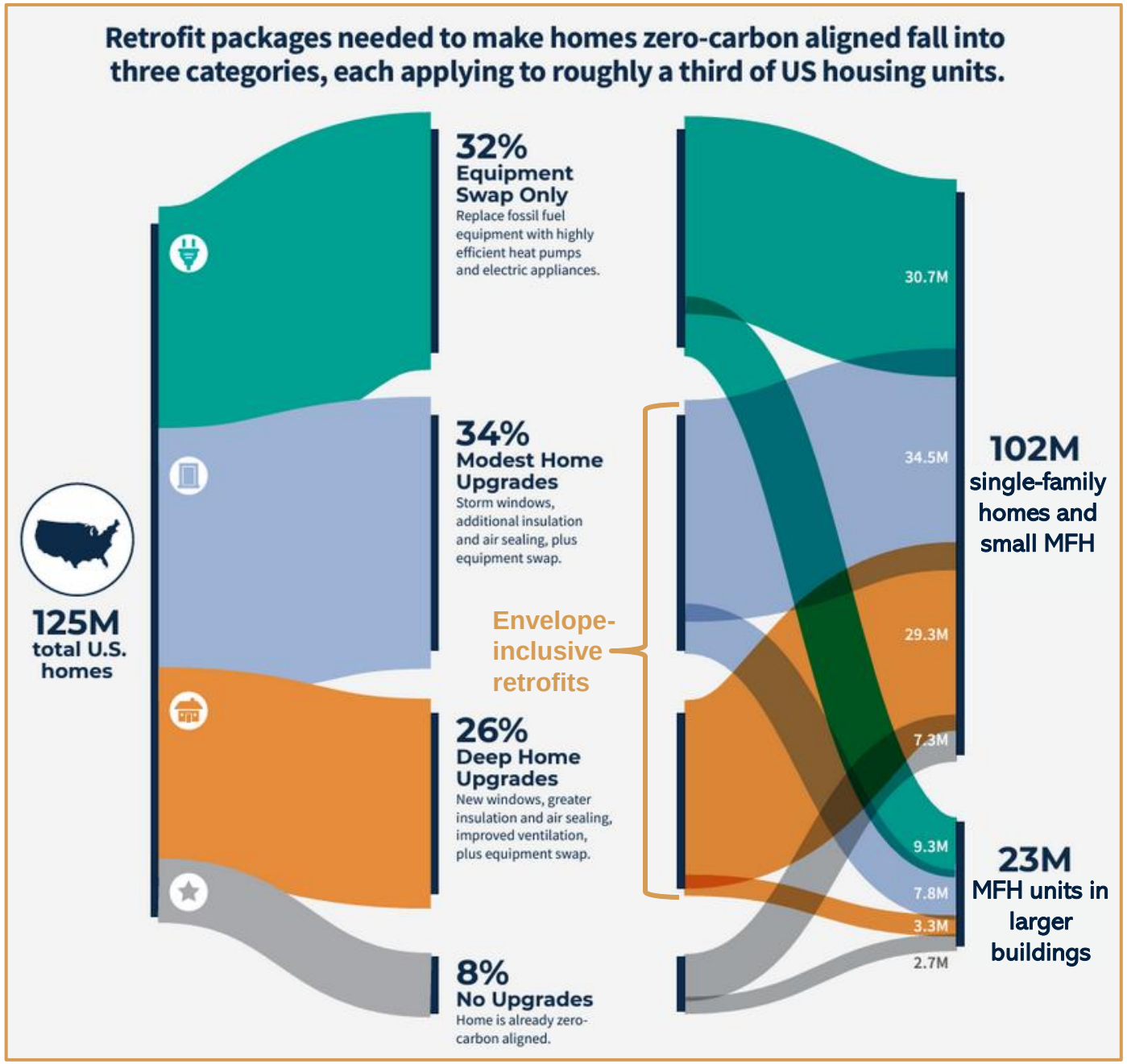
Catastrophic climate change is on the horizon — and the buildings sector is responsible for almost 40% of global GHG emissions.

Most existing US buildings are inefficient and direct emitters; many are fragile and unhealthy; millions will need retrofits.

US housing needs — to bridge the existing gap and meet new demand — risk greatly worsening buildings' climate impact.

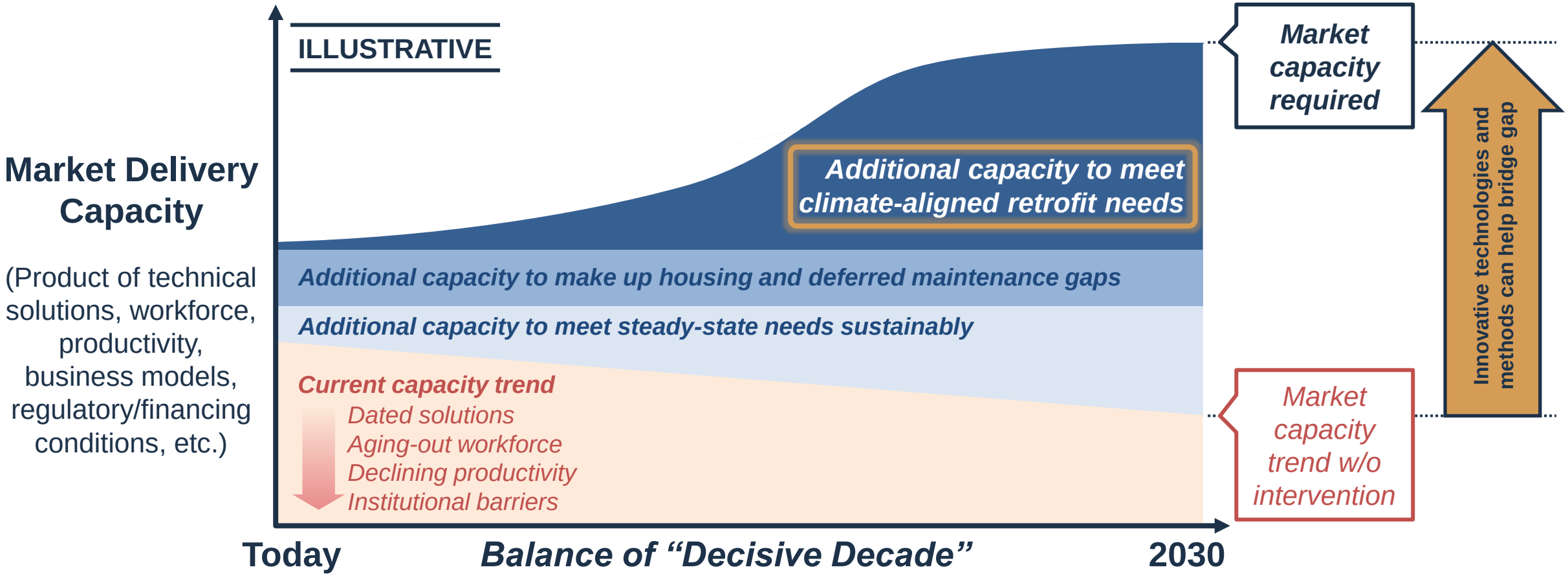
Unfavorable construction industry trends are a drag on the market's ability to adapt.

Around 90% of US homes need a retrofit to become zero-carbon aligned.



ABC-C / RMI / LBNL / NREL / PNNL

Innovation is essential to address retrofits (and other needs) in a climate-aligned manner.



Advanced building construction (ABC) leverages innovation to accelerate decarbonization.

ABC
ADVANCED BUILDING CONSTRUCTION
Collaborative

Energy-efficient building decarbonization

- Increased thermal and acoustic comfort
- Improved indoor air quality and health
- Resilience, incl. passive survivability
- Reduced maintenance
- Electricity system benefits
- Reduced emissions (climate, compliance)
- Utility savings

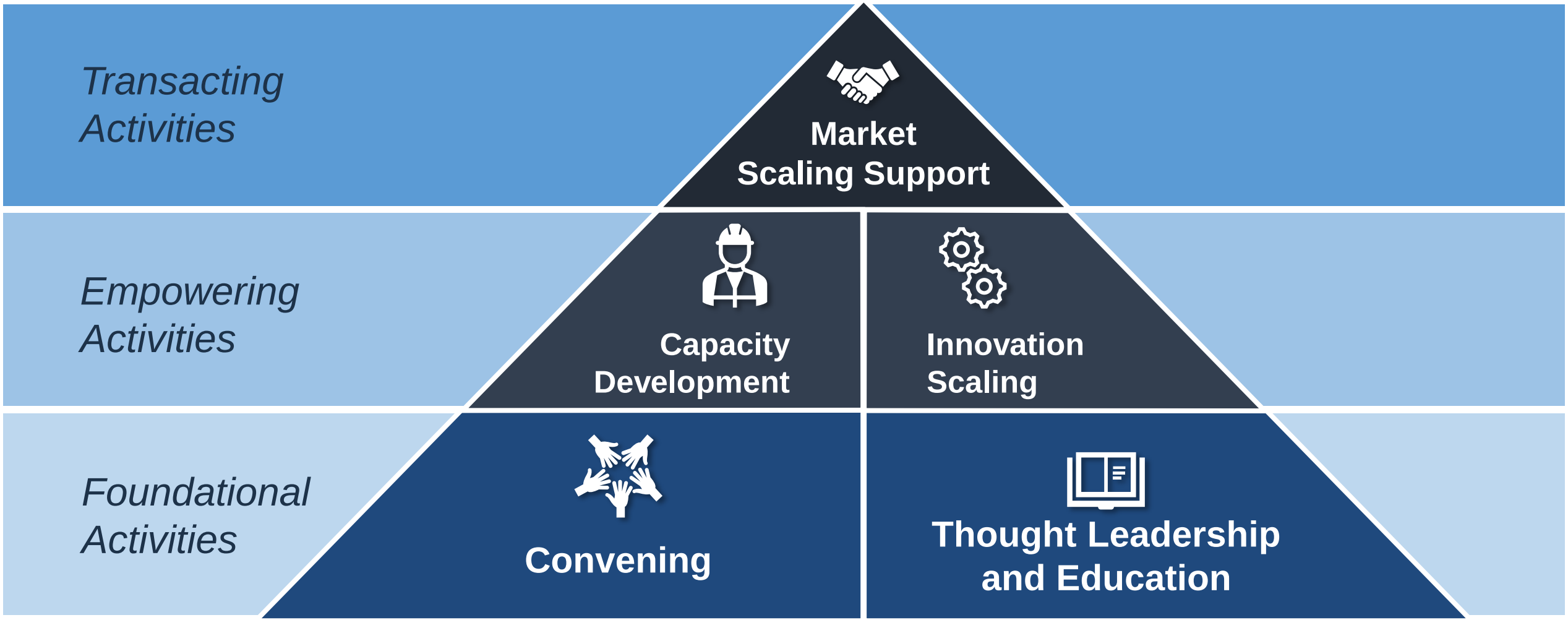
+

Streamlined, replicable industrialized construction (IC) methods

- Higher productivity and faster delivery to achieve requisite speed and scale
- Reduced disruption
- Increased schedule and budget certainty
- Reduced waste
- Enhanced precision and quality control
- Workforce benefits, incl. improved safety
- Regional economic development

The ABC Collaborative's core activities foster, inform, and accelerate an ABC ecosystem.

ADVANCED BUILDING CONSTRUCTION Collaborative



RMI's REALIZE initiative has been at the forefront of advanced retrofits in the US.

REALIZE

2016

RMI hosts inaugural **convening on advanced retrofits** in Pocantico, NY, with industry, building owners, DOE, NYSERDA, city stakeholders, and Phius to discuss strategy for scaling rapid retrofits in North America.

2017

NY State commits **$40M for RetrofitNY**.

RetrofitNY, REALIZE, and the ABC Collaborative will become close collaborators.

2018

RMI kicks off first DOE award to demonstrate Energiesprong-style AMFH retrofit in a cold or mixed-humid climate zone.

REALIZE-MA launched.

2019

RMI launches **REALIZE-CA** with CEC support to demonstrate—and establish a market scaling platform for—AMFH decarb retrofits in California.

2020

RMI launches the **Advanced Building Construction Collaborative** with DOE support.

DOE awards **$26M for ABC RD&D.**

2021

REALIZE-MA launches the **1000-Apartment Challenge.**

2022

DOE awards **$32M** for 38 **advanced whole-building retrofit demonstrations**, including REALIZE-led ABC retrofits.

2023–4

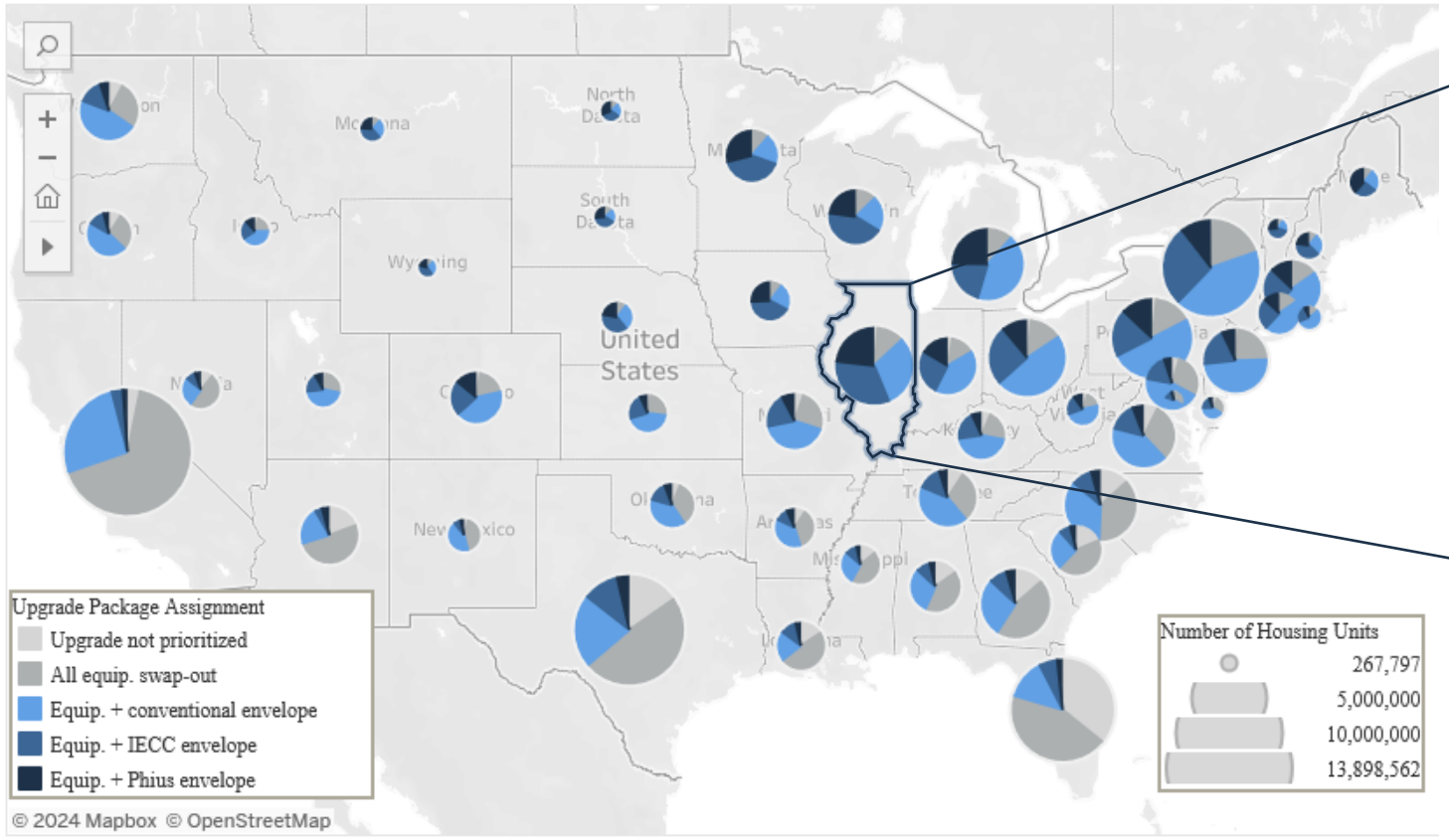
The ABC Collaborative and REALIZE support owners in **leveraging IRA opportunities** for AMFH, including the GRRP.

FUTURE

Continue accelerating the pace of building decarbonization retrofits!

RMI / Self Help Enterprises

The Illinois Retrofit Need



ABC-C / RMI / LBNL / NREL / PNNL

Retrofit packages	Number of units	Percent of IL res. building stock
Upgrade not prioritized	82,082	2%
All equip. swap-out	608,475	11%
Equip. + conventional envelope	1,630,036	31%
Equip. + IECC envelope	1,751,091	33%
Equip. + Phius envelope	1,229,541	23%

87% of the existing homes in Illinois may need an envelope retrofit.

Benefits of Industrialized Retrofits Include:

Eliminating occupant displacement and minimizing disruption.

Industrialized retrofits can be performed without displacing residents from their homes, reducing costs and preserving tenant stability.

Overall project speed

On-site deep retrofit work can be reduced from weeks or months to a matter of days and can reduce sequential delays.

Health outcomes

The elimination of fossil fuel combustion from the building coupled with continuous, controlled ventilation (at very low energy cost due to energy recovery) translates into clear health benefits for residents.

Improved comfort and passive survivability

Higher-performance envelopes passively preserve safe indoor conditions longer—in some cases providing survivability for days, both in extreme heat and cold events.

Reduced grid impact

Reduced annual and peak energy demand from improvement of both envelope and equipment mean smaller demands on the electricity grid.

Follow-on effects of reduced loads

Envelope improvements reduce the design loads and, consequently, size and cost of mechanical systems as well as renewable generation, energy storage, and/or back-up generation systems.

Quality and durability

The manufacture of industrialized retrofit components in controlled, off-site environments, using technology-based quality control practices, can enable a more consistent quality assurance.

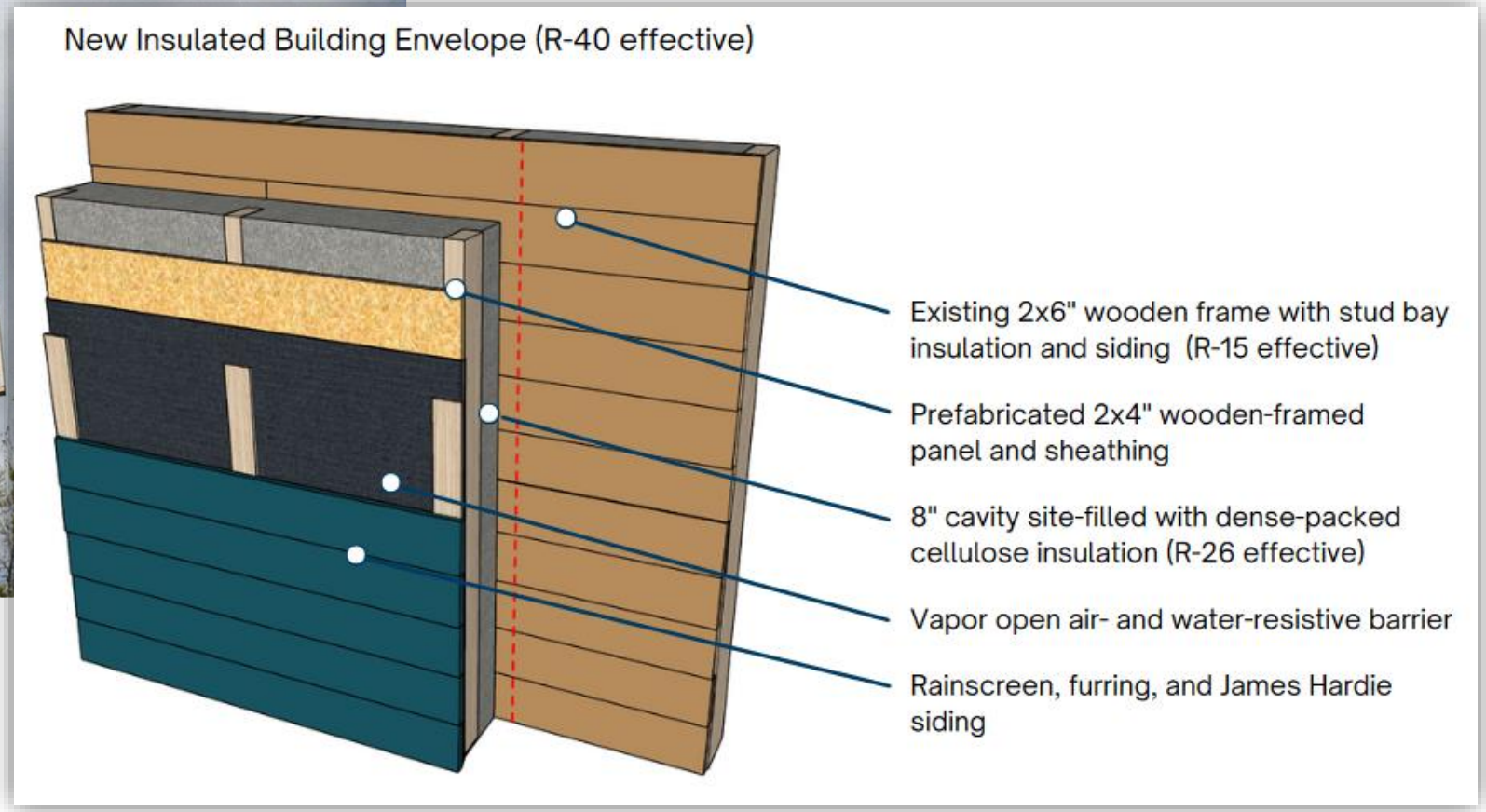
Cost compression opportunity

Innovative approaches have the most potential for project cost compression at scale, delivering a host of benefits at progressively decreasing cost.

Single-family/townhome: Sundance Co-op

Sundance Housing Cooperative
Edmonton, Alberta
2023 (complete)

Single-family/townhome: Sundance Co-op

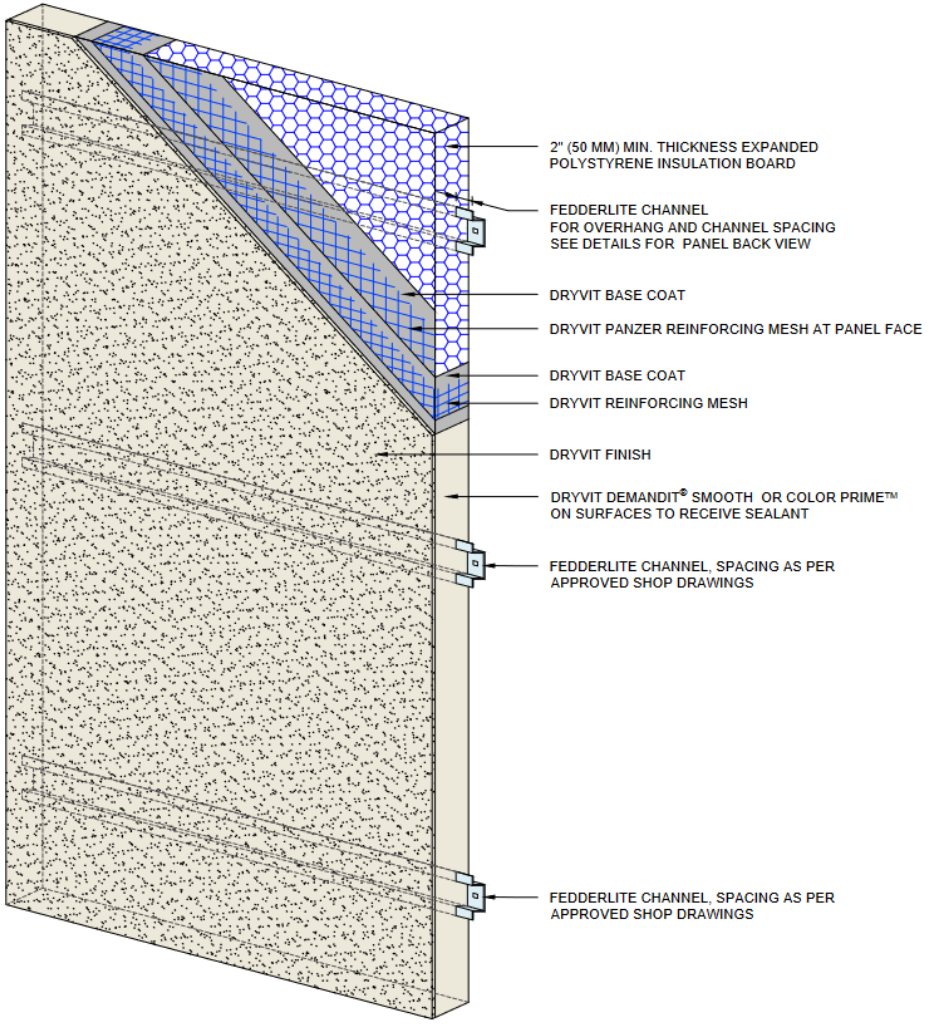


Low-rise multifamily: Corona del Rey

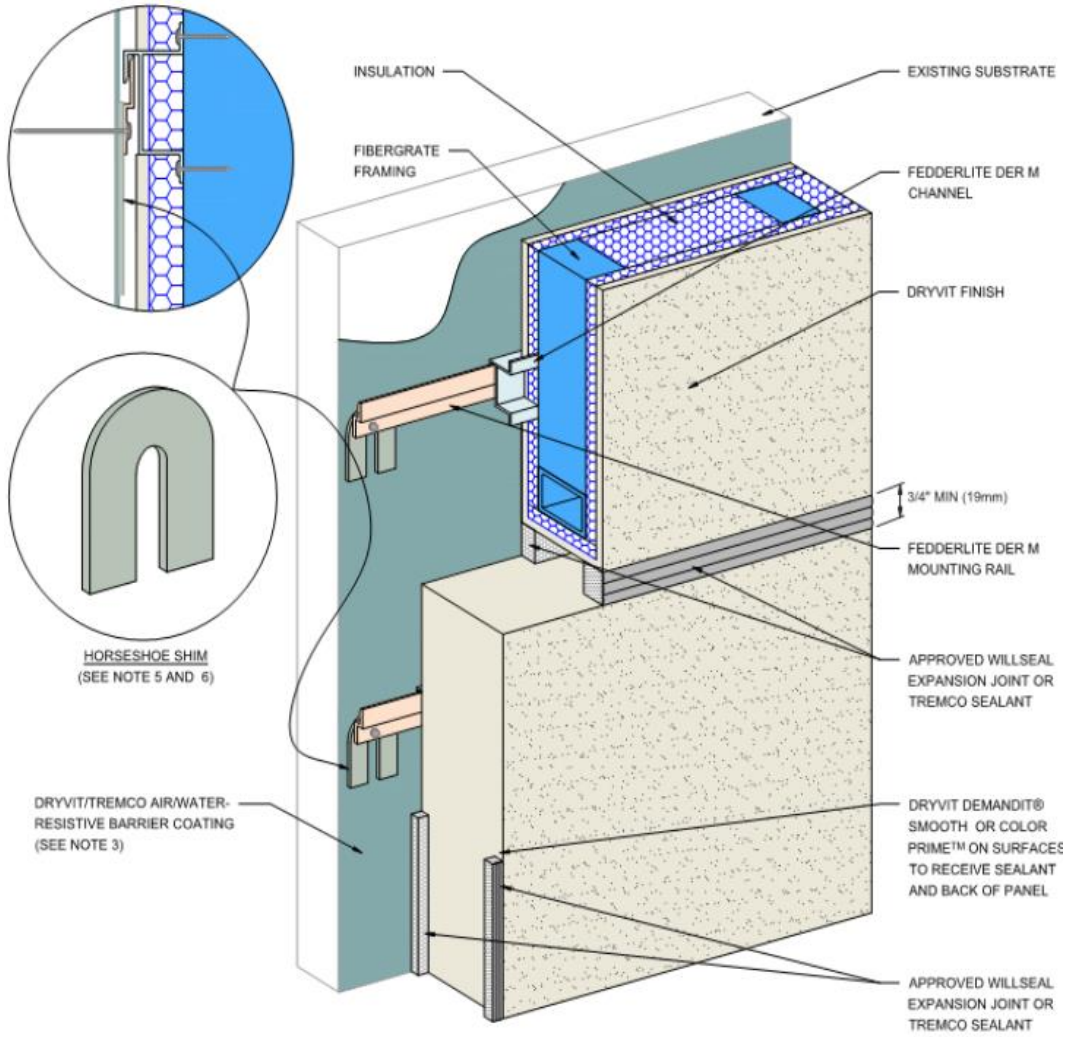
REALIZE

Corona del Rey Apartments
Corona, CA
2024 (substantially complete)

Low-rise multifamily: Corona del Rey

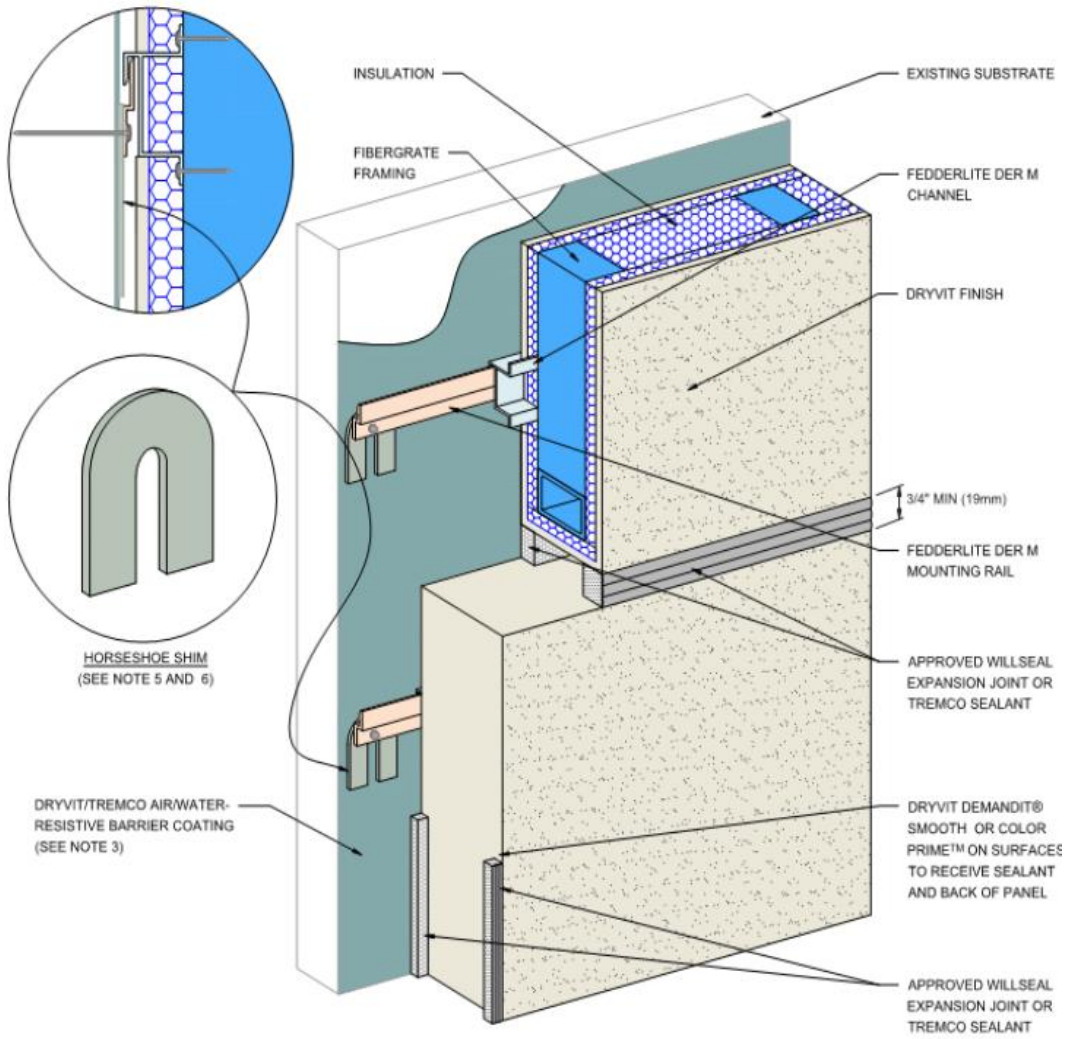


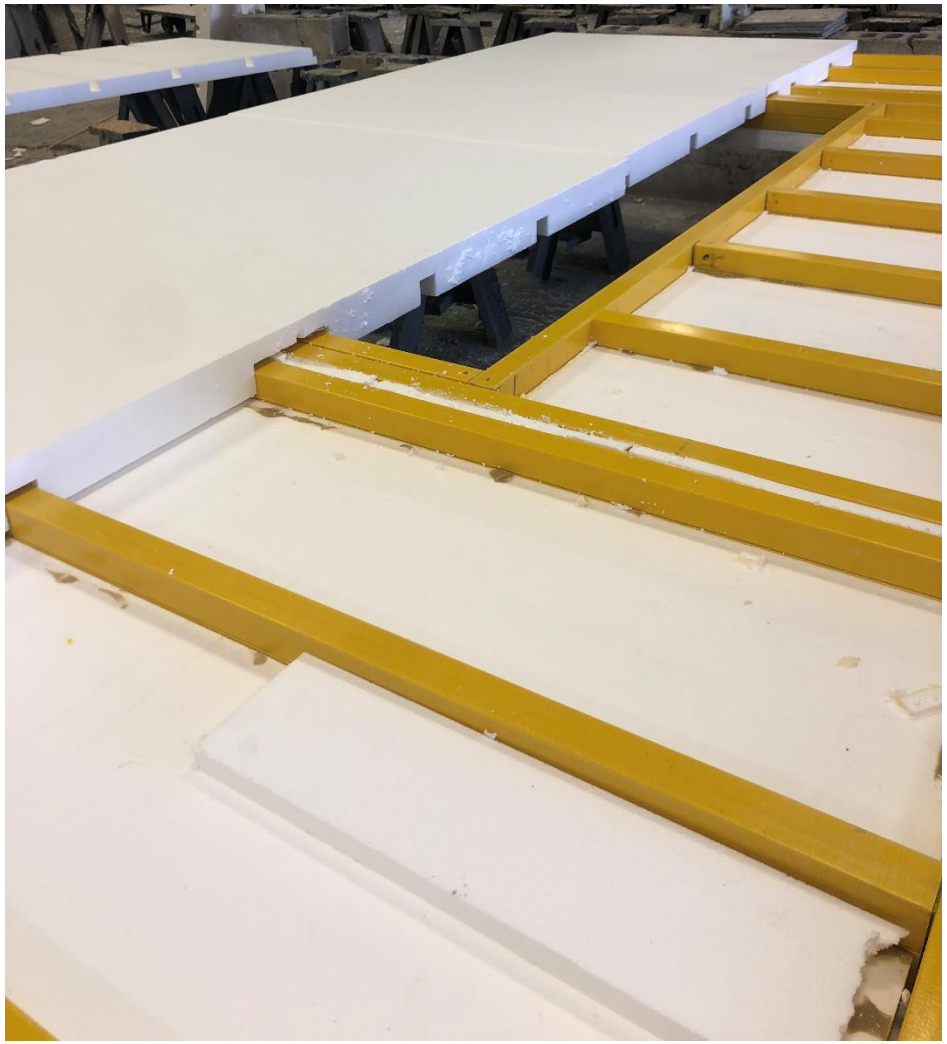
Fedderlite panel system



Revitalite panel system

Low-rise multifamily: Corona del Rey



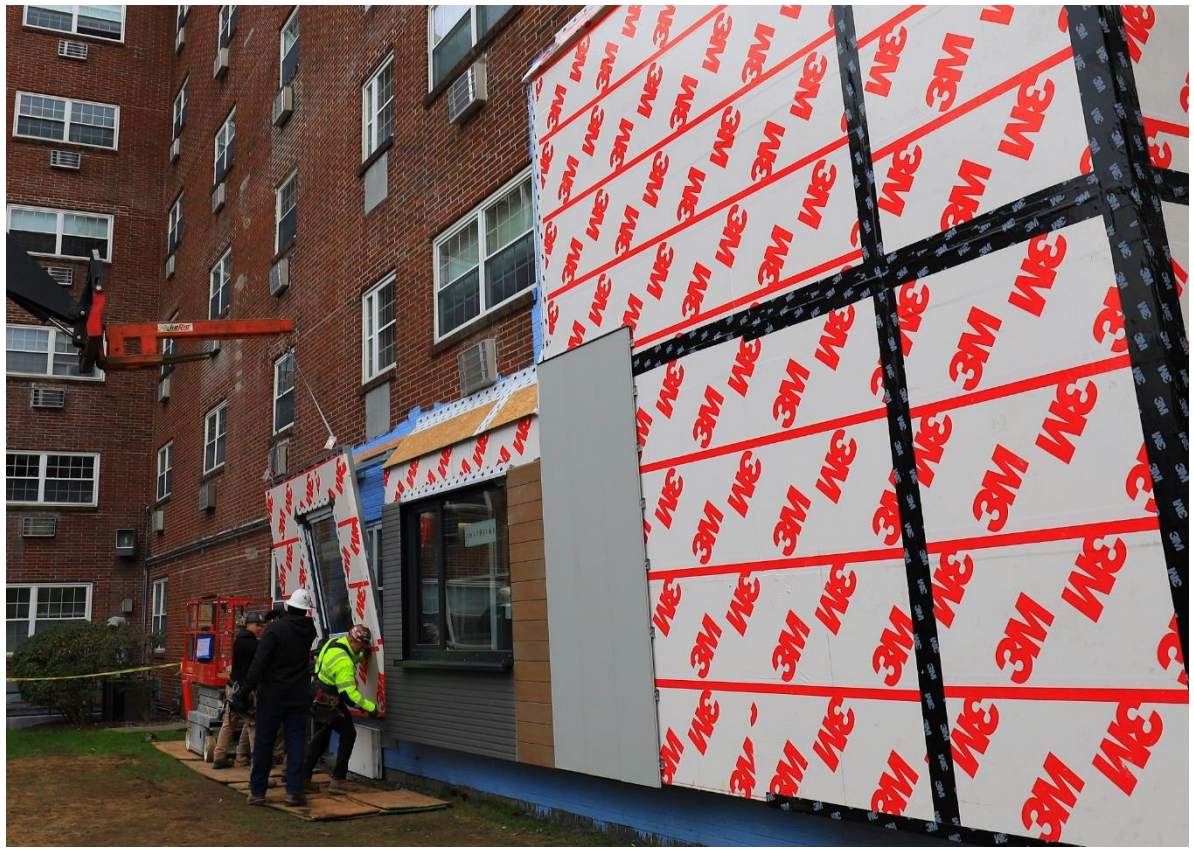


Revitalite panel system

Mid-rise multifamily: Fairweather Salem

Fairweather Apartments – Salem
Salem, MA
2024 (pre-construction)

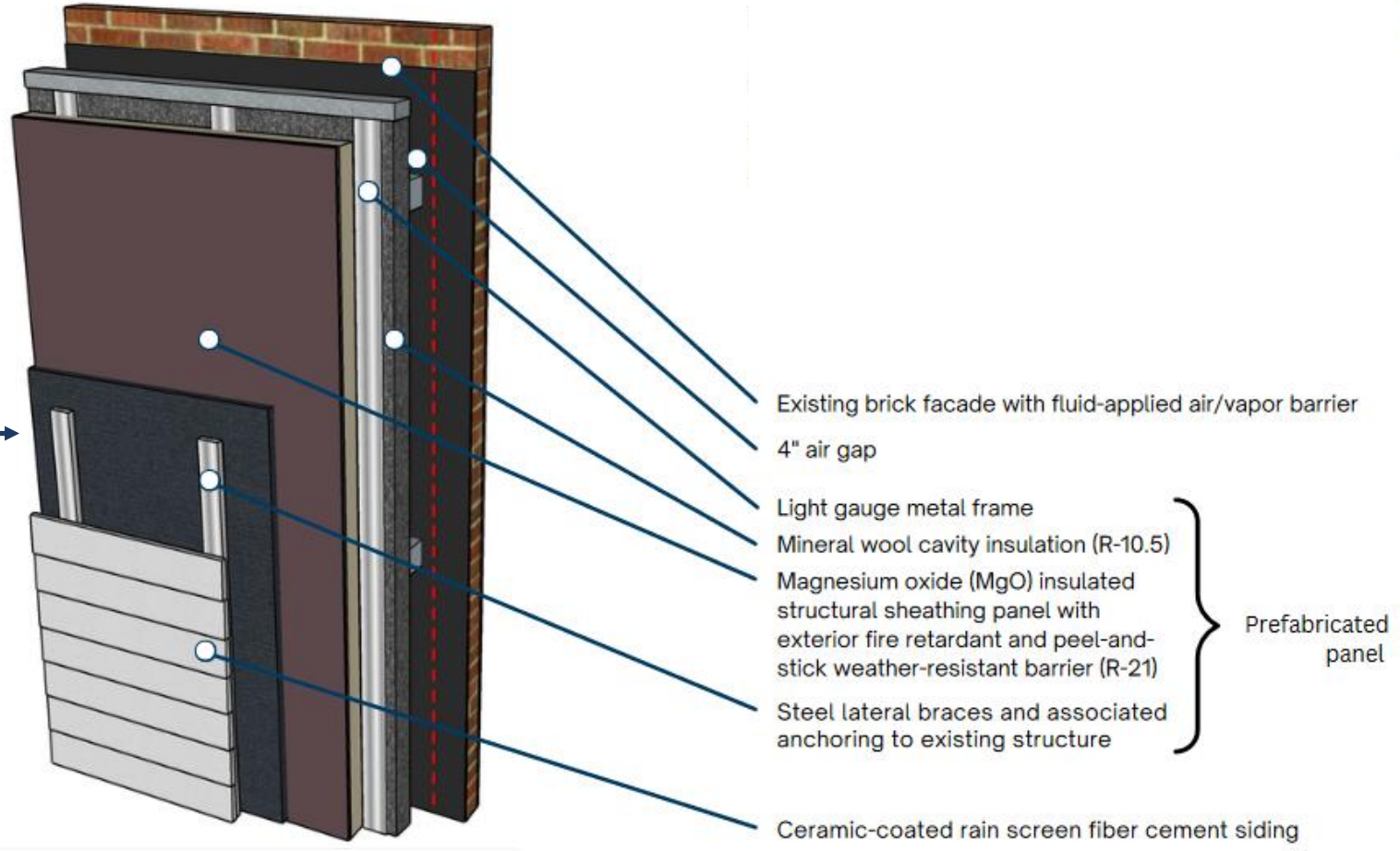
Mid-rise multifamily: Fairweather Salem



Fairweather Apartments – Salem
Salem, MA
2024 (pre-construction)

Mid-rise multifamily: Fairweather Salem

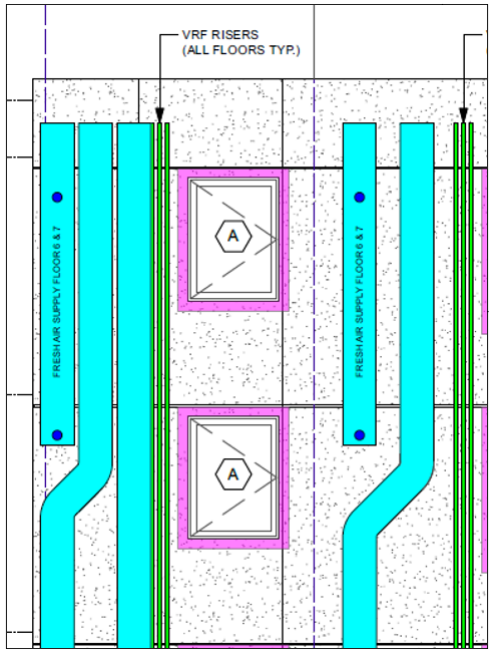
New Insulated Building Envelope (R-30)

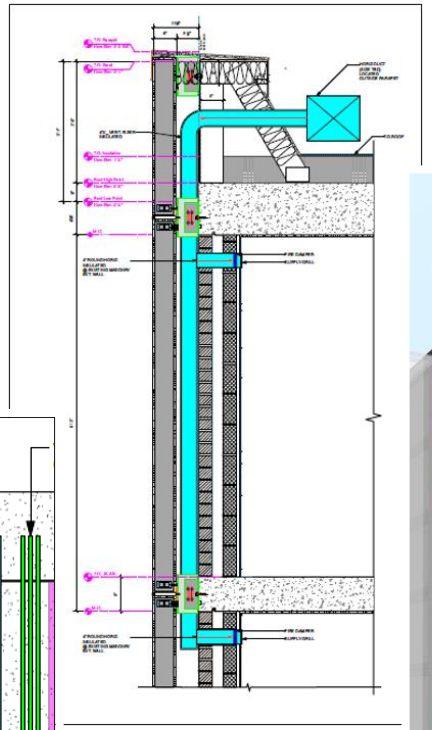


Mid-rise multifamily: all-electric mechanicals

Centralized heating, cooling, and ventilation solution

- **Standard systems**
  - Heating/cooling: VRF
  - Ventilation: roof-mounted ERVs
  - DHW: central HPWH
- Central systems selected for **simpler maintenance**
- **Utilizing new cavity space** for distribution
- **Low-disruption** installation (multiple HVAC options investigated in feasibility study)

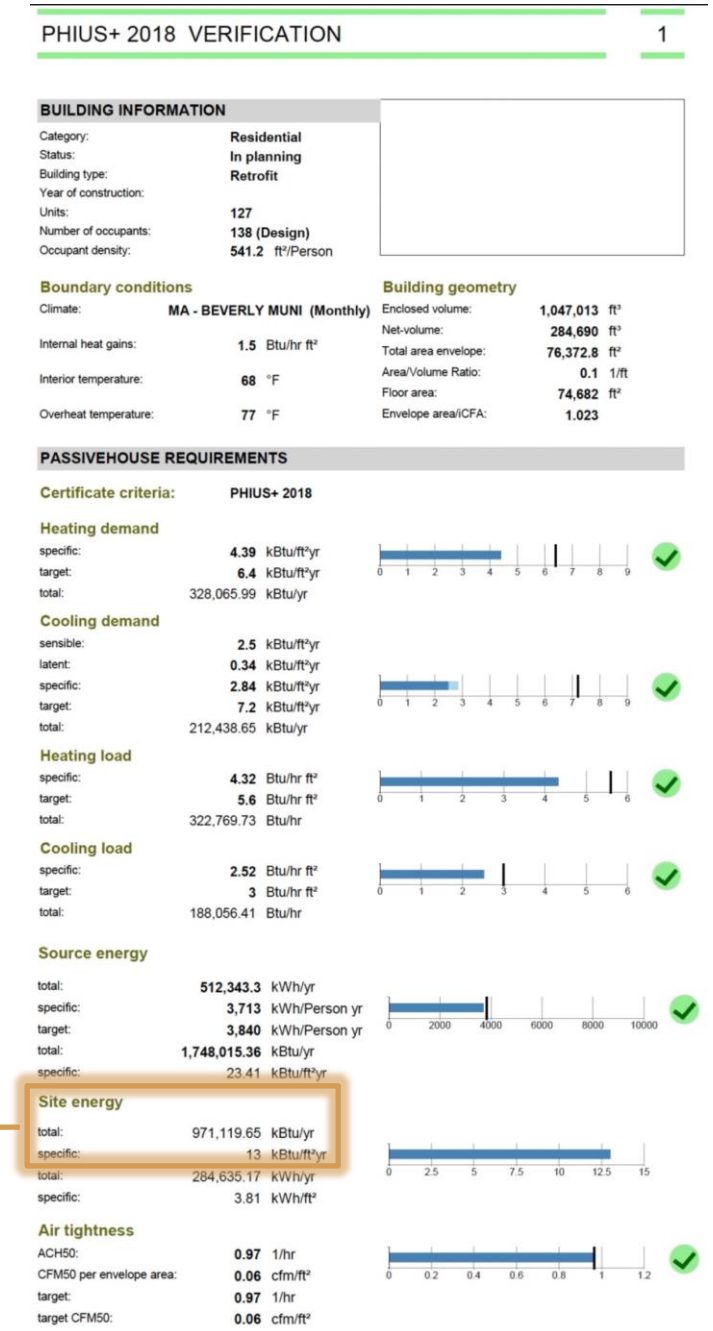




Images: WinnCompanies, Reisen Design Associates

Mid-rise multifamily:
passive house performance

- **Meets Phius+ 2018** standard
- **Baseline EUI:** ~150 kBTU/sf-yr
- **Pre-solar site EUI:** ~23 kBTU/sf-yr
- ***86% reduction*** *vs. baseline*
- **Site EUI w/ solar:** ~13 kBTU/sf-yr
- ***92% reduction*** *vs. baseline*



PHIUS+ 2018 VERIFICATION 1

BUILDING INFORMATION

Category:	Residential
Status:	In planning
Building type:	Retrofit
Year of construction:	
Units:	127
Number of occupants:	138 (Design)
Occupant density:	541.2 ft²/Person

Boundary conditions

Climate:	MA - BEVERLY MUNI (Monthly)
Internal heat gains:	1.5 Btu/hr ft²
Interior temperature:	68 °F
Overheat temperature:	77 °F

Building geometry

Enclosed volume:	1,047,013 ft³
Net-volume:	284,690 ft³
Total area envelope:	76,372.8 ft²
Area/Volume Ratio:	0.1 1/ft
Floor area:	74,682 ft²
Envelope area/iCFA:	1.023

PASSIVEHOUSE REQUIREMENTS

Certificate criteria: PHIUS+ 2018

Heating demand

specific:	4.39 kBtu/ft²yr
target:	6.4 kBtu/ft²yr
total:	328,065.99 kBtu/yr

Cooling demand

sensible:	2.5 kBtu/ft²yr
latent:	0.34 kBtu/ft²yr
specific:	2.84 kBtu/ft²yr
target:	7.2 kBtu/ft²yr
total:	212,438.65 kBtu/yr

Heating load

specific:	4.32 Btu/hr ft²
target:	5.6 Btu/hr ft²
total:	322,769.73 Btu/hr

Cooling load

specific:	2.52 Btu/hr ft²
target:	3 Btu/hr ft²
total:	188,056.41 Btu/hr

Source energy

total:	512,343.3 kWh/yr
specific:	3,713 kWh/Person yr
target:	3,840 kWh/Person yr
total:	1,748,015.36 kBtu/yr
specific:	23.41 kBtu/ft²yr

Site energy

total:	971,119.65 kBtu/yr
specific:	13 kBtu/ft²yr
total:	284,635.17 kWh/yr
specific:	3.81 kWh/ft²

Air tightness

ACH50:	0.97 1/hr
CFM50 per envelope area:	0.06 cfm/ft²
target:	0.97 1/hr
target CFM50:	0.06 cfm/ft²

Image: Onion Flats, Building Evolution Corporation

Implementation

The ABC Collaborative is not an implementation partner, but we can provide:

Advice and Consultation

The ABC Collaborative provides leading-edge expertise and strategy support on innovative construction to program designers and industry stakeholders.

Facilitation

RMI provides convening services across the industry with utilities and energy stakeholders to ensure energy efficiency is scaled effectively and equitably.

Industry Network and Teaming

The ABC Collaborative can provide program administrators, implementers, and project teams with connections to innovative providers/suppliers across the industry and teaming support.

Programmatic Decarbonization in MA

Build market capacity with technical innovation

Create a favorable landscape with policies and funding opportunities

Streamline the process with standardized systemization

Strategic Partnerships

MASSACHUSETTS CLEAN ENERGY CENTER®

LISC BOSTON

Agency Stakeholder Engagement

AFFORDABLE HOMES ACT
SMART HOUSING. LIVABLE COMMUNITIES.

MHP

MASSHOUSING

CITY of BOSTON

Influence Program & Incentive Design

mass save

EVERSOURCE

nationalgrid

Lean Multifamily

DOER
Massachusetts Department of Energy Resources

Lessons from Massachusetts

1	**Leverage coordinated, integrated partnerships across agencies and municipalities** Illinois has a rich environment of climate-related incentives, labor, agencies, policies, and resources. Illinois is encouraged to continue developing and integrating its climate networks to drive action. State leadership also has a role in providing “top cover” to ambitious action by agencies and partners.
2	**Prioritize and publicize strong customer value propositions for climate solutions** Provide insight on successes and challenges with program incentives, which can inform the efficacy of future incentive policies across the state. Policies should ultimately ensure climate solutions are affordable for LMI communities.
3	**Integrate climate solutions into existing programs, missions, and services** Identify and leverage the strengths of state agencies. Climate programs should be seamlessly integrated into agency operations rather than treated as standalone initiatives.
4	**Prioritize LMI households, EJ communities, and equity** Utilities should be mindful of operational and logistical realities in delivering equitable climate solutions and drive efforts to address barriers.
5	**Support complementary actions outside the state** Illinois utilities should explore avenues to influence pivotal changes outside their jurisdiction that can increase the chance of success and ultimate effectiveness of decarbonization-integration across agencies

Closing Thoughts

We encourage the Illinois Energy Efficiency Strategic Advisory Group to consider innovative “ABC” approaches and their associated benefits. Effective incorporation of ABC approaches into program design will likely require specific, dedicated support to attract, encourage, and intentionally build the market but can provide deep benefits to Illinois residents and its utilities.

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Thank You!

advancedbuildingconstruction.org/contact-us

https://rmi.org/our-work/buildings/

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Renusol