Transforming global energy use to create a clean, prosperous, and secure low-carbon future.
WHO WE ARE
OUR MISSION IS TO DRIVE THE EFFICIENT AND RESTORATIVE USE OF RESOURCES
RMI’s Theory of Change

METHODOLOGY

- GENERATE BREAKTHROUGH INSIGHTS
  - Whole system design to develop integrated solutions

- PARTNER WITH EARLY ADOPTERS
  - Collaboration processes that achieve breakthrough solutions

- CREATE REPLICABLE SOLUTIONS
  - New business models that capture exciting value

- ENGAGE WITH MARKETS TO SCALE SOLUTIONS
  - Sustainable finance to scale deployment of efficiency and renewables

- SCALE IMPACT TO TRANSFORM GLOBAL ENERGY USE
  - Breakthrough innovation in technologies, design, policy, and strategy together fueling the new business models

CORE COMPETENCIES
CONCEPT
The Problem
The Problem

Source: Garber, Megan. 8 Guys, 6 Weeks: How the Cell Phone Was (Finally) Invented. The Atlantic. 2013.
The Solution

- **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 Organization Model

- Business Model
  - Demand
  - Supply
  - Regulation
  - Coordination
  - Aggregation

- Finance
  - Funds
  - Products

- Technical Solution
  - Delivery
  - State
  - Local
VALIDATING THE BUSINESS MODEL
Socializing the Concept – Supply
Technical Feasibility and the “Investment Envelope”
Feasibility

Is ZNE economically and technically feasible for San Francisco Bay Area affordable housing?

**Category: 5-9 unit building**

Market Share: 8.9% (~6.2K)

6 Unit Prototype
- Built pre-1980s
- 4,725 sf
- 3 stories
- Row home
- Furnace, no cooling*
- Individual gas HW heater

**Category: 10-19 unit building**

Market Share: 22.5% (~16K)

15 Unit Prototype
- Built pre-1980s
- 11,270 sf
- 3 stories
- Stand alone building
- Furnace, no cooling*
- Central gas HW heater

**Category: 20+ unit building**

Market Share: 66.2% (~46K)

65 Unit Prototype
- Built pre-1980s
- 40,900 sf
- 5 stories
- Stand alone building
- Central boiler, no cooling*
- Central gas HW heater

* 58% of San Francisco homes use natural gas, 36% electricity according to an ACEEE 2017 report
## Value Proposition – 6 Unit Prototype

### Increased 15 YR Debt Capacity:
$75,807

### Implication:
Initial REALIZE Project Budget:
$75,807 ($12,635 per unit)

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**Note:** Debt Service Coverage Ratio assumed to be 1.4. Debt capacity calculated using a 5% cost of debt and amortized over 15 years.

* Utilities are assumed to be reduced 85% for electricity, 100% for natural gas, 20% for water and sewer. O&M costs are modeled to be reduced 25% and replaced with an Energy Service Agreement for a performance guarantee.
With incentives, the ZNEc retrofits is well below the increased debt capacity.

* The 25 YR PV was calculated using a 5% discount rate and an escalation rate of 2.35%, which is a blended average rate based on last 10 years of gas and electric escalation in California from the EIA. The water escalation rate is assume to be 5%, well below historical rates.
Value Proposition – 65 Unit Prototype

Increased 15 YR Debt Capacity: $714,532

Implication:
Initial REALIZE Project Budget: $714,532 ($10,993 per unit)

- Note: Debt Service Coverage Ratio assumed to be 1.4. Debt capacity calculated using a 5% cost of debt and amortized over 15 years.
- * Utilities are assumed to be reduced 85% for electricity, 100% for natural gas, 20% for water and sewer. O&M costs are modeled to be reduced 25% and replaced with an Energy Service Agreement for a performance guarantee.
65 Unit Prototype: ZNEc Retrofit vs. Baseline

Even with incentives, the economics are more challenging for larger, high rise buildings.

*The 25 YR PV was calculated using a 5% discount rate and an escalation rate of 2.35%, which is a blended average rate based on last 10 years of gas and electric escalation in California from the EIA. The water escalation rate is assume to be 5%, well below historical rates.
The Solution Cost Curve

With incentives most low-story projects are well in the money.

<table>
<thead>
<tr>
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<th>6 Unit Prototype</th>
<th>15 Unit Prototype</th>
<th>65 Unit Prototype</th>
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<tbody>
<tr>
<td>Current Zero Net Carbon Retrofit Cost ($/Unit)</td>
<td>$19,013</td>
<td>$22,255</td>
<td>$22,296</td>
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<tr>
<td>Cost With Current Incentives ($/Unit)</td>
<td>$7,527</td>
<td>$8,985</td>
<td>$11,329</td>
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<tr>
<td>Price Point for 15 Year Discounted Payback Period ($/Unit)</td>
<td>$11,808</td>
<td>$14,590</td>
<td>$7,839</td>
</tr>
<tr>
<td>Cost Reduction Required for 15 Year Discounted Payback Period (Without Incentives/With Incentives)</td>
<td>37.9% / 0%</td>
<td>34.4% / 0%</td>
<td>64.8% / 30.8%</td>
</tr>
</tbody>
</table>

*Energy savings PV calculated using a 5% discount rate and an escalation rate of 2.35% for the 6 unit prototype, 2.28% for the 15 unit prototype, and 2.48% for the 65 unit prototype. Escalation rates are a blended average based on 10 years of gas and electric escalation in California from the EIA. Water and sewage savings calculated assuming 5% discount rate and 5% escalation rate.
Socializing the Concept – Demand

Direction is so much more important than speed. Many are going nowhere fast.
## Challenges Pain Points: Demand

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<th>Issues to Avoid</th>
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<td>Trust in Accuracy of Models</td>
<td>Affordable Housing Has Low Risk Tolerance</td>
<td>Land Mines/Code Triggers</td>
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<td>Maintenance</td>
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<td>Timing</td>
<td>Diversity of Building Stock</td>
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<td>The Cost vs. Reward Balance</td>
<td>Technology Risk</td>
<td>SF Lacks Financing</td>
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<td>Codes/Permits</td>
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<td>Technical Knowledge</td>
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## Challenges Pain Points: Supply

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<tr>
<td>Risk of Underperformance</td>
<td>Technology Bias</td>
<td>Ineffective Zoning</td>
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<td>Complexity</td>
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<td>Perverse Incentives</td>
<td>Culture</td>
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<td>Supply Chain Engagement</td>
<td>Future Proofing</td>
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<td>Knowledge</td>
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<td>Definitional Challenges</td>
<td>Rate Structures</td>
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<td>High Risks w/Low Risk Tolerance</td>
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WHERE TO FROM HERE?
KEY TAKEAWAYS:

- Key to unlocking the market
- Differentiates between operational and behavioral risk
- Metering determines structure of contract

Themes

- Develop Energy Plan
- Simplify & Improve Financing
- Develop Integrated NZE Retrofit Solution
- Aggregate Demand of Housing Providers

Research

- Catalog property characteristics (syndication date, meter types, façade system) to initially target

Action

- Drive efforts to expand UA adjustment
- Identify property characteristic (syndication date, meter types, façade system) to initially target
- Draft standardized contracts
- Draft large scale conditional contract between housing providers and solution providers

Outcomes

- Execute conditional contract (financing, guarantee, energy plans, tech solution)
- Leverage demand established in conditional contract to improve market conditions

Final Objective

- Mass Scale Net Zero Energy Retrofit Market
- Draft large scale conditional contract between housing providers and solution providers
- Execute conditional contract (financing, guarantee, energy plans, tech solution)
- Leverage demand established in conditional contract to improve market conditions
KEY TAKEAWAYS:

- Market wants to see the physical product
- NZE technical solutions exist
- Competitive bidding process will drive whole solution innovation and collaboration
REALIZE Timeline

PHASE I: Validating Business Model
- CNCA Grant
- Supply Side
- Demand Side (CA/SF)
- Technical

PHASE II: Market Enablement
- Energy Plan and contractual templates
- Developer proformas
- Design guidelines

PHASE III: Early Market Demonstration
- Mechanical Subsystems
- Integrated Envelope
- Deliver & Test

PHASE IV: Large Scale Housing Deal
- Leverage for any necessary code or regulatory reforms

PHASE V: Disseminate
- Open Market Solutions Across US

Completed

Q3 2017 through Q2 2018
Q3 2018 through Q4 2020
Launch Q3 2018
Transforming global energy use to create a clean, prosperous, and secure low-carbon future.

Thank You

ROCKY MOUNTAIN INSTITUTE

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