DEPARTMENT OF AGRICULTURAL ECONOMICS

staff paper

AGRICULTURE AND ENERGY

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In the United States approximately 6 percent of the world's population consumes about 35 percent of the world's marketed energy. Our prodigious appetite for energy has been increasing at an awesome rate. In the mid-1930's the annual rate of consumption of purchased energy in the U.S. was under 20 quadrillion BTU's; in 1970 the consumption was 60 quadrillion BTU's. For the year 2000, Bureau of Mines projections indicate an annual rate of consumption of 160 quadrillion BTU's. One quadrillion BTU's equals the energy of combustion in 965 billion cubic feet of gas, 175 million barrels of oil or 38 million tons of coal. Currently about 20 percent of the BTU's come from coal, 75 percent from petroleum, including natural gas, and less than 5 percent from hydroelectric power. Only a fraction of a percent now comes from nuclear sources.

Our heavy dependence on fossil fuels poses two major sets of problems. First of all, the stocks of these materials, in the U.S. and in the world, are limited in quantity and are irreplaceable. As high quality and easily accessible stocks are depleted or exhausted, we must turn to sources which are lower in quality or less readily accessible. Increasingly these sources lie outside the United States. Inevitably, costs of exploitation and utilization rise. Furthermore, problems of international trade and power politics become factors to be considered.

The second set of problems relates to stresses on the environment. In recent years, this problem has been alleviated in part by shifts from fuel oil and coal to natural gas. However, declining stocks of natural

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gas, particularly within the U.S., are making this source increasingly inadequate. Clearly, natural gas, "the clean fuel," will not be available in the future for even the present rates of energy consumption, much less for projected increases. Nor are opportunities available for a major increase in electricity from hydroelectric installations.

Coal is the only source of energy of a conventional nature which the U.S. and the world possess in large quantities relative to current rates of consumption. However, from the standpoint of environmental stress coal is the least desirable of the fossil fuels. Coal tends to be damaging to the environment both in the mining of it and in its use. Strip mining, the method by which nearly all coal deposits are now exploited, tears up large areas of land. Unless rigid controls are imposed on the mining companies the operation devastates the terrain leaving behind pools of acrid liquids and vast piles of barren rubble.

Since Nebraska apparently has no economically exploitable coal, the problems associated with mining do not affect the State directly. However, utilization of energy and particularly of coal, also places stresses on the environment. True enough, the serious cases of environmental deterioration stemming from energy consumption occur in the large metropolitan areas. Emissions from motor vehicles, residences, factories, electric generating plants, waste incinerators, etc. pollute air and water in the densely populated areas. With the exception of Omaha, and to a lesser extent Lincoln, Nebraska has not up to this time had to face severe problems of air pollution.

Recent trends are to locate thermal generating plants in rural areas. The "clean" electricity is to be transmitted to the areas of heavy consumption. These electric generating plants do pose threats to the environment even in sparsely populated areas. Thermal electric generating plants put gaseous waste products into the air and usually employ adjacent

streams to dissipate surplus heat. If the plants are coal fired the stack gases tend to be particularly noxious and in addition large quantities of solid wastes are produced.

Various exotic sources of energy have been suggested as alternatives to fossil fuel. The sun and the earth's molten core are energy sources that can presumably be used with minimal adverse side effects. However to date, little research has been invested to develop the necessary technology which would permit the major substitution of these energy sources for fossil fuel. Nor have nuclear power plants lived up to early expectations. Construction of atomic fission plants has encountered many problems and delays with costs rising more sharply than for fossil fuel plants. In addition, many problems remain to be solved in disposing of radioactive wastes. The "fast breeder" plants, and ultimately the "fusion" plant which will eliminate the creation of radioactive wastes and expand the "fuel" resources to a virtually limitless supply, appear to be many years in the future.

A potential source of energy which has received considerable attention in Nebraska is that of using materials of agricultural origin as fuel. This alternative is appealing on two bases. First the crops we harvest capture the energy of the sun and store it in a useful form. This energy is derived from a source which would not be diminished by use. The "gasahol" program has the additional attraction of providing a large market for our agricultural products.

True enough, agriculture could be an energy producing sector of the economy. For example, for each unit of energy the Oriental paddy rice farmer expends in rice production, more than 50 units are produced in return. However, these figures look very different for U.S. agriculture. In the U.S. the equivalent of approximately 150 gallons of gasoline is consumed to provide agricultural products to feed and clothe one person.

Although this does not seem extravagant in light of our prodigious appetite for energy for other purposes, the fact is that the heat value in the agricultural products, sufficient to supply a person for a whole year, is equal to that found in only 30 gallons of gasoline. In other words, under current practices U.S. agriculture consumes five BTU's of fossil fuels to produce an agricultural product containing one BTU of energy.

In the United States, efficiency in agriculture has been measured in terms of output per man employed in farming. Our choice of this measure likely reflects the fact that, on this basis, we have the most efficient agriculture in the world. However, one might legitimately question the appropriateness of this measure of efficiency on at least two grounds. In the first place, those who produce and distribute to farmers the inputs which are utilized in farm production are also employed in agriculture. The energy utilized in the production and distribution of these inputs should be included as energy utilized in agricultural production. By the same token, those who are employed in the storage, transportation, processing and distribution of agricultural products are also employed in agriculture, as is the energy consumed in those activities. Incidentally, the off-farm consumption of energy in agriculture is several times the amount used on farms.

Agricultural products have substantial values in addition to the energy contained in them. However, a product of agricultural origin, which is to be used as a motor fuel, can legitimately be evaluated in terms of the energy it contains. The figures concerning the expenditure of five units of energy in U.S. agriculture for each unit of energy contained in the product are rough estimates and average for many products. However, the highly capitalized and mechanized grain farmer is a heavy consumer of energy. In any case, these figures provide little encouragement to those who would on the one hand look to agriculture as

an inexhaustible source of energy or on the other hand would look to the consumer of fossil fuels as a lucrative market for grain.

The potential contribution of Nebraska agriculture to the energy crisis appears to be in the area not of producing energy resources but instead of improving the efficiency of use of purchased energy in agriculture. Agriculture, as a heavy consumer of energy, should strive to become increasingly dependent on solar energy. The corollary is, of course, to reduce the consumption of purchased inputs per unit of output. An example of the kinds of developments which hold real promise is that of producing crops with reduced tillage operations. Also the potential apparently exists on many Nebraska farms to achieve current or higher yield levels with substantially less irrigation water and fertilizer than is presently being used. Saving irrigation water and fertilizer saves energy. A final example would be a greater reliance on perennial crops, such as alfalfa and grasses, as sources of nutrients for cattle. Nature was kind enough to design the ruminant for effective utilization of roughages. Perhaps we in agriculture should further exploit this potential and in so doing reduce the consumption of purchased energy associated with producing grain crops.