Reinventing Residential Retrofit

Innovation in Energy Efficiency Retrofits to Meet Climate, Energy, Environmental, and Health Goals

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Berkshire Hathaway Company (WHQ in Denver)

Three business divisions -
- Insulation Systems (thermal, acoustic)
  - Building
  - Industrial
  - OEM, aerospace
- Commercial Roofing Systems (membranes, insulations)
- Engineered Products (nonwovens-mats, reinforcements, filtration)

Basic stats
- 7,100 employees
- 44 mfg’ing locations (NA, EU)
- $2.6B annual sales
“Buffett-isms” Affecting JM’s Approach

• Crave efficiency and detest bureaucracy
• Emphasize avoidance of bloat
• Delight your customers
• Build long-term competitive advantage
• Relentlessly attack costs
Johns Manville, a Berkshire Hathaway company, manufactures residential and commercial insulation, commercial roofing, mechanical insulation and materials for other manufacturers' products and applications.
Existing Utility Programs for Contractors

- Multiple but limited entry points
  - Increased costs
  - Reduced revenues
  - Inability to exploit synergies
A Better Way?

• Need completely new entry point
  – Combines all programs
  – Recognizes the convergence: EE $\rightarrow$ DR $\rightarrow$ Storage
  – Expands/stacks revenue streams + locational value
  – Reduces cost (especially fixed costs)

• Long term: change IOU business model

• Short term:
  – Look outside utilities
  – New entry point: NEBs?
Energy Efficiency to Achieve Emissions Reductions

Basic residential energy efficiency retrofit:
- Air sealing: attic, HVAC ducts
- Additional insulation: attic, ducts
Energy Efficiency to Achieve Emissions Reductions

Use the power of large numbers

Quantify and Aggregate Energy Savings

Savings models

Quantify emissions Reductions

Attribution method

Modeling; EnergyPro; Other methods

E-grid
Avert

\[ \int_a^b f(t) \, dt = \lim_{n \to \infty} \sum_{i=1}^{n} f(t_i) \Delta t \]
Using Energy Efficiency to Reduce Emissions

- Opportunity is greatest where pollution is worst
- Focus on CAA non-attainment areas
  - Must show reasonable further progress
  - Typically more open to innovative ideas/approaches
- LA Basin non-attainment
  - Ozone - severe/extreme
  - PM2.5 – serious
Coachella Valley Project: Origin

- Coachella Valley Sentinel Power Plant
  - South Coast AQMD RFP issued for emissions mitigation projects
  - JM worked with Add Insulation to propose “utility-scale” energy efficiency retrofit project
  - Initial award in Nov. 2013: $2.35 million
  - Later increased to approx. $4.00 million

- Basic efficiency retrofit
  - Attic air sealing
  - Increased attic insulation to R-38

Not a low-income program
Coachella Valley Project: Approach

- Overall: minimize costs and project time (relentlessly)
  - Minimize cost
    - No diagnostics
    - No custom jobs; basic EE retrofit
    - Installation clusters
    - EM&O < 1.5%
  - Minimize project time
    - Neighborhood/block approach
    - New installation techniques → 3 hour completion
    - New products
  - Maximize
    - Energy savings, emissions reductions
    - Customer engagement: free installation
Coachella Valley Project: Status

- Environmental Justice area completed: 506 homes
- Total homes
  - Completed: 2,000
  - Total by 2016 EOY: 2,100
- Average cost per home
  - EJ: $2,200; All: $1,980
  - Compare to EUC: >$8,000
- Achieving:
  - High quality installation
  - Detailed documentation
  - High customer satisfaction and engagement

Dwelling archetype
Coachella Valley Project: Results

• Annual energy savings
  – 1,560 kWh/home; 3,275,000 kWh total*
  – 35 therms/home; 73,500 therms total*

• Annual energy bill savings
  – Per home: $310
  – Total: $650,000

• Total annual emissions reductions
  – GHG: 1,750 tons
  – PM2.5: 95 lbs

* Energy savings based on EnergyPro v5.1 software
Coachella Valley Project: Results

- Key achievements
  - Clean-green virtual power plant
  - Emissions reductions and health/comfort benefits
  - Community engagement
  - Climate justice, climate resilience
  - Project approach formally adopted by AQMD as pollution control measure to demonstrate RFP to meeting NAAQS

- Control Measure No. ECC-02 ("CO-BENEFITS FROM EXISTING RESIDENTIAL AND COMMERCIAL BUILDING ENERGY EFFICIENCY MEASURES [NOX, VOC]")
Project Expansion: Efficiency + High-Tech

• Efficiency measures: seal/insulate attic and ducts
• Estimated combined energy savings
  – Suite of EE measures: 20% → 18% (TDV)
  – Nest learning thermostat: 5+% (TDV)
  – Combined with synergies: ≈ 25+% 
• Cost: ≈ $3,350
• “Utility-scale” Residential Retrofit Project criteria:
  – large # of projects; reas. cost; short completion time
  – Single installer crew – in home < 3 hours
  – Close to Goal: 3-3-3 - $3000 – 3 hours – 30% savings
Proposed Expansion Projects

- Energy Efficiency Measures:
  - Air seal attic floor
  - Attic insulation to R-38 - 49
  - Air seal AC ducts
  - Insulate ACducts
  - Nest thermostat
  - 3 LED lights

Approx. $3,400 per home – 1,200 homes → $4 million total
Project Expansion: DR + Energy Storage

- Commercially available technology that is capable of absorbing energy, storing it for a period of time, and thereafter dispatching the energy.

- Proprietary technology for energy storage
  - Residential
  - Behind the meter
  - Non-battery

Bytes not batteries
Backup Slides

* Energy savings based on EnergyPro v5.1 software
Other Irons in the Fire

- Zero net energy residential retrofits
- Title 24 compliant residential cool roof retrofits
- High performance attic retrofit
Health Benefits of Energy Efficiency

Levy et al. 2016

- 90% of homes under-insulated
- Energy savings from all homes meeting 2012 IECC
- Emissions reductions
- Public health benefits
  - mortality
  - morbidity
Attic Insulation

- **R-15**: 4”-5” deep, Poorly Insulated, Older Home
- **R-21**: 6”-7” deep, Completely Filled Joist, Inadequately Insulated
- **R-38**: 13”-14” deep, Recommended For Most Southern Climates
- **R-49**: 16”-18” deep, Recommended For Northern Climates

*Recommended Dept. of Energy attic insulation levels for commonly used fiberglass, mineral wool, and cellulose insulation assuming about R-3 per inch.*

“Standard joists are sold as 2’ x 8” but usually measure closer to 1.5” x 7.5.”

Source: ENERGY STAR®
Deteriorated Attic Insulation

Desert Hot Springs
Relationship between percentage of incentive and participation rate: energy efficiency measures

- **Recalcitrants**
- **Negative inflection point**
- **Positive inflection point**
- **False failure area**
- **Origin issue: some will do w/o incentive**

Percentage of incentive/subsidy vs. Participation rate
Priority Actions

• Find shape of the curve
• Investigate and adopt policies that
  – Move along the curve to higher participation rates
  – Move the curve itself to the left
    • Increase participation rates
    • But at lower cost
  – Change shape of curve
    • Make curve steeper between positive and negative inflection points
Relationship between percentage of incentive and participation rate: energy efficiency measures

Adopt policies to shift curve to left