

COLORADO OIL SHALE: ANALYZING PROJECTED
FUTURE LEVELS OF DEVELOPMENT AND ASSOCIATED SOCIO-ECONOMIC
AND ENVIRONMENTAL IMPACTS

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ABSTRACT

A methodology is being developed to predict the socio-economic and environmental impacts of possible future levels of oil shale and other energy production in Northwest Colorado. The goal is to improve information available to State government so that it can exercise its responsibilities concerning energy, environmental, and socio-economic areas. This improved information will be required to respond to the initiatives of the expected Energy Mobilization Board, Energy Security Corporation, and new Federal initiatives to accelerate oil shale leasing and production.

The model being developed links spatial aspects of energy development, using a Geographical Information System software package, with tabular descriptions of predicted energy impacts. Later phases of the project will integrate air quality, transportation, and strengthened socio-economic modelling components.

INTRODUCTION

Colorado will be the focal point for major synthetic fuels experimentation and development

during the decade of the 1980's. The State is unique in the nation because of its high-grade oil shale resources and potential for achieving commercial scale production by 1990. The conclusions of a December, 1979 meeting to review "most likely" levels of energy development in Colorado through 1990 show that oil shale development will be accompanied by additional development of coal resources, continued interest in oil and gas, especially in tight sands formations, and uranium development (Colorado Natural Resources, 1979-a).

Northwest Colorado will simultaneously experience development activity in all of these energy resources. This area is sparsely populated and predominately agricultural at the present time. While other areas of Colorado will likewise see development of energy resources, none of them will have the type of multiple resource development and magnitude of impacts which will occur in Northwest Colorado. The extent of such impacts is analyzed in a recent study by the Department of Natural Resources

(Colorado Natural Resources, 1979-b).

State government has the responsibility to assure that energy development occurs in a responsible manner which enhances the economy of the State and does minimum damage to its environment. More specifically, the State has a number of important principles which will help guide energy development:

- conservation of energy resources to maximize recovery rates
- deliberate and orderly growth of communities to assure that community needs are available to existing and new residents
- protection and enhancement of environmental conditions
- promotion of stable, long-term economic growth and the healthy balancing of energy, agriculture, industry and commercial sectors.

To achieve these goals, synthetic fuels development in general and oil shale development in particular must proceed along a deliberate path. This path is one of "phase development" which has been outlined by the Governor in testimony before Congress (Lamm, 1979). First, it is essential that the commercially untested oil shale technologies be developed at the smallest scale possible to provide information necessary to evaluate a subsequent scale-up to commercial size production. This initial size would be on the scale of one module per technology, from 5 to 12 thousand barrels per day. Once the available technologies had been tested in this manner and the results of the preliminary production were assessed, there would then be a scale-up to commercial size production, approximately 50,000 barrels per plant, on an orderly basis. To approach oil shale development otherwise would mean a boom--bust cycle of construction force and community impact in Northwest Colorado, threat of inordinate environmental damage, potential wastage of the oil shale resource, and possible climax levels of production at less than the

optimum because of commitment to first generation technologies.

In order for Colorado to carry out its responsibilities and support responsible energy development, it is necessary to evaluate the potential future levels of development and their associated impacts. The Colorado Energy Resource Development Plan, within the Executive Director's Office of the Colorado Department of Natural Resources, intends to carry out this function. The goal is to predict likely levels of development. Such analysis will support the State's efforts to prepare for development and assure that it occurs at an orderly pace and in a responsible manner.

BACKGROUND

Colorado State Government is engaged in an intensive effort to prepare itself for energy development during the decade of the 1980's. There are a number of programs being put in place by those State agencies which will deal with energy issues; all of these programs have a common theme of providing the necessary information and capabilities to handle orderly energy development. There is also thought being given to how the federally mandated Energy Mobilization Board and Synthetic Fuels Corporation will affect Colorado and its energy resources. The Energy Resource Development Plan is one of these State programs.

This project began in May, 1979 with the intention of developing a rapid response analytical capability which could provide a common base of information, analysis, and impact identification for various potential future levels of energy development throughout Colorado

(Hecox, 1979). With industry plans for oil shale and other energy resource development changing rapidly and federal initiatives to promote additional domestic synthetic fuels production in a continuing state of flux, a quick response analytical capability was deemed essential. The first step was to provide a preliminary method of analyzing site-specific energy development plans from Northwest Colorado as a prototype test for the concept of a Colorado Energy Resource Development Plan. Northwest Colorado was chosen because of the magnitude of multiple energy resource development which will occur in that area relative to its sparse population and small level of community infrastructure facilities available to handle the expected development.

Funding for this effort comes from the Assistant Secretary for Resource Applications in the U.S. Department of Energy. Their interest in funding this Colorado effort stems from concern about possible constraints to oil shale development in Northwest Colorado. Without adequate quick response analytical capabilities, the State of Colorado could, for instance, potentially find itself unable to provide the necessary community infrastructure to support development. This lack of infrastructure could well act as a constraint to timely development activities on the part of the individual entities developing oil shale as well as other energy resource sites. Thus, it was deemed essential by Colorado and DOE to obtain a synergistic and regional perspective on total energy development which is likely to occur through 1990. Without this comprehensive view of multiple resource development, the estimates for community infrastructure and site-specific impacts would be underestimated, again raising the possibility of delays in development and unnecessary impacts and

damages to Northwest Colorado.

One of the first steps in developing an Energy Resource Development Plan was to assess existing State capabilities for developing and processing information concerning energy development (Pook, 1979-b). As this project proceeds, it will be essential to integrate the Energy Resource Development Plan, which is being tested with a prototype project on Northwest Colorado, into existing State agencies. Failure to do this would mean the development of an information system without dedicated users and without a continuing base of financial and political support for its continuation and expansion. The Colorado Department of Natural Resources, Health, Local Affairs, Agriculture, and Highways have major responsibilities in the area of energy development. They likewise have existing program activities which generate information pertinent to energy development and analyze potential impacts.

ANALYSIS OF INFORMATION SYSTEMS AVAILABLE

Concurrent with the analysis of State agency capabilities and information needs, an assessment was made of various information systems available to the State of Colorado for the purpose of providing quick response prediction and analysis of potential future energy development levels (Pook, 1979-a). This review of available information systems included a look at systems available from other States, universities and educational institutions and federal agencies as well as the various commercial information packages available from proprietary sources. It was necessary to analyze these potential information systems against a background

of State agency information capabilities and needs as well as Colorado State computer capabilities. Without this type of analysis it would be impossible to recommend an information system approach which was relevant to Colorado's needs and feasible to integrate into State Government (Pook, 1980).

DESIGN OF PROTOTYPE NORTHWEST COLORADO EFFORT

The outcome of this review of State agency capabilities and information needs as well as available information systems was a decision to enter into a cooperative agreement with the Western Energy Land Use Team (WELUT) in Fort Collins, a research arm of the Office of Biological Services within the U.S. Fish and Wildlife Service. The Western Energy Land Use Team has spent the last three years developing extensive information systems which are well suited to many of the quick response analytical capabilities needed in the Energy Resource Development Plan (U.S. Fish and Wildlife 1979-b; Van Derwalker 1979; U.S. Fish and Wildlife 1979-c). Thus, in December, 1979 a Prototype Northwest Colorado Regional Energy Planning and Monitoring Effort was begun between the Colorado Department of Natural Resources and the Western Energy Land Use Team. Phase One of this cooperative arrangement was designed to provide by April, 1980 demonstration of the potential capabilities of an information system tailored to the rapid response projection and impact analysis needs described above.

The WELUT Systems Application Group, headed by Dr. Jack Gross, is working with the Department of Natural Resources to adapt the capabilities of their geographical information system program and data base management program to the specific needs of Colorado for this Prototype Northwest Colorado effort. In addition, the Mineral Resources Institute of the

Colorado School of Mines is developing tabular parts of the Prototype package to perform the site-specific projections of energy development and aggregate these site-specific predictions to county and regional levels. This effort is being linked to an ongoing project by the Energy and Mineral Impact Division of the Department of Local Affairs to develop a software package which would take site-specific predictions of energy development and their associated operation and construction work force estimates and allocate those people to the likely counties where they would reside. This effort includes an estimate of multipliers for dependents and secondary workers associated with levels of energy development. It also includes estimates of the necessary community infrastructure needed to support each county's predicted population levels and estimates of the cost of obtaining these necessary types of infrastructure by year and by community.

The Prototype project is essentially a gaming approach which allows the user rapid analysis of specified levels of energy development. There are stored assumptions of high, medium and low levels of development on a site by site basis for the energy types which are being analyzed, namely oil shale, coal, oil and gas, and uranium. There will later be the capacity for the user to design other possible levels and rates of development for each specific energy development site.

In Phase One of the Prototype Effort the user can specify on a site-specific basis the projected levels and rates of development. These site-specific assumptions are then aggregated

together into a county and regional level and rate of development. The user also specifies the proportion of each site's workforce expected to reside in each surrounding community. The number of workers expected to reside in each community each year is then multiplied by the ratios of dependents and secondary workers to arrive at total new increments of population, which are added to baseline demographic projections of future non-energy induced population growth.

Once the user has specified for each site the level and rate of development as well as the expected population impacts, the Phase One Prototype System then analyzes the impacts of the specified potential future level of energy development for Northwest Colorado. This analysis is a combination of spatial or mapped base analysis and tabular or numerical analysis. The Prototype Effort ties together in unique ways an interaction between spatial information and tabular information.

For instance, it will be possible, given any projected level of energy development, to display through computer mapping the location of energy development and its relationship to other digitized (computer stored) variables, such as land ownership, land cover and use, wildlife, surface water, energy resources, political boundaries, highways, etc. Further, it will be possible to compute areas of conflict or overlap, such as the proportion of an energy development site which overlaps a particular grazing or nesting area for wildlife, or other energy resource deposits, or a particular land cover type. The extent of such overlap can be measured and displayed. It will also be possible to search for areas of minimum overlap or conflict between variables of interest to the user. An analysis of the

Yampa Basin and coal development has been completed and published; this short document shows some of the types of analysis discussed above (U.S. Fish and Wildlife 1979-a).

The tabular part of the system will display for specified geographical areas (such as a county, or multi-county region) the projected levels of energy production through 1990, associated populations levels, impacts on communities affected by the energy development, growth rates of energy production, magnitude of solid waste disposal or area disturbed, expected water usage, and a variety of other pertinent summary measures of impact associated with a specified level of energy development. A comparison of spatial analysis as well as tabular analysis for alternative projections of energy development in Northwest Colorado will allow policy makers to grasp quickly the implications of different possible levels of energy production and activity.

SCOPE OF LATER PHASES

The Second Phase of the Prototype Effort will strengthen the data, both spatial and tabular, which resides in the system. It will also experiment with the addition of other impact identification capabilities. Among these will be air quality, transportation, and socio-economic modelling. Attempts will be made to use the Phase One version and the improved capabilities added during Phase Two in analyzing national goals for oil shale development as they relate to Northwest Colorado and that region's expected additional growth based upon other energy resource production. This will provide Colorado with a tool to respond to

initiatives in the energy area through rapid response impact identification and analysis. Such a capability will be critical to the State's having a voice as the Energy Security Corporation and the Energy Mobilization attempt to stimulate domestic energy production.

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