

Highlights of Recent Projects of the Urban Consortium Energy Task Force

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Introduction

Large cities play an instrumental role in improving the overall energy efficiency of the United States. Key characteristics of these cities include: (1) ownership and operation of large buildings and facilities, as well as diverse vehicle fleets and mass transit systems; (2) planning and designing major water, wastewater and solid waste facilities; (3) regulation of development of residential, commercial and industrial development; (4) an interest in improving the quality of air, water and land; (5) provision of services to all residents and businesses; and (6) the ability to apply proven solutions to local problems. These characteristics provide both the self-interest and basis for urban governments to serve as valuable "test beds" for the development of programs, solutions and markets for energy-efficiency technologies and management practices.

Research Approach

The proposals funded by the UCETF are intended to produce results which will directly improve local government services and/or the revenue base of participating cities. To illustrate the range of urban energy applications investigated and implemented by the UCETF, six examples depicting a sample of energy end-use programs are presented below. Detailed information on these projects, including methodology and quantified results, are presented in final reports published by Public Technology, Inc. for the Urban Consortium Energy Task Force. Public Technology Inc. is the research, development and commercialization arm of the National League of Cities and ICMA, and a non-profit association of local governments dedicated to improving the use of technology and management systems.

1. Commercial/Residential - "Energy Savings from Operation and Maintenance Training for Apartment Boiler Systems", Portland, Oregon.

The Portland Energy Office provided operations and maintenance (O&M) training to the operators of boiler heating systems for ten low - income apartment complexes

in the Fall of 1990. This study tracked energy usage before and after O&M training to determine if savings occurred. Training was provided on both weatherized and non-weatherized apartments to determine if weatherization impacted the amount of O&M savings obtained. The O&M training averaged about four hours per building. The training content was modified at each site to match the needs of the boiler operators. A component of the training was a boiler tune-up by a service technician.

Nine of the ten apartment complexes in the study used less energy per heating degree day after the O&M assistance. Average savings were 10%. Four apartments chosen randomly as control buildings had negative savings. These buildings utilized slightly more energy during the same post - O&M time frame. Weatherized and unweatherized apartments showed similar savings after the O&M assistance.

Results from this study indicate that there is energy savings potential from improved boiler maintenance. Delivery of the O&M assistance cost about \$850 per boiler unit in an apartment building. The results suggest the need for a larger study to confirm the extent of savings. The program design and purpose from this study are transferable to other jurisdictions who want to establish an O&M program.

2. Residential - "Impact of Heat Island on Cooling and Environment", Phoenix, Arizona.

The replacement of vegetation with buildings and pavement is reported to be responsible for an increase in the current average summer temperature in Phoenix. It is nearly 10 degrees warmer than 40 years ago. This urban "heat island" is associated with increases in cooling demand and water consumption. The Phoenix project was designed to test the relationship of landscaping with water and energy consumption. Four similar houses using different landscape designs were evaluated on the basis of energy and water consumption. Additionally, the purpose of the project was to develop procedures; data collected will be used to develop a computerized Landscape

Evaluation and Design System that will be available to builders and landscapers to develop most cost effective landscapes.

The study, performed in conjunction with the University of Arizona, indicates the effect of different landscapes on exterior temperature and cooling load of buildings. Micro climate measurements of houses landscaped with rock and turf revealed that air temperature around the house was 1.8 degrees C warmer at midday and up to 04 degree C at night. The house with tree landscape was cooler by 1.4 degree C than the house with rock treatment. Total measured cooling load in kwh was lowest for turf than for rock landscaping. According to preliminary analysis, energy cost was reduced by \$17 per year for the house studied with turf landscaping. The cooling of the ambient temperature surrounding the house represents a savings of 5.4 percent of total cooling load for turf treatment.

3. Industrial/Public - "Hydraulic Waste Energy Recovery", Detroit, Michigan.

One of a municipality's largest expenditures is the electrical cost required to pump drinking water to its consumers. In the City of Detroit, this cost approaches \$15 million annually. The project employs turbine generators to capture hydraulic energy of water flowing in the transmission system and convert it to electricity. The electricity produced will in turn be used to power water distribution pumps offsetting electricity costs. Very few hydraulic turbines have been installed in water transmission systems. A review of the Detroit water distribution system uncovered several locations where a turbine generator installation may be feasible and economically desirable.

The annual electric bill of the facility which was evaluated for the turbine generator installation is \$1.5 million. It is expected that the electricity produced by the turbine generators could reduce the energy use by \$440,000 per year. At this reduction in energy use, the investment would pay for itself in approximately 3.3 years.

4. Transportation - "Trolley Conversion: Ethanol Injection", Las Vegas, Nevada.

The City of Las Vegas owns and operates a diesel powered trolley system. In cooperation with the University of Nevada at Las Vegas Engineering Department and Midwest Power Concepts, this project consists of retrofitting two diesel powered trolleys with equipment that injects hydrous ethanol into the engine's intake manifold. The objective of these tests was to compare the visible emissions and fuel economy for vehicles with and without ethanol injection. The test included operating the vehicle

around a closed course. The visible emissions for the vehicle were measured using an opacity meter attached to the end of the exhaust pipe. By introducing ethanol, the particulate, nitrogen oxide, and hydro carbon emissions have been reduced.

Preliminary data indicates that the level of visible emissions was reduced by 45% compared to the diesel only case. During the runs with ethanol injection, diesel fuel economy increased by 9%.

5. Public - "Measured Indoor Air Quality and Energy Demand with Increased Fresh Air Ventilation", Columbus, Ohio.

Via a case study of public buildings, the City of Columbus conducted a comprehensive analysis of the relationship between increasing the minimum fresh air ventilation and the resulting impacts on indoor air quality and energy usage. This study focused on actual measurements. The tasks consisted of the following:

1. Install a ventilation retrofit to accurately control minimum outside air;
2. Simulate the energy impacts of increased minimum outside air;
3. Measure increased electricity demand;
4. Assess perceived indoor air quality;
5. Measure indoor air pollutants at three ventilation levels, 5 and 20 CFM per person and 100% outside air.

Energy increases from increasing outside air from 5 to 20 CFM per person may be significant (up to 25% increases in heating energy) for smaller buildings with higher occupancy, such as schools; but may be insignificant for larger buildings operating with air economizers.

The indoor air quality was not noticeably improved by increasing the outside air from 20 CFM per person to 100%. Increasing the outside air did little to reduce pollutants and could greatly increase energy use.

Many commercial buildings in temperate climates that require cooling all year with air economizers should provide more than 20 CFM of outside air per person whenever the outdoors is between 20 to 70 degrees F. If there is inadequate ventilation under these conditions it is likely that the central economizer and/or the room air supply boxes are operating improperly. Improved maintenance is needed.

6. City-Wide - "The Sustainable Cities Project", Portland, Oregon, San Francisco, California and San Jose, California.

Sustainability means finding ways to reverse the harmful effects of traffic congestion, pollution, wastefulness, and environmental degradation on our urban landscape. It means developing a healthy economy and an improved quality of life for all who live and work in our cities. By carefully managing energy, water, waste disposal, and recycling to meet the needs of the present and future generations, urban communities can strive to become sustainable.

Each of the three cities collaborating on this project selected a different project focus and objectives for developing their city's proposed plan for sustainable energy use and management practices. The purpose of the Sustainable Cities Project was to develop a planning process to identify, rank, and implement energy policies and program options for promoting urban sustainability. By using a common planning process, the basic steps that cities may take to determine and begin to implement community-specific approaches have been identified. Other local governments may wish to adapt these lessons as they plan for a future in which efficient use of resources is a key to local economic and environmental well-being.

With the help of a National Advisory Committee, the development and application of a "sustainable city planning process" involved compilation of an environmental scan to identify the impacts of energy use by sector, identification of key issues for policy planning, identification of program and policy options, analysis of options, creation of strategies, implementation of new programs and evaluation of the project process.

Portland established a goal of increasing efficiency by 10 percent. To accomplish this goal, nine policies with detailed two year action plans covering a broad range of topic areas were adopted by the City of Portland. San Francisco has developed a methodology for prioritizing energy policy options according to their contribution to sustainability. This provides a reference tool when considering where and how to allocate limited staff resources. San Jose has set a specific goal for its efforts to reduce citywide energy use by 10 percent existing consumption. San Jose's Office of Environmental Management has adopted the concept of a "sustainable city" and has integrated the various resource conservation strategies including water, solid waste and toxics.

Cost Effectiveness of Program

Currently, 85% of the U.S. population lives in cities. Urban energy consumption should become a strategic matter of greatest importance, involving complex and dynamic relationships between energy, the environment, natural resources, and economics. The work of the UCETF is a start towards developing a coherent plan towards this end. Other energy researchers, from the federal, state and utility levels, may wish to collaborate with the UCETF in the joint development of future programs.

The members of the UC Energy Task Force define annual work programs to meet three specific objectives:

- definition of critical urban energy problems;
- development of technologies and management practices to resolve these problems; and
- transfer of resulting solutions to Urban Consortium and other local governments.

Proposals to meet the specific objectives of these annual work programs are solicited from the full UC membership. Projects based on these proposals are then selected by the Energy Task Force for direct conduct and management by staff of city and county governments. Projects selected for each year's program are organized in thematic units to assure effective management and ongoing peer-to-peer experience exchange, with results documented at the end of each program year.

The projects summarized in this abstract reported cost-effective results for participants. As shown, a payback with 3.3 years is predicted in the Detroit study. A nine percent energy savings was found in the Las Vegas study. Operations and Maintenance procedures were found to be cost effective in the Portland and Columbus studies. New tools were developed as a result of the Phoenix study and the Sustainable Cities Project.

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