Final Report

Massachusetts 2010 Residential Retrofit and Low Income Evaluation—Deep Energy Retrofit

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Prepared by:
The Cadmus Group Inc. / Energy Services
Navigant Consulting
Opinion Dynamics Corporation
Itron
Energy and Resource Solutions

Prepared for:
The Electric and Gas Program
Administrators of Massachusetts
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1. Executive Summary

This report summarizes the initial findings from a process evaluation of the 2010 Deep Energy Retrofit (DER) pilot, conducted by The Cadmus Group Inc. (Cadmus), Opinion Dynamics, Navigant Consulting (Navigant), Itron, and Energy and Resource Solutions (ERS), collectively referred to as the Cadmus Team.

We prepared this report for the program administrators (PAs), NSTAR, National Grid, Columbia Gas, Unitil, Cape Light Compact, Berkshire Gas, New England Gas, and Western Massachusetts Electric Company (WMECO).

The evaluation findings, conclusions, and recommendations we present were drawn from an array of data collection activities, including interviews with PA staff, regulators, and program contractors, and surveys of participating and nonparticipating customers. This evaluation focused on the process of the pilot programs. It did not include an impact evaluation or a policy assessment, and therefore this document has limited information and should not be used to formulate broad DER policy recommendations.

Evaluation Objectives and Activities
The 2010 evaluation goal was to provide the PAs/implementers with actionable findings to improve customer and contractor participation and pilot program delivery. Evaluation objectives were to:

- Identify the various PA perspectives concerning the pilot design, its success metrics, and the next steps.
- Identify participation barriers and strategies for increasing participation, based on interviews with all in-progress and drop-out customers and contractors.
- Better identify ways to improve services or overcome barriers. Determine the customer views of the project life cycle and the contractor views of the market and measures.
- Document elements of each PA’s program delivery by examining pilot documents and interviewing PAs and select stakeholders.

The 2010 pilot pipeline consisted of approximately 118 customers who made inquiries, completed an application, had a project in progress, or completed a project. By the end of 2010, 12 projects had been completed, falling short of the goal to have 130 completed projects.  

Due to differences in PA pilot delivery and mismatches between pilot goals and the completes-to-date, the evaluation focus has shifted from impact to process activities. This process evaluation focused on identifying information to aid in formulating a consensus about the pilot’s mission and goals, rather than fine-tuning delivery mechanisms.

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Summary of Findings
Four energy-efficiency administrators (National Grid, NSTAR, WMECO, and Cape Light Compact) provided customer incentives for the DER pilot in 2010. Given that one purpose of a pilot is to experiment with different approaches, each administrator had broad flexibility in the program design and rollout. By the end of 2010, National Grid’s pilot completed nine equivalent dwelling units, while NSTAR, Cape Light Compact, and WMECO completed a combined total of three projects.

The number of completed projects fell short of projected participation goals, partly due to 2010 being the pilot’s launch year and the difficulty with obtaining high levels of participation during a program’s first year (also experienced by most other efficiency programs). In addition, DER projects in 2010 were complex and took up to between six and 24-months of planning. Promotional activity has been limited to referrals, a subdued Web presence, and promotion at targeted events, along with other media outreach, such as e-mail blasts. However, this level of promotion appears to be appropriate to the pilot’s current capacity to manage inquiries and process applications.

Successful DER candidates are those that have already decided to conduct a major home project. About half of the 2010 customers considered a maintenance-oriented, re-roofing or re-siding project; the other half considered a major interior and exterior renovation, although one-third of that half remain open to future deep energy retrofit work.

A large majority of customers who dropped out of the pilot still opted to re-side, re-roof, insulate, or renovate through another program or independently; though in most cases, the amount of energy efficiency they included was less and/or the whole-house coverage was less complete than what they had planned prior to dropping out. The primary reasons stated for nonparticipation were project cost and complexity.

Participants who completed projects were satisfied with the end-product, particularly noting improved comfort and energy savings. However, they reported that the process proved to be arduous, cost more than they originally expected, and required compromises.

High project costs were a major concern to all stakeholders, customers, and contractors. As currently structured, the pilot is not tenable for full deployment due to these high costs. As one stakeholder stated: “The rate payers cannot be expected to sustain the level of incentives at the current levels.” This cost crisis has led some stakeholders to question the pilot’s mission; other stakeholders identified cost reduction as the primary research goal for the pilot. The DER program cannot significantly contribute to the savings goals mandated by the Energy Efficiency Advisory Council (EEAC) as currently designed, but a model designed to achieve deeper savings (though not the deepest possible) could deliver significant savings.

Summary of Recommendations
These preliminary recommendations focus on the pilot’s mission:

- **Restructure and refocus the pilot.** The pilot is primarily focused on completing projects. Though pilot performance will clearly fall short of the cost-effective energy saving goals, it is still valuable. The Cadmus team recommends restructuring the pilot as a research effort with a voluntary board and implementation team (both of which could include PA members) and refocusing the research on activities that will lead to a scalable
program. Resolving some inherent policy issues and establishing a pathway to lowering costs and overall cost-effectiveness should be a near term focus of the research effort.

- **Seek to fill program gaps.** Customers, as well as some stakeholders, have identified the need for energy efficiency services that fill the gap between basic PA programs (e.g., Home Energy Assessment) and comprehensive deep retrofits:
  
  o **Partial deep retrofits.** Identify a DER track that meets the needs of customers who are prepared for a major project but are not willing or able to commit to all the requirements of a comprehensive DER project. This could be accomplished by providing incentives for deep retrofits of one building system at a time, possibly when normal maintenance would take place, such as re-roofing, re-siding, or window replacements. Such partial deep retrofits, with much smaller up-front costs, might attract a larger number of homeowners, and would greatly reduce the size of an incentive provided to any one customer.

  o **Deep (but not as deep) retrofits.** As reported by several PAs and also in the Massachusetts Clean Energy and Climate Plan for 2020, there is need for a middle ground between the level of savings provided by the current relatively low-cost programs and the very high savings achieved at a high cost in the pilot homes. Customer re-roofing and re-siding events present opportunities for additional savings at a relatively low cost.
2. Introduction

Program Overview
It is worthwhile to review the political and regulatory forces which created and have shaped the Deep Energy Retrofit (DER) pilots. The DER pilots were created in response to the Governor’s energy policy, but are subject to the regulations of the Department of Public Utilities which examines cost-effectiveness, ratepayer impacts, and equity of energy efficiency programs.

DER was created in response to the Massachusetts Governor’s Zero Energy Task Force’s² call for demonstration of deep energy savings in 250 existing residential buildings. The pilot’s purpose is to investigate the potential for energy savings of at least 50 percent of total on-site energy use through extensive retrofits of residential homes. Pilot elements include: 1) financial and technical assistance for implementation; 2) best practice implementation techniques; and 3) identifying ways to reduce costs and challenges associated with deep retrofits. The pilot has a $5 million budget for 2010 to 2012.

The Massachusetts Clean Energy and Climate Plan for 2020,³ identifies DER as one of eight building policy initiatives. The DER policy statement reflects parallel issues to those identified in this report, including:

- Building maintenance, such as re-roofing and re-siding present opportunities to add insulation, should not be missed.
- Partial deep retrofits may be more attractive and affordable.
- Whole building deep retrofits present an opportunity to press for innovation.
- The current cost-effectiveness test should be reviewed.
- Current substantial incentive levels create equity issues.
- Complex construction techniques may be required to manage moisture and may limit the ability to implement partial or less deep measures without risking the durability and comfort of the building.

The PAs operate programs under the Department of Public Utilities (DPU)-08-50-A and 08-05-B⁴ and are mandated to implement all cost effectiveness measures on a total resource cost basis. This means all programs must pass the Benefits Costs test in order to justify using rate-payer funds towards energy efficiency programs. While pilots are not required to be cost-effective, their costs and savings are rolled into the sector portfolio which must remain cost effective as a whole. While cost-effectiveness is not a near-term test of the pilot, this requirement does impose a challenge for bringing DER to scale.

Sponsored by electric and gas program administrators (PAs), the 2010 DER pilot’s implementation details vary by administrator. The pilot provides participants with the following:

- Technical assistance, which may include Building Science Corporation (BSC)\textsuperscript{5} or HERs raters\textsuperscript{6} to inspect and run tests, or the Center for Ecological Technology (CET)\textsuperscript{7} services in reviewing customer plans, modeling Building America case study dwellings, and detailing construction efforts.

- Incentives (capped at $42,000 for a single-family home) for implementation of a package of measures, designed to reduce energy use by at least 50 percent.

- National Grid’s program also provides educational and technical services to customers and contractors, with a particular focus on correct implementation techniques.

Delivery mechanisms vary between PAs. National Grid, for example, requires installation of a somewhat prescriptive combination of shell and HVAC measures. In total, measures are expected to achieve 50 percent or more savings. Other PAs, such as WMECO, require designs to achieve a HERS rating of 50 percent or better, without reference to specific measures.

Several PAs offer a “partial” implementation track. Regardless of the approach, participants must mitigate standard 2x4 construction by expanding wall cavities on interiors or over-cladding exteriors. Participants must also implement additional significant measures, such as mechanical ventilation and considerable improvements to roof and basement insulation, which together create complex and expensive installations. The project’s complexity and affordability have been viewed as participation barriers. Table 1 summarizes PA’s key pilot delivery features.

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\textsuperscript{5} Building Science Corporation (BSC) is a professional architecture, engineering, and research firm, dedicated to durable, healthful, and energy-efficient residential construction. BSC has a contract with the Department of Energy, which provides funding for services BSC contributes to the program.

\textsuperscript{6} A Home Energy Rating System Rater is an individual who is certified by an accredited HERS Provider to inspect and test a home in order to evaluate each minimum threshold set forth by Residential Energy Services Network, [<http://www.resnet.us/rater/what-is-a-hers>].

\textsuperscript{7} The Center for Ecological Technology (CET), a nonprofit (501c3) organization, engages in work demonstrating and promoting practical, affordable solutions to environmental challenges encountered in daily activities. CET’s mission is “to research, develop, demonstrate and promote those technologies which have the least disruptive impact on the natural ecology of the Earth.”
Table 1. Summary of Delivery Characteristics by PA

<table>
<thead>
<tr>
<th>PA</th>
<th>NATIONAL GRID</th>
<th>NSTAR</th>
<th>CLC</th>
<th>WMECO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>Prescriptive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010 Pilot Participation Goals</td>
<td>41</td>
<td>-</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Implementation Contractor</td>
<td>National Grid Staff, Building Science Corp for technical services and inspections</td>
<td>List of contractors</td>
<td>HERS list</td>
<td>CET</td>
</tr>
<tr>
<td>Primary Marketing</td>
<td>In program referrals</td>
<td>Contractor network, robust Web, e-mail distribution, open houses, TV, speaking engagements, lawn signs</td>
<td>Mass Save Website only</td>
<td>Website</td>
</tr>
<tr>
<td>PA Resource</td>
<td>~1.5 FTE PM</td>
<td>~.5 FTE PM</td>
<td>~1 FTE PM</td>
<td>~.5 FTE PM</td>
</tr>
<tr>
<td>2010 Pilot Completions (Participants)</td>
<td>9</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Pipeline Activity</td>
<td>76</td>
<td>4</td>
<td>25</td>
<td>13</td>
</tr>
<tr>
<td>Incentive Cap</td>
<td>$42,000 single-family Varies by size of building and # of units $106,000 multifamily</td>
<td>Project dependent</td>
<td>$35,000</td>
<td>$42,000</td>
</tr>
</tbody>
</table>

The pilot uses a complex participation process, with the project seeking to achieve deep savings by addressing an existing dwelling comprehensively, including shell and mechanical systems beyond standard practice. All programs require a technical review of initial plans and inspections. Appendix F includes flow diagrams of participating PA pilot delivery. For example, National Grid’s process includes formation of a team, customer training requirements, and a two-stage application, as illustrated in Figure 1.

By the end of 2010, the pilot pipeline consisted of 118 customers who made inquiries, completed an application, were in progress, or completed a project. Twelve units were completed.

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8 There may be a slight discrepancy between PA’s definition of the number of participants completed ‘dwelling units’ vs. ‘projects.’
<table>
<thead>
<tr>
<th>National Grid Application Process</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Program Outreach</strong></td>
</tr>
<tr>
<td>Contractor</td>
</tr>
<tr>
<td>Flyers</td>
</tr>
<tr>
<td>Lawn Signs</td>
</tr>
<tr>
<td>Email Blasts</td>
</tr>
<tr>
<td>Questionnaires</td>
</tr>
<tr>
<td>List Serves</td>
</tr>
<tr>
<td>Website Mass Save</td>
</tr>
<tr>
<td>TV</td>
</tr>
<tr>
<td><strong>Pre-Screen</strong></td>
</tr>
<tr>
<td>Customer Inquiry</td>
</tr>
<tr>
<td>NGRID</td>
</tr>
<tr>
<td>Questionnaire</td>
</tr>
<tr>
<td>Partial Type 1</td>
</tr>
<tr>
<td>Partial Type 2</td>
</tr>
<tr>
<td>Comprehensive</td>
</tr>
<tr>
<td>DER</td>
</tr>
<tr>
<td>Team Formation</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td>Other Program</td>
</tr>
<tr>
<td><strong>Application Part 1</strong></td>
</tr>
<tr>
<td>NGRID, BSC &amp; Project Team</td>
</tr>
<tr>
<td>Reviews Application</td>
</tr>
<tr>
<td>Conference Call</td>
</tr>
<tr>
<td>Make Adjustments</td>
</tr>
<tr>
<td><strong>Application Part 2</strong></td>
</tr>
<tr>
<td>Inputs</td>
</tr>
<tr>
<td>Physical Drawings</td>
</tr>
<tr>
<td>Proposed Equipment</td>
</tr>
<tr>
<td>Detailed costs</td>
</tr>
<tr>
<td>Health &amp; Safety</td>
</tr>
<tr>
<td>FL Plan with Dimensions</td>
</tr>
<tr>
<td>Proposed Conditions</td>
</tr>
<tr>
<td>THC Project Submission (L2)</td>
</tr>
<tr>
<td>NGRID Inputs</td>
</tr>
<tr>
<td>Expected Incentive</td>
</tr>
<tr>
<td>Conference Call</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td><strong>Agreement</strong></td>
</tr>
<tr>
<td>Incentive Payment</td>
</tr>
<tr>
<td>Finalize Plans &amp; Sign Agreement</td>
</tr>
<tr>
<td>Pass</td>
</tr>
<tr>
<td>BSC conducts Field Inspection</td>
</tr>
<tr>
<td>- air leakage</td>
</tr>
<tr>
<td>- building tightness</td>
</tr>
<tr>
<td>Fail</td>
</tr>
<tr>
<td><strong>Post Completion</strong></td>
</tr>
<tr>
<td>Install Equipment</td>
</tr>
<tr>
<td>Construction</td>
</tr>
<tr>
<td>Verify Equipment was Installed</td>
</tr>
<tr>
<td>Final Incentive Payment</td>
</tr>
<tr>
<td>Marketing/Promoting Pilot</td>
</tr>
<tr>
<td>IAQ &amp; Energy Modeling (THC)</td>
</tr>
</tbody>
</table>
Evaluation Activities and Objectives

Table 2 summarizes evaluation tasks started in 2010 and completed in early 2011.

The evaluation’s goal has been to provide the PAs/implementers with actionable findings to improve customer and contractor participation and pilot program delivery. Objectives for interviews completed in 2010 particularly focused on:

- Determining the customer’s view of the project’s life cycle, and the contractor’s view of the market and measures, to better identify points for improving services or overcoming barriers.

- Document elements of each PA’s program delivery through examination of pilot documents and interviews of PAs and select stakeholders.

- Identify the various PA perspectives concerning pilot design, success metrics, and next steps for the pilot.

### Table 2. Summary of 2010 Evaluation Tasks

<table>
<thead>
<tr>
<th>Evaluation Task</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant and nonparticipant (Drop-outs) interviews (n=40)</td>
<td>Provides insight into participant and nonparticipant motivation, decision making, and satisfaction with delivery.</td>
</tr>
<tr>
<td>Plan contractor interviews (n=15)</td>
<td>Provides insight into DER’s role in the market, program delivery, and measure barriers.</td>
</tr>
<tr>
<td>Research pilot delivery</td>
<td>Documents program delivery and examines differences by PA.</td>
</tr>
<tr>
<td>Conduct PM and other stakeholder interviews (n=10)</td>
<td>Provides insight into the pilot mission, research goals, and improvements.</td>
</tr>
</tbody>
</table>
3. Methodology

As noted, the DER evaluation included interviews with customers, contractors, and stakeholders, as described in detail below.

Customer Interviews

The Cadmus Team’s goal was to conduct in-depth interviews with a census of all customers in the pipeline, consisting of approximately 60 customers when the evaluation plan was written. Subsequent information provided by the PAs identified 118 customers in the pipeline, as shown in Table 3.

<table>
<thead>
<tr>
<th>PA</th>
<th>Completes</th>
<th>In Progress</th>
<th>Drop-outs</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NATIONAL GRID</td>
<td>9</td>
<td>33</td>
<td>34</td>
<td>76</td>
</tr>
<tr>
<td>WMECO</td>
<td>2</td>
<td>3</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>NSTAR*</td>
<td>0</td>
<td>4</td>
<td>unknown</td>
<td>4</td>
</tr>
<tr>
<td>CLC</td>
<td>1</td>
<td>1</td>
<td>23</td>
<td>25</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12</strong></td>
<td><strong>39</strong></td>
<td><strong>65</strong></td>
<td><strong>118</strong></td>
</tr>
</tbody>
</table>

* NSTAR asked the Cadmus Team not to contact drop-outs, concerned the survey might be viewed as bothersome to customers.

“Completes” are defined as all projects that have or will have all project components installed by December 31, 2010. In-progress projects are those in construction or with an active application. “Drop-outs” are projects where a customer made a formal inquiry into the program or began an application, but decided not to proceed with a project. For this report, these terms are used as follows:

- **Active**: a customer with a project completed, in construction, or has an active application.
- **Drop-out**: a customer that made a formal inquiry or began an application, but did not proceed with a DER project to completion.

By the interview period’s end, we had attempted contact with 67 customers, resulting in 40 completed interviews. Table 4 summarizes the disposition of these attempts and completes, by PA.

<table>
<thead>
<tr>
<th>PA</th>
<th>Population</th>
<th>Responded</th>
<th>No Response</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Active</td>
<td>Drop outs</td>
</tr>
<tr>
<td>National Grid</td>
<td>76</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>WMECO</td>
<td>13</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>NSTAR</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CLC</td>
<td>25</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>118</strong></td>
<td><strong>20</strong></td>
<td><strong>20</strong></td>
</tr>
</tbody>
</table>
We structured the interview questions, based on a consumer decision-making model. This model aided us in structuring questions and identifying customers’ progress in their decision-making processes, factors influencing them to start the project, where and how the pilot influenced them at various points during the process, and similar questions. Appendix A includes an interview guide.

The in-depth interviews addressed the following research areas:

- Achieve a start-to-finish view of a project, from the customer’s initial concept through installation, including:
  - A breakdown of reasons customers began a project (i.e., energy efficiency, large-scale renovation, re-siding).
  - Typical number of days in each stages.
  - Points in the cycle where customers contact the PAs.
- Identify where and when the pilot influenced the customer.
- Learn the customers’ views of pilot services and measures, and how these have factored in their projects. Also examine how measures changed over time.
- Identify where and how the pilot might additionally influence a positive outcome.
- Characterize customers who drop out, and identify their reasons for doing so.
- Characterize customers who stay the course.

**Contractor Interviews**

The Cadmus Team’s goal was to conduct 15 in-depth interviews with contractors that have knowledge of the DER pilot or other, aggressive, residential energy-efficiency programs. With one exception, these contractors were in some way affiliated with the pilot program, either listed as a National Grid Recommended Contractor or hired by one of the PA customers interviewed. Table 5 contains contractor interview outcomes by response types.

<table>
<thead>
<tr>
<th>Respondent Type</th>
<th>Total Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participated in at least one DER project through the pilot</td>
<td>8</td>
</tr>
<tr>
<td>Did not participate in any DER projects through the pilot</td>
<td>7</td>
</tr>
</tbody>
</table>

**Stakeholder Interviews**

Table 6 lists those interviewed for this process. Appendix C includes a complete interview guide.

The formal, in-depth interviews addressed the following research areas:

- Current pilot delivery model for each PA:
  - Current pilot design and delivery, including trade allies, collateral, and back-office resources.
Where the pilot targets services in the customer project cycle, and whether that approach has perceived gaps or strengths.

How program methods and metrics were determined.

Future pilot vision:

Minor or major pilot adjustments that should be considered, including research activities, manpower, and measure changes.

Appropriate pilot metrics.

**Table 6. DER PA Interviews to Date**

<table>
<thead>
<tr>
<th>Program Administrator</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stephanie Terach, NSTAR</td>
<td>Program Manager</td>
</tr>
<tr>
<td>Charlie Olsson, NSTAR</td>
<td>Program Manager</td>
</tr>
<tr>
<td>David Legg, National Grid</td>
<td>Program Manager</td>
</tr>
<tr>
<td>John Walsh, WMECO</td>
<td>Program Manager</td>
</tr>
<tr>
<td>Megan McDonough, WMECO</td>
<td>Program Manager</td>
</tr>
<tr>
<td>Margie Izzo, Columbia Gas</td>
<td>Program Manager</td>
</tr>
<tr>
<td>Briana Kane, Cape Light Compact</td>
<td>Program Manager</td>
</tr>
<tr>
<td>Larry Masland, Susan Kaplan - DOER</td>
<td>Energy Analyst, Marketing Manager</td>
</tr>
<tr>
<td>Ken Neuhauser, Building Sciences Corp.</td>
<td>Building Science Engineer</td>
</tr>
</tbody>
</table>

Nonparticipant Panel

We conducted a separate, cross-program nonparticipant survey to generally inform current and future Residential Retrofit and Low-Income program area evaluations. This longitudinal approach to surveying program participants and nonparticipants permitted: (1) identification of customers participating in multiple programs over the three-year period; (2) following new occupants in participating premises; and (3) obtaining required data for tracking measure and education persistence.

As the nonparticipant survey leveraged all programs, it covered a broad range of topics, relevant to each program’s evaluation, in addition to program-specific questions. Nonparticipant survey objectives included assessing the following:

- Program awareness.
- Sources of program information.
- Reasons for not participating.
- Awareness and interest in energy efficiency.
- Demographic and household characteristics (for use in future billing analysis).

The DER program’s key parameter of interest was the rate at which customers generally embarked on major renovations of shell upgrades.
4. Findings

Study findings are organized as follows:

- Customer Findings
- Contractor Findings
- Stakeholder Findings
- Pilot Design and Delivery Findings

Customer Findings

The customer-focused section begins with an overview of DER customer characteristics and key definitions. Key findings are structured the same as the interviews (using the model adapted from “Principles of Marketing” by Philip Kotler and Gary Armstrong), as illustrated in Figure 2.

![Figure 2. Consumer Decision-Making Model](image)

DER Customer Characteristics

The findings review begins by presenting background information about populations served by the DER pilot, and definitions of participants and nonparticipants.

For the report’s purposes, Active is: a customer completing a project, having a project in construction, or having an active application. Table 7 summarizes project stages of the 20 interviewed Actives. In-construction projects will very likely proceed to completion, while the in-application projects may or may not.

<table>
<thead>
<tr>
<th>Table 7. Project Stage of Interviewed Actives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interviews</td>
</tr>
<tr>
<td>------------</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

The report defines a Drop-out as a customer making at least one inquiry into the program or beginning an application, but deciding not to participate. As DER is a unique and complex program, random PA customers without knowledge of the program would not provide meaningful responses. Table 8 shows disposition of Drop-outs.

<table>
<thead>
<tr>
<th>Table 8. Status of Interviewed Drop-outs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interviews</td>
</tr>
<tr>
<td>------------</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
Income may prove an important characteristic in distinguishing Actives from Drop-outs. Interviewers did not directly ask DER customers about their incomes. Rather, customer home values were researched using Zillow.com, comparing them for nonparticipants and participants. Results are shown in Figure 3.

Currently, the median Massachusetts home price is $280,000. Interestingly, Active projects span the lowest and highest assessments, while Drop-outs cluster in the middle.

**Figure 3. Home Value for Customers**

DER customers (both Actives and Drop-outs) demonstrated certain characteristic attitudes or inclinations. The majority, as indicated in Table 9, identified an interest and commitment to the environment, either professionally or through self-identification. A second group expressed a desire to make good, long-term consumer decisions that were cost-effective and of overall benefit to their families.

---

9  http://www.trulia.com/home_prices/Massachusetts/
### Table 9: DER Customer Attitudes

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Actives</th>
<th>Drop-outs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contractor/engineer</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Green professional</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Self-identified 'greenie'</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Careful consumer</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>N/A</td>
<td>5</td>
<td>11</td>
</tr>
</tbody>
</table>

It was also useful to consider typical Active and Drop-out situations as indicative of issues concerning customers. The following two case studies present the experiences of a typical Active and Drop-out.

**Case Study—Active Customer 31**
Customer 31 bought his house in 2010. He worked with an architect to draw up initial plans for interior renovation. Initially, he had not thought to include exterior siding or a new roof because these were in good condition. He was interested in making the renovation energy efficient.

Customer 31 found out about the program through the Mass Save Website. He discovered the program was similar to the plans he’d made, and he started an application. In the course of completing the application, he realized he would lose much interior square footage because of insulation requirements. He had his architect redesign the space layout to account for the lost area.

Customer 31 reported the energy piece complicated things quite a bit and considerably slowed the process. He was particularly reluctant to replace a roof that was in good condition. He had many back and forth discussions with the contractor because he did not feel he needed a new one. In the end, Customer 31 made the decision to replace the roof. He stated he learned much from the DER experience, and was happy with what he received. He admitted it was hard to accept the trade-offs, but overall, was satisfied with the program.

**Case Study—Drop-out Customer 68**
Customer 68 bought a house and wanted to add an extension and replace his old heating system with a new, high-efficiency unit. He looked into different Mass Save programs, including DER.

Customer 68 decided not to participate in DER because it was too expensive, even with the incentive dollars. He said: “Only the rich can afford to do this program.” He thought he could complete the same work for less money, though it might be less energy efficient (which he did not consider an issue). Customer 68 was satisfied with his decision to make his home more efficient using less money.

**Customer Decision Making**
Findings are organized into five consumer decision process sections, beginning with the original identification of a need, through to the final project disposition.
1: Need Recognition

A consumer triggers a need when they recognize an imbalance between their current and preferred status.

The first step in consumer purchasing decisions is having a need. DER Customers overwhelmingly reported they were initially motivated by the need for a major home upgrade or renovation. Those customers seeking to make their homes more efficient, but not simultaneously pursuing other upgrades, did not proceed far into the process. Research shows it was almost a necessity that a customer concurrently pursues a major home project and DER. The one exception was a participant downsizing, who wanted their smaller home to be as efficient as possible, with no concern for cost.

Customers were almost equally divided into two groups:

- Maintenance: customers needing to replace roofing, siding, and/or windows, which had reached the end of their useful life.
- Renovation: customers planning major home renovations, additions, or gut-rehabs to add functionality and amenities to their dwellings.

Of 14 interviewed Actives with completed or nearly completed projects, five started by intending a major renovation.

### Table 10. Motivation for Starting a Project

<table>
<thead>
<tr>
<th>Reasons for Starting a Project</th>
<th>Actives</th>
<th>Drop-outs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance – single or multiple component</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Major Renovation</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Energy Motivator</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>N/A</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

While a project may have triggered the need, energy efficiency proved an important motivator for all customers in the pipeline. Table 11 summarizes reasons customers valued energy efficiency. Customers could cite more than one benefit.

### Table 11. Perceived Benefits of Energy Efficiency

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Actives</th>
<th>Drop-outs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Better for the environment</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Improved comfort</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Best for the long term</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Reduced bills</td>
<td>9</td>
<td>6</td>
</tr>
</tbody>
</table>
Given DER participants’ profiles as self-described “greenies,” the high number of customers identifying a better environment as a project benefit was not surprising. The primary benefit customers associated with energy efficiency was reductions in their utility bills. Most Actives associated accumulation of energy savings with this reduction. Another perceived benefit of energy efficiency is comfort. Actives made efforts to decrease the level of discomfort in their home thereby increasing the comfort levels with DER. Therefore, customers identified comfort as a benefit of a highly efficient home.

2: Information Search

After the consumer recognizes their need, they search for information to support the fulfillment of that need.

To participate, a customer must know the program exists, and the pilot has been promoted on a limited basis. At the end of 2010, only National Grid and CLC had obvious and clear Website links to DER program information; the other PAs and Mass Save had less obvious or no links to the pilot. All PAs relied on trade allies for referrals. This limited promotion has been partly intentional, one stakeholder reported, due to concerns the pilot could be overwhelmed with indecisive customers.

A majority of customers learned about the DER program through an online search, as seen in Table 12. Some customers conducted a Web search and found press-related items, such as a case study of the DER program. This either led them to the Mass Save or the individual PA’s Websites.

Trade allies proved almost equally as important as the Web in introducing customers to DER. Trade allies included home services contractors providing in-program referrals (i.e., Rise Engineering for CLC) or vendors directly serving the DER program.

Some customers learned of DER from friends, who typically were personal contacts working in the energy-efficiency or renewable field. Customers cited three events as first introductions to DER: Western Mass Green Consortium, Mass Climate Action Network Meeting, and the NEASEA Green Building Open House Tour.
Customers reported making initial program inquiries, expecting monetary incentives and technical direction would be offered.

### 3: Evaluation of Alternatives

Consumers take the information and develop a set of criteria for a product’s attribute. This set of criteria enables consumers to evaluate and compare alternatives.

Most Drop-outs (16 of 20 interviewed) concluded early and quickly they would not participate due to the project’s anticipated cost, measure requirements, and complexity.

Two Actives, presented with a DER opportunity by their contractor late in a renovation project, decided to participate quickly due to limited time. Most Actives, however, underwent a lengthy decision process, considering pricing, potential project benefits, and incentives. Figure 4. summarizes alternatives customer decision making considerations.
Contractor selection was the criteria weighing most heavily in the decision-making process. Actives often sought pricing from multiple contractors, and expressed uncertainty and some frustration with the process. Qualified Contractor (QC) pricing met with some suspicion. In particular, a number of customers noted QC pricing as exceptionally high. Some customers observed the variability in pricing, and concluded some contractors did not really know what they were doing.

Table 13. Customer Attitudes Towards Contractors

<table>
<thead>
<tr>
<th>Attitude</th>
<th>Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Found the Qualified Contractors significantly more expensive than other contractors</td>
<td>5</td>
</tr>
<tr>
<td>Were confident in their contractor, but felt the contractor was still learning</td>
<td>6</td>
</tr>
<tr>
<td>Spoke with contractors that were not technically competent</td>
<td>3</td>
</tr>
</tbody>
</table>

The incentives played an instrumental part in customers’ decision making. It is clear that these Actives would not have implemented all of the desired DER type measures, nor to the level that is required of the pilot without the program’s direction and incentives. Very few participants
would have proceeded without the incentive knowing they would be granted technical assistance. Mostly all viewed the incentives as critical to implementing the additional DER measures.

4: Purchase

Following the evaluation of alternatives, the consumer decides if and which product to buy.

Drop-outs almost always cited cost as a primary factor in their decision not to participate. Other reasons for nonparticipation included:

- Project extent was overwhelming and too much to take on (common).
- Concerns about the project aesthetics (less common).
- Concerns about actual savings (less common).

The following two tables summarize pro and con arguments customers expressed

Table 14. Reasons for Deciding Whether to Participate in the DER Program

<table>
<thead>
<tr>
<th>Pros</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incentives.</td>
</tr>
<tr>
<td>Good long-term investment.</td>
</tr>
<tr>
<td>Expect to see a reduction on energy bills.</td>
</tr>
<tr>
<td>Clear set of defined goals to achieve the max amount of energy savings.</td>
</tr>
<tr>
<td>The rigorous process forces checks and balances to ensure things are completed correctly.</td>
</tr>
<tr>
<td>The technology is interesting and worthwhile.</td>
</tr>
<tr>
<td>Program administrator and staff are very helpful.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is too expensive.</td>
</tr>
<tr>
<td>The measures are too involved.</td>
</tr>
<tr>
<td>Need more guidance.</td>
</tr>
<tr>
<td>Time constraints.</td>
</tr>
<tr>
<td>Need to see the data to support the energy savings claims.</td>
</tr>
<tr>
<td>There are other ways to approach the concept without the program.</td>
</tr>
<tr>
<td>Contractors lack the expertise to determine the correct equipment size of mechanical equipment.</td>
</tr>
<tr>
<td>Forced to replace equipment in good condition.</td>
</tr>
<tr>
<td>The cost is uncertain and becomes a moving target.</td>
</tr>
<tr>
<td>Updating plans becomes a burden with different parties involved in the process.</td>
</tr>
</tbody>
</table>
5: Post-Purchase

The consumer evaluates the product after purchase.

Actives

All Actives stated they would not have implemented full DER measures without the program. Some mentioned they may have completed some measures, but they would not have done so as fully without participating in the program. For those that did comment, they noted the incentive played a vital role in moving forward their participation. Seventeen said they did not anticipate spending as much as they did.

Drop-outs

Many Drop-outs pursued efficiency related projects after deciding not to participate. As noted, the prime trigger for DER customers was the need for a major home project. Table 15 tabulates other actions taken by Drop-outs. The table notes the number of drop-outs stating they would consider future DER participation.

Table 15. Other Work Completed by Drop-outs

<table>
<thead>
<tr>
<th>What They Decided to do Instead of DER</th>
<th>Completed</th>
<th>Future Plans</th>
<th>Would Still Consider the DER Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>No improvements</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Moved</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Major Renovation Program</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Replaced siding *</td>
<td>4</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Replace furnace/boiler *</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Replaced roof *</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Replaced some windows *</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home air sealing and insulation services (Energy Audits or Weatherization program included)</td>
<td>11</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Don’t know</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>30</strong></td>
<td><strong>5</strong></td>
<td><strong>11</strong></td>
</tr>
</tbody>
</table>

* More than one response possible.

The five interviewed Actives completing projects express general satisfaction with their homes and with the pilot. They reported enjoying the benefits of a comfortable home with extremely low energy bills. Some participants, in particular to National Grid’s pilot program found the process to include additional oversight which forced contractors to double check their work e.g. right sizing mechanical equipment. Actives of National Grid’s pilot noted the pilot requirements were stringent and the application process arduous. Compromises were made between extending exterior insulation and reducing interior floor space, and selecting preferred equipment that may not have been market ready at that time. One participant noted they initially thought the incentives were extremely generous, but, in the end, only displaced about one-third of the cost.
“Making the switches to high efficiency mechanical equipment, upgrade of the energy-efficiency levels, and meeting the parameters of DER has definitely improved my quality of life.” — Customer 43

“I had to compromise on just about every decision we made, but overall we are happy with the end result.” — Customer 31

Contractor Findings
The contractor-focused section begins with an overview of contractor characteristics. Subsequent sections address the contractors’ views of the housing market, the high-efficiency housing market, and their experiences with the pilot.

Interviewed Contractor Characteristics
Interviewed contractors were selected from a PA-approved DER vendor list, referred by a DER pilot program participant, or referred by a participant in a weatherization program (one interview). These contractors primarily serviced the residential market, although their work portfolio could include light commercial and public housing. All but two firms provided general contracting and/or design-build contracting services. One firm was a Design Energy Modeling company, and another was a subcontractor for a weatherization program.

For this report, a “participant” is considered a contractor either in the process of or has already completed a DER pilot. The “in-process” stage may either be in the project’s preconstruction or construction phase. For this report, a “nonparticipant” is considered a PA-approved provider, but has not submitted a project application to a PA. Table 16 summarizes the project stage of the 15 contractors interviewed.

<table>
<thead>
<tr>
<th>Participants</th>
<th>Nonparticipants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple Projects</td>
<td>Completed One Project</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total: 8</strong></td>
<td><strong>Total: 7</strong></td>
</tr>
</tbody>
</table>

The eight participating contractors had experience with three PAs, as seen in Table 17. Three of these participants worked with different PAs.

Table 17. Contractor Participation by PA

<table>
<thead>
<tr>
<th>NATIONAL GRID</th>
<th>WMECO</th>
<th>NSTAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Interviewed contractors cannot be considered representative of contractors in general, but were selected based on demonstrated experience with energy-efficiency projects. Most of the contractors had experience in multiple, energy-efficiency initiatives as summarized in Table 18.

Table 18. Experience in the Area of Energy Performance
The person interviewed was either a company owner or a senior company representative. Those willing to respond reported annual sales in the $0.5 million to $2 million range. One contractor characterized his annual workload as about 40 projects, averaging $30,000 each.

**Contractor View of the Energy-Efficiency Market**

Despite the difficult housing market, participant and nonparticipant contractors were optimistic (90% vs. 70%, respectively) about the 2011 construction market. The contractors see signs of an increase in demand, and noted the effects of federal stimulus dollars.

Figure 5 displays the types of jobs contractors take on. Some are exclusive to new construction or gut renovations others provide a variety of services to their clients. Services related to energy efficiency proved an important part of the interviewed contractors’ service portfolios. Contractors included an energy performance component (additional insulation or more efficient equipment, for example) in most of their core work. All weatherization contractors’ work was considered energy performance work.

![Figure 5. Contractor Services by Project Type](image)
Case Studies

CONTRACTOR: 9, Non Participant
Service Type: General Contracting: Remodeling, Gut Rehab
2010 DER Experience: 5 projects (not through program), ENERGY STAR homes/other

Why have you not decided to participate?
“I would like to but I just can’t find many customers that are interested. Being a traditionalist, the DER pilot program requires the homeowner to drastically change the look of some of the house...there is a lot of work that is involved on a project of this magnitude and not to mention, the cost and whether homeowners can recoup from the cost-what is the true payback?”

CONTRACTOR:6, Participant
Service Type: Greenbuild and General Contracting:
Type of Client: Light Commercial and Residential-Low income-Upper Class
2010 DER Experience through program: 3
*2 not through program

What is your experience going through the pilot program?
After working on a few projects, “I believe the definition of DER is still being defined. We are all learning and sharing info in this growing industry. The best candidates for the pilots are those which contractors are already remodeling the entire house anyway. Most of the clients hear about the program through us. They may have an initial plan but after we mention the pilot they slowly warm up to it.

We have a fantastic relationship between BSC and National Grid. Having now gone through National Grid’s process, some of the paperwork has been reduced but it is still a long under taking. In a competitive bidding process I include the 40hrs of admin time for a project if we are participating in National Grid’s pilot program.

Making sure to air seal the house tight is very important on a DER project. Sometimes we find that moisture and thermal protection are at odds. I look to Canadian and European energy efficiency products but wish to know more about other types of materials that are coming out on the market.

For customers, the barrier to participate is the cost. I would love to see this pilot explore other creative ways to make it both convenient and financially flexible to homeowners. Taking a staged approach by extending the timeframe and breaking out interior and exterior measures may help. I think the program should put more emphasis on the builders implementing the work. Cultivating dialogue on DER related topics at Open Houses are insightful but we can address more issues in one room on a regular basis with a structured format. Separate from the DER pilot program, a DER builder’s support group (25-35 people) has emerged.
Over two-thirds of contractors stated a portion of their work could have been a candidate for the DER pilot, given their work at the homes was extensive enough and their customers had some interest in energy efficiency. While contractors indicated these sites as potential candidates, it is not clear if these clients would participate in a program if it was offered to them. Table 19 presents the total number of DER-related projects by project types and respondents.

Table 19. Potential Candidate Projects for DER Pilot Program

<table>
<thead>
<tr>
<th>Project Type</th>
<th>Participant</th>
<th>Nonparticipant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrofit</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Gut Renovations</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Renovations</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>N/A</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>32</strong></td>
<td></td>
</tr>
</tbody>
</table>

In general, most contractors reported DER being a hard sell. Six out of 15 contractors did not actively market the program, though two of whom were participants. Reasons some nonparticipants did not actively market the program are listed below:

- They felt the entire pilot process would tie them up and prevent them from moving forward on other projects.
- They experienced a delay in receiving responses from the administrative support staff.
- They found alternative programs that better suited to their client’s needs.
- They were not aware of the program.
- They did not believe there was much demand for the program.

Two participants offered other reasons they did not actively market the program:

- It is not their primary line of work, but they wouldn’t mind doing one if the customer was interested in it.
- It is a hard program to sell to all but the wealthy.

Those contractors reported they marketed the pilot to good, prospective customers, not necessarily all customers. In a competitive bidding situation, one contractor reported he offered two proposals: one proposal to spec, and second with DER as an option. Other contractors reported offering the idea to customers already under contract. Several nonparticipants reported offering customers a DER option, but without success.

When asked to characterize a good prospect for a DER project, contractors noted they looked for the following:

- Complete house remodeling: doors, windows, walls, mechanical, roofing, siding.
- Environmentally aware and motivated customer, committed to doing “the right thing.”
- Customer with money and willing to put more money into the project.

Regardless of whether they actively marketed the program, all eight participants said they would work on another DER project again.
Contractors noted a need for DER alternatives for customers wanting more efficient homes, but not willing to implement all DER measures nor meeting the criteria for a particular measure (due to cost and the intrusiveness of requirements).

“When our clients are looking to only do one component such as re-roof, it is hard to find a program that matches the need for our client. Especially if the customer is doing a phased approach it is hard to account for how these single components will react with each other.” — Contractor 11

“I have clients that do not wish to build out walls to R30 they would primarily prefer 2x4 walls instead.” — Contractor 15

“We’ve received comments from our clients that the DER pilot program is too extreme and are frequently asked upfront what the payback would be.” — Contractor 9

**Contractor View of Energy Efficiency**

Contractors had a sophisticated understanding of energy efficiency, and were tuned into not only the technologies, but also the implementation process and also how energy performance is measured.

Contractors were surprisingly focused on being able to demonstrate performance. This focus on performance measurement partly arose out of a lack of clarity about what constitutes “efficient” performance and the number of agencies setting benchmarks for energy-efficient performance. Contractors tended to relate federal and state energy-efficiency programs as a way to define energy performance, including:

- ENERGY STAR for HOMES
- Net Zero Energy Homes
- Thousand House Challenge
- National Grid’s DER Pilot Program

Contractors most often mentioned the blower door test and HERS rating as ways to verify air tightness and energy performance. Contractors stated focusing on a building’s envelope was the first step in achieving the greatest energy savings.

Contractors reported implementing a range of energy-efficiency measures from “good performance” to “better than DER.” Two participant contractors stated common practice for them is to aim to achieve 60 to 90 percent reductions, compared to the minimum DER goal. They have referenced HERs ratings as a way to measure the results of their success.

Table 20 presents the contractors’ views and perceptions of how they would define Deep Energy Retrofit in comparison to the current pilot program. While some contractors agreed with how the pilot defines DER, a greater majority felt the measures need to be less stringent. They believe the pilot gets too lost in the additional savings. A contractor stated, “After R25 it gets too expensive.” Contractors expressed the cost and difficulty to implement the measure outweighs the additional savings’ benefit. Only two contactors stated these measures are not stringent enough. They believe the pilot needs to actively address renewables as part of the package.
### Table 20. Contractor View of Measures

<table>
<thead>
<tr>
<th></th>
<th>Non Participant</th>
<th>Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Less Stringent</strong></td>
<td>• Can do more with insulation but not as far as R30</td>
<td>• Rigorous blower door testing</td>
</tr>
<tr>
<td></td>
<td>• After R25 it gets expensive</td>
<td>• Isonene vs. Fiberglass insulation for cavity</td>
</tr>
<tr>
<td></td>
<td>• Must tackle structural issues, moisture and water mitigation not to the same degree</td>
<td>• Outside insulation board before siding</td>
</tr>
<tr>
<td></td>
<td>• Weatherization, air infiltration</td>
<td>• Installing Mini-Splits</td>
</tr>
<tr>
<td></td>
<td>• Envelop, mechanical work</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Blown in cellulose</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 50 HERs Rating</td>
<td></td>
</tr>
<tr>
<td><strong>More Stringent</strong></td>
<td>• 12 inch thick walls</td>
<td>• 60-70% reductions</td>
</tr>
<tr>
<td></td>
<td>• Geo-thermal</td>
<td>• 70%-90% reductions focusing on envelop of building then renewables</td>
</tr>
<tr>
<td></td>
<td>• Solar</td>
<td>• R60 Walls</td>
</tr>
</tbody>
</table>

Contractors were asked what measures they perceived being the most difficult to implement; responses are listed below.

- Prevention of water intrusion.
- Sealing air leaks.
- Bringing in outside air.
- Adding insulation where it connects with floor, stairs, and doors.
- Matching and sealing windows and doors.

**Contractor View of Pilot**

On the whole, contractors were very supportive of the pilot concept, since energy efficiency is a business focus (see Figure 5). Participants were “thrilled” to be a part of this effort. The pilot provided a platform for them to learn about energy efficiency beyond their current expertise.

Currently, PAs offer two design and delivery models. The National Grid pilot follows a prescriptive model, while the other PAs have a performance-based design. Although National Grid has prescriptive requirements, they provide intensive, custom services to assist the customer in meeting those requirements. Delivery also significantly differed. The features of the two approaches are provided in Table 21.
Table 21. Pilot Design and Delivery Models

<table>
<thead>
<tr>
<th>Feature</th>
<th>NATIONAL GRID—Prescriptive Design</th>
<th>Other PAs—Performance Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>Prescriptive Based: requires implementation of components meeting specific specs (R40 walls). Also requires a minimum number of components to be installed, although staging is permitted.</td>
<td>Performance: suggested component specs, but final implementation must meet a HERs rating target. Incentives for approaching 50% reductions.</td>
</tr>
<tr>
<td>Delivery</td>
<td>Multistage reviews.</td>
<td>Inspections, but perceived as less rigorous.</td>
</tr>
<tr>
<td></td>
<td>Team conference.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Multiple inspections.</td>
<td></td>
</tr>
<tr>
<td>Application</td>
<td>Multistage, very detailed component, by component application.</td>
<td>Relatively simple with submission of other documents, such as HERs rating documents and plans.</td>
</tr>
<tr>
<td>Services</td>
<td>Detailed technical review of plans and typically 3 or 4 site visits for test and inspections by BSC.</td>
<td>WMECO – CET technical assistance.</td>
</tr>
<tr>
<td>Customer requirements</td>
<td>Lighting/Appliance Workshop. Open houses, Yard sign.</td>
<td>None.</td>
</tr>
</tbody>
</table>

Generally, contractors valued the technical direction and knowledge in National Grid’s delivery, but strongly preferred a performance-based design.

A performance-based design was seen as providing the flexibility to meet each home’s unique needs and to permit innovation. In addition, HERs ratings provided brand recognition, better crossover with other programs, and the ability to benchmark against other homes. Most contractors agreed the HERs rating was the preferred rating method. Contractor 3 addressed the disadvantages in following National Grid’s prescriptive design:

“*I don’t know if there is enough brand awareness currently to support this pilot program...if they tie it with the HERs rating it would come off as a stronger and more recognizable pilot program.*” —Contractor 3

At the same time, contractors valued the detailed direction and services flowing from the National Grid pilot. Some contractors found it helpful to aim for specific targets, based on standard requirements. Several contractors reported the prescriptive approach reducing the uncertainty and risk in promoting the pilot. Others noted the value of BSC’s technical assistance. The contractors also acknowledged and appreciated the National Grid’s role in defining a DER community, marketing, and generally promoting the pilot.

National Grid’s pilot delivery was acknowledged to do the best job at increasing the contractor’s quality and ultimate savings results. As part of this delivery, detailed technical requirements, BSC’s technical review and the multiple review and inspections were all included. However, while that method helped ensure quality, the application process was very time consuming and added to customers’ incremental costs.10

Table 22 presents views of contractors participating in both program design and delivery models.

10 The basis for National Grid ‘s detailed application process is to be able to more easily evaluate the program.
### Table 22. Comparing and Contrasting Program Delivery

<table>
<thead>
<tr>
<th>Performance</th>
<th>Program Delivery</th>
<th>Admin Support</th>
<th>HRs Spent</th>
</tr>
</thead>
<tbody>
<tr>
<td>WMECO</td>
<td>“This performance based approach motivates the homeowner to do more”-P11</td>
<td>CET-quality issue</td>
<td></td>
</tr>
</tbody>
</table>
| NSSTAR      | “They are more open minded but need more direction on what is acceptable and what isn’t.”-P6  
“Hard to know where you stand compared to National Grid”-P4  
“NSSTAR’s overall goal is a good one. They give good guidelines and allowed for flexibility.”-P13  
Referring to NSSTAR’s program-“Not the best way to get quality work compared to National Grid’s process.” | “Much more reluctant and half heartedly”-P4  
“Grossly over worked need more staff to add to support pilot”- P4 | “Three-month process but two hrs for writing the proposal setting”-P4 |
| NATIONAL GRID | “Their current process hinders creativity and innovation”-P11  
“We understand what National Grid was after but it sure is a convoluted process”- P11  
“It’s too early in the process to include HVAC models, running manual J calc., Chews up not only my time but my subcontractor’s time.”-P6  
“Give living proof on how good we will do on a project.”- P6 | “BSC and PA is extremely helpful throughout the different steps of the program”-P11 | “Three-month process, after a while it becomes routine”-P4  
“40hrs”-P6 |

Contractors knew and understood the pilot’s resource-constrained administrative support, but would prefer a faster process, with readier access to support, for all PAs. Those participating through National Grid’s program commented they spent more on administrative support (10 to 40 hours) compared to other DER pilot programs. With few PA support staff assigned to the pilot, participants felt their questions were not always addressed in a timely fashion. Further, those interacting with a larger project team found it more difficult to make decisions because they had to wait for others. Nevertheless, none of the contractors indicated PA delays significantly impacted overall project timelines. Above all, they were satisfied working with support staff through the pilot.

One contractor noted the current pilot delivery requirements would not be suitable for a foreclosure “flip” because the process was much too slow, and flips only make money in a compressed timeframe.

Other comments of note included:

- Contractors expressed some confusion over the roles of BSC and CET. Participants specifically involved in National Grid’s process stated they did not have a clear indication what role BSC played and what they truly inspected.

- Except for those participating in additional efficiency programs, such as the Thousand House Challenge, contractors felt both models did not include building monitoring, and should make this a priority.
Participants and nonparticipants shared similar recommendations for improving the current DER pilot program:

- Want the pilot to reach a broader sector of the population, not just the wealthy:\footnote{The evaluator refers the reader to Figure 3 that illustrates, based on home value, that not just the wealthy participate.}
  - Offer flexible financial packages.
  - Technical assistance—supporting the contractor to up-sell.
  - Keep the incentive level at current levels.
- Require use of pre- and post-energy modeling, and wish Program Administrator’s would consider incorporating this tool in the pilot.
- Continue to use or apply the HERs Rating as a tool for home performance.
- Participating contractors would like to see a standalone Website dedicated to DER projects, including best energy-efficiency practices and lessons learned.

Contractors were asked for ways costs could be reduced for the pilot program; comments included:

- Nature of the work is expensive.
- Using different material, such as recycled foam board, fiberglass vs. Isonene.
- Implement measures over a longer time period:
  - Prioritizing measures based on receiving the largest energy savings reductions.
  - Rather than do everything at once, break out measures.
- Take the same model as other Mass Save programs, with zero percent financing for insulation, etc.
- Several contractors found the uncertainty of what qualifies added to the cost. They felt a risk in promoting the program because of the ambiguity of how the PA selected projects awarded.

Stakeholder Findings

Stakeholder findings begin by characterizing stakeholders interviewed. Subsequent sections provide stakeholders’ overall assessment of the pilot.

Characterizing the Stakeholders

DER Pilot stakeholders are those parties responsible for the pilot’s design, implementation, and oversight; their roles are summarized in Table 23.
Table 23. Stakeholder Roles

<table>
<thead>
<tr>
<th>Title</th>
<th>Number</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Implementation Manager</td>
<td>3</td>
<td>PA staff member responsible for all residential and low-income program implementation. Consists of about a dozen different programs, pilots and initiatives.</td>
</tr>
<tr>
<td>Program Manager (PM)</td>
<td>2</td>
<td>PA staff person with direct responsibility for the DER pilot implementation. With one exception, all had responsibility for at least one other program.</td>
</tr>
<tr>
<td>Consultant</td>
<td>3</td>
<td>Technical or process consultant contracted to assist program administrators in implementing the pilot program. Two of the consultants also assist with other residential program efforts.</td>
</tr>
<tr>
<td>State agency</td>
<td>2</td>
<td>Responsible for state-level administration of energy-efficiency programs and energy-efficiency publicity and outreach messaging.</td>
</tr>
</tbody>
</table>

Stakeholder Assessment of the DER Pilot

Although all stakeholders expressed enthusiasm for the overall concept of seeking deep savings from existing home projects, most expressed concerns with the pilot’s current direction. Stakeholders fell into three distinct categories concerning the pilot’s future:

- Continue the pilot, making minor adjustments as needed.
- End the pilot now unless significant modifications can be made.
- Permit the PA to opt-out, while allowing others to continue if so desired.

Figure 6 illustrates stakeholders’ attitudes: some of which are not supported by this evaluation and others that are outside the scope of this evaluation:

Figure 6. Spectrum of Stakeholder Attitudes
Stakeholder Assessment of the Program Overall

All of the PA, their program consultants, and the State Agency Program Managers supported the concept that residential efficiency programs should play a role in promoting projects for existing homes, resulting in deeper energy savings than those of simple weatherization programs. However, all but one PA interviewed felt the pilot contained serious flaws, and/or did not serve their customers well.

Stakeholders offered the following overall feedback:

- **Pilot benefits.**
  - **Admirable Program Goals** – Pilot goals were viewed as an appropriate long-term strategy for the Commonwealth to pursue.
  - **Research and Development** – All stakeholders appreciated the technical and programmatic lessons learned through the effort’s R&D aspects.
  - **Knowledge Spillover** – Stakeholders observed contractors and designers took the technical skills learned through the DER pilot and applied them to other projects not meeting all DER requirements.
  - **Energy Savings Spillover** – Most program administrators saw contractor knowledge transferred to non-DER projects, resulting in spillover. In addition, interested homeowners deciding to not proceed with DER often pursued more limited projects, generate savings not recorded by the program.

- **Overall project and administrative costs:**
  - **Message Confusion** – Nearly every stakeholder interviewed felt terming the projects retrofits was inaccurate. They felt customers viewed projects as major renovations of their homes.
  - **Project Costs** – All but one PA believed full DER projects were too costly to be marketable to a wide audience. Some reported their customers expressed shock at DER project costs for their homes.
  - **Potential Customers** – Several stakeholders felt the program inappropriately served only customers who were financially well-off. “Probably less than 5% of my customers could afford a DER project. We can’t justify using funds that all pay into for that small audience.”
  - **Program Resource Issues** – Representatives of some smaller PA programs did not believe they were well-equipped to implement the program. “I handle all residential programs here, I cannot justify spending any more time on DER.”
  - **Program Administration Effort** – Because of the variety of program concerns expressed in this section, some PAs admitted, although they technically offered the program, they did little or nothing to promote or support the effort. “We need something much simpler and less expensive to offer our customers.”
  - **Complexity** – Most felt the program was administratively too complex.
**Technical Hurdles** – Respondents expressed strong confidence in BSC’s technical leadership, and WMECO experienced good results with CET. Yet, fears were expressed that if the program expands, quality may suffer. “It is not that hard to learn to do it right, but it is really easy to mess it up, and if you do, the consequences are huge.”

**Program Enthusiasm** – Many PAs shared the view that the program has one enthusiastic supporter in their group. Although they admired that enthusiasm, they felt it overrode their practical concerns and made for majority concerns difficult to be heard.

**Program Gaps** – PAs felt DER produced a program gap. “If you were to use a number scale, we offer 1 and 2 level programs, such as weatherization and a level 10 program in DER. We have nothing in between. Our programs need to cover a range, or customers walk away.”

**Confidence in Savings Predictions** – PAs have decided to approach project savings predictions in several differing ways. Concerns were raised those savings predictions would not prove accurate and might be suspect at impact evaluation time.

**M&V Potential** – When asked if an M&V protocol would be useful in verifying savings, respondents felt it was needed from a technical point of view, but feared additional costs. “This program is already too costly, if that burden is added it only becomes worse.”

**Pilot Design and Delivery**

Pilot service delivery varied by PAs, providing a basis for comparison.

**Project Cost**

Project cost was the fundamental barrier identified by customers, contractors, and stakeholders. Costs included all elements of a DER project’s comprehensive, innovative nature: incentives, customer implementation costs, PA administration, contractor resources, materials, and installation labor.

“We can’t possibly continue to fund the projects at this level with rate-payer funds.” — Stakeholder

“If people were only paying $72,000 for the entire project and the program focused on 10 other homes that cut their energy by half it would make a greater impact than having one home reduce their energy by 100% ...” — Participant

While cost was always a perceived barrier to energy efficiency, it proved a particularly urgent issue for DER because:

- Projects reportedly did not pass the TRC cost-effectiveness test, required for ratepayer-funded deployment programs. However, cost-effectiveness is not a criterion for a pilot, unless the expenditures in the pilot make the entire sector not cost-effective.

- Stakeholders and participants questioned how appropriate it was to use such high levels of ratepayer funds for a single residence.
While incentives were high, they only covered about one-third of the cost, and even though cost was a major reason customers dropped out of the application process about 1/3 of the drop outs would consider DER in the future.

Installation costs were high as DER, by its nature, is custom work, requiring site-by-site adaption of existing buildings. Most DER projects required most of the following work:

- Demolition of major building components (interior walls, windows, roofing).
- Replacement of systems (HVAC equipment, siding, roofing) before end-of-life.
- Build-out of existing architectural elements (such as eaves).
- Retrofit of ductwork into existing space, which requires opening interior walls.
- Painstaking shell sealing (particularly basements) to thermally isolate the main structure. Often, basements are left unheated, resulting in some diminishment of utilitarian space.
- The current incentives, roughly $45,000 to $52,000, offset about a third to one half of incremental costs associated with a DER project. This implies installation costs of about $120,000 per site.

These same factors drove administrative costs. Contractors acknowledge a steep learning curve in effort to achieve the minimum requirements of the pilot. Each project required custom review to ensure it met complex DER requirements, and that building integrity and longevity were maintained as well. Customers and/or contractors were required to complete lengthy applications to demonstrate the project met requirements. One experienced contractor estimated 40 hours for applications in his budgets. Even though some contractors have predicted the application process will take less time to fill out the second time around, they still consider unique building types, new technologies on the market and client personalities to be a factor in weighing administration costs. One contractor said, “It is very rare you will have several projects that are one of the same.”

Cost data for three projects, made available from National Grid, are summarized in Table 24. National Grid uses a comprehensive application process, including detailed information on both total project costs and portions of costs related to measures. The application includes estimates of energy usage without the DER upgrades, which are included in the table.

### Table 24. Sample Project Analysis

<table>
<thead>
<tr>
<th>Customer #</th>
<th>Home Size (sq ft)</th>
<th>Full Project Cost</th>
<th>Incremental DER Costs</th>
<th>DER Costs Incentive as % of Total</th>
<th>DER Costs ($/sq ft)</th>
<th>Electric Usage (kWh)</th>
<th>Oil Usage (Gallons)</th>
<th>Energy Costs ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>4,092</td>
<td>$650,000</td>
<td>$151,628</td>
<td>23%</td>
<td>$37.05</td>
<td>32,693</td>
<td>688</td>
<td>$6,624</td>
</tr>
<tr>
<td>#2</td>
<td>2,050</td>
<td>$227,791</td>
<td>$77,314</td>
<td>34%</td>
<td>$37.71</td>
<td>22,218</td>
<td>345</td>
<td>$4,194</td>
</tr>
<tr>
<td>#3</td>
<td>3,560</td>
<td>$476,082</td>
<td>$105,228</td>
<td>22%</td>
<td>$29.56</td>
<td>12,570</td>
<td>445</td>
<td>$2,998</td>
</tr>
</tbody>
</table>

Table 25 summarizes various analyses of these three projects, assuming 50% and 75% savings rates for both electric and fuel, and impacts of the life of the measure.
Though not intended to be comprehensive or definitive, this analysis simply illustrates how costly the projects have been and how large the hurdles are for reaching cost-effectiveness.

**Table 25. Estimated Measure Life Costs**

<table>
<thead>
<tr>
<th>Customer</th>
<th>Payback vs. Savings Rate</th>
<th>Avoided Cost Benefit At 50% Savings Rate</th>
<th>BCR At 50% Savings Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50%</td>
<td>75%</td>
<td>25 Year</td>
</tr>
<tr>
<td>Customer #1</td>
<td>46</td>
<td>31</td>
<td>$ 61,874</td>
</tr>
<tr>
<td>Customer #2</td>
<td>37</td>
<td>25</td>
<td>$ 38,146</td>
</tr>
<tr>
<td>Customer #3</td>
<td>70</td>
<td>47</td>
<td>$ 31,430</td>
</tr>
</tbody>
</table>

Table 26 summarizes the range of reported costs and resource requirements for various pilot elements.

**Table 26. Reported Range of Project Resources Required**

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Resource Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participating customer</td>
<td>Total project budget, including renovations: $30k-$700k \ DER portion of total cost: $50k-$150k \ Application hours: 16-100</td>
</tr>
<tr>
<td>Contractor</td>
<td>25-100 hours</td>
</tr>
<tr>
<td>PA implementer</td>
<td>Completing individual customer applications \ FTE in 2010 for 1-4 projects: varies by PA from &lt;1 to 1+ FTE</td>
</tr>
<tr>
<td>PA vendor (BSC or CET):</td>
<td>Estimated 50-100 hours per site for analysis and inspections [to be confirmed]</td>
</tr>
</tbody>
</table>

Mission Definition

PAs, stakeholders, and even participants expressed differences in opinion about the DER’s purpose, its ultimate status, and the pilot’s fundamental structural elements. Stakeholder views particularly diverged regarding the program’s next steps, generally dividing into two categories:

1. Modify DER to better fill a program gap.
2. Find ways to mitigate the costs.

**Fill a Program Gap**

This idea focused on achieving more savings for more participants. Stakeholders argued DER’s mission should include a track for participants committed to deeper savings, but unable to commit the resources to complete DER measures. Figure 7 shows the spectrum of program offerings for existing, single-family homes. At one end of the spectrum are product-oriented programs for single, high-efficiency equipment units (specialty CFLs, appliances, unitary AC, etc.). Offerings increase in complexity, unit costs, comprehensiveness, and cost per delivered kWh. The DER pilot falls at the far end of this spectrum.
“Fill the Gap” stakeholders advocated for a DER track or independent program assisting customers seeking to complete additional projects when re-roofing or re-siding, but needing best-practice solutions less extensive than DER. This option would offer technical solutions and higher incentives than direct-install weatherization home services. Philosophically, these stakeholders believed DER may be valuable as a demonstration effort, but it is not a practical deployment model for everyone.

“Fill the Gap” could include, for example, both “partial deep retrofits” where one building system is addressed at a time, and “deep but not as deep” retrofits of particular systems, that are midway between the standard program offerings and the very deep measures currently included in the DER program.

**Mitigate Costs**

DER program implementers were intent on finding cost-effective ways to achieve 50 percent or better savings per participant. The pilot’s drive to 50 percent savings requires addressing 2x4 construction and mechanicals as its core and defining characteristic.

Stakeholders suggested the following approaches for addressing the cost problem:

- **Change factors in the total-resource test.** It is imperative a program (although not necessarily a pilot) pass the cost-effectiveness test to qualify for ratepayer funding. The test considers total installed costs, not just incentives paid. Even if PAs pay no incentive, they could not provide technical assistance for projects not passing the test. Existing projects do not pass the test, but might with a few changes:
  - **Extended life of measure years.** The current model caps measure life at 25 years. Many DER measures, particularly the shell measures, will provide benefits for the life of the structure.
  - **Capture other benefits.** DER homes can be more comfortable, healthy, and valuable. Quantifying and adding this benefit to calculations would improve the BCR.

- **Reduce incentives.** Assuming projects pass, equity issues remain. Stakeholders have expressed concerns about providing a single homeowner with $40,000 in incentives. Strategies to lowering the incentive costs include:
  - **Only offer technical assistance.** One theory is participants primarily seek technical information and would forgo incentives.
- Offset incentives with shared savings loan products.
- Make DER more attractive to consumers. Provide credible estimates of lifetime savings and property value improvements.

- **Technological solutions.** Identify cheaper, faster, and better ways to implement DER components. For example, one vendor is experimenting with a pre-constructed component approach for roofs.
5. Conclusions and Recommendations

This section presents our conclusions and recommendations, which were developed through completing customer, contractor, and stakeholder interviews, and through the Cadmus Team’s careful consideration. The section is divided into separate Conclusions and Recommendations subsections.

Conclusions
The pilot produced 13 completed projects in 2010. This first phase allowed for much learning, and preliminary conclusions were reached by stakeholders and the Cadmus Team.

Pilot Rollout
The four largest electric PAs and two gas-only PAs successfully rolled out the DER pilot and services. National Grid’s effort included robust outreach and technical assistance, and they completed the most projects and experienced the most customer activity. NSTAR, Cape Light Compact, Columbia Gas, Berkshire Gas, and WEMCO were active in 2010 and largely plan to continue in 2011. Table 27 provides an update of actual participation in 2010 and projects currently underway in 2011.

Table 27. 2010 Completed Projects and Current Active Projects

<table>
<thead>
<tr>
<th>PA</th>
<th>2010 Installs</th>
<th>Q1 2011 Installs</th>
<th>2011 Applications in Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Grid</td>
<td>9</td>
<td>6</td>
<td>42</td>
</tr>
<tr>
<td>NSTAR Electric &amp; Gas</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>WMECO</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Cape Light Compact</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Columbia Gas</td>
<td>0</td>
<td>0</td>
<td>Minimal</td>
</tr>
<tr>
<td>Berkshire Gas</td>
<td>0</td>
<td>Suspended</td>
<td>Suspended</td>
</tr>
</tbody>
</table>

Several overall pilot rollout factors proved key for developing the conclusions presented:

- **Audience.** The pilot demonstrated a population of homeowners that are willing to make significant investments to dramatically reduce the energy consumption and improve the occupant comfort in their homes. It is likely that a steady stream of 10 to 30 customers a year would participate in the DER program as currently conceived, although this estimate is speculative due to the market uncertainties associated with early adopters.

- **Contractor Participation.** Contractors are actively engaged in the program. The pilot clearly demonstrated that contractors are willing participants and are willing to devote time for training and marketing the program. Referring to the qualified list NSTAR and National Grid use, thirty-six contractors met the minimal requirements to be listed as qualified; of those, eight have completed or are currently working on DER projects.

- **Design and Building Science Community.** Building scientists and architects involved in energy-efficient construction have quickly embraced the pilot concept as a way to expand the promotion of energy-efficient housing beyond new construction.
• **Cooperation and Compatibility.** The program intersects well with national and international efforts, such as LEED for Homes, ENERGY STAR for Homes, Net Zero Energy Homes, Thousand House Challenge, Build America, and PassiveHaus.

• **Spillover Benefits.** The program creates significant spillover, as contractors are learning and adapting the techniques and materials to non-DER projects. In addition, homeowners who are not ultimately pursuing DER often perform some energy-efficiency improvements independently or through other programs.

• **Commonwealth Goals.** The pilot aligns with the spirit of Governor Patrick’s statements regarding energy efficiency in buildings: “Buildings that reduce their energy use by 40% are great, but that is simply not enough... my challenge to you is to help us get to zero. That is the least we can do!”

• **Project Completions.** The number of completed projects fell short of the stated pilot goals, partly due to 2010 being the pilot’s launch year. DER projects also are complex, and may take six to 24 months of planning. Promotional activity has been limited; however, the promotion levels appear to be appropriate to the pilot’s current capacity to manage inquiries and process applications.

• **Competing Goals and Regulations.** The pilot demonstrated that the goals stated by the Governor and regulations under which the programs must operate are not necessarily compatible. All stakeholders agree that in order for the program to operate under the current TRC Benefit/Cost structure, significant regulations or program adjustments are required.

**Pilot Structure**

The current pilot structure is resource intensive and unlikely to be scalable in its current design.

• **Too costly.** As currently structured, the pilot incentives are too costly to be rolled-out as a full program, and cannot meet the TRC screening.
  
  o Cost-effectiveness, determined through the Massachusetts screening tool, is a necessary condition for a program, although not necessarily for a pilot. Currently, the DER projects are not cost-effective. A sample of three projects produced a range of BCRs between 0.3 and 0.5.

• **Non-energy benefits.** The benefits currently attributed to the non-low-income residential programs are not sufficient to pass the TRC screening test. An effort is underway to quantify DER non-energy benefits by another study group. While it is likely other non-energy benefits can be attributed to DER projects and an extended life can be assigned some DER measures, it is not apparent that these will prove sufficiently beneficial to make a DER program cost-effective.

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• **Project costs.** It is also not apparent that project costs will be significantly reduced as contractors gain experience because each project is essentially a custom construction project. The path to a sustainable cost model cannot be solved by improving cost-effectiveness alone, without addressing underlying costs:
  
  o If the current benefits were increased by assigning a longer measure life or including other non-energy benefits, projects might prove cost-effective under the PA screening models. However, this approach does not lower installed costs or reduce administrative costs.
  
  o Current levels of incentives create equity concerns, yet a reduction in incentives would impact participation levels.

• **PA Administrative Resources.** Some of the PAs do not have the staff or financial resources to effectively implement the program, while others focused resources on those programs that produce much larger cost-effective savings. PMs reported they are sometimes “dragged” into participating in the pilot, although it is a distraction from their primary mission of meeting yearly savings goals.
  
  o Based on the current BCR calculations and PA incentives, reaching a small audience with large incentives is less attractive than reaching a large audience with modest incentives.
  
  o Program enthusiasm is important, yet mixed. Some PAs wish to end their involvement now, while others prefer to continue and assist with restructuring the program.

**Program Marketing**

One of the purposes of the process evaluation was to assess customer response to the pilot with intent of boosting participation rates.

• **Generally satisfied customers.** Participants completing projects were satisfied with the end-product, particularly noting improved comfort and energy savings. However, they reported that the process proved arduous, cost more than they originally expected, and required compromises.

• **Drop-outs do further work.** A large majority of customers who dropped out of the pilot still opted to re-side, re-roof, insulate, or renovate their homes independently or through another program. The primary reasons stated for nonparticipation were project cost and complexity.

• **Considered a renovation.** Most PAs, contractors, and homeowners viewed these projects as major renovations, not retrofits. DER projects are disruptive due to their complexity and scale, which can affect activity inside and outside the home for many months and in some cases, homes must remain vacant for at least a portion of the construction period. This is also indicative of major renovation projects.

• **Incentive levels.** Valid concern exists that a similar, full program with lower incentives will be impossible to market.
Technical Issues
The individual projects are complex to implement

- **Impact of code changes.** Some concern exists about projects possible being termed as renovations. With the newly adopted IECC 2009, the energy code applies regardless.

- **Program gap.** The program gap between DER and Mass Save is considered to be a serious problem by PAs. They seek partial and/or less aggressive measures to fill the gap.

- **Potential building damage with poor design and implementation.** Building scientists consulting with the program warn that measures involving lesser amounts of insulation may create improperly placed dew-points in assemblies, introducing moisture and mold issues. As the Massachusetts Clean Energy and Climate Plan for 2020 states, “...Less heat is used in a building the drying potential is greatly reduced, so both interior and exterior water management details become critical for the health of occupants and durability of the structure.”

- **Importance of M&V.** M&V is universally believed to be the most accurate way to gauge project performance, but PAs are concerned about investing more of their budgets into the effort.

- **Use of HERS ratings.** To predict performance and select options, most stakeholders are using a modeling and/or HERS rating approach rather than a prescriptive approach. Related to HERS rating a consensus must be achieved as to how “50% reduction” or “50% improvement” should be determined.

Core Recommendations
The full cooperation of stakeholders, contractors, and participants in this process evaluation has allowed us to gather valuable data, develop our own conclusions, report on others’ conclusions, and recommend program changes that address the concerns and needs of various stakeholders.

This section focuses on significant recommendations; those affecting decisions that will need to be addressed concerning deployment of a full DER program. Less structural suggestions are discussed in the Existing Pilot Modifications section.

Restructure and Re-focus the Pilot
The pilot is primarily focused on completing projects under a fairly fixed and static design. Pilot participation is projected to fall short of cost-effective goals and it is difficult to see how scaling the pilot could result in a cost-effective program, raising the issue of whether the goals are appropriate. The Cadmus Team recommends restructuring and refocusing the pilot as a research effort rather than as a PA by PA deployment effort. A restructured and refocused pilot should include:

- **Determine a governing structure.** A research venture is different from a program deployment effort, so the structure should reflect that. One research model to consider consists of a governing board and an executive team. The governing board of interested

---

sponsors provides some level of funding, direction, and setting of research goals. The implementation arm plans and executes the activities required to meet the board goals. This research model could be adapted to the needs and strengths of the PAs and could include other stakeholders as well. PAs could voluntarily participate as sponsors, providing some level of funding and/or direction. Other PAs could more robustly participate in the implementation of particular research activities.

- **Resolve policy conflicts.** The current DER attempts to serve two masters: goals set forth by the Governor’s Climate Plan, and regulations governing PA-run programs. The regulatory mandate of adhering to a TRC model is not fully compatible with working towards the aggressive energy reduction goals established for DER, an issue which is also identified in the Climate Plan. The conflict must be resolved for DER and other aggressive programs to succeed. This issue should be resolved before finalizing a governing structure.

- **Set goals appropriate for a research effort.** The goals of a refocused pilot should include:
  
  - **Establish a theoretical pathway to cost-effectiveness.** Conduct analysis which identifies scenarios where DER is and is not ultimately cost-effective. This exercise would incorporate measure life and non-energy benefits findings from other research areas. It should examine alternate technologies, incremental installed costs and savings, and PA cost delivery scenarios. It is expected that this activity will define the subsequent research agenda, including targeted cost reductions, testing of new technologies, reconfiguring of measure packages, and possibly alternate delivery models.
  
  - **Code compliance.** Some programs across the country have received regulatory permission to claim savings associated with energy-code compliance. The newly adopted IECC applies the energy code to most renovation work. Collaboration with the sponsoring PA code group may allow code-related savings to be applied to deep energy renovations. If regulators will not allow harvesting of code-related savings, PAs should explore extracting code compliance-related expenses from the TRC screening.

**Seek to Fill Program Gaps**

Customers in particular and some stakeholders have identified the need for energy efficiency services that fill the gap between basic PA programs (e.g., Home Energy Assessment) and comprehensive deep retrofits. Although technical difficulties exist, securing ways to allow a continuum of residential energy measures would ease program marketing and prevent many potential customers from being dropped. This offering could be a track in the DER program and part of its research agenda or a different effort all together. Possibilities include:

- **Partial deep retrofits.** Identify a DER track that meets the needs of customers who are prepared for a major project but are not willing or able to commit to all the program requirements for a comprehensive DER project. This could be accomplished by providing incentives for deep retrofits of one building system at a time, and staging future measures as part of an overall plan. Such partial deep retrofits, with much smaller up-front costs,
might attract a much larger number of homeowners, and would greatly reduce the size of an incentive provided to any one customer, greatly reducing the initial investment. The DER program managers are currently moving in this direction. There are technical issues to be addressed to insure that a partial deep retrofit does not compromise building integrity and administrative issues to ensure incentives are appropriate.

- **Deep (but not as deep) retrofits.** There is a need for a middle ground between the level of savings provided by the current relatively low-cost programs and the very high savings achieved at a high cost in the pilot homes. Explore techniques for adding less insulation which do not require other extensive work, such as insulated siding, and assess their impact on savings, cost, and building durability. Seek ways to intersect home maintenance markets, and piggyback deeper measures with other needed maintenance (such as siding, roofing, etc.). Some concern was expressed that this “inoculates” buildings from future projects, but it is equally valid to say that a new siding job without added insulation also inoculates the building, and does so without harvested savings.

### Existing Pilot Modification Suggestions

While the pilot may be refocused, we offer the following specific suggestions for the existing pilot:

**Marketing and Program Outreach**

Both contractors and customers reported that they had difficulty in defining what DER means. Some customers lack knowledge and understanding of how buildings function. Consider developing a consumer-friendly description of the measures. This can be accomplished in several ways:

- Rewrite the marketing material and application narratives from a more customer friendly approach. One customer commented: *“It is written in an inside baseball vocabulary.”*
- Explain what “super-insulation” means and describe its benefits.
- Use more graphics to explain the marketing text.
- Describe what becoming a program candidate requires, including overall estimates of the time and money spent during participation, and describe what happens during each stage of the process.

Contractors and motivated customers are searching for additional DER information. Consider updating and expanding the DER Mass Save Website to include the following elements:

- Various options for materials/mechanical equipment available in today’s market, including the types of equipment used for particular living space types and the pros and cons of the various equipment options.
- Selected local municipal laws impacting project construction decisions.
- Common standards and best practices to apply to projects.
Contractor Training. Contractors expressed a strong interest in expanding their knowledge of DER technical aspects. Many contractors stated that they learned on-the-job, but would have preferred learning through a less difficult method. Two suggested ways to meet this need:

1) Hold regular, sponsor-facilitated information and exchange sessions for contractors to discuss their various DER building approaches.

2) Continue formal training sessions (such as what BSC has done) that focuses on DER topics, such as the following:
   - Market-ready energy-efficiency equipment
   - Bringing outside air into a building
   - How to install HRVs
   - Air and moisture controls (air barriers, vapor retarders)
   - Common mistakes and bad habits, and how to avoid them

Application/Selection Process. Prior to discovering the DER pilot program, several customers had energy audits completed on their homes. These customers were not satisfied with the results and looked to make modification to increase their energy efficiency. Tracking of a customer’s building history, motivation level, and plans for their homes could be used to help market the program. An effective tracking system would identify these potential DER pilot program candidates and help streamline the selection process.

National Grid DER Pilot-Specific Suggestions
The following suggestions are specific to National Grid’s pilot:

- Customers and contractors find the application process daunting and time consuming. Several stated they were not comfortable using Microsoft Excel®. Contractors pushed additional costs onto customers for filling out the application. The application adds to the list of obstacles preventing customers from moving forward. We suggest alleviating customers and contractors from having to determine how to fill out the application on their own. Routinely providing application assistance would help relieve this stress.

- National Grid’s pilot program uses a prescriptive-based model. Currently, they do not require the use of HERs or any other benchmarking tool. The Cadmus Team suggests that National Grid consider using HERs as a supplement or an alternative to the prescriptive approach. HERs is an easy way for contractors and customers to benchmark a building’s expected performance, and is used across multiple federal and state programs to measure the performance of homes. As a nationally recognized brand, it establishes a level of contractor and customer confidence. It also is a logical path for bringing the pilot to scale. However, National Grid has expressed concerns that the HERs ratings do not accurately predict building performance nor does it necessarily drive appropriate measure implementations; all valid concerns. As part of the research effort, National Grid might consider providing a HERs rating for all of its participants as a means of calibrating rating systems. It may also want to consider a HERS option for participants.
- One of National Grid’s DER requirements is to attend a lighting/appliance workshop. Customers, contractors, and designers found the content of this workshop to be extremely informative. Customers took away ideas for the design and purchasing stages. They also found the opportunity to interact, share, and learn from other homeowners and professionals to be very valuable.
  - Customers reported that it was difficult for them to make a day-long commitment to attend the workshop during weekdays. The Cadmus Team suggests restructuring this workshop, offering two separate sessions on weekdays (after work hours) in addition to a daylong session on a Saturday or Sunday.
  - Customers should be encouraged to attend this workshop prior to breaking ground.
  - More workshop time should be spent on Q&A and information-sharing among participants, and less time should be spent on lectures.

Requirements. Our interviews revealed some concerns with health issues associated with construction of tighter houses. The program establishes methodologies for bringing outside air into dwellings, including the use of heat recovery ventilation. We suggest considering a requirement for installation of CO₂ monitors to track indoor air quality.
6. **Areas for Further Research**

Based on the 2010 evaluation’s draft findings, the Cadmus Team identified several areas that would benefit from additional research during the 2011 evaluation. Table 28 provides a brief summary of these tasks.

**Table 28. Potential 2011 DER Evaluation Tasks**

<table>
<thead>
<tr>
<th>Process/Impact</th>
<th>Task</th>
<th>Task Description</th>
<th>Basis for Recommendation</th>
</tr>
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</table>
| Process         | Cost and Market Research | **Areas for Further Research**  
Based on the 2010 evaluation’s draft findings, the Cadmus Team has identified several areas that would benefit from additional research in the 2011 evaluation. Given the current rules, it does not appear a program modeled after this pilot will be able to pass the TRC screening process. Therefore, some effort should be placed on researching methodologies able to pass regulatory hurdles:

- Stay current with advances in building science and materials that may lower costs.
- Research various, less deep scenarios that would be more cost-effective on a TRC basis and more affordable.
- Explore with regulatory consultants the possibility of extending measure lives for envelope measures.
- Attempt to quantify NEBs for TRC inclusion.
- Include real estate market actors on the possibility of performing DER for foreclosed properties.
- Research the possible precedents for technical assistance for deep energy savings projects supporting market transformation but not passing a TRC test. | Preapproved as continuation of 2010 tasks. |
| Process         | 2010 DER "Rollover Tasks" | 2011 dollars already approved to complete 2010 tasks. | Basis for Recommendation                      |

2011 dollars already approved to complete 2010 tasks.
Appendix A: Program Administrator Interview Guide

Massachusetts Residential Retrofit & Low Income Evaluation

Deep Energy Retrofit – National Grid Specific

Program Administrator Interview Guide

<table>
<thead>
<tr>
<th>Name</th>
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<tbody>
<tr>
<td>Program Administrator</td>
<td></td>
</tr>
<tr>
<td>Title</td>
<td></td>
</tr>
<tr>
<td>Interviewer Name/Firm</td>
<td></td>
</tr>
<tr>
<td>Date of Interview</td>
<td></td>
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</tbody>
</table>

**Introduction:**

The purpose of this interview is to understand your perspective of the deep energy retrofit program. We’d like to pursue two lines of inquiry: 1) the current program design and delivery and 2) pilot goals and future pilot direction. We have particular materials we’ve gathered to assist in the discussion about the current program.

In addition to interviewing all program administrators, we will also be speaking with other stakeholders including DOER and Building Science Corp staff.

Is there anyone else at [program administrator] who we should also be sure to talk to?

<table>
<thead>
<tr>
<th>Name</th>
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<tbody>
<tr>
<td>Title</td>
<td></td>
</tr>
<tr>
<td>Phone/Email</td>
<td></td>
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</tbody>
</table>

If at any time during this interview you think of someone else we should speak with as part of our research, please just let me know.

**Project Cycle and Status Notes**

**Reference documents are here:**
INTRODUCTION

Roles and Responsibilities
1. To begin, could you please describe your history and role in this pilot program?
2. [If you have indicated other parties involved] please state their role and responsibility. Probe regarding: marketing, QA/QC
3. Can you describe to me the mission of the pilot?
4. If you could, would you change that mission?

DER PILOT- Current Delivery

<table>
<thead>
<tr>
<th>Need Recognition</th>
<th>Information Search</th>
<th>Eval Alternatives</th>
<th>Purchase Decision</th>
<th>Post Purchase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Idea</td>
<td>Research</td>
<td>Budget / Finance</td>
<td>Bidding</td>
<td>Contracting</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Project Revisions</td>
</tr>
</tbody>
</table>

Identify the project stage when the customer made the first inquiry.
1. First, for the pool of potential DOER customers, what are finding is the primary motivator for them to begin a project? [Probe: renovating a house, energy savings, residing, additions]
2. Do you know how large this pool is?
3. Can you tell me how your program creates awareness in this pool?
4. Can you summarize your outreach efforts and which have been most effective in generating leads (not necessarily completes, but leads).
5. Are there other entry points that might yield additional customers [i.e. new roof]

**Information Stage**
6. What kind of information are the potential pool customers seeking when they are considering DER? [Probe: approximate cost, eligibility requirements – what does that mean to the customer?]
7. Can we look at the information available to customers – and do you feel that the material provides them with that information? [Review website data, brochures, etc. quickly.]
8. How many leads have you had that were not appropriate at all and how would you characterize them? [Example, seeking free windows, wrong territory, etc.]

**Evaluation and Decision Stage**
9. How does the pilot support the customer’s decision to commit to a DER project?
10. At what point in the customer decision process would you expect them to be ready to complete an application? [Probe: still considering?, selected a contractor]
11. What program resources are required to bring a customer to a decision point?
12. How many customers fall away at this point and why?
13. Can we discuss the barriers to participation?
   a. Project complexity and cost both may factor in as barriers – how do you rank them?
   b. Do you have an adequate pool of contractors?
   c. The application process is complex from a contractor perspective – have you heard of a contractor dissuading a customer from participation?
   d. Paybacks are long, even with incentives, in the order of 30 – 50 years. How do customers view the finances? [Probe: huge incentives, believe energy costs will go up more, don’t care, like the comfort …]

**Application Process**
The application process is complex – but the project is complex. We have several general questions regarding the application process.
14. Have there been any cases where the application process itself was the barrier to implementation – did a customer implement the DER package, but did not participate because of the application?
15. What PA resources, internal and PA direct contractors like BSC, has it taken to process an application? Might this be reduced in the future – and where might those efficiencies come from?
Pilot Future

Pilot Metrics
16. We have some documentation that indicates National Grid had a goal of 41 completed projects with 130 statewide in 2010. National Grid is on track for about 9 [confirm] completes.
   a. Does this result surprise you?
   b. What do you see as the chief reasons for this result?

17. Do you know how the metrics were set in the first place?

18. What do you believe are appropriate indicators of success for the pilot? [Prod: such as spillover, contractor awareness, number of completes]

Future program changes
19. Can we discuss future marketing of the pilot? We’ve been asked to ask customers what we should call the pilot – which might indicate further definition of mission is required. If we think about the residential program ‘brands’ –
   a. MassSave – audit and insulation/air-sealing lite
   b. New construction
   c. Major renovation
   d. Deep energy retrofit

   Do they cover all of the bases – and if so, where are the gaps and does this suggest a broadened mission for DER or a broadened mission elsewhere? Or are there significant overlaps?

20. What suggestions do you have for increasing interest and participation?

21. What changes to program delivery do you think should be pursued?

Evaluation
22. Can you please share with us what you believe the market research and evaluation tasks should be for next year? [suggestions: market size of customer pools, impacts, identify other measures or technologies]

23. How do you think savings should be calculated for a project – before and after metering or is modeling required? If metering is preferred – what would you consider an appropriate baseline to be?
Appendix B: Customer Interview Guidelines

Massachusetts Deep Energy Retrofit
Consumer Interviews
October 2010

Name of Interviewee: _____________________________ Date: __________________
Home Owner Address: ____________________________ PA: __________________

[Note to Reviewer] The Interview Guide is a tool to guide process evaluation interviews with homeowners who may or may not have participated in the Massachusetts Deep Energy Retrofit Pilot programs. The guide helps to ensure the interviews include questions concerning the most important issues being investigated in this study. Under special circumstances, there may be a need to follow-up with certain respondents. Therefore, there will be sets of questions that will be more fully explored with some individuals than with others. The depth of the exploration with any particular respondent will be guided by the level of participation the respondent played within the pilot.

INTRODUCTION

Hi, may I please speak with [NAME]? My name is ___ and I’m calling on behalf of [PA]. We are part of the team hired to evaluate the Massachusetts Deep Energy Retrofit Pilot programs and we’re interested in speaking with [ ] the homeowner that[PARTICIPATED/Made an Inquiry] about a house renovation project in [month of inquiry].

[Prompts]
This program provides customer with incentives and technical information for extensive energy savings in the home with superinsulation, very high efficiency windows, advanced heating, mechanical ventilation and water heating equipment and other techniques/ measures.

Your results will be anonymous and will help [PA] to make improvements to the program. Verify who I am with – PA contact.

Our questions will take about approximately [X minutes]. Is this a good time to talk? [?] [IF NOT, SCHEDULE A CALL BACK.]
Project Cycle and Status Notes

A project cycle model will be used to identify the customer stage and the point at which the Pilot intervened in the customer’s conception of their project. The cycle may be revised based on customer response; if for example, they selected a contractor before developing initial project concept.

<table>
<thead>
<tr>
<th>PROJECT STAGE CHECK SHEET</th>
</tr>
</thead>
<tbody>
<tr>
<td>First idea</td>
</tr>
<tr>
<td>Initial Date</td>
</tr>
<tr>
<td>Revisions</td>
</tr>
<tr>
<td>Todays Date</td>
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</table>

<table>
<thead>
<tr>
<th>PROJECT PLANNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project description</td>
</tr>
<tr>
<td>Cycle stage</td>
</tr>
<tr>
<td>Date</td>
</tr>
<tr>
<td>Project scope</td>
</tr>
</tbody>
</table>
### PROJECT SCOPE

<table>
<thead>
<tr>
<th>Impacted Components</th>
<th>Renovation Type</th>
<th>High Efficiency Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>[] Windows</td>
<td>[] Adding sqft</td>
<td>[] Added insulation</td>
</tr>
<tr>
<td>[] Roof</td>
<td>[] Adding Changing function</td>
<td>[] Adding High efficiency windows</td>
</tr>
<tr>
<td>[] Walls</td>
<td>[] Removal of interior walls</td>
<td>[] Adding PV panels</td>
</tr>
<tr>
<td>[] Heating, cooling, or ventilation system</td>
<td>[] Removal of Exterior walls</td>
<td>[] Adding High efficiency boiler, furnace or heat pump</td>
</tr>
</tbody>
</table>

### Establish Project History

I would like to start by asking you a couple of questions about your home and the project you were considering or may have completed [MAY or MAY NOT HAVE RECEIVED] in Massachusetts.

1. I would like to first confirm the home address [about which you made the inquiry/you had work done]. Is it located at [ADDRESS]?
   a. Confirm information that could not be obtained through Google earth pictures or zillow.

   **Identify the project stage when the customer made the first inquiry.** The wording of the question will match the apparent stage of the customer and the notes provided.

2. Our records show that you made an inquiry in [Date] – was that about the first time you had contacted [PA] about the project?

3. At that time – how far along were your plans? [Prompts: contractor selected, budget]

4. At that time, what were you considering to include in the project? [Prompt: components, reno-type]

   **Complete the Program Intervention block.**

5. Why did you contact [PA] the first time – what were you hoping for? [Prompts: incentive $, technical details, contractor list]

6. What do you recall was offered? [application, training, brochure]

7. Was the information/services helpful?
8. Did you change your plans or approach based on that information?
   Probe for how changed. Prompt with did you consider changing windows or wall
   insulation, for example?

9. [if no application submitted] Did you consider submitting an application?

10. How did you know who to call? [Prompt: utility program administrator]

   **Identify the current stage of the project.** The wording of the question will match the
   apparent stage of the customer and the notes provided. **Complete the Current Stage Matrix.**
   Maybe pre-populated with information an application.

11. How has your project progressed since that initial inquiry?[?][PROBE FOR: R&D,
   Planning, Implementing, Reviewing, Completed, No longer doing the project]

12. Has the project scope changed since you originally contacted [PA]?

13. When do you hope to have the project completed?

14. Can you share with me your plans for walls and windows- these are areas of particular
   interest to the program? How many inches of what type of wall insulation was or will be
   added? If possible, confirm that they do or do not meet the Pilot requirements.
   a. Are you planning on replacing windows? -?- percentage and type-double/triple
      panes
   b. Are you improving or increasing your roof or attic insulation levels?
   c. Will there be work on the exterior walls? Can you describe –
   d. Are you replacing your boiler?
   e. Are you adding mechanical ventilation?

   **Identify the motivation for starting the project.** The wording of the question will match the
   apparent stage of the customer and the notes provided.

15. When did you first begin thinking about the project?

16. What work were you considering for work when you first started the project?

17. Why did you consider retrofitting your home?
   [PROB FOR: Energy Efficiency measures, DER program, previous plans]

18. What do you think a home has to have to be extremely energy efficient?
[REFERENCE FOR some EE measures from program]

- Exterior wall super-insulation build-outs
- Attic insulation enhancements
- Foundation wall/slab insulation
- Extensive whole-house air sealing
- High-performance windows and storm windows
- High-performance lighting, including the use of CFL and light-emitting diode ("LED") technologies
- High-efficiency heating and cooling systems
- Advanced thermostatic controls
- High-efficiency appliances and products
- Advanced energy use feedback and monitoring technology
- Mechanical ventilation
- Solar photovoltaic systems
- Solar thermal systems

More detailed:

**Insulation**
- Roof-R60
- Above grade wall-R40
- Below grade wall-R20
- Basement floor- R10
- Air Sealing Target.1 CFM50/sqft of thermal enclosure surface area (6 sides)

**Windows and Doors**
- Ideal R5 (U<0.2) whole unit thermal performance
- Infiltration resistance performance of <= 0.15 CFM/sqft. Of air leakage, per AAMA8 standard infiltration test
- Windows and doors will be either NFRC rated/high performance storm windows

**Mechanical Ventilation**
- Fan energy and heat recovery-balanced, distributed and automatic
- All kitchen stoves/ovens should have an exhaust fan vented to the outside (ASHRAE 62.2)
PARTICIPANT

Applicants that have completed the 1 & 2 parts to the application and has successfully received the incentive

19. Through your experience and involvement in the Deep Energy Retrofit pilot which included the following steps: pre-application, application stage (1 & 2), finalizing project plans and agreements, site visits made by the tech team, attending workshops, etc. What aspects about the program did you like?

20. In your experience through participating in this pilot, has the program changed your thinking as a result? [Probe: EE, DER]. If so, please elaborate. We reviewed a list of components previously, were those different as a result of your participation?

21. At what point did you get the builder involved?

22. Did you fill out the MA DER pilot application yourself? Some parts? Which sections?

23. Did you install additional program-qualifying efficient equipment/insulation/windows due to the program?

24. In absence of the Deep Energy Retrofit Multifamily and Single-family Pilot, would you have installed the same efficient equipment/insulation/windows anyway? Would you have installed it at the same time?

25. What challenges did you face while participating?

26. What are some of the recommendations/changes you would like to give [PA Utility] in order to enhance this pilot?
NONPARTICIPANT

Scenario 1. Customers that never filled out the application

1. Why did you choose not to participate in [PA] Pilot? [PROBE FOR: was not aware of program, barriers to entry (price, qualified contractor, ineligibility, time/commitment, equipment not available), not interested]

2. What information would you like to have at your finger tips while making the decision to retrofit your home?

Scenario 2. Applicant filled out part or all of the first and/or second part of the application but never proceeded any further through the pilot

3. Did you install program qualifying efficient equipment/insulation/windows but did not go through [PA’s] National Grid’s Deep Energy Retrofit Multifamily and Single-family Pilot?


5. Were there things you got from DER that helped you decide on what you eventually ended up doing.

6. Did you fill out the MA DER pilot application yourself?

7. At what point did you get the builder involved?

8. What information would you like to have at your finger tips while making the decision to retrofit your home?

9. What were some of the challenges you face through the process of retrofitting your home?
FINANCIAL QUESTIONS

1. What was or would be the total project budget for your home project?

2. A Deep Energy Retrofit project often includes super-insulate exterior walls – where walls have to be thicker than standard 2x4 construction, make enhancements to attic insulation, apply foundation wall/slab insulation, conduct extensive whole-house air sealing and install, high-performance windows and/or storm windows?

3. Would you consider any or all of these EE measures? What do you think about the cost of these measures – what might be your criteria for how much you are willing to spend?
Appendix C: Contractor Interview Guide

Massachusetts Residential Retrofit & Low Income Evaluation
Deep Energy Retrofit – Contractor Interview Guide

Introduction:

The purpose of this interview is to understand [contractor] view of the construction market, technical and market view of specific measures implemented in Deep Energy Retrofit (DER) Pilot Program, the overall pilot and its offerings.

We will select a diverse mix of 15 contractors who have completed a DER project and those who have had projects stalled out for a particular reason. We have selected these contractors based on their affiliation with the pilot, either through independent inquiries, participation in training, or actual implementation of a project. In addition, we will use the PA’s leads and customer feedback as a reference for selecting these 15 contractors.

Is there anyone else at your company we should speak with?

<table>
<thead>
<tr>
<th>Name</th>
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<tbody>
<tr>
<td>Title</td>
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<tr>
<td>Phone/Email</td>
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</table>

If at any time during this interview you think of someone else we should speak with as part of our research, please just let me know.
REFERENCE GUIDE FOR EE MEASURES

- Exterior wall super-insulation build-outs
- Attic insulation enhancements
- Foundation wall/slab insulation
- Extensive whole-house air sealing
- High-performance windows and storm windows
- High-performance lighting, including the use of CFL and light-emitting diode ("LED") technologies
- High-efficiency heating and cooling systems
- Advanced thermostatic controls
- High-efficiency appliances and products
- Advanced energy use feedback and monitoring technology
- Mechanical ventilation
- Solar photovoltaic systems
- Solar thermal systems

More Detail:

**Insulation**

- Roof-R60
- Above grade wall-R40
- Below grade wall-R20
- Basement floor- R10
- Air Sealing Target .1 CFM50/sqft of thermal enclosure surface area (6 sides)

**Windows and Doors**

- Ideal R5 (U<=0.2) whole unit thermal performance
- Infiltration resistance performance of <= 0.15 CFM/sqft. Of air leakage, per AAMA8 standard infiltration test
- Windows and doors will be either NFRC rated/high performance storm windows

**Mechanical Ventilation**

- Fan energy and heat recovery-balanced, distributed and automatic
- All kitchen stoves/ovens should have an exhaust fan vented to the outside (ASHRAE 62.2)
INTRODUCTION

Roles and Responsibilities
5. To begin, could you please describe your contractor role and the typical jobs you implement in the field?
6. [If you have indicated other parties involved] please state their role and responsibility. Probe regarding: marketing, QA/QC
7. Have you had prior experience being a contractor for clients that have participated in other EE programs?
9. What types of services does your company offer? [Prompt: General Contracting, sustainable design]
10. In your view, what makes a project successful?

Construction Market
11. Can you briefly identify the specific market you serve [Prompt: Low income, middle class, upper class]
12. Given in a percentage, what types of projects do you take on? [Prompt: Kitchen, Bath Renovations, DER projects]
13. What projections do you foresee happening for the construction market? [Prompt: use the SWOT analysis]
14. What are your projected sales for the next three years?
15. What types of technologies do you know of or foresee coming to the mass market? [Prompt: Mechanical Equipment]

DER Pilot Program
Philosophy and Motivation
16. What DER experience do you have?
17. Can you describe to me the mission of the pilot?
18. If you could, would you change that mission?
20. Is your definition different from the way it is perceived in the pilot?
21. What were some of the factors that motivated your involvement with the pilot?
22. Describe the relationship you have with the specific utility in delivering the program to your client.

Application Process
23. Describe your experience going through National Grid’s or other application process [Prompt: Hours spent on application, inspections, project team, working the project team, learning curve]
24. If you have done more than one DER project, has there been less of a learning curve the second time around?
Program Requirements
25. In your opinion, what are the most difficult measures to implement on a project? And why?
26. Through your experience, what is your opinion on these required measures?
   <Refer to list on page 2>
27. how have your clients responded to each of these measures? [Prompt: Insulation, Windows, HVAC equipment]
28. Describe an experience you had working on a project that required shell and mechanical measures. [Prompt: were there several changes in plans that occurred, did it set the project back]
29. Describe what has been a your experience going through the application? [Prompt: Hours spent on application]
30. What would you like to see added or removed from this program? [Prompt: Energy Modeling, 4inch poly iso wrap around the exterior]
31. What are you least likely to know and wish to find out about?
32. How do DER components positively or negatively affect a sale?

Client Participation
33. What types of questions have you received from your clients about the program?
34. How would you characterize the clients that wish to participate in the DER pilot? [Prompt: Who do you see as potential clients for the DER program]
35. What are some of the strategies you use to increase participation in the program?

Contractor Participation
36. What do you see as some of the barriers to participate as a contractor in the program?
37. What would you like to see changed about the pilot?
38. What information and resources would you like to have in order for you to complete a DER project?
39. How would you suggest to improve the pilot program? [Prompt: Design Charettes, training]

Pricing
40. How did you look at ways for taking the cost out vs. putting costs in?
## Appendix D: DER Pilot- Current Delivery

<table>
<thead>
<tr>
<th>Need Recognition</th>
<th>Information Search</th>
<th>Eval Alternatives</th>
<th>Purchase Decision</th>
<th>Post Purchase</th>
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<tbody>
<tr>
<td>Initial Idea</td>
<td>Research</td>
<td>Budget / Finance</td>
<td>Bidding</td>
<td>Contracting</td>
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<td>Project Revisions</td>
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<td></td>
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<td>Satisfaction</td>
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</tbody>
</table>
Appendix E: Case Studies

CASE STUDIES

CONTRACTOR: 9, Non Participant
Service Type: General Contracting: Remodeling, Gut Rehab
Type of Client: Residential, Upper Class
Years in Construction Business: 36
2010 DER Experience: 5 projects (not through program), ENERGY STAR homes/other

Why have you not decided to participate?
“I would like to but I just can’t find many customers that are interested. Being a traditionalist, the DER pilot program requires the homeowner to drastically change the look of some of the house..there is a lot of work that is involved on a project of this magnitude and not to mention, the cost and whether homeowners can recoup from the cost-what is the true payback?”

CONTRACTOR: 6, Participant
Service Type: Greenbuild and General Contracting:
Type of Client: Light Commercial and Residential-Low income-Upper Class
2010 DER Experience through program: 3
*2 not through program

What is your experience going through the pilot program?
After working on a few projects, “I believe the definition of DER is still being defined. We are all learning and sharing info in this growing industry. The best candidates for the pilots are those which contractors are already remodeling the entire house anyway. Most of the clients hear about the program through us. They may have an initial plan but after we mention the pilot they slowly warm up to it.

We have a fantastic relationship between BSC and National Grid. Having now gone through National Grid’s process, some of the paperwork has been reduced but it is still a long under taking. In a competitive bidding process I include the 40hrs of admin time for a project if we are participating in National Grid’s pilot program.

Making sure to air seal the house tight is very important on a DER project. Sometimes we find that moisture and thermal protection are at odds. I look to Canadian and European energy efficiency products but wish to know more about other types of materials that are coming out on the market.

For customers, the barrier to participate is the cost. I would love to see this pilot explore other creative ways to make it both convenient and financially flexible to homeowners. Taking a staged approach by extending the timeframe and breaking out interior and exterior measures may help make it more financially feasible. I think the program should put more emphasis on the builders implementing the work. Cultivating dialogue on DER related topics at Open Houses are insightful but we can address more issues in one room on a regular basis with a structured
format. Separate from the DER pilot program, a DER builder’s support group (25-35 people) has emerged.
Appendix F: Flow Diagrams on PA Pilot Delivery

WMECO’s Application Process

Program Outreach
- Calling all Customers: DER Pilot Program
- Training Presentations: Stakeholder Meetings

Pre-select
- Application
- Application and Agreement Form
- Info Site Visit
- Waiting List
- Selected Participants

CET Reviews applications and HERs rating performed

Project Deployment
- Contractor Implement Plans
- Agree with Improvements for Plans

CET Conducts Mid Construction Inspection

Post-Project
- CET Conducts Final Inspection
### NSTAR Process

<table>
<thead>
<tr>
<th>Phase</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Program Outreach</td>
<td>Web-site</td>
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<tr>
<td>Contractor Proposal</td>
<td>Customer agrees to implement the improved measures</td>
</tr>
<tr>
<td>Project Deployment</td>
<td>NSTAR Verifies performing HERS</td>
</tr>
<tr>
<td>Post-Completion</td>
<td>PR Opportunities</td>
</tr>
</tbody>
</table>

**NSTAR Customer Inquiry**

**Contractor**

**Materials**

**NSTAR PM**
INTERVIEW WITH BRIANA KANE, CLC on 05/09/11

- Referral to pilot either from contractor, call center or customer.\(^{14}\)

- PA has a call with the customer to go over what a DER is and what their proposed project is. **if gas customer for heating referral to Nationalgrid**

- If it does not fit, interaction with DER is over, possible referral to RCS or JMC

- If it does fit, PA conducts site visit and determines if the project qualifies

- If project qualifies, customer fills out application which includes customer information (name, address, phone, email, electric account and gas account)

- After the application has been completed, a HERS rating is administered

- CLC customer works with their chosen contractor

- A periodic site visit may be done by either the PA or a HERS rater

- Upon project completion, a final HERS is conducted

- Payment made\(^{15}\)


\(^{15}\) Due to receiving information at a later date a flow diagram was not drawn