A Preliminary Survey of Some Major Factors Bearing On the Feasibility of Energy Centers in Michigan

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Federal Energy Administration

ENERGY CENTERS IN MICHIGAN

PART I

ENERGY CENTER COMPLEX

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FOREWORD

The Federal Energy Administration (FEA) has contracted with the Environmental Research Institute of Michigan (ERIM), a nonprofit research organization, for a preliminary study on the feasibility of establishing an energy center at one or more sites in the State of Michigan. The FEA's purpose for the study was to establish for this region the principal technical issues and criteria involved in locating a number of power producing and using facilities at one location.

The Michigan energy center study is one of several commissioned at different places throughout the United States to identify and analyze real issues at real locations. The commissioning of this study by the FEA should not be construed as an endorsement or encouragement of the construction of an energy complex in Michigan. In fact, State and local siting authorities control many siting decisions. However, the FEA has the responsibility to promulgate programs and policies to achieve adequate, reliable, and cost-effective energy supplies and to insure timely siting of sufficient energy-production facilities to meet national needs. The FEA's role is to provide effective mechanisms for integrating and coordinating Federal, State, and local objectives and activities. The commissioning of this study is one action taken to provide such mechanisms.

Results of the Michigan energy center study are contained in one volume and an executive summary. First, the development of an energy center complex and criteria for siting such facilities in Michigan are presented. Next is a compilation of the basic and readily available data for two study sites in Michigan. Then the socioeconomic effects and environmental impact on the area from construction and operation of such facilities are discussed.

The FEA appreciates all the courtesy and assistance provided to ERIM by individuals and organizations throughout the State of Michigan.

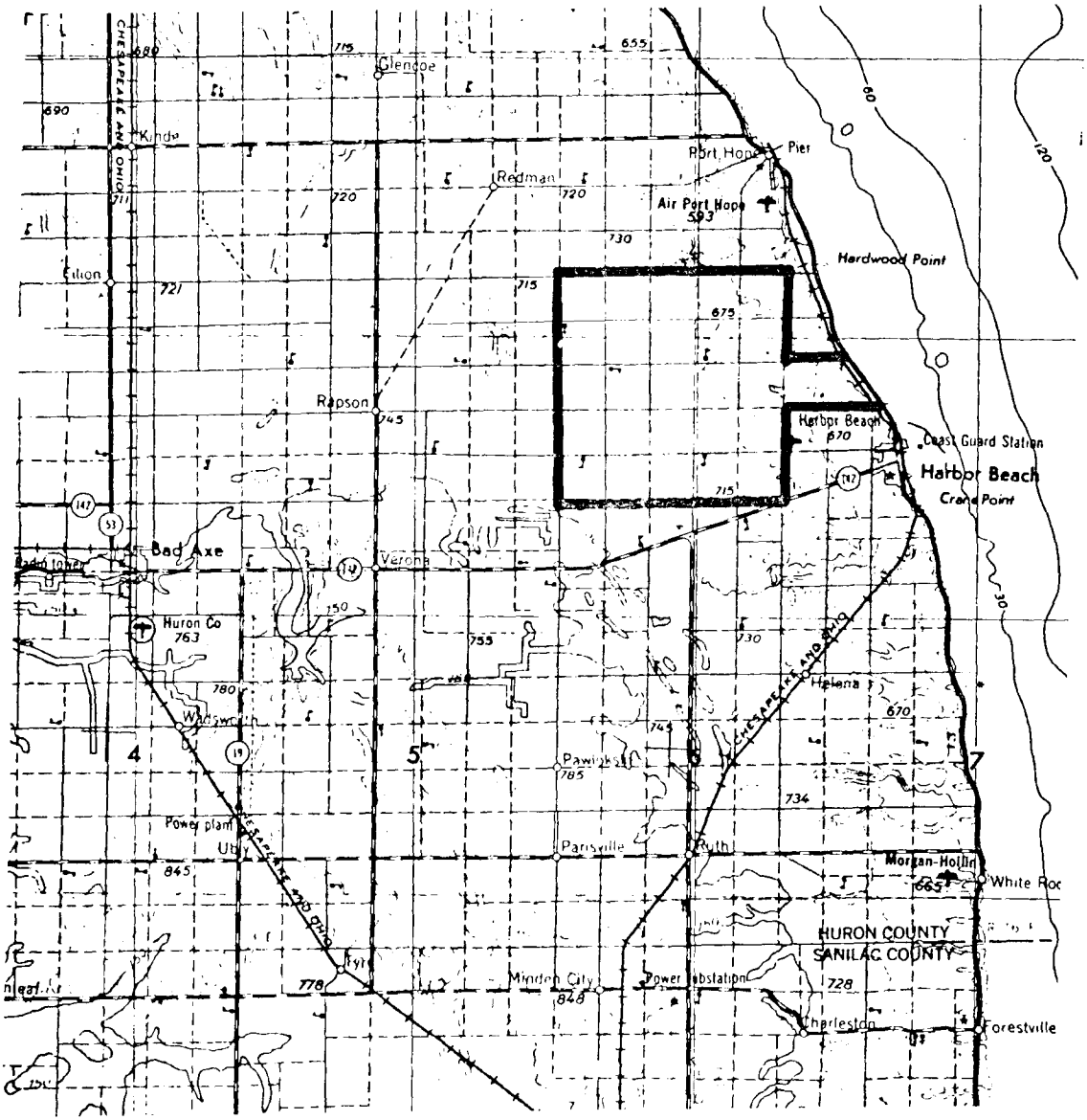

Figure 7. Regional location of study site 1

Table 11.--Land Requirements for Michigan Energy Center (Acres)

	Fossil-Fueled Section	Nuclear Section	Total
Number of Units	8	14	22
Total Capacity, MWe	6,225	16,900	23,125
Land Use			
Generating plant	430	1,100	1,530
Cooling towers and makeup pond	720	2,900	3,620
Fuel storage	160	---	160
Waste disposal	3,600	---	3,600
Construction area	300	300	600
Total	5,210	4,300	9,510

Recreation

Recreational activities have not been a dominant aspect of the thumb area economy. This is related to the dominance of agricultural activity, the small number of acres that remain forested, and paucity of unique natural features within this region. Because of the proximity of this area to the major urban areas of the State, attempts have been made to attract people for fee hunting and snowmobiling and to utilize the extensive lakeshores. The future of this area as a recreational area is uncertain.

Within Huron County there are two State parks, eight county parks, and two State game areas. These are all located along the shore of either Lake Huron or Saginaw Bay and primarily lie in the northern portion of the county. Figure 19 located both the State and county parks and the State game areas in the county. Table 57 lists the size of the parks and their distance to the study site. The city of Harbor Beach has three parks, North Park, Waterworks, and Bathing Beach, which are the public recreational areas closest to the study site ("Welcome to Your County Parks...").

Land use and availability

Study Site 1 primarily contains privately owned lands. About 85 percent of this is in agricultural use, and the remainder is small scattered hardwood parcels. The availability of land for an energy center (or any other activity) may be governed by two factors: one, its market availability; that is, the willingness of the current owner to sell and his price; two, the existing dedication of the land by one or more levels of government to a specific use or condition. Both of these factors may affect either private or public lands, although in general it is only public land which is dedicated.

In Michigan, there is a unique situation with respect to agricultural and open space land which may have an important bearing on the availability of an area for development and thus directly affect the location of an energy center in the State. That unique situation is the dedication of agricultural and open space lands under the Michigan Farmlands and Open Space Preservation Act of 1974. This act provides for the formation of a contract between the land owners and the State, whereby the owner agrees to maintain his land in its current use for a set number of years and gets in return income or property tax benefits. The intent of the Act is to encourage farmers to maintain their land in agricultural use, especially in proximity to expanding urban areas by protecting them from the usual "potential use" taxation policies, which force selling of the land to developers.

The contract must be entered into for a minimum of 10 years and becomes an integral part of the land title. The land can be sold, of course, but the agreement remains in effect. It cannot be negated by the owner or the State except (1) by an heir (when the original party has died), (2) by mutual agreement between the administering agency (the Michigan Department of Natural Resources) and the land owner, and (3) by the State, if the land has been determined to be needed for the public good. The actual interpretation of this third exception remains to be clarified with regard to what constitutes a use for the public good and who can make such a determination. Whether governments even retain a right of eminent domain over property covered by a preservation agreement must await a challenge and decision from the courts.

The implication that this Farmlands and Open Space Preservation Act has for development of a large energy center are obvious. Both study sites show that a major portion of any projected energy center site in the Lower Peninsula may consist of lands, of which some, if not all, may be under a preservation agreement. Under current law it is doubtful whether such agreements can be nullified for development controlled by private enterprise. Thus, building a large energy center may not be possible. (Smaller dispersed sites would present less of an obstacle, inasmuch as smaller blocks of land not under preservation agreement are more likely to be found.) If feasibility of a large center is to be maintained, the role of government in an energy center must be more clearly defined and significant changes in the power of governments over land use decisions must be contemplated.

The question of using publicly dedicated lands also presents a problem in Michigan. There is a probability that a large energy center will impinge

PART III

Introduction and Summary

Objective of Impact Analysis

An energy center capable of providing 23,125 M of electricity for Michigan and neighboring States has been described in Part I. This energy center would provide not only electric power, but process steam and low-Btu gas to a number of colocated industries. Agricultural and aquacultural enterprises also colocated with the center would use about 12 percent of the waste heat for soil warming, greenhouses, fish culture, grain drying, and wastewater treatment.

Two study sites in Michigan were selected for further study as possibilities for an energy center. Both sites are close to the Great Lakes shoreline in order to make available large quantities of cooling and process water needed at the center. Study Site 1 is located in Huron County near Lake Huron and study Site 2 is located in Muskegon and Oceana Counties near Lake Michigan. Detailed data on each of these sites is presented in Part II.

Insofar as the impact of an energy center at the study sites can be determined, we have included estimates in Part III. These impacts include economic, social, and environmental impacts. This volume also considers the different impacts resulting from the construction phase.

The goal of constructing and operating a large-scale energy center is to emphasize economies of scale, energy conservation, relationships, and concentration of negative environmental impacts, as opposed to the alternative of a number of dispersed sites. These advantages have been discussed in some detail in Part I. However, it is recognized that no physical change in land use can be accomplished without some detrimental impact regardless of the efforts to mitigate such effects. The magnitude of an energy center would virtually insure that some detrimental impacts will occur. It has been the purpose of this study to identify both positive and negative impacts and to estimate their magnitudes, so that potential tradeoffs will be defined and an informed decision on an energy center can be made.

Summary

During the construction phase of an energy center, substantial social, economic, and environmental impacts can occur that are different in character from those that will exist after construction. It is estimated that the combined construction and operating requirements for labor will buildup over a period of 16 years to a peak, estimated at 13,000 workers, and then drop off to an operating level of 10,300 by the year 2000. Altogether, a permanent population in excess of 100,000 persons will be required at the center area, with the temporary population during the peak of the construction period considerably in excess of this. Provision for this buildup of population must be carefully planned. Residential and commercial construction must be scheduled

for the early stages of center construction to accommodate this population influx without serious social and environmental impacts.

The social impact of the energy center will be primarily that resulting from the influx of a population of more than 100,000 persons for the construction and operation phases of the center. This will be more pronounced at Site 1 than at Site 2 because of the smaller existing population and the inherently rural character of Huron County. The impact will be felt both by the new population moving into the area and by the present residents of the area. Social and economic impact on existing agricultural production would consist of the reallocation of some prime farm land and the displacement of farm population. Good planning and control of urban growth will be required to minimize the impact on the area. The magnitude of center development would make it very difficult for the municipal and county governments to handle the problems, so that assistance from the State and possibly the Federal government would be essential.

The economic impact of the energy center development will have major economic effects at the local and State levels. The total development involves capital investment in the energy center, industrial center, and biocomplex of $11.5 billion, expressed in 1975 dollars. This estimate is expected to rise in this era subject to continued inflation. These figures all represent only a minor addition to currently anticipated economic activity, since energy generation and industrial additions are already largely included in economic projections. Problems of providing necessary center financing are discussed later.

Principal effects of an energy center on water quality in local receiving waters and the Great Lakes will be from (1) fallout on the lakes as a result of atmospheric pollutants discharged by the center, (2) soil erosion, especially during construction, (3) groundwater recharge with center-contaminated waters, (4) surface storm runoff containing contamination deposited by center activities, and (5) discharge of heated powerplant cooling waters into the Great Lakes, if once-through cooling is used. In order to meet the national water quality goal of zero discharge by 1985, the best method is to use closed cycle systems, in which waste waters from center activities are treated to reach a quality level sufficient for reuse.

Hazards to water quality include the possibility of oil contaminated discharges and catastrophic spills, release of nutrients that would stimulate aquatic plant growth, increased turbidity from construction activities, increased biological and chemical oxygen demand, and changes in the pH level.

Control measures for stormwater runoff include catch basins, sludge removal, sweeping of impervious areas, high particulate standards, land drainage modifications, and stormwater treatment using standard waste treatment practices.

The national water quality goal of zero discharge by 1985 would preclude the use of once-through cooling and require the use of cooling towers or ponds. The use of once-through cooling as a partial or complete method of waste heat

disposal should not yet be completely ruled out, but this method would require careful study to determine its probable impact on aquatic organisms. One major environmental impact that could result from operation of cooling water intakes, which would entrain or entrap benthic, planktonic, and/or nektonic organisms. Movement of the large quantities of water needed for once-through cooling could have a significant impact on aquatic organisms as well as on lake circulation patterns.

Potential problems associated with powerplant cooling towers include (1) restriction of sunlight caused by a visible plume, (2) deposition of chemicals in cooling water onto surrounding areas, (3) ground fogging, (4) spatial and temporal changes in the pattern of precipitation, and (5) initiation of severe weather such as thunderstorms and tornadoes.

The meteorological alteration caused by direct atmospheric discharge of waste heat from the energy center through the use of cooling towers or cooling ponds may be substantial and have an adverse effect. However, the impact of rejecting large amounts of waste heat to the atmosphere in this manner is not well understood. Values of waste heat rejected to the atmosphere by the proposed energy center would be about 44,000 MW, as compared to 100,000 MW from a large brush fire. The energy flux density would be about 1,000 watts per square meter, as compared to 630 for Manhattan in New York City.

There would possibly be large amounts of air pollutants discharged by the fossil-fueled powerplants and the industries at an energy center. The combined effect from all center sources might be of sufficient magnitude to create an air quality problem outside the center. If agriaquaculture industries are colocated with fossil-fueled plants, the levels of air pollutants and liquid effluents, while meeting standards and regulations, can still be damaging.

Areas of Michigan that may be designated as Class I areas would likely include a large portion of the Upper Peninsula and the northern Lower Peninsula. The remaining portions will probably be designated Class II with the exception of the Detroit Metropolitan Area. Both study sites would therefore be in Class II areas. In considering stack emissions from coal-fired units, sulfur dioxide is perhaps of more concern than other pollutants. Although emission control technology is available for sulfur dioxide, there are uncertainties as to whether such technology can remove quantities greater than required by EPA's emission standards for new stationary sources.

It appears that if the center components are sufficiently spread out over the site and meet stack emission standards, there will not be a problem in meeting the national ambient standards nor for the most part of the Class II standards for sulfur dioxide. The principal exception is the 24-hour maximum sulfur dioxide level for Class II areas, which will be exceeded about 23 days per year. This figure may be reduced by greater dispersal of the point sources or by cutting electric power generation by the fossil-fueled units to 50 percent at capacity. Without these kinds of measures, the percent of sulfur dioxide removed from the stack discharge must be increased beyond that which is required to meet the emission standards for new stationary sources and the amount of sulfur in the coal. If these measures are impractical, the energy center would be excluded from Class II areas, but could be sited in a Class III area.

Radioactive materials released in nuclear plant effluents are dispersed to the environment, transported along pathways, and may result in human exposure to radiation. The most critical factors with regard to site safety are the surrounding population densities and gradients and the local meteorological and hydrological conditions, which will govern the spread of radioactivity in the air and water. The requirement on maximum radiation dose at the exclusion area boundary will ultimately determine the distance to this boundary, and therefore the minimum possible size and shape of the site.

Also of great concern are the possibilities and consequences of large radioactive release from an abnormal external or internal accident to a nuclear reactor. Recent reports have suggested that the probability of a large release of radioactivity as a consequence of such external accidents as floods, earthquakes, tornadoes, and impact from cars, aircraft, and wind-blown objects is very small, of the order of 10^{-6} per reactor-year. In addition, safety analyses must consider the possibility of a sequence of incidents and accidents that lead to a core meltdown and a release to the environment of a large proportion of the radioactive inventory. The estimated probability of occurrence of a core meltdown has been stated as 10^{-5} per reactor-year. This figure is subject to question; nevertheless, the probabilities of a single core meltdown and coremelt accidents involving more than one reactor unit are very small.

Site 1 has characteristics relatively favorable for energy center siting with respect to climatological, pollutant dispersion characteristics, tornado frequency, geologic and seismic conditions, and population density. Site 2 differs from Site 1, primarily because it has larger urban areas and a greater number of small towns in the surrounding region. Energy center sites outside of Michigan but within or contiguous to the East Central Area Reliability region would most likely be located in lakeshore counties of Wisconsin north of Milwaukee, where the population density is low.

Michigan is similar to most other States in having a number of constituencies with differing economic, social, and environmental goals. Michigan has traditionally been an environmentally conscientious State. The Michigan environmental community consists of a number of diverse elements, including such representative groups as the United Auto Workers, the Michigan United Conservation Clubs, the League of Women Voters, the Michigan Lung Association, the Sierra Club, and the Michigan Student Environmental Confederation. These and other groups have been active in working with the legislative and executive branches of government to promote strong environmental legislation, and in undertaking court action, specifically including action on nuclear energy issues.

Constituencies that would be expected to favor energy center construction would include some business elements, labor elements, and State agencies. It is expected that the public in the vicinity of the selected center site would be divided depending on individual views of the economic, social and environmental impact of the center.

A study of current issues being strenuously debated, which represent a conflict between economic and environmental goals, indicates that the opposing

Social and Economic Impact

Construction of such a planned city of 200,000 would be possible only with extremely careful planning and control. Even with careful attention to this requirement, the influx of between 100,000 and 200,000 people to an area will have a profound effect on the existing social structure of the area.

The magnitude of the energy center development will also have major effects on the local and State economic picture. The total development involves capital investment in the energy center, industrial center, and biocomplex of $11.5 billion, expressed in 1975 dollars, and much more expressed in dollars in an economy subject to continued inflation. Additional capital investment will be necessary for the construction of the urban areas needed to supply housing and services for the center employees and their families. The magnitude of the overall project will affect the economy at both the local and State level, and the need to supply necessary investment funds will raise substantial financing problems.

Possible Undesirable Social Impacts

In the vicinity of Site 1 (near Harbor Beach in Huron County) the current means of livelihood is predominantly farming. The sparse settlement patterns and small urban centers are typical of midwest agriculture. The influx of permanent construction workers, engineers, and operating personnel will demand not only an increase in the quantity of public and commercial services, but also an increase in quality of such institutions and facilities as schools, hospitals, and the transportation network. Traditionally, the cost of such improvements and additions has been borne by the local government (with some State, and Federal grant assistance). Experience shows, however, that even the best of planning and anticipation by the local authority may be thwarted by the pressures of development generated in the public market place, which are not under direct control. Much can be done to alleviate this through more sophisticated planning and use of the powers local governments have. The social science theory for achieving this result has really come into its own only in the last 5 to 10 years. Consequently, new and innovative designs for planned development must be devised to avoid degradation of the natural and cultural environment by creation of undesirable urban sprawl, commercial strips, concomitant inefficiencies in use of the land, and difficult-to-control "suburban inflation," where the local government is always two steps behind the public demand for services.

Unless planned otherwise, the residential development to house the expected influx of workers will most likely occur first along the lake front in a tightly packed strip which could block access to this resource to others. The wages of the various types of workers will allow ownership of modest single family homes, and the pressure will be to provide these. As soon as the first contingent of construction and operations people arrive and the settlement pattern is established, the associated "service" businesses will establish themselves adjacent to the residential areas--the fast food shops, movie houses, and small retailers. After a few years, there will be pressure to construct one or more large shopping centers, as the total population of the area increases. The rise in the number of people not directly associated with the energy center will lead to construction of modestly priced apartments around these centers.

Along with these changes will come the complete disruption of the existing small urban centers. Harbor Beach, the closest, and by the lake, will be hit by the first construction workers. Temporary motel housing may be required, and a plethora of such establishments will be built. As permanent housing becomes available, the market for these motels will disappear, forcing them out of business. As the outlying commercial development expands, the small towns will be replaced by the shopping centers and commercial strips.

Since the county, and not an established town, will have jurisdiction over much of the area to be developed, it will be expected to bear the brunt of providing the public services--schools, water and sewage lines, hospitals. However, residential and commercial development can occur at a rate an order of magnitude faster than the financial and even physical capability of the local government grows to meet these needs. Initially, the existing financial tax base of the area will not support the necessary water and sewage systems required, and the first wave of residential and commercial building will rely upon wells and septic systems. Drainage in the area of Site 1 is poor, and the land's ability to sustain septic systems probably very limited. This could begin a rapid degradation of the quality of the available water table and surface waters both and a lessening of the quantity. The tax base will not allow construction of the required schools and other public services; thus, the existing facilities will be overcrowded and the quality will deteriorate. These situations eventually will be alleviated as the population stabilizes but the harm done to both the natural and social environment could be irreversible.

The above sequence has been followed many times in urban and suburban environments. A Michigan energy center would offer a unique opportunity to exercise planning techniques to try to avoid these problems, which so far have plagued all of our urban areas. Avoiding these problems will require, however, not only good advanced planning, but some perhaps significant changes in the current power structure between State and local governments and their ability to control private development. Currently, the only direct control available lies with the local government, through zoning. It is difficult or impossible for a local authority to anticipate and prepare for such a major development as the energy center, because of insufficiencies in both funding, and staff and lack of technical expertise. Some type of joint effort between State and local agencies, probably with assistance from Federal funds, will be required to properly anticipate and plan for the major development brought by an energy center of this magnitude.

Even given good multilevel cooperation, the ability of any level of government to control private development is limited. Existing zoning ordinances, which are the only direct method available, are in general weak and fairly readily circumvented. Indirect methods have been proposed, but these usually rely on establishing public services, such as sewers and schools, before development occurs and assume that the private developer will follow these in his choice of location. Obviously, though, this requires major capital investment before the tax base exists to provide it.

The whole idea of planned development to optimize and preserve the quality of the social and natural environment associated with an energy center is one that obviously needs to be studied in much greater depth. Many of the problems and questions are political and legal ones that need to be anticipated well in advance, and potential solutions to them need to be found before they become moot. It is not known to what degree the public of Michigan will accept a planned community, and tradeoffs between the perceived loss of individual choice and benefits gained in improved quality of life and efficient use of resources; hence, this subject must be explored. We recommend further studies in all of these areas as being critical to maximizing the benefit to be gained from an energy center in Michigan.

Impact on Population and Regional Economics

A considerable emigration and population decline in Huron County is projected for 1980. This reflects a decrease in farm population as a result of mechanization and an emigration to areas where employment and higher wages are available. This trend, the emigration of current imhabitants of Huron County, would be expected to continue as the center is constructed. The acquisition of land for the center would take additional farmland out of use and cause migration from the area, probably to regions nearby. The center itself requires, for the most part, highly skilled construction workers. In view of the average educational level noted for residents of the county, very few would find center employment. In effect then, one could expect an almost complete turnover of the population; present inhabitants would seek homes elsewhere and center workers and their families would replace them.

It would be erroneous to assume that because the overall economic structure of the county would be improved by center construction, the current economic problems of the area would be solved. Indeed, the opposite may be the case. The present farmers and lesser skilled workers would be presented with further economic burdens because they would have to move to other areas. This dislocation might be alleviated to some extent, however, by opportunities opened up in local commerce and the government service needed to support the center community. The sizable biocomplex to be located at the center and the supporting services needed would also provide a market for some of the current labor skills in Huron County. The anticipated social and economic impacts of agricultural development at the center are discussed below.

Social and Economic Impact of Agricultural Applications

The location of an energy center at Site 1 would absorb some prime farm land. The displacement of the farm population and reduction in agricultural production would have less impact on the region if some of the waste heat were dissipated through agricultural uses. The proposed integrated waste heat system would have 960 acres of labor-intensive, high-productivity agriculture. Following, the labor-economic and displacement factors are discussed.

The construction of the integrated agricultural/aquacultural system would result in several side effects locally and perhaps State-wide. These positive and negative side effects are external to the system and therefore are not

The status of the Federal and State acts and a more precise understanding of the flora and fauna of the area need to be ascertained prior to commitment of the area for use as an energy center. It might well be, for example, that micrometeorological changes (weather modification) even on a small scale, resulting from construction of an energy center, could irrevocably alter the climate-soil-topography association that supports the ridge-swale-dune vegetation association (braken fern, polygala, clintonia, and other more northerly types). This could compromise the integrity of such specific sites as the Federated Women's Club Wildflower Sanctuary south of Oak Beach in Hume Township.