

## **Project: Building Energy**

**Project Leader: Ben Weil**

### **Project Overview**

The Building Energy Extension Program conveys current energy efficiency, renewable energy, and building science information to stakeholders including those in the building trades, design professionals, state government agencies, and building owners and occupants through workshops, web publication, and consulting. Applied research in building energy systems is conducted to respond to perceived stakeholder need. The intent is to establish long-term and recurring energy savings statewide through information transfer to stakeholders and through consultations and integrated extension research projects. Stakeholders contact the program directly by phone, email and in person with specific requests for information. Municipal governments and their energy and special building committees have asked Dr. Weil to consult directly with them as well as to sit as a non-voting committee member. State agencies, such as DCR and DOER, bring specific policy relevant questions, and have helped fund and provide data for active research. Portions of the plan that are educational in focus will use an energy savings potential-weighted evaluation of contact hours to account for the fact that one consultation at the right phase in a building's planning or lifecycle can have a much higher impact than 100 contacts that are educational but do not impact directly any building decision. Research and extension of UMass-originated research is among the highest values of the program and should be evaluated in terms of published work as well as extension workshops, web presence, and invited presentations.

### **Activity Summary – 2016**

- Extension of Greening the Gateway Cities Project (1)
- City of Holyoke Renewable Energy Development Plan (1)
- UMass Clean Energy Extension (1)
- Presentations for the Community Works Pre-Apprenticeship program (2)
- Research on tree impact on energy usage for DCR (1)
- Consulting and facilitation for Utility energy efficiency programs (3)
- Remote Sensing calibration and microclimate verification (1)
- Published research on hygrothermal issues (1)
- Member - Board of Directors of the Western Mass Green Consortium (1)
- Organized, presented or hosted presentations for the Western Mass Green Consortium Green Night Education Series (7)
- Member - Building Committee for Pioneer Valley Habitat for Humanity (1)
- Consulting for major energy savings in state institution buildings (2)
- Provided extensive analysis and recommendations in a detailed consulting report to the City of Greenfield (1)

- Grant development - Assessing the effectiveness and efficiency of incentive policies for commercial scale solar photovoltaic in Massachusetts and the Northeast (2)
- Needs assessments for municipalities: towns of Ware, Southampton, Greenfield and Amherst (4)
- Individual consultations and site visits (12)

***Total Educational contacts***

	Youth	Adult
Contacts		
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Direct Contacts		1247
Indirect Contacts (Print, Web, etc...)		8737

**Narrative summary and Impact**

Municipal Consulting: The major project in this area was a comprehensive green building redevelopment plan for the City of Holyoke. The Sustainable Redevelopment and Green Building Retrofit Guide for the City of Holyoke is a major undertaking. It involved developing a novel approach with GIS to calculate roof areas, heights, and angles without the use of LIDAR which is required for conventional methods. These calculations were necessary to estimate photovoltaic (PV) output potential. I worked with Christine Crago (UMass, Resource Economics) to develop an incentive and contract design to maximize PV installations in areas prioritized by the City redevelopment plan. I worked with Peggi Clouston (UMass, Env. Cons.) to present the city with options to use connected concrete cap on existing mill building floor systems to bring them up to modern standards of stiffness and silence. By building three detailed building energy models for existing former factory buildings, I developed a set of options for redeveloping the building stock of the innovation district so that economic and cultural activity can increase without increasing the city's dependence on fossil energy. This largely has to do with innovative designs including passive stack effect ventilation with heat recovery, heat exchange with the flowing water in the canal systems, low delta-T radiant heating and cooling systems, re-use of masonry exterior walls as Trombe walls for passive solar heating, super insulation to reduce heating and cooling demand, and thermally active building systems to shift demand off peak times to allow the utility to provide base load energy from existing hydroelectric facilities.

In addition, I worked with Clean Energy Extension (I am a co-PI, funded by DOER) to pilot a Clean Energy Corps which provided consulting and energy analysis to towns preparing their applications for Green Community designation or those seeking to meet their 20% energy use reduction.

Most extension or research projects are multi-year endeavors and require investments that may not bear fruit within one annual cycle. This year, in particular, represented a period of laying groundwork for projects that will realize significant outputs in the future. This includes setting up experiments that require several months to multiple years of data collection to find meaningful results, planning a statewide conference, and organizing a new program to train students and provide services to municipalities, state agencies, and businesses.

Trees: Massachusetts DCR funded a program for planting street trees in urban areas based largely on research I had done using a natural experiment in Worcester indicating that neighborhood trees were providing a large energy saving benefit. The Greening the Gateway Cities program started with three cities (Holyoke, Chelsea, and Fall River) but has since expanded. DCR has worked with me to organize the planting as a randomized controlled experiment. Foresters not only educate and persuade city residents to accept and care for new street trees, but also place temperature, humidity, and windspeed data logging sensors in canopy-cover stratified, random grid locations, coterminous with Landsat pixels. This is a major investment of time and labor, that will create a long-term data record as the trees grow. Additionally, the foresters survey the survival and growth of the planted trees. One output that is currently in development is a collaboration with John Rogan (Geography, Clark Univ.) to use the near-surface recorded temperatures and the Landsat remotely sensed temperatures to develop an interpolation algorithm for temperatures occurring between Landsat passes. We have one year's worth of data from Chelsea, and are waiting for data from the other cities. Confidence in interpolated temperatures will allow us to assign temperatures to all locations (not just the ones with data loggers). This will enable a more statistically robust approach to estimating energy impacts given the constraints imposed by the cooperating utilities. And of course, one can expect more significant differences as the trees grow.

Conference: As in previous years, I have organized a statewide conference targeting municipal decision makers. This year's conference attracted about 92 people: 40 municipal, 15 general public, 10 students, 10 speakers, 10 sponsors, 7 CEE staff or associated faculty. In particular, this year I made sure to include presentations by non-energy focused Extension Faculty from UMass, including Christine Hatch and Rick Harper.

Materials Testing: One of the primary components of modern air barriers in buildings is pressure sensitive acrylic (PSA) tapes. Little is known about their performance under "real world" conditions. To evaluate the materials and application techniques, I am cooperating with the private sector building science organization, Building Green, to set up long-term exposure testing of PSA tapes. This involves not only coordination with manufacturers, but development of a new testing protocol, and implementation over a period of 6 months. I have been involved much activity on this project especially in the last months of the current AFR cycle, but the resulting outputs will take longer to realize.

UMass Clean Energy Corps: Over the past few years I have continued to struggle to find the best way to provide valuable extension services in building energy to communities. After facilitated workshop with municipal energy leaders, it was clear that the most valued service was specific help with buildings and energy planning. This is something that I had been doing, but was limited by my own capacity. To expand this service, I needed to recruit and train people capable of doing a large portion of the work under my supervision. I conceived of the Clean Energy Corps as a service-learning course that would create a growing cadre of student energy experts capable of the sophisticated analysis and diagnostics required. This summer I trained the first two interns in this project and met with success in serving several towns. There was a steep learning curve involved in developing the training, gaining access and capability in using the MassEnergyInsights database. I expect the Clean Energy Corps to grow every semester going forward so that energy analysis and guidance can be provided statewide.

## **Collaborating Organizations**

- **Department of Geography – Clark University**
- **UMASS Clean Energy Extension**
- **BuildingGreen Inc.**
- **The Commonwealth Corporation**
- **Massachusetts Department of Energy Resources**
- **Massachusetts Department of Conservation & Recreation**
- **City of Holyoke, Massachusetts**
- **Massachusetts Clean Energy Center**
- **Guardian Energy Management Solutions**