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LOCAL BUILDING OFFICIALS AND RENTAL HOUSING ENERGY EFFICIENCY

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Abstract

This study examines the energy-efficiency of rental housing through ratings provided by 45 building inspectors. The study area was narrowed to four rural New York counties via a two-stage selection process (Laquatra and Chi, 1989). Data were obtained by means of a questionnaire. Questions covered demographic characteristics, availability of energy-conservation programs, frequency of inspections, perceptions about energy efficiency by housing types, and perceptions about successful energy-conservation programs. Of the respondents, 73 percent stated there was no program in their community to promote energy conservation in the rental-housing sector. Fifty-two percent of the municipalities had no housing codes. The existence of a housing code in an inspector's jurisdiction, however, related positively to energy-efficiency ratings. The propriety of using the knowledge of building officials in developing strategies for increased energy efficiency in rental units is discussed.

Introduction

Housing affordability for renters can be defined as the ability to pay monthly rent plus recurring costs such as utility expenses. When defined in these terms, the economic burden of home occupancy has increased substantially during the past decade (Gilderbloom and Appelbaum, 1988). This trend is most noticeable among low-income tenants. This group spends an average of 65 percent of its income on housing (Megbolugbe, 1989).

Although many components of housing costs are fixed, those associated with energy are not and can be easily reduced. Such reductions could make housing more affordable for two million households in the United States (Prindle and Reid, 1988). In addition, the technology to achieve these reductions is readily available and widely recognized as an economically sound investment. Institutional barriers have impeded the adoption of these achievable levels of thermal efficiency.

In the United States, successful energy-conservation programs targeting residences have depended on educational approaches at community and household levels. Though numerous programs have been designed and implemented using such approaches, the majority have been designated for households who own. For these households, the benefits of investing in energy-conserving technology are simple to convey because savings accrue directly to the investors. This is not typically the case with households who rent.

In single-family and multifamily rental units, investments in energy efficiency are hindered mainly by financial and institutional issues (Laquatra, 1987). Financial barriers to energy conservation in rental housing first occur at the development stage. Energy costs are not always considered in financial decisions unless required by building codes. When those making energy-efficiency decisions about a dwelling are not its occupants, the incentive to invest in energy conservation is lost. Circumstances such as these are sometimes referred to as a "split incentive."

At the occupancy stage, tenants are limited in what they can do to improve the thermal integrity of their units. Financial and legal constraints discourage tenant investment in major energy-conservation improvements like insulation and storm windows. In cases where tenants pay a fixed charge for rent and utilities, conservation incentives are lost to indifference.

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Short tenant-occupancy patterns also discourage conservation investments in rental housing. As 75 percent of renters reside in their units for less than three years,

> ...tenants are not interested in funding (through their rent payments) improvements that may not pay back for several years. By the same token, owners are unlikely to make substantial energy investments on behalf of tenants who can be expected to leave within a few years" (Prindle and Reid, 1988, p. 14).

Energy efficiency is important in rental housing because of its impact at the community level (Kirschling and Pnazek, 1982; Scales and Popkin, 1983). Currently much of our energy is imported in the form of oil. Money spent on imported energy supplies is transferred to foreign economies. Financial repercussions eventually affect local economic development and aggravate the existing affordability crisis (Prindle and Reid, 1988).

These impacts are likely to be more noticeable in the event of future oil-supply shocks. Oil imports are presently at levels higher than those during the 1973-74 oil embargo. Imports could amount to 50 or 60 percent of total consumption by 1995 (Copulos, 1989). Repercussions are not strictly limited to economic considerations. The environmental consequences of inefficient use of fossil fuels mandate that institutional barriers to energy conservation be overcome (Ledbetter, 1988).

Efforts to improve levels of energy efficiency in rental housing have focused on the existing housing stock and additions to it through new construction. In both cases, building codes, housing codes, and zoning ordinances have influenced improvement efforts (Tomasi, 1981). Other noteworthy approaches at improving energy efficiency in rental-housing include educational programs, grants, and low-interest loans for conservation investments.

Local Policies and Energy Efficiency

State and local government policies to promote energy conservation are justifiable interventions. As discussed by Fisher and Rothkopf (1989), the inhibition of efficient resource allocation is a special characteristic of energy markets. The rapid depletion of nonrenewable resources underscores the importance of corrective policies. In addition, shrinking energy reserves impact our national security and environment.

Local energy policies can address distorted consumption patterns that result from specific market failures. To resolve "split incentives," Fisher and Rothkopf (1989) recommend individual metering of rental units and utility-sponsored conservation programs. Individual metering can improve energy management by tenants but improvements are limited by the thermal characteristics of buildings and equipment. Programs developed at the local government level have a potential for greater citizen involvement. Total reliance on utility-sponsored conservation programs often precludes local programs.

A number of state and local governments have implemented various energy-conservation programs. Some have focused on building and housing codes. Frequently these require that minimum levels of thermal performance be met by new buildings. Others have focused on the stock of buildings that are owned and operated by government entities. Local governments can lead effective energy-conservation efforts that reflect the unique climatic, economic, and demographic factors of the community (McCarthy, 1985). This is because of greater accessibility and accountability than at other governmental levels. Local officials, as a result, emerge as community educators on matters related to energy efficiency (ICMA, 1980).

Building officials play a key role in local housing policies. Normally these individuals are charged with the enforcement of energy-efficiency standards mandated for rental housing by state or local governments. These officials, variously called building commissioners, inspectors, and zoning or code enforcement officers, often play pivotal roles in the effectiveness of these regulations. Code provisions related to the thermal envelope or mechanical systems of a building can be enforced when staffing is sufficient to allow it (Field and Rivkin, 1975). Variations in enforcement may also reflect the age, education, and experience of the building inspectors (Vincent, 1986).

Building officials can exert an influence on energy-efficiency through advocacy or code enforcement. For this reason, it would be useful to gain some insights into their perceptions about energy efficiency in the rental housing stock of their communities. A better understanding of those impressions may be instrumental in the development of more effective educational programs.

Framework for Analysis

Fourteen rural counties in western New York were selected for the study. From these, four representative counties were chosen through a two-stage selection process. In the first stage, cluster-analysis employed in previous research (Laquatra and Chi, 1989) was used for pattern recognition. The basic approach of cluster analysis is explained at length by Tyron and Bailey (1970). The objective was to identify mutually exclusive sets of objects. The sets share similar attributes. In this case the objects were the rural counties in western New York. The attributes of these counties were six population and housing characteristics of the counties. All were obtained from the *1980 Census of Population and Housing*. The attributes were 1) persons per household, 2) proportion of housing units in multi-unit structures, 3) proportion of housing units that are mobile homes, 4) proportion of housing units that are renter-occupied, 5) proportion of housing units built prior to 1969, and 6) proportion of housing units built between 1969 and 1979.

The data for the 14 counties were analyzed using the Statistical Analysis System (SAS) hierarchical cluster-analysis technique. The procedure begins by forming one cluster for each object (rural counties) in the analysis. The two closest clusters are combined into a new cluster, then the two closest of the new sets are combined into another cluster, and so on (SAS Institute Inc., 1985).

Through this technique, four clusters were finally identified. The first was an urban cluster with two counties, Chautauqua and Chemung. It contained the two major cities of the region, Jamestown and Elmira. Next was a rural cluster that included Allegany, Schuyler and Yates counties. The third cluster consists of eight counties--Cattaraugus, Genesee, Livingston, Ontario, Orleans, Steuben, Wayne, and Wyoming. Tompkins county was the fourth cluster. It was isolated because it contained Cornell University and Ithaca College and did not resemble any other county in the area. Within each cluster, one county was chosen at random. The counties selected were Chemung, Schuyler, Steuben, and Tompkins.

Sixty-four municipalities were included in the four counties. All officials charged with the enforcement of building and housing codes within these municipalities were surveyed during the spring of 1989. The survey instrument consisted of self-administered questionnaires that were delivered by mail and picked up by field workers. Survey questions covered the following six areas: 1) demographic characteristics, 2) attitudes about energy efficiency, 3) the availability of municipal and utility-company energy-conservation programs, 4) frequency of housing inspections, 5) perceptions about energy efficiency in various housing types, and 6) perceptions about the effectiveness of different approaches for improving energy efficiency in rental housing.

Potential relationships between community conditions and perceived levels of energy efficiency in rental housing were examined. A framework was devised representing these variables: local housing stock, inspection practices, and the officials themselves. The framework provided a model to illustrate the factors that could affect energy-efficiency in rental housing. Critical components of this framework are the size of the rental housing stock within the jurisdiction of an official, the number of staff persons available to assess levels of energy efficiency through inspections, the existence of specific codes, and the practice of inspections. These are represented by the general model: PE = f(DC, MC, HS).

In the formula PE represents the perceived level of energy efficiency in the local rental housing stock; DC is a vector of demographic characteristics of the survey respondents; MC is a vector of municipal characteristics; and HS represents characteristics of the housing stock.

A second model was constructed specifically to examine the perceptions of building officials. Did they perceive varying levels of energy-efficiency in the local rental stock for different types of housing? Assigned ratings for perceived efficiencies in the building envelope, windows, and heating systems were compared for: (μ_1) buildings with more than ten dwelling units, (μ_2) between three and nine units, (μ_3) duplexes, (μ_4) stick-built, single-family dwellings, (μ_5) manufactured (mobile) units, and (μ_6) other types of factory-built housing. Symbolically stated, the null hypothesis underlying this model is: H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6$. In the formula μ_1 through μ_6 represent the mean ratings assigned to the building components of the various housing types.

The final issue in this study concerned building-officials perceptions regarding the relative effectiveness of various approaches for improving levels of energy efficiency in rental housing. These included incentives directed to tenants and landlords, educational programs, and regulation. Rating scores are discussed in the context of percent distributions and mean scores.

Study Area

Data from the 1980 Census indicate that of the 105,257 occupied housing units in the four representative counties, about a third are renter-occupied. This is shown in Table 1. A large number of rental units are in buildings with five or more units. These units are prevalent in Ithaca where Cornell University and Ithaca College are located. Two-unit rental dwellings are the second-most common type. The largest concentration of these buildings is in the city of Elmira. There are approximately the same number of rentable mobile homes in the four-county region as single-family, detached units. Houses with three-to-four rental units account for about 15 percent of the total in rental dwellings.

Table 1. Rental housing characteristics in nonmetropolitan counties of New York State.

Characteristic	Chemung	Schuyler	Steuben	Tompkins
Number of rental units	10,513	1,195	8,885	13,236
Rentals as percent of occupied units	44.79	30.45	20.00	25.28
Dwelling type				
One unit detached	2,117	539	2,542	2,014
One unit attached	625	54	238	409
2 units	3,071	264	2,441	2,170
3-4 units	1,766	151	1,284	2,116
5+ units	2,768	94	1,834	6,051
Mobile homes	231	125	544	476
Year units were built				
1979-1980	140	9	147	126
1975-1978	578	51	481	680
1970-1974	928	72	849	2,198
1960-1969	997	113	936	2,606
1950-1959	826	91	653	1,450
1940-1949	1,709	141	811	1,167
1939-earlier	5,415	718	5,003	5,011
Type of heating system				
Steam/hot water	2,761	222	1,565	1,408
Central furnace	5,520	383	3,980	2,902
Electric heat pump	129	22	69	206
Other built-in elect. units	985	114	685	1,817
Floor, wall furnace	332	92	731	162
Room heaters with flue	539	181	1,181	382
Room heaters no flue	81	20	246	65
Fireplace, stove, and portable heaters	143	139	400	319

Almost half of the rental units in the study area were built prior to 1940. Most of these units are in the small cities. This group comprises the largest component in the age category of each of the four counties. Likewise, the majority of rental units in all of the counties were built before 1975.

These points are noteworthy because a statewide building code dictating minimum levels of energy efficiency in new structures was enacted in 1977. These older buildings are likely to have low levels of thermal efficiency. This is due in part because energy costs and management were not as important when the majority of these buildings were constructed.

It is not surprising that central heating systems are the most common among these older buildings. Most are systems that circulate steam, water, or air. Mullen (1984) suggested that energy losses from these types of systems may be as large as the losses from the building shells.

Data

Of the 70 questionnaires that were delivered to building officials, 45 were completed. In eight cases, surveys were not completed because one person was the only building official for a number of municipalities. Other reasons for a nonresponse included one vacant position and six refusals to cooperate.

Various job titles were assigned to the building officials in the sample. Twelve were code enforcers, nine were zoning officers, eight were zoning/building code inspectors, five were building commissioners, and the rest were fire inspectors and some combination of the aforementioned titles.

Just over 60 percent of the building officials had been in their job for less than four years. Ages ranged from 30 to 69, with an average of 50. Almost all had a high school education; 36 percent had completed college, and 7 percent had attended graduate school. Four percent of the respondents had not completed high school. Forty-three percent of the building officials had no staff or assistants, 35 percent had one staff person, and the rest had between three and six assistants. Over half of the survey respondents reported that their municipalities had no housing code. Almost 60 percent of them did not inspect rental housing units. About three fourths of the respondents reported that they knew of no municipal or county programs that promoted energy conservation in privately owned buildings.

Building officials were asked to rate three energy-conservation issues on a ten-point scale: 1) the importance of energy conservation to their community leaders; 2) how important the building officials themselves considered it to be; and 3) how important they considered the issue of energy efficiency in rental housing to be. They also used this scale to estimate energy efficiency for different housing types in the rental stock and to rate the effectiveness of options for improving energy efficiency in this sector.

Results

A model was constructed using ordinary least squares multiple regression. It was devised to investigate the possibility of causal relationships that influence the importance a building official placed on energy efficiency in rental housing. Six independent variables were considered. These were: 1) the total number of rental units in the municipality, TOTREN; 2) the percentage of the total housing stock that consists of rentals, PREN; 3) whether inspections of rental units are conducted, INSP; 4) whether the municipality has a housing code, CODE; 5) number of staff people assigned to the building official, STAF; and 6) the level of education of the building official, EDUC.

TOTREN and PREN were considered because of potential impacts that size of the stock may have on a building official's perceptions of rental housing quality. INSP and CODE were examined for two reasons: 1) because actually inspecting rental units can form a basis for perceptions of their conditions; and 2) because the presence of housing codes can offer a vehicle for the enforcement of minimum standards. STAF was ob-

served because the number of staff people assigned to a building official is likely to influence the quality of official observations. EDUC was considered because the education of a building official is likely to influence his or her perceptions on a variety of issues.

To examine the potential for multi-colinearity, a correlation matrix of the above variables was constructed. This is shown in Table 2. The only correlation coefficient greater than.50 is between PREN and CODE. Since the total number of rental units is represented by TOTREN and the presence of housing codes is a likely influence on how building officials view issues related to the housing stock in their communities, PREN was dropped from the list of independent variables.

Table 2. Correlation matrix of independent variables.

	EDUC	STAF	CODE	TOTREN	INSP	PREN
EDUC	1					
STAF	.136	1				
CODE	.05	-.217	1			
TOTREN	.22	.389	-.091	1		
INSP	.116	.277	.06	.031	1	
PREN	.307	-.022	.588	.088	.003	1

The final regression model is of the general form: PE = f (EDUC, STAF, CODE, TOTREN, INSP). Results from this regression analysis are presented in Table 3.

Table 3. Regression model on building officials' perceptions of energy efficiency in the rental housing stock (N=38).

Independent variables	β	SE	t
EDUC	-.76	.417	1.824
STAF	.341	.333	1.023
CODE	1.298	.594	2.185*
TOTREN	-.00007	.00009	.749
INSP	-.366	.308	1.186
F value	1.973		
Adjusted R^2	.113		

Note: seven cases deleted because of missing variables.
*$p \leq .05$

A significant finding was that the existence of a housing code in an official's jurisdiction related positively to the energy-efficiency ratings by officials. This implies that an enforceable housing code may be one mechanism for affecting energy efficiency. Moreover, it indicates that building officials in those communities with housing codes may recognize relationships between certain code provisions and energy efficiency. This result should be viewed cautiously, however, because of the small sample size and because the regression only explains 11 percent of the variance in the dependent variable.

Because some of the variables are categorical, a test of association using Chi-square analysis was conducted. This analysis featured a contingency table that included four components: 1) the building officials' ratings of the importance of energy efficiency in rental housing; 2) the presence or absence of housing codes; 3) whether rental units are inspected; and 4) the officials' level of education. No significant Chi-square statistics were observed.

Building officials were also asked to rate the energy efficiency of different building components of various types of rental units. Using a ten-point scale, they assigned scores to the building envelope, windows, and heating systems for the six building types under scrutiny. Results from an analysis of variance (single factor repeated measures) on these scores are presented in Table 4.

Table 4. ANOVA results on scores applied by building officials to energy efficiency of components of alternative rental housing types.

F-test results						
Windows comparison		F = 2.575	p = 0.0035			
Building envelope comparison		F = 4.616	p = 0.0001			
Heating systems comparison		F = 3.868	p = 0.0001			
Scheffe´ F-test result						
	Mean			F		
		> 10	3-9	Duplex	Stick	Mfd
> 10						
Windows	5.368					
Bldg envelope	6.000					
Heating system	5.947					
3-9						
Windows	4.529	0.383				
Bldg envelope	4.676	0.670				
Heating system	5.294	0.939				
Duplex						
Windows	4.724	0.522	0.011			
Bldg envelope	5.103	0.965	0.027			
Heating system	5.207	1.325	0.033			
Stick						
Windows	6.405	1.533	3.449*	3.843*		
Bldg envelope	6.189	0.584	2.504*	3.049*		
Heating system	6.189	0.235	2.114	2.675*		
Mfd						
Windows	5.559	0.024	0.216	0.322	1.940	
Bldg envelope	5.794	0.429	0.027	0.107	2.013	
Heating system	6.000	0.180	0.297	0.528	0.826	
Other						
Windows	7.314	1.288	3.077*	3.449*	0.011	1.664
Bldg envelope	7.286	0.241	1.715	2.171	0.074	1.313
Heating systems	7.371	0.528	2.877*	3.526*	0.059	1.325

*p <.05.

A one-way analysis of variance (ANOVA) was conducted separately for each building component. The F-test for each of the three comparisons is significant. This indicates that respondents perceived differences in energy efficiency among the various housing types.

Scheffe´ F-test for all possible comparisons (Winer, 1971) was applied to each pair. The results indicate that mean scores are significantly different for stick-built, single-family dwellings in two instances: 1) when windows and the building envelope are compared with 3-9 unit buildings, and 2) when all three components are compared with duplexes. An examination of the mean scores for these items indicates that ratings are higher for the stick-built, single-family dwellings.

Significantly different mean scores are also observed for windows in other types of factory-built housing in two instances. These are: 1) when they are compared with 3-9 unit buildings and with duplexes; and 2) for heating systems in these same categories. Mean scores indicate that the ratings are higher for these components in the factory-built housing.

The scores building officials placed on alternatives to improving energy efficiency are summarized in Table 5. Generally, educating landlords about energy efficiency is perceived as more effective than educating tenants. Likewise, providing incentives to the property owners is considered more effective than incentives for tenants. Energy-efficiency incentives and education directed at landlords received higher mean scores than did regulation.

Table 5. Percent distribution and means of rating scores applied by building officials to alternatives for improving energy efficiency in rental housing stock.

Rating	Tenant incentives	Landlord incentives	Tenant education	Landlord education	Regulation
1	2.5	2.5	10.0	4.9	10.0
2	2.5	2.5	20.0	9.8	5.0
3	10.0	0.0	12.5	2.4	0.0
4	5.0	7.5	5.0	14.6	2.5
5	10.0	12.5	15.0	4.9	17.5
6	20.0	7.5	7.5	12.2	10.0
7	7.5	20.0	5.0	24.4	10.0
8	17.5	12.5	12.5	12.2	12.5
9	15.0	35.0	10.0	14.6	15.0
10	10.0	0.0	2.5	0.0	17.5
Mean	6.5	8.0	4.8	6.9	6.6

Note: Scores ranged from 1-10; 1 = least effective, 10 = most effective.

Conclusions and Implications

The relationship between an extant housing code and the energy-efficiency ratings given that community's rental housing stock by building officials is promising. This suggests that educational programs directed toward community officials could be developed to encourage discussions of benefits of housing codes. Such programs, which could be targeted through the Cooperative Extension Service, could stress the effect of codes on perceptions among building officials of energy-efficiency levels in a community's rental housing stock. The role of these officials as key individuals who can influence energy-efficiency through advocacy or code enforcement could also be stressed. The benefits to small towns, where most rental housing stock is located, are increased housing affordability and decreased economic leakage. As previous findings have shown (Laquatra, 1987), justification for such programmatic approaches may be necessary before the issue will receive adequate attention from community leaders. Educational efforts must begin at a basic level and focus on the problems and benefits of achieving energy efficiency in rental housing. Then, employing strategies from successful programs can be considered.

Another issue examined in this study centered on the perceived differences in energy-efficiency levels between different types of rental housing. When the officials rated the energy efficiency of windows, the building envelope, and heating systems of the six housing types, significant differences were observed. The differences between smaller stick-built and factory-built structures were most notable. Further research on the accuracy of these perceptions may indicate that programs to encourage energy efficiency should be tailored to specific housing types. On the other hand, these results may indicate a need on the part of building officials for education in the rapidly evolving area of housing technology. Energy efficiency can be achieved in all types of housing. This point may need emphasis as different approaches are applied to resolve availability and affordability problems in rental housing.

Building officials were also asked to rate the effectiveness of incentives, education, and regulatory programs for increasing energy efficiency in rental housing. Programs directed to landlords received generally higher scores than those directed to tenants. The highest mean score was assigned to landlord incentives. These results are inter-

esting since these approaches have succeeded as components of rental housing energy-conservation programs throughout the United States (Bleviss and Gravitz, 1984). Therefore, educational programs for building officials should include a review of successful efforts in various municipalities. It should also demonstrate the usefulness of integrated approaches that include tenants, landlords, and community officials.

Some aspects of this study highlight the need for further research. Although all building officials in four counties were surveyed, the resulting sample size was small and may have biased the results. In addition, the rural nature of the study area may limit applicability of the findings. Perceptions of the same issues among building officials in urban areas may differ from these respondents. Factors that may affect differences in urban areas are greater availability of resources for energy-conservation programs; a higher likelihood that housing codes are enforced by more building officials; and a more homogeneous building stock.

Impressions of local building officials regarding energy efficiency in the rental-housing stock of a community may influence their advocacy or regulatory efforts in this area. Hence, insights into these impressions may be useful for policy development. Alternative approaches to improving energy efficiency in rental housing have been used by state and local governments nationwide. As building officials are in unique positions to assess the viability of particular alternatives in their jurisdictions, their perceptions of workable strategies and assistance in program development may be valuable.

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