260
8-10-79

ND-REAP/DOE Cooperative Project: Final Report

January 1979

Prepared by:
North Dakota
Regional Environmental Assessment Program
Bismarck, North Dakota

MASTER

Contract No. ERDA Grant No. EF-77-6-01-2720

Prepared for:
U.S. Department of Energy
Assistant Secretary for
Energy Technology
Fossil Energy Division

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

Available from:

National Technical Information Service (NTIS)
U.S. Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22161

Price: Printed copy: \$5.25
 Microfiche: \$3.00

ND-REAP/DOE Cooperative Project : **Final Report**

January 1979

Prepared by:
North Dakota
Regional Environmental Assessment Program
Bismarck, North Dakota

Contract No. ERDA Grant No. EF-77-6-01-2720

Prepared for:
U.S. Department of Energy
Assistant Secretary for
Energy Technology
Fossil Energy Division
Washington, D.C. 20585

NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Department of Energy, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, mark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

TABLE OF CONTENTS

	<u>Page</u>
FORWARD	i
SUMMARY OF REAP/DOE COOPERATIVE EFFORT	ii
THE REAP CONCEPT AND EVOLUTIONARY PROCESS	1
Background	1
DOE Sponsorship of REAP/DOE Cooperative Effort	4
1. REFINEMENT AND EXPANSION OF THE ECONOMIC-DEMOGRAPHIC MODEL	6
1.1 Objectives	6
1.2 Procedures	16
1.2.1 Conceptualization and Design Specification	16
1.2.2 Model Development and Implementation	19
1.2.3 Documentation	20
1.2.4 Model Validation/Evaluation	20
1.2.5 User Orientation and Information Dissemination	22
1.3 Results	22
1.3.1 Status of Project	23
1.3.2 Capabilities of E-D Model (Version 2)	24
2. EVALUATION OF THE APPLICABILITY OF THE ECONOMIC-DEMOGRAPHIC MODEL TO OTHER STATES	29
2.1 Objectives	29
2.2 Procedures	30
2.3 Results	30
3. IDENTIFICATION AND EVALUATION OF THE USAGE OF REAP DATA AND CAPABILITIES TO DATE	31
3.1 Objectives	31
3.2 Procedures	32
3.3 Results of E-D Model Surveys	32
3.4 Results of R ³ S Surveys	35
4. R ³ S STATUS AND EXPANSION POTENTIAL	37
4.1 ND-REAP Resources Reference System (R ³ S) Status and Expansion Potential	37
4.1.1 Status of R ³ S	37
4.1.2 R ³ S Expansion Potential	39

5. EVALUATION AND RECOMMENDATIONS FOR FUTURE EFFORTS	39
REFERENCES	42
APPENDIX A	
REAP Publications	A-2
APPENDIX B	
Presentation of E-D Information With the Use of Graphics	B-2
APPENDIX C	
E-D Model User Advisory Committee	C-2
North Dakota State Planning Regions	C-3
APPENDIX D	
Example of State, County and Municipality Fiscal Impact Reports	D-2

EO
FORWARD

This report was prepared by the North Dakota Regional Environmental Assessment Program (REAP) for the U.S. Department of Energy (DOE), Fossil Energy Division, and represents the final report of work conducted under the terms of ERDA grant number EF-77-6-01-2720.

It would be impossible to extend individual thanks to all those whose contributions made this project possible. However, REAP gratefully acknowledges the valuable assistance of Natalie K. Lobe, who acted as DOE contract monitor during the project. Acknowledgement is also due Dr. Fred Abel and Ms. Linda Ludwig whose expertise were invaluable to the project's successful completion.

SUMMARY OF REAP/DOE COOPERATIVE EFFORT

In the past decade, North Dakota--especially southwestern North Dakota--has experienced a variety of energy-related developments, such as coal-fired electric generating facilities with mine-mouth coal mines and lignite export mines. The potential exists for North Dakota to experience other energy-related developments such as synthetic natural gas development and nonenergy developments such as various agricultural processing and manufacturing facilities. Similarly, the state could experience a decline or termination of certain kinds of basic economic activity.

These developments have in the past, and will continue to have, profound effects on the state and its residents. Among the most significant of these effects will be those on the state's economy and on its population. Major developments will create new employment and will necessitate the in-migration of new residents. The extent of the impacts of such events will be determined by the level of economic and demographic change brought about by the developments. Knowledge of the economic and demographic effects of development is, thus, a necessary prerequisite for effective planning and decision making.

By the spring of 1977, it had become clear that the REAP Economic-Demographic Model offered unique and valuable capabilities to the state's decision-makers and planners. However, the model's usefulness was limited by its geographic scope. In addition, a number of users had insisted that the model's general utility would be enhanced if it were adapted to the analysis of nonenergy industrial and construction projects, as well as energy projects. Other users suggested that the addition of certain capabilities to the model (for example, the capability to project needs for specific social and medical services) would make it even more useful. Accordingly, in June of 1977, REAP initiated contracts for E-D Model expansion and refinement.

A grant from the Fossil Energy Program of the U.S. Energy Research and Development Administration (now part of the U.S. Department of Energy) provided partial support for the E-D Model expansion refinement activity. Objectives of the effort included:

1. Refinement and expansion of the Economic-Demographic Model;
2. Evaluation of the applicability of the Economic-Demographic Model to other states;
3. Identification and evaluation of the usage of REAP data and capabilities to date;
4. Report on the status of R³S and its expansion potential.

The refinement and expansion of the E-D Model included such activities as the expansion from a thirteen-sector economic module to a module with a capability to handle up to thirty economic sectors; modifications to the structure and coefficients of the economic module to reflect differences in economic structure among the state's functional economic areas; modifications to the demographic module to allow more precise population projections and to provide the ability to account for unique demographic characteristics of various types of industrial and resource developments; improved procedures in the residential allocation module; improved fiscal impact projections at the local level; and the ability to provide projections of various special services at the local level.

The results of this refinement/expansion effort are as follows.

1. REAP has received final code and code-related documentation for all components of the expanded Economic-Demographic Model (Version 2).
2. REAP has received a complete draft of the E-D Model (Version 2) Technical Description (Hertsgaard, et.al., for future publication).
3. Validation of the computational procedures for the E-D Model (Version 2) is complete, and REAP has received a validation report.
4. Expectations are that E-D Model (Version 2) will be available in the fall of 1979, after the conceptual design team finalizes the data base for the model.

Evaluation of the applicability of the Economic-Demographic Model to other states consisted of assessing the extent to which the model or the concepts embodied therein may be transferable to energy impact assessment in other states. This objective involved conducting several workshops in states dealing with energy-related impact assessments. The results of the evaluation indicate widespread agreement that a model such as the E-D Model could be a useful planning tool.

The success of a transferability evaluation effort is also indicated on the basis of whether other entities choose to adopt or adapt the modeling technique. To date, Texas is currently adapting the E-D Model for use in lignite-producing areas of that state. The Center for Energy and Mineral Resources of Texas A&M University has assumed the lead role in adapting the model to Texas conditions.

Identification and evaluation of the usage of REAP data and capabilities to date consisted of conducting both user and potential user surveys for the E-D Model and the REAP Resources Reference System. Results of the surveys were both useful and encouraging.

The analysis of the user and potential user surveys indicate substantial use of REAP capabilities by decision makers, as well as by researchers, planners, academia and the general public, with few or no problems in using the information supplied. Though serving all user groups, the Resources Reference System (R³S) was most useful to three functional groups: researchers, planners and

educators. Literature searches of both the bibliography and project files assisted several users in determining what research had been conducted in a subject area, what research was in progress, and where future research efforts ought to be directed. In addition, the reference files have provided numerous ongoing research efforts with easy access to past research.

E-D Model users emphasized economic and demographic reports and required that such information be supplied at the state, regional and local (county and municipal) levels. For some users, the E-D information serves to establish a general understanding of energy development impacts; for others, E-D information supplements a decision maker's "stock of information" before making a decision. However, for most, E-D information is used as a valuable input to a study in which further analysis is to be conducted. It has never been the sole information source in decision making.

Potential E-D users have indicated that E-D information is useful in determining the impacts on future service levels and program priorities. At the regional level, economic development plans were of significant importance, while at the local level, school-related impacts as well as other governmental service requirements were of significant importance.

The REAP/DOE Cooperative Effort also included an evaluation of the status of the REAP Resources Reference System and its expansion potential.

As of August 1978, R³S contained more than 10,000 references on people--resumes of persons with North Dakota technical expertise; research projects--abstracts of current study/research projects; bibliographies--abstracts of published data and analysis; and data sources--descriptions of unpublished data. The data base of R³S will be expanded periodically.

Negotiations have begun and work has progressed on the development of a work plan to expand R³S and possibly to transfer the reference system to the North Dakota State Library system.

THE REAP CONCEPT AND EVOLUTIONARY PROCESS

Background

North Dakota is experiencing the impacts of a variety of energy-related developments, such as coal-fired electric generating facilities, synthetic natural gas facilities, and export mines, as well as nonenergy developments such as various agricultural processing and manufacturing facilities.

These developments have profound effects on the state and its residents. Among the most significant of these effects are those on the state's economy and its population. Major developments create new employment and necessitate the immigration of new residents. The extent of the impacts of such events is determined by the level of economic, demographic, and other environmental changes brought about by the developments. Knowledge of the total environmental effects of development is a necessary prerequisite for effective planning and decision making.

This final report addresses the conceptual design and functional evolution of REAP, the results of the REAP/DOE Cooperative Effort, as well as evolution of the REAP/DOE effort and recommendations for future directions.

The threat of massive coal development in southwestern North Dakota was used to focus the need for passage of the enabling legislation for the Regional Environmental Assessment Program by the 1975 Forty-fourth North Dakota Legislative Assembly. While REAP's activities are not limited to assessing the impacts of coal development, the initial priority of the program was directed to the issues surrounding coal-related development. REAP was designed to use science and technology to address the problems posed by science and technology.

One unique aspect of REAP is that it resides in the legislative branch of government under the control of a legislative interim committee. That committee, the Resources Research Committee (RRC), is a statutory committee comprised of representatives from both houses of the legislature, the executive branch, the two state universities, and citizens at large.

During REAP's first biennium, the program's efforts were largely devoted to research and development, including the collection of baseline data in a variety of subject areas. The second biennium effort continued several of these research efforts; but, in addition, efforts were devoted largely to technical computing system design and development. In addition, progress has been made with the possibility of integrating REAP products with existing state capabilities where they are more directly available to those state entities that will more effectively continue their operation and thereby reduce costs to the citizens of the state.

Finally, REAP staff experienced an increasing commitment to the provision of user services of operational products during this period. These products (capabilities) have consisted of the Economic-Demographic Model, the Land Cover Analysis and the Resources Reference System.

The Economic-Demographic (E-D) Model was developed to give North Dakota decision-makers a tool with which to evaluate the impacts of coal development. It is a computer-based, mathematical model which projects social, economic and fiscal characteristics of North Dakota. While the model cannot predict the future, the fact that it can rapidly produce projections provides a way to "get a feel" for what the future holds.

For example, the model can predict the population for Hazen, North Dakota, if no more power plants are built, if one more is built, or if a dozen more are built. As such, by comparing the various population projections, one can get a feel for the range of values within which the actual population should fall.

Briefly, the E-D Model (Version 1) makes projections for a 15-county area (Golden Valley, Billings, Dunn, Stark, Slope, Hettinger, Bowman, Adams, McLean, Mercer, Oliver, Morton, Grant, Sioux, and Burleigh). It projects populations (total, construction force, operating force, indirect employment, total employment, additional school enrollment, and population age and sex distributions) for the region, each county, and each municipality in the region. The model also projects housing requirements and fiscal impacts on state, county, and municipal governments. The model is continually being updated to include the most current information about energy development. (E-D Model Version 2 is a 53-county model with various refinements/enhancements--these are described in section one.)

The REAP Land Cover Analysis (an additional capability), consisting of maps and data, was generated in response to an expressed need for a comprehensive land cover inventory for North Dakota. Several different technologies were considered for inventorying the land cover of North Dakota's 70,665 square miles. The one chosen, satellite remote sensing, uses imagery (not photographs) obtained from the LANDSAT satellites launched by the National Aeronautics and Space Administration (NASA) in July 1972, and January 1975. LANDSAT data are collected and transmitted electronically and reformatted in photo-like images or as computer compatible tapes (CCTs).

For the REAP Land Cover Analysis project, 11 different categories were classified using the LANDSAT digital data: built-up land; cropland; fallowland; exposed subsoil; rangeland; pasture, and agriculture (mixed); forest; water; wetland; barren; and uncategorized. On Land Cover maps, each category is represented by a different color. The utility of the maps and data is limited to applications for broad, regionalized (Level I) planning. The Land Cover Analysis project represents the first time a computerized categorization of LANDSAT imagery has been conducted for an entire state.

As part of its mandate to provide North Dakota decision makers with easy access to information systems and to past research and present studies about aspects of North Dakota, the REAP Resources Reference System (R³S) was developed. R³S is a computer-based library reference system designed to allow quick and easy access to information resources concerning North Dakota.

The R³S data base is an organized collection of references with selected subjects and information categories pertaining to the State of North Dakota

which supports decision making regarding environmental issues. A search of the R³S data base provides information tailored to match the requestors' interests in the form of a printed bibliography.

The data base contains approximately 12,000 references to four information categories: North Dakota technical experts (people), research projects, data sources, and reports or publications. It is limited to (22) twenty-two subject areas. These areas are considered to be REAP-related.

Agronomy	Geography	Noise	Vegetation
Air Quality	Geology	Paleontology	Water
Animals	Historical Sites	Radiation	
Anthropology	Land Ownership	Sociology	
Archaeology	Land Use	Soils	
Demographyc	Meteorology	Solid Waste	
Economics	Natural Resources		

The role of REAP, the RRC, and the manner in which REAP operates have undergone considerable evolution from those early days in 1975. The RRC (and the interim committee proposed for the next biennium) exists to assist in the development of new laws, policies, and governmental actions; and to provide facts and information to the citizens of North Dakota. Specifically, it is responsible for:

1. the development of a comprehensive environmental data base for North Dakota;
2. the development of information systems capable of meeting the needs of North Dakota decision makers;
3. the development of assessment/modeling capabilities to forecast the environmental characteristics of North Dakota;
4. the development of monitoring systems to detect changes in the characteristics of North Dakota; and
5. the coordination of data collection, monitoring systems, assessment/modeling capabilities, and information systems to avoid duplication of effort in areas of current interest to the committee.

REAP research and development projects are documented by the REAP Report series. These documents are generally made available free of charge. A complete list of REAP Reports, other REAP publications, and unpublished papers is listed in Appendix A.

A fundamental change in REAP has been the transition of the staff organizational structure from one emphasizing research and development efforts to a structure that reflects an increasing commitment to operational products and to provision of user services.

It is significant that a new division is emerging within REAP. It is dedicated to the provision of services to users and ensuring that user needs, user comments, and user evaluations are continually taken into account with respect to research and development efforts. The last change in staffing philosophy is the transition to one full-time associate director with a multi-disciplinary team of research coordinators. This approach reduces the tendency to categorize projects as either economic, social, or environmental and define the research approach being defined solely in those terms.

The last area of major evolution with respect to REAP's mode of operation is the way in which REAP provides services to its various user communities. Originally, it was thought that REAP would be a focal point for requests and analysis. This is still true to a large extent; however, a number of the products that have been developed can be more efficiently used if they are integrated with existing state capabilities; and thus, become directly available to state agencies.

Two principal examples of this are the REAP Resources Reference System which is being expanded and may move to the State Library, and the REAP computer system which, as of September 1, 1978, was placed under the operational control of Central Data Processing. These events are significant in that now state agencies have direct access to REAP capabilities to assist them in their day-to-day operations as well as access to REAP for the additional capabilities that REAP can provide.

DOE Sponsorship of REAP/DOE Cooperative Effort

Public decision makers at all levels of government have become increasingly aware of environmental impacts of major industrial developments. Environmental impact statements, in recent years, have emphasized in more detail the social, economic, demographic, and cultural impacts, in addition to other physical environmental effects of major developments. These additional considerations have taken on an increasing level of importance in the decision making process at all levels of government. The significance of the impacts is illustrated in the fact that several western states (e.g., North Dakota, Montana, Wyoming) have established systems to provide financial assistance to communities experiencing rapid growth resulting from the sudden realization of numerous energy-related industrial developments.

The federal government has established a program to provide financial aid to communities affected by outer continental shelf petroleum development. Similar assistance programs have been considered and are expected to be proposed for communities affected by other developments of federal minerals (e.g., coal, oil shale, and uranium) or by synthetic fuels commercialization. However, whatever mechanism is used to provide impact aid, a means to project the social and economic impacts of existing and new projects is needed to guide planning efforts aimed at providing assistance in a timely and efficient manner. These projected impacts become extremely important at the local level where net deficit cash flows have been widely illustrated.

In addition to providing guidelines for impact planning for effective growth management, accurate assessments of social and economic impacts are needed as input to national energy policy formulation. In contributing federal funds to the REAP/DOE Cooperative Effort, the U.S. Department of Energy provided assistance to more accurately determine social and economic impacts of energy-related developments in North Dakota and to establish a mechanism to provide input to national policy formulation (i.e., with respect to socioeconomic characteristics and other physical environmental effects of large-scale energy-related industrial projects). The following report (Sections 1 through 5) describes in detail the objectives, procedures, and results of each of the REAP/DOE Cooperative Effort objectives, and discusses several recommendations for future efforts.

1. REFINEMENT AND EXPANSION OF THE ECONOMIC-DEMOGRAPHIC MODEL

The first objective of the project was for REAP to expand and refine the REAP Economic-Demographic (E-D) Model. Expansion was to be both in terms of geographic area (i.e., from 15 to 53 counties) and in terms of variables projected. (Figure 1 illustrates the geographical area of REAP Economic-Demographic Model (RED-1.0)--RED-2.0 will include all 53 counties.) Refinement in computational procedures was to occur in all major modules of the modeling system. (Figure 2 illustrates components of the REAP E-D Model.)

1.1 Objectives

The model expansion and refinement effort was to include the following major activities.

- A. The economic module of Version 1.0 of the E-D Model uses a thirteen sector input-output model to forecast economic characteristics (i.e., gross business volume by sector, employment, and personal income estimates).

The input-output model is used to estimate economic activity in the 15-county area that will be associated with projections to the year 1999 (in 1972 dollars) of the existing economic base in the area. These estimates constitute the baseline projections upon which are superimposed the changes in economic activity associated with alternative scenarios of coal resource development. The procedure for computing baseline projections involves projecting final demand vectors (future levels of the economic base of each economic sector) through the year 1999, applying interdependence coefficients (economic multipliers) to these vectors to obtain estimates of gross business volume in each sector for the respective years, and dividing those estimates by projected gross business volume per worker in each year to obtain estimated regional employment in each year. Finally, each county's projected share of regional baseline employment and each municipality's projected share of regional baseline employment is applied to total regional employment to obtain employment estimates each county and municipality in each year.

Economic activity associated with the construction and operation of coal resource development projects is assumed to be additive to trends in baseline activity. Thus, the model first computes baseline economic activity associated with the resource development scenario specified by the user. The user must select the projects he wishes included in the coal resource development scenario to be evaluated. The model contains a set of projects which are various possible configurations of export mine, coal-fired thermal electric generating plant, or substitute natural gas plant characteristics. The

NORTH DAKOTA

Figure 1. Eight State Planning Regions and the 15-County Shaded Area Indicates the Geographic Area of the REAP Economic-Demographic Model (Version 1).

Figure 2. Data and Output Flows of Economic-Demographic Model (RED-1.0)

additional business activity and employment requirements (direct, secondary and tertiary) are added to baseline economic activity. (Business activity is at the regional level, and employment is at the regional, county and municipal levels for both baseline and project-related activity.) For a flow chart of the Economic Module, see Figure 3.

The economic module was to be modified through changes in structure and coefficients to reflect differences in economic structure among the state's functional economic areas. Figure 1 illustrates the eight functional economic regions included in RED-2.0 in comparison to the one functional economic region included in RED-1.0. In addition, the projected final demands (economic base) for each region are uniquely defined, therefore, accounting for differences in economic activity by economic region.

- B. The demographic model, which uses a cohort-survival population projection technique, consists of the application of a set of birth rates, migration rates, and survival rates to a set of baseline population data for a projected period in order to determine the population at the end of that period.

For the impact periods, populations by age and sex (for RED-1.0) are maintained within four matrices denoting four separate subpopulations. These subpopulations are a baseline (or indigenous) population, a construction worker-related population, an operational worker-related population and a population related to indirect workers. The characteristics of the baseline population are derived from 1970 census data while those for each of the other worker types are taken from direct survey results conducted on construction and operating workers of coal mine and electrical generating facilities in the Northern Great Plains. The matrices of these four populations are subjected to the migration, fertility, and survival rates noted previously in separate computations. (See Figure 4 for a flow chart of the step-by-step process of the Demographic and Interface Modules of the E-D Model.)

The demographic model for RED-2.0 was to be modified to allow for more precise population projections, to account for unique demographic characteristics of various types of industrial and resource developments other than coal-related developments, to allow separate sets of allocators for agricultural and nonagricultural employment and to redesign the model's rural-nonrural migration conventions/procedures.

- C. The E-D interface component is the linkage between the economic input-output model and the demographic cohort-survival model. In general, it consists of the following elements:

1. A set of worker requirements (from the input-output model),

Figure 3 Flow Chart for Economic Module of E-D Model.

DEMOGRAPHIC MODULE

D Loop

Figure 4 Flow Chart for Demographic and Interface Modules of E-D Model, Population Types A-D.

- Type A - Baseline Employment
- B - Indirect (Secondary) Employment
- C - Direct Construction Employment
- D - Direct Operational Employment

2. A set of worker availability functions (from the demographic cohort-survival model),
3. A procedure for comparing required and available workers, and
4. A procedure for determining the demographic effects of procedure 3.

The residential allocation component of the model is used to estimate the probable location patterns among all municipalities in the region of in-migrating workers (and their dependents) that the interface model indicates will be needed. These allocations are made at the municipal level using a gravity model.

Use of the gravity model involves the basic assumptions that in-migrants will tend to settle in population centers in direct proportion to the population of those centers, but that the number of in-migrants moving to a city will be inversely related to the distance between that city and the employment site. Finally, the model assumes that qualitative differences between possible settlement locations will affect settlement choices.

In symbolic form, the assumptions of the model may be stated as follows for each work site:

$$M_i = \frac{\left[\frac{P_i}{D_i^a} \right] W_i}{\sum_{i=1}^n \left[\frac{P_i}{D_i^a} \right] W_i}$$

Where: M_i = Fraction of the total in-migrants locating in city i

P_i = Population of city i

D_i^a = Distance between city i and the work site, raised to the power a

W_i = The relative qualitative attractiveness of city i

The user may specify values for the power (a) to which distance is raised and the value of the community attractiveness index (W_i) for any city. Separate gravity model allocations are made for each type of worker.

The existing interface and residential allocation (gravity) modules were to be reevaluated to determine modifications that were necessary or desirable to make them applicable on a wider basis (i.e., multi-county planning region, statewide). Refinements in the gravity module were to include improved procedures for allocating project-related employment changes among communities and for taking account of different baseline growth rates among communities. In general, the cohort-survival technique produces projected population derived from the basic population equation:

$$P_{t_2} = P_{t_1} + B - D + M$$

Where: P_{t_2} = Population at a given future year t_2

P_{t_1} = Population at a preceding base year t_1

B = Births between t_1 and t_2

D = Deaths between t_1 and t_2

M = Net migration between t_1 and t_2

The final component of the REAP Economic-Demographic Model-1 is the fiscal impact component. This model, utilizing the expected settlement patterns from the gravity model and subsequent population changes determined for each area by the economic and demographic models, determines the expected public costs and revenues (in current year dollars) associated with such changes. The model provides for the estimation of both state and local costs and revenues as a result of the development projects chosen in the scenario.

In each case the model works through a three-step procedure:

1. Computation of expected increased public revenues,
2. Computation of expected increased public costs, and
3. Computation of net difference between increased costs and revenues, referred to as the net fiscal balance.

For a diagrammatic illustration of a flow chart of revenue and cost estimation procedures, see Figures 5 and 6.

The fiscal impact module was to be revised to provide greater cost and revenue detail at the local level. These revisions were to include provision of fiscal impact reports for individual school districts and development of more detailed cost functions for schools and for road and highway construction and maintenance.

Figure 5

Flow Chart of Revenue Estimation

*INCLUDES COAL SEVERANCE TAX AND TAXATION OF CONVERSION FACILITIES.
 DASHED LINES (---) REPRESENT REVENUE FLOWS NOT ESTIMATED BUT INCLUDED FOR CONCEPTUAL COMPLETENESS.

Figure 6

Flow Chart of Cost Estimation

- E. A new module was to be developed to provide projections of changes in demand for medical, criminal justice, and social services. Data from the REAP Socioeconomic Monitoring Project were to be utilized and supplemented as necessary by other sources. At a minimum, the projection techniques developed were to provide outputs showing the new employment requirements by broad service category. In addition, an attempt was to be made to provide more refined projection procedures so demands for medical and social services by type of service and frequencies of various types of criminal offenses could be determined.

1.2 Procedures

The project has six major activities:

1. Conceptualization and design specification;
2. Model development, implementation, and documentation;
3. Model validation and testing, including interaction with key user groups;
4. Installation of the model on the REAP computer system;
5. Model evaluation by a committee of technical experts and incorporation of final enhancements; and
6. User orientation and information dissemination.

The procedures employed in each of these activities are discussed below.

1.2.1 Conceptualization and Design Specification

With the introduction of E-D Model (Version 1, RED-1.0), REAP was able to provide economic and demographic projections of economic-demographic baseline and the economic, demographic, and fiscal impacts of large-scale energy-related industrial projects for a 15-county area of southwestern North Dakota. Many users expressed a need for a statewide capability of the type embodied in RED-1, with the ability to address impact questions of nonenergy industrial projects. Further validation and testing of RED-1 suggested a number of ways in which the computational procedures could be refined.

1. A new technique for allocating baseline employment and, hence, population to counties and communities. Rather than using a municipalities projected annual population in determining its share of projected baseline county employment from the regional level, Version 2 of the E-D Model will use a technique employing annually projected employment to allocate baseline employment directly from the regional level to the municipal level;

2. A more precise routine for modeling demographic changes through time (use of single-year cohorts rather than five-year cohorts);
3. A capability to assess the impacts of other resource and industrial development projects (e.g., potash mining projects, dam construction, agricultural processing plants), in addition to coal development;
4. The capability of producing output in other than a limited set of tabular formats (e.g., charts, graphs, maps, custom formats, etc.); for an example of the use of graphics in presenting E-D information, see Appendix B;
5. The capability of assessing certain dimensions of social impacts including demands for social services, demands for medical services, and impacts on the criminal justice system; and
6. Numerous other refinements in data, computational procedures, and capabilities.

The detailed design of the model was developed in conjunction with a technically oriented advisory committee comprised of potential model users. The E-D Model Advisory Committee was comprised of nine persons. Entities represented were state agencies, the North Dakota Legislative Council, state regional planning councils, and private industry.

The User Advisory Committee was asked to provide input with respect to both model structure (i.e., general nature of input data and computational procedures) and the nature and format of output desired. Additional meetings were held with all eight regional planning councils and each was provided with a brief summary of the model's structure, but their major contribution was with regard to the type and format of outputs desired and the nature of model applications they envisioned. (See Appendix C for a list of the initial E-D Model User Advisory Committee and a list of the North Dakota Regional Planning Councils.)

Major model design activities occurred during the period June through August 1977. A preliminary high-level description of the resulting design is provided in REAP E-D Model (Version 2), Conceptual Design Report (Hertsgaard, et.al., 1977). Nine of the major design changes from the Version 1 Model described in that document are outlined broadly below.

1. The model is now divided into three sequential modules--an economic module (E-Model), a demographic model (D-Model), and a fiscal impact module (FI-Model). (Version 1 consisted of five modules--an economic module, a demographic module, an economic-demographic interface module, a gravity module, a fiscal impact module.) The gravity module of Version 1 has been incorporated into the economic module, and the economic-demographic interface module has been incorporated into the demographic module.

2. The model can be used to develop projections for each of the eight state regions, each county, and most of the incorporated municipalities that had populations greater than 50 in 1970. Variables projected will include all of those projected by the Version 1 Model as well as a number of additional variables, such as demands for specific types of medical and law enforcement services.
3. The model can develop projections under baseline conditions (i.e., no change from past trends) and under the assumption that one or several new energy projects or other resource development projects (e.g., sugar beet plants, irrigation projects) are developed at specified locations. When projects are located near the state's borders, the model attempts to account for
 - a. those workers employed at projects located in North Dakota who reside outside the state. For example, a project located beside the North Dakota-Montana border will allow for the fact that workers will commute from the Montana side of the border; and
 - b. those workers employed at projects located outside the state who reside in North Dakota communities.
4. Baseline workers are allocated to communities of residence using a series of allocation functions (one for each community size group) which describes the community's projected share of the region's baseline employment. Thus, the model accounts for the differential attractiveness (or viability) of communities of various sizes.
5. Immigrating project-related workers are allocated to communities of residence through use of a gravity model. The gravity model differs from that used in RED-1, in that each community's attraction value is recalculated each year based on employment (by main job type) for the preceding year. Thus, the new gravity model provides for dynamic residential allocation.

In symbolic form, the assumptions of the model may be stated as follows for each work site (in comparison to those mentioned earlier for RED-1.0):

$$M_i = \left[\frac{E_{Bt-1} + fE_{Ct-2} + E_{Ot-1} + E_{It-1}}{d_{ij}^a} \right] \{W_i\}$$

$$\sum_{i=1}^n \frac{E_{Bt-1} + fE_{Ct-2} + E_{Ot-1} + E_{It-1}}{d_{ij}^a}$$

Where: M_i = the fraction of the project-related employment that resides in city i ,

E_B , E_C , E_O , and E_I are baseline, construction, operating, and indirect employment, respectively, in the previous year (except for construction employment, which is two years previous),

f = a fraction applied to construction employment in the year $t-2$,

d_{ij}^a = the distance from municipality i to the location of project j raised to the power a , and

W_i = the relative qualitative attractiveness of city i

6. The cohort-survival model employs single-year cohorts which allow for more precise modeling of population dynamics than was possible with the five-year cohorts used in Version 1.
7. The model is capable of greatly enhanced fiscal reporting, including revised education costs (as linear step functions), state highway costs, county road costs, personal property tax replacement payments, and coal impact fund revenues.
8. A total state revenue forecasting capability was to be incorporated.
9. Segregation of school districts and municipalities in financial reports was to be implemented.

1.2.2 Model Development and Implementation

Major efforts to develop data and relationships began in July 1977. An integral part of the design and relationship development was a series of back-casting runs for all counties and cities; runs were performed for the period 1960 through 1975 for each of the eight state planning regions using the Version 1 Model. Comparison of "projected" and actual values was useful in identifying areas for concentrated effort in data collection and analysis.

Most of the development of relationships and input data was completed by November 1, but some work continued into January 1978. The processes of development and implementation were somewhat iterative as early test runs of the new E-D Model in December of 1977 identified needs for additional analysis and refinement.

1.2.3 Documentation

The basic documentation materials will include

1. An expanded Technical Description (Hertsgaard, et.al., for future publication) that will describe the model's structure, data sources, and computational procedures. Major assumptions, explicit and implicit, will be specified. An evaluation of the model's validity based on comparisons of computed and actual values will be included. (This document will differ from the Version 1 Technical Description (Hertsgaard, et.al., 1978) primarily in terms of including more detailed descriptions of computational procedures.)
2. A System Documentation report will provide a detailed description of code design philosophy and how the code performs certain tasks, as well as a complete code listing.
3. Once the model validation, testing, and evaluation phases have been completed and the model has been installed on the REAP computer system, three additional items of documentation are contemplated:
 - a. A user option manual should be developed and designed for wide-scale distribution to prospective users. This manual will describe the various scenarios and their implications and output formats for E-D users. The manual will supplant and supercede the current user manuals.
 - b. A user operation manual is suggested to be designed for experienced users who will choose to do extensive on-line running of the E-D Model, taking advantage of the enhanced capabilities of on-line graphics and various development and analytic capabilities of the REAP monitor system and data base under which the model will operate. This document is intended for the more sophisticated technical user.
 - c. A REAP Report will summarize the results of the Version 2 evaluation effort. This report will address model reliability and identify those areas in which the model can aid decision makers and those areas in which it cannot be relied on to provide analysis.

1.2.4 Model Validation/Evaluation

The purpose of this task is to answer three basic questions: (1) Does the basic design of the model conform to acceptable economic and demographic analysis procedures (i.e., are the logic and basic design sound)? (2) Does the software properly execute the desired computations? (3) Do the results, if properly computed, appear valid in terms of what is known regarding economic and demographic relationships? The nature of the computations and the underlying

economic-demographic-fiscal relationships is sufficiently complex that simple and unambiguous tests are difficult to devise. While some computations can be checked easily (e.g., severance tax collection and distribution) because the formulas are well defined by statute, the question of assessing the validity (i.e., the degree of approximation to reality) of the results of various components of the model interacting with each other is substantially more complex than merely verifying accuracy of computations.

The approach to this task will involve three independent processes:

1. empirical testing; 2. evaluation of assumptions and procedures by selected technically oriented users, potential users, and recognized experts in the field of economic, demographic and fiscal analysis; and 3. the incorporation of recommended enhancements to the model.

- A. Empirical testing--An important element of the technical validation effort must be comparisons of projected values (computed values) of key variables with known (actual) values of these variables. Thus, a major emphasis was placed on historical simulation with the model. Such historical simulation will consist of running the model over an historical period for which "true" values of the variables of interest are known. Comparison of "projected" and actual values would then give an indication of the reliability or validity of the data and algorithms which constitute the model. The historical simulation runs provide the basis for objective analyses of the model's reliability for the past.

Historical simulation runs involve loading historical input data for the period 1960-1975. Comparisons of "projected" and actual values are then made for the following variables:

Personal Income--by region for each year;
Population--by county and municipality for 1970;
School enrollments--by county;
Other variables also may be examined.

- B. Evaluation by Recognized Experts and Technically Oriented Users--The theoretical strengths and weaknesses of the model will be evaluated, those areas for which the model can provide useful information to decision makers will be identified, and recommendations will be made about future enhancements and modifications.

To aid in the evaluation process, a small committee is being established, consisting of individuals who have technical expertise either in economic and demographic modeling or in the economic, demographic, or governmental field characteristics of North Dakota and would, thus, be able to participate in a detailed evaluation. The essence of this task will be to obtain from

recognized experts in the field an evaluation of the appropriateness of the model's structure, computational procedures, input data and the assumptions inherent in those procedures and data. In addition, two other topics will be addressed--the types of decisions/planning the model can support and output formats.

- C. Incorporation of Enhancements--Following review of the report submitted by the evaluation committee, recommended enhancements will be incorporated into the E-D Model (Version 2). In addition, documentation such as code listings, code descriptions, technical descriptions, user manual and brochures will be revised to reflect relevant portions of the evaluation effort and the enhancements to the model.

1.2.5 User Orientation and Information Dissemination

User orientation activities will be similar to those conducted in conjunction with the E-D Model (Version 1), but substantially more extensive. A series of user seminars will be conducted.

In preparation for the seminars, care will be taken to identify key user groups and tailor each seminar to the unique needs of each group. Briefing materials will include summaries of major model assumptions, capabilities and data sources; summaries of major model outputs from one or more "standard" scenarios; and visual aids including overhead transparencies, slides and flip charts.

In addition to user orientation workshops, additional efforts will aim toward rapid and widespread dissemination of information about the model and its capabilities. Useful tools in this dissemination effort would include a new model brochure; a summary of model assumptions, uses and limitations; and a summary of business activity, employment, and population and school enrollment projections for a "standard" scenario. A document similar to the report The REAP E-D Model: Background, Structure and Applications (Leistritz, et.al., 1978) should be prepared for Version 2. Its purpose would be to create a widespread, more complete understanding of the model and its capabilities and limitations for industrial development impact analysis.

1.3 Results

The purpose of this section is to summarize the status of model development, documentation, validation and related activities as of mid-August 1978, and to briefly summarize the capabilities of the expanded model.

1.3.1 Status of Project

Major past and future milestones for model development, documentation, validation, evaluation, and user orientation are as follows.

Major Past Milestones

February 1978	Final E-Model code and code-related documentation delivered to REAP.
March 1978	Final D-Model code and code-related documentation delivered to REAP.
June 1978	Complete draft of <u>E-D Model Technical Description</u> (Hertsgaard, et.al., 1978) delivered to REAP (earlier drafts of E-Model and D-Model sections had been delivered during March and April).
August 1978	Revised draft <u>Technical Description</u> delivered to REAP.
August 1978	Final Fiscal Impact Model and Services Module code and code-related documentation delivered to REAP.
September-December 1978	Validation efforts to be completed.
December 1978	External review of draft <u>Technical Description</u> .
January 1979	Validation report to be received by REAP from the conceptual design team.
January-March 1979	REAP internal validation and evaluation of the model and incorporation of modifications.
March-July 1979	Version 2 evaluation effort and incorporation of enhancements.
July-November 1979	Revision of E-D Model (Version 2) documentation, preparation of user oriented materials, and training users of the model.

1.3.2 Capabilities of E-D Model (Version 2)

Version 2 of the REAP Economic-Demographic Model extends the coverage of the model to include all 53 North Dakota counties and includes the ability to address impacts of nonenergy developments as well as energy-related developments. It allows the ability to use up to a 30-sector input-output module to estimate secondary economic (i.e., gross business volume by sector, personal income and employment) impacts of industrial projects. The user is allowed to select either a state planning region or a group of counties (up to 15 counties may be specified) as the basis for model output. The eight state planning regions are defined as functional economic areas with each region being served by a major trade center.

Version 2 provides both baseline projections and impact projections through the year 2000. The baseline projections produced by the model indicate the expected response of economic and demographic factors in a designated area if the economic and demographic trends of the 1960s and early 1970s were to continue through 2000. Because the historical trends in this region have involved declining farm numbers and rural population, these projections represent limited economic development and, for most areas in the region, limited growth alternatives. They provide, however, the necessary background against which the impacts of industrial developments and their effects must be assessed.

The projections provided by the model allow for the assessment of the impacts of single or multiple developments at alternative sites anywhere in the state. In these projections, baseline populations and economic data for the 1960s and 1970s are taken as starting points. However, all changes from this baseline for the years 1975 through 2000 are predicted on the expected levels of expenditures and employment resulting from various developments.

Version 2 of the model, however, has involved numerous alterations in the model's structure and provides several refinements. The most evident of the structural changes include the inclusion of the gravity model within the economic component of the model, the inclusion of nonenergy-related economic and demographic parameters in the model, and the addition of several community service modules. The refinements include such factors as lagging estimates of parameters in the gravity model for construction and operational populations, direct allocation of employment to municipalities rather than counties, and the disaggregation of five-year cohorts to single-year cohorts. The details of these changes and refinements are described in the REAP Economic-Demographic Model: Technical Description (Hertsgaard, et.al., 1978).

The model remains fully interactive and allows the user to specify numerous dimensions of the proposed project. Model outputs, for economic and demographic activity, for the years specified by the user, are indicated in Figure 7.

Figure 7
Economic-Demographic Model Outputs

[illegible]

*GBV = Gross Business Volume

25

Reports:	Demographic Activity							
	Total Population	Employment						Total Employment
		Project-Related				Baseline		
		Const.	Energy Operating	Non-Energy Operating	Indirect	Non-Agri.	Agri.	
State Summary Report	For all economic regions	For all economic regions	For all economic regions	For all economic regions	For all economic regions	For all economic regions	For all economic regions	For all econ. regions
Regional Summary Report	Separately, for ea. reg.	Separately, for ea. reg.	Separately, for ea. reg.	Separately, for ea. reg.	Separately, for ea. reg.	Separately, for ea. reg.	Separately, for ea. reg.	Separately, for ea. region
County Summary Report	For each county	For each county	For each county	For each county	For each county	For each county	For each county	For each county
Municipality Report	For each muni.	For each muni.	For each muni.	For each muni.	For each muni.	For each muni.	For each muni.	For each muni.
County Age/Sex Report	For each county, total population by age and sex for 5-year age-sex cohorts.							

Fiscal Impact Reports indicate, for the units of government and years selected by the user, the project-related changes in public revenues and costs for the scenario selected by the user. The state report of aggregate income is for project-related state tax revenues from sales and use tax, personal income tax, corporate income tax, and corporate privilege tax from the entire impacted region. However, other items of tax revenue and the state report of aggregate expenditures are only for those expenditures associated with the counties selected by the user. The reports for the units of government and years specified by the user contain the following information. (See Appendix D for an example of Fiscal Impact Reports.)

State Report
(For those counties and projects selected by the user)

Aggregate Income	Aggregate Expenditures
Sales and Use Tax	Education Transfers
Personal Income Tax	Personal Property Tax Replacement
Corporate Income Tax	(Transfers)
Corporate Privilege Tax	Highway Fund (Transfers)
Highway Tax	Cigarette and Tobacco (Transfers)
Cigarette-Tobacco Tax &	Conversion Tax (Transfers)
Liquor-Beer Tax	Severance Tax (Transfers)
County Equalization	Highway Construction
Coal Conversion Tax	General Government Functions
Severance Tax	Total Expenditures
Federal Coal Royalties Oil &	
Gas Tax	
Total Revenue	

Net Balance (Total Revenue Minus Total Expenditures)

County Report
(For counties and years selected by user)

Revenue	Expenditures
Share of Local Property Tax	Law Enforcement
Federal Revenue Sharing	Social Services
Highway Fund (Transfers)	Highway Maintenance
Severance and Conversion Tax	Other Government
(Transfers)	

Net Fiscal Balance (Total Revenue Minus Total Expenditures)

Municipality Report
(For counties and years indicated)

Revenue	Expenditures
Share of Local Property Tax	Streets
Personal Property Tax Replacement (Transfers)	Police and Fire
Federal Revenue Sharing	City Government
Users' Fees	Debt Service
Special Assessments	
Highway Fund (Transfers)	
Cigarette and Tobacco (Transfers)	
Severance and Conversion Tax (Transfers)	

Net Fiscal Balance (Total Revenue Minus Total Expenditures)

School District Report
(For each school district and years identified by the user)

Revenue	Expenditures
Share of Local Property Tax	Debt Service
Education Transfers	Operating
Severance and Conversion Tax (Transfers)	

Net Fiscal Balance (Total Revenue Minus Total Expenditures)

Version two of the Fiscal Impact Module will also contain an Aggregate Fiscal Baseline Report. This report indicates total state revenues for sales and use taxes, personal income taxes, corporate income taxes, and corporate privilege taxes associated with projections of baseline economic activity for the entire state.

Special Services Report--The service module provides projections of total service requirements on the basis of population based rates for four types of service needs:

- Educational Services
- Housing Services
- Medical Services
- Criminal Justice Services

Educational Services Report--The model provides projections of school enrollments by age at the municipal level for the years specified by the user.

Housing Services Report--The housing module provides projections of the number of units, by housing type, required for each population type, for the years specified by the user at the municipal level.

Medical Services Report--The medical services module projects requirements for several aspects of medical services on the basis of age-sex specific rates of medical usage applied to age-sex specific cohorts at the county level.

Items included are:

- Number of persons visiting physicians
- Number of physician visits
 - Number of office visits
 - Number of hospital outpatient visits
 - Number of emergency room visits
- Number of persons hospitalized
- Number of patient days
- Number of physicians needed
- Number of hospital beds required.

Criminal Justice Services Report--The criminal justice module provides total regional projections for selected criminal justice services for the years specified by the user. The criminal justice services are

- Total number of offenses
- Offenses by type
- Number of officers required
- Number of police vehicles required.

The "REAP Economic-Demographic Model 2: User Manual" and supplements to that manual will describe the various possible outputs the user may obtain from the model in greater detail.

Given the outputs summarized previously, the model provides for a wide range of possible uses.

1. Baseline and impact projections of total population size for the impact region, individual county, and individual municipality for 1975 through 1999.
2. Baseline and impact projections of regional and county populations by age and sex (i.e., males 0-4, 5-9, etc.; females 0-4, 5-9, etc.).
3. Projections of school enrollments by age for each region, each county, and each municipality under impact conditions.

4. Expected settlement patterns of immigrating population and their effect on current population characteristics.
5. Projections of the levels of business activity and personal income at the regional level with and without alternative development projects.
6. Projections of the levels of employment for the region, counties, and municipalities with and without alternative development projects.
7. Projections of changes in public revenues and costs associated with alternative development projects for the state, counties (or groups of countiess), school districts, and municipalities.
8. Projections of changes in service demands resulting from increased development-related populations.

2. EVALUATION OF THE APPLICABILITY OF THE ECONOMIC-DEMOGRAPHIC MODEL TO OTHER STATES

2.1 Objectives

The general objective of the project was to disseminate information regarding the capabilities, structure and data base of the E-D Model and to assess the extent to which the model or the concepts embodied therein may be transferable to energy impact assessment in other states. Specific sub-objectives included

- a. to establish contact with decision makers and researchers in other western states affected by energy development in order to describe the capabilities of the E-D Model and to determine their degree of interest in exploring the transferability of the model;
- b. to conduct a series of workshops to discuss, with state and local officials of the respective states, the capabilities of the E-D Model and to determine the availability of the data needed to implement the model for each state; and
- c. based on the results of workshops and other contacts, to determine the extent to which the model might be adaptable to assessment of the economic, demographic, and social impacts of energy developed in rural areas of other states.

2.2 Procedures

The first step in this project was to establish contact with decision makers and researchers in western states affected by energy development in rural areas. A total of 64 organizations in 15 states were contacted. A list of the organizations contacted is appended to an earlier report (see Appendix A of Assessment of the Transferability of the REAP Economic-Demographic Model, Leistritz, 1978).

Almost all of the organizations contacted expressed interest in receiving information regarding the model. Virtually all of the local government officials indicated a need for the type of impact projections which the E-D Model provides. The responses of state officials indicated that, while localized impact projections are vital to planning and growth management, analytical efforts already underway in the state were expected to provide the needed information. In some states, a clear dichotomy was apparent between the responses of state and local officials, with state officials indicating that present research projects would provide all the information necessary, while local officials were much less optimistic.

The states contacted can be divided into several groups on the basis of their responses to the initial contacts. One group believed that large-scale energy projects were not likely to occur in their states in the near future and, hence, did not feel that a major impact assessment effort was needed. Another group recognized that major impacts were likely, but were looking to their present research efforts to provide necessary information. (Several states in this group indicated that additional approaches to impact assessment would be desirable but that they wished to evaluate the outcome of their own projects before considering alternative approaches.) A third group of states considered energy impacts to be a high priority concern and were not yet heavily committed to a specific impact assessment approach. States in this group were the most receptive to the concept of the E-D Model workshop.

Workshops were held in Utah, Texas, and Alaska. In each case, representatives of interested state agencies, local government and the research community were invited to attend. Each workshop followed the general format outlined in the draft Workshop Schedule, and involved an overview of the model's capabilities, structure, data base, and uses/users to date. A general question and answer session followed the presentation. The workshop presentations were augmented through distribution of a set of briefing materials to each participant.

2.3 Results

Information feedback from workshop participants indicated that most found the sessions to be informative and that most believed that a modeling system like the E-D Model could be extremely useful. In an attempt to obtain a more formal evaluation of the success of the workshop, a brief questionnaire was mailed to each workshop participant. In summary, most participants felt that the explanation of the model was presented at an appropriate technical level, the explanation was complete, and distributed materials provided sufficient

information. Many respondents expressed the belief that the model could be a useful planning tool and their overall evaluation of the workshops was one of satisfaction.

Another index of the success of a project like the E-D Model transferability effort is the extent to which other entities choose to adopt or adapt the technique. Some officials in each of the states where workshops were conducted expressed interest in utilizing the model. However, transfer of the E-D Model technology has been inhibited by several factors. The most serious constraint on transfer to date appears to be uncertainty regarding the extent of data collection, analysis, and code revision which would be required to adapt the model to another state. Other constraints appear to include difficulty in determining which state entity should take the lead role in adapting the model and the long lead times involved in obtaining support for such a project.

To date (January 1979), the only state which is progressing in adapting the E-D Model for its use, or developing a model with similar capabilities, is Texas. Implementation of a model quite similar to the E-D Model for lignite producing areas of Texas is underway with completion expected in June 1979. The Center for Energy and Mineral Resources of Texas A&M University has assumed the lead role in this model development project. The Texas Energy Advisory Council is cooperating in the project and will coordinate state agency input. Selected local officials have been contacted and have expressed their enthusiasm for the project. The Texas project should provide extremely useful information regarding the time and resources required to transfer the E-D Model technology. If the Texas experience is encouraging, other states may be inclined to pursue a similar course.

3. IDENTIFICATION AND EVALUATION OF THE USAGE OF REAP DATA AND CAPABILITIES TO DATE

3.1 Objectives

During 1976 and 1977, REAP undertook the collection of a broad base of environmental and socioeconomic data and the development of several interim informational and modeling capabilities. Since early 1977, REAP has made available for use: the REAP Resources Reference System, and an Economic-Demographic Projection Model. It is the usage of these capabilities that is the concern of Objective 3 of the ND-REAP/ERDA (DOE) Detailed Work Plan.

This involved conducting two surveys of users of REAP capabilities during the periods August to September 1977, and February to March 1978. The first survey of users was to acquire information on the "specific use of data, suitability for that use, and particular problems or benefits." The approach to the second survey was to be similar to that employed in the initial survey. However, the second survey was to include a sample of agencies and groups which had not utilized REAP capabilities (potential users), in order to determine "why these entities have not utilized REAP capabilities."

3.2 Procedures

The initial survey of E-D Model and R³S users was conducted during September and October 1977. The survey was designed to provide information regarding specific uses of REAP information and the role of such information in the decision making process of various user entities, to provide information that would enable REAP to improve the E-D Model and R³S, and to better serve users of these capabilities.

Questionnaires were mailed to all individuals who had used the E-D Model and R³S during the period January to June 1977. Follow-up telephone calls were made to users who did not return the questionnaire within three weeks and also to users whose responses to certain questions were incomplete or unclear. Responses were received from 27 E-D Model users (77 percent) and 16 R³S users (73 percent). Although the response rates for both the E-D and R³S surveys were good after reviewing the user responses, it was clear that six months was an inadequate period of time for which to allow users to both acquire information from the capabilities and to make effective use of the information. The analysis did, however, indicate substantial use of REAP information by decision makers, with few or no problems in using the information.

A second survey of users was conducted during February to March 1978, for the period of use from July 1 to December 31, 1977. The survey procedure, again, involved the development of a questionnaire to be mailed to all individuals who had used the E-D Model and R³S during the period July through December 1978. Follow-up telephone calls were made to users who did not return the questionnaire within two weeks, and also to users whose responses to certain questions were incomplete or unclear. Responses were received from 16 E-D Model users (76 percent), and 15 R³S users (100 percent).

To evaluate why certain agencies and groups had not utilized REAP capabilities, potential user communities were identified for R³S and the E-D Model. A separate questionnaire was developed for the "non-user survey," or potential user survey. Understanding that some past non-users, or future potential users, might not be familiar with the respective REAP capabilities, the questionnaires were designed to first briefly inform the potential user of the capability.

3.3 Results of E-D Model Surveys

Briefly summarizing the results of the analysis of the E-D Model User Survey:

1. Users emphasize economic and demographic reports from the E-D Model and require such information at the state, county and local levels. In addition, because of changing development situations, users will continue to require to use the E-D Model, as well as to require economic and demographic reports.
2. For some users, the E-D information serves to establish a general understanding of energy development impacts; for other users, E-D

information supplements a decision maker's "stock of information" before making a decision. However, for most users, E-D information is used as a valuable input to a study in which further analysis is to be conducted. It has never been the sole information source in decision making, nor does, or can, the E-D Model fulfill all the socioeconomic information requirements of users.

3. Most users encountered no problems in their use of the E-D information. Several E-D users have made suggestions such as the use of graphics to improve the ease of understanding of E-D information and the use of subtraction functions to compute differences in projections between alternative development scenarios.
4. Users have been able to receive E-D information in a timely manner.

Following are several examples of uses of E-D Model information.

Division of Health Planning, North Dakota State Health Department--This division of the North Dakota State Health Department, which has the responsibility to conduct overall health planning for the state, is concerned about the impact that large-scale energy development will have on the health system in southwestern North Dakota. The request for E-D information involved economic and demographic projections for various levels of development to be used to estimate health service needs in the energy impacted region. These needs include manpower requirements for various health services. The Division of Health Planning has not indicated any problems in its use of E-D Model projections at the municipal level. This has provided valuable information to conduct more effective planning of the needs for a comprehensive health delivery system.

North Dakota Coal Impact Office--A repeated user of the E-D Model to date has been the North Dakota Coal Impact Office. The Coal Impact Office has the statutory responsibility for distributing several million dollars annually to aid local governments which are experiencing unusual expenditures as a result of coal development. These impact funds have been used primarily for capital facilities improvement, and the Coal Impact Office has used E-D Model projections as one source of information to assess the need for various facilities. A recent request for E-D Model projections for Coleharbor (McLean County) by the Coal Impact Office is one example of the model's extensive use in meeting some of the informational needs of decision makers. The E-D request was prompted as a result of a request by local officials of Coleharbor for impact assistance from the Coal Impact Office. Local officials were concerned with their ability to meet the needs of the immigrating population resulting from energy development in McLean County. Impact assistance required to meet the needs of increasing student enrollments was of immediate concern. Therefore, projections of population, number of energy-related workers most likely to commute from Coleharbor, and projected additional elementary and secondary students were provided to the Coal Impact Office to assist in assessing the community's need for impact assistance.

Transportation Services Division, North Dakota Highway Department--The North Dakota Highway Department has the responsibility for constructing, upgrading, and maintaining the state highway system. It therefore, has an obvious concern about the impact that energy development may have on the state's highway system. The Transportation Services Division has requested E-D Model population projections by county and municipality on several occasions. In addition, a nonstandard report of energy-related workers (by type), by industrial project, by community of residence, and by year was provided to the Transportation Services Division in order to determine the impact on the state's highway system and on county and municipal road systems. These commuting patterns were used to determine traffic volumes in the coal impact region.

In addition, the North Dakota Highway Department provided significant input into the West-Central North Dakota Regional Environmental Impact Study on energy development in southwestern North Dakota (for the Bureau of Land Management--Department of the Interior). Population projections and projections of workers (by type), by industrial project, by community of residence, by year (from the E-D Model) were used to determine the energy-related impact on the state, county, local and recreational road system in southwestern North Dakota. No problems were encountered in the use of E-D information. In fact, Highway Department engineering staff has expressed interest in using a statewide E-D Model in assessing future statewide highway needs.

Court Planning, North Dakota Supreme Court--In October 1977, the North Dakota Supreme Court court planner requested and received county population projections for the counties in the coal impact region, assuming the Bureau of Land Management's Level II energy development scenario. The purposes of this request were to review population projections in the coal impact region and to determine possible impacts of energy resource development on various types of caseloads to be handled by the judicial system in order to conduct effective court planning. Subsequent discussions with court planners have resulted in the development of a coefficients matrix indicating per capita rates for various types of caseloads. Work is proceeding on the conceptual development of a judicial module to the E-D Model, using caseload rates in conjunction with population projections.

Mercer/Oliver County Engineer--In August of 1977, Interstate Engineering, Inc., requested and received revised projections from the E-D Model. Periodically, project data files are updated, and users may receive revised projections of economic, demographic and fiscal impacts. Interstate Engineering was interested in comparing revised projections with previous E-D information to determine the change in projections as a result of updating the project data files for several industrial projects proposed for Mercer County. In addition, this firm is constantly involved with the various Mercer County municipalities and their efforts to effectively plan for growth.

Responses of potential E-D Model users to the question of how they might use such information varied considerably. However, some general conclusions are evident:

1. State agencies generally indicated that E-D Model projections would be of use to them in determining the impacts on future service levels and program priorities.
2. State associations expressed interest in using E-D information to assist in school administration planning and service capabilities and needs.
3. At the regional level, the principal concern was with regional and local development plans.
4. The uses expressed at the academic level varied from concern about social problems of energy development to using the E-D Model as a teaching tool.
5. The principal concern of private potential users is to provide information to the general public or to the organization's members.
6. At the county and local government levels, school-related impacts were of significant importance.

The critical question of the potential user survey, however, is why the potential user had not yet used E-D information. A significant number of potential users (50 percent) indicated that they had not been aware of the E-D Model capability prior to the questionnaire. In addition, 44 percent indicated their "unawareness" of the E-D Model as the reason for not using the model's capability. In addition, the geographical limitation of the model has limited use of the model by a number of potential users. The low response to such alternatives as "information is not in a usable format for my purpose" and "the variables measured do not apply to my job functions," justifies the conclusion that the general consensus is not that the E-D Model does not provide useful information, but rather, potential users have not used the E-D Model for various reasons, and a significant number see E-D information as being of assistance to them in performing their job functions.

3.4 Results of R³S Surveys

The types of organizations polled for the R³S user and potential user survey include county and local government, educational institutions, private industry, state regional planning councils, and state and federal agencies.

In reviewing the R³S user questionnaires, it can be seen that users are pleased with the R³S services provided. R³S users stated they were able to employ the information provided to them for a variety of uses.

An example of how R³S information served multiple functions for one state agency follows:

1. A literature search assisted in determining what research had been completed and what research was in progress, which served as a base for determining what research remained to be initiated in the user's area of interest in North Dakota.
2. Information supplied by R³S assisted with the planning of future research activities within the state. The information indicated that a particular study was already funded and in progress, which avoided duplication of research effort.
3. R³S supplied the literature reference printout needed for an out-of-state contact who requested information about North Dakota environmental concerns. The results of the search provided information to be used for the compilation of a report concerning the amount of money expended on project development due to environmental concerns.

The results of the R³S potential user survey indicated that the system can serve in many decision making capacities. Briefly summarizing the results of the R³S Potential User Survey:

1. Questionnaire responses indicated that all listed potential uses could be served with R³S information. R³S could best assist with three functions--research, followed very closely by education, and then planning purposes.
2. When asked whether R³S could be helpful in their work, 81.5% of the respondents indicated "yes," while only 10.5% stated "no," and 8% said they "didn't know."
3. The largest number of potential user respondents indicated that, to date, they have not used the R³S capability because they have not been involved in REAP-defined research, and they were not aware of the R³S capability.
4. Responses indicated that potential users anticipated most frequent usage of R³S categories in the following ranking order: data source; and project and bibliography ranked equally. All categories were noted.
5. The responses to how R³S information could assist in performing job functions substantiate that the REAP Resources Reference System goals are being met. One can also infer from the responses to this question that R³S information can also serve unique informational needs.

4. R³S STATUS AND EXPANSION POTENTIAL

4.1 Resources Reference System (R³S) Status Potential

4.1.1 Status of R³S

R³S became operational with a limited data base of 3,200 documents in January 1977. The data base categories were expanded on October 5, 1977, to more than 10,000 references, and some additional references have been incorporated since that time. A recap of the number of documents contained in the R³S data base by category is listed below for the first (1977) and second (1978) years of R³S operation.

<u>Category</u>	<u>Number of Documents</u>		<u>Contents</u>
	<u>Jan. 1977</u>	<u>Aug. 1978</u>	
People	498	536	Resumes of people with technical expertise
Project	432	661	Abstracts of current study/ research projects
Bibliography	1,955	9,404	Abstracts of published data and analysis
Data Source	140	143	Description of non-published data
Total	3,025	10,744	

Users in six categories were provided with R³S printouts between January 1, 1977, and August 11, 1978.

Types of Users

Federal Government

United States Department of Defense
Corps of Engineers, St. Paul, MN
United States Department of the Interior
Bureau of Land Management, Portland, OR
Bureau of Reclamation, Bismarck, ND
Geological Survey

State (Executive Branch)

Business Industrial Development Department
Energy Management and Conservation Office
Governor's Office

State (Executive Branch) continued

North Dakota Geological Survey
Public Service Commission
Soil Conservation Committee
State Game and Fish Department
State Historical Society
State Planning Division
State Water Commission

State (Legislative Branch)

Council of State Governments Midwestern Office
House Majority Leader
Natural Resources Coordinator
State Senator

Educational Institutions

Halliday High School
Minot State College
North Dakota State University
 Biology Department
 Botany Department
 Water Resources Research Institute
University of North Dakota
 Biology Department
 Center for Teaching and Learning
 Geology Department
 Marketing Department
University of Wisconsin
 Sociology/Anthropology Department
Saxvik School

Regional

North Central Regional Planning Council
Old West Regional Commission
Roosevelt-Custer Regional Council
South Central (ND) Regional Planning Council

Private Users

Ecology Consultants, Denver, CO
ERT/Ecology Consultants, Inc., Fort Collins, CO
Futgro National, Inc., Long Beach, CA
Henningson, Durham and Richardson, Santa Barbara, CA
Minot Daily News, Minot, ND
Woodford Consultants, Denver, CO

4.1.2 R³S Expansion Potential

Users' comments indicated that the usefulness and value of R³S relies on the completeness and timeliness of the data base. These comments, together with REAP staff evaluation, led to the conclusion that the R³S capability must be expanded to provide services equivalent to that of a comprehensive research library.

To develop that comprehensive capability, many approaches can be taken.

1. The development of informational literature (i.e., user manuals, brochures, etc.) to inform the public of R³S existence and how to use system capabilities vital to the successfulness of R³S.
2. To stimulate R³S information activity (input as well as output), publish selected bibliographies and/or project descriptions contained in the data base.
3. To expand the R³S scope and information services, a close working relationship should be established with the North Dakota State Library and other major libraries within and outside the state.
4. National information systems should be reviewed and evaluated for R³S affiliation.

5. EVALUATION AND RECOMMENDATIONS FOR FUTURE EFFORTS

REAP has received a conceptual design report, technical description, code and code-related documentation for a statewide expanded and enhanced Economic-Demographic Model (Version 2.0); numerous E-D Model transferability workshops were held in several states indicating broad support for such a modeling capability. The effort by the Center for Energy and Mineral Resources of Texas A&M University in adapting the E-D Model (Version 1) to lignite-producing areas of Texas should provide valuable information on the usefulness of the E-D Model in other states, its ease of adaptability, and additional enhancement/refinement capabilities.

The user surveys conducted by REAP staff indicate widespread use of all REAP capabilities; in fact, the potential use of various capabilities has increased to a degree necessitating the establishment of a User Services Division to ensure that the appropriate user services are provided in a timely manner.

The REAP/DOE Cooperative Effort has been a valuable and useful research effort. The expanded and refined E-D Model, when available for use, will provide North Dakota with the capability to more accurately assess energy development impacts, as well as other nonenergy-related industrial development impacts. The expanded capability provides a tool to address more comprehensive socioeconomic issues related to industrial development. In addition, the

expanded model and other available REAP services provide useful information to both state and federal users in assessing the energy impact issue.

The REAP Resources Reference System (R³S) has the potential to expand to a comprehensive research reference system. Such a system is proposed to be located within the State Library system. The development of such a system, while dependent on legislative funding approval, would not only expand the R³S capability, but would illustrate that REAP-developed capabilities are transferable to other state entities that can assure their continued development and successful operation.

With an expanded statewide economic-demographic projection capability, data requirements become more significant. These requirements consist of industrial project data and revised parameters reflecting the most current development situation and/or economic-demographic relationships. With an eight-region economic module, emphasis will be placed on the identification and updating of site specific industrial project data for each region, acceptable model management policy suggests a close working relationship with the technical staffs of each of the state's regional planning councils, the state Business and Industrial Development Department, and such entities as the North Dakota League of Cities. In addition, industry groups are a valuable source of both data and support for gathering the necessary data to update the model's existing parameters. These should include such variables as family characteristics of immigrating workers, the number of local workers as compared to nonlocal workers, housing preferences, etc. For fiscal relationships, continuous reviewal of state and local detailed budget data is essential to providing realistic estimates of fiscal impacts associated with large industrial projects.

In the long term, a vital consideration will be the use of existing and additional primary data to check the consistency of input-output (I-O) coefficients over time. Where recent comparisons with census data indicate the model's ability to perform well at local levels, the model's ability to continue with the same reliability can only be assured with I-O consistency checks, as each region's economic base changes from a rural agrarian base to one of more industrial and service-oriented complexity.

Discussion about the future potential of the REAP Economic-Demographic Model must also pay special attention to the fiscal impact module. REAP's fiscal impact projections were the center of controversy in the 1977 North Dakota Legislative Session. Following that session, the REAP staff decided that the controversy centered on the way in which the numbers were presented and, as such, spent two years enhancing the model, conducting training, and packaging model outputs. Surprisingly, fiscal projections were even more controversial during the 1979 Legislative Session. Out of this ongoing controversy grew a realization that the problem was much more fundamental than either the validity of the numbers or the manner in which they were presented.

The fiscal impact module provides projections of average costs that are useful when one tries to get a feel for the effects of alternative levels of energy

development. The problem, with respect to fiscal impact information for legislative users, is two-fold and does not rest with the fiscal impact module, or in the manner in which the fiscal impact module performs its computations. Rather, the problem rests with the expectation that results from a modeling effort, by their very nature, must be "comprehensive."

In addition, given the nature of the North Dakota part-time legislature (the North Dakota Legislature meets for 2 to 3 months every two years) there is neither the desire nor the expertise to become involved in long-range planning and management activities during the legislative session. Rather, the North Dakota Legislature seems to concentrate on short-range adjustments, or fine-tuning the taxing system--an activity the Fiscal Impact Module was not designed to perform.

While documentation, valid methodologies and realibility of estimates are important concerns in developing any information for decision making with the use of modeling techniques, the above problems demonstrate the critical need for a different approach to fiscal impact analysis in North Dakota.

The presentation of modeling results, by themselves, is insufficient. A fundamental realization must be made that "models" can provide only so much information (within the limits of the objectives of the model design criteria). A legislator, in making a policy decision related to energy and/or industrial fiscal impacts, will undoubtedly use a "stock of information." This stock could consist of other related facts and/or fundamental philosophical opinions. An important concern for those presenting "fiscal" analysis is the commonly phrased "comprehensive" nature of modeling techniques.

REAP has experienced that the presentation of average cost and revenue estimates, by themselves, is insufficient. Modeling is useful, up to a point; then further analysis is necessary to account for those factors not accounted for in the model and the various limitations of the modeling technique itself. In presenting comprehensive information for the decision making process, modeling results may be a small portion of the information package.

With respect to the second problem, providing fiscal impact information through two legislative sessions, REAP has learned that the use of computer printouts and one- to two-page summaries is inadequate. The first is "impossible to understand," and the second is ambiguous--providing an opportunity for "misinterpretations." Because of these difficulties, and the nature of the North Dakota Legislature, it is highly unlikely that Version 2 of the Fiscal Impact Module will be completely developed, tested, or ever released for general use as a module designed to provide comprehensive fiscal impact analysis. Use of Version 2 will probably consist more of answering individual questions through the use of model components that have been refined/enhanced to incorporate factors/considerations resulting from legislative requests.

In conclusion, each of the REAP capabilities addressed in this report will continue to be enhanced/refined to meet user needs for information and/or analysis in the decision making process.

REFERENCES

- Hertsgaard, Thor A., Mark S. Henry, Richard Ludtke, Steven H. Murdock, and Norman E. Toman, N.D. REAP Economic-Demographic Model Version II Conceptual Design Report, North Dakota Regional Environmental Assessment Program, Bismarck, 1977.
- Hertsgaard, Thor A., Steven H. Murdock, Norman E. Toman, Mark S. Henry, and Richard Ludtke, REAP Economic-Demographic Model: Technical Description, (Version I), North Dakota Regional Environmental Assessment Program, Bismarck, 1978.
- Hertsgaard, Thor A., Norman E. Toman, and Steven H. Murdock, REAP Economic-Demographic Model: Technical Description, (Version II), North Dakota Regional Environmental Assessment Program, Bismarck, for future publication.
- Hertsgaard, Thor A., Mark S. Henry, Richard Ludtke, and Steven H. Murdock, REAP Economic-Demographic Model-1: User Manual, North Dakota Regional Environmental Assessment Program, Bismarck, 1976.
- Leistritz, F. Larry, Assessment of the Transferability of the REAP Economic-Demographic Model, North Dakota Regional Environmental Assessment Program, prepared for the U.S. Department of Energy Fossil Energy Division, Washington, D.C., 1978.
- Leistritz, F. Larry, Thor A. Hertsgaard, Donald M. Senechal, Steven H. Murdock, Norman E. Toman, K. Wiig, and Glenn D. Schaible, The REAP Economic-Demographic Model: Background, Structure, and Applications, North Dakota Regional Environmental Assessment Program, prepared for the U.S. Department of Energy Fossil Energy Division, Bismarck, 1978.

APPENDIX A

REAP PUBLICATIONS

REAP PUBLICATIONS

REAP Reports

An Evaluation of the Need for and Desired
 Location of Additional Meteorological
 Stations in North Dakota
 A File of Archaeological Sites in North Dakota
 Paleontologic Sites in North Dakota (Through 1976)
 Known Historic Site Survey of 21 Western North Dakota
 Counties
 Land Cover Analysis of North Dakota
 Invertebrates of North Dakota: Aquatic Mollusks
 Land Mollusca of Southwestern North Dakota
 REAP E-D Model, Technical Description
 Invertebrates of Southwestern North Dakota:
 Parasites
 Vertebrates of Southwestern North Dakota:
 Amphibians, Reptiles, Birds, Mammals
 Bibliography of North Dakota Geology and
 Water Resources
 An Input-Output Linear Programming Model of the
 Western North Dakota Water Economy
 Coal Development Handbook
 Fishes of the Western Tributaries of the Missouri River
 in North Dakota
 Arthropods of Southwestern North Dakota

Other Publications

REAP Brochures
 E-D Model
 REAP Resources Reference System
 Land Cover Analysis
 REAP Newsletters
 Technogram
 Infocom
 The REAP Economic-Demographic Model:
 Background, Structure and Applications
 The REAP Economic-Demographic Model-1:
 User Manual
 REAP Land Cover Analysis of North Dakota
 Using Computer-Based LANDSAT Imagery
 Alternatives for Action--REAP in North Dakota
 REAP/RRC User Handbook

Unpublished Papers

Synopsis of Information Requests
 1979-1981 REAP Program as Tentatively Approved
 by the RRC on September 27, 1978
 ND-REAP Resources Reference System (R³S)
 The Automated Library Reference Service About
 North Dakota
 Water Data and the North Dakota Regional Environmental
 Assessment Program
 Department of Energy Reports
 Keyword Descriptors

APPENDIX B

Presentation of E-D Information With the Use of Graphics

PROJECTED POPULATION--MERCER COUNTY

BY YEAR FOR 3 DEVELOPMENT SCENARIOS

(see text for description of assumptions)

Draft Copy

POPULATION PROJECTIONS

BY YEAR FOR THREE DEVELOPMENT SCENARIOS

BLM-BASELINE

BLM-LEVEL I

BLM-LEVEL II

Draft Copy

PROJECTED STATE NET FISCAL BALANCE

FOR NORTH DAKOTA BY YEAR FOR 3 DEVELOPMENT SCENARIOS

(see technical description)

PROJECTED FISCAL BALANCE--MERCER COUNTY

BY YEAR FOR THREE DEVELOPMENT SCENARIOS

(see text for description of assumptions)

Draft Copy

PROJECTED FISCAL BALANCE--BEULAH

BY YEAR FOR THREE DEVELOPMENT SCENARIOS

(see text for description of assumptions)

Draft Copy

ADDITIONAL SCHOOL ENROLLMENTS--BEULAH

PROJECTIONS BY YEAR FOR THREE DEVELOPMENT SCENARIOS

BLM-BASELINE

BLM-LEVEL I

BLM-LEVEL II

LIST OF FIGURES

	<u>Page</u>
Figure 1 Eight State Planning Regions and the Geographic Area of the REAP Economic-Demographic Model (Version 1)	7
Figure 2 Data and Output Flows of Economic-Demographic Model	8
Figure 3 Flow Chart for Economic Module of E-D Model	10
Figure 4 Flow Chart for Demographic and Interface Modules of E-D Model, Population Types A-D	11
Figure 5 Flow Chart of Revenue Estimation	14
Figure 6 Flow Chart of Cost Estimation	15
Figure 7 Economic-Demographic Model Outputs	25

Appendix C

E-D Model User Advisory Committee
and
State Regional Planning Councils

E-D Model User Advisory Committee

Name

Darrell Ohlhauser	Executive Budget Analyst, Governor's Office
Ralph Dewing	North Dakota Coal Impact Office (Director)
Joe Smith	North Dakota Employment Security Bureau
Duane Bye	Basin Electric Power Cooperative
Dean Monteith	North Dakota State Planning Division
Richard Blair	State Department of Health
Chester Nelson, Jr.	North Dakota Legislative Council
Oscar Lund	North Dakota State Planning Division
Bill Goodrich	North Central Regional Planning Council

State Planning Region*

I	Williston Basin Regional Council for Development
II	Souris Basin Regional Council for Development
III	North Central Regional Council for Development
IV	Red River Regional Council for Development
V	Lake Agassiz Regional Council for Development
VI	South Central Regional Council for Development
VII	Lewis and Clark 1805 Regional Council for Development
VIII	Roosevelt-Custer Regional Council for Development

*The attached map indicates the geographic area of each state planning region.

NORTH DAKOTA STATE PLANNING REGIONS

APPENDIX D

Example State, County and Municipality Fiscal Impact Reports

*** **

NORTH DAKOTA R.E.A.P.
ECONOMIC DEMOGRAPHIC MODEL - RED 1.3

*** **

REAP HAS MADE EVERY EFFORT TO ENSURE THAT THE E-D MODEL HAS BEEN DEVELOPED ON A THEORETICALLY SOUND BASIS AND HAS BEEN PROPERLY VALIDATED. DEFAULT VALUES REPRESENT REAP'S "BEST GUESS"; HOWEVER, REAP ASSUMES NO RESPONSIBILITY FOR THE VALIDITY OF THE DEFAULTS, THE VALIDITY OF ANY USER-SPECIFIED OVERRIDES OF THE DEFAULTS, OR THE RESULTS THAT LOGICALLY FOLLOW FROM THOSE ASSUMPTIONS.

ALL INFORMATION CONTAINED IN THIS DOCUMENT IS PROPRIETARY TO REAP AND IS TO BE HELD IN THE STRICTEST CONFIDENCE. THIS INFORMATION CANNOT BE REPRODUCED FOR SALE OR FREE DISTRIBUTION WITHOUT THE EXPLICIT WRITTEN PERMISSION OF THE DIRECTOR OF REAP.

MASTER RUN NUMBER : 1977 9 20 137 47 29 560

APL USER NUMBER : 6007

FINMODEL RUN FROM 1975 UNTIL 1999

PROJECTS INCLUDED IN THIS RUN : 0 3 4 5 6 7 10 18 19

PROJECT NUMBER	PROJECT NAME	PROJECT SITE	STARTING DATE	DESCRIPTION
0	BASLINE	1	1975	BASLINE ECONOMIC ACTIVITY
3	GASCOYNE	9	1975	MINE EXPANSION
4	BASIN	44	1975	440 MW ADDITION, MINE EXPANSION TO 3.8 MTPY
5	MINNKOTA	51	1975	440 MW ADDITION, MINE EXPANSION
6	UPA-CPA	38	1975	COAL CREEK ELEC. GEN. PLANT AND ASSOC. MINE
7	COYOTE1	41	1977	440 MW ELEC. GEN. PLANT AND 2.3 MTPY MINE
10	NGPL	14	1980	250 MCFD NATURAL GAS PLANT AND 14 MTPY MINE
18	ANGBASINAV	41	1978	125 MCFD GAS PLANT, 440MW ELEC. GEN., 7.3 MTPY MINE
19	ANGBASAVS2	41	1978	SAHE AS PRJ 18--NO FINAL DEMANDS

GRAVITY POWERS :	CONSTRUCTION	OPERATION	INDIRECT
	1.5000	2.9000	1.6000

BIRTHRATE : 2.1

UNALLOCATED LABOR POOL : MAX= 0.13 MIN= 0.05

COMMUNITY ATTRACTION INDICES :

UNDERWOOD	0.65
WASHBURN	0.9
BEULAH	3
HAZEN	3
STANTON	1.3
CENTER	1.8

*** **

ECONOMIC DEMOGRAPHIC MODEL - RED 1.3
FISCAL MODEL

FISCAL RUN NUMBER : 1977 9 20 137 47 29 560 10

APL USER NUMBER : 6007

FINMODEL WAS RUN UNTIL : 1999

COUNTIES INCLUDED IN THIS RUN : 4 5 9 10 11 12 15

ANNUAL INFLATION RATE	1.07000
SALES AND USE TAX	.03000
COAL ELECTRICITY CONVERSION TAX	.00025
COAL CONVERSION TAX	.00010
SEVERANCE TAX	.35000

DO YOU WANT A STATE FISCAL IMPACT REPORT?

YES

YEAR OPTIONS-- TYPE A,B,C,D, OR EXPLAIN

STATE INCOME

YEAR	SALES AND USE TAX (\$000)	PERSONAL INCOME (\$000)	CORPORATE INCOME (\$000)	CORPORATE PRIVILEGE TAX (\$000)	HIGHWAY TAX (\$000)	CIG.-LTO.-BEER (\$000)	EQUALIZATION TAX (\$000)	CONVERSION FUND (\$000)	COAL SEVERANCE TAX (\$000)	TOTAL INCOME (\$000)	NET BALANCE (\$000)
1975	0	0	0	0	0	0	0	0	0	0	1262
1976	774	465	61	42	212	48	0	0	0	1602	7691
1977	1430	893	120	83	328	74	16	009	1431	5183	1485
1978	1779	1135	140	102	532	120	59	000	1531	6177	39
1979	1939	1202	158	109	962	217	107	1600	3920	10221	173
1980	2689	1547	203	139	1610	363	156	3225	9165	17796	3001
1981	3375	1740	229	157	2171	474	210	3225	11510	23130	2033
1982	5492	2622	345	237	2701	627	326	4025	16150	32605	9077
1983	6549	3037	376	273	2601	604	454	4025	18142	36461	10355
1984	7574	3552	450	315	3073	697	593	9375	32719	50355	21825
1985	5569	2762	335	230	3333	751	693	9375	36829	59877	10820
1986	6111	2602	360	240	3579	811	803	10475	69799	104209	49106
1987	6957	3308	377	273	3867	871	1020	10475	77765	111003	54249
1988	7345	3561	419	288	3892	877	1176	10475	86289	122312	59565
1989	6714	3292	382	262	4032	907	1446	23825	115775	156537	85410
1990	6771	3415	383	263	4267	962	1600	23825	127617	167103	90400
1991	7245	3654	409	281	4541	1024	1827	23825	140209	183095	98470
1992	7752	3910	410	301	4839	1071	2091	23825	153147	190091	108760
1993	8075	4104	449	322	5155	1162	2393	23825	168154	214159	116074
1994	8875	4476	501	345	5403	1236	2738	23825	183876	231353	127716
1995	9477	4790	537	369	5842	1317	3132	23825	200406	247795	136071
1996	10151	5125	574	395	6217	1401	3586	24025	218257	267741	147111
1997	10873	5484	614	422	6614	1491	4109	23825	237273	290704	159029
1998	11634	5860	657	452	7004	1579	4702	24025	257620	313441	171700
1999	12440	6270	703	484	7414	1671	5377	24025	277392	337592	185706

STATE EXPENDITURES

YEAR	EDUCATION TRANSPORTERS (\$000)	HIGHWAY CON. FUND (\$000)	CIGARET AND TOBACCO (\$000)	CON. SEVERANCE TAX (\$000)	SEVERANCE TAX (\$000)	HIGHWAY CON. STRUCTURE (\$000)	GENERAL GOV. FUNCTIONS (\$000)	TOTAL EXPENDITURES (\$000)	NET BALANCE (\$000)
1975	0	0	0	0	0	373	879	1252	1262
1976	291	65	9	0	0	577	1341	2233	7691
1977	437	100	14	270	72	767	2030	3596	1485
1978	645	152	21	200	306	1157	3597	6103	39
1979	1159	269	36	560	786	1598	5987	10394	173
1980	1223	446	61	1129	1973	2156	8827	15755	3001
1981	2684	621	84	1122	2302	3749	10355	21104	2033
1982	3446	785	107	1407	3220	4132	10452	28540	9077
1983	3346	770	106	1469	3400	4786	11974	26107	10820
1984	3961	891	121	3201	6544	8295	13464	32539	21825
1985	4472	1004	136	3201	7566	9205	16594	41020	10355
1986	4915	1110	151	6466	13740	11177	16275	54102	49106
1987	5361	1215	165	6466	13853	12707	17100	58450	54249
1988	5417	1291	174	6466	17250	13753	18303	62657	59565
1989	5415	1324	185	8337	26155	14817	19441	73114	85410
1990	5776	1424	179	8337	29523	15957	21157	78615	90470
1991	6411	1577	214	8337	28950	17191	22835	84625	98470
1992	6907	1702	231	8339	30767	18530	24654	91132	108760
1993	7455	1838	250	8339	32671	19759	26593	98104	116074
1994	8023	1982	269	8337	36775	21525	28727	106406	127716
1995	8646	2142	291	8337	40027	23177	31009	113723	136071
1996	9300	2312	314	8337	43651	25027	33486	122429	147111
1997	9776	2476	339	8337	47455	26990	36072	131675	159029
1998	10664	2607	365	8337	51924	29140	38832	141253	171700
1999	11372	2895	393	8339	55070	31359	41570	151806	185706

DO YOU WANT A COUNTY AGGREGATE REPORT?

YES

THE MODEL WAS RUN FOR COUNTIES: 1 4 5 9 10 11 12 15

DO YOU WISH TO SEE DATA AGGREGATED FOR ALL OF THE ABOVE COUNTIES?

YES
YEAR OPTIONS-- TYPE A,B,C,D, OR EXPLAIN
D

COUNTY FISCAL IMPACT REPORT

COUNTY: MERCER

YEAR	INCOME					EXPENDITURES			NET FISCAL BALANCE (\$000)
	SHARE OF LOCAL PROP. TAX (\$000)	FEDERAL REVENUE SHARING (\$000)	HIGHWAY FUND (\$000)	CON-VERSION TAX (\$000)	SEVERANCE TAX (\$000)	LAW ENFORCE-MENT (\$000)	SOCIAL SERVICES (\$000)	OTHER GOVT. (\$000)	
1975	0	0	0	0	0	3	3	49	-55
1976	0	0	11	0	0	3	4	62	-58
1977	8	0	14	108	72	8	10	139	45
1978	32	0	31	112	123	20	25	361	-109
1979	53	0	80	112	157	40	52	745	-436
1980	71	0	165	112	186	54	69	991	-580
1981	99	0	219	112	217	61	79	1133	-626
1982	165	176	250	224	481	51	66	939	240
1983	222	189	208	224	549	61	79	1134	116
1984	260	202	251	973	1568	70	90	1294	1799
1985	284	216	286	973	1765	74	96	1374	1979
1986	320	231	304	973	1976	79	102	1461	2160
1987	358	247	323	973	2201	80	103	1482	2436
1988	384	264	327	973	2442	85	109	1561	2636
1989	407	283	345	1722	4330	90	116	1667	5215
1990	477	303	368	1722	4773	97	126	1799	5622
1991	510	324	397	1722	5246	105	136	1946	6013
1992	547	320	430	1722	5753	114	147	2107	6403
1993	585	342	465	1722	6276	123	159	2277	6832
1994	626	366	503	1722	6877	134	172	2469	7319
1995	670	392	545	1722	7498	145	186	2670	7825
1996	717	417	590	1722	8167	157	202	2879	8322
1997	766	449	640	1722	8873	170	219	3133	8930
1998	819	460	692	1722	9634	182	235	3368	9562
1999	875	514	744	1722	10449	194	250	3506	10272

DO YOU WANT A MUNICIPALITY AGGREGATE REPORT?

YES

DEFAULT COUNTIES OF INTEREST: 4 5 9 10 11 12 15

DO YOU WISH TO SEE DATA AGGREGATED FOR ALL MUNICIPALITIES IN THE ABOVE COUNTIES?

1. STATE COUNTIES (C) OR MUNICIPALITIES (M)

2. ENTER MUNICIPALITIES OF INTEREST

3. YEAR OPTIONS: TYPE A,B,C,D, OR EXPLAIN

D

MUNICIPALITY FISCAL IMPACT REPORT

MUNICIPALITY: FREEDOM

YEAR	-INCOME-						-EXPENDITURES-							CITY GOVT.	DEPT. SERVICE	NET FISCAL IMPACT
	SIMPLE CHRG. OF LOCAL PROP. TAX (\$5000)	CHRG. TRANS. FEE (\$5000)	FEDERAL REVENUE SHARING (\$5000)	UNEMP. FEES (\$5000)	SPECIAL ASSESS (\$5000)	HIGHWAY FUND (\$5000)	CIGARET AND TOBACCO (\$5000)	CHRG. AND SEC TAX (\$5000)	SCHOOLS (\$5000)	STREETS (\$5000)	POLICE AND FIRE (\$5000)					
1975	0	0	0	0	0	0	0	0	22	1	5	25	39	91		
1976	0	15	0	7	32	1	0	0	37	2	11	50	74	118		
1977	13	21	0	15	41	3	1	57	139	8	37	172	258	433		
1978	141	100	0	51	211	10	3	122	474	23	112	577	788	1334		
1979	16	400	0	155	443	30	6	149	933	50	242	1139	1685	1864		
1980	127	678	0	335	1360	64	23	190	1290	60	330	1349	2003	2684		
1981	192	940	0	455	1703	87	31	215	1550	79	384	1304	2447	3261		
1982	330	1131	93	530	1760	101	36	215	1255	85	320	1501	2447	3805		
1983	487	914	99	441	1730	84	30	580	1527	80	302	1828	2816	4217		
1984	557	1124	105	537	2247	103	36	2002	1887	97	467	2175	3182	5103		
1985	650	1275	114	645	2548	125	43	2294	2001	105	507	2380	3270	5420		
1986	723	1425	122	697	2588	134	47	2516	2107	113	548	2573	3254	5313		
1987	809	1531	130	756	2622	145	51	2702	1893	111	536	2520	3254	491		
1988	879	1363	139	740	2622	142	50	2710	1647	116	582	2639	3254	418		
1989	932	1334	149	775	2622	143	52	5231	1735	125	604	2838	3273	2148		
1990	1123	1320	160	854	2641	160	56	5683	2089	136	656	3090	3332	2781		
1991	1255	1504	171	905	2695	173	61	6182	2247	147	713	3347	3405	3038		
1992	1293	1626	185	983	2760	188	66	6694	2440	160	776	3645	3501	3268		
1993	1335	1772	198	1071	2850	205	72	7295	2651	174	842	3954	3581	3635		
1994	1484	1717	211	1162	2708	222	78	7880	2890	190	918	4313	3703	3859		
1995	1537	2072	226	1267	3012	243	85	8504	3130	205	994	4670	3745	4313		
1996	1760	2264	242	1375	8849	263	92	9271	3405	224	1084	5073	3952	4571		
1997	1818	2462	259	1476	3141	287	101	10005	3691	244	1178	5536	3769	5230		
1998	1943	2657	277	1627	3100	311	109	10711	3744	265	1284	6032	3401	6011		
1999	2075	2845	297	1772	2805	339	119	11937	4140	286	1383	6495	2559	7326		

DO YOU WANT A SCHOOL ENROLLMENT REPORT?

**United States
Department of Energy
Washington, DC 20585**

**Official Business
Penalty for Private Use, \$300**

**PENALTY FOR PRIVATE
USE TO AVOID PAYMENT
OF POSTAGE, \$300**

DOE 350

THIRD CLASS MAIL