CET FINAL REPORT

Leadership in Energy and Environmental Design (LEED) for HOMES - A Demonstration Project

August 2007

The Center for Ecological Technology (CET) is pleased to report on our involvement in the Leadership in Energy & Environmental Design (LEED) for Homes program. EPA's support has allowed us to encourage more widespread use of green building construction and design in western Massachusetts and subsequently work towards our goal of long-term environmental, health and economic benefits for the region. This report will outline how we met the specific objectives and tasks outlined on our original proposal. Please contact us if you have questions about any of these items.

TASK 1: Recruitment and Public Awareness

Deliverable: Commitments from 4-6 homes for LEED Certification

CET was successful in recruiting four homes to serve as our initial pilot test cases. Single-family homes in Conway, Amherst, Buckland and Williamstown have served as the foundation for our LEED for Homes involvement. Since early 2005 when these initial homes were recruited, CET has continued to increase enrollment in the program (see chart 1).

	2005	2006	2007
Builder Enrolled	4	7	18
Units Enrolled	4	7	37

Chart 1: Total Projects enrolled each year

Deliverable: Report to EPA on strategies for marketing and promoting LEED for Homes.

During the initial pilot phase of the project CET did not conduct significant marketing for the LEED program - primarily because clients were able to find us through existing networks. However, we have integrated our LEED for Homes services into information distributed about CET's programs through tabling, presentations, cross-program marketing, CET e-mail lists and literature. Specific LEED promotions have included:

- Tabling with the northeast team of LEED for Homes Providers at the 2006 NESEA Green Building conference (see Attachment A)
- Tabling at the Albany NY County, Energy Efficiency, Renewable Energy & Housing Fair in May 2006 (see Attachment B)
- Participating in the 2006 NESEA Green Building Tour (see Attachment C)

We have created display materials and handouts for these presentation and tabling events. These efforts have helped to heighten awareness about the program in the

community. CET has found that new clients have been brought into the program primarily through three avenues:

- The US Green Building Council's online list of LEED for Homes providers at www.usgbc.org
- Increased incentives for LEED Homes available for small renewable installation from the Massachusetts Technology Collaborative
- Referral from ENERGY STAR for Homes program and other programs managed by CET

Deliverable: LEED Homes included in 2006 Green Buildings Tour and information posted to web site(s). Copies of news articles, numbers of people attending presentations and materials from the 2006 Green Building Tour.

CET in collaboration with the Northeast Sustainable Energy Association (NESEA) helped to promote the fall 2006 "Green Buildings Open House Tour". CET distributed press releases about the tour, helped coordinate publicity in the Berkshires and helped recruit a LEED pilot home to be on the tour. Over 100 people participated in the tour – many visiting the LEED pilot home. The tour was announced in CET's e-mail newsletter and specific information on the LEED pilot home could be found online at NESEA's website (see Attachment C). CET used the tour as an opportunity to raise public awareness about the LEED for Homes pilot, and has, to date, recruited four LEED pilot homes to participate in the 2007 Green Building Open House Tour.

Deliverable: Track types of requests for information

The increasing public awareness about "green building" has also lead to more requests for information from homeowners, builders, architects and others in design fields. Below is a brief summary of the types of requests for information that we receive:

- Homeowners:
  - Technology selection – Homeowners or buyers looking for information on the best type of green/efficient technology for a specific component (e.g. a hot water heater or ventilation system)
  - Priority setting – Homeowners who want to be greener, but are not sure how to determine priorities
  - LEED certification – Homeowners managing the homebuilding process for themselves have called CET about certification
- Builders/Architects/Design Professionals
  - LEED process confusion – Some professionals have called CET to find out how they can certify LEED Homes as LEED Accredited Professionals, not understanding the new LEED-H provider role that has been developed by the USGBC. In previous LEED certification programs there was no local provider who could do on-site verification of credits, and a LEED Accredited Professional (AP) was needed to prepare extensive documentation for the USGBC. Having a LEED AP involved is still helpful, but is not necessary for certification.

- LEED certification – Professionals building/designing spec houses or managing the homebuilding process for clients have called us about certification

TASK 2: Technical Assistance, Training & Certification

Deliverable: Data on LEED certified (or in process) homes; protocols and reports about work with each builder.

Through the pilot project CET has been able to identify potential roadblocks to certification and develop processes that help address these concerns early in the process. We have created a submission form that outlines the steps involved in certification that we have all builders sign before they begin working with CET (see Attachment D) and an internal document outlining staff responsibilities for each of these steps (see Attachment E).

We found that the time needed for the certification process greatly exceeded expectations for the early projects. In part this was due to the untested nature of a pilot program – the rating system itself changed at several points during the pilot. It may also have been due to the fact that several of our early projects were homeowner managed or built projects, where the client's primary goal was getting things done right not quickly. The certification process varies with the length of the building process but can take anywhere from 4 months to several years.

CET tracks data needed for certification on all currently enrolled projects and have created filing and record keeping systems to communicate necessary project documentation with the USGBC. Through this process of tracking our projects we have also been able to track general trends in the type of projects enrolling. Some statistics include:

- 4 of 9 projects with completed preliminary ratings seek to achieve a gold or platinum certification
- 1 out of 18 projects currently enrolled are being built by an affordable housing developer
- 13 of 18 projects currently enrolled are building custom homes

Deliverable: Provide 2-4 green building workshops, press releases, outreach materials, evaluations

Deliverable: Document presentations, meetings and other venues; provide to EPA power point presentations or other materials developed

CET has organized, taught or assisted with five training opportunities related to the LEED for Homes rating system. These trainings have ranged in scope and intent and have been important for educating building professionals.

- Training 1: Ten building professionals attended a full day Green Building training marketed, developed and taught by CET in May 2006. Handouts included resources and case studies for residential construction waste reduction and copies of the presentation. A desire for more reference materials was expressed in the feedback forms. To address this concern we

have been developing a list of websites (see attachment F) and a reference book for use in our office to organize our research into different credits.

- Training 2: Mark Newey, Director of Energy & Green Building Programs at CET, taught a full-day Green Building training to a group of architects in Springfield, MA. The training, organized by Conservation Services Group in Westboro, had over 40 attendees and earned the attendees professional development credits
- Training 3: The Northeast HERS Alliance gave a 90-minute presentation on the LEED for Homes pilot in August 2006 using materials developed by CET.
- Training 4: CET presented on LEED for a forming co-housing development. Five homeowners, three builders and two architects attended.
- Training 5: CET organized a morning training on Forest Stewardship Council (FSC) certified wood for LEED clients and interested parties. Fifteen building professionals and two wood dealers attended

CET's LEED training was one of the first in the northeast. The curriculum that CET developed for the full day training was shared with other LEED for Homes providers in the northeast and has been the foundation for many subsequent trainings in the region (see attachment G). This is a key resource for the early days of the pilot because the USGBC has still not fully developed an official training program or trained its official LEED for Homes faculty.

CET has worked cooperatively with the Northeast Team of LEED-H providers – participating in monthly conference calls, sharing information and having occasional in-person meetings. We expect this foundation of communication in the region will be helpful as the LEED program continues to grow.

Deliverable: Document as feasible LEED for Homes builders that either donate or use materials from the ReStore or other outlets; outreach materials to builders.

We have strived to assist a wide range of green building constituents – from building professionals to homeowners – in our education efforts. Part of our educational efforts have included developing packets of information to give to each new client (see attachment H). This packet has included information about opportunities to use or donate materials to the ReStore, CET's used building and surplus materials supply store. Some of the reused materials used at LEED projects include countertops, doors and vanities.

TASK 3: Evaluation, Sustainability and Sharing Project Results

Deliverable: Prepare final report including materials developed for project

The introduction of the LEED for Homes pilot to CET's programs has been integral to connecting with new building professionals to implement changes at the design stage that will have lasting environmental benefits. We have trained over 75 building professionals and are currently in the process of certifying 37 units of housing. We

have developed a project release form that gives CET authorization to refer or share information with the media and other potential project participants (see attachment I). Over time, this will bring more recognition to LEED homes and homeowners and foster information sharing.

TASK 4: Project Evaluation Measures

By looking at the first four houses CET enrolled in the LEED for homes program we can project significant benefits to the environment when builders incorporate green building practices into their home designs.

- 53-74% less waste than the national average[1] was created at 3 of the 4 early pilot homes
- 6,000 to 13,000 gallons of water saved annually with high efficiency toilets, faucets & showerheads
- Nearly 300 MMBtu's/year of energy will be saved

Evaluation Measure: Pounds of pollution reduced or waste recycled

These pioneers in LEED certification were asked to reduce their on site construction waste by 50%. CET assisted these projects with achieving this goal by providing individual project consulting through a grant from the Massachusetts Department of Environmental Protection (Mass DEP) and by distributing an informational handout on residential construction recycling options that was developed. (see attachment J).

Pilot Waste Facts	lbs of waste to landfill	% reduction	lbs per sq ft of conditioned space	% reduction	estimated lbs of waste diverted	Estimated Tons of waste diverted
Project 1	2420	70%	1.06	74%	6712	3.36
Project 2	2441	69%	1.11	72%	6355	3.18
Project 3	3760	53%	1.7	58%	5087	2.54
Project 4	9860	No reduction	3.62	10%	1035	0.52
National Average for 2,000 sq ft home[1]	**8000**		**4**			

Chart 2: Waste Reduction

Project 4 did not show the same waste savings as the other projects. This may have been due to the material-intensive wall system that was used on this building. They used a double framed 2x4 wall with two layers of sheathing and Larson trusses for the roof that were built on site. This unique home design coupled with renewable energy generation made this the most energy efficient of the initial LEED pilot homes (see chart 3). Another issue for this project is that they were not successful in finding a waste hauler who would recycle their waste, and relied on the contractor to haul waste in his personal vehicle. It was largely put on this one individual to sort out recyclables, and another more systematic approach may have been more successful.

[1] National Association of Home Builders Research Center, 2001, www.nahbrc.org

Evaluation Measure: BTU's of energy saved

All of CET's LEED clients have also gone through the ENERGY STAR for Homes program and received a HERS Index. According to energystar.gov, the HERS index is:

> The HERS Index is a scoring system established by the Residential Energy Services Network (RESNET) in which a home built to the specifications of the HERS Reference Home (based on the 2006 International Energy Conservation Code) scores a HERS Index of 100, while a net zero energy home scores a HERS Index of 0. The lower a home's HERS Index, the more energy efficient it is in comparison to the HERS Reference Home.

In addition to the HERS Index we have compared fuel savings for each of our pilot projects to the HERS reference home. See the chart below for a summary of savings and attachments K through R for full reports from each home.

Fuel Savings compared to the HERS reference home (2006 IECC)	Project 1 Stegeman	Project 2 Erslev	Project 3 Sharp	Project 4 Moomaw	Totals
electricity (kwh)	2010	2131	3061	29097	*36299*
oil (gallons)	114	n/a	n/a	n/a	*114*
propane (gallons)	n/a	352	n/a	n/a	*352*
natural gas (therms)	n/a	n/a	574	n/a	*574*
biomass (MMBtu)	76	49	n/a	n/a	*125*
total fuel savings (mmbtu/yr)*	77.6	67.7	46	59.3	*250.6*
HERS Index	57	44	63	14	

Chart 3: Energy Savings

Evaluation Measure: Gallons of water saved

In the current LEED pilot one point is awarded for installing high efficiency lavatory faucets, toilets and/or showerheads and two points for very high efficiency lavatory faucets, toilets and/or showerheads. Most of our clients met the point goals for high efficiency fixtures, but did not reach the very high efficient goals. The requirement was that all fixtures meet the requirement – so even though one of our clients used a composting toilet that uses no water at all, they did not receive the points for having very highly efficient fixtures.

To calculate the amount of water saved with these measures – CET looked at statistics on indoor water use by EPA Water Sense[2] and Flex Your Power[3] – two programs that promote water efficiency. Using statistics from these programs we estimate installing high efficiency toilets can save 1,752-2,920 gallons of water per year, installing high efficiency showerheads can save from 3,650-7,300 gallons of water per year and

[2] EPA "Water Sense" August 2007. http://www.epa.gov/WaterSense/pubs/indoor.htm
[3] Annual usage Estimates from "Flex Your Power", August 2007.
http://www.fypower.org/res/tools/products_results.html?id=100160

installing high efficiency faucets can save 1,460 to 5,110 gallons of water per year (see attachment S).

Our water saving figures compare the high effiency fixtures required to get LEED points with modern fixtures available in the marketplace. We chose to make this comparison because it would be more accurate than comparing the high efficiency fixtures to older fixtures that are not likely to be found in new home construction. Even more significant water savings could be concluded if the high efficiency fixtures were compared to national estimates for water use in the home. For example a comparison to water use figures from EPA water sense could increase the water savings from installing a high efficiency faucet from 1,460 gallons per year to 9,780 gallons per year (see attachment S).

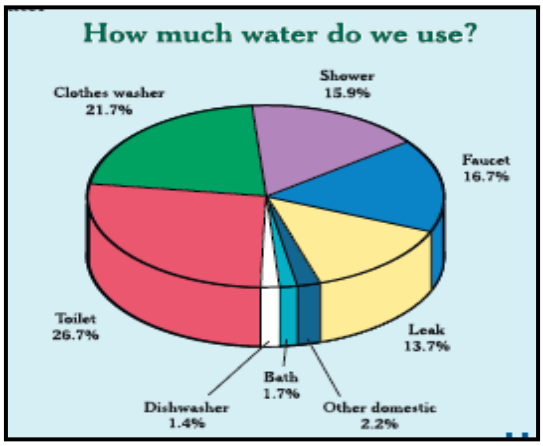

Chart 4: EPA Water Sense Graph of Indoor water Use

The projected water savings from our first four pilot projects is over 28,000 gallons per year (see chart 5).

Pilot Project Results	toilets	showers	faucets	*total per house*
Project 1	1,752	3,650	1,460	*6,862*
Project 2	1,752	3,650	1,460	*6,862*
Project 3	2,920	3,650	1,460	*8,030*
Project 4	1,752	3,650	1,460	*6,862*
Total of gallons saved annually	*8,176*	*14,600*	*5,840*	**28616**

Chart 5: Estimated annual water savings from first four LEED projects