

Efficiency Maine, Demonstration and Test Systems

The need:

Efficiency Maine Trust is a quasi-public agency which is tasked with the reduction in energy usage in the State of Maine. Funding comes from a charge to customers on their electric bill and from revenue from the regional greenhouse gas initiative (RGGI) money. Because the changes have not been applied to heating oil, the traditional focus of the program has been on electricity usage in the state. However, data from the US Department of Energy shows that electricity usage is unusually low in Maine already. This is due to relatively high cost of electricity and the structure of the state economy. In contrast Maine spends an inordinate amount of money on heating, primarily in the form of home heating oil, which has high cost and high impact in the form of carbon emissions. However, with the exception of the RGGI money, the focus of the programs of Efficiency Maine remains primarily on electricity for regulatory and policy reasons.

The cost of some of the Efficiency Maine programs and resulting savings to customers and resulting reduction in greenhouse gas emissions has recently been questioned. Challenges related to energy usage and cost remains the most important single issue facing the first world countries for the next generation. In Maine energy is a particular challenge for many residents and businesses. The idea of increasing costs of energy in Maine without a clear benefit in carbon emissions or even long term cost reduction is clearly a problem. This project will be used to help evaluate \$10's of millions of dollars of future expenditures on energy conservation in Maine.

The key project design objective:

The goal of these projects is to understand the role of technology and the associated cost effectiveness of five major programs of Efficiency Maine which represent more than \$10 million dollars of expenditures of money from the residents of Maine. This evaluation will be performed and a physical demonstration system will be built for each of the systems which can be transported around Maine to show the capabilities of the UMaine students for the evaluation of the programs and to assist residents in making proper decisions for their homes. Most importantly the data and demonstrations will be used to communicate with lawmakers and the Efficiency Maine Trust board to communicate the strengths and weaknesses of each of the programs. The key design objectives include:

- Clearly communicated heat transfer and thermodynamics concepts in a way that can be understood by a non-technical audience. This must include not only the issues at hand for the Efficiency Maine programs but also peripheral issues such as occupancy and management of other factors which have a large impact on the overall energy usage.
- A demonstration of the principles where the system can be passively observed to demonstrate the principles in a concrete fashion which meet all possible safety and health requirements.
- A physical structure which is transportable and compact which is capable of being moved around the state. This system must meet the absolute highest esthetic standards demonstrating both excellent design and professional fabrication
- Hands on demonstration of the concept where possible.

It cannot be overemphasized; these systems must look professional when complete.

Systems which will be evaluated for this project will include:

- Hybrid or heat pump based water heaters
- Air to air heat pumps for residential usage
- High efficiency electric motors for industrial applications
- LED, incandescent and compact florescent bulbs for indoor and outdoor use in Maine
- Energy storage
- The role of air-to-air heat pumps in water heating.

Who is the final customer for this device;

The projects are supported by a coalition of public and private entities who want to communicate these concepts to the public.

Who will be supervising and evaluating the outcome of the project:

The primary oversight of these projects will come from scientists and engineers employed by Bangor Hydro, Central Maine Power and Bangor Gas. In addition James Labreque and Professor Richard Hill will provide regular reviews of progress and input on the design concepts.

UMaine Mechanical Engineering technical contact point:

Professor Peterson will provide primary oversight on the goals and objectives of the project. Additional technical support will come from other faculty in the areas of thermodynamics and heat transfer.

Core Mechanical Engineering classes required as background:

- Thermodynamics
- Fluid mechanics
- Design I and II (for system structure)

Resources available:

Fabrication and assembly areas are available. Basic software is available for analysis

End of year deliverables:

A complete design for the test system including thermodynamic and/or heat transfer analysis of the system. The test system will require a solid model and complete drawings with tolerances for the fabrication of the test system. Complete material selection must be performed along with costing and manufacturing analysis for the test/demonstration system. The test system will be designed for use in public education events and the associated material and the test system will be used in two public events, one on the UMaine campus and one in a high visibility public off campus event.