# MASSACHUSETTS DIVISION OF ENERGY RESOURCES
# MASSACHUSETTS DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT

# REBUILD MASSACHUSETTS
# PUBLIC HOUSING ENERGY EFFICIENCY PROJECT
# FINAL REPORT


**Final Report for DOE Grant #** DE-FG41-03R101319
**Ending September 31, 2007**

**Sponsored by the United States Department of Energy**
***Rebuild America Program***

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## PROGRAM RESOURCES AND GOALS

The Rebuild Massachusetts Program (Program) brings together the public and private sector in a partnership to help communities be more environmentally and economically sound through smarter energy management. The Rebuild Massachusetts Public Housing Energy Efficiency Program (PHEEP) is a Rebuild Massachusetts partnership initiative between the Massachusetts Division of Energy Resources (DOER) and the Massachusetts Department of Housing and Community Development (DHCD).

In October, 2003, the Massachusetts Division of Energy Resources (DOER) received a grant of $97,700 in federal funds for the PHEEP program. Additionally, PHEEP benefited from strong support provided by most of the state's major electric and gas utilities providing a cost share of $329,250 - $99,500 of which was direct technical assistance. The project also generated additional investment not in the scope of the grant proposal. This included the Northeast Energy Efficiency Council (NEEC) - $19,917, and the Massachusetts Executive Office of Environmental Affairs (EOEA) - $20,700.

The Rebuilding MA project leader at DOER, Eileen McHugh, and the PHEEP project leader at DHCD, Stan Kruszewski, created grant proposals, coordinated state level partners, managed outreach strategy, and oversaw project progress. As the representative for the statewide Program, DOER was the gateway for DHCD to access the wealth of resources, information, and assistance by which they can integrate and manage a variety of locally defined energy initiatives.

## PROGRAM MANAGEMENT

With the growth and expansion of the Program, including the Public Housing Energy Efficiency Project, the addition of the MA Executive Office of Environmental Affairs (EOEA), and various investments from partners, DOER and DHCD found the need for a more systematic way of tracking all the Program investments.

Both agencies and NEEC representative, Peregrine Energy Group, designed a method (using Excel) to track and report all technical costs that includes not only Program costs but also PHEEP, EOEA, and municipal partner technical costs not included the grant.

## ENERGY INFORMATION SYSTEM

| | Completed Square Feet (sq ft) | Total Annual Cost Savings ($) | Total Annual Energy Savings (MMBTUs) | Total Energy Efficiency Investment ($) |
|---|---|---|---|---|
| **Total** | **17, 500,000** | | | |

### Energy Information System Initiative

Electric, Gas, Oil, and Water bills are the centerpiece of every energy and water savings investment project that Rebuild Massachusetts partners work on. Utility bills help Rebuild's

program partners like DHCD identify high priority energy projects, provide a benchmark of performance for potential savings, and help confirm that targeted energy savings have been achieved. At the same time, however, utility bills are surprisingly difficult and time consuming to collect and analyze. With this in mind the PHEEP initiative supported an online energy information system (EIS) initiative that is designed to collect utility bill information electronically and summarize utility bill and building information.

The Energy Information System currently captures utility and building data several MA state agencies that include MA DCAM, MA EOEA, MA DOER, and MA DHCD. In addition, the EIS captures more detailed information for individual clients that received partial or full funding from these agencies, several schools, and a few cities and downs.

The total completed square footage listed in this final report includes the total square footage for DHCD that the EIS has either partial or full building information or partial or full utility bill information. The level of information available for any individual building depends significantly on the building's location, utility service territories, and associated building and utility bill database supporting information accuracy and availability. Actual cost and MMBTU savings are not included in the summary because the EIS is primarily a support tool for individual projects and does not save energy directly.

Examples of uses for the EIS include:

Energy Performance Contract Data Collection – The Lynn Housing Authority and Watertown Housing Authority have used the EIS to collect and make available online baseline utility data for proposed energy efficiency investment Requests for Responses (RFR).

Energy Performance Contract Monitoring and Verification – EIS utility collection has been designed to all DHCD and DOER specifications to review the same utility bill information that is shared with individual agencies and energy performance contractors. This allows DHCD to monitor and summarize the energy savings performance for future ESCO contracts.

Building Performance Benchmarking – The EIS has been designed to allow detailed building benchmarking. MA DHCD reviewed electricity data for "all-electric 667" developments to identify high cost, high use all-electric apartment buildings with elderly residents.

Rebuild MA rolled out the EIS initiative in several phases with DHCD taking a lead role:

***Phase One:***

MA Department of Housing and Community Development partnered with DOER Rebuild Massachusetts program[1] to collect and manage utility bill information for housing authorities

[1] The EIS is being used today by DHCD, other state agencies, housing authorities, and cities and towns in Massachusetts, thanks to generous support from the Massachusetts Division of Energy Resources, Massachusetts Department of Housing and Community Development, Massachusetts Executive Office of Environmental Affairs, the Cape Light Compact, and four utilities: National Grid, NSTAR Electric and Gas, Western Massachusetts Electric, KeySpan

with a pilot project electronic energy information system. The purpose of the EIS Project was to determine whether a customized, web-based energy information system can eliminate the barriers that prevent DHCD's public housing authorities from gaining access to, and making effective use of, energy information, and thus provide an easy method to enable those agencies to implement energy efficiency projects.

For public agencies, the primary source of energy usage information is their utility bills. Unfortunately, numerous barriers prevent public agencies in Massachusetts from acquiring and effectively using this energy information.

- There is no readily available analytical connection between utility bills, building performance, and occupant energy and water use.
- There is limited access to utility bills by the agency personnel responsible for energy management and building performance.
- Paper utility bills, which end up in file cabinets, are not an effective energy management tool.

Because of these barriers, many public agencies do not have useable energy information and, therefore, numerous energy efficiency opportunities are being lost. Rebuild MA and PHEEP undertook a demonstration project to determine whether these barriers could be addressed through a web-based energy information system.

**Utility Data Collection**

The input of utility data is one of the greatest challenges involved in providing effective energy information services to public agencies in Massachusetts. Given their many other responsibilities, agency staff simply do not have time to enter utility data manually.

Accordingly, utility direct data collection needs to be automated to the greatest extent possible. This applies to both the entry of historic information and the entry of new information over time. Automated data collection itself has challenges. While many Massachusetts utilities and energy suppliers provide electronic data, they use different protocols and data formats, including web pages, Excel spreadsheets, ASCII files, and email. The EIS must be sufficiently robust to accommodate all of these approaches.

**Building Data Collection**

The collection of building data presents another challenge to providing effective energy management information services to public agencies.

In Massachusetts, there is very little building data available online. The demonstration project identified and investigated two online data sources: online city assessor databases and some Geographic Information System (GIS) services. However, we found that this data was not adequate.

Having explored numerous data sources, it is clear that individual customers are consistently the best sources for customer specific building information. The two primary sources of building energy performance PHEEP concentrated on were building floor area (square feet) and number of apartments.

**Lessons Learned by Housing Authority**

Following is a summary of building and utility information "lessons learned" by housing authority.

- **Amesbury Housing Authority** – Building data for the Amesbury Housing Authority (AHA) came from AHA and DHCD. Building data from AHA included Excel spreadsheets with meter account information listed by development and by building, development construction completion summary with numbers of apartments and size of apartments. Additional building data came from oral confirmation of building energy end uses with AHA's business manager. Building data from DHCD included a filtered report from DHCD's CIIS Data Table.

- **Lawrence Housing Authority** – The Lawrence Housing Authority (LHA) had detailed building information for two of their two state-funded developments. LHA had hired a consultant to collect this information and analyze the energy performance of these developments for an energy performance contract savings guarantee contract review. LHA's building information includes energy audit documentation, precise meter location and end use information, documentation of energy and water-related capital investment installations, and the consultant's analysis. One other LHA development has equivalent building information that was collected for an earlier energy performance contract. Building data for the rest of LHA's building portfolio will need to be collected from LHA management. For future potential consideration, LHA staff has installed a comprehensive energy management system in all of their developments. Trending data from this system could be collected to enhance the analysis of LHA's building energy use and mechanical system performance.

- **Boston Housing Authority** – As noted above, the work done for the energy master plan in 2001 greatly accelerated the collection of building and utility data for the five state-funded developments included in the Demonstration Project.

  In anticipation of collecting building information for other housing authorities that do not have an energy master plan, Peregrine and DHCD investigated several alternative building resources, including GIS-related data, City Assessor data, and scanned copies of the original building site plans. The Energy Master Plan data combined with a BHA supplied apartment inventory list provide the most complete building information. The other building information resources were less useful.

***Phase Two***

The priority for Phase two was to continue to use the EIS to collect utility data for energy performance contract procurements as a reimbursable expense in the energy performance

contract. The EIS was upgraded to include fields and calculations necessary for DHCD to develop a standard energy monitoring and verification report to document utility cost and consumption savings.

**Data Collection and Reporting for Housing Authorities to Date**

1. **Building data:** For Massachusetts state funded properties, DHCD has building data for 239 housing authorities encompassing over 7,400 buildings.

2. **Electric utility data:** DHCD is collecting electric utility data for 201 housing authorities, with over 8,000 utility accounts. We collected data from all four of the state's investor-owned electric utilities: National Grid, NSTAR, Western Massachusetts Electric, and Fitchburg Gas and Electric.

3. **Gas utility data:** We are currently collecting gas utility data for eight housing authorities with over 900 utility accounts. We collected data from the state's two largest investor-owned gas utilities: KeySpan and NSTAR Gas.

4. **Reporting on the EIS:** DHCD has collected data on the EIS for the housing authorities listed below. Together, these housing authorities have over 1,000 electric utility accounts and consume 50,000,000 kWh of electricity per year.

| | | |
|---|---|---|
| Brookline | Newton | Salem |
| Chelsea | North Adams | Waltham |
| Haverhill | North Andover | Watertown |
| Lawrence | Northampton | Woburn |
| Lynn | | |

5. **Additional authorities tentatively planned for the EIS.**

| | | |
|---|---|---|
| Amesbury | Fall River | Somerville |
| Attleboro | Ludlow | Springfield |
| Belmont | New Bedford | Taunton |
| Boston | Norton | Worcester |
| Cohasset | Saugus | |

The system as envisioned will 1) prepare reports necessary for establishing performance contract baselines, 2) independently monitor results of energy efficiency improvements, 3) identify high users and spikes for further assessment and troubleshooting, 4) prepare financial reports and budgets, 5) quantify greenhouse gas emissions and savings, and 6) provide reliable utility histories, including various permutations of aggregations, for energy purchase decisions and contracts.

## REBUILD MASSACHUSETTS PUBIC HOUSING ENERGY EFFICIENCY PROJECT RESULTS

### *Funding and Cost Share*

| GRANTEE | TOTAL OBLIGATED | TOTAL PAID | UNPAID BALANCE | REPORTED COSTS | UNCOSTED BALANCE |
|---|---|---|---|---|---|
| Federal Funds | $97,700 | $97,700 | -0- | $97,700 | -0- |
| Cost Share | $329,250 | $329,250 | -0- | $329,250 | -0- |
| Total | $426,950 | $426,950 | -0- | $426,950 | -0- |

### *Outcome*

| HOUSING AUTHORITY | COMPLETED SQUARE FEET (SQ. FT.) | TOTAL ANNUAL COST SAVINGS ($) | TOTAL ANNUAL ENERGY SAVINGS (MMBTUS) | TOTAL INVESTMENT |
|---|---|---|---|---|
| New Bedford Housing Authority | 712,000 | $398,412 | 23,202 | $3,900,417 |
| Somerville Housing Authority | 738,874 | $271,762 | 25,651 | $2,349,351 |
| Springfield Housing Authority | 846,000 | $508,992 | 40,067 | $3,873,634 |
| Watertown Housing Authority | 439,584 | | | $3,916,127 |
| Lynn Housing Authority | 315,000 | | | $1,000,000 |
| Results Total | 3,051,458 | $1,179,166 | 88,920 | $15,039,529 |

## UTILITY PARTNERS

The investor owned utility companies and a municipal aggregator currently active in the existing statewide program provide a major cost share for this grant. This included a cost with a total value of $99,500 for direct technical assistance to the PHEEP initiative. In Massachusetts the utility companies provide both direct energy services and manage the State's demand side management program funds. Assistance to Rebuild during the grant period included both direct energy service support and DSM program support.

Direct Energy Service Support – DHCD's housing authorities are large customers for utility companies. These agencies fulfill important civic roles that utility companies understand and are eager to support. Direct energy service support services utility companies provided included new construction hookup and meter assistance, load building-related new technology financial support, and meter and utility bill technical support.

Demand Side Management Service Support – As managers of the State's Demand-Side Management (DSM) programs in their service territories the Massachusetts investor-owned oversee several million dollars in energy efficiency investment projects each year. Rebuild MA

PHEEP staff worked closely with the energy efficiency program managers at each utility to facilitate and maximize the level of technical support and investment the programs provide Rebuild partners.

Except where stated otherwise, individual utility commitments are part of the following overall Compilation of Energy Efficiency Program Statistics reported to DOER by Program Administrators for the Commercial and Industrial Sector (under which most housing authorities fall).

| **Customer Sector**<br>**BCR-Activity** | **Cost SBC** | **Cost TRC** | **Annual MWh** | **Lifetime MWh** |
|---|---|---|---|---|
| **C&I Lost Opportunity** | $22,988,851 | $26,105,290 | 61,293 | 971,964 |
| **Large C&I Retrofit** | $25,419,516 | $43,575,946 | 132,100 | 1,895,144 |
| **Small C&I Retrofit** | $17,653,405 | $22,025,245 | 38,336 | 500,436 |
| **Grand Total** | $123,483,001 | $163,836,883 | 454,726 | 5,123,738 |

## MILESTONES

Milestones that PHEEP reported on quarterly included:

1. Adapt existing RFR for Performance Contracting - Completed 2004
2. Integrate state and federal public housing performance contract language – Completed 2004
3. Electronic transfer and manual entry support for utility bill analysis – Completed 2004
4. Develop investment strategies for smaller developments – Completed 2004
5. Coordinate energy and water efficiency improvements with regional HUD office Completed 2007
6. Screen and identify high priority investment opportunities – Completed 2007
7. Create action plans for authority properties – Completed 2006

## RESULTS

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1. Adapt existing RFR for Performance Contracting – DHCD updated existing documents to facilitate a streamlined process for housing authorities and to remove any barriers to aggregate projects. This included work to simplify the procurement process from the energy service provider's perspective, while maintaining traditional state oversight on expected and actual costs and savings.

2. Integrate state and federal public housing performance contract language – Many public housing sites in Massachusetts have both state and HUD properties. DHCD and DOER met with HUD staff to discuss aggregated projects. HUD agreed that the Massachusetts bid documents were consistent with HUD requirements. The first combined project was Somerville Housing Authority. Although the project required two different contracts, one state and one federal, the work proceeded on a simultaneous schedule.

3. Electronic transfer and manual entry support for utility bill analysis – Most of the technical support from the PHEEP grant was applied to assist with this task. As

mentioned earlier in the report the investment leveraged parallel funding from other sources for access and use of the Rebuild EIS and direct support collecting and summarizing utility and building information for the energy performance contracts that DHCD worked on during this grant period.

4. Develop investment strategies for smaller developments – DHCD staff investigated opportunities to aggregate small housing authority building portfolios into single energy performance contracts that energy performance contractors would be willing to invest in. The first project was to combine a proposal for the Watertown and Belmont Housing Authorities. The Watertown performance contract was quite far along when this was considered and the Belmont Housing Authority was unable to coordinate with Watertown in time to be included in a combined proposal.

5. Coordinate energy and water efficiency improvements with regional HUD office – PHEEP's project manager at DHCD met several times with US HUD's regional director and designated staff during the course of the grant period. HUD was apprised of DHCD's data collection, performance contract RFP coordination with HUD RFP language requirements, and energy procurement initiatives. HUD was most interested in DHCD's energy procurement efforts.

6. Screen and identify high priority investment opportunities – The focus of this effort was to identify high cost "all-electric 667" developments that could be prescreened for significant capital investments. NEEC was able to collect the utility data for the all-electric developments in the National Grid Electric service territory. The project manager for this task left DHCD prior moving this effort to the next phase of measure selection for selected developments.

7. Create action plans for authority properties – The focus of this work was on the New Bedford, Springfield, Somerville, Watertown, Belmont, and Lynn Housing Authorities. DHCD development action plans for these three housing authorities that led to comprehensive energy performance contracts for the Watertown and Lynn Housing Authorities. The total investment for these performance contracts was over $15,000,000 with an estimated total cost savings of over $1,200,000 per year.

## PROJECT EXAMPLES

### Somerville Housing Authority

Project Cost: $2,349,351 (state)
Total Annual Savings: $315,183
1,919,163 Electric (kWh)
(27,576) Gas (therms)
20,039 Water/sewer (ccf)

Installed measures:

- Low Volume Water Closets
- Showerheads & Aerators
- Common Area Lighting
- Apartment Lighting
- Convert Electric Heat to Gas
- Convert DHW from Elec. To Gas
- Improve Site Irrigation
- Reduce Water Supply Pressure
- Install Cogeneration Systems
- Replace Space Heat Boilers
- Install High Efficiency DHW System
- Add/Replace Space Temp Controls
- Replace Windows
- Weather-strip Apartment Entree Doors, Install Pipe Ins.
- Insulate Crawl Spaces & Under 1st Flrs.
- Consolidate Electric Meters

**Watertown Housing Authority**

Project Cost: $3,916,127
Total Annual Savings: $422,188
883,976 Electric (kWh)
(13,982) Gas (therms)
47,125 Fuel Oil (gallons)
14,026 Water/sewer (ccf)

Installed Measures:

- Replace Toilets
- Replace Showerheads
- Replace Faucet Aerators
- Install Front-Loading Washers
- Convert Electric Dryers to Gas
- Replace Common Area Lighting
- Replace Apartment Lighting
- Weather-strip Apartment Entry Doors
- Replace Windows
- Furnace Replacement - Oil to Gas
- Oil Burner and DHW Heater Replacement - Oil to Gas
- Boiler and DHW Heater Replacement(s) - Oil to Gas
- Boiler and DHW Heater Replacement(s) - Gas to Gas
- Replace Heating System Zone Valves
- Install Limiting Thermostats
- Install Packaged Cogeneration
- Upgrade and Expand Alerton EMS
- Decentralize Space Heat & DHW Systems
- Install Energy Star Refrigerators
- Consolidate Electric Meters
- Air Curtain for Vestibule