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ENERGY AND THE SOCIAL SCIENCES

A PRELIMINARY LITERATURE SURVEY

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Abstract

Energy and the Social Sciences
A Preliminary Literature Survey (Paul Sommers, 1975)
Mapping Project on Energy and the Social Sciences
Institution for Social and Policy Studies
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The social science literature pertaining to energy problems is reviewed, and preliminary suggestions for research projects and research strategy are presented. Since this review was intended to be brief, research ideas are not fully developed. In this abstract only a few major themes are noted.

Much of the social science literature on energy is in the field of economics, where such themes as econometric models, pricing policy, taxation, and government-industry interactions are discussed. Among the suggested research efforts is a study of proper economic criteria for determining rates of development of alternative sources of energy.

The political science literature on energy is not well developed, but a review of it indicates interesting possibilities for research. The kinds of social and political institutions which would be most effective in an energy-constrained economy should be studied, and a comparative study of institutions now in existence in the United States and other countries is suggested. The social effects of centralized, comprehensive decision-making, which might be necessary in the event of significant shortages of energy, should be studied. The roles of community groups, interest groups, the media, government, etc., in decision-making should receive continuing attention.

In the fields of sociology and psychology there is a need for more understanding of the attitudes, beliefs, and behavior of individuals about

energy matters. The ways in which people adapt to energy shortages and changes in energy prices should be a subject for continuing studies. It is suggested that plans be made for surveys of coping strategies under emergency conditions as well as under conditions of gradual change. A possible long-range reaction to energy shortages and high prices might be a decrease in living-space available to individuals and families, and the work of psychologists in this area should be analyzed.

"Oil holds a unique place in the popular imagination; it is always news. Oil is revered and oil is feared. Its power for good is eulogized with almost fanatic enthusiasm; its power for evil is exaggerated to the wildest extremes" (Frankel, 1946, p. 1).

"October 17, 1973 was energy Pearl Harbor day. Instead of dropping bombs, a handful of oil-rich Arab nations shut off a few valves and sent shock waves through the closely linked high-energy industrial civilization in the United States, Western Europe and Japan...On January 1, 1974, the oil producing nations dropped the other shoe, so to speak, by more than doubling the price of crude oil. To the energy-starved industrial nations the prospect of paying billions more coupled with continued shortages of oil put the entire industrial world economy in jeopardy" (Freeman, 1974, p. 3).

The salience of Frankel's comment is apparent in the second quote from Freeman. Hyperbole has been a frequent feature of public discussions in the months following the oil producers' boycott and price hikes. The tendency of academic, business and political leaders to exaggerate, to predict the worst possible future is in itself adequate reason for the social sciences to undertake a serious examination of the effects of a continuing energy shortage upon the behavior and opinions of all segments of the population.

Social science input into decisions about our energy future is also needed because the significant problems are social as well as technical. The demand for energy is a social phenomenon. Energy conservation is a mode of behavior which government policies would like to encourage. Exploiting new sources of energy may significantly stress the social structure and greatly stimulate the economies of local areas.

This paper will review the existing social science literature on the effects of the energy shortage and will emphasize the needs for further research.* A sizeable literature is already in existence, with many contributions from economists and a few works from the other social science disci-

*Several of the research suggestions offered are a result of discussions with Charles A. Walker and Edward J. Woodhouse of the Institution for Social and Policy Studies, Yale University.

plines. The spector of the events of 1973 and 1974 will no doubt spawn many more efforts in the future.

Energy: The Basic Fact of Shortages

The reality of the energy shortage is becoming increasingly apparent. The basic facts are set out in Freeman (1974), Kwee and Mullender (1972), Melkus (1974) and the recent report from the National Academy of Sciences (1975). Energy use in this country grew at a rate of 4% per year through the 1960's and the early 1970's. Annual consumption of energy in 1972 totaled 72 quadrillion Btu's. Of this total, 25% was for transportation, 18% was for space heating, 36% was for direct industrial use and 5% was for petrochemical raw materials (Freeman, 1974, pp. 27-29). Oil and natural gas provided 75% of the U.S. energy supply in 1972, while coal provided 17% (Freeman, 1974, pp. 21-22).

This constitutes an enormous demand for oil products relative to the known reserves recoverable with current technologies. With 1975 prices for crude oil and presently available technology, it is estimated that the Persian Gulf oil reserves will be substantially exhausted by the end of this century (NAS, 1975). U.S. reserves of oil and natural gas may be depleted in as little as 10 years (Melkus, 1974, p. 244). At higher prices additional oil might be extracted from existing fields with more exotic technologies, but the quantity recoverable with presently known or future technologies is impossible to accurately estimate.

Coal is the most likely alternative to oil in many uses. Many of the nation's utility companies switched from coal to oil burners in the past, and could be prevailed upon to switch back at a considerable cost. Industrial boilers can be fired with coal. Homes can be heated with coal. Furthermore,

coal is relatively abundant in this country. Using present extraction technologies, the U.S. has enough coal to supply all of its energy needs for at least a century (Melkus, 1974, p. 246). Pollution problems due to particulate byproducts of coal combustion and due to sulfur in the coal are a major hurdle to be overcome before any massive conversion to coal can be contemplated.

Other alternative sources of energy are geothermal, solar, tidal and wind energy. These sources are especially attractive because they are "income" or non-depletable energy sources, in contrast to "capital" or non-renewable sources such as fossil fuels. Much of the technology for exploiting these sources is unknown or experimental at this point in time. The engineering lead time required for mass production of the capital equipment needed to utilize these sources, and the large investments that would be required of utility companies, households or governments, imply that these are sources of the 1980's and 1990's rather than immediate alternatives.

As for nuclear power, it has its own special economic, environmental and safety problems (see Sagan, 1972). The proven reserves of high grade uranium ore, currently used to fuel the light water fission reactors, are not plentiful. The availability of appropriate ores in the future is uncertain due to inadequate exploration, and the economics of using lower grade ores is not known. If planned expansion of this source takes place in the late 1970's and 1980's, the fuel may be in short supply by the end of the century. The controversy surrounding the breeder reactor, which would use up much less uranium ore, is still raging. The safety of the system is in serious question; transportation of relatively large quanti-

tities of fissionable material easily converted into a bomb by a competent physicist is required by a breeder economy. End of the cycle fuel wastes have to be stored in lead and guarded far longer than our civilization is likely to survive. Fusion reactors are not yet a reality. Hence the future of nuclear power in this country is quite unpredictable.

These facts add up to a challenge to the American lifestyle. Our present investment in an urban and suburban, car-centered, energy-intensive way of life is not easily transformed. The houses, cars and community facilities are going to be around for many years to come. The extent and quantitative significance of energy conservation possibilities are not completely known, but it is probable that an extended boycott of the U.S. by the Persian Gulf oil producers could disrupt the lifestyles of millions and set off another recession. The effects of high energy prices in such a context are a subject for further research. Will suburbanites reverse their flight from the city if faced with $1.00 per gallon gasoline? Or will they pay the higher prices for energy and sacrifice vacation trips, private schools for the children, and other "luxuries" in order to maintain their suburban residences? What will higher energy costs do to the nation's poor? What effects will higher energy prices have on GNP and on employment? What could a single severe winter do to the nation's reserves of heating fuels, and what social consequences could this have?

A further effect of energy shortages may be a threat to environmental preservation and conservation efforts. Cleaning up pollution often requires extra use of energy. Environmental legislation may be attacked in the name of conservation of energy. Coal combustion may darken our skys, buildings and lungs again. What price are we willing to pay for preservation of the

environment, particularly if the price is a reduction of the supply of energy to some other sector of the economy? Kwee and Mullender's (1972) volume and White (1973) give some explicit attention to this problem, but it is an area deserving much more research effort.

Economic Studies of Energy

The classic study of the economics of petroleum is that of Frankel (1946). Re-issued in 1969, his volume is a useful outline of the economics of petroleum extraction, refining and transportation. His main conclusions of price inelastic supply and demand seem appropriate today, especially on the demand side.

Recent efforts include the studies by Allvine and Patterson (1972, 1974) of the refining retail gasoline industries in the U.S. Allvine and Patterson conclude that vertical integration in the petroleum industries from wellhead to gas pump is undesirable because it leads to higher prices, inefficient allocation of resources within the industry, and other evils usually associated with significant market power at a given level of production rather than with vertical integration. The Alaskan oil discoveries have resulted in economic studies of recovery costs, and the costs of alternative shipping and pipeline routes (Adelman et al., 1971; Cicchetti, 1972).

McDonald (1971) has examined state and federal governments' regulation of the petroleum industry in the name of conservation of domestic reserves. A detailed outline of the technology and economics of petroleum extraction is included. McDonald's basic argument is that a private enterprise system can be made consistent with an optimal rate of petroleum extraction if externalities can be internalized and if petroleum reservoirs are developed and operated as single units. The tradition of privately owned mineral rights

in this country makes the last condition difficult to achieve. The usual result is that too many wells are drilled too close together relative to optimum numbers and spacing as a result of the competition between different owners tapping the same reservoir of oil.

Recent journal literature includes Greenwood's (1974) examination of Canadian-American trade in energy resources. The principal items traded are Canadian oil and American coal. Unresolved issues in this area are the international distribution of income resulting from the trade, the role of U.S. corporations in the economic development of Canada, and the extent to which national resources should be restricted to domestic uses.

Cicchetti and Gillen (1973) analyse the mandatory oil import program of the Federal government. They conclude that abandoning the program and allowing free market conditions to prevail would save consumers $8 billion to $13.5 billion per year in 1975 at the costs (non-quantifiable) of loss of national security and protection of domestic production from foreign competition. These conclusions were reached on the assumption of stable OPEC oil prices from 1971 through 1975 (stated OPEC policy until January 1, 1974).

Lichtenberg and Norgaard (1974) have considered the effects of tax and energy policies on the petroleum industries. They note the evidence for distortions resulting from these policies which raise the rate of extraction, and lower the consumer's costs, relative to socially optimum levels. Delay in the development of alternative energy resources is also traceable to tax policies.

Other contributions include Griffin's (1974) paper on energy prices and electricity consumption, Kennedy's (1974) model of the world oil mar-

ket, Carter's (1974) paper on the effects of higher energy prices and environmental preservation efforts on economic growth, and the Hudson and Jorgenson (1974) attempt to predict the levels of economic activity and energy utilization for the last quarter of the 20th century. The effects of alternate energy price or taxation policies can be explicitly explored with their rather complex combination of consumer demand, interindustry input-output and macroeconomic models.

Project Independence, the program to make the U.S. self-sufficient in energy by 1980, has been examined by a group of MIT researchers (Adelman et al., 1974). This multi-disciplinary effort includes judgemental forecasts of supply and demand. The Hudson and Jorgenson paper mentioned above is a part of the MIT study. The results of the study indicate that at prices of $10.00 to $12.00 per barrel of oil, and equivalent prices for other fossil fuels, domestic supply will be sufficient to meet domestic demands by 1980. The price of this self-sufficiency includes a sharp increase in prices to energy consumers. Special policies to encourage large corporate investments may be required to insure development of synthetic natural gas industries. The ability of the construction and transportation industries to keep pace with the increased orders from utilities, extraction and refining industries is an area needing research attention.

Suggestions for further research on the economics of energy abound. The Rose-Ackerman memo (1975) suggests building a macroeconomic model to predict technological change and the future status of environmental variables. This approach would call for joint efforts by economists and engineers in developing models to predict technological change. The linkage between energy policy and the environment is an area of great importance deserving

additional work. Rose-Ackerman also suggests studies of competing and interacting regulatory agencies at Federal and state levels, of the nature of the incentives for technological change provided by various government policies, and of the relationships between OPEC, the major oil companies and American policy. This last suggestion should certainly be expanded to consideration of the policies of the other consuming nations, especially since the major oil companies are multi-national in character. Many of these suggestions have the advantage of providing opportunities for collaborative efforts among economists, political scientists and sociologists, in Rose-Ackerman's view.

Other possibilities include studies of the automobile industry. Possible topics include its importance to the U.S. economy, the effects of energy saving innovations, the effects of major technological changes in engines and in overall design, the effects on the economy of a drastic curtailment of the gasoline supply, and the availability of substitutes for automobiles (most auto trips are very short; what percentage could be accomplished by bus, bicycle or foot; what percentage of the population could or would switch to these substitutes at high gasoline prices?).

Recycling could be examined in the new light of energy shortage. Does recycling of glass, of metal, of paper, save energy? Does it save dollars at current energy prices? Could new legislation alter the ICP (informational, contractual and policing) costs in such a way as to make more recycling and less net energy use a possibility (c.f., the State of Oregon's attempts in this direction).

The energy costs of consumer goods have been analysed by Hannon (1973), who uses an input-output model to trace the direct and indirect costs of

consumer goods in Btu's. He suggests that this approach could be used to develop a national energy budget with a goal of minimizing total energy use in the economy. One could also use such a model to search for energy conserving substitution possibilities. A massive linear programming problem is suggested.

Studies of industries could be carried out to determine the effects of higher energy costs on employment, technological change, entry and exit from industries, etc. The emergence of energy conservation consulting firms could be studied. The relationship of the proposed national economic plan now being discussed in the Congress to energy and environmental policies could be explored. Can such a plan be useful in protecting the environment while stimulating energy extraction and conversion industries? Can it help to make short-run business cycle policy consistent with long-run energy conversion goals?

Cooperation with the Nelson-Orcutt-Ruggles microanalytic effort could be explored. The possibilities for simulation of the effects of proposed policies are tantalizing, if the data are available or obtainable. Similarly, cooperative efforts could be considered with the political science project on income distribution, and with the Ackerman-Burch-Orcutt-Stolwijk effort to quantify environmental costs.

The distinction between capital and income sources of energy suggests a number of research projects. What is the optimal rate at which to use up our capital sources? For what purposes should we utilize non-renewable resources such as fossil fuels? What would be the costs of switching to income sources by a specified date (see Energy, Earth & Everyone, 1974)? How much time do we have to accomplish such a conversion given our fossil fuel

resources? What are the total environmental costs of each possible source of energy?

The appropriate criteria for making decisions about energy source development is a matter for debate. Economists traditionally recommend equalizing the marginal costs of utilizing each available resource (assumming perfect substitutability) and allowing the price mechanism to equate supply and demand so as to ration out the supplies. The price mechanism is also supposed to take care of consumer preferences for cetain forms of energy by allowing consumers to pay more for, and get more of, preferred forms of energy (e.g. electricity). However, perfectly competitive conditions do not exist in this country's energy industries, and therefore the price mechanism cannot be relied on to give an optimal result.

Engineers have suggested that net energy use be the criterion for choosing sources of energy. Nuclear power plants do badly on this criterion because so much energy has to be invested in their construction. Secondary recovery of oil from existing fields by more exotic technologies may also look bad by the net energy use criterion. This approach often assumes perfect substitutability of energy forms, thereby ignoring consumer preferences for certain forms of energy over others. If consumers really prefer electricity over oil for home heating, why shouldn't we use up some Btu's to give them electricity instead of oil?

Energy, Earth & Everyone suggests that the only proper use of capital sources of energy is to convert the world economy to income sources as fast as possible. Other people have suggested that fossil fuels be saved for petrochemical industries, and that use for transportation and heating be drastically reduced. Hannon (1973) suggests that we minimize total energy

use. Just what is the proper criterion for deciding how fast, and at what cost, to develop energy sources?

Political Science

The existing political science literature on energy questions is small but exciting. The possibilities for further work are also of interest. The Kwee and Mullender volume (1972) provides a good overview of the energy policies of the U.S. and several European countries, including Poland. This suggests the possibility of comparative studies to uncover the most successful institutions and policies for dealing with energy problems. Are Communist systems more stable in the face of an energy shortage due to their greater isolation from other economies and societies? Are private or public oil companies more desirable? Are socialist societies better able to cope with energy shortages and to come up with effective policy responses than capitalist mixed economies with strong democratic traditions? Is indicative planning of any value in formulating and implementing energy policy?

The Schooler article in Kwee and Mullender (1972) offers a typology of political systems in relation to energy and environmental problems. National political systems may progress through three stages: expansion and resource development, environmental confrontation, and ecology. The developed nations are just now moving from the first to the second stage. Whether any nation will achieve the third is uncertain. This last stage is characterized by centralized, comprehensive decision-making which takes into account all of the complicated inter-relationships of an ecological setting. A surrender of individual perogatives to the collective interest is implied.

Other visions of the future could be explored. The recent work of

economists on stationary, non-growing economies comes to mind (Daly, 1973; Schumacher, 1973). Political and social thinkers could work on the nature of the social systems appropriate to an energy-constrained economy, and the extent to which traditional democratic freedoms could be tolerated in an ecologically managed society.

Beer's article in Kwee and Mullender (1972) suggests that an International Energy Agency be created to resolve regional conflicts, to balance international power assymmetries arising from ownership of energy resources, and to protect the international environment. The shortages of energy and mineral resources in the world economy of the future and the environmental problems resulting from fossil fuel exploitation make such an international body a very attractive idea.

Much of our energy policy is made in the Congress. Study of the internal politics of the Congress is hence an important task. An outstanding effort in this area is the monograph by Oppenheimer (1974). Oppenheimer uses a policy continuum developed by Edelman which envisages policies ranged along a continuum from symbolic to material. Oppenheimer chooses the oil depletion allowance as a policy representing the material end of the continuum because of its concrete financial consequences, and water pollution as representative of the symbolic end because levels of enforcement of the numerous legislative acts in this area have been low. The expectation is that policies from opposite ends of the continuum will be reacted to differentially by participants in the Congress' policy-making process.

Oppenheimer also examines the effects of more traditional variables such as the constituencies of committee members (more oil state members on the Senate committee than on the House committee), the rules and procedures

of the two legislative houses, and the existence of significant opposition. Much of the fate of the issues studied can be explained with these traditional variables. Oppenheimer contends that the policy continuum is important in explaining a shift in the oil industry's tactics which could not be predicted from the other variables. The focus of the industry's efforts shifted from the legislative to the executive branch as policy changed from a symbolic to a material emphasis.

The major international institutions involved in the recent oil crisis have been examined to some extent. The Organization of Petroleum Exporting Countries (OPEC) was founded in 1960, and has a U.N.-style secretariat and professional staff as well as bi-annual ministerial level meetings of the member countries (Mikdashi, 1974; Rouhani, 1971). Mikdashi notes that OPEC has achieved a moderate level of institutionalization. It remains a creation and policy tool of the member states, whereas an independent policy role is characteristic of fully developed institutions. OPEC is more highly institutionalized than the Organization of Arab Petroleum Exporting Countries (OAPEC), however.* The success of OPEC is due to the newly achieved solidarity of the member countries (pricing solidarity is a very recent achievement of the organization) and due to the price inelasticity of petroleum demand. The small number of major oil companies with which OPEC must negotiate may also contribute to its success. The seven major oil companies are neither too many for competitive conditions to prevail on the demand side of the market, not too few so as to concentrate more power on the demand side than on the supply side.

The international institutions on the other side of the market provide

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*OPEC is the organization responsible for the crude oil price hikes of 1974;OAPEC is responsible for the boycott started in October, 1973.

a striking contrast to the developing institutionalization, member solidarity and organizational success of OPEC. No coherent political organization exists to counter OPEC and/or to give support to the oil companies at the bargaining table. The Council of Ministers of the European Economic Community is ineffective on the oil issue due to predominant national interests. The Organization for Economic Cooperation and Development, which had organized international cooperation in previous oil crises (1956 Suez Crisis and the 1967 Six Day War in the Middle East) failed to act in 1973 and 1974 to provide the embargoed Dutch with a secure supply of petroleum (Turner, 1974).

Efforts by U.S. Secretary of State Kissinger and his assistant Thomas O. Enders to create a consumer organization to counter producer demands and to present a united consumer front in negotiations with OPEC have proved largely fruitless. The only tangible result has been a start towards establishing an international financial safety net to help out countries threatened by the "oil weapon", financial warfare on the part of producing countries or persistent balance of payment deficits.

Further research effort should certainly be expended in the area of international organizations. The disarray of the consumers and the recent success of the producers' organization after 14 years of careful groundwork are an indication that successful organizations at the international level cannot be created overnight with a little shuttle diplomacy. The possibilities for strengthening EEC and OECD participation in energy policy should be examined. The difficulties of creating, and the advantages of having, new international organizations of energy consumers, and/or consumers and producers together, should be explored. The Beers suggestion of an inter-

national energy agency, possibly under U.N. auspices, should be considered. The factors promoting the success of OPEC and OAPEC should be considered. The inter-relationships of all of these organizations and the national and international oil producing companies need close attention. Theoretical constructs from political science (institutionalization, organizational theory) and economics (cartel, oligopoly and monopoly theories) should be helpful analytical tools. Game theory could be applied in this area.

Other possibilities for political scientists include further attention to legislative politics and to regulatory agencies. Additional issues (coal, imports, overall energy policy) and other methodological approaches should be used. Regulatory agencies should be examined for the effects of interest groups upon them, the types and consequences of differing internal structures and legislative mandates, and their relationship to legislatures and to elected executives. The current and possible future roles of the Office of Technology Assessment in the legislative branch and the Science Advisor in the executive branch need to be explored.

Sociology

Little literature is available from this field on energy related issues. Cottrell's (1955) book is a classic work with an historical emphasis and a broad, sweeping view of the effects of man's energy conversion efforts on society. Three articles with a sociological emphasis are the extent of the recent journal literature presently at hand.

Ross (1973) considers the social effects of restricting energy use. He feels that public participation in planning and decision-making is necessary if the public is to accept the restrictions on energy use which will be necessary to protect the environment.

The more recent concern with the limitations of our energy resources makes Ross' point even more important. Further research could outline mechanisms for public participation in energy decisions and could explore factors contributing to public acceptance or rejection of energy policies. The nature of public attitudes and beliefs about energy availability, about the energy industries, and about government policies sould be explored. The likely behavioral consequences of various policies need to be predicted. The linkages between attitudes, beliefs and behavior in the energy area need further elucidation.

Bruce-Briggs (1974) examines the effect of higher gasoline prices upon the suburban lifestyle. He concludes that drastic price increases are not a major threat to suburbia because suburban expansion has occurred in the past with much higher prices of gasoline relative to median income than presently obtain. A rise of gasoline prices to 80¢ per gallon would return gasoline to its 1955 level relative to median income. A switch to a smaller size car can more than compensate for the increased fuel cost due to a compact's lower purchase price, greater fuel efficiency and lower maintenance costs. The only threat to suburbia in Bruce-Briggs' mind is a repetition of the 1973 supply limitation.

This conclusion would be stronger if Bruce-Briggs had examined the median incomes of several social classes and regions of the country, and if he had examined the total energy costs of family units instead of just gasoline costs. His complacency may not be justified for inner city or rural Americans. Additional research effort is indicated.

Schexnider (1974) outlines the case for the resurgence of the central city as a result of the energy crisis. Blacks have become the dominant

ethnic group in many central cities and have very recently achieved political control of several, as exemplified by the rising number of Black city mayors. In many cases they have inherited what Schexnider calls "hollow prizes," i.e., cities left to the Blacks because the Whites consider them undesirable. If the White population's flight to the suburbs is reversed by energy shortages and high prices for energy, they may return to the cities to find them controlled politically and economically by Blacks. This would constitute a major shift of social status and power, which could be followed by renewed tensions between the two groups.

The need for further research on the sociological effects of the energy crisis on ethnic and low income groups is compelling. Concern for the environment has been mainly a middle and upper class phenomenon, but an energy shortage hits everyone. It may affect different social groups differentially, however, which points to the need for research in our potentially explosive urban cores, in the rural backwaters, and in the suburban developments.

Other possible topics for research include factors leading to public acceptance of energy-saving innovations in transportation and housing, the effects of voluntary groups and community organizations on energy policy formation and implementation, the changes in land use resulting from energy shortages and their social effects (will the coal-rich states experience social transformations comparable to the effects of the oil boom on Texas?), and the effects of energy shortages on recreation activities.

The sociological impact of a radical re-structuring of the energy sector of the economy should be explored. A switch from capital to income sources of energy carries with it the possibility for a fundamentally altered

social system in the future. Solar and wind energy can be tapped by individual households if mass production of energy conversion units and construction of appropriate houses takes place. Over the long term, perhaps by the middle of the next century, a much different, more decentralized social system could emerge. The possibilities and consequences need to be carefully considered by sociologists.

Psychology

No literature dealing with the implications of the recent energy crisis from a psychological viewpoint is known to the reviewer. This certainly leaves the field wide open to the academic entrepreneur. Some of the areas in which research might be done include use of interior spaces, thermal comfort standards, strategies for coping with crisis situations brought about by energy shortages, and the effects of fossil fuel shortages on attitudes, beliefs and behavior.

Peoples' uses of interior spaces and their needs for spaces of various shapes, sizes and configurations for work, play, sleep and recreation are areas of interest for environmental psychologists. Robert Sommer (1969) and E.T. Hall (1959) are known for their work on the use of interior space, need for personal territories in public spaces, and cross-cultural differences in preferences for spaces. Office designs and their effects on behavior have been considered (Heilweill, 1973). The relationships between environmental conditions and the behavior of school children have been studied (Pepler, 1971).

Studies are needed to determine the minimum-sized spaces which can be utilized for homes, offices, work areas, etc., so as to minimize the use of energy for space heating. Subjective affect needs to be considered in relation to room size and configuration as well as the behaviors to be

performed in the area.

The existing thermal comfort and environmental psychology literature on comfort sensations and human behavior in climate-controlled interior spaces has implications for energy policymakers. Comfort standards have been developed for a variety of kinds of spaces and kinds of human activities. Turning down the thermostat to save energy has its limits due both to comfort sensations and to performance of workers and students. Thermal comfort standard-setters might wish to reexamine their standards in the light of energy shortages. Behavioral as well as comfort effects of the thermal environment should be examined, and the effects of wearing additional clothing should be considered.

Case studies of crisis situations could be conducted to discover what coping strategies are particularly successful during fuel shortages, brownouts, transportation system breakdowns and other disruptive events resulting from energy shortages. Actual crises could be the source of data (interviews after the fact, on-the-spot observations of future crises) or experimental situations could perhaps be devised.

People's attitudes towards energy sources and uses, their beliefs about energy companies and the availability of energy, and the linkages between attitudes, beliefs and actual behaviors need to be explored. Does the public presently perceive energy as being in short supply? How do their beliefs about energy affect their expressed attitudes? Is their behavior consistent with their attitudes and beliefs? What are the likely behavioral consequences of short or long-term fuel rationing for heating or transportation uses? How can attitudes, beliefs or behavior be influenced so as to conserve energy? Careful and systematic studies are needed

in this area. Bruvold's (1971, 1972) work on attitudes, beliefs and behaviors of people using reclaimed water provides an excellent model for efforts of this sort.

Legal Studies

There are many interesting research possibilities for legal scholars in the energy field. Working on their own or in collaboration with social scientists, legal scholars might consider research in some of the following areas. Enforcement of national energy policies is an important topic needing some fresh ideas. The 55 m.p.h. speed limit is unenforceable at present because such a large proportion of the driving public ignores it. How could the government encourage compliance with this law or other restrictions on behavior which may be legislated in the future in order to conserve fossil fuels? Does the legal context in this country encourage waste of energy in any way by making passage of constitutionally acceptable laws difficult or by making enforcement impossible? Can ICP costs be reduced by legislation or court action so as to make more energy conservation possible? What are the implications of established property rights for resource development and environmental conservation, particularly with respect to energy resources? Can and should these rights be changed? How do you compare the rights of environmentalists, wilderness-lovers, farm and ranch owners with those of energy industries, developers and governments interested in energy resource development? The recent public battles over development of oil wells in Californias Santa Barbara Channel and over construction of nuclear power plants and oil refineries along the coast in the Northeast provide data for study of many of these questions. Present and future controversies over strip mining of coal in the Western states will provide

much more material, and hopefully, incentive for legal scholars to consider energy-related problems.

Strategies: Energy and Social Scientists

The literature review above and the specific research suggestions developed from it suffer from a certain myopia. One specific energy study suggests another related project. Social science literature on the environment provides ideas for energy-related projects. An alternative approach to the problem is to sit back and think about the energy problem and what the social sciences need to contribute to its solution, in more general terms and without reference to what has already been done in the social sciences. In this vein, two possible strategies for a group of social scientists concerned about energy are offered below.*

Strategy 1: Assume that petroleum-derived forms of energy are going to be in short and variable supply over the next 10-15 years due to resource depletion and unstable import levels, and that alternative sources of energy are not going to be "on-line" in a major way in this time period. Local and national fuel shortages and brownouts are likely to increase in frequency. Industries will sometimes have to shut down, homes will sometimes go unheated or unlit, transportation may be restricted. Social scientists could consider the many implications of these disruptions of our usual lifestyle in this country, and the prospects for other developed and underdeveloped countries. Many of the specific research proposals offered above are relevant. Historical incidents or ongoing events could provide data.

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*Strategy 1 is a synthesis of suggestions offered by Edward Woodhouse and Charles Walker; Strategy 2 benefits from conversations with Matthew Berman, Howard Brown and John Hendricks.

Individual social scientists will be able to do many of these projects on their own; some will require teams from several disciplines. ISPS could tackle specific projects requiring inter-disciplinary teams, encourage individual projects, and act as a national clearing-house for information about possible projects, on-going studies and sources of data. By being a participant in specific projects, and by acting as a national clearing-house, input could be provided to policy-makers about the social implications of specific technological proposals and national energy policies generated elsewhere.

Strategy 2: Adopt a longer time horizon, perhaps to the end of the century. Develop technological scenarios for the energy sector for the next 25 years. Consider primary sources of energy and the desirable forms of energy at the consumer level. Outline a number of scenarios assuming various combinations of primary sources, forms of energy available to consumers, level of supply of each source and form, and costs of developing and utilizing each source and form. This would result in a preliminary document synthesizing work done by the Ford Foundation (1974), Energy, Earth & Everyone (1974), and other groups. It would involve a larger number of scenarios than the Ford Foundation work so that more policy options and tradeoffs could be explored.

Once this preliminary document is completed, social science teams could attempt to spell out the social implications and costs of each scenario. The result over a period of several years would be the fullest possible consideration of the economic and social costs of implementing each scenario, an outline of political strategies for, and consequences of, each scenario, information about policy options available and tradeoffs

inherent in the technology and social systems, considerable developments in policy modeling, progress in costing of environmental effects, and much, much more. The opportunities for inter-disciplinary work seem exciting. However, this strategy is far more ambitious than Strategy 1, and would require a stronger guiding hand to manage and coordinate the project.

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