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

Program Summary Report

**U.S. Department of Energy
and
U.S. Department of Housing
and Urban Development**

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

PROGRAM SUMMARY REPORT

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June 1, 1996

Research sponsored by the

Existing Buildings Efficiency Research Program
Office of Building Systems
Energy Efficiency and Renewable Energy
U.S. Department of Energy

under

Purchase Order Number 1BX-SM840V

for

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37831

managed by

LOCKHEED MARTIN ENERGY RESEARCH CORPORATION

for the

U.S. DEPARTMENT OF ENERGY
under Contract Number DE-AC05-96OR22464

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Acronyms

ACEEE	American Council for an Energy Efficient Economy
AICAE	American Indian Council of Architects and Engineers
ANL	Argonne National Laboratory
CCC	Citizens Conservation Corporation
CDBG	Community Development Block Grant
CHAS	Comprehensive Housing Assistance System
CIAP	Comprehensive Improvement Assistance Program
DOE	U.S. Department of Energy
HUD	U.S. Department of Housing & Urban Development
IHA	Indian Housing Authority
LBNL	Lawrence Berkeley National Laboratory
MAHMA	Midwest Assisted Housing Management Association
NAIHC	National American Indian Housing Council
NCAT	National Center for Appropriate Technology
NEES	New England Electric System
NREL	National Renewable Energy Laboratory
ORNL	Oak Ridge National Laboratory
PHA	Public Housing Authority

Acknowledgements

The author of this document wishes to acknowledge the contributions of the following individuals: Robert Groberg, Director, Energy Division, Office of Community Viability, U.S. Department of Housing & Urban Development; Michael Myers, Director, Existing Buildings Efficiency Research Program, U.S. Department of Energy; Mark Ternes, Energy Division, Oak Ridge National Laboratory; Richard Zelinski, BMS Management Services; Mark Finks, U.S. Department of Housing and Urban Development; Jean Diggs, Weatherization Program, U.S. Department of Energy; James Kolb; William Mixon; Bernard Manheimer; and all of the **DOE-HUD Initiative on Energy Efficiency in Housing** project managers who so willingly responded to our requests for information.

Abstract

One of the primary goals of the U.S. Department of Housing and Urban Development (HUD) is the expansion of home ownership and affordable housing opportunities. Recognizing that energy efficiency is a key component in an affordable housing strategy, HUD and the U.S. Department of Energy (DOE) created the **DOE-HUD Initiative on Energy Efficiency in Housing**. The DOE-HUD Initiative was designed to share the results of DOE research with housing providers throughout the nation, to reduce energy costs in federally-subsidized dwelling units and improve their affordability and comfort. This ***Program Summary Report*** provides an overview of the DOE-HUD Initiative and detailed project descriptions of the twenty-seven projects carried out with Initiative funding.

Executive Summary

More than 4 million dwelling units in the United States are subsidized through public financial aid from the U.S. Department of Housing and Urban Development (HUD). They include public and privately-owned single, multifamily, and Indian housing, and housing supported with rental certificates.

Utility costs for public and assisted housing, currently estimated at over \$5 billion annually, are important components of housing affordability and community viability. Incorporating more energy efficient building design, equipment, and building practices into new construction, retrofit, and rehabilitation can have a substantial impact on energy consumption and costs within this building sector.

Because of the need to incorporate energy efficiency into the publicly subsidized housing market, the U.S. Department of Energy (DOE) and HUD began a joint, five-year initiative in 1990 with the overall goal of improving the energy efficiency of public and other federally-assisted housing. This partnership, the **DOE-HUD Initiative on Energy Efficiency in Housing**, was 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 to others in the field who design and implement housing assistance programs.

To carry out these objectives, a set of 27 projects was initiated and carried out by DOE and HUD support offices, local energy and housing organizations, private and public interest organizations, and the national energy laboratories. These projects

brought structure to the important task of improving housing with energy efficiency in mind.

Most of the original 27 projects are now complete. Results from the DOE-HUD Initiative clearly demonstrate that significant energy and cost savings for both residents and the federal government can be realized by improving the energy efficiency of public and assisted housing. The DOE-HUD Initiative illustrated that energy efficiency can be integrated into normal management practices. HUD's own Office of the Inspector General concurred, recommending that housing authorities practice better energy management.

Alternative sources of financial assistance for energy improvements were shown to be available. The Initiative defused the myth that energy efficient housing is expensive. Findings indicated that 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.

Two new programs have begun to carry on the energy techniques and practices started through the Initiative:

- the DOE Energy Partnerships for Affordable Homes; and
- the NCAT Clearinghouse for Energy Efficiency in Public and Assisted Housing.

The Partnership is a focused deployment effort designed to achieve an average 20-30% improvement in energy efficiency in at least one million low-income housing units within the next five years, saving \$200-300 million annually. This voluntary, collaborative program between DOE, HUD, and state and local organizations throughout the country is envisioned as a significant effort to improve the energy

“Energy consumption is an important component of housing affordability and rebuilding local communities. This Partnership really drives home the opportunities for affordable, energy efficient housing for all Americans.”

**— Christine Ervin,
DOE Assistant Secretary**

efficiency and affordability of the nation's homes, including public and assisted housing. The Partnership will provide a range of direct, on-site assistance services to housing providers from DOE's national laboratories and other organizations. It is designed to build lasting capabilities among housing

“The Partnership complements the ‘New HUD’ by improving the quality and affordability of housing units for residents, and by making them more competitive with low-income housing in the private market . . . it will enable DOE resources to reach housing managers more quickly and effectively, and it will ensure that energy improvements are installed concurrently with HUD’s major initiatives for housing modernization.”

**— Andrew Cuomo,
HUD Assistant Secretary**

managers for technical analysis, as well as project and financial management of energy efficiency improvements.

The NCAT Clearinghouse, managed by the National Center for Appropriate Technology (NCAT), complements the Partnership by assuring that managers of public and assisted housing are aware of existing information and past experience on the design, installation, and financing of energy efficiency improvements.

Both programs are intended as collaborative efforts, carried out through partnerships among government, members of

the housing and financial industries, utilities, and local community organizations. They provide a means of widely implementing the lessons learned by DOE, HUD, and state and local organizations over the past five years of the Initiative. By sharing DOE's substantial store of technical expertise with HUD staff and local housing providers, these continuing partnerships promise more affordable housing for families throughout the nation.

Introduction

More than 4 million dwelling units in the United States are subsidized through public financial aid from the U.S. Department of Housing and Urban Development (HUD). They include private and publicly-owned single, multifamily, and Indian 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 the federal government, is over \$5 billion annually. Utility costs for public housing are considerably higher than those for private dwellings, translating into higher annual utility costs for the American taxpayer, through utility assistance payments by HUD. Higher utility costs are a result of more intensive use, inefficient building design and construction management practices in subsidized dwelling units, poor or non-existent building and equipment maintenance, and disincentives for, and lack knowledge about, energy efficiency.

Energy use, and its associated cost, is an important component of housing affordability and community viability. Incorporating more energy efficient building design, equipment, and building practices into new construction, retrofit, and rehabilitation can have a substantial impact on energy consumption within the buildings sector.

Investments in energy performance lead 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 well understood and able to be implemented for the publicly subsidized housing market. Because of the great necessity for residential weatherization and rehabilitation in this market, the U.S. Department of Energy (DOE) and HUD began a joint, five-year initiative in 1990 with the overall goal of improving the energy efficiency of public and other federally-assisted housing.

This partnership, the **DOE-HUD Initiative on Energy Efficiency in Housing**, was 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 to others in the field who design and implement housing assistance programs.

To carry out these objectives, representatives of both agencies solicited project ideas from DOE and HUD program managers and regional support offices, as well as from energy and housing professionals throughout the country. A set of 27 projects was then initiated and carried out by the support offices, local energy and housing organizations, private and public interest consulting organizations, and the national energy laboratories.

The projects were designed to further the four strategic objectives and to serve as "leveraging" instruments to begin working relationships where there were none, create awareness, provide education and training, and make institutional and administrative improvements in the HUD housing system which would guide publicly-supported housing toward energy efficiency in future years.

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 Energy Efficient Property Rehabilitation, Cobb, DeKalb, and Gwinnett Counties, Georgia	Owner's Guide to Energy Efficiency in Single Family Rental Housing HERS/EEMS 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.

The 27 projects addressed public and private single family, multifamily, manufactured, Indian, and homeless/transitional housing. They brought together a wide variety of organizations with the common goal of improving the energy efficiency, cost, 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 completed. 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 document provides a summary of the results or conclusions of these projects, and then provides a detailed description of each project in three Appendices, one each for single family, multifamily, and public housing. Copies of the reports and other products produced by the DOE-HUD Initiative are available from the sources cited in Appendix E.

The DOE-HUD Initiative on Energy Efficiency in Housing: A Summary

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, as is shown in Table 1. As can be seen from this table, a number of projects appear in more than one area, illustrating the cross-cutting nature of the Initiative. 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. Through both laboratory research and demonstration of two buildings in a field application, one with super-insulation and one without, the project did so.

The project showed that for an average Chicago heating season with 6,455 heating degree-days, use of 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. The project team worked cooperatively with several community development organizations and the Illinois Department of Energy and Natural Resources. A report on the project was written and presentations have been given at national conferences such as the annual Affordable Comfort Conference.

A specific objective of the Initiative was the linking of energy and housing organizations. Thus, each of the regional support offices of DOE was directed to design, with their HUD counterparts, projects to be carried out in their region. The regional support office projects are shown in Table 2.

"The evaluation has found that incorporating energy efficiency in gut rehabs with the super insulation protocol conservatively saves approximately one month's rent in energy bills each year for a low-income family. The cost of super insulation is approximately \$2000 per apartment, and the payback period is less than six years."

**— James Cavallo, Ph.D.,
Argonne National Laboratory**

The regional support office projects reflected the interests and needs of housing providers in each particular region. DOE and HUD staff, together with energy and housing organizations in the region, designed and implemented projects to fulfill a specific need and opportunity. For instance, the DOE 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.

Table 2: Regional Support Office Projects

REGION I - BOSTON Utility Retrofit of Public Housing (Chelsea Project)
REGION II - NEW YORK Energy Efficiency Financing and Submetering Modifications, Mt. Vernon, NY
REGION III - PHILADELPHIA Homeless Interagency Cooperative Partnership
REGION IV - ATLANTA Low Cost/No Cost Energy Conservation in Public Housing Energy Efficient Property Rehabilitation, Three Georgia Counties
REGION V - CHICAGO Energy Conservation Retrofit Program for Transitional Housing
REGION VI - DALLAS Energy Audits, Technical Support, and Training, Texas Public Housing
REGION VII - KANSAS CITY ENACT, Kansas City Housing Authority Energy Performance Contract, and Energy Performance Contracting Consortium
REGION VIII - DENVER Improving Energy Efficiency in Public Housing: A Colorado Field Experiment
REGION IX - SAN FRANCISCO Energy-Efficient Home Design for the Navajo People
REGION X - SEATTLE Weatherization and Housing Rehabilitation Demonstration Program, Spokane, Washington

The DOE-HUD Initiative projects were carried out in cities and local communities throughout the country, as shown in Figure 1. This United States map illustrates the national nature of the Initiative.

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.

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

Research

The DOE-HUD Initiative was conceived not as a traditional research program, but primarily as an outreach and technology transfer program to share previously conducted research results with others. With almost 20 years of energy research, development, and demonstration experience, the DOE had a significant repository of technical information on building energy efficiency. HUD's housing stock, much of it in disrepair and in a state of energy inefficiency, was ripe for energy improvements. The Initiative was thus a "match-up" of available information and opportunity - one organization benefiting from the experiences of another. Thus, although certain 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 to industry low and no-cost methods for meeting this standard.

A homebuilder constructed two homes to meet the new standard, and National Renewable Energy Laboratory (NREL) scientists tested their performance. 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 publication 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 help 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. Most of the field demonstrations were managed by DOE regional support offices, with technical assistance from the national energy laboratories. This collaborative process created successful field demonstrations which have been replicated by other organizations.

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 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 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. The local community action agencies 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

Figure 1: Project Locations

“ It makes more sense to build them correctly in the factory than to retrofit them later, at taxpayers’ expense, under the Federal Low-Income Weatherization Program.”

— Ron Judkoff, NREL

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 retrofit program. Each building was audited and retrofitted with DOE-HUD Initiative funding, state and local support, and "sweat equity" provided by the housing organizations. \$57,582 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 their dwelling units for transitional housing.

Institutional/ Administrative Changes

Early in the planning stages, 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. Guidelines used by housing providers to renovate their dwelling units omitted information on energy efficiency. Building owners received subsidies for housing without being advised or required to improve the energy efficiency of their buildings. 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 roadblocks to energy efficiency in federally supported housing.

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.

An Owner's Guide to Energy Efficiency in Single Family Rental Housing was also produced with Initiative funds, to provide guidance on energy efficient improvements which can be easily and cost-effectively made to improve investments in single family dwellings. DOE and HUD hoped to tie rehabilitation financing and energy retrofit together. Over 17,000 copies of the 15-page *Guide* were distributed to Community Development Block Grant (CDBG) grantees, HOME participating jurisdictions, Comprehensive Housing Assistance System (CHAS) coordinators, to the HOME Affordable Housing Information Center, and to cities, states, and localities throughout the country. The *Guide's* wide distribution has improved the chance that investment decisions are being tied to energy improvements.

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 procedure.

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. Partnerships and innovative financing arrangements among public and private organizations were encouraged and supported. By creating these linkages, the Initiative hoped to impact substantial numbers of dwelling units and realistically save energy and dollars.

The Initiative sponsored many projects in this area. Among the most successful were the **Homeless Interagency Cooperative Partnership**, the **Utility Retrofit of Section 202 and 221(d)(3) Housing**, and the **Utility Retrofit of Public Housing in Chelsea, Massachusetts**.

The **Homeless Interagency Cooperative Partnership**, sponsored by the Philadelphia Regional Support Office under the umbrella of an Interagency Council of the Homeless, designed and conducted a pilot project to rehabilitate fifty 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, which established the working relationship among them. Local utilities, non-profit agencies, and the dwelling occupants designed a no-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. Selected retrofits, including lighting measures and heating controls, were found to be cost-effective, saving over 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

“The partnership has been a ‘win-win’ for both residents and taxpayers. Residents of the Margolis Apartments are more comfortable in their homes while taxpayers benefit from energy cost savings.”

**— Bob Nason, Executive Director
Chelsea Housing Authority**

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 of 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

This element of the DOE-HUD Initiative was perhaps the most important for achieving long-lasting results. Almost

“Many Indian houses built with federal funding were designed to minimize initial cost in order to construct the most houses possible. The unfortunate result has often been very high energy bills, making the housing almost unaffordable for their occupants. The *Energy Efficiency Design Guide for Indian Housing* shows how to change this picture dramatically by building in energy efficiency from the beginning – at usually no more than a 4%-5% added initial cost.”

— J. Douglas Balcomb, NREL

every project undertaken with Initiative funding contained an education, training, or technical assistance component. It was understood that without it, the research or demonstration, the institutional change, or the partnership would not be used by others. Educating others was seen as a critical part of the Initiative.

A number of projects were initiated to develop educational materials or provide technical assistance in specific housing areas. One such project was the publication of the guide, *Energy Conservation in Housing for the Homeless, A Guide for Providers*. It

receive federal funds for, construction, rehabilitation and conversion of facilities for homeless people. 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 Area Offices of Native American Programs.

A third educational effort was developed 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 completed and distributed nationally to housing and community development agencies involved in building rehabilitation. They are also available through HUD’s American Communities Information Clearinghouse (See Appendix E).

Two technical assistance programs were particularly successful. The first, **Technical Assistance Program in the Midwest**, was undertaken by the Chicago Regional Support Office (CRSO) of DOE, working cooperatively with HUD’s Chicago Field Office. Together, they provided technical assistance to HUD and its grantees on the incorporation of energy efficiency

techniques in federal housing policies, practices, and its assisted-housing program. Three training workshops, targeted to the private, assisted housing (Section 8) community were held, using materials jointly developed with the University of Illinois Energy Resources Center. After the workshop series, 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 and procedures 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 education, training, and technical assistance program concerned energy performance contracting for public housing officials. DOE and HUD first sponsored publication of a guidebook, *Energy Performance Contracting for Public and Indian Housing - A Guide for Participants*, which provided detailed guidance on using HUD's Energy Performance Contracting program to obtain and keep non-federal investments in energy improvements in public housing.

The *Guidebook* was written by researchers at ORNL, with technical input from the Illinois Department of Energy and Natural Resources, the Citizens Conservation Corporation CCC, selected housing authorities, and other housing and energy professionals. It has been used in training and technical assistance programs during the course of the Initiative, in particular for the Performance Contracting Training and Technical Assistance program.

Three training workshops on energy performance contracting for public and Indian housing, one each in Boston, San Francisco, and Chicago, were held following publication of the *Guidebook*. 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. Professionals in this form of public financing, as well as energy experts, shared their knowledge with workshop attendees with the hope that they would return to their housing authorities and initiate rehabilitation and weatherization projects using performance contracts.

One year after the Boston workshop, the 66 participants, representing 21 PHAs, were surveyed to ascertain their progress in initiating energy performance contracts. Results showed that of the 21 housing authorities responding, 17 in the New England region had initiated energy performance contracts for public housing rehabilitation. The Boston workshop served as a catalyst for initiating these kinds of financing arrangements.

It is clear that DOE-HUD Initiative projects with the most long-lasting potential 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.

Partnerships and leveraging programs, combined with education and training, resulted in significant energy savings. Those involved became "vested" in the energy opportunities and worked to see them successfully achieved. The most successful projects were those which achieved real energy savings and could be used as models for improving the affordability and comfort of people least able to spend their limited incomes on high utility costs.

"Energy performance contracting allows the capture of benefits from energy savings without upfront capital expenses on the part of building owners. The *Guidebook* developed under the DOE-HUD Initiative instructs housing authorities on its use."

— Mark Ternes, ORNL

"The Energy Performance Contracting Training Workshop in Boston was excellent. Following the workshop, we issued a Request for Proposals, selected an energy service company, and conducted energy audits of our public housing units. We plan to complete energy modifications next year on 1,416 units."

— Gary Foster, Assistant Executive Director/Operations
Wilmington Housing Authority

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:

- **DOE Energy Partnerships for Affordable Homes**

This Partnership 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. DOE and HUD are seeking to improve the

energy efficiency and affordability of public and assisted housing. The Partnership will provide a range of direct on-site assistance services to housing providers from staff in DOE's national laboratories and other organizations. The Partnership is designed to build lasting capabilities among housing managers for technical analysis, financial management and

“Energy consumption is an important component of housing affordability and rebuilding local communities. This Partnership really drives home the opportunities for affordable, energy efficient housing for all Americans.”

— Christine Ervin,
DOE Assistant Secretary

project development that are essential in planning and carrying out energy efficiency improvements.

- **NCAT Clearinghouse for Energy Efficiency in Public and Assisted Housing** The National Center for Appropriate Technology (NCAT), under a special purpose grant administered by HUD, is operating a program that complements the Partnership by assuring that managers of public and assisted housing are aware of information and experience on the design, installation, and financing of

energy efficiency improvements. It will also serve as an important link to customized assistance available from the Partnership.

Aimed at the large scale delivery of energy efficiency, both programs will focus on accelerating housing improvements within whole communities or regions, as well as in individual buildings. The Partnership will leverage HUD's available capital improvement funds with investments from energy performance contractors, utilities and other sources.

While the DOE-HUD Initiative was intended to demonstrate the feasibility and benefits from energy efficiency improvements, the Partnership is a focused deployment effort designed to achieve two aggressive goals within the next five years:

- Create local and community partnerships that collectively commit to making energy efficiency improvements in at least one million, low-income housing units; and
- Achieve energy efficiency improvements that average 20% to 30% for all housing units treated under the program, saving \$200 to \$300 million annually.

Other goals of the Partnership include demonstrating financing strategies that maximize use of capital investment resources available from the private sector, and creating transferable local infrastructures and building specifications that support the development of affordable low-income housing.

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 federally assisted housing. The pilot projects described in this report prove that well-designed measures for energy efficiency can bring lasting cost reductions 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.

Conclusions resulting from the DOE-HUD Initiative have been independently confirmed by HUD's Office of the Inspector General. Results from the Inspector General's report (*Review of Opportunities to Reduce Utility Costs at Public Housing Authorities*, 95-SE-101-0001, U.S. Department of Housing and Urban Development, May 31, 1995) showed that housing authorities spend about 27% of their annual operating budgets on utility costs, and that effective management of these costs should be a continuous process that requires an ongoing energy management program, taking advantage of existing and new energy efficient technology. Additional findings concluded that:

- many housing authorities have not taken advantage of current technology or practices which are known to reduce utility costs; and
- housing authorities that have taken advantage of both new and old techniques for lowering utility costs have, in fact, achieved significant reductions, and expect these savings to continue.

Actions recommended in the Inspector General's report emphasized the need for better energy management programs within housing authorities that are characterized by clear-cut goals and objectives, and backed by strong management

commitments, energy performance standards, and training in energy conservation techniques. Additional recommendations were made for supporting actions that can improve the exchange of information about energy conservation in public housing, the pursuit of alternative funding sources, and the provision of continuing technical assistance to assure that housing managers have the tools needed to plan, implement and monitor their programs.

The Partnership and NCAT Clearinghouse

effectively address these recommendations. They provide a means for widely implementing the lessons learned by DOE, HUD, and state and local organizations over the past five years of the 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.

“Changes are occurring in public housing that will make it more important than ever that housing authorities manage their utility costs . . . The challenge for HUD and for housing authorities is to make public housing more energy efficient.”

— Audit Report,
HUD Inspector General

“The Partnership complements the ‘New HUD’ by improving the quality and affordability of housing units for residents, and by making them more competitive with low-income housing in the private market . . . it will enable DOE resources to reach housing managers more quickly and effectively, and it will ensure that energy improvements are installed concurrently with HUD's major initiatives for housing modernization.”

— Andrew Cuomo,
HUD Assistant Secretary

Appendix A

Project Descriptions:
Single Family Housing

Manufactured Housing Thermal Standards

Project Period: 1990-92

Goals and Objectives: The goal of this project was to test the proposed new HUD Thermal Standard for manufactured housing and to transfer to industry low and no-cost methods for meeting this Standard. A secondary goal of this project was to test the accuracy of the new HUD Compliance Computer Program.

Accomplishments: Two homes were built by Schult, Inc. to meet the new Standard. National Renewable Energy Laboratory (NREL) scientists conducted a factory observation visit while the homes were constructed. The homes were transported to the NREL Environmental Enclosure for testing.

Test results showed that manufacturers could meet the new standard with current technology and without major design or production modifications. With some design, production, and quality control modifications, manufacturers could exceed the standard.

Several loopholes in the standard were uncovered and fixes recommended. Improvements to the compliance calculation computer program were also recommended.

Project Partners: NREL; Manufactured Housing Institute; Schult Homes Inc.; and Pacific Northwest Laboratories (PNL).

Publications: Judkoff, Ronald D. and Gregory M. Barker, *Thermal Testing of the Proposed HUD Energy Efficiency Standard for New Manufactured Homes*, NREL/TP-253-4490, October 1992.

Judkoff, Ronald, "Checking Out HUD's Proposed Mobile Home Performance Standards," *Home Energy Magazine*, November/December 1993, pp. 21-26.

Continuing or Spin-off Activities: NREL is developing a computerized mobile home audit for the DOE Low Income Weatherization Assistance Program. NREL is also conducting thermal tests for the Modular Building Institute and the Structural Insulated Panel Association to improve the energy efficiency of modular offices and classrooms.

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Weatherization and Housing Rehabilitation Demonstration Program in Spokane, Washington

Project Period: 1992-93

Goals and Objectives: This project was one of four demonstration projects designed to improve the energy efficiency of low income housing. The goal of these projects was to illustrate the manner in which energy retrofits can and should be completed during housing rehabilitation to improve housing comfort and affordability. The other three projects, in Boston, Chicago, and Kansas City dealt with public, multifamily, and homeless shelter housing.

The project undertaken by the DOE Seattle Support Office was designed to show Community Development Block Grant (CDBG) and Residential Retrofit Program officials that program efficiency and energy savings could be the result of scheduling housing rehabilitation and energy efficient improvements at the same time. The goal of this effort was to leverage federal, state, and local funding to rehabilitate and weatherize 80 low income homes in the Spokane, Washington, area. A further goal of the project was to evaluate the efficiency of this process and its energy use impacts.

Accomplishments: The Spokane Neighborhood Action Program (SNAP) combined funding from Washington Water Power (a local utility), DOE, U.S. Department of Health and Human Services, CDBG, and the Farmer's Home Administration to weatherize, rehabilitate, and provide conservation education to 80 low income single family households in Spokane County, Washington. SNAP developed a database that tracks financial, demographic, and energy usage data. This database allows projects with varying sources of funding to be adequately tracked.

Each participating dwelling was audited for both weatherization and rehabilitation improvements. Work orders for both aspects of the job were prepared simultaneously. Typical weatherization measures included insulation, furnace repair and replacement, and infiltration improvements. Typical rehabilitation measures included new roofs, septic and drain field work, sheetrock installation on interior walls, and sheeting on exterior walls.

SNAP gained "first-hand" experience in combining funds, procedures, and goals of weatherization and rehabilitation programs. Both the positive and negative aspects of combining funding programs with different mandates and requirements were examined and experienced. This project allowed SNAP to develop software for tracking projects which can be replicated by other community organizations. SNAP has presented project results to numerous national and regional conferences.

Project Partners: DOE Seattle Regional Support Office; SNAP; Washington State Department of Community, Trade, and Economic Development; Spokane County Community Development Department; Washington Water Power; Farmer's Home Administration; and U.S. Department of Health and Human Services.

Publication:

Quaid, M. and Don Andre, *Evaluation Report, Spokane Neighborhood Action Program, DOE/HUD Comprehensive Rehabilitation Program, Spokane Neighborhood Action Program, Spokane, Washington, October 1994.*

Continuing or Spin-Off Activities:

SNAP continues to receive funding from several sources to complete rehabilitation on homes that are being weatherized. Rehabilitation funding sources include HOME, Farmer's Home Administration Housing Preservation Grants, and the Washington State Housing Trust Fund. The agency has 54 new clients for the combined weatherization and rehabilitation program, with another 350 on a waiting list. Two more agencies have combined their weatherization and rehabilitation programs, and eight more are beginning the process. SNAP is also continuing to present project results to interested parties, advocate for reconciliation of weatherization and rehabilitation eligibility and work standards, and make available the tracking database to weatherization and rehabilitation providers.

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Energy Efficient Rehabilitation of Single-Family Homes in Knoxville, Tennessee

Project Period: 1994-1996

Goals and Objectives: The goal of this project was to provide technical assistance to the Knox Housing Partnership (KHP) and to the City of Knoxville, Tennessee, on energy efficient housing rehabilitation, ensuring that residents have affordable utility bills in addition to affordable rents. An approach was developed to identify the level of energy efficiency that should be achieved during rehabilitation and to inspect the quality of completed work. The project was designed to serve the immediate needs of the Partnership and the City of Knoxville, and to serve as a model for fostering collaboration between local organizations and addressing energy efficiency during rehabilitation.

Accomplishments: KHP and the City of Knoxville are addressing the problems of substandard housing conditions and lack of affordable housing opportunities for low-income households in Knox County, Tennessee. They revitalize purchased housing for subsequent ownership or rental by low-income families. Similar organizations are performing comparable work in other states such as Maryland and Texas.

Southface Energy Institute, Inc. and Oak Ridge National Laboratory (ORNL) provided a one-day workshop for KHP and City of Knoxville personnel on energy efficiency rehabilitation tailored to the southeast. The workshop provided general information on energy efficiency and corrected some myths and misconceptions about repairs targeted at energy conservation. The workshop addressed diagnostic and installation techniques related to insulation, air sealing, and equipment, and discussed how to prioritize the expenditure of energy rehabilitation dollars.

Project Partners: ORNL; Southface Energy Institute, Inc.; KHP; and City of Knoxville, Tennessee.

Publications: None

Continuing or Spin-off Activities The University of Tennessee Municipal Technical Advisory Service has expressed interest in broadcasting a condensed version of the workshop to other Tennessee municipalities over their video-teleconferencing system.

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HERS/EEMS National Collaborative

Project Period: 1991-92

Goals and Objectives: The goal of this project was to gain consensus on a program for linking mortgage financing to voluntary home energy rating systems (HERS).

Accomplishments: DOE, with the cooperation of HUD and the National Renewable Energy Laboratory (NREL), sponsored a series of 10 meetings, utilizing a facilitator to develop a program linking mortgage financing to voluntary HERS. Participants in the meetings formed a HERS Council, which, along with other organizations, is now involved in implementing the program and is providing input into the HERS guidelines required by the Energy Policy Act (EPACT). The program plan, *Blueprint for Action*, was prepared by the participants and published by NREL.

Project Partners: NREL; building industry representatives; financial institutions; real estate interests; utilities; consumer, environmental, state, and local organizations. Financial institutions included HUD/FHA, Veterans Administration, Farmers Home Administration, Fannie Mae, Freddie Mac, and mortgage bankers.

Publication: *Blueprint for Action*, DOE/NREL, NREL/TP-261-4677, March 1992.

Continuing or Spin-Off Activities: The HERS Council is working on program implementation and providing input into the HERS guidelines. Other organizations are beginning to develop mechanisms to also participate in program implementation.

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Energy Conservation Retrofit Program for Transitional Housing

Project Period: 1991-92

Goals and Objectives: This project was designed as a pilot project to provide funding and technical assistance for energy retrofits of homes obtained by homeless service providers through the HUD Property Disposition Program. These HUD repossessed single family properties were to be used as transitional housing.

Accomplishments: With funding provided by the Initiative, the Illinois Department of Energy and Natural Resources (ENR) offered transitional housing providers in the Chicago area the opportunity to participate in the retrofit program. After considerable evaluation and interviews, the following five housing providers were selected: Calumet City Housing Authority; Chicago Youth and Community Service Organization; Willfeed Community Organization; the City of Urbana; and Inner Voice. Together, these organizations operated 19 living units. HUD provided the structures for a \$1 per year lease. Homeless providers were to fund general rehab of the structures, after which grants up to \$5,000 would be made for cost effective energy retrofits.

Because some of the housing providers needed more technical assistance than anticipated, ENR contracted with the Center for Neighborhood Technology of Chicago to assist in conducting energy audits, and reviewing and selecting contractors.

Each building was analyzed to determine both building rehabilitation and energy efficiency needs. Participating organizations managed the building rehabilitations, with the assistance of state and local funding and "sweat equity," and the DOE-HUD Initiative and ENR funding paid for the energy improvements.

In all, \$57,582 was expended on the project. Nineteen housing units were retrofitted, providing homes for 15 families and over 30 individuals. The majority of houses received high efficiency furnaces; other energy improvements included insulation, flue dampers, storm windows, caulking, and weatherstripping. Clients received explanations of the energy measures installed, as well as educational materials encouraging energy conservation. Initial estimates of combined energy savings for the 19 dwellings is estimated at over \$12,000 annually.

The project generated positive working relationships between ENR and homeless providers in the Chicago area, as well as greater coordination between state and local energy and rehabilitation programs. Community groups began to understand the importance of energy efficiency for affordable housing and realized, with the help of the Center for Neighborhood Technology, that installing energy measures in their dwellings was not difficult.

Project Partners: ENR; Center for Neighborhood Technology of Chicago; Calumet City Housing Authority; Chicago Youth and Community Service Organization; Willfeed Community Organization; City of Urbana; and Inner Voice.

Publication:

Final Report, the Energy Conservation Retrofit Program for Transitional Housing as Part of the HUD/USDOE Initiative, Submitted by the Illinois Department of Energy and Natural Resources, Consumer Assistance Section, October 1993.

Continuing or Spin-Off Activities:

ENR requested additional funds from the DOE-HUD Initiative to continue this effort. That funding was denied, but funding was granted from the petroleum violation fund ("Oil Overcharge Monies") to assist two community groups with the energy retrofit of their facilities.

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Homeless Interagency Cooperative Partnership

Project Period: 1992-94

Goals and Objectives: The objective of this project, undertaken by the DOE Philadelphia Regional Support Office (PRSO), under the umbrella of an Interagency Council of the Homeless, was to improve the energy efficiency of federally supported housing, in particular dwellings used to shelter homeless persons. The PRSO's goal was to design and conduct a pilot project to rehabilitate 50 selected residences used for homeless housing, to make them more habitable as well as more energy efficient. The project was designed as a two-year effort. DOE-HUD Initiative funds were used to leverage funds from the Philadelphia Housing Development Commission and the Pennsylvania Department of Community Affairs Weatherization Assistance Program, as well as from other state and local sources.

It was hoped that non-profit homeless assistance providers would take advantage of purchasing properties at an annual lease of \$1 per property per year, extendable up to five years, through HUD's "Lease and Sale of Acquired Single Family Properties for the Homeless" program.

Accomplishments: The following agencies signed a Memorandum of Understanding to begin this program: HUD; PRSO; the City of Philadelphia; the Philadelphia Housing Development Corporation (PHDC); the Pennsylvania Department of Community Affairs; the City of Philadelphia Office of Housing and Community Development; and Food for All, a non-profit agency which assisted in the rehabilitation of the houses and in the selection of homeless families.

PRSO developed a set of guidelines for operation of the project, and presented them to all participating agencies to ensure the installation of energy efficient equipment and supplies in each dwelling, monitoring of energy savings, and furnishing of results to other interested parties.

In cooperation with local utilities, the non-profit agencies, and dwelling occupants, a no-cost energy improvement and education program was developed for occupants of the renovated houses. The purpose of this program was to assist them with implementing no-cost measures which would reduce operating costs once the energy efficiency measures were installed.

Rehabilitation of dwellings was coordinated by the PHDC. Once properties were identified, an energy audit was conducted of each home to determine which energy measures to install. Following rehabilitation and retrofit, each dwelling would again be subject to an energy audit to determine the improvement in energy efficiency. The energy audits were jointly conducted with local utilities.

In the first year of this project, twelve organizations retrofitted twelve properties, at a cost of \$10-12,000 each. DOE-HUD and Weatherization Assistance Program funds provided \$5,000 toward this cost, and HUD Community Development Block Grant funds provided the remainder. Energy measures installed included insulation, furnace replacements, energy efficient equipment, and energy related repairs to roofs, ceilings, windows, and doors.

Project Partners:

DOE PRSO; City of Philadelphia; PHDC; Pennsylvania Department of Community Affairs; the City of Philadelphia Office of Housing and Community Development; Food for All; and utility companies.

Publications:

None

Continuing or Spin-Off Activities:

None

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Homeless Shelter Retrofit Guide

Project Period: 1990-92

Goals and Objectives: *Energy Conservation in Housing for the Homeless, A Guide for Providers*, was written for three targeted audiences: (1) human and social service providers, with little or no experience in the ownership and operation of residential properties; (2) religious or secular based non-profit organizations with limited experience in the ownership and operation of housing; and (3) housing authorities or experienced non-profit organizations that have had experience in owning and operating residential facilities but have limited experience in applying energy analyses or retrofit strategies to their properties.

The objective of the *Guide* was to provide energy retrofit information to homeless housing providers who are renovating existing buildings using federal funds. The *Guide* was written specifically for McKinney fund recipients, who utilize federal funds for rehabilitation, construction, and conversion of facilities to assist homeless people.

Although the term "homeless housing" applies to a wide range of building types, from single-family homes to institutional shelters, this *Guide* is most useful for large group homes, transitional homes, or small shelters of less than 10,000 square feet. The *Guide* was designed to be used with a case study document and a short videotape, neither of which was funded; all three products were to be used as outreach tools for providers in need of education, training, and technical assistance.

Accomplishments: The *Guide*, written by the National Renewable Energy Laboratory and printed by HUD, incorporated the ideas and concerns of homeless housing providers, through the involvement of the American Institute of Architects Search for Shelter program. The first printing was exhausted following distribution of 3350 copies to HUD field offices for distribution to homeless assistance organizations, 600 copies to the members of the Interagency Council on the Homeless, and 1650 copies which were distributed on an as-requested basis. Of the second printing, over 900 copies were distributed (after publicity) to the Federal Emergency Management Agency.

The *Guide* has five sections: (1) a four-step strategy for approaching energy efficiency in a renovation project; (2) suggestions on what to look for when buying a building to renovate, including energy-efficient design options; (3) energy saving measures for a homeless shelter; (4) operation and maintenance issues; and (5) resources for further information. Energy saving measures range from no- and low-cost to more costly options. Most of the measures recommended in the *Guide* are based on a 10- year payback period.

Project Partners: National Renewable Energy Laboratory; and American Institute of Architects, Search for Shelter.

Publication: *Energy Conservation in Housing for the Homeless, A Guide for Providers*, National Renewable Energy Laboratory, Mechanical and Industrial Technology Division, HUD-1382-CPD, January 1993

**Continuing or Spin-
off Activities**

None

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Indian Housing Design Guide

Project Period: 1990-93

Goals and Objectives: The goal of this project was to research, write, and produce an Indian Housing design guide which would address two issues related to the design of houses built with federal funds: cultural relevance and energy efficiency. The National Renewable Energy Laboratory (NREL), formerly the Solar Energy Research Institute, was selected to address the energy efficiency issue.

NREL wished to address the concern that most houses built for Indians do not consider Indian traditions or culture in their design, nor do designers solicit input from the future occupants of these buildings. By integrating energy design improvements into these dwellings, the goals of cultural relevance and energy efficiency would be jointly achieved.

Accomplishments: For this project, NREL built on passive solar design guidelines for homebuilders developed in collaboration with the National Association of Homebuilders and the Passive Solar Industries Council. These guidelines, with the addition of Indian sensitive issues such as native materials, open-plan layouts of traditional Indian houses, and the need for sunlight from the east or south, were used to bring out the ideas of the American Indian Council of Architects and Engineers (AICAE) and to integrate them into energy conscious design guidelines.

NREL and its project partners wrote *Our Home, Buildings of the Land, Energy Efficiency Design Guide for Indian Housing*. The AICAE wrote the companion document, *Our Home: Giving Form to Traditional Values, Design Principles for Indian Housing*, published at the same time and under the same auspices as the energy efficiency guide. This second guide discusses the cultural issues of Indian housing.

Both of these design guides were written to complement the PC software designed by NREL, entitled *BuilderGuide*. *BuilderGuide* is most useful for, but not limited to, design of passive solar systems. This software allows the designer to calculate different energy-efficient strategies or combinations of strategies and the effect that design changes will have on the overall energy performance of the house.

NREL and its partners participated in six workshops in various regions throughout the country to solicit opinions from local Indians regarding their views on house design. AICAE brought together their members, composed mainly of Indian architects and engineers with a knowledge of Indian traditions and also with design, contracting, and construction of HUD-funded Indian housing, with energy professionals concerned with energy efficiency in HUD-financed housing. The workshops provided an opportunity for participants to identify and prioritize issues important to Indian housing and to allow those present to design houses that incorporate both energy efficient and culturally relevant concerns.

Our Home, Buildings of the Land, Energy Efficiency Design Guide for Indian Housing was distributed by HUD's Office of Native American Programs to all Indian Housing Authorities. Additional copies were sent to all HUD Area Office of Native American Programs.

Project Partners:

NREL; AICAE.

Publication:

Our Home, Buildings of the Land, Energy Efficiency Design Guide for Indian Housing, National Renewable Energy Laboratory, HUD Publication Number HUD-1410-CPD, March 1994.

Continuing or Spin-Off Activities:

NREL is using the same format to develop an Energy Efficiency Design Guide for U.S. National Park Service employee housing.

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Energy-Efficient Home Design for the Navajo People

Project Period: 1992-94

Goals and Objectives: The need for new housing is one of the most pressing issues facing the Navajo today. The goal of this project was to work together with the Navajo in finding solutions to their housing needs that would improve their energy efficiency and comfort. To help reach this goal, the DOE San Francisco Support Office (SFSO), with the assistance of HUD and Lawrence Berkeley Laboratory (LBL), proposed to design and build a Navajo home which would incorporate traditional cultural values and utilize local building materials and labor.

Accomplishments: The San Francisco Support Office provided funds to the Navajo Nation to hold a workshop, or "design charrette" in late 1992, to explore design alternatives for new energy-efficient housing. Participants in the workshop included representatives from the Navajo, local and national architects, and two energy experts from LBL.

The workshop led to the development of several construction methods, including the use of straw bales, adobe and rammed earth, conventional framing, as well as the use of fibercrete. Plans for a prototype home were finalized in the spring of 1993, with construction begun in July of that year, near Ganado, Arizona, on the Navajo Nation. The prototype home was a combination of adobe and straw bale construction, both materials having over a 100-year history as construction materials in this area. The home incorporates passive solar design and was constructed with local materials and labor. It has been completed, and is now occupied by a Navajo family.

DOE wrote a 16-page booklet on Straw Bale Construction, entitled *House of Straw: Straw Bale Construction Comes of Age*, for distribution to Indian Housing Authorities and Indian architects and engineers throughout the country. A technical report on this project was also prepared.

Project Partners: DOE SFSO; LBL; Navajo Housing Authority; Navajo Housing Services; and Navajo Nation, Division of Community Development.

Publications: *House of Straw: Straw Bale Construction Comes of Age*, DOE San Francisco Support Office, U.S. Department of Energy, DOE/6010094-01, April 1995.

Navahomes: A Dinelogical Study of Navajo Dwelling in Balance with the Land, The Navajo Nation, Division of Community Development, Design and Engineering Services, December 1992.

Hanford, Jim and Joe Huang, *Energy Efficient Building Technologies for the Navajo, Reservation and Analysis of a Straw Bale/Adobe Dwelling Prototype*, Final Review Draft, LBL, November 1994.

Continuing or Spin-Off Activities: A workshop on Indian housing was presented at the 1995 DOE National Weatherization Conference, with representatives from the Navajo Nation as well as others working in Indian housing.

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Video and Resource Guide for Energy Efficient Housing Rehabilitation

Project Period: 1990-93

Goals and Objectives:

The goal of this project was to provide technical information on energy efficient housing modifications which can be made during moderate or gut rehabilitation on single family, federally-subsidized dwellings. Production of a 58-minute training videotape and a companion *Resource Guide* was the method used to provide this information. DOE and HUD's Office of Affordable Housing had the following objectives in mind:

- illustrate energy efficient retrofit measures which are technically and cost-effectively appropriate during single-family housing rehabilitation;
- encourage energy retrofit during housing rehabilitation, rather than afterwards, to save both time and money; and
- provide easy to follow checklists for housing rehabilitation specialists to use when working with their clients, to make rehabilitation specialists comfortable with the retrofit/rehabilitation process.

Accomplishments:

Energetics, Incorporated, with the combined efforts of many individuals and organizations, produced a 58-minute videotape entitled *Eye on Energy: Rehab for All Seasons*. The videotape was written and produced by a professional company, and filmed primarily in the Baltimore metropolitan area. Additional footage was obtained at the DOE Weatherization Training Center in Williamsport, Pennsylvania. Technical assistance was provided by Oak Ridge National Laboratory (ORNL).

Narrated by a professional actor, the videotape was divided into three segments: overview and air infiltration measures; ceiling, wall, and floor insulation; and heating, ventilation, and air conditioning (HVAC) equipment and systems, water conservation, and appliances. The three segments are each 19-21 minutes in length and provide state-of-the-art energy efficiency and installation information for equipment and house sealing, and "tips" for working with occupants on the selection of energy measures prior to the rehabilitation process.

A *Resource Guide* was produced and submitted to DOE and HUD so that one of HUD's contractors could produce a final text. The *Guide* was designed to be used alongside the videotape, in a training setting. In this way, the videotape could be viewed, stopped at appropriate places, and the *Guide* used for actual energy measure calculations with the assistance of teachers or trainers.

Both the videotape and *Guide* have been distributed to HUD regional offices and housing and community development organizations. Many more copies were sent out to regional, state, and local housing organizations throughout the country, for them to copy and utilize in training programs. Four hundred fifty videos and 2500 copies of the *Guide* have been provided to the American Communities Information Clearinghouse, operated by HUD.

Project Partners:

Energetics, Incorporated; ORNL; Montgomery County Department of Housing and Community Development; Baltimore City Housing Department; Home-Tech, Inc.; Pennsylvania Weatherization Training Center; National Association of Housing and Redevelopment Officials; Baltimore Gas & Electric; Rockville Window and Door; Melroy Plumbing; Harford County, MD, Weatherization Program; Baltimore Neighborhood Housing Services; Baltimore Jobs in Energy; and Acadia Windows & Doors, Inc.

**Publication and
Audio-Visuals:**

Eye on Energy: Rehab for All Seasons, Energetics, Incorporated, Columbia, MD, 1993.

Video Companion Guide, Eye on Energy: Rehabilitation for All Seasons, ICF, Inc. and Energetics, Incorporated, HUD-1528-CPD, May 1995.

**Continuing or Spin-Off
Activities:**

HUD's Training Contractor, ICF Incorporated, has designed a training package, including the videotape and *Resource Guide*. The package is available through the American Communities Information Clearinghouse.

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American Communities Information Clearinghouse
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Owner's Guide to Energy Efficiency in Single Family Rental Housing

Project Period: 1990-91

Goals and Objectives: The purpose of this project was to develop and produce a guide on energy efficient improvements which can be made by single family building owners and investors. Owners and investors often make cosmetic improvements to properties they wish to rent out, but do not recognize that a financial return is possible as well from energy efficient improvements. Moreover, because the energy improvements persist over time, the savings and the value of the building also persist.

DOE and HUD hoped to reach investors and owners at the time they approached HUD for rehabilitation financing. By providing a short, concise guide on energy efficient improvements which can be easily and cost-effectively made to improve investments in single family dwellings, DOE and HUD hoped to tie rehabilitation financing and energy rehabilitation together. Although not a requirement for HUD financing, energy efficient improvements made during rehabilitation are known to be more effective, both from a technical and cost perspective.

Accomplishments: Energetics, Incorporated, produced a fifteen-page guide, *An Owner's Guide to Energy Efficiency in Single Family Rental Housing*. HUD initially printed 7000 copies in 1992. Over 3000 were sent to HUD field offices, and over 2000 were mailed to Community Development Block Grant grantees, HOME participating jurisdictions, and Comprehensive Housing Assistance Strategy coordinators. Remaining copies were quickly used up by bulk requests from localities.

A second printing in March 1993 provided 10,000 copies, of which 3000 were sent to the American Communities Information Clearinghouse. Extra sets of the negatives were made and provided to cities and states interested in printing their own supplies.

Project Partners: Energetics, Incorporated; Oak Ridge National Laboratory; Baltimore City Department of Housing and Community Development.

Publication: *An Owner's Guide to Energy Efficiency in Single Family Rental Housing*, Energetics, Incorporated, HUD-1381-CPD, November 1992.

Continuing or Spin-Off Activities: None

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Appendix B

Project Descriptions:
Multifamily Housing

Multifamily Rehabilitation in the Midwest

Project Period: 1993-94

Goals and Objectives: The purpose of this project was to evaluate the performance of super-insulation energy efficiency measures in multifamily moderate rehabilitation and to develop cost-effectiveness estimates for energy saving measures through energy efficient rehabilitation in the Midwest. Further goals of this project were to provide information dissemination on super insulation to rehabilitation professionals, and to develop an analytic method which would assist housing providers in analyzing the differences between super-insulation and conventionally insulated rehabs.

Accomplishments: The project team, Argonne National Laboratory (ANL) and the Energy Resources Center of the University of Illinois at Chicago, collected and analyzed energy and cost data on two multifamily buildings, located side by side in the same Chicago neighborhood. The team also conducted blower-door tests on the two buildings; interviewed community developers on super-insulation and conventional insulation techniques; developed architectural drawings of energy conservation measures for the two buildings; and provided technical assistance for the installation of energy conservation measures in the two buildings. Oak Ridge National Laboratory provided test instrumentation to measure energy savings. Lawrence Berkeley Laboratory assisted with blower door diagnostics.

Super-insulation measures included R-43 insulation in attics, R-19 insulation in exterior walls, low-emissivity coatings on windows, air infiltration sealing, and high-efficiency heating systems. Typical building rehabilitations did not include wall insulation, heating systems were rehabbed rather than replaced, and air infiltration sealing was sporadically done.

The two buildings were rehabbed using the conventional and the high efficiency techniques.

The project team presented their project at the Affordable Comfort Conference to share their information on energy efficient rehabilitation - both super-insulation and conventional - with housing and rehabilitation providers. The team also utilized DOE-2 building simulation software to compare the energy costs and savings between the two buildings.

For an average Chicago heating season with 6,455 heating degree-days, use of the super-insulating retrofit techniques was estimated to save about 710 therms of natural gas and lower gas energy costs in a 1,100 square foot apartment by about \$355.

Among the recommendations made by the project team were to expand super-insulation rehabilitation and retrofit techniques to multifamily building projects in which demolition of the interior structures is not required or buildings are not vacant, and to expand research into the special opportunities for incorporating energy conservation in low-income communities.

The project team established working relationships with several community development organizations to the extent that they will now permit monitoring of their rehabbed buildings in exchange for technical assistance on the installation of energy conservation measures.

Project Partners:

ANL; ORNL; LBL; Energy Resources Center of the University of Illinois at Chicago; Domas Plus, Inc.; Kenwood-Oakland Development Corporation; and the Illinois Department of Energy and Natural Resources.

Publication:

Energy-Efficient Rehabilitation of Multifamily Buildings in the Midwest, An Argonne National Laboratory Technical Memorandum (ANL/DIS/TM-16). Report on WorldWideWeb (http://www.eren.doe.gov/ee/cgi-bin/rehab_doc/rehab_title.html).

Conference Presentation at Affordable Comfort 1994, by John Katrakis.

Continuing or Spin-Off Activities:

The ANL team developed a new project as a result of the findings of this project, to look at the incorporation of energy conservation measures in moderate rehabilitation. This new project is part of a larger partnership with a community development corporation. The partnership will examine how DOE technologies can assist in the economic development of a distressed urban community.

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**Utility Retrofit of Section 202 Housing in
Worcester, Massachusetts
and
HUD 221(d)(3) Housing in
Burlington, Vermont**

Project Period:	1990-92
Goals and Objectives:	The goal of both of these projects was 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). A further goal of these projects was to evaluate energy savings and demonstrate their replicability elsewhere.
Accomplishments:	<p>The Worcester demonstration was a comprehensive retrofit of multifamily housing for the elderly. The New England Electric System (NEES) included this retrofit as part of their multifamily retrofit program. After reviewing over one hundred sites in Massachusetts, NEES selected Colony Retirement Homes IV, a 70-unit all-electric housing project in Worcester.</p> <p>A technical walk-through audit was completed by Rhode Islanders Saving Energy in May 1991 and reviewed by DOE and Lawrence Berkeley Laboratory (LBL). Selected retrofits, including lighting measures and heating controls, were installed in October 1991. They were found to be successful and cost-effective, although some heating controls were consistently overridden by the building manager. NEES estimated that the retrofits would save over 150,000 kWh/year, at a cost of \$38,312.</p> <p>The Northgate project in Burlington, Vermont, involved the total rehabilitation of 350 low-income units with extensive energy retrofits and fuel switching from electricity to gas. 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.</p> <p>LBL provided technical assistance in the design and evaluation of both projects. Both projects had high visibility and the findings have been reported widely in energy publications and at energy conferences and meetings. A videotape of the Northgate experience was also produced and shown at numerous energy and housing meetings.</p>
Project Partners:	Colony Retirement Homes; NEES; Northgate Housing, Inc.; the Burlington Electric Department; Rhode Islanders Savings Energy; and LBL.
Publications:	<p>Patullo, Chip, "Making Low Income Housing Affordable: The Northgate Retrofits," <i>Home Energy</i>, Volume 10, Number 2, March/April 1993, pp. 13-16.</p> <p>Patullo, Chip, <i>The Northgate Miracle: Energy Efficiency and Affordable Housing</i>, Northgate Housing Inc., Burlington, VT, 1992.</p> <p><i>The Northgate Miracle</i>, 15-minute videotape, Northgate Housing, Inc., Burlington, VT, 1993.</p>

R.C. Diamond et al., *Affordable Housing Rehabilitation in Vermont: Energy Savings, Cost-Effectiveness, and Resident Satisfaction*, published in the Proceedings of the Thermal Performance of the Exterior Envelopes of Buildings V, Clearwater, FL, December 1992.

**Continuing or Spin-Off
Activities:**

One spin-off activity was the development of a case-study based on the Northgate work which was included in the curriculum of two architecture schools, the Graduate School of Design, Harvard University, and the California College of Arts and Crafts (1992-94)

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Energy Efficiency Financing and Modifications in Mount Vernon, New York

Project Period: 1993-94

Goals and Objectives: The New York Regional Support Office (NYRSO) coordinated two projects in the multifamily area.

The first project was designed to obtain financing, both public and private, for energy efficiency improvements on a 131-unit retirement building (Petrillo Homes) owned by a non-profit organization. Saving federal dollars through energy conservation and rehabilitation was the overall goal; using financing from a variety of sources was the secondary goal.

The second project was designed to develop and demonstrate electric submetering of HUD-assisted multifamily buildings through bank financing provided, in part, by electric utilities incorporating submetering in their DSM programs. A secondary goal of this effort was to identify major institutional barriers to electric submetering in multifamily buildings.

Accomplishments:

The New York Regional Support Office secured a total of \$267,651, a \$105,000 grant for window retrofits and \$162,651 in loans and loan subsidies to pay for HVAC and lighting retrofits. The grant came from the New York Department of State. The loans came from Community Mutual Savings Bank, White Plains, N.Y. The interest subsidy and 75% of the loan were guaranteed by the New York State Energy Office's Investment Loan Program, and the remaining 25% was secured with a HUD-mandated reserve fund maintained and controlled by Petrillo's owners.

Energy efficiency measures installed included low-E glass windows; two new dual-fuel burners on existing boilers; a super-high-efficiency gas-fired, semi-instantaneous modulating water heater; a custom motorized fuel valve system; and upgraded exterior lighting.

Energy savings from the window retrofit are estimated at 2,007 million Btu/year, and from the HVAC and lighting upgrades, 1,038 million Btu/year. Total dollar savings are estimated to be over \$28,000 annually.

To complete the submetering project, two Task Forces (Financing and Barriers) were established. Financing models were developed, with barriers and solutions identified by the respective Task Forces. Publication of a contractor report was the primary achievement of this project.

Project Partners:

DOE NYRSO; EIS Inc.; New York Department of State; New York State Energy Office; Petrillo Apartments; and Community Mutual Savings Bank. Project partners for the submetering effort included EIS Inc.; building managers for a number of HUD-assisted multifamily buildings; utility companies; and lending institutions who participated in the Task Forces.

Publication:

E.I.S., Inc., *Regulatory Reform and Financial Incentives for Electric Submetering Conversions: A Blueprint for Achieving Energy Conservation Fairness and Personal Responsibility Through the Metering and Billing of Apartment Electric Use in Electrically Mastered-Metered Multifamily Buildings in New York*, July 1995.

**Continuing or Spin-Off
Activities:**

As a follow-on to the Petrillo Homes project, the New York Support Office is developing a demonstration project to further illustrate innovative financing for multifamily energy efficiency retrofit. As a follow-on to the submetering project, the Support Office has proposed a demonstration project to test the financing models proposed by the Financing Task Force.

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Guidelines for the HUD Capital Improvements Loan Program

Project Period: 1990-91

Goals and Objectives: The goal of this project was to assist HUD in re-writing the *Multifamily Asset Management and Project Servicing Handbook* to include energy audit requirements for multifamily housing, as well as conversions from master metered to tenant paid utilities. Energy surveys are 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.

Accomplishments: Chapter 12 of the Handbook was reviewed and rewritten to include requirements for energy surveys and technical audits for HUD multifamily housing stock. Suggested energy conservation measures were provided, as was guidance on selection of professional architects and engineers for the conduct of technical energy audits. Guidance was also written on the conversion of master metered utilities to individual or tenant paid utilities.

Project Partners: Lawrence Berkeley Laboratory.

Publication: *Chapter 12, Energy Conservation, 4350.1, Rev-1, Multifamily Asset Management and Project Servicing Handbook*, HUD Office of Multifamily Housing Management.

**Continuing or Spin-Off
Activities:** None

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Multifamily Property Disposition Handbook

Project Period: 1990-92

Goals and Objectives: The purpose of this project was to develop guidelines for multifamily housing projects where HUD is Mortgagee-in-Possession or Owner. Resident involvement in improved property management was an additional objective of this project.

Accomplishments: Existing literature was reviewed. Revisions were made to various provisions of the *Multifamily Property Disposition-Management Handbook*. Appendix 10-2, *Energy-Efficient Guidelines for Projects Where HUD is Mortgagee-in-Possession or Owner* was added as a checklist. The resident initiatives revisions set out requirements for resident participation in management decisions, including energy efficiency improvements that impact their living conditions. Building repair revisions provide policies and procedures regarding repairs to owned and MIP projects. Repairs specifically dealing with energy efficiency are highlighted for repair surveys, plans, and implementation. Appendix 10-2 addresses energy conservation measures which are to be considered during building repair, planning, and implementation.

The *Handbook* revisions were completed in July 1992. 6,500 copies were printed and distributed to managers and staff in the field. This document impacts multifamily housing where HUD is Mortgagee-in-Possession or Owner.

Seventy field staff received training on the *Handbook* revisions, including the policies and procedures for cost-effective energy efficiency improvements. Field staff are responsible for implementing departmental policy and monitoring procedures.

Project Partners: HUD's Multifamily Property Disposition Division.

Publication: *Handbook 4315.1 for Multifamily Property Disposition-Management, and Appendix 10-2.*

Continuing or Spin-Off Activities: HUD Energy Division staff arranged for field staff to receive information on utility programs to implement use of this material.

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Technical Assistance Program in the Midwest

Project Period: 1992-94

Goals and Objectives: DOE Region V, the Chicago Regional Support Office (CRSO), undertook the task of providing technical assistance to HUD and its grantees on the incorporation of energy efficiency techniques into HUD policies, practices, and its assisted-housing program. The goal of this effort was to educate HUD staff on energy and to provide outreach to HUD grantees as well. An additional goal was to reach the assisted housing market, including private developers, owners, and managers who have HUD-subsidized tenants in their buildings, with education and training on cost-effective energy efficient improvements.

Accomplishments: DOE and HUD agreed to a Memorandum of Understanding which provided that the CRSO would serve as an energy clearinghouse; provide assistance for presentations, meetings, conferences, workshops, and other related events; and facilitate communication among housing and energy providers and organizations such as weatherization providers, state energy offices, housing, energy and related building associations, and research, training, and consulting organizations in state and local government.

DOE contracted with University of Illinois at Chicago's Energy Resources Center to develop a manual with slides on energy efficient multifamily building rehabilitation. The manual was used in three training workshops in the region, targeted to the private, assisted (Section 8) housing community.

After the workshop series, DOE continued its technical assistance program through a column on energy efficiency in the *Midwest Assisted Housing Management Association Journal (MAHMA)*.

DOE Staff introduced a number of software packages to HUD audiences that could be used in the conduct of their own energy audit and retrofit projects, including ENACT, ASEAM 3.0, BLCC 4.0, ENVSTD 2.0, WINDOW 4.0., and MECHECK.

CRSO also conducted a series of introductory courses on energy efficiency for Chicago HUD staff, and began an initial examination of HUD procedures for reviewing projects and proposals to determine the best way to institute compliance with the 1992 Model Energy Code and ASHRAE 90.1B.

Project Partners: DOE CRSO; Energy Resources Center, University of Illinois at Chicago; state and local energy and housing organizations.

Publications: Knight, Paul, *Energy Saving Opportunities in Rehabilitation Training Manual*, and Companion Slides, Energy Resources Center, University of Illinois at Chicago, 1993

Regular series in *Midwest Assisted Housing Managers Association Magazine*

**Continuing or Spin-
Off Activities:**

A second round of workshops will be conducted in Chicago that will center on computer software assistance tools. The tools will be for both in-house review as well as field diagnostics. Introductory and advanced workshops will be offered for the other HUD Field Offices located in the region. HUD grantees in both public, assisted, multi- and transitional housing will be invited to participate in the educational program.

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Appendix C

Project Descriptions:
Public Housing

Overcoming Obstacles to Performance Contracting in HUD-Assisted Housing

Project Period: 1993-94

Goals and Objectives: The goals of this project were to 1) examine the financial, institutional, behavioral, and technical barriers to performance contracting in publicly assisted housing; and 2) to document the persistence of savings generated by energy efficiency improvements in public and assisted housing funded through performance contracts.

Accomplishments: A report was produced on the barriers to performance contracting in publicly assisted housing and recommendations for overcoming these barriers. Savings were analyzed from 17 gas-heated public housing developments to determine persistence factors. A report was written discussing these factors and presenting recommendations for lasting savings.

Project Partners: Citizens Conservation Corporation (CCC), Oak Ridge National Laboratory.

Publications: J. DeBarros and S. Nolden, *Energy Efficiency in Publicly Assisted Housing: Barriers and Recommendations*, Citizens Conservation Corporation, Boston, Massachusetts, 1994.

S. Nolden and J. Snell, *Persistence of Savings in Low-Income Multifamily Housing Retrofits Involving Equipment Measures*, Citizens Conservation Corporation, Boston, Massachusetts, 1994.

"The Key to Persistence," *Home Energy*, Vol. 12, No. 5, pp. 46-48, Sept./Oct. 1995.

Continuing or Spin-Off Activities: None

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Durability of Energy Conservation Measures in Public Housing

Project Period: 1990-92

Goals and Objectives: The goals of this project were twofold: to determine whether savings from energy efficiency retrofits installed during modernization continue past the first year of operation; and to learn, if possible, what factors contribute to the durability of savings. If these goals could be realized, the project's objectives could be met: to assist public housing authorities (PHAs) with selection of energy savings measures which could reliably be expected to return savings over an extended period of time.

Accomplishments: A previous study of 43 retrofit projects in PHAs located in various locations in the U.S. found that initial energy savings did not always persist into the second and third post-retrofit years. Using 24 of these projects (including about 12,500 apartment units), Lawrence Berkeley Laboratory (LBL) collected utility bills from these projects covering several years (2-4 years) following their retrofit, and normalized them for weather and occupancy. The analysis considered climate variation, type of building and occupant, type of conservation measure, and pre-retrofit energy use.

LBL determined that the extent to which savings persist depends on the type of conservation measure installed. Energy savings from equipment measures that require ongoing maintenance (i.e., heating controls, new boilers, solar hot water systems, etc.) are less likely to persist beyond the first post-retrofit year. Shell measures (i.e., window replacements, insulation, etc.) maintain their savings over several years.

A paper on this research was published and presented at the ACEEE Summer Study (1992).

Project Partners: LBL; and forty PHAs throughout the country who opened their utility records to LBL.

Publications: R. Ritschard and A. McAllister, *Literature Review on Durability of Energy Conservation Measures*, LBL, June 1991.

R. Ritschard and A. McAllister, "Persistence of Savings in Multi-family Public Housing," in the *Proceedings of the 1992 ACEEE Summer Study on Energy Efficiency in Buildings*, American Council for an Energy Efficient Economy, Washington, D.C. 1992.

Continuing or Spin-Off Activities:

The DOE-HUD Initiative continued the analysis of the persistence of savings by supporting Citizens Conservation Corporation in Boston, MA, in their study of several multifamily buildings retrofit projects. The Initiative also made funding available to track energy savings from the Northgate Housing Project in Burlington, VT, and for continuing energy savings analysis on Chelsea Housing Authority buildings.

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Energy Use and Cost Accounting/ Tracking System

Project Period: 1991-94

Goals and Objectives: The goal of this project was to assist public housing authority (PHA) managers in developing and institutionalizing the concepts of long-term system operation, maintenance, and repair; and to educate PHA staff on reducing energy use, increasing equipment life, reducing equipment outages, and improving the living environment for public housing residents. A secondary goal of this project was to test the appropriateness of energy performance contracting for PHA energy rehabilitation.

Accomplishments: Three major activities were initiated. The first was a performance-based renovation and recommissioning project with the Housing Authority of Kansas City, Missouri. Using the publication *Energy Performance Contracting for Public and Indian Housing - a Guide for Participants*, a Request for proposal (RFP) was issued, an energy service company (ESCO) was selected, and the initial study of the housing authority buildings was performed. The ESCO contract is being renegotiated to expand the scope of the project to include services and renovations that could not be funded under the original shared savings contract.

The second activity involved the development of a second RFP and contract award for an energy performance contractor to develop a project for a consortium of housing authorities. This consortium consists of six housing authorities whose utility bills fall below the normal threshold normally considered cost-effective for an energy performance contract. By grouping the housing authorities into a consortium, it was possible to attract an ESCO to the renovation and recommissioning effort. This project is in the initial study phase.

The third activity was the adaptation of a utility record-keeping system, "Energy Accounting" (ENACT), produced by the Washington State Energy Office, for use by housing authorities and HUD. The goal of this system was to assist PHAs in monitoring and tracking utility costs and to identify housing facilities with unusually high utility costs, so that they could be targeted for energy efficient retrofits. ENACT was field tested and modified, using an elderly high-rise apartment in Nebraska and other apartments managed by the Kansas City HUD field office.

Project Partners: Kansas City HUD Field Office; Engineering Extension Programs at Kansas State University; Kansas City Metropolitan Energy Center; Washington State Energy Office; and several housing authorities located in Kansas and Missouri.

Product: A customized version of ENACT software is due by the end of FY 95.

Continuing or Spin-Off Activities: Each of the three activities of this project is continuing.

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Utility Retrofit of Public Housing (Chelsea Project)

Project Period: 1991-93

Goals and Objectives: The goals of the Chelsea Project were to demonstrate energy improvement strategies in multifamily, high-rise, public housing, using both public and private sector technical and financial resources; to make housing more affordable through energy efficiency improvements; to apply existing technical energy information to HUD-assisted housing construction and retrofit activities; and to reduce Federal utility expenditures.

Accomplishments: Chelsea, Massachusetts, served by Boston Edison Company, was chosen as the site for this demonstration project. The Margolis Apartments are managed by the Chelsea Housing Authority, and provide housing for elderly residents in 150 units. The building is an all-electric, 13-story, brick construction high-rise with utility costs exceeding \$150,000 in 1991.

Joint funding was provided by HUD's Boston Regional Office, through the HUD Comprehensive Improvement Assistance Program (CIAP), from Boston Edison Company, and the DOE-HUD Initiative. Energy audit and equipment installation was completed by Boston Edison's public housing program contractor, Citizen's Conservation Corporation (CCC) in Boston, with technical and monitoring support provided by Oak Ridge National Laboratory (ORNL) and Lawrence Berkeley Laboratory (LBL).

Installed measures included a direct digital control building automation system, efficient interior and exterior lighting, water tank insulation, energy efficient windows and sliding glass balcony doors, and faucet aerators. Total project cost was \$368,154, with a simple payback of just under 10 years, saving a total of 329,160 kwh or \$37,000 per year. All work performed was completed in conjunction with HUD-funded improvements such as upgrade of sprinkler systems and fire-alarms, winterization of the generator, new roofs, exterior masonry repair/ waterproofing, and elevator cab and motor refurbishing.

ORNL's technical support included project management, characterization of the building, conduct of diagnostic tests, summary of energy efficiency measures, and development and management of the energy evaluation. LBL's support included technical input on the building audit, measurement of air flows and ventilation, and evaluation of the new mechanical ventilation system after retrofit. The Massachusetts Weatherization Assistance Program also offered technical assistance with blower door training.

Project Partners: Chelsea Housing Authority; Boston Edison Company; Commonwealth of Massachusetts, Division of Energy Resources and the Massachusetts Office of Economic and Community Development; Citizen's Conservation Corporation; DOE Boston Regional Support Office; HUD Boston Field Office; ORNL; and LBL.

Publications:

W.R. Mixon, "Experimental Plan for the Boston Region Demonstration of Cooperative Rehabilitation of Public Housing for Improved Energy Efficiency," Oak Ridge National Laboratory, January 1992.

M.M. Abraham, H.A. McLain, and J.M. MacDonald, *Energy Retrofits Installed in the Margolis High-Rise Apartment Building, Chelsea Housing Authority*, ORNL/CON-413, Oak Ridge National Laboratory, March 1995.

M.M. Abraham and H.A. McLain, *The Evaluation of Retrofit Measures in a Tall Residential Building*, Proceedings of the Thermal Performance of the Exterior Envelopes of Buildings VI, December 1993.

Continuing or Spin-Off Activities:

ORNL is continuing the evaluation of the Chelsea Project to assess the durability of energy savings from the completed retrofit work. LBL is assessing the success of the buildings' ventilation systems. DOE and HUD, along with the other project partners, are continuing to work together to leverage public and private funding for additional retrofit opportunities in public housing.

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Improving Energy Efficiency in Public Housing: A Colorado Field Experiment

Project Period: 1992-94

Goals and Objectives: The goal of this project was to determine the impact of energy improvements and tenant education in the Rocky Mountain public housing arena. Two sites, one hundred miles apart - Boulder and Colorado Springs - were selected. A total of 40 units in eight buildings were involved, with 24 units (4 buildings) in Boulder and 16 units (4 buildings) in Colorado Springs. Using four different situations, energy efficiency measures and energy education were delivered to each of these units and energy savings were measured during a one-year savings period. The end result was to determine which combination of energy improvements and tenant education resulted in the longest term, most effective, energy savings.

Accomplishments: Audits and cost-benefit analysis were conducted on the selected measures. Pre- and post-tenant interviews were conducted. Energy conservation measures were installed through funding support from the Colorado Weatherization Assistance Program and from contract funds, rather than a performance contract (as originally planned). Public housing authority maintenance personnel were trained and used to install a variety of measures.

Education was delivered one-on-one to 20 tenants. Education follow-up was provided in two newsletters. Early savings were determined over a partial heating season (January - April 1993) and awards made to tenants based on the level of savings achieved. Final savings were determined over a fourteen month period (January 1993 - February 1994), and show the following results:

In Boulder, preliminary utility data suggest annual gas savings of \$108 per year, per building. Yearly electrical savings of \$690 are estimated. Water savings to date have averaged about \$8.50 per month per building.

In Colorado Springs, gas savings have been 702 therms, or \$370 per year per building. Yearly electrical savings have been estimated at \$98 per year. Water savings have averaged about \$22 per month per building.

Project Partners: DOE Denver Regional Support Office; Financial Energy Management, Inc.; Boulder and Colorado Springs Housing Authorities; Colorado Division of Housing Weatherization Program; Public Service Company of Colorado; and a Denver-area supermarket chain.

Publications: Newsletters.

Manage Utility Costs and Increase Comfort: A Handbook for Public Housing Authorities and Indian Housing, Financial Energy Management, Inc., June 1995.

Final Report, Phase I, Improving Energy Efficiency in Public Housing: A Colorado Field Experiment, Financial Energy Management, 1994.

**Continuing or Spin-
Off Activities:**

A handbook was written by financial Energy Management in 1995 for housing authority managers. The handbook deals with energy and water use, and contains a pull-out booklet with tenant education material.

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Energy Audits and Technical Support, Texas Public Housing

Project Period: 1992-94

Goals and Objectives: The objectives of this project were to 1) conduct energy audits on various size public housing authority facilities; and 2) provide an energy management and technical assistance workshop for a selected number of PHAs in the five state area served by DOE and HUD (Arkansas, Louisiana, New Mexico, Oklahoma, and Texas).

Accomplishments: At three separate PHAs (Granbury, Corsicana, and Fort Worth), audits were conducted on a 1,200 square foot duplex, a 2,200 square foot fourplex, and a two-story building with eight apartments and approximately 8,200 square feet. Based on these energy audits, a one-day energy management and technical assistance workshop was conducted for other housing authorities. The workshop included training on: the analysis of energy inventory/utility bills; operation and maintenance opportunities; elements of energy assessments, including review of sample audits; possible energy conservation measures and related energy and cost savings; health and safety concerns of energy activities, i.e., asbestos removal; possible methods of financing retrofits, including performance contracting; and recommendations for tenant education and counseling on energy efficiency.

DOE and HUD have worked cooperatively to establish linkages with state housing associations and PHAs in Region VI. They have increased awareness among PHAs of the cost-effectiveness of energy improvements and have explored methods of financing energy improvements in public housing.

Project Partners: DOE Dallas Regional Support Office; HUD Region VI Field Office; Granbury, Corsicana, and Fort Worth PHAs.

Publication: *Energy Management and Technical Assistance Workshop Workbook*, DOE Dallas Regional Support Office, 1994.

Continuing or Spin-Off Activities:

Under DOE's Weatherization Assistance Program, the DOE Dallas Regional Support Office, the Texas Department of Housing and Community Affairs (Weatherization Program Grantee), and Community Services, Inc. (Weatherization Program Subgrantee for Dallas County) cooperated in installing energy conservation measures on a HUD-supported apartment facility for homeless families in Dallas, Texas. This was completed in January 1995.

The DOE Dallas Regional Support Office is working with the HUD Region VI Field Office to work with several large PHAs during Fiscal Year (FY) 95 to pursue the use of performance contracting for energy retrofits in high-rise public housing. Workshops for PHAs will be conducted during FY 95.

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Guidebook on Energy Performance Contracting for Public and Indian Housing

Project Period: 1990-91

Goals and Objectives: The goal of the Performance Contracting Program was to assist HUD in reducing utility costs for Public and Indian Housing Authorities by attracting private investment in cost-effective energy conservation measures. The objective of the guidebook, entitled *Energy Performance Contracting for Public and Indian Housing--A Guide for Participants* was to develop standardized technical, contractual, financial, and institutional guidance so that public housing authorities (PHAs), Indian Housing Agencies (IHAs), HUD field staff, and energy service companies (ESCOs) could more easily initiate energy performance contracts.

Accomplishments: The *Guide*, written by Oak Ridge National Laboratory (ORNL), was published by HUD in 1992 and distributed to all PHAs and IHAs with 500 or more housing units. It was used during three technical training workshops on energy performance contracting in Boston, San Francisco, and Chicago. It continues to be a reference book for PHAs and IHAs which are beginning the energy performance contracting process.

Project Partners: ORNL; Citizens Conservation Corporation (CCC); the National Association of Energy Service Companies (NAESCO); the National Association of Housing & Redevelopment Officials (NAHRO); TAG Associates; and the Illinois Department of Energy and Natural Resources.

Publication: *Energy Performance Contracting for Public and Indian Housing -A Guide for Participants*, HUD-CPD-1354, February 1992.

Continuing or Spin-Off Activities: Two regional energy performance contracting training workshops were held in 1992 and 1993, and one in 1994, using the *Guide*. Technical sessions and tutorials on energy performance contracting for public housing were given at two Affordable Comfort Conferences in 1992 and 1993. ORNL provided on-site technical assistance to PHAs in New England to help them initiate energy performance contracts. The *Guide* has been widely distributed to housing authorities throughout the Country and continues to be used by PHAs and IHAs as an authoritative reference.

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Performance Contracting Training and Technical Assistance

Project Period: 1991-93

Goals and Objectives: Following publication of *Energy Performance Contracting for Public and Indian Housing--A Guide for Participants*, Oak Ridge National Laboratory (ORNL) and Energetics, Incorporated, a private energy consulting firm, planned and conducted a training and technical assistance program for public housing authorities (PHAs) and Indian Housing Authorities (IHAs). The goals of this effort were to provide information and assistance to PHAs and IHAs in linking up with experts in the energy and performance contracting field so that projects could be initiated. An additional goal of this project was to educate energy service companies (ESCOs), financiers, utilities, and building operators on non-federal sources of financing for improving the energy efficiency of public housing stock.

Accomplishments: A number of efforts were undertaken by ORNL and Energetics, including:

- Design, construction, staffing, and distribution of three free-standing exhibits, one on energy performance contracting specifically. The exhibit was displayed at the national conventions and regional meetings of the National Association of Housing and Redevelopment Organizations (NAHRO) and the Public Housing Authority Directors' Association (PHADA), as well as at Affordable Comfort conferences in 1992 and 1993.
- Technical panels on performance contracting were conducted at each of these national and regional meetings. Energetics coordinated and moderated them, and ORNL presented information at them along with energy performance contracting experts. ORNL also presented two intensive tutorials at the 1991 and 1992 Affordable Comfort conferences.
- Energetics and ORNL planned and coordinated two regional energy performance contracting training workshops, one in Boston, Massachusetts, and the other in San Francisco, California, for the states in Federal Regions I, IX, and X. Energetics served as moderator for the workshops and ORNL presented technical sessions and small group meetings at each.
- A third energy performance contracting training workshop was held in Chicago, Illinois, for the states in Federal Region V. This workshop was coordinated by the Energy Division at HUD headquarters and the HUD Chicago Field Office.
- ORNL provided limited technical assistance to four PHAs in HUD Region I to review prospects for performance contract/energy rehabilitation efforts. Two of these PHAs received more in-depth technical assistance, which led to their initiation of energy performance contracts.

These activities led to significant enthusiasm for energy performance contracting in the housing authorities trained, and to initiation of Requests for Proposals and contract vehicles for public housing energy retrofit using this financing technique.

Project Partners:

Energetics, Incorporated; ORNL; energy service companies in New England and throughout the country; utility companies; financiers; and energy consulting firms.

Publications:

Evaluation of Training Workshops on Performance Contracting for Public Housing Agencies in HUD Regions I, IX, and X, ORNL/CF-94/18, February 1994.

Status Report, Energy Performance Contracting for Public Housing in New England, Energetics, March 1994.

Energy Performance Contracting in Public Housing - What It Is, How It Works, Presentation by James Kolb (ORNL), at Energy Performance Contracting Training Workshop, October 1993.

Energy Rehab Project Identification, Presentation by James Kolb (ORNL), at Energy Performance Contracting Training Workshop, October 1993.

Continuing or Spin-Off Activities:

PHAs are initiating projects in all regions of the country where personnel participated in the regional training workshops. Rehabilitation is being done and non-HUD financing is being used with cost-effective energy and dollar returns to justify energy performance contracting as a financing method.

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Low Cost/No Cost Energy Conservation in Public Housing

Project Period: 1992-96

Goals and Objectives: The DOE Atlanta Regional Support Office received funding support for three projects: 1) production, circulation, and evaluation of the effectiveness of energy pamphlets for public housing residents and maintenance staff in the Southeast; 2) assistance to non-profit housing developers in the Atlanta area in making their affordable housing more energy efficient, and coordinating and leveraging this with community revitalization programs in preparation for Atlanta's hosting of the 1996 Olympic Games; and 3) training and demonstration of the blower door diagnostic technique and the National Energy Audit (NEAT) in cooperation with three Georgia Weatherization Assistance Program grantees.

Accomplishments: The Georgia Tech Economic Development Institute produced four different pamphlets for four target audiences: low-rise apartment residents; high-rise apartment residents; single-family detached unit residents; and facility maintenance personnel. The pamphlets were evaluated after being distributed to facility maintenance personnel at the Atlanta Housing Authority (AHA) and to residents at three of AHA's housing communities, Palmer House high-rise apartments, Clark Howell Homes, and Wildwood Homes.

A public housing project, the Techwood-Howell Homes Development, was selected for renovation. One hundred twenty building units have been torn down and new, energy-efficient dormitories are built for the Olympic Games, after which they will be used by Georgia Tech students. Remaining homes in this development will be renovated or replaced with new units, with energy efficiency a primary consideration. Oak Ridge National Laboratory (ORNL) is providing technical energy support for the design of the renovations and new units. Architectural planning is underway on this project, which is to be completed by June 1, 1996.

The following three weatherization agencies were selected and trained by ORNL in the blower door technique and NEAT to improve the efficiency of combining weatherization and rehabilitation activities: Cobb County Community Action Agency, DeKalb County Community Action Agency, and Gwinnette County Community Development Block Grant Agency. Thirty homes were analyzed using these diagnostic tools. Each agency combined weatherization and rehabilitation funds to comprehensively improve these public housing units. Each agency collected and analyzed data during the 1993-94 heating season to determine the results of the joint effort in these dwellings.

Cobb County appears to have been the most successful in utilizing the DOE-HUD Initiative funds to combine weatherization and rehabilitation activities to achieve energy savings. Program managers in this agency regularly analyze housing improvements from a "whole house" perspective, and do whatever is necessary to completely rehabilitate and retrofit homes so that they are both rehabbed and energy efficient. The Cobb County agency uses the NEAT audit developed by ORNL and the blower door

equipment and testing techniques taught to them by ORNL for their rehabilitation/retrofit work.

Project Partners:

DOE Atlanta Regional Support Office; HUD Atlanta Field Office; Georgia Tech Economic Development Institute; Georgia Office of Energy Resources; ORNL; Atlanta Gas and Light; City of Buford Utilities; Georgia Power Company; Jackson Electric Member Cooperative; City of Lawrenceville Utilities; the three weatherization grantee agencies; and the Atlanta Housing Authority.

Publication:

Preparation of Public Housing Efficiency Publications for the Atlanta Housing Authority, Georgia Tech Economic Development Institute, Atlanta, Georgia, August 1995.

Continuing or Spin-Off Activities:

The blower door training and technical assistance have proven useful for the three community action/development agencies targeted in Georgia.

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Appendix D

Project Descriptions:
Technology Transfer,
Education and Outreach

Exhibits, Briefing Materials, and Presentations

Project Period: 1990-94

Goals and Objectives: The goal of this effort was to share the activities, the projects, and the "success stories" of the DOE-HUD Initiative with interested professionals throughout the country. To that end, DOE's Support Contractor, Energetics, Incorporated, developed opportunities for DOE and HUD to share information on the projects described in the preceding pages with others. By initiating and coordinating this sharing process, DOE and HUD hoped to replicate the successes in other parts of the country, and with other energy and housing providers who are concerned with housing affordability and efficiency.

Accomplishments: Energetics, working cooperatively with DOE and HUD, developed three free-standing exhibits on various aspects of the DOE-HUD Initiative. The first dealt with energy efficiency and Indian Housing, and was displayed at two national conferences of the National American Indian Housing Council (NAIHC). The second exhibit, on HUD's Energy Performance Contracting Program and its use for improving the energy efficiency of public housing, was displayed at the national convention of the National Association of Housing and Redevelopment Officials (NAHRO), as well as at regional conferences of this same organization, and at the national meeting of the Public Housing Authorities Directors Association (PHADA). The third exhibit, on the DOE-HUD Initiative in general, was displayed at two Affordable Comfort Conferences, at two National Low-Income Energy Consortium conferences in 1993, 1994, and 1995, as well as at press conferences and smaller technical and program meetings of the DOE and HUD.

The exhibits served as a "backdrop" for HUD, DOE, and Energetics personnel to talk with conference participants about the DOE-HUD Initiative and to encourage them to develop joint efforts of this kind with their own constituencies. Accompanying each exhibit were many technical and non-technical publications for conference/meeting attendees to take and read later.

At each of these conferences and meetings, Energetics, DOE, and HUD coordinated and moderated technical sessions and tutorials on the Initiative and on various special projects/issues developed under Initiative sponsorship.

Briefing materials, presentations, and program planning and evaluation assistance was provided to DOE and HUD Headquarters staff on an as-needed basis.

Project Partners: DOE and HUD Headquarters and Field staff; NAHRO; PHADA; selected housing authorities throughout the country; NAIHC; Affordable Comfort, Inc.; and National Low Income Energy Consortium.

Publications and Exhibits: Three free-standing Exhibits on Energy and Indian Housing, Energy Performance Contracting for Public Housing, and the DOE-HUD Initiative on Energy Efficiency in Housing.

**Continuing or Spin-
Off Activities:**

The Affordable Comfort Conference now has a "track" for Energy and Affordable Housing. DOE-HUD Initiative participants present the results of their projects each year at this national conference, as well as at other well-known conferences throughout the country. The exhibits have traveled to other meetings and conferences, such as the National Low-Income Energy Consortium Conferences, and have been displayed at HUD Headquarters and DOE regional office buildings.

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Appendix E

List of Publications

Publications List

The following list includes reports, articles, videos, and other products of the DOE HUD Initiative in the order presented in the report. Unless otherwise noted, all HUD publications signified by a HUD publications number are available from HUD USER at 1-800-245-2691; E-mail: huduser@aspensys.com.

Project	Publications	Contact
SINGLE FAMILY HOUSING		
Manufactured Housing Thermal Standards	<p>Judkoff, Ronald D. and Gregory M. Barker, <i>Thermal Testing of the Proposed HUD Energy Efficiency Standard for New Manufactured Homes</i>, NREL/TP-253-4490, October 1992.</p> <p>Judkoff, Ronald, "Checking Out HUD's Proposed Mobile Home Performance Standards," <i>Home Energy Magazine</i>, November/December 1993, pp. 21-26.</p>	<p>Ronald Judkoff National Renewable Energy Laboratory 1617 Cole Boulevard Golden, Colorado 80401 (303) 275-3000</p>
Weatherization and Housing Rehabilitation Demonstration Program in Spokane, Washington	<p>Quaid, M. and Don Andre, <i>Evaluation Report, Spokane Neighborhood Action Program, DOE/HUD Comprehensive Rehabilitation Program</i>, Spokane Neighborhood Action Program, Spokane, Washington, October 1994.</p>	<p>Richard Putnam DOE Seattle Support Office 800 Fifth Ave. Suite 3950 Seattle, Washington 98104 (206) 553-2157 FAX (206) 553-2200</p>
HERS/EEMS National Collaborative	<p><i>Blueprint for Action</i>, DOE/NREL, NREL/TP-261-4677, March 1992.</p>	<p>Mary Margaret Jenior Office of Building Energy Research U.S. Department of Energy, EE-42 Washington, D.C. 20585 (202) 586-9445 FAX (202) 586-1628</p>
Energy Conservation Retrofit Program for Transitional Housing	<p><i>Final Report, the Energy Conservation Retrofit Program for Transitional Housing as Part of the HUD/USDOE Initiative</i>, Submitted by the Illinois Department of Energy and Natural Resources, Consumer Assistance Section, October 1993.</p>	<p>Henry Kurth Consumer Assistance Section Illinois Department of Energy and Natural Resources 325 W. Adams Street, Room 300 Springfield, Illinois 62704-1892 (217) 785-2800 FAX (217) 785-2618</p>

Project	Publications	Contact
Homeless Shelter Retrofit Guide	<i>Energy Conservation in Housing for the Homeless, A Guide for Providers</i> , National Renewable Energy Laboratory, Mechanical and Industrial Technology Division, HUD-1382-CPD, January 1993.	Diane Sterenbuch Office of Special Needs Assistance Programs U.S. Department of Housing & Urban Development 451 7th Street, S.W. Washington, D.C. 20410 (202) 708-0614 Ext. 4498 FAX (202) 708-3617
Indian Housing Design Guide	<i>Our Home, Buildings of the Land, Energy Efficiency Design Guide for Indian Housing</i> , National Renewable Energy Laboratory, HUD-1410-CPD, March 1994.	Dr. J. Douglas Balcomb National Renewable Energy Laboratory 1617 Cole Boulevard Golden, Colorado 80401-3393 (303) 384-7507 FAX (303) 384-7574
Energy-Efficient Home Design for the Navajo People	<p><i>House of Straw: Straw Bale Construction Comes of Age</i>, DOE San Francisco Support Office, U.S. Department of Energy, DOE/G010094-01, April 1995.</p> <p><i>Navahomes: A Dinelogical Study of Navajo Dwelling in Balance with the Land</i>, The Navajo Nation, Division of Community Development, Design and Engineering Services, December 1992.</p> <p>Hanford, Jim and Joe Huang, <i>Energy Efficient Building Technologies for the Navajo, Reservation and Analysis of a Straw Bale/Adobe Dwelling Prototype</i>, Final Review Draft, LBL, November 1994.</p>	<p>Carole Gates DOE San Francisco Support Office 1301 Clay Street, Room 1060 Oakland, California 94612-5219 (510) 637-1958 FAX (510) 637-2017</p> <p>Rick Diamond and Joe Huang Energy and Environment Division Lawrence Berkeley National Laboratory 90-3074 Berkeley, California 94720 (510) 486-4459 FAX (510) 486-6658</p>
Video and Resource Guide for Energy Efficient Housing Rehabilitation	<p><i>Eye on Energy: Rehab for All Seasons</i> Videotape, Energetics, Incorporated, Columbia, MD, 1993.</p> <p><i>Video Companion Guide, Eye on Energy: Rehabilitation for All Seasons</i>, ICF Inc., and Energetics, Incorporated, HUD-1528-CPD, May 1995.</p>	<p>Jeannette Brinch Energetics, Incorporated 7164 Gateway Drive Columbia, Maryland 21046 (410) 290-0370 FAX (410) 290-0377</p> <p>American Communities Information Clearinghouse U.S. Department of Housing and Urban Development 1-800-998-9999</p>

Project	Publications	Contact
Owner's Guide to Energy Efficiency in Single Family Rental Housing	<i>An Owner's Guide to Energy Efficiency in Single Family Rental Housing</i> , Energetics, Incorporated, HUD-1381-CPD, November 1992	Robert Groberg Director, Energy Division U.S. Department of Housing & Urban Development 451 7th Street, S.W. Washington, D.C. 20410 (202) 708-0614 Ext. 4642 FAX (202) 708-3363

Project	Publications	Contact
MULTIFAMILY HOUSING		
Multifamily Rehabilitation in the Midwest	<i>Energy-Efficient Rehabilitation of Multifamily Buildings in the Midwest</i> , An Argonne National Laboratory Technical Memorandum (ANL/DIS/TM-16). Report on WorldWideWeb (http://www.eren.doe.gov/ee/cgi-bin/rehab_doc/rehab_title.html).	James Cavallo, Ph.D. Economics and Law Section Argonne National Laboratory Building 900 9700 South Cass Ave. Argonne, Illinois 60439-4832 (708) 252-8688 FAX (708) 252-5327
Utility Retrofit of Section 202 Housing in Worcester, Massachusetts and HUD 221(d)(3) Housing in Burlington, Vermont	<p>Patullo, Chip, "Making Low Income Housing Affordable: The Northgate Retrofits," <i>Home Energy</i>, Volume 10, Number 2, March/April 1993, pp. 13-16.</p> <p>Patullo, Chip, <i>The Northgate Miracle: Energy Efficiency and Affordable Housing</i>, Northgate Housing Inc., Burlington, VT, 1992.</p> <p><i>The Northgate Miracle</i>, 15-minute Videotape, Northgate Housing, Inc., Burlington, VT, 1993.</p> <p>R.C. Diamond et al., <i>Affordable Housing Rehabilitation in Vermont: Energy Savings, Cost-Effectiveness, and Resident Satisfaction</i>, published in the Proceedings of the Thermal Performance of the Exterior Envelopes of Buildings V, Clearwater, FL, December 1992.</p>	<p>Rick Diamond Energy and Environment Division Lawrence Berkeley National Laboratory 90-3074 Berkeley, California 94720 (510) 486-4459 FAX (510) 486-6658</p> <p>Chip Patullo Spectrum Solar Consulting 107 Cherry Lane Burlington, Vermont 05410 (802) 660-8903</p>
Energy Efficiency Financing and Modifications in Mount Vernon, New York	E.I.S., Inc., <i>Regulatory Reform and Financial Incentives for Electric Submetering Conversions: A Blueprint for Achieving Energy Conservation Fairness and Personal Responsibility Through the Metering and Billing of Apartment Electric Use in Electrically Mastered-Metered Multifamily Buildings in New York</i> , July 1995.	<p>Charles Baxter DOE New York Support Office 26 Federal Plaza Room 3437 New York, New York 10278 (212) 264-3103 FAX (212) 264-2272</p> <p>Lewis Kwit E.I.S. Inc. 45 West 21st Street New York, New York 10010 (212) 366-6661</p>

Project	Publications	Contact
Guidelines for the HUD Capital Improvements Loan Program	<i>Chapter 12, Energy Conservation, 4350.1, Rev-1, Multifamily Asset Management and Project Servicing Handbook, HUD Office of Multifamily Housing Management.</i>	Barbara Hunter Planning & Procedures Division U.S. Department of Housing & Urban Development 451 7th Street S.W. Washington, D.C. 20410 (202) 708-3944 FAX (202) 401-3270
Multifamily Property Disposition Handbook	<i>Handbook 4315.1 for Multifamily Property Disposition, and Appendix 10-2.</i>	Marc A. Harris U.S. Department of Housing & Urban Development 451 7th Street S.W. Washington, D.C. 20410 (202) 708-4280 FAX (202) 708-3710
Technical Assistance Program in the Midwest	Knight, Paul, <i>Energy Saving Opportunities in Rehabilitation Training Manual</i> , and Companion Slides, Energy Resources Center, University of Illinois at Chicago, 1993 Regular series in <i>Midwest Assisted Housing Managers Association Magazine</i>	Mark Burger U.S. Department of Energy Chicago Regional Support Office 1 South Wacker Drive Suite 2380 Chicago, Illinois 60606-4616 (312) 886-8583 FAX (312) 886-8561 E-Net: mark.burger@hq.doe.gov

Project	Publications	Contact
PUBLIC HOUSING		
Overcoming Obstacles to Performance Contracting in HUD-Assisted Housing	<p><i>Energy Efficiency in Publicly Assisted Housing: Barriers and Recommendations</i>, Citizens Conservation Corporation, Boston, Massachusetts, 1994.</p> <p>S. Nolden and J. Snell, <i>Persistence of Savings in Low-Income Multifamily Housing Retrofits Involving Equipment Measures</i>, Citizens Conservation Corporation, Boston, Massachusetts, 1994.</p> <p>"The Key to Persistence," <i>Home Energy</i>, Vol. 12, No. 5, pp. 46-48, Sept./Oct. 1995.</p>	<p>Steve Morgan, Lillian Kamalay EUA Citizens Conservation Services, Inc. Boot Mills South 100 Foot of John Street Lowell, Massachusetts 01852-1197 (508) 656-3502 FAX (508) 656-3539</p> <p>John Snell, Janice DeBarros, and Sandra Nolden Citizens Conservation Corporation 530 Atlantic Avenue Boston, Massachusetts 02210</p>
Durability of Energy Conservation Measures in Public Housing	<p>R. Ritschard and A. McAllister, <i>Literature Review on Durability of Energy Conservation Measures</i>, LBL, June 1991.</p> <p>R. Ritschard and A. McAllister, "Persistence of Savings in Multi-family Public Housing," in the <i>Proceedings of the 1992 ACEEE Summer Study on Energy Efficiency in Buildings</i>, American Council for an Energy Efficient Economy, Washington, D.C. 1992.</p>	<p>Rick Diamond Energy and Environment Division Lawrence Berkeley National Laboratory, 90-3074 Berkeley, California 94720 (510) 486-4459 FAX (510) 486-6658</p>
Energy Use and Cost Accounting/Tracking System	A customized version of ENACT software is due by the end of FY 95.	<p>Kirk Bond Kansas City Regional Support Office U.S. Department of Energy 1100 Main Street, Suite 1350 Kansas City, Missouri 64105 (816) 426-7054 FAX (816) 426-6860</p>

Project	Publications	Contact
Utility Retrofit of Public Housing (Chelsea Project)	<p>M.M. Abraham, H.A. McLain, and J.M. MacDonald, <i>Energy Retrofits Installed in the Margolis High-Rise Apartment Building, Chelsea Housing Authority</i>, ORNL/CON-413, Oak Ridge National Laboratory, March 1995.</p> <p>M.M. Abraham and H.A. McLain, <i>The Evaluation of Retrofit Measures in a Tall Residential Building</i>, Proceedings of the Thermal Performance of the Exterior Envelopes of Buildings VI, December 1993.</p>	<p>Mike MacDonald Energy Division, Oak Ridge National Laboratory P.O. Box 2008 Oak Ridge, Tennessee 37831 (423) 574-5187 FAX (423) 574-9338</p>
Improving Energy Efficiency in Public Housing: A Colorado Field Experiment	<p><i>Final Report, Phase I, Improving Energy Efficiency in Public Housing: A Colorado Field Experiment</i>, Financial Energy Management, 1994.</p> <p><i>Manage Utility Costs and Increase Comfort: A Handbook for Public Housing Authorities and Indian Housing</i>, Financial Energy Management, Inc., June 1995.</p>	<p>Kit Wasmondt Denver Support Office DOE 2801 Youngfield Street, Suite 380 Golden, Colorado 80401 (303) 231-5750 Ext. 143 FAX (303) 231-5757</p> <p>Rebecca Vories Financial Energy Management, Inc. 1625 Downing Street Denver, Colorado (303) 832-9210 FAX (303) 831-8221</p>
Energy Audits and Technical Support, Texas Public Housing	<p><i>Energy Management and Technical Assistance Workshop Workbook</i>, DOE Dallas Regional Support Office, 1994.</p>	<p>John Harper U.S. Department of Energy Dallas Regional Support Office 1240 West Mockingbird Lane, Suite 400 Dallas, Texas 75247 (214) 767-7137 FAX (214) 767-7231</p>
Guidebook on Energy Performance Contracting for Public and Indian Housing	<p><i>Energy Performance Contracting for Public and Indian Housing -A Guide for Participants</i>, HUD-1354-CPD, February 1992.</p>	<p>Mark Ternes Energy Division, Oak Ridge National Laboratory P.O. Box 2008 Oak Ridge, Tennessee 37831 (423) 574-0749 FAX (423) 574-9338</p>

Project	Publications	Contact
Performance Contracting Training and Technical Assistance	<p><i>Evaluation of Training Workshops on Performance Contracting for Public Housing Agencies in HUD Regions I, IX, and X</i>, ORNL/CF-94/18, February 1994.</p> <p><i>Status Report, Energy Performance Contracting for Public Housing in New England</i>, Energetics, March 1994.</p> <p><i>Energy Performance Contracting in Public Housing - What It Is, How It Works</i>, Presentation by James Kolb (ORNL), at Energy Performance Contracting Training Workshop, October 1993.</p> <p><i>Energy Rehab Project Identification</i>, Presentation by James Kolb (ORNL), at Energy Performance Contracting Training Workshop, October 1993.</p>	<p>Jeannette Brinch Senior Associate Energy Supply and Environmental Sector Energetics, Incorporated (410) 290-0370 FAX (410) 290-0377</p> <p>Mark Ternes Energy Division, Oak Ridge National Laboratory P.O. Box 2008 Oak Ridge, Tennessee 37831 (423) 574-0749 FAX (423) 574-9338</p>
Low Cost/No Cost Energy Conservation in Public Housing	<p>Preparation of Public Housing Energy Efficiency Publications for the Atlanta Housing Authority, Georgia Tech Economic Development Institute, Atlanta, Georgia, August 1995</p>	<p>Fred Singleton Atlanta Regional Support Office U.S. Department of Energy 730 Peachtree Street Suite 876 Atlanta, Georgia 30308 (404) 347-3482 FAX (404) 347-3098</p>

Project	Publications	Contact
TECHNOLOGY TRANSFER, EDUCATION AND OUTREACH		
Exhibits, Briefing Materials, and Presentations	<p>Three free-standing Exhibits on Energy and Indian Housing, Energy Performance Contracting for Public Housing, and the DOE-HUD Initiative on Energy Efficiency in Housing.</p> <p><i>Energy Performance Contracting Brochure</i>, Energetics, Incorporated, 1991.</p>	<p>Jeannette Brinch Energetics, Incorporated 7165 Columbia Gateway Drive Columbia, Maryland 21046 (410) 290-0370 (410) 290-0377</p>