

A Market Transformation Approach TO RENEWABLE ENERGY IN GREEN BUILDINGS

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In March 2003, the Massachusetts Technology Collaborative presented a vision of the future:

“Massachusetts will have the most environmentally advanced infrastructure with energy efficient green schools and buildings the norm in communities throughout the state. Families live in affordable green housing that saves them money on energy bills while leading to a cleaner environment.”

In order to achieve a sustainable green development market transformation, several simultaneous approaches have been undertaken. The Massachusetts challenge has been to nurture conditions in the marketplace that increase the supply and demand for energy from clean sources and promote the development of a renewable energy industry in the Commonwealth.



The Renewable Energy Trust (Trust) is an operating arm of the Massachusetts Technology Collaborative (MTC). The Trust is just one of the Commonwealth's tools for promoting and sustaining renewable energy. In addition, the state has adopted one of the most aggressive Renewable Portfolio Standards in the nation. Executive Order Number 438 has provided direction on sustainable building to state agencies. And the state's utilities have some of the best ratepayer-funded energy-efficiency programs in the United States.

The Trust's Green Buildings and Infrastructure Program is designed as a market transformation tool to change construction practices within Massachusetts by:

1. Tapping Consumer Markets – through active engagement with building owners, operators, financial

community, school building committees and health organizations on the synergy between energy efficiency, high performance design and renewable technologies working together

2. Fostering Communities of Practice – through aggressive funding of feasibility and design studies that stretch the envelope beyond standard design practices

3. Promoting Public Learning – through far-reaching, stakeholder-focused information sharing and lessons learned and school curricula development, and

4. Developing Public Policies – through funding incentives such as the Massachusetts School Building Assistance Program and codes and land use regulatory policies that encourage sustainable development (e.g., tax credits, zoning) or remove barriers to sustainability



NESEA's Building Energy '04 conference included a public debate on wind power. Panelists, L to R: Jim Gordan of Cape Wind Associates, Seth Kaplan of Conservation Law Foundation, and Susan Nickerson of the Alliance to Protect Nantucket Sound.



The Woods Hole Research Center's new Gilman Ordway Campus in Falmouth incorporates numerous energy efficiency and green building features that will provide valuable data on the performance of highly energy-efficient buildings served entirely by renewable energy.

The Mission of the Green Building and Infrastructure Program

The Massachusetts Green Buildings Program has its foundation in the synergy between three essential building component elements:

1. Energy efficiency
2. Green buildings design, construction, and renovation, and
3. Inclusion of renewable energy technologies

The Trust established a simple mission statement for the Green Buildings and Infrastructure Program: "With an overwhelming body of evidence produced through a series of demonstration projects, the Green Buildings and Infrastructure Program will prove the benefits of distributed renewable energy generation working in concert with energy efficiency measures and/or green design." The board then authorized a \$49 million seven-year budget.

The Green Buildings and Infrastructure Program has provided incentives to a variety of buildings types (schools, affordable housing, municipal buildings and corporate offices). The lessons of these projects are varied and useful to re-inventing the support programs – learning constantly from the experiences of awardees. Under one initiative that supports the design and construction of model green schools, initial indicators of success are

showing an average of 30%+ reduction in energy usage.

The Definition of a Green Building

There's no single definition of what a "green" or "sustainable" building comprises and different individuals have very different definitions of them. For green building supporters, "green" means minimal consumption (e.g. energy efficiency); minimum atmospheric emissions (e.g. greenhouse gasses, global changes); minimum discharges during construc-

tion and operations (e.g. construction wastes); and maximum quality of indoor environment (e.g. air quality, thermal regime, illumination, acoustics).

For detractors, "green" means expensive. MTC's experience indicates that if done poorly or late in the design process, "green" will be more expensive. Similarly, if done overboard there will be a premium for green design and construction. But when done sensibly and directed towards defined end-state goals, green will be less costly on a life-cycle basis. This means

that one must evaluate the first capital costs against the operation/maintenance costs to get a true picture of the costs of any construction feature.

Importance of Integrated Design

The Green Buildings and Infrastructure Program maintains that basic energy-efficient green building concepts should not increase first costs of construction although non-typical systems such as on-site power generation using photovoltaics, rainwater collection, green roofs, or on-

2004 Green Buildings Open House LOCAL ORGANIZERS

The Green Buildings Open House would not be possible without the volunteer efforts of local organizers. NESEA would like to give special thanks to the following individuals for their generous assistance. For more information, please call Anissa Sanborn at NESEA: (413) 774-6051, ext. 30, or visit www.nesea.org.

This annual event is part of American Solar Energy Society's *National Solar Tour*.

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site waste-water treatment will add costs. But even leaving aside such extra features, first costs will definitely increase if a design is not well integrated. Therefore good integration is critical. Design should not be a relay race of passing the baton from the designer to the engineer and down the line. It should be an up-front integrated process that is facilitated by whole-systems thinking to capture tremendous synergies and thus financial, environmental and, ultimately, community-based benefits.

“ . . . the Green Buildings and Infrastructure Program will prove the benefits of distributed renewable energy generation working in concert with energy efficiency measures and/or green design.”

This has not been a common approach for the many designers who treat building systems in a more linear fashion. Traditionally, the architect completes the vision – then turns the building over to the other disciplines. An integrated design process requires a more iterative process. It also requires earlier expenditure of funds – quite simply because more of a designer’s time is required earlier in the process. The adoption of new ideas (and even established approaches) into common usage is still developing. The

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number of architectural and engineering firms with comprehensive capabilities and strong track records in green design is growing, but remains relatively small.

A design process is deficient when it leads to:

- Perverse incentives that reward expenditure rather than saving
- Formulaic building not optimized to local climate and conditions
- Pervasive overdesign and overcapacity
- Little reliable measurement
- “Value engineering” which is neither of value nor engineering

Standard practices rarely produce excellent performance. Tight schedules and budgets dominate project decisions, creating disincentives to trying new approaches. Often, sustainable features are included in a design at the beginning, only to fall victim to the process along the way and fail to make it into the final structure.

There are several design processes that are not common in most building projects but are essential to cost-effective integrated green design. They include:

- **Energy modeling** – allows the owners to determine the financial implications of various construction energy-related components (some will have short pay back periods while others will have longer)
- **Life-cycle costing** – a big step towards creating a green building is to conduct a rigorous life-cycle analysis of the building before it is constructed. Decisions can then be made in the context of what the building will cost during the amortization period – not solely on the cost of initial construction. Most design teams do not include these services, so it is a new field for many. The real-estate industry remains first-cost driven and rarely factors operating costs into construction decisions, so design teams must provide life-cycle costs to change this dynamic.
- **Daylight modeling** – a developing field that allows designers to maximize the advantages of natural daylight



Peter Senge from MIT and the Society for Organizational Learning speaks with Barbara Batshalom of the Green Roundtable following Peter's plenary speech at the Building Energy '04 conference.

while minimizing the deleterious effects of too much direct sun

- **Indoor environmental** – quality plans to ensure that visitors and staff have the best indoor spaces possible – adding to productivity and visitor experience (this is particularly important during a construction process that keeps a building operating during renovation)
- **Commissioning** – verification by a third party that the owners' requirements are achieved

Signs of a Transformed Market

MTC's Green Buildings and Infrastructure Program is funding a large number of demonstration design and construction projects to encourage design teams to use some of the tools of an integrated design process and to help create sample green buildings that others can see, learn from, and emulate. We have already funded 16 schools and 30 other buildings, as well as a larger number of feasibility studies. MTC staff believes that our grant awardees are positively affecting and changing the market.

In order to accomplish market transformation, MTC is providing incentives to public- and private-sector building

owners who require integrated design services, which provides a learning environment for designers and contractors who are building cleaner, healthier and more energy-efficient buildings.

To a certain extent, contractor training occurs “on the job” as owners and design teams ask selected contractors to do something new. However, it is clear that this may lead to increased costs as contractors include a risk premium in their bids. It can also lead to serious problems such as construction delays, call-backs and potential threats to future occupants. MTC has supported a number of efforts to help contractors up the learning curve by sponsoring the development of training programs, workshops, and conferences. One of the more fruitful of these efforts has been a successful partnership with Local 103 of the International Brotherhood of Electrical Workers which has led to the implementation of comprehensive PV installation training programs and a training video (freely available on DVD) for union electricians and a soon-to-be-developed training video for wind turbine installations.

A number of successful partnerships have been created through the Green Buildings and Infrastructure Program

which will lead to fundamental changes in the way buildings are designed, funded, constructed or renovated in Massachusetts. Existing partnerships with the Massachusetts Department of Education, Massachusetts Division of Capital Asset Management, Massachusetts Executive Office of Environmental Affairs, the City of Boston, and Museum of Science are focused on elements of market transformation, barrier removal and incentive development. Other partnerships and collaborative efforts have been developed or convened to analyze and promote distributed generation and the monetization of renewable energy credits.

MTC hosts and sponsors numerous opportunities for professional development and continuing education. In addition, MTC staff and grantees often serve as presenters helping to educate others

about trends in green building and renewable energy. These opportunities have reached thousands of design and construction professionals from Massachusetts and other states. Feedback from attendees proves the value of these activities, as was the case when MTC served as title sponsor of NESEA's 2004 Building Energy Conference. Not only is important information imparted in formal sessions, but informal networking contacts among the growing cluster of Massachusetts-based professionals is enabling a vibrant exchange of ideas and improving work products.

Demonstrating the viability and efficacy of renewable technologies working hand in hand with energy efficiency in a "high performance" design setting is considered essential to leveraging future market change. The primary, long term benefit of activities completed under the Green Buildings Program will be assis-

ting market transformation through the development of well-researched case studies that explore the full range of successes and failures experienced in the program. MTC views its case study process as the key component to providing education, decision support and lead generation in a number of markets. The case study process has been redefined, refined and expanded to promote market development for green building technologies. Specific attention is being given to approaches that provide customized and context-specific messages and delivery channels.

Massachusetts is fortunate to have the balance of state legislation, committed and responsible programs and people, and a ratepayer-supported renewable energy and energy efficiency program that combine to provide an environment for success.

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