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Socioeconomic Data Requirements for Environmental Assessment: Coal Gasification and Liquefaction Projects

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SOCIOECONOMIC DATA REQUIREMENTS FOR ENVIRONMENTAL ASSESSMENT: COAL GASIFICATION AND LIQUEFACTION PROJECTS

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ABSTRACT

Environmental and socioeconomic monitoring are key aspects in the planning, construction, and operation of evolving coal conversion technologies. Development of data bases and monitoring programs will allow (1) identification of baseline conditions and existing levels of stress in the environment; (2) prediction of the potential impacts of construction, operation, and decommissioning of a coal conversion complex at a specific site; (3) determination of whether these or unanticipated impacts actually occur during these periods; and (4) evaluation of the effectiveness of mitigation measures designed to lessen adverse impacts on the environment. Socioeconomic data requirements include characterization of land uses, land-use management alternatives, demography and employment, economic and fiscal indicators, and infrastructure capacities for site-specific study areas. The socioeconomic monitoring program should be designed to identify appropriate study areas, assess resource management alternatives, incorporate input from citizen groups and local planning officials, and affect key project decisions and criteria in the siting process. The primary purpose of socioeconomic environmental assessment is to enable decision makers to incorporate into their overall assessment reliable and credible information on socioeconomic factors.

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INTRODUCTION

The foremost goal of any research, development, and demonstration program is to provide reliable and credible information to all parties-at-interest in decision making. Reliable data and analysis contain scientifically estimated error ranges to aid the evaluation of emerging energy supply technologies. This evaluation must consider institutional, demand, and environmental and socioeconomic impact uncertainties as well as strictly engineering performance characteristics and uncertainties (1). Institutional uncertainties refer to those in public-private relationships and governmental policies. Demand uncertainty is used in the classic economic sense to reflect the extent to which energy innovations will be utilized under given market conditions. Impact uncertainties address the generic and site-specific effects of a given technology on socioeconomic, physical, and biological systems.

This paper focuses on the socioeconomic impact uncertainties of coal gasification and liquefaction demonstration projects and their relationship to environmental impact assessment. Socioeconomic impact assessment is important because successful commercialization of these technologies will depend on publicly acceptable distributions of costs and benefits, especially to local and regional environmental and social systems. Local and regional social systems include those communities which will experience additional service and infrastructure demands as a result of plant construction and operation.

There is a legal requirement to assess impacts on social, physical, and biological systems. The National Environmental Policy Act (NEPA) of 1969 requires environmental impacts statements (EIS's) on proposals for legislation and other major federal actions significantly affecting the quality of the human environment [Section 102(2)(C)]. Coal conversion demonstration projects will likely be required to meet NEPA requirements due to federal actions in entering into partnership with private industry in the construction and operation of demonstration plants. Commercial coal conversion projects will probably have the same requirements due to federal actions involving issuance of permits, such as the National Pollutant Discharge Elimination System (NPDES) permits. Section 102(2)(A) of NEPA requires agencies of the Federal Government to "utilize a systematic, interdisciplinary approach which will ensure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision making which may have an impact on man's environment." The intent and judicial interpretation of NEPA promotes environmental assessment and preparation of environmental impact statements as means of informing parties-at-interest and reducing uncertainty so that decisions will reflect considerations of environmental values and impacts as well as economic viability and technical feasibility.

It should be recognized that socioeconomic impact assessment may initially increase perceived uncertainty by introducing relatively complex questions and uncontrolled variables. Public participation also has similar effects by encouraging representation of interests concerned with the unanticipated consequences of social actions (Ref. 2, p. 3). However, if project planning and the EIS do not reflect concerns for regional and local environmental and social systems most directly affected by the energy facility, demonstration of the technology may be plagued by delays, litigation, or ultimate rejection of project plans. The design of a socioeconomic impact monitoring and evaluation program provides an opportunity to facilitate public acceptance and provide input to key project planning decisions aimed at mitigating adverse impacts and promoting beneficial impacts. Examples of key project decisions include water and land acquisition, coordinating project plans with municipal officials, and selection of appropriate technology and processes.

THE SOCIOECONOMIC IMPACT MONITORING AND EVALUATION PROGRAM

Program Design

The social and economic impacts of coal conversion facilities are similar to those of other large-scale projects, such as electric generating stations, in that their large demand for skilled labor creates an influx of in-migrants during construction and/or operation. One may expect the skilled labor requirements during operation to be equivalent to those at a chemical manufacturing plant, where many more skilled operators are required than in electric power generating plants. Figure 1 outlines the interaction of facility and community characteristics that produces socioeconomic impacts. The nature and severity of socioeconomic impacts will vary from site to site, depending on the size of the in-migrating work force, stress in and capacity to accommodate impacts for local and regional environmental and social systems, and process-specific factors (such as the characteristics and environmental transport of effluent streams and total water consumption).

The interaction between labor requirements (under facility characteristics) and community characteristics occurs when workers and their families move into a region. The size of the in-migrating work force depends on facility characteristics and the economic structure and demography of the region in which the plant is sited. An initial influx of workers creates secondary impacts because additional workers and their families will be required to meet the demands for services and infrastructure (e.g., housing, health care, transportation, education, police and fire protection, recreation, historic, archaeological and cultural sites, solid waste and wastewater treatment) created by the initial new population. This "multiplier effect" creates further impacts on public finances, taxes, community infrastructure, and service capacities. Social, economic, and political institutions and relationships are also affected by the siting of a coal conversion facility, as indicated by the feedback loop (depicted by a solid line) in Figure 1. As shown in the "project planning feedback loop," project decisions determine facility characteristics which ultimately impact community characteristics. For example, external labor demands might be decreased by substitution of capital for labor in host areas with low unemployment and limited infrastructure capacities. Another project planning option is to increase service and infrastructure capacities to ameliorate adverse impacts.

Socioeconomic impacts on communities can generally be expected to occur as a function of the size and labor requirements of the project, proximity of the site to urban areas, labor availability, commuting patterns, land uses on and surrounding the site, and infrastructure and service capacities of communities. For those interested, the detail on profiling and forecasting of baseline variables describing facility and community characteristics shown in Figure 1 is extensively covered in the Environmental Monitoring Handbook for Coal Conversion Facilities (Ref. 3, pp. 2.3.2-1 to 2.3.5-1). Impacts generated by the interaction of facility and community characteristics are also discussed in this and many other publications (e.g., Refs. 2-12). Monitoring of actual project experience is not unprecedented, and it can greatly aid forecasting efforts. For example, the Tennessee Valley Authority (TVA) has collected and evaluated construction employee surveys for a number of its nuclear plants (24) and has begun a long-term, broad-scale socioeconomic monitoring program at its Hartsville site. Monitoring may be required by federal agencies to assure implementation of their decisions (31, Section 1505.3).

Design of a monitoring program should confront the following major areas of uncertainty in socioeconomic impact assessment:

- How shall the impact area be defined?
- Is the mine, preparation plant, conversion plant, and product distribution system to be evaluated as a "complex?"
- What variables are important in forecasting the residential location decisions of in-migrating construction and operation workers?
- How shall costs and benefits be determined?
- What are the interfaces and interdependencies among socioeconomic, biological, and natural features?
- How shall resource management alternatives be evaluated?
- How can responsiveness to concerns of parties-at-interest be achieved?

The remainder of this paper addresses these areas of uncertainty. The socioeconomic impact monitoring and evaluation program contemplated should be initially broad in scope, as certain concerns might be eliminated if monitoring and evaluation indicate that they will not present problems. A prime example is the evaluation of demand for infrastructure and services in communities by relocating construction workers. If monitoring shows that these demands are very small relative to total capacity and services in particular towns, there is no need to continually monitor or evaluate the socioeconomic impacts. Instead, effort should focus on those towns where socioeconomic impacts are significant. For example, annual population growth rates of about 5% were found in one study to be generally as much growth as small communities can comfortably absorb (10).

How Shall the Impact Area be Defined? Regional definitions vary with the impact being evaluated. Whenever there are significant options involved in the use of natural resources, materials, or productive services for the coal conversion complex, the region under study should be defined to highlight these trade-offs. Construction and operation of coal gasification and liquefaction plants may require substantial quantities of coal, water, and labor. These requirements will obviously be much lower for demonstration projects than commercial plants. Using water demands as an example illustrates the potential for significant options in resource use. A commercial coal conversion complex, producing 250 million cubic feet (7.08 Mm^3) of synthetic gas per day or 50,000 barrels (7,950 m^3) of synthetic crude oil equivalent per day is expected to require 10,000 acre-feet (12.3 Mm^3) of water per year (25, also see Ref. 4, p. 61). Whereas a demonstration project may only require about one-fifth of this demand (25), proposed commercial coal conversion complexes involving multiple plants have estimated requirements several times this amount (27, also Ref. 4, p. 60). Using 25,000 acre-feet (30.8 Mm^3) per year as a typical requirement for the total water use of a city of 100,000 people (Ref. 4, p. 55), it is apparent that other industrial, urban, or agricultural water uses may be affected or precluded in regions outside the site of the coal complex. This potential impact in arid regions of the western U.S. may lead to efforts to evaluate alternative sources of water, engineering design recycling options, and cooling system alternatives.

The region to be affected by the siting of a coal gasification or liquefaction project should initially be defined to include the coal mine (especially if dedicated to the project), preparation plant, conveyor and/or associated transportation facilities, coal conversion plant, solid waste disposal facilities, and the municipalities (and/or counties) which are expected to experience development and service demands as a result of the influx of construction and operation workers. In cases where resource uses outside the land required for the entire complex are affected or precluded, the impact area should be enlarged to consider these resource options. Where impacts are insignificant with respect to any particular impact--such as demand for housing which is very small in towns remote from the complex--the impact area can be defined to exclude certain areas ("outlying towns") from the analysis. The definition of the appropriate region for analysis is dependent on the impact being evaluated and site- and region-specific factors.

Is the Mine, Preparation Plant, Conversion Plant, and Product Distribution System to be Evaluated as a Complex? For demonstration plants which will utilize coal from existing mines, the socioeconomic impacts depend on whether the in-migrating work force for construction and operation of the coal conversion plant will augment mining impacts and whether the plant is mine-mouth or at some distance removed from the source of coal. If mining operations cause an influx of relocating workers who place additional demands on infrastructure and services in towns affected by the siting, then these impacts should be addressed with those of the preparation and conversion plants. This is also true for consideration of impacts from construction and operation of the product distribution system. Opening of new mines will be much more likely for commercial gasifiers and liquefaction projects than for demonstration projects, making this portion of the study area more relevant for impact evaluation. Thus, the question of whether these several systems should be considered as a complex is essentially related to their distribution over time and space. Through construction scheduling and project planning, project planners can disperse the interaction of those systems at key periods, such as at the construction peak of the conversion plant.

Secondary effects of building a coal conversion complex may include, for example, the location of a refinery to process the synthetic crude oil product or siting of an industry or industrial park to make use of low Btu synthetic fuel gas. The product from early coal liquefaction plants will be used largely to substitute for and release petroleum-derived fuel oil and residual oil for its further refining to produce transportation fuels. These secondary effects may increase the number of workers and their families who will relocate to obtain employment in the service sectors of the economy. When other major facilities such as power plants are to be concurrently sited in the same region, careful attention should be focused on regional labor availability, skill requirements, and construction scheduling options. The cumulative socioeconomic impact of these decisions by firms and households is a major concern of municipal officials in planning for growth management and provision of municipal services. Failure to consider these cumulative impacts may increase the probability that boom towns will develop. Boom towns often experience low worker productivity, absenteeism, high turnover, and deterioration of the quality of life for local and regional social systems (10, 23).

What Variables Are Important in Forecasting the Residential Location Decisions of In-Migrating Construction and Operation Workers? Reliable forecasts of the size of the peak labor force, the number of relocating construction workers, and the distribution of labor force requirements over time are a critical first step in projecting socioeconomic impacts and designing mitigation measures to ameliorate adverse effects. Impacts on housing, municipal services, transportation, other infrastructure, and tax bases will depend on the labor dispersion pattern of in-migrating primary and secondary workers to individual cities and towns during construction, as well as operation. Due to the uncertainty of predicting worker location decisions, planners and economists have tended to rely on very generalized, but limited, assumptions about the residential location choices of in-migrating workers. The analysis of labor dispersion, however, should consider the following variables:

- labor requirements (defined over time and space) of the coal conversion complex;
- secondary labor requirements (such as jobs in retail sales, services, etc.);
- labor supply (indigenous versus in-migrating workers);
- relationship of population and available housing units, either for sale or for rent;
- existence or absence of car pooling and public transportation;
- valuation of time and out-of-pocket transportation costs;
- zoning and public works in individual cities and towns;
- supply of competing job opportunities;
- spatial infrastructure such as highways;
- historical patterns of service use (i.e., marketing spheres);
- site-specific residential location factors, such as existence of resort towns or other attracting forces; and
- special transportation incentives and modes which could be provided by the contractor.

A typical commercial coal conversion complex producing 250 million cubic feet (7.08 Mm^3) of synthetic gas per day or 50,000 barrels (7,950 m^3) of synthetic crude oil equivalent per day would create over 3,000 jobs in the mine and plant during construction. Depending on the process used, whether the project is located in the eastern or western U.S., and the type of mining, operational jobs may range from 1,000-2,100, according to one study (Ref. 4, p. 120). Regional multipliers, which will vary with economic and demographic characteristics, can be used to estimate secondary employment impacts. This estimate must be further disaggregated by some sort of labor market model to forecast in-migrating secondary workers. These workers will relocate to provide additional services and expand community infrastructures to support the primary construction workers and their families. Demographic analysis is important in translating the secondary employment into a projected population influx. Thus creation of 1,000-2,100 operational jobs at the coal conversion complex will induce jobs in other sectors of the economy which could result in a significant new population influx. The portrayal of employment and income effects can best be done by direct techniques such as (1) input-output analysis of surveys of local firms and consumers and (2) measurement of commodity and money flows (13-17).

How Shall Costs and Benefits be Determined? The primary and secondary in-migrating work force produces direct costs to local communities. Both types of workers demand services and infrastructure and are expected to pay taxes and affect public finance. A problem arises in that the front-end financing for expansion of infrastructure capacity is often inadequate to meet demands unless there is a sufficient prepayment of taxes by the coal conversion facility. Also, short-term expansion of facilities requiring large capital outlays may be impractical (e.g., sewage treatment plants). The dissociation between social costs and benefits due to time-lag between when costs are incurred and when revenues are received needs attention by municipal and project planners. In the case of housing and municipal services, early project planning can address labor camps and other measures, if necessary. Municipal planners may be provided with planning funds if the Inland Energy Development Impact Assistance Act of 1977 (S-1493) is passed by Congress. This Act, proposed by Senators Hart and Randolph, would provide federal funding to municipalities to manage impacts caused by energy development. This approach attempts to address the equity issue arising from the fact that the direct benefits of the facility accrue to areas outside the region bearing the majority of social and environmental costs during construction and operation.

Socioeconomic impact monitoring and evaluation programs should explicitly identify the direct benefits and costs, secondary benefits and costs, environmental benefits and costs, and income distribution effects (18). This is essential to evaluation of two separate but related issues: (a) Is the project justified based on an "efficient allocation of resources" criterion? and (b) What are the various distributions of costs and benefits to different groups? The former issue can be addressed using economic analysis (e.g., see 32). The weighing of the merits of alternative resource management options should explicitly identify project evaluation criteria and highlight considerations, such as environmental factors or impacts, which are relevant to the decision (see 31, Section 1502.23). Many difficult problems arise from neglecting qualitative considerations in analytic frameworks, especially monetary cost-benefit analyses. Analysts may gain insights into the portrayal of the distribution of costs and benefits by exploring frameworks which organize impacts according to effects on geographic regions or groups.

Fundamental differences of opinion arise from values and priorities, not facts, and this re-emphasizes the need to inform rather than determine positions for parties-at-interest. Achieving an acceptable balance of social costs and benefits often requires public participation in decision making. The goal of environmental impact analysis should be to improve key project decisions and the decision making process. Ultimately, the decision making process should reflect federal and state land use planning and development control legislation and inform the public and decision makers on the resource management options and income distribution objectives relevant to proposed project.

What Are the Interfaces and Interdependencies Among Socioeconomic, Biological, and Natural Features? Examination of the interfaces among socioeconomic features, natural resources, and biological features allows one to more adequately define the trade-offs involved in resource management options. It also forms the basis for comparing mitigation measures which may need to be included in the proposed action. Mitigation measures are designed to fulfill the responsibility of the federal agencies to consider the environmental impact of their actions "to the fullest extend possible" (NEPA, Section 102, first sentence). Thus environmental issues should be considered at every important stage where the appropriate balancing of environmental and other factors would lead to a minimization of environmental costs (26). The Council on Environmental Quality (CEQ) has issued final regulations (31, Federal Register, November 29, 1978) that will require explicit consideration of resource management options and appropriate mitigation measures (see Section 1502.14 "Alternatives including the proposed action" and Section 1508.20 "Mitigation").

Alternatives in the CEQ final regulations are defined to include (1) no action alternative, (2) other courses of action, and (3) appropriate mitigation measures required by federal agencies that are not already included in the proposed action. Alternative (1) can be satisfied by scoping and assessing the uses to which natural resources, materials, and productive services would be put in the absence of the coal conversion complex (18). Defining these uses is a critical task. "Other courses of action" (2) include production of equivalent amounts of energy at this or other alternative sites by different types of generation. Conservation should also be considered since both structural and nonstructural measures need to be evaluated as "other courses of action." Evaluation of "appropriate mitigation measures" (3) focuses on avoiding, minimizing, rectifying, reducing, and/or compensating for environmental impacts in the proposed action (CEQ final regulations, Section 1508.20).

(A) Socioeconomic Factors, Key Decisions, and Socioeconomic Impacts Are Interdependent. The socioeconomic impact monitoring and evaluation program should be designed to reveal the interfaces and interdependencies among options in water acquisition, site selection, mine-preparation plant-conversion plant-product distribution systems layout, process selection, and measures to mitigate or avoid adverse impacts (see Figure 2). For example, efficiency can be promoted by use of existing pipelines, multiple uses of rights-of-way, turning waste products into byproducts (e.g., sulfur--depending on demand and supply), and subsequent use of reclaimed land. For these opportunities to be realized, the socioeconomic impact monitoring and evaluation program should yield information at key points in the decision making process, rather than be designed to justify decisions after the fact. Figure 3 illustrates the socioeconomic and environmental criteria (or "opportunity costs") for key project decisions. Since project planning is a dynamic process, the emergence of the more critical criteria should receive the attention of project planners.

(B) Interfaces Produce Levels of Environmental Quality. Interfaces occur between socioeconomic factors and terrestrial ecology, aquatic ecology, hydrology, surface and groundwater quality, and air quality. The existing land-use pattern (e.g., housing development in the Everglades) influences environmental quality (e.g., impact on aquifiers of swamp draining or groundwater withdrawals) in these areas and vice versa. In planning the expansion of social infrastructure, the interfaces among man-made systems and natural and biological features should be considered. A generalized portrayal of these interfaces is shown in Figure 4. The shaded area may be thought of as the combination of

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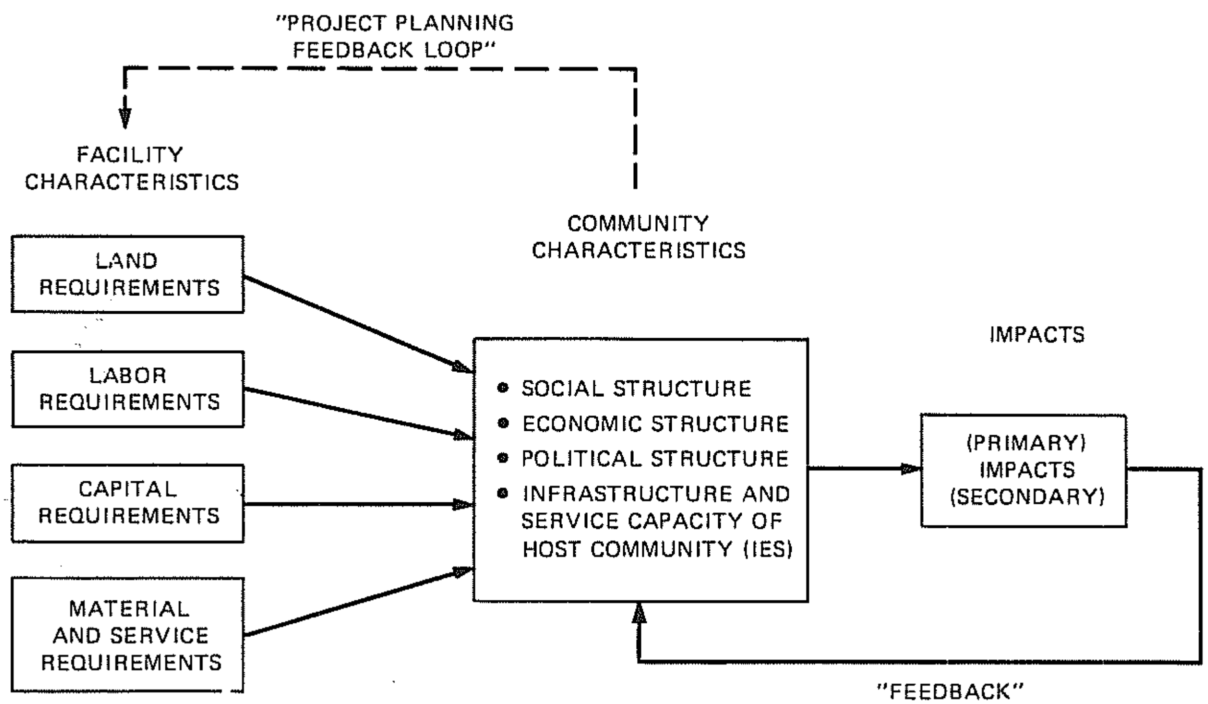

FIGURE 1. GENERATION OF SOCIOECONOMIC IMPACTS BY INTERACTION OF COAL CONVERSION FACILITY CHARACTERISTICS AND COMMUNITY CHARACTERISTICS

ADAPTED FROM: *ENVIRONMENTAL MONITORING HANDBOOK FOR COAL CONVERSION FACILITIES,* EDITED BY M. S. SALK AND S. G. DeCICCO, FOSSIL ENERGY ENVIRONMENTAL PROJECT, OAK RIDGE NATIONAL LABORATORY, ORNL-5319, MAY 1978, p. 2.3.1–2. CREDITS: L. G. BERRY AND D. L. KASERMAN.

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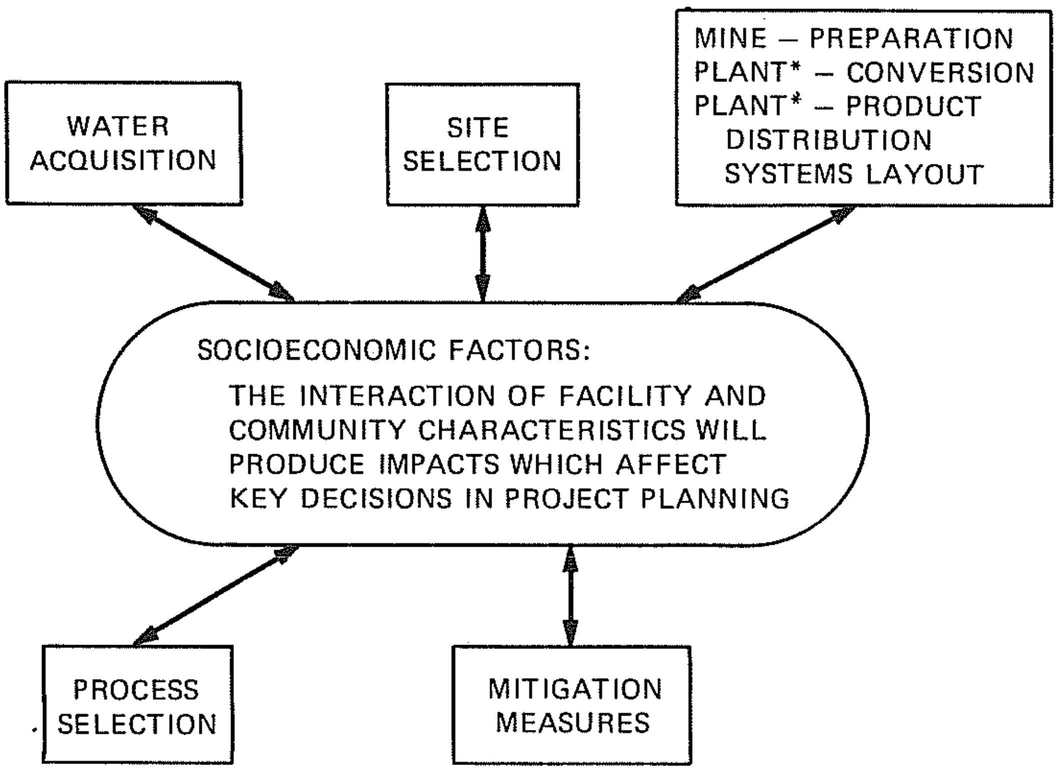

FIGURE 2. SOCIOECONOMIC FACTORS PRODUCE IMPACTS WHICH AFFECT KEY DECISIONS IN PROJECT PLANNING

*NOTE: THE PREPARATION AND CONVERSION PLANTS SHOULD BE DEFINED TO INCLUDE THE SOLID WASTE DISPOSAL FACILITIES.

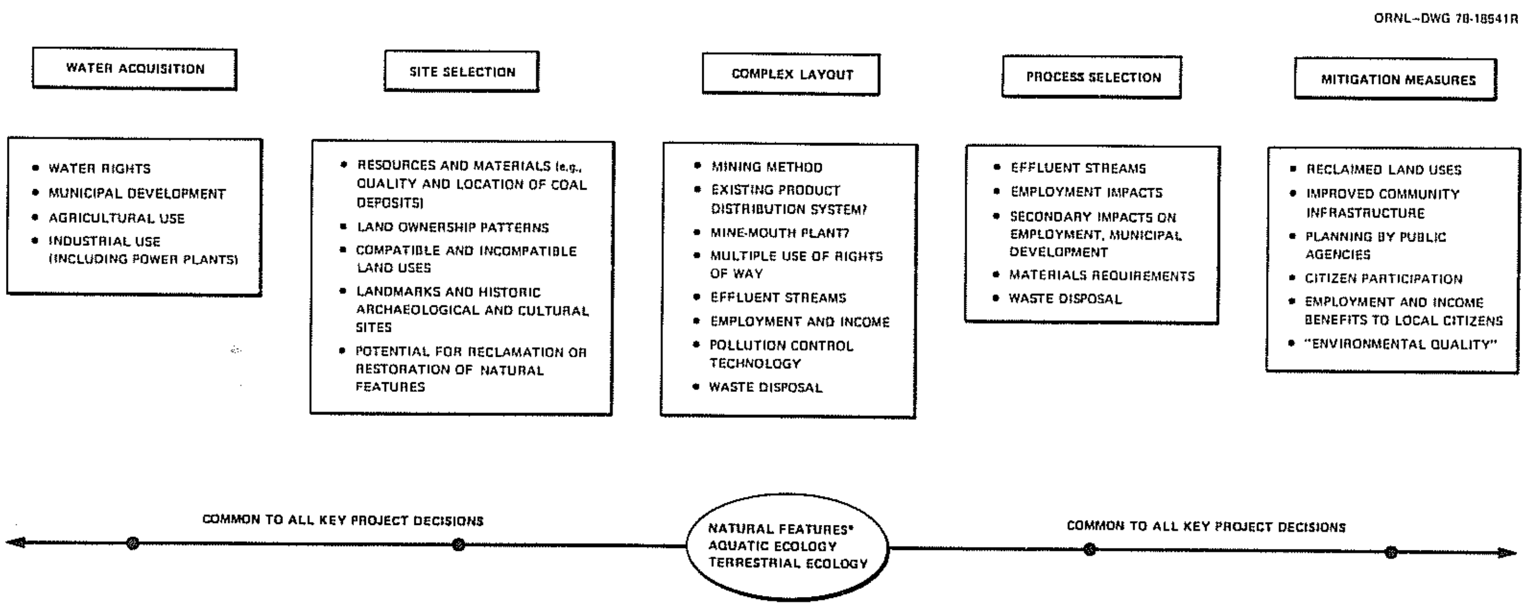

FIGURE 3. SOCIOECONOMIC AND ENVIRONMENTAL CRITERIA OR "OPPORTUNITY COSTS" FOR WATER ACQUISITION, SITE SELECTION, COMPLEX LAYOUT, PROCESS SELECTION AND MITIGATION MEASURES

NOTE: ITEMS LISTED UNDER KEY PROJECT DECISIONS MAY BE THOUGHT OF AS CRITERIA OR "OPPORTUNITY COSTS." FOR EXAMPLE, ONE CONSIDERS NOT ONLY WHO OWNS WATER RIGHTS BUT ALSO USES OF THE WATER PRECLUDED BY CONSUMPTION FOR THE COAL CONVERSION COMPLEX.

*NATURAL FEATURES INCLUDE SOILS, SLOPES, TOPOGRAPHY, GEOGRAPHIC SETTING, AIR QUALITY HYDROLOGY (SURFACE/GROUNDWATER) AND AESTHETIC QUALITY.

"HUMAN ENVIRONMENT SHALL BE INTERPRETED COMPREHENSIVELY TO INCLUDE THE NATURAL AND PHYSICAL ENVIRONMENT AND THE RELATIONSHIP OF PEOPLE WITH THAT ENVIRONMENT . . . ."

CEQ FINAL REGULATIONS, FEDERAL REGISTER, SECTION 1508.14, NOV. 29, 1978

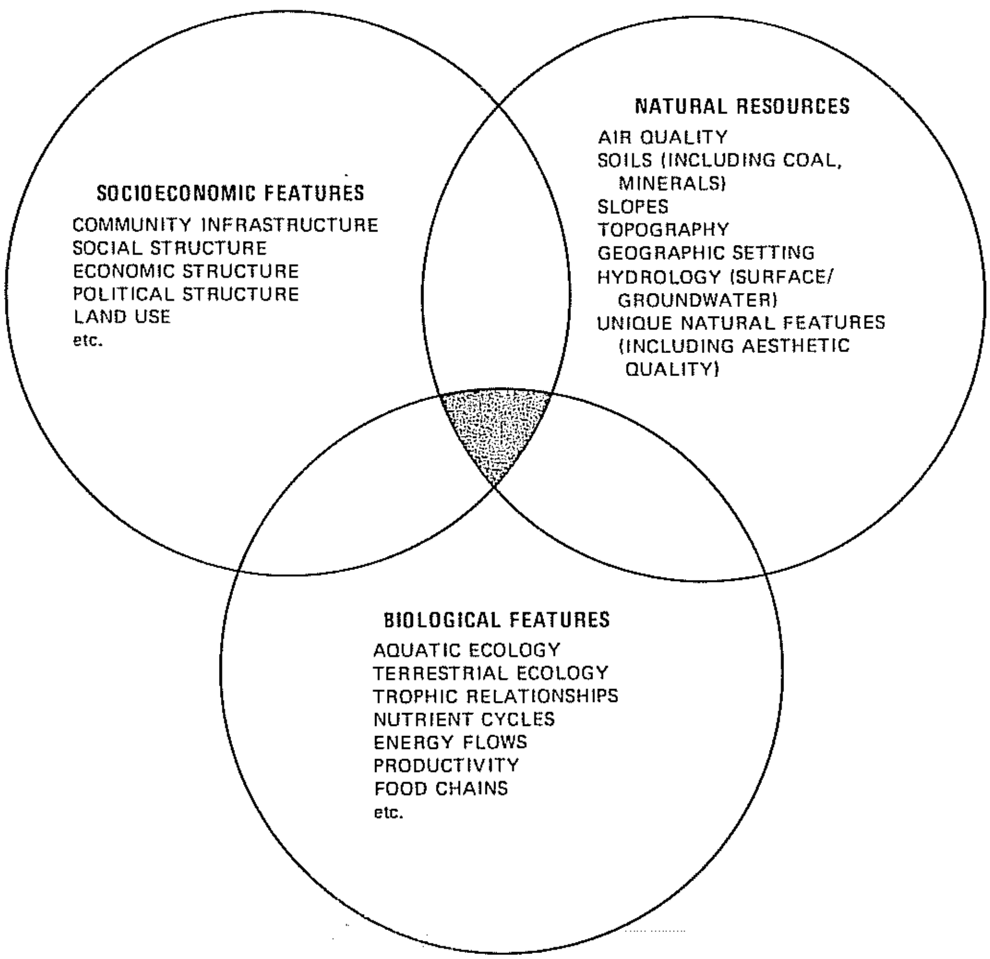

FIGURE 4. EXAMINATION OF INTERFACES AMONG SOCIOECONOMIC, NATURAL, AND BIOLOGICAL FEATURES IS INTEGRAL TO DEFINING TRADE-OFFS INVOLVED IN DIFFERENT RESOURCE MANAGEMENT OPTIONS

the appropriate region for "surrounding environs" may be expanded beyond the 15-180 square miles (Ref. 4, p. 179) to be impacted by mining over the 30-year operation of the mine and additional acreage required for coal preparation, transportation, conversion, solid waste disposal, and product distribution as deemed appropriate to the specific case (see How Shall the Impact Area be Defined?). There may well be significant trade-offs between agricultural productivity or other mineral development on certain mining tracts. The ultimate basis for evaluating alternative sites should be the comparison of resource management options WITH mitigation measures at alternative sites. Thus environmental values and impacts affect the suitability of the proposed site for any given project.

The suitability of particular sites for particular projects has become increasingly controversial in the public arena. Whereas past decisions have focused and whether a given project was acceptable at a given site, more emphasis is now being placed on whether more suitable sites are available. Evaluation of alternative sites should focus on the comparison of resource management options with particular mitigation measures at given sites. Mitigation measures, such as changes in process design to recycle more water or cooling system alternatives to affect visual impacts or lower heat discharge to waterways, can lessen the environmental costs at a given site and thereby improve its suitability for a proposed project. Failure to address alternative resource management options, such as water uses that may be precluded by consumption of the coal conversion complex or the removal of agricultural land from crop production, may lead to challenges of the EIS on substantive grounds. It is uncertain how agencies will implement and how the courts will interpret CEQ's final regulations with respect to evaluation of alternative sites. There are presently no proposed commercial coal conversion or other projects that have been evaluated under these regulations. However, EIS's have been prepared for several proposed commercial gasification projects (27). Actions by federal agencies other than DOI or DOE may set a precedent for evaluation of EIS requirements for proposed commercial gasification and liquefaction projects. Recent decisions by the Nuclear Regulatory Commission (NRC) and Atomic Safety Licensing Board suggest that the NRC staff will have greater responsibilities to independently evaluate proposed sites for electric generating stations than has previously been the case (28).

How Can Responsiveness to Concerns of Parties-at-Interest be Achieved? The different levels of functional responsibility for government and private agencies should be defined in terms of their role in land management (19, 20, 30). Allocating responsibility based on functions in assessing land-use management provides project management with a tool to ascertain relevant environmental laws and permit requirements, design mitigating measures, and integrate study of local and regional environmental and social systems into key project planning decisions. This process leads to greater efficiencies in documenting the procedures used to evaluate alternative sites and improves the substantive quality of project plans. Ultimately, the EIS is designed to inform the public of resource management options and trade-offs through the provision of credible and reliable information.

Responsiveness to the concerns of parties-at-interest facilitates public understanding of the coal conversion complex. The socioeconomic impact monitoring and evaluation program will yield understanding of the trade-offs in resource management options and efforts to provide local and regional benefits. As the primary benefits of the synthetic crude oil product or pipeline gas production accrue to regions outside the lands impacted by the coal conversion complex, innovative ways to promote municipal and project planning should aid siting efforts by providing benefits to the impact areas themselves (21). Mitigation measures should be designed to address issues such as financing of expansion of community infrastructure, reducing tax disparities and fiscal uncertainty, improving employment opportunities, and managing growth of local communities.

Two procedures for promoting consensus are to involve all representative interests at an early stage in order to define common ground whence decisions on trade-offs can be made and to internalize the social costs of siting (i.e., make them a "business cost"). The former approach was adopted in the National Coal Policy Project (22); the approach of internalizing social costs is perhaps best illustrated by the recently passed Surface Mining Control and Reclamation Act of 1977 (P.L. 95-87), enacted August 3, 1977.

CONCLUSION

Emerging energy supply technologies will continually be evaluated in technical feasibility studies of their performance characteristics and uncertainties. The resolution of demand, technological, institutional, and impact uncertainties will ultimately determine whether technologies proceed from the demonstration to commercialization stages.

Socioeconomic impact monitoring and evaluation programs can be designed to provide information to decision makers on resource management options for environmental assessment under NEPA. If these programs are structured to highlight interfaces among socioeconomic, biological, and natural features, decision makers should have more reliable and credible information. By ascertaining relevant environmental laws and permit requirements, designing mitigation measures, and integrating the study of local and regional environmental and social systems into key decisions in project planning, project management can encourage public acceptance of coal gasification and liquefaction projects.

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REFERENCES

(1) Kash, Don E. et al., Our Energy Future: The Role of Research, Development, and Demonstration in Reaching a National Consensus on Energy Supply, for the National Science Foundation's Directorate of Research Applied to National Needs (RANN), NSF SIA-7417866, University of Oklahoma Press, 1976.

(16) Stenehjem, E. J., Forecasting the Local Economic Impacts of Energy Resource Development: A Methodological Approach, Argonne National Laboratory, Regional Studies Program, December 1975.

(17) Stenehjem, E. J. and Metzger, James E., A Framework for Projecting Employment and Population Changes Accompanying Energy Development, prepared for Planning, Analysis and Evaluation, Energy Research and Development Administration, 1976.

(18) Mishan, E. J., Cost-Benefit Analysis, New York: Praeger Publishers, 1976. For the discussion of alternatives (especially opportunity costs), see pp. 65-74, 84, 86-90, 92-94, 104, 149, and 293-297).

(19) Research Applied to National Needs (RANN) Program, National Science Foundation and Harvard Graduate School of Design, The Interaction Between Urbanization and Land: Quality and Quantity in Environmental Planning and Design (progress reports for years one, two, and three). Landscape Architecture Research Office, Cambridge, Massachusetts, October 1974.

(20) Maine Department of Environmental Protection and Edward C. Jordan Company, Inc., Guidelines for Lake Watershed Management Planning, Division of Water Quality Evaluation and Planning, April 1976.

(21) Twomey, James P. and Kuh, Peter G., Governmental Programs, Resources and Regulatory Powers Available to Assist Localities During Coal Development, prepared for the Northern Great Plains Resources Program, U. S. Department of Housing and Urban Development, June 1974.

(22) Alexander, Tom, "A Promising Try at Environmental Detente for Coal," Fortune, February 13, 1978, pp. 94-102.

(23) Gilmore, John S., "Boom Towns May Hinder Energy Resource Development," Science, February 13, 1976, pp. 535-540.

(24) Tennessee Valley Authority, Regional Planning Staff, Division of Navigation Development and Regional Studies

- Watts Bar Nuclear Plant Construction Employee Survey, July 1974 (dated November 1974) and May 1976 (dated November 1976).

- Browns Ferry Nuclear Plant Construction Employment Impact, April 1971 (dated August 1971) and July 1973 (dated May 1974), also see September 1969 survey results.

- Hartsville Nuclear Plants Socioeconomic Monitoring and Mitigation Report, September 30, 1976 (dated April 1977).

- Bellefonte Nuclear Plant Construction Employee Survey, April 1975 (dated November 1975) and May 1976 (dated November 1976).

- Sequoyah Nuclear Plant Construction Employment Impact, July 1972 (dated May 1973) and August 1974 (dated December 1974).

(25) Personal communication, D. W. Lee, Oak Ridge National Laboratory, July 1978.