Where do Local Governments Fit into an Energy Conservation Strategy?

It has been nearly three years since the Arab Oil Embargo awakened the nation to a crisis in energy. Still, a consistent national energy policy has not emerged. No doubt, this has been due in part to a relaxation of the short-term crisis atmosphere; but primarily it can be attributed to the enormous complexity of the energy issue. There is so much we yet do not know, that the evolution of policy may take many more years.

It would be a mistake, however, to conclude that no progress has been made. At the height of the fuel crisis in 1974, almost everyone saw the problem as one of short-run fuel availability, and whether there was a conspiracy on the part of the petroleum industry. Accordingly, the most conspicuous policy issues were those of emergency allocation and independence from foreign suppliers. Those who saw a longer-range problem were divided into two camps: one favored the "supply" solution of finding new domestic sources (coal, nuclear and off-shore oil), while the other favored a "conservation" solution (reducing the existing rate of use and develop "flow resources" such as the sun).

As the public understanding of the energy problem has matured, two things have happened. First, a growing number of people realize that a long-range problem exists. Second, although there is still public misapprehension regarding the immediate development of miracle sources of energy, such as fusion or solar sources, it is increasingly being recognized that neither supply nor conservation solutions alone will be able to deal with the energy problem.[1] On the one hand, the lead times for development of new supplies are so long that a serious conservation effort is inevitable, whether voluntary or not; on the other, the economic impacts of too much conservation may be intolerable.[2]

Thus, conservation has come to be recognized as an integral part, but not the only part, of energy policy. Left to be resolved is the chicken-egg pair of questions: How much energy conservation do we need? How are we to achieve it? Since in most aspects, the energy problem is national in scope, the federal government has the primary responsibility for formulating policy. Even so, it is beginning to be recognized that there also may be significant opportunities for state and even local involvement. This study examines local government's role in energy conservation.

There are three broad areas where local government intervention can affect energy conservation. These include: (1) emergency allocation of fuels; (2) information and exhortation; and (3) policies which may influence individual energy consumption.

Emergency Allocation

During the fuel crisis, emergency allocation was the most important governmental activity. Necessarily, the federal government took the lead, allocating gasoline to each state according (roughly) to a fixed percentage of historical consumption. Each state also set up an energy agency to attempt to deal with distribution problems and to draw up allocation plans for future emergencies. As the crisis subsided, the state energy agencies began to delve into longer range problems. But, many retain a significant emergency orientation. In North Carolina the State Energy Division is still in the Division of Military and Veterans Affairs.

Some local governments also became involved in

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emergency allocation. In Durham, North Carolina, one of the hardest-hit areas in the nation during the energy crisis, the city government persuaded most of the service station operators to serve an individual motorist only on a certain day each week, depending on the last digit on his license plate.[3] Although widely disregarded, this action did seem to reduce the lines at the pumps during the critical period. In the aftermath of the crisis, a number of communities passed ordinances to help them cope in the event of a recurrence. Also, a few manuals have been designed to help communities handle emergencies better.[4]

Information and Exhortation

Operating on the premise that a great deal of energy waste is caused by ignorance, many states have established communication channels by which energy conservation tips can be conveyed to citizens, small businesses and local governments. Some, for example, have required that conservation information be included with utility bills. In North Carolina, the State Energy Division has appointed a conservation officer in each county. Usually a county official, this person is responsible for disseminating conservation information throughout the country. Within the Federal Energy Administration, there is talk of federal participation in a program similar to this, on the model of the soil conservation officer of the agricultural extension service.

Policies Which Affect Individual Energy Consumption

Ultimately, of course, a meaningful and sucessful energy conservation effort will necessarily affect the way of life of virtually everyone. Accordingly, a significant role for local government must go beyond the relatively minor elements mentioned up to now. That is, the potential for direct local intervention in individual energy consumption patterns must be investigated. It turns out that the range of policy alternatives is considerable. The possibilities run the gamut from mild incentives to direct regulation.

But which activities will local conservation efforts most likely be directed toward? It seems that there are three major possibilities: buildings, urban transportation,and urban land use. Intervention in these three areas has traditionally been in the province of local government (building codes, road construction and traffic control, zoning); moreover, they all hold out the prospect of large energy savings. Before proceeding, a brief examination of those savings is in order.

First, note the significance of the order in the preceding paragraph—buildings, then transportation, then land use. The corresponding energy conservation policies will more or less be arranged in decreasing order of technological (hardware) orientation, and correspondingly in increasing order of their impacts on the habits of individuals, which in turn implies a decreasing probability of successful implementation. There is indeed, an enormous gap between the first two and the third. Between energy use in buildings and transportation on the one hand and energy-land use relationships on the other is a difference in degree so great as to constitute a difference in kind.

Table 1
Energy Use in the United States, 1974[a]

	Net Consumption		*Gross Consumption*	
Sector	QBTU	Percent	QBTU	Percent
Residential	10.0	13.7	14.2	19.3
Commercial	7.5	10.3	10.0	13.6
Industrial	23.9	32.7	30.6	41.7
Transportation	18.3	25.0	18.4	25.1
Utilities (waste heat)	13.3	18.2	—	—
Other	0.2	0.3	0.2	0.3

[a]Source: Laurence I. Moss, "Energy Conservation in the U.S.: Why? How Much? By What Means?", *Energy Conservation Training Institute*, Washington, D.C., The Conservation Foundation, 1976.

Table 2
Energy Use by Function, 1974[a]

	Gross Consumption		*Annual Growth Rate*
Function	QBTU	Percent	Percent
Transportation	18.1	24.8	4.2
Space Heating	13.1	17.9	4.0
Process Steam	12.2	16.7	3.6
Direct Heat	8.3	11.4	2.8
Electric Drive	5.8	7.9	5.3
Feedstocks and Raw Materials	4.0	5.5	5.1
Water Heating	2.9	3.9	4.3
Air Conditioning	1.8	2.5	10.1
Refrigeration	1.6	2.2	5.3
Lighting	1.1	1.5	—
Cooking	0.9	1.2	2.2
Electrolysis	0.9	1.2	4.7

[a]Source: Laurence I. Moss, "Energy Conservation in the U.S.: Why? How Much? By What Means?", *Energy Conservation Training Institute*, Washington, D.C., The Conservation Foundation, 1976.

Buildings

Energy use in buildings is approximately coterminous with residential and commercial use. As shown in Tables 1 and 2, approximately 24 Quadrillion British Thermal Units (QBTU) were consumed in these sectors in 1974, of which about 15 QBTU were used for space heating and cooling. Appreciable amounts were also used for water heating, refrigeration, lighting, and cooking. Evidently, substantial percentage savings are achievable in every one of these uses, but because of their promise of large absolute savings, space heating and cooling are attracting the greatest interest.

Initial work in this area suggests that surprisingly large energy savings can be achieved through simple changes in operating procedures and relatively minor retrofit. Lowering of thermostats from 72 to 68 degrees in northern climates can save at least 15 percent on annual heating bills.[5] Likewise, case studies by the Federal Energy Administration (FEA) indicate that office buildings can reduce energy consumption by up to 15 percent when operating procedures are changed.[6] Simple capital improvements of existing buildings offer even more promise. An energy conservation study by the Enviromental Protection Agency (EPA)[7] suggests that additional insulation—in attics, storm windows, and weatherstripping—can save close to 20 percent of home energy consumption in the approximately 18 million older homes without such insulation.

"What is surprising about the ADL results is that construction costs were also found to be reduced under the new standard."

As one would expect, nonetheless, the greatest efficiency in building use will result from the incorporation of energy-conscious design from the ground up.[8] The American Society of Heating, Refrigeration and Air Conditioning Engineers has recently drafted a standard (ASHRAE 90-75) for new construction which strongly emphasizes the goal of energy conservation. According to a study done by Arthur D. Little, Inc. (ADL) for the Federal Energy Administration,[9] use of this standard would result, for various types of buildings, in the following average savings over current practice:

Single-family dwelling	11.3 percent
Low-rise apartment	42.7 percent
Office Building	59.7 percent
Retail store	40.1 percent
School building	48.1 percent

What is surprising about the ADL results is that construction costs were also found to be reduced under the new standard. It turns out that while ASHRAE 90-75 increases the cost of walls, floors and roofs, the savings in lighting and heating and air conditioning equipment would be more offsetting. Construction savings are largely balanced by increased architectual fees, but nonetheless, it appears that ASHRAE 90-75 would result in buildings that would cost no more to build and would still be considerably less expensive to operate.[10]

If these results are valid, then there presumably is no need to have a policy to encourage or force adoption of ASHRAE 90-75. Despite this, a number of alternative policies have been suggested, such as tax incentives, new rules for lending institutions, and incorporation of ASHRAE 90-75 into building codes. The last has local implications. While localities typically do not draw up their own building codes, they do enforce them. Thus, building code enforcement may offer an energy-conserving opportunity—or burden—to local governments.

Will more compact development aid in the energy conservation effort?

Photo by Bruce Stiftel

Transportation

Energy savings of a similar order are potentially achievable in urban transportation, which accounted for approximately 9 QBTU in the United States in 1974. This total is the sum of energy consumption across all urban modes (almost all private auto). Within each mode energy consumption is a product of three factors: (1) Total person miles traveled (demand); (2) Vehicle occupancy ratio (use efficiency); and (3) Energy consumed per vehicle mile (technical efficiency). The demand factor is intimately connected with land use, and therefore will be considered in more detail later. The technological efficiency factor is clearly beyond the scope of local government. This leaves two possibilities: switching travel to modes which are inherently more efficient technically, and improving the occupancy in each mode. There are steps local governments can take at each level to reduce energy consumption.

Carpooling

Improving vehicle occupancy has received an enormous amount of attention lately,for several reasons, not least of which is that there are few places where energy waste is more glaringly evident. Nationally, about 5 QBTU per year are consumed transporting people to work in cars containing an average of 1.2 persons each. The United States Department of Transportation estimates that if the use of carpools expanded beyond the current 47 percent of all workers to 75 percent, then 375,000 barrels of oil per day would be saved. No costly capital investment is required in carpooling, and the energy savings are realized immediately.

However, belonging to a carpool often entails some individual sacrifice. Car poolers must adapt travel schedules with co-riders. For those with even moderately irregualr working hours, membership in a carpool might be impossible. Carpooling also presents information problems. A person interested in forming a carpool must be able to find similarly minded people who both live and work in reasonably close proximity. For this reason, the most successful carpooling programs have been organized at major installations of large corporations, where at least one destination is fixed. Some corporations, notably the 3M corporation, have gone beyond carpooling to vanpool programs, in which the company supplies a van for 8-10 people to use for the journey to work.[12]

There is an obvious role for local governments to play in localities where employment is too small-scale and dispersed to permit intracompany carpooling programs. In Washington, D.C., a computerized carpool matching program service is provided by the Metropolitan Washington Regional Council of Governments. (MWCOG) Anyone who wishes to join a carpool fills out a questionnaire and returns it to the MWCOG. Beyond this information role, some cities are experimenting with incentives to join carpools.

Transit

The most obvious and widely discussed conservation strategy involves changes in mode choice: get people *out* of their cars and into less energy consumptive vehicles. Inevitably this means mass transit, although other modes offer more energy-saving potential. Motor scooters, for instance, get up to 150 miles per gallon (mpg), and bicycles of course consume no fuel at all. Unfortunately, they have their own drawbacks. Neither is what could be called an all-weather vehicle, and they are almost surely not as safe as cars. The latter problem is one which can be largely if not entirely eliminated by construction of a bikeway network to obviate the need to travel on busy urban thoroughfares.[13] However, in spite of the obvious attractiveness of bikeways for energy conservation, the funds allocated for their construction have been very limited, and there has been no discernible groundswell among the public to speed up the program.

In any case, transit does offer some promise of energy as well as money savings.[14] A bus with 20 passengers achieves about 80 passenger miles per gallon, compared to about 30 passenger miles per gallon for a car with two occupants. Traffic-choked cities for years have been trying to induce their inhabitants to forsake their cars for new or refurbished transit systems. In doing so they have been primarily concerned with the automobile's profligate use of space instead of energy: space on the freeway and in the parking lot. With the energy crisis, then, modal choice policies gain new interest and importance.

Price in Transportation

Modal choice policies fall into two categories: those which discourage auto use and those which encourage transit use. To discuss the relative merits of the two we must touch briefly on the concept of price in transportation. With most goods, the price one pays is a reasonably good surrogate of the opportunity cost of having the good.* The price of auto transportation, on the other hand, has as one component this same out-of-pocket cost: fuel, maintenance, tools, parking (which is marginal with respect to number of trips, if not to miles traveled), but this is only the tip of the iceberg. There is a large fixed component, mainly amortized purchase price and insurance, which must

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be paid regardless of whether the vehicle is operated, and which therefore does not enter into the short-run travel decision. The short-run or perceived price of travel is rather small compared to the fixed cost. Ordinarily, people make their trip decisions based on only a small fraction of the cost of auto use, and this makes it very difficult for transit to compete solely on the basis of price. Besides, the mode decision rests on much more than price, for people consider elapsed time, comfort, security, and privacy. Under most circumstances it is hard for transit to compete successfully on these terms. For these reasons, policies which attempt to entice people out of their cars by improving the quality and price of transit will rarely succeed.

Even if transit is made so attractive, the energy savings might be at least partially nullified by what economists call an "income effect " The lower price of one good will free up resources for the consumption of other goods, including those that compete with it. The suburban commuter who switches to transit because of its lower price may spend the money (and time) saved on still more energy-consumptive activities. For these reasons it appears that modal shift can be more easily achieved by policies to discourage automobile use, either by increasing the price of trips or by decreasing their quality.

Taxation to increase the cost of fuels and maintenance, even if localities had the power, would probably be of limited effectiveness, because it would probably drive people into buying gasoline in neighboring jurisdictions before it would affect their automobile use. Tolls, on the other hand, require a

**The opportunity cost of a good is the sacrifice a person must endure in order to possess the good; namely the opportunity to enjoy other goods and services.*

large maintenance expense. Accordingly, it may be that the most effective way of increasing the marginal cost of automobile travel is through parking restrictions which are therefore potentially valuable energy conservation strategies for cities. Again, there are a number of ways to discourage parking, especially in municipally owned lots. In addition, surcharge or taxes can be directed against privately-owned lots.

At present, urban policy actually encourages the provision of parking facilities in at least one way. Zoning and subdivision regulations often stipulate that so many parking spaces must be provided for a building of a certain size. The aim of such clauses, of course, is to prevent congestion, but the result may be to encourage overprovision of parking spaces,as well as to promote low-density development.[15]

Unlike controls on buildings and vehicle occupancy, for which secondary effects will probably be relatively unimportant, there are a great many uncertainties in the establishment of parking regulations or taxes. Parking management will likely have strong spatial implications, and it seems that any proposal with spatial implications cannot fail to have secondary effects. Will parking management make the central business district less attractive than suburban locations? It would seem that retail establishments would be especially affected, and it is not inconceivable that over time, overall development downtown might suffer. Obviously, these are not policies to be embarked upon casually. Indeed, parking management might better belong in a category of land use policies rather than purely transportation policies. It seems, therefore, that this is a good time to move on to an examination of the relationship between land use and energy consumption.

Energy Consumption and Urban Spatial Structure

Up to now, two prominent links between urban spatial structure and energy consumption have received the most attention. First, as population density increases, it is hypothesized less energy will be required for transportation because the demand for travel will drop and more efficient transportation modes can be supported. Secondly, higher population density implies a shift away from detached single-family dwellings to multiple units, which can be heated and cooled more efficiently.

The Empirical Evidence

These suppositions imply that as population densities increase, both transportation and residential energy consumption should decline. The earliest attempt to support such assumptions through empirical examination was conducted jointly by the Regional Plan Association of New York and Resources for the Future.[16] The study area, the New York City region, has one of the highest population densities in the country, while New York City itself supports the largest transit system in the world. The feeling was, if density does make a difference in energy consumption, it would certainly show in New York.

The study indicated in 1960, per capita energy consumption in the region was 71.3 percent of the national average, and had dropped to 67.4 percent by 1970. Not only was energy consumption in the region lower than in the nation as a whole, but it was also growing more slowly.

Part of this disparity, however, could be accounted for by the relative lack of manufacturing in the New York region. When allowances were made for the "importation" of energy into the region in the form of manufactured goods, the differences observed would be moderated considerably. However, the differences would not disappear, especially in the case of New York City alone. Residential plus transportation energy consumption (Table 3) in New York City is dramatically smaller (nearly 40 percent) than in the United States as a whole. Per capita differences between the region and the United States are not as large, but still highly significant. These findings are substantited by a similar analysis of energy consumption in metropolitan Washington,[17] another high-density area, where per capita residential and transportation energy consumption is only 82 percent of the national average. Actually, the true percentage in Washington is probably even smaller, because

Table 3

Per Capita Energy Consumption by Sector, 1970: New York, Washington, and the United States

	Energy Consumption (million BTU)			
Sector	New York City	New York Region	Metropolitan Washington	United States
Residential	53.1	54.2	45.3	46.9
Commercial/ Public	39.2	44.0	53.7	30.1
Industrial	8.0	16.0		96.1
Transportation	24.3	57.7	61.6	81.9
Total	124.6	171.9	160.6	255.0

[a]Sources: Joel Darmstadter, *Conserving Energy,* Baltimore: Johns Hopkins Press, 1975, Chapter 1; Metropolitan Washington Council of Governments, Energy Consumption in the Metropolitan Area, Washington, D.C.: The Council.

Table 4
Space Heating and Cooling Demands
(10^6 BTU/Square foot/year)

Housing Type	*Arthur D. Little Associates* [a] North-east	North Central	South	West	*Hittman Associates, Inc.* [b] Baltimore-Washington
Mobile Home	.1307	.1536	.0961	.1107	___
Single-family-detached	.1148	.1307	.0714	.0906	.0585
Single-family-attached	.0999	.1261	.0662	.0835	.0689
Low-rise Apartment	.0838	.0991	.0467	.0546	.0512
High-rise Apartment	.0776	.0889	.0414	.0466	.0506
		(Percent of Single-family-detached)			
Mobile Home	114	117	135	122	___
Single-family-detached	100	100	100	100	100
Single-family-attached	87	96	93	92	118
Low-rise Apartment	73	76	65	60	88
High-rise Apartment	67	68	58	51	86

Cited in Curtiss Priest, Kenneth Happy, and Jeffrey Walters, *An Overview and Critical Evaluation of the Relationship between Land Use and Energy Conservation*, Washington, D.C.: Federal Energy Administration, 1976.

[b] Hittman Associates, Inc., *Residential Energy Consumption - Single Family Housing*, Report No. HUD-HAI-2, Washington, D.C.: U.S. Department of Housing and Urban Development, March 1973; Hittman Associates, Inc., *Residential Energy Consumption - Multifamily Housing*, Report No. HUD-HAI-4, Washington, D.C.: U.S. Department of Housing and Urban Development, June 1974.

1973 Washington data are being compared to 1970 U.S. data.

In both New York and Washington, D.C. the difference can be accounted for entirely by the large savings in the transportation sector, a result which lends support to our first hypothesis. Although these findings tell us high density development can lead to substantial transportation savings, they do not tell us exactly why. In other words, we do not know to what extent, if any, these savings are attributable to a reduced demand for travel, and to what extent to the more extensive use of transit. Also, the magnitude of the savings in New York and Washington may not be generalizable to other cities. For might not the near-dearth of manufacturing in both the New York and Washington regions affect the demand for transportation? After all, more than 30 per cent of the nation's transportation energy use moves goods.

The second hypothesis is not supported by either the New York or the Washington study. Since space heating typically consumes approximately 70 percent of residential energy, one would certainly expect lower space heating use to show up as lower residential energy use. As shown in Table 3, however, per capita residential energy consumption in New York City is 16 percent *higher* than in the nation as a whole. One possible explanation for this surprising result is that per capita income in the New York region is 24 percent higher than in the nation. With income elasticities of energy consumption being variously reported as between 0.3 and 0.7, it is evident that a portion of this difference can perhaps be ascribed to higher income levels.

However, under closer examination, the income explanation will not hold up. While per capita residential energy consumption is 20 percent to 50 percent greater than the national average in various places in the New York region, per capita electricity consumption is 30 percent to 50 percent *less,* probably a reflection of the fact that electric power costs in the region are the highest in the nation. Since the overwhelming bulk of nonelectric residential energy consumption goes for space heating, this only intensifies the discrepancy.

A second possible explanation for the higher residential consumption is that the climate of the New York region, while not severe, is rather colder than the national average. (Space heating requirements in New York City exceed those of Washington by about 10 percent).[18] Nonetheless, although climate may be a factor, the fact remains that neither the New York nor the Washington study support the second hypothesis.

Energy and Type of Building

The relationship between energy consumption and housing type can be explored by empirical or hypothetical studies. An empirical investigation would require a controlled comparison of household energy consumption among various housing types, but apparently none have yet been completed. Fortunately, the hypothetical studies in this area seem to be on firmer ground than transportation studies, because they depend more on well-understood engineering principles and less on the responses of individuals.[19] It appears the most accepted data on energy consumption and housing were derived by Hittman Associates, Inc.[20] and Arthur D. Little Associates, Inc. (ADL).[21] Their results are compared in Table 4. As shown, the two studies agree that energy savings can be achieved by a shift away from single-family-detached dwellings, *ceteris paribus,* although ADL is considerably more optimistic.

The principal mechanism promoting greater energy efficiency among multiple family dwellings is the ratio between building volume and the surface area exposed to the outside air. Thus, a row house should consume less energy for space heating than a detached dwelling, a low-rise apartment less still, and a high-rise even less.

In practice, however, energy savings may not be achieved in existing multiple-family dwellings. For example, ADL found multiple-family dwellings were not as well constructed as single family homes. Even where apartments are soundly constructed, energy conservation may be thwarted by a failure to meter utilities separately. In many apartments and condominiums the electricity, water, and even heat are included in the rent or monthly service charge. In that situation, utilities become essentially free goods, and are subject to the abuse that is the fate of free goods everywhere. The resulting waste could not be corrected by charging each dwelling the same average (but time-variant) utility fee, for although utilities would no longer be free, they would be common property resources and still subject to abuse. Separate metering is the only way of confronting each apartment dweller with the cost of his energy consumption, giving him an incentive to conserve.

Spatial Structure and Behavior

The analyses described in the foregoing attempted to estimate the effects of spatial structure on energy consumption while assuming the underlying individual preferences remain fixed. However, it is commonplace that changes in spatial structure have profound impacts on lifestyle and preference patterns, and these changes may also have significant energy implications. For example, when people live in apartments, compared to single-family homes, do they have a greater desire to travel, to get out into open space? What are the implications for travel demand?

Some Caveats

Up to now, everything which has been said suggests that high density will be a powerful impetus to energy conservation. However, some contrary considerations should be mentioned. In the first place, many of the more extravagant claims of 40 percent and 50 percent savings almost certainly can never and will never be achieved. After all, it is extremely unlikely the existing spatial pattern will be dismantled in favor of a more energy-saving one, so savings will be limited by the existing pattern. This pattern will only change slowly, which means that energy savings from land use changes are well into the future.

In an article on this subject, Dale Keyes[22] tried to calculate the energy savings which could reasonably be expected from land use controls by the year 1990. He concluded it would be extremely unlikely that consumption would be reduced more than 3 percent from a projection with no controls. This is considerably more modest than many of the claims discussed above, but nonetheless is significant.

Furthermore, high density development may even interfere with other conservation possibilities. Among environmentalists, the ultimate clean energy source is the sun, but solar energy may conflict with high-density development.[23] Although there are some prospects in the distant future of solar electric power generation, the only commercially available application of solar energy for a long time to come is for space and water heating. Solar collectors for heating, of course, must be located on site, and therefore they need space not found in high-density areas.

So far, the entire land use discussion has taken place within a metropolitan area: the regional or national land use pattern has been assumed to be fixed. Yet in one of the great demographic movements of history, urban areas continue to grow at the expense of the hinterland. In the 1970 census, 70 percent of the population lived in SMSA's, and this is projected to rise to 85 percent in 1990. At the same time, there seems to be a shift among urban areas, with the South and Southwest (the famous "Sunbelt") gaining at the expense of the Northeast. While this latter shift may imply lower per capita consumption of space heating, it also involves the movement from generally high-density urban areas to generally lower ones. The regional implications of such shifts have only begun to be investigated.[24]

Energy Conservation and Intergovernmental Relations

From this review it appears that there is at least a potential for meaningful local government intervention for energy conservation. There are several activities which have been shown to be of great importance for energy conservation, and which have traditionally been within the regulatory province of local government. These activities, discussed in previous sections of this exploration, are land use, building construction, and the local transportation network.

"After all, it is extremely unlikely the existing spatial pattern will be dismantled in favor of a more energy-saving one, so savings will be limited severely by the existing pattern."

However, whether a strong local involvement in energy conservation policy is desirable remains to be seen. What, after all, are the incentives for local governments to intervene to conserve energy? To be sure, the motivations for dealing with emergency allocation problems are clear enough, but what of longer range problems? When energy conservation programs are implemented successfully, the result is that more energy is available nationally. Local energy conservation is therefore a public good, since its benefits cannot be captured by the unit providing it. The theory of public finance indicates that conservation will be underprovided if left to local initiative.

If this is true, how can the apparently intense local and state activity in energy conservation be explained? The amount of state energy legislation enacted since the fuel crisis literally fills volumes, and much of it deals with conservation. Local and metropolitan planning agencies have also been quite active in energy planning. Up to now, however, the conservation measures that actually have been implemented are quite inexpensive in that none has entailed a large sacrifice (a statement as true at the national level as at the state and local level). Any attempt to implement a program with teeth may be a different story, and the natural question for local people to ask is, "What good will it do *us*?"

An incentive for local governments to adopt energy-conserving land use measures may arise out of the reciprocal relationship between energy consumption and spatial structure. As energy becomes more expensive or unavailable, compact cities will suffer less than their sprawling neighbors. It takes time for spatial structure to change, and decisions being made now, when energy is inexpensive,will continue to influence consumption decades hence, when it probably will not be so inexpensive. The specter of a spread city run out of gas may prompt a local concern for conservation, although it is rather difficult to visualize this argument successfully presented as a sole justification for curbing sprawl. On the other hand, there are indications that the private sector may be thinking along these lines. A survey of prominent developers in the Richmond, Virginia area land development market suggests a major shift in the evaluation of site attractiveness has occurred since the energy crisis, with trip lengths and access to transit now being given much more weight.[25]

Apparently then, local and to a lesser extent state involvement in energy conservation will require incentives beyond the rather weak and problematical ones discussed here, and the federal government, for which energy conservation incentives obviously do exist, must transmit these incentives to local governments.

Conclusions

This examination has reviewed a rather wide range of current research relating to energy conservation, with particular attention to those aspects of energy use which can be affected by the actions of local governments. At this point, unfortunately, there is no good answer to this question: What is the role of local government in energy conservation policy? The review and analysis has revealed a number of serious research gaps which must be filled before appropriate local roles and policies can be delineated. In particular, three separate issues are involved. First, what is the potential for local intervention to conserve energy? Second, what can be said about the policies available to implement a local conservation program? And third, what motivations would local units of government have to adopt them, anyway?

As to the energy conservation potential of local government, we must know where and how energy is used and the variables affecting that use. Very nearly all the work described in this report was directly concerned with this question. The results can be summarized briefly in the following assertions.

1. Nearly 18 percent of national energy use goes for space heating. Dramatic opportunities for energy savings are available in this area. Changing operating procedures (for example lowering thermostats) can save at least 15 percent of annual energy consumption for space heating. Simple capital improvements to existing buildings can save up to 20 percent. In new construction, energy consumption can be cut by up to 60 percent depending on the type of building.
2. More than 10 percent of the total U.S. energy budget is used by the urban automobile, and rather inefficiently at that. The potential for reducing this figure through increased use of carpools and transit is considerable, although it is uncertain at this point how successful such programs will be.

Unfortunately, neither of these assertions is particularly well established, being based to an unacceptably high degree on simulation models instead of empirical studies. Even where this is not the case, the empirical support is often very sparse, for data on energy consumption either are not kept or are kept in such a way as to make analysis difficult.

Figure 1 provides a partial list of potential energy-saving policies suitable for local implementation and administration. How effective will each be in curbing energy use, and what will be the costs? What is the timing of the conservation benefits: Will they be realized immediately or will they only be significant in the long term? What impacts will conservation policies have on other public policy goals? What about legal and political feasibility: in particular, how will the implementation of conservation policies be affected by the pattern of jurisdictional atomization so prevalent in metropolitan areas? How do various strategies interact with one another? Some pairs may be mutually exclusive in that they attempt to conserve the same energy. Finally, how do these policies compare with conservation programs to be implemented at the federal or state level?

Answers to these questions are absolutely necessary if the previously discussed bias against policies which raise the price of energy is to be corrected. Indeed, the whole exercise can be viewed as a step in a larger analysis of the extent to which we should or can rely on noneconomic means to control energy use.

If, it turns out that there is probably no significant role for local government to play in energy conservation, the search will not have been in vain, for much of this same information must be developed for energy policy at any governmental level. But if there is a role, the third issue arises. What incentive does local government have for playing it? A great many of the proposals listed in Figure 1, especially those concerned with transportation or land use policy, have been advocated by planners for years in connection with other urban problems. It would appear, then, that energy conservation is consistent with the generally accepted principles and practice of urban planning.

Maybe this suggests a strategy for getting local governments involved in energy conservation. Instead of federal sanctions to encourage local conservation programs for their own sake, such as the national building code, a program of subsidies or incentives to encourage localities to do what they would almost be willing to do by themselves might be more appropriate. Actually, programs of this sort already exist, such as capital grants to communities to establish transit systems. There is, to be sure, much research remaining to be done. Specifically, just how consistent is the goal of energy conservation with other community objectives, and how much energy will be involved? If the answer is not much, then we must question whether local government is the proper place to implement conservation programs. If a significant amount of energy is at stake, then this multiple objective approach is likely to be far more effective in the long run.

Figure 1

Local Energy Conservation Strategies

Automobile Discouragement Strategies

1. Increase fixed cost:
   a. Tax engine displacement, weight, and/or miles per gallon.
   b. Tax second cars.
   c. Require mandatory maintenance/inspection.
2. Increase variable cost:
   a. Increase gasoline tax.
   b. Enact road-use tax.
   c. Increase perception of variable costs through smaller gasoline tanks and/or limits on the amount of gasoline purchased at one time.
3. Increase out-of-pocket costs:
   a. Increase parking costs; require that costs be paid daily.
   b. Increase tolls.
4. Increase travel time:
   a. Reserve lanes for efficient vehicles.
   b. Delineate automobile-free zones.

Land Use Strategies

1. Require land use plans to incorporate conservation guidelines.
2. Require coordination of land use and transportation planning.
3. Create high density zones along transit corridors.
4. Adopt housing and taxation strategies to encourage repair and rennovation in the inner city.
5. Curb redlining and insure the availability of mortgage money for inner city homes.
6. Create incentives for the creation of mixed-use centers.
7. Make cities aesthetically attractive through the public acquisition of historic buildings and other means.
8. Redistribute property taxes so that central city services do not suffer.

Parking Management Strategies

1. Amend zoning ordinances that require construction of off-street parking facilities.
2. Reduce off-street commuter parking.
3. Ban early-morning on-street parking.
4. Require residential parking permits.
5. Tax commercial parking.
6. Revise off-street parking rate structures to make all-day parking more expensive than short-term parking, thereby discouraging commuting.
7. Eliminate free and subsidized government parking.
8. Redesign parking facilities.

Transit Strategies

1. Extend transit service.
2. Increase population density.
3. Improve coordination of transit services with other modes of travel.
4. Improve the security of walking, bicycling, paratransit, and promote their use.
5. Remove legal restrictions against paratransit.
6. Provide more frequent and reliable transit service.
7. Improve transit fare collection procedures.
8. Provide better transit route and scheduling information.
9. Decrease perception of waiting time by providing shelters and increasing security.
10. Decrease riding time by using express buses, priority buses, bus activated traffic signals and other means.
11. Decrease crowding by expanding capacity, initiating peak-load pricing, and encouraging flexible working hours.
12. Subsidize transit fares.
13. Change perception of fares by changing from out-of-pocket to monthly or annual passes.
14. Improve seating design.
15. Improve personal privacy by encouraging company vans and carpools and providing commuter trains.
16. Improve passenger security.

Footnotes

1. However, a strong case that the two paths are mutually exclusive is made by Amory B. Levins, in "Energy Policy: The Road Less Traveled By," *Foreign Affairs,* June 1976.

2. Two well-known publications which make a case for conservation are Energy Research and Development Administration, *The National Energy Plan,* ERDA-48, Washington, D.C.: U.S. Government Printing Office, 1975 and Energy Policy Project of the Ford Foundation, *A Time to Choose: America's Energy Future,* Cambridge, Mass,: Ballinger Publishing Company, 1974. There were many who accused the Ford Foundation report of being far too sanguine regarding our ability to reduce energy consumption to any substantial degree. See, for example, Donald C. Burnham's statement at page 362. ". . . Nonetheless, given the latest cost estimates for new electric power facilities and synthetic fuel plants (e.g. 1000dollars/kw installed and $25dollars/barrel for crude oil from coal), it is clear that conservation investments involving a substantial share of U.S. energy consumption are now justified on the basis of cost alone."

3. A. Light, R. Navazio, and R. Spaulding, "Allocation and Conservation: The Triangle Responds to the Energy Crisis," *Popular Government,* Vol. 41 (Summer 1975), pp. 44-49.

4. See Edward H. Allen, *Handbook of Energy Policy for Local Governments,* Lexington, Mass.: D.C. Heath and Company, Lexington Bo ks, 1975.

5. David A. Pilati, "The Energy Conservation Potential of Winter Thermostat Reduction and Night Setback," Oak Ridge, Tenn.: Oak Ridge National Laboratory, 1975. Actually, percentage savings in the South are even greater (32 percent in Atlanta), although absolute savings are greater in colder climates.

6. Federal Energy Administration, "Total Energy Management: A Practical Handbook on Energy Conservation and Management," Washington, D.C.: Office of Conservation and Environment, Federal Energy Administration.

7. Environmental Protection Agency, *Comprehensive Evaluation of Energy Conservation Measures,* Final Report, 230-1-75-003, Washington, D.C.: The Agency, March 1975, p. 11-25. This report was cited in D. Large," Hidden Waste," in *Energy Conservation Institute,* Washington, D.C.: The Conservation Foundation, 1976, which offers a good account of the possibilities of energy conservation generally.

8. National Bureau of Standards, "Technical Options for Energy Conservation in Buildings," Gaithersburg, Md,: The Bureau, June 1973.

9. Federal Energy Administration, "Energy Conservation in New Building Design: An Impact Assessment of ASHRAE 90-75," Conservation Paper No. 43A, Washington, D.C.:

10. National Bureau of Standards, 1973.

11. *Pool-it News,* Vol. 1 (September 1975). (This is a bimonthly publication of the U.S. Department of Transportation and the Highway Users Federation.)

12. *Pool-it News,* Vol. 1 (May 1975).

13. Although a recent study by the League of American Wheelmen indicates that bikeways exceed even the busiest streets in serious accident frequency per mile of bike travel, presumably because of poor design, low maintenance and multiple use.

14. Albeit not as easily as carpool. See "Comparison of Urban Travel Economic Costs," TSM #6, Washington, D.C.: Highway Users Federation, February 1973.

15. Durwood J. Zailke, "Energy Conservation through Automobile Parking Management," ECP Report, Washington, D.C.: Environmental Law Institute, 1976.

16. See Joel Darmstadter, *Conserving Energy,* Baltimore: Johns Hopkins Press, 1975.

17. James S. Roberts, *Energy, Land Use and Growth Policy: Implications for Metropolitan Washington,* Washington, D.C.: Metropolitan Washington Council of Governments, 1975.

18. James Ruffner, ed., *The Weather Almanac,* Detroit: Gale Research Company, 1974, pp. 286, 443.

19. Good bibliographies of engineering analyses of various housing types are available. See, for example, Curtiss Priest, Kenneth Happy, and Jeffrey Walters, *An Overview and Critical Evaluation of the Relationship Between Land Use and Energy Conservation,* Washington, D.C.: Federal Energy Administration, 1976.

20. Hittman Associates, Inc., *Residential Energy Consumption - Single Family Housing,* Report No. HUD-HAI-2, Washington, D.C.: U.S. Department of Housing and Urban Development, March 1973: Hittman Associates, Inc., *Residential Energy Consumption - Multifamily Housing,* Report No. HUD-HAI-4, Washington, D.C.: U.S. Department of Housing and Urban Development, June 1974.

21. Cited in Priest, et al., 1976.

22. Dale Keyes, 1976. Additional skepticism can be found in Guy Parker, "Can Land Management Reduce Energy Consumption in Transportation." Santa Monica, Calif.: RAND Corporation, May 1974.

23. On the other hand, there are some strong sources of compatibility between the two. Solar heating requires large amounts of plumbing and ductwork, which would be much cheaper on a per unit basis in a multiple family as opposed to a detached dwelling. Solar heated apartments and office buildings would require the use of the sides of the building as well as the top, and this would probably intensify the legal issues associated with solar access.

24. However, see Owen Carroll, *et al., Land Use and Energy Utilization: Interim Report,*: Brookhaven-Stoneybrooke, 1975. They make a first attempt to get at the relationship between land use and industrial energy use.

25. Richmond Regional Planning District Commission, "The Energy Fuel Crisis and Land Development Trends," Richmond, Va.: The Commission, February 1974.

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