RENEWABLE ENERGY IN CITIES

Center for Renewable Resources

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Preface

Since research for this study began in 1979, the renewable energy scene has changed in several ways, some of which have hastened solar development whereas others have set it back. The most visible change occurred in the Federal solar research and development budget, which dropped from almost $600 million in 1981 to about $175 million in 1984. Efforts at demonstration and commercialization were virtually eliminated during this period as federal priorities shifted to long-range, high-risk research. Moreover, the Solar Bank, which subsidizes loans to low- and middle-income people for solar and conservation measures, is now receiving only $25 million a year instead of the $300 million originally authorized. The economic recession of 1981 and 1982 also hurt solar development. The demand for new housing dropped dramatically, and builders were reluctant to adopt conservation measures, solar systems, or anything else that would boost the price of a new home. Likewise, individuals and city governments had less money to spend on renewable energy investments. When oil prices finally stabilized in 1983 and the housing slump ended, energy seemed a less pressing issue than it had been during the "energy crisis."

Other variables, meanwhile, were encouraging solar development. The Public Utility Regulatory Policies Act (PURPA), passed in 1978 to promote small, nonutility electric generation from renewable energy sources and cogeneration, was ineffective in its early years because of court challenges from the utility industry. These delays ended, however, when the Supreme Court upheld all PURPA's major provisions in a June 1983 ruling, and utilities are now required to interconnect with small power producers and pay them for their electricity at a rate equal to "full avoided cost," that is, what it would cost the utility to produce the electricity from other sources. The Supreme Court ruling stimulated a spurt in cogeneration, solar photovoltaic, and windfarm development. Cogeneration capacity now stands at 11,000 megawatts, and market forecasters project that capacity will reach 35,000 megawatts by 1995. California alone added 250 megawatts of capacity from 3,000 wind turbines in 1983. Photovoltaic cells are also entering the utility market faster than expected. Several multimegawatt facilities will go on line in 1984, and peak watt prices should drop below $5. The Sacramento Municipal Utility District

is one of the leaders in photovoltaic development, with construction already begun on a 100-megawatt facility.

Innovative financing has helped spur this growth in solar electric generation. Smart investors saw a promising opportunity in a technology backed by tax credits, investment credits, and accelerated depreciation. Large solar thermal installations also attracted investor interest. Creative financing opened the commercial water-heating market for such applications as hospitals and food-processing plants. Several multimillion-dollar projects of this kind were installed in 1983, including a $30-million water-heating system at the Packerland meatpacking plant in Green Bay, Wisconsin. Third-party investors are also taking over energy management for apartment houses and office buildings, guaranteeing energy savings for the owners and making a profit for themselves.

Technical progress has not been dramatic, but it has been steady. Not only have single-crystal silicon photovoltaic cells dropped in price, but polycrystalline and amorphous silicon cells have entered the market. Large-scale photovoltaic facilities became feasible in 1983. Wind developers appear most satisfied with machines of 100- to 200-kilowatt capacity, since the multi-megawatt machines have been disappointing. Although solar water heaters made exclusively of plastic continue to be heralded, the traditional glass and metal systems still dominate the market. Thermosyphon collectors, less expensive than other types because they do not require pumps, are gaining a growing share of the California market. It is now possible to boost the efficiency and cleanliness of some wood stoves with a catalytic converter. One can also buy a refrigerator, freezer, air conditioner, electric water heater (or furnace), or gas water heater (or furnace) that uses less than half as much energy as the average model for sale in 1980.

In spite of the setbacks and triumphs of the early 1980s, the data base used for this study of renewable energy is aging remarkably well. Conventional fuel prices have remained relatively stable, and so too have the problems faced by cities. Public attention may have wandered, but city officials are still aware of the importance of energy to a local economy. High energy prices continue to influence cities' ability to attract and hold industry, keep housing affordable, and maintain basic services. Indeed, cities are becoming more involved in energy considerations as the focus of concern shifts from oil to electricity. The sudden crisis of nuclear power, reflected in rapidly rising costs and widespread plant cancellations, is creating financial chaos for the many municipal utilities with a share in these projects.

Whether the energy problem concerns uncertain oil, gas, or electricity prices, however, *Putting Renewable Energy to Work* can provide an answer because it is based on stable supplies of renewable energy and permanent energy-effi-

ciency improvements. Its cost equations are as useful in this period of stable oil prices as they were during the tumultuous 1979 oil crisis. Throughout all the shifts in energy costs and fads, the need to improve energy efficiency and increase the use of inexhaustible and inexpensive renewable energy continues to make itself felt.

KEVIN FINNERAN

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Contents

I. THE RIGHT KIND OF ENERGY PLANNING

1. Making the Best Use of Scarce Resources

This book supplies some of the information needed to develop local energy plans and policies based on the use of energy conservation and renewable energy technologies. Although the analysis is objective, it reflects and supports the belief that these options together represent the country's best energy choices if weighed in terms of long-range economy, environmental benevolence, increased community control, and strengthened national security.

Three basic assumptions undergird this book. The first is that city energy officials need technical information to discriminate between appropriate and inappropriate technologies and options. Here, both the strengths and the weaknesses of various technologies are discussed to indicate which technologies would work best in which types of cities. For example, to show how conservation or solar approaches can be combined, the presentations are organized according to end-use (such as water heating or space heating) rather than technology.

The second assumption is that urban energy managers need to understand existing constraints and opportunities: land-use patterns, building stocks, energy supply and distribution networks, and social and economic conditions.

The third assumption is that no urban energy program can afford to overlook the links between energy and housing, employment, and economic development.

Cities themselves must come up with detailed plans for implementing renewable resources programs. But this book summarizes what is known now. It outlines not distant proposals, but immediate possibilities.

ENERGY AND THE CITY

When the U.S. Department of Energy surveyed local government energy activities in 1978, most local governments had not yet linked energy to high unemployment or a declining tax base.[1] But all that has changed. The National League of Cities reported in mid-1981 that 76 percent of city officials it polled identified energy as a major factor in national economic stagnation, and 67 percent felt energy costs were undermining the local economy as well.[2]

Rising energy costs do account for ever larger portions of municipal budgets. Testifying before Congress in 1977 during the relative calm before the most precipitous oil price rises, former Hartford City Councilman Nick Carbone put things this way:

> [W]e must understand how rising energy costs over the past few years have affected local budgets and the delivery of services. Hartford's experience with inflation is relatively typical. Since fiscal year 1971–2, Hartford's budget has increased from $84 million to $130 million . . .
>
> [E]ven though our budget has increased by 28 percent, we have been forced to cut back on services by 31.6 percent . . . at the heart of these inflationary price increases is the rising cost of energy.[3]

Of course, more recent gasoline and fuel price hikes mean that still more is being spent to deliver even less.

A Drain on the Local Economy

Spiralling energy costs have meant more to cities than simply higher figures on municipal budget sheets. Cities' overall economic health, measured by the size of the tax base, the availability of decent housing, and the number of jobs provided by business and industry, is also being threatened. Energy problems exacerbrate other economic woes.

Energy expenditures can drain the local economy, especially in such solar-energy-poor regions as the Northeast and Midwest.[4] In Washington, D.C., the Institute for Local Self Reliance found in 1979 that for every dollar that city residents spent on energy, only 13 cents stayed in the city.[5] In New Orleans, say city planners there, the monetary drain caused by energy price increases means "less local capital for investment, less purchasing power for consumers, and, consequently, slower economic growth than could be possible in the absence of such a cash outflow. Additionally . . . less tax revenue is generated for the city."[6]

Some urban groups and interests are even worse off than the big picture suggests. Struggling industries must endure energy price rises even as they face the threat of energy cutoffs or curtailments. In Philadelphia, industries use relatively little natural gas, and yet the instability of gas supplies has been a driving force behind the city's recent energy-management efforts. Minneapolis, St. Paul, and other cities located at the far end of regional gas pipelines are commensurately more vulnerable to shortfalls.

When energy shortages or curtailments are severe, industries are forced to fold or relocate, costing workers jobs. Indeed, hard on the heels of the energy

price rises and shortages of 1977 came the loss of 11,000 jobs in Philadelphia, twice the previous year's loss.[7]

Substandard housing is also hard hit by energy price inflation. Energy price hikes contribute to the premature demise of the marginal units that constitute much of inner city housing. In Rochester, for example, the number of abandoned buildings jumped from under 400 in 1970 to 1,900 by late 1978. During this same period, fuel oil prices rose by 153 percent, natural gas by 105 percent, and electricity by 108 percent.

The Plight of the Urban Poor

Housing abandonment and growing unemployment are only the most dramatic examples of the steady and severe pressure that energy costs exert upon the urban poor. Families with annual incomes under $5,000 devote three to five times more (on a percentage basis) to energy than higher-income families do. In colder areas with high-priced fuels, the poor are in even worse straits.[8] In Hartford, families with an average yearly income of $3,800 or less spend 30 to 46 percent of their total income on energy alone.[9] What's more, people who cannot afford to fill their oil tanks at each delivery pay a 10 to 15 percent premium as a delivery charge. Since the same people who cannot spare another dollar for energy or who cannot afford to buy heating oil by the tankful will most likely be the first to lose their jobs when businesses or industries cut back, price increases are a matter of double jeopardy.[10]

THE BEGINNINGS OF LOCAL ACTION

Many local governments have responded to this challenge by developing policies to conserve energy and to tap renewable energy technologies. In a landmark study, Portland, Oregon, discovered it could reduce energy consumption to 34 percent below predicted levels by 1995 by adopting a broad range of conservation policies.[11] Davis, California, has cut residential, commercial, and transportation energy use radically by adopting energy-conserving building codes and zoning ordinances, developing land-use controls to encourage the use of solar energy, and officially discouraging automobile traffic and encouraging bicycling. A nine-week campaign in Fitchburg, Massachusetts, paid off handsomely by motivating over 3,000 homeowners to take low-cost or no-cost conservation measures that reduced their heating bills an average of 14 percent.[12]

More cities have launched conservation programs than have developed incentives to encourage alternative energy technologies. But urban solar projects have proven successful. Solar waterheating systems in multifamily structures dot cities from Boston to Honolulu. New infill housing using passive solar

energy is planned for neighborhoods in Denver and Buffalo. St. Paul may use a community-scale solar energy system to provide heat and hot water in a developing industrial park that will house mostly energy firms.[13]

Just as energy problems interlock and take their toll in many economic sectors, the benefits of developing conservation and renewable energy in cities would reverberate throughout the urban economy. Far fewer dollars would leave the local economy if money now spent for foreign oil or out-of-state natural gas were instead spent on manufacturing and installing conservation or solar energy materials and equipment. Besides assisting businesses and creating jobs, investments in local energy would indirectly improve housing and reduce energy costs.

Local energy development based on conservation and renewable resources will be neither automatic nor simple. While the pioneering efforts of a few cities provide precedents and inspiration, few local governments have any experience in community energy management. To develop renewable energy resources, cities will need integrated energy plans. How else can they expect to combine energy-supply and conservation options economically and to make sure that beneficial, long-term energy options are selected over "quick fixes" that ultimately backfire?

Strategies for Developing Local Energy

One strategy open to cities is to *implement federal and state conservation programs* vigorously. The Portland study just cited made this option central to its energy-conservation projections: fully 27 percent of the city's projected 34 percent energy savings in 1995 are to be derived from state and federally sponsored conservation programs.[14] But to get such results, a city would have to lobby legislatures and agencies to adopt energy conservation policies and devise local initiatives to turn federal or state "paper policies" into real programs. State weatherization requirements, for instance, mean little if cities don't have the capacity to conduct energy audits, install energy equipment, and provide financing. With the federal government retrenching on its energy conservation and renewable energy initiatives, support for state and local programs has been diluted in state block grants and reduced. This is bad news, but it may jolt cities to take more responsibility and be more creative. Cities can work more speedily than the federal bureaucracy, and municipal regulatory or incentive programs can be designed to fit each city's energy needs precisely.

Another approach favored by cities is contingency planning. Good contingency plans do force several city departments to coordinate their activities. But while planning for energy emergencies is necessary, it does little to alleviate the underlying problems that caused the energy shortage in the first place.

(One exception is Los Angeles, where contingency planning is part of a general plan to reduce future energy consumption.[15])

The limits of meeting energy emergencies by stepping up lobbying for guaranteed, ongoing conventional energy supplies are especially severe in cities like those in New England that must import nearly all their energy supplies. In contrast, New Orleans has oil and gas deposits within its boundaries, so it need only reduce the legal and environmental obstacles that threaten fuel production to guarantee continuing supplies.[16] But in the end, securing additional oil and gas does nothing to reduce vulnerability to price escalations, and it may delay the search for energy sources even as they grow more scarce.

Still another energy policy available to cities is the use of market barriers and incentives. Rather than rely on mandatory powers to compel energy efficiency, the city in effect changes the pattern or mix of opportunities and constraints that the private energy user faces by, for example, reserving certain roadways exclusively for carpools, providing density bonuses for developers and renovators who include energy conservation features, and providing tax breaks for users of solar energy equipment.[17] Even more common is the adoption of such energy-saving pricing policies as increasing local gasoline taxes and charges for public parking while holding mass transit fares down.

Despite its significant strengths, the barriers-and-incentives approach lacks breadth. As John Alschuler, City Manager of Santa Monica, California, notes:

> [The] use of municipal regulatory power and fiscal resources is not . . . an alternative to the market approach. Successful local programs depend on the present price structure and on the anticipation of continued price increases. However, market strategies without local government support will not yield the anticipated or necessary benefits . . . equal amounts of savings can be achieved with less price-induced hardship if local government action is coupled with price signals.[18]

Moreover, simply changing the constraints on private decisions will not necessarily have the desired public effects. To the city, any policy that preserves its tax base, reduces the flow of dollars from the local economy, and minimizes consumer hardships without costing more than it saves is economical. But the private consumer is more interested in his own cash flow or his rate of return on investment. Thus, what is most economical for the city over time may not appeal to the consumer in the short term. The degree to which the barriers-and-incentives approach can make some publicly beneficial choices more privately appealing without some form of regulatory support is questionable, and the most rational incentive program may be short-circuited if one market factor can simply shift the costs of energy consumption to others.