Chapter V

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HOUSING DECISIONMAKERS

INTRODUCTION

This chapter assesses the efforts to improve the energy efficiency of new and existing housing. It identifies the opportunities for and impediments to more residential conservation. The characteristics of residential buildings, the factors that influence property owners' attitudes and behavior toward energy conservation, the participants and processes involved in new housing development and improvement of existing housing, and trends and institutional factors that encourage or discourage conservation are examined. Based on those judgments, some policy options and considerations that might further energy conservation are noted.

CHARACTERISTICS OF THE EXISTING HOUSING INVENTORY

To understand the context within which residential conservation actions occur, it is useful to review the general characteristics of existing housing. The types of units, tenure arrangements, the age of the housing stocks, and the income of property owners all influence the need, potential, and feasibility of energy conservation. In 1976 the inventory totaled nearly 81 million units, of which more than 79 million were all-year housing units and 74 million were occupied. The housing stock is diverse, varying by age, construction quality, size, design, and amenities. Most structures are single-unit buildings and most housing is occupied by owners. As shown by table 29, 53.6 million units or 67.6 percent are one-unit structures. Only 11.9 million units or 15.0 percent are in buildings with five or more units.

Table 29.—Structure Type: Year-Round Housing Units, 1976

Type	Units in thousands	Percent
1 unit	53,611	67.6
2-4 units	10,189	12.8
5 or more units	11,888	15.0
Mobile homes or trailers	3,627	4.6
Total	79,315	100

SOURCE: U.S. Department of Commerce and U.S. Department of Housing and Urban Development, *Annual Housing Survey, 7976 U S and Regions, Part A: Genera/ Housing Characteristics,* p 1

Table 30 gives information on tenure and structure size. Nearly two-thirds of all Americans families are owner-occupants; 47.9 million units or 64.7 percent are owner-occupied; and only 26.1 mill ion units or 35.3 percent are occupied by renters. The percentage of owner-occupied housing is increasing, with the biggest changes having occurred in the 1940's and 1950's. In 1940, owner-occupied units represented only 43.6 percent of all units; by 1960, they accounted for 61.9 percent of all units.

Table 30.—Tenure and Number of Units by Type of Structure, 1976 (units in thousands)

	Owner occupied	Renter occupied	Total
Occupied units	47,904	26,101	74,005
l-unit structure	42,136	8,477	50,613
2- 4-unit structure	2,143	7,116	9,259
5 or more unit structures	638	9,867	10,505
Mobile homes	2,987	640	3,627

SOURCE' U.S. Department of Commerce and U.S. Department of Housing and Urban Development, *Annual Housing Survey, 1976 U S. and Regions, Part A Genera/ Housing Characteristics,* p 1

Most one-unit structures and mobile homes are owner-occupied, but a significant number are rented. Only 14 percent of all units are in buildings with five or more dwellings.

Most housing is located in urban areas. More than two-thirds of all housing is in standard metropolitan statistical areas (SMSAs). But as shown in table 31, only 31.0 percent of the housing stock is found in central cities, and

most housing in SMSAs is not in central cities but in suburban areas.

Table 31 .—Year-Round Housing Units by Location, 1976

Location	Units in thousands	Percent
Inside SMSAs ., ...	53,606	67.6
Within central cities	(24,547)	(31.0)
Not in central cities.	(29,059)	(36.6)
Outside SMSAs.	25,710	32.4
Total	79,315	100.0

SOURCE: U.S. Department of Commerce and U.S. Department of Housing and Urban Development, *Annual Housing Survey, 1976 U.S. and Regions, Part A: General Housing Characteristics,* p 3

Housing tenure varies by location. As shown by table 32, the incidence of rental housing is greater in SMSAs than outside SMSAs and more prevalent in central cities than in suburban areas. Nearly half the housing in central cities is rented, but in suburban areas of SMSAs rental housing makes up only 29 percent of all units. The Northeastern section of the country has the largest percentage of rental housing and the North-Central section the smallest.

Table 32.—Tenure by Location, 1976 (units in thousands)

Location	Rental units	Percent within location	Owner-occupied units	Percent within location
Inside SMSAs	19,557	38.8	30,895	61.2
Within central cities	(11,581)		(1 1,349)	
Not in central cities.	(7,976)		(19,546)	
Outside SMSAs.	6,544	27.8	17,009	72.2
Total	26,101		47,904	

SOURCE: U.S. Department of Commerce and U.S. Department of Housing and Urban Development, *Annual Housing Survey, 1976 U S. and Regions, Part A: General Housing Characteristics,* p 3

Owner-occupants earn more than renters, but a significant number of homeowners have low or moderate incomes. (See table 33.) Nearly 35 percent of homeowners had an income of less than $10,000 in 1976; this group could be expected to be particularly affected by the increasing costs of homeownership.

More than one-third (34.3 percent) of the stock predates 1940, even with the high level of construction over the past three decades. As noted in table 34, a large fraction of the stock is new: 27.9 percent of the inventory has been built since 1965.

Table 33.—income by Type of Occupancy, 1976 (numbers in thousands)

Family income	Number of owner occupants	Number of renter occupants
Total	47,904	26,099
Less than $3,000	3,001	3,938
$3,000-4,999	3,625	4,074
$5,000-6,999	3,644	3,301
$7,000-9,999	5,061	4,252
$10,000-14,999	9,574	5,318
$15,000-24,999	14,046	3,948
$25,000 or more.	8,953	1,268
Median income in dollars	$14,400	$8,100

SOURCE: U.S. Department of Commerce and U.S. Department of Housing and Urban Development, *Annual Housing Survey, 1976 U.S. and Regions, Part A General Housing Characteristics,* p. 10.

Table 34.—Age of Housing Units, 1976 (units in thousands)

Year structure built	Units in structure	Percent
April 1970 or later.	12,493	15.8
1965-70 (March)	9,581	12.1
1960-64	8,093	10.2
1950-59	13,840	17.4
1940-49	8,103	10.2
1939 or earlier	27,206	34.3

SOURCE: U.S. Department of Commerce and U.S. Department of Housing and Urban Development, *Annual Housing Survey, 1976 U.S. and Regions, Part A General Housing Characteristics,* p. 1.

A significant amount of the housing stock changes hands each year. In 1977, more than 3.5 million existing homes were bought and sold. The cost of existing housing has been rising rapidly. The median price in 1972 was $27,100; in 1977, it was $42,900. The median sales price disguises a significant variety of home prices, generally and by region. Nearly 15 percent of all existing houses sold for less than $25,000, but nearly 16 percent of all sales exceeded $70,000. Table 35 provides a breakdown of sales by price class and region for 1977. Housing in the West is substantially more expensive than in other parts of the country. The incidence of lower cost housing is greatest in the North-Central and Southern sections of the country.

Based on this data it would appear that the focus of a residential conservation program should be on owner-occupants, most of whom occupy single-unit properties. Even though they own their own homes, many owner-occupants have limited incomes. Homes of many

Table 35.–Sales of Existing Single-Family Homes for the United States and Each Region by Price Class, 1977 (percentage distribution)

Price class	United States	Northeast	North-Central	South	West
Under $14,999	2.9	2.3	4.3	3.2	0.5
$15,000-19,999	4.6	3.5	6.8	5.7	1.0
$20,000-24,999	7.2	5.7	9.9	8.6	2.2
$25,000-29,999	10.0	9.4	12.8	11.5	4.6
$30,000-39,999	20.4	20.8	24.3	21.4	13.3
$40,000-49,999	17.3	19.1	18.2	16.4	16.3
$50,000-59,999	12.9	14.0	10.5	12.2	16.6
$60,000-69,999	9.0	9.1	6.1	8.2	14.2
$70,000-79,999	5.5	5.4	3.1	4.8	9.7
$80,000 and over	10.2	10.7	4.0	8.0	21.6
Total	100.0	100.0	100.0	100.0	100.0
Median price	$42,900	$44,400	$36,700	$39,800	$57,300

SOURCE: National Association of Realtors, *Existing Home Sales*, 1977, p. 32.

types and classes are available in spite of significant inflation in the cost of existing housing. Most housing is located in metropolitan areas, but most homeowners live outside central cities in suburbs. In central cities nearly half the occupants are renters. Differences in Location, tenure, price, and age of housing and in the resources and interests of occupants influence the incentives and barriers to energy conservation in residential buildings.

CHARACTERISTICS OF NEW HOUSING

The construction industry is a cyclical industry whose production varies widely year by year. In recent years, production has ranged from a low of 1.2 million units in 1975 to 2.4 million units in 1972. In 1977 nearly 2 million units were started, and 277,000 mobile homes were shipped to dealers. As might be expected, single-family construction predominated. Table 36 provides a breakdown of housing starts by type of structure. More than 73 percent were single-unit structures, only 21 percent were in structures of five or more units.

Table 36.—Private Housing Starts by Type of Structure, 1977 (units in thousands)

Type	Number of units	Percent
1 unit	1,451	73.1
2 units	61	3.1
3-4 units	61	3.1
5 or more units	413	20.8
Total	1,986	100
Mobile homes or trailers	277	

NOTE: Totals may not add to 100 due to rounding.
SOURCE: Department of Housing and Urban Development's Office of Housing Statistics.

Nearly 70 percent (1 .377 million of the total 1.986 million housing starts) were located within SMSAs. Housing construction activity is greatest in the South and West, where the population is growing fastest. New construction is heavily concentrated in fast-growing metropolitan areas. Ten market areas are expected to account for 372,289 units or nearly *19* percent of all construction starts in 1978, with Houston and Dallas-Fort Worth alone accounting for nearly 109,000 units.

Table 37 shows the regional distribution of completed housing construction for single-family and multifamily housing. Over 38 percent of the completions occurred in the South. More than one-third of all multifamily completions were located in the West, an area with only 27 percent of total completions. The

[1] National Association of Home Builders' estimate. The top 10 markets are Houston, 62,706; Dallas-Fort Worth, 46,000; Chicago, 44,000; Phoenix, 40,000; Los Angeles-Long Beach, 38,500; Riverside-San Bernardino, 35,000; Seattle-Everett, 31 ,320; San Diego, 28,000; Denver-Boulder, 23,400; and Detroit, 23,360.

Table 37.—Private Housing Completions by Location, 1977 (excluding mobile homes) (units in thousands)

Location	Total	Number of single family	Number of multifamily
Northeast	176	135	41
North Central	399	300	99
South	637	512	125
West	444	311	133
Total	1,656	1,258	398

SOURCE: Department of Housing and Urban Development Office of Housing Statistics.

Northeast had a small fraction of activity relative to its population.

The cost of new housing has been rising rapidly and is significantly higher than the average cost of existing housing. In 1977, the average sales price of a new home was $54,200, but the price of housing varied by region of the country. As is the case with existing housing, the highest average costs are in the West and East. In the Northeast, the average sales price was $54,800; in the South $48,100; and in the West $60,700.[2]

In 1978 prices have continued to escalate and to reflect a diversity in housing costs. *Housing* **magazine reported that in the first half of 1978 new single-family detached houses sold and conventionally financed averaged $60,100. San Francisco had the highest prices at $88,200 per unit, followed by Los Angeles ($83,800), San Diego ($80,600), and New York City ($78,000).**

Table 38 presents a breakdown by price class of housing sold in 1977. A majority of the housing sold was in the $30,000 to $60,000 range, but 18 percent sold for more than $79,000.

[2]*Characteristics of New Housing* **(Bureau of the Census and Department of Housing and Urban Development, 1977).**

Table 38.—Sales Price of New One-Family Homes Sold, 1977

Price class	Percent
Under $30,000	7
$30,000-39,000	21
$40,000-49,999	24
$50,000-59,999	18
$60,000-69,999	11
$70,000 or over	18

SOURCE Bureau of the Census and the Department of Housing and Urban Development, *Characteristics of New Housing, 1977*

New homes sold in 1977 totaled 819,000, of which 782,000 were financed. More than three-fourths of these homes were financed by banks, savings and loans, and other mortgage lenders without the involvement of the Federal Government. The Federal Government's role in housing finance is relatively modest except in the case of lower income home purchasers, but Federal insurance programs and secondary financing mechanisms provide important leverage on the financing actions. Table 39 provides data on the role of Federal financing activities and shows that the average federally assisted loan is much smaller than the average conventional mortgage.

Table 39.—New Homes Sold, Sales Price by Type of Mortgage Financing, 1977

Type of mortgage financing	Number of units in thousands	Percent	Median sales price
FHA insured	73	9	$37,700
VA guaranteed	93	12	41,600
Conventional	592	76	53,400
Farmers Home	24	3	25,800
Total	782	100	

SOURCE Bureau of the Census and the Department of Housing and Urban Development, Characteristics of New Housing, 1977.

HOUSING PROCESSES AND PARTICIPANTS

To assess the barriers to and opportunities for energy conservation in the housing sector, it is important to understand the attributes and institutional structure of the three general types of housing markets—new construction, retrofit, and manufactured housing— and the attitudes and interrelationships of the key decisionmakers in each market. The design,

construction, financing, and operation of housing involve a multitude of participants. Each of these participants operates under different circumstances and conditions and each attempts to maximize profits and limit risks.

New Construction

The development of new housing is a complex entrepreneurial activity, involving many participants whose interactions and cooperation are necessary for its successful completion. The manner and extent of participation and interaction differ between single-family and multifamily construction and between housing constructed on behalf of an owner and that constructed on a speculative basis, which is more common. Participants in the process include the builder or developer' who plans, initiates, and carries out the development; lenders who provide construction and mortgage financing; specialized subcontractors who undertake construction activities; construction workers; architects and engineers who design the housing; local government officials who establish and administer local land use regulations, including zoning and building codes; realtors who assist in the sale or rental of the housing; and the homeowner, owner-occupant, or investor.

A new residential construction project, regardless of type, involves five basic steps: 1) determining whether the project is financially feasible and marketable; 2) detailed planning and securing the site and financial commitments; 3) detailed design and engineering and the organization and securing of labor and materials; 4) construction; and 5) sale or rental of the completed project or home. At each step the builder works closely with one or more of the participants.

The building industry is fragmented into many small producing units, none of which controls a significant percentage of the housing market. There are more than 100,000 builders. The largest single-family builder in 1977 produced only 8,830 units and the largest multifamily builder 3,974 units.[3] In 1976 the top 419 builders built 21 percent of all new housing. The average builder operates a small business and builds fewer than 20 houses a year.[4] A 1970 survey of the building industry found that three-fourths of all builders who built only single-family housing built less than 25 houses, and 46 percent built less than 10 houses a year. Only 2.5 percent of these builders constructed more than 100 houses annually. Firms that built both multifamily and single-family housing tended to be larger. As a result only 57 percent of them built less than 25 units each year and 11.7 percent built more than 100 units. Firm's that handled only multifamily housing were the largest. Only 17.6 percent constructed less than 25 units a year and 52.6 percent built more than 100 units.

No builder dominates or controls a particular housing market, and the competition among builders is intense. Except in the largest housing development firms, the planning, design, construction management, and financing functions are carried out by different parties.

Most builders have few full-time employees. (An average builder employs 2.8 full-time executives, 3.4 office personnel, and 24.8 supervisors and tradesmen).[5] The size of the firm and the precise role of the builder vary with the type of housing being constructed, as does the role of the builder and his relationship to other participants. Some builders only coordinate the developmental process; they rely fully on specialized subcontractors to construct the various building elements. Others carry out all or some part of the construction process. Some builders only build for clients on a custom basis. Most, however, build speculatively. A speculative project may involve a single lot or a large subdivision. Sixty-one per-

*The term builder is typically used in single-family construction. In multifamily construction the builder may be the developer or may only build the project for the developer. In this study the terms are used interchangeably.

[3] "California Builders Still Going Strong," *Housing,* November 1978, p. 18.

[4] "Housing Giants on the Grow Again," *Professional Builder, July* 1977.

[5] Michael Sumichrast and Sara A. Frankel, *Profile of the Builder and His Industry.*

cent of the single-family housing started in 1976 was built for sale or rent; the remainder was built by the owner or by a contractor for the use of the owner.

The builder is involved in a high-risk, highly leveraged situation, with his success or failure dependent on his ability to judge market demand and conditions accurately. Builders try to avoid situations that increase risk or that may hurt the marketability of the housing they produce. To be successful the builder must respond to local tastes and produce housing that is competitively priced. During the construction process decisions must be made quickly to deal with a constant stream of unforeseen events.

An analysis of the building industry commissioned by OTA noted:

> Despite apparent outward similarities, the resulting product is quite heterogeneous in nature. It must be produced for all types of unique building sites and in an incredible range of community types and climatic regions. Viewed in this light, the production of housing would seem to demand a significant combination of market sensitivity and managerial/organizational talent. This suggests that entrepreneurship is almost more 'important' than the other inputs because it is the entrepreneur who must organize, become at least practically responsible for, and eventually commit those resources. [b]

As the entrepreneur, the builder or developer determines the character of the housing. If he is building on a speculative basis, the builder must decide what type of house is in demand and will sell at a profit within the local market and price class. The builder must not only weigh and evaluate the multitude of features that might be used but must gauge his market correctly in terms of price, style, and amenities, and compete with other builders serving the same market. Typically a builder keeps track of local market conditions and competitive projects. The National Association of Home Builders (NAHB)–to which most homebuilders belong–and material suppliers alert builders to new trends and products.

Homebuilders tend to use stock plans, draft their own plans, or modify designs they or competitors have used previously; most homes are not directly designed by architects or engineers. Only 27 percent of homebuilders reported they used staff or consultant architects.[7] Architects and engineers are more frequently used in multifamily projects because of their greater complexity.

Builders are adaptable and willing to change the characteristics of the housing they build, but only as a result of proven market demand. Most builders are reluctant to pioneer unproven changes that may adversely affect the marketability of housing and may meet consumer resistance. Builders must be concerned about the cost of their product and the cost of adding standard features will be carefully weighed against the advantages of those features in helping to sell the housing. First cost is given more consideration than lifecycle cost. Large builders are in a better financial position to take risks–but even they must carefully assess the risks and opportunities involved in deviating from established market practices.

The builder of custom homes is in a different position and need not make all the market judgments of the speculative builder. Many decisions will be made by the owner, perhaps on the builder's advice. The builder does have to manage the construction process so that costs fall within the budget of his client while the builder earns a profit.

The role of the builder and the financial management is different in the multifamily market. In the case of multifamily housing the builder may or may not be the owner/developer of the project. The owner/developer assumes the key decision making role and determines the character of the project. Project design is based on an estimate of the rents that

[6] Ibid.

[7] *1976 HUD Statistical Yearbook* (Washington, D. C.: Department of Housing and Urban Development), p. 284.

can be charged for that location and type of unit. Rent projections determine an acceptable level of construction cost, which in turn serves to determine the features to be included in the project. The terms and conditions of available financing determine the ultimate feasibility of multifamily construction. Most developers build multifamily projects with only a token equity so that project characteristics and features are determined by the extent to which lenders believe they add to the value of the project and are willing to finance their inclusion. Multifamily property is an investment, and decisions are based on their impact on profit. The profit to be realized can be in the form of cash flow, depreciation, future appreciation, or amortization of debt. Additional cash investment to add a special feature may be avoided, in some cases, even if such an investment would be profitable over the long run. Developers seek to achieve maximum leverage; thus f rent-end costs may be more important to them than lifecycle costs.

These concerns, combined with the requirements of local codes and regulations, provide the context within which the builder selects a site, determines what he can pay for the site, and makes decisions about the housing design and the specifications and quality of the different construction components.

Lenders are key participants in the housing construction process. Housing normally involves long-term debt financing. Lenders provide interim financial assistance to builders, developers, and subcontractors during the development process, and long-term mortgage loans to house purchasers or multifamily investors. Lenders seek to make profitable loans and protect themselves against default. Because they lend money, by nature and circumstance they tend to be conservative. Typically, lenders do not examine homebuilders' plans in detail. They rely instead on the experience and reputation of the builder in deciding whether to provide short-term financing. In terms of a level of mortgage debt, lenders base their willingness to finance particular homes on appraisers' estimates of value, on the perceived risk of the investment over the term of the loan, and on the credit-worthiness and ability of the borrower to afford the expense of homeownership. Appraisers play a key role in determining the availability of financing by estimating the value of the property to be financed. Appraisals are intended to reflect market values, so appraisers discount any housing features they believe are not accepted in the marketplace. Because multifamily loans are larger, plans and specifications for multifamily projects are scrutinized more carefully than for single-family homes, but typically lenders would not review indepth the specifications for the project. Lenders make financial judgments based on appraisers' estimates of value and, perhaps to some degree, on the demonstrated skills and experience of the developer/owner.

Funds for housing construction are made available by banks, savings and loan associations, life insurance companies, and federally related credit agencies such as the Federal National Mortgage Association (FNMA) and the Federal Home Loan Mortgage Corporation (FHLMC). For multifamily lending, savings and loan associations and Federal credit agencies are the most active lenders; for single-family housing, savings and loan associations are the dominant lenders. There are more than 23,000 lending institutions throughout the country.

Other participants play less central roles in development. Subcontractors and workers working under the direction of the builder carry out specified construction tasks. Architects and engineers may be involved in the design of housing. Government agencies may be involved in a number of ways: the Federal Government for example, may provide subsidies, loans, or mortgage insurance to lenders to assist in the development or financing of housing. Such housing must be designed to Federal construction standards. These programs are discussed in detail in chapter IX. Local governments establish and administer local building codes to which most new housing must conform. Realtors may be employed to sell or rent completed housing.

Retrofit

The home-improvement or retrofit market, which involves upgrading or improving existing

housing, functions differently from the new construction market. Typically, the property owner determines what improvements should be made to the property and how the work should be done.

Improvements can range from minor paint-up/fix-up activities to substantial modifications to a building's structure or condition. Work can be accomplished by hiring a home-improvement contractor or installer, or by the do-it-yourself approach. Home-improvement contractors are not normally involved in new construction projects. Property owners often look to hardware stores, lumber yards, or home supply centers for information on particular products or names of contractors. An estimated one-half of all property improvements are done on a do-it-yourself basis. The property owner usually specifies the work to be done, although some contractors promote and solicit business for particular types of work. This means that the homeowner must be knowledgeable about what improvements he or she wants or have access to reliable information or contractor advice. The most common types of retrofit energy-saving improvements are installation of insulation, storm windows, caulking and weatherstripping around doors and windows, and furnace replacement or improvements in furnace efficiency.

Qualified Remodeler magazine estimates that professional remodelers will be responsible for $21.5 billion of remodeling in 1979,[8] including both residential and commercial activity. Nearly 31,000 firms do remodeling work. Firms vary from large and sophisticated enterprises capable of undertaking any type of renovation work, to one-person outfits specializing in a particular trade such as electrical work or storm window installation. Most firms are small; the average remodeler employs only nine full-time and two part-time employees. Most projects are also small, and contractor profits as a percentage of overall cost are higher than in new construction. More than half do less than $250,000 worth of business a year, while only 11.6 percent have an annual volume in excess of $1 million.

In terms of conservation improvements, the average firm installs $58,000 worth of insulation annually, and on an average each firm installs 663 storm windows and 152 storm doors. As might be expected, contractors are predominantly involved in installing blown-in insulation. In 1978, contractors were expected to carry out 647,000 jobs involving blown insulation, 375,000 jobs using foam insulation, and 91,000 using batt insulation. Approximately three-fourths of all remodelers install storm windows and doors, and about 13,000, or 43 percent, install insulation. [9]

Financing is less important in retrofit work than in new construction because most projects are small. The most common energy improvements represent relatively small sums of money, ranging from $100 to $1,000 for most homes. Improvements may be made all at once or over an extended time. In 1976, the average maintenance and improvement expenditure for owner-occupants of single units was $450 per property. Expenditures varied widely by income group; those with incomes of less than $5,000 averaged $203; those whose income exceeded $25,000 averaged $822. As a result of the small sums involved, most improvements are paid for by cash on hand, short-term credit, or savings. It is estimated that only 17 percent of home improvements are financed by lending institution home-improvement loans. Small loans are not profitable to these institutions because of the high overhead costs in relation to the interest earned. Many lenders do not make home-improvement loans for less than $1,000 or even $1,500. As a result they are not involved in most home-improvement projects.

Manufactured Housing

Manufactured housing, including mobile homes and modular housing, is built in a factory Construction and sales processes for manufactured housing bear little resemblance to onsite construction. The housing is constructed by factory workers, rather than by

[8] "Market Report: Five Year Forecast for Remodeling is Rosy," Qualified Remodeler, September 1978.

[9] Booz, Allen, and Hamilton, *Building* I-lousing *Outline:* Energy *Conservation* Assessment Study for the Office of Technology Assessment, p. I I I-10.

[10] M. Sumichrast, op. cit.

subcontractors. As a result, the manufacturer maintains total control over the construction process.

About 276,000 mobile homes were shipped in 1977. Single-width homes range in price from $7,000 to $25,000; double-widths cost $13,000 and up. All mobile homes built since June 1976 conform to the Federal Mobile Home Construction Standards, which preempt earlier and inconsistent State requirements. Homes are typically designed by company staff or consultants who might be draftsmen or engineers who have specialized in mobile home design.

Besides the manufacturer, the other key participants are the distributors or dealers who sell mobile homes and arrange financing, commercial banks who finance the manufacturing firms, and commercial banks, finance companies, and other lenders who finance the purchase of mobile homes. Manufacturers sometimes help distributors with financing. Mobile homes are considered personal property, although there is a growing trend to consider them real property. Mobile home loans, which are considered chattel mortgages, commonly run for 7 to 10 years at 12- to 1 3-percent interest.

THE EXISTING HOUSING STOCK

How existing houses are built must be known before realistically assessing how much their thermal envelopes can be improved in a cost-effective manner. Very little information exists about the thermal characteristics of existing housing. A good deal of information about the general characteristics of the housing stock is contained in census data and in information collected by the Federal Housing Administration (FHA) for houses with FHA mortgages. But the only study of the thermal characteristics of existing houses seems to be that of Rowse and Harrje,[11] which combines information from census data, FHA data, and historical trends in insulation use in the construction industry to estimate the potential for upgrading the thermal shells of existing housing. The situation is further complicated by the lack of information about the massive retrofits that have been underway for the last 3 or 4 years.

Nearly two-thirds of the houses existing in 1975 were built after 1940; almost a quarter were built in the 1960's. (See table 40.) Thus a majority of the housing stock has been constructed since insulation materials were generally available. Tabulated information on the thermal characteristics of houses is shown in table 41. Nearly three-fourths of the homes have at least some attic insulation, with more than two-thirds of the houses in all parts of the country reporting attic insulation. Over half the homes have at least some storm windows or other double glazing, but these are largely concentrated in the Northeast and North-Central regions. Similar results hold for storm doors.

Rowse and Harrje[12] point out that insulation was rare in homes built before 1940, and even for the 27 percent of the homes built between 1940 and 1960, the standard attic insulation was 2 inches of mineral wool. Thus all of these homes are potential candidates for retrofit. Additional savings are possible even for housing constructed in the 1970's, as illustrated by the experiments at Twin Rivers, N.J. Rowse and Harrje conclude that more than two-thirds of the existing housing stock is ripe for additional attic insulation.

From a practical viewpoint, it is likely that considerably less than the 90 percent of houses noted by Rowse and Harrje will actually be retrofitted, as the payback for the homes containing some insulation is not likely to appear

[11] R. E. Rowse and D. T. Harrje, "Energy Conservation: An Analysis of Retrofit Potential in United States Housing" (unpublished) (Center for Environmental Studies, Princeton University).

[12] Ibid.

Table 40.—The Original 1975 Annual Housing Survey Data Plus Tabulated Data for Years Prior to 1940 Expressed as a Percentage of the Total Housing Units in the United States

Year built	United States	Northeast	North-Central	South	West
1970-75	14.5	1.8	3.1	6.1	3.4
1960-70	23.1	3.8	5.5	8.7	5.0
1950-59	17.5	3.2	4.2	6.1	4.0
1940-49 .....,	10.3	2.0	2.3	3.9	2.1
1930-39	6.5	1.5	1.7	2.1	1.2
1920-29	8.4	2.6	2.5	2.0	1.3
1910-19	5.8	1.7	2.0	1.3	.8
1900-09	5.7	2.0	2.1	1.1	.5
1890-99	3.5	1.4	1.5	.4	.2
1880-89	2.0	.8	.9	.2	.1
1879-earlier.	2.7	1.6	.8	.3	.0
Total	100.0	22.5	26.6	32.3	18.6

NOTE: Totals may not add to IOO due to rounding.
SOURCE: R. E. Rowse and D. T. Harrje, "Energy Conservation: An Analysis of Retrofit Potential in United States Housing" (unpublished), Center for Environmental Studies, Princeton University.

Table 41.—Thermal Characteristics of Houses: Regional Summary (percent)

a) Attic or Roof Insulation

	United States	Northeast	North-Central	South	West
Yes	74.0	78.7	84.0	67.3	67.4
No	16.5	13.8	9.0	22.5	18.8
Don't know	7.8	5.7	5.4	8.5	12.0
Not reported.	1.7	1.8	1.6	1.7	1.8

b) Storm Windows or Other Protective Coverings

All occupied units	100.0	100.0	100.0	100.0	100.0
All windows covered	46.0	76.3	80.5	21.7	11.9
Some windows covered	10.0	14.6	10.7	8.5	7.2
No windows covered..	42.9	8.0	7.6	68.9	79.7
Not reported.	1.1	1.2	1.2	1.0	1.2

c) Storm Doors

All occupied units	100.0	100.0	100.0	100.0	100.0
All doors covered.	47.8	77.9	82.0	25.0	11.1
Some doors covered	11.7	12.7	9.2	14.6	8.9
No doors covered.	39.4	8.1	7.6	59.4	78.8
Not reported.	1.2	1.3	1.3	1.1	1.3

debasement

All year round units	100.0	100.0	100.0	100.0	100.0
With basement.	47.9	85.2	70.5	18.3	21.7
No basement	52.1	14.8	29.5	81.7	78.3

SOURCE: U.S. Department of Commerce and U.S. Department of Housing and Urban Development, Annual *Housing Survey, 1976 U.S. and Regions, Part A: Genera/ Housing Characteristics,* p.1.

attractive to many owners, and the 15.6 percent of homes that have masonry or concrete walls are considerably harder to retrofit.

Owens-Corning Fiberglas Corporation has developed estimates of the potential for energy conservation through reinsulating existing housing.[13] Its studies indicate that approximately three of every four owner-occupied dwellings had accessible attics and that the remainder had either no attic (15.1 percent)

[13]Owens-Corning data are taken from presentation to the Federal Energy Administration, Feb. 25,1977.

or an inaccessible attic. In this part of the housing market only 10.9 percent of respondents reported their dwelling had no insulation, but the majority of homes appear underinsulated, with less than 4 inches of insulation in the attic. Only 15.3 percent of respondents had more than 6 inches of attic insulation.

A Gallup survey for the Department of Energy (DOE) in early 1978 is generally consistent with the Owens-Corning findings. Nearly three-fourths of all homeowners reported that they have attic insulation or some storm windows or storm doors.

In 1977, *Construction Reports* conducted a study of insulation requirements and estimated that the market for additional insulation totaled 25.5 million single-family and two- to four-family units. The report notes, however, that there is no agreement on the actual number of homes or properties that need insulation or on how many owners could cost-effectively reinsulate their homes.

Table 42 characterizes the types of heating equipment and fuel used in occupied units. The majority of housing units are heated by warm air furnaces. Gas is the dominant heating fuel, followed by fuel oil or kerosene. Gas and electricity are the predominant fuels used for cooking.

Table 42.—Heating Equipment and Fuels for Occupied Units, 1976 (in thousands)

	Number	Percent
Total occupied units	79,315	100
Warm air furnace	40,720	51.3
Steam or hot water	14,554	18.3
Built-in electric units.	5,217	6.6
Floor, wall, or pipeless furnace	6,849	8.6
Room heaters with/without flu	8,861	11.2
Fireplaces, stoves, portable heaters	2,398	3.0
None	716	.9
Total occupied housing units	74,005	100
House heating fuel:		
Utility gas	41,219	55.7
Fuel oil, kerosene	16,451	22.2
Electricity	10,151	13.7
Bottled gas or LP gas	4,239	5.7
Coke or coal/wood/other	1,482	2.0
None	463	.6
Cooking fuel:		
Utility gas	32,299	43.6
Electricity	35,669	48.2
Other	5,748	7.8
None	287	.4

SOURCE. U.S. Department of Commerce and U.S. Department of Housing and Urban Development, *Annual Housing Survey, 1976 U.S. and Regions, Part A: General Housing Characteristics,* pp. 7,8.

TRENDS IN HOUSING AND CONSERVATION

Trends in Housing Costs

It is clear that property owners and the building industry have become more aware of the importance of energy conservation and, as knowledge has improved and the cost of energy has risen, have taken steps to improve the energy efficiency of housing. This trend is apparent in both new construction and in the retrofit market.

Interest in conservation coincides with rapidly rising costs both for new and existing housing. Builders have been particularly concerned about the negative impact that rising costs may have on the ability of purchasers to afford housing. Table 43 provides a breakdown of changes in the Consumer Price Index during the period 1968-76, when the costs of homeownership nearly doubled. Fuel and utilities represent a rapidly rising element in housing costs over the past few years, although their total contribution to owning a home is still well below other factors.

Figure 15 portrays the relationships among the increases in median housing costs, ownership costs, income, and the Consumer Price Index between 1970-76. For the median-price

[4] "Gallup Organization, Inc., *A* Survey of Homeowners *Concerning Home Insulation,* conducted for the Department of Energy, April 1978.

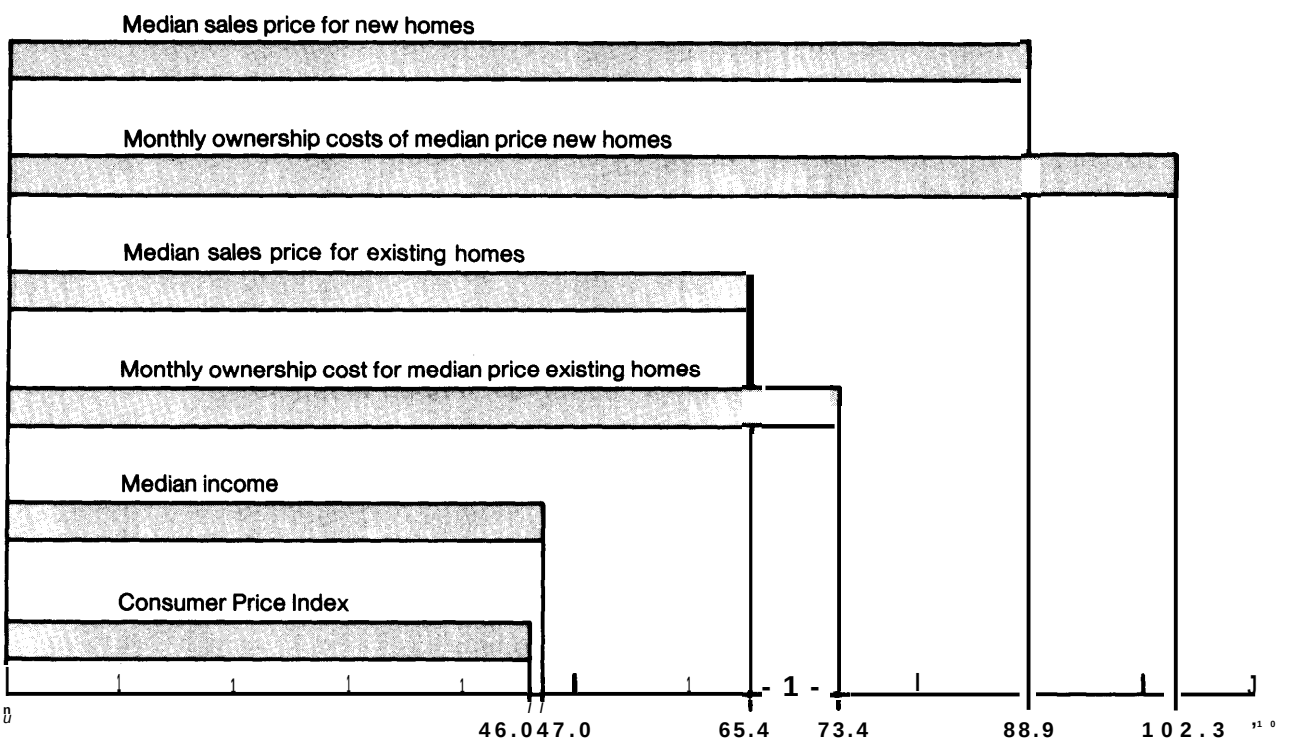
[5] Bureau of Census, "Estimates of Insulation Requirements and Discussion of Regional Variation in Housing Inventory and Requirements," *Construction Reports,* August-September 1977.

Table 43.—Selected Housing Series of the Consumer Price Index: Selected Years (1967 = 100)

Year	Shelter[a]	Rent	Home ownership				Fuel and utilities
			Total[b]	First mortgage interest rates	Property insurance rates	Home maintenance and repairs	
1968	104.8	102.4	105.7	106.7	104.7	106.1	101.3
1969	113.3	105.7	116.0	120.0	109.3	115.0	103.6
1970	123.6	110.1	128.5	132.1	113.4	124.0	107.6
1971	128.8	115.2	133.7	120.4	119.9	133.7	115.1
1972	134.5	119.2	140.1	117.5	123.2	140.7	120.1
1973	140.7	124.3	146.7	123.2	124.4	151.0	126.9
1974	154.4	130.6	163.2	140.2	124.2	171.6	150.2
1975	169.7	137.3	181.7	142.1	131.4	187.6	167.8
1976	179.0	144.7	191.7	140.9	144.3	199.6	182.7

[a]Includes rent, homeownership, and hotel and motel room rates.
[b]Includes home purchase, mortgage interest, real estate taxes, property insurance, and home maintenance and repairs.
SOURCE: Department of Housing and Urban Development, 1976 HUD *Statistical Yearbook,* p 258

Figure 15.—Increases in Housing Costs, Income, and Consumer Price Index, 1970-76



SOURCE: Joint Center for Urban Studies of MIT and Harvard University, *The Nation's Housing,* 1970-76, p. 119.

homebuyer, new housing operating costs have doubled (102.3 percent), and for the existing homebuyer they have increased 73.4 percent. During the same period median income increased only 47 percent. In 1970, 46 percent of all families could afford the median-price new home and 36 percent the median-price existing home. By 1976 only 26 percent of all families

could afford the median-price new home and 36 percent the median-price existing home. '6

A recent Department of Housing and Urban Development (HUD) study of housing costs also determined that housing costs outpaced family income in the period 1972-76. '7 During that period median family income increased at an average annual rate of 7.05 percent. During the same period the average annual rate of increase in the median sales price of new one-family homes was 12.49 percent, and the median sales price of existing one-family homes increased 9.30 percent.

Even with the rapid escalation of housing costs demand for both new and existing homes has been strong. Several reasons explain why demand continues in the face of rapidly rising prices. Homeownership provides attractive tax advantages over rental housing. Buyers anticipate that owning a home is a sound and profitable investment and will cost more in the future. Many home purchasers buy existing housing rather than newly constructed housing. Americans are willing to devote more of their income to housing than would be expected based on traditional income/housing cost guidelines. As a result, the majority of Americans has been able to afford a house. In 1977, nearly 60 percent of all homebuyers had incomes of less than $25,000 and nearly 40 percent less than $20,000.18

Several factors have enabled families to continue to afford housing. A traditional industry rule of thumb has been that housing cost should not exceed 25 percent of gross income. In fact only 52 percent of all homeowners spend less than 25 percent, 24 percent spend 25 to 30 percent, and 14 percent spend more than 30 percent. Table 44 breaks down the percentage of buyers who exceed the 25-percent income rule.

[16] *The Nation's Housing:* 1975-1985 (Joint Center for Urban Studies of the Massachusetts Institute of Technology and Harvard University, 1977), p. 103.

['7Final *Report of the Task Force on Housing Costs* (Washington, D. C.: Department of Housing and Urban Development, May 1978), p. 3.

[18] *Homeownership: Affording the Single Family Home* (U.S. League of Savings Association, 1978), p. 27.

Table 44.—Percentage Distribution by Income of Homebuyers Exceeding the 25. Percent Rule

Annual income	Percentage of all homebuyers
Less than $15,000	30
$15,000-19,999	30
$20,000-24,999	19
$25,000 or more	21
Total	100

SOURCE: U.S. League of Savings Associations, *Homeownership: Affording the Single Family Home,* p. 32.

There are two general types of homebuyers–first-time homebuyers and repeat homebuyers. Repeat homebuyers tend to be older, have higher incomes, and have an equity from their old house to invest in the purchase of their new home. As a result they can afford to buy more expensive housing. The median price for first-time homebuyers is $37,500 but for repeat buyers it is $48,500. First-time homeowners are often able to afford a home because they are willing to buy existing housing.

About 43 percent of first-time homebuyers purchase housing constructed before 1955, compared with 25 percent of repeat buyers. By contrast, 29 percent of repeat buyers purchase new housing, versus 18 percent of the first-time buyers. Table 45 describes the difference between the two types of buyers.

Table 45.—Percentage Distribution of Age of Homes Purchased by First-Time and Repeat Homebuyers

Year of construction of home purchased	First-time buyers	Repeat buyers	All buyers
Before 1945	26.5	16.2	19.9
1945-54	16.0	8.8	11.5
1955-64	17.8	16.0	16.7
1965-69	8.1	9.7	9.0
1970-75	13.3	19.9	17.5
New homes	18.3	29.4	25.4

SOURCE: U.S. League of Savings Associations, *Homeownership: Affording the Single Family Homes,* p. 46.

First-time homebuyers are able to purchase housing partly because of the availability of liberal financing. Forty-five percent make downpayments of less than $5,000, and 73 percent put down less than $10,000. Forty-seven percent of first-time buyers make downpayments of less than 20 percent of the purchase price. By contrast, only 11 percent of repeat buyers make downpayments of less than 20 percent of the purchase price.

It is also important to recognize that housing costs and markets vary significantly by region of the country and community size. Table 46 shows the substantial cost variation in new housing by metropolitan localities of different sizes.

Table 46.—Median Home Purchase Price, 1977

Metropolitan area	Median home purchase price
All U.S. metropolitan areas with population of 1.5 million or more . . .	$49,500
All U.S. metropolitan areas with populations between 250,000-1.5 million	$42,900
All U.S. metropolitan areas with populations of less than 250,000 . . .	$37,000
All of the United States	$44,000

SOURCE: U.S. League of Savings Associations, *Homeownership: Affording the Single Family Home,* p. 13.

The increase in housing costs is pricing most lower middle-income families out of the new housing market; they must purchase existing housing or improve the dwellings they are currently living in. Only 3.7 percent of all house purchasers in 1975-76 earned less than $10,000, although this income bracket represents 32 percent of the population. Families earning $10,000 to $14,999 represent more than 22 percent of the population but bought only 13.4 percent of the new housing. '9 While the pace of construction has remained high, much of the housing is being built for upper income groups. Families earning more than $25,000 comprise 14.1 percent of the population, but they bought 32.4 percent of the new housing.[20]

Trends indicate that the new construction market is increasingly oriented to the upper income buyer. In 1965-66 the top quarter of the population, in terms of income, bought 58 percent of the new homes. By contrast the lower third of the population bought only 4 percent of the new housing in 1975-76, but bought 17 percent of the new housing in 1965-66.2'

Trends in Utility Costs

Historically, utility costs have been a small component of housing costs. As a result, builders and consumers were not concerned, until recently, about the energy efficiency of housing. While utility costs have been rising substantially, so have other elements of homeownership, particularly in larger communities. As shown in table 47, utility costs are not uniform and also vary by region. They are highest in the South and lowest in the West, particularly California.

Table 47.—Median Utility Costs by Region

Region	Median utility costs	
	Monthly	Annual
Northeast.	$ 6 0	$720
North Central.	60	720
South	70	840
West	50	600

SOURCE: U.S. League of Savings Associations, *Homeownership: Affording the Single Family Home,* p. *22.*

Table 48 documents that utility costs still represent a relatively small fraction of monthly housing expenses. In metropolitan areas the mortgage payment is the largest element of monthly costs, followed by utilities and taxes. But in small communities, where taxes are low, utilities represent a much larger cost element than real estate taxes.

Buyers seem to be demanding reasonable levels of insulation and double-glazing or storm windows in most housing markets. Because of this demand, builders are including these features in their homes and appraisers and lenders are recognizing the added costs in their lending judgments. Although the larger downpayments and increased carrying costs may affect the ability of the marginal purchaser to buy a home, the overall marketability for housing has not been significantly affected by including such features, which builders view as adding to the appeal and salability of their homes.

Trade publications report strong buyer interest in energy-saving features. As noted in chapter 11, surveys by *Professional Builder* in 1974-77 indicate that the proportion of homebuyers willing to spend $600 or more initially to save $100 per year in energy costs increased from 78 to 93 percent.[22] As figure 16 shows,

'[9]Ibid.
[20]1 bid.
[21] Ibid.

*[22]" Consumers Tell What They Want in Housing," *Professional Builder,* December 1977.

Table 48.—Percentage Distribution of Median Expenditures for Major Elements of Monthly Housing Expenses

Metropolitan area	Mortgage payment	Real estate taxes	Hazard insurance	Utility costs	Total monthly expenses
All U.S. metropolitan areas with populations of 1.5 million or more	67.6	15.8	2.9	13.6	100
All U.S. metropolitan areas with populations between 250,000 and 1.5 million	69.1	11.8	3.4	15.7	100
All U.S. metropolitan areas with populations less than 250,000	69.8	9.4	3.7	17.7	100
All of the United States	68.3	13.5	3.3	15.0	100

SOURCE: U.S. League of Savings Associations, *Homeownership: Affording the Single Family Home,* p. 25.

generally similar attitudes are apparent in all parts of the country.

A survey of builders reported by *Professional Builder* confirms this trend. It documents strong consumer interest in and builder response to energy conservation features in new homes.[23] Builders report that buyers believe energy conservation is an important consideration in buying a home— and that for a majority of buyers in some regions it is a very important consideration. Such interest does not vary significantly by housing price.

The *Professional Builder* study reports that double-glazed windows are now a standard feature employed by almost 7 out of 10 builder respondents. Almost three of every four builders use some type of attic ventilation, and nearly two out of three use a zoned heating/cooling system with separate thermostats in different rooms.[24] As a result, about half of the builders indicated they have been able to reduce the size of the heating and cooling systems used, thus mitigating the added costs of other energy-conserving features.

Simple conventional equipment and materials are most typically used by builders to upgrade the energy efficiency of their homes. The most common features used in the past 2 years are: increased attic (ceiling) insulation (83 percent), double/triple glazing (67 percent), improved weatherstripping/caulking (50 percent), roof overhangs (50 percent), heat pumps (39 percent), and attic fans (29 percent) .[25]

Buyers are clearly concerned about energy costs and will invest in energy-saving improvements. *Housing* magazine recently conducted a survey of approximately 400 prospective new homebuyers in five market areas around the country to determine their attitude toward different features including energy-saving improvements.[26] While the estimated costs of these improvements varied by region, the survey revealed some attitudinal similarities and some clear-cut differences among the market areas. The willingness to pay $500 to $1,500 for upgrading insulation was strongly evident in all five markets. Outside California, a large majority of respondents were willing to pay for double-glazed windows. Both types of improvements seem well accepted by consumers and would appear to be viewed as a worthwhile investment. Table 49 presents the data on the five markets.

The National Association of Home Builders Research Foundation conducted detailed surveys of members of NAHB in 1974, 1975, and 1976 to gain a comprehensive summary of the thermal characteristics of homes built in recent years. Table 50 compares the average levels of insulation and the glazing characteristics of more than 120,000 homes built in 1974 and more than 112,000 homes built in the last half of 1975 and the first half of 1976.

The data show a rather remarkable jump in the levels of insulation and in the use of double- and triple-glazing. The levels of both ceiling and wall insulation increased in all nine census regions and now show surprisingly little

[23] "Energy and the Builder," op. cit.
[24] Ibid.
[25] Ibid.

[b] "What Home Shoppers Seek in Six Major Market," *Housing,* October 1978.

Figure 16.—Percent of Homebuyers Willing to Spend $600 or More on Energy Conservation in New Construction Housing

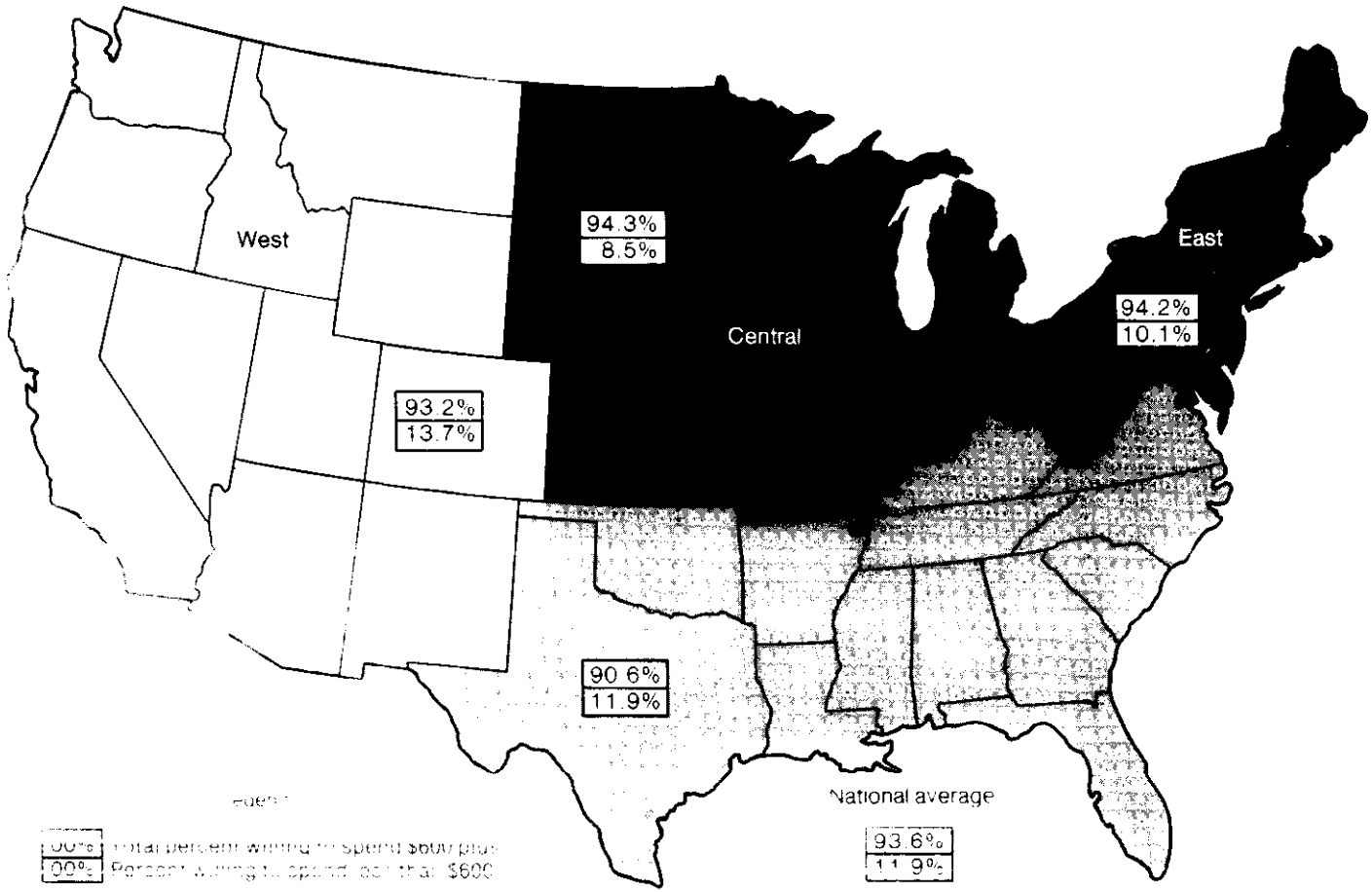


Table 49.—Consumer Attitudes Toward Conservation Improvements in New Homes in Selected Localities

	Washington, D.C.	Miami	Chicago	San Francisco	San Diego
Upgraded insulation					
% want	97	88	95	95	83
% don't want	3	12	5	5	17
Double glazed windows					
% want	91	70	86	68	34
% don't want	9	30	14	32	66
Solar water heater					
% want	34	58	25	41	36
% don't want	66	42	75	59	64
Solar water heater and house heater					
% want	32	48	21	42	24
% don't want	68	52	79	58	76
Heat pump					
% want	92	—	44	—	—
% don't want	8	—	52	—	—

SOURCE: *Housing,* October 1978, p. 54.

variation by region, with the average R-value of the wall ranging from 10.9 in the South Atlantic region to 12.2 in New England and the East North Central (States bordering on the Great Lakes) regions. Somewhat more variation is shown for attic insulation, with a low of 16.9 in the South Atlantic region and a high of 22.5 in the Mountain States. These data reflect the greater variety of materials used in attics and the ease of installing different amounts. The use of insulation between the floor joists actually showed a decrease, but this may reflect the fact that the 1976 survey separately tabulated basement wall insulation and insulation of the crawl space walls, rather than an actual decrease in the amount of floor insulation. A significant decline in the use of single-glazed windows is also evident, with only the East South-Central States (Kentucky, Tennessee, Mississippi, and Alabama) showing an appreciable increase in the use of single glazing. Triple glazing was not tabulated separately in the 1974 survey, but it is now being used in a small number of homes in the Midwest and East.

It should not be inferred that similar increases have occurred every year since the oil embargo of 1973, because the NAHB survey of houses built in 1973 showed insulation levels very similar to 1974, with weighted average R-values for the walls of 10.0 (vs. 9.2 in 1974), 14.4 for the ceilings (vs. 15.8), and 4.0 for floors (vs. 4.3).[27] The F. W. Dodge Co. surveyed 1,000 randomly selected homes built in 1961 and found that 65 percent contained exterior wall insulation, 92 percent had ceiling insulation, and 7 percent had perimeter insulation.[26] By contrast, 99 percent of the houses built in 1975-76 had both ceiling and wall insulation and 11 percent had perimeter insulation .29

The percentage of homes built in 1975-76 with various levels of insulation is shown in table 51. Almost 100 percent have ceiling insulation of some kind, with 83 percent having R-1 3, R-19, or R-22. Nearly 100 percent of the houses have wall insulation, with 93 percent having either R-11 or R-13 because of the almost universal use of 2x4 studs. It may seem surprising that only 20 percent of the houses have insulation between the floor joists, but this may be due to the fact that in many areas substantial cooling is provided through the floor in summer, offsetting the winter heating savings of floor insulation to a considerable degree. However, it is clear that a large number of houses with ventilated crawl spaces would benefit from insulation; increased in-

[27] Therma/ Characteristics of Sing/e Family Detached, Single Family Attached, Low Rise Multi-Family, and Mobile Homes for the Office of Technology Assessment (National Association of Home Builders, October 1977). (See appendix C.)

[28] Ibid.

[29] Ibid.

Table 50.—Comparison Between Average Insulation and Glazing Characteristics of New Single-Family Detached Houses Built in 1974 and in 1975-76

	New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mountain	Pacific	Total U.S.
Average exterior wall insulation R-value										
1974	10.3	9.3	10.6	11.3	7.2	10.3	10.3	6.7	8.8	9.2
1975-76	12.2	11.8	12.2	12.0	10.9	12.0	11.9	11.0	11.4	11.7
Average ceiling or roof insulation										
1974	17.9	17.9	15.7	16.6	14.8	15.1	15.1	18.1	14.6	15.8
1975-76	18.2	18.7	18.5	19.3	16.9	18.0	18.4	22.5	18.0	18.4
Average insulation R-value between floor joists										
1974	4.8	4.8	2.8	5.2	5.4	5.2	6.6	1.8	1.8	4.3
1975-76	5.0	6.7	5.0	4.8	3.7	2.9	0.1	1.8	1.4	2.6
Windows										
1974										
Single glazing	37.1	*40.7*	28.3	34.3	69.4	42.4	92.7	74.1	85.1	52.0
Double glazing (insulation glass or single w/storm)	62.9	*59.3*	71.7	65.7	30.6	57.6	7.3	25.9	14.9	48.0
1975										
Single glazing	37.6	26.6	5.8	14.3	58.8	49.6	80.2	22.6	76.0	44.0
Double glazing (insulation glass or single w/storm)	62.2	71.6	89.5	82.8	41.1	49.4	19.8	76.6	23.5	55.0
Triple glazing (insulation w/storm. .,...	0.2	1.7	4.8	2.9	0.1	0	0	0.8	0.5	1.0

SOURCE: NAHB Research Foundation, inc. See appendix B of this volume for this and all other referenced NAHB data.

Table 51.– Insulation Characteristics of 1975-76 Single= Family Detached Housing Units

	New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mountain	Pacific	Total U.S.
Ceiling (% of all houses)										
None	0.7	0	0.6	0.6	1.4	1.5	0	5.6	0.7	1.0
R-7 & R-11	7.0	12.3	4.5	3.0	9.8	4.2	3.0	0.7	2.8	5.4
R-13	24.1	7.8	30.6	25.7	23.6	25.6	20.7	13.4	12.8	20.4
R-19	52.7	46.7	28.4	25.5	51.1	42.6	59.5	42.8	80.9	50.0
R-22	8.1	14.2	25.3	22.8	5.3	17.0	6.8	22.9	0.9	12.3
R-25, R-26, R-30, R-31, & more than R-31	7.2	12.4	9.2	18.7	6.9	8.1	7.8	24.5	1.5	9.3
Other	0.2	6.6	1.4	3.7	1.9	1.1	1.2	0.1	0.4	1.8
Exterior wall (% of all houses)										
None	0	0	0	0	0.6	0	0	0.2	0.2	0.2
Less than R-7	0	0	0	0	8.0	0	0	2.0	0	1.4
R-7	0.4	0.5	0	0	0.9	0.3	0.2	8.7	0.4	1.1
R-li	58.2	73.0	61.1	63.8	69.3	64.5	77.8	62.8	87.5	71.0
R-13	35.6	21.7	33.7	32.5	18.6	30.0	15.5	22.1	8.9	21.8
R-19	4.5	4.0	3.4	3.4	2.1	4.6	5.9	2.6	3.0	3.5
Other	1.3	0.8	1.8	0.3	0.5	0.6	0.6	0	0	1.0
Between floor joists (% of all houses)										
None	63.0	51.0	63.1	65.7	75.0	75.7	99.1	88.3	88.9	80.1
2-1/4'' batts R-7	0.9	1.7	1.9	1.1	1.8	4.4	0.1	0.4	1.1	1.4
3-1/2'' batts R-n	16.5	32.9	18.5	14.3	16.8	11.5	0.4	4.1	7.3	11.2
R-13, R-19&Other	19.6	14.4	16.7	18.9	6.4	8.4	0.4	7.4	2.7	7.3
Crawl space walls(% of all houses)										
None	99.6	98.7	98.7	99.7	97.1	97.5	99.8	98.2	93.6	98.2
Insulated (R-7 through R-19)	0.4	1.3	1.3	0.3	2.9	2.5	0.2	1.2	6.4	1.8
Basement walls (% of all houses)										
None	87.0	93.5	93.0	81.8	97.4	95.1	99.8	93.9	97.7	96.0
insulated (mostly R-7, 11, 13, & 19)	13.0	6.5	4.6	18.2	2.6	4.9	0.2	6.1	2.3	4.0
Slab-on-grade perimeter (% of all houses)										
None	99.3	96.7	92.6	99.3	86.3	88.8	89.0	93.3	91.9	89.3
1" rigid	0.4	2.6	5.1	0.6	11.0	9.3	9.1	6.1	2.6	8.3
2" rigid	0.2	0.7	2.2	0.1	2.3	1.3	0.9	0.1	0.8	2.1
Other	0.5	0	0.5	0	0.4	0.6	1.0	0.5	0	0.3

SOURCE: NAHB Research Foundation, inc.

sulation of basement walls and increased use of insulation between the floor joists are the most obvious areas where added insulation would be useful in new construction.

The window and door characteristics of the houses built in 1975-76 are shown in table 52. It shows that 42 percent of the entrance doors were insulated.

Table 53 shows the percentage of homes by price that have R-11 or greater levels of insulation in the exterior walls and R-13 or greater levels of insulation in the ceiling. More than 94 percent of all houses had exterior insulation levels of R-11 to R-19, and the incidence of less than R-11 levels does not seem to correlate with housing price. The data related to ceiling insulation are similar. Nearly 90 percent of all houses had ceiling insulation levels of R-13 or greater, and housing price does not seem to affect the levels of insulation.

There appears to be some buyer resistance to expensive conservation packages; many homeowners would prefer to invest in additional amenities rather than more conservation improvements. A Los *Angeles Times*[30] article about Chicago builders indicated that while most builders provide R-11 exterior wall insulation and R-19 ceiling insulation, customers pass up beefed-up conservation packages for such luxury options as extra rooms or garages. One builder offered a $3,800 optional energy package, but only 18 of 77 homebuyers bought it. Another reported a lack of interest in an optional feature to double the amount of insulation in the homes in one subdivision.

While builders have responded to consumer demand for energy-saving improvements, lenders have begun to promote saving in lending. Some lenders have promoted energy conservation through advertising the advantages of conservation - and providing special arrangements and rates for conservation loans. Many lenders have offered conservation home-improvement loans at interest rates below normal market rates. One California bank offers to rewrite homeowner loans and lend 100 percent of the cost of adding a solar system without raising the interest rate on the home mortgage and normally without increasing the total monthly payments. A bank in Washington State offers preferential terms for loans on homes that meet certain energy conservation requirements.[31] A Minnesota bank promotes its conservation program as "the way lenders can help, " while an Illinois bank group offers a home inspection at a $50 cut-rate fee to detect heat-loss problems.[32] A survey by the Savings Institutions Marketing Society of America indicated that 20 percent of the 656 institutions surveyed featured energy-related homes in their 1977 advertising. 33 But while lenders have launched many types of programs, many have dropped them or lowered their expectations in the face of weak consumer response. Below-market interest rates appear to offer only a limited incentive to take conservation actions. Presumably, this reflects the general low-level of demand for small home-improvement loans (see Retrofit, page 97).

Data on retrofit are less precise, but many homeowners have been improving the energy efficiency of their homes. As noted in table 54, *Building Supply News* estimated that in 1977 4.2 million jobs involved insulation and 1.3 million jobs involved storm windows and doors.

Extensive retrofit is confirmed by Owens-Corning data. To monitor the extent of ceiling reinsulation activity by homeowners, Owens-Corning conducted surveys in 1975 and 1976. During this period the average insulation installed increased from 4¼ to 5½ inches. The extent to which reinsulation occurred did not vary widely across income groups: in fact, households with incomes under $10,000 had a slightly higher rate of activity than their percentage of the population. Based on other studies Owens-Corning estimated that between 1974 and 1976, 8 million homeowners appeared to have reinsulated their ceilings, an additional 7 million did so in 1977. In 1978, 5

[30] Don Debat, "Lending Institutions Say That Energy Expenses May Exceed Monthly Mortgage Payments," Los Angeles Times, Oct. 8,1978.

[31] Urban *and Community Economic Development* (American Bankers Association, May 1977).

32 I bid.

[33] Energy *Savings Is Good* (Savings Institutions Marketing Society of America).

Table 52.—Window and Door Characteristics of 1975-76 Single-Family Detached Housing Units

	New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mountain	Pacific	Total U.S.
Window glazing (% by region)										
Single glaze	37.6	26.6	5.8	14.3	58.8	49.6	80.2	22.6	76.0	44.0
Single w/ storm	25.3	21.6	27.2	40.6	15.5	22.7	12.1	22.7	4.9	20.0
Insulating glass	36.9	50.0	62.3	42.2	25.6	26.7	7.7	53.9	18.6	35.0
Insulating w/ storm	0.2	1.7	4.8	2.9	0.1	0	0	0.8	0.5	1.0
Window (ft² per unit by region)										
Single glaze	81.7	47.8	7.5	23.4	105.4	84.1	123.4	49.7	152.8	82.0
Single w/ storm	55.0	38.7	42.0	66.9	25.8	35.1	16.4	55.1	9.2	32.6
Insulating glass	80.3	89.8	104.9	71.0	44.8	41.7	11.1	92.7	35.8	58.9
insulating w/storm	0.5	3.1	8.2	4.9	0	0	0	1.2	0.9	2.1
Totals	217.5	179.4	162.6	166.2	176.0	160.9	150.9	198.7	198.7	175.6
Sliding glass doors										
Number per unit	0.88	1.02	0.88	0.93	0.89	0.68	0.84	1.00	1.26	0.95
Square feet per unit	35.2	40.8	35.2	37.2	35.6	27.2	33.6	40.0	50.4	38.0
Exterior doors (% by region) (Entrance)										
Not insulated	41.0	16.1	23.1	46.1	69.6	69.2	78.8	56.5	89.4	57.9
Insulated	59.0	83.9	76.9	53.9	30.4	30.8	21.2	43.5	10.6	42.1

SOURCE. NAHB Research Foundation, Inc.

Table 53.—Single-Family Detached Homes Wall and Ceiling Insulation by Housing Price

	Exterior wall insulation			Ceiling insulation		
Price range	Less than R-1 1	R11-19	Other	Less than R-13	R-13 or Greater	Other
Less than $30,000	2.7	96.7	.6	3.7	95.8	.5
$30,000 -34,999	4.6	94.8	.6	7.4	89.7	2.9
$35,000 -39,999	3.5	94.1	2.4	8.3	89.8	1.9
$40,000 -44,999	2.6	96.5	.9	6.4	93.4	.2
$45,000 -49,999	1.3	98.0	.7	4.7	92.2	3.1
$50,000 -54,999	4.2	94.8	1.0	6.7	91.3	2.0
$55,000 -59,999	1.9	97.6	.5	4.0	94.4	1.6
$60,000 -64,999	1.7	97.6	.7	4.9	95.0	.1
$65,000 and over	1.3	98.2	.5	4.8	93.6	1.6

SOURCE: NAHB Research Foundation, Inc.

Table 54.—Estimates of Insulation and Storm Door/ Storm Window Activity in the Retrofit Market, 1977

Type of activity	Dollar volume ($000)	Number of jobs	Average cost per job
Additional insulation	$1,035,292	4,243,000	$244
Storm windows & doors	$ 212,901	1,339,000	$159

SOURCE: *Building Supply News,* Homeowners Remodeling/Modernization Study, 1978.

million to 5.5 million more homeowners were expected to invest in ceiling reinsulation.

The Gallup survey conducted for DOE in early *1978* found that 1 out of *6* respondents said that they had added insulation and 1 out of 10 installed storm doors or windows in the previous 12 months. Thirty-six percent of those with insulation believe more is needed.[34] Ninety-three percent believe their bills will be lower-–(but only 44 percent know how large the savings will be). More than 80 percent of the homeowners said they know the type of insulation they want, where to buy it and how to install it. On the other hand, only 50 percent know what a fair price would be.

Energy conservation is a concern for the mobile home industry. The Federal standards under which all mobile homes are built include thermal performance standards. Three different thermal performance standards are used depending on the zone of the country. The NAHB study of 175,000 mobile homes built in 1976-77 shows that most homes had R-13 to R-18 levels of insulation in the ceilings, though sizable portions had R-19 to R-21. Walls and floors were typically insulated to an R-11 standard. Most units had single-glazed windows with storm windows, but in units to be sold in southern areas single-glazed storm windows were common. The Federal standards have had a positive effect in raising insulation standards in mobile homes. Most existing mobile homes have some insulation but its effectiveness is not known. Few mobile homes have storm windows or storm doors. Due to the nature of the industry, Federal regulation has been welcomed, and improved standards should not represent a major barrier.

FINDINGS AND OPPORTUNITIES FOR ENERGY CONSERVATION

Operating practices and market conditions largely determine the incentives for and obstacles to energy conservation. Opportunities for energy conservation differ among the three housing submarkets– new construction, manufactured housing, and existing housing. These differences must be considered in setting energy conservation goals and programs. Differences in practices, levels of knowledge, and attitudes toward conservation vary depending on whether the housing is investor-owned and rented or owner-occupied, and whether the housing is single-family or multifamily. These differences affect the economic circumstances, attitudes, and characteristics of the participants in the housing sector and the incentives needed to motivate property owners to take energy-saving actions.

There is no single national housing market; each locality has its own characteristics and features. Practices, attitudes, and requirements vary by such factors as geography, supply and demand for housing, climate, tradition, cost and availability of fuel, patterns of tenure, community size, and type of construction. As a result, housing costs and characteristics differ widely depending on locality or region. These variations, true of both the existing housing stock and the new construction market, affect the attractiveness of investing in energy conservation improvements and determine in part the building industry response to conservation. The attitudes of property owners toward energy costs and energy conservation have changed significantly over the past 5 years. In response, many builders have raised their standards for energy efficiency in homes and are now actively promoting energy features in sales. Persons owning homes have

[34] Gallup Organization, Inc., op. cit.

begun to alter their homes to save energy; this effort is being augmented and supported by contractors, utilities, and some lenders.

Despite the growing response of the building industry and individuals, a great deal more can be accomplished. New construction offers more energy-saving potential per dwelling than existing housing, as many improvements possible during construction cannot be added, or can be added only at high cost, after the building is finished. Because most new construction must conform with local building codes, a system is in place to inspect plans and construction practices.

Because of the size of the existing housing stock — some 80 million units — retrofit will be most productive in saving energy in the short run. The level of thermal performance of the total housing stock will change only slowly as a result of new construction, with annual starts of 2 million units on the average.

Builders' Attitudes

The construction industry responds to wide-ranging changes in taste and demand. Since the new construction market is highly competitive, and most firms are relatively small, builders must compete in terms of price, design, and amenities as demanded by the public at a given time. Builders therefore add energy conservation improvements to their houses to the extent they expand or improve the marketability of the house.

In addition to watching buyer demand closely, builders also stay in close touch with building material suppliers, and some follow the research and publications of NAHB and similar groups. From such marketer's associations and other builders, they learn of new industry trends, practices, and products. Features like air-conditioning, once considered a luxury, became standard in a short time in response to buyer demand and technology transfer. Thus, education through building trade groups, combined with growing public concern over energy cost, should work to accelerate the use of conservation options by builders.

Although most builders now seem generally aware of opportunities for conserving fuel, their expertise is limited. Most building companies do not have design or engineering skills, but rely on architectural and engineering firms, utilities, design reviewers, and lending institutions to make decisions on energy-based changes. Designing energy-efficient housing requires consideration of climate, site, style, material costs, and specifications, financing costs, and taxes. Builders often cannot afford to hire experts in all these areas. Without proper engineering and design, housing can contain many "energy saving" features and yet fail to operate efficiently.

Builders appear willing to experiment with new materials, particularly if others in their area are also experimenting. I n 1978, a *Professional Builder* survey found that 25 percent of the builders had tried 2x6 framing with 6 inches of insulation to obtain an R-19 wall; this number was up from 20 percent of the builders surveyed in 1977.35

The other factor that determines how builders build is the local building code, Inspections normally include both design review and on-site inspection. As code requirements relating to energy use become more stringent, builders will presumably comply. Most homes are constructed by builders who use prescriptive codes; i.e., acceptable materials and practices are clearly specified. These builders will easily cope with most new codes that can be translated into simple, easy to follow formats. (See the section in chapter VI 1 I on standards.)

Property Owners' Attitudes

The price of energy seems to be the most powerful incentive to conserve, and future conservation will depend on property owners realizing increased economic benefits. Where fuel costs are high and climatic conditions extreme, it appears that consumers are especially willing to invest in energy efficiency.

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[35]" Energy and the Builder," op. cit.

A lifecycle costing analysis, while commonly used to make investment decisions of certain types, is not typically used by the homeowner. The commercial real estate investor may conduct a lifecycle cost analysis in an informal manner, balancing the analysis with judgments about the future of the property, the investment required, and other investment plans. Short ownership periods and investment horizons mitigate against adoption of lifecycle costing approaches.

The marketplace makes distinctions between conservation improvements that are clearly cost-effective and those which return the investment over a longer pried. This partially explains the greater interest in insulation and double-glazed windows than in, for example, solar energy systems. The difference in attitude may also reflect consumers' and building professionals' different levels of awareness and information about various conservation technologies.

Homeowners and investors assess energy conservation opportunities differently. Homeowners view conservation improvements in terms of their potential for reducing energy costs, effect on the downpayment and the monthly carrying costs, and the possibility of future maintenance difficulties. Investors in rental housing consider conservation improvements in terms of improved profitability, reduced risk, or additional income or profit. If increased energy costs can be directly passed on to tenants by increasing rents, conservation may not be an attractive investment. (See the section in chapter VI I I on tax policy.)

The principal opportunity for additional conservation activity in the retrofit market centers on ways to motivate the homeowner to improve the efficiency of his home. The homeowner can be made more aware of conservation opportunities through the media, utility advertising and energy audit programs, and publicity by manufacturers and suppliers of building materials. Realtors and lenders can also encourage homeowners and homebuyers to take conservation action.

Is the Cost of Adding Energy Conservation Features to New or Existing Housing an Impediment to Conservation?

The inclusion of conservation improvements in new housing is tempered by market conditions and considerations. The dramatic rise in the price of housing in recent years has made builders sensitive to increases in first costs or in carrying charges.

Including energy conservation features in a new home often increases downpayment requirements and fixed monthly charges. While it does not follow that if builders choose to upgrade the energy-saving characteristics of their housing and increase the price accordingly, households are priced out of the market altogether, marginal buyers might have to scale down their expectation. For example, assuming a 10-percent interest rate and 30-year term, a house cost of $50,000 and $45,000 loan, and a $5,000 downpayment, a monthly mortgage payment of $394.91 would be required. Extra improvements of $2,000 financed on the same terms would increase the downpayment $200 and the monthly payment would rise to $410.18. The $15.27 monthly increase would add $183.24 a year to housing costs. Using the rule of thumb (which is no longer universally used) that a purchaser should spend 25 percent of his income for housing, a purchaser would have to earn an additional $733 of annual income to afford the house. This additional cost might affect the marketability of the home; NAHB estimates that 39.8 percent of the public–22,771,000 households–could afford a $50,000 home with the financing described above. Increasing the price to $52,000 reduces the number of households who can afford the house to 21,283,000 households or 37.2 percent of all households, according to NAHB. The builder therefore makes a decision to increase cost with great care.

Are Problems of Financing Impeding the Pace of Residential Conservation?

Lenders generally have been willing to finance the added cost of energy-efficient

housing. Financing has not been a problem for the credit-worthy borrower. Lenders rely on appraisers to make judgments about the extent to which conservation improvements add to the value of a property; standard conservation improvements are not seen as valuation problems. Houses based on "solar passive" principles or other design approaches may not be acceptable to lenders if the houses have an unusual appearance or require no purchased energy; they are considered experimental. Lenders appear increasingly willing to make conservation-related home improvement loans, although most conservation improvements are inexpensive and not profitable for banks to finance. Most homeowners, however, pay for home improvements through cash on hand, savings, or short-term credit arrangements such as credit cards. Those who do need financing may not meet requirements for income and established credit. Low-income homeowners have more difficulty financing conservation improvements and may need some form of subsidy to make those improvements. The Community Services Administration (CSA) and DOE weatherization program partially meets the needs of low-income homeowners, but many may fail to qualify for or be reached by weatherization assistance. Newly authorized utility audit programs may also assist those who need financial help.

Lenders have limited interest in promoting energy conservation and do not consider it a significant factor in lending decisions. On the other hand, some financing institutions estimate utility costs in calculating the monthly housing expenses of a potential borrower. Some lenders may view energy-conserving improvements as potential means of reducing lending risks by reducing fuel costs, or as ways to improve resale value, but most do not evaluate the energy efficiency of housing they finance. Many lending institutions have initiated special, below-market interest-rate loan programs to promote conservation activity. These programs have not generated strong consumer response. Lenders therefore give these programs a low priority, treating them primarily as public relations endeavors.

Few lenders are concerned with the energy efficiency of the homes they finance. Since financing is essential to homeownership for most Americans, a change in the attitude of lenders could quickly facilitate a shift to much higher levels of conservation. If review of mortgage applications included a review of energy costs, much greater investments in saving energy could be expected.

What Are the Current and Potential Roles of the Federal Government in Encouraging Residential Conservation?

The Federal Government currently affects the housing sector through programs that regulate lenders, through tax policy, programs that provide housing subsidies, insurance, and guarantees, and standards setting. The impact of Federal actions is much greater than the level of Federal insurance, guarantees, or subsidies would suggest. The role and impact of Federal programs are reviewed in chapter Vlll.

The implementation of HUD's Building Efficiency Performance Standards (BEPS) and the adoption of federally sponsored "model code" standards should raise the energy efficiency of new housing. By using nationally developed energy standards and enforcement guidelines for all new construction, builders and local building code officials will be in a better position to understand and implement conservation actions. The process of reviewing and implementing standards should improve consumer awareness of energy conservation. (See chapter Vll l.)

Other Federal initiatives that will affect energy efficiency in the residential sector have been mandated by the National Energy Policy and Conservation Act of 1975 and the Housing and Community Development Amendments of 1978, which established programs to finance energy-conserving improvements and promote solar energy and energy conservation in HUD-assisted housing. Tax credits for conservation improvements have been enacted.

DIRECTIONS FOR THE FUTURE

Much remains to be done to upgrade residential structures and to encourage property owners to adopt energy-conserving practices. Tens of millions of homes require reinsulation and other energy-saving improvements. The design and features provided in new housing could be significantly upgraded even beyond current levels to improve their energy efficiency.

The key issue is whether the current pace of change is satisfactory, or whether additional Federal actions directed to property owners or the building industry are required to increase either the pace or the direction of current trends. Available information provides no conclusive answer, but signs indicate that increasing energy prices, greater awareness among property owners and industry participants, and previously enacted Federal legislation are encouraging property owners to invest in conservation. Legislation enacted in 1978, recent changes in Federal policies and practices, and the promised issuance and implementation of BEPS promise to bring about further improvement in the energy efficiency of residential buildings. Other new incentives for energy conservation in both the public and private housing sectors are described in detail in chapter VII I.

These new initiatives, plus those related to other aspects of residential energy conservation discussed elsewhere, should help to expand the awareness and knowledge of property owners and building industry participants about energy conservation, and stimulate further investments in conservation improvements. In the context of rising energy prices, further conservation can be expected.

Given the breadth of these recent Federal initiatives and the market dynamics of the housing industry, it seems appropriate to move cautiously in terms of proposing additional actions. A cautious approach is warranted to avoid Federal actions that may be unnecessarily costly, provide windfalls, or have a negative impact on housing costs. Actions that increase housing costs must be weighed carefully in terms of costs and benefits.

Assuming that the availability and price of energy remain about as expected, it may be most efficient to focus on improving the quality or expanding the coverage of existing conservation programs, and to monitor the impact of the new initiatives, before mounting any major new efforts. Priority should also be given to modifying policies or practices that act as barriers to conservation.

Efforts to inform the building industry and property owners about the opportunities and techniques for saving energy need to be improved. Industry needs better technical information, and the average homeowner needs simpler, more useful information. The quality of information now available varies widely and is disseminated unevenly. The expanded energy audit program appears to be a promising educational approach. The Government should continue to work closely with trade groups to assure that building professionals are not only aware of the importance of considering energy costs in making housing decisions, but know how to design and construct more energy-efficient houses. Demonstration efforts promote the market for energy-saving improvements and should be continued.

More research should be directed to conservation. Promising technological approaches must be encouraged. More information is needed about the thermal efficiency of the housing stock and the extent and character of retrofit actions. A better understanding of real estate investors' attitudes and motivations, and the extent to which they are making conservation improvements, is needed.