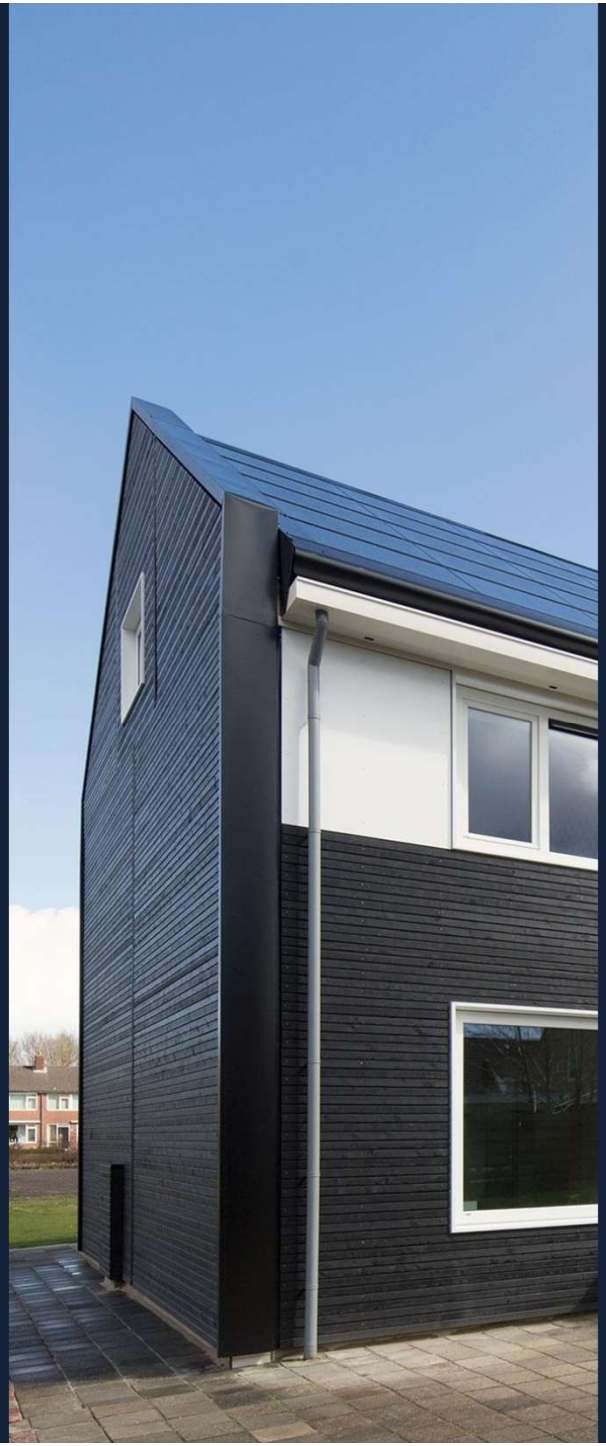
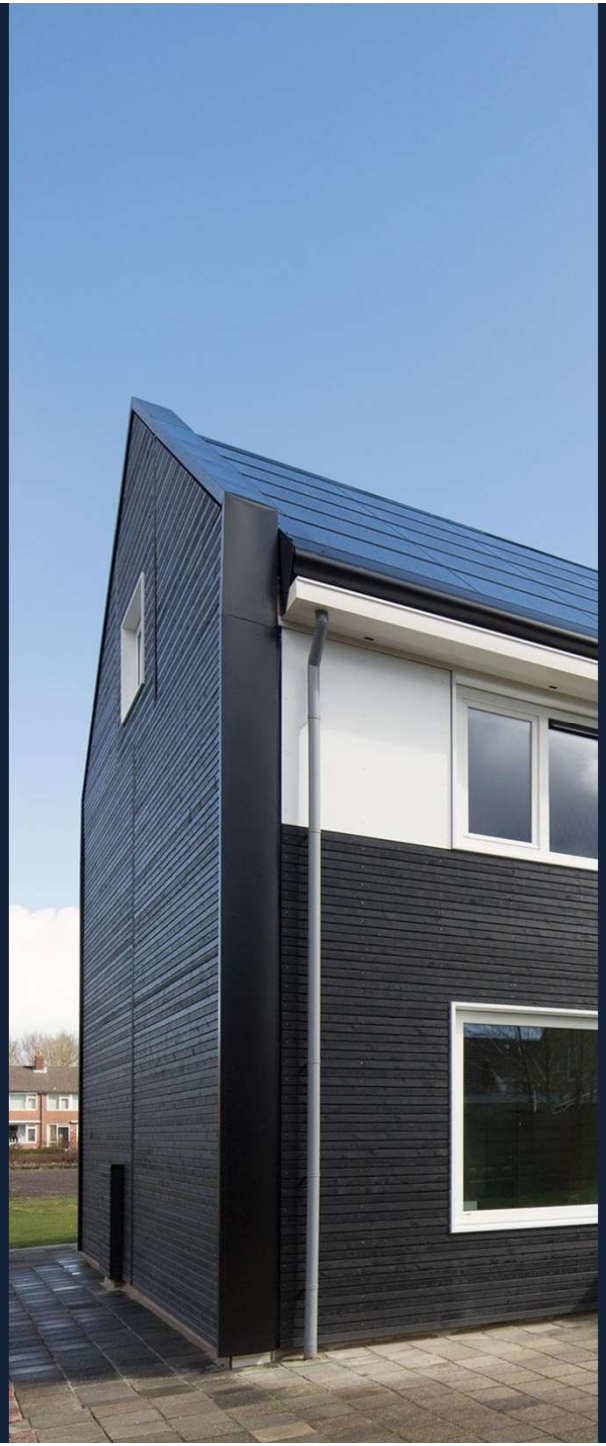

REALIZE
Industrialized ZC Retrofits for Low-income Multifamily Buildings
ROCKY MOUNTAIN INSTITUTE
Transforming global energy use to create a clean, prosperous, and secure low-carbon future.



# AGENDA

- REALIZE OVERVIEW
- RETROFIT MODEL
  - ENVELOPE SYSTEMS
  - MECHANICAL SYSTEMS
- DOE PROJECT PROGRESS



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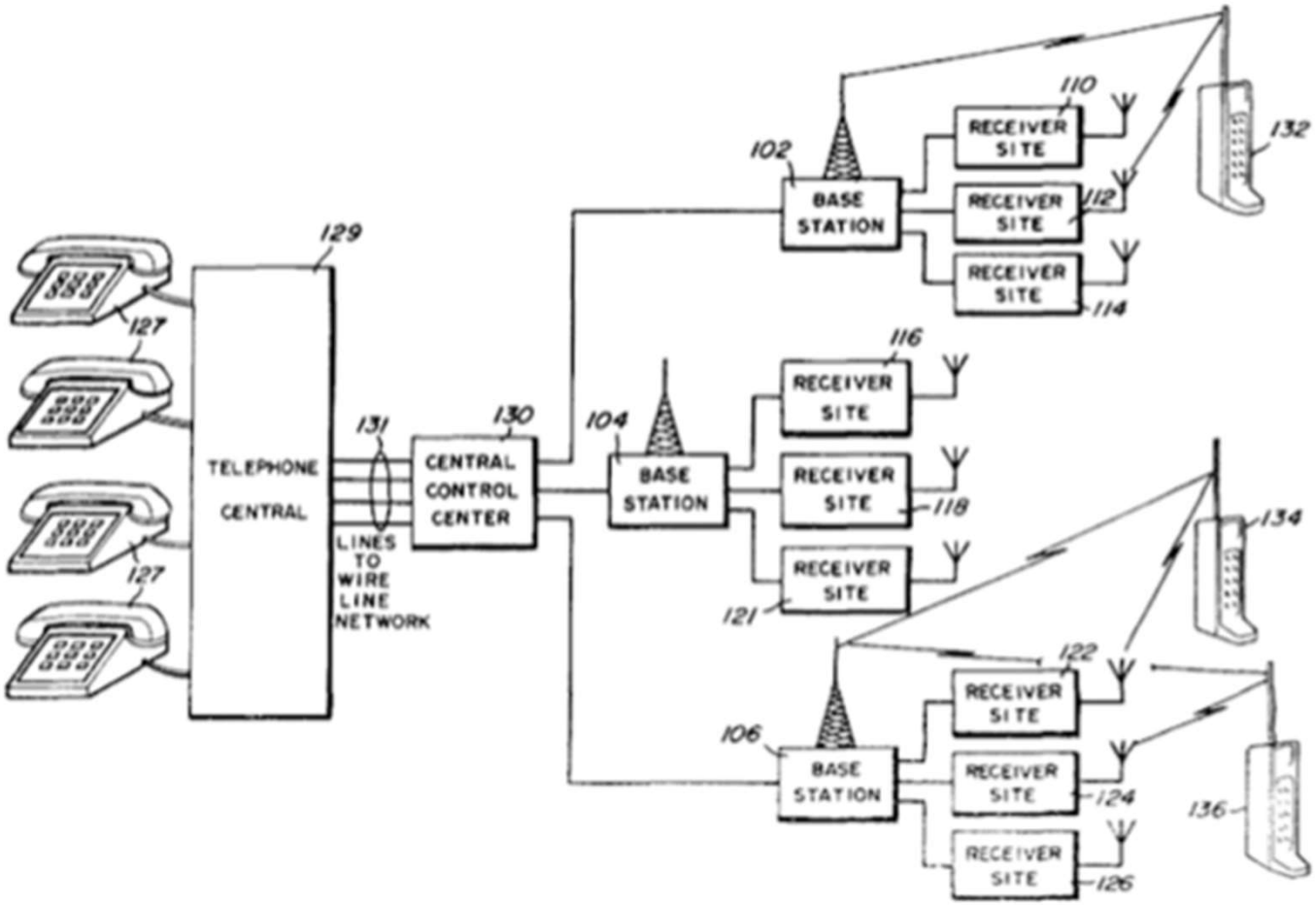
# THE PROBLEM

# A “MODERN” DAY RENOVATION

# A SERVICE ANALOGY



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# THE SOLUTION

# ENERGIESPRONG: A MODEL OF INSPIRATION

Core offering: A net zero carbon retrofit bundle that is 1) affordable, 2) attractive, 3) ensures energy performance, and 4) can be delivered in less than two weeks

**QUALITY**

*Net-zero energy homes with long performance warranties*

**NON-INTRUSIVE**

*Refurbishment within a week to 10 days*

**AFFORDABLE**

*Financeable through energy cost savings*

**LOOK & FEEL**

*Attractive and comfortable homes*

# MARKET ENABLEMENT MODEL

# REALIZE: GOAL AND MISSION

REALIZE seeks to create a business model inspired by Energiesprong to catalyze industry to develop readily available, cost-effective, deep energy retrofits for the US residential market

# SOME OF OUR PARTNERS


U.S. DEPARTMENT OF ENERGY

CNCA
CARBON NEUTRAL CITIES ALLIANCE

PHIUS
Passive House Institute US

Net-Zero
ENERGY COALITION

SEA
stone energy associates

NEW ECOLOGY
Community-Based Sustainable Development


CALIFORNIA ENERGY COMMISSION

EnergieSprong




ELEVATE ENERGY
Smarter energy use for all


nyserda
Energy. Innovation. Solutions.

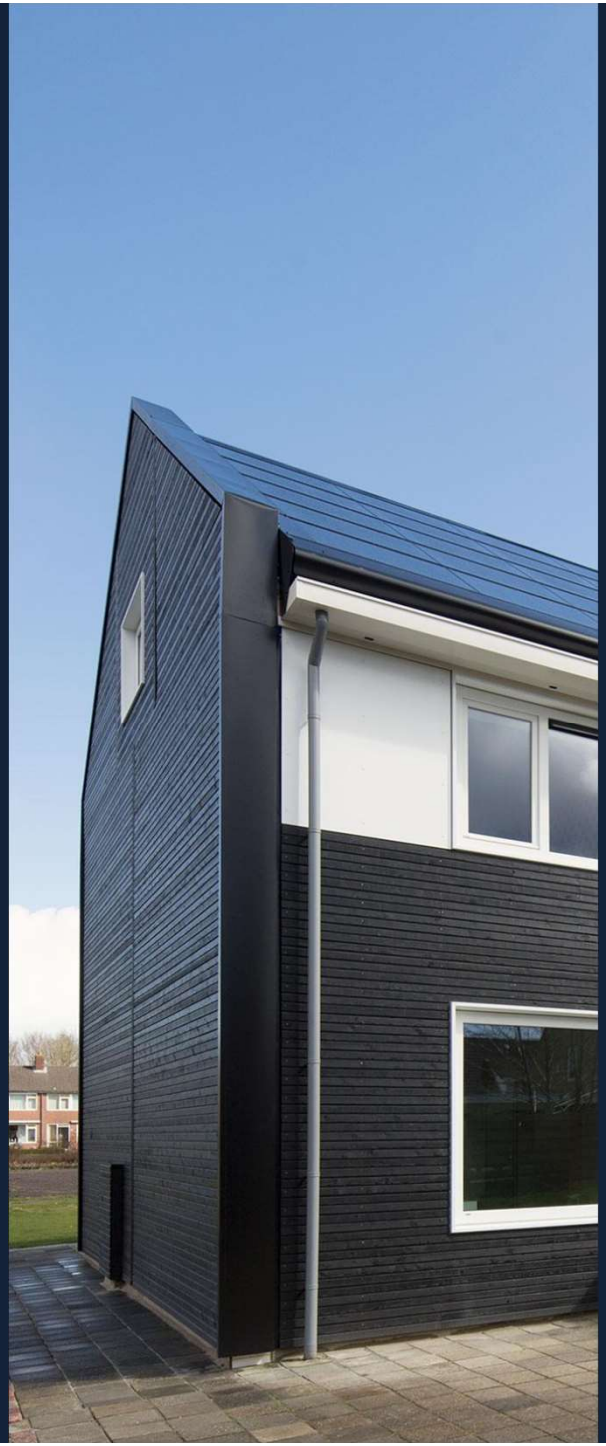



Natural Resources Canada









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# ENVELOPE SYSTEMS

# FACADE PANELS: A VARIETY OF SOLUTIONS



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# THE KEY PLAYERS

- There are three main facade panel manufacturers in the Netherlands:
  - RC Panels - SIPs
  - Renolution - light gauge steel
  - Dijkstra Draaisma Bouwgroep (DDB) - timber framed

- RMI visited RC Panels' production facility and several project sites with RC Panels or Renolution products

# RC PANELS FACTORY PRODUCTION

Panel Description:

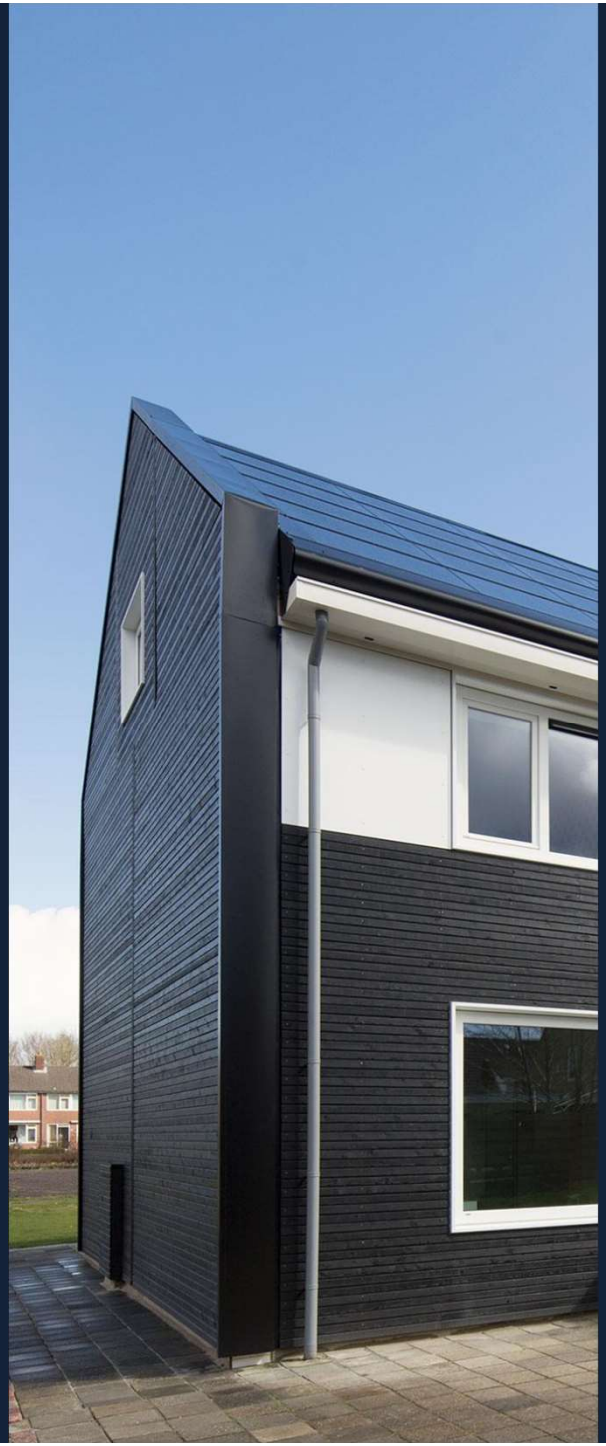
- SIP panels made with fiberglass, OSB, graphite-infused foam, and waterproofing sealant material.
- Cut to meet 3D imaging model specifications by CNC machine
- Windows and doors installed into panel
- Exterior claddings applied to panel: stucco and STO brick veneer

# FACADE INSTALLATION SITE PRE-WORK

# RENOLUTION PROJECT

# KEY LESSONS LEARNED FOR US PILOTS

- **Design** - develop scalable systems, focusing on unitized yet customizable panels
- **Building Science** - improve on building science while also embracing Dutch spirit of learning through implementation
- **Foster Innovation** - Develop multiple solution types
- **Tenant engagement are key to success**
  - Set expectations on *total* delivery time
  - Collaborate with tenants during planning phase



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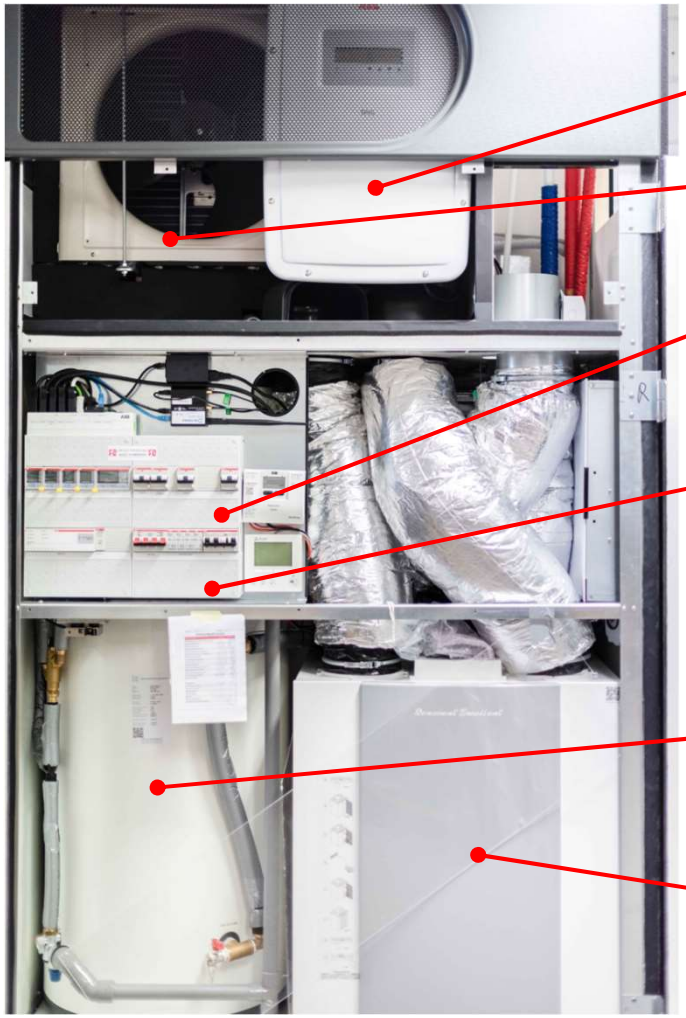
# ENERGIESPRONG MECHANICAL SYSTEMS

- Retrofits are always **all-electric**
- The mechanical systems typically consists of:
  - heat pump (space heating and DHW)
  - ERV
  - solar panels & inverter
  - printed circuit board controls
- Systems are either **distributed or centralized** into one closet/unit
- The **market was late to innovate** on the mechanical side and more progress has been made on the facade systems

# FACTORY ZERO INTEGRATED CLIMATE ENERGY MODULE (iCEM)



**PV Inverter**

**Heat Pump (for DHW and space heating)**

**Control Board and Thermostat**

**Plumbing (behind control board and ducting)**

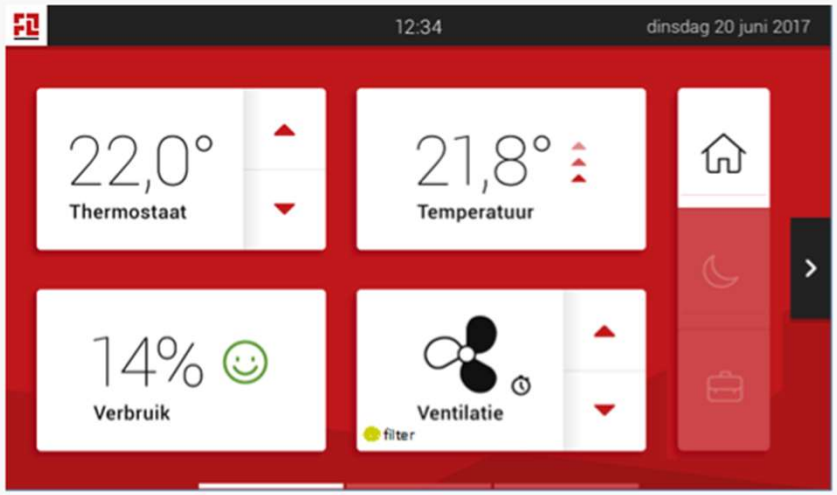
**DHW Tank**

**ERV**

- Parts sourced from various OEMs and assembled on site
- Approximately 8 units assembled per week
- Working with Denzo to get standardized parts for next model

# FACTORY ZERO PROJECT EXAMPLES

# FACTORY ZERO INTEGRATED CLIMATE ENERGY MODULE (iCEM)






Slide content courtesy of Factory Zero



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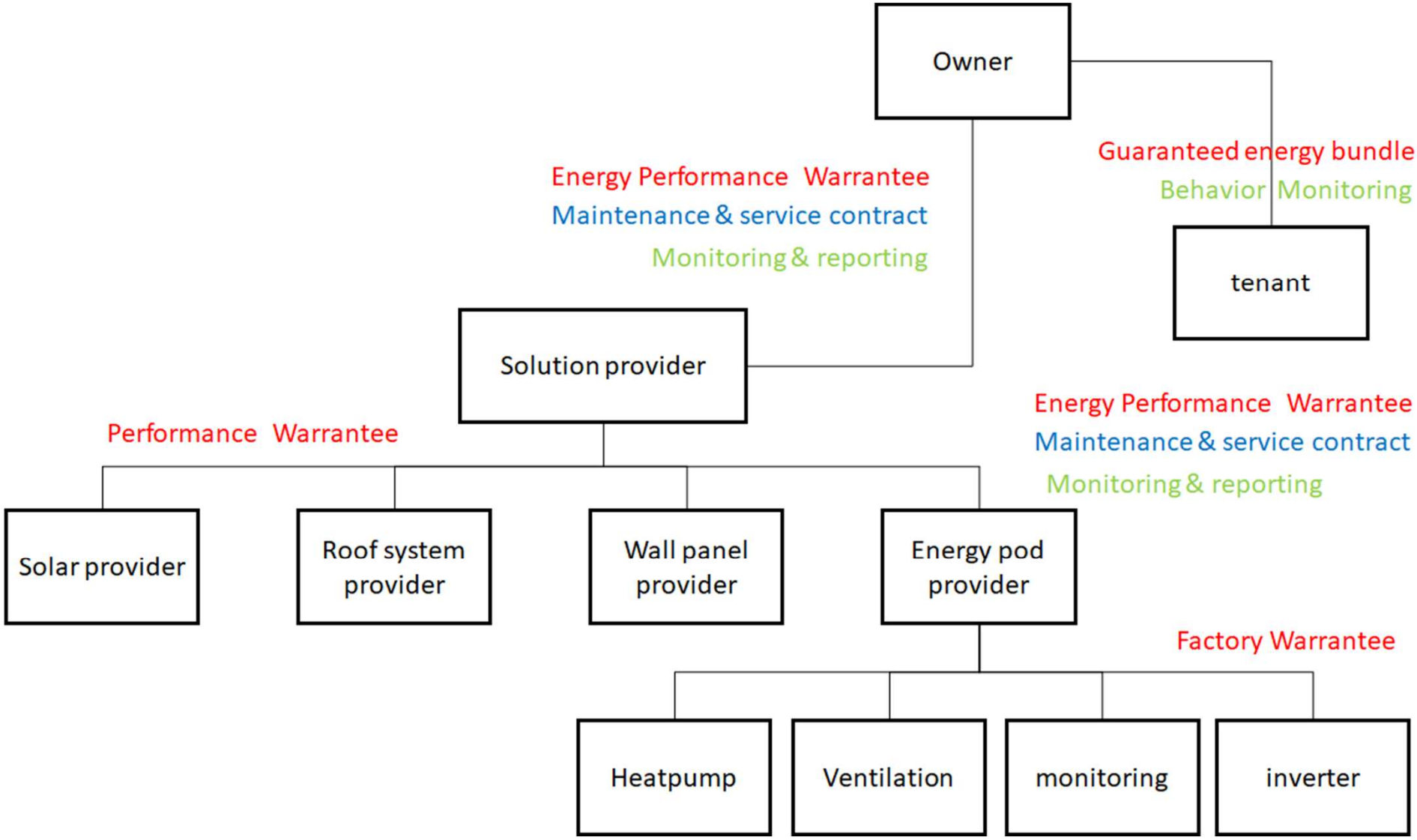
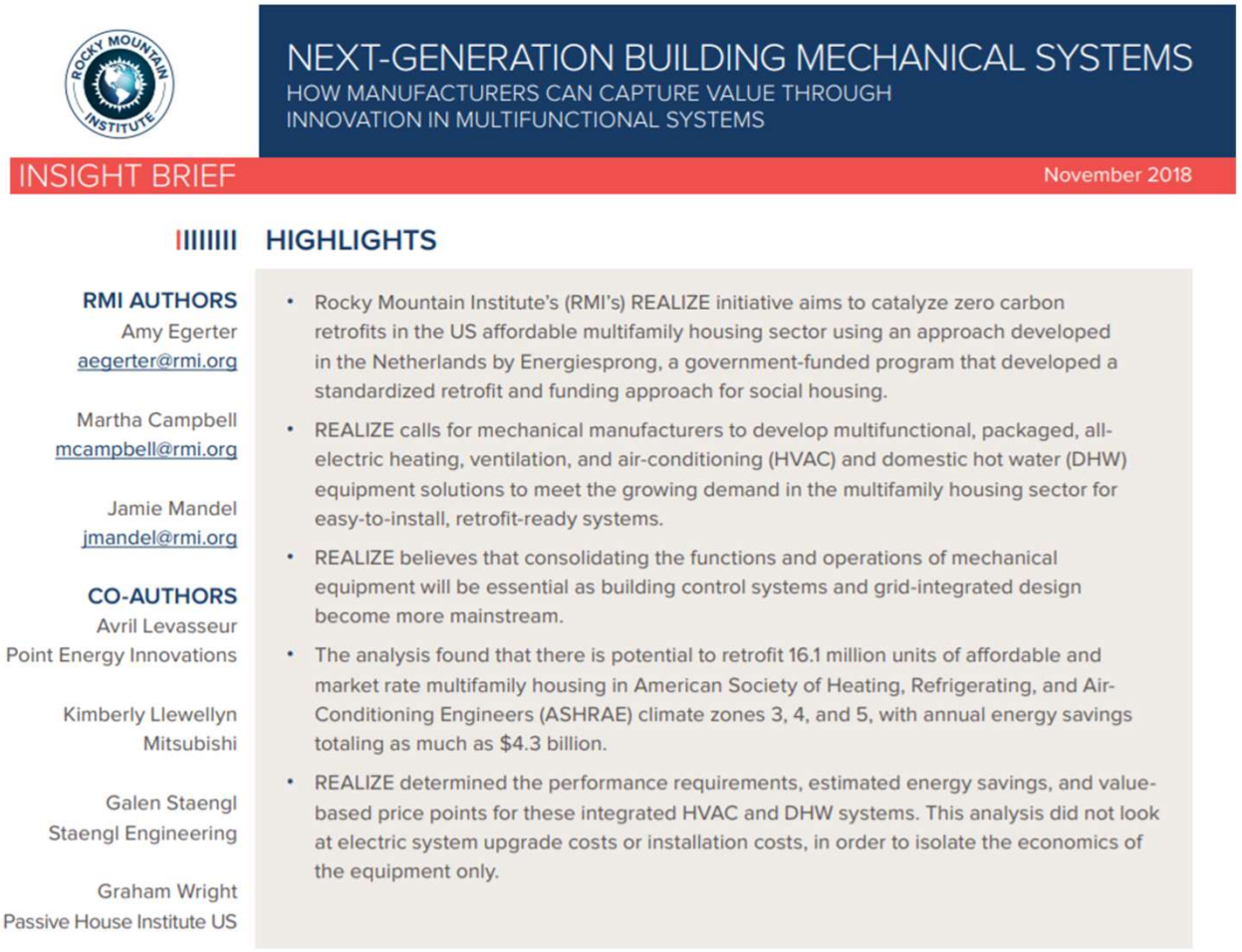
# PERFORMANCE MONITORING STRUCTURE



# KEY LESSONS LEARNED FOR US PILOTS

- **Stimulate mechanical system innovation** - encourage the use of integrated, packaged systems early on to
- **Develop US climate-specific designs** - design for cooling and dehumidification (depending on the climate)
- **Foster Innovation** - Develop multiple solution types

# INTEGRATED MECHANICAL SYSTEM MARKET STUDY



NEXT-GENERATION BUILDING MECHANICAL SYSTEMS

HOW MANUFACTURERS CAN CAPTURE VALUE THROUGH INNOVATION IN MULTIFUNCTIONAL SYSTEMS

INSIGHT BRIEF

November 2018

## HIGHLIGHTS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- Rocky Mountain Institute's (RMI's) REALIZE initiative aims to catalyze zero carbon retrofits in the US affordable multifamily housing sector using an approach developed in the Netherlands by Energiesprong, a government-funded program that developed a standardized retrofit and funding approach for social housing.
- REALIZE calls for mechanical manufacturers to develop multifunctional, packaged, all-electric heating, ventilation, and air-conditioning (HVAC) and domestic hot water (DHW) equipment solutions to meet the growing demand in the multifamily housing sector for easy-to-install, retrofit-ready systems.
- REALIZE believes that consolidating the functions and operations of mechanical equipment will be essential as building control systems and grid-integrated design become more mainstream.
- The analysis found that there is potential to retrofit 16.1 million units of affordable and market rate multifamily housing in American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) climate zones 3, 4, and 5, with annual energy savings totaling as much as $4.3 billion.
- REALIZE determined the performance requirements, estimated energy savings, and value-based price points for these integrated HVAC and DHW systems. This analysis did not look at electric system upgrade costs or installation costs, in order to isolate the economics of the equipment only.

**https://www.rmi.org/wp-content/uploads/2018/11/RMI_REALIZE.Next_Gen_Building_Mechanical_Systems_2018.pdf**

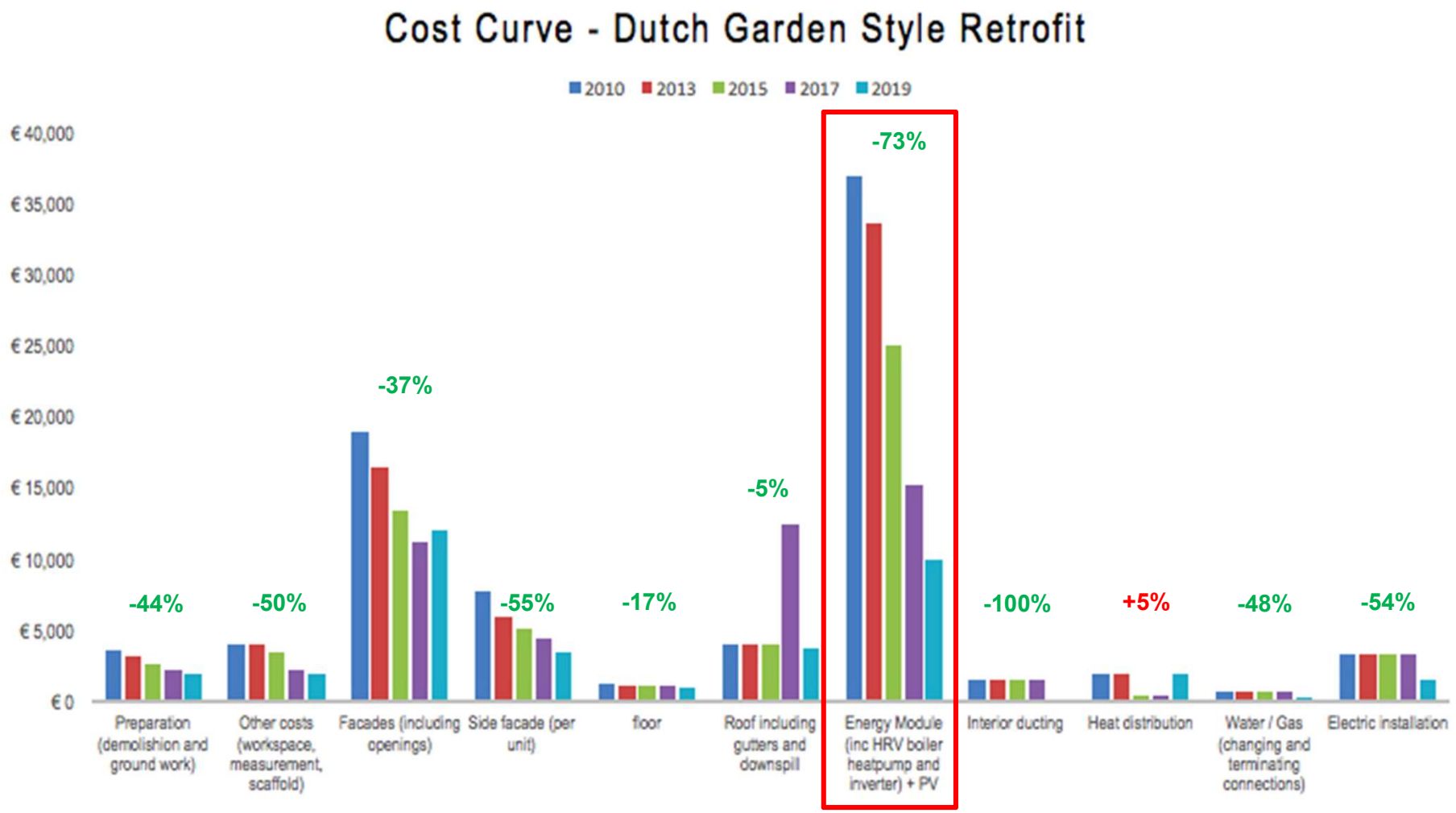
# HVAC INNOVATION IS NEEDED TO ADDRESS EXISTING MULTIFAMILY ENERGY USE

REALIZE calls for mechanical manufacturers to develop new systems that are:

- **Multifunctional:** The mechanical system solution should provide heating, cooling, ventilation, dehumidification, and domestic hot water.
- **Packaged:** The equipment used to meet the functional needs of the mechanical unit should be packaged together into one integrated system. This will allow for simpler installation and scalability.
- **All-electric:** As the grid becomes cleaner and policies begin to demand the use of clean energy in all sectors, deploying all-electric solutions will be the most impactful strategy for building retrofits.

This next generation of mechanical systems will enable less disruptive retrofits and enable manufacturers to stay ahead of policy trends.

# DUTCH COST COMPRESSIONS ACHIEVED TO DATE



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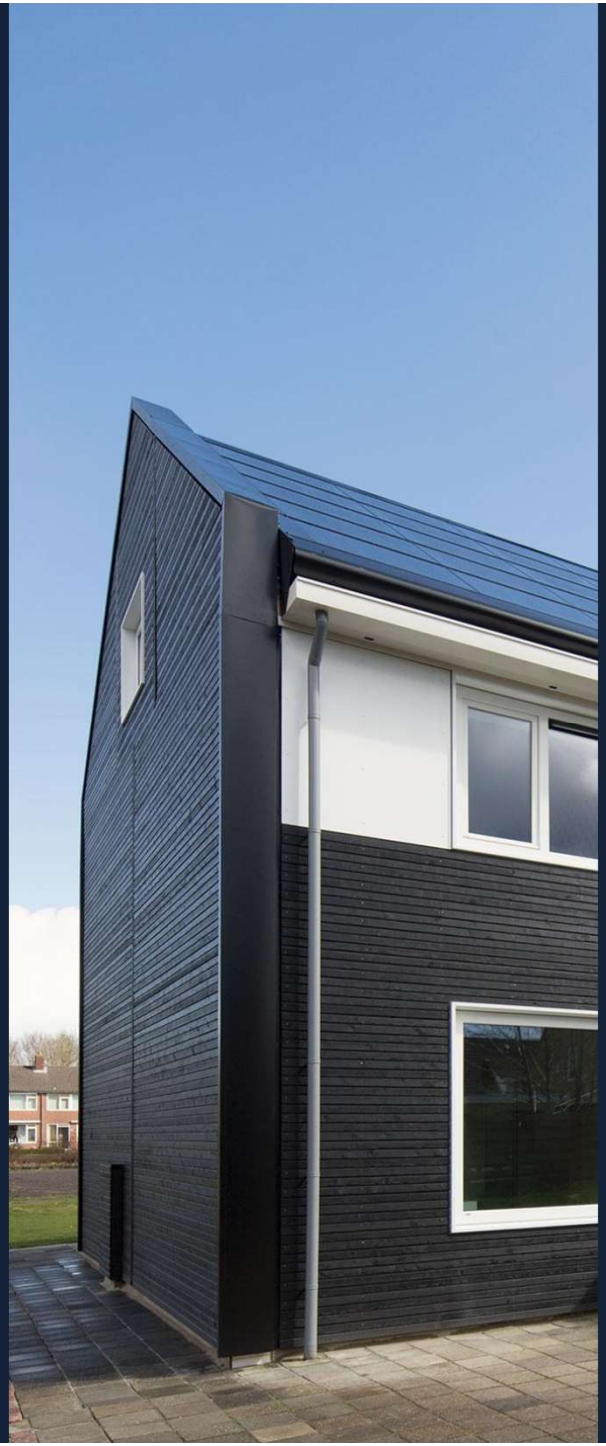
# HOW TO ACHIEVE COST REDUCTIONS

## LESSONS LEARNED FROM ENERGIESPRONG CAN HELP THE UNITED STATES MARKET ACHIEVE SIMILAR RESULTS

- **Standardized factory manufacturing:** Standardize and streamline the component parts to enable an assembly line–style manufacturing process.

- **Reduced installation costs:** Determine a standard existing condition to target to reduce site pre-work, foster contractor education to reduce installation confusion, and reduce size of equipment to minimize the likelihood of required electric panel upgrades.

- **Mass procurement through demand aggregation:** Work with large portfolio owners and other demand aggregators, such as REALIZE, to ensure that high demand for the product is secured.



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# DOE PROJECT OVERVIEW

US DEPARTMENT OF ENERGY BUILDING AMERICA PROGRAM FOA-0001630

**Major Partners:** Passive House Institute US, Net Zero Energy Coalition, Re:Vision Architecture, The Levy Partnership, Staengl Engineering, Energiesprong, Centria, Bunting Architectural Metals, Mitsubishi, Goodman Manufacturing, RenewAire, and PowerWise

**Desired Project Outcome:**
Develop a standardizable, transferable, climate zone specific net zero energy ready retrofit system, designed with at least a 50% lower energy use intensity relative to the measured baseline energy performance

# DOE TEAM SELECTION PROCESS

https://www.rmi.org/our-work/buildings/realize/rfps/

# PILOT SELECTION CRITERIA

| | Primary Condition | Secondary Condition |
|---|---|---|
| **Building Size** | Approximately 30 units | Two buildings of approximately 15 units or a single building with> 30 |
| **Structure** | Brick/masonry mass wall, in good condition | None |
| **Historic Quality** | No historic or aesthetic quality that is protected by the city/state | None |
| **Lot Line Restrictions*** | None, ability to expand building envelope 6-10” | Ability to remove façade depth or receive variance |
| **Geometry** | Simple, no excessive architectural details | Architectural details that can be removed |
| **Adjacencies** | 2 adjoining walls | Stand-alone |
| **Facade** | Simple façade without balconies or patios | Removal of balconies or patios acceptable |
| **Roof** | Flat roof with secure structure for PV | East-West orientation preferred |
| **Foundation** | Basement with ceiling or building perimeter access | Ground contact with building perimeter access |
| **Heating Fuel** | Natural gas | Electricity |
| **Heating System** | Central system | Steam/hot water radiators |
| **Cooling System** | Central system | Terminal AC units |

# PILOT BUILDING SELECTED

809 SPRING STREET, MINNEAPOLIS, MN - MINNEAPOLIS PUBLIC HOUSING AUTHORITY

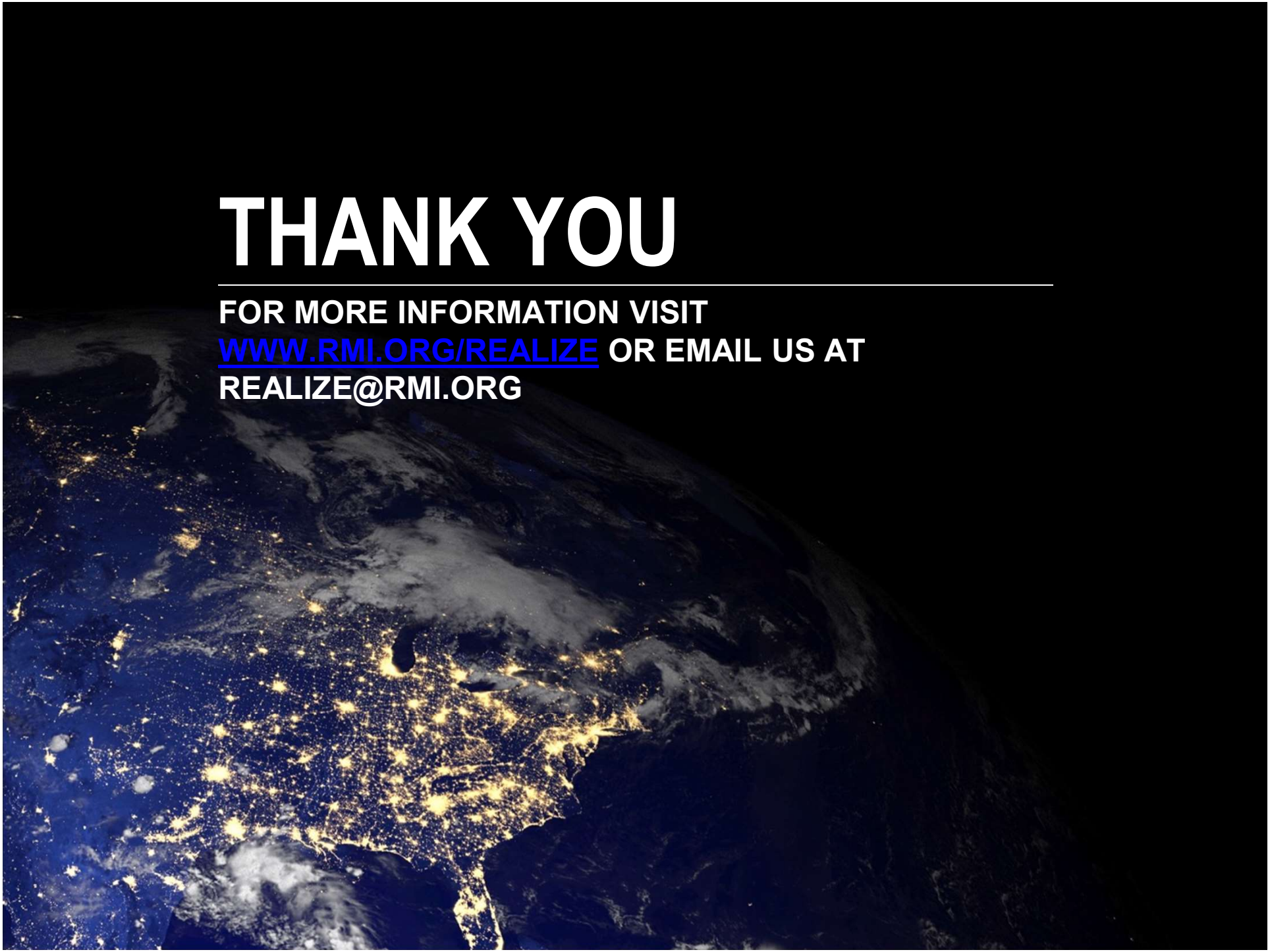
# PILOT BUILDING SELECTED

440 TREMONT STREET, BOSTON, MA - WINN COMPANIES

# PILOT BUILDING NEXT STEPS

- Select mechanical manufacturer partner
- Develop panel designs with Re:Vision Architecture and Centria
- Conduct detailed costing exercise
- Start construction by Q1 2020!

Centria panel examples



# THANK YOU

**FOR MORE INFORMATION VISIT WWW.RMI.ORG/REALIZE OR EMAIL US AT REALIZE@RMI.ORG**