

DOE-HUD Initiative on Energy Efficiency in Housing: A Federal Partnership

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A five-year initiative between the U.S. Department of Energy (DOE) and the U.S. Department of Housing and Urban Development (HUD) demonstrated the feasibility of improving the energy efficiency of publicly-assisted housing. Twenty-seven projects and activities undertaken during 1990–95 involved research and field demonstrations, institutional and administrative changes to HUD policies and procedures, innovative financing and leveraging of federal dollars with non-federal money, and education, training, and technical assistance. They brought together a wide variety of organizations with the common goal of improving the energy efficiency and affordability of public and assisted housing.

With most of the 27 projects and activities completed, the two departments have initiated a five-year deployment effort, the **DOE-Energy Partnerships for Affordable Homes**, to achieve energy and water savings in public and assisted housing on a large scale throughout the country. A **Clearinghouse for Energy Efficiency in Public and Assisted Housing** managed by the National Center for Appropriate Technology (NCAT), will offer hands-on energy assistance to housing providers to complement DOE's assistance.

This paper presents the findings of the **DOE-HUD Initiative**, with primary attention paid to those projects which successfully integrated energy efficiency into private and public single and multifamily housing. The paper includes examples of the publications, case-study reports, exhibits and videotapes developed during the course of the Initiative.¹ Information on the new **DOE Energy Partnerships** and on the **NCAT Clearinghouse** is also presented. New **Partnership** projects with the Atlanta and Chicago Housing Authorities describe the technical assistance envisioned under the **Partnership**.

INTRODUCTION

More than 4 million dwelling units in the United States are subsidized, in whole or in part, by the U.S. Department of Housing and Urban Development (HUD). They include public and privately-owned single and multifamily housing, Native American housing, and housing supported with rental certificates.

The cost of electricity, oil, gas, and water for these units, most of which is also subsidized by HUD, is more than \$5 billion annually. High utility costs result from inefficient building design and construction management practices, poor or non-existent building and equipment maintenance, and disincentives for, and lack of knowledge about, saving energy by residents.

Energy use, and its associated cost, is an important component of housing affordability and community viability. Incorporating more energy efficient design, equipment, and building practices into new construction and rehabilitation can have a substantial impact on energy consumption, leading to other positive outcomes, including:

- occupant comfort;
- increased affordability;
- reduced homelessness;
- added value;
- improved environment;
- reduced utility requirements;
- reduced financial risk; and
- neighborhood viability.

Energy and cost saving opportunities have been well known in the private sector since the years following the Arab oil embargo. These same opportunities have been less understood and implemented for the publicly subsidized housing market. Because of this, the U.S. Department of Energy (DOE) and HUD initiated the **DOE-HUD Initiative on Energy Efficiency in Housing**, designed with four strategic objectives:

- prioritize HUD housing programs to receive energy assistance;
- develop public-private institutional linkages to focus on energy;
- revise HUD guidelines to capture opportunities for improving energy efficiency; and
- provide technical energy information, assistance, and training to HUD staff, public and assisted housing managers, and others who design and implement housing assistance programs.

To carry out these objectives, representatives of both agencies solicited project ideas from HUD program managers, DOE and HUD regional support offices, and energy and housing professionals throughout the country. A set of 27 projects was carried out by DOE and HUD support and field offices, local energy and housing organizations, private and public interest consulting organizations, and the national energy laboratories, who brought together a wide variety of individuals and organizations with the common goal of improving the energy efficiency and affordability of public and assisted housing. These projects began the “bridge building” that is so necessary if such housing is to be available for those who so desperately need it. The **DOE-HUD Initiative on Energy Efficiency in Housing** brought structure to the important task of improving housing with energy efficiency in mind.

Most of the original 27 projects are now complete. A number of them have continued or “spun off” into new projects which are serving to expand project results in local communities throughout the country. This paper provides a summary of the results of these projects and an overview of the new five-year **DOE Energy Partnerships for Affordable Homes** and **NCAT Clearinghouse for Energy Efficiency in Public and Assisted Housing**. These new efforts are designed to achieve energy and water savings of 30% in one million units of low-income housing through community-scale efforts.

THE DOE-HUD INITIATIVE ON ENERGY EFFICIENCY IN HOUSING

The **DOE-HUD Initiative** directed its efforts in five areas to meet the objectives established by the two agencies. They included:

- **Research** on energy efficient building technologies appropriate for the public and assisted housing market;
- **Field demonstrations** of energy efficient building technologies;

- **Institutional and administrative changes** to HUD policies and procedures;
- **Innovative financing, partnerships, and leveraging** of federal dollars with non-federal dollars; and
- **Education, training, and technical assistance** on energy and housing for those involved in publicly assisted housing.

Projects were developed in each of these areas, in cities and local communities throughout the country (see Figure 1). A number of projects addressed more than one area, illustrating the cross-cutting nature of the Initiative (see Table 1). For example, the **Multifamily Rehabilitation in the Midwest** Project, led by researchers at Argonne National Laboratory (ANL), contained both research and field demonstration elements. This project was designed to evaluate the performance of super-insulation energy measures in multifamily moderate rehabilitation. The project showed that for an average Chicago heating season with 6,455 heating degree-days, use of the super-insulating retrofit techniques saved about 710 therms of natural gas, lowering gas energy costs in a 1,100 square foot apartment by about \$355 annually.

Since a specific objective of the Initiative was developing linkages between energy and housing organizations, each of the DOE support offices designed, with their HUD counterparts, projects which reflected the interests and needs of housing providers in that region. DOE and HUD staff, together with energy and housing organizations, implemented projects which fulfilled specific regional needs and opportunities. For instance, the San Francisco Regional Support Office, cognizant of the need for affordable, energy-efficient housing on Indian reservations, carried out a project entitled **Energy-Efficient Home Design for the Navajo People**. This project involved both DOE and HUD, the Navajo Housing Authority, Navajo Housing Services, and the Navajo Nation, Division of Community Development in the design and construction of a prototype home, on the Navajo Nation, near Ganado, Arizona.

Other projects were designed to impact housing throughout the country, rather than in a specific geographic location. The *Guidebook on Energy Performance Contracting for Public and Indian Housing* as well as the **Performance Contracting Training and Technical Assistance** program, for example, were intended to reach public and Indian housing agencies throughout the country. By distributing the *Guidebook* nationally, and offering selected public and Indian housing authorities in four federal regions the opportunity to participate in energy performance contracting training workshops, information on this financing technique was provided to a national audience.

Figure 1. Project Locations



The following discussion highlights the five categories of projects conducted with Initiative funding and describes some significant results.

Research

With over fifteen years of energy research, development, and demonstration experience, DOE has developed a significant repository of technical research on building energy efficiency. HUD's housing stock, much of it in disrepair and in a state of energy inefficiency, is ripe for energy improvements. The Initiative was thus a "match-up" of available information and opportunity—one organization benefitting from the experiences of another. Research projects conducted under the auspices of the Initiative were primarily designed to ascertain how energy efficiency improvements known to perform in a private sector environment would perform in federally-subsidized housing; each had educational and/or outreach components as well.

For instance, the **Manufactured Housing Thermal Standards** project was designed to test the proposed new HUD Thermal Standard for Manufactured Housing, and to transfer methods for meeting this standard to the industry. A homebuilder constructed two homes to meet the new standard, and National Renewable Energy Laboratory (NREL) scientists tested their performance using infrared scanning devices, and coheating, blower-door, tracer-gas, and furnace efficiency tests. Results showed that manufacturers could meet the new standard with current technology and with only minor design or production modifications. Results of the testing project and cost-effective ways to meet the standard

were shared at conferences and through publications in trade journals.

Improving Energy Efficiency in Public Housing: A Colorado Field Experiment was another research program with a strong energy education component. The goal of this project was to determine the impact of energy improvements and tenant education at two public housing authorities (PHAs), Boulder and Colorado Springs. Residents of forty units were provided with a combination of energy audits and educational information. A savings of \$1,195 was measured in Boulder from energy improvements costing \$6,453, and a savings of \$745 was measured in Colorado Springs from improvements costing \$4,845. Education alone did not produce demonstrable savings, in part because of the mediocre condition of the housing stock, but findings did suggest that education could increase savings in units that were weatherized.

Field Demonstrations

Field demonstrations were used by the **DOE-HUD Initiative** to illustrate and apply energy efficient building technologies and techniques in federally-subsidized housing. Actual energy expenditures were reduced in many housing units and complementary training and educational programs further enhanced the effectiveness of field activities.

One of these field demonstrations, **Weatherization and Housing Rehabilitation Demonstration Program in Spokane, Washington**, was coordinated by the DOE Regional Support Office in Seattle. This was one of four demonstration

Table 1. Project Matrix

	Research	Field Demonstrations	Institutional/ Administrative Changes	Financing/ Partnerships/ Leveraging	Education/ Training/ Technical Assist.
Single Family	Manufactured Housing Thermal Standards	Weatherization and Housing Rehabilitation Demonstration Program, Spokane, WA Energy Efficient Rehab of Single Family Homes, Knoxville, TN	Owner's Guide to Energy Efficiency in Single Family Rental Housing HERS/BEEMS National Collaborative	Weatherization and Housing Rehabilitation Demonstration Program, Spokane, WA	Video and Resource Guide for Energy Efficient Housing Rehabilitation Owner's Guide to Energy Efficiency in Single Family Rental Housing
Multifamily	Multifamily Rehabilitation in the Midwest	Utility Retrofit of Section 202 Housing, Worcester, MA, and 221 (d) (3) Housing, Burlington, VT Energy Efficiency Financing and Modifications, Mt. Vernon, NY Multifamily Rehabilitation in the Midwest	Guidelines for the HUD Capital Improvements Loan Program Multifamily Property Disposition Handbook, Energy Guidelines for HUD	Utility Retrofit of Section 202 Housing, Worcester, MA and 221 (d) (3) Housing, Burlington, VT Energy Efficiency Financing and Modifications, Mt. Vernon, NY	Technical Assistance Program in the Midwest
Public Housing	Overcoming Obstacles to Performance Contracting in HUD-Assisted Housing Durability of Energy Conservation Measures in Public Housing Energy Use and Cost Accounting/Tracking System, Kansas City, MO Improving Energy Efficiency in Public Housing: A Colorado Field Experiment, Denver, CO	Energy Use and Cost Accounting/Tracking System, Energy Performance Contract and Housing Authority Consortium, Kansas City, MO Utility Retrofit of Public Housing, Chelsea, MA Energy Audits and Technical Support, Texas Public Housing Improving Energy Efficiency in Public Housing: A Colorado Field Experiment, Denver, CO	Energy Use and Cost Accounting/Tracking System, Energy Performance Contract and Housing Authority Consortium, Kansas City, MO	Utility Retrofit of Public Housing, Chelsea, MA Low Cost/ No Cost Energy Conservation in Public Housing, Atlanta, GA Energy Use and Cost Accounting/Tracking System, Energy Performance Contract and Housing Authority Consortium, Kansas City, MO	Guidebook on Energy Performance Contracting for Public and Indian Housing Performance Contracting Training and Technical Assistance Performance Contracting Exhibit and Brochure Low Cost/No Cost Energy Conservation in Public Housing, Atlanta Energy Audits and Technical Support, Texas Public Housing Improving Energy Efficiency in Public Housing: A Colorado Field Experiment, Denver, CO
Indian Housing		Energy Efficient Home Design ("Straw Bale") for the Navajo People, San Francisco, CA		Energy Efficient Home Design ("Straw Bale") for the Navajo People, San Francisco, CA	Indian Housing Exhibit Indian Housing Design Guide Energy Efficient Home Design ("Straw Bale") for the Navajo People, San Francisco, CA
Trans./Homeless Housing		Energy Conservation Retrofit Program for Transitional Housing, Chicago, IL Homeless Interagency Cooperative Partnership, Philadelphia, PA	Energy Conservation Retrofit Program for Transitional Housing, Chicago, IL Homeless Interagency Cooperative Partnership, Philadelphia, PA	Energy Conservation Retrofit Program for Transitional Housing, Chicago, IL Homeless Interagency Cooperative Partnership, Philadelphia, PA	Energy Conservation Retrofit Program for Transitional Housing, Chicago, IL Homeless Interagency Cooperative Partnership, Philadelphia, PA Homeless Shelter Retrofit Guide

Note: Projects appear in multiple categories due to their cross-cutting elements.

projects designed to illustrate the manner in which energy retrofits can and should be completed during housing rehabilitation to improve housing comfort and affordability. By scheduling housing rehabilitation and energy improvements at the same time, 80 low-income homes in the Spokane area were audited and work orders prepared for both weatherization and housing rehabilitation. Funds and procedures were combined, resulting in a comprehensive housing rehabilitation process which was both effective and efficient. This process addressed heating systems and fuel switching more frequently than could be addressed by individual programs. It served dilapidated housing that needed rehabilitation as well as energy modification, and also accommodated the special needs of elderly residents, such as the construction of wheelchair ramps.

With the assistance of Oak Ridge National Laboratory (ORNL), a similar field demonstration project was carried out in Cobb, Dekalb, and Gwinnett Counties, Georgia, as part of the Atlanta DOE Regional Support Office project. Community Action Agencies in the three counties provided energy audit and blower door training to their staffs and then combined weatherization and rehabilitation funds to significantly improve their public housing stock.

Another field demonstration project, **Energy Conservation Retrofit Program for Transitional Housing**, was designed to test the effectiveness of retrofitting HUD-reposessed single family properties obtained by homeless service providers, and using them to house individuals on a transitional basis. Five non-profit housing providers in the Chicago area, operating 15 individual homes for women and children and 4 group homes for drug users, were selected to participate in the program. Each building was audited and retrofitted with **DOE-HUD Initiative** funding, state and local support, and “sweat equity” provided by the housing organizations. \$56,582 was expended on the project; 19 units were retrofitted, providing homes for 15 families. Initial monitoring indicated combined energy savings for all 19 units at over \$12,000 annually. As a result of this successful field demonstration, two additional community groups received funding from the petroleum violation fund (“Oil Overcharge Monies”) to retrofit transitional housing units.

Institutional/Administrative Changes

HUD identified a number of administrative and institutional roadblocks to energy efficiency in federally supported housing. Rehabilitation standards made minimal or no mention of energy. Building owners received subsidies for housing with no requirements for improving energy efficiency. In an effort to make energy efficiency a normal part of doing business at, and with, HUD, the **DOE-HUD Initiative** supported a number of efforts to reduce institutional and administrative constraints to energy efficiency.

One such project, **Guidelines for the HUD Capital Improvements Loan Program**, supported the review and revision of Chapter 12 of the *Insured Project Servicing Handbook*. This handbook establishes requirements for owners of multifamily buildings who apply for HUD-backed mortgage insurance and capital improvement loans. Chapter 12 now includes requirements for energy surveys and technical audits, suggests energy conservation measures, and provides guidance on selection of professional architects and engineers for technical audits. Guidance is also provided on the conversion of master metered utilities to individual or tenant paid utilities. Energy surveys are now required by HUD when building owners request rent increases. When owners apply for capital improvement loans, technical energy audit results must accompany the loan application, showing that federal funds will be used for energy, not just cosmetic, improvements.

The **Energy Use and Cost Accounting/Tracking System** was another project designed, in part, to institutionalize the concept of long-term operation, maintenance, and repair of public housing. A utility record-keeping system (ENACT), produced by the Washington State Energy Office, was modified to assist PHAs in the Kansas City region with tracking utility costs and identifying housing facilities with unusually high utility costs, so that they could be targeted for energy efficient retrofits. By keeping on top of these utility costs, building operation and maintenance expenditures could be reduced. At the same time, maintenance personnel could be trained to “trouble-shoot” energy problems before they became unmanageable.

Institutional constraints are difficult, at best, to break down. The **DOE-HUD Initiative** recognized the difficulty of doing so, particularly in the short term. By attempting to institutionalize energy efficiency within the HUD financing and administrative process, the Initiative made energy concerns a more accepted part of HUD’s normal operating procedures.

Innovative Financing/Partnerships/Leveraging

A major objective of the **DOE-HUD Initiative** was to leverage federal funding with non-federal funding sources to improve energy efficiency in publicly-supported housing. Through leveraging, greater good could be accomplished with fewer federal dollars.

The **Homeless Interagency Cooperative Partnership**, sponsored by the Philadelphia Regional Support Office under the umbrella of an Interagency Council of the Homeless, conducted a pilot project to rehabilitate 50 selected residences used for homeless housing to make them more habitable as well as more energy efficient. **DOE-HUD Initiative** funds leveraged funds from the Philadelphia Housing

Development Commission, the Pennsylvania Department of Community Affairs Weatherization Assistance Program, and from other state and local sources. Local public and non-profit organizations signed a Memorandum of Understanding with HUD, and local utilities, non-profit agencies, and the dwelling occupants designed a low-cost energy improvement and education program to complement utility-installed weatherization and rehabilitation measures. In the first year of this project, twelve properties were retrofitted, at a cost of \$10,000-12,000 each.

The Utility Retrofit of Section 202 Housing in Worcester, Massachusetts and HUD 221(d)(3) Housing in Burlington, Vermont projects were designed to demonstrate the effectiveness of utility-housing partnerships for energy retrofit of HUD multifamily housing, specifically Section 202 (elderly and disabled) and 221(d)(3) (low-income). The Worcester demonstration was a comprehensive retrofit of a 70-unit, all-electric elderly housing project; it was included in New England Electric System's (NEES) multifamily demand side management program. Other partners in the project included Rhode Islanders Saving Energy (RISE), which conducted the technical audit, and Lawrence Berkeley National Laboratory (LBNL), which reviewed the audit results. Retrofits included both lighting measures and heating controls; estimated savings were 150,000 kWh/year, at a cost of \$38,312.

In Burlington, Vermont, the Northgate housing project involved the total rehabilitation of 350 low-income units with extensive energy retrofits and electric-to-gas fuel switching. Both shell and equipment modifications were made, resulting in a 50% reduction in energy costs for tenants and a 99% tenant-reported satisfaction rate with the retrofits, an almost unprecedented level of success. Burlington Electric Company, a small electric utility in Vermont, provided financial and technical support to this project, enhancing its success. LBNL provided technical assistance in the design and evaluation of the project.

The Utility Retrofit of Public Housing Project in Chelsea, Massachusetts, was another partnership which proved successful in accomplishing joint rehabilitation and weatherization in public housing. The Margolis Apartments, managed by the Chelsea Housing Authority, provides housing for elderly residents in 150 units. In 1991, utility costs exceeded \$150,000. Joint funding to rehabilitate and weatherize this building was provided by HUD's Boston Field Office, from the HUD Comprehensive Improvement Assistance Program (CIAP), Boston Edison Company, and the **DOE-HUD Initiative**. Others involved included Citizen's Conservation Corporation (CCC), which conducted an energy audit and installed equipment, and ORNL and LBNL, both of which provided technical and monitoring support. Other project partners included state and local government organizations.

This project achieved success through the efforts of all these individuals and organizations, who leveraged both money and expertise to improve the living environment for residents and save \$37,000 per year in energy costs.

Education/Training/Technical Assistance

A number of projects were initiated to develop educational materials or provide technical assistance. One such guidebook, *Energy Conservation in Housing for the Homeless, A Guide for Providers*, was written to provide energy information to homeless housing providers who renovate buildings using federal funds, specifically for McKinney fund recipients. The *Guide* was written by NREL, with the input of the American Institute of Architects Search for Shelter program. Over 6,500 copies of the *Guide* have been distributed nationwide.

A second guide, *Our Home, Buildings of the Land—Energy Efficiency Design Guide for Indian Housing*, was written by NREL also, in collaboration with the American Indian Council of Architects and Engineers (AICAE). The goal of this project was to produce a document which would address both Indian cultural concerns and energy efficiency in the design and rehabilitation of homes inhabited by Indians. A companion document, *Our Home: Giving Form to Traditional Values, Design Principles for Indian Housing*, written and published by AICAE, discusses the cultural issues of Indian housing. Both guides were written to complement computer software, designed by NREL, for use by building designers. The guidebooks were distributed nationwide to Indian Housing Authorities and HUD field offices.

A third effort was designed to educate rehabilitation specialists on energy efficient modifications which can be made at the same time as moderate or total rehabilitation. The Initiative sponsored production of a 58-minute training videotape and companion *Resource Guide* to illustrate energy efficient retrofit measures which may be cost-effectively installed during rehabilitation. The *Resource Guide* provides checklists for rehabilitation specialists to use when working with their clients, so that they become more comfortable with the combined retrofit/rehabilitation process. The videotape, *"Eye on Energy: Rehab for All Seasons,"* and the companion *Resource Guide* have been distributed nationally to housing and community development agencies involved in building rehabilitation.

Two technical assistance programs were particularly successful. The first, **Technical Assistance Program in the Midwest**, was undertaken by the DOE Chicago Regional Support Office (CRSO), and HUD's Chicago Field Office. Together, they sponsored three training workshops, targeted to the private, assisted housing (Section 8) community, using materials jointly developed with the University of Illinois

Energy Resources Center. After the workshops, DOE continued its education and outreach program through a column on energy efficiency in the *Midwest Assisted Housing Management Association (MAHMA) Journal*. CRSO also conducted a series of courses on energy efficiency for Chicago HUD staff, and began an initial examination of HUD procedures for reviewing projects for compliance with the Model Energy Code. The education and technical assistance program has continued, with DOE and HUD working cooperatively to share information and train others on energy efficient technologies and building techniques.

A second successful training and technical assistance program concerned energy performance contracting for public housing officials. DOE and HUD sponsored publication of a guidebook, written by ORNL, *Energy Performance Contracting for Public and Indian Housing—A Guide for Participants*, which provided detailed guidance on using HUD's Energy Performance Contracting program for energy improvements in public housing.

Three training workshops on energy performance contracting were held in Boston, San Francisco, and Chicago. Public and Indian housing authority directors, maintenance supervisors, and financial managers came to the two-day workshops to learn how to utilize energy performance contracting. One year after the Boston workshop, an evaluation showed that a majority of participants had initiated energy performance contracts; the Boston workshop thus served as a catalyst for initiating these kinds of financing arrangements.

It is clear that **DOE-HUD Initiative** projects with long-lasting results were those which had some form of technical assistance or education and training component. Field demonstrations illustrated potential; adding education and training transferred the potential to reality. Those involved became "vested" in the energy opportunities and worked to see them successfully achieved.

NEXT STEPS: THE NATIONAL ENERGY PARTNERSHIP AND CLEARINGHOUSE PROGRAMS

Results from the **DOE-HUD Initiative** clearly demonstrate that significant savings for both residents and the federal government can be realized by improving the energy efficiency of public and assisted housing. Two new major actions are underway to continue the efforts started under the **Initiative: the DOE Energy Partnerships for Affordable Homes** and the **NCAT Clearinghouse for Energy Efficiency in Public and Assisted Housing**. Aimed at the large scale delivery of energy efficiency, both programs focus on accelerating housing improvements within whole communities or regions, as well as in individual buildings. Together

they leverage HUD's available capital improvement funds with investments from energy performance contractors, utilities, and other sources.

DOE Energy Partnerships for Affordable Homes

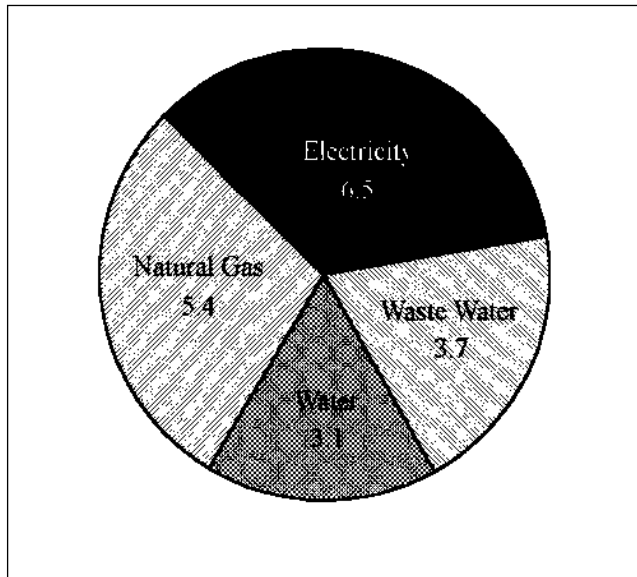
The **DOE Energy Partnerships for Affordable Homes** program is a focused deployment effort that seeks to establish voluntary collaborations with federal, state, and local governments, utilities, and the housing development and financing industries to make the nation's homes more energy efficient and affordable. The **Partnership** is designed to upgrade at least one million units of low-income housing in the next five years, to a level of energy efficiency equivalent to that of comparable market-rate housing. A 20% to 30% improvement is anticipated, saving \$200 to \$300 million annually in federal expenditures for energy. The **Partnership** provides direct, on-site assistance services to housing managers to build lasting capabilities for technical analysis, financial management, and project development that are essential to carrying out energy efficiency improvements. The **Partnership** also demonstrates financing strategies that maximize the use of capital investment resources available from the private sector and creates transferable, local infrastructures that support affordable low-income housing.

Two projects, currently underway with the Atlanta and Chicago Housing Authorities in support of the **Partnership**, are described below.

Atlanta Housing Authority. Atlanta was the first city in the nation to adopt the **Partnership's** Initiative on Energy Efficiency in Public and Assisted Housing. A Memorandum of Understanding was signed between DOE and Atlanta Housing Authority (AHA) in December 1995, that sealed the commitment to conserve energy and reduce high utility costs. The goal of the voluntary agreement is to reduce utility costs by 20% to 30%, resulting in savings of as much as \$3 million annually.

The AHA currently pays nearly \$19 million annually in utility costs (see Figure 2) for approximately 14,416 units of public housing. In many instances, the consumption rate of these units is more than twice that of equivalent private sector housing. This high consumption is caused by a combination of (a) inefficient building design (e.g., masonry construction with no insulation); (b) heating and cooling equipment and appliances that are old or poorly maintained; (c) lack of effective means for tracking, allocating, and analyzing utility costs; and (d) insufficient incentives for tenants to save energy and reduce water consumption. While specific causative factors may differ, the general situation in Atlanta is typical of other housing authorities across the nation.

Figure 2. 1994 Utility Costs, Atlanta Housing Authority (\$Millions)



Technical assistance will be provided to AHA by ORNL and through the **NCAT Clearinghouse**. Assistance to be provided to the Authority will focus on the following needs:

- **Revitalization Action Plans.** Action plans are needed to identify energy-efficient measures during the revitalization and/or replacement of existing housing stock, where opportunities may include both capital measures (heating systems, replacement windows, improved insulation, appliances, etc.) and non-capital measures (operations and maintenance, equipment tune-ups, etc.). In-depth audits and analysis will be performed to identify existing energy deficiencies, and reviews of engineering specifications will be performed to ensure that corrective actions are properly specified.
- **Procurement Practices that Support the Purchase of Efficient Equipment Appliances.** Current procurement procedures are designed to provide AHA with equipment (water heaters, furnaces, and air conditioners) and appliances (refrigerators and ranges) at the lowest initial cost rather than the lowest total life cycle cost. Support for acquiring equipment and appliances that have the lowest life cycle costs and best overall value will be provided through better bidding and evaluation processes.
- **Utility Cost Allocations.** Fair and defensible utility cost allocations, based on engineering calculations rather than community standards are needed. At the same time, energy conservation by tenants will be encouraged, which will prepare them for transition to private sector

housing. Support will be provided to establish utility allocations which incorporate weather, dwelling size, location (middle unit, end unit, etc.), construction type, and installed equipment.

- **Energy Accounting.** Knowledge of energy consumption and trends for each housing facility is a critical management tool which targets facilities with especially high energy costs and changes in performance. This information can also identify potential maintenance problems, locate high impact energy efficient opportunities, and help in evaluating the success of corrective actions. Support will be provided to account for and track energy consumption, and to train housing authority personnel on data collection analysis, and trend-following techniques.

Chicago Housing Authority. A Memorandum of Understanding was signed on March 20, 1996, between the Chicago Housing Authority (CHA) and DOE to integrate energy and resource efficient building techniques into both new and rehabilitated scattered-site housing. The goals of the program are to improve the energy efficiency of all scattered-site construction, integrate energy- and resource-efficient building measures into all standard procurement specifications, and reduce construction costs.

Thirty units will be rehabilitated by the Habitat Company as part of CHA's Scattered Site Housing Program. The program will build upon the success of the Energy Efficient Affordable Housing Program established in 1988 by the Illinois Department of Commerce and Community Affairs (DCCA). The DCCA Program has achieved average annual space heating savings of between \$166 and \$277 in rehabilitated multifamily housing units and \$250 in new single-family homes.

Rehabilitated units will be upgraded with R-43 attic insulation, R-28 wall insulation, R-10 foundation insulation, and air infiltration measures. A healthier indoor environment will be provided through use of direct vent/sealed combustion furnaces and water heaters, a controlled ventilation system, and formaldehyde-free building products. Finger jointed studs, cellulose insulation, building products with recycled content, and other resource-efficient building products will be utilized. The units are expected to be built at no greater cost than currently rehabilitated, scattered-site housing units, through the use of 2" x 6" framing on 24" centers and optimum value engineering building details.

Argonne National Laboratory (ANL) will provide technical assistance by providing input on construction specifications, and measuring energy consumption and air leakage rates in the rehabilitated housing units. This data will be compared to existing scattered-site housing to determine efficiency

improvements. Construction practices, products, and costs will be documented for use in other scattered-site housing projects.

NCAT Clearinghouse for Energy Efficiency

In 1995, the National Center for Appropriate Technology (NCAT) received a special purpose grant, administered through HUD, to provide technical assistance on energy and water efficiency to public housing authorities, Indian housing agencies, and assisted housing owners and managers throughout the country. In addition to direct technical assistance on energy issues, NCAT's activities through the **Clearinghouse** will help ensure that housing managers are aware of nationwide information and experience on the design, installation, and financing of energy efficiency improvements. A variety of technical assistance services will be provided, including analysis of existing fuel use, development of plans for energy and water use reduction, and initiation of energy performance contracts to implement efficiency improvements.

CONCLUSIONS

Results from the **DOE-HUD Initiative on Energy Efficiency in Housing** illustrate well the ways in which energy efficiency can be integrated into normal management practices for public and federally assisted housing. The pilot projects described in this report show that well-designed measures for energy efficiency can bring lasting cost reduc-

tions in both retrofit applications and in new construction. They show that financial assistance for these improvements can be found outside of federal funds, and defuse the myth that energy efficient housing is expensive. In fact, findings indicate the opposite is true—energy efficiency is a key element in assuring the creation and maintenance of truly affordable housing for low and moderate income families.

The new **DOE Energy Partnerships** program and **NCAT Clearinghouse** provide a means for widely implementing the lessons learned by DOE, HUD, and state and local organizations over the past five years of the **DOE-HUD Initiative**. By sharing DOE's substantial store of technical expertise with HUD staff and local housing managers, this continuing partnership promises more affordable housing for families throughout the nation.

ENDNOTES

1. Over 40 reports, articles, videos, and other products of the **DOE-HUD Initiative** are available. Refer to Reference 1. below, or contact J. Brinch at Energetics, Incorporated for a Publications List (Phone: 410-90-0370; Fax: 410-290-0377; E-mail: Jan____Brinch@energetics.com).

REFERENCES

Brinch, J. 1996. *DOE-HUD Initiative on Energy Efficiency in Housing: A Federal Partnership*. ORNL/SUB/93-SM 840V. Oak Ridge Tenn.: Oak Ridge National Laboratory.