Chapter 4

Will Building Owners Invest in the Energy Efficiency of City Buildings?

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INTRODUCTION

Virtually all types of city buildings (as is clear from ch. 3) can be retrofit to save a substantial portion of their energy. Some can be retrofit easily and cheaply. Others can be retrofit only with difficulty and at considerable expense but nonetheless in such a way that the expense would be justified by energy savings over the building's lifetime.

The question remains, however, will these buildings be retrofit? The answer given by this chapter is that city buildings will not be retrofit unless several more conditions are met beyond the fact that the building is cost effective to retrofit.

If a building that can be retrofitted is to be retrofitted three additional conditions must be met:

- the building's energy inefficiency must cause a noticeable loss in present or future return from the building,
- an investment in improved energy efficiency is consistent with the building owner's goals, and
- the building owner has the means—adequate information, decisionmaking ability, time, and financial resources—to make the investment.

Furthermore, even if the building owner is willing and able to make such an investment, it will not happen unless there are businesses ready to recommend and install the retrofit. The state of the energy retrofit business is mentioned briefly in this chapter but is discussed more completely in chapter 7.

For example, it should be easy (given the analysis in ch. 3) to prescribe a set of very cost-effective retrofits for a small frame multifamily building with an old inefficient steam system in a city with a cold climate. Yet for the identical building with identical retrofit potential the chances of retrofit range from good if it is an owner-occupied building in an up-and-coming neighborhood to *very poor* if it is owned by an absentee landlord, and is located in a declining neighborhood.

A curtain wall office building with a decentralized heating system of electric baseboard heat and window air conditioners has much poorer prospects for inexpensive easy retrofit than the small frame steam-heated building. In most cases, only expensive retrofits are available for such a building, replacing the electric resistance heaters with heat pumps or installing double glazed window panels. Nonetheless, because of the potential goals of its owners and their resources the chances that such a building will actually be retrofit range from good for a corporate headquarters or office building owned by an insurance company or pension fund to *poor* if it is owned by a small local partnership for tax shelter purposes.

The likelihood that a building will be retrofit depends both on its type of owner and on the importance of energy costs for the purpose the owner uses the building for. Table 27 illustrates in a schematic way the general prospects for retrofit for different combinations of buildings and owners. In general, the chances that a building will be retrofit are less likely for multifamily than for commercial buildings, less likely for buildings owned for investment than for buildings occupied by their owners, and less likely for buildings owned by individual owners or local partnerships than for those owned by institutional owners such as pension funds and insurance companies, or national partnership syndicates.

In fact real estate is not quite so simple as table 27. The rest of the chapter explains some of the complexity of investment for energy efficiency in buildings. To date little specific research work has been done on the subject of

Table 27.—Likelihood of Retrofit by Building Type and Owner Type

		Decreasing likelihood →				
	Owner-occupants	Office	Hotel	Retail	Multifamily master-metered	Multifamily tenant-metered
Decreasing Likelihood	Corporation	L	L	L	x	x
	Individual	M	M	M	M	P
	Condominium	X	x	x	M	M
	investor-owners					
Decreasing Likelihood	Institutional (pension, insurance)	L	L	L	L	M
	Development company	M	M	P	P	u
	National partnership	M	M	M	M	P
	Local partnership	P	P	P	P	u
	Individual	P	P	u	P	u

L = Likely.
M = Moderate.
P = Possible.
U = Unlikely.
X = There are none or very few examples of such building types owned by these owners.

SOURCE: Office of Technology Assessment

the motivation to invest in energy efficiency per se although there is voluminous literature on investment i n real estate.[1] The chapter relies heavily on work done for OTA by the Real Estate Research Corp. (RERC) a Chicago-based consulting firm specializing in the investment analysis of real estate and in appraisal.

RERC conducted a comprehensive literature review, and interviewed buildings owners i n four case study cities (Buffalo, N.Y., Des Moines, lowa, Tampa, Fla., and San Antonio, Tex.) as well as "national" real estate owners with holdings in all parts of the country. RERC also analyzed prototype multifamily buildings to evaluate the impact of rising energy costs and energy retrofits financed in several alternative ways. In total, RERC talked to 96 building owners representing different types of owners and different building uses. (The breakdown of interviews is shown in tables 28 and 29.) These interviews, supplemented by extensive reading in real estate trade literature, in-house RERC expertise, and OTA staff research form the basis for this chapter.

This chapter focuses on privately owned, urban commercial, and multifamily buildings–offices, retail facilities, hotels, and small, medium, and large apartment houses—partly because these form the bulk of the urban building stock and partly because these have been woefully neglected i n the literature on investment in energy efficiency. The chapter does not specifically address the motivation for investment by owners of single-family houses. This subject was fully covered in the previous OTA study on Residential Energy Conservation, and other literature,[2] and is addressed to some extent in other chapters of this report Chapter 5, *Retrofit for the Housing Stock of the* Urban *Poor* and *Chapter 9, The Public Sector Role in Urban Building Energy Conservation.* Under some conditions the motivation of single-family home owners parallels that of the owner-occupants of small multifamily buildings and this will be pointed out in the text.

[1] Several other useful sources on real estate decisions and energy conservation include: Hittman Associates, *Physical Characteristics, Energy* Consumption and *Related Institutional Factors in the Commercial Sector,* DOE report, February 1977; *Proceedings of the Multifamily* and *Rental* Housing *Workshop,* Dec. 4, 5, and 6, 1980, Washington, D. C., sponsored by the Federation of American Scientists Fund prepared by Deborah L. Blevis; Alice Levine, and Jonathan Raab, *Solar Energy, Conservation* and *Rental Housing,* Solar Energy Research Institute, March 1981; *Multi-Family Energy Conservation:* A Reader, Coalition of Northeast Municipalities, July 1981.

[2] A comprehensive analysis of the potential for energy conservation in single-family houses are the final report and working papers of the *Residential Energy Efficiency* Standards *Study* submitted to Congress by the Department of Housing and Urban Development in July 1980.

Table 28.—Types of Building Owners Interviewed[a]

Owner status	Buffalo	Des Moines	Tampa	San Antonio	National
Individual	8	4	1	3	6
Partnership	7	5	4	4	5
Corporate	3	4	1	2	4
Institutional	0	1	0	0	10
Development company	3	0	0	1	4
Bank	4	2	4	3	—
Condominium	0	0	1	1	1
Total	25	16	11	14	30

[a]Some owners interviewed had multiple ownership positions (e g., as Individual owners and members of partnerships) Owners were tabulated on the basis of their principal ownership role

SOURCE Real Estate Research Corp

Table 29.—Building Types Covered in Building Owner Interviews

Building type	Buffalo	Des Moines	Tampa	San Antonio
Multifamily	10	9	3	7
Retail	2	3	3	2
Shopping centers				
Department stores				
Retail strip				
Offices	8	6	4	6
Hotels	1	1	0	2
Total	21	19	17	10

NOTE, The number of building types WIII *not* exactly correspond to the number of owner types due to multiple ownership and the fact that banks were not Interviewed as owners in all cases

SOURCE, Real Estate Research Corp

The decision to make energy improvements in response to rapidly rising energy costs is above all a real estate investment decision. Like other real estate decisions it is affected by overall investment strategy, tax laws, marketability of the property, lease terms, cost and availability of financing, perception of risk, and many other considerations for a particular building. Furthermore, real estate is a complex and diverse industry. Markets vary sharply from city to city and even from neighborhood to neighborhood. ownership runs the full range from the giant corporation that owns its own headquarters building to the retired couple holding onto their small three-story walkup as their nest egg. The conditions under which real estate decisions are made can change drastically from year to year. The rapid increases in inflation and interest rates of the last few years have had profound consequences for decisions made by all kinds of real estate owners. (More recently, the 1981 tax law has made sweeping changes in the importance of real estate as a tax shelter for other income.) The chapter treats each of these influences on a building's prospects for retrofit.

CONTEXT FOR BUILDING OWNER DECISIONMAKING IN 1980-81

Although the general goals of investment in real estate remain the same over years and decades, the specific concerns of building owners are significantly influenced by the structure of costs and opportunities in a particular place and time. The year 1980, when most of the survey work was done, had its particular features, many of which continued into 1981.

Energy is Now Important. First of all, after many years of energy price increases, energy began to be, for many building owners, a seri-

ous concern in 1980. It was widely perceived, as reported to RERC, as having crossed a threshold of importance within the overall balance of income and expense for particular buildings. In its annual national survey *Emerging* Trends in Real Estate 1981, RERC described this change in consciousness of energy by building owners:[3]

> In 1979, their attitude was that increased costs would simply be passed on to consumers; but this year's comments are less cavalier. Lenders are examining the energy efficiency of buildings being purchased or developed; investors are concerned about absolute operating costs, and not just those they will pay themselves; and tenants are seriously evaluating energy costs when considering space alternatives.

Although some of the building owners interviewed for OTA did not share this perception, most did and echoed the concern of the manager of a downtown office tower in Buffalo: "That electric bill is incentive enough, believe me!"

For most categories of building operations and businesses, the rapid increases in energy prices (described in ch. 2) have been faster than increases in other costs of doing business such as labor or property taxes. For all except hotels (see table 30), the cost of energy was a far greater share of costs in 1979 than it was in the early 1970's. **(Vigorous conservation by hotels appears to be responsible for holding the** energy share down.) Further rapid increases in energy prices since 1979, especially in heating oil, help account for the obvious concern about energy which was evident i n the interviews with building owners in late 1980.

The energy retrofit business scarcely existed a few years ago, and is still in the process of getting organized in response to the increasing interest in controlling energy costs. A few long-established companies offer specialized energy retrofits such as energy control systems. Many other companies already expert in the installation and maintenance of heating, ventilating, and air-conditioning systems are acquiring experience and are recommending and installing energy retrofit measures. There are still only a few general retrofit companies that have both experience with mechanical systems and experience with such envelope retrofits as double glazing, blockage of air infiltration or insulation. The current embryonic state of the private market ability to prescribe and install retrofits is described in more detail in chapters 3 and 7. Nonetheless, observers of this process believe that it will take a few more years for enough businesses to acquire solid reputations in this field, so that the building owners' interest that is now manifest will be matched by a private market response.

The current state of knowledge about the demonstrated effects of retrofit on energy use is as embryonic as the energy retrofit business. Although proprietary information is now being developed on retrofit results for such businesses as restaurant chains and department stores, there is still very little published information, in a few years there should be more publicly available information on actual retrofits from surveys, from demonstration projects and from such programs as the federally funded program to retrofit schools and hopitals. Improved knowledge of retrofit results, coupled with longer track records of the now-forming energy retrofit companies will reduce the element of uncertainty that still looms large in any decision to invest in building energy efficiency.

[3] **Real** Estate Research Corp., "Emerging Trends in Real Estate: 1981 ," Chicago, Ill., October 1981.

Table 30.—Energy's Share of Operating Costs
(in percent)

	1970		1975	1979
Downtown office(1)	18.90%		19.1%	23.80/o
Center city hotel (2)	NA		7.9	7.5
Neighborhood shopping (3)	5.9	(1972)	4.2	9.1
Elevator multifamily (4):				
Heating **fuel**	**5.5**		**NA**	**13.4**
Electricity	**6.9**		**NA**	**13.8**
Gas	**1.3**		**NA**	**2.7**
Low-rise (12-24 units) (4):				
Heating fuel	**13.1**		**NA**	**18.9**
Electricity	**2.8**		**NA**	**8.9**
Gas	**1.3**		**NA**	**2.7**

NA = Not available.

SOURCES: 1980, 1976, 1971, *Downtown Office Experience Exchange Report,* Building Owners and Managers Association (BOMA), Washington, D.C.; Laventhol and Horwath, U.S. Lodging Industry, 1976, 1979, 1980 reports; *Dollars and Cents of Shopping Centers, 1972, 1975, 1978* ULI — The Urban Land Institute, Washington, D. C.; *Income/Expense Analysis: Apartments,* Institute of Real **Estate Management (19S0 and 1975 editions). All figures are national averages.**

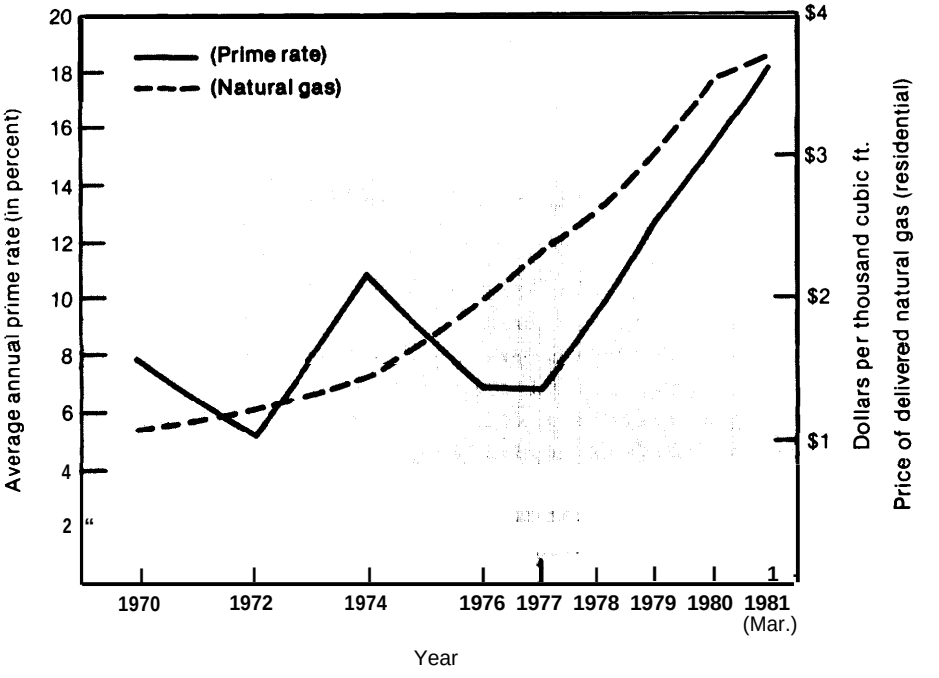
Leasing Trends. Offsetting increasing owner concern with energy costs, is an increasing tendency for leases to be written so as to pass all or most energy costs to the tenants. The different types of leases and their implications for energy use are described below in sections on each building type. In multifamily buildings owners are converting master-metered buildings to tenant metering if technically feasible and introducing prorata billing systems for energy costs when it is not technically feasible. In office buildings new leases are written with passthrough clauses in a variety of forms. In the last decade, retail buildings (especially shopping centers) have almost entirely converted from gross to net leases in which not only energy costs, but maintenance and cleaning costs, taxes, and a prorata share of the common space are passed on to tenants.

Net leases, and passthrough leases encourage tenant responsibility for sensible use of energy in their rented space. Although little has been documented of the impact of these types of leases on energy use in commercial space, one estimate of the energy savings from tenant metering in multifamily buildings is 5 percent for heating costs (more for electric heat, less for gas) and **20** percent for other energy costs,[4] However, for those buildings for which substantial investments in energy retrofits such as new lighting systems or more efficient central boilers would increase their energy efficiency, the prevalence of net and passthrough leases clearly reduces the immediate incentive of the owner to invest.

Over the longer term the owner of a building with net leases may still invest in its energy efficiency but will take into account the competitive importance of an energy efficient building to his tenants in the overall market that they operate in. The variations among office, hotel, retail, and multifamily tenants in their concerns about the energy efficiency of their buildings will be described below.

[4]Lou McLelland, "Encouraging Energy Conservation in Multi-Family Housing: RUBS and Other Methods of Allocating Energy Costs to Residents, " Executive Summary, 1980, **Institute of** Behavioral Science, University of Colorado, p. 8.

Figure 34.—Comparison of Prices of Natural Gas and the Prime Rate, 1970-81



SOURCE: Federal Reserve Board; Department *of* Energy, Energy Information Administration, ***Annual*** *Repel't* to *Congress,* ***1980,*** p 119, ***Monthly*** *Energy Review,* August 1981, p. 16.

Costs of Financing. Energy isn't the only cost of doing business that has increased in the past few years. Since 1977, the cost of financing–for buildings, equipment, inventories, and energy retrofits—has increased just as fast. Since 1970 (as can be seen in fig. 34), the prime rate is seen to increase as fast as the price of natural gas. Most energy retrofits substitute capital for energy. The high cost of financing has been a serious disincentive to retrofits.

Traditionally, major building improvements including energy retrofits were financed by refinancing (remortgaging) the entire building, Alternatively, second mortgages might be used at premium, but not prohibitive, rates. In the current climate neither is practical. Refinancing a fixed rate mortgage issued 5 years ago at 9 percent with a note of 14 to 17 percent or higher is neither sensible nor affordable. Furthermore, in response to persistent high inflation, most financial institutions are moving away from fixed rate, long-term mortgage loans, which in late 1980 were virtually unavailable. Instead they are developing 5-year renegotiable mortgages, variable rate financing methods and equity participation. As a banker interviewed in Tampa put it: "This last round of madness in money markets has destroyed the conventional means of financing income property. Now they say 'give me a piece of it'. "

Some shorter term alternatives to refinancing and second mortgages for building improvements—such as commercial bank loans, lines of credit, signature loans or borrowing against personal assets—are generally available at the same interest rate as construction loans, floating 2 points over prime (21 percent in both the summer of 1980 and spring of 1981). To be sure, banks may lend below prime to preferred customers but these generally must maintain large deposits in exchange for prefered treatment on loans. At such high financing rates, virtually all building owners will postpone building improvements including energy retrofits unless they can be financed internally (see the later discussion of the availability of internal funds).

Overall Context. To sum up, the year 1980-81 finds several contradictory influences on the likelihood of energy retrofit investment in buildings. Building owners' newly recognized concerns about energy costs, the gradual improvement in the organization of the energy retrofit business, and the knowledge of the impact of energy retrofit all tend to increase the amount of retrofit that is likely to occur. Strongly offsetting these influences, however, is the growing tendency toward net and passthrough leases and the very high cost of financing.

WHO OWNS WHAT?

The prospects for energy retrofit to a particular building depend on both what a building is used for and who owns it. Although all kinds of buildings, large and small, commercial and residential, are owned by individuals or local partnerships, other organizations active in real estate, such as insurance companies or national partnership syndicates, tend to specialize in only a few building types, Before proceeding to a discussion of the impact of owner types, or building types on retrofit, it is important to know who owns what.

Most of what is known about ownership of buildings is known from real estate trade literature and the expertise of real estate analysts and operators. There is virtually no detailed data on ownership. In some States such as Illinois, moreover, ownership is hidden by various devices permissible under State law. In only a few cities for a few particular markets, office buildings, multifamily, etc., have there been surveys of types of owners.

The consensus of conventional wisdom in real estate on who owns what is shown in table 31. Small buildings are usually owned by individuals and partnerships, and small business corporations. Large buildings may be owned by individuals and partnerships as well, but may

Table 31.— Ownership Types Believed To Be Most Characteristic of Various Building Types

	Owner-occupants			Investor-owners				
	Corporation	individual or small business	Condominium	Institutional	National partnership	Development company	Local partnership	Individual
Small buildings:								
Multifamily (2-9 units)		x					x	x
Office buildings		x					x	x
Retail strip stores		x					x	x
Large buildings:								
Multifamily (more than 10 units)			X	X	X		X	X
Office buildings	X			X	X	X	X	X
Shopping centers				X	X	X	X	
Department stores	X						X	
Hotels	x				x	x	x	

SOURCE" Off Ice of Technology Assessment

also be owned by insurance companies, pension funds, major corporations, national partnership syndicates, or development companies.

Partnerships are believed to be the most common form of real estate ownership, because of the real estate tax advantages a partnership has over a corporation. in a survey of office buildings in the city of Atlanta (table 32), partnerships and corporations were not distinguished. If, however, partnerships were the bulk of the owners, as predicted by conventional wisdom, then they accounted for more than half of all office buildings in the city.

Table 32.—Ownership of Office Buildings— Atlanta, 1974

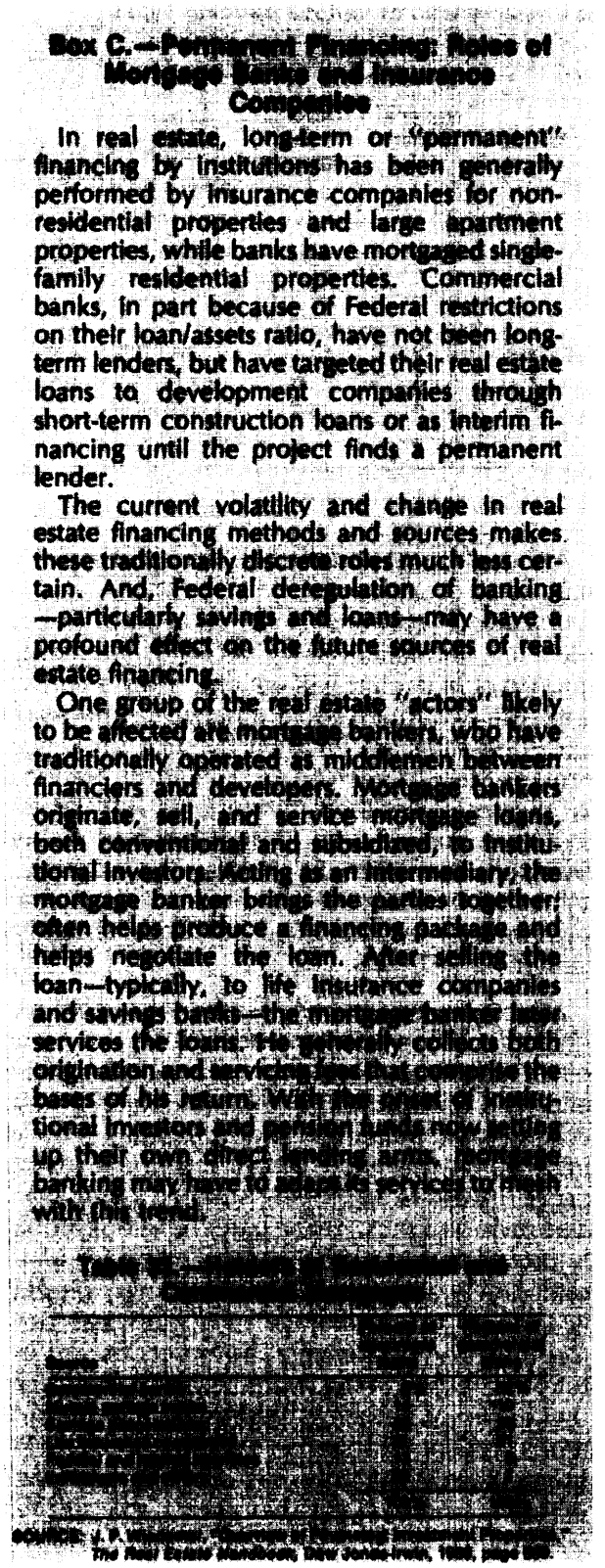
Type of ownership	Number of buildings
Corporations and partnerships	216
Savings and loans	19
Banks	17
Individuals	**50**
Labor unions	3
Real estate companies	13
Insurance	26
Real estate investment trusts	3
Nonprofit organizations	8
Uncertifiable	8
Total	363

NOTE Survey Included urban structures of at least 10,000 ft² and suburban structures of at least 30,000 ft², all withi n the vicinity l imits

SOURCE *Commercial* Space *Policy Analysis of Profitability of Retrofit of Energy* Consewat/err, *Metro* Study Corp , Washington, D C , June 1976

Although local partnerships are still the dominant form of partnership in real estate, national *syndicates of partnerships* (such as JMB, Robert MacNeil, and Balcor) have become increasingly important in the last half decade. They are listed with the Securities and Exchange Commission and their sales are handled by such brokerage firms as Merrill Lynch and E. F. Hutton. National syndicates select their investments with an eye to future appreciation. A few (such as Robert MacNeil) specialize in multifamily properties; others favor the generally higher returns from owning and leasing office buildings, shopping centers, and hotels.

Development companies, when they own real estate as well as build and develop it, also prefer office buildings, shopping centers, and hotels and tend to avoid the smaller returns of smaller commercial buildings and multifamily buildings. So do the increasingly important *institutional* investors such as insurance companies, *and pension funds.* These latter have traditionally provided the permanent financing for larger multifamily and commercial buildings, generally through the brokerage of a mortgage bank (see box C). Increasingly, however, these institutions are becoming more active in the equity ownership of buildings themselves. For pension funds, recent changes in the Employment Retirement and Security Act (ERISA) have permitted a more aggressive direct role in real



Box C.—Permanent Financing: Roles of Mortgage Banks and Insurance Companies

In real estate, long-term or "permanent" financing by institutions has been generally performed by insurance companies for nonresidential properties and large apartment properties, while banks have mortgaged single-family residential properties. Commercial banks, in part because of Federal restrictions on their loan/assets ratio, have not been long-term lenders, but have targeted their real estate loans to development companies through short-term construction loans or as interim financing until the project finds a permanent lender.

The current volatility and change in real estate financing methods and sources makes these traditionally discrete roles much less certain. And, Federal deregulation of banking —particularly savings and loans—may have a profound effect on the future sources of real estate financing.

One group of the real estate "actors" likely to be affected are mortgage bankers, who have traditionally operated as middlemen between financiers and developers. Mortgage bankers originate, sell, and service mortgage loans, both conventional and subsidized, to institutional investors. Acting as an intermediary, the mortgage banker brings the parties together; often helps produce a financing package and helps negotiate the loan. After selling the loan—typically, to life insurance companies and savings banks—the mortgage banker usually services the loans. He generally collects both origination and servicing fees that comprise the bases of his returns. With the trend of institutional investors and pension funds now setting up their own direct lending arms, mortgage banking may have to adapt its services to meet with this trend.

[illegible]

estate. As of 1979, the eight biggest life insurance companies had about $3.8 billion in real estate purchases, joint ventures and income property construction, out of total assets of $215 billion including about $64 billion in mortgages.[5] Institutions are a small but increasing share of building owners.

Corporations tend to own *buildings for their own* use partly because corporate tax laws discourage the use of building losses to shelter other income (see box D). They commonly own office buildings, hotels, and department stores, more rarely shopping centers and almost never apartment buildings.

As a group, the *owners of multifamily buildings are the smallest and least organized of all owners.* About 2.7 million owners occupy one or more apartments of multifamily building they own.[6] The Urban Institute found in a 1976

[5] Crittenden Financing, Inc., 1980.

[6] U .S. Bureau of the Census, General Housing *Characteristics,* U.S. and Regions 1977, 1978.

Box D.—Corporations: Taxes and Accounting

Corporations are inhibited from owning real estate for investment purposes because of several characteristics of their tax and accounting requirements. Unlike real estate partnerships that can operate as tax shelters for unrelated income, corporations cannot pass on tax losses from real estate depreciation and interest deductions to shareholders to shelter shareholders' income from other sources. Corporations also find it more difficult than partnerships to pass on cash flow profits from real estate since profits are taxed twice, once as corporate income and again as shareholder dividends. Finally, accounting standards for corporations require that all debt be shown on the balance sheet and that the asset value of real estate be recorded as "original cost less depreciation." Due to these [illegible] real estate investment [illegible] debt to equity ratio of corporations without [illegible] nonresidential real estate over the last decade.

study of Boston that 60 to 70 percent of the multifamily buildings were owned by individuals who owned less than 30 units. Only 10 to 15 percent held buildings with 150 units or more. These findings are consistent with findings from Baltimore and Newark.[7]

Condominium ownership of multifamily units has not yet made a large dent in the overall rental market but has become significant in a few cities where escalating property values encourage conversion. According to a 1979 Department of Housing and Urban Development (HUD) study, only 1.3 percent of all rental units had been converted to condominiums from *1970-79.* In Washington, D. C., however, 6.8 percent had been converted and in Denver and Boulder, Colo., 8.8 percent. In such cities as New York where cooperative apartments are traditional, there was a large number of conversions to cooperatives, rather than to condominiums.[8]

[7]Larry Ozanne and Ray Struyk, *Housing From the Existing Stock,* The Urban Institute, 1976, pp. 107-108. The information was obtained by Struyk from interviews with large property managers in Boston. Results from Newark are reported in George Sternlieb, The *Tenement Landlord,* Rutgers University Press, 1966, and results from Baltimore are reported in Michael Stegman, *Housing Investment in the Inner City,* MIT Press, 1972.

[8]Department of Housing and Urban Development, *The Conversion of Rental Housing to Condominiums and Cooperatives A National Study of Scope, Causes and Impact,* 1980.

Many commercial buildings are small and occupied by their small business owners, who may be individuals, partners, or small corporations. Based on information in a recently published Energy Information Administration survey of commercial buildings, as many as 60 percent of the smallest buildings of up to 5,000 ft^2 are likely to be occupied by their owners.[9]

The structure of ownership is significant for the prospects for energy retrofit. In general, as is explained in the next section, the largest, most financially independent and best advised owners (corporations, national partnership syndicates, development companies, insurance companies, and pension funds) tend to own the large commercial buildings. The smaller and least organized owners tend to own multifamily buildings.

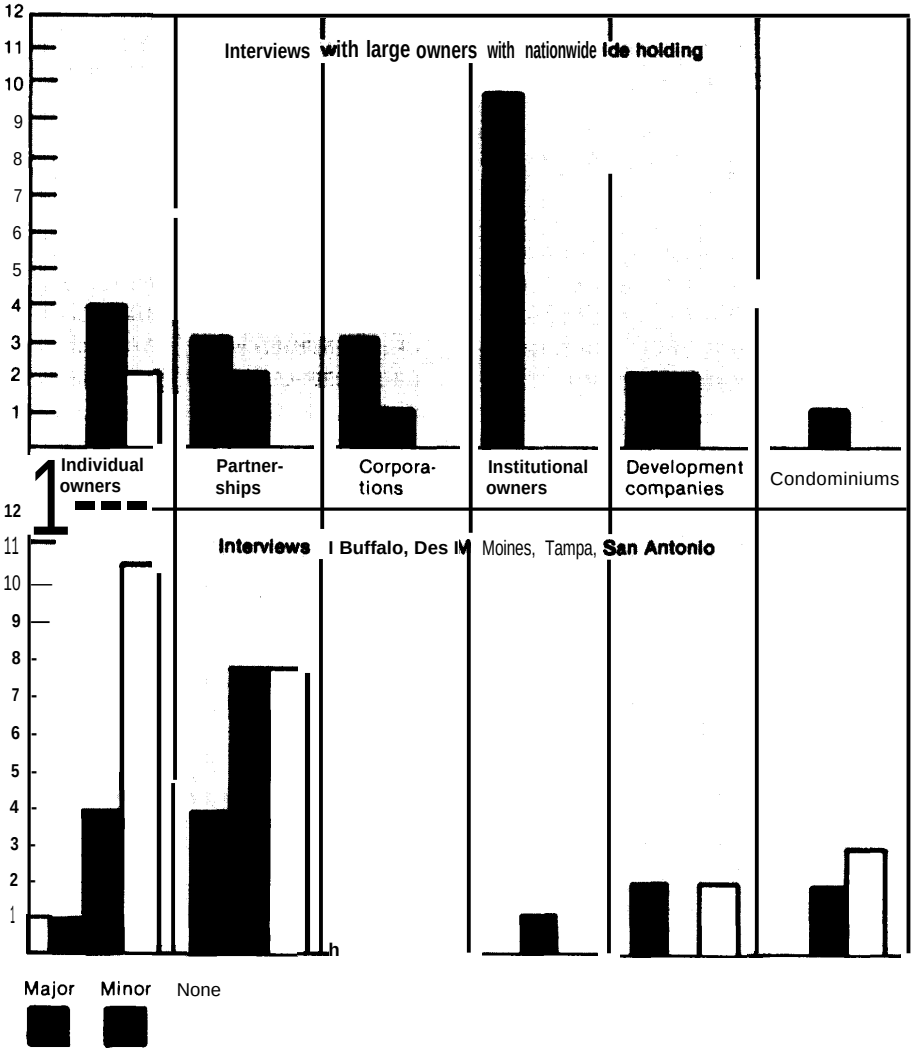
[9]Energy Information Administration, *Non-Residential Buildings Energy Consumption Survey,* 1981, table 23 B. It is harder to be precise about larger buildings because EIA asked if buildings were occupied by the owner or his agent. Since larger buildings may be occupied by a manager agent of the owner, they are not truly owner-occupied

IMPACT OF OWNERSHIP ON BUILDING RETROFIT

Among the types of owners interviewed, there were striking differences in the extent to which they had made major energy investments in some or all of their buildings, minor energy investments (including significant operational improvements), or, no energy investments or operational changes at all. The survey of building owners was not constructed to be a statistically valid sample of building owners and for this reason only tentative and suggestive conclusions can be drawn from the results; nonetheless the pattern of retrofits reported by the different types of building owners is consistent with what they said about their motivation and resources to carry out a retrofit.

The retrofit experience of the owners interviewed is shown in figure 35. The top level shows the "national" owners with holdings across the country; the bottom level shows the owners interviewed in the four case study cities. The differences among types of owners is striking. Out of 22 interviewed, only one individual owner, of any kind, had made a major energy investment, although **8** had made minor investments. On the other hand, 10 "national" insti-

Figure 35.— Frequency of Major and Minor Energy Retrofit Among Building Owners Interviewed



NOTE: Minor energ investments cost little enough that they could be handled as "expenses" and not "capital investments, "

SOURCE: Real Estat Research interviews for OTA

tutional owners interviewed had made major energy investments in their buildings. National partnership syndicates, national corporations, and development companies all had either made major or at least minor energy investments.

Significant numbers of the local individual owners and local partnerships had done nothing to their buildings in response to increasing energy prices. Of the four condominium associations interviewed, none had made major energy investments.

The results of the interviews cannot be compared with any statistically valid survey data because none has been conducted by owner type. The. interviews did make clear, however, the thinking that goes into a building owner's decision to retrofit or not retrofit and why it is likely to be different for different types of owners. The rest of this section explains how owners differ i n

the motivation to make energy investments in their buildings, and, equally important, in the financial and managerial resources they can call upon to make an investment.

The Differences Among Owners' Payback Criteria for Retrofits. In their interviews, different types of owners were explicit and quite consistent in their criteria for how fast an energy retrofit should "pay back" i n energy savings. Almost all owners used simple payback as the criterion, namely how many times would the first year's savings have to be multiplied to equal the cost of the retrofit. Only banks (who were generally not interviewed as building owners, but as financiers) reported using a discount rate, their borrowing cost from Federal funds. Although building owners expected increases in fuel and electricity cost over the payback term and took this into account in a general fashion, most of them cited payback terms so short that fuel escalation would not make a substantial difference.

The payback criteria used by owners, shown in table 34, varied from the fairly long paybacks of 5 to 7 years used by institutional owners to the very short payback requirement of 1 year or less used by individual investor-owners. The longer paybacks would permit more comprehensive retrofits to more buildings such as burner or boiler replacement, complex energy management systems, full window retrofits, and even replacement of less efficient window air conditioners with more efficient air conditioners (see ch. 3 for a full discussion). A payback requirement of a year or less, on the other hand, eliminates all but operational improvements and small investments such as flow restrictors, clock thermostats, or more efficient light bulbs.

The rest of table 34 helps explain why different types of owners had such varied" criteria. owners with longer payback criteria have longer expected holding periods for their buildings as well as much better access to financing and professional advice. The owners with shorter payback criteria expect to hold their buildings for shorter periods of time and also have problems getting adequate financial or professional advice.

Among owners, there is a major distinction among owner-occupants and investor-owners. For business *owner-occupants* (large corporations and smaller businesses) energy costs are one of the many expenses of doing business. Because these costs are rising so rapidly, they have become a major concern, but cost containment is only one of many possible uses of their available funds. owner-occupants hold real estate principally for their own use, though

Table 34.—Retrofit Payback Criteria, Holding Periods, and Access to Financing and Advice Among Different Types of Owners

Building owner type	Typical payback criteria	Building for own use?	Expected holding period	Access to capital	In house professional advice
Owner-occupants:					
Large corporations	**3-5 yrs.**	**Yes**	**Long**	**Good**	**Good**
Small businesses	**1 yr.**	**Yes**	**Long**	**Poor**	**Poor**
Multifamily owner occupants	1-3 yrs.	Yes	Long	Poor	Poor
Condominium	No data	Yes	Long	Mixed	Fair
Investor-owners:					
Institutional owners . . .	**5-7 yrs.**	**No**	Long	Good	Good
Development companies	1-3 yrs.	No	Short	Fair	Good
Partnership syndicates	3 yrs.	No	Short	Fair	Good
Local partnerships	1-2 yrs.	No	Short	Poor	Fair
Individuals	1 yr.	No	Mixed	Poor	Poor

NOTE *Long* holding period = more than 10 years, short holdlng period = 8-10 years.

SOURCE: Office of Technology Assessment.

tax benefits may be enjoyed and appreciation in real estate value hoped for. Residential owner-occupants who live in one unit of a small apartment building and condominium owners do not use their real estate to conduct a business but share with business owner-occupants the point of view that the primary purpose of the building is for their own use and real estate return is secondary. Investor-owners, on the other hand, are not interested in buildings for their usefulness as buildings but for the many forms of economic return they may obtain from holding them. The rest of this section describes the motivation for energy retrofit of each of the owner-occupants and investor-owners included in table 34.

Large Corporate Owner Occupants. Large corporations almost always occupy any buildings that they own. Corporations are inhibited from owning real estate for investment purposes by aspects of corporate tax status that reduce the return to corporations from real estate below what is available to individuals and partnerships (see box D). Thus, the chief economic benefit of corporate buildings is their efficiency as business facilities and, in some cases, the extent to which they enhance the corporate image.

Corporate owners of their own office facilities or downtown retail stores or hotels reported in interviews that they base energy improvement decisions on expected business return not on real estate return. If energy-efficiency results in lower business operating expenses, greater employee productivity, enhanced attractiveness to patrons or better business image, improvements are likely to be considered in competition with alternative corporate investments in marketing, expansion or inventory control. The dilemma of choices among business investments was well expressed by the president of a department store in Buffalo: "we make energy improvements to help control our operating costs, but there's a limit. Remember capital for energy improvements does not increase sales." At the same time, for owner-occupants, there is no way to escape the burden of energy costs which investor-owners can duck with passthrough leases. The president of a national motel chain in San Antonio said he expected to see energy

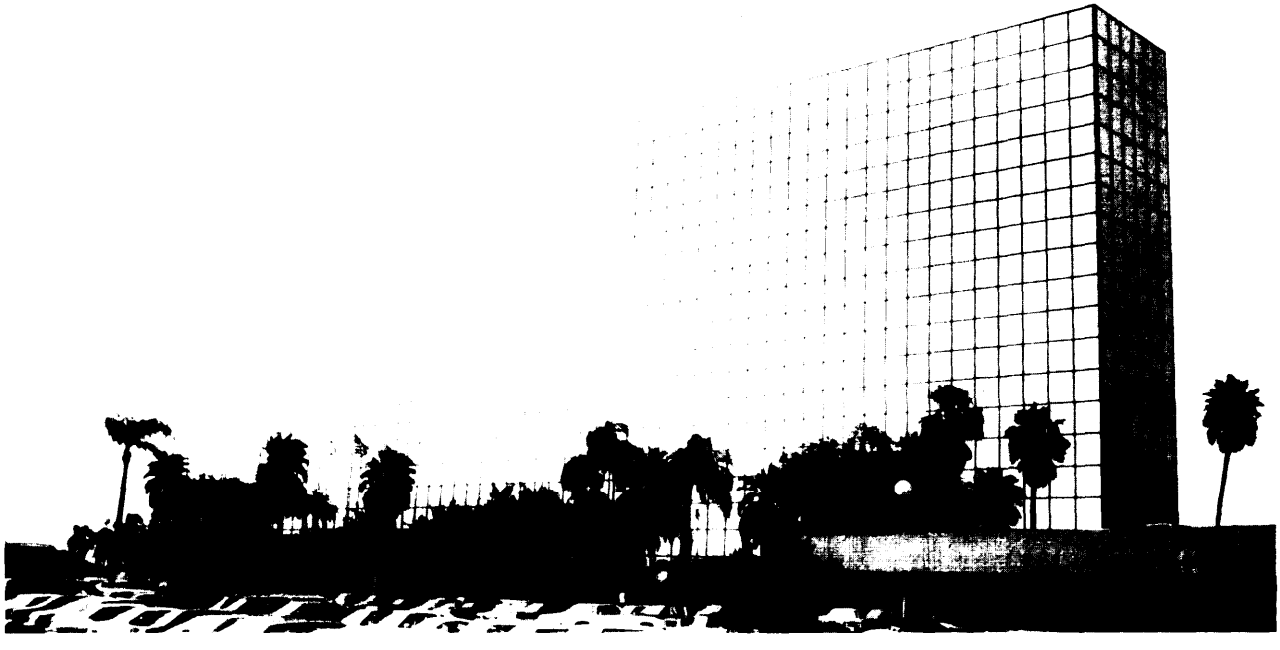


Photo credit: Steve Friedman

Energy efficient features of this building in Tampa, owned by a corporation, include double glazing, and controls on outside air mixing

costs exceed mortgage costs i n the near future, "1 increase my return by controlling my costs—now, not later. "

Large corporations have good access to capital for energy improvements. Most moderate to large-sized corporations have formal capital budgeting procedures and routinely make capital investments drawing on financing from a variety of sources: retained earnings, corporate debt issues, lines of credit, and commercial loans. Of the five local and three national corporate owners interviewed, who had made major retrofit investments, all had been financed with internal funds.

Large corporate owners also have good access to professional advice. They have professional facility managers as part of corporate headquarters staff. They often can afford to employ internal experts in energy conservation or can retain consultants. The basic corporate planning cycle encourages explicit consideration of energy investments.

The corporate owners interviewed all mentioned 3- to 5-year paybacks as the criteria they apply to energy investments. In contrast to many types of investor-owners this period is not related to their holding period for the building but rather to a corporatewide business standard of return for nonmanufacturing facility investments. Unlike smaller owners, corporations have both financial and professional resources to make energy investments based on these criteria.

Small Business Owner-Occupants. Small businesses may be individual proprietorships, partnerships, or small corporations. Like large corporations, they own the buildings to use in their businesses. Said a San Antonio shopping center owner of the typical small shoestore "they're in business to sell first and in times like this, it's tough to do everything you might like or should do. "

Information on the motivation of small businesses is scanty. A few interviews were conducted directly with small business owners, mostly individual proprietorships. Further insight was provided by several brokers of small business properties.

Compared to large corporate owners of their buildings, small businesses have much less access to internal funding for energy improvements and usually limited access to outside capital at reasonable rates. Such owners are particularly dependent on maintaining reasonable cash flow from their businesses. Energy investments with high initial costs and burdensome debt service due to high interest rates, short loan terms, or both (see discussion in the last section of this chapter) are serious obstacles to energy conservation investments.

Small business owners also lack the time and financial resources to obtain good professional advice about energy investments. Because of their dependence on adequate cash flow the risks of a mistake are also much greater than for the large corporation. For all these reasons, small business, especially individual proprietors, appear to limit energy investments to those that will pay back in 1 year or less.

Owner-Occupants of Multifamily Buildings. This category of owner is very similar to the small business owner, lacking time or professional advice to learn about energy improvements and lacking sufficient cash flow to fund energy investments from internally generated funds but with very limited access to outside financing at reasonable interest rates. However, because these owners also live in their building and pay some of its energy costs as part of their own household expenses, there is a slightly greater chance that they will consider retrofits with paybacks of up to 3 years. Of the very small number of multifamily buildings reported as retrofitted in the building owner survey, two were owner-occupied small buildings in Buffalo.

Condominium-Owners. Owners of condominium apartments are responsible for energy improvements to their own units, but the improvements to the buildingwide systems are the responsibility of the condominium association. Condominium association fees have been rising at rapid rates and condominium trade associations have recognized the importance of rising energy costs.

Nonetheless, for a systemwide energy improvement to be made, the condominium asso-

ciation, in a collective process, must agree on the improvement's value and pay for it from replacement reserves, debt finance, or a proportionate assessment to each owner. The four' condominium associations interviewed reported mixed experience with lenders. Collateral is a problem for some because the condominium association does not hold title to the building. For some associations their authority to levy special assessments on owners has been sufficient to obtain loans. None of the four associations interviewed had made a major retrofit investment but two had made minor investments. In general, condominium owners appear motivated to consider energy retrofits but are handicapped by the awkwardness of their form of ownership from making commitments to longer payback investments.

Investor-Owners: General. Investor-owners own buildings only for the economic return they bring as real estate. Investor-owners neither live in their buildings nor do they use them primarily to house their businesses, although for convenience they are likely to have their own offices in one of the buildings they own. For an investor-owner an investment in the energy efficiency of the building must contribute to one or more of the three forms of economic return in real estate:

- Cash flow. Energy retrofits may decrease expenses in buildings where the owner pays all or part of the energy expenses. For buildings with net or passthrough leases, energy retrofits only increase cash flow if they allow higher rents to be charged or reduce vacancies.
- Tax *benefits.* Many energy retrofits can be depreciated and used to shelter taxable income. Interest on loans to pay for energy retrofits can also be deducted from taxable income. Tax credits from Federal or State governments may also be available to owners for specific energy investments.
- Resale value. An energy retrofit that increases a building's net income will have a direct effect on its resale value as the net income is capitalized by appraisers at some rate typical for that type of building and location (see Box E.–As the Appraiser Sees It). Appraisers usually use 3 years average net income to make this determination. A recent energy retrofit without 3 years' impact on net income may not have much impact on resale value.

The main types of investor-owners—institutional, development company, partnership, and individual—emphasize different elements of the return on real estate and thus have distinctly different motivation for energy retrofit to their buildings. The building owner types also differ in the financial and professional resources they can bring to bear on energy investments.

Institutional Owners. Insurance companies and pension funds are the major form of institutional owners. Typically they hold buildings for holding periods of 12 years or more, emphasizing the healthy cash flow in the buildings over the long term. For this reason, energy retrofit which promises to increase cash flow over the long run is viewed as sensible. Such owners have the longest payback criteria of all owners, 5 to 7 years.

Insurance companies and pension funds have extensive financial capacity to fund building improvements internally. They also support a professional management and property investment staff to recommend and carry out investment and management practices to increase income from a property and improve its long-term value. Property managers (see Box F: The Role of the Property Manager) and in-house property planning staff for institutional owners have clearly defined job performance objectives, incentives, and capital budgets. Cost consciousness is rewarded. operational improvements to save energy have been a property management task since 1975 and annual energy audits and building energy system inventories a regular routine, All 10 national institutional owners interviewed had made major capital investments in their buildings including full replacement of boilers and air conditioning systems and installation of sophisticated computerized energy timing and control systems.

Development Companies. The four national and four local development companies interviewed varied in their expected holding periods

Box E.-A Question of Value: How the Appraiser Sees it

Do energy improvements enhance a property's value? To appraisers, the answer is not at all clear. But what is clear is the importance of their response to this question in a go/no-go retrofit investment decision. The appraiser's consideration of the impact of energy improvements on value can be crucial to some lending decisions if loan-to-value ratios are close to accepted limits and can also be important to the return assessment of owners if the improvement is capitalized into the value of the building.

Professional appraisers should, in theory, consider the improvement to value that results from a reduction in energy costs. In income properties, this would occur through the capitalization of the resulting higher net income. The appraiser normally does this by examining 3 years' operating results on the building understudy and operating results of comparable buildings to arrive at stabilized income and expense data. Comparability of energy equipment among other things should be considered in selecting buildings for comparison.

At present, several factors make it difficult for appraisers to conform to this procedure. Few buildings exist with 3 years of results of energy improvements, either to use as comparable, or to appraise. Hence, there is little experience to use in judging indirect or direct impact on market value. As yet, no other standardized methods for incorporating energy concerns have been developed. The appraisal division of a commercial bank in San Antonio instituted lifecycle costing as a nonstandard way to approach the issue and to serve as a proxy for acceptable comparable.

In the face of limited information, many appraisers have responded to rapidly increasing energy costs by, in effect, incorporating the increased risk in their valuation judgments. This has occurred by raising capitalization (which lowers the effective multiplier applied to income to arrive at value). The higher rate reflects many factors, but the recent rates of inflation in interest rates, operating costs and energy prices are considered to be among the major factors that result in higher risks.

Efforts have been made by appraiser professional associations to improve their members' skills in evaluating energy conservation in real estate. In addition, many appraisers are active in local building owner and manager associations, which have become very concerned about energy.

Box F.-Role of the Property Manager

Professional property managers play an important role in building operations for many owners, particularly institutions and partnerships. Property managers have the discretion to identify and make operational energy improvements, but only limited authority to make capital improvements. For example, at one large office building in a case study city, the manager's authority was limited to improvements costing $5,000 or less.

Managers can, and often do, identify both operations and capital possibilities for reducing energy costs. In some cases, such as hotels, the compensation formula is based on net income, which actively encourages managers to seek ways to cut costs. The presence of professional managers has led to widespread adoption of operational improvements in larger office buildings and to more active consideration of energy measures elsewhere. This is true regardless of who owns the property. In addition, professional managers interviewed were by far the most knowledgeable about energy costs and technical options. They felt that there was a steep dropoff in awareness and knowledge among the less professional managers and owners who were not themselves active full-time managers. There appears to be less knowledge and less conservation where there are no professional and/or full-time managers.

for buildings but on the whole their holding periods were shorter than those of institutional owners and their payback criteria for energy retrofits were correspondingly shorter (1 to 3 years). Short payback criteria can be explained partly by the greater difficulty of development companies in financing retrofits. Their investments have been traditionally highly leveraged with a very high ratio of debt to equity (although they are now moving more toward equity financing). This leaves very little flexibility to add further debt. Development companies have also tended to specialize in owning shopping centers with fully indexed net leases, so that the incentive to retrofit is somewhat less than that of owners of other commercial buildings (see discussion of commercial buildings below). of the eight owners interviewed, four had made major retrofits, two had made minor retrofits and two had done nothing.

partnership: General. The popularity of the partnership, now the most common form of real estate ownership, is in part due to the tax status of this form of ownership and in part due to the small capital requirements for entry. The partnership is itself not a taxable entity but a tax conduit which passes on the tax advantages of real estate ownership fully and directly to the partner/investor. While partnerships are interested in the cash flow and resale impact of an energy retrofit, they are very concerned about leaving intact or enhancing the tax benefits of a property. Since partnerships are formed only for purposes of owning a particular piece of property, it is often difficult for the partners to agree on further capital investment once the particular deal has been struck. The tax benefits to a partnership diminish after 7 to 10 years as interest and depreciation deductions diminish and at this point, the property is frequently sold.

National partnership Syndicates. These are the most sophisticated of the partnerships and bear some resemblance to the institutional owners. All syndicates have a general partner, responsible for managing the property held by the syndicate, and many limited partners who buy into the syndicate either privately or by purchasing publicly placed security investments.

National syndicates maintain professional management staffs in-house and onsite. As part of the syndication, reserves are set aside for building expenses sufficient to fund most improvements including moderate energy retrofits without returning to the investors for extra equity capital. For these partnerships, energy or other building improvements are an aggressive way to increase building value and create more return for investors than passive management would create. As the head of a national syndicate's property management department explained: "Any new value we create is a selling point to our customers (investors), old or new. The sophisticated investors we deal with want quality in their product not just shelter."

Of the five national partnership syndicates interviewed, three had made major energy investments in their buildings and the other two had made minor investments. The national syndicates agreed on a 3-year payback as a suitable criteria for retrofit.

Local partnerships. Local partnerships may be formed with a general partner and limited partners or with conventional (equal) partners. They almost always have far more limited financial and managerial resources than the national partnership syndicates. Reserves set aside at the time of creation of these partnerships are generally insufficient to cover major building improvements such as energy. It is usually very difficult to raise further equity capital from the original partner investors. Said a San Antonio general partner: "Thirteen can put the new money up but two others (partners) don't have the cash on hand; so I can't do it; we are simply talking group dynamics."

Of the 20 local partnerships interviewed, only four had made major energy investments, eight had done nothing. One or two years was the standard payback criteria for retrofits, corresponding to the short (7 to 10 year) holding period typical of partnerships. If they are done at all, energy retrofits are done early in the property's holding period. As the San Antonio general partner explained, "After the sixth year, I'm looking at another building purchase and syndicate setup, not the one I'm about to get out of. "

Individual Investor-Owners. Most individual investor-owners, like individual owner-occupants, are owners of small amounts of property and this constrains their ability to make energy investments in their buildings. Because most individual owners lack financial depth, maintaining a building's cash flow is usually far more important than sacrificing current cash flow for the sake of future resale value. Many individual owners also lack sophisticated property investment advice that would help them evaluate the resale potential of their property. A large Buffalo broker of small property observed:

> Resale value is important but requires some sophistication to be appreciated. Your **Mom** and Pop single investor or owner who thinks his single unit or two is going to support his retirement or give him financial security is not going to think in terms of future value, It's hard to get them to think of real estate as an investment . . . the way an investor where real estate is his living would; it is a thing to be kept and kept up, not improved for investment reasons,

With today's high cost and inaccessibility of debt finance, the cash flow of an individual's property is threatened by substantial energy investments. Most of those individual owners interviewed set 1 year as their maximum energy retrofit criteria. This extremely short payback reflected their uncertainty about the risks of an energy investment and their fears of a mistake as much as insistence on a high rate of return. A few individuals personally concerned about energy efficiency accepted higher. paybacks than this; one as long as 10 years.

Conclusion. In today's climate of high cost of finance and continued uncertainty about the risks and benefits of energy retrofit, building owner types—institutional owners, corporations, national partnership syndicates, and development companies—with good access to in-

Photo credit Steve Friedman

The individual who owns this office building in a Northern city has made low capital cost investments in calking and boiler efficiency. The owner is currently unable to finance a new boiler

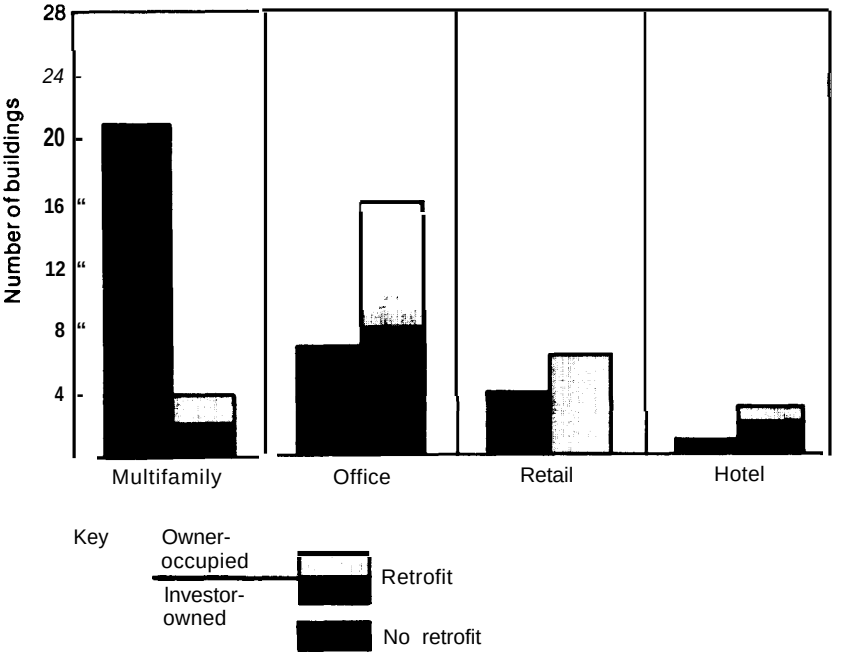
ternal capital funds and professional information are far more likely to retrofit their buildings than owners—individual and local partnerships —who are constrained by their building's cash flow from taking on the high debt service cost of outside finance and who have poor access to professional advice about retrofit. Despite these handicaps there is somewhat more chance that smaller owners will retrofit their buildings if they occupy them than if they hold them as investor-owners.

IMPACT OF BUILDING TYPES ON THE LIKELIHOOD OF RETROFIT

It is not only the owner type that affects the likelihood that a building will be retrofit, it is also the building type—office, retail, hotel, or multifamily. Each building type has its own characteristic market response to energy costs, leasing structure and balance between income and expense and these all affect the likelihood that a particular type of owner will retrofit that building rather than another type of building.

Of all the types of buildings covered in the building owner survey, office buildings were by far the most frequently retrofitted, followed by retail buildings and hotels (see fig. 36). Multifamily buildings were retrofitted much less frequently than the other types. Out of 29 multifamily buildings covered in the interviews, only four had been retrofitted at all, only one of these with a major retrofit. This imbalance between retrofits of office buildings, multifamily buildings and other buildings is also echoed in a recent survey of buildings with documented retrofits and energy savings by Howard Ross and Sue Whalen. Out of 220 buildings with documented

Figure 36.— Frequency of Retrofits Among Building Types Covered in Building Owner Interviews[a]



[a]Interviews in Buffalo, Des Moines, San Antonio, and Tampa.

SOURCE: Office of Technology Assessment.

retrofits, 38 were office buildings, four were hotels, while there was only one shopping center and one multifamily building.[10]

part of the explanation is that multifamily buildings tend to be owned by the types of owners—individuals and local partnerships—who require very short paybacks to make any retrofit at all and who frequently do nothing to their buildings in response to rising energy costs. However, the problem of retrofits to multifamily buildings goes beyond ownership. The sections that follow discuss the particular market characteristics of multifamily and commercial buildings that affect their prospects for retrofit.

[10]Howard Ross and Sue Whalen, ''Building Energy Use Compilation and Analysis: Part C: Conservation Progress in Commercial Buildings" (unpublished), May 1981, revised August 1981. To be published in Energy and Buildings magazine, Lausanne, Switzerland.

LIKELIHOOD OF RETROFIT IN MULTIFAMILY BUILDINGS

The problems of the owner types who own the bulk of multifamily buildings explain much of their very low rate of retrofit. Individual owners lack access to capital and are constrained by their dependence on the buildings cash flow from taking on high debt service to pay for retrofit. Local partnerships may put capital into retrofit at the time of purchase, but it becomes increasingly difficult to obtain funds from the partners after that. Both categories of owners lack information on retrofit opportunities and risk and both have much to lose from a mistake. Multifamily buildings owned by better financed and informed owner types such as insurance companies, pension funds, and national partnership syndicates are somewhat more likely to be retrofit than those owned by individual owners and local partnerships.

The type of owner, however, does not explain all of the low rate of multifamily retrofit. Owners' problems are exacerbated by overall problems in the market for multifamily buildings.

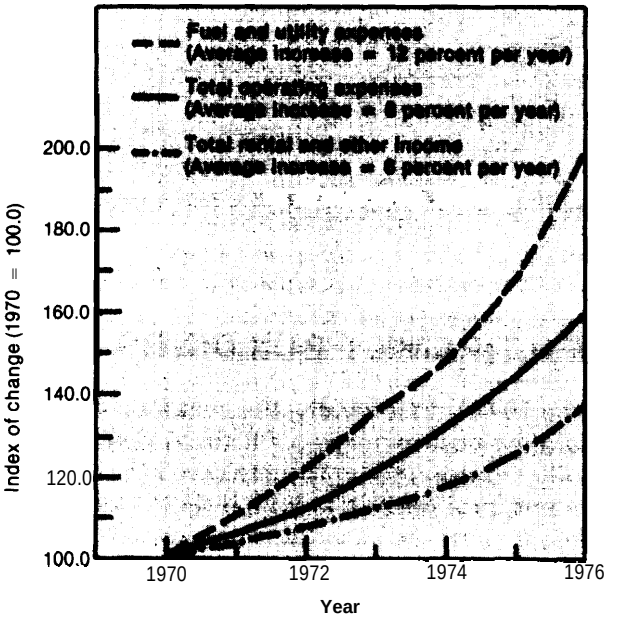
Squeeze on Cash Flow. More than owners of other building types, multifamily building owners have been caught in an income squeeze both because of rising costs and their inability to raise rents. The latter is attributable to several factors, including rent control, consumer resistance, and management efforts to minimize turnover in tenancy. Using operating indexes from actual special samples of properties in one area, a Rand Corp. study of multifamily units underlines the expense-revenue gap that emerged in the 1970's. "Generally, the evidence suggests operating cost increases of 8 to 10 percent annually, compounding to between 115 and 160 percent for a decade in which rents rose by 74 percent and vacancy rates (which also affect revenue) changed only slightly.'" This trend leads to diminished rates of growth in net operating income, and results both in relatively less money available for debt service and in lower market values. In the face of recent increases in mortgage interest rates, this creates a cash squeeze for any new owner or a relative diminution of value for a potential seller.

Energy cost increases have been a major contributor to this cash squeeze. As figure 37 shows, increases in fuel and utility costs alone outpaced average rental adjustments by more than **2 to 1 (98 to 39 percent) between 1970 and 1976.** The trend continued from 1976 to 1979, according to data from the Institute of Real Estate Management (I REM). Heating costs per square foot increased over 3 years anywhere from 62 percent for elevator apartments to 120 percent for low-rise small buildings (see table 35).

Average rental adjustments for multifamily buildings have not kept pace with increases in energy costs for reasons that elude the experts although many explanations have been given. One is that traditional renters such as newly-

[11]Ira S. Lowry, draft report, "Rental Housing in the 1970'5: Searching for the Crisis," the Rand Corp., November 1980; presented at HUD Conference in Rental Housing, Nov. 14, 1980. See also David Scott Lindsay and Ira S. Lowry, *Rent Inflation in St. Joseph County,* Indiana, 1974-78, the Rand Corp., 1981.

Figure 37.—Apartment Operating Revenues and Expenses 1970-76



NOTE: Data from 189 properties.

SOURCE: Touche Ross & Co. using data from Booz, Allen & Hamilton (May 1979). *Achieving Energy Conservation In Existing Apartment Buildings: Appendix D.*

Table 35.—Annual Heating Fuel Costs in Apartment Buildings

Apartment building type	Heating cost (dollars/ft² of rentable area) 1976	1979	Percent change
Elevator	$0.21	$0.34	62%
Low-rise (24 units +)	0.14	0.23	64
Low-rise (12 units)	0.15	0.33	120
Garden	0.13	0.23	77

NOTE: Only buildings reported for 4 consecutive years,

SOURCE. *Income Expense Analysis. Apartments 1980* Edition, Institute of Real Estate Management.

weds, single households, and empty-nestors, in response to rapid appreciation in property values and the tax-deductible status of mortgage interest, have been shifting to single-family or condominium ownership for investment as well as housing, and are leaving the rental market to a larger proportion of lower income people, who are less able to adjust to increases in rent. There is also some evidence, however, that lower income renters have increased the quality of their housing over the decade without increasing their average rent. Finally, some of the lag in rents can be explained by a preference of some multifamily building owners to reduce vacancy ratios and retain long-term tenants by holding back rent increases. Some observers practicing strict market economics believe that the overall explanation for the possibility of a lag in rents relative to expenses may be that there is an oversupply of multifamily houses.[12] Careful studies have shown that this indeed may be a cause of abandonment of multifamily houses in certain areas (see discussion in ch. 5).

The potential for rent adjustment to cover utility costs varies greatly from strong rental housing markets to weaker ones. Among the case study cities, owners in Buffalo and Des Moines perceived the rental market to be weaker and the potential poor for raising rents sufficiently. Several owners expressed a strong sense of crisis in the interviews, foreseeing grim futures as real estate apartment owners unless they "got out soon" at a decent sales price or by converting to condominiums even when they acknowledged that the market for condominiums was poor in their cities. Apartment owners in the stronger markets of Tampa and San Antonio were more optimistic. Even in these markets, however, institutional owners and national syndicates expressed an intention to reduce the amount of investment in multifamily property.

Most important of all, an apartment owner's ability to avoid the squeeze on cash flow described above depends directly on whether the owner pays for heat and electricity or whether tenants do.

Prospects for Retrofit When Tenants Pay Utilities. Almost one-half of the multifamily apartment units in the country are fully tenant-metered (see table 36). If structurally feasible, multifamily owners have converted to tenant metering as the first and often final response to

[12] This debate is set forth in several papers prepared for the November 1980 HUD Conference on Rental Housing, Anthony Downs, "The Future of Rental Housing—Overview;" Ira Lowry, "Rental Housing in the 1970's: Searching for the Crisis."

Table 36.—National Distribution of Metering Types of Rental Units[a]

Type of rental unit	Percent of total
Master (full)	19 "/0
Tenant (full)	46
Mixed (tenant pays *electric* but not heat or hot water)	29
Miscellany [b]	6
Total	100 "/0

[a]Two or more units
[b]Systems too mixed to Categorize

SOURCE *National Interim Energy Consumption Survey* 1978.79, Department of Energy, Off Ice of Consumption Data.

escalating energy costs, even though conversion costs were clearly capital investments (costing from $125 to $1,600 per apartment unit with a median of about $1 ,600). ' [3] Yet payback is very rapid, depending on how the base rent is adjusted: paybacks of 1 year or less are not unusual, although the average simple payback is 1 to 2½ years. There are several benefits of tenant-metering, in addition to sheltering the landlord from the full impact of energy increases:

- Many buyers, particularly national syndicates and institutional investors, are unwilling to consider purchase of multifamily property unless tenants pay the full cost of utilities. Conversion to tenant metering, therefore, creates resale value in itself.
- Banks are more willing to refinance or lend to tenant-metered building owners.
- professional journals, particularly the widely read Journal of *Property Management,* have taken an advocacy stance toward tenant metering with clearcut articles describing investment return mechanics and owner benefits, including resale value, from tenant metering. There is practical advice on such topics as tenant counseling techniques during remetering.
- Many States, particularly in the South and Southwest, have made tenant electrical metering in new buildings and sometimes existing ones a mandate of State conservation policy law.[14] Five out of seven apartment owners interviewed in San Antonio had tenant-metered buildings partly because it is required by law.

Owners interviewed in both the case study and national interviews described little negative market impact as a result of conversion. Tenants have not reacted against tenant-metered buildings during sellout or in existing buildings during remetering. To the contrary, some owners noted that tenant metering successfully transferred to the utility companies the "bad guy" image that owners formerly bore for energy increases in gross rent.

In the opinion of most landlords interviewed for the study, tenant metering has created greater and more reliable savings in energy consumption than any other improvement they could have made because tenants make behavioral adaptations as a result. Savings from tenant metering have also been documented. A best estimate is 5 percent for heating and as much as 20 percent for other energy.[15] At the same time, tenant metering may result in higher per unit energy costs for tenants i n utility areas where large users pay significantly lower rates than small individual users. (See ch. 5 for more discussion of this point.)

For all its advantages in inducing energy conservation behavior by tenants, tenant metering provides virtually no incentive for apartment owners to invest in greater efficiency of their buildings. There is no incentive to improve insulation levels, add storm windows, or improve heating system efficiencies (usually of decentralized systems since central heating and cooling systems cannot be tenant metered except with great difficulty and expense). None of the owners of tenant metered buildings had made energy investments except to make operating

[13]Jeffrey M. Sei sler, "Escaping the Energy Bite: Converting Master Meters," *Journal of Property* Management, May/June 1980.

[14]*Metering:* States b,nning all master metering include California, Florida, Maryland, Michigan, North Carolina, Oklahoma, Rhode Island. States banning master metering for electricity include Louisiana, Massachusetts, Minnesota, New Jersey, New York, Oregon, and Texas. Source: Steven Ferrey & **Associates,** *Fostering Equity in* Urban Conservation. *Utility Metering and Utility Financing,* to be published as a working paper to this report.

[15]Lou Mc Lelland, op. cit.

improvements in the heating and cooling and lighting of the building's common areas.

In theory, energy conservation investments can enhance the value of the property by permitting the owner to charge a higher rent, allowing for the lower utility cost to the tenant. In theory, if everyone else in the market also made energy efficiency investments, or there were substantial new energy-efficient competition from new buildings, an owner would be forced to improve in order to compete. Also in theory, if no one else improves, the owner could improve his competitive position if he could market the necessarily incremental rent adjustment.

To obtain the higher rent, however, requires both a sound market and marketing skill. The tenant must be convinced that the total occupancy cost will still be comparable to the lower rent competition. Given the fragmented nature of multifamily ownership, levels of professionalism, traditional tenant-landlord relationships and tendency to hold rents down to reduce turnover, it is unlikely that this logic will be readily adopted by the typical multifamily building owner. Some sophisticated national syndicates and management organizations interviewed for the study, however, are making the link between conservation and value. It is conceivable that over the long run, the adoption of such a strategy by a few large operators in each market or the advocacy of such an economic rationale by one of the trade information sources might stimulate such a perspective.

Prospects for Retrofit If the Owner Pays the Utilities. Although multifamily owners are converting to tenant metering whenever possible as a reaction to the rising cost of energy, it is not possible to convert all types of heating systems, (especially central air systems, central steam and hot water systems,) to tenant metering except at great expense. As the above table **36** showed, more than one-half of all rental units are fully master metered or master metered for heat and hot water and tenant metered for electricity.

Multifamily owners whose buildings have not been or cannot be fully tenant metered are aware of and concerned about rising energy costs. They have a strong incentive to contain costs that are rising faster than other expenses and threatening to become uncontrollable, However, they are limited to actions which can be paid for within the confines of their own cash flows since financing is either too costly and/or unavailable. An individual owner of over 200 apartment units in Buffalo commented: "I would normally want to spend $5,000 to save $2,000 a year, but not when I can't afford to service the $5,000. " A large apartment owner and broker in the Southwest bluntly summarized a basic constraint for city apartment owners in today's economic environment: "Apartment managers must conserve capital in the

Photo credit: Steve Friedman

Retrofits to this HUD-subsidized apartment building for the elderly in Tampa included improved chiller efficiency and a shift from incandescent to fluorescent lights

early years. They are not going to want to touch the cash flow. " Only if the building owner has access to government property rehabilitation funds (see ch. 9) is he likely to be able to service the debt within the building's cash flow.

For most multifamily building owners, the only benefit of energy retrofit is cost savings. There is no discernible marketing advantage; the level of tenant demand for rental units that are energy efficient (and which might therefore have more controlled future rent increases) is low. The tenants's rental decision is first linked to location and the size and appearance of the apartment, regardless of energy features.

Energy retrofit for resale value is also not an important motivation for the large share of multifamily building owners who are individual owners, especially those with small amounts of property. Such owners do not generally have the planning time, staff or perspective to make an energy investment for return "down the road." The concept of future return through enhanced resale value as a result of energy improvement seems nebulous. In multifamily markets with many weak spots, such as Buffalo and Des Moines, a building's future, even if viable now, might be uncertain.

To sum up, although an owner of a master-metered multifamily building has strong motivation to curb the increase in his expenses by controlling energy costs, the constrained cash flow of many multifamily buildings (coupled with uncertainty about retrofit results) makes it extremely hard to expect to pay for a retrofit out of retained earnings or to service a loan to pay for it. The uncertain long-term viability of multifamily buildings constrains an owner's motivation to invest in the energy efficiency of multifamily buildings for its resale value.

LIKELIHOOD OF RETROFIT IN COMMERCIAL BUILDINGS

Commercial buildings have been retrofit far more frequently than multifamily buildings, according to the partial data available. To some extent this is explained by the better financed, better informed owner types which own commercial buildings. Many commercial buildings —office, retail and hotel—are occupied by their owners which are large corporations, able to plan and carry out a retrofit.

Within the category of commercial buildings, however, there are significant differences among office buildings, shopping centers, department stores, and hotels in the sensitivity of owners and tenants to rising energy costs, the rewards for retrofit and the resources for making energy investments. The sections which follow describe these differences.

Office Buildings. Office buildings appear to have been retrofit in greater numbers than other building types. Out of 27 interviews with office building owners in the case study cities, 20 had retrofit their buildings. Retrofits by and large were carried out by corporations who owned their own buildings and by institutional and national partnership syndicate owners. Retrofits mentioned included installation of task lighting, heat pumps, new boilers and timing and control systems. Two of the retrofits of corporate headquarters buildings were carried out as part of overall modernization programs. In both modernization cases, in Des Moines and Buffalo, the directors of facility planning reported that such energy improvements might have been made anyway, but "only very gradually. "

For other kinds of owners, limits on energy investments in office buildings are typically set within the constraints of the building's cash flow because the extremely high cost of outside financing eliminates the possibility of borrowing to pay for a retrofit. Fortunately office buildings offer many opportunities for low-cost/no-cost retrofits (see Chapter 3: The potential for *Building Retrofit).* Many building owners interviewed had made low-cost investments such as: installing timer devices to turn systems and lights off from 6 p.m. to 7 a.m. when the build-

Photo credit: OTA Staff

Retrofits to this office tower owned by a bank in Tampa included elimination of mixed cooling and reheat, reflective film, computerized temperature controls, and high-efficiency fluorescent lights

ing is not in use; reducing lighting levels and installing more efficient bulbs and making many different adjustments and improvements to the building's heating ventilating and air-conditioning systems.

Mentioning the need to stay within the building's cash flow, several building owners said that any capital investment in energy retrofit less than 25 cents per square foot would be considered feasible. A 25- to 50-cent-per-square-foot improvement cost would bring more scrutiny. Fifty cents per square foot was the basic cost cutoff point for the office owners interviewed. Alternatively, another cutoff measure was the building's total energy bill. An office owner in Des Moines observed: "The building costs $40,000 a year in total energy bills. No matter what I think about the future, I have a hard time laying out a capital investment costing more than my bill, which is what a window retrofit would do to me." The office owners interviewed for this study acknowledge they are basically on the "last round" of the low-cost/no-cost improvements for controlling energy cost and would have to make capital improvements next.

passthrough Lease Disincentive. For investor-owners of office buildings, by far the greatest disincentive to retrofit is the prevalence of the passthrough lease in existing class A and most class B offices. passthrough lease terms vary. Escalators include direct operating costs, average of costs in other buildings, operating cost increases above the base year, and CP1-indexed leases. In class B offices, some gross leases still exist, but owners are gradually rolling them over to passthrough leases that include an energy escalation clause. Lease terms for small tenants are also getting shorter, down from an average of 7 to 10 years in older office buildings to an average of 3 to 5 years.

passthrough leases allow the owner to recover utility and other expenses but are usually written to prohibit passthrough of debt service to cover the capital expense of an energy retrofit investment. With passthrough leases the chief incentive for energy retrofit by an investor-owner is to curb the costs of energy for the common spaces that can average **40 percent of the total** energy bill for a high-rise office building.

There are signs, however, that new kinds of passthrough leases are being developed to permit energy efficiency investments. Large owners such as insurance companies are starting to institute a new uniform passthrough in their leases, This provision would allow the owner to pass through to the tenant the capital costs of energy improvements that benefit only the tenant until the investment is paid back by energy cost savings. At that time, any future savings benefits would accrue directly to the tenant. Owners pioneering this type of lease feel that although tenants need to be convinced of the

merits, such a lease adjustment would give the owner an incentive that does not now exist, while offering tenants a saving that a standard passthrough lease never would. None of the institutional owners interviewed had as yet introduced this type of lease into their buildings.

Energy Retrofit to Improve Marketing. In current markets for office buildings, tenants rarely seem concerned about total occupancy costs including energy passthroughs although a few office owners in Buffalo mentioned a growing tendency for lease competition to be based on quoting comprehensive rent including utilities. More typical is the situation cited by an executive for a national housing firm. "Tenants don't seem to care in general; they still look, as they have traditionally, to the quoted rent, not the escalators. "

All office owners acknowledged that tenant concern about the energy costs in passthrough leases might become a market factor in the future especially in a stagnant economy where office users would tend to be more zealous about every cost-cutting opportunity (despite the relatively small cost energy represents to a typical office user). Even owners with short holding periods would probably invest in energy efficiency if the market called for it. Owners interviewed cited four market conditions which might spur such a change.

- For tenants "shopping" with expectations of rising costs, lower cost will improve an owner's marketing position. Managers are aware of this.
- Significantly improved energy efficiency of new buildings can reduce the effective rent spread between new and energy efficient existing buildings, especially in a soft market. Managers of older buildings may have to look for ways to protect their competitive position, especially vis a vis some new hotels and office buildings that are benefiting from subsidized financing or other government programs such as industrial revenue bonds, tax abatement and urban development action grants.
- New office construction i n many downtowns has been substantial, creating strong competitive pressures on existing offices. As yet, there has been little overbuilding, but with the economy weak, in some cities offices may become temporarily overbuilt. If this occurs, it will put a downward pressure on rents and hence provide greater incentive to control costs (and therefore total rents) to keep or attract tenants.
- Office owners and managers generally understand that the long-term value of the property can be enhanced or at least preserved by controlling energy costs.

In summary, operational improvements and low-cost investments are the main response to rising energy costs in office properties. While large corporate owner-occupants (and to some degree, banks) may make capital improvements, other office owners are less motivated and prefer to pass energy costs on to the tenant. For those with the interest, poor access to financing and good technical information continues to be a substantial barrier.

Retail Owners and Energy Investments. Except for some owner-occupied department stores and small stores, most retail buildings are owned by investor-owners. Shopping centers within cities are commonly owned by real estate development corporations that may or may not be subsidiaries of major retail corporations, by institutional owners and by large partnerships, including national syndicates. Urban retail strips or freestanding small retail stores are generally owned by individuals or small local partnerships. Downtown department stores are owned by their corporate owner-occupants, as are generally the department store anchors of shopping centers. Type of retail ownership is a factor in decisions to retrofit, but the most critical variable for retail owners is lease standards.

Except for owner-occupants of freestanding department stores, owners of retail buildings today generally charge their tenants rent on a net lease basis with a duration, except for those of anchor stores, often averaging 3 to 5 years. In older shopping centers or retail strips in cities, gross lease standards and longer term contracts of the past still exist but for retail owners the net lease has become standard at lease-up or re-

newal. In fact, one of the ways a buyer can add value to an older shopping center purchase is to convert gross leases outstanding to net leases. The net lease has made a shopping center one of the most valuable and coveted real estate investments because of the long-term security it provides.

Net leases operate essentially like passthrough leases in offices; a wide range of total net costs are charged to tenants, but energy costs in a retail lease are generally borne by the tenant. The owner is responsible for whatever common area energy costs may exist, such as mall or arcade lighting and HVAC. The net lease, according to retail owners in case study and national interviews, is the single key investment disincentive for energy retrofit of these buildings by the owners. It is a bigger disincentive for retail owners than the passthrough lease is to office owners. In contrast to office tenants, retail tenants on whom the passthrough burden falls cannot "shop around" and exert market pressure on owners. Retail tenants have to go where the goods will sell, first and foremost.

None of the small number of investor-owners of retail buildings interviewed had made operational improvements in older city retail shopping centers and retail strips on net leases. Although new centers are being outfitted with energy efficiency components such as computerized energy management systems as a marketing lever, this type of retrofit for an older center or strip is very costly, and difficult to implement architecturally without disturbing the tenant. In these retail buildings, lighting reductions and savings in the common areas are the principal response to the energy conservation issue, with tenants making whatever improvements they see fit and find affordable for their own stores.

For retail owner occupants, such as downtown department chain stores, on the other hand, energy savings are direct business savings. Energy costs have been targeted by downtown department store chain owners as an area for cost-cutting. Sears recently reported at an energy conference that it had set up demonstration stores in which potential energy retrofit products could be pretested before national application. Its overall energy conservation program was estimated to save the nation's largest retailer $37 million annually. Another nationwide retailer with many urban outlets regularly directed stores to examine energy savings devices. It too has local tests of equipment before ordering widespread use.

Photo credit:. Steve Friedman

For owner-occupied department stores, energy savings are direct business savings

For owner occupants of downtown stores interviewed for the report, energy improvements have been funded in conjunction with the annual capital budget. Improvements are linked to payback and to demands on capital for other purposes. The 3-year payback period for one chain was the same as that traditionally used for labor saving devices. Improvements such as lighting level adjustments are limited to those consistent with the competition as well. For the most part, the level of investment per store appears to be in the 25 to 50 cents per square foot range or less ($25,000 or so). This level has not resulted in problems of competition for capital, but higher levels have not yet been tested.

Hotel Owners and Energy Investment. City hotel ownership has changed over the last decade as hotel chain corporations have frequently sold their buildings to private investors while maintaining a franchiser and sometimes a management role. The private owners typically are partnerships of various sizes. Recently, institutional owners have begun to increase hotel

holdings in their portfolios, partly because of the hotel industry's ability to adjust rates somewhat to counter rising costs brought about by inflation

Despite a shift to investor ownership, hotels are being retrofitted for improved energy efficiency. In hotel operations, energy costs are experienced directly by the operators and energy savings directly enhance net income margins. The standard contract for hotel managers includes a bonus incentive for net income performance. Hotel owners and managers find a definite economic incentive for energy investment in this type of city building and the result can be dramatic. "My costs per room this year are less than last year due to energy improvemerits, " a motel chain president emphasized.

Hotel operators analyze energy investment in the context of their primary business objective—renting rooms and other facilities—and the alternative investments owners make to improve rent revenues—such as promotional campaigns. Hotel owners will not consider an improvement that causes significant tenant discomfort.

The degree of energy improvement is usually dependent on the hotel's capacity to fund them from internal moneys. Outside financing is considered neither feasible nor traditional. Hotel owners and operators are often uncertain about what could be done technically to a hotel in order to save energy i n a cost-effective manner. This energy information problem is now being tackled by the hotel industry's main trade association, the American Hotel & Motel Association, which is using a Department of Energy (DOE) grant to study prototypical hotels and consumption patterns and to disseminate instructional and technical information resulting from the study to the industry.

The consensus of hotel owners concerning energy retrofit investments is nevertheless a clear one: energy savings and owner expense savings have a one-to-one relationship despite the theoretical prospect that rates could be adjusted daily to recover costs.

Photo credit: OTA staff

Retrofits to this hotel building in a Northern city included improved boiler efficiency, a shift from incandescent to fluorescent lights and radiator valves

To sum up, hotel buildings are likely to be retrofitted because energy costs directly affect profit margins and hotel operators are given incentives to reduce them. Office buildings are likely to be retrofit to a low level which can produce substantial savings given the usage patterns of the building. Retrofits beyond a low level will occur in owner-occupied office buildings and in tenant occupied buildings if market conditions change to make total occupancy costs important. Finally, retail shopping centers are unlikely to be retrofit beyond a low level of retrofit to the common areas. Owner-occupied large stores are likely to be retrofit within the limits of cash flow, competition and client comfort.

POTENTIAL FOR RETROFIT IN MARGINAL NEIGHBORHOODS

For owners of both commercial and multifamily buildings in low-income and risky neighborhoods, increases in energy costs create severe economic pressure. Although property taxes and debt service on such properties are low, rents are even lower and there is no cash flow margin to absorb the escalating energy costs. An owner faced with such a situation must choose among a series of bad alternatives: covering the escalating energy costs by undermaintaining the building in other ways, providing inadequate heat and utilities to the building, obtaining enough funds in some way to retrofit the building, or abandoning the building altogether.

There is considerable evidence that rapidly increasing energy costs are the last straw on top of a set of burdens that causes owners to "disinvest" in their buildings. Studies of disinvestment behavior among owners in the South Shore area of Chicago, Cleveland, and Newark explicitly show the importance of energy costs to owners in their ranking of "disinvestment variables" (see table 37). In both 1975 studies, energy costs were ranked as important immediate causes of disinvestment, while in the 1971 study of Newark (before the 1973 oil embargo) energy was not a factor. It is important to note that in the South Shore study, energy cost increases ranked equal to tenant and neighborhood problems. Under the pressure of severe winter demands for regular oil heat deliveries it is easy for a vicious cycle to begin in which the landlord cuts back on heat, or fails to heat the building altogether, the tenants leave the building or withhold their rent in response, and the landlord finds his income stream drying up. Such vicious cycles have been described by city officials in New York City, Jersey City, and Hartford. The issue of abandonment of housing is discussed further in *Chapter 5: Retrofit for the Housing Stock of the Urban Poor.*

Despite the severe economic pressure caused by energy costs, there are many reasons why owners of commercial and multifamily buildings in marginal neighborhoods are unlikely to retrofit their buildings, The most important of these is that owners are reluctant to "throw good money after bad" if the property has little cash flow, if tenants and market rents in the area will not support recovery of costs, and if neighborhood conditions do not promise at least stable property values. The problem is a little different in revitalizing neighborhoods where owners, expecting future improvement in property values, may defer minor improvements until they are ready to make a major investment or until they sell to another owner for rehabilitation.

It is unlikely that owners of buildings in declining neighborhoods will be able to raise rents to recover energy retrofit costs. Such owners also face much more severe financing problems apart from the economics of their buildings. Historically, lenders have tended to limit their role in such areas because of their

Table 37.—Landlords' Ranking of Reasons for Disinvestment

South Shore Chicago, 1975(1[a])	Cleveland, 1975(2[a])	Newark, 1971(2[a])
Energy cost increases	Tenants	Tax level
Tenants[a]	Neighborhood problems	Neighborhood problems
Neighborhood problems[a]		Tenants
Maintenance	Energy cost **increases**	Building inspection
Tax level	Building inspections	Mortgage costs
Insurance	Tax level	Insurance
Janitorial costs	Insurance	
Lack of housing programs and bank financing		

[a]Ranked equally.

SOURCES: 1") Management Firm Interviews, 10 sample properties from Robert Giloth, ***Disinvestment*** *in* ***South*** *Shore's Large Rental Properties,* June 1978.
2") Real Estate Research Corp. ***Real Estate*** *Review,* spring 1976, p. 65.

perception of high risks. Both strict qualifying terms and higher rates are often used to discourage borrowing. Insurance rates for housing or commercial structures in marginal areas have likewise been very high; coverage often is available only through high risk pools.

Typically owners of properties in such marginal areas may be unable to afford to service new debt and if they refinance, it is often to convert long-term equity into cash. Because they lack access to more conventional financing, such owners often have to buy and sell using extra-institutional personalized securities, such as contract-for-deed and seller/purchaser money mortgages. This makes investments in improvements all the more costly and risky.

In short, energy conservation retrofit in marginal areas is part of the broader issue of rehabilitation and reinvestment in marginal neighborhoods. Simply because energy costs are the "last straw" does not mean that energy-caused disinvestment is inevitable. If a particular owner would have otherwise retained the property, if the neighborhood is stable or revitalizing, or if significant public actions are under way to stabilize the area, it may be possible to facilitate investment in energy conservation.

POTENTIAL FOR INCREASING THE RATE OF RETROFIT BY BUILDING OWNERS

Some buildings are relatively easy to retrofit; some buildings can be retrofit only with considerable difficulty and expense. As has been clear from this chapter some owner types are willing to retrofit their buildings even at considerable expense; others are not motivated to install even low-cost energy conservation retrofits. The likely pace of retrofit for a particular building, whether rapid or slow, depends on both the building's physical characteristics and on the resources and motivation of its owner.

The significant differences among physical characteristics of buildings are summarized in table 38 based on the extensive analysis in chapter **3.** Buildings for which substantial energy savings are available for low capital cost (less than 2-year payback) include all types of small framehouses, moderate or large multifamily buildings with central air or water systems and commercial buildings except those with central water systems and window air-conditioners. On the other hand, retrofits of moderate capital cost compared to savings (2 to 7 years payback) are required for substantial savings in small masonry rowhouses, moderate or large multifamily buildings with decentralized heating and cooling systems and commercial buildings with central water systems and window air-conditioners.

Given these physical types of buildings and the owner types discussed in this chapter it is possible to classify buildings into those that are very likely to be retrofit, those that are moderately likely and those that are very unlikely. Sooner or later the market will take care of a building that can be retrofitted at low capital cost by an owner who is strongly motivated to retrofit. The prospects are dim indeed for a building that requires moderate capital cost investments for any substantial energy savings by an owner who is unwilling to retrofit.

Small Multifamily Buildings. Three owner types and two physical types can account for a large share of the small multifamily buildings in U.S. cities (see table 39). The most likely small multifamily building to be eventually retrofitted for improved energy efficiency is the owner-occupied frame building with a central air or water system. Such buildings are common in all New England cities, and many cities elsewhere in the United States. The long-term perspective of the owner and his need to pay his own energy costs, coupled with the relatively low cost and ease of insulating such buildings and improving the efficiency of their heating systems all make it likely that market incentives will eventually bring about a retrofit.

Table 38.—Thirteen Types of Buildings With Significantly Different Retrofit Options[a]

Building type and wall type	Mechanical system type	Retrofit options predominantly: Low capital Cost[b]	Retrofit options predominantly: Moderate capital Cost[c]
Small house with frame walls (single family or 2-4 units)	Central air system	X	
Same	Central water system[d]	X	
Same	Decentralized system	X	
Small rowhouse with masonry walls (single family or 2-4 units)	Central air system		X
Same	Central water system		X
Same	Decentralized system		X
Moderate or large multifamily building (masonry or clad walls)	Central air system	X	
Same	Central water system	X	
Same	Decentralized system		X
Moderate or large commercial building (masonry or clad walls	Central air system	X	
Same	Central water		X
Same	Complex reheat system	X	
Same	Decentralized system	X	

[a]See ch. 3 for a discussion of retrofit options.
[b]Compared t. savings, See ch. 3 for a definition, Approximately defined as retrofits with a 2-year payback Or less.
[c]Compared t. savings, Approximately defined as retrofits with a 2- to 7-year payback.
[d]OTA's assumption is that this building type has a central water system and air-conditioners.

SOURCE: Office of Technology Assessment.

Table 39.—Typology of Small Multifamily Buildings According to the Likelihood of Major Improvement in Energy Efficiency

Owner type/ meter type	Building type	Likelihood of major improvement in energy efficiency	Owner's willingness to invest in retrofit	Retrofit options predominantly: Low capital Cost[a]	Retrofit options predominantly: Moderate capital Cost[a]
Owner-occupant	Frame type	Moderate	Willing—low capital cost only	x	
Owner-occupant	Masonry wall	Unlikely	Willing—low capital cost only		x
Absentee owner master-metered	Frame wall	Unlikely	Unwilling	x	
Absentee owner master-metered	Masonry wall	Unlikely	Unwilling		x
Absentee owner tenant-metered	Frame wall	Unlikely	Very unwilling	x	
Absentee owner tenant-metered	Masonry wall	Very unlikely	Very unwilling		x

[a]Compared to savings.

SOURCE: Office of Technology Assessment.

The least likely building to be retrofit is the fully tenant-metered masonry-walled rowhouse owned by an absentee landlord. Such buildings are the dominant form of urban housing in the Middle Atlantic States and are also quite common in cities of the Southeast. Usually moderate paybacks are required for substantial savings in such buildings. With tenant metering, absentee landlords under most circumstances have no incentive to retrofit them, regardless of the payback.

Owner-occupied masonry-walled buildings and absentee-owned frame buildings are intermediate cases, the former because retrofit is fairly expensive, offering only moderately fast payback and the latter because the owner is likely to be fairly unwilling to retrofit even with low capital cost measures offering a fast payback. Both of these categories might be susceptible to private or public programs which reduce the risk and financing cost of retrofit.

Large Multifamily Buildings. Two physical types and three owner types can explain much of what is likely to happen i n the retrofit of large multifamily buildings (see table 40). The most likely buildings to be retrofit are the relatively rare buildings with central air or water heating systems owned by institutions such as pension funds or insurance companies. (As explained earlier in the chapter, institutions are trying to reduce their holdings of multifamily property or at least to give preference to tenant-metered build ings.) The least likely to be retrofit are large buildings with tenant-metered decentralized systems owned by individuals or local partnerships. Such buildings can be retrofit only if owners are willing to accept moderate paybacks. Under current conditions of capital cost and retrofit uncertainty such owners are willing to invest only in retrofits of very low capital cost with very fast paybacks.

Between the extremes, decentralized buildings owned by condominiums and institutions are only moderately likely to be retrofit because of the expense. Central system buildings owned by individuals and local partnerships may offer opportunities for substantial retrofit but such owners generally require extremely fast paybacks.

Small Commercial Buildings. Four combinations of owner and physical types can characterize most small commercial buildings (see table 41). Most of such buildings in cities have masonry or curtain walls which are expensive to in-

Table 40.—Typology of Large Multifamily Buildings According to the Likelihood of Major Improvement in Energy Efficiency

Owner type/ meter type	Building type	Likelihood of major improvement in energy efficiency	Owner's willingness to invest in retrofit	Retrofit options predominantly	
				Low capital Cost[a]	Moderate capital Cost[a]
Institution master-metered	**Central air or water system**	**Very likely**	**Very willing**	X	
Institution tenant-metered	Decentralized system	Likely	Willing		x
Condominium master-metered	Central air or water system	Likely	Willing— low capital cost only	x	
Condominium tenant-metered	Decentralized system	Unlikely	Willing– low capital cost only		x
Individual or small partnership master-metered	Central air or water system	Moderate	Willing– low capital **cost only**	x	
Individual or small partnership tenant-metered	**Decentralized system**	**Very unlikely**	**Unwilling**		X

[a]Compared to savings.

SOURCE: Office of Technology Assessment

Table 41.—Typology of Small Commercial Buildings According to the Likelihood of Major Improvement in Energy Efficiency

Owner type	Building type	Likelihood of major improvement in energy efficiency	Owner's willingness to invest in retrofit	Retrofit options predominantly	
				Low capital Cost[a]	Moderate capital Cost[a]
Owner-occupant	Air system or decentralized system[b]	Moderate	Willing—low capital cost only	X	
Owner-occupant	Water system[c]	Unlikely	Willing—low capital cost only		X
Absentee owner	Air system or decentralized system[a]	Unlikely	Unwilling	x	
Absentee owner	Water system[b]	Very unlikely	Unwilling		x

[a]Compared to savings.
[b]Electric resistance baseboard heat and window air-conditioners. See ch. 3.
[c]Water or steam central heat and window air-conditioners. See ch. 3

SOURCE: Office of Technology Assessment.

sulate. Retrofit opportunities are limited to heating and cooling systems and lighting. Most small commercial buildings are owned by an individual or local partnership.

The most likely building type to be retrofit is occupied by its owner and has a central air heating and cooling system or decentralized heating and cooling. Such owners are willing to invest in low capital cost retrofits because the energy savings can directly increase their business profits. Buildings with central air systems or decentralized heating and cooling can achieve substantial energy savings with retrofits of low capital cost.

The least likely building to be retrofit is owned by an absentee owner and has a water or steam heating system and window air-conditioners requiring at least moderate capital investment for substantial energy savings. Individual or local partnership absentee owners, short of cash and with little access to good information on retrofit potential, are very unlikely to retrofit, but instead will try to avoid the burden of energy costs by passing them on to tenants using net or passthrough leases.

Large Commercial Buildings.–Due to the greater variety of owner types, six combinations of owner type and physical type are necessary to explain much of the predicted variation among large commercial buildings (see table 42). There are many opportunities for low capital cost retrofits among commercial buildings with central air systems, complex reheat systems, or decentralized systems; if they are owned by owners with long holding periods—corporate owner-occupants or institutional investors—it is likely that retrofit has already occurred.

On the other hand, older commercial buildings with central water or steam systems and window air-conditioners are fairly expensive to retrofit. If such buildings are owned by individuals or local partnerships with short holding periods, constraints on cash flow and poor access to financing and information, they are very unlikely to be retrofit. Other large commercial buildings fall between these extremes either because they are fairly difficult to retrofit or because their owners are unwilling to undertake retrofit regardless of the payback.

As with all simplifications, readers should avoid applying the categorization described above to any particular building. Any given building may easily have prospects quite different from these for quite individual reasons. These categories are to help distinguish the buildings most likely to be retrofit from those least likely and identify the large group in the

Table 42.—Typology of Large Commercial Buildings According to the Likelihood of Major Improvement in Energy Efficiency

Owner type/ meter type	Building type	Likelihood of major improvement in energy efficiency	Owner's willingness to invest in retrofit	Retrofit options predominantly	
				Low capital Cost[a]	Moderate capital Cost[a]
Owner-occupant or institutional investor[b]	Air, complex reheat or decentralized system	Very likely	Very willing	X	
Owner-occupant or institutional investor	Water system	Likely	Very willing		X
National partnership or development company	Air, complex reheat or decentralized system	Likely	Willing—low capital cost only	X	
National partnership or development company	Water system	Moderate	Willing—low capital cost only		X
Individual or local partnership	Air, complex reheat or decentralized system	Unlikely	Unwilling	X	
Individual or local partnership	Water system	Very unlikely	Unwilling		X

[a]Compared to savings.
[b]E.g. pension fund, insurance company.

SOURCE: Office of Technology Assessment

middle which are most likely to be influenced by aggressive marketing and outreach by private sector entrepreneurs or public sector programs.

Buildings that are likely to be retrofit within current private sector practices include:

- Large commercial buildings with central air, complex reheat or decentralized heating and cooling systems owned by corporations, other large owner-occupants, institutional owners, national partnership syndicates, and development companies.
- Large master-metered multifamily buildings owned by institutional owners and national syndicates.
- Small owner-occupied commercial buildings with central air or decentralized heating and cooling systems.

Buildings which are very unlikely to be retrofit due both to owner unwillingness and difficulty of retrofit include:

- Small masonry walled multifamily buildings by absentee owners.
- Large tenant-metered multifamily buildings owned by individuals or local partnerships.
- Small commercial buildings owned by absentee owners.
- Large commercial buildings with central water or steam heat and window air-conditioners owned by individuals or local partnerships.

All of the other building types have prospects for retrofit that are less than very likely and more than very unlikely. Whether they are actually retrofit will depend in part on the owner's knowledge of retrofit opportunities and the risk of retrofit and also on the owners access to financing, Each of these is discussed below.

INFORMATION: DIMINISHING THE RISKS OF RETROFIT

For all building types, in all locations, a major constraint on investment is the uncertainty about the performance of energy conserving measures. Except for a few small studies there is almost no data on the actual performance of retrofits. This is especially true for buildings other than single-family houses.

This lack of information is a substantial barrier to retrofit for smaller owners who lack the technical capacity to evaluate conservation alternatives and the financial wherewithal to experiment. For smaller operators–the dominant group of real estate owners—there is not enough leeway in a building's cash flow to be able to afford a costly mistake. And although larger owners have resources at their disposal they also want to be very sure that energy conservation is indeed the best use of their investment funds. The most sophisticated owners with the best engineering staffs at their disposal said in interviews that they test the equipment first to establish its performance in actual applications. They reported that much of the experience with these tests has not matched either manufacturers' or official expectations owing to the effects of previous measures or operational limitations.

Building owners who have installed retrofit measures report mixed results. I n a 1979 survey by Booz Allen of apartment building owners, only half the owners, who had installed energy efficiency measures, were satisfied that insulation and furnace modifications were effective measures and only a third were satisfied that weatherstripping was effective (see table 43).

In the most comprehensive survey of documented retrofits done to date, (described in ch. 3) researchers Ross and Whalen obtained data on retrofit results in 222 buildings,[16] Their data illustrates the uncertainty of predicting savings from a retrofit:

. 10 percent of the buildings failed to have any savings at all.
. Although those buildings which saved energy saved an average of 22 percent, the savings ranged (within a standard deviation) from **7 to 37 percent.**
- For 60 buildings for which predictions of savings were available as well as savings, there was a substantial difference between predicted and actual savings. Sometimes savings were much better than predicted (a group of schools in Maine), sometimes they were much worse (another group of schools) and sometimes they varied widely within a similar group of buildings (a group of community centers in Columbia, Md.).
- For 15 buildings, with more than 1 year's data after the-retrofit, 60 percent saved more in the years following the first year after the retrofit, but 40 percent saved less.

[16] Ross and Whalen, op. cit.

Table 43.—Percentage of Apartment Building Owners Who Perceived Measures They Installed To Be Effective

Measure installed	Percentage of owner-installers perceiving the measure to be effective[a]
Insulation , ...	540/0
Furnace modification	**50**
Individual metering or submetering.	43
Storm windows	39
Clock thermostats.	38
Weatherstripping	31 %

[a] The Sum of the percentages is greater than 100 because owners could Identify more than one measure as being effective,

SOURCE. National Apartment Association Survey and Booz, Allen & Hamilton. op. cit., exhibit D-6.

On the other hand, the Ross and Whalen survey is evidence that, on average, energy retrofit brings a large return on investment. For 65 buildings with good retrofit cost data, almost half had paybacks of less than 1 year. All but seven had paybacks of 3 years or less.

To be effective, information on actual retrofits is most useful when available through the channels which building owners turn to for advice. One of the best are trade associations, The program referred to earlier between DOE and the American Hotel & Motel Association to retrofit and document six different types of buildings is an excellent example. Restaurant trade associations might be able to do the same kind of

testing in conjunction with various restaurant chains. Another possible channel is the local chamber of commerce which might cooperate with local energy retrofit businesses to make information available on documented retrofits.

Impact of Risk on Building Owner's Payback Preferences. For many reasons discussed in this chapter some owner types, especially individuals and small partnerships, cannot tolerate large cuts in the cash flow from their buildings. The next section illustrates the cash flow cuts caused by retrofits with moderate paybacks of 6, 7, and 9 years. Given the uncertainty of attaining audit predictions of savings, such owners must avoid moderate payback retrofits because of the risk that they will turn into very long payback retrofits with devastating impact on the building's cash flow.

Table 44 illustrates the impact of predictable deviations in savings from audit results. A 5-year payback retrofit will become a 17-year payback retrofit if actual savings are **70** percent below predicted, a figure perfectly consistent with the comparison of audits and actual savings above. A building owner unable to cope with an actual payback longer than 3 years must avoid all promised paybacks longer than 1 year, if he wishes to allow for the risk that savings might be 70 percent less than predicted.

Improved private sector or public sector information on retrofits could reduce the likely risk that actual savings would be less than audit predictions. As table 44 shows, for an owner unable to tolerate more than a 5-year payback, an improvement in downside risk from 70 percent to 50 percent will allow that owner to make a predicted 3-year payback investment.

Table 44.—impact of Uncertainty on Expected Annual Energy Savings From a Retrofit Costing $10,000

	Annual savings	Expected payback
Case 1: 3-year payback		
Predicted by an audit	$ 3,300	3 years
50°/0 below prediction	1,650	6 years
70°/0 below prediction	990	10 years
50°/0 above prediction	4,950	2 years
Case 2: 5-year payback		
Predicted by an audit	**$ 2,000**	**5 years**
50°/0 below prediction	**1,000**	**10 years**
70°/0 below prediction	**600**	**17 years**
50°/0 above prediction	**3,000**	**3½ years**
Case 3: l-year payback		
Predicted by an audit	$10,000	1 year
50°/0 below prediction	5,000	2 years
70% below prediction	3,000	3½ years
50% above prediction	15,000	8 months

SOURCE Off Ice of Technology Assessment

Better documentation of safe retrofits which reduces the risk of a retrofit would be of most use to cash-starved individual owners and small partnerships. With reliable information in hand, they might be willing to consider retrofits with paybacks beyond the strict 1-year payback they now insist on.

IMPACT OF LESS COSTLY FINANCING ON THE PACE OF RETROFIT

For some building types, long-lasting retrofits are available which will, if successful, earn substantial returns in improved net income and building resale value over the life of the measure. Two such measures are installing more efficient air-conditioners in a large building with cooling from window air-conditioners, and replacing the roof of a flat-roofed building and adding roof insulation. Such measures would not be expected to payback for 6 to 10 years. Since they will last 20 years or more, however, both would be sound long-term investments for a building.

A major obstacle to making such investments attractive to many building owners without internal sources of funds is the high cost of debt service in the early years as a result of the tradition of amortizing loans in equal annual payments of interest and principal repayments.

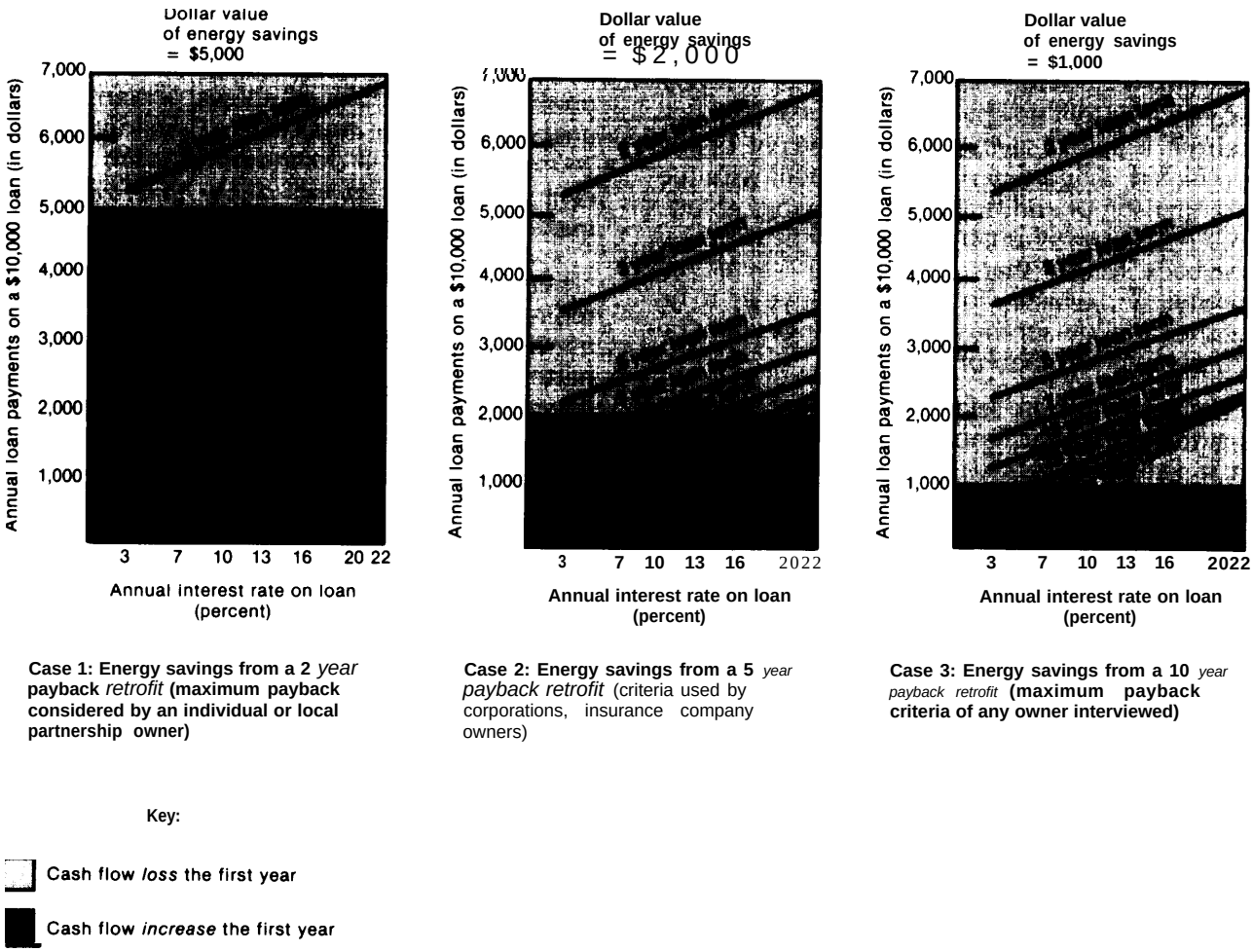
Simple Relationship Between Debt Service and Payback. Without examining all the com-

plexities of real estate finance with depreciation schedules and tax deductions of energy costs and interest, it is useful to examine the simple relationship between debt service and energy retrofit payback, shown in figure **38.** For energy retrofits with a 2-year payback, there are many combinations of interest rate and loan term that would allow energy savings to exceed the cost of borrowed money the first year. The financing options are far fewer for a retrofit with a 5-year payback. Only 10-year loans at interest rates of less than 10 percent per year or 20- or 30-year loans with interest rates as high as 18 percent would keep debt service costs the first year below energy savings.

For most building owners interviewed who lacked access to internal funds for retrofits, the only option for borrowing money was a commercial loan at 2 points over the prime rate (which in the summer of 1980 and the spring of 1981 was 21 percent). The best available outside financing mentioned was a 5-year loan at 16 percent.

Given such financing options, especially with the very short terms of loans available from

Figure 38.-Combinations of Loan Terms and Interest Rates Which Allow the Value of Energy Savings to Exceed the Cost of Borrowed Money the First Year



Case 1: Energy savings from a 2 *year* **payback** *retrofit* **(maximum payback considered by an individual or local partnership owner)**

Case 2: Energy savings from a 5 *year payback retrofit* (criteria used by corporations, insurance company owners)

Case 3: Energy savings from a 10 *year payback retrofit* **(maximum payback criteria of any owner interviewed)**

commercial banks (often less than 2 years), it is not surprising that only 2 of the 33 major building retrofits reported i n the building owner interviews were financed through outside borrowing. All the rest were funded from internal capital resources. It furthermore is no surprise that a building owner, without internal funding and with limits on the extent to which he can cut into a building's cash flow, would limit consideration of retrofits to those with short paybacks of 1, 2, or 3 years.

The term of a loan matters more than the interest rate in reducing annual debt service costs below energy savings. For retrofits with long lifetimes such as new boilers, air-conditioners, new lighting fixtures, or new insulation all of which should be expected to last 20 years or more, building owners might well accept fairly long-term financing, even at moderate to high interest rates, if it were available.

Unfortunately, two programs that help make long-term property improvement loans available to single-family homeowners have not been available to owners of multifamily or small commercial buildings. Title 1A loan insurance has helped stimulate 7- to 10-year property improvement loans for single-family homes (1 to **4** units) since World War ll. However, its companion program, title IB, for multifamily buildings has been very little used. Similarly, the Federal Home Loan Mortgage Corporation launched in 1981 a pilot program to purchase home improvement loans for single family homes from savings and loan associations. The loans must be secured by a second trust and may be on amounts up to $30,000 and have terms of up to 15 years. There are no plans to create a secondary market for property improvement loans for multifamily or commercial buildings.17

Adding Complications: Return on a Retrofit for a Prototypical Building. For a more realistic appraisal of the impact of a retrofit on particular buildings, OTA developed information on six prototypical buildings from published average expense and income data in particular localities as well as appraisal data.[18] The prototypes illustrate some of the variations in income and expenses in multifamily buildings: large and small, master and tenant metered, low rent structure, and moderate rent structure.

For one such building analyzed, a medium small building with 18 units, in a cold climate typical of St. Paul, Minn., but in a moderate rent area where both rental income and taxes are substantial, a specific retrofit investment was simulated. It was a fairly large package of retrofit measures, costing $22,303 or $1.45 per square foot. It saved 30 percent of the buildings energy use or about $2,500 the first year. Such a retrofit would be typical for a masonry-walled building for which wall and roof insulation is expensive, and would payback in 9 years, well beyond the planning horizon of the building owners interviewed for this study.

There would be substantial benefits to the owner from such a retrofit. After all tax benefits from interest and depreciation were taken into account there would be a substantial increase in net income from the building.

	First year	*Fifth year*
Energy savings.	$2,500	$4,480
Increased net Income. . .	$1,459	$4,452

such an increase in a building's net income should be translated directly into increased resale value for the property, if general economic conditions for the building remain the same. For a building in a stable neighborhood with the moderate rent structure described above, an appraiser would capitalize the net income at 9½ or 10 times in order to assess the building's resale value (see box E above). After 5 years such a building should have an increased resale value more than $40,000 higher than with no retrofit.

Fifth year value without retrofit.	.$402,133
Fifth year value with retrofit.	.$442,601
Increased value.	+ *$40,468*
Percent increase in value.	+ 10.4%

Such an increase in value would be almost double the cost of the retrofit.

[17] The i "f ormat lon in this paragraph is based on presentations by Michael Ehrman of HUD and Mark Shaefer of the Federal Home Loan Mortgage Corporation at a community energy workshop meeting on financing held at HUD on Oct. 29, 1981.

[18] A description of th e methods used to analyze the prototypical buildings and presentation of the results will be published in work-i ng papers to this report.

Although there are clear long-term benefits to the owner of such a building from undertaking a retrofit with a fairly long payback, there are serious short-term reductions in the building's cash flow as a result of the high cost of conventional debt service. If the retrofit is paid for with a 16 **percent** 5-year loan (which was the most favorable conventional financing available to any building owner interviewed) there is a sharp drop in cash from building operations from the first year all the way through the fifth year (see fig. 39). If the building owner survives until the sixth year, debt service to pay for the retrofit ends and the increase in net income is completely retained.[19]

Subsidy Options. Given the loss in building cash flow from a substantial retrofit financed with a 16-percent interest loan, **OTA compared the impact of two different financing subsidies on the building's cash** flow. The two subsidies, one a tax credit and the other a financing subsidy, are of comparable cost to the Treasury. The first of these is a tax credit of 30 percent that OTA (somewhat arbitrarily) defined as substituting for the first 30 percent of depreciation taken on the retrofit. The cost to the Treasury of such a subsidy would be $6,690 the first year but it would be offset over the first several years by a reduction of the same amount in depreciation deductions. For building owners in the 50- percent income tax bracket such a depreciation deduction would be worth $3,345 over several years of depreciation deduction. Thus, the net tax loss is only half of the $6,690 or 15 percent of the retrofit cost.

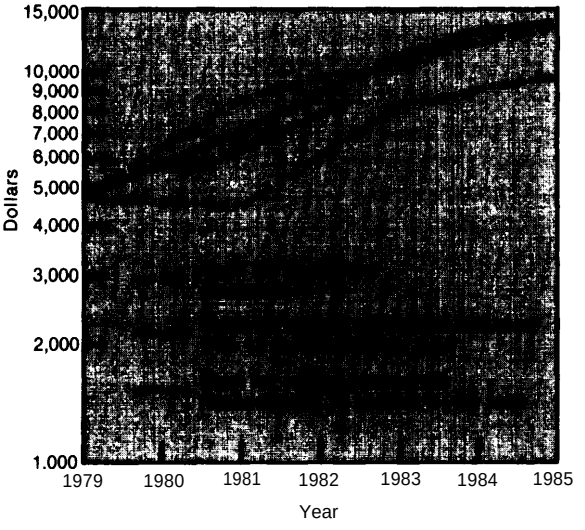
The other subsidy, of approximately equal or slightly less cost, is a loan subsidy designed both to reduce the effective interest rate on the retrofit loan and to increase the loan term. The interest rate subsidy is straightforward. A lump-sum payment of about $2,200 deposited in a bank in the first year of a loan is the present value equivalent of a reduction in interest from 16 to 13 percent and an increase in loan term from 5 to 10 years. This amount is only about 10 percent of the cost of the retrofit. A significantly larger subsidy, however, would be needed to actually induce banks to increase loan terms. This could take the form of loan insurance (about 2 percent of a loan's value) and administrative and financial support for a secondary market for retrofit loans. For this reason OTA estimates the total cost as comparable to the 15 percent of retrofit cost for the net impact of the tax credit.

The impact of the two subsidies is compared in figure 40. The tax credit restores or slightly increases aftertax cash flow the first year but leaves a large reduction in the pretax cash flow. The fifth year, however, both pre and aftertax cash flow are reduced from their no retrofit level. With the loan subsidy, the building's pretax and aftertax cash flow are both slightly reduced the first year from the no retrofit situation, but by the fifth year, both pretax and aftertax cash flow exceed the no retrofit situation.

Impact of Retrofit on Two Other Prototypical Buildings: Low Rent and Tenant Metered. Two other prototypical buildings illustrate some

[19] For a discussion of the **impact on cash** flow **of an even** longer **payback solar retrofit see Arthur J. Reiger, "Solar Energy:** The Market Realities," Rea/ *Estate Review, vol.* 8, winter 1979.

Figure 39.—Cash From Operations" for an 18-Unit Apartment Building With and Without an Energy Retrofit[b]

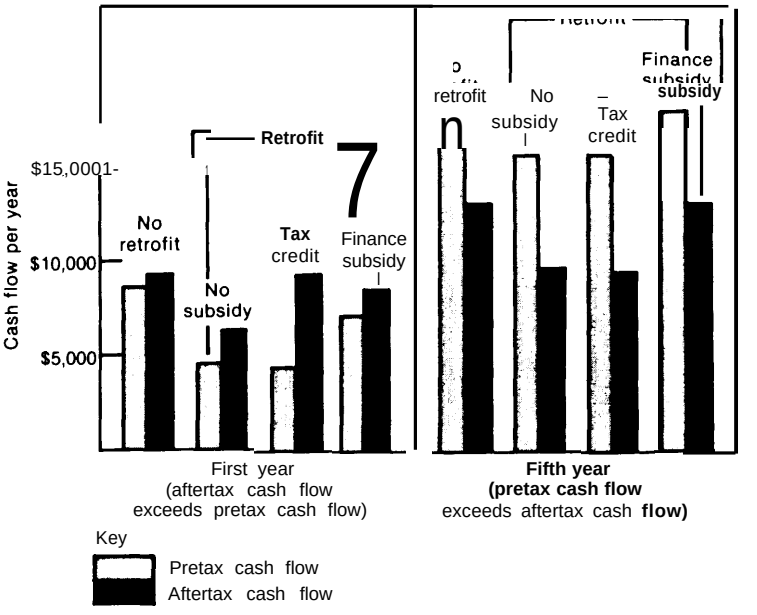


[a] Pre-tax while functioning as a tax shelter and after tax once it starts generating an after-tax profit.
[b] Retrofit costing $22,300 with about a 9-year payback.

SOURCE: Office of Technology Assessment.

Figure 40.— Impact of Energy Retrofit Subsidies on Pretax and 'Aftertax Cash Flow for a Prototypical Apartment Building

Building A: 18-units, moderate rent, moderate taxes, master-metered



SOURCE: Office of Technology Assessment.

interesting variations on the kind of impacts described above. Both are illustrated in figure 41.

Building B is a small multifamily building with low rents and low taxes and substantial energy costs, based on rent and cost structures found in St. Louis. A retrofit costing $34,809 is simulated. It saves $4,979 in energy costs the first year for a simple payback of 7 years. This building has very poor cash flow to begin with. The first year pretax cash flow is essentially wiped out by a retrofit with a 7-year payback. Aftertax cash flow the first year suffers considerable but less damage than pretax cash flow; it is reduced by about half. By the fifth year an unsubsidized retrofit or one subsidized with a tax credit has still reduced aftertax cash flow way below what it would have been. A retrofit with a financing subsidy on the other hand has increased both the building's pretax and aftertax cash flow. Although a retrofit is very damaging to this building's cash flow, it also has a very beneficial impact on its resale value which increases by almost 27 percent.

Building C (also shown in fig. 41) is at the opposite extreme from building B. This large building is tenant metered with moderate rents and taxes based on income and cost structures found in Tampa, Fla. The owner makes a retrofit only to save on energy costs in the common areas, which are a small fraction of building expense. The energy retrofit costs the owner $41,794 and saves $6,975 in energy costs the first year for a simple payback of 6 years. Such a retrofit is neither very important to the building's resale value which increases by only 3.9 percent, nor is it very important to the buildings pretax or aftertax cash flow which does not change much with either an unsubsidized or subsidized retrofit. Such a building has adequate cash flow to cover this retrofit easily.

A conclusion to be drawn from this comparison of prototype analyses is that a retrofit is most beneficial to the overall return of a low-rent building with high energy use but it is also most devastating to its cash flow. Under such circumstances, a financing subsidy (as opposed to a tax

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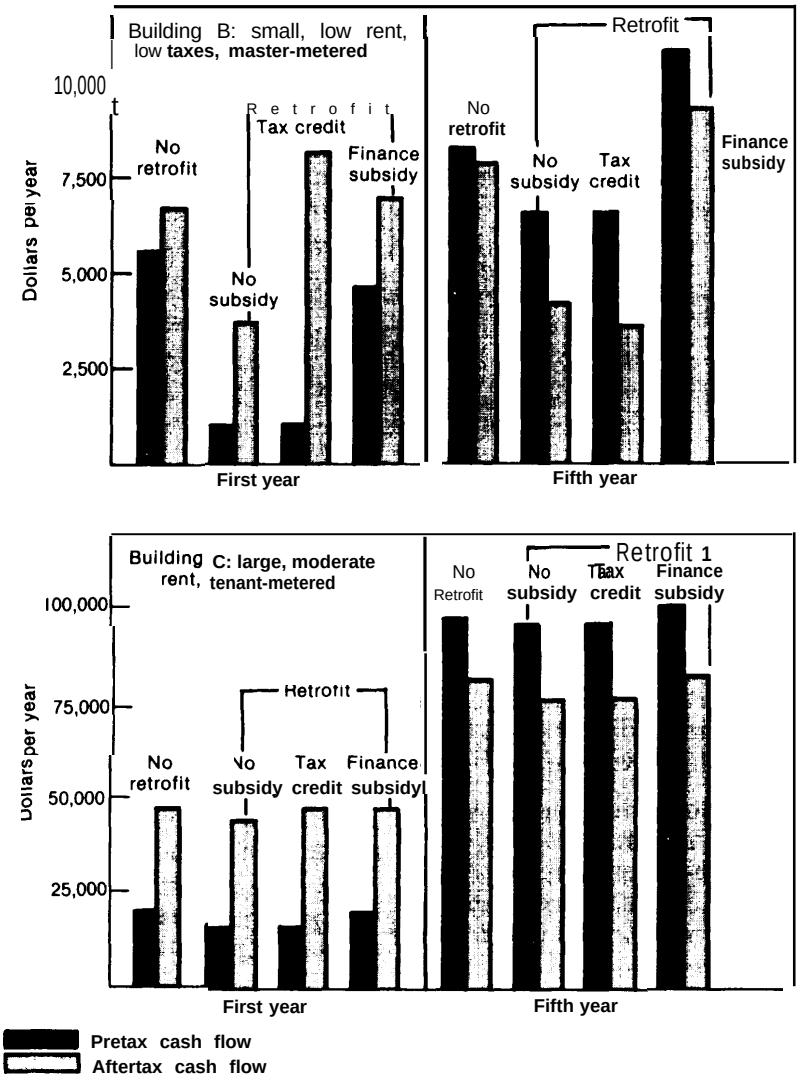
Figure 41 .—Impact of a Retrofit on Pretax and Aftertax Cash Flow for Two Other Prototypical Apartment Buildings



SOURCE: Office of Technology Assessment.

credit) will have a most beneficial impact to prevent sharp cash flow losses the first year and even increase cash flow by the fifth year.

Building Owners' Preferences for Subsidies. Building owners interviewed in the four case study cities preferred subsidized financing of retrofits to a subsidy in the form of a tax credit by a 3 to 1 ratio for reasons that are consistent with the prototype analysis (see table 45). A financing subsidy assists the building's cash flow over several years while a tax credit doesn't assist the building's cash flow at all the first year and actually decreases the aftertax cash flow after **5** years.

The not quite 25 percent of the building owners interviewed who preferred tax credits, did so because tax benefits were important to them in the return from their real estate holdings. Most of these owners were partnerships. A few were corporations which had adequate internal sources of finance for retrofit but welcomed a tax benefit.

Table 45.— Building Owner Preferences for Tax Credits or Financing Subsidies

Case study city	Financing	Tax credit	Total
Buffalo	**18**	**5**	**23**
Des Moines	**13**	**3**	**16**
Tampa	**7**	4	11
San Antonio.	10	3	13
Total	48 (76.20/,)	15 (23.80/o)	63

SOURCE Off Ice of Technology Assessment

Summary: Likely Impact of Risk Reduction and Financing on the Pace of Retrofit in City Buildings. How willing owners are to retrofit their buildings depends on several conditions apart from the ease of retrofitting their buildings:

- IS energy retrofit important to the owners' goals for the building and consistent with them?
- IS the risk of retrofit and the cost of financing it tolerable to the owner?

Owners can crudely be divided into four categories on the basis of the product of these four conditions.

Owners' access to finance and tolerance of risks	Importance of reducing energy costs to owners's goals: Important	Not important
Owner can both finance and absorb risk	Willing and able	Able but unwilling
owner can't tolerate risk and/or lacks financing.....	Willing but not able	Unwllllng and unable

SOURCE: Office of Technology Assessment.

Public and private programs designed to reduce risk or lower the cost of financing retrofit (a variety of such programs are described in ch. 11) are likely to have the greatest impact on the group of owners who are willing and even anxious to retrofit but who lack the financial flexibility to finance retrofits at reasonable cost and to absorb the costs of a mistake. Such owners include:

- Owner-Occupants of small multifamily buildings.
- Small business owner-occupants of their buildings.
- Individual and small (local) partnership owners of master metered multifamily buildings.
- Individual and partnership owners of office buildings in markets that have become sensitive to energy costs.

Programs to reduce risks and/or lower financing costs can take a wide variety of forms, including:

- Private market investment and assumption of risk through leasing or guaranteed savings.
- Private- or public-sponsored programs to test retrofits for specific kinds of buildings, e.g., several current restaurant and hotel programs.
- Financing by private utilities, insurance companies, or any level of government designed to increase loan terms and lower interest rates.
- Tax credits, although these are relatively less helpful to most building owners than the same amount of government money in the form of a financing subsidy.

For building owners who are able to retrofit but not highly motivated to retrofit because it is not consistent with their goals for the building, the long-term operation of the market may eventually have an impact. Such owners include:

- Well-financed owners (such as national syndicates and development companies) of tenant-metered multifamily buildings.
- Ž Well-financed owners of office buildings i n tight markets that are insensitive to energy costs.
- Well-financed owners of shopping centers in retail markets that are insensitive to energy costs.

In some governmental jurisdictions there may be political support for requiring energy retrofit for certain categories of these buildings, especially tenant-metered multifamily buildings. Such requirements might be imposed at the time a master-metered building were converted to a tenant metered one, or at the time of sale. In response to such a requirement, well-financed building owners will be able to make the retrofit. Whether they can recoup the investment over time will depend on the nature of the rent structures in the building's market area.

By contrast, building owners who are both unwilling to retrofit and unable to finance or tolerate the risk of a retrofit, are not likely to be able to respond to a requirement to retrofit unless some financing and risk reduction assistance is provided. Such owners include:

- Small individual or partnership investor owners of tenant metered multifamily buildings.
- Small individual or partnership investor owners of retail or office space with net or passthrough leases.
- Owners of buildings in marginal areas.

Any political jurisdiction wishing to speed up the pace of retrofit by regulation of such buildings would have to see to it that financing and risk-reduction assistance were available. It is at least possible that local private utilities and leasing and energy savings guarantee companies would be active enough in a particular city that no public program would be needed,

Owners of buildings in marginal areas are a special case. For these, retrofit makes sense only in the context of the potential resale value of buildings in the entire neighborhood or district. For such buildings, programs to speed up energy retrofit only make sense in the context of overall rehabilitation programs designed to encourage general owner investment in their buildings (in structure, facade, wiring, plumbing, *and* energy efficiency) and to increase confidence in the area by potential building purchasers and the financing community.