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IMPLEMENTATION OF HOME ENERGY RATING SYSTEMS

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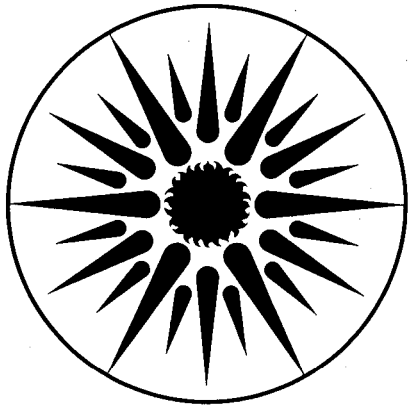
February 1987



APPLIED SCIENCE DIVISION

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IMPLEMENTATION OF

HOME ENERGY RATING SYSTEMS

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EXECUTIVE SUMMARY

In this paper, we present the findings of a national survey of home energy rating and labelling programs (HERS). We discuss the nature of different implementation problems and the kinds of strategies that have been used to deal with them to ensure the effective penetration of HERS to all HERS-users. Of further special interest to us has been the nature of different delivery systems.

We examined 34 HERS, located in 28 states: 13 of these were located in the southeast, 8 in the midwest, 5 in the northeast, 4 in the Pacific/mountain region, and 3 in the southwest. Although our survey does not represent a scientific sampling of HERS, we believe that the final distribution accurately reflects the distribution of HERS through the country and the full range of likely implementation and delivery programs.

The target populations included homeowners and homebuyers (consumers), builders, real estate agents, primary and secondary lenders, state building code enforcement agencies, associated energy service specialists, and real estate appraisers. Different expectations for, and uses of, HERS exist within these groups, and these differences affect the kinds of strategies evolved for successful implementation of HERS.

The success in implementing a HERS is less dependent on the degree of accuracy of a rating tool than it is on how successful the HERS program has been *marketed.* Successful marketing is achieved only after a comprehensive appreciation and treatment of the diversity in target populations. Programs that have had a restrained approach to the implementation of HERS, or programs that have adopted an aggressive, non-responsive approach, have had a poor track record. Successful implementation requires sensitivity to the diversity of the market; the range of different uses; the range of apprehensions felt by the various target groups; an active constructionist approach to marketing; and the willingness to be responsive to the major user groups in the administration and further development of the program.

Thus, HERS that are actively marketed, have a comprehensive appreciation of the market, are adaptive to the needs of particular users, and include user participation in the operation and revision of the program, are more successful in terms of penetration rates and in improving the energy efficiency of the older housing stock. Where successful, HERS have penetrated an estimated 40% of the new construction market and 20% of existing construction, and energy savings have ranged from 10% to 50%. These savings do not take into account the impact of HERS on non-participants, so that HERS are more successful than indicated by the direct savings alone.

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CHAPTER 1. INTRODUCTION

The rating and labelling of new and existing energy-efficient homes by local, state, and federal government agencies, utility companies, and other organizations has been an activity marked by periods of intense interest and benign neglect. During the late 1970's, home energy rating systems (HERS)[†] became important components of several energy conservation programs conducted by governmental and non-governmental organizations at national, regional, and local levels. By 1982, when the first national review of HERS was prepared (Hendrickson et. al., 1982), it seemed that the idea of a home energy rating system had become entrenched as an effective means of pursuing the goal of energy conservation. Since that time, however, a number of these systems have been abandoned, and only a few have endured.[‡] Moreover, most HERS are currently reputed by those organizations that have abandoned HERS or declined to implement them to be transitory programs, with low effectiveness, low accuracy, low public support, and much opposition from builders, real estate agents, and lending institutions.

In this paper, we survey existing home energy rating and labeling programs to examine the validity of the above impression of HERS and, most importantly, to determine how these programs were implemented. We hypothesize that implementation systems responsive to the "perspectives" of the individuals targeted by home energy rating programs (consumers, builders, realtors, appraisers, and lenders) and of those sponsoring these programs (local and state government agencies, utility companies) will be more persistent and successful than those that do not take these perspectives into account.[*] In addition, we examine a number of other issues related to HERS (Table 1), especially, the promotion of HERS, their delivery mechanisms, HERS raters and rater reliability, the success of HERS, and their penetration in the multi-family and low-income sectors.

[†]For the purposes of this paper, HERS includes both rating *and* labelling activities.

[‡]For example, in 1982, over 170 utility companies were operating under the Edison Electric Institute's National Energy Watch (NEW) program. In 1986, only a very weak commitment is evident from a few of these companies. In fact, the NEW program is dormant and all but abandoned by Edison Electric. Some of these programs have been merged or replaced with other ones.

[*]We distinguish our approach from an engineering approach in which the success of a HERS is determined by its technical accuracy. As described later in this paper, the fine points of the accuracy of a HERS tool have been incidental (or less important than expected) to the prediction of HERS success than the implementation process itself.

Table 1. HERS Implementation Topics.

Nature of HERS

Type and units of rating system, date of implementation, type of demonstration program, validation studies, ongoing research and development of system, and targeting of HERS to existing and/or new housing.

HERS implementors (developers/sponsors)

Local, state, and federal government agencies, utility companies, and energy service industries connected to the building trades (e.g., insulation companies): perspectives, current and future marketing strategies, relationship of HERS to other programs, and organizational resources for implementing HERS.

HERS target groups

Consumers (homeowners, homebuyers, sellers, and renters), builders and developers, realtors, appraisers, lending institutions, and landlords: perspectives, rating utilization, level of support/opposition to ratings, and marketing strategies.

HERS rating method

Type and training of raters, rating characteristics (occurrence, cost, and duration of rating), evaluation of raters, satisfaction with rating method, and changes in rating method over time.

Penetration of HERS

Proportions of new and existing homes rated in program, annual changes in certification, retrofit activity, and economic conditions affecting penetration.

Economic analysis of HERS

Energy and cost savings per rating and/or per retrofit, and annual costs and benefits (energy and financial savings) to implementing agencies and to targeted groups.

This investigation was conducted to provide contextual material for Lawrence Berkeley Laboratory's (LBL) evaluation of two HERS demonstration projects in California. In addition to examining the effectiveness of alternative delivery mechanisms, the demonstration programs will evaluate the accuracy of a simple hand-calculational rating tool with a slide calculation format (developed by LBL) that can rate the energy efficiency of single-family residences for specific climate zones (Ritschard et. al., 1985).

CHAPTER 2. METHODS

In January 1986, we conducted a national telephone survey of home energy rating systems to examine the different kinds of HERS and implementation systems being used and to discover the range of possible implementation problems and solutions experienced by the users of these systems (Table 1). In addition to examining the perspectives and attitudes towards HERS by their implementors and target groups, we examined rating methods, HERS penetration, and economic analyses used by HERS.

Because of our interest in a statewide HERS, we first contacted all state energy offices in the U.S. to discover where existing HERS were operating.[†] Major systems were followed up in each state, and we examined those operated by local governments and utility companies. Because we were primarily interested in obtaining a description of only one HERS per state, we did not normally investigate additional HERS in a particular state if that rating system was a duplication of one already reviewed. As a result, 28 states were able to provide examples of some form of HERS that was currently in operation. These states provided information about 34 HERS programs (Table 2).[‡] In each interview, we used a structured questionnaire organized by key areas of interest as identified in Table 1.

This procedure had its shortcomings: for example, we were told in some states that HERS did not exist, when in fact very important ones did. Undoubtedly, some of the states that have been listed as void of a HERS may have large and very successful systems in operation. For example, the Bonneville Power Administration's Super Good Cents program (covering Washington, Oregon, Idaho, and western Montana) was not reported as an ongoing HERS in these states. There were two reasons why state energy departments were poorly informed concerning the use of HERS in their states: (1) the locus of responsibility for operating the HERS did not reside in the state energy office (increasingly, local governments have become the dynamic governmental force in implementing energy conservation programs (Lee, 1980)), and, therefore, state personnel were uninformed about these sub-state HERS, and (2) due to personnel transfers, there was no one responsible for HERS at the time of our interview. Consequently, in this paper, we have not attempted to present the definitive case on HERS, but have tried to highlight

[†] Lawrence Berkeley Laboratory has developed a simple hand-calculational rating tool that can rate the energy efficiency of single-family residences for specific climate zones in the State of California. The tool is being tested in three demonstration projects to see if statewide adoption of a HERS is warranted.

[‡] These included two currently defunct programs, Illinois Power's and Union Electric's (Missouri) NEW programs, which we followed up, since we wanted to know why these programs had failed.

some of the key issues involved in implementing these kinds of systems.

Because of the methodological limitations described above, the distribution of home energy rating system types, their support features and implementation systems, and the implementation problems encountered are not representive of the entire HERS population. Nonetheless, the findings do reflect a large range of HERS types and attendant features, which is adequate to the task of articulating the kinds of implementation systems that are available, problems that have been encountered with each type and how they have been handled, as well as providing a general sense of the current status of HERS in terms of the aims, accomplishments and dissatisfactions expressed with them. Before describing the sample and examining the implementation topics in greater detail, we present a brief overview of the different types of home energy rating systems.

Table 2. Home Energy Rating Systems Surveyed.

HERS Program	Single Family		Multi-Family	
	New	Existing	New	Existing
Alabama Power : Good Cents	C			
Energy Rated Houses of Alaska	A/C	A/C		
Salt River Project (Arizona) : Energy Efficient Homes	A			
Arkansas Power and Light : Energy Efficient Rating:	A/C	A/C		
Denver Energy Resource Center (Colorado) : Home Energy Rating	B			
Conn Save (Connecticut) : Cornerstone Home Energy Rating	C	C	C	C
Florida Energy Proficiency Award	A	A		
Gulf Power (Florida) : Good Cents	C	C		
Georgia Power : Good Cents	C	C		
Illinois Power : NEW	A/C	A/C		
Delmarva (Delaware, Maryland, Virginia) : Super E Home	C			
Mass Save (Massachusetts) : Mass Save	C	C		
Mississippi Valley Gas : Gas Mark	A		A	
Mississippi Power and Light : E3 and Energy Saving Home	C			
St. Louis Home Builder's Association (Missouri) : Energy Mark Program	A			
Union Electric (Missouri) : NEW	A	A		
Kansas City power and Light (Missouri) : Save America's Valued Energy	A			

A = Prescriptive; B = Performance; C = Calculational.

Table 2 continued. Home Energy Rating Systems Surveyed.

HERS Program	Single Family		Multi-Family	
	New	Existing	New	Existing
Nevada Power : Energy Efficient Homes	A			
Southwest Gas (Nevada, Arizona) : Flame of Excellence	A			
Public Service Company of New Mexico : SMART	C			
New York State Department of Energy : Thermal Rating	A/C	A/C		
Duke Power (North Carolina) : Energy Efficient Structures	A	A	A	A
Ohio Department of Energy and Conservation : Home Energy Analysis Audit		C		
Oklahoma Natural gas : Conservator Home Award	A			
Pennsylvania Governor's Council : Home Energy Cost Estimator	C	C		
Tennessee Valley Authority : Super Saver Homes	A/C		A/C	
Watt Count Engineering	C	C		
Texas Utilities Electric Company : Energy Action Homes	A	A	A	
Gulf States Utilities (Texas) : Good Cents	C			
City of Austin (Texas) : Look for the Star	C			
Virginia Power : Energy Saver Home	A			
Western Resources Institute (Washington) : Energy Rated Houses	A/C	A/C		
Wisconsin Division of State Energy : Energy Auditing Program	C	C	C	C
Wisconsin Electric power Company : Good Cents	C			

A = Prescriptive; B = Performance; C = Calculational.

CHAPTER 3. HERS CLASSIFICATION

Hendrickson et. al. (1982) classified home energy rating systems into three generic categories: (1) prescriptive systems, (2) calculational systems, and (3) performance systems. We use this classification scheme below in our overview of the different kinds of HERS. It is important to note that while most HERS are easily distinguished by one of these systems, some HERS fit into two or more of the above categories.

A. Prescriptive Systems

Prescriptive systems involve the rating of a structure based on the presence of specified energy-efficient features. These features often include the following: wall, ceiling, attic, slab, crawlspace and basement insulation; duct insulation; caulking and weatherstripping; vapor barriers; window glazing; storm doors and shutters; fireplace dampers, air intakes, and glass doors; lighting systems; heating, ventilation, and air conditioning (HVAC) systems; hot water systems (including pipe insulation and low-flow shower heads); appliances; and active and passive solar features. These ratings are often conditioned or affected by type of building (e.g., detached versus semi-attached), type and severity of climate (heating or cooling), and, sometimes, occupant-related features (e.g., size of household).

A point system is often used to tabulate the number of energy-efficient features present and their contribution to the total energy efficiency of the structure. Accordingly, prescriptive certifications use simple calculations, and, at the most, aid from a hand calculator. Previous calculational work and testing (e.g., ASHRAE standards) often forms the basis for confirming the validity of the tool. Where there is a valid point system, energy use and cost can be estimated.

Prescriptive systems have been further differentiated into four groups: (1) certification ratings, (2) point score ratings, (3) category ratings, and (4) energy use ratings. As mentioned above, a HERS can fit into one or more of these groups. **Certification ratings** indicate that some "authority" has judged that a particular structure has some relatively desirable level of energy efficiency. Claims about how efficient that structure might be tend to be very cautious. Structures with the minimum characteristics needed for an energy rating are compared with "base case" structures (similar structures built to an earlier building code, or to current (presumably, less energy-efficient) practice). On the basis of such comparisons, an estimate of the relative energy efficiency (and, sometimes, financial savings) of a structure is made, and the structure is certified as having met the specified level of energy efficiency. The estimates are

not very exact because these kinds of systems are most often developed and used by utility companies and home builder associations who are usually interested in a simple absolute increase in energy efficiency.

Point score ratings refer to those prescriptive systems that specifically allocate points for particular energy-efficient features. Because a greater degree of scaling is possible, estimates of use and energy cost are more precise for the structure being rated. Point score validations are based more on simulation studies (rather than field studies), since experimental field work requires extensive sampling or multiple testing conditions which most organizations do not have the resources to conduct. Base cases used in point score ratings are often similar housing types with "no energy-efficient features," so that a ratio level of measurement can be used. With point score ratings, it is possible to qualify for certification through alternate paths.[†] Further, by selecting among alternative component retrofit possibilities and examining their contribution to overall points, the procedure exists for *ranking* retrofit actions as part of a HERS.

Category ratings lie between simple certifications and point score ratings, involve the rating of buildings according to the presence of particular features, and use an ordinal level of measurement. As more features are accumulated, or as the energy efficiency of particular features is increased, the rating classification can change (e.g., from a bronze category to a silver category). Ordinal scales allow plenty of room for judgment: a silver is better than a bronze, but the quality of a bronze is left wide open, and there is no way to tell how *much* better a silver is to a bronze. Category ratings can be field-tested, and, on the basis of these tests, estimates of relative efficiencies can be made.

Energy use ratings utilize structure-related information to estimate energy use and cost for a particular structure. With prescriptive systems, energy-use ratings are usually made on the basis of point scores. Accordingly, the accuracy of the energy use ratings depend on how well the points are determined. More detailed analyses of energy use are conducted in calculational systems, described below.

B. Calculational Systems

Calculational systems estimate the actual energy needs of a structure by primarily considering heating and air conditioning loads, and secondarily considering appliance and hot water loads. The aims of the HERS varies by region, with different emphases on

[†]For example, when cathedral-type ceilings are built, ceiling insulation standards cannot always be met, but the heat loss levels might be manipulated through increased energy efficiency of other components.

heating and cooling loads. The rating itself is likely to be presented in terms of Btu per square foot, per hour, or per degree day.

Calculational systems have been further differentiated into four groups: (1) detailed computer models, (2) simplified computer models, (3) hand calculational models, and (4) slide calculators. **Detailed computer models** are often developed to run on main-frame computers so that a large number of variables can be considered. Also, these models will often be the basis for the development and testing of prescriptive home energy rating tools. They are more expensive to develop and require more training to run and to gather the data compared with other models. **Simplified computer models** make a greater number of assumptions, and, therefore, involve a greater number of constants (and less variables).

Hand calculation models make an even larger number of assumptions and can require a considerable amount of training. There is a considerable increase in the possibility of human error, since this method places the greatest burden on the skills and competence of the rater. The number of components considered in the rating is restricted, and variation in the components examined is also limited. Heating and cooling loads are often considered, and hot water systems and appliances are frequently neglected.

Slide calculators consider the same number of components as hand calculations, but reduces the number of required calculations, which reduces human error as well as the training required to perform the rating. Slide calculators can be developed to give a reasonably accurate rating in terms of both energy consumption and cost, and they can be used by most people. The consequences of different retrofit choices, in terms of cost and consumption, can be estimated and adapted to climate zone and housing type.

C. Performance Systems

Performance systems are based on information contained in past energy bills. The past energy bill is used to predict future energy bills (in terms of consumption or cost). Houses can be compared to similar housing stock within the same climate zone, controlling for household size. This allows some form of category certification, such as 'average', 'above average', etc..

Performance systems are highly dependent on existing databases containing the following kinds of information: past billing data, building type (e.g., ranch-style and two-story house), household size, weather data, and use of secondary fuels. Using this data, performance methods can be very accurate in predicting future consumption when the structure has not been modified or retrofitted. Assuming that the structure and the

energy-lifestyle of households are fairly average, such a rating might be useful in selecting between houses in making a purchasing decision. However, structural modifications do occur and households do differ in lifestyles and, therefore, energy consumption. Consequently, this method has deficiencies if retrofits and occupant behavior are not included in the calculations.

Another limitation with the performance method is that it cannot be used to estimate the cost-effectiveness of different retrofits, but it can be used as a simple preliminary diagnostic device. For instance, the method can be used to make a gross estimate of the comparability of the target structure to some average energy use; if the target structure is below 'average', then an energy retrofit audit may be recommended.[†]

[†]It is important to distinguish between HERS and home energy audits. Theoretically, the difference between a HERS and an audit is that the former is primarily concerned with estimating the energy efficiency of the entire house while the latter is primarily concerned with evaluating the potential for energy retrofits. A further difference between an audit and a HERS is that the former is usually more comprehensive using more detailed calculational models while the latter is more simple with less information to collect and less calculations to perform. Audits often cost more than HERS (which are usually free). HERS can be used as a simple diagnostic tool to indicate whether a more extensive and intensive energy audit is needed. In practice, HERS and audits are often highly connected, with the information used in a home energy rating being collected during an audit.

CHAPTER 4. SAMPLE DESCRIPTION[†]

A. Current Status

Based on our survey of 52 state energy offices, 20 states had no strong HERS program. Three other states were covered by a HERS operated from outside that state's boundaries (Kentucky, Maryland, and Louisiana). Of the 20 states without a strong HERS program, one state (Hawaii) felt that it didn't need a HERS because housing structure was not perceived to be an important factor in affecting energy use in their climate. Three states (Idaho, Iowa, and Rhode Island) were interested in a HERS, but opposition from real estate and/or building interests prevented them from initiating any activity in this area. Three states (New York, New Jersey, and Michigan) wanted a HERS and were working on ideas for its implementation. Thirteen states (Illinois, Indiana, Kansas, Maine, Montana, Nebraska, New Hampshire, North Dakota, South Dakota, Utah, Vermont, West Virginia, and Wyoming) expressed no interest in a HERS. Two of these states (Montana and New Hampshire) were not interested because of anticipated problems connected to HERS development and implementation. One state (Illinois) was disinterested because they didn't see the general public expressing any interest. The other states were not interested because they perceived other issues to be more salient to them.

Elsewhere, particularly in the southern states, HERS were critical and highly successful tools in load management and in the marketing of energy conservation programs. For example, the Good Cents program, confined to a few companies in 1982, was being marketed by 151 utilities. Non-utility programs also were on the increase. The Watt Count program was being marketed by 24 energy-service industry dealerships, and participants were expected to increase. In the sections below, we discuss in greater detail the characteristics of current HERS programs.

[†]A detailed description of each HERS is presented in an accompanying report by the same authors: **Home Energy Rating Systems: Program Descriptions**, LBL Report 22919.

B. Regional Distribution of HERS Types

Twenty-eight states provided examples of some form of HERS that were currently in operation and included 34 HERS programs. Of these 34 HERS, 15 were calculational rating systems, 12 were simple prescriptive rating systems, 6 were mixed rating systems (but predominantly prescriptive), and 1 was a performance based rating system (Table 2).†

In terms of regional distribution, the southeast was highly represented: 13 of the 34 HERS operated in southern states. Of the remaining programs we reviewed, 5 programs operated in the northeast, 8 in the midwest, 3 in the southwest, and 4 in the Pacific/mountain state region. Similarly, of those using HERS to manage peak demand, 16 programs were directed towards managing summer peak demand, while only 7 were oriented towards managing winter peak demand.

C. HERS Sponsors

Of the 34 HERS surveyed, 14 were developed locally, and the remaining 20 were applications of regional or nationally used systems (Table 3). One-half of the local HERS was developed by utility initiative, using utility resources. One local HERS was developed by a local Home Builder's Association (Texas Utilities Electric Company), and the rest of the local programs were developed as a result of consultations between various groups on a fairly equal basis. Participating groups included city officials, local realtors and builders, and independent organizations (e.g., Watt Count Engineering, Energy Rated Homes of America, and Energyworks). Consultations with local groups were also an important feature in programs in Washington and Alaska.

At the regional level (including programs distributed nationwide), 6 programs were developed primarily by state organizations, and 7 programs were developed and distributed by utilities and associated companies on a regional or national level (e.g., Southern Electric International's Good Cents program was run by Alabama Power, Georgia Power, Gulf Power, Mississippi Power, Gulf States Utilities, and Wisconsin Electric Power). One regional HERS was primarily developed using the National Association of Home Builders' Thermal Performance Guidelines, and six regional programs were developed by independent organizations - WATT Count Engineering, Cornerstones of Maine, Energy Rated

†See Chapter 3 for a discussion of the different kinds of rating systems. The 'mixed' systems allow for flexibility in meeting various component standards (sometimes using performance criteria); however, compliance to overall standards is determined by calculational means, as in prescriptive systems.

Homes of America, and the Edison Electric Institute.

In sum, 14 of the 34 HERS were developed by utility companies, 7 by independent energy service organizations, 7 by governmental bodies, 2 by home builder associations, and 4 by two or more of the above groups.

D. HERS Perseverance

The lifetime of HERS is somewhat short, as evidenced by the fate of 17 utility-based prescriptive HERS mentioned in a 1982 survey (Hendrickson et al., 1982): two participants in the National Energy Watch (NEW) program (Union Electric and Illinois Power) shelved their interest in a HERS "until the public renews its interest in them"; the ECH2ONERGY program in Colorado became defunct and was not replaced; the Texas Utilities Electric Company (comprising Dallas Power, Texas Power and Light, and Texas Power) co-opted a HERS that had been used by the National Association of Home Builders; Gulf States abandoned the NEW program and was using the Good Cents program; Kansas City's program was replaced with another HERS; and the Cities of Visalia and Boulder were experimenting with different kinds of HERS. Only 4 of the 17 programs were still in operation, either as they were in 1982, or with program modifications reflecting new technologies. All the other programs had been either discontinued or replaced.

Table 3. Developers of Home Energy Rating Systems Surveyed.

Program	Local				Regional			
	Utility	Home Builders Association	Independent	Mixed	Utility	NAHB	Independent	State/ Federal
Alabama Power	-------	-------	-------	-------	X	-------	-------	-------
Energy Rated Houses of Alaska	-------	-------	-------	-------	-------	-------	X	-------
Salt River Project (Arizona)	X	-------	-------	-------	-------	-------	-------	-------
Arkansas Power and Light	-------	-------	-------	X	-------	-------	-------	-------
Denver Energy Resoure Center (Colorado)	-------	-------	X	-------	-------	-------	-------	-------
Conn Save (Connecticut)	-------	-------	-------	-------	-------	-------	X	-------
Florida Governor's Energy Office	-------	-------	-------	-------	-------	-------	-------	X
Gulf Power (Florida)	-------	-------	-------	-------	X	-------	-------	-------
Georgia Power	-------	-------	-------	-------	X	-------	-------	-------
Illinois Power	-------	-------	-------	-------	-------	-------	X	-------
Delmarva (Delaware, Maryland, Virginia)	X	-------	-------	-------	-------	-------	-------	-------
Mass Save (Massachusetts)	-------	-------	-------	X	-------	-------	-------	-------
Mississippi Valley Gas	X	-------	-------	-------	-------	-------	-------	-------
Mississippi Power and Light	X	-------	-------	-------	-------	-------	-------	-------
St. Louis Home Builders Association	-------	-------	-------	-------	-------	X	-------	-------
Union Electric (Missouri)	-------	-------	-------	-------	-------	-------	X	-------
Kansas City Power and Light	-------	-------	-------	X	-------	-------	-------	-------

Table 3 continued. Developers of Home Energy Rating Systems Surveyed.

	Local				Regional			
Program	Utility	Home Builder's Association	Independent	Mixed	Utility	NAHB	Independent	State/ Federal
Nevada Power								X
Southwest Gas (Nevada, Arizona)	X							
Public Service Company of New Mexico	X							
New York State Department of Energy								X
Duke Power (North Carolina)					X			
Ohio Dept. of Energy and Conservation								X
Oklahoma Natural Gas				X				
Pennsyvania Governor's Council								X
Tennessee Valley Association					X			
Watt Count Engineering							X	
Texas Utilities Electric Company		X						
Gulf States Utilities (Texas)					X			
City of Austin (Texas)				X				
Virginia Power	X							
Western Resources Institute (Washington)							X	
Wisconsin Division of State Energy								X
Wisconsin Electric Power Company					X			

CHAPTER 5. HERS USERS AND PERSPECTIVES

One of the key determinants of HERS success is whether the rating system is responsive to the needs of HERS users. There are essentially two groups of HERS users: targeted groups (e.g., consumers, builders, realtors, appraisers, lenders, and building contractors) and implementing groups (e.g., utilities, and local and state government agencies).† Each group has a certain perspective (as reflected in their stated needs and motivations) for investing in energy conservation. By examining these perspectives in detail, one can then see whether HERS have directed their implementation efforts to obtain the support and participation of these groups.

A. The Consumers' Perspective

One reason why some states were not involved in HERS was because not enough interest had been shown by the general public in demanding a home energy rating system, and, therefore, justify the expenditures necessary for agencies to develop and implement a HERS. Consumers (homebuyers, homesellers, or homeowners) are interested in HERS if they are interested in energy-efficient homes, and the latter interest exists if such construction can be shown to decrease energy costs and maintain indoor comfort. To be convinced of the usefulness of HERS and to believe in the value of energy efficiency, consumers must believe the sponsoring authority; such acceptance is based on respect and trust. In addition, consumers' commitment to energy efficiency is also motivated by other concerns: for example, the reduced consumption of non-renewable resources and the reduced dependence on foreign (imported) oil.‡ We explore the first three factors (cost, comfort, and trustworthiness) in greater detail below.

1. Cost

Energy-efficient houses are desirable to consumers because they have lower operating costs while maintaining or increasing the level of comfort. The decision to invest in

†In 70% of the cases surveyed, the primary target group was builders, followed by consumers (homeowners or homebuyers) in 25% of the cases. Other primary targets included associated building contractors (e.g., renovation and retrofitting specialists), building appraisers, and financial institutions. Secondary targets included real estate agents, building inspectors, and tenants.

‡The upper-middle class (providing many of today's homeowners and homebuyers) is known for its commitment to an energy conservation ethic (Anderson et al., 1974; Harry et al., 1969; Heslop et al., 1981; Kinnear et al., 1972; and Shama, 1983), a motivating factor for demanding energy-efficient housing and HERS. However, until surveys of consumers in HERS programs have been conducted, we do not know the intensity and distribution of these motivating factors among consumers.

energy-efficient homes is often based on the following criteria: (1) the expected first-year savings or **annual savings** accruing as a result of the investment, (2) the **cost-effectiveness** of the investment (often represented as simple payback - the number of years it takes for the principal to be paid back), (3) the **expected capital returns upon resale** of the building, and (4) the homebuyer's **ability to pay** for a particular home. Individual HERS have attempted to address one or more of these criteria in the implementation of their program.

HERS have been primarily marketed to homebuyers at the upper end of the socioeconomic scale, and these programs have been typically presented as energy-saving/cost-saving programs. Ten HERS offered estimated **annual savings** as part of their rating product, either as a principal component or as an option (Table 4). Eight other HERS estimated annual savings (energy saved or financial savings) for the most typical case (Table 5), but these estimates were mainly for private (in-house) use and were not presented to the consumer. Prescriptive systems were the most common types of HERS making these private kinds of estimations, and their cost savings varied from a high of 50% (Kansas City Power and Light) to a low of 15% (Salt River Project, Arizona, and Okalahoma Natural Gas).

Most utilities were very cautious in estimating annual savings because of the sensitivity of the base case used to make comparisons. Most of the high savings estimates and low savings estimates were made with reference to minimum standards and current building practices, respectively. From a technical point of view, an inherent problem in many of these comparisons, leading to an underestimation of the benefits of a HERS, was that both standards already have been influenced by previous HERS. Where there is a successful HERS in operation, building practices have changed, often dramatically, to upgrade the energy efficiency of buildings, even though they are not formally rated and certified by a home energy rating program. State and local building codes are also influenced by HERS. Consequently, in comparing a HERS certified structure with average current construction, there was a HERS contamination in the reference point (base case).

From the consumers' point of view, the only comparison of interest is with current practice. When consumers are being asked to pay several thousands of dollars more for a house with a particular energy-efficiency rating, they expect a real return on their investment. An estimated savings based on a comparison with minimum standards will overestimate the actual savings obtained from purchasing the energy-efficient home. For the consumer, calculating their investments based on current practice is more realistic (e.g., 10% savings versus 50% savings).

Table 4. Consideration of Cost-Effectiveness for Homeowners and Presentation of Cost Estimates.

Program	Cost Estimate Presented	Cost-Effectiveness Considered
Alabama Power : Good Cents		X
Energy Rated Houses of Alaska	X	
Arkansas Power and Light : Energy Efficiency Rating	X	
Conn Save (Connecticut) : Cornerstone Home Energy Rating	X	
Gulf Power (Florida) : Good Cents		X
Delmarva (Delaware, Maryland, Virginia) : Super E Home	X	
Mississippi Valley Gas : Gas Mark		X
Mississippi Power and Light : E3 and Energy Saving Home	X	X
Nevada Power : Energy Efficient Homes		X
Duke Power (North Carolina) : Energy Efficient Structures		X
Ohio Department of Energy and Conservation : Home Energy Analysis Audit	X	X
Oklahoma Natural Gas : Conservator Home Award		X
Pennsyvania Governor's Council : Home Energy Cost Estimator	X	X
Tennessee Valley Authority : Super Saver Homes		X
Watt Count Engineering : Watt Count	X	X
Texas Utilities Electric Company : Energy Action Homes		X
Gulf States Utilities (Texas) : Good Cents		X
Virginia Power : Energy Saver Home		X
Western Resources Institute (Washington) : Energy Rated Houses	X	
Wisconsin Division of State Energy : Energy Auditing Program	X	X
Wisconsin Electric Power Company : Good Cents		X

Table 5. Estimated Percentage Savings of Certified Construction (Prescriptive Systems Only)

State	Agency	Estimated Percentage Saving
Alabama	Alabama Power	Heating and cooling by 49% (Energy)
Arizona	Salt River Project	15% (Costs)
Mississippi	Mississippi Valley Gas	30-33% (Energy)
Missouri	Kansas City Power and Light	over 50% (Costs)
New Mexico	Public Service Company of New Mexico	50% (Energy)
Oklahoma	Oklahoma Natural Gas	15% (Costs)
Tennessee	Tennessee Valley Authority	$250 or 5,200 kwh annually.
Virginia	Virginia Power	20 to 45% (Costs)

Most of these estimates were for new construction. Annual savings connected to retrofitting were, on the average, more conservative. A study of the Conn Save program revealed that, based on actual implementation of recommendations, actual savings ranged from 300 therms per year for large investment measures (e.g., the installation of a new heating system) to 10 therms per year for the more frequently implemented low-cost measures (e.g., insulating a hot water tank). The annual average savings was 192 therms, over a four year period. This represented approximately 20% of savings which were possible if all measures had been implemented.

Annual savings varies with the price of energy, weather, and occupant lifestyles. For example, when prices decrease, savings accruing from energy-efficiency investments are reduced; if there is a short-term moderation in weather conditions, energy consumption for heating and cooling purposes will decrease. To provide some kind of stability to the expectation of economic returns, some HERS provided subsidies in the form of rebates (Tennessee Valley Authority) or guaranteed savings, reducing the amount of risk to homeowners. For example, Duke Power Company charged a lower rate to customers that had their homes rated and certified. Also, Virginia Power guaranteed its estimate of energy savings for one year. And Watt Count Engineering guaranteed that energy costs would not exceed a determined amount for a period of two years, or it would pay the difference. By guaranteeing savings, these incentives also had other benefits: they increased the trustworthiness of the HERS provider and increased the value of the rating system (see below).

Cost-effectiveness, defined as the amount of time needed to recover the initial investment (payback), was considered in several HERS: counting the Good Cents programs as a single system, 13 of 28 home rating programs included cost-effective calculations within the criteria used to develop certification standards or retrofit evaluations (Table 4). Some of the programs that considered cost-effectiveness were of the simple prescriptive type. In the simple prescriptive programs, acceptance of a HERS by the general public (and builders) often emphasized cost-effectiveness, and much of the promotion of the program often hinged on the demonstration of such effectiveness.

A 7-year time frame was generally used by utility company HERS in their cost-effectiveness calculations. It is important to note that the general public typically has a different time frame for their investments. For example, in a 1975 study by Cunningham and Lopreato, it was shown that investment horizons varied by socioeconomic status. Low-income groups wanted to be able to recoup a $100 investment in insulation within 6 months in order for them to consider it. As the investment increased to $500, the recovery period was extended to 18 months. In contrast, high-income groups were willing to wait for 18 months and 4.5 years, respectively. These expectations were also true for investments in storm windows and in solar energy. No income group was willing to wait more than 5 years for a return on its investment. Thus, the evidence to date suggests that consumers have a much more restricted investment time frame than anticipated by the developers of HERS. Accordingly, effective marketing programs need to be instituted by HERS sponsors to demonstrate the real savings that consumers can enjoy through a HERS within their time frame.

Capital appreciation and the resale value of a house were considered by only a few HERS in the implementation of their program, although many HERS were concerned with the demand elasticities for new housing - whether energy efficiency in new construction was a feature for which people were willing to pay. In Delmarva Power's program in Delaware, Maryland, and Virginia, houses rated with their HERS not only sold at a price that was $1,000 to $1,500 higher than the average house, controlling for size and type, but also sold four to five times faster. In Gulf Power's program, Good Cents homes sold for $4,000 to $5,000 more than non-certified homes. Only one HERS had any information about the use of a HERS rating in the *resale* of a house: in Mississippi Power and Light's region, the demand for old construction was often contingent on a HERS rating (which had been designed and administered for new construction). For HERS that were designed for existing houses, the resale value was also salient to HERS builders (see below).

The **ability to pay** for a home was often affected by the presence of a HERS. HERS were a good way of demonstrating energy efficiency and reduced predicted energy expenditures, and HERS influenced financing policies by bankers and the secondary mortgage market. Lending policies revolve around estimates of a borrower's ability to meet credit obligations, and this ability is measured by two ratios. The "debt-to-income ratio" compares total debt to total household income, and the "payment-to-income ratio" compares monthly housing payments to monthly income. The Federal Home Loan Mortgage Corporation has established minimum standards of 36% and 28%, respectively, to qualify for a home mortgage. The lower energy expense anticipated from an energy-efficient structure changes the payment ratio so that a borrower can afford to pay for a larger loan than would otherwise have been the case. Alternatively, this means that borrowers who would not normally qualify for a loan (marginal borrowers) could now meet the standards. In recognition of the economic benefits of energy-efficient construction, the debt-to-income ratios have been changed in many instances by around 2%. In addition, other borrowing practice easements have been instituted, so that loans can be made for retrofitting at the time of purchase with much greater flexibility than if they were to be made at a later date (Roll and Haynie, 1984). HERS were also often associated with zero interest and low-interest loan programs, increasing the value of rating systems to lower income groups.

In summary, construction to HERS standards has resulted in real energy savings, with a lower limit of approximately 15%. Through the use of a HERS, homeowners reduced energy expenditures through investments that pay for themselves within a reasonably limited time frame, add capital appreciation, and realize a higher resale price. All of these benefits are of direct importance to consumers and to the creation of consumer demand for more HERS.

2. Comfort

All HERS programs indicated that increased energy efficiency was connected to increased thermal comfort, but the latter was typically presented as an after-thought. Accordingly, the standard promotion of HERS has been as an energy-saving/cost-saving tool. This emphasis reflects the results of surveys of purchasing motivations that indicate that energy efficiency is one of the prime criteria in purchasing a home. However, these surveys tend to have structured forced-choice questions that rarely included comfort as a possible response. Depending on climate, comfort may be a strong motivator, especially when the potential for discomfort is great (e.g., in climate zones with harsh winters, or those with hot and/or humid summers). In general, when cost considerations

come into conflict with personal comfort, comfort may often be the final arbiter of behavior. In economic terms, thermal comfort is generally seen as an essential need with a highly inelastic demand: as the price goes up, the demand remains fairly constant (Winkler and Winett, 1982). However, as the price goes up, the value of alternate solutions to the provision of such thermal comfort also rises. For instance, the thermal qualities of the building shell become more valuable, facilitating changes to greater energy efficiency in new and existing structures.

Many HERS programs combined the value of comfort with energy and cost savings in the promotion of their programs. Moreover, two programs, in particular, actively promoted the value of increased thermal comfort in energy-efficient homes in their HERS programs (Nevada Power and the Tennessee Valley Authority). Nevada Power is an investor-owned, electric utility that operates under the state's public utility commission's regulations that prioritize energy conservation. These regulations have been interpreted in the state as being a prohibition on the marketing of electricity or the promotion of any program that might displace the use of natural gas. These regulations have affected the promotion of HERS as well as the marketing of heat pumps (seen as the marketing of electricity). Trying to work within these restrictions, Nevada Power offered a free service in the design of air distribution systems (including duct layout and the sizing of equipment). This service was contingent on the home first meeting a prescriptive certification level of energy efficiency. The program was offered to builders as an introduction to the latest energy-efficient technology and as a means of ensuring the highest thermal comfort levels possible. The thermal comfort advantage was then used by the builder in selling the house. This was a successful strategy because thermal comfort had previously been found to be the prime consideration in buying a home for homebuyers in the Las Vegas area.

The Tennessee Valley Authority (TVA) has, until recently, focussed on the consumer as the primary target of their HERS program. Influenced by studies by the National Association of Home Builders (NAHB) and the National Board of Realtors, which indicated that energy efficiency had become one of the three top criteria used in purchasing a home, TVA's HERS had been promoted as part of an energy efficiency program. However, TVA discovered in their own survey work that attitudinal measurements involving the rating of motivations for home searching had little relationship to the factors which finally influenced a purchasing decision. TVA found that decisions were being made on the basis of traditional real estate factors: house price, neighborhood, access to local conveniences (schools, shopping facilities, etc.), house size and floorplan, builder's qualifications, and aesthetics of the home. Energy efficiency was a critical factor only in

the case of custom-built homes. Consequently, TVA redesigned their marketing approach towards builders and offered them extensive rebates for the correct sizing of air distribution systems in association with a HERS rating.[†] TVA also provided a marketing strategy for developers and contractors focusing on "Comfort, Quality and Value".

3. Trustworthiness

One of the factors contributing to a reluctance on the part of consumers to participate in conservation programs, such as a HERS, has to do with the trust that the individual feels towards the rating agency. If consumers feel there is a lack of trustworthiness on the part of the HERS sponsor, then there is little participation in the program. On the other hand, HERS can be used by utilities to increase their credibility and good will in the view of their ratepayers.

In order to develop trust and respect and increase the value of a rating program, HERS sponsors reduced the risk to the consumer by offering incentives, such as guaranteeing savings (e.g., one year for Virginia Power, and two years for Watt Count Engineering). Moreover, some HERS sponsorers changed their rating systems in order to create greater trust among its consumers. For example, Gulf State Utilities (Beaumont, Texas) became dissatisfied with the NEW program because that program could never capture the consumers' belief that the rating was authoritative and relevant. This problem, they felt, was overcome when they changed to the Good Cents program, which was more thorough and better promoted.

It is also important to note that one of the great benefits that utilities and government agencies have experienced from HERS was the increased respect they received from consumers after implementation of the HERS program. Consequent to the use of a HERS, consumers sometimes developed the belief that the utility (or local government) was caring, considerate, benevolent, and trustworthy.

B. The Builders' Perspective

As Schoen et. al. (1975) point out, the construction industry is highly regional and fragmented, and it has an orientation to the past, not necessarily the future. It is extremely conservative, preferring the tried and tested. Further, the industry is not science-oriented, as mechanical engineers involved in the development of a HERS might

[†]Several other organizations offered sizing services in relation to a HERS. Prominent among these were Mississippi Power and Light, Watt Count Engineering, the Texas Utilities Electric Company, and Alabama Power.

be, but rather is a craft industry connected to a tradition of apprenticeship and long-term practice. They are tradition-oriented and operate with a process that works. They build houses that people are content with and which they sell at a reasonable profit. The introduction of any kind of innovation is problematic, and the builders' experience has been that most innovations in design and technology fail. However, it is important to note that there are some builders who deviate from this norm and are considered to be innovative, especially with respect to energy-efficient construction (see below). In addition, some builder organizations, such as the National Association of Home Builders, have encouraged builder support of HERS (see below).

Within the general realm of energy efficiency, builders' acceptance of a HERS is contingent on two criteria. First, builders are often actively opposed to what they feel is an **infringement of their rights** to build as they wish. Consequently, mandatory policies and programs are often actively resisted. For a HERS to be accepted, builder cooperation and active participation needs to be secured from the start. HERS should be seen as supportive of builders, in their best interests, and of general benefit to the industry. Second, builders seek a reasonable return on any financial outlay, and are very sensitive to **costs** which affect the marketing of their product. There are two aspects of cost that need to be considered: costs to the builder, connected to the added requirements of building energy-efficient houses, and costs to the consumer, in terms of higher initial capital outlay (the purchase price of a house) and the potential for reduced operating costs as a result of energy efficiency. These costs to the consumer are directly related to **consumer demand** for energy-efficient housing. A HERS will only be attractive to builders if it can help them increase their profitability, or beneficially influence consumer demand for their homes.

1. Builders' Rights

The use of enforced building codes has been suggested as an effective way for ensuring the successful introduction of energy-efficient measures (Kaiser, Marsden, and Burby, 1980). Building codes are presented by builders themselves as one of the major determinants of their behavior when it comes to the introduction of conservation features (ibid.). But across the country, there was clearly a negative reaction by builders to the prospects of mandatory building regulations and unwanted interference in traditional building practices and job performance (Table 6).[†]

Table 6. Resistance to HERS by Target Groups

State	Agency	Builders	Real Estate Agents	Lending Institutions
Arizona	SRP	X		
Colorado	DERC		X	
Florida	State	X	X	
Georgia	GP	X		
Iowa*	State	X		
Rhode Island*	State		X	
Tennessee	TVA	X		
Texas	Austin	X		X

* These HERS have not gotten off the ground due to opposition.

Few HERS were mandatory, but builder experience, such as with the transformation of California's voluntary Energy Conservation Home (ECH) program into mandated building standards (Title 24), has made them suspicious of avowed voluntary programs. However, builders were not just concerned with the coercive results of legislative action. A successful HERS will also impact the building industry by affecting consumer demand and professional standards. It will invariably mean that builders will have to upgrade their skills, learning new construction techniques and materials to build to higher

[†]An example of unwanted interference in traditional building practices is the requirement to do more to a house, such as added caulking, installing vapor barriers and perimeter insulation, providing duct insulation, sealing wiring and plumbing holes, providing make-up air intakes in fireplaces, and other practices that previously may not have been considered necessary. Also, many energy efficiency programs require a series of inspections of the work in progress to ensure that the energy efficiency components are of the agreed quality and are being installed correctly (i.e., performance checks).

energy-efficient standards.

Much of the development of home energy rating tools was done by mechanical engineers, working within a strong scientific ethic. The language of HERS is an engineering language, and the commitment to energy-efficient technology came from that scientific background. Builders rarely shared this language, or this cultural background. The prospect of the introduction of new technologies or building practices not only threatened the builder's sense of personal choice, but also his sense of control and professionalism. The builder may feel a lot of apprehension: his worth will be judged on knowledge of an area that is outside his area of expertise. Further, if the new technology is successful, the future of his industry may be seen as becoming dependent on outside experts.

The prospect of mandated standards was of concern to the HERS agency itself, which often abhorred the prospects of becoming policemen. For them, enforcement was a difficult and expensive proposition, especially in the case of a mandatory HERS requiring multiple inspections at different stages of construction. Further, most of the proposed mandatory HERS, used for determining compliance with building codes that allow flexible pathways, only applied to new construction and not the existing housing stock, and, therefore, applied to only a small fraction of single-family residences. More often, it was the builder who offered resistance to a mandated HERS, but often such resistance spread to all forms of HERS, both mandatory and voluntary. The nature of the resistance took the form of preemptive lobbying efforts to thwart the introduction of home energy rating systems, or, if enacted, the form of defiant noncompliance. For example, in Iowa, where there was a lot of support for a HERS from the state and from academia, builders effectively stalled the implementation of a HERS until a rigorous demonstration of its reliability and the cost-effectiveness of its structural standards has been completed. In Florida, local governments apparently will fail to enforce state legislative standards because of the ideological implications of the regulations. Whether a HERS was mandatory or voluntary, it would still require builder cooperation, and most HERS authorities believe that the situation is better all around if the HERS remained voluntary.

Some HERS authorities relied on educational/informational programs to win the support of builders when the latter's resistance was directed at perceived intrusion. Specifically targeted programs fared better than general educational ones. For example, Gulf Power designed their information program to convince builders that the utility had a legitimate reason for seeking to promote the maximum energy efficiency of residential housing by explaining the role of a HERS in its load management program, and what this meant in terms of decreasing the need for additional generating plant equipment.

Educational programs elucidating the general benefits of a HERS to all parties, as well as stressing the social responsibility of the builder in providing energy-efficient housing were not very successful by themselves in stimulating participation (State of Florida). Builders felt as socially responsible as anyone else, but this was not an effective behavior modifier, nor did it alleviate their fears over intrusion and coercion.

Given their reservations, builders were not very interested in HERS unless it was economically attractive to them. However, "builder innovators" did exist and formed a critical nexus for change within the industry. For example, the consequences of actions by Missouri's "Young Turks" (see below) was mirrored in Florida where Gulf Power was able to effectively mobilize the "movers and shakers" of the building industry. Once the movers and shakers had been convinced to build to higher energy-efficient levels, they were given such a competitive edge that their rivals were forced to cooperate with the HERS. In both Missouri and Florida, innovative forces in the building trade were supported by extensive promotional effort on behalf of the utility companies. The builders not only had an energy-efficient product, but also had a major promotional effort working on their behalf.

Builders were sometimes personally appeased by including them in the developmental stages of a HERS (Mass Save and WRI). Another strategy consisted of the provision of free equipment sizing and the design of air distribution systems (Nevada Power and Tennessee Valley Authority). Demonstration and training programs were also often conducted to educate the builders in the techniques required to construct energy-efficient structures and to provide the skills needed to rate a building, and estimate and plan the "correct" sizing of efficient air distribution systems. Builders were introduced to the latest technologies (e.g., air-to-air heat exchangers) and the most energy-efficient equipment and building practices. By participating in a HERS program, therefore, builders often were assured of an increase in their skills and a corresponding increase in their competitive edge. These relationships between the HERS agency and builders were built on mutual support, rather than a quasi-authoritarian one involving coercion.

2. Cost

Builders are sensitive to the perceived increase in costs as a result of changes in building practices and the addition of new technologies. Many of the structural changes required for a higher HERS rating, or certification, are not only time consuming and bothersome, but also represent hidden capital improvements that builders fear might prevent the house buyer from purchasing the home. The costs of the energy-efficient features may total up to several thousand dollars, and house buyers may be unwilling to

pay any more for a house that looks the same, compared to a house without any added energy-efficient features. If these costs are to be passed on to the consumer, the builder must be able to increase the price of the house to cover the costs without affecting the ability to sell the house within a reasonable time period. In addition, builders may be able to market these higher-priced houses more effectively by promoting the energy savings and improved thermal comfort associated with the rated houses.

It is important to note that the introduction of a HERS need not always mean an increase in capital costs. Often, by increasing the energy efficiency of the building shell, sizing requirements change, so that smaller equipment can be used to provide the same overall efficiency. Smaller equipment usually means lower cost, so that with the use of a HERS as a tool for determining sizing of equipment, builders are often able to reduce their costs, and hence increase their profit margins.

By demonstrating the financial and technical soundness of the proposed standards, many HERS were successful in converting builders to HERS. The cost-effectiveness of a HERS was conveyed through demonstration homes which were built by some of the large utility companies. For example, by building demonstration homes, Duke Power showed builders how to build to certification levels and how cost-effective such construction was. More convincing than a demonstration home was the evidence of the successful use of a HERS by competing builders.

3. Consumer Demand

Whether a HERS can represent a profit to builders or not is dependent on the elasticity of demand for energy-efficient housing. If energy efficiency is in great demand, depending on the market saturation of energy-efficient houses, the builder may be able to increase his prices above the cost of the energy-efficient components and increase the profit margin. Typically, HERS authorities made a great effort to stimulate demand for energy-efficient homes. One of the ways that utilities have won builders over to using a HERS was to initially create the demand among homebuyers and then use them to pressure the builders into changing building practices. Some HERS authorities used extensive advertising in combination with educational campaigns to make the general public aware of the benefits of a HERS, and builders' self-interest in increased energy efficiency (see Chapter 6 - Promotion of HERS). The energy problems of the seventies and the environmental movement of the past two decades also introduced the issue of energy efficiency into the general American lexicon, while other conservation efforts served to make the idea of energy efficiency more attractive to the general public. With the increased general awareness of energy efficiency, the marketing of energy-efficient houses

became that much more easy.

The condition of the housing market was viewed by our respondents as a major obstacle to HERS participation (Table 7). The ability of energy-efficient features to sell a house may only be an adequate motivator to builders in particular economic circumstances. Economic depressions, in particular, have played an important role in the adoption of energy-efficient building practices by providing the environment where a home energy rating can give builders a marketing edge over their competitors. For example, in Kansas City, Missouri, an HERS initially became entrenched during a recessionary cycle when young builders committed to an energy conservation ethic proved to be the most successful sellers as a result of the energy-efficient features of their construction. Their success convinced older builders that energy efficiency was financially beneficial. However, their success occurred when the housing market was soft - when there was plentiful supply and little demand. It is a time of builder vulnerability when they might be most susceptible to arguments in favor of a HERS and more desirous of HERS' rebates, loans, or other incentives (e.g., Watt Count Engineering). As the demand for housing picks up and housing is in short supply, builders may find that they don't need costly "gimmicks" to sell a house, since they can sell whatever they build. During these times, builder support for HERS may be reduced.

A depressed housing market may be beneficial to the establishment of a HERS, but the economic health of the industry may have a mixed impact once the HERS has become "institutionalized." Once a HERS has been established, it becomes a standard feature for builders, taken almost for granted (Public Service Company of New Mexico). At such a time, builders may come to regard the costs of energy-efficient features as a necessary cost, and not an optional one. Furthermore, homebuyers are likely to expect an energy rating to come with their home purchase and may become suspicious when a rating does not exist. In Virginia and Mississippi, there is evidence that home sales have fallen through because of the lack of a particular home energy rating. Such institutionalization allows for much stability in the penetration rate of HERS. Usually, a depressed market will prove advantageous to converting marginal builders to supporting energy-efficient construction (the builders who do not conform are forced out of the market), but, on the whole, with HERS concentrated in new construction, depressed purchasing necessarily means less energy-efficient construction in absolute terms.

Table 7. Cases Where Market Circumstances Are Stated as Major Determinants of HERS Success

Alaska	Energy Rated Houses of Alaska. As energy costs decrease, the effect of a home energy rating on financing qualifications diminishes, since the energy expense component of the debt-to-income ratio is reduced. Construction costs are always high, and the economic benefits of retrofiting, or building an energy efficient new house, are marginal when energy costs are low. Mortgage rates are also low, so that financing is relatively easy, and marginal qualifiers have no need of the benefits of a favorable home energy rating.
Arizona	Salt River Project. When there is a seller's market, builders can sell anything, and there is no incentive to participate in a HERS.
Georgia	Georgia Power. When the housing market is soft, certification is used extensively as a selling tool. When there is a seller's market, there is no interest in a HERS.
Maryland	Delmarva. Any building boom overtaxes the program's resources which cannot handle the demand for a home energy rating with adequate inspection/reliability checks.
Mississippi	Mississippi Valley Gas. The collapse of the building market compromised program.
Missouri	Kansas City Power and Light. In 1981, there was a severe housing depression, but energy-efficient houses had a strong marketing edge. This formed the basis of the current acceptance of a HERS by builders in the area.

Table 7 Continued. Cases Where Market Circumstances Are Stated as Major Determinants of HERS Success

Nevada	Nevada Power Las Vegas. The housing market in southern Nevada is a seller's market. Energy efficiency can only be sold through its connection with *comfort.*
Tennessee	Watt Count. Watt Count Engineering try to convince their dealers that the new housing market is often a cyclical one, and that when construction is down, so is the HERS market. Those periods of economic depression that are likely to dampen the construction industry, however, can benefit the retrofit market, if existing home energy analyses are promoted.
Texas	Texas Utilities Electric Company. Implementation of recommended features required to bring a house up to certification standards are dependent on the demand elasticity of housing. If the increased cost to the builder cannot be passed on to the consumer, the features will not be added. The cost-effectiveness of the recommendations has to be translated into an altered demand curve for housing, so that consumers are willing to pay for energy efficiency.
Oklahoma	Oklahoma Natural Gas. Currently, Oklahoma's is a depressed oil economy. There is a negative population gain. Construction is down, and there is a buyer's market. Absolute numbers of certifications are down as new construction is down.

Strategies have been developed by builders and HERS sponsors for preparing HERS to successfully weather economic cycles (e.g., Watt Count Engineering). For example, in buoyant times, the new construction market might be active and retrofit activity low; in depressed times, the new construction market might be low and the retrofit market active. Accordingly, HERS would be more appropriate for the existing housing stock during depressed times and would find more support at that time, too. Thus, as money becomes expensive and disposable income decreases, people would be less interested in new construction and more interested in energy retrofits in existing structures to decrease their energy expenditures while maintaininging their thermal comfort.

Another strategy employed by builders to promote their product during buoyant times has been their emphasis of comfort over energy savings. When the market is good, the builder can sell anything built, and support for HERS deteriorates. The most effective strategy in these conditions has been to repackage the marketing of energy efficiency as a thermal comfort promotion, especially in climates with temperature extremes, where comfort is considered to be a necessity, not a luxury. This change from promoting energy efficiency to the promotion of thermal comfort was an effective strategy by both the Tennessee Valley Authority and Nevada Power, and thermal comfort has also been added to the promotional efforts of all the Good Cents dealers (utilities), Delmarva, Watt Count Engineering, and Nevada's Southwest Gas. Thermal comfort is a feature that people are willing to pay for and, therefore, has proven to be a good means of generating increased profits for builders.

Another key strategy in reaching builders with a HERS program was using the support of the National Association of Home Builders (NAHB) and local home builders associations. The NAHB has been committed to energy efficiency in construction for many years and has fostered the development of its own HERS (based on its Thermal Performance Guidelines) which it distributed through local organizations. Many of these programs were either adopted by, absorbed by, or replaced by utility-based programs (e.g., Oklahoma Natural Gas). Sometimes, the local home builders association and the utilities formed alliances, with the utility administering the entire HERS program and the local home builders association recruiting builders (Texas Utilities Electric Company). In addition, NAHB's support was also often instrumental in obtaining loan approval from secondary lending institutions (Freddie Mac (Federal Home Loan Mortgage Corporation) and Fannie Mae (Federal National Mortgage Association)), thereby providing convincing "proof" to builders and realtors that a HERS was a serious and worthwhile program.

C. The Realtors' Perspective

In our survey, most HERS were targeted to new construction, although a few HERS were marketed to existing homes. In the new construction market, most developers use in-house sales people, not real estate agents, to sell their product. Hence, typically, realtors have little contact with HERS since they would only encounter them in the sale of existing homes. In addition, realtors are generally regarded as being reluctant to participate in HERS. For example, Alabama Power noted that real estate agents in Alabama were a transitory professional group. Many worked as real estate agents as a second job, and the turnover was high. As a consequence of their transitory nature, real estate agents had a restricted knowledge of housing confined to the most overt marketable characteristics. The complexities introduced with energy-efficient structures and equipment were confusing to realtors and were perceived as unwanted complications. The effort required to educate real estate agents was seen by Alabama Power as being wasted, because, given the rate of turnover, the education process would have to be continuous.

Gulf Power also noted that realtors were unfamiliar with energy-related complexities. If realtors felt uncomfortable and somewhat ignorant about the energy rating, it was suspected that they were apprehensive of being unable to answer buyer inquiries. They might look unknowledgeable and incompetent which made for bad public relations. Gulf Power's solution to this dilemma was to educate realtors so that they could impress their clients and use their recently obtained knowledge competitively in promoting themselves over other less knowledgeable realtors. This approach was combined with Gulf Power's prediction of increased revenues expected in selling more valuable and often higher-priced rated houses.

From the realtor's point of view, there were more complicating factors connected to their willingness to cooperate with a HERS program, and most of these were connected to the process of the sale itself. A HERS could transform the simplicity of the buying situation into one fraught with added and novel uncertainties, as well as added costs. For example, several utilities mentioned that homebuyers were a one time market, and, therefore, were rarely experienced. The investment in a house is considerable, and although all homebuyers may want to make a good economic choice, this does not mean that that choice will be financially rational. Aesthetics are important as well as many other considerations that are difficult to price. The purchasing experience is often a traumatic one for the new homebuyer: they are afraid of their new commitment to years of mortgage payments, paying too much, and being cheated by a seller or realtor. Hence, part of the skill in the selling situation includes being able to assuage the buyer of his fears. To ensure this, contractual terms are kept as simple as possible, clearly

understood by all parties. However, some practices can easily upset these agreements. For example, termite inspections can act to stimulate or confirm buyer fears that the situation is complicated, dishonest or otherwise untrustworthy. Similarly, home energy rating systems have the potential for obfuscating the buying situation. If HERS are vague and simply presented, they may lack authority and meaning. If they are substantial and comprehensive and yet give the structure a mediocre to poor rating, their meaning may become threatening. Thus, the use of a HERS in the home buying situation only makes sense if all parties are educated to its meaning before the buying process. The greatest benefit to the realtor comes from the general education of the public in energy efficiency, and their prior knowledge of the rudiments of the home energy rating. Only this way can the complicating surprise component of the rating be diminished, and a HERS become a reasonable tool for the use of realtors.

Realtors have also been concerned about the possibility of selling houses with poor energy ratings. For example, on a scale of one to ten, how are threes to be sold? It has been suggested that a comprehensive HERS could be valuable in showing how the threes could be upgraded to higher levels, and what the expected costs and energy savings would be. This type of HERS could help placate realtors and convince them that the HERS is a friendly tool.

Realtors have been presented in the literature as major opponents of HERS. In a few cases, we found this image to be accurate. For example, in Rhode Island, powerful and hostile realtors were credited with defeating an attempt at legislation aimed at supporting a HERS. Also, in Colorado, a HERS sponsor sought realtor support, failed to get it, and took special precautions not to provoke any active hostility by the realtors. As a consequence, the program deliberately kept as low a profile as possible.

In our survey, however, we found the negative image of realtors to be uncommon. In most cases, realtors didn't use the HERS ratings. This was not seen as a handicap for HERS directed to new construction, since sales of new homes were primarily affected by developers rather than realtors. Realtor acceptance was more salient for the existing housing stock, and programs directed towards the existing housing stock (Mass Save and WRI) went to great lengths to secure the support of realtors.

Of 25 programs that provided information concerning the relationships of their programs to realtors, seven specifically mentioned that their programs were directed to large-scale developers with their own selling departments and not to realtors per se. Two of these identified the developers with realty companies and indicated that such companies had become major promoters of the HERS program and were using it to their advantage. Another two programs (not included in the subset of the seven programs)

specifically mentioned that HERS were of no interest to realtors because realtors were only concerned with existing housing stock, not new construction.

Realtors were successfully utilized in six programs. In two programs (Public Service Company of New Mexico's SMART program, and Duke Power's Energy Efficient Structure program), HERS had been established and successful long enough that the HERS rating had become an essential aspect of the home selling business and had enjoyed widespread use among realtors. Texas Utilities Electric Company's component utilities also succeeded in making energy efficiency a necessary selling criteria, although the HERS rating itself was not always widely used by realtors. Gulf States Utilities (Texas) had been using the National Energy Watch (NEW) program, but met with limited success, in part, it felt, because the NEW program lacked "substantiality," both in terms of the authoritativeness of its product and the conviction of its marketing. Gulf States switched programs and sponsored the Good Cents program which was believed to have made up these deficiencies and to have attracted more attention from realtors.

Gulf Power met with some initial resistance from realtors in their Good Cents program. This was overcome by an intensive educational program supplemented by a novel incentive. Because Good Cents houses sold for $4,000 to $5,000 more than comparable uncertified houses, home energy ratings actually increased the value of the home, along with its marketability, and this ultimately meant less selling work for the realtor, plus a larger commission. This was a very successful approach.

Virginia Power also met with a lot of success in its strategy to introduce cooperative advertising with realtors. The use of guaranteed savings was also an asset, an experience shared by Watt Count Engineering. Watt Count Engineering found their two year guarantee to be highly valued by homeowners, and upon resale, these homeowners made a point of informing the realtors, who used it in their selling.

One strategy in reaching realtors was through the National Association of Realtors (NAR) which supported the concept of a HERS and provided educational materials to its members explaining energy efficiency and how it could be marketed. They also provided a rough prescriptive HERS for the use of realtors to do their own rating.

As in the case for builders, the acceptance of a HERS by secondary lending institutions (Fannie Mae and Freddie Mac) stimulated participation and support by realtors (Conn Save and Kansas City Power and Light Company). Once Fannie Mae and Freddie Mac agreed to recognize a program and alter debt-to-income and payment-to-income ratios, households at all income levels were potentially able to purchase houses of a value that would normally be beyond their reach. Realtors could sell their clients more expensive houses, and, therefore, increase their commissions, and in a soft market situation,

the size of effective demand is also increased as marginal buyers become qualified purchasers.

Other attempts at wooing realtors were not so successful. The Tennessee Valley Authority (TVA) made a determined effort to reach realtors by working in conjunction with the National Association of Realtors. A series of workshops were held with audio-visual presentations, and TVA and NAR surveys were presented showing the importance of energy efficiency for the house-buying public. The response was described as being so lukewarm that TVA abandoned realtors as a prime target and concentrated on real estate appraisers.

The City of Austin also tried to involve realtors in their program. Despite active cooperation from the local Board of Realtors and a series of seminars where participation was actively encouraged through the use of door prizes, realtors were not interested in the HERS. Because realtors were not involved in the selling of new construction (the focus of Austin's HERS), but were only used to sell existing houses, they saw the HERS as irrelevant.

D. The Appraisers' Perspective

Building appraisers are in the home rating business already and are responsible for making the evaluations upon which lending institutions make their decision. In part, the failure to translate secondary mortgage market acceptance of a HERS into market reality may be due to the failure of building appraisers to include it in their evaluations. They have to be convinced to accept and use a HERS, especially if they are the ones who are responsible for administering it. Freddie Mac's "Energy Appendum to the Residential Appraisal Report" provides a ready means for the incorporation of energy efficiency information into the evaluation process.

For appraisers, the inclusion of a home energy rating within the financing appraisal might be used as an added service that can be charged for. One HERS, developed by Western Research Institute (WRI) and marketed by Energy Rated Houses of America (ERHA), in operation in Washington and Alaska, uses appraisers to perform the rating. This service cost between $90 to $130. Under the ERHA program, the HERS service was performed at any time, unrelated to the financing process related to the purchase of a home. This meant that the service was available to any homeowner, at any time, and provided the appraiser with an added source of revenue.

E. The Lenders' Perspective

There are two types of lending institutions currently involved in financing energy-efficient construction - primary (usually, local ones like banks and savings and loan associations) and secondary (Freddie Mac and Fannie Mae) lenders. Freddie Mac and Fannie Mae are federal organizations which buy mortgages from banks, savings and loans associations, and credit unions. Both types of lending institutions are very important in affecting the investment decisions of consumers. However, the consumer deals only with primary lenders, since the secondary institutions operate at a more general level in setting qualification levels and in supporting lending activity.

The ability of a homebuyer to purchase a home is often contingent on their ability to qualify for a mortgage loan, and that qualification is a function of current income, total debt, and the price of the house. The two ratios that are considered by lenders are the "payment-to-income ratio" and the "debt-to-income ratio".

Traditionally, lending institutions have implicitly penalized energy efficiency by not including reduced energy costs in their loan calculations. For those cognizant of the possible benefits of energy-conserving construction, there was no accurate way to ascertain the energy efficiency of a particular structure, and determine the impact of this on debt-to-income ratios. However, in the last five years, there has been a substantial change in this situation. This has been largely due to the development of HERS which provide the means for ascertaining energy efficiency and energy costs. With a relatively accurate and reliable estimation of energy costs, a lending institution has a basis for altering the expected debt-to-income and payment-to-income ratios. Since a household may be meeting a lower-than-average heating and cooling bill, household funds will be freed for other purchases, such as a higher mortgage payment. The same income can thus sustain a higher loan. Thus, buyers are now able to qualify for homes that previously were considered too expensive. Households of all income levels, previously considered to be on the borderline of qualification, can qualify more easily (Schuck and Millhone, 1982).

Not all HERS are able to provide the information necessary to allow an estimate of energy expenditure. Moreover, some HERS may be considered inaccurate or unreliable. Each one has to be considered individually on its own merits, and this has proven to be time consuming. Some utilities have had to endure two years of negotiation and demonstration (Duke Power and Florida). Where a HERS has incorporated calculations that have proven to be effective and acceptable to the secondary mortgage industry in the past, the process seems to be more easily expedited. For example, the NAHB Thermal Performance Guidelines were readily accepted, and any HERS based upon these guidelines has a good chance of success with Fannie Mae and Freddie Mac.

HERS may also be used for more than securing advantageous financing for energy-efficient new construction. Since late 1982, it has been possible to write loans on future retrofit activity and include this in the mortgage amount, if it can be demonstrated the such retrofits will decrease energy expenses (Roll and Haynie, 1984; Tuccillo, 1984). This is a function that a HERS, capable of evaluating retrofits, can fulfill. In this situation, the funds are placed in an escrow account with a time limitation for the completion of the retrofit. The funds are limited to 10% of the total mortgage. This type of financing retrofit activity is considered to be the easiest and possibly the cheapest (apart from zero-interest and low-interest lending by utilities).

The number of HERS accepted by **secondary lending institutions** is increasing at a greater rate than in the past (Table 8).

Table 8. Lending Institution's Acceptance of Home Energy Rating Systems

State	Agency*	Fannie Mae/ Freddie Mac	Local Lending Institutions
Alabama	AP	X	
Colorado	DERC		X
Connecticut	Conn Save	X	X
Florida	State	X	X
Florida	Gulf Power	X	X
Georgia	GP	X	
Missouri	St.Louis HBA	X	
Missouri	KCPL	X	
Nevada	NP		VA and FHA approval
New Mexico	PNM		X
North Carolina	Duke		X
Pennsylvania	State		X
Tennessee	TVA	X	X
Texas	Gulf State	X	
Texas	TEUC	X	X
Virginia	VEPCO	X	X
Wisconsin	WEP	X	
Watt Count		X	X

* For Agency names, see Table 2.

Connection to the National Association of Home Builders' program was very helpful. However, in several cases, utility contacts spoke of negotiations with the secondary mortgage market lasting several years. Though the secondary mortgage market has made its commitment to the use of HERS, they still seem to be very conservative in their acceptance of particular programs. Both accuracy and reliability of ratings are important to them.

HERS acceptance by the secondary mortgage market was not easy to come by, and when once attained, it did not seem to have been fully exploited in HERS promotions. Whether this agreement with Freddie Mac and Fannie Mae was actually used to qualify buyers, it was a useful promotional tool used by utilities in selling their program to builders and to real estate agents. These promotional benefits were not trivial and may have represented the most beneficial consequence of Fannie Mae and Freddie Mac acceptance. Local HBAs and utilities expected that Fannie Mae and Freddie Mac acceptance would convince energy-efficient builders to go to the added trouble of participating in the HERS program, rather than promoting their work externally (e.g., as being "up to HERS standards"). Local HBAs and utilities also expected that real estate agents would become more interested in the program once they discovered that there might be an upscaling in buyer qualifications when a HERS was used. When a HERS was used to increase the mortgage to cover a retrofit loan at resale, this was a benefit in the purchasing of existing houses.

Primary lending institutions are commercial organizations impelled by the profit motive. They use energy-efficient considerations for promotional purposes in making their loan packages more attractive to the potential borrower. As a promotional device, energy-efficient considerations may be effective only in a soft market where the organization is having difficulty in selling their loan packages. However, when the market is strong, primary lenders will have little motivation to consider energy efficiency. Most primary lenders are also seen as being conservative and tradition-oriented: they work by conventional procedure and are not likely to readily embrace innovation, unless such innovations are economically advantageous.

The number of primary lending institutions that considered energy efficiency and used a HERS rating in their determinations was small. One study cited by Hendrickson (1984) estimated that only 10% of lending institutions considered energy efficiency. A lot of promises to include energy efficiency at some time in the future continue to be made. Some utility and other HERS authorities made a great effort to gain Fannie Mae and Freddie Mac approval for their HERS programs which was often necessary to ensure

local, primary lender consideration. But there was little follow-up, and no real attempt to determine if the HERS actually had some affect on lending practices. One company (Watt Count Engineering) indicated that the HERS had helped qualify a large number of low-income buyers.

The simple acceptance of a HERS by Freddie Mac and Fannie Mae did not necessarily mean that local institutions were going to follow suit. In fact, we found that about one-half of the states having HERS approved by Fannie Mae/Fannie Mac did not have approval by their local lending institutions (Table 8). Energy remains a minor component in assessing the value of a home, and the number of people (and number of loans) affected by changes in the loan ratio because of energy concerns is small, so that local lending institutions often do not want to bother with the extra paperwork. On the other hand, utilities often used one or two local lending institutions who were willing to use home energy ratings. However, the presence of only one or two agreeable institutions restricted HERS acceptance, often excluding realtors who either liked to shop around for the lowest interest rate possible, or who developed special relations with particular lending institutions. Thus, HERS authorities need to make an effort to approach all parties involved in financing, including all primary lenders and appraisers.

F. The Associated Energy Services' Perspective

"Associated energy services" is a term meant to cover all those involved as associated contractors in the provision of energy-related services, including insulation contractors, heating and cooling equipment dealers, weatherization, and other retrofitting and remodeling specialists.

HERS were used as a promotional tool by several associated energy service specialists (e.g., Owens Corning). HERS can be effective when used as a lure to entice the consumer into getting a complete audit, obtaining an energy retrofit, and in purchasing energy-efficient appliances, and, therefore, can prove invaluable as a marketing device.

As noted previously, many energy-efficient homes resulted in the ability to reduce the size of space conditioning equipment. Because these reduced size requirements meant a reduction in the sale of higher priced equipment, there was a short-run disadvantage in a HERS for some heating and cooling equipment dealers. However, in the long-run, earnings were increased with a larger market associated with an aggressive HERS program.

Watt Count Engineering is an organization whose HERS was operated through dealerships purchased by associated energy services contractors. Such dealers aggressively used a HERS to promote their full package of energy-efficient measures. While

new construction had been the traditional lucrative market, Watt Count Engineering encouraged the dealers to actively develop the retrofit market because it was larger than the market for new construction, and because it was more stable in the face of economic fluctuations. In fact, in periods of recession, when the new construction market was faltering, conditions were often beneficial for the development of the retrofit market and the increased penetration of HERS into the existing housing stock.

G. The Utilities' Perspective

Utilities have a restricted perspective, defined by their service districts and such organizational goals as **profit, public good-will, and professionalism.** Their decision to develop and implement a HERS depends upon the extent to which the rating system can be used to attain any of these goals. The profit motive is directed at ensuring optimized returns while public good-will legitimizes the utility's efforts in obtaining optimized profits and in conducting their work. Utilities also need to demonstrate that they operate at the highest levels of professionalism, both for public relations purposes, to maintain its standing within the community of utility companies, and to satisfy individual needs among its employees. Utilities are also motivated by the actions of their **competitors**, and their behavior is influenced by **mandatory regulations**.

In the late 1970's and early 1980's, HERS were still largely experimental, especially on the delivery end, and utility companies made many attempts to launch programs that were basically undeveloped and underfinanced. For utilities, there was no real commitment to HERS, no sense of their importance to peak load management, no expectation of their public relations consequences, and no real commitment to energy conservation as a long-term goal. HERS were simply something in vogue at the time, a response to public demand that 'something be done' to deal with an energy crisis, a demonstration of the company's concern for resource management, and 'proof' of the company's willingness to experiment. When the 'energy crisis' faded in the public imagination, so too did the company's support for a HERS program.

When HERS were developed, they were rarely developed in isolation. Few were simply rating and labeling devices. Most involved the promotion of energy efficiency standards through the upgrading of components of the thermal shell and, in some instances, of equipment. They were associated with educational programs and incentive schemes involving low or zero-interest loans, or rebates on efficient equipment. When one talked of a home energy rating system, it included more than just a rating tool: it was a package designed to promote higher levels of energy efficiency. HERS was also an important tool in complementing other conservation programs. For example, to ensure that a

retrofitting activity subsidized by a utility company was going to be cost-effective, a HERS could be used to evaluate the current structure and predict the consequences of the retrofit. Sizing and air distribution services, often subsidized by the utility, could also be contingent on an energy rating.

1. Profit

A key technique for ensuring profit optimization was **peak load management**, and HERS were initially seen as potentially having an important role in implementing this management strategy. Plant generating requirements are determined by seasonal peak loads: in general, northern states are more concerned with winter peak loads, and southern states with summer peak loads. In the early seventies, without effective peak load management, there was often a large discrepancy in plant utilization between seasons: much of the plant and equipment was underutilized, allowing for certain seasonal diseconomies of scale. By managing peak loads, utilities could contain the requirements for plant growth, and hence, reduce the need to build extra generating capacity. Accordingly, the earliest objectives of utility HERS were to help contain this need for added plant generating capacity (Arkansas Power and Light, Georgia Power, Conn Save, Gulf Power, Duke Power, and Texas Utilities Electric Company), which could be achieved through increasing the energy efficiency of the housing stock (e.g., via HERS).

The peak load management programs were often so successful that their objectives were extended: HERS were utilized to increase energy demand in the normally low peak seasons. This was particularly the case for electric utilities where HERS were combined with other utility programs (e.g., the promotion of heat pumps) (Texas Utilities Electric Company, Gulf Power, Georgia Power, Duke Power, and TVA).

Where a utility company had generally excess generating capacity, with low or slow growth service areas, it was usually not very interested in a home energy rating program. Rather than encouraging energy frugality, these companies were more likely to stimulate consumption (e.g., by promoting extra lighting). Several of the utility companies surveyed fitted this general description, but they continued to support their HERS programs, presumably because of benefits other than load management (Oklahoma Natural Gas, the Public Service Company of New Mexico, and Alabama Power).

2. Public good-will

Once established, HERS programs were used very effectively for public relations reasons. Public relations was never presented as a reason why a HERS was developed and

implemented by utility companies, but it was often presented as the main reason why utility companies continued to support and expand existing HERS programs.

Utility companies were seen as the benefactors of consumers because HERS programs were promoted as specifically directed at saving the consumer money. This image of 'utility-as-benefactor', promoted by HERS, was in direct contrast to a more common, negative image of utilities as all-powerful and unconcerned, stemming from their monopolistic control. The institution of a HERS in conjunction with a comprehensive educational package, including detailing of low-cost retrofitting measures, also gave the consumer a sense of personal control. The consumer no longer perceived himself as a 'victim' of the utility company; he now saw himself 'empowered' to be an active participant. Particularly with low-income and disadvantaged groups, where helplessness and feelings of being controlled by external forces was more rife, the consequences of this sense of 'empowerment' could be great (Hiroto, 1974; Krishnan and Valle, 1979; and Shippee, 1980). This 'sense of personal control over the consumer's own utility bills' was specifically mentioned as a major consequence of the use of a HERS by one utility (Mississippi Power and Light).

3. Professionalism

The professionalism motive is directed at corporate and personal images and self-esteem. Individuals gain added status by working for companies with a good reputation. The company benefits from its professional reputation, by convincing its customers, employees, and governmental regulatory boards of its competency and efficiency in getting a job done. Such efficiency is necessary to minimize costs, ensure reasonable pricing and a quality product, which are all concerns of its consumers and governmental regulatory commissions. Further, such efficiency helps provide an effective work-place culture that can positively affect the job performance of its employees.

Competence in a professional technological organization is perceived to be connected with productivity and demonstrations of familiarity with the latest advances in one's discipline area - theoretical advances as well as innovation in applications. HERS had a role to play within this dynamic. For a time, HERS seemed to enjoy a certain professional prestige and were offered by all "truly professional" companies. As the potential magnitude of HERS became apparent and as other programs became more important and/or prestigous, support for HERS among professional staff diminished and sometimes evaporated.

Some of the preoccupation with the accuracy of HERS could be related to "professional" motivations. Often, companies would consider the poor market penetration of their HERS to be caused by the lack of funding for the further technical development of the rating tool, or by the lack of professional personnel capable of doing the research for refining the tool. This would be true even with an adequate rating tool, and where the problem was demonstrably a marketing one. Marketing professionalism did not have the same cultural glamour as engineering professionalism, and when further monies need to be appropriated to solve a problem, those monies were appropriated for an attempted engineering solution, not a marketing one. However, successful HERS had strong and resourceful marketing departments. In general, HERS failures were not manifested through the technical inadequacies of the rating tool, but through failures in creating demand, and, therefore, market penetration.

4. Market competition

By the mid-1980's, a compelling reason for utilities to have a HERS was a response to the actions of competing utility companies marketing other energy sources. For instance, as a consequence of their seasonal load enhancement activities using a HERS (where utilities increased the demand for electrical energy in off-peak times by marketing heat pumps in combination with a home energy rating), a means was discovered whereby an electrical utility could limit and even reverse the inroads made by natural gas into the energy market. This often, in turn, provoked a response by competing utilities to develop their own HERS.

Utilities also worked with builders in supporting a HERS in order to maintain or increase their market. Consequently, utilities offered HERS with packages containing incentives to builders in the forms of rebates, special design services, and cooperative advertising. The advent of a HERS, marketed properly, also generated a marketing edge for builders of energy-efficient houses. Builders and developers, therefore, often developed a preference for working with a particular utility. Consequently, an electric utility marketing a HERS can be so successful that the builders associated with a competitive gas utility will pressure that utility for a comparable rating package, either directly or indirectly, through the threat of moving to the HERS competitor. Occasionally, the competition can become very aggressive, negatively affecting HERS. For example, attempts are made to undermine the 'authority' of competitive HERS by questioning their accuracy and delivery procedures. Once the public suspicion as to the validity of the HERS is raised, the promotion of all HERS may be undermined.

5. Mandatory regulations

In some cases, utility companies were restrained in their objectives by state and local government regulations (particularly, those promoting energy conservation). For example, one utility was required to support and implement conservation programs (Nevada Power). In this case, HERS was used to demonstrate that such an objective was being seriously undertaken. In some cases, locally developed HERS have been used to replace the federally-mandated RCS audit, which many felt was inefficient, cumbersome, and not cost-effective. In addition, utilities sometimes were required to provide weatherization assistance and financial incentives and subsidies to the disadvantaged. To prove that such programs had been carried out and had been effective, HERS were used to demonstrate changed efficiencies of household structures as a result of the utility's efforts (Pennsylvania).

H. The State and Local Governments' Perspective

State and local governments are interested in supporting HERS primarily because of their general interest in regional energy management and, especially, in controlling the inflow of out-of-state energy (see below). Regional energy management is important to ensure an optimal provision and distribution of energy throughout the region. It becomes important politically through its direct impact on the consumer in terms of the availability and price of energy. At the local level, problems with energy supply have been important stimulants to city-based energy conservation action (e.g., Davis, Los Angeles, Portland, and Wichita (Lee, 1980)). Indirectly, the provision of inexpensive and reliable energy is important to sustain the economic welfare of a region and to keep and attract industry to the region. States and cities can manage energy use in the region through the adoption of state building codes and the provision of home energy rating systems (on a mandatory or voluntary basis). Furthermore, as discussed in the preceding section, HERS are also effective in limiting the growth of peak load demand, reducing the need for generating plants and concomitant environmental problems.

As mentioned above, the major reason why many states supported HERS was their desire to manage the volume of energy imported from another state, region, or country (e.g., Connecticut, Virginia, Pennsylvania, Wisconsin, and Florida). This was especially true for energy dependent states where energy expenditures represented a significant amount of money crossing state boundaries. For example, in Wisconsin, the cost of energy imported from other states exceeded monies received from tourism. The money spent on imported energy ends up in other states, and, hence, represents a drain on the local economic system. If this energy expenditure outflow can be managed, then the

amount saved can be rediverted into the state economy. Its effect on the economy will not be a simple additive effect, since its consequence will be subject to local multipliers. Hence, states favor HERS so that their region can benefit from the positive economic features of managing their own energy use.

State and local officials are also aware of the element of public service created by HERS. The rating programs are improving the energy efficiency of houses, benefitting the residents of their community or state. As public servants, many officials welcome the idea of promoting public goods (energy savings, thermal comfort, etc.) through home energy rating and labeling programs.

Mandatory HERS, however, have problems that make state and local governments reluctant to participate in HERS. For example, builders may feel that they are being forced to subsidize energy efficiency with uncertain cost-effectiveness. Moreover, as mentioned in the section on builders' perspectives, the cost involved in building to new standards is not simply a fiscal one, but also includes acquiring new skills needed for implementing new building practices. Accordingly, builders may feel that they are being unfairly singled out for governmental interference, and, therefore, may organize and oppose HERS and other governmental policies. In addition, mandatory codes may also mean an increased burden on local governments' building inspectors in permit processing, inspections, and enforcement. Generally, states feel that the costs of enforcement are enough to outweigh any benefits that might be derived from making a HERS mandatory. For example, in Florida, local authorities have been ideologically opposed to governmental intrusiveness and minimized cooperation with mandatory HERS. In Missouri, the building code required a specific limit to the heat loss in a building, but with no easy access to a rating tool and no enforcement, the code has been described as "totally ineffective". Voluntary HERS were alive and well in Missouri, but not the mandatory building code.

Many of these complications also exist with voluntary programs, but, with a voluntary program, a builder can decide to cooperate with a HERS or not. Builders are also often compensated for their participation (e.g., cash incentives, rebates on the installation of efficient equipment, free sizing and air distribution planning, new marketing strategies and materials, and cooperative advertising), all of which facilitate a more successful HERS.

CHAPTER 6. HERS PROMOTION

The promotion of HERS was seen as one of the most important and necessary activities for generating public demand for energy-efficient housing as well as for educating and obtaining support in the building and financial communities. HERS were promoted through a variety of vehicles and with the assistance of many groups. Newspaper and magazine advertising was common, and opportunities to write special interest articles for inclusion in real estate supplements and weekend magazines were often used. Mailings and inclusion of promotional materials with utility bills were also common. Point-of-sale promotion and special open house tours for HERS rating new construction was popular as was the distribution of brochures at fairs and to special interest groups. Radio, television, and billboards were used, and there were special educational seminars presented to specific potentially interested groups, from home gardening clubs to neighborhood activist associations. Other promotional devices were video tapes and audio-visual presentations (Table 9).

Consumers were rarely the primary target when the HERS was developed for new construction, so that promotional efforts directed to them by such HERS programs were usually low key. A few HERS agencies used television campaigns or heavily-used newspapers and magazines. More frequently, promotion of HERS to consumers became a device ultimately aimed at builders. This was through point-of-sale promotions, cooperative advertising, or advertising that urged the buying public to specifically compare builders on the energy efficiency of their construction. Point-of-sale promotions included decals, posters, explanatory brochures, and rating certificates to be used by builders in the marketing of their homes. One utility (Mississippi Power and Light) provided developers with utility personnel to hold open houses, where they were available to educate the walk-in market as to the benefits accruing from the energy efficiency of those particular structures. Kansas City Power and Light, in conjunction with the local HBA, conducted two tours of energy-efficient houses each year - one for the builders as a demonstration program, and the other for the general public. In 1985, the tour included 76 houses. These promoted the concept of energy efficiency as well as the builders participating in the program.

Cooperative advertising was also an important promotional device, apparently aimed at consumers, but actually focussed on builders. Under cooperative advertising schemes, the HERS agency agreed to pay a large (usually 50%) portion of the advertising expenses, if the HERS name (logo) and energy efficiency were prominently presented.

Table 9. Promotional Media used by HERS Programs

Agency*	Point of Sale	Radio	Television	Newspapers	Billboards	Mail/Brochure	Fairs	Seminars
Alabama Power			X	X				
Salt River Project	X							
DERC				X				
Conn Save				X				X
Florida State						X	X	X
Gulf Power				X		X		X
Georgia Power				X				
Illinois Power						X		X
Delmarva	X		X	X	X			
MVG		X	X	X	X			
MP&L				X			X	
NP	X				X			
KCP&L				X	X	X		
NP	X		X					
Watt Count			X					
Duke Power		X	X	X		X		X
ONG	X							
Pennsylvania							X	X
TVA								X
GSU		X		X				
Austin	X	X	X	X	X	X	X	X
Wisconsin Power		X		X		X		
Soutwest Gas	X							
VEPCO				X		X		

* For Agency names, see Table 2.

Cooperative advertising was used with builders, developers, real estate agencies, associated service industries, landlords, and dealerships.

At least one company (Virginia Power) felt that continuing a general promotional program directed toward consumers was important in order to gain the maximum public relations benefits, continue the education of the general public in energy efficiency, and convince them of the need to integrate energy conservation into their regular lifestyles. The generalized promotional effort was also felt to be of benefit in putting pressure on all relevant parties to upgrade energy-efficient building standards, and, hence, had considerable political consequences. Builders were lured by cooperative advertising, but they were mainly accessed through HERS administrators within the utility and the state home builders association.

Other utilities also used HERS promotional campaigns to bolster their political positions, either in fending off hostile lobbying from real estate or builder/developer groups, or pressuring builders to participate in a HERS program.

Advertising budgets for HERS displayed much variability. Because few HERS agencies had done any kind of detailed analysis of the impact of a HERS program on their operations, few were able to state what the cost-effectiveness of the program was to themselves. Accordingly, few programs had any idea of what a reasonable expenditure in promoting and administering a HERS might be. Program benefits were often expressed in relatively unquantifiable terms, such as improved public relations. Where the impact of HERS and associated programs were highly monitored (e.g., Duke Power and Gulf Power), the magnitude of the financial consequences of advertising were appreciated, and the companies were very willing to allocate large budgets for promotional purposes. In such cases, advertising budgets amounted to millions of dollars each year, and the administrators of the program had the opportunity to fully utilize the marketing expertise of specialists. For smaller companies, HERS penetration remained low due to less ambitious promotion and the relatively small financial impact of the program on the company. In such cases, there was no apparent justification for allocating much money to it. If an economic assessment of the potential consequences of a HERS for that specific company had been performed, then the company might have well regarded the HERS in a different perspective, and allot a budget to it accordingly.[†] When such companies encountered financial difficulties, the HERS was one of the first programs to be cut back.

[†]Such economic impact assessments were rarely done (see Hirst et. al. 1984 for an evaluation of one RCS program).

Even if the company did have a sense of the magnitude of the economic importance of a HERS in its operations, it still might elect not to spend much of its money on general advertising to the public if their market research suggested that such promotion may not be cost-effective. For example, the Tennessee Valley Authority (TVA) used to target the general public as its primary audience, but reconsidered this approach. Their HERS was developed only for rating new construction. TVA felt that the proportion of repeat buyers of new construction was too small and their interest in a rating of the energy efficiency of a new home was transitory, so that it was a waste of promotional resources trying to reach this weak market. Instead, TVA redirected their efforts to the builder, since convincing a single builder would have a more widespread impact, compared to convincing a single short-term buyer. TVA is now interested in reaching building appraisers.

CHAPTER 7. HERS DELIVERY MECHANISMS

HERS delivery mechanisms refer to those procedures where "raters" are used to **collect input data, perform calculations, and interpret and present results**. The term "rater" is often used to refer to an individual who performs one or more of these functions. Delivery mechanisms can be extremely simple or quite complex. A simple mechanism would be where a consumer performs the rating himself for his own information by following instructions accompanying a prescriptive rating form, or a slide calculational tool. Sometimes, no certification is involved (the Pennsylvania Home Energy Cost Calculator). More commonly, with a simple system, a builder will check a prescriptive list and notify a HERS agency that a particular structure qualifies for certification (e.g., Home Builders Asssociation of St.Louis, and Kansas City Power and Light).

In contrast, the skills required to **collect the data** may necessitate special training (e.g., the use of depressurization fans to measure infiltration, or the ability to gauge the R-value of insulation in existing structures). In such cases, the ability to collect the input data is contingent on being professionally qualified, or being a graduate of a special training course. Such courses have been necessary to qualify RCS auditors, and often the information acquired in RCS audits are used for HERS purposes (e.g., SouthWest Gas - Nevada, Conn Save, and Mass Save). Many other programs have similar courses: for example, the Public Service Company of New Mexico's use of New Mexico's Energy Audit School, the Watt Count Engineering's training school at the Watt Count Center in Tennessee, and Duke Power's six week intensive 'boot camp' training school.

The process of **performing the calculation** may entail a simple confirmation that all items have been checked, or it may refer to the actual calculation of consumption and costs using particular equations and input data. The calculations may be performed on a computer, requiring the rater to have computer skills to input the data and run the program. In calculational rating methods, the tasks of collecting input data and of performing calculations are often conducted by different parties. When this is the case, the term "rater" usually applies to the individual collecting the input data.

The **presentation and interpretation of results** can be as simple as reading the documentation that comes with a simple prescriptive form, or a slide calculational tool (e.g., Pennsylvania Cost Estimator). Sometimes, the results are returned to the consumer with a printed explanation along with educational materials, suggestions for improving the energy efficiency of the home, and a list of retrofit specialists (e.g., Denver Energy Resource Center (DERC)). Home energy ratings may also be presented individually to homeowners or builders with a range of alternatives to the initial blueprint, and

information about energy efficiencies and cost-effectiveness. These results are discussed with the homeowner/builder, and consumer questions are answered (e.g., Watt Count). For new construction needing to meet code requirements, results might involve a consultation with the builder with suggestions on how the design might be modified to meet mandated standards, or qualify for a HERS certification.

A. Utility Raters

Among our surveyed HERS, the most common form of rater was the utility representative (Table 10). However, the utility representative often performed only one of the rating functions described in the previous section. In many cases, where the RCS audit provided the basic data used in the HERS, the utility representative was responsible for collecting the input data which was processed by some other party (either in-house, or by some utility-sponsored and shared independent organization (e.g., Conn Save and Mass Save)). Ratings were often calculated by computer and individually presented to the consumer along with recommendations by the original rater.

When the RCS audit was not used for data collection purposes, utility companies often handed the data collection function over to the builder or homeowner who usually provided blueprints to the utility company to perform the calculations. The utility company usually had marketing representatives in the field who made one or more inspections of the construction to ensure that work was up to standard. The inspections were rarely meant to be complete, for they were more a device to encourage builders to build to a certain pre-agreed standard. The builders were usually required to sign a document guaranteeing that construction would meet that standard. This process of using builders to provide the basic information, along with follow-up inspections, was often meant to limit the utility's liability with regard to the rating, as well as to provide a means of redressing potential damages through the agreement signed by the builder.

The final part of a HERS delivery--the presentation and interpretation of results--was a function of the perception of what a HERS was and what its aims were. If the HERS was seen as a comprehensive auditing tool, part of an audit, or was detailed enough to examine retrofit options, then the rating was presented and explained in detail, and recommendations to encourage greater energy efficiency in the home were made. These conditions were more likely to be met with applications to older construction. As an example, Conn Save used a HERS based on RCS audit information and ran a program developed by Cornerstones of Maine. It provided a summary of the audit and the home energy rating with an explanation. A few weeks later, homeowners were contacted, and the summary was reviewed along with a preliminary discussion of the range

Table 10. Rating Delivery Mechanisms

State	Agency *	Data Collection	Rating Calculations	Rating Interpretation/ Renegotiation	Reliability Checks
Alabama	AP	B	UF,UO	UF	M
Alaska	ERH	A	A	N/A	N/A
Arizona	SRP	UF	UF	N/A	∅
Colorado	DERC	UO	UO	P	∅
Connecticut	Conn Save	UF(RCS)	UO	UF, P	∅
Delaware	DELMARVA	B	UF,UO	UF	R
Florida	State	B/C	B/C (I)	N	R
Florida	Gulf	B	UF,UO	UF	R
Georgia	GP	B	UF,UO	UF	R
Massachusetts	Mass Save	UF(RCS)	UO	UF, P	∅
Mississippi	MVG	B/C/UF	UF,UO	UF	M
Mississippi	MPL	B/C	UO	N/A	∅
Missouri	St.Louis HBA	B	B	N	∅
Missouri	UE	O	O	UO	∅
Missouri	KCPL	B	B	N	∅
Nevada	NP	B/UF	UO	UF	R
Nevada	SWG	UF(RCS)	UO	N/A	∅
New Mexico	PNM	B/UF	UO	UF	M
North Carolina	Duke	UF	UO	UF	M
Ohio	State	C	S	N	∅
Oklahoma	ONG	UF	UF	UF	∅
Pennsylvania	State	*	*	Nβ	∅
Tennessee	TVA	B	UF/UO	UF	R
Texas	TUEC	UF	UF	UF	R
Texas	GSU	B/UF	UF,UO	UF	M
Texas	Austin	B	S	S	R
Virginia	VP	UF	UF	UF	M
Washington	WRI/ERHA	A	A	N/A	N/A
Wisconsin	WEP	B/C	UF,UO	UF	M
National	Watt Count	O	O	O	R

* For Agency Names, see Table 2.

UF = Utility field representative
B = Builders
A = Appraiser
S = City/State
N = Service not provided

UO = Utility office staff
C = Consumers
O = Other/Professional
I = Building Inspector
P = Printed materials

M = Multiple Inspections
R = Separate Reliability Check
∅ = No Reliability Check
* = Used by all groups
β = Facilities available for discussion of results

of possible retrofits appropriate to that particular structure. Finally, homeowners were mailed a detailed report covering all retrofit possibilities along with cost estimates for various alternatives, accompanied by a graphical presentation of their savings estimates.

Where the HERS was primarily connected with a program to upgrade building standards for new construction, utility HERS marketing programs attempted to convince the builder to make any required changes to qualify for certification. Original blueprints were often reconsidered with the builder, recommendations for modifications were made, and where alternate paths were available to certification, the necessary calculations were done to ensure compliance.

Where there was a more limited conception of the HERS, where it was regarded simply as an adjunct to an audit, or as a marketing tool, this last stage was often neglected, and consumers were left with the initial introductory brochure or other general information upon which to interpret the results of the rating.

B. Builder Raters

Home builders associations, utility companies, state energy agencies, and local building departments were likely to use builders to rate new construction. Home builders associations promoted and sponsored HERS to advance building technology and provide the opportunity to develop a competitive edge among its members. Having developed the HERS and a marketing strategy and tools to promote the rating, implementation was turned over to the builders to input data, calculate the rating, and confirm to the certification-granting authority that certification had been met. As mentioned above, when a utility used input data other than RCS audit information, builders were often chosen to provide blueprints.

In general, builders were not intensively trained for the rating task as they generally used familiar rating criteria. Sometimes, they required a training manual (St. Louis Association of Home Builders), or a utility representative would be sent out to overview the rating mechanics (Kansas City Power and Light). Typically, builders were simply required to provide blueprints.

C. Consumer Raters

Where calculations were performed on easily collected data, consumers often collected the necessary data and sent it to the HERS authority for rating calculations. Consumers were an alternative to the builder in cases of new construction, since they were also capable of presenting the blueprints. When prescriptive or simple calculational

methods were used, the consumer sometimes performed the rating calculations (Pennsylvania Cost Estimator, Florida State Model Energy Efficiency Code). Moreover, a few HERS were developed specifically for actual use by homeowners (Florida, Ohio, and Wisconsin). The Pennsylvania Cost Calculator, for example, was designed to be used by anyone, regardless of economic status or educational level, or whether they were homeowners or tenants.

D. Appraiser Raters

Appraisers are professional home raters and could easily extend their ratings to include energy efficiency. The Western Resources Institute (WRI) designed a program to be executed by professional appraisers, with additional training, to implement the HERS. This program was developed for the entire shelter industry in consultation with the secondary mortgage market to ensure maximum acceptance by the financial community. Energy Rated Houses of America (ERHA) marketed WRI's program in Washington and Alaska. In this program, interested consumers contacted ERHA who referred them to certified appraisers. Appraisals were not necessarily connected to a financing application, though once made, and if current, they were valid for financing decisions involving the secondary money market (Fannie Mae or Freddie Mac).

E. Local and State Government Raters

Local and state governments often developed and marketed HERS and provided the facilities for the calculation of the rating and for the presentation and interpretation of results (Florida, Ohio, Wisconsin, and the City of Austin). In our survey, most government agencies did not conduct any field work. However, building inspectors were used in Florida as a reliability check, and the City of Austin conducted on-site inspections to test the ratings of 400 homes.

F. Other Types of Raters

Some HERS used other types of raters, such as associated building contractors specializing in renovation or retrofitting work, insulation specialists, and professional auditors. They were used at all stages of the rating process in the Watt Count program and in the Owens-Corning program, and were used to collect data in the Union Electric program in Missouri (a National Energy Watch program, now defunct). In the Watt Count program, the raters were specially trained to perform the rating.

CHAPTER 8. RELIABILITY AND ACCURACY OF HERS TOOL

The accuracy of any particular rating may be affected by errors in the testing instrument (**instrument errors**), caused by inadequate formulations or limitations of the assumptions used in the development of the rating tool (e.g., overestimating appliance efficiencies, assuming a household size of 3 people, and assuming a specific thermostat setting for a particular climate). Much of the concern expressed by engineers for the accuracy of HERS has focussed on instrument errors. There are also errors in the implementation of HERS. The first of these errors (**data errors**) results from poor data (for example, when insulation R-values cannot be determined in an existing structure, or when input data are estimated rather than measured). Another type of implementation error (**rater errors**) occurs when: (1) the rater is poorly trained and inputs the wrong data or makes faulty calculations, or (2) when the rating tool is used inappropriately (e.g., for the wrong housing types and/or climate zones).

Rater reliability refers to the accuracy of a rating in terms of the minimization of rater and data errors. Rater reliability can be estimated by comparing ratings made by different raters on the same structure. Where certification is contingent on the concurrence of a second rater, rater reliability is expected to improve. Several HERS included the testing of rater reliability as an important component of their program. The Florida State Model Energy Efficiency Code used building inspectors to check the accuracy of the builder's or homeowner's rating. Dallas Power and Light's version of the Texas Utilities Electric Company's program also used building inspectors to check the accuracy of the rating with spot checks. Gulf Power randomly selected and re-rated five certified houses per rater each year to ensure the reliability of the rating and rater. Kansas City Power and Light elucidated what the potential negative fallout of unreliable ratings to the builders might be. These builders were then used to keep a quality check on one another. Watt Count Engineering sent out representatives regularly to check the performance of its dealers. Georgia Power, Tennessee Valley Authority, and Nevada Power used builders to do the rating and sent out their own representatives for multiple reliability inspections of the construction. Duke Power, Mississippi Valley Gas, Gulf States Utilities, Virginia Power, Wisconsin Electric Power, and the City of Austin raters made multiple passes of all new structures.

The success of a HERS probably had little to do with errors in the rating tool. Builders might use **accuracy** as an argument to stall the implementation of a HERS when they are unwilling to abide any 'interference'. However, there was no evidence that a HERS failed because the public considered the ratings to be erroneous, and, in fact,

there were few complaints from the general public regarding the accuracy of the HERS. Nevertheless, most HERS authorities were particularly sensitive to the issue of the accuracy of their ratings. For example, the accuracy of the Cornerstones program in Connecticut was evaluated by examining how much actual energy use deviated from predicted energy use: if actual energy use was greater than 10% above the predicted energy use, the home was individually investigated. Connecticut completed approximately 180,000 ratings, and found few errors. Concerns for HERS accuracy were sometimes translated into savings guarantees. For example, Watt Count Engineering offered to pay the difference between the predicted energy bills and the actual energy bills, but there were no takers. And Virginia Power guaranteed the accuracy of their ratings, and out of 35,000 ratings, no complaints were filed.

CHAPTER 9. SUCCESS OF HERS

As mentioned in the chapter on HERS users, there were a number of reasons why individuals and organizations participated in or sponsored HERS. These reasons included the following: the desire to curb the import of out-of-state energy resources and the reverse flow of state money, important to both state and regional authorities; the increase in comfort and regulation of energy expenditures, desired by individual households; a successful tool for selling retrofits, for associated energy service specialists; a marketing device for builders; and a peak-load management device and public relations opportunity for utilities. Accordingly, the success of a HERS is contingent on how these needs were met by the rating system; however, information on all of these consequences was rarely collected, so that it is difficult to judge success in these terms. In addition, HERS were rarely implemented in isolation, but were often an integral part of an energy conservation package. These packages contained full auditing services, financial incentives, marketing privileges, educational campaigns, and other conservation strategies. Consequently, it is difficult to disentangle the effective elements of a particular conservation package and to isolate which benefits were derived from a HERS as distinct from other programs. And finally, the effects of a HERS were direct (influencing the behavior of participants) as well as indirect (influencing the behavior of the general housing market, such as by generally raising expectations with regard to energy efficiency). Consequently, these complexities make it very difficult to evaluate the impact of HERS and, therefore, measure the success of these programs. To date, there has been no attempt to measure the complete impact of HERS. However, we do have some data on HERS market penetration and energy savings that present a partial picture of the success of HERS.

A. Market Penetration

Market penetration data are expressed in absolute terms (the number of rated homes) and relative terms (the percentage of rated homes to the total market) (Table 11). In reviewing the data, we noted that new housing stock was more easily accessed and rated than existing stock. Market penetration was almost twice as high for new construction (around 40%) than for existing stock (around 20%). However, the high percentages for new construction are somewhat deceptive because the size of the new housing market is often small.

Table 11. Market Penetrations of Home Energy Rating Systems

State	Agency*	Old Stock	New Stock
Alabama	AP	(RCS)	35% (3174)
Arizona	SRP	(RCS)	60% (30,000)
Connecticut	Conn Save	20% (180,000: RCS)	
Georgia	GP	20%	50%
Illinois	IP	80,000 (RCS)	
Maryland	Delmarva		18%
Mississippi	MVG		10% (60)
Mississippi	MPL		10% (41,000)
Missouri	St.Louis HBA		20%
Missouri	UP	20,000	
Missouri	KCPL	(Virtually all construction to HERS standards, but not all certified.)	
Nevada	NP		7,900
New Mexico	PNM	(RCS)	almost 100%
North Carolina	Duke	"High%"	90-95%
Oklahoma	ONG		15% (11,000); 25% actually qualify
Tennessee	TVA		15% (900,000 under various programs)
Texas	TEUC		60%, another 20% structurally certifiable, but equipment not up to standard.
Texas	Austin		25-30%
Virginia	VEPCO		25-30% (35,000)
Wisconsin	WEP		14%
Watt Count			8,000

* For Agency names, see Table 2.

As a HERS matured and became an established part of the market, its market penetration naturally increased. For example, the Public Service Company of New Mexico has been promoting energy-efficient homes since the 1950's when it participated in the Gold Medallion Home program. Today, it markets the SMART program which has been around since 1976. The SMART program is such an established feature of the housing market that, according to the utility company, it has reached approximately 100% penetration of the new housing market (for existing stock, the utility uses the RCS audit). Similarly, the Duke Power Company, committed to a HERS since the 1950's, has penetrated 90 to 95% of new construction.

We believe that the HERS market penetration data presented in Table 11 are poor indicators of the actual influence of HERS programs for three reasons. First, many of the programs surveyed were relatively new, and some (e.g., the older, established Good Cents programs in Florida and Georgia) had undergone recent upgrades leading to penetrations lower than those before changes in the rating system had been introduced. For instance, prior to a 1984 upgrade of their program, Georgia Power claimed a 90% penetration of new construction and a 50% penetration of their older housing stock with their Good Cents program; post-1984 penetrations were less than 50% in new construction and 20% in the older housing stock. It is expected that within a few years the older penetration ratios will be reestablished. Second, market penetrations presented in Table 11 describe current HERS and do not reflect the success of past programs, mainly because such information was not readily available to us. Companies that subscribed to the NEW program, and now use Good Cents, are described with only their current penetration statistics.

Third, the influence of HERS is broad and affects non-participants as well as HERS participants. As HERS alter the housing market so that energy efficiency becomes entrenched as a marketable feature of a house, some builders will build to the standards of a particular HERS program and advertise their homes as meeting the standards without obtaining an actual certification. A builder is likely to avoid participating in the program in order to save program enrollment fees (the Kansas City experience indicates that fees as low as $10 can be discouraging to builders), save the inconvenience of processing paper, or save the time and loss of control resulting from added inspections. Also, other builders, realizing the strong selling power of comfort and energy efficiency, have upgraded their own standards, although not to certification levels. In sum, the entire housing market may have upgraded the energy efficiency of its product without participating in a HERS. This impact has been one of the goals of most HERS: to develop a HERS to influence the entire shelter industry. A simple examination of their

overt penetration rates, therefore, may be misleading.

B. Energy Savings

Typically, the reported success of a HERS was inferred from rough estimates of energy savings made under certification programs. HERS authorities often had some notion of the average saving per certified structure, and they also had some concrete data on the number of residences actually certified. Simple arithmetic produced a value used to index the success of the program. Some HERS qualified their estimates by noting that many HERS had an impact beyond that represented in the number of actual ratings as building practices and standards changed throughout the industry (see previous section on market penetration).

The estimates of the savings attributed to construction to a certain HERS standard were based on either computer simulation studies or on some, usually limited, field test. Major exceptions to this were large utility companies and companies that metered the heating and cooling consumption of homes (Public Service Company of New Mexico). Savings were estimated in dollars or in energy consumption units (kWh, therms, Btus) and were often made in relative terms with a shifting reference base. The reference base could be a fixed minimum standard (e.g., a state minimum standard of a prior year), or an estimate based on typical "current building practice." If the savings were made in relation to a past regulatory standard, the savings approached 50%. If the savings were made in relation to current building practices, the savings were approximately 10% (Table 11). However, estimates based on a past regulatory standard were deceptive because the standard might be a poor indication of what builders were currently building in the marketplace. In this situation, a HERS would exaggerate the energy savings attributed to a HERS because it did not control for the upgrading expected through normal market forces and the diffusion of innovations and higher standards adopted without the presence of a HERS. In contrast, estimates based on current typical building practices were most likely to be "guesstimates," since "current building practice" was poorly defined, not practiced by everyone, had uncertain energy use implications, was always estimated rather than measured, and did not take into account the influence of HERS on non-participants. Because of these limitations, those utilities offering estimates based on current standards were the most cautious of the utilities. They were wary of the utility's liability and did not want to deceive consumers with uncertain promises. Hence, their 10% saving estimates were very conservative, underestimating actual savings.

An illustration of the problems encountered in using a "minimum standard" base case was provided by a Kansas utility. In a 1985 study done for the Kansas City Power

and Light Company and the Kansas City Association of Home Builders (Hannifan and Associates, 1985), savings of HERS certified homes were compared to "standard homes" using computer simulation. The simulation involved both an energy and financial analysis of two home types, selected to represent the average range of home sizes typically built and sold in the metropolitan area. The base case homes assumed construction to minimum local energy standards. The analysis suggested that operating costs for an upgraded building, which resembled their SAVE Gold Label house, represented only 40% of the costs expected with the base house, while energy savings approached 50%. The validity of the results was limited by the fact that the analysis was based on computer simulations with selected economic, climatic, and lifestyle assumptions. In discussing the pervasiveness of the influence of the HERS, KCP&L noted that all new construction was now up to their 'Silver' standard, quite different than the base case, and representing an energy consumption level only approximately 20% less than the 'Gold' standard (and not the 50% difference discussed in the computer simulation). KCP&L and KCHBA expect that recent recognition by Freddie Mac and Fannie Mae will induce builders currently building to 'Silver' levels to have their buildings certified.

We found one study that claimed to be concerned with peak load savings as a result of a HERS. In a 1981 study, Alabama Power's Good Cents program estimated the effect of a HERS on peak load. The study involved 30 metered Good Cents homes and 3 metered mobile homes rated under their mobile home energy rating system. All cases included the use of a heat pump which was not required for Good Cents homes. Regardless of climate zone, these homes saved over 49% of their annual kWh compared to "standard homes" with heat pumps, and 81% compared to "standard homes" with electric furnaces. Cooling energy savings were 41% compared to "standard homes" with heat pumps, and 50% compared to "standard homes" with central air conditioners. But no direct relationship between these individual estimates and energy savings for the whole system was made.

In a study for Conn Save (Market Facts, Inc.), the incidence and distribution of the implementation of recommendations based on a HERS (RCS) audit and rating were investigated as another way of examining the success of a HERS. This kind of study is particularly appropriate when the HERS is of a non-certification type, or when it is an elaborate point prescriptive or calculational system that evaluates alternate retrofits, such as with the Conn Save program. This analysis examined first year implementation rates and how long people waited before implementing various energy-conserving measures. This study confirmed previous reported findings: the kinds of measures most likely

to be adopted, and to be adopted in the shortest possible time, were low-cost, easily installed features (e.g., weatherstripping, caulking, installing hot water blankets, lowering hot water temperatures, tuning up heating systems, and installing low-flow shower heads). Recommended measures were implemented 40-60% of the time within one year, rising to 60-80% within two years, and 75-90% within three years. There was also an increase in the implementation rates since the beginning of the program. Demographic variables were only slightly related to the prospects of implementation. The reasons most often cited for failing to implement recommendations included the belief that the measure was not needed, financial reasons, lack of time, and the belief that the recommendation had already been implemented.

Reasons for implementing recommendations varied with the actual recommendations. The main reason given for the installation of the most commonly installed features (weatherstripping, caulking doors and windows, and insulating windows) was comfort; secondary reasons included the general desire to conserve energy, the fact that the recommendation had been made by Conn Save, and cost savings. The desire to improve energy efficiency was distinguished from the desire to conserve energy and was considered important only a very small percentage of the time. Cost considerations were most important in the determination of large-scale investments (e.g., solar water heating, trombe walls, or wind generators). Thus, promoting comfort may be best for low-cost retrofit improvements, while cost-effectiveness may be best for capital intensive investments.

Savings that were made as a result of implementing recommendations represented approximately 25% of the savings that could be made if all recommendations had been implemented. Over 40% indicated that they would consider further implementation if rebates were offered, and 38% would be encouraged by zero-interest loans.

CHAPTER 10. HERS IN THE MULTI-FAMILY SECTOR

Most of the previous discussion of HERS has dealt with the rating and labelling of new and existing single-family homes. However, we did encounter several multi-family rating systems (Tennessee Valley Authority, Conn Save, Mass Save, Duke Power, and Mississippi Valley Gas) which present different issues not discussed in our earlier presentation.† In this section, we examine those issues primarily related to the presentation of HERS to landlords and tenants, rather than to the technical issues related to the calculation of the ratings themselves, for the success of multi-family HERS is dependent on the resolution of the tension between landlords and tenants.

Most multi-family HERS placed the burden on the landlord to upgrade the energy efficiency of the building, and the methods provided for a rating were the prescriptive and performance types. An immediate problem arises with the interaction between lifestyle and energy consumption in master-metered buildings. The effectiveness of any energy efficient improvement to a building is always qualified by lifestyle factors. Regardless of the structural integrity of the building, energy consumption will be high if the tenant's lifestyle is energy intensive. For instance, if occupants leave their windows open with the heater on, use dishwashers several times a day, and keep winter thermostat settings turned up at all times, energy consumption will be high, and nobody will benefit from the increased energy efficiency of the building structure. Consequently, energy ratings of apartments based on *performance* standards can be expected to arouse opposition from landlords, since a performance rating is influenced by the lifestyles of previous tenants.

One of the objectives of a rental residential rating is to provide information to prospective tenants, so that, based on this information, they can make an informed decision about where to live. This would reward the energy-conscious landlord and encourage others to upgrade their buildings. However, if the performance rating was low due to energy-intensive lifestyles, the landlord would be penalized. Possibly, the landlord's opposition could be muted or eliminated if the performance rating is based on data covering multiple tenants over a number of years, so that fluctuations in weather and the idiosyncratic behavior of tenants can be controlled.

Cost and comfort are the two big motivators in selling a HERS in the single-family sector, but neither of them apply to the multi-family sector as long as the landlord is the

†The Texas Utilities Electric Company, the Wisconsin Utility Committee, and Bonneville Power Administration are developing or considering HERS for the multi-family sector.

target. Landlords argue that structural improvements are expensive, and they cannot expect immediate payback in terms of reduced energy expenditures, since most energy is paid for by the tenant. The people who recoup the investment, as well as the comfort, will be the tenants. There exists no effective motivation for the landlord.

Most people who implement HERS recommendations make easy, low-cost investments (often recoverable within a six-month period). These kinds of investments are viable for most tenants. In addition, given the problems of access and of measuring energy efficiency in multi-family structures (e.g., wall insulation), the ability to retrofit existing structures to meet certifiable standards is usually limited. Consequently, most HERS authorities only require low-cost improvements, the kind of modifications that are economically feasible to tenants. Finally, special technical and financial assistance already exists for multi-family tenants in financing (zero or low-interest loans, or free installation) and installing low-cost measures. Consequently, landlords feel that if tenants want to decrease their energy bills through increased energy efficiency, then the effort should be left to them, since they have the motivation, will enjoy the benefits, and can economically afford the investment (often with subsidies from HERS sponsors).

On the other hand, tenants anticipate that the return of such investments will be long-term, so that if they made the investment, they would not be around long enough to recoup it. Thus, they don't want to pay for the upgrading of the landlord's building. These issues become more important if the tenants are low-income households (see next chapter).

In summary, HERS have often avoided intervening in the multi-family sector because of the landlord-tenant relationship. There are few, if any, advantages in making the landlord primarily responsible for reducing energy use in the multi-family sector, and HERS sponsors are afraid of provoking landlords to lobby the legislature to eliminate HERS or to refuse to cooperate with all energy-efficiency programs. A solution to this dilemma may be available by utilizing a two-pronged approach. First, a prescriptive HERS would be used for individual units, and the HERS would target tenants to adopt low-cost energy conservation measures. After this program has been implemented (and the landlord assuaged), a more rigorous calculational HERS would be used for increasing the thermal integrity of the entire building, and the HERS would target landlords with educational programs, describing the real benefits available to them (e.g., decreased operating expenses for common areas (hallways), increased property value, and increased competitive edge over other desirable buildings). Such sharing of the energy burden would enable both tenants and landlords to take advantage of the energy-efficient opportunities available to them.

CHAPTER 11. HERS AND LOW-INCOME HOUSEHOLDS

HERS can be used to reduce energy use in low-income households (renters and homeowners). The special circumstances of low-income households make them excellent candidates for benefiting from HERS. However, these same circumstances often prohibit their participation in these programs, or at least, make it very difficult, as compared to other income groups. These circumstances include the following: (1) their typically low energy consumption, (2) their energy costs as a percentage of their disposable income, (3) their need for comfort, (4) their socioeconomic condition as it affects capital investments and participation in financing programs, (5) their attitudes towards government and utility companies (HERS implementors), and (6) their basic psychological disposition.

Low-income households are often unable to reduce their energy consumption because their consumption is very likely to be at the subsistence level, or at some lifeline level (Brown and Rollinson, 1985; Cullen, 1984; and Hutton and McNeil, 1983). As a result, their demand for energy is "inelastic": as the price of energy increases, low-income households are unable to further reduce their consumption because little of that consumption is for luxury purposes. Moreover, energy costs can represent a major component of a household's expenditures, particularly at lower socioeconomic levels (Newman and Day, 1975). Thus, where energy expenses are a major budgetary consideration and behavioral changes in reducing energy are unlikely, one would expect households to be interested in instituting cost-effective structural changes that would decrease energy use.

One of the main problems in promoting energy-efficient investments to low-income households is that they are more likely to consider energy conservation in terms of comfort deprivation (a lowering of thermal comfort) than in terms of the efficient use of energy (Winett and Geller, 1981; Becker et.al., 1981). Comfort deprivation is more likely to induce a negative perspective on conservation and apathy (no action) than to encourage energy efficiency.

Audits and retrofit investments are more likely to be sought by households that have higher incomes, better education, larger homes, younger members, and more likely to be residents of high-income neighborhoods (Berry, 1982; Arthur D. Little, 1985; Pacific Gas and Electric Company, 1982; and Northeast Utilities, 1982). Low-income households do not make long-term energy investments because they are more interested in short-term benefits and, when they have the opportunity for doing so, in improving their socioeconomic status through traditional investments in education and business. They tend to be very suspicious of zero and low-interest loans because indebtedness is often seen as the relinquishing of economic control, and "special deals" as too good to be true

(Berry, 1982; and Cunnningham and Lopreato, 1977). They also prefer rebates, while higher income households prefer reduced-interest loans (Berry, 1982). Thus, low-income groups are not likely to take advantage of key HERS activities - audits and special loans.

Low-income groups are likely to be suspicious of HERS implementors because of their distrust and fear of what is being offered. This distrust develops as a response to the complexity of the rating and implementation process, about which these households understand very little. In addition, they often feel they are "victims" of energy suppliers, so that utility companies, in particular, are not to be trusted and are sometimes resisted.

Finally, low-income households are particularly susceptible to "uncontrolled inertia," where the estimation of effort required to make a change is great, and the negative aspects of the present situation are felt to be more tolerable, so that no change in a present situation is effected (Penz, 1981). Connected with this inertia is a variety of sociopsychological, motivational, and cognitive factors which manifest in apathy, feelings of lack of control over the situation, or mistrust of powerful others (such as utility companies) (Aronson, 1980).

A few HERS had special features that directly addressed some of these issues affecting low-income households. Duke Power's Energy Efficient Structure Program approached low-income groups with a conservation package that included a HERS. The company conducted special energy education programs for low-income groups, and Duke Power subsidized its low-cost weatherization program by offering free weatherstripping materials for low-income groups. The company also provided coordination facilities for community groups to help in their weatherization program in which free installation services were provided to the elderly, handicapped, etc.. In addition, Duke Power shaped its incremental rate structure to meet the needs of low-income households and to increase the value of a HERS rating by providing a cheaper rate to rated structures. Duke Power operated their program because of the energy needs of lower-income households and also for public relations: the operation of their conservation package for low-income groups was evidence that Duke Power did have the consumer in mind in developing its programs, that it was acting to minimize the cost-impact of energy expenditures on low-income household budgets, and that it was trying to educate the public and special groups about energy conservation and the effectiveness of simple and inexpensive retrofit measures.

Florida's Department of Community Affairs program, based on their Model Energy Efficient Code, concentrated on educational programs for the disadvantaged and the

elderly, and they used landlords as the effective target for a HERS to be used to improve the energy efficiency of their structures. Florida targeted low-income households because their energy-consumption habits were large and impacted on peak loads. By combining education with the provision of a HERS and a campaign directed at landlords, Florida hoped to transfer these low-income individuals from their state of helplessness in energy consumption, and their role as victims of the energy distribution system, into active energy conservationists and controllers of their thermal environments.

The Pennsylvania program (the Pennsylvania Cost Estimator) was designed specifically so that the HERS could be used by anyone, particularly the poor and those with lower levels of literacy.[†] They extended the usability of the Cost Estimator to the low-income sector by offering the rating tool at no cost and widely distributing it through a variety of outlets. It was available for any consumer, so that they could perform their own rating and cost calculations. As a result, the rating tool was used by real estate appraisers, building contractors (to demonstrate compliance with state building codes), associated energy service industry dealers (insulation contractors, etc.), and it has replaced the RCS in Pennsylvania. In addition, because the Public Utilities Commission (PUC) of Pennsylvania mandated that utilities provide weatherization services to low-income groups, the Pennsylvania Cost Estimator was used by these companies to demonstrate the most cost-effective retrofits, the effectiveness of their program, and their compliance with the PUC requirements.

The Conn Save program used three strategies to increase HERS penetration to low-income groups. First, they increased their cooperation with state and federal agencies concerned with energy assistance programs, either in terms of funding, subsidization, or weatherization assistance. Second, they developed a low-income component to their existing Conn Save programs to intensify their effort to reach low-income households at all points: more aggressive promotion of the program, acquisition of additional funds, assistance to contractors and utilities on the delivery end, and close monitoring of the implementation rates for low-income households. Third, Conn Save increased their cooperation with community groups involved with low-income households. This involved pursuing strategies that would result in a greater promotion of the program and a higher rate of implementation. This was achieved through "bulk-buy" insulation programs and community insulation programs which involved an intensive mass effort directed at particular towns or neighborhoods.

[†]The program recommended that the user make calculations with a hand calculator. This may have limited its accessibility, since a hand calculator may not be a tool of the illiterate.

Finally, Mississippi Power and Light specifically indicated that their HERS played a major role in facilitating public relations through the fact that it increased the user's sense of personal control over energy usage and cost. Consumers felt that they were less dependent on the vagaries of the utility company and the even more remote machinations of energy supply. The HERS and its attendant information transformed the consumer from an energy victim to an active determiner of energy consumption, energy expenditure, and thermal comfort. As a result of the HERS, the consumer became empowered.

CHAPTER 12. SUMMARY AND CONCLUSIONS

In this paper, we present the findings of a national survey of home energy rating and labelling programs (HERS). We discuss the nature of different implementation problems and the kinds of strategies that have been used to deal with them to ensure the effective penetration of HERS to all HERS-users. Of further special interest to us has been the nature of different delivery systems.

The survey does not represent a scientific sampling of HERS, but it does cover a large range of different types of HERS and most of the problems that HERS are likely to have encountered. The study was merely intended to be an exploratory one, so that our aim was to sample the area as widely as possible, and not to attempt to rigorously analyze any one issue. Our findings are general and designed to serve an educative function in providing a background for dealing with more specific problems.

The first critical observation, based on our survey, is that it is virtually impossible to treat HERS in isolation from other energy conservation efforts. In particular, HERS' connection to auditing is often complex and inseparable. The promotion of HERS is intimately connected to the promotion of energy efficiency, and HERS are rarely offered in isolation. More frequently, a HERS is a part of an energy efficiency package that might include anything, from free-sizing services and air-duct distribution design to free or subsidized weatherization materials and low-cost loans. This has made our task more difficult, since it means that, effectively, the study of HERS resists being reduced to a conveniently discrete subject matter.

This diversity in implementation is in part a consequence of the diversity in the target populations which range from homeowners and homebuyers (consumers) to real estate appraisers. Moreover, different expectations for, and uses of, HERS exist within these groups, and these differences affect the kinds of strategies evolved for successful implementation of HERS.

The success in implementing a HERS is dependent on success in *marketing* the HERS. Successful marketing is achieved only after a comprehensive appreciation and treatment of the diversity in target populations. Programs that have had a restrained approach to the implementation of HERS--by insisting on treating implementation problems as technical, engineering problems (e.g., focusing on the accuracy of the tool), or by taking a laissez-faire approach to marketing (e.g., simply meeting a demand for energy efficiency, rather than helping to create more demand)--or programs that have adopted an aggressive, non-responsive approach, have had a poor track record. Successful implementation requires sensitivity to the diversity of the market; the range of different uses;

the range of apprehensions felt by the various target groups; an active constructionist approach to marketing; and the willingness to be responsive to the major user groups in the administration and further development of the program.

We examined 34 HERS, located in 28 states: 13 of these were located in the southeast, 8 in the midwest, 5 in the northeast, 4 in the Pacific/mountain region, and 3 in the southwest. Although our sampling procedure was crude, we believe that this distribution accurately reflects the distribution of HERS through the country and the full range of likely implementation and delivery programs. They seem to be concentrated mainly in those areas concerned with regulating cooling loads. Most (20) of the programs were developed at the national or regional level, 6 by states and 7 by large utility companies or energy production and distribution authorities, as compared to the local level, where 14 HERS were developed, usually, by smaller utilities. However, the role of utilites should not be overestimated. Home Builders Associations, in particular, have tended to play a critical role in the adoption of most successful programs, are often used in consultation within the development phase, and have helped implement some of the major HERS in operation.

We categorize the explanations offered by other states for their lack of HERS into three areas. First, there were those who indicated the lack of general public interest. They typically felt that interest in energy efficiency was a response to the "energy crisis" of the early 1970s. HERS were, therefore, seen as part of a temporary arsenal of tools for dealing with short-term crises. They felt the public would not be interested, would not accept, and would not use HERS once the energy crisis was no longer visible. This attitude was particularly the case in the midwest. Second, there were those who felt that the benefits of a HERS could only be marginal, and that such programs would not be cost-effective to them. Such states were unaware of the strong commitment to HERS and attendant programs in the south, and their effect on managing peak loads and building demand in off-peak seasons. And third, there were states who simply had not considered HERS and who didn't understand the meaning and relevance of HERS.

In considering **consumers'** (homeowners and buyers) interests in a HERS, it is apparent that their aims or motivations were primarily based on costs and their desire for physical comfort. HERS programs have in the past been promoted to these groups through an emphasis on energy efficiency, yet accumulated evidence seems to suggest that this motivation plays little part in home-purchasing decisions. Much more important to them are the costs of energy and the provision of thermal comfort. Savings

through energy efficiency has been a successful promotional device, but there is still a widespread belief, especially for low-income groups, that energy-efficiency and cost savings can only be achieved with reduced thermal comfort. This belief is one of the main barriers that must be overcome in dealing with the general public. To this end, recent promotional programs have focused on the thermal comfort advantages of energy-efficient homes, and rebates have been offered to builders to promote the correct sizing of air-distribution systems, and, therefore, make the homes more comfortable. To date, these strategies have been particularly successful.

The kinds of economic factors considered in investment decisions by consumers include the size of the investment, its effective rate of return in terms of annual savings on energy bills, the repayment period, the capital appreciation of their property accruing as a result of energy-efficient improvements, and the related change in the resale value of their property. In response to these concerns, HERS sponsors have used educational programs, rebates, guaranteed savings, and lower utility rates to assure consumers that they will be definitely saving energy and money by investing in energy-efficient homes. It is important to note that different socioeconomic groups seem to have different criteria for making an investment decision. The time frame for repayment is more restricted in the case of low-income groups, and no group seems to have a time frame nearly as long as the 'conservatively short' periods used in the cost-effectiveness calculations of most HERS developers. HERS developers use a 7-year time frame, while consumers prefer less than 6 months for smaller investments, and only up to 5 years for larger ones (and this time frame is even smaller for low-income groups).

Consumers are also dependent on energy authorities for providing them with information about the economic benefits of energy efficiency, how they might be effected, and what their cost will be. Vague information is typically inadequate for making a rational investment decision, so that HERS should be as adaptable and as specific as possible. Problems with the accuracy of the tool as it relates to the viability of savings predictions can be successfully buffered through the offering of securities, in the form of guarantees, lower energy rates, or rebates on more efficient equipment.

Highly connected to these issues is that of the trustworthiness of the HERS sponsor. When the sponsor is a utility, consumers are suspicious about the potentially contradictory objectives of the organization: make money by selling energy versus decrease energy consumption by promoting HERS. Consumers do not readily see the connection between energy efficiency and the profitability of utility companies. Consequently, consumers (especially, low-income groups) become suspicious of energy-efficiency programs. Such suspicions can be alleviated through the use of educational programs that promote not

only energy efficiency investments, but explain the interest of the implementing authority in them. The offering of actual guarantees (e.g., rebates, guaranteed savings, and lower utility rates), used to assure the investor of a real return, has the secondary consequence of reinforcing the trustworthiness of the agency.

Builders are very conservative and resistent to the introduction of novel ideas and technologies. New, energy-efficient technologies need to be tactfully introduced, or builder resentment of 'outside' intereference will prevent their widespread adoption. To this end, the implementation of HERS, in particular those designed for new construction, needs to be sensitive to the needs of builders. Through educational programs, builders need to be convinced that HERS sponsors have a legitimate interest in promoting energy-related building technologies so that HERS can be seen as acceptable activities and not as attempts to arbitrarily intrude on the builders' domain. Having convinced the builders of the legitimacy of their interest, the strategy of HERS sponsors has been to work with builders as 'partners', not infringing on the traditional prerogatives of the building trade. This 'partnership' approach has strongly characterized most successful HERS programs and has been repeatedly identified by the administrators of such programs as a critical factor in their success.

Builders operate by the profit motive, and both the cost-effectiveness of HERS and their ability to be used as effective marketing devices need to be demonstrated. Typically, building to HERS standards within a HERS program costs money, time, and effort. For example, many programs charge a fee for participants, which seem to be generally prohibitive, regardless of the actual size of that fee. Also, new building materials and techniques require new skills, which have to be acquired and paid for, and HERS programs often involve a series of inspections that entail much effort on the part of the builder. In short, HERS can be very demanding of builders.

Builders are uncertain as to how a HERS will affect the marketability of his product. Typically, building to a higher HERS standard translates into added costs of several thousand dollars. If costs do increase, the builder is going to be concerned as to how this can be passed along to the consumer. He is concerned with the elasticity of the demand for his product, and, hence, is ultimately dependent on the consumer's interest in energy efficiency. HERS sponsors have typically responded to this need of the builder by providing a marketing program, offering cooperative advertising, and independently promoting individual builders participating in the program. Furthermore, energy-efficient construction is often accompanied by decreased sizing requirements for various equipment (often as an inducement to the builder), and this can generally translate into

reduced costs to the builder. HERS agencies also offer rebates to builders for installing energy-efficient equipment. To increase their understanding of HERS and energy-efficient construction, informational and training programs, workshops, and the construction of demonstration homes were targeted to the building community.

Some of the biggest advantages of participating in a HERS have occurred in depressed markets. When demand for housing is high and supply low, builders can usually sell whatever they build and, therefore, are not interested in participating in HERS. But when the market is depressed, energy efficiency can be used to increase the marketing advantage of participating builders.

Two groups have been very active in encouraging builders to support and participate in HERS, and their involvement has given credibility to the rating and labeling programs. The first group consists of 'innovators', the 'Young Turks' of the trade, whose commitment to energy efficiency has paid off in economically depressed times. The second group is composed of home builders associations (local and national) who actively research the market, promote the success of building innovators, and help develop local and regional HERS. Home builders associations are generally committed to energy efficiency and strongly support HERS programs.

HERS have basically been directed to new construction and, most typically, to large construction projects. Under these conditions, sales are usually made by sales department personnel connected to the developer and not by independent realtors. Consequently, **realtors** are often ignored. In addition, realtors are often perceived as part-time or transitory workers and, consequently, represent a moving target. Because realtors have a high turnover, requiring continuous education, educative efforts are often "wasted." Nevertheless, for HERS that are directed at existing construction, a largely untapped area, a key to successful implementation in this sector continues to be the real estate agent.

The most effective strategies directed to realtors have been educational. Realtors that use HERS in selling houses can often increase their competitive edge by being more knowledgeable and more concerned with the future comforts of the prospective buyer. The National Association of Realtors assisted in the educational process and gave some credibility to the program. Energy-efficient houses also usually sell at a higher price, and higher prices translate into higher commissions for the realtor. When HERS are accompanied by recognition from the secondary lending community (Fannie Mae or Freddie Mac), the buying market is expected to increase, as lower-income households are helped in home purchasing through lowered income-payment ratios. The plausible house price

range for all income levels actually increases, as they can finance more expensive property. All of this can translate into more commissions to the realtor.

There is little evidence of the impact of **secondary lending institutions** (Fannie Mae and Freddie Mac) on home buying. **Primary lenders**, the local banking and credit union institutions, can potentially have a greater impact since their contacts with consumers are closer. However, relatively few banks actually consider energy efficiency in their lending decisions. Consequently, Freddie Mac and Fannie Mae endorsement has mainly been of great marketing value to the HERS agencies in dealing with recalcitrant builders, or in arguing the potential of HERS to realtors, than in creating greater demand for energy-efficient housing by the general public. Home building associations, in particular, have successfully used the marketing argument with their members. Actual research on the number of loans made consequent to the use of energy efficiency information is sorely needed.

In terms of HERS delivery, the two major vehicles are utility representatives and builders. To a large extent, the appropriateness of the **rater** is determined by the type of HERS in operation, since different types of HERS place different requirements on the delivery operation. Simple prescriptive systems can be constructed to allow mimimal training and can often be used by the consumers themselves. Calculational systems either require more detailed data (e.g., building blueprints) or are more complex in their calculational methods (requiring special training). Detailed information can usually be supplied by the builder, and, in such cases, builders become the default raters; special training requirements usually require utility raters.

Two other delivery systems are **real estate appraisers and associated energy service industry experts** (e.g., insulation specialists). The major problem in using appraisers as raters is that the actual appraisal occurs late in the home selling process, so that the appraiser's rating has little effect on whether a house is sold or not. In addition, appraiser ratings may cost as much as $100, and this added expense may be seen as a major detriment.

Some very successful HERS have been developed and aggressively marketed by engineering companies specializing in energy efficiency or insulation. Local dealers or franchise owners, after specialized training, perform the rating in conjunction with the marketing of particular conservation services. To date, these activities have been mainly directed to new construction, which is easily accessed and involves large-scale sales. More recently, existing stock has been suggested as having a larger potential, and a greater

stability, particularly in depressed housing markets.

It seems to us that a critical factor in the delivery of HERS has to do with the perceived authority of the rating agent. Simple HERS seem attractive in that they are easy to use, inexpensive, and allow consumers to perform their own ratings. In these situations, there is no information about effective implementation rates for retrofit procedures as a consequence of the rating process. If the HERS intends to be separate from the auditing process, the authority of the rating will still be critical for its acceptance and will be used by the consumer to judge whether the HERS is simply a marketing gimmick or provides critical information. Rated homes have to be seen as very effective investments, representing genuine improvements in thermal comfort with energy-saving advantages over other alternatives. We suspect that single sheets of paper and a simple calculation with mimeographed comments to aid the interpretation of results are not going to be very compelling. The results of a HERS rating should be clear and the recommendations should be precise, but they should also have the appearance of authority in order for them to be accepted and acted upon.

In summary, HERS that are actively marketed, have a comprehensive appreciation of the market, are adaptive to the needs of particular users, and include user participation in the operation and revision of the program, are more successful in terms of penetration rates and in improving the energy efficiency of the older housing stock. Where successful, HERS have penetrated an estimated 40% of the new construction market and 20% of existing construction, and energy savings have ranged from 10% to 50%. These savings do not take into account the impact of HERS on non-participants, so that HERS are more successful than indicated by the direct savings alone.

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APPENDIX A

HERS DELIVERY SYSTEMS AND CONSUMER IMPACT TELEPHONE SURVEY 1.

I would like to find out whether your state operates some kind of Energy Rating and Labeling System for residential housing. Could you give me this sort of information? [Do you know who could give me this information?]

NAME:

ADDRESS:

PHONE NUMBER:

Actually I have a series of questions to ask you, and it could take twenty minutes to answer them. Do you have the time for such an interview now?

If not now, when is a good time for you?

If not yourself, is there someone that you know who has both the knowledge and the time?

NATURE OF RATING SYSTEM:

Are there any home energy rating systems being used in your state?

1. Yes
2. No

Is there a single HERS for the state or are there a number of localized ones?

1. One
2. Two
3. Three
4. Four or more

Who was the Developer of the Rating Tool?

What form does the Rating Code take? (i.e. what are the rating units - percent, ten point, word scale).

How did it express the amount of energy consumed? (- total heating cost, heating cost per square foot, millions of BTUs consumed, BTUs per square foot.)

Does the rating tool evaluate potential retrofits?

Can it be used for comparison purposes?

1. Estimating energy savings for target structures.
2. Comparing efficiency with similar stock.
3. Comparing efficiency with any other stock.
4. Other.....

What was the date of implementation?

Was this HERS the first HERS tried, or is it the latest in a series of attempts?

1. First
2. One in a series of....

[What happened to the other HERS? Why was it abandoned?]

How accurate is it (the current HERS)?

What kinds of studies have been made to determine this accuracy?

Is there any attempt being made to refine it?
1. Yes
2. No
How?

Is the rating voluntary or mandatory?
1. Voluntary
2. Mandatory

Who are the actual Raters?

What is the cost of Rating to consumer?

Is the rating a part of a package?(For example is it connected to a RCS audit?)
1. Yes
2. No
Nature of package:

What is the incidence of rating in new construction?

And what is the incidence of rating in Old Stock?

How is this HERS set-up? (How is it organized and administered?)

What was the cost of the program's development and implementation?

What are the current annual costs of the program?

Is there any evidence of an effect on energy consumption, peak-load demand, etc.?

TARGET GROUPS:
How has the program been received by Buyers and Sellers?

Landlords and Tenants

Real Estate Agents

Real Estate Appraisers

Lending Institutions

Building Contractors

Building Inspectors

Tax Assessors

OTHER IMPLEMENTATION PROBLEMS:

What kinds of problems have you had implementing the program?

1. Technical

2. Financial

3. Political

4. Other

What are the future plans for Ratings System?

Do you personally feel that the program has been a successful one?

What do you think have been its strengths?

What have been its weaknesses?

What do you think should be done differently if the program were started over again?

APPENDIX B

LIST OF ORGANIZATIONS SURVEYED

State Offices

Alabama	Department of Economic and Community Affairs, Division of Energy
Alaska	Department of Conservation and Natural Resources
	Department of Commerce and Economic Development
Arizona	State Office of Economic Planning and Development, Energy Programs Division
Arkansas	Energy Office
Colorado	Office of Energy Conservation
Connecticut	Office of Policy and Management, Energy Office
Delaware	Division of Facilities Management, Energy Office
Florida	Department of Community Affairs
	Governor's Energy Office
Georgia	Office of Energy Resources
Hawaii	Energy Division
Idaho	Department of Water Resources
Illinois	Energy and Natural Resources
Indiana	State Energy Office
Iowa	Energy Policy Council
Kansas	Energy Office
Kentucky	Energy Cabinet
Louisiana	Department of Energy and Natural Resources
Maine	Office of Energy Resources
Maryland	Energy Office
Massachusetts	Council of Energy Resources
Michigan	Department of Commerce, Energy Administration

Minnesota	Energy and Economic Development
Mississippi	Department of Energy and Transportation
Missouri	Department of Natural Resources, Division of Energy Programs
Montana	Department of Natural Resources and Conservation, Energy Office
Nebraska	State Energy Office
New Hampshire	Governor's Energy Office
New Jersey	Department of Energy
New Mexico	Energy and Minerals Department
New York	State Energy Office
Nevada	Department of Community Services
North Carolina	Department of Commerce, Energy Division
North Dakota	Energy Office
Ohio	Department of Energy and Conservation
Oklahoma	Department of Energy
Oregon	Department of Energy, Energy Saving Center
Pennsylvania	Governor's Energy Council
Rhode Island	Governor's Energy Office
South Carolina	Governor's Office, Division of Energy Resources
South Dakota	Energy Office
Tennessee	Economic and Community Development, Energy Division
Texas	Energy Resources
Utah	Energy Office
Vermont	State Energy Office
Virginia	Housing and Community Development
Washington	State Energy Office
West Virginia	Fuel and Energy Office

Wisconsin	Division of State Energy
Wyoming	Energy Conservation Office

Utilities

Alabama Power Company	Montgomery, Alabama
Alaska Electric Light and Power Company	Juneau, Alaska
Arkansas Power and Light	Little Rock, Arkansas
Baltimore Gas and Electric Company	Baltimore,Maryland
Carolina Power and Light	Raleigh, North Carolina
Central Illinois Light Co.	Peoria, Illinois
Chugach Electric Association	Anchorage, Alaska
CONN SAVE	Wetherfield, Connecticut
DELMARVA	Delaware
Duke Power Company	Charlotte, North Carolina
Elizabethtown Natural Gas	Elizabeth, New Jersey
Georgia Power	Atlanta, Georgia
Golden Valley Electric Association	Fairbanks, Alaska
Gulf Power	Pensacola, Florida
Gulf States Utilities	Beaumont, Texas
Idaho Power Company	Boise, Idaho
Illinois Power Company	Decatur, Illinois
Iowa Power	Des Moines, Iowa
Jersey Central Power and Light	Trenton, New Jersey
Kansas City Power and Light	Kansas City, Missouri
Lincoln Electric	Lincoln, Nebraska
Louisiana Power and Light	New Orleans, Louisiana
Mississippi Power and Light	Jackson, Mississippi

Mississippi Valley Gas	Jackson, Mississippi
Nebraska Public Power District	Columbus, Nebraska
Nevada Power	Las Vegas, Nevada
Oklahoma Natural Gas Company	Tulsa, Oklahoma
Omaha Public Power District	Omaha, Nebraska
Public Service Company of Colorado	Denver, Colorado
Public Service Company of New Mexico	Albuquerque, New Mexico
Salt River Project	Phoenix, Arizona
Savannah Electric and Power Company	Savannah, Georgia
Southern Electric International	Pensacola, Florida
SouthWest Gas	Las Vegas, Nevada
Texas Electric Utility Company,	Dallas, Texas
Union Electric Company	St. Louis, Missouri
Virginia Electric and Power Company	Richmond, Virginia
Wisconsin Electric Power Company	Milwaukee, Wisconsin
Wisconsin Power and Light	Madison, Wisconsin

Private Consultants/Companies

Cornerstones	Brunswick, Maine
Edison Electric Institute	Washington, D.C.
Energy Rated Houses of Alaska	Anchorage, Alaska
Energy Rated Houses of America	Seattle, Washington
Energyworks, Inc.	Massachusetts
Denver Energy Resource Center	Denver, Colorado
Sarah Balcomb	Denver, Colorado
Watt Count Engineering	Franklin, Tennessee
Yates Associates, Inc	Portland, Oregon

Home Builders' Associations

Colorado Home Builders' Association	Denver, Colorado
Kansas City Home Builders' Association	Kansas City, Missouri
North Carolina Home Builders' Association	North Carolina
Northern Nevada Home Builders' Association	Reno, Nevada
Southern Nevada Home Builders' Association	Las Vegas, Nevada
St. Louis Home Builders' Association	St. Louis, Missouri

Regional Authorities

Tennessee Valley Authority	Chattanooga, Tennessee
Bonneville Power Administration	Portland, Oregon

City

Austin, Texas	Resource management Department

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