THE HOME POWER MOVEMENT: TECHNOLOGY, BEHAVIOR, AND THE ENVIRONMENT

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Extended interviews with about 50 widely distributed participants in the "Home Power" movement suggest that approximately 25,000 homes in the U.S. now rely on their own photovoltaic (PV) power systems augmented (often) by small windmills or micro hydro systems. These home power systems are typically sized to provide a small fraction of traditional home electricity use and participants in the home power movement have come to be among the most efficient and technically sophisticated of residential energy users, not only adopting but contributing to the development and marketing of super efficient refrigerators, well pumps, and other residential appliances. While most of the installations are in remote homes where utility connection charges would have been comparable to home power system costs, this economic comparison alone is inadequate to explain the full range of observed energy-related behavior. Strongly internalized environmental values, a desire for a rejuvenated sense of community, and attempts to reconstitute work roles in ways that move away from exclusive dependence on specialized paid work, all appear to be more fundamental explanatory factors. The apparent success of the movement and the effectiveness of the motives involved suggest that more attention should be given to PV-based home power systems as a means for dealing with energy and environmental (e.g., global warming and acid deposition) problems than would otherwise be justified by a simple comparison of costs per kilowatt hour.

INTRODUCTION

The "home power" movement consists of approximately 25,000 home owners[1] who have installed their own photovoltaic (PV) power generation and battery storage systems, often augmented by small wind power or micro-hydroelectric generation. Participants in this movement are without doubt among the most energy conscious of all residential consumers, having *both* restricted their use of electricity to end uses requiring high quality energy sources *and* carefully maximized the efficiency of their remaining use of electricity. In many respects, they are at the opposite extreme from the stereotypical residential consumer who has taken little or no interest in either energy supply or end use systems and fails even to implement those efficiency improvements that would serve his/her immediate economic interests.

Based on extended ethnographic interviews with about 50 participants in the home power movement all over the western United States in the summer of 1989,[2] this paper will begin by briefly reviewing the

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1 *This is a rough consensus estimate by the major retail equipment dealers and is, based on the study underlying this paper (see footnote 2), the most accurate available. Other, older estimates include a SERI estimate of 15,000 systems (SERI 1989) and an estimate of 22,000 systems (Maycock 1990).*

2 *The initial "map" for this study was provided by the bi-monthly* Home Power Magazine *(Perez and Perez 1988-1990). Interview subjects included subscribers, major distributors of home power*

technologies that have been implemented (and in some cases developed) as a part of the movement. It will then offer an interpretation of the movement itself and explore the energy and environmental policy implications of lessons that might be drawn from such an apparently anomalous body of behavior. Specific questions will be raised regarding the possible existence of an untapped reservoir of potential for the implementation of environmentally beneficial conservation and renewable energy systems, and about the adequacy of conventional models of energy-related consumer behavior.

TECHNOLOGY

Home power systems rely almost exclusively on renewable energy supplies at the home site to provide the electrical power for a home. Most of these systems have been installed in homes that are half a mile or more from the nearest power lines--a situation in which the entire home power system may cost less than an initial connection to the conventional utility grid. As such, they are generally stand-alone systems (not interconnected with the utility grid). They cover a wide range of sizes in terms of generation capacity, with the majority of systems in the lower portion of the range from 100 to 1000 peak Watts. While PV panels are now clearly preferred to wind and micro-hydro systems even in low insolation areas such as the upper peninsula of Michigan (with average daily insolation only about half that in the southwest), location does influence the addition of wind or micro-hydro to PV supplies: combined PV and wind systems in parts of Idaho, for example, take advantage of higher wind speeds during sunless winters, while PV based home power systems in parts of California add micro-hydro to take advantage of higher precipitation during similarly sunless winters.

Many of the smaller (50 to 200 peak Watt) home power systems are designed to provide power for minimal electricity use, covering only lighting and communications. ("Communications" generally includes a small stereo system, a TV, and, where there are no traditional phone connections, a CB and/or radio telephone.) At the low end of this size range, thousands of American Indian homes have recently been equipped with PV systems as their first source of electricity for lighting alone. In more conventional applications, cooking and refrigeration are fueled by bottled gas, with at least one major manufacturer re-entering the market for gas-fired absorption refrigerators, as a result.[3] With respect to thermal energy use, passive solar heating, solar water heating, and heavy use of insulation are widespread, and underground homes have also been observed. Given the remoteness of many sites, some use of wood as a heating fuel is common. In a few cases (e.g., near Tonasket, Washington) normal economic expectations have been inverted as home owners with relatively easy access to wood and fairly small living spaces to heat have given only modest attention to traditionally cost effective home insulation while at the same time adopting PV power systems that are not traditionally cost justified. Oddly enough, these situations seem to arise as a product of budgetary limits, however (i.e., lack of funds to pay for thermally tighter homes), and home power homes generally incorporate strict thermal as well as electrical efficiency measures.

Larger home power systems are distinguished from smaller systems primarily by the addition of electric (compression) refrigerators that roughly double the energy requirements associated with smaller systems limited to lighting and communications alone. Clothes washers are often added to the larger systems also. In both the smaller and larger categories, home power systems in combination with solar

systems, major component manufacturers, and other home power home owners from distributors' customer lists. The study was formed around four questions: (1) who is involved in the home power movement? (2) how widespread is the movement? (3) why are home owners installing their own power systems? (4) what, if any, significance does the home power movement have for energy policy making or for society more generally? Detailed ethnographic interviews (generally one hour to a full day in length) in Michigan, Minnesota, Idaho, Washington, Oregon, California, Arizona, New Mexico, and Colorado revealed repeating motivational and other patterns suggesting both that the movement is in these respects relatively uniform and that the interviews conducted are reasonably representative of the movement as a whole.

[3] *Company names have not been used as a matter of ACEEE editorial policy but can be obtained on request from the author.*

thermal and user-collected wood fuels typically eliminate or nearly eliminate conventional energy purchases for the home.

Those who adopt home power systems have, of course, unusual incentives to be efficient, at least in their use of electricity: electric power from photovoltaic systems is widely perceived within the movement as being on the order of two times as expensive as conventional utility power, based on PV panel costs alone of around $5 to $10 per peak Watt. In addition, adopters must generally pay all of their electric power system costs "up front" as initial capital costs, and generally cannot include those costs in a home mortgage--in fact, homes that have only home power systems and no grid connection have generally been entirely ineligible for traditional mortgages (personal communication: Steve Verchinski, Albuquerque, New Mexico).

Many adopters quickly appreciate the fact that vast savings in electricity supply costs can be achieved through relatively modest added investments in increased end use efficiency. Even after this basic point is clear, however, the details of system design and appliance selection typically involve serious study. Even a brief visit to a retail outlet or mail order business selling home power equipment quickly reveals that equipment vendors often spend as much time talking with prospective customers about the efficient use of electricity as they do about PV and other supply systems. Retail outlets almost invariably include efficient lighting displays demonstrating that new high efficiency fixtures can provide lighting comparable to traditional incandescent bulbs while consuming a small fraction of the normal amount of energy. And both retail and mail order outlets devote substantial selling space to efficient lighting, refrigeration, water supply pumping, and other end use systems.

The home power movement appears, in fact, to be one of the primary markets for super efficient refrigerators--standard sized refrigerator/freezers using on the order of 1/10 as much electricity as traditional models (i.e., on the order of 0.5 kWh/day for a 16 cubic foot model). And home power markets have been a major factor in the development as well as the continued marketing, not only of super efficient refrigerators, but also of specialized well pumps and more efficient and reliable inverters for running 110 volt AC appliances from DC battery and PV electricity supplies (personal communications: L. Schlussler, Arcata, California; W. Dankoff, Santa Cruz, New Mexico; B. Summers, Arlington, Washington). Some of these developments have strong overlaps with other markets--PV powered refrigeration of medicines in remote areas of the third world and inverters for recreation vehicles and sail boats, for example. There are even signs of some spill over into more traditional settings. One company in Arizona, for example, is marketing attic fans and filter pumps for swimming pools that use super efficient DC motors driven directly by small PV systems without battery storage; company representatives argue that because of the extreme inefficiency of conventional pumps and fans in these applications (and because the coincidence of demand with sunshine allows the elimination of battery storage), the PV powered devices are cost competitive even in the grid connected applications the company sees as one of its primary marketing targets. (Personal communication: L. Garrett, Scottsdale, Arizona). In another potential carry over, the home power movement now appears to be one of the primary markets and proving grounds for small, short range electric commuting vehicles; many of the models currently being marketed within the movement are essentially electric mopeds or three wheel vehicles, and many of them incorporate small PV charging panels.[4]

Before leaving the topic of "technology," it should be noted that home power systems typically provide a double environmental benefit. If manufactured with proper care, silicon-based PV systems, as well as small wind and hydro systems can have substantial environmental benefits when compared with conventional energy systems (Holdren et al. 1980; OECD 1988). But home power systems also afford the environmental benefits of avoided energy production due to extreme efficiency measures. This bright picture must be tempered somewhat where

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4 *Depending on the precise evolution of air quality concerns in areas like Los Angeles, this early experience could be of greater significance in the long run than is immediately apparent. See, for example, Reinhold 1989.*

wood is used as a heating fuel, although efficiency measures and solar heating in many cases reduce that use also to a minimal back up role. In competition with other proposals for dealing with major environmental problems--e.g., the proposal to remove carbon dioxide from power plant stack gases and dispose of it in the oceans as a means of combatting global warming (Golomb et al. 1989)--home power systems may have much to offer even in their present configurations.

BEHAVIOR AND MOTIVATIONS

Participants in the home power movement come from a wide range of backgrounds and are representative of a wide range of income groups. Most, however, appear to have deliberately pursued, developed, and adopted patterns of life that at least initially departed significantly from traditional norms.

The movement itself appears to have originated in individual efforts to live more comfortably in remote areas. Beginning in the late 60s and continuing through the 70s, the founders of what are now the largest home power businesses first moved to remote areas with little in the way of resources, employment, or clear designs for the better way of life they hoped to find or develop. As young people emerging from the Viet Nam era, some were powerfully disaffected with traditional patterns or simply unconvinced of the desirability of technological progress as it had traditionally been defined. A few just felt generally ill suited to normal society, while a great many had a controlling desire to live in areas of remote natural beauty.

Living for some years under rather primitive conditions in school buses and other simple shelters, often without running water or electricity, these "pioneers" typically developed their first lighting and other "improvements" around automobile batteries charged when their cars were driven. Small gasoline generators were often added later to free the batteries from the car. During the 70s, wind generators were added to many of these systems and in the late 70s and 80s, photovoltaic panels have become widespread.

In each of these transitions, economic constraints and the fact that utility connections would be prohibitively expensive in many cases, have certainly been important factors. An apparent commitment to personal involvement in the design, operation, and control of the energy supply system is also much in evidence, however, both directly and in recent decisions by whole communities *not* to shift to conventional utility power as it has become more easily available with increasing population densities in certain home power communities (personal communication: Steve Willey, Sandpoint, Idaho).

The major home power businesses have emerged somewhat unexpectedly from local efforts to develop home power systems from the original car battery approaches to the more sophisticated and convenient PV-based systems. Individuals who successfully developed their own systems first became local "experts," assisting others in their remote areas to develop their own systems, and eventually became recognized on a regional or national basis as sources of information and equipment. Mail order catalogues began to appear and, over a period of years, a number of self-supporting businesses emerged, in many cases without loans or other start-up assistance. (Personal communication: S. Willey, Sandpoint, Idaho; R. and E. Perez, Medford, Oregon.)

Over the years, some home power people have found careers in their remote areas that have proven lucrative by conventional standards, developing businesses and home power homes that would blend in well in any upscale suburban town. One California family, for example, has developed a small business employing perhaps 10 others in the manufacture of children's musical instruments; except for its remote location and PV power system, their very attractive home is like any other upper middle class California home.

Others, on the other hand, continue to live very simply, often in small, close knit communities of home power families. Employment ranges from refurbishment of old Volvo automobiles through operation of remote radio transmitters to teaching philosophy in a community college. And homes range from $8,000 owner-built underground structures to $100,000 plus cabins equipped with a full range of comforts including satellite dish TV.

At least three motivational themes are widely identifiable within the home power movement: (1) a desire for a strengthened sense of community, (2) a desire to reformulate work roles, and (3) strong environmentalist commitments either of an implicit or of a carefully articulated nature. Implicit in each of these is a desire for greater independence in the formulation of the participants' own patterns of life.

With respect to "community" motivations, many of the people involved in the home power movement originally moved to their present remote locations with groups of friends and continue to live in a more closely integrated community than is typical of most modern suburbs. In other cases, home power communities[5] have grown up gradually as increasing numbers of families have settled in particular areas. Whatever their mode of origin, home power communities often also display their own internal specialization and an unusually close internal cooperation. They frequently include their own "home schooling" systems and road maintenance operations, with associated "specialists." As implied earlier, most present home power businesses have arisen from this very kind of internal specialization, as certain community members gradually became local experts helping their neighbors with home power systems and subsequently became known beyond their own communities for the same speciality. Cooperative home construction and trading of labor for home power components or other goods are not uncommon. As a further indicator of the appreciation of a strengthened sense of community, residents often note with apparent pride that an outsider can ask almost any member of the community where another lives and get the necessary directions through what is often something of a maze of small dirt roads to the appropriate house--even in communities numbering on the order of 100 residents, all seem to be closely acquainted.

The apparent desire among many home power people to reformulate traditional work roles is closely related to efforts to strengthen the sense of community. Home power people seem strongly to prefer self employment over traditional jobs in large organizations, and may also seek a wider range of less specialized work activities. Many have part time paid jobs and spend the remainder of their time working on the construction of their own homes (owner built homes are remarkably common), on wood gathering for winter heating fuel, on large food gardens, and in other activities directly providing for their own and their community's immediate needs.

Environmentalist motivations take several forms. Most obviously, home power people have chosen to live in remote areas of often spectacular beauty, generally at the sacrifice of urban and suburban employment opportunities substantially more remunerative than those available locally. Environmental activism is also common, often with a strong local focus. In many instances, this activism stems from a unique familiarity with particular environmental conditions--e.g., the presence of bald eagles in a proposed lumber harvest tract, or actual numbers of cattle grazing in certain areas of National Forest land--and is aimed at protection of local environmental resources through enforcement of existing laws and regulations. Finally, a number of people have explicitly adopted home power systems at least partly on the basis of environmental concerns and a belief that such systems ease environmental damage. This motivation is perhaps most clearly articulated among the minority of home power adopters who have installed systems even though they are within easy (hence inexpensive) reach of conventional power lines, but it appears to be at least implicit in virtually all cases. Examples can also be found of recently formed home power businesses that have been launched explicitly as a means of working toward the resolution of environmental problems--one, for instance, in which a possible career in forestry was dropped in favor of starting a home power business on the theory that more good could be done for the environment through home power. (Personal communication: Becky Brandborg, Hamilton, Montana.)

Interestingly, the home power movement seems to be concerned less with self-sufficiency *per se* than

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5 *The home power communities referred to are those near Lamy, New Mexico; Sandpoint, Idaho; Tonasket, Washington; Pinehurst, Oregon; Garberville, California; and Davenport, California.*

with independence. There is no apparent reluctance, for example, to rely on sophisticated photovoltaic panel manufacturing outside the movement, nor is there any apparent effort to bring panel production to a local level. Efforts are focused, instead, on independence from the constraints imposed on employment, for instance, by the purchase of conventional appliances and utility power, and by the continuing obligations to pay for these. Commitments to home food production are also too modest to support arguments for a desire for self sufficiency *per se*. To the degree that self sufficiency is implicit in home power efforts, it appears to be a means to greater independence in the pursuit of more satisfying patterns of life in the respects described above.

As a final comment on behavior and motivations, it is worth noting that participants in the home power movement display a remarkable lack of interest in possible federal or state assistance programs that might support their efforts to develop home power systems. Such programs simply never come up in conversation and do not appear to have provided any significant support in the development of the home power movement except at the remote level of basic technology development such as the development of photovoltaic cells. This disinterest, again, does not appear to be explained by a simple desire for self sufficiency. It seems to stem, instead, partly from an awareness that the whole philosophy of home power systems is at odds with Department of Energy approaches to PV power either for homes (where DOE emphasizes multi-kilowatt systems whose marketability would depend on much lower future PV prices) or for more centralized applications. It may also stem from a shared sense that national energy policies and federal or state grants were beyond the range of influence of the relatively isolated, institutionally unaffiliated individuals initially involved in the development and demonstration of home power systems. And it may stem in part from the fact that the originators of the home power movement began their efforts with a generalized departure from conventional patterns of life that set them somewhat apart from the society at large and its shared resources. The home power movement now seems to be generating a growing number of more traditional homes[6] and to be developing new markets among, for example, retired persons who wish to move permanently to their remote vacation homes (and hence want to make those homes more comfortable by adding home power systems). (Personal communication: S. Willey, Sandpoint, Idaho.) But by now, home power businesses are a self-supporting enterprise and accustomed to being so; in this context, the question of state or federal assistance again, simply is not pursued.

LESSONS TO BE LEARNED?

Even with 25,000 home power systems in place, the behavior of participants in this movement cannot be described as "mainstream." It may, nevertheless, help to illustrate the broad range of behavior that is possible, and suggest questions about existing policies and policy assumptions that are worthy of attention.

There is strong evidence throughout the home power movement to suggest that *minimization of expenses* has been used--even consciously and explicitly in some cases--as an alternative to maximization of income, as a means of implementing satisfying patterns of life.[7] Inexpensive (remote) land, owner-constructed homes, reconstituted community relations and work roles, and photovoltaic power systems are all, in a certain sense, part of this alternative approach. Collectively, they have contributed to very different patterns of "consumer behavior" well apart from traditional norms. These patterns, in turn, suggest the possibility of a bimodal or multimodal distribution of behavior as opposed to a single "mainstream" behavioral mode with only marginal departures from that central pattern.

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6 *Homes now being equipped with home power systems include not only new remote homes and the small number of homes within easy reach of the power grid, but also a surprising number of remote ranch homes previously powered by fossil-fueled generators. For examples in each category, see Perez and Perez 1988-1990.*

7 *This approach has echoes in other research--e.g., discussion of analogous approaches to farming in Vidich and Bensman 1968.*

Energy and environmental policy analysis tends to assume that dominant patterns of behavior are in an optimal "neighborhood" and that policy alternatives should examine marginal changes within that neighborhood. Alternatives to existing energy supply systems are typically compared on the basis of costs per Btu or costs per kilowatt hour, with less expensive sources preferred (Stern and Aronson 1984). Efficiency potentials are evaluated in a similar manner, comparing, for example, the life cycle costs of less efficient supply/end-use combinations with those of more efficient combinations (as in Geller 1987).

Very different bimodal or multi-modal images of consumer preferences raise basic questions about limiting consideration of alternatives to the immediate neighborhood of presently dominant preferences. These questions, in fact, extend to the very roots of the theory of socially optimal energy choices (Baumol 1964; Baumol and Bradford 1972).

The patterns of behavior evident in the home power movement, do, on the other hand, tend to confirm the more general notion that "consumers" are ultimately interested in attractive supply/end-use systems ("energy services") at affordable costs--not in "energy" *per se* (Lovins 1977). Such interests, of course, involve many more variables than can be accounted for in simple cost comparisons among fuels and efficiency options. The complications introduced by other variables have, in the case of the home power movement, unexpectedly resulted in the selection of *more expensive* efficiency measures and PV power supplies as components in the equally unexpectedly *more affordable* (cheaper in absolute terms) systems most attractive to movement participants.

In an odd reversal of the usual patterns of consumer behavior, home power adopters seem to have incorporated (or "internalized") nearly all of the social and environmental effects of their energy choices in their energy decision making. In a further departure from widespread consumer behavior, home power decisions appear to be biased in ways that cause *more* energy conservation than would be expected from an economically rational response to price (cf. Kempton and Montgomery 1982). While the methods of home power adopters may remain, in many cases, less quantitatively sophisticated than traditional methods, it can be argued that the adopters' decision processes are substantially more sophisticated than traditional methods with respect to the integration of disparate factors into coherent choices.

The home power movement suggests in a small way that the assumption that consumers act only from very narrowly conceived self interest--and imperfectly at that--may be misplaced. The capacity for choice based on more broadly conceived self interest, and for integrative conceptualization of more sustainable patterns of life based on those broadened concepts of self interest may, this movement would suggest, have been underestimated.

The behavior of those involved in the home power movement suggests, then, both that "consumer preferences" may be more complex in important respects than normal market data would suggest, and that consumer decision making can be substantially more sophisticated in its responsiveness to large scale energy and environmental concerns than the usual models would predict.

These observations raise further questions in at least two areas with respect to energy and environmental policy.

First, is there, as the home power movement might indicate, an untapped reservoir of potential for the implementation of conservation and renewables--and, if so, how large is that reservoir?[8] If 25,000 home power systems have been implemented with little in the way of direct encouragement, how many more might develop--if indeed more would be socially desirable--with concerted and systematic support? And what means other than home power might be worth exploring for tapping into this potential if indeed it does exist?

As a second question, it may be wise to ask whether the dynamics of the home power movement might be--or might have been--*damaged* by active government involvement. Would we, in fact, now have as

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[8] *Related indicators might be drawn from sources such as the "voluntary simplicity" literature. See, for example, Elgin 1981.*

many as 25,000 systems in place if there *had* been an active public policy involvement from the start? And what does the answer to this question tell us about national energy policy or policy making? To pursue one angle, it has certainly been amply demonstrated in other areas that expanded participation in energy decision making can greatly expand the range of alternatives considered and adopted.[9] To what degree might historical patterns of specialization in the supply and use of energy have systematically (though perhaps unintentionally) *disabled* residential and/or other consumers of energy when it comes to making intelligent energy/environmental choices? To what degree might such a "disability" be cured by efforts to reverse traditional tendencies toward specialization, and how far would it be worth pursuing such a reversal purely in the interest of "improved" decision making?

Even at their present scale, home power activities clearly raise interesting and very basic questions about traditional images of consumer behavior and the role of public policy as regards energy and the environment. At the very least, the apparent success of the home power movement and the effectiveness of the motives involved suggest that substantially more attention should be given to PV-based home power systems (and perhaps to other unconventional alternatives[10]) as a means for dealing with energy and environmental problems than would be justified by simple comparisons of costs per kilowatt hour alone.

REFERENCES

Baumol, W. J. June 1964. "External Economies and Second-Order Optimality Conditions." *The American Economic Review* 54(4).

Baumol, W. J., and D. F. Bradford. May 1972. "Detrimental Externalities and Non-Convexity of the Production Set." *Economica* 39.

Elgin, D. 1981. *Voluntary Simplicity: Toward a Way of Life That is Outwardly Simple, Inwardly Rich.* William Morrow and Company, Inc., New York.

Geller, H., J. P. Harris, M. D. Levine, and A. H. Rosenfeld. 1987. "The Role of Federal Research and Development in Advancing Energy Efficiency: A $50 Billion Contribution to the US Economy." *Annual Review of Energy* 12:357-395. Annual Reviews Inc., Palo Alto, California.

Golomb, D., H. Herzog, J. Tester, D. White, and S. Zemba. 1989. "Feasibility and Economics of CO_2 Capture in Flue Gas of Power Plants." MIT Energy Laboratory Report, Cambridge, Massachusetts.

Holdren, J. P., G. Morris, and I. Mintzer. 1980. "Environmental Aspects of Renewable Energy Sources." *Annual Review of Energy* 5:241-291. Annual Reviews Inc., Palo Alto, California.

Kempton, W., and L. Montgomery. 1982. "Folk Quantification of Energy." *Energy.* 7(10):817-827.

Lovins, A. 1977. *Soft Energy Paths: Toward a Durable Peace.* Ballinger Publishing Company, Cambridge, Massachusetts.

Maycock, P. 1990. "Photovoltaic Technology Cost and Markets Forecast to 2000." PV Energy Systems, Casanova, Virginia.

Ogden, J. M., and R. H. Williams. 1989. "Solar Hydrogen: Moving Beyond Fossil Fuels." World Resources Institute, Washington D.C.

Organization for Economic Cooperation and Development. 1988. "Environmental Impacts of Renewable Energy." OECD, Paris.

Perez, R., and E. Perez. 1988-1990. *Home Power Magazine.* P.O. Box 442, Medford, Oregon.

Reinhold, R. March 18, 1989. "Southern California Takes Steps To Curb Its Urban Air Pollution." *New York Times* p.1.

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[9] *I have in mind especially, here, the expansion of independent power production following passage and implementation of the Public Utility Regulatory Policies Act of 1978, particularly in California. See, for example, Tatum and Bradshaw 1986.*

[10] *Such as hydrogen fuels (Ogden and Williams 1989).*

Solar Energy Research Institute. November 1989. "Photovoltaics Entering the 1990s." SERI/SP-220-3461, Golden, Colorado.

Stern, P. C., and E. Aronson, editors. 1984. *Energy Use: The Human Dimension*. Committee on Behavioral and Social Aspects of Energy Consumption and Production, National Research Council. W. H. Freeman and Company, New York.

Tatum, J. S., and T. K. Bradshaw. 1986. "Energy Production by Local Governments: An Expanding Role." *Annual Review of Energy*. Annual Reviews Inc., Palo Alto, California, 11:471-512.

Vidich, A. J., and J. Bensman. 1968. *Small Town in Mass Society*. Princeton University Press, Princeton, New Jersey.