



Photo Credit: David C. Legg, National Grid

Deep Energy Retrofit Incentive Programs, The National Grid Pilot

Residential Building Energy Efficiency Meeting
Denver, July 21, 2010

Ken Neuhauser



Partnership for a Pilot

Partnership for a Demonstration, Research and Market Development Pilot:

National Grid

- Program implementation and administration
- Financial resources
- Marketing

Building Science Corporation

- DER experience
- Expertise in energy performance and moisture management
- Measure verification

Pilot Program Overview

- Pilot program for existing MA and RI homes
- Pilot launched June 2009, renewed for 2010 - 2012
 - Initially 1-3 family owner-occupied, comprehensive DER
 - Expanded to include multifamily and “staged” retrofits
- Pilot Outline:
 - DER Projects
 - Workshops
 - Publicity events
 - Evaluation

Pilot Program Overview (continued)

- Ambitions performance goal: 50% overall energy savings
- Significant financial incentives
- Long application process
- BSC serving as Technical Team
 - Evaluation and approval of applications
 - Technical support to project teams
 - Inspection, verification and testing
 - Support program design and administration

We Mean *Deep!*

Desired Project Characteristics:

- 5-10-20-40-60
 - R5 windows
 - R10 slab
 - R20 below-grade wall
 - R40 above-grade walls
 - R60 roof/attic
- Air tightness: 0.1 cfm50 / s.f. enclosure
- Mechanical Ventilation

We Mean *Deep*!

Performance safeguard requirements:

- Sealed combustion or direct vent appliances
 - Includes heating, water heating, fireplaces, woodstoves...
 - Excludes ovens/ranges, condensing dryers
- Project must resolve known issues
 - Wet basement, asbestos, lead, radon, wood rot...
 - Possible 3rd party inspection to sign-off
- Prove adequate financing

Program Scale

Small number of projects with large number of issues, situations, conditions:

- 2010 Program Goals – 21 units
 - Single family
 - Multifamily
 - Some partial DER

- 3-year program budget approved
 - Massachusetts: ~44 units
 - Rhode Island: ~4 units

Program Scale

- Currently active: 7 projects, representing 10 units
 - 4 projects / 6 units in construction
 - 3 projects / 4 units in application process
 - 1 project complete
- Many prospective participants

Program Incentives

Two tiers of incentives:

- Level I: 75% of net incremental measure costs up to a \$42K
 - Comprehensive (6-sided) enclosure retrofit
 - Meet or approach Desired Project Characteristics
- Level II: additional reimbursement incentive up to \$10K
 - Passive House, Thousand Homes Challenge, Net Zero Energy

Program Incentives

Maximum Level I Incentives per Building

Dwelling Units in Facility	Conditioned Floor Area per Unit	Maximum Project Incentive	Dwelling Units in Facility	Maximum Project Incentive
1	<2000	\$35,000	3	\$72,000
1	2000 - 2500	\$38,000	4	\$80,000
1	>2500	\$42,000	5	\$85,000
2	<1000	\$50,000	6	\$90,000
2	1000 - 1500	\$55,000	7	\$94,000
2	>1500	\$60,000	8	\$98,000
			9	\$102,000
			=>10	\$106,000

Program Incentives

- Incentive applicable to net incremental cost
 - Project documents “allowable” and “renovation” costs



Renovation costs:

- New siding, trim and installation

Program Incentives

- Incentive applicable to net incremental cost
 - Project documents “allowable” and “renovation” costs

Example: insulation over roof sheathing

Allowable costs:

- Insulation and installation
- Nail base

Renovation costs:

- Stripping roof
- Re-roofing



Program Incentives

- Incentive applicable to net incremental cost
- Specific limits for mechanical systems 50% of cost up to heating - \$4K , cooling - \$1K
- Windows reimbursed 100% after \$15 / s.f. deductible
- Leveraging certain additional incentives permitted:
 - Tax credits
 - Utility lighting, appliance and equipment incentives
 - Low interest energy efficiency loans

Pilot Project Process

Process designed to protect stakeholder interests:

- Rate payers
- Participating customers
- Contractor
- Program sponsor
- Building industry

Pilot Project Process

Process for Participating Pilot Projects:

- Qualification of contractors and consultants
- Screening
- Application Phase
 - Two(+) stage application
 - Data collection in application
 - Project design guidance, technical support
 - Detailed customer agreement

Pilot Project Process

Process for Participating Pilot Projects (continued):

- Construction support and measure verification
- Incentive payments



Photo Credit: David C. Legg, National Grid



Pilot Project Process

Process for Participating Pilot Projects (continued):

- Construction support and measure verification
- Incentive payments
- Post construction monitoring and publicity



Photo Credit: David C. Legg, National Grid



Photo Credit: David C. Legg, National Grid

Staged or “Partial” DER

- Reality: Opportunities for comprehensive retrofit is rare
- “Staged” DER accommodated in pilot:
 - Incentives prorated
 - Project must save at least 50% of full DER savings
 - Measures and sequence demonstrate sound building science
 - Plan includes details that facilitate completion of full DER at a later date

Pilot Project Examples

Variety of Approaches!

- Variety of housing types
- Interior/exterior insulation
- Conditioned/unconditioned basement
- Conditioned/unconditioned attic
- Window replacement/retrofit
- Forced air/hydronic heating
- Mix of fuels

Pilot Project Examples



18th Century Cape



Small 1950s Cottage Home



Philadelphia (2 family) Gambrel
~1910



1980s Contemporary



1905 Bungalow



1960s Garrison Colonial

Pilot Project Example – 18c Cape

Pre-Retrofit Conditions:

- Heat by woodstove only
- Water flowing through basement
- Poor/absent flashing details
- >10,000 cfm 50!



Standing water in basement

Pilot Project Example – 18c Cape

- Extensive basement water remediation
 - Trenching with pipes to daylight
 - Yards and yards of gravel
- Extensive drainage plane remediation



Siding removed to remediate flashing



Basement gravel fill and chimney demolition



Basement prepared for slab

Pilot Project Example – 18c Cape

- New stud wall constructed to interior
- Closed-cell spray foam



Siding removed to remediate flashing



Stud wall constructed to interior

Pilot Project Example – 18c Cape

Post-Retrofit:

- High R enclosure
- 96 AFUE variable speed furnace
 - High SEER coil for future ASHP
 - Total duct leakage <100 cfm25
- Heat recovery ventilation
- Water-managed, insulated and conditioned basement
- 468 cfm50 <2.0 ACH50 (pre-retrofit >10,000)



Irene and Alex Clark during home renovation

Pilot Project Example – Early 20c Duplex

Pre-Retrofit Conditions:

- Uninsulated wall assembly
- Steam heating
- ~5,300 cfm50 (units 1&2 combined)



24-26 Princeton Street, Medford



Steam boiler in basement

Pilot Project Example – Early 20c Duplex



North Elevation

24-26 Princeton Street, front elevation

DER project plan:

- Aiming for THC and Passive House airtightness
- High R enclosure:
 - Thick insulating wall sheathing
 - Cellulose cavity, attic insulation
 - Strategic spray foam
 - Triple-glazed windows
- Unconditioned basement
- Condensing water heater hydronic radiant heating
- PV + solar water heating

Pilot Project Example – 1950s Cottage



Tweedly residence pre-retrofit

Project Highlight (lowlight):

- Significant moisture damage uncovered in retrofit

Pre-Retrofit Conditions:

- Heating by oil-fired hydronic, pellet stove
- High cooling energy use

DER project plan:

- Air barrier and Insulating sheathing on walls and roof
- High efficiency ducted mini splits
- CFIS ventilation
- New tankless water heater

Pilot Project Example – 1920s Duplex



1920s Duplex

DER project highlights:

- Aggressive air barrier targets in contract
- Insulating sheathing on walls and roof
- “Chainsaw” retrofit
- Conditioned basement with uninsulated slab

Pilot Project Example – 1905 Bungalow



1905 Bungalow

- DER project highlights:
- Zero Net Energy target
 - Excavated basement slab
 - Raise roof
 - Embedded structure roof panels
 - PV and solar water heating



Pilot Lessons

- Each project presents a unique situation –
No standard solutions
 - Despite common target, multiple paths to success
 - Non-energy objectives are drivers
- Water management is absolutely critical!
 - Homeowners and contractors not sufficiently aware of risks
 - Homeowners and contractors not sufficiently aware of existing problems
 - Correcting moisture issues could (should) be a major motivation for DER (insurance, preservation, ...)

Pilot Lessons (continued)

- Energy is only one of the benefits
 - Energy is seldom the most valuable benefit
 - Inappropriate to saddle energy savings with the entire cost burden (beware: SBC, “cost effectiveness”, etc.)

Major DER Challenge / Opportunity

Opportunity:

- Huge number of projects involving major component retrofit:
 - Re-siding, re-roofing, window replacement, replace mechanical equipment...

Challenge:

- Capture the opportunity
 - When a component is retrofit it is inoculated against further improvement for the life of the component
 - ? How to change the decision making of building owners, contractors, suppliers, financial institutions, insurers...

Capturing DER Opportunity

Desiderata:

- Move away from code as standard of care / basis of design (it's not a bar, it's a floor!)
- Move away from evaluation based on current energy costs
- Move away from evaluation based on energy
- Education:
 - Building owners, insurers – likelihood of current moisture issues and of moisture risk reduction in DER
 - Contractors, suppliers – it can be done