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TECHNOLOGY TRANSFER FOR RESIDENTIAL ENERGY PROGRAMS IN NEW CONSTRUCTION AND EXISTING HOUSING

A Joint Venture
Between the City of St. Louis and Hennepin County

ENERGY TASK FORCE
OF THE URBAN CONSORTIUM

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PREFACE

The Urban Consortium for Technology Initiatives was formed to pursue technological solutions to pressing urban problems. The Urban Consortium conducts its work program under the guidance of Task Forces structured according to the functions and concerns of local governments. The Energy Task Force, with a membership of municipal managers and technical professionals from eighteen Consortium jurisdictions has sponsored over 120 energy management and technology projects in thirty-four Consortium member jurisdictions since 1978.

To develop in-house energy expertise, individual projects sponsored by the Task Force are managed and conducted by staff of participating city and county governments. Projects with similar subjects are organized into *Units* of four to five projects each, with each Unit managed by a selected Task Force member. A description of the Units and projects included in the Seventh Year (1985-86) Energy Task Force program follows:

UNIT -- LOCAL GOVERNMENT OPERATIONS

Energy used for public facilities and services by the nation's local governments totals about 1.5 quadrillion BTU's per year. By focusing on applied research to improve energy use in municipal operations, the Energy Task Force helps reduce operating costs without increasing tax burdens on residents and commercial establishments. This Seventh Year Unit consisted of five projects:

- **Baltimore, Maryland** -- *The Activated Sludge Oxygen-Air Aeration Process: Improved Technology for Wastewater Treatment Efficiency*
- **Boston, Massachusetts** -- *Ground Source Heat Pumps for Commercial Application in an Urban Environment*
- **Detroit, Michigan** -- *Computer Assisted Control for a Municipal Water Distribution System: Phase II - Testing and Implementation*
- **Kansas City, Missouri** -- *Water Supply System Energy Conservation through Computer Control*
- **Phoenix, Arizona** -- *Energy Use Reduction through Wastewater Flow Equalization*

UNIT -- COMMUNITY ENERGY MANAGEMENT

Of the nation's estimated population of nearly 240 million, approximately 60 percent reside or work in urban areas. The 543 cities and counties that contain populations greater than 100,000 consume 50 quadrillion BTU's annually. Applied research by the Energy Task Force helps improve the economic vitality of this urban community by aiding energy efficiency and reducing energy costs for the community as a whole. This Year Seven unit consisted of four projects:

- **Memphis, Tennessee** -- *Technology Transfer for Energy Management in Cooperation with Regional Energy Providers*
- **New Orleans, Louisiana** -- *An Incident Prevention and Response System for Hazardous Energy Resource Materials: Phase 2*
- **New York, New York** -- *A Management Approach for Reducing Business Energy Costs: Joint City/ Utility Actions*
- **San Antonio, Texas** -- *Neighborhood Energy Efficiency and Reinvestment*

UNIT -- ALTERNATIVE AND INNOVATIVE TECHNOLOGIES

Effective use of advanced energy technology and integrated energy systems in urban areas could save from 4 to 8 quadrillion BTU's during the next two decades. Urban governments can aid the capture of these savings and improve capabilities for the use of alternative energy resources by serving as test beds for the application of new technology. This Year Seven unit consisted of four projects:

- **Albuquerque, New Mexico** -- *On-Site Municipal Fuel Cell Power Plant: A Feasibility and Applications Guide*
- **Atlanta, Georgia** -- *Atlanta District Heating and Cooling Project*
- **Denver, Colorado** -- *Disposal Techniques with Energy Recovery for Scrapped Vehicle Tires*
- **Philadelphia, Pennsylvania** -- *High Efficiency Gas Furnace Modifications for Low-Income Residents*

UNIT -- PUBLIC/PRIVATE FINANCING AND IMPLEMENTATION

City and county governments often have difficulty in carrying out otherwise sound energy efficiency or alternative energy projects due to constraints in the acquisition of initial investment capital. Many of these constraints can be overcome by providing means for private sector participation through innovative financing and financial management strategies. This Year Seven Unit consisted of five city/county projects plus a combined effort supported by USHUD to define effective strategic planning guidelines:

- **Chicago, Illinois** -- *A Neighborhood Energy Conservation Program: Phase 2*
- **Columbus, Ohio** -- *Development of a District Heating System: Organizational and Financial Strategies*
- **Hennepin County, Minnesota** -- *Technology Transfer for Residential Energy Programs in New Construction and Existing Housing* (Joint project with St. Louis)
- **St. Louis, Missouri** -- *Technology Transfer for Residential Energy Conservation in New Construction and Existing Housing* (Joint project with Hennepin County)
- **San Francisco, California** -- *A Commercial Building Energy Retrofit Program*
- **Public Technology, Inc.** -- *The Hidden Link: Energy and Economic Development -- Phase I: Strategic Planning*

Reports from each of these projects are specifically designed to aid the transfer of proven experience to staff of other local governments. Readers interested in obtaining any of these reports or further information about the Energy Task Force and the Urban Consortium should contact:

Applied Research Center
Public Technology, Inc.
1301 Pennsylvania Avenue, NW
Washington, DC 20004
(202) 626-2400

ACKNOWLEDGEMENTS

The work covered in this report completes a three-year effort to explore and implement the benefits of energy-efficient construction to enhance housing affordability in St. Louis. A variety of actors have participated to ensure the success of this project.

During this past year, the work of Don Bollinger, Technical Coordinator of the Energy Management Program and Brian Murphy, Housing Section Head, has been particularly critical to the project success.

Mr. Bollinger's work in modeling energy standards for use in Minneapolis, and his comparision of various software programs for analyzing monitoring utility data has been invaluable.

Mr. Murphy has been highly instrumental in the effort to combine energy conservation with other City housing strategies aimed at produce affordable housing.

From Hennepin County, the efforts of Bob Miller, Planning Supervisor, and Carole Martin, Senior Planner, were central to our work in evaluating the benefits of previous work in Minnesota for potential use in St. Louis. Mr. Miller assisted in making the technology exchange program as mutually useful as possible and acted as a great host during visits to Minneapolis.

For their assistance in coordinating HUD assistance in providing project support in St. Louis, a special thanks to Bernard Manheimer of the HUD Energy Office, Washington D.C.; and Richard Zelinski and Diane Rooney of Public Technology Inc., Washington D.C.

Finally, a note of thanks to housing specialists Miriam Simon and Karen Watkins, for their work in integrating the St. Louis energy standards into the application and contract documents of the Community Development Block Grant housing program.

James G. Sackett
Director,
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CHAPTER 1 - OVERVIEW

ABSTRACT

The St. Louis Year VII project built on previous work conducted in St. Louis to demonstrate the technology and financing of superinsulated housing, to implement a full-scale, energy efficient housing program in St. Louis. The project also involved the transfer of elements of the St. Louis program to assist Hennepin County in establishing a program to promote energy efficient new residential construction in Minnesota.

During the project, Hennepin County (Minneapolis, Minnesota) presented the results of a performance contracting program implemented in Years V and VI to provide energy retrofit for existing homeowners in Minneapolis. This program has special appeal in St. Louis because of the difficulty in motivating middle-income homeowners to invest in conservation options.

Project Purpose

Aside from the more obvious benefits of having municipalities and counties share ground-work in establishing successful energy programs, this project had as a primary purpose the testing of various technology transfer tools. Among the approaches utilized were site visits, guest speaking by St. Louis staff at conferences hosted in Minneapolis, shared information on computer software, literature exchange and technical and financial assistance for each "sister" city. Some of the benefits and shortcomings of the approaches used will be discussed in this report to guide other entities embarking on similar exchange programs.

An additional element of this program was participation by the HUD Energy Office in providing technical assistance to both Hennipin County and St. Louis during the course of the project. In Hennipin, this took the form of consultants assisting in developing a training program for builders of energy efficient homes (this is covered in the Hennepin Year VII report and will not be addressed here). In St. Louis, a seminar for leading bankers was held to introduce liberalized "energy addendum" financing for energy efficient housing. In addition, HUD and the National Association of Homebuilders Research Foundation chose St. Louis as one of four national sites to explore energy efficiency upgrades during the rehabilitation of multi-family buildings.

Report Organization

This report is organized in three basic sections. First, the implementation of mandatory energy standards in St. Louis as a component of the City's Community Development Block Grant program is addressed. Included are the results of quality control work in assuring that energy efficient units were built as per specifications and suggestions for incorporating quality control in projects developed elsewhere.

Secondly, the technology exchange process between the participant government energy divisions is discussed. This is broken down between St. Louis support for Hennepin followed by the work received by St. Louis from Hennepin.

Finally, financing energy conservation in housing is discussed. The analysis of the applicability of performance contracting in St. Louis is presented for existing houses. Future directions this form of alternative financing can take in developing a program in St. Louis are then outlined.

CHAPTER 2 - IMPLEMENTING ST. LOUIS ENERGY STANDARDS AND MONITORING SUPERINSULATED PROJECTS

ENERGY STANDARDS IN ST. LOUIS

The City of St. Louis provides funding to assist the construction of a large number of for-sale and rental units built in revitalized neighborhoods. Using Community Development Block Grant Funds, financing is used to write-down development costs or assist families in buying homes by reducing interest payments and paying closing costs.

Given the funding that is going into affordable housing, including energy conservation improvements during construction to reduce operating costs makes sense. Previous work with demonstration projects has shown that dramatic reductions in heating and cooling costs are possible in St. Louis. However, no clear standard existed to guide builders in meeting a threshold of energy efficiency. Towards this end, the City decided to develop energy standards that would be required as a condition of receiving City development monies.

In 1985, as part of the Year VI project funded by the Energy Task Force of the Urban Consortium, St. Louis developed mandatory energy standards for all housing receiving federal funds through its Community Development Agency. These market-rate new construction and rehabilitated structures for both rental and sale, are in revitalized neighborhoods requiring "gap" financing assistance from the City to be cost-effective.

The minimum energy standards adopted were an upgrade of the National Association of Homebuilders Thermal Performance Guidelines, adopted locally by the St. Louis Homebuilders Association under the name of the "Energy Mark" Program. These standards are aimed at producing housing with a uniform level of insulation, heating and cooling equipment efficiency, window treatment and tightness. Though the basics in these standards represent good standard construction practice for average residential development, urban redevelopment requires more stringent energy standards and greater attention to compliance.

Many "rehabilitated" buildings require extensive rearrangement of floor plan for efficient space utilization. In converting older structures for updated use, space is often at a premium, placing limits on the amount of interior wall furring that can be allowed for insulation. Though many builders fully insulate rehabilitated projects as common course, this was by no means standard practice. Plaster finished brick structures in good shape would often have walls retained as a cost-saving measure. In other projects, historic preservation guidelines placed constraints on the use of new windows with double glazing, because of requirements for "true mullions" or architectural window styles requiring exact reproductions.

In addition to uniform rehabilitation specifications, the minimum energy standards upgraded the thermal envelope for both new and rehabilitated construction above common practice. This was accomplished in two ways.

First, computer modeling by the St. Louis Energy Management Program identified several opportunities for cost-effective upgrades to conventional building practice. Most prominently, low-emissivity glazing and basement or foundation insulation were on the top of the list. Other items included higher furnace and air conditioning efficiency, tighter construction and higher than standard wall insulation levels. In discussions with builders, basement insulation was added to the mandatory measures in the adopted energy standards.

Secondly, other items identified from the computer modeling not adopted as mandatory, made up a voluntary upgraded "superinsulated" standard. Builders were encouraged however to adopt items from the "superinsulated" standard on top of the mandatory standard, and receive added points in competition for City funds by doing so.

The process of developing these standards is detailed in the St. Louis Year VI final report. Though the standards were ready for adoption early in 1986, several key elements of the standards needed to be worked out during the year.

Legal and Other Constraints

Meetings with builders, developers and neighborhood groups were held to explain the standards and the application procedure for City housing funds in the spring of 1986. As applications were submitted however, it became clear from a review of plans and specifications by the Energy Program that many builders were continuing to do business as usual, and were submitting projects with uninsulated walls, inadequate window treatments and other deficiencies.

These problems were increased by the fact that projects receiving City funds get "staggered" between applications for funds. Some projects funded may not begin construction for six or, even in exceptional cases, twelve months from approval. Consequently, projects get "reprocessed" that were originally designed and bid under the old procedure that didn't require wall insulation.

To address this problem, all new projects initiated under the minimum energy standards were required to incorporate a legal instrument to assure compliance with the standards. Similar to certification already in the housing program for other federal requirements (such as elimination of lead-based paint), the energy certification was developed to assure that the architect was legally responsible for the adoption of energy standards during the design and construction of the project.

A form was included with other closing documents on receiving funding from the City requiring signature by the project architect, and allowing space for additional voluntary energy upgrade items to be checked-off.
This system was put into place in the fall of 1986 and will be fully operational during the next request for proposals.

MULTI-FAMILY REHAB ENERGY DEMONSTRATION

Another project initiated during the year gave the City a chance to work closely with builders to encourage quality control. St. Louis was selected as one of four cities nationwide to participate in a demonstration of cost-effective energy conservation improvements during the rehabilitation of a multi-family building. The program, sponsored by the City, HUD and the National Association of Homebuilders Research Foundation, provided an opportunity to highlight the energy standards already adopted, and explore the use of various voluntary upgrades with a key developer in town. This allowed for very close technical work with the developer both during the design of the project and during construction. The project helped this large apartment developer to to become confident with energy as an affordability tool.

The goal of the project reinforced the basic economic criteria used to develop the minimum energy standards. Namely, to identify energy improvements that would be cost-effective during the rehabilitation of an apartment building, reasonable for both owner and tenants, and which would not require additional subsidies.

The Energy Management Program provided technical support for the participant St. Louis developer, Westminster Builders, on two five-unit apartment buildings being "gut rehabbed" in a historic neighborhood on the near-south side of St. Louis. The various potential upgrades in envelope insulation, mechanical efficiency and window treatments were analyzed using the same computerized approach developed during the adoption of energy standards. In addition, other related issues, such as the cost-benefit of changing laundry areas from all-electric to gas hot water heating and gas dryers, and upgrading to more efficient hot water heaters in each apartment were analyzed separately.

The targeted conservation items for both buildings are shown in Tables I and II. A list of all conservation items considered is shown in the Table III.

The St. Louis Community Development Agency agreed to provide a $5000 grant to assist the developer in incorporating these conservation elements. Because the project was geared to low-income families on rental subsidy, the cash-flow on the project could not be increased to cover the added costs of the energy improvements. This was compounded by the fact that this project was already designed and fully bid at the time Westminster was approached by the City to participate in the program. It should be noted, however, that these costs would have been able to be incorporated without the City grant, had the energy improvements been targeted earlier in the design process when other trade-offs could have been made (such as lowering costs elsewhere or increasing rents slightly). In particular the laundry modifications were targeted to reduce operating costs to the building owner.

OPTIMIZATION SUMMARY

TABLE I

3001-03 TEXAS

RUN	ITEM	INDIVIDUAL ITEM COST	CUMULATIVE PACKAGE COST	ENERGY SAVINGS	MORTGAGE INCREASE	CASH FLOW
				YEAR 1		
[1]	INFILTR-CAULKING + DOOR FAN	250.00	250.00	450.71	26.27	424.44
[2]	HEATING-ELEC IGN + FLUE DAMP	1030.00	1280.00	604.31	134.75	469.56
[3]	WINDOW- LOW-E STORM	817.19	2097.19	675.96	220.80	455.15
[4]	WALL- R-13	266.50	2363.69	698.04	248.87	449.16
[5]	CEILING-R-40	360.22	2723.91	709.19	286.80	422.39
[6]	HEATING-RECUPERATIVE FURNACE	1345.00	4068.91	731.99	428.51	303.48

TABLE II

2623-25 ARSENAL

RUN	ITEM	INDIVIDUAL ITEM COST	CUMULATIVE PACKAGE COST	ENERGY SAVINGS	MORTGAGE INCREASE	CASH FLOW
				YEAR 1		
[1]	INFILTR-CAULKING + DOOR FAN	250.00	250.00	364.19	26.28	337.91
[2]	HEATING-ELEC IGN + FLUE DAMP	1030.00	1280.00	479.63	134.75	344.88
[3]	WALL- R-13	254.89	1534.89	499.80	161.64	338.15
[4]	WINDOW- LOW-E STORM	1010.36	2545.25	574.55	268.08	306.47
[5]	CEILING-R-40	285.20	2830.45	582.95	298.08	284.87
[6]	HEATING-RECUPERATIVE FURNACE	1345.00	4175.45	599.15	439.68	159.47

TABLE III

WALL OPTIONS

DESCRIPTION	R-VALUE	ACH	INCREMENTAL COST ($/SQFT)
[0.] R-11	13.3	1	0
[1.] R-13	14.62	1	.07

CEILING OPTIONS

DESCRIPTION	R-VALUE	INCREMENTAL COST ($/SQFT)
[0.] R-30	30	0
[1.] R-40	40	.155

FLOOR OPTIONS

DESCRIPTION	R-VALUE	INCREMENTAL COST ($/SQFT)
[0.] R-19	19	0

WINDOW OPTIONS

DESCRIPTION	WINDOW TYPE	INCREMENTAL COST ($/SQFT)
[0.] STORM	1	0
[1.] LOW-E STORM	4	1.65

AIR TIGHTNESS OPTIONS

DESCRIPTION	AIR CHANGES PER HOUR	COST
[0.] STANDARD PRACTICE	1.2	0
[1.] CAULKING + BLOWER	.7	250

FURNACE OPTIONS

DESCRIPTION	EFFICIENCY	AC SEER	COST	FUEL TYPE (1 = GAS) (2=ELECTRICITY)
[0.] STD GAS FURNACE	66	0	0	1
[1.] ELEC IGN + FLUE DAMP	78.8	0	1175	1
[2.] RECUPERATIVE FURNACE	81.5	0	2375	1

AIR CONDITIONER OPTIONS

DESCRIPTION	SEER	COST
[0.] NONE	0	0

The conservation items included in the demonstration are shown in Table IV. To hold costs down, the Energy Management Program agreed to do blower-door testing with its own equipment, allowing a $50 per apartment allocation for caulking materials and labor. Because the demonstration apartments received rental subsidy, the St. Louis Public Housing Authority had approval over the design and specifications on the project. Although the project developer was enthusiastic about the use of low-emissivity coated storm windows, this option was initially rejected by the Housing Authority.

A presentation was made by Energy Program staff to Housing Authority architects to convince them of the cost-effectiveness of the "low-e" windows (Low-e windows are a double glazed window coated with a low-emissiving film for enhanced energy performance. A waiver was subsequently gained allowing the use of "low-e" windows. Support for the developer in overcoming this obstacle, however, was absolutely necessary in getting the "low-e" glazing approved. Had Westminster attempted to use this upgrade and met with resistance, they would have dropped the upgrade in the interest of keeping the project on schedule. This type of "unforseen" resistance can create real disincentives for builders to use untested conservation strategies, particularly when pioneering an approach can mean added headaches.

Quality Control During Future Projects

On the Westminster project, quality control was directly undertaken by the Energy Management Program. This grew out of experience with earlier demonstration projects where detailed plans and specifications were not sufficient to produce the desired level of quality.

After interface with the Westminster project architect, change orders were developed for all items of work effected by the energy upgrades. During construction, inspections were made periodically to the site. During these inspections, installation of "low-e" glazing was verified, insulation levels were checked and furnaces were inspected. The furnaces installed on this project were not the electronic ignition and flue damper models specified, to the surprise of the project architect and construction manager (neither had caught the mistake). This problem was corrected when the architect contacted the furnace contractor that the change order had been made before installation.

Quality control was also carried out by blower door testing each unit after completion of interior drywall. At this stage of construction, the envelope was completed except for final trim. Therefore, air leaks could be corrected without creating problems during the finishing stage. Each building was pressurized and crews checked each unit for exfiltration using a smoke gun. Caulking and foam sealant were used in combination to tighten up the envelope. In addition, exterior caulking around windows, electrical and plumbing penetrations was completed.

TABLE IV

CONSERVATION IMPROVEMENTS IMPLEMENTED ON HUD/NAHB MULTI-FAMILY REHAB ENERGY DEMONSTRATION

	ITEM	3001-03 Texas	2623-25 Arsenal	TOTAL
1.	Blower Door Testing	$250	$250	$500
2.	Gas Hot Water Heater & Dryer	$421	$376	$797
3.	Furnace upgrade (elect. ignition/flue damper)	$1,030	$1,030	$2,060
4.	Low-E storm windows	$806	$488	$1,294
	Subtotals	$2,507	$2,144	$4,651
5.	Architectural/Administrative Allowance			$349
	TOTAL PROJECT UPGRADE COST			$5,000

This project demonstrated the need for close inspection to assure good performance for projects, even when energy standards are in place. This work has led to the design of a quality control program for all City projects in 1987, featuring inspections, blower door and infra-red visits. This inspection work will be subcontracted to local contractors utilizing state energy grant monies awarded to the City during the course of this project.

ON-GOING MONITORING WORK

To gather the most complete data from past demonstration units, monitoring of energy bills will continue throughout the winter of 1987 on the multi-family demonstration described above and a base of 100 existing house. Previous monitoring described in the Year VI final report was inconclusive due to unoccupied units, a variety of mechanical problems (defective air-to-air heat exchangers and defective heat pump units) and incomplete billing histories. These deficiencies have been corrected and the local utility companies are cooperating in gathering meter readings on all identified units, rather than relying on estimated readings.

This data will be analyzed using a least-squares method (described in the Year VI report) to correlate usage with weather data. The approach used in St. Louis will be compared with a different approach experimented with in Hennipin County, later in this report.

The results of monitoring through the next winter will be made available through an addendum to this report in the summer of 1987.

CHAPTER 3 - TECHNOLOGY TRANSFER OF SUPERINSULATED HOUSING STRATEGIES TO HENNEPIN COUNTY

ORGANIZATION OF THE TRANSFER PROCESS

The avenues for exchanging experiences in developing energy conservation programs between St. Louis and Hennepin County were developed during two site visits. During these visits, the applicability of each local jurisdiction's previous experience in energy efficiency was compared to the needs created by the new residential projects each was conducting. Relevant materials were identified and shared in the form of computer analysis, research into the local situation, financial analysis software and review and comment by the "experienced" visiting party. This chapter is going to discuss the technical assistance provided to Hennepin County by St. Louis. (Chapter 4 will discuss the technical assistance provided to St. Louis by Hennepin County.) An overall analysis will be presented, followed by a detail description of the transfer elements.

Site Visits

Actual site visits proved to be one of the most beneficial aspects of the program. This allowed for assistance by the visiting local jurisdiction in "selling" the results of previous work to assist the new municipality in bringing other actors on board. Hennepin County also became acquainted with St. Louis's active Community Development Block Grant supported housing programs, which provided additional information and ideas on Hennepin's own program. Hennepin County explained in detail the financing plan for performance-based contracting for St. Louis. This aided St. Louis in evaluating the benefits of this approach to a community with lower-income residents, less harsh winters and less concern for energy.

Software/Computer Technologies

Other successful transfer opportunities were in the technical and software areas. A comparision of two software programs for evaluating energy usage in residential buildings was conducted. Each local jurisdiction ran comparisons on a group of buildings, with Hennepin County using PRISM and St. Louis using BILL. This work assisted Hennepin County in making a choice between the two programs and showed differences in analyzing building performance between climates requiring air conditioning an those that do not.

St. Louis staff ran computerized design optimization programs on a prototype house in Minneapolis to determine if upgrades to standard construction practice were cost effective. This work involved a survey of current building practice in Hennepin County that showed that most builders met or came close to the state energy standard. This led Hennepin staff to the realization that improving energy standards was not the issue to be dealt with in Minneapolis.

Telecommunications

An area that did not prove particularly useful in technology transfer was the use of direct computer linkage for communications. Early discussions to connect computers via modem for transferring documents proved to be too involved for the "low level" copy flow between the jurisdictions. Additionally, the level of use of the PTI Energy Net was about the same as the normal level of communication between municipalities within a unit from previous years. Users need access to electronic mail services at their desks to be used on a regular basis. Phone conversations to answer questions or requests for reports or other hard-copy, took precedent.

The reasons for a reliance on site visits and phone conversations were two-fold. First, the need for quick information in starting new programs based on another local government's work was critical. With a one year time frame, meetings were the most effective way to present information and explore questions involved in transferring an approach to a new municipality. These meetings produced in-depth exchanges that uncovered most of the useful information transferred during the program.

Secondly, there was an element of trust that needed to be established between each jurisdiction. Though both programs had been successful each participant also experienced unsuccessful aspects to the programs. In St. Louis, monitored savings were less than initially projected, though still significantly higher than conventional construction. In Hennepin, the installed package of conservation elements did not produce a return large enough to justify the financing involved. On the other hand it demonstrated the market and showed effective marketing techniques for reaching that market.

These circumstances put each participant in the role of testing and challenging the results of the other. This developed out of a natural in interest assuring that the program each adopted would be based on solid principles and conclusive research. In the areas where deficiencies were evident, there was a genuine concern that these be correctable problems. Neither City was interested in trying to sell a new concept that was not thoroughly reviewed. This was at times hard on the host City, since there was a natural tendency to emphasize the successful aspects of their project. The following paragraphs discuss in detail the site visits, survey of the Minnesota Building and Energy Code, and the software development for Hennepin County.

Superinsulated Housing Conference

The first site visit was conducted by St. Louis staff to Minneapolis in March, 1986 in conjunction with the Fourth International Energy Efficient Building Conference. St. Louis staff gave a presentation at the conference on energy standards developed during the Year VI project and showed marketing and financing benefits accessible to builders of energy efficient homes.

The conference was attended by a number of builders from the Twin Cities area, though it was held before Hennepin County had a chance to target specific builders for participation in their project. Before the conference, a meeting was held with Hennepin County staff and a presentation on the St. Louis project was made.

SURVEY OF MINNESOTA BUILDING AND ENERGY CODES

Before the Minneapolis site visit, St. Louis staff assisted Hennepin County in conducting a survey of building practice in Minneapolis. Phone surveys were conducted with several area builders to determine insulation levels and equipment efficiencies for new home construction. Copies of the Minnesota energy code were provided by Hennepin staff.

In general, builders in the Minneapolis area build to high levels of insulation. Even an "economy" builder claimed to offer R-20 walls though actual calculated values were about R-17. Roof insulation of R-38 is common. Windows are double-glazed and basement walls typically have two inches of rigid insulation. One builder estimated that only about 40 per cent of all new homes built have central air conditioning. The results of the survey were used to develop the "base case" used to analyze upgrades in the thermal envelope described in the following section.

In addition to an across-the-board upgrade in the thermal envelope of Minneapolis homes compared to St. Louis, there were regional design differences. In Minneapolis, split-level homes were common and basement walls are required to be insulated under the Minnesota energy code. There is comparatively little rehabilitation in Minneapolis compared to St. Louis.

Though good building practices were generally evident in Minnesota, the more severe climate made an analysis of various building envelope upgrades the next step in support for the Hennepin project.

COMPUTER OPTIMIZATION OF ENERGY DESIGN

Using software tools developed in previous work with energy efficient homes in St. Louis, an analysis of potential upgrades in energy performance for builders in Minneapolis was conducted. First, a model single-family home was generated to roughly match the buildings surveyed by telephone.

Construction costs for various building elements costed out in St. Louis were factored to the Minneapolis situation using national estimating books. A variety of wall, ceiling and basement insulation levels were modeled. Additionally, various window types, furnace and air conditioning efficiencies were put into the optimization routine. The list of options is shown in Table V.

A summary of energy upgrades produced by the analysis is shown in Table VI. Improvements in all areas of the building envelope, with the exception of added wall insulation, was shown to be cost-effective. Additionally, low-emissivity glazing was cost-effective over conventional double-glazing. Higher efficiency furnaces of even 96% (condensing furnaces) were cost-effective over standard 73.5% efficient models.

The optimization run showed that Minneapolis's cold climate and energy costs did allow for improvement in construction practice to make houses more energy efficient cost-effectively. However, other influences within the Hennepin building and financing community made it difficult to push for improved energy performance during construction.

Table V

PHASE II SUMMARY
MINNEAPOLIS PHASEI - STD CASE

RUN	ITEM,	INDIVIDUAL ITEM COST	CUMULATIVE PACKAGE COST	CUMULATIVE ENERGY SAVINGS	CUMULATIVE MORTGAGE INCREASE	CUMULATIVE CASH FLOW
				YEAR 1		
[1]	INFILTR-VAP.BAR. + INT.CAULK	296.00	296.00	59.76	39.35	20.40
[2]	WINDOW- LOW-E	163.00	459.00	92.64	60.95	31.68
[3]	HEATING-RECUPERATIVE FURNACE	200.00	659.00	120.12	87.47	32.64
[4]	HEATING-CONDENSING - AFUE 96	375.00	1034.00	158.16	137.28	20.87
[5]	CEILING-R-44	89.28	1123.28	162.12	149.15	12.96
[6]	WALL- R-23	361.62	1484.90	175.44	197.15	-21.72
[7]	CEILING-R-50	89.28	1574.18	178.32	209.03	-30.72
[8]	INFILTR-HEAT EXCHANGER	950.00	2524.18	207.96	335.15	-127.20
[9]	WALL- R-30 T	458.64	2982.82	220.32	396.00	-175.68
[10]	WINDOW- TRI-PANE	428.00	3410.82	228.84	452.75	-223.92
[11]	COOLING-HIGH EFFICIENCY	250.00	3660.82	233.64	486.00	-252.36
[12]	WALL- R-33 DW	449.82	4110.64	237.00	545.75	-308.76
				YEAR 7		
[1]	INFILTR-VAP.BAR. + INT.CAULK	296.00	296.00	383.15	275.51	107.64
[2]	WINDOW- LOW-E	163.00	459.00	602.76	426.71	176.04
[3]	HEATING-RECUPERATIVE FURNACE	200.00	659.00	778.31	612.35	165.96
[4]	HEATING-CONDENSING - AFUE 96	375.00	1034.00	1021.80	960.96	60.83
[5]	CEILING-R-44	89.28	1123.28	1047.11	1044.11	3.00
[6]	WALL- R-23	361.62	1484.90	1132.68	1380.11	-247.44
[7]	CEILING-R-50	89.28	1574.18	1151.27	1463.27	-312.00
[8]	INFILTR-HEAT EXCHANGER	950.00	2524.18	1340.28	2346.11	-1005.84
[9]	WALL- R-30 T	458.64	2982.82	1419.48	2772.00	-1352.52
[10]	WINDOW- TRI-PANE	428.00	3410.82	1468.56	3169.31	-1700.76
[11]	COOLING-HIGH EFFICIENCY	250.00	3660.82	1506.72	3402.00	-1895.28
[12]	WALL- R-33 DW	449.82	4110.64	1528.08	3820.31	-2292.24

MEETINGS AND SITE VISITS WITH HENNEPIN BUILDERS

Though the St. Louis evaluation showed that higher levels of energy conservation were cost-effective in Minnesota, a shift in local perception had become apparent. Energy efficient housing had been in the news for about six years in Minnesota. Several larger builders had perceived that energy might be a way to sell homes by presenting an image of being "progressive" and "quality conscious". Unfortunately, most builders had come away from this effort with the impression that energy conservation does not sell homes. Additionally, most of the competition was building to the state energy code but not beyond it. Therefore, emphasizing energy was not viewed as a way to go with Hennepin the most successful marketing strategy for Hennepin County builders.

Secondly, the advantages in housing affordability stressed in the St. Louis project did not seem applicable in Minneapolis. Interest rates were low and therefore interest in the "energy addendum" financing tool was also low. This program, which emphasizes adjusted underwriting procedures allowing families to qualify for loans on energy efficient structures more easily, simply did not have a market in Hennepin County.

Finally, builders in Minnesota ironically were beginning to lobby for a roll-back in the state energy code. After having been among the leaders nationally in pioneering improvements in residential energy performance, these builders were now concerned that the higher up-front costs simply were not registering as that important with homebuyers.

Therefore, the Hennepin County project adapted a hybrid approach to promoting energy conservation in new home construction. Rather than stressing energy and housing affordability as was the case in St. Louis, the decision was made to use energy performance as a measure of "quality". The emphasis became how to build "quality" homes rather than "energy efficient" homes. The approach centered around training and information on quality construction, rather than upgraded energy standards with more insulation and higher efficiency equipment. This approach, covered more fully in the Hennepin County report for Year VII, should offer a new dimension to the ground work pioneered in St. Louis.

Field work and monitoring over the past five years has led to new accepted conclusion that attention to detail during home construction can make a large difference in the cost of heating. Especially in the areas of exterior envelope design to prevent thermal bridge, insulation type and installation, and sending and caulk to creak to create an air-tight house, the correct execution of details is necessary to achieve the planned energy savings. This attention to detail has been equated to quality construction.

By monitoring houses theoretically built to the same standard, energy consumption should be an indication of the quality of the home construction itself. The need for quality control emerged as a critical element to gain reliable reductions in energy consumption during the 30 unit demonstration project built in St. Louis. The Hennepin project, combined with on-going monitored performance results from units with upgraded insulation levels in St. Louis, should provide a clear direction of the benefits of combining optimal design with builder training in producing high quality, energy efficient housing.

REVIEW OF TWO ENERGY ANALYSIS SOFTWARE TOOLS

Background

During an early meeting of St. Louis and Hennepin County staff in Minneapolis, both local jurisdictions discovered that they were using energy analysis software to measure energy savings achieved by conservation efforts. In Hennepin County the computer program PRISM was being used to measure the energy savings achieved by the residential shared savings contractor. In St. Louis the software program BILL was being used to measure energy savings achieved by increased levels of energy conservation in rehabilitated and new construction. Even though the applications for the programs were on somewhat differing housing types, a comparison of the two programs appeared to be useful since both projects involved savings based on measured energy savings.

The specific differences in applied uses were as follows:

1) Hennepin needed to measure the weather correlated energy usage of an individual house before and after an energy conservation package had been installed in order to determine the level of energy savings that had been achieved; and
2) St. Louis needed to measure the energy usage of 25 units of superinsulated housing in three housing types (single family detached, townhouses, and apartments) and compare them to energy usage in similarly constructed units without the extra energy package.

Computer Program Description

Both computer programs used inputs of actual utility bill readings and weather data. They varied in procedures for processing that information and in their outputs.

BILL was developed by Londe-Parker-Michels, Inc. an energy consulting firm in St. Louis. It was designed to normalize energy usage from year to year with respect to weather. This process factors out the influence of weather so that valid comparisons of energy usage can be made between winters (or summers), especially, for example, between a mild winter and a very cold winter. Variations between heating degree days (or cooling degree days) can reach 30% between years. This magnitude of change can easily mask or accentuate energy usage changes due to energy conservation efforts and lead to incorrect assessment of the effect of these efforts without this weather normalization.

The inputs to this program are the energy usage data from actual meter readings and the average daily outside temperature for the time period under study. Billing periods are divided into summer and winter depending on whether there are more heating degree days or cooling degree days in that period. The model assumes energy usage for each fuel type is linear with respect to the number of degree days (heating or cooling) in each season. Straight lines are fitted to the data for each season by the method of least squares. This method generates an energy usage equation which contains values for the slope (temperature dependent energy usage); the intercept (temperature independent energy usage or baseload); and the correlation coefficient (a measure of how well the straight line fits the data - this is also a good measure of how well the data fits the model.) The program is adapted to write a data file of this information to be compatible with a commercially available graphics program which can be used to make a graph of the data. For the work in St. Louis comparing energy usage, the slope of the line for each unit is divided by the efficiency of the heating unit and divided by the heated floor area to calculate the Space Heating Index in BTU/DD/SQ.FT. or the Space Cooling Index. These indexes are compared between the types of units. The equation can also be evaluated for annual energy consumption in a typical year.

PRISM is produced by the Center for Energy and Environmental Studies at Princeton University. It was created to compare pre- and post-weatherization energy usage data on an individual building to measure actual energy reductions. There was concern on the part of the creators of PRISM that energy retrofit work was being undertaken on residential units without any systematic or ongoing effort to measure the actual results. Without such results, weatherization programs can promulgate mistaken concepts about what are the most effect energy conservation retrofit items. Such a scorekeeping method is also important for the following reasons. There are a lot of unsubstantiated energy savings claims for various products; people are very imprecise in their sensory evaluation of energy conservation efforts, responding to price, not energy usage, and remembering one large monthly energy bill much longer than an entire winter of somewhat higher cost when monthly bills seem reasonable; reasonable answers need to provided for critics of weatherization programs; and weatherization programs need to be honest about and critically evaluate what they are actually achieving.

The inputs to PRISM are actual energy meter readings, the average outside daily temperature, and at least ten years of annual heating degree days. The model used assumes that above some reference temperature heating energy usage is constant on a daily basis and below the reference temperature, heating energy usage increases proportionally to the number of heating degree days. The reference temperature is determined by iteratively fitting least square lines to the data at different reference temperatures and determining which reference temperature gives the "best fit" (highest correlation coefficient). The energy values generated are the slope, the base line usage (the intercept at the reference temperature), the reference temperature, and the normalized annual heating fuel consumption. Statistical parameters are calculated for all these numbers. Graphs can be generated by the program. The program can handled large numbers of cases - both pre and post data.

Evaluation

Both programs allow one to calculate energy savings from energy conservation efforts. The advantages of PRISM are that it calculates statistical parameters on the energy values generated, it requires less operator intervention, it has built-in graphic capabilities, it requires fewer data points to get accurate results, it automatically calculates a normalized annual fuel consumption, and it is set up to process large numbers of samples internally. Its limitations are that it requires the heating fuel not to have any other temperature dependent activity - specifically it cannot be the fuel for air-conditioning. The incoming temperature for the domestic water should desirably be constant, as happens with well water.

In practice this means that PRISM can only be used for gas heated houses without gas air conditioning or for electrical resistance heated houses (not heat pumps) that do not have electrical air conditioning. The major advantage of BILL is that it allows evaluation of winter and summer usage separately so that the energy usage of all-electric and "all-gas" buildings can be analyzed.

In St. Louis 18 out of the 25 superinsulated units were electrically heated with electric air conditioning, which meant that PRISM was not usable. Also with an annual variation in incoming domestic water of 45 degrees the assumption of constant gas use outside of the heating season could be questioned. This does not seem to be a problem at sites where PRISM has been used to date, so this variation has not been tested. BILL allows St. Louis to address these situations and so the St. Louis Energy Management Program continues to use BILL. A variety of conditions in Hennepin County favored PRISM, specifically minimal air-conditioning, minimal operator intervention in processing the data, the internally handling of large number of samples, and the reduced data requirements and so Hennepin continues to use PRISM.

CHAPTER 4
FINANCING CONSERVATION FOR EXISTING HOMEOWNERS IN ST. LOUIS

PERSPECTIVES ON THE HENNEPIN COUNTY SHARED SAVINGS PROJECT

In early May, Hennepin County staff visited St. Louis to tour energy efficient demonstration units and present the results of the shared savings program carried out in Minneapolis. The shared savings demonstration program was reviewed for applicability to the St. Louis situation.

Key elements of the shared savings concept reviewed included the marketing approach used; the pro forma of the shared savings vendor; the applicability of the retrofit approach used in Minneapolis to the St. Louis situation; and how the residential market served by this alternative financing methodology differed between the two local governments. This chapter will discuss the technical assistance provided to St. Louis by Hennepin County.

The marketing approach used in Hennepin County was among the most successful of the elements to emerge from the program. A controlled market survey was conducted to determine the most effective manner for the County to be involved in helping to market the shared savings approach to middle-income homeowners. Nearly 800 residences were served by the program, a remarkable first year impact for a conservation program.

Given the proven ability to market a performance contracting program, emphasis shifted to an analysis of the pro forma of the shared savings vendor. One key problem with the Minneapolis experience was the inability of the savings from the installed retrofit measures to carry the financing costs and vendor profit. The reasons essentially had to due with the inability of the retrofit package to reap maximum performance. Since the program payback relied upon the cashflow from the energy savings, the program was essentially unprofitable.

Hennepin staff discovered that commercial lending rates made performance contracting a risky business for a private company. Difficulty in obtaining lending insurance on these ventures also added to the risk. An analysis of the cashflow from the Hennepin program showed that the cost of borrowed money had to be reduced and/or the package of installed conservation measures had to be less expensive to install and more effective in producing energy savings. Hennepin staff also emphasized that subcontractors used by the vendor did not meet the quality installation goals on many projects and many return visits were necessary.

UTILIZING SUBSIDIZED FINANCING

As a result of this review process, it became apparent that a program in St. Louis had to emphasize a subsidized loan source. A survey of potential funding sources was made. A variation on the local utility company energy conservation loan pool was proposed. Currently both the electric and gas utility in St. Louis offer 5% loans for a variety of energy saving improvements. One approach studied was to access a portion of these loan pools to provide lower cost capital for vendors offering an effective retrofit package. This would allow for easy repayment from energy savings as part of the energy bill, since this is how the current method of loan repayment for the programs.

Another alternative funding source is the Missouri Housing Development Commission. MHDC initiated a $4 million energy conservation loan program in the summer of 1986. Roughly similar to the utility company loan programs, the MHDC product was offered at a higher (10-3/4%) interest rate and was administered by local banks. An energy audit is required.

The MHDC program has not been successful since its interest costs are higher than conventional home improvement loans. It is, however, a state-sponsored program and therefore could be accessed for potential use with performance contracting. The Missouri Division of Energy was contacted concerning an interest-write-down program to make the terms of the MHDC loans more marketable, using petroleum violation monies to fund the write-down. The Division of Energy suggested a pilot program in St. Louis, with an option for funding performance contracted retrofit packages. The Division decided not to fund this program during its initial expenditure of oil overcharge grant funds.

However, this approach appears to have a high degree of potential. It would automatically provide a funding source for existing energy conservation vendors and thereby lower risks considerably. It would also allow existing contractors to be used in the program, rather than relying on the creation of a vendor combining both the ability to install a retrofit package and providing the financing. It would address the problem of high interest rates, while providing all of the benefits of essentially no up-front cost for the homeowner.

THE MARKET FOR SHARED SAVINGS IN ST. LOUIS

Next, the applicability of performance contracting to St. Louis was explored. St. Louis has a much larger number of families below poverty level, and therefore eligible for federal weatherization funds, than does Hennepin County. As Hennepin discovered, families who are able to access free or subsidized energy services are highly unlikely to participate in shared savings programs. However, a large number of elderly persons reside in the City who are above poverty level and are on fixed incomes but do not qualify for energy assistance. This group would be a prime target for performance contracting due to the elimination of up-front costs.

In conclusion, the market in St. Louis for this service looks moderately strong, but perhaps not strong enough to create a new business venture. Therefore, adaptation of existing insulation, heating and other conservation related contractors would need to be emphasized to make the program operational.

ANALYSIS OF RETROFIT ITEMS APPLICABLE IN ST. LOUIS

Site visits to homes retrofited in Minneapolis along with monitored savings confirmed that the package of installed options used in the demonstration program was not highly effective. The vendor in the demonstration program both installed and manufactured the conservation items used in the program. Though the general approach used of tightening and "tuning up" the home is sound, there was no quality control to verify the impact of the installed items. The benefit of items such as fins on furnace flues to dissipate heat into the basement, is clearly questionable. In many cases, the installed items were more show for the homeowners benefit than cost-effective. Notably, nothing was done in the program as originally conceived to deal with upgrading furnace efficiency.

Clearly, the installed package needed modification for the St. Louis context. The best approach would have been to determine the best retrofit items, field test installations on several houses and monitor results. This was not possible given the constraints of the program financially.

However, testing on several key conservation items was undertaken in cooperation with Union Electric Company in St. Louis. UE was ordered to test the effectiveness of several energy conservation options by the Missouri Public Service Commission. This included the impact of air tightening, hot water heater insulation, heat pump hot water heaters, and upgrades in furnace, heat pump and air conditioning efficiency. With funding from the electric utility, the St. Louis Energy Program purchased a Retrotech RDF-610 blower door for use in testing demonstration homes.

In cooperation with Union Electric, this door was used to field test the energy savings of tightening existing homes. First a radon test was performed on all 60 homes to determine whether there were potential indoor air quality problems that might be exacerbated by tightening. Homes in the program were then air tightness tested, sealed with caulking, weatherstripping and other improvements and retested until a 25% level of improvement was achieved. These homes were chosen to statistically represent the Union Electric Service area and will be monitored through the winter of 1987. Results on the energy reduction due to the tightening program, along with results from the other conservation options tested, will be available as an addendum to this report.

CHAPTER 5
CONCLUSION

Lessons Learned: The Benefits of Technology Transfer Between Local Governments

Summary

This joint project explored methods for accelerating the transfer of innovative energy conservation programs between local governments. Though concern with energy as a cost issue has waned, especially with the fall of oil prices in January, 1986, there is little doubt that prices will rise in the near future. At such a time, the ability to quickly implement programs to respond to higher energy costs or shortages may depend upon the ability of cities, counties and states to quickly resurrect programs to reduce energy demand.

With this perspective in mind, this joint St. Louis/Hennepin County experience provides some important groundwork. Once programs have been proven in part or total to be effective in one area of the country, the ability to quickly spin-off sister efforts is in direct correlation to the transfer of information. Written reports take time to be produced and disseminated. Their very nature, much like formal city planning documents, tends to ossify information, freezing the full experience gained from a research venture at the time of printing.

The process explored in this demonstration program went beyond the written report. Through on-going interaction, site visits, informational updating and critical peer review, the process of effectively transferring information on programs between communities can be effectively quickened. Unlike conferences, where limited questioning can take place with presenters, the hands-on site review of a project being evaluated for potential transfer allows for a critical examination that can go beyond the sometimes rosy analysis performed by staff on their own work. Furthermore, the transferability of a program has at least as much to do with the local situation as the technical or financial components of the project itself. Local needs must be assessed as well as the proper role of government in attempting to address those local needs.

Government's Role in Energy Conservation

As pointed out by Hennepin County staff, the first step in developing a program is not what government can do, but indeed whether government has a role. This was explored in determining the relative benefit of the county's role in marketing performance contracting in Minneapolis, with positive results. It was explore in St. Louis in developing energy standards for new and rehabilitated housing with positive results. In both situations, the government was seen as having a role in promoting energy conservation.

Marketing and Financing Energy Efficient Housing

In transferring these two programs to new localities, however, a new needs assessment was needed to evaluate the previously successful program within a new community context. In Hennepin, the role of government in promoting energy standards was hampered by the lack of a centralized source of government seed-funding for housing development as is found in St. Louis. With no central "pressure point" to promote energy standards, the benefit energy efficient construction was to have in the community relied more heavily on the market place alone. At the time this program began, the market in Minneapolis was weak for energy efficient buildings. Financing benefits for energy efficient buildings did not become the anticipated successful marketing tool because low interest rates have increased demand for housing, and therefore lowered the banking communities interest in any terms but conventional financing. Thus the Hennepin program turned to the issue builders did see as beneficial, namely quality construction. The "house as a system" approach, emphasizing quality construction and energy performance as a measure of that quality emerged as a marketable benefit to pursue with the building community. Energy in housing evolved as a different concept from that developed in St. Louis.

St. Louis perceived a need to reach existing homeowners with an affordable method of reducing energy costs. However, a review of the local situation showed that a higher percentage of households were low income and therefore eligible for subsidized weatherization monies. In addition, the financing structure of the Hennepin program appeared too weak to support a private vendor in installing and financing a retrofit service. Finally, the conservation measures implemented in Minneapolis proved to have a low savings cash flow from energy savings.

Therefore, St. Louis turned to local funding sources to explore the viability of "subsidized" loan money for performance based contracting. Utility low-interest loan pools and the Missouri Housing Development Commission's energy conservation loan program were both studied as lower risk financing sources for shared savings. The program was geared to be able to take advantage of existing contractors by providing them with a financing umbrella to work within, rather than relying on the ability to create vendors capable of both installing and financing their own projects. Finally, efforts were begun to evaluate a variety of conservation options and field test their performance, to develop a cost-effective package of retrofit improvements that would perform best in St. Louis.

Technology Transfer Process

In both of the above cases, the "technology transfer" process involved much more than simply transplanting one successful program to a new context. It involved honest, critical evaluation of the strengths and weaknesses of a program and a review of the local situation. This may be one reason federal programs such as low-income weatherization have consistently produced disappointing results. An effort to run one type of retrofit program - typically insulation and storm windows- on a national scale simply ignores the needs of specific regions, climates, housing types and delivery systems. A process to "transfer" the idea of saving energy through weatherization based on a process of understanding the most effective way to run each local program would go far to eliminate waste and stretch the use of limited funding.

Financing Considerations

This project has laid groundwork for alternative financing of retrofit improvements for existing homeowners in St. Louis. Drawing from the Hennepin County demonstration of performance-based contracting, the financing and technical aspects of starting a sister program in St. Louis were fully explored.

Several financing alternatives were identified to overcome the obstacle of raising private capital for a residential shared savings program. The local utility company low-interest loan program is a viable source of funding for a package of conservation items installed to produce optimal savings on homeowners' homes. Another source of public funding for "shared savings" retrofit is the Missouri Housing Development Corporation. The possibility of marrying petroleum violation monies with the MHDC conservation loan program offers a large potential pool of monies for conservation work. Initial work has begun to allow this program to finance a performance-based contracting package for homeowners. Furthermore, the Missouri Division of Energy has expressed enthusiasm for an interest-write down program to subsidize loans for this purpose. Though not funded this year, the ground-work has been laid to pursue an oil-overcharge grant in the future to make this program a reality.

Technical Consideration

To determine the most effective conservation options for use in a shared savings retrofit program, the St. Louis Energy Management Program is cooperating with Union Electric Company in testing house tightening on some 60 homes in the area. In addition, the electric company is field testing a variety of other conservation options. The results of monitored energy usage on these field tests, along with monitored energy usage on 27 "superinsulated" houses and 100 conventional homes, will form a substantial data base by the summer of 1987. The results of this work will be presented in an addendum to this report.

A key change from Hennepin in the St. Louis perspective on shared savings vendors is that the installation and financing of these programs must be separate to have serious market penetration. Most energy-related subcontractors such as insulation companies, home remodelers, or "house doctor" energy businesses, simply have no access to the amount of capital needed to finance their own work. Furthermore, the financial expertise needed to structure a successful shared savings business has not been demonstrated to date. The success of the Hennepin County demonstration of this approach was not a success for the participating vendor in the project. Technical issues aside, the number of vendors with $1 million or more available to spend on financing home energy improvements up-front for homeowners is extremely limited.

Future Directions for Residential Conservation Efforts

Several conclusions can be draw from this transfer process.

First, close cooperation between communities in transferring programs works. It does not work in the same manner as was initially expected however. The programs that emerge within a new community will not be copies of successful programs elsewhere. This is however a strength of the transfer process conducted in this study.

Secondly, there is a need to establish new methods to penetrate the residential market in terms of promoting energy conservation. In both Hennepin and St. Louis, middle-income residents whose paycheck is above income guidelines for subsidized programs but is not enough to feel comfortable financing energy improvements themselves, simply don't buy energy improvements.

Thirdly, extra energy conservation in new construction is not in demand. Builders in the Minneapolis market don't use energy efficient construction as a marketing tool to sell homes. There simply isn't a demand. In St. Louis, support within local government for establishing a shared savings program for homeowners is lukewarm. Even though electric prices in St. Louis are rapidly climbing, the electric utility still views residential energy conservation as a lower priority than other methods of reducing costs. In both new construction and with existing homeowners, however, this situation could reverse quickly with a return of climbing oil prices.

Fourth, financing shared savings programs at market financing rates to serve existing homes is probably too expensive to make a significant market impact at today's energy costs and today's cost of money.

Fifth, given the technology for saving energy in both new homes and existing homes it is hard to predict dollar savings. This is largely due to variations in occupant behavior (though the Hennepin demonstration also indicates that weak retrofit packages are an obstacle to gaining satisfactory results).

Sixth, the availability of low-interest loan programs through the utility companies in St. Louis, has shown that consumers will buy conservation if it is percieved as a good buy. These utility loan programs not only offer periodic 5% interest (this program is only avaible when limited funds are "repaid" by former borrowers), they are also easy to get. There is no up-front loan fee and repayment is "invisibly" added to the monthly utility bill. Though the programs have been quite popular, they also would be competition for an subsidized loan pool program. This would have to be addressed in structuring a loan pool to be paid back out of savings so that the perceived expense and ease of applying would compare favorably with the low-interest utility program.

Seventh, subsidized financing can alter shared savings programs into highly effective mechanisms for marketing home energy conservation. The basic concept of financing retrofit for homeowners upfront and allowing for payback out of savings is sound. In order to provide what is generally recognized as a reasonable period of payback, however (five to seven years), interest rates must be low and installed retrofit items must have a three year payback or less.

REPORT AND INFORMATION SOURCES

Additional copies of this report, "Technology Transfer for Residential Energy Programs in New Construction and Exisiting Housing" are available from:

Publications and Distribution
Public Technology, Inc.
1301 Pennsylvania Avenue, NW
Washington, DC 20004

For additional information on the process and the results of the work described in this report or for information on the overall energy management programs in St. Louis, Missouri, please contact:

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