

UMASS CLEAN ENERGY EXTENSION

Quarterly Progress Report to MA Department of Energy Resources

Period ending December 31, 2015

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This Progress Report provides a summary of work accomplished by the UMass Clean Energy Extension (Extension) through the period October 1, 2015 to December 31, 2015. This report reflects the first period for which the Director of the Extension has been in place (since October 13th) to support and extend the efforts of the principal investigators.

During this reporting period, the Clean Energy Extension has made substantial progress in developing the administration structure and operations of the Extension, and has begun a hiring process to bring on a core staff with capacity for strategic market outreach and support. This report provides a summary of progress in the administrative development of the extension, initial outreach opportunities, and research activities.

1. Extension Administration and Management

Clean Energy Extension Website

A [website](#) for the Extension was developed with IT staff of the Center for Agriculture, Food and the Environment (CAFE). The website conforms with the CAFE format and search capabilities common to all the UMass extension programs. Once final changes are made, the on-going management of the website will be transferred to the Clean Energy Extension staff. The website was made available to the public in mid-December, though any changes based on a final review by DOER will be quickly accommodated.

Staffing Plan and Activity

A staffing plan to provide strategic expertise for the Extension was proposed by the Director and reviewed by the PI and CAFE administration, along with review by DOER. The initial core staff positions will include 1) Research Fellow for energy efficiency and renewable thermal (currently hired through the Center for Energy Efficiency and Renewable Energy) 2) Research Fellow for Distributed Generation and Energy Storage (new position), and 3) an Energy Market Analyst and Outreach Coordinator (new position). The two new positions have been processed through the University HR process. The Research Fellow position was posted on December 10th and review of applications will begin on January 15th; though applications will continued to be received until a sufficient pool of candidates have been identified. A significant outreach and advertisement plan has been executed for this position to attract strong candidates. The Coordinator position is in the final stages of review by HR, and is expected to be posted by mid-January.

New Office Space

The Clean Energy Extension moved into its new office space in Morrill Science Center I over the week of November 23. The office suite contains an entrance office area to accommodate the two new staff positions, two internal offices for the Director and for a DOER dedicated office, and a conference room.

DOER Meeting and ISA Amendment

Clean Energy Extension Director visited DOER for a series of meetings with senior management on November 30th. The meeting provided an opportunity to review the initial development of the Extension, the staffing plan, and identify areas of collaboration with each of the divisions. Amendments to the DOER-UMass ISA were discussed to facilitate opportunities for additional funds to be added to the ISA budget to accommodate new project opportunities beyond the normal functions of the Extension, and to formalize an agreement to accommodate DOER office space within the Clean Energy Extension. Drafting of the amendments is on-going in January.

Branding/Logo for Clean Energy Extension

In coordination with CAFE, and in consideration of their desire to maintain branding consistencies across extension programs and limitations with regard to the use of the University name and trademarks, a logo for the Clean Energy Extension was finalized. The logo is provided below, along with the UMass Amherst logo which will be used as helpful in conjunction with the Extension logo.



2. Extension Outreach Activities

The Extension has not made public outreach a priority during this reporting period while the administration development and staffing of the program is underway. The Extension will pivot heavily to these activities once a core staff is in place to coordinate and serve the planned outreach efforts. Nonetheless, the Extension has provided opportunistic outreach for inquires and opportunities that have come forward. These activities are summarized below.

Public Presentations

At the invitation of meeting organizers, the Extension staff made two public presentations with outreach context as follows.

| Event | Date and Location | Extension Presenter | Presentation Title | Audience | Estimated Attendance |
|---|--|----------------------------|--|---|-----------------------------|
| Co-op Power Meeting, Solar For All! - Build Your Own Community Shared Solar | Center for Cultural Evolution, Colrain, MA; October 24, 2015 | Dwayne Breger | Solar Ownership Options for Home and Community Shared Solar Projects: How do you choose? | Coop Power members and others interested in community shared solar projects | 35 |

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|---|-------------------------------------|---------------|---|--|----|
| Science Roundtable, Five College Learning in Retirement | Northampton, MA; November 19, 2015. | Dwayne Breger | Renewable Energy in Massachusetts | Retired professional members of the 5-College community | 25 |
| Community Works: pre-apprenticeship program | Holyoke, MA; December 21-22, 2015 | Benjamin Weil | Day 1:Sustainability and the Building Trades Day2: Making Energy Efficient Buildings | Low-income and minority pre-apprenticeship trainees entering the building trades | 20 |

Businesses, Organizations, and Municipalities

The Extension staff held substantive direct interactions with the following businesses, organizations and municipalities.

| Entity and Attendees | Date and Format | Extension Staff | Purpose and Outcomes |
|--|---|--------------------------------------|--|
| Co-op Power, Community Shared Solar Leadership Team (Lynn Benander, Isaac Baker, River Strong, Ben Underwood) | November 24, 2015; Meeting in Amherst, MA. | Dwayne Breger | Role and progress of Co-op Power to develop community shared solar projects with innovative business/ownership plans. Discussed role of Extension and opportunities to collaborate. |
| MA Forest Alliance (Charlie Thompson, Acting Director) U.S. Forest Service (Rob Clark, Forest Management Group Leader) | December 3, 2015; Meeting at UMass, Extension Conference Room. | Dwayne Breger (with Rob Rizzo, DOER) | Discussed changing leadership of MA Forest Alliance and common interests in Mohawk Trail Regional Partnership. Discussed opportunities to work collaboratively on Mohawk Trail biomass economic development. |
| City of Holyoke, Office of Planning and Development (Marcos Marrero, Director of Planning and Economic Development and Jim Lavelle, Holyoke Gas & Electric) | December 8, 2015; Meeting at Holyoke City Hall | Benjamin Weil and Christine Crago | Presented best practices guidance document and GIS analysis of PV potential in Holyoke as per RED fund contract with the city. Crago and Weil helped design a solicitation approach and incentive structure. |
| CTI Energy Services, Inc. (Craig Meadows, CEO and Tom Timmins, COO) | December 14, 2015; Meeting at company offices in Amherst, MA and lunch. | Dwayne Breger | Introduction to Amherst-based energy service company with approx. 20 years of experience, mainly federal contracts. Discussed opportunities for renewable/EE markets in MA and role of Extension. |
| Greening the Gateway Cities (Mathew Cahill, DCR, and John Rogan, Clark University) | December 15, 2015; meeting at Clark University | Benjamin Weil | Developed coordinated data collection and management plan, including instructing Mat Cahill on launching and uploading microclimate sensor data loggers. Discussed project to re-visit Worcester study that helped launch the Greening the Gateway cities Tree Planting Pilot. |
| Clean Energy States Alliance – Energy Storage Technology Advancement Partnership (Todd Olinsky-Paul, Project Director) | December 17-18, 2015; email and phone call | Dwayne Breger | Discussed Research Fellow position and recruitment. Discussed role of Extension in working with CESA and Sandia in providing energy storage technical assistance to MA cities and towns. |

UMass/State Program Support

UMass Center for Urban Sustainability: The Extension Director has provided technical review and feedback on opportunities for net-zero energy design for the emerging design of the UMass Center for Urban Sustainability in Waltham, MA. The redevelopment of this underutilized UMass agriculture extension facility is supported through a \$3 million in a state bond bill, which remains to be appropriated. An email memo was provided to UMass Center for Agriculture, Food and the Environment with comments on the current architectural design and ample opportunities for electric and thermal renewable energy generation to meet the needs of the center. The memo provided energy data and analysis that should be considered as the design development is finalized, and the priority and programs of the state and DOER for zero net energy buildings. The CNS Dean was briefed on the memo prior to his meeting with the EEA Secretary on the project funding.

Interagency Team – Energy in Food Processing Sector: The Clean Energy Extension was invited by to join an interagency group including DOER, MassDEP, OTA, U.S. EPA Boston, and UMass Lowell Center for Sustainable Production. This group has had some acclaimed success in addressing energy savings and renewable generation for the water/wastewater treatment sector, and has reconvened to consider other sectors in MA to potentially serve. The group had identified the food processing sector. The Extension Director and Research Fellow Lauren Mattison participated in the team meeting on December 21, 2015, from which emerged team member tasks and a scheduled follow-up meeting in January to further consider the merits and strategies for approaching the food processing sector. The Extension has reached out to the Energy Efficiency Division at DOER and staff at MDAR which recently published a MA Food System Plan.

3. Extension Research Activities

During this reporting period, the Clean Energy Extension has supported the following research activities.

Support to EEA/DOER on Energy Sections of the U.S. Housing and Urban Development (HUD) Proposal

In coordination with EEA and DOER, the Extension Director provided lead review and final drafting of the clean energy sections in the state proposal to HUD under the National Disaster Resilience Competition. The energy activities primarily focused on the Mohawk Trail biomass economic development for the eligible towns in that region, and on serving low income populations in the eligible city of Springfield and elsewhere. The Extension Director gained University approvals for the proposed UMass activities and budgets. HUD is expected to inform applications of rewards in January 2016. If successful, the Clean Energy Extension may be in a position to hire additional staff to dedicate to the Mohawk Trail biomass development and Springfield activities.

Support to DOER Leading-by-Example Inquiry on State Role in Pollinator Habitat

The Extension Director has worked with DOER LBE in response to inquiry as to the role the state might play to support pollinator habitat using underutilized state lands, and as to the resources of the University to support the research and implementation of such an effort. The Extension Director has discussed the opportunity with entomology researchers in biology and environmental conservation, and the Environmental Conservation department chair. Follow-up discussions are planned with DOER.

DOER Case Studies: Green Communities and Renewable Thermal

Lauren Mattison is continuing to work with DOER to create two-page case studies on each of the seven municipalities that has achieved a 20% municipal energy reduction in the Green Communities program: Arlington, Belchertown, Cambridge, Natick, Palmer, Springfield and Sutton. The case studies for Natick, Palmer and Sutton are completed. The text of the Cambridge and Arlington case studies was approved by DOER and sent to the communities for their review in October and December, respectively. Development of the case studies for Belchertown and Springfield is nearing completion.

4. Clean Energy Extension – Faculty Seed Grant

The Clean Energy Extension is currently supporting three seed grant projects which were awarded in 2015. A summary of the progress of each of these projects during this reporting period is provided below.

Additionally, the Clean Energy Extension faculty is preparing to solicit proposals for a second round of the Seed Grants early in the spring semester. To do so, Extension faculty has begun to reach out over the reporting period to colleagues and departments to stimulate ideas. Departments that have been engaged include Mechanical and Industrial Engineering, Economics/Political Economy Research Institute, Environmental Conservation, UMass Lowell Center for Sustainable Production, UMass Boston McCormack Graduate School of Policy and Global Studies.

Progress on the on-going Seed Grants is provided below. A summary of the scope and goals of each project are available on the Clean Energy Extension [website](#). Starting next reporting period, faculty will be asked to provide short progress reports on these seed grants every other quarter to better coincide with the academic semesters.

Seed Grant Project 1: *Improved Efficiency through Environmental Control*, PI Simi Hoque, Environmental Conservation

Progress report: In the fall term, we hired an undergraduate student to work with us on analyzing the data from the summer and previous (spring 2015) academic semester. We trained the student on data collection protocols. The student helped to organize the data into a manageable format. Following this, we defined a series of statistical tests to apply to the data, which we began analyzing. These preliminary results were reviewed by the research team. Our plan is to write a paper on these results in the following months.

Seed Grant Project 2: *Solar Policy Effectiveness*, PI Prof. Christine Crago, Resource Economics

Progress report: Data collection is complete, and we have assembled a database of county level commercial-scale solar PV installations for 13 states in the Northeast and the District of Columbia for the years 2005-2013. The database also includes different solar incentives policies, demographic information, indicators of pro-environmental preferences and geographic characteristics for the counties in the sample. Statistical analysis is in progress, and we have obtained preliminary results about key policy drivers of commercial solar installations. Abstracts of the research will be submitted January 2016 for possible presentation of research findings at academic conferences to be held summer 2016.

Seed Grant Project 3: *Green, Energy Efficient Data Centers*, PI Prof. David Irwin, Electrical & Computer Engineering

Progress report: Progress report: Over the fall, we continued collecting and analyzing data from our instrumentation of the MGHPCCC (a green data center in Holyoke, Massachusetts). We refined and published our initial findings with citation below. The work includes an initial modeling component where we leveraged machine learning/regression techniques to learn a model that correlates energy usage data with the setting of the in-row chiller (IRC) knobs (which are part of the cooling system). The model enables better forecasting of cooling system energy usage, and better control. The abstract from the article is below, which summarizes all of our findings to date.

P. Pegus II, B. Varghese, T. Guo, D. Irwin, P. Shenoy, A. Mahanti, J. Culbert, J. Goodhue, and C. Hill. Analyzing the Efficiency of a Green University Data Center. In Proceedings of the Seventh ACM/SPEC International Conference on Performance Engineering (ICPE), Industry Track, Delft, the Netherlands, March, 2016.

<https://icpe2016.spec.org/>

DOI: <http://dx.doi.org/10.1145/2851553.2851557>

Pre-print: <http://www.ecs.umass.edu/~irwin/mghpcc.pdf>

Abstract: Data centers are an indispensable part of today's IT infrastructure. To keep pace with modern computing needs, data centers continue to grow in scale and consume increasing amounts of power. While prior work on data centers has led to significant improvements in their energy-efficiency, detailed measurements from these facilities' operations are not widely available, as data center design is often considered part of a company's competitive advantage. However, such detailed measurements are critical to the research community in motivating and evaluating new energy-efficiency optimizations. In this paper, we present a detailed analysis of a state-of-the-art 15MW green multi-tenant data center that incorporates many of the technological advances used in commercial data centers. We analyze the data center's computing load and its impact on power, water, and carbon usage using standard effectiveness metrics, including PUE, WUE, and CUE. Our results reveal the benefits of optimizations, such as free cooling, and provide insights into how the various effectiveness metrics change with the seasons and increasing capacity usage. More broadly, our PUE, WUE, and CUE analysis validate the green design of this LEED Platinum data center.