1980

Residential Energy Management Education

Stephen J. Mecca, *Providence College*
Joseph E. Robertshaw

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This article is a description of some efforts by the authors in the area of energy management education. In particular, we shall describe two formal programs and mention some informal activities in this area.

The two formal efforts were, (1) A Faculty Development Program funded by the Department of Energy: Residential Energy Management Summer Institute; (2) An energy auditor curriculum funded by the R.I. Governor's Energy Office: Residential Energy Management for Energy Auditors.

Residential Energy Management Summer Institute

DOE's Faculty Development Program funds workshop-institute programs for secondary school through university faculty that normally run at various colleges and universities around the country. In FY '79, 69 projects for about 2,500 teachers were funded. Approximately 20 percent of these were in the area of energy conservation.

The authors ran such an institute in FY '78 at Providence College on Residential Energy Management for secondary school science, math, and home economics teachers from Rhode Island. In FY '79 the program was renewed and extended to include participants from all of the New England states. The program ran for three weeks on an all-day basis. Letters of participation were awarded, but no formal academic credit was given for participation. The program first covered national and regional energy issues and state plans, and then focused on residential energy management (REM) and adult education topics. An outline of the course follows.

I. General Considerations
   - A. Global and National Energy Outlook
   - B. Regional and Local Issues
   - C. An Overview of Energy Problems
   - D. The Systems Approach

II. Energy Management
   - A. A Comprehensive Approach to Conservation
   - B. Recent Studies on Residential Energy Conservation

III. Technical and Economic Issues
   - A. Energy Fundamentals
   - B. Heat Loss Mechanisms
   - C. Residential Power Plants—Combustion

D. Implications of Weather in Energy Management
E. Energy Audits
F. Project Retrotech
G. Evaluating Energy Conservation Opportunities
H. Life Cycle Costing
I. Computer Analyses
J. Weatherization Materials and Methods, New Construction and Retrofit

IV. Retrofit and Conservation Programs—the Institution
A. Resource Recovery Projects
B. Utility Based Retrofit Programs
C. Energy Management Through Rate Structure Redesign
D. Community and Agency Based Retrofit Programs
E. Extension Service Resources and Programs

V. Adult Education Component
A. Problems and Opportunities in Residential Energy Management Education
B. Traditional Approaches
C. Nontraditional Approaches
D. Energy Education Projects in the Region
E. Energy Education Resources

Lectures were interspersed with workshops and laboratory exercises throughout the program. During the first two weeks, participants were given relatively constrained problems emphasizing skills and information related to the above topics. In the third week, less constrained problems or adult education situations were confronted by the participants in a team approach. Sample problems in this phase included goal setting and program development for the following (among others):

1. How can you improve the quality of REM decisions made by your neighbors?

2. How can you sensitize an audience of landlords and tenants to the benefits of conservation?

3. You have an audience of thirty elderly or economically disadvantaged homeowners for one hour on an Energy Night sponsored by the Senior Citizens group in town. What should be done in this forum?

We have, through formal DOE and in-house evaluations, been most impressed with the participant activities that have been carried out in the community as a result of this institute. One science teacher, for example, ordered 100 audit booklets to be used by his students to get parents to become involved and interested in the conservation potential at home. Another made a presentation to her YWCA board which encouraged them to do a weatherization retrofit on the organization's residential-type building. Others did in-school seminars for other teachers or formal adult education courses. "Neighborhood Energy Nights" were also organized. The science teacher response was enthusiastic.

Residential Energy Management for Energy Auditors

The state of Rhode Island's Energy Office established some time ago, as did many states, a Hot Line telephone service, which provided advice to callers on energy matters. There was increasing pressure by callers for the state to recommend qualified tradespeople to assist the homeowner in identifying and evaluating Energy Conservation Opportunities (ECOs) and in doing the actual work. The state responded by establishing a curriculum and a 20-hour course, which the authors developed and implemented. The course prepares individuals to take an auditor certification examination. Certified individuals are placed on a list which is provided to any individual who inquires through the Hot Line or otherwise.

The course is divided into eight modules and is normally run two sessions per week for three weeks. The curriculum objectives for each module are as follows:

1. Energy Basics: Definitions, Units, Concepts of Efficiency

To be able to quote a correct definition of energy and thermal energy, power, efficiency (physical and economic), BTU, heat flow, temperature, heat capacity (specific), density, energy audit, degree-days.

2. Heat Loss Mechanisms

To be able to recognize and explain conductive versus infiltrative heat loss.

To be able to calculate the hourly and seasonal conductive heat loss rate through a surface, given the temperature difference, the R or U value of the surface, and its area.

To be able to calculate the hourly and seasonal infiltrative heat loss rate through a crack, given the temperature difference and the appropriate Q value (B value) for the crack.

To be able to calculate, given appropriate tables, the R value of a composite surface.

To be able to identify Q values (V values) for a crack, given appropriate tables.

3. Billing and Field Audits

To be able to summarize residential utility bills and extract consumption trends and costs of the energy forms used.

To be able to convert fuel costs in original units (e.g., ¢/gal.) into common units ($/BTU or $/MBTU), given conversion factor tables.

To be able to quote the average current local prices of gas, electricity, fuel oil, and wood in residential use.

To be able to quote hindsight design temperatures and degree days for this region.

To be able to reconcile heat loss from a billing audit with those from a field audit.

To be able to list and describe the fundamental concepts and purpose of a field audit.

4. FEA Project Retrotech

To be able to perform a FEA Retrotech Audit on a model residence.

To be able to calculate a pay back information on the six standard *E*nergy *C*onservation *O*pportunities of Project Retrotech.

5. Vapor—Moisture Problems

To be able to list and describe the factors governing vapor transmission through barriers and the appearance and effects of moisture within residential surfaces.

To be able to list and describe the basic remedies for vapor-moisture problems.

6. Evaluation of ECOs and Life Cycle Costing

To be able to list and define the standard physical and economic indices used in the evaluation of an ECO, including energy saved, cost avoidance, savings investment ratio, simple payback, present value of savings less costs, rate of return on investment.

To be able to display a cost or savings stream for an ECO.

To be able to calculate the present value of a future cost or

savings given a discount rate, year of occurrence, and an appropriate table.

To be able to calculate the present value of a future cost (or savings incurred or accrued) yearly for a given number of years at a given discount rate, given an appropriate table.

To be able to evaluate two ECO alternatives having different cost streams using present value techniques.

7. *Heating System Sizing and Efficiency*

To be able to estimate, from energy audit data, design sizing for a heating system.

To be able to list the basic processes and factors affecting heating system efficiency and to describe the established procedures used to maximize this efficiency, including CO_2 testing, stack temperature control, flame retention, and furnace maintenance.

To be able to calculate payback estimates on furnace improvements.

8. *Materials and Methods in Current Technology*

To be able to list insulation types, their properties, and their applications in current use.

To be able to identify the wall framing and offset trussing methods in current building technology.

To be able to describe proper installation for common insulation applications.

To be able to quote the current thermal efficiency code in summary form for the State of Rhode Island.

It was anticipated that about 10 individuals would register for the course. The first announcement resulted in registrations which filled the first course (30 students) and forced the immediate scheduling of two additional runs of the program.

This program puts important residential energy management competencies in the hands of those who are close to the residential consumer, e.g., the oil-burner technician, the utility customer representative, the community action worker. The certification process gives the state a way of insuring threshold skills and competencies for all those individuals it might recommend.

A textbook following this curriculum has been produced and is in the process of being published.

Informal Modes

We have been talking about some formal educational modes that we have used. Nontraditional, less formal activities can also be effective. Periodic seminars on energy management on the campus let fellow faculty and staff know that one is willing to provide advice where possible on REM matters. Nearly all science departments and schools have public community service objectives. There is hardly a more timely way to meet such objectives than by involvement in REM practice in in the community. In the past year we have given talks or workshops to:

1. Secondary school teacher—staff groups
2. A R.I. bankers association
3. The R.I. Solar Energy Association
4. The New England Chapter of the American Marketing Association
5. City employee groups: executives, staff, maintenance personnel

The impact of a science teacher's involvement in a single REM forum such as a neighborhood energy night or a well-developed seminar for campus personnel can be relatively large. Consider one science teacher's presentation to 40 homeowners with an effectiveness of 70 percent (i.e., convincing 28 homeowners to implement a typical conservation measure) and an average savings to a homeowner of $100 per year. The net savings is $2800 per year to the homeowners. The present value of these savings (at 10 percent discount rate and no fuel escalation beyond inflation) is about $28,000. From an energy perspective, the savings is about 350 MBTU per year, or approximately 60 bbl of oil (equivalent) per year.

One must be cautious when advising that energy coursework be added to curricula for fear that more critical and basic study will be displaced. However, the energy problem is a critical one, and some integration of energy management principles and methods should take place in secondary school curricula (as well as at other levels). But there is another mode that teachers can use effectively, viz., adult education outside the classroom as well as in. Adults are, for the most part, the decision makers in the residential sector. They are the example setters, and the improvement of their energy decisions—through energy management education—can have great impact.

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Dr. Mecca is a professor of physics, and Dr. Robertshaw is chairman of the Physics Department, Providence College, Providence, RI 02918.