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A FRAMEWORK FOR COMPARATIVE ANALYSES OF SOCIOECONOMIC IMPACT: CASE-I

by

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1 INTRODUCTION

This report briefly describes a technical framework currently under development at Argonne National Laboratory (ANL) for projecting changes in major socioeconomic parameters as a consequence of energy development. The parameters forecasted by the CASE-I framework include:

- Annual changes in the base or natural population of the area by age, sex, and race,
- Annual changes in employment due to energy development,
- Annual changes in natural population and employment due to energy development,
- Annual changes in the migration of new households to (and from) the various jurisdictions within the impact area,
- Annual changes in public service needs within the jurisdictions of the impact area.

These projections can be provided by county for any of the 3188 counties in the continental United States, and within each county, for the impacts of eight different energy technologies, including:

- Strip and in-situ mining facilities
- Offshore oil and gas facilities
- Nuclear power facilities
- Coal-fired electric generating facilities
- Oil shale conversion facilities
- Coal gasification facilities
- Geothermal facilities

This framework, though computerized, is not referred to as a model since it is a collection of interdependent modules which permit (and even require) extensive user interaction. Its purpose is to permit users to evaluate, with relative ease, the timing and magnitude of socioeconomic changes expected from energy development. As such, CASE-I should prove to be of significant value to local officials in areas expecting some form of energy activity. However, because of its ability to consider any county in the continental U.S. and as many as eight different energy technologies, CASE-I is also expected to be of interest to federal and state planning officials. These officials could make use of this flexibility to conduct analyses of the sensitivities of local socioeconomic changes to alternative types and intensities of energy development within counties having different pre-impact economic, demographic, and geographic characteristics. Such information would permit both federal and state officials to consider the socioeconomic consequences of siting alternative energy technologies within the counties of their respective jurisdictions. In addition to assisting them in making decisions on the technology mix and siting patterns which will minimize socioeconomic impacts in their respective regions, the sensitivity analysis previously described can be used by state and federal officials to examine the impacts of multifacility siting within a region. That is, given the sensitivities of impacts to local economic, demographic, and geographic differences and to differences in the types and levels of energy development, extrapolations of results can be made to any number of potential sites once the type of facility and characterization of the potential site is known. A final application of CASE-I involves its potential role in assisting planning officials at all levels of government in structuring and recommending impact mitigation strategies appropriate for the county or community being impacted. Because the socioeconomic impacts of energy development vary with both the characteristics of the area affected and the nature and scale of the energy activity, no single or generic mitigation strategy is likely to be either appropriate or even necessary in all cases. The use of CASE-I would permit those persons responsible for mitigating impacts to evaluate expected changes in the social and economic characteristics at individual sites quickly and easily and structure appropriate policies to meet the needs of each. As pointed out, the CASE-I framework can be applied to a variety of comparative assessment problems. In what follows, the conceptual framework of CASE-I is outlined so that each of the prospective categories of users indicated above can evaluate its applicability to their needs.

2 OVERVIEW OF THE FRAMEWORK

As stated, the CASE-I framework evaluates the timing and magnitude of local (i.e., county and community) socioeconomic changes expected as a result of energy development. Although the uses to which this analysis can be applied include evaluations of:

- The socioeconomic consequences accompanying a single energy facility in a single county;
- The sensitivity of socioeconomic impacts to alternative types and levels of energy development and differences in the economic, demographic, and geographic characteristics of impact areas;
- Alternative mitigation policies; and,
- The regional consequences of multifacility energy siting;

the basic analytical methodology of the CASE-I framework is the same.

As shown in Fig. 2.1, the CASE-I framework consists of three analytical components or modules which perform the following functions:

- Projections of the changes in county population by year under both a natural growth and energy-induced growth situation,
- Allocations of these population changes among and within surrounding communities on an annual basis, and
- Estimation of the effects of this projected employment and population change on the requirements for public services in each of the impacted jurisdictions by year.

The first module provides annual projections for a given county of the natural population change expected by age, sex, and race without the proposed energy facility. This is referred to as a baseline projection. This module then considers what changes can be expected to occur in the baseline population over time. It does this by forecasting total employment opportunities both directly and indirectly created by the proposed facility and determining, from the baseline projection, the numbers of indigenous residents likely to fill these jobs. Jobs in excess of those filled by local residents are assumed to attract in-migrants. The first module uses this data and information on household sizes and characteristics of in-migrating workers to project the age, sex, and racial structure of the energy-induced population change by year.

The second module accepts these estimates of county population change and distributes the immigrants attracted by job opportunities to particular communities or sub-county jurisdictions which can be either inside or outside of the county being studied. This distributive projection of local population can be driven by either a spatial allocation model that maximizes residential location patterns under the constraints of housing availability and immigrant purchasing power or a less sophisticated gravity model that considers local community sizes and their distances to the development. Thus, this model points to specific localities which are likely to be most severely impacted by energy development. It enables the user to examine potential areas in which housing shortages will occur and whether local infrastructure capacities will be able to keep pace with annual population changes.

The final module of the CASE-I framework provides greater detail on the housing and infrastructure requirements in impacted communities. The per capita, per pupil, or per household public service requirements of the in-migrating population, for example, are estimated directly. The data for making such estimates are obtained from service requirements for communities of varying types (e.g., independent outlying communities, rural, metropolitan) and varying sizes (e.g. less than 10,000; 10,000 to 30,000). When compared to the existing capacities of services in the communities, these estimates offer a general impression of types and magnitudes of service shortages expected as a result of energy-induced growth.

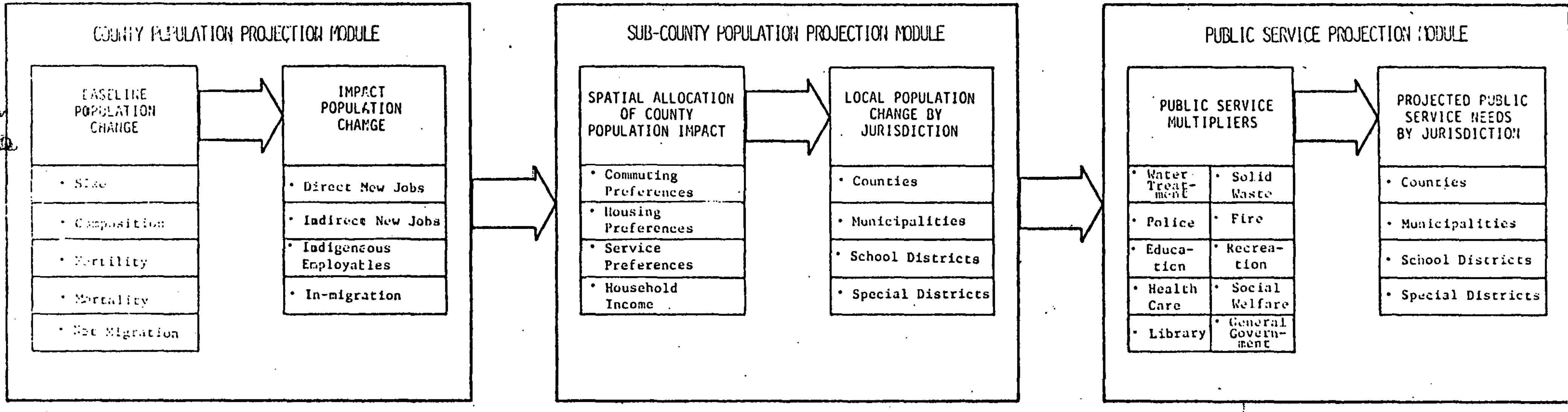

Fig. 2.1
The CASE-I Framework for Comparative Analyses of Socioeconomic Impact

3 A DESCRIPTION OF THE COMPONENTS OF CASE-I

In this section of the report, the prospective user of the CASE-I framework is provided with a more complete description of each of its interdependent modules.

3.1 PROJECTING COUNTY POPULATION CHANGE

To gauge the effect of siting a proposed development in any given county, it is necessary to compare the growth induced by the development to the change expected to occur without the development. For this purpose, the CASE-I framework relies on a county demographic model that considers two aspects of population change: (1) baseline trends (comprising fertility, mortality, and net migration), and (2) impact trends (resulting from emergent job opportunities and producing additional net migration). Briefly, the elements of this population projection module are as follows.

3.1.1 Baseline Population Change

A varient of POPROJ, a model of demographic change developed by Donald Bogue at the University of Chicago,* is employed to project baseline population changes by county on an annual basis. This model outputs annual projections of county population by age, sex, and race on the assumption that there will be no change in trends due to the exogenous development being studied.

The model requires the following inputs:

- 1970 Census of Population data on county population characteristics; particularly age, sex, race, occupation, and labor force participation,
- Current U.S. fertility data by age, sex, and race,
- Current mortality data by county, by age, sex, and race, and
- 1960-1970 county net migration data extrapolated to and reflective of 1970-1974 changes.

The model produces annual projections of population and labor force changes by county for the years during which the impact is anticipated. It provides,

*Bogue, Donald J., *Techniques for Making Population Projections: How to Make Age-Sex Projections by Electronic Computer*, Family Planning Research and Evaluation Manual, No. 12, (1974).

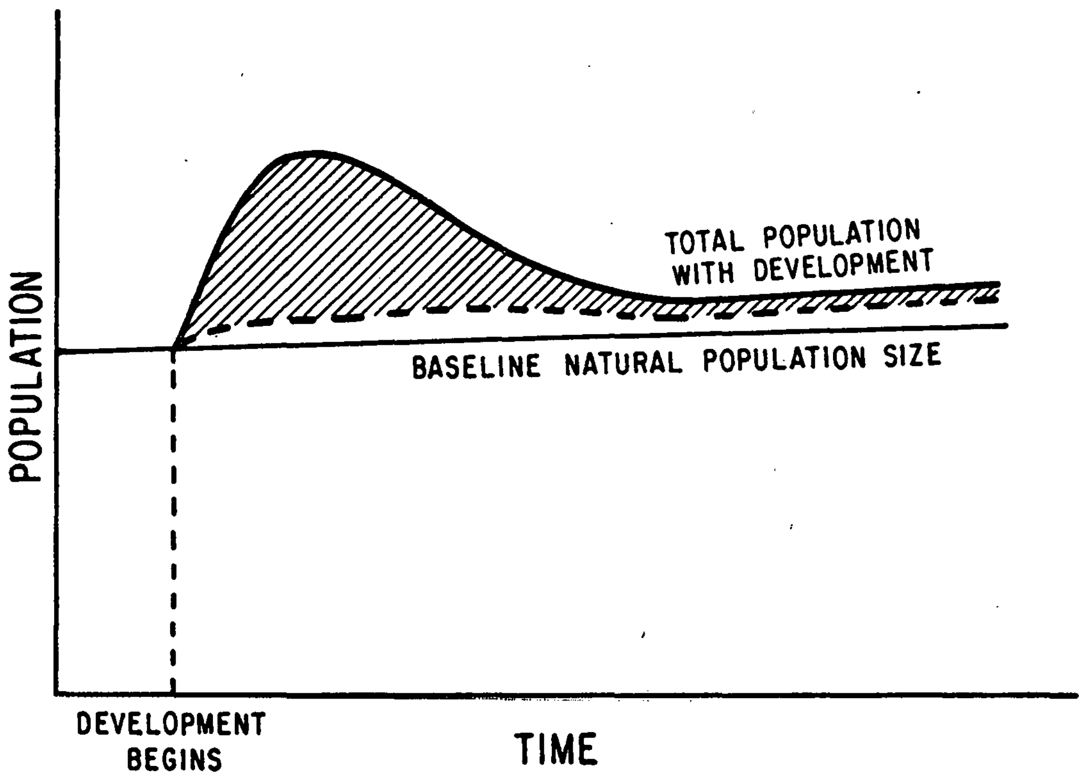

Fig. 3.1 County Population Projections

therefore, an estimate of baseline change that includes data on the natural availability of local employables by age, sex, race, and type of skill during the period being studied.

3.1.2 Impact Population Change

In this component, population change resulting from the direct and indirect employment opportunities generated by the development are projected. This involves a two-step procedure. First, technology-specific manpower requirements, obtained from various sources including industry data, environmental impact statements, etc., are provided by the CASE-I data bank. Second, indirect employment requirements are estimated using multipliers which have already been computed for every county in the contiguous United States. Finally, an employment lag model is also available to estimate the timing of newly created secondary jobs.

Given the information obtained from these steps, the increase in total county population attributable to the energy development is projected by age, sex, race, and occupation. This model estimates annual population change based on forecasts of the number of new households expected to move to the county taking into consideration the number of employables available in the indigenous population. Thus, this element interacts with the estimates of baseline net migration to estimate annual changes in net migration that can be attributed to the impact of the development being studied.

3.1.3 County Impact Population Change

The preceding figure (Fig. 3.1) exemplifies how projected changes in total county population are separated into baseline and development impact estimates The solid dark line represents the annualized projection of total population and adds in-migration resulting from the impact of new employment opportunities plus, changes in local net migration patterns to the baseline. The lighter, solid line represents projected baseline population change resulting from natural phenomena (births minus deaths) and net migration. The broken line represents the influence that development has on reducing net out-migration of the indigenous population and the shaded area represents the new immigrant population attracted by the development being studied.

3.2 PROJECTING SUB-COUNTY POPULATION CHANGE

The second module of the CASE-I framework distributes the annual projections of county in-migration to sub-county areas based on the expected settlement patterns of immigrant households. These settlement patterns are estimated using one of two techniques available. In the more sophisticated approach, indicated in Fig. 2.1, an econometric spatial allocation model is used. This method distributes the immigrant households according to a statistical maximization of commuting and housing preferences which is constrained by housing availability and family income. A less sophisticated gravity model technique is also available for this purpose. It distributes immigrant households based on the size and proximity of communities to the development being studied. This technique is appropriate where there are insufficient data regarding the commuting and housing preferences of the anticipated immigrants or where future housing availability cannot be reliably estimated by type and location.

The local population projection module outputs annualized estimates of population size for each sub-county area specified in the analysis. As indicated in Fig. 2.1, these sub-county areas are service-based jurisdictions. These projections of local population are input to the third module which estimates public service requirements that will need to be met by the geopolitical units that are responsible for their provision.

3.3 PROJECTING LOCAL PUBLIC SERVICE REQUIREMENTS

The third and final CASE-I module projects public service requirements from the projections of local population change. This is accomplished by applying service-specific multipliers to the sub-county population projections generated by the second module. Hence, the public service module projects annual public service requirements for each jurisdiction designated in the sub-county projection analysis.

The public service multipliers used in this projection analysis have been developed for ANL by the Real Estate Research Corporation (RERC). These multipliers have been specified for each of the ten public services listed in Fig. 2.1, and they quantify average acceptable standards per unit of population, students, or dwelling units according to the service in question. Separate multipliers for each per unit standards have been computed for alternative types of communities (e.g., independent outlying community, rural community, etc.) and communities of different sizes (e.g., less than 10,000 persons, 10,000 to 30,000, etc.) There are three outstanding advantages to using this multiplier approach. First, the public service requirements can be projected directly from the expected distribution of immigrant households. Second, the multipliers promote analytical efficiency and insure the comparability of case study results because they eliminate the need to survey local officials in the areas selected for analysis. Finally, the service projections can be generalized to similar types of impact areas because they have been estimated using standardized parameters.

4 SUMMARY

As demonstrated, the CASE-I framework projects the changes in the major socioeconomic parameters from energy development at the local (i.e., county and municipal) levels. The framework, when completed, will consist of three interdependent computerized modules and accompanying data which will permit its user to project and evaluate these changes within any county in the continental United States for any of eight different energy technologies. However, the framework has been specifically designed to permit maximum user interaction. It is precisely this feature which gives CASE-I its flexibility and permits its user to conduct analyses of the sensitivity of local socioeconomic impacts to alternative assumptions and conditions. For example, the user can, if he/she wishes, alter the model's assumptions concerning:

- County migration projections,
- Energy facility employment estimates,
- The employment multiplier,
- Household size projections,
- The spatial distribution technique, and service requirements, among others.

In addition to an analysis of the sensitivities of local impacts to changes in these assumptions, CASE-I permits its user to examine the sensitivities of impacts among counties having different economic, demograhic, and geographic characteristics, and the sensitivities of impacts within similar counties to differences in the types and/or levels of energy development. Thus, as pointed out in the beginning of this report, CASE-I offers an important analytical capability to energy planning officials at all levels of government.

Finally, in addition to the preceding list of possible uses to which CASE-I can be applied, it should be pointed out that this framework also provides the critical empirical data from which assessments of energy alternatives can be made. The annualized projections of changes, at the county and local levels, in employment, population, and service needs, provide the necessary information from which assessments of:

- The groups of organizations and individuals burdened most severely by energy development,
- The major constraints at the local level to an orderly process of change, and

- The plausible mitigation strategies for meeting these impacts,

can be identified and evaluated.

The CASE-I framework is, for all of these reasons, a powerful analytic tool which should be of interest to planners in both the public and private sectors.