IMPACTS OF ENERGY DEVELOPMENT ON THE WATERS OF THE NORTHERN GREAT PLAINS

621-77

By

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I am very pleased to be here this morning in the sunny southwest and since New Mexico is the largest energy producer in the Region, energy development and water are very appropriate topics to be discussed. I think the type of person that should be addressing this topic today may best be a prophet. Neither the states that I am familiar with nor the federal government has at present a clear cut energy policy that would allow one to make accurate forecasts as to what might happen in the way of future energy development. It is very difficult at present if not impossible for people within a state to agree on an energy plan for that state much less on a regional or national basis. The Region I am most familiar with is that served by the Old West Regional Commission. The five states the Commission serves are Montana, Wyoming, North Dakota, South Dakota and Nebraska. My talk today will be primarily geared to that Region. One point appears clear, we have an energy shortage, and our supplies of natural gas and oil are limited and will become higher and higher priced. One source of energy that we have in abundance is coal and the Northern Great Plains; particularly the states of Wyoming, Montana and North Dakota have a vast amount of this resource. Major contributions to our energy supply from other sources such as solar, nuclear and geothermal appear to be at least 15-20 years in the future. The estimated coal reserve base of the Northern Great Plains is 160 billion tons.

There are many factors which will enter into the decision making process which will in turn formulate future energy policy and development. Some factors include the price of oil, socioeconomic considerations, deregulation of natural gas, individual state severance taxes and reclamation laws, delivered price of water and policies prohibiting the siting of additional coal conversion plants in the Region. These are certainly not all the factors that could have an effect but they are important ones.

The northern tier states are currently faced with losing their main source of natural gas. Canada, who in the past supplied many of these northern states with natural gas has now raised the price and has announced natural gas exports will be eliminated entirely by the 1980's. One state that has a go slow approach to energy development has not indicated an interest in looking at the feasibility of a state owned coal gasification plant. Gasification plants are being talked about in at least three of the Old West states. There are bills in three of the Old West states legislatures that are taking a look at water for possible use in coal slurry pipelines. While these may not come about it does point out that policy makers are taking a new and close look at their energy development policies and alternatives, some of which received little consideration a short time past.

The environmental movement which had a very strong impact on early energy development plans now appears to be coming more in balance with other concerns.

In a recent survey conducted by Montana State University on the Social Effects of Water Allocation for Coal Development in the Yellowstone River Drainage (Faulkner, 1976) the following points appear to be of high priority to Old West Region residents.

Social issues of importance include potential rapid population growth, associated lifestyle changes, economic impacts and potential impacts on the Indian reservations. Most of the residents are satisfied with the present way of life and the area in which they live. They do not desire an increase in population, but do not greatly fear properly planned growth. Many residents are concerned about loss of local control and increases in crime that may accompany an increase in population.

Most decision makers indicated that likely future levels of coal development exceeded the amount they believed to be desirable for the area. Residents preferred relatively low levels of coal development, with approximately half in favor of exporting the coal outside the Region for conversion.

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Slurry pipelines as a method of exporting coal were not favored by residents, but were preferred to frequent unit trains by most decision makers who discussed the question.

Concerning environmental protection, residents were unwilling to allow environmental degradation in exchange for jobs. They also felt more energy development could occur without such degradation.

Water Resources of the Region

Any development in the Northern Great Plains which is a large scale user of water will increase the already keen competition among governments and users for a resource in relatively short supply and of high value. Since the Northern Great Plains is primarily an energy exporter the pros and cons of mine mouth generating facilities vs. exporting raw coal to the point of use has been much discussed. In most cases the power is scheduled for the Pacific Northwest or eastern states that have a much more abundant supply of water. It appears if exporting the coal is desired the transportation facilities to handle the coal are the restricting factor. If large scale development is to occur, one alternative solution is to transfer water from water - rich energy demand areas to the water poor energy rich west.

The significance of western energy development in respect to water availability is that it will be more difficult to continue to deal with water resource problems on a piecemeal basis. Many questions that could remain unanswered in the past will now have to be answered. For example, the reservation doctrine (which created a priority for Indian water use originating from the date the land was set aside for Indians) and the beneficial use doctrine (which stipulates that water can be withdrawn from rivers or streams only in accordance with the public interest) have been allowed to remain ambiguous but pressures are already developing to remove the ambiguity (Faulkner, 1976).

The area of discussion is illustrated by the next slide. Most development in the Northern Great Plains appears to be planned around the waters of the main stem of the Upper Missouri River Basin or the Yellowstone sub-basin.

At the 1970 level of development, average annual streamflow in the Upper Missouri Basin amounted to about 26 million acre feet. Only about a fourth of this natural streamflow is presently consumed. This statistic suggests that there is plenty of unused water available to support new developments.

Gross water availability can be a misleading statistic; however, for water availability may not coincide in location or season with water demand. It does not reveal that the climate of the Upper Missouri Basin is characterized by wide variability in annual precipitation so that in abnormally dry years far less water is available.

Shallow ground water resources are very large in the Upper Missouri River Basin, but they are distributed most unevenly. The immense shallow ground water reserves in Nebraska, for example, are located far from the sites of anticipated large increases in water demand. By contrast, the upstream areas in Montana and Wyoming, where major energy developments are occurring possess reserves only slightly greater than mean annual surface run-off.

Water law in the Western states is coming to recognize increasingly the inseparable nature of surface water and ground water. The base flow of perennial streams generally is supported by inflow of ground water, and, conversely, ground water reserves are often fed by surface water infiltration.

The six reservoirs on the Missouri River provide 74.7 million acre feet of storage. According to 1970 figures, the average annual flow of the Missouri River at Sioux City, Iowa, below the reservoir system is 21,821,000 acre feet, while average annual depletions above that point amount to 6.5 million acre feet (NGPRP Water Work Group, 1974). No current projections of increased water use would equal or exceed the quantity of water which could be made available from the six Missouri River mainstem reservoirs.

Many potential water storage sites remain undeveloped in the Upper Missouri Basin, including at least 57 in the Yellowstone sub-basin alone (NGPRP Water Work Group, 1975). The Yellowstone sub-basin new storage construction could make available more than 3 million acre feet of additional water annually, or about 2 million acre feet if suggested minimum

flows were to be maintained. New storage is a lesser possibility elsewhere in the Region (Lord and others, 1975).

Wyoming embodies 51% of the Yellowstone drainage, Montana about 48% and North Dakota nearly 1%. In 1950, long before western coal development became an issue, irrigation was the matter at hand and Montana and Wyoming agreed to apportion the water they shared.

An agreement, known as the Yellowstone Compact, was ratified by Congress in 1951. North Dakota is signatory to the compact, but does not share in the water. The allocation divides by percent the flow at the mouth of the Yellowstone's major tributaries originating in Wyoming - the Clarks Fork Yellowstone, Bighorn, and Tongue and Powder rivers. While the compact recognizes all water rights prior to 1950, it prohibits other diversions of water out of the basin without the consent of the legislatures of the signatory states.

The current issue is industrial water use. Coal development in Wyoming which is proceeding at a faster rate than in Montana, is rapidly creating an industrial need for Wyoming's share of the water. Montana's position is to withhold approval of any diversions out of the basin until the two states can quantify the compact's percentages. Although Montana has not agreed, Wyoming has published an estimate claiming its share is in excess of 2.4 million acre feet (maf), or roughly 27% of the Yellowstone River's average annual flow, which the Bureau of Reclamation has estimated at 8.8 maf.

Water Requirements

There is much conflicting data on the amounts of water required to sustain the various uses both present and anticipated. The largest variance is that projected for energy development and agriculture.

In the Upper Missouri Basin, agriculture accounts for over 2/3 of water withdrawals and over 90% of consumptive water use. The great bulk of agricultural water use in the Region is for irrigation.

Irrigable acreage in the Upper Missouri Basin[4] is well in excess of that which could be irrigated with available water. Limited water supplies and economic constraints, rather than the availability of irrigable land, limit the expansion of irrigation in the Region.

Urban water use is a distant second, only to irrigation in consumptive volume. In the Region as a whole, urban water use accounts for about 4% of water withdrawals and a similar percentage of total consumptive water use. On the average, urban water use throughout the West is 42% consumptive (Howe, et al., 1971).

Mining of all types has been a minor use of water in the Upper Missouri River Basin, and only about a quarter of the water withdrawn is consumed.

Energy conversion activities have consisted almost entirely of steam electric power generation and hydroelectric power generation, but production of gas and liquid fuels is anticipated in the future. Water use in the production of hydroelectric power is almost totally nonconsumptive. Water use for cooling in steam electric generation is approaching 20% of total withdrawals in the Region, but consumptive use is much lower, about 1% of total consumption in the Region. Gasification plants, producing four billion cubic feet of gas daily could use up to one half million acre feet of water annually, and could be a reasonable prospect for the Northern Great Plains by the year 2000 (NGPRP, 1975). Such a level of water use, all of it consumptive, would represent about 41/2% of total annual consumptive water use in the Region. (Lord and others, 1975)

The main means of coal transportation is and probably will continue to be by rail. Only under the highest development scenarios are coal slurry pipelines projected to make up a percentage of the transportation network. If coal slurry pipelines become a reality it most probably will occur after the 1985 period. If coal exports during that time were at a level of 110 million tons annually all of which was exported by slurry pipeline, approximately 77,000 acre feet of water would be required (NGPRP, 1975). If half that amount was exported by slurry pipeline, a more likely occurrence, then 38,500 acre feet would be required. 77,000 acre feet would represent less than one percent of current water consumption. If return flow lines are built, as has been discussed, the consumptive use would be much smaller.

A report prepared for the Missouri River Basin Commission by Harza Engineering Company, December, 1976, projects the following:

COAL PRODUCTION AND DISPOSITION IN 1985 AND 2000
MOST PROBABLE SCENARIO

Upper Missouri River Basin

Annual Coal Production (Million Tons)

1985 Most Probable		
Transport by Rail		139.4
Transport by Slurry Pipeline		0
Convert to Electricity in Study Area		13.1
Convert to Gas in Study Area		10.3
	Total	162.8
2000 Most Probable		
Transport by Rail		330.8
Transport by Slurry Pipeline		0
Convert to Electricity in Study Area		35
Convert to Gas in Study Area		147.5
	Total	513.3

The Bureau of Reclamation in 1976 projected that up to a million acre feet of water per year could be withdrawn from the Missouri main stem reservoirs for the period extending potentially to 2035 for energy development. Early predications from the Yellowstone Basin and Adjacent Coal Field Level B Study indicate total energy water needs (under most extensive development in the Yellowstone Basin and western North Dakota) will amount to no more than 550,000 acre feet (Madsen, personal communication, 1977).

Conclusions

Approximately ninety percent of the proved U.S. energy reserves are in the form of coal. There is little doubt development of this resource will take place. Predicting the extent of development at present is very difficult because of the many variables mentioned earlier that can affect the outcome. A key to having adequate water seems to lie in improving efficiency and technology, primarily in the agricultural and energy sectors. Studies have been completed which show a savings of up to 50% in energy required for irrigation pumping and a 35% increase in irrigation efficiency can be attained (Splinter, 1976). The determination not to irrigate marginal crop lands would conserve both energy and water.

As the price of water rises and the commodity becomes more limiting technologies are available or will be developed to make the most efficient use of this valuable resource. There is also the alternative of additional dam sites, 57 additional sites are identified on the Yellowstone Sub-basin alone. Another alternative would be to import water from the water rich areas. Traditionally there has been a strong trend by policy makers in the Region to preserve the agricultural economy. In my opinion I can not see major competition for water between agriculture and energy or any other present use. Admittedly shortages could occur on certain tributaries.

With proper planning and scheduling it appears there is ample water in the Northern Great Plains to adequately supply all requirements with little loss in quality in the foreseeable future.