

UC Berkeley
IURD Working Paper Series

Title

MAPPING THE LAND USE AND ENERGY POLICY TERRAIN: LAND USE AND ENERGY CONFLICTS

Permalink

<https://escholarship.org/uc/item/5ps5x9xf>

Journal

Institute of Urban and Regional Development

Author

Dowall, David E.

Publication Date

1978-08-01

MAPPING THE LAND USE AND ENERGY POLICY TERRAIN:

LAND USE AND ENERGY CONFLICTS

David E. Dowall*

Working Paper No.290

August 1978

*Assistant Professor of City and Regional Planning, Institute of Urban and Regional Development, University of California, Berkeley.

This research was funded by the U.S. Department of Energy, Office of Environmental Policy Analysis, through Lawrence Berkeley Laboratory. The views expressed are solely those of the author.

ABSTRACT

This paper identifies potential areas of conflict between land use and energy policy. Extending Guttenberg's land use pattern framework, the paper illustrates that energy-environmental conflicts center on the land use attributes of intensity, location, mix, interaction, and the rate of land utilization. The constellation of regulations affecting land use and energy planning are presented and areas of policy trade-off are indicated. Three alternative energy programs--distributed technologies; energy conserving land use planning; and energy facility siting are presented to illustrate land use planning issues. The paper concludes by outlining needed planning and policy research for trade-off resolution.

MAPPING THE LAND USE AND ENERGY POLICY TERRAIN:
AN EXPLORATION OF LAND USE AND ENERGY CONFLICTS*

I. INTRODUCTION

The Department of Energy manages a complex of technology Research Development and Demonstration (RD&D) programs. The National Energy Plan mandates: "The federal government should support many research options in their early stages, but continue support into the later stages only for those that meet technical, economic, national security, health, safety, and environmental criteria" (Executive Office of the President, 1977). It is doubtful that there are "correct" choices; rather, policy decisions will reflect a multitude of trade-offs. Sound administrative judgement requires that DOE determine how the various energy technologies interact with the constellation of criteria outlined in the National Energy Plan. This paper explores potential areas of conflict between energy technologies and land use and environmental policies.

DOE's Office of Environmental Policy Analysis is charged with responsibility for reviewing, evaluating, and anticipating the impacts of environmental policies on energy R&D, and determining how external policies and institutions impact on DOE policy objectives. One significant concern is land use policy. Land use policies are proliferating as state and local governments respond to

*The author would like to thank colleagues Melvin M. Webber, Kenneth Phillips, Sam Berman, and Larry Susskind for comments on an earlier version of this paper.

perceived declines in environmental quality, growing fiscal pressures, and uneven city-suburban growth. Continued development of comprehensive land use programs reflects an increasing awareness of the workings of ecological systems and appreciation that land use impacts extend beyond local boundaries. DOE can expect significant resistance to policies and programs that imply environmentally undesirable changes in land use patterns.

This paper identifies and explores land use policy issues that directly influence energy policy considerations. The topics of primary concern are:

- (1) What land use patterns are best suited for meeting energy and environmental policy objectives?
- (2) How do existing land use controls and environmental policies influence energy production and consumption?
- (3) What land use and environmental policies are needed to create energy efficient and environmentally desirable land use patterns?
- (4) What second order effects will energy efficient land use and environmental policies and actions have on various social, ethnic, and economic classes?

Land use issues exist when the values of divergent groups cause conflict over the design, development, and siting of settlements and their attendant facilities. Battles over land use are manifold, centering on economic, resource, environmental, and aesthetic considerations. In "screening" research options, DOE should identify and analyze the relationships between various energy technologies and land use and environmental values.

Of all areas of energy policy analysis, land use is the most difficult to articulate. Unlike technical or economic criteria, land use policies do not rely on consistent and immutable "benchmarks" or levels of performance. On the

contrary, land use regulations are largely determined by other policy objectives. Land use patterns are not managed because it is inherently useful to do so; they are regulated to achieve environmental, social, economic and energy goals. Trade-offs exist among objectives and concomitant land use policies. Environmentally responsive land use policies may be incompatible with energy responsive land policy. Similar conjectures can be made about the land use implications of economic development or housing policies.¹

At the present time a myriad of federal, state, and local policies dictate the direction and scope of land use policy. Given the emergence of energy concerns, DOE policy analysts need to understand the interplay of these policies and how they limit the menu of feasible energy technologies. To do this, policy makers must systematically explore how policies shape land use and anticipate conflicts among these various policies.

Any systematic exploration of land use policy trade-offs must begin with a sound understanding of "land use." As Guttenberg pointed out nearly twenty years ago;

. . . Not only does its (land use) meaning continue to be uncertain, it is actually growing more uncertain with time. This increasing ambiguity is due, in part at least, to our own efforts to probe more deeply into the use of land than heretofore. As interest in the subject broadens and knowledge of relevant variables expands, we endow "land use" with more and more meanings. (Guttenberg, 1959, p. 143)

This paper presents a framework for exploring land use policy issues and uses it to identify conflicts between energy technologies and land use and environmental policies. After discussing the origins to the land use energy issue, the paper outlines a framework for analyzing land use policies. Next, federal, state, and local land use policy directives are outlined. Three cases are presented to identify broad areas of trade-off among environmental, economic, and energy responsive policies. General conclusions are drawn from these cases and future research is suggested.

II. BACKGROUND

The proliferation of land use policies and controls reflects the increased awareness of the workings of ecological systems and an appreciation that "changes in land use have profound effects on the environment and that these effects are not limited to the parcel property whose use has changed" (Healy, 1976). While environmental policies are clearly appropriate, reliance upon environmental criteria as sole determinants of land use is inappropriate. Intelligent resource management requires that energy considerations be given standing in the design of regulatory programs. Environmental, energy, and economic development criteria imply significant conflicts in the design of public policies. Future policy directions need to reflect these trade-offs.

Contentions that energy, environmental, and economic development objectives be given priority significantly influence the course of public policy. While there is no "correct" priority, the resolution of conflicting values over the use of land should be based on a clear understanding of how various policies shape land use patterns. Metaphorically, land use is the "transmission mechanism" through which various federal, state, and local energy, environmental and economic development policies interact. For example, the Clean Air Act requires that states develop a plan for reducing air pollution. While these plans rely upon a variety of implementation devices, they often contain elements promulgating land use patterns that minimize vehicle miles traveled. Similarly, Section 208 of the Federal Water Pollution Control Act stresses the need to control land use patterns in ways that will reduce nonpoint pollution runoff sources. Given the need to develop energy technologies and promote the intelligent management of energy resources, comparable legislation will also be developed. The interaction between policies needs to be addressed.

III. ANALYZING LAND USE POLICY: A FRAMEWORK

Land use can be regulated to achieve a variety of objectives: environmental quality, economic development, housing, energy conservation, energy production, resource management, and aesthetics. To these and other ends, land use regulations attempt to control, in some fashion, the character of land use patterns. To varying degrees, land use regulations control the following:

- (1) intensity of development;
- (2) location of land utilizing activities;
- (3) the mix or diversity of activity per area;
- (4) the way that activities interact with one another over space; and
- (5) the rate at which land gets used or reused over time.

By controlling these attributes of the built environment, regulations can determine overall patterns of land uses. In managing the use of land, these policies, either directly or indirectly, determine the nature and types of environmental, social, and economic impacts.

These five attributes can be utilized to systematically describe the way that environmental, energy, or economic objectives determine land use policy. Determining that the intensity of development best suited to achieve environmental objectives is in conflict with the objectives of economic development, provides more powerful insights than merely to indicate that environmental and economic objectives are in conflict. Since these attributes are the framework for our analysis of energy/land use issues, they warrant further discussion.

Intensity is a more general measure of density. It may refer to employees per kilometer², persons per kilometer², floor area ratios, sales, or value added per meter², and other indicators of spatial activity. For a variety of reasons, public policies are often directed towards the control of intensity.

Location refers to proximity. As an attribute for policy analysis, it has no value unless paired with something else. As we shall see, this pairing depends upon the policy context and its objectives. Most often, it is used to refer to the siting of facilities and structures.

Mix refers to the relative homogeneity or heterogeneity of human activities that occur on a piece of land. In order for mix to have a meaning, it must be linked with some system of classification, e.g., Standard Industrial Classifications. Because of the presumed association between mix and externalities, land use regulations have long attempted to homogenize mix.

Interaction measures linkages between land uses. To varying degrees, all activities interact with one another. Transportation systems reflect this phenomena as do telephone networks and other means of communications. Since interactions often generate "external effects," planners have always attempted to control this facet of land use. Because interaction requires energy, this land use attribute will be given much attention in the future.

Rate refers to the tempo at which land is converted from one use to another. Urban growth and urbanization directly influence the rate of land utilization. Planners have become increasingly aware of the impacts that rapid land conversion have on environmental quality and fiscal resources. Planners pursuing environmental objectives are often opposed to policies that directly or indirectly increase the rate of land conversion or reuse.

These then are the dimensions of land use that environmental, energy, and economic policy objectives either control or affect. If policy analysis at DOE is to identify land use conflicts and areas of possible trade-off, it should proceed by identifying conflict areas that occur in regulating these attributes of land use. For a given environmental or energy policy objective, concomitant land use patterns are implied. Using the above framework, areas of conflict

may be systematically identified and analyzed. Such an approach would proceed by exploring the impacts of energy and environmental objectives on the desired level of land use intensity. This process would be repeated for the other land use attributes (location, mix, interaction, and rate). At DOE this policy analysis research design should be applied to all relevant federal and state legislation and to DOE's energy technologies. This approach seems superior to current reactionary and ad hoc policy analysis being done at DOE.

IV. THE REGULATORY CONSTELLATION

A major theme developed in the previous section is that land use is controlled for the express purpose of achieving a predetermined objective or set of compatible objectives.² Land use policy issues emerge when attempts to control land for various purposes are in conflict. In order to understand these issues, we must first identify the array of policies that, in pursuit of their objectives, attempt to control the use of land.

There appear to be four broad categories of policies and regulations that either directly or indirectly influence land use patterns:

- (1) generic land use and environmental regulations;
- (2) air quality controls;
- (3) water quality controls;
- (4) housing and transportation policies.

Land use regulation is a firmly established local responsibility. First established after the turn of the century and upheld by the U.S. Supreme Court in the 1926 Euclid Decision (Village of Euclid, 1926), zoning is a widely used form of local land use control. Most states authorize local land use controls. Direct state involvement in land use occurred during the 1960's and 1970's as

a response to interjurisdictional spillovers, divergences between local and area-wide interests, absence of local controls, and recognition that state investments in infrastructure and broad social and economic policies influence land use patterns.

Major changes in traditional land use regulations are widespread. At the state level, the recently completed American Law Institute's Model Land Development Code (American Law Institute, 1976) will significantly influence energy facility siting and the implementation of resource conserving land use strategies. State-level intervention, such as industrial siting, energy facility siting, coastal zone management, critical area designations, surface mining regulations, wetlands protection, state EIS programs, and state review of development of greater than local impacts promise to significantly influence the effectuation of DOE programs (Survey of State Land Use Planning Activity, 1976).

At the regional level, a series of review and regulatory mechanisms impact on the implementation of energy technologies. The A-95 review process is one example of federal government attempts to strengthen regional coordination of planning and programming of projects that indirectly influence land use patterns. Although covered below, response to federal legislation covering air and water quality is increasingly coming from regional agencies. Plans such as the Association of Bay Area Governments' Environmental Management Plan attempt to achieve federal air and water quality standards by influencing land use patterns. A recent internal HUD memorandum, "Departmental Program for Implementing Regional Strategies," suggests increased emphasis on regional and metropolitan approaches for the achievement of environmental, social and housing goals.

The Federal government has long been involved with land use matters. Influence over land use decisions can be categorized in three ways: direct control over federal lands; indirect influence through a myriad of federal

regulations and programs; and secondary effects of federal investment in infrastructure. While the overall influence on land use patterns is large, the net effect of Federal policy is not clear--considerable conflicts exist among policies. As a GAO report indicates, "Until recently, the Bureau of Land Management alone operated under 3,500 different and frequently conflicting laws, hundreds of court decisions, and thousands of administrative precedents." (U.S. General Accounting Office, 1977)

Direct land use control of federally owned lands accounts for 760 million acres of land. These lands are managed by a variety of governmental units--Bureau of Land Management; Fish and Wildlife Service; National Park Service; other Department of Interior agencies; Forest Service; Department of Defense; and others. Much of these lands are located in energy rich western portions of the continental U.S. Direct Federal control of land accounts for between 20 and 40 percent of the total land area of Colorado, Montana, New Mexico, and Washington. In Wyoming, the range is 40 to 60 percent. In Idaho and Utah, the figure is 60 to 80 percent. While these figures may startle some observers, they represent the proverbial "tip of the iceberg" of Federal influence in land use planning and management.

A 1973 Library of Congress study identified 23 Federal Departments and Agencies that administered programs which directly effect land use patterns (U.S. General Accounting Office, 1977). Despite the fact that national land use planning legislation has failed to make its way through Congress, we clearly have a de facto national land use planning program. An array of Federal policies indirectly influence land use decisions. The National Environmental Protection Act, and its attendant programs, is the most widely recognized piece of Federal legislation affecting land use planning decisions. Programs administered through the Environmental Protection Agency (EPA) include: the Clean Air Act; the Federal Water Pollution Control Act; the Resource Conservation and

Recovery Act; and the Noise Control Act. These legislative mandates promote the development of comprehensive plans that achieve the attainment of environmental objectives. The Coastal Zone Management Act requires States to draft and implement plans that control the use of all lands within coastal zones. The Department of Housing and Urban Development distributes funds for community development, new communities, open space lands, water and sewer facility planning and requires that communities prepare flood plain zone management programs. The Water Resources Planning Act authorizes the Water Resources Council to develop comprehensive water management plans that affect land use patterns in watersheds. The Federal Highway Administration, the Federal Railroad Administration, and Federal Aviation Administration all address transportation investment and are thus concerned with land use patterns. Finally, direct Federal investment in infrastructure dramatically influences the form of future land use patterns. How such investments facilitate energy production and consumption objectives and energy technologies is not clear.

This constellation of policies affect the attributes of future land utilization patterns. The location and scale of energy facilities (centralized solar collectors, nuclear and fossil fuel plants) are circumscribed by this web of conflicting policies. Environmental mandates influence future levels of development intensity, location, diversity of activity, communication networks, and the rate at which future growth occurs. The orientation of policy, i.e., the relative commitment to energy, environmental and economic development goals, will largely influence the configuration of future land use patterns, and as a consequence the implementability of energy technologies. DOE policy analysts need to unravel the interplay of policies and programs.

V. LAND USE ENERGY POLICY TERRAIN--AREAS OF CONFLICT

This section discusses three policies which promote energy technologies or energy conservation planning strategies. The first example explores the land use and environmental impacts of the "soft energy path" promulgated by Amory Lovins (Lovins, 1976, 1977). The second case focuses on the ability of land use planning techniques to significantly decrease energy consumption levels. The third example outlines the issues and problems associated with the siting of large scale energy facilities. These three areas represent present and future policy concerns at DOE.

Soft Energy Paths--Some Possible Areas of Conflict

During 1977, the University of California, Lawrence Berkeley Laboratory and Lawrence Livermore Laboratory conducted a comprehensive analysis of how the State of California might look if it followed the soft path of distributed technologies (Distributed Energy Systems in California's Future, 1977). While difficult to state succinctly, the "Lovins Scenario" combines a prompt and serious commitment to efficient use of energy, rapid development of renewable energy sources matched in scale and in energy quality to end-use needs, and special transitional fossil-fuel technologies (Lovins, 1976, 1977). In analyzing the implications of moving to the soft path, the California study restricted its attention to the following sources of energy: solar energy; biomass; hydro-electric pumped storage; geothermal; ocean energy; wind energy; and fossil fuel sources. The report evaluates each of these technologies from a variety of perspectives. Our focus is on the land use and environmental consequences of several of these technologies.

The intensity at which land is utilized appears to be an area of major conflict for the successful implementation of decentralized technologies. Chapter Ten of the California study simulates the necessary land use requirements for a community of 10,000 persons. Requirements for solar energy

generation is concluded to be "modest," but there appear to be conflicts with the built environment. Land requirements for solar energy for space conditioning a community shopping center would exceed the gross leasable floor space by a factor of two and that the collector space would equal the entire amount of land comprising the site. (The conflict looms even larger outside of the sunbelt region.) Large areas would be required for more centralized community level solar energy systems. In the same prototype model, a minimum of 700 acres would be needed for the collector--amounting to 75 percent of the total area of the community. In addition to land requirements, conflicts will arise over sun rights and building orientation. A report prepared for the California Energy Commission indicated that only 65 percent of the existing residential structures in the state could be retrofitted to passive solar. "The 35 percent difference between feasible and maximum potential is the result of problems caused by the shading of the roof area for solar collectors as well as poor orientation of the slope of many family units (Hirshberg and Davis, 1977).

Collection problems are only one aspect of land use conflicts associated with solar implementation. Storage requirements become serious impediments as densities increase and opportunities for storage become fewer and land assembly more expensive. In suburban settings, residential applications of solar collection and storage does not seem to present serious problems. In areas of high land use intensity, e.g., San Francisco, and in regions where, for reasons of air quality maintenance, compact land use development is necessary, land use and environmental policies may conflict with the implementation of solar energy systems (Association of Bay Area Governments, 1977).

Locational conflicts regarding the placement of solar facilities may emerge in situations where the scale of the technology is oriented to the community level. As referred to above, siting issues are bound to develop in

locating collectors and storage facilities. Such conflicts seem reminiscent of urban renewal efforts of the 1950s. In urban and suburban areas, the pre-emption of land will be raised as an argument against development.

Conceivably, solar applications could facilitate greater acceptance and use of mixed development patterns. Cluster patterns of development would generate large roof surface areas and promote the development of community level solar systems. The prospect for such development patterns increases when one considers cogeneration. Implementation of solar technologies raise several issues with considerable importance to land use planning and environmental management objectives. Our brief conjectures leave us with several important policy questions: Does solar energy promote suburban sprawl? Will reliance on solar generation increase location conflicts? If so, how can we anticipate them and mitigate their adverse affects? Will solar technologies promote mixed use development?

Biomass conversion is the process of converting organic materials into energy. There are several approaches to biomass production: 1) the collection and processing of agricultural, municipal wastes, and lumber industry waste; 2) the production of organic materials on energy farms--the cultivation of crops for energy generation. This alternative energy path generates several major land use and environmental impacts. Recycling of organic wastes is the least disruptive. But it will generate air and water pollution problems--particularly in urban areas. Anaerobic digestion will convert sewage to methane. This process would mitigate the disposal of sludge, but it will be costly to convert treatment facilities and the risk of explosion will increase.

The most dramatic land use impacts are generated by the large scale production of biomass. Assuming a one percent photosynthesis conversion efficiency factor, 12 percent of the total land area of the U.S. would be required to meet

current energy demands (Davidson, 1977). Land preemption issues come to the forefront as do trade-offs regarding water and soil quality. Algae and kelp farms may be a less disruptive approach to energy farming. But one is struck by the possibilities of coastal zone impacts of a scale similar to offshore oil exploration. Distribution of biomass energy to consumers raises several questions regarding the most efficient siting of energy farms. Will the locational calculus result in siting patterns resembling resource based industries, or will they be more market oriented? Should planning agencies influence the siting process?

Wind power is another possibility for energy generation that is renewable. As the University of California team suggests, wind power is non-polluting in the traditional sense (no air or water pollution), but conversion systems have a wide variety of adverse land use and environmental effects: noise; aesthetics; microclimate; tree and building removal; hill alteration to promote wind movements; preemption of land; risk form system failure; TV interference; hazards to animals; navigational hazards to airplanes or ships (if placed offshore); and secondary impacts associated with construction and operation. This particular technology appears to generate locational conflicts similar to those commonly associated with energy production facilities.

Cogeneration and solar thermal may create the most complex effects of all soft path technologies. Generally, this set of technologies refers to various combinations of electrical generation, process heating, and space conditioning to utilize energy in a more efficient way. Essentially, several technologies are used to move "waste heat" around so that it can be used more efficiently. The land use implications are substantial. Industrial-energy parks of considerable size are suggested by the technologies. Due to scale and environmental concerns, it may be that these facilities will be located at substantial distances

from existing urban centers. This could promote the continued trend of demetropolitanization and job location. The location requirements of such industrial energy parks is not well understood. Interregional industrial location patterns may shift to those states which are energy rich and accepting of large-scale energy producing projects, e.g., Utah.

Geothermal and pumped storage hydroelectric energy production generate similar land use and environmental effects. Locational criteria will change and industrial activities may move towards areas with these sources of energy (other things being equal). Hydroelectric power requires dams creating severe environmental conflicts. The Wild and Scenic Rivers Act prohibits the federal government from licensing power facilities in designated areas. Geothermal impacts are generally localized. Land use effects are directly generated by facility construction and the movement of secondary impacts of induced migration. Both hydro and geothermal energy production create environmental problems: water quality degradation (water table changes and salt intrusion in some instances), not to mention visual intrusion, noise and smell in the case of geothermal, and adverse socioeconomic impacts.

Our brief reconnaissance of soft path energy technologies suggests that land use and environmental impacts will be manifold, but not overwhelming. The conclusions of the University of California study suggest that the land use and environmental impacts of certain soft technologies:

notably increased end-use efficiency, active and passive solar heating and cooling with individual building or neighborhood units, fuel production from biomass in the form of wastes, and the dispersed on-site wind generators--will prove markedly smaller than those of virtually all of the traditional "hard" technologies, as well as smaller than those of the more centralized technologies for harnessing renewables (e.g., large scale solar).
(Distributed Energy Systems in California 1977, Vol. 2, p. 60)

This conclusion, while highly tentative, is an important one. It suggests that smaller scale energy technologies will generate less environmental and land

use externalities. As policies are being evaluated, it seems of paramount importance to incorporate the net land use and environmental benefits associated with soft technologies. As the above has illustrated, land use and environmental conflicts arise in cases where production options are outlined. The larger the scale of production, the larger the land use and environmental impact. Location, intensity, and mix attributes of land use configurations should be analyzed in more detail to determine whether land use and environmental regulations can be made more elastic and accomodate suitable energy technologies.

Land Use Planning for Energy Conservation

Much research has been generated during the last several years assessing the ability of land use planning to promote energy conservation. Major efforts have focused on: 1) housing density and cluster development; 2) mixed use development and generic strategies that reduce travel patterns, mainly work trips; and 3) decreasing the energy requirements of commercial establishments. Research has followed several modes, the most popular being the development and assessment of prototype developments (The Costs of Sprawl, the Washington, D.C. study and the work at Stony Brook on the Nassau-Suffolk regional planning area³). While highly touted, The Costs of Sprawl has come under attack for methodological inadequacies. Most resulting increases in energy efficiencies are highly dependent upon site characteristics and building design. It is difficult, if not impossible, to generalize the results.

Most of the studies promulgate increased residential densities. This result seems to support environmental quality considerations, particularly in the design of metropolitan regions. The Environmental Management Plan developed by the Association of Bay Area Governments to deal with the regional problems of air quality, water quality, and solid waste relies on "compact development" to achieve air quality standards. Due to political pressure from real estate and development interests, the land use element was recently dropped from the plan.

The encouragement of dense development for energy conservation may receive strong support from environmentalists--but not from development and labor interests. Conflicts over the increase in land use intensity loom large. Frieden conducted several case studies of development projects in the Bay Area recently (Frieden, 1977). He concluded that infill development, constructing housing or commercial projects in areas that for various reasons had been passed over in the first wave of urbanization, is fraught with political problems. Adjacent land owners and environmentalists routinely oppose new projects. As the Oakland Tribune recently pointed out about a project delayed six years, neighborhood opposition was very strong because people thought that since the project was to be mainly cluster housing, the new residents would be "undesirable" (Dengel, 1978). The developer was quick to point out that were the housing of the same size and quality and at the same density of the surrounding neighborhood, prices would exceed \$120,000--a price that none of the neighborhood opponents could afford. Densification--the key to increasing overall metropolitan land use intensity--is clearly controversial. Roberts' study of the Washington, D.C. area concluded that:

energy efficiency seems to require extensive use of public transportation, combining land uses into clusters and complexes, and locating activities so that less energy is expended to complete them. (Roberts, 1975)

This result, which is in agreement with other similar studies, suggests that locational and mix attributes of land use patterns are important energy conserving design criteria. Locational criteria are bound to generate significant conflicts. Compact, clustered development patterns might imply the pre-emption of land for park and recreation space, areas of aesthetic beauty, or the placement of activities in areas that are candidates for different activities. As planning agencies begin to draft proposals for the siting of industrial facilities at the

regional level, conflicts regarding fiscal impacts, housing location, employment impacts, travel patterns, air and water quality objectives, will undoubtedly arise.

Issues relating to land use mix are also beginning to develop. Standard zoning and land use controls have historically operated on the principle of land use homogeneity. The city of Emeryville, California, an industrial enclave north of Oakland, has had great difficulty in coping with the conversion of warehouses to residential-studio uses by artists priced out of Berkeley. Our existing land use institutions must be overhauled if we are to facilitate greater land use mix. Such an overhaul will require research into performance standards, better understanding of land use externalities, technologies for their mitigation and legal mechanisms for their implementation. The notion of predetermination and restraint as the cornerstone of standard zoning must give way. Opposition to such change is great. Land use enforcers must be retrained, laws changed, and professional attitudes altered.

The rate of housing construction will also be an area of land use conflict. Demographic shifts in the population are already sending shock waves through the housing markets. Although fertility rates have declined steadily over the past several years, the rate of household formation is on the rise. The baby boom of the post war is becoming the household boom of the 1970s. Rates of housing construction may not keep pace with market demands. The obvious result will be rapid housing increases. Energy objectives effecting the rate and cost of new housing construction will generate consumer backlashes of significant dimensions.⁴ Owing to neighborhood opposition and policies of infilling, high land use intensity and greater mix, may squeeze the housing market's rate of construction.

The overall impact of energy conserving land use planning is to alter the energy consumption attributes of human behavior. Beyond the scale of house unit or commercial or industrial land use activities, most land use design criteria attempt to manipulate that land use interaction. Densities are

increased, uses are mixed, and activities clustered to facilitate mass transit and reduce travel demand and trip length. Environmental issues associated with the pursuit of these objectives seem to be: land pre-emption, possible air and water quality trade-offs, and the urgent need for new land use strategies and institutions that rely on performance standards. Economic development objectives may end up being the major area of conflict inhibiting future energy conserving land use patterns. Little attention has been given to the employment, income and wealth effects associated with the attainment of energy conserving land use patterns. Direct impact obviously falls on land owners, developers, real estate interests, the construction industry, the auto industry, and labor. The secondary and indirect effects of these land use policies are not well understood.

Energy Facility Siting--Conflicts of Location and Scale

This final example appears to be an area of immediate importance to DOE policy formulation. Nuclear and coal power plants, outer continental shelf oil exploration, and development of liquefied natural gas (LNG) represent four technologies whose fate hang largely on siting issues. The passage of the National Environmental Protection Act (NEPA), state escalation of "little NEPAs," e.g., the California Environmental Quality Act (CEQA), as well as the Clean Air Act, and the Federal Water Pollution Control Act, have increased the difficulty of energy facility siting. DOE involvement with siting needs to be predicted on the principle that all siting decisions are essentially local issues. "In the absence of a greater national consensus on the energy problem and its solution, unilateral federal action is not a realistic option." (Ellickson and Merrow, 1977) In their case study of the Geysers area in Northern California, Ellickson and Merrow conclude that the degree of opposition is not proportional to the actual impact of the project. Locals do not compare energy development, in this case geothermal,

to other energy facility alternatives, e.g., coal fired plant, centralized solar, but to no development alternative. Second, opposition can be anticipated, but that policymakers need to determine the winners and losers to be effective. Such anticipation is necessary to develop processes of environmental mitigation. While it is difficult to characterize the generic qualities of a "good" siting process, Ellickson and Merrow's cases and other research suggest the following:

- knowledge of local politics;
- participation by local interests;
- clear lines of communication between parties;
- ability to adapt to changing conditions;
- ability to mitigate adverse effects where possible; and
- where mitigation is not possible--the compensation of individuals and groups that are adversely affected.

Successful implementation of energy facilities requires that existing siting processes be significantly altered. The process must be streamlined to reduce administrative costs, but at the same time, the process must be opened up to participation and allow for the negotiated resolution of conflicts.

The land use and environmental implications of energy facility siting are great. If the current process continues, we may find that large scale facilities will be sited in areas far removed from population centers. Such isolation may prove costly. The combination of new technologies with better siting methods could provide for more efficient locations and better ways of managing environmental and land use conflicts. Such changes require alterations in land use and environmental management instructions, more effective modes of citizen participation, and better ways of assembling and disseminating technical information.

Untying the Energy-Land Use Policy Knot--an Agenda for Research

Locational attributes are the single most important aspect of the land use energy conflict area. Conflicts over location will be the most important factor in constraining the achievement of land use patterns that are energy and environmentally desirable. Research on locational criteria should be based on the assumption that no "best" or "ideal" location exists, rather that the issue of location is inexorably linked to the political process. This orientation suggests that research focus on the design and development of siting methodologies that enhance the likelihood of success, i.e., expeditious politically acceptable siting of energy facilities or land use projects that promote energy and environmental objectives.

Mixed use development research should proceed by developing measures of performance so that mixed use projects can be pursued more effectively. Social research could contribute to this area in ways that parallel current work on density. Existing land use planning standards are inadequate for resolving energy-land use environmental trade-offs. New methods and approaches for land use planning are needed.

Research on the effects of land use and environmental policy on energy programs should focus on the effect of land use controls on shaping metropolitan spatial structure, the location of employment centers, and how these environmental controls effect the location of energy production facilities. The relationship between governmental regulation of land using activities and energy consumption and production urgently needs to be identified.

Research to identify "energy responsive" land use and environmental policies should focus on the role of bargaining and negotiation as models for future land use planning strategies. Controls need to be more elastic--they should be capable of balancing diverse interests and resolving value conflicts. Given the

vulnerability of facility siting and location trade-offs, emphasis should be placed on developing alternative siting models. Research on second order effects of new energy efficient land use and environmental policies is problematic, but essential to DOE policy attainment. Arguments against energy policies will come from groups adversely affected. Broad distributional implications underlie all the land use models outlined above. Energy efficient land use patterns could have the same dramatic effect that the Interstate Highway Program had on central city residents during the 1950s and 1960s. These are difficult equity questions. But they need to be anticipated and reconciled if energy policies are to be politically acceptable.

The research agenda is enormous--priorities now need to be set and projects begun. Hopefully, DOE will address questions like those raised here and develop a research program that systematically explores these issues.

FOOTNOTES

¹HUD's TASK Force on Housing costs is suggestive.

²Most arguments for public intervention in land markets center on the need to "patch" market failures. Such patching, as economists suggest, increase allocative efficiency. This line of argument does not, however, imply carte blanche land market intervention.

³Real Estate Research Corporation (1974) The Costs of Sprawl, Washington, D.C.: U.S.G.P.O.; James S. Roberts (1975) Energy, Land Use, and Growth Policy: Implications for Metropolitan Washington, Washington, D.C.: METCOG; T. Owen Carroll et.al., (1975) Land Use and Energy Utilization--Interim Report, Stony Brook N.Y.: Brookhaven National Laboratory.

⁴H.U.D. and E.P.A. interest in the relationship between government regulations is indicative.

REFERENCES

- American Law Institute (1976) A Model Land Development Code, Washington, D.C.
- Association of Bay Area Governments (1977) Environmental Management Plan, Berkeley, California: ABAG.
- Carroll, T. Owen, et.al, (1975) Land Use and Energy Utilization--Interim Report, Stony Brook, New York: Brookhaven National Laboratory.
- Davidson, Grether and E. Wilcox (1977) Ecological Considerations of the Solar Alternative, Berkeley: Lawrence Berkeley Laboratory.
- Dengel, John, "Success Follows Hill Stuggle," Oakland Tribune, May 7, 1978, p. 1-C.
- Distributed Energy Systems in California's Future: A Preliminary Report, 2 Vols. (1977) University of California.
- Ellickson, Phyllis and Edward Merrow (1977) "Resolving Environmental Issues in Energy Development: Summary of Findings," A Working Note, Santa Monica, California: Rand.
- Executive Office of the President, Energy Policy and Planning (1977) The National Energy Plan, Washington, D.C.: U.S.G.P.O.
- Frieden, Bernard J., "Environmental Politics," Urban Land, Vol. 36, March, 1977, pp. 3-8.
- Guttenberg, A.Z. (1959) "A Multiple Land Use Classification System," Journal of the American Institute of Planners, Vol. 25.
- Healy, Robert G. (1976) Land Use and the States, Baltimore: Johns Hopkins Press.
- Hirshberg, Alan and E. S. Davis (1977) Solar Energy in Building Implications for California Energy Policy, Pasadena: Jet Propulsion Laboratory.
- Lovins, Amory, "Energy Strategy: The Road Not Taken," Foreign Affairs, October, 1976, pp. 65-96.
- Lovins, Amory (1977) Soft Energy Paths: Toward a Durable Peace, Cambridge, Massachusets: Ballinger Press.
- Real Estate Research Corporation (1974) The Costs of Sprawl, Washington, D.C.: U.S.G.P.O.
- Roberts, James S. (1975) Energy, Land Use, and Growth Policy: Implications for Metropolitan Washington, Washington, D.C.: METCOG.

REFERENCES (continued)

U.S. Department of Housing and Urban Development (1976) Survey of State Land Use Planning Activity, Washington, D.C.

U.S. General Accounting Office (1977) Land Use Planning Management and Control, Washington, D.C.

Village of Euclid v. Amber Realty Co., 272 U.S. 365, 390, 1926.