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**Project: Optimizing Food Storage systems for Quality, Safety and Energy Efficiency**

**Project Leader: Ben Weil**

## Project Overview

Many Americans experience food insecurity and depend on food banks, which must attempt to minimize food spoilage and expenses. Energy costs are a major expense for food banks, so reductions in energy use are critical to increasing the availability of food for the most vulnerable. Meanwhile, local small-farms, particularly in New England, are a potential growth area for local economies and the ability to store produce, particularly in winter is critical to expanding their market share and economic viability. Effective, energy efficient food storage and handling procedures and facilities will enable season extension and increase farm incomes. Food banks are among the major customers for local producers, so energy efficiency and cost reduction for the entire local food system and have synergistic benefits for both types of enterprise.

The objectives of this project are to identify and implement systemic energy savings strategies on a multi-enterprise level while increasing food safety and reducing food spoilage. Since refrigeration is among the largest contributors to energy consumption in the regional food system, the design and implementation of economizer-based evaporative refrigeration is a key goal. Findings will be distilled into best practice guides, interactive web tools, food temperature monitoring protocols and evaporative refrigeration engineering designs and controls, and disseminated through a variety of educational workshops and publications.

## Activity Summary – 2015

- Provided process engineering and operations consulting to the Food Bank of Western Mass. based on two years of observation and analysis (1)
- Print dissemination of schematics and guidance for controllers for exhaust fans and humidification - Evaporative enhanced cooling for fruit and vegetable crops: Design and Control Guide both in print and electronic form for greatest distribution (2)
- Board member for educational community organization (1)
- Consulting and facilitation for Utility energy efficiency programs (1)
- Consulting toward Zero Energy Buildings (1)
- grant development (1)
- Hygrothermal Modeling and Monitoring (1)

***Total Educational contacts***

| | Youth Contacts | Adult Contacts |
|---|---|---|
| In Person | | 40 |
| Indirect Contacts (Print, Web, etc…) | | |

**Narrative summary and Impact**

Food Systems

Two building types consume more energy per unit floor area than any other commercial building type: food service and food sales. The food system is responsible for about 15% of total primary energy consumption in the US, with food processing, storage, and sales accounting for almost half of that. Building Energy Extension addresses these building types by focusing on low energy refrigeration and heat recovery systems for conventional refrigeration technologies. Additionally, I continue to contribute to farm-based food systems research, extension, and teaching.

Low Energy Refrigeration

Prior work on evaporative enhanced economizer refrigeration focused on winter storage of root and brassica crops where high humidity and near freezing temperatures are ideal. By grouping crops by harvest season and storage conditions, we have been working with local farmers and the UMass Student farm to expand the use of evap-econ refrigeration to provide shorter-term food storage at optimal conditions for roughly 15% of the energy cost of conventional systems. Recently a modified version of this technology was employed at the North Quabbin Harvest Food Coop. It is a critical energy saving measure that will enable them to achieve net- zero energy consumption. By demonstrating the rapid payback and the simplicity of installation, this case study will help promote evap-econ refrigeration to the food sales industry more broadly.

Heat recovery from Refrigeration

This category of research and extension exemplifies the interconnection of the four program emphases. Most food stores have to provide simultaneous heating for human comfort and refrigeration for food preservation even during the summer. By capturing the heat rejected from refrigeration, we can provide "free" heating for food stores. Similarly, food processing and dairy operations have high demand for hot water and refrigeration and freezing. In three projects, Food Coop, Spartan Solar, and FCCDC Food Processing Center, I helped design and implement innovative ways to capture waste heat while making the refrigeration systems more efficient. These interventions are leading to economic development in Greenfield, a patentable innovation, and a case study of a zero energy food store.

**Collaborating Organizations**

- **Massachusetts DOER**
- **Holyoke Gas & Electric**
- **John Rogan/Clark University**
- **North Quabbin Harvest Co-op**
- **Habitat for Humanity**