MULTIFAMILY BUILDINGS TECHNOLOGY TRANSFER

Final Report

Prepared for

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ENERGY RESEARCH AND DEVELOPMENT AUTHORITY**
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ABSTRACT

The New York State Energy Research and Development Authority has sponsored the development of 15 training modules by the Apartment House Institute to teach multifamily building owners, managers and superintendents how best to operate and maintain their buildings to save energy, enhance the value of the buildings and provide more comfort and safety to residents.

The report discusses the development of the training modules, the methods used to teach a trial series of workshops and suggestions for improvement. The modules address boiler room operation; the importance of dry steam; heating distribution system balancing; troubleshooting steam distribution systems; leak prevention and water treatment; fuel delivery, storage and monitoring; heating system controls; domestic hot water; thermal windows; electricity and lighting; the choice of energy systems when rehabilitating buildings; contracting outside work; combustion efficiency training; and basic subjects in mathematics, chemistry and physics that prepare students to understand energy conservation theory and practice.

KEY WORDS: Energy Efficiency, Multifamily Buildings, Operation and Maintenance

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SUMMARY

A series of workshops has been produced under agreement with the New York State Energy Research and Development Authority (the Energy Authority) by the Apartment House Institute (AHI) of New York City Technical College on 15 subjects relating to the energy-efficient operation and maintenance of multifamily buildings. These modules are now available from the Energy Authority to organizations qualified to conduct technical training.

Compared to industrial and office building management, management of multifamily buildings is generally poor. This is so because of a very different economic climate and a very fluid ownership pattern since World War II, so that a large proportion of owners, managers and superintendents are either inexperienced, undertrained or both. In this report, we are primarily concerned with the resulting poor maintenance of the physical plant (the building's structure, appurtenances and mechanical/electrical equipment).

Energy efficiency and the quality of operations and maintenance skills have been shown to be clearly linked. The training modules make this link explicit, showing that building programs to enhance energy efficiency result not only in saving fuel and electricity but in enhanced occupant comfort and safety and the value of the building to its owners.

Each of the 15 modules is designed to be used independently or in serial progression. The modules, taken together, constitute a course of study that trains owners, managers

and superintendents to specify and oversee the performance of the requisite measures. In many cases, the owner, manager or superintendent can perform the measures. Many measures require expert contractors.

Each module contains: a) a guide for the instructor, b) a text for the student (in both English and Spanish), c) questions for review or for use as a final examination and d) a separate set of sheets with review questions with answers, to be distributed at the end of each workshop, as a reference for students. In addition, there are overhead projection slides to facilitate instruction or review.

Following the development of the training modules, each module was tested by conducting actual workshops, both on-campus and off-campus. Participant evaluations were very positive. Hence, it is believed that these workshops can be effective training tools.

Subject titles of the 15 modules are: boiler room operation --1-pipe steam or --2-pipe steam, along with facilities for good maintenance; the importance of dry steam; heating distribution system balancing; troubleshooting steam distribution systems; leak prevention and water treatment; fuel delivery, storage and monitoring; heating system controls; domestic hot water; thermal window specification, installation and maintenance; electricity and lighting; the choice of energy systems when rehabilitating buildings; contracting outside work; conducting a combustion efficiency test; and two modules on basic subjects in mathematics, chemistry and physics that prepare students to understand energy conservation theory and practice.

Section 1

INTRODUCTION: THE NEED FOR TRAINING PROGRAMS

With the exception of many industrial buildings, the operation and maintenance of most buildings has been often neglected, largely because real estate ownership has been speculative and the concomitant waste of energy has had minimal impact on owning costs in the past era of cheap energy. The quality of residential building operation and maintenance, in general, has been the most neglected.

Industrial facilities management is the vital support for processes involving large-budget payrolls and demanding production schedules. Senior management will not generally tolerate down time due to sloppy maintenance of equipment related to production machinery or the environmental services (heating, ventilation, lighting, sanitation, etc.) that foster worker productivity. Typically, these plants were and are operated in a "preventive maintenance" mode.

Commercial buildings have enjoyed a lesser quality of maintenance, especially after World War II. Most of them were built speculatively. High-quality equipment, which would enable low maintenance cost, was sacrificed because the builder typically sold the building shortly after erecting it. Second, because of high inflation rates and the lucrative return on investment from new buildings in high demand, owners skimped on maintenance to finance new construction. Typically, these buildings were operated according to the motto, "If it ain't broke, don't fix it". The resulting high maintenance costs could be substantially offset by deductions from income for tax purposes.

With rare exceptions, residential buildings suffered even more than commercial buildings. Development has been largely speculative, as in the case of commercial buildings. Multifamily owners took out balloon mortgages to finance their purchases (the major repayment of principle came at the end of the mortgage period). Because the value of land continued to spiral, the bulk of the profits accrued in the resale of the buildings at the expiration of the mortgages. Thus, the owners were content if rents covered only the operating costs and the least possible investment was made in, or attention was paid to, operating efficiency and maintenance of the building.

A maintenance factor especially at work in the case of multifamily buildings was the non-professional character of building ownership and management. Building owners were, in many cases, persons in other occupations who invested in the speculative real estate market. If they knew anything about the physical plants, it was only after years of operating buildings themselves.

This factor fostered an unfortunate attitude by owners toward building labor. Typically, building superintendents were unskilled individuals willing to work long hours for low pay. There was virtually no investment in training. The one bright, early counter-trend was free education provided by Local 32B/J in New York City (the building service workers union) for those employees in the unionized buildings, generally the larger, more luxurious ones.

This was the milieu when the post-war housing shortage in New York City turned into a crisis. First, in the construction of middle-income, state- and city-assisted housing, almost all of the housing officials who supervised housing development and operation, the architects and engineers commissioned to design them, and the builders solicited to build them, came from, and inherited the attitudes and practices of the era of speculative building construction and operation. The laudable goal of constructing as many units of housing as possible within the budget (rigidly limited by the size of the New York State's bond sales) was essentially uninhibited by an understanding that skimping on capital costs creates wasteful operations and high maintenance costs.

As one consequence, the City and State have a stock of moderate-income buildings that do not have individual apartment metering of electricity or gas, for instance. Both utilities are used excessively as a result.

Section 2

PROJECT ORIGIN

In the 1980s, the Energy Conservation Division of the New York City Department of Housing Preservation and Development (HPD) contracted with the Energy Authority to conduct a number of research projects relating to fuel and electricity consumption in New York City multifamily buildings. Included was a study of actual fuel and electricity consumption in several categories of buildings that constitute the housing stock: high-rises, prewar, post-war, government-supervised middle-income, etc., and a study of the art of buying and installing thermal replacement windows for these buildings.

One of the Division's next projects was to incorporate what it had learned into discrete workshop modules for use by qualified educational institutions. Before it could complete the modules, the Division was, in all practical terms, disbanded. The project was reinitiated under a new agreement between the Energy Authority and the Apartment House Institute. (Dick Koral, Director, had been an unpaid consultant to the Division on the project when the Division began to develop the project.) Koral added two modules (No. 14 and 15) to the original plan, which are preparatory exercises in mathematics, physics and basic energy conservation concepts.

Section 3
PROJECT ORGANIZATION

Two groups were organized to guide AHI in developing the modules. The first group was the Project Advisory Committee (PAC), consisting essentially of representatives of New York State government agencies most directly concerned with energy consumption in multifamily buildings. Members were:

- . New York State Energy Research and Development Authority: Norine Karins, Project Manager, and Paul Larrabee, Communications Associate
- . New York State Division of Housing and Community Renewal, Management Bureau: Paul Kotik, heating specialist
- . New York State Department of State, Weatherization Unit: Rick Gerardi, Director
- . New York State Energy Office, Energy Conservation Bureau: Sam Bell
- . Energy Management & Research Associates: Fred Goldner, Principal.

Three meetings of the PAC were held in Albany to review the progress of the project and to provide technical recommendations, which are incorporated in the final product.

The second group, experts in various aspects of housing, donated their time to review the work in progress, before its review by the PAC. They contributed invaluable suggestions for improvement. The group consisted of:

- . Andrew Anzalone, Grenadier Realty Co., with extensive experience in managing maintenance of multifamily buildings
- . Prof. Alfred Finger, Chair, Environmental Control Technology Department, New York City Technical College, which

conducts a certificate program in building/housing superintendency technology

. Fredric Goldner, Energy Management and Research Associates (cited above)

. Dan Holohan, Dan Holohan Associates, considered by many in the industry to be the most skilled conductor of workshops on steam and hydronic heating systems

. Solomon Schwartz, Director, and Laverne Lum, Deputy Director, Alternate Management Training Program, New York City Department of Housing Preservation and Development.

The challenge was to develop training modules that would:

- Suit a variety of audiences: owners of privately-owned, cooperatively-owned and governmental-owned buildings; managers and superintendents of these buildings; employees of housing supervisory agencies; and employees of neighborhood-based, not-for-profit managers of low-income buildings.

- Be used conveniently in a variety of workshop settings, from the well-equipped college classroom to the odd space without blackboards

- Be able to be used by instructors that were skilled in the art of instruction but not necessarily expert in the subject of the workshop.

The solution was:

- Take each subject in easy steps and explain technical words immediately after their use in the texts

- Pay attention to print and illustration quality for maximum legibility

- Provide Spanish editions of texts, to the extent it was feasible

- Provide texts that eliminate the need for audio-visual equipment; but

- Provide (audio)-visual aids in the form of overhead projection transparencies (because light-weight, portable

overhead projectors are available which are powerful enough to project onto most room walls)

- Include a set of questions that facilitate the instructor's review of the workshop and provide the instructor with a workshop subject outline

- Develop modules for those who need elementary mathematics or physics or the basic concepts in energy conservation in order to benefit from the other workshops.

Section 4

GENERAL CONCLUSIONS

The contract between Apartment House Institute and the Energy Authority specified that each training module was to be conducted twice before this report was rendered. One series was conducted on the college campus; the other, off-campus. A profile of the workshop participants is included in Appendix A, which also describes both the workshop series and the conclusions reached. Some general conclusions of special importance are:

· In the workshop series conducted both on- and off campus, substantial outreach effort had to be expended to bring the participants to the workshops, and the attendance was generally disappointing. This will surprise no one who has conducted building energy efficiency workshops in the recent past, except in those cases where:

- Attendance was required by their employers; e.g., workshops conducted for certain (but not all) employees of New York City Department of Housing Preservation and Development
- Attendees were already attending a larger meeting, such as an organization's popular, annual building workshop event, e.g., annual day seminars conducted by the Council of New York Cooperatives
- Attendance was a prerequisite to some type of sought-after certification, e.g., when included in a series of courses required for certification as housing manager.

Only after the workshop has begun, in our experience, do most participants begin to understand the relevance of energy efficient operation and maintenance of multifamily buildings to their pocketbooks or their professional

life. We conclude from this that any institution that undertakes to conduct these workshops, other than in some program otherwise well subscribed, needs to budget more time and funds for marketing than for other subjects that appear to be more closely related to building problems (e.g., security or finances).

- The 2 or 3 hours devoted to each workshop never seemed adequate. There was rarely time to conduct adequate reviews and final examinations. There were always participants who obviously would, and would want to, benefit from more help in mastering the subjects. These individuals were either poorly educated, and so were slow to learn, or mastered what was presented and were stimulated to seek more. At the very least, we recommend that each such person be assured that some follow up assistance be provided when requested. The assistance might include:

- Encouragement to study the texts provided (which had probably not been adequately studied) and to acquire and read the books and pamphlets listed at the end of the workshop texts, with face-to-face or over-the-telephone assistance to master difficult sections

- Counseling on where to go for further instruction, depending on the individual's needs

- Development of supplementary courses or workshops if the teaching institution does not have them, and/or referral to other institutions that do.

- As short as a 2- or 3-hour workshop module is, the time is greater than most participants can tolerate without a break or breaks. For example:

- In the case of the two preparatory workshops, which take a lot of concentration by participants who are not used to extended classroom attendance, we suggest that the workshop be broken into two 1 1/2 hour segments, no two of which should be conducted on the same day.

- In the case of the series conducted on-campus, we provided refreshments in the classroom which were available at all times.

Although the conclusion is subjective, we discerned a more relaxed and receptive group of day time participants than at some off-campus workshops where no provision for refreshments had been made. Evening workshops, where many participants arrive from work, become especially difficult as hunger and weariness set in. If nothing else, valuable workshop time is consumed during breaks as participants scour the neighborhood for refreshments, returning late.

It may not be clear to administrators of teaching programs, but it is clear to almost all instructors that the act of teaching stimulates the adrenal juices of the instructor, who may go on for hours without becoming weary. However, the students fade. Hence, we urge administrators of these workshops to institute the breaks and to provide refreshments.

Appendix A
PROFILE OF TRIAL WORKSHOP PARTICIPANTS

Note: Identification of the participants is limited to: 1) their first names; 2) the borough of New York City where they reside or work; 3) the numbers of the modules that each attended (see Appendix C for a list of modules and numbers); and, 4) if available, their occupancy classification according to the key that follows.

KEY: P (private) 1 = owner, 2 = manager, 3 = superintendent
H (HPD) 1 = manager, 2 = superintendent, 3 = mechanic,
4 = staff
C (Co-op) 1 = board officer or member, 2 = manager,
3 = superintendent
CON (contractor)
O (other)

Total number of participants: 82

- By borough: Brooklyn, 33; Manhattan, 32; Bronx, 9;
Queens, 6; Staten Island, 2)
- By ownership or job category (of those identified):
Managers, 17; Superintendents, maintenance staff, 10;
Cooperative building officers, board members, 7
Contractors, 6; Private building owners, 4
- By number of modules attended: 1, 16 (i.e., 16 people
attended only one module); 2, 33; 3, 8;
4, 10; 5, 2; more than 5, 13

Gary; Manhattan; 15
Julian; Bronx; 1A, 1C; C2
Ida; Bronx; 1A, 1C; C2
Tony; Manhattan; 1B, 1C

Marta; Brooklyn; 1A,1B,1C,3,4,5,6,7,8,9,10,11,12,13,15 CON
Ann; Brooklyn; 15; C1
Chris; Brooklyn; 10,11 H4
Issachar; Brooklyn; 3
Linda; Brooklyn; 1A,3,4,5,6,7,8,9,12,13,14,15 P1
Solomon; Manhattan; 2,11
Michael; Brooklyn; 3; CON
Gregory; Manhattan; 1B,1C,2,3,6,8,10
Richard; Manhattan; 1A,1C,2,3,4,5,6,7,8,9,10,11,13,14,15;P1
Margaret; Manhattan; 1A,9,14,15; P1
Charles; Manhattan; 13
Jose; Bronx; 1A, 1C; C2
David; Manhattan; 1A,1C,5,6,7,11; H4
Derrick; Brooklyn; 5,6,11,12
Albert; Brooklyn; 1A,1C,3,11,15; P1
Andrew; Manhattan; 1B,1C,2; P2
Leamon; Manhattan; 2,8,10
George; Queens; 15; C1
Fred; Brooklyn; 1B,1C,11; H4
Dory; Bronx; 1A, 1C; C2
Paul; Bronx; 1A, 1C; C2
Bev; Manhattan; 8, 11; CON
Thomas; Brooklyn; 10; H4
Nelson; 1B, 1C; C2
Stan; Manhattan; 13; C2
Jacqueline; Brooklyn; 1A, 1C; C2
Karen; Manhattan; 15; C1
Anthony; Manhattan; 14; C1
Bob; Brooklyn; 1A,1C,3,4,9,11,12,13; P1, P2
Norman; Queens; 1A,1C,3,4,7,8,9,10,11,12,13,14; C2
Hart; Manhattan; 15
Harry; Staten Island; 1B, 1C; C1

Lloyd; Brooklyn; 4,5,6,9
Glenn; Brooklyn; 4,5,6,9
Michael; Brooklyn; 1A,1C,2,3,4,7,8,9,11,13 CON
Edna; Bronx; 1A, 1C; C2
Horiatiu; Queens; 5,6
Allen; Manhattan; 1B, 1C; H4
William; Manhattan; 1A, 1C
Stephen; Manhattan; 14,15; C2
Jimmy; Queens; 1A,1C,2,3,4,7,8,15
Quintine; Brooklyn; 1A,1C
Hipolito; 1A,1C
George; Brooklyn; 4,5,6,9
Barbara; Manhattan; 1A,1C; H1
Babbette; Bronx; 1A,1C; C2
Angeleto; Manhattan; 1A,1C; C2
Eric; Manhattan; 10,13; CON
Frank; Brooklyn; 9
Eugene; Manhattan; 2,3
Tooraj; Queens; 14
William; Brooklyn; 3,10,11
Vera; Brooklyn; 15; C1
Marta; Brooklyn; 13,14,15; CON
Cecilio; Manhattan; 14,15; C3
Charles; Bronx; 2,3,8,11
Keith; 1A,1C
Sookdeo; Brooklyn; 1B,1C,2,3,8,10,12; C3
Miguel; Manhattan; 1A,1C
Jerome; Brooklyn, 1A,1C
Mary, Manhattan; 14,15; C1
Maud; Manhattan; 1A,1C; C2
John; Brooklyn; 5,6,9
Edward; Manhattan; 1A,1C,3,5,6,13,14,15; P2

Christopher; Brooklyn; 2,3
Bernice; Brooklyn; 14; C2
Benjamin; Queens; 1B,1C,3,8,13
Felix, Manhattan, 1A,1C; C2
Alexander; Brooklyn; 3,10,11,12
Maye; Bronx; 1A,1C; C2
Myrna; Staten Island; 6,8,10,11; H4
Yonaira; Brooklyn; 10,14,15; CON
Joseph; Brooklyn; 4,5,6,9; C3
Cecil; Brooklyn; 2,8,10
Allen; Manhattan; 14,15
Bonnie; Manhattan; 1B,1C
Miguel; Manhattan; 1A,1C; C2
Barbara; Brooklyn; 1A,1C; C2
Don; Manhattan; 14; C1
Cleveland; Brooklyn; 4,5,6,9; C3
Reuben; Brooklyn; 3,6,8,10,11,13; H4

Appendix B
CERTIFICATE OF PARTICIPATION

(reduced approximately 33%)

Apartment House Institute
New York City Technical College
of the City University of New York

Certification of Attendance for

Name of Workshop Participant
at the following workshops on
Efficient Operation of Multifamily Buildings
sponsored by New York State Energy Research & Development Authority

Boiler Room Procedures, 1-Pipe Steam

Facilities for Good Maintenance

Issued (this date) by: _____
Richard L. Koral, Director

Appendix C
EVALUATION OF TECHNOLOGY TRANSFER

INTRODUCTION

Project Background

The energy crisis of the 1970s occurred in the midst of a severe shortage of housing in New York City. Otherwise viable apartment houses were being abandoned by their owners because they were losing a considerable amount of money on them. Some of these buildings burned down under mysterious circumstances. In other cases, owners just walked away from their buildings after falling into arrears on property taxes owed to the City. One result is that these properties, both tenanted and empty, came into the portfolio of the City's Department of Housing Preservation and Development and have become an enormous administrative and fiscal burden.

At the same time, the energy crisis alerted housing administrators and many owners and managers of buildings to the probability that they were paying excessive amounts for heating, hot water and electricity due to wasteful practices. In an attempt to slow the flow of abandoned buildings into the City's portfolio and to lessen the financial burden of operating buildings taken into City ownership and operation, the Housing Department's Division of Energy Conservation provided help to multifamily building owners to make their buildings more energy efficient, reasoning that the money saved might be used to maintain the buildings and, in the case of private owners, to pay taxes.

The effort to help building owners was hobbled by the lack of two key elements. The first was that no one knew, with any accuracy, what level of efficiency was feasible, so owners could not, with any surety, know whether the money required to perform the necessary measures to achieve enhanced efficiency would actually be good investments. The second element was that there were very few practical manuals to guide owners and their employees in conducting energy conservation measures with any certainty that the goals sought would be achieved.

Hence, in the late 1980s, the Division of Energy Conservation embarked on a series of research projects, largely under contract to the Energy Authority, to determine actual consumption of fuel for heating, domestic hot water and electricity. The projects were aimed at various types of multifamily buildings in the city, and designed to produce practical manuals based on this and other research.

The research into energy consumption revealed consumption levels for many multifamily buildings in New York City to be six times that of other multifamily buildings in the City of similar age and construction. These other buildings provided equivalent comfort and convenience to their tenants. The results confirmed the assumption that many buildings were operating at very inefficient levels. Furthermore, the researchers found that, in large measure, the most inefficient buildings were those where maintenance was the poorest, and where the concepts of preventive maintenance and the keeping of logs of operations were absent. On the assumption that the poor maintenance was at least partly the result of ignorance of proper operating and maintenance

procedures, the need for practical operations manuals was further reinforced.

Moreover, a practical way to train owners, managers, superintendents and others with significant input into multifamily building operations and maintenance was required. Multifamily building operation and maintenance training in New York City has been spotty, at best. A mechanism was needed to enable teaching institutions to offer courses and/or workshops in these subjects even if these institutions had not offered any courses in this area.

This project, then, has been a work of compiling the technologies for operating and maintaining multifamily buildings into 15 workshop modules based on simple concepts that will transfer these technologies to this audience. The workshops will be in a form the participants can easily master and apply to their buildings.

Goals and Objectives

Goal 1: Define the scope of the technologies.

Objective 1: Review Previous Plans of Energy Conservation Division Training modules were in an advanced stage of planning at the Energy Conservation Unit when the unit was severely reorganized by the City and the task was transferred to Apartment House Institute, which had served as a consultant to the program. Essentially, 12 modules had been previously defined.

Objective 2: Modify, as needed Based on the Apartment House Institute's experience in conducting workshops and courses covering much of this subject matter, we concluded that three additional modules were needed: 1) one that would serve as an introduction to the basic mathematics and phys-

ics that underlie most elementary energy studies; 2) one that would familiarize those new to energy conservation concepts in basic energy conservation programs that are involved in a self energy audit; and 3) a module that addressed the options and energy consequences available upon substantial renovation of a multifamily building.

Since a substantial number of building superintendents' native language is Spanish, it was necessary to produce Spanish editions of the student notes in each module. (This objective was incorporated in the contract with the Energy Authority.)

In this and subsequent efforts, voluntary consultants with special expertise in one or more of the technologies involved provided valuable input.

Goal 2: Produce Drafts modules for Review A Project Advisory Committee was assembled to review the work. Members represented New York State agencies with interest in the products of the program: Management Bureau, Division of Housing and Community Renewal; Weatherization Program, Department of State; the Energy Office; and one person who had been the chief research person in the old New York City Department of Housing Preservation and Development's Energy Conservation Division. The Advisory Committee was chaired by the Energy Authority project manager.

Objective 3: Define format of modules

1. Boiler Room Operation Procedures: 1A. 1-Pipe Steam or 1B. 2-Pipe Steam. Objective: To train boiler attendants to operate their heating systems in a methodical way so that heating system components will last and fuel will be conserved. The organizing principle is the maintenance of a heating system log. Recommended hours of instruction: 3.
1C. Facilities for Good Maintenance. Objective: This workshop is intended to follow either Module 1A or 1B. It addresses the physical environment of the boiler room and auxiliary spaces in which the superintendent and staff work. Recommended hours of instruction: 1.

2. Dry Steam, Its Importance and How to Achieve and Maintain It Objective: To train superintendents, owners, managers, and boiler service installers and technicians to understand why and how to eliminate moisture in steam. It is based on boiler installation, header design and operation, specifying dry steam and diagnosing wet conditions. Recommended hours of instruction: 2.

3. Heating Distribution System Balancing Objective: To train those who are in a position to influence the operation and maintenance of 1- and 2-pipe steam-heated multifamily buildings. At the conclusion of the workshop, attendees will understand why and how to balance their heat distribution systems and thereby achieve fuel economies. Recommended hours of instruction: 2.

4. Trouble-Shooting Steam Distribution Systems Objective: To train those with significant input in a multifamily building's operation and maintenance. Superintendents will be able to identify heating systems problems and solutions. Owners and managers will be able to supervise these efforts. The problems and solutions should be identified as quickly as possible so that heating and domestic hot water systems can be maintained in their most efficient and safe condition, with maximum comfort. Recommended hours of instruction: 2.

5. Leak Prevention in Heating Systems and Water Treatment in Steel Boilers Objective: To train superintendents, managers and owners to undertake a heating system preventive maintenance program. Specifically, they should monitor the operation of the heat generation and distribution systems and take corrective measures, including eliminating costly should also use chemicals properly in the boiler water to retard corrosion. Recommended instruction hours: 2.

6. Fuel Delivery, Storage and Monitoring Objective: To train superintendents in the proper procedures to ensure accurate oil delivery and billing, maintenance of the fuel tank and tracking of consumption. Recommended instruction hours: 1.

7. Heating Systems Controls: Safety, Heat Regulation, Management Objective: To train owners, managers and superintendents to use timer heating system controls to decide whether fuel computers can be gainfully substituted, and to regularly check on and respond to their steam pressure, safety and domestic hot water controls. Recommended hours of instruction: 2.

8. Domestic Hot Water Objective: To train those with significant input in the operation and maintenance of multifamily buildings to operate their domestic hot water generation and distribution systems in the most fuel-efficient manner consistent with New York City law and tenant comfort and safety, and to consider minor and major changes in the system consistent with these fuel conservation and economic objectives. Recommended hours of instruction: 2.

9. Thermal Windows: Installation, Maintenance and Repair Objective: To train owners, managers and superintendents to specify a good aluminum replacement window, supervise its installation, and maintain the new window. The module also contains sources for window repair in the New York City area. Recommended hours of instruction: 4.

10. Electricity and Lighting Objective: To inform owners, managers and superintendents of the advances in electrical technology, including lighting, that have led to great improvements in efficiency and economy. The module will also show how to apply these improvements to multifamily buildings. Recommended hours of instruction: 2.

11. Energy Systems for Substantially Rehabilitated Buildings Objective: To inform developers, owners, managers and superintendents rehabilitating their buildings of their options for selecting the most energy efficient new systems and equipment. Topics include roof and wall insulation, hydronic and steam heating, ventilation and domestic hot water. Recommended hours of instruction: 3.

12. Performance Contracting in Multifamily Buildings Objective: To give those in a position to influence the awarding of contracts for implementing energy measures in multifamily buildings the knowledge to decide whether or not to pursue a performance-based contract and, if they do, how it might be structured. Recommended hours of instruction: 2.

13. Combustion Efficiency Testing Objective: To train building superintendents and staff to conduct boiler combustion efficiency tests and to know which measures to pursue based on test results. Recommended hours of instruction: 3.

14. The Concept of Energy Efficiency Objective: To train those who intend to enroll in Modules 1 through 13 but whose lack a basic understanding of such concepts as simple heat transfer and the payback of investment in energy conservation measures will make mastering these workshops difficult. This module and Module 15 supplement the other modules in

this series. Recommended hours of instruction: two 1.5-hour sessions.

15. Basics of Temperature, Pressure, Heat, Electricity and Flow of Fluids Objective: To train those who have never had high-school-level elementary physics or chemistry to understand the basic characteristics of each of the physical phenomena and how they are measured. The module includes a unit in measurement techniques. This module is intended to prepare students for Module 14. Recommended hours of instruction: two 1.5-hour sessions

Each module is bound into a three-ring binder and includes the following: a) descriptions of all 15 modules, as above; b) instructions for the institution conducting the workshop and suggestions for its instructor; c) student text (notes) in English; d) student text in Spanish; e), questions on the text, with answers, to be distributed at the conclusion of the workshops; and f) overhead projection slides to help in instruction.

Objective 4: Produce drafts for review. As the work proceeded, review drafts were circulated among the voluntary consultants for suggestions for improvement and many of these comments were incorporated. Amended drafts were submitted to the Project Advisory Committee for review and comment.

Objective 5: Modify as suggested by Committee. The suggestions of the Advisory Committee were incorporated into final drafts of the modules.

Goal 4. Pilot testing of modules.

Objective 6: Select sites at New York City Technical College and identify other potential locations The workshops are designed to be conducted in both a traditional college classroom or in a meeting room minimally equipped for lectures. Each workshop module was conducted once at New York City Technical College and once at other sites. These additional sites included the community room of a large cooperative housing complex (for the superintendents and handymen);

a meeting room of a cooperative housing organization of many cooperatives (for members of boards of directors, city-wide); and a room set up for workshops of a group that helps low-income cooperatives (for their building board members, city-wide). None of the non-college sites were equipped with boards or screens, so portable, easel-mounted flip charts and markers were used.

Attendees at the workshops conducted at the college were required to pay a registration fee of \$5 for each workshop, most of which was returned as coffee, sodas and cookies. No fee was charged to sponsors of off-campus workshops. In most cases, the organizations supplied snacks and beverages.

Objective 7: Conduct workshops Attendance at workshops, both day and evening, varied from a low of 3 to a high of about 15. Many of the participants attended more than one workshop, treating the sum of the workshops as a multi-session course where they could pick and choose the session topics that were of particular interest.

Objective 8: Evaluate workshop experience (This evaluation appears later in this report.)

DEVELOPMENT OF TRAINING MODULES

Overview of the 15 Modules

All 15 modules are outlined above. Module 1 is the only one that is subdivided, with Module 1A applicable to 1-pipe steam-heated buildings; Module 1B to 2-pipe steam; and 1C, to be used with both 1A or 1B.

Most modules are designed to be conducted in 2- or 3- hour segments. Every effort was made to keep them to 2 hours. Our experience with students who are also full-time workers is that they find it difficult to maintain alertness after 2 or 3 hours, no matter how stimulating the instructor attempts to be.

In the case of the 3-hour Modules 14 and 15, which tend to be dry, we recommend two 1.5-hour sessions rather than a single session of 3 hours.

Role of the Project Advisory Committee

This committee consisted of representatives from state agencies with considerable experience in housing energy conservation work. Their task was to review the draft modules for both technical accuracy and appropriateness and to provide guidance and direction to the contractor. The Committee met with the project director three times in Albany and made very many valuable suggestions, including sources of data, visual presentations, and corrections in general. All comments were incorporated in the final draft.

EVALUATION/TESTING OF MODULES

Success Criteria

A teacher's measure of success is largely subjective. When the students remain alert, ask relevant questions, answer questions correctly, thank the instructor at the end of the session, and come back for additional workshops, the teacher believes the materials are relevant and that the delivery is adequate.

A criterion for success is the responses to questionnaires completed at the end of each workshop. See "WORKSHOP EVALUATION FORM" on the next page.

WORKSHOP EVALUATION FORM

Your honest evaluation of this workshop will help us improve it for future workshops. Please take a few minutes to answer these questions:

1. Were the ideas presented clearly (very, ok, could be better, poorly, not clearly)? What parts were not clear?

2. What subjects were not covered that you would have liked to be? _____

3. This workshop is one of 15 workshops in a series on efficient operation and maintenance of multifamily buildings. As a result of your experience in this workshop, do you think you would like to attend some of the others?

___yes, ___no

4. Below, please write down any comments that you wish. We're paying attention! _____

NO NEED TO SIGN THIS

Criteria for Future Applications

Testing for performance-based competency (the ability of the student to apply the knowledge gained at workshops in the

field) and academic proficiency (as evidenced by passing a written test) were not used in this project. However, we recommend that field competency and knowledge be tested whenever economically and practically feasible.

A test for academic proficiency is provided at the end of each module. We suggest that tests for field competency would be best conducted at the building or buildings with which each student is professionally affiliated (as owner, manager, superintendent, etc.). Evidence of mastery might be completed logs or short reports on various topics.

Continuation at Select Institutions

The 15 workshop modules were designed to be used by responsible institutions that have assigned an instructor who is knowledgeable in the subject area through field experience and who has also demonstrated a fair ability to teach. If no such instructor can be found, then a professional teacher (who can be relied upon to master the material contained in the module package) might be teamed with a resource person who may not be a teacher but who is experienced in the field application of the subject to answer questions germane to the workshop subject but not covered in the module notes. (These type of questions come up frequently and their answers are often a very valuable part of each workshop. For example, if the subject was 1-pipe steam systems and the particular topic was maintenance of the inlet steam valve, an attendee of the workshop might very well ask about techniques for unscrewing parts of the old valve and partly rusted piping without cracking them.)

Among the institutions and instructors that might obtain Energy Authority permission to use the modules are:

Any Technical or Engineering College or Technical Department of a College. Among these, for example, are most of the colleges of the State University of New York and several colleges of the City University of New York, including City College, New York City Technical College, Bronx Community College and LaGuardia Community College; certain private colleges, such as New York Institute of Technology, Technical Career Institute (TCI-the College of Technology); and Cornell University (Ithaca) and some of its Cooperative Extension units.

Technical and Vocational High Schools. These exist throughout New York State.

Training Units of City and State Agencies. For example, New York City Department of Housing Preservation and Development (HPD) manager and superintendent training unit for private sector residential buildings at risk of abandonment, its housing inspector's training unit, and training programs conducted by the Department's Office of Property Management; C-12

the New York State Division of Housing and Community Renewal's Management Bureau; the Training Department of New York City Housing Authority; New York State's Department of State's Weatherization Program; and the New York State Energy Office.

Training Programs Conducted by Manufacturers and their Representatives. Their products are applied in multifamily buildings. In spite of the potential for commercial bias, some firms are well equipped and have excellent reputations for training.

Local Chapters of Technical Societies of Architects, Engineers and Contractors. For example, the American Institute of Architects; the Association of Energy Engineers; the American Society of Heating, Air-Conditioning and Refrigerating Engineers; the American Society of Plumbing Engineers; the American Society of Sanitary Engineering; and the Construction Specifications Institute.

Local Societies of Real Estate Owning and/or Managing Organizations. For example, the Associated Builders and Owners of Greater New York (RAM program); the New York Association of Realty Managers (NYARM) certification program; real estate

boards; the Small Property Owners of New York (SPONY); the Rent Stabilization Association; the Community Housing Improvement Program (CHIP); and Association for Neighborhood Housing and Development (ANHD), which represents the non-profit organizations managing low-income housing.

The Public Gas and Electric Utilities. For example, in connection with their Utility Low-Income Energy Efficiency (ULIEEP) programs or demand side management programs in general.

Selected Individual Entities. For example, many consulting engineers and large owning or managing firms conduct training workshops for their employees.

Each of the above may have instructional resources in-house or might be willing to contract for it.

Success in Transferring Data to Users

The 15 workshops were each conducted twice, as specified in the Apartment House Institute/Energy Authority agreement. In almost all cases, participants filled in a questionnaire at the conclusion of each module and, almost without exception, provided very positive comments.

Applicability of Modules

Personal remarks to the instructor and the responses to questionnaires clearly indicated that the subjects and the materials were on target. The essence of the responses was

that the workshops were very useful to the participants in their efforts to contain energy costs while improving the maintenance of their buildings.

Most of the modules are targeted to the problem of steam-heated buildings because most multifamily buildings in New

York City are heated with steam boilers. However, some of the workshop participants needed help with hydronic systems and two participants (from one building) needed help with an electrically-heated building. Our response was to discuss the problems and solutions briefly during the workshop and to provide these participants with supplementary material from the Apartment House Institute library.

We conclude that instructors should be prepared with a few copies of appropriate materials on hydronic (especially) and electrically heated (resistance and heat pump) multifamily buildings.

Several responses expressed disappointment that the workshops did not incorporate hands-on practice on equipment. (The exception was Module 13, Combustion Efficiency Testing, half of which was conducted in the college's combustion laboratory.) We conclude that there is a great need for hands-on training but that it is beyond the scope of this program.

There was also disappointment that the illustrations in the texts did not include more detailed, photographic illustrations of equipment, which would have clarified the subjects

for those not familiar with the equipment. We conclude that future workshops should attempt to supplement the illustrations in the text with posters, 35mm slides, or overhead slides with drawings and photographs (especially cut-a-ways) that show the equipment in detail. Manufacturers and their agents are often the best sources of these illustrations.

We attempted to reduce the equipment required to a minimum because workshops are so often conducted in spaces without readily accessible equipment and without convenient or secure parking spaces for a car or van. Therefore, there is no reliance on 35mm slide projectors with heavy projection screens or VCRs, which require monitors big enough for a large class to see. It is very often impractical to bring this equipment to the instruction site, along with flip charts, easels and copies of the text for each student. The instructor limited the visuals to illustrations in the text and overhead projection slides. (The use of overhead projection slides is convenient because there are portable models that are lightweight and easy to carry on a train or bus.)

Feasibility for Replication.

The 30 trials of the workshop modules were conducted either at the college or on the off-campus sites. When conducted at the college, a fee of \$5 per workshop was charged, which covered the cost of coffee, sodas and cookies. Outside the college, no fee was charged. In the fall of 1993, the Division of Continuing Education offered all the modules in its Fall Bulletin at a registration fee of \$25 for the 2-hour modules and \$35 for the 3-hour modules.

It remains to be seen what the response will be at this tuition rate. The Division of Continuing Education is not subsidized by the state. The \$35/\$25 rate represents the absolute minimum charge it can consider. Other colleges, especially those designated in the New York City and New York State university systems as "Community" colleges, may get subsidies for this type of program and be able to offer a lower tuition rate.

We conclude that significant replication of the program will depend on subsidization of program costs for critical audiences, including building superintendents in low-income buildings and small private building owners. The financial support might come from the state's public utilities' demand side management program funds, not-for-profit and for-profit management companies and associations, banks and other investors in affordable multifamily housing, and charitable foundations that support housing programs.

LESSONS LEARNED

Suggested Modifications to Modules

The subject matter was on target, except that a 16th module on hydronic heating systems would be useful because of the increased use of these systems in newly rehabilitated and newly constructed housing. Also, additional illustrations, particularly those suggested by building owners who have little hands-on experience with their own building equipment, would be useful. These illustrations could be incorpo-

rated into the student texts or provided on overhead projection slides.

Some participants expressed a desire for a hands-on extension of the workshops. This desire could be accommodated only in laboratories designed for the purpose. There are few available, so it would be impractical to add such sessions to the existing modules.

Successful Instructional Techniques

It is not easy to impart all the training each module requires in 2 or 3 hours. Therefore, it was most useful to distribute the text notes as the students were signing in. Even a 5- to 10-minute look by some of the students helped to orient them and facilitated getting to the heart of each subject. When we could distribute the notes of an upcoming workshop at the conclusion of a prior workshop, it proved to be quite effective.

Because the attendees at any given workshop were of different occupations and levels of experience, it was important to announce that interruptions for questions were welcomed and to watch the students' faces for evidence of questions that were not surfacing. (On the other hand, the mix of occupations, in most cases, created a valuable exchange among the participants - e.g., superintendent to owner - which we encouraged).

Each student text concludes with questions for review. In

addition, each module includes a separate publication with these same questions and answers. We found there was inadequate time to use the questions at the end of the texts. To compensate, we distributed the questions and answers, and asked the participants to indicate which they did not understand. In this way, we dealt only with the questions that the students had problems with and had the time to answer them adequately.

There was a problem with evening presentations of Modules 15 and 14 (they are designed to be presented in that order). These are elementary and theoretical mathematics and physics preparatory lessons. We had violated our own recommendation that these 3-hour workshops be presented in two 1.5-hour sessions. As a result, older participants complained at a mid-session break that, after a full day's work, it was difficult to focus. We conclude that, when conducted at night, except for young adults, the workshops should be presented in two 1.5-hour sessions and that the instructor should intersperse frequent problems for each participant to work out in the course of the workshop, followed by a discussion of the answers. The student text includes many such exercises.

In any future editions of these modules, we would attempt to add illustrations of equipment that students indicate would help them best understand the subject matter. The following would be useful: cutaways of boilers and details of heating distribution systems, boilers and domestic hot water controls; cross-sections of insulated roofs; and sketches or

photographs of onsite electrical generating systems and submetering would be useful.

Visual Aids

The overhead projection slides accompanying each module reproduce either illustrations and/or the questions for review that are in the text. Therefore, they are for the convenience of the instructor but not essential to the students. Since we distributed the student texts at the beginning of each workshop, we did not need to use them.