ECONOMIC IMPACTS OF GEOTHERMAL DEVELOPMENT IN MALHEUR COUNTY, OREGON

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TABLE OF CONTENTS

	<u>page</u>
INTRODUCTION	1
BACKGROUND	3
Geothermal Compared to Conventional Plants	3
Development Phases & Workforce	5
Exploration	5
Well Drilling	6
Steam/Water Gathering System	7
Power Plant Construction	8
Wellfield Maintenance	10
Power Plant Operation and Maintenance	10
MALHEUR COUNTY PROJECT ASSUMPTIONS	12
Labor Requirements	13
Capital Requirements	16
Public Service Impacts	16
Costs	17
Revenues	18
ECONOMIC IMPACTS	19
Methodology	19
Local Purchase Shares	20
Use of the IMPLAN Model	20
Assumptions	22
Impact Estimates	23
Response Coefficients	23
Impacts	24
CONCLUSIONS	27
REFERENCES	30
APPENDICES	A-1

LIST OF TABLES & FIGURES

	<u>page</u>
TABLES	
1. Generating Plant Equipment Comparison	3
2. Range of Employee Estimates	11
3. Workforce & Wage Projections	14
4. Geothermal Development Projections	15
5. State & Local Projected Revenues	19
6. Local Share Estimates	20
7. Malheur County Response Coefficients	23
8. Local Annual Economic Impacts	25
9. Local Annual Employment Impacts	26
10. Malheur County Property Comparison	27
11. Malheur County Revenue Comparison	29

FIGURES

1. Location of Malheur County	2
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INTRODUCTION

This study provides local economic impact estimates for a 100 megawatt (MW) geothermal power project in Oregon. The hypothetical project would be in Malheur County, shown in Figure 1. Bonneville Power Administration commissioned this study to quantify such impacts as part of regional confirmation work recommended by the Northwest Power Planning Council and its advisors. Malheur County was chosen as it has both identified resources and industry interest.

Geothermal energy is defined as the heat of the earth. For purposes of this study, geothermal energy is heat capable of economically generating electricity (using available technology). That translates to steam or hot water over 300°F.

Local economic impacts include direct, indirect, and induced changes in the local economy. Direct economic impacts result from the costs of plant development, construction, and operation. Indirect impacts result from household and local government purchases. Induced impacts result from continued responding as goods and services to support the households and local governments are purchased.

Employment impacts of geothermal development follow a pattern similar to the economic impacts. The workers associated with plant development bring their families to the area. Additional labor is required to provide support services for the new population. Local government services must also increase to support the new community growth and the geothermal plant itself. These changes yield indirect and induced employment impacts associated with the geothermal plant.

Public service impacts include costs such as education, fire protection, roads, waste disposal, and water supply. The project assumption discussion notes experiences at other geothermal areas. Negotiated agreements between developer and impacted public agency are a good tool to mitigate public costs associated with development. Public services are also affected by increased revenues from geothermal development. Property tax revenues increase significantly as plants begin producing electricity. The county also receives royalties from steam production. These revenue increases are assumed to translate into increased public services.

The background section first compares geothermal with conventional power plants. Power plant fuel distinguishes geothermal from other power sources. Other aspects of development are similar to small scale conventional thermal sources. The process of geothermal development is then explained. Development consists of well drilling, gathering system construction, power plant construction, plant operation and maintenance, and wellfield maintenance.

FIGURE 1
MALHEUR COUNTY

The next section addresses labor, infrastructure and capital requirements of the hypothetical plant in Malheur County. The section first provides estimated labor requirements of each development phase. The construction phase is described in detail with regard to estimated work force, public service requirements, and construction costs. The last part of the development discussion addresses public service impacts of geothermal plant development.

The economic impacts section summarizes operating revenues, local royalty and tax payments, and local payroll of the hypothetical plant development specified for this study. In addition, we estimate both indirect and induced economic impacts associated with payments made by the plant owners to local governments and individuals.

The last section presents conclusions and a brief comparison with other industries in Malheur County.

BACKGROUND

Geothermal Compared to Conventional Plants

Thermal power plants convert fuels into electricity. Equipment necessary to create thermal energy or steam varies according to fuel type. Boilers are the most common device. Once steam is created, equipment that transforms thermal energy into electricity is used. Power generation components (turbine, generator, condenser, buildings, switchyard) are similar for all thermal power plants. Table 1 shows example power plant equipment groupings.

Fixed and variable costs differ among plant types. For example, hydroelectric dams have high capital costs and low fuel costs. In contrast, gas combustion turbines are relatively cheap to build and have high fuel costs.

TABLE 1
GENERATING PLANT EQUIPMENT COMPARISON

<u>PLANT TYPE</u>	<u>STEAM GENERATION</u>	<u>POWER GENERATION</u>
Coal	Boiler/fluidized bed	Turbine-generator
Gas	Boiler/gas turbine	Turbine-generator
<i>Geothermal</i>	<i>Wells</i>	Turbine-generator
Hydro	Diversion, dam	Turbine-generator
Nuclear	Reactor	Turbine-generator
Wood	Boiler/fluidized bed	Turbine-generator

All power projects require a large construction force of contractors and craftsman. This is then followed by a small plant staff that includes engineers, management/clerical, mechanics, and operators.

Geothermal power plants share some construction and operation characteristics common to all power plants. Where geothermal differs is source of fuel, and, to a lesser extent, size. The "fuel" is discussed below. Geothermal plants are typically less than 80 MW due to past federal incentives. Clusters of modular plants, e.g., 3 units at Mammoth Lakes, 9 units at Coso and 26 units at ORMESA, are the latest trend. Given the combination of clustered plants and conservative reservoir development, new projects should mirror the hypothetical configuration of this report. Plants in this size range have the added benefits of matching load growth and reduced financial risks. Small power plants - regardless of fuel - offer reduced risks to ratepayer, developer, banker and utility alike.

As the table above shows, geothermal power plants get steam from the ground rather than a boiler. Thermal generating equipment - steam or hot water wells - is unique to geothermal power. An analogy would be the case of a gas power plant located next to the gas wells. Instead of gas (and its requisite combustion), geothermal steam comes out of the ground ready to drive a turbine and generate electricity. Pollution control equipment is only slightly different than from fossil fuel plants. The cost of geothermal plant pollution controls is similar to fossil fuel plants, and is included in our cost estimates.

What further distinguishes geothermal power from other sources is the ability to account for steam either as fuel or as part of the plant. Geothermal power can be developed in either joint ventures of steam suppliers and utilities, or entirely by suppliers. That is, a utility can own and operate the power plant, buying steam from a supplier. Like buying fuel, the steam purchases would be expensed each year of operation. Or, a non-utility developer can build, own and operate both wells and plant. Electricity - not steam - would be sold to a utility. In accounting terms, the resource is expensed (as fuel) in the former example and capitalized (as plant) in the latter. For purposes of this report, we will assume an integrated non-utility operation with both wells and plant under one owner, as all recent projects are of this type.

For fossil fuel plants, a mineral royalty paid to the resource owner is part of the coal, gas or oil cost. Geothermal resources are treated similarly, with a royalty paid to the land or resource owner. For this study, royalty impacts on the local economy are significant because the resource is assumed to be on federal land. This is likely the case with actual projects. By law, half of all federal royalties are returned to the state. Oregon passes the state share through to the county of origin. Malheur County already receives rentals from geothermal leases. No production on federal lands has occurred, so royalties have yet to accrue to the county.

Development Phases & Workforce

Exploring for and developing geothermal resources is very similar to oil and gas activities. (In fact, many developers started in the petroleum industry.) Today's geothermal firms coordinate resource exploration, oversee steam or hot water field development, maintain resource production and operate power plants.

Generating power from geothermal resources is typically done in several major stages. Environmental permitting occurs before each stage. Activities overlap: Some well drilling, steam line construction and plant building will occur concurrently. Some workers will move between these stages in the course of work. Typical stages are as follows:

- Exploring for the resource;
- Developing the wellfield & gathering system;
- Constructing the power plant and related facilities;
- Operating and maintaining resource supplies; and
- Operating and maintaining plant facilities.

Much data is available for geothermal development at The Geysers in northern California. It is the largest developed geothermal field in the world, with 23 plants and about 1850 MW of capacity installed. The first plant there was completed in 1960; the most recent in 1989. Many lessons are to be had from experience at The Geysers. Data from another 36 plants at newer developments in California, Nevada and Utah is also available. The authors draw upon data from all U.S. geothermal power developments.

Exploration

Developing geothermal energy begins with the leasing of large tracts of land. Passive exploration includes geologic field surveys, mapping and analysis. Passive exploration occurs both before and after leasing, to reduce prospect area size. Exploratory drilling then follows, to determine the location, amount and quality of underground steam or hot water.

Generally, geothermal development companies maintain a small office in or near the county where development occurs to manage local operations. Staff size in local offices depends upon the amount of leased land, the extent and stage of development activities, and the level of subcontracted work. Geothermal developers have both office staff and field staff. Office staff may include clerical workers, administrative managers, professionals - such as geologists, earth scientists and environmental specialists - and land agents. Permit compliance work is jointly performed by both corporate staff and contractors. One developer at The Geysers responsible for about 370 MW of steam supplies and 55 MW of power

plants has a regional office with eight full time employees (Dellinger, 1990). Office personnel include environmental compliance staff. Some staff perform both office and field duties. Many workers manage a varying number of subcontractor activities e.g., preparing well pads and access roads, and drilling.

Information provided in Matthews, 1983, and subsequent plant permit documents indicates that local office employees of developers tend to be relatively long-term residents of the local area. Given the length of time between resource leasing and producing electricity, this makes sense. Many skills required for developer office jobs are available in the local labor pool. Those employees whose job skills require familiarity with geothermal resources or specialized technical knowledge may move into the local area for initial development activities and then remain.

Exploration is occurring now at the Vale Known Geothermal Resources Area (KGRA) in Malheur County. For that reason, the Vale site is used in this report for illustrative purposes. Local impacts to date have been insignificant. Geothermal company staff manage exploration from offices outside the state and county.

Well Drilling

Older geothermal plants in The Geysers require approximately 2,000,000 pounds of steam per hour to produce 110 MW of power (Matthews, 1983). This equates to about 1,820,000 pounds per hour for a 100 MW plant. Newer Geysers plants require about 10 to 20 percent less steam per MW of capacity (Bloomquist, 1987; Nolte, 1987). Therefore, a new 100 MW plant needs about 1,545,000 pounds per hour.

The range of resource flow and number of wells is due to variations in reservoir characteristics and steam quality. Approximately 20 to 30 wells provide steam for a 110 MW power plant (Matthews, 1983). Prorating that range results in an estimate of 18 to 27 wells per 100 MW plant. In simple terms, the hotter the steam or hot water, the less flow (and fewer wells) necessary to generate a fixed amount of power. Similarly, with greater flow of steam or hot water per well, fewer wells are needed to generate a fixed amount of power. Each well is unique and different steam characteristics for wells in the same leasehold are common. Without knowing specific resource parameters, we will assume the same well count of 18 to 27 total for this project.

Development of each well varies with depth and lithology, but at The Geysers it takes approximately 60 days with drilling crews working around the clock. A typical drill rig is operated by four crews of 5 or 6 persons during each 24-hour period (USGS, cited in Matthews, 1983). Overseeing the rig crew is a

drilling superintendent employed by the geothermal developer. Thus, there is generally a total work force of about 25 persons associated with each drilling rig.

Workers needed during the steam field development stage include drillers, derrickmen, roughnecks, roustabouts, floorhands, tool pushers, motor operators, welders, and rig superintendents (Cornelison, cited in Matthews, 1983). Most of the steam drilling work force at The Geysers do not belong to a craft union (Matthews, 1983).

Information provided by geothermal developers indicated that The Geysers drilling rig work force tends to be relatively long-term residents of the local area (Matthews, 1983). That drill rig workers moved into the area and stayed is logical, given the mature (30+ years) development of that field. Although there may be changes within the personnel assigned to a drilling rig as workers move in and out, a minimum number of workers must be maintained for the rig to function. Once a particular rig and crew are active in an area, developers prefer to keep it busy there. The crews become familiar with the geologic idiosyncrasies of the area, and drilling equipment is prepared to address those characteristics.

For this study it is estimated that well drilling will employ an estimated 50 persons each year until 1999.

Steam/Water Gathering System

Once the majority of wells are complete and plant construction is underway, work begins on the steam/hot water gathering system. The gathering system is a pipeline network that collects the resource and delivers it to the plant. Typical gathering systems have two components: a short two phase resource (steam and hot water) line from the wells, and a longer steam line from separators to the plant. Steam line workers are different from drilling crews and plant constructors. The work force involved in pipeline construction may include plumbers, welders, pipefitters, foremen and the laborers involved in preparing foundations and footings.

The number of workers constructing steam gathering systems varies with the pipeline design, routing and interconnection plan. The construction period may be a few weeks or a few months. The work force varied between as few as 4 or as many as 50 for a 110 MW plant at The Geysers. Peak steam field and gathering system workers for the 27 MW West Ford Flat plant completed in 1988 were estimated at 35 (Nolte, 1987). The amount of steam gathering system workers is not proportional to plant size. This phase can be either a short term, high worker number effort, or a longer term, low number effort. Weather, construction schedule and contract requirements all affect gathering system employee number.

The gathering system work force is less likely to be long-term local residents, since the duration of the work is short and months may elapse between jobs (Matthews, 1983). Pipeline gathering system workers will be needed shortly before completion of the first plant through startup of the last plant. This is estimated to be 20 workers for six months each year, for an average of 10 workers per year for 1995 through 1999.

Power Plant Construction

Once the first production wells are in, plant design begins. Power plant design is based on resource chemistry and enthalpy (heat content). Commercially available power plants range in size from 620 to 135,000 kilowatts. Geothermal plants in the range of 10,000 to 30,000 kilowatts, or 10 to 30 megawatts (MW) are common today. Also prevalent in the power industry is a trend towards more factory fabrication of components and less onsite erection. New geothermal power plants specify modular components where feasible. Engineering and design can be reduced, the construction schedule shortened and revenues generated earlier as a result of modular components (Phair 1989). Equipment obtained as modular units for the Bear Canyon plant included air compressors & accessories, electrical equipment modules, emergency deisel generator, fire water pumps & accessories, gas removal equipment, Stretford™ process and turbine generators (Phair 1989). Skid-mounted modular turbine generator units are available from several firms: Barber-Nichols Inc., ORMAT Energy Systems Inc. and Geothermal Power Co.

Geothermal plant sizes refer to net power at the utility (busbar) grid. Plants are typically designed and operated as baseload facilities; availability and capacity factors average over 90 percent for recent plants. For a background discussion see *PURPA Influence on Contemporary Geothermal Plants*, (Sifford, Bloomquist & Geyer, 1987), and *Innovative Design of New Geothermal Generating Plants*, (Bloomquist, Geyer & Sifford, 1989). Optimizing economics calls for operating the plant as much as possible, or "baseload" operation. Therefore, typical average power output for geothermal plants approaches net design capacity. Net output is commonly used to describe geothermal plant performance, and will be throughout this report.

Average construction time for early geothermal plants in The Geysers was about 28 to 30 months (Matthews, 1983). Recent plants there have shortened this period considerably. The Bear Canyon plant was built in about 20 months instead of a projected 24 months (Phair 1989). The West Ford Flat plant came online only eight months after groundbreaking (Urbank, 1989). Other new plants in California, Nevada & Utah had construction periods of less than two years due to significant shop fabrication of standard or similar units. Two Nevada plants which came online in 1992 used factory assembled turbine generators and other components. The Brady Hot Springs 20 MW plant was constructed in only 13 months as a result (Ettinger & Brugman, 1992).

Construction of the power plant and related facilities is usually managed by one general contractor and several subcontractors. Construction of these facilities involves a succession of diverse tasks. Work tasks include construction of access roads; site clearance and preparation; placement of foundations and pads, construction of the power plant buildings; placement of the generating unit(s) and associated piping and electrical work; construction of related facilities, e.g., hydrogen sulfide abatement systems; air or water cooling systems; the switchyard and transmission system; and final site and facility finish work.

Workers needed for these tasks include pipefitters, welders, electricians, iron workers, carpenters, painters, equipment operators, concrete workers and finishers, teamsters and laborers, other manual labor skills, and supervisory and quality control inspection personnel. Many of the work tasks throughout the construction period are of relatively short duration, ranging between a few weeks and a few months. Some of the craft skills required are very specialized, and the number of workers in the state who are qualified to perform the skilled tasks is relatively small. However, a worker with a wide range of abilities and a high degree of skill in each of those various areas could maintain relatively continuous employment on a progression of geothermal power plants.

The peak work force during power plant construction is active on site after the foundations and pads are set, when work begins on generating unit(s) installation and mechanical and electrical connections. Once the major equipment is placed, construction continues simultaneously on the rest of the power plant structure and related facilities.

The majority of the construction work force is composed of electricians and pipefitters who are dispatched through union hiring halls. The number of electrical workers active during the peak period usually ranges between 5 and 35 but has been as many as 55 on a single project. The number of pipefitters active during the peak period may range between 6 and 50. It has been as high as 110. Generally, this peak period extends out over one year, with the largest number of workers needed for six to eight months (Matthews, 1983). At new projects in California, Nevada and Utah, the choice of using union labor rests with the developer and construction firm.

Based on information plant developers provided the California Energy Commission, the maximum number of construction workers of a 110 MW geothermal power plant ranged between 75 and 205 (Matthews, 1983; CEC, 1985). The wide variation may be due to both seasonal limits on earth movement work and phase of construction. Peak plant construction workers for the 27 MW West Ford Flat plant completed in 1988 were estimated at 40 (Nolte, 1987). We therefore have an old range of numbers, and a recent point between them. The old range is .68 to 1.87 workers per MW. The West Ford Flat figure was 1.48. No

straight line correlation is made for construction workers and plant capacity. Power sales schedule, seasonal slowdowns, financing and degree of shop fabrication all affect construction workforce levels.

Based on a range of 13 to 36 months, a 24 month construction period for the each plant is assumed. Workers would begin earth movement activities for the first plant in late 1993, but for ease of modelling, all construction is shown to begin in 1994. Plant building will be staged, but will include overlapping work whenever possible. It is expected that construction will be more efficient after the first plant is built.

Wellfield Maintenance

Once a geothermal power plant comes on line, it operates at full capacity all the time, barring technical or mechanical problems. Periodically throughout the lifetime of the power plant, the steam wells supplying the plant need to be redrilled to clear out obstructions or to regain full flow of the steam. New wells must be drilled if an existing supply well does not maintain sufficient output.

The work force needed to maintain an adequate resource supply for each well field and power plant is similar to the field development phase. A California Division of Oil and Gas representative in Santa Rosa believed that the average number of drilling rigs active in the Geysers in the early 1980s will continue to be active for the lifetime of the geothermal resources in the Geysers. Steamfield work has shifted from developing new steam supplies to maintaining existing supplies. This makes sense as the last plant built there was in 1989. California Division of Oil and Gas staff estimated in Matthews that 9 to 12 rigs maintain steam flow at The Geysers. That requires a continuing work force of 225 to 300. An estimated 8 field staff maintain over 370 MW of Calpine Corp. wellfield at The Geysers (Dellinger, 1990). As discussed earlier, the steam field work force is expected to be drawn from long-term residents of the local area.

Power Plant Operation and Maintenance (O&M)

In the final months of construction, personnel from the plant developer/operator begin testing equipment and systems. These workers may include power plant operators, plant engineers, electricians, instrument repairmen, and maintenance workers. Once the power plant comes on line, the permanent operation and maintenance work force maintains routine operations. Periodically, this work force may be supplemented by additional outside workers for facility overhaul and maintenance activities.

The number of workers that operate and maintain power plants and related facilities, (excluding the wellfield), varies by power plant owner/operator. The Pacific Gas & Electric Company (PG&E) operation and maintenance work force in 1981 for 17 Geysers plants (and 1135 MW of net capacity) was about 130 (Matthews, 1983). At that time, PG&E managed the plants from one administration center, the West

Geysers Power Plant. In 1984 PG&E created a separate satellite administration center, Geysers East, to manage growth in that part of the field. Geysers East had full duplicate staff of Geysers West. However, PG&E recently reduced management at the Geysers East center and now operates the various units from Geysers West. Periodic checking of daily operations and necessary maintenance are performed by roving crews based at each administrative center. Each crew is responsible for two or more units. Current staff numbers about 210 persons, responsible for 1302 MW of capacity (Stukey, 1991). This results in an average of .16 plant O&M employees per MW. This number is low due to the enormous size of development there. PG&E Geysers data provides the low end of plant O&M staff levels.

In the last decade developers other than PG&E began operating new plants in The Geysers. These developer/owners have initial operation and maintenance work forces of 10 to 20 workers per power plant. Fewer workers are required to operate and maintain subsequent power plants since the basic work force is already involved in their initial operation. This staff economy of scale holds true at the recently built Bear Canyon and West Ford Flat plants operated by Calpine Corp. Approximately 12 plant staff operate and maintain these plants (49 MW total), for an average of .24 employees per MW (Dellinger, 1990). Factoring in an additional 8 field staff results in an average of .41 total employees per MW. (This conservatively excludes additional, sizable steam reserves managed by the same field staff.)

The recently completed 240-MW Coso development currently employs about 90 persons in plant operations and 170 people total (McClain, 1991). This results in an averages of .38 plant employees per MW and .73 total employees per MW. Table 2 provides ranges of employees by development phase. From these estimates Malheur County assumptions were chosen.

TABLE 2
RANGE OF EMPLOYEE ESTIMATES

<u>PHASE</u>	<u>NUMBER PER MW</u>	<u>NUMBER PER 25 MW</u>
Drilling	25 per rig	25 per rig
Wellfield Construction	.04 - 1.30	4 - 33
<u>Plant Construction</u>	<u>.68 - 1.87</u>	<u>17 - 47</u>
Total Construction	.72 - 3.17	21 - 79
Wellfield Maintenance	25 per rig	25 per rig
<u>Plant Operation</u>	<u>.16 - .38</u>	<u>4 - 10</u>
Total Operation	.41 - .73	10 - 18

Sources: Cited above

One reason for a range of worker estimates is economy of scale that affects plant personnel. Such ranges are not linear as plant sizes increase. A minimum number of employees is needed for any plant. Research shows that a geothermal plant 10 MW in size requires almost as many operating staff as a plant two to five times that size (Bloomquist, Geyer & Sifford, 1989). There is no record of the total number of geothermal industry workers. Neither is there sufficient accounting of actual numbers of workers employed in each stage of development. Contractual employees further compound estimates. However, there are at least some ranges of employees estimates, both with and without construction and field maintenance personnel.

MALHEUR COUNTY PROJECT ASSUMPTIONS

Development assumptions are presented below. Information in this section is directly related to development phases. Cost and operation estimates are provided in detail. Research reveals some unique factors regarding public service impacts in Oregon counties. These are discussed below.

Construction and operation assumptions for the hypothetical 100 MW (net) project are as follows. Drilling for the first plant is assumed to begin in early 1994. Well drilling is assumed to average about 18 months per plant. (It will likely be longer than average for the first wells, and shorter than average for the last ones.) Given the uncertainty of Northwest resources, this report conservatively uses high well numbers. Approximately 23 wells - the midpoint of our 18 to 27 range - are needed to provide steam for a 100 MW project. This total includes observation and injection wells. That same number of wells will be drilled again over the 30 year life of the power plant as replacement resources are needed.

The project will have four 25 MW double flash or binary plants. Both technologies are capable of generating electricity from expected resources in Malheur County's geothermal area (Vale KGRA). Double flash refers to the number of separator stages needed to get usable steam. Hence, a double flash plant uses two separators to provide steam to the turbine. Binary refers to the use of a second working fluid, heated by geothermal steam or water, that drives the turbine.

Inclement weather in the winter season in Vale should not impede construction. Elevation varies but averages about 2,700 feet above sea level. Precipitation is only about 10 inches each year. A 24 month construction period per plant, conservative compared to most recent plants, is assumed for this analysis. The development scenario is presented over a six year period leading up to full operation at the end of 1999. The plants will operate 90 percent of the year.

Most high temperature geothermal resources in the Pacific Northwest are on federal land. Such is the case at the Vale KGRA. Therefore, a 10 percent operating royalty will be collected by the federal government. Half of the royalties are given back to the state. All such (mineral) royalties are passed back to the counties

in Oregon, per Oregon Revised Statutes 294.055. Royalties derive from steam - not power - production. Therefore, data from existing steam supplier agreements are useful to estimate plant royalties. Steam cost values are estimated from two-party contractual data. Power plant steam use is taken from one of the most efficient plants at The Geysers. Royalty estimates are thus conservative. Less efficient plants may be built for slightly lower capital costs, but will be less efficient and experience higher operation, maintenance and royalty costs. Prudent developers will optimize plant steam efficiency with capital costs.

Labor Requirements

Table 3 shows estimated workforce and wage projections. The well drilling, pipeline gathering and plant construction crews will vary each year, depending on development stage. Well drilling will employ an estimated 50 persons each year until 1999. Plant construction staff will go from 10 in 1994 to 80 each year until 1999, when the last plant nears completion with only 40 workers. The same workforce would build each plant. Construction staff levels will remain constant (plus or minus a few supervisory personnel) after the first year.

Table 4 shows development projections from construction through the first years of operation. The first plant would begin commercial operation in January 1997. Over the power plant lifetime (typically 30 years), an additional 23 wells could be drilled to maintain the necessary supply of steam or hot water. One hundred percent reinjection of the resource (by using binary plants) would likely reduce this number. Replacement well drilling will require workers only for a few months per year. This equates to about six full time employees maximum. At that time, drilling workers may be gradually drawn from the local labor pool. Wellfield maintenance employees start at 2 in 1997 and rise to 6 once replacement well drilling begins. The number of plant and wellfield operation staff will ramp up from 8 with the first plant to 20 at full operation. The breakout of local labor (and equipment) is highlighted in the purchase share discussion later.

For the complete 100 MW development assumed for this study, 20 operation and maintenance workers are forecast. This is low compared to the ranges in Table 2. One reason is the expectation that a single main control room will serve all plants. Direct employment estimates used in this analysis are intentionally conservative.

Construction worker wages vary between wellfield and plant. Given the specialized nature of well drilling, those staff wage levels are projected at \$40,000 per year. The average salary in Oregon for industrial building construction is about \$30,000 per year (Lux et al., 1989). Plant construction workers are not distinguished as union or non-union, but salaries are projected to closely match local union scale. For this study, above average plant construction salary rates of \$34,000 per year were chosen. Note that

TABLE 3

WORKFORCE & WAGE PROJECTIONS

	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>	<u>1998</u>	<u>1999</u>	<u>2000</u>	<u>2001</u>
WORKFORCE								
Well Drilling	50	50	50	50	50	50	0	0
Pipeline Gathering	0	10	10	10	10	10	0	0
Plant Construction	<u>0</u>	<u>40</u>	<u>40</u>	<u>40</u>	<u>40</u>	<u>40</u>	<u>0</u>	<u>0</u>
Construction Workforce	50	100	100	100	100	100	0	0
Replacement Drilling	0	0	0	0	0	6	6	6
Wellfield Maintenance	0	0	0	2	2	2	2	2
Plant Operation	<u>0</u>	<u>0</u>	<u>0</u>	<u>6</u>	<u>12</u>	<u>12</u>	<u>12</u>	<u>12</u>
O & M Workforce	<u>0</u>	<u>0</u>	<u>0</u>	<u>8</u>	<u>14</u>	<u>20</u>	<u>20</u>	<u>20</u>
TOTAL WORKFORCE	50	100	100	108	114	120	20	20
PAYROLL								
Construction Jobs	50	100	100	100	100	100	0	0
Average Salary	<u>\$34,000</u>	<u>\$34,000</u>	<u>\$34,000</u>	<u>\$34,000</u>	<u>\$34,000</u>	<u>\$34,000</u>	<u>\$34,000</u>	<u>\$34,000</u>
Construction Payroll	\$1,700,000	\$3,400,000	\$3,400,000	\$3,400,000	\$3,400,000	\$3,400,000	\$0	\$0
Operation Jobs	0	0	0	8	14	20	20	20
Average Salary	<u>\$40,000</u>	<u>\$40,000</u>	<u>\$40,000</u>	<u>\$40,000</u>	<u>\$40,000</u>	<u>\$40,000</u>	<u>\$40,000</u>	<u>\$40,000</u>
Operation Payroll	\$0	\$0	\$0	\$320,000	\$560,000	\$800,000	\$800,000	\$800,000
TOTAL PAYROLL	\$1,700,000	\$3,400,000	\$3,400,000	\$3,720,000	\$3,960,000	\$4,200,000	\$800,000	\$800,000

TABLE 4

GEOTHERMAL DEVELOPMENT PROJECTIONS

	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>	<u>1998</u>	<u>1999</u>	<u>2000</u>	<u>2001</u>
Plant Size (MW)	0	0	0	25	50	75	100	100
Plant Value (\$/KW)	<u>2,800</u>	<u>2,800</u>	<u>2,800</u>	<u>2,800</u>	<u>2,800</u>	<u>2,800</u>	<u>2,800</u>	<u>2,800</u>
Capital Value (\$000)	0	0	0	70,000	140,000	210,000	280,000	280,000
Property Tax Rate (\$/000)	<u>21.04</u>	<u>22.50</u>	<u>20.00</u>	<u>17.50</u>	<u>15.00</u>	<u>15.00</u>	<u>15.00</u>	<u>15.00</u>
Property Taxes	\$0	\$0	\$0	\$1,225,000	\$2,100,000	\$3,150,000	\$4,200,000	\$4,200,000
Steam eff. (#/kWh)	14	14	14	14	14	14	14	14
Steam price (\$/000#)	<u>1.45</u>	<u>1.45</u>	<u>1.45</u>	<u>1.45</u>	<u>1.45</u>	<u>1.45</u>	<u>1.45</u>	<u>1.45</u>
Steam value (\$/kWh)	0.0203	0.0203	0.0203	0.0203	0.0203	0.0203	0.0203	0.0203
Steam value per yr.	\$0	\$0	\$0	\$4,001,130	\$8,002,260	\$12,003,390	\$16,004,520	\$16,004,520
Royalty Rate (%)	<u>10.00</u>	<u>10.00</u>	<u>10.00</u>	<u>10.00</u>	<u>10.00</u>	<u>10.00</u>	<u>10.00</u>	<u>10.00</u>
Royalty per year	\$0	\$0	\$0	\$400,113	\$800,226	\$1,200,339	\$1,600,452	\$1,600,452
County 50% Share	\$0	\$0	\$0	\$200,057	\$400,113	\$600,170	\$800,226	\$800,226
Power Sales (kWh/yr)	0	0	0	197,100,000	394,200,000	591,300,000	788,400,000	788,400,000
Power Price (\$/kWh)	<u>0.000</u>	<u>0.000</u>	<u>0.000</u>	<u>0.065</u>	<u>0.065</u>	<u>0.065</u>	<u>0.065</u>	<u>0.065</u>
Gross Revenue per yr.	\$0	\$0	\$0	\$12,811,500	\$25,623,000	\$38,434,500	\$51,246,000	\$51,246,000
Profit (@20 %)	\$0	\$0	\$0	\$2,562,300	\$5,124,600	\$7,686,900	\$10,249,200	\$10,249,200
Corp. Tax Rate	<u>6.50%</u>	<u>6.50%</u>	<u>6.50%</u>	<u>6.50%</u>	<u>6.50%</u>	<u>6.50%</u>	<u>6.50%</u>	<u>6.50%</u>
Corp. Income Taxes	\$0	\$0	\$0	\$166,550	\$333,099	\$499,649	\$666,198	\$666,198
Pers. Tax Rate	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%
Total Payroll \$/yr.)	\$1,700,000	\$3,400,000	\$3,400,000	\$3,720,000	\$3,960,000	\$4,200,000	\$800,000	\$800,000
Income Taxes (\$/yr.)	\$170,000	\$340,000	\$340,000	\$372,000	\$396,000	\$420,000	\$80,000	\$80,000

all wages forecast are average for many levels of workers and do not include benefits. Plant O&M wages were estimated to be \$40,000 per year.

Capital Requirements

Project cost assumptions are \$2,800 per net kW, for \$280,000,000 total, all in 1992 dollars. The authors again use conservative assumptions for capital costs. Data from prior studies show a range of \$1,550 to \$3,778 per net kilowatt for recently built geothermal plants (Bloomquist, Geyer & Sifford, 1989; OESI, 1991). Our estimate is broken down as \$1,800 for the plant and \$1,000 for the wells, on a per kW basis. While resources in Malheur County appear easier to exploit, this report use conservative figures. Total costs include engineering, construction, management, materials, and regulatory compliance. Construction costs include everything from preliminary earth movement through transmission line interconnection.

Little information is available on relative shares of labor, materials, and other costs as a portion of total plant capital costs. For the 20 MW Bear Canyon plant, share estimates before completion were about 41% labor, 40% materials and 19% other (Bloomquist, Geyer & Sifford, 1989). We assume relatively high percentages of material to total costs. For this study, labor cost share was estimated at twice the total payroll to account for fringe benefits, overhead and other labor-related costs generally billed as markups to labor. The total labor cost share projected in this report is about 16 percent. Materials cost are expected to be higher for this plant because of the availability of newer, more efficient technology, extensive use of modular components and because labor costs have not kept pace with inflation in recent years. For this study, materials cost share is estimated at about 60 percent and other costs at 24 percent. Materials are assumed to be spent in proportion to labor costs over the development time period.

The Vale KGRA has an existing power line running through it. Exact plant sites are not known at this time. Therefore, a two mile transmission line was chosen as representative for this study. Transmission costs equal about \$220,000 for materials plus \$300,000 for labor totalling \$520,000 (Hubsky, 1990). These costs are included in construction estimates, and are in 1992 dollars.

Capital necessary for this project will come from sources outside of Malheur County. Financing geothermal power plants typically involves developer equity and lender debt packaged in a project finance loan or leveraged lease. Energy projects of this size obtain capital in either national or international markets (Bloomquist, Geyer & Sifford, 1989).

Public Service Impacts

This section describes public sector costs and benefits associated with geothermal development.

Geothermal power generation in Malheur County will yield local government revenues in the form of

property taxes and resource royalties. It will also generate costs as the county will need to provide increased education services and some infrastructure. Some costs may occur before revenues are generated. As noted below, recently developed techniques now allow fees to be collected prior to incurring public service costs.

Costs

Public service impacts are the costs of education, fire protection, roads, waste disposal, and water supply. Any large scale development will require some additional public services. Education and road impacts that adversely affected prior developments in California would be avoided in Malheur County.

Education impacts are increased enrollment of project-related students (children of new workers) and potential new classroom space and buses. Schools in Oregon are financed by a combination of base level property tax levies and specific school bonding levies. Given the passage of Ballot Measure 5 in November 1990 and its attendant drop in school property tax rates, it is assumed that bond funding will no longer be available to fund increased services. Increased property taxes from geothermal development should raise school funding revenues. The critical factor is existing school enrollment: will new students exceed current capacity? Given the Vale KGRA location, any students will go to schools in Vale. The staged nature and small size of these projects is not expected to result in negative school capacity impacts. However, given the worst case scenario of maximum enrollment capacity, developers and the school district may choose to adopt a mitigation agreement providing for some expanded facilities in Vale.

Matthews, 1983 compares Geysers area school impact mitigation agreements. The one used by an 80 MW project there could be useful here. For a period of 8 years, the developer pays the school district an agreed upon amount. The developer and district then settle accounts between prepaid fees and property tax payments. The amount is calculated as follows:

The number of students times 55 square feet of classroom per student times the construction cost per foot, plus \$1,000 per student for buses.

Education impacts will be mitigated through increased property tax revenues, royalties returned to the county, negotiated agreement or perhaps some combination of the three sources. Net cost to the County should approach zero, depending upon how much additional cost is borne by the developer.

Fire protection measures will likely be negotiated agreements with the Bureau of Land Management to build and maintain water storage facilities at the plant site. Temperature gradient drilling to date included

fire protection measures, i.e., water tanks on site. This cost is included in plant capital costs. Net cost to the County should be zero.

Roads in north Malheur County are the responsibility of both the state Highway Division and the county Roads Department. Interstate Highways 20 and 26 join at Vale. Malheur County manages Lytle Boulevard between Vale and Adrian. Less than 50 percent of payments in lieu of taxes from federal agencies are dedicated to County road maintenance (Moore, 1992). County road costs are estimated at less than \$1,000,000 per year. Increased royalties to the county will cover those costs.

Preliminary indications are that the developer with prospects in Malheur County prefers a binary power generation process. If this technology is used, no solid wastes would result as the power cycle is closed, i.e., all resources are returned to the reservoir. Should a flash steam process be used, some solid wastes would result. Solid wastes from flash plants may be cooling tower sludge and sulfur cake from air pollution control and treatment systems (Felperin, 1989). It is expected that these solid wastes would be classified as hazardous wastes unless trace elements are washed out. In that case, the sulfur cake is classified as designated waste (Nolte, 1987). Waste disposal will consist of truck trips from the plant to a landfill near Arlington, Oregon. (Arlington is the state's only commercial facility licensed to accept chemical hazardous waste.) It is premature to estimate numbers of such truck trips based on other plants because of the likelihood of binary cycle technology being used. Regardless, solid waste disposal costs will be borne by the developer.

Water supplies are primarily dust suppression and fire protection up until plant operation. At that time, a single large purchase of water from a market source (e.g., a holder of a valid water right) may occur to fill the cooling system. For flash-cycle plants, cooling water makeup will come from resource condensate once plant operation begins. Binary plants typically use dry cooling. Net cost to the County will be zero.

Revenues

State and local government revenue projections based on the above assumptions are included in the annual summary shown in Table 4. Capital costs, steam efficiency, and tax rates all affect the accuracy of these projections. Higher capital costs and lower steam efficiency would result in additional property taxes and royalties accruing to Malheur County. Lower property tax rates will yield less revenues to the county. Building permit fees are not included in this work because they are "fees for service" (Prante, 1989).

Taxes and royalties are the primary revenue sources, and are the biggest direct economic impacts to Malheur County. This report uses the book value construction cost to base property taxes on. The property tax rate in Tables 4 and 5 reflects limitations imposed by the passage of Ballot Measure 5 in 1990.

Current Malheur County property tax rates are only slightly above newly mandated levels. Table 5 summarizes revenues to state and local governments at full operation.

TABLE 5
STATE & LOCAL PROJECTED REVENUES
100 MW PLANT (1999)

<u>SOURCE</u>	<u>STATE</u>	<u>COUNTY</u>
Federal Royalty (50% county return)	\$0	\$800,226
Property Tax	\$0	\$4,200,000
Corporate Income Tax (6.5% of Pretax Profit)	\$666,198	\$0
Personal Income Tax (10% of wages)	<u>\$80,000</u>	<u>\$0</u>
TOTALS	\$746,198	\$5,000,226

ECONOMIC IMPACTS

Methodology

Estimation of local economic impacts associated with plant development is a three-phase task. First, the costs of building the plant and the returns to local governments associated with plant operation must be estimated for each year of plant development and for a typical year in which the plant is fully operational. These are based on the plant development assumptions and information described in the preceding section.

The second step in estimating local economic impacts is to identify or estimate the share of goods and services associated with plant development, construction and operation that are purchased locally, and the share of revenues that is returned to the local government. For this study local expenditures are those made within Malheur County.

The last phase of assessing economic impacts is to estimate the indirect and induced impacts of the local expenditures and local government revenues identified in phases 1 and 2. An input/output model describes interactions between industries and estimates the impacts of changes in demand for goods and services provides this information. The model used for this study is the IMPLAN model developed by the U.S. Forest Service. Estimates of local expenditure shares and development of multipliers from the IMPLAN model are discussed below.

Local Purchase Shares

The identification of local and non-local expenditure shares for wages paid and equipment purchased during plant development represents an estimate drawn from interviews with industry representatives, consultation with Washington State Energy Office researchers, and the author's knowledge of the industry. Data on payroll for geothermal plants is proprietary and there is little literature on the topic. The authors did find one vendor list that was useful in identifying sources of equipment. For Malheur County we estimate 20 percent of the drilling crew, 40 percent of the pipeline gathering crew and 25 percent of construction labor will be local to the county. Non-local workforce includes workers commuting in from other counties and temporary workers that live elsewhere. Some workers may commute from Ada County Idaho (about 50 miles east), or send their wages back to whatever locale they originally came from. Most wage impacts will be concentrated in Malheur County, but the local trade area includes Boise, Idaho. Table 6 shows local share estimates of labor and equipment used in this study: Because Malheur County has few industries producing materials and equipment needed for geothermal development, those respective local share estimates are assumed to be near zero. In fact, some gravel or concrete supplies would likely come from local sources. This construction material local share, estimated to be three percent, produces no appreciable indirect and induced impacts.

TABLE 6
LOCAL SHARE ESTIMATES

	<u>LOCAL</u>	<u>NON-LOCAL</u>
MATERIALS AND EQUIPMENT		
Drilling	0%	100%
Well field	0%	100%
Plant	3%	97%
LABOR		
Drilling Crew	20%	80%
Pipeline	40%	60%
Construction	25%	75%
Operation	100%	0%
Maintenance	100%	0%

Use of the IMPLAN Model

Input/output models estimate the direct, indirect and induced impacts of changes in final demand for a product or service. In the case of geothermal development, the direct impacts are the local employment and supply purchases associated with plant construction and maintenance. Indirect impacts are the employment and supply purchases associated with production of the supplies for plant development. For example, *direct* purchase of locally produced sheet metal for the plant *indirectly* generates additional purchases of supplies used to produce the sheet metal, such as raw metal and energy. The additional employment associated with production of the supplies for the geothermal plant also *induces* increased

household spending as the employees spend their wages. Further information related to the IMPLAN model and data used in this study is included in Appendix A.

Total impacts are the sum of the initial and subsequent rounds of direct, indirect and induced impacts. In larger economies, total impacts are greater because in each successive round of respending, more money is respent locally. In smaller economies, fewer supplies and consumer goods are available locally. Total local impacts are reduced because purchases occur outside of the region.

The IMPLAN model lacks a specific sector that relates closely to geothermal development. The impact analysis conducted for this study is therefore based on patterns of household and local government spending, and purchases of construction materials generated by development. Most local impacts result from wages paid to plant construction workers and maintenance and operation staff, and from royalties and taxes paid to the Malheur county government. Local government spending falls into two general categories, education and other local government services (including road and infrastructure development and other public services).

For this study, the IMPLAN model was used to develop response coefficients or estimates of the impacts of wages paid to local employees and the impacts of education and non-education related local government expenditures. The advantage to using response coefficients is that they represent the response - in both dollars and jobs - associated with an increase in spending valued in dollars. It therefore becomes unnecessary to convert values from current dollars to the 1982 base used by IMPLAN for analysis, and then convert back to current dollars for presentation. It also allows readers to differentiate between the impact estimate and the initial analysis of payroll and government spending associated with the project.

The IMPLAN model also provides information that can be used to generate a spending pattern for local purchases of construction materials. The "New Utility Structures" interindustry purchases identified by the model were used to help select sectors impacted by construction purchases. However, only 10 other local industries expected to be main recipients of geothermal development were included in the spending patterns used for this analysis. A portion of the construction expenditures were also allocated to the New Utility Structure sector. The response coefficient reflects both the author's judgement of spending patterns and the model's version. Sectors represented and their respective portion of local expenditures allocated to them are listed in Appendix D.

Programs developed by Jonathan Lesser at the Washington State Energy Office were used to expedite extraction of the household and local government spending patterns. Appendices B, C and D include tabular presentations of spending patterns generated from the model. For this study, the mid-range

spending level was used as the input in developing household expenditure response coefficients. The response coefficient or multiplier associated with spending in each category is generated and then applied to estimates of local payroll and government spending to calculate the impacts of geothermal development. Each expenditure pattern illustrates the average impact of project related spending in the Malheur County economy. It describes the portion of each dollar of spending that goes to each industry in the local economy.

Before presenting the results of the IMPLAN analysis, it is important to review some of the assumptions associated with use of this model.

Assumptions

Using IMPLAN or any input/output model for impact analysis requires several assumptions:

1. The interindustry trade patterns provided in the model are a reasonable estimate of trade patterns in the county.
2. The total industry output (final demand components) and regional purchase coefficients used in the model reflect the county.
3. Relative prices of goods and services relevant to this analysis have not changed significantly since 1982. If, for example, the price of concrete has gone up more than the price of other goods since 1982, the model will yield somewhat inaccurate estimates of trade patterns that involve concrete.
4. The relative quantities of each input used in producing goods and services are consumed in fixed proportion to the quantity produced.
5. Activity in each project year is independent of activity in any other year. This assumption is required because IMPLAN is not a dynamic model -- it does not incorporate estimates of change during one year into estimates of change in subsequent years.
6. New employment generated by changes is assumed to be met via population increases. But the percentage unemployment in the county is assumed to stay the same.

The IMPLAN model yields estimated changes in output, income, employment and population. These results depend on assumptions about profit margins, population per employee, wages in each industry, and ratio of part-time and full time jobs in each industry. For this analysis, model assumptions were accepted and data provided with the model was used without modification, with a few exceptions which are discussed below.

Impact Estimates

Response Coefficients

This section summarizes results of the impact analysis. Response coefficients (also called income multipliers) calculated for each component of the analysis are summarized below. Additional detail on response by major sector categories is included in Appendix D.

TABLE 7

MALHEUR COUNTY RESPONSE COEFFICIENTS
(Dollars or Jobs per Thousand Dollars of Increased Local Spending)

	<u>INCOME</u>	<u>EMPLOYMENT</u>
Household spending	\$327	0.015
Local Government Education Spending	\$696	0.024
Other Local Government Spending	\$480	0.017
Construction	\$686	0.021

Total impacts are calculated as the initial local response plus additional impacts estimated with the response coefficient. Thus the income multipliers for household, government education, other government spending and construction are 1.327, 1.696, 1.480, and 1.686 respectively. Calculations for household spending are explained below. The response coefficient is higher for education spending than for other services, implying that a greater share of purchases related to education are made locally. The direct impact of education related spending is about \$620; indirect and induced impacts bring the total to about \$696. For other local government services, the direct impact is smaller, about \$428, so the total response coefficient is a lower \$480. For construction spending, the direct impact is about \$447, so the total response coefficient is \$686.

In developing the employment multipliers, the results of the IMPLAN model were adjusted to account for the author's disagreement with the model's assumptions. For education spending impacts, the model assumes fixed proportions of employment and other inputs. In reality, the school district is unlikely to hire as many new teachers as the model would indicate because the increase in population associated with geothermal development is fairly small. The county would probably hire a few teachers, and use the remainder of the new revenues for other improvements in the education system. The employment estimates were therefore adjusted downward for the government industry sector, which includes teachers' wages.

For construction materials purchased locally, it was assumed that local merchants would divert as much of the increased business to profits as possible. So IMPLAN's fixed proportion assumption was overridden again, and the authors assume that there would be no local wholesale and retail employment

impacts associated with purchase of construction materials. This reduces the total employment response coefficient to .021 jobs per thousand dollars of local spending on construction materials.

For employment impacts associated with household and other government services expenditures, the estimated employment impacts were checked against employment impacts calculated by dividing income impacts by \$20,000 annual salary. The results appear reasonably consistent, so IMPLAN's employment impacts were accepted for these categories.

Impacts

Table 8 shows the calculation of local economic impacts associated with geothermal development. Local employment and equipment shares are shown. For every additional thousand dollars in household expenditures resulting from geothermal development payroll (take-home pay), about \$327 additional income accrues to businesses and individuals in the Malheur County economy. Construction spending produces \$686 in direct, indirect and induced impacts for every \$1,000. Similarly, local government tax & royalty revenues spent on education generate about \$686 in additional local income for every \$1000 in spending. Other government services produce \$480 in direct, indirect and induced impacts for every \$1,000.

The response coefficients or multipliers are applied to the wage and local government values to compute estimated impacts. To compute total payroll impacts for each year, the estimated payroll associated with construction is first multiplied by the 75 percent local share. Then it is adjusted downward again to reflect take-home pay at 75 percent of local payroll. The household expenditure impacts are calculated as the multiplier times the household expenditures. The total payroll impacts are the sum of household expenditure impacts and local payroll.

To compute the impacts of local government spending, the local government revenues are shared out between (60 percent) education related spending and (40 percent) spending for other government services. Share proportions are rough estimates from data provided by the Malheur County Assessor's Office. The multiplier for each type of government spending is one plus the response coefficient because the impacts include the initial payments to local government plus the response to local government spending.

As shown in Table 8, there are payroll impacts but no local government spending impacts during the first three years of geothermal development. As the first plant comes on line in 1996, royalties and taxes are paid to the county government. Local government revenues and impacts increase until 1999 and then stabilize. Payroll impacts decline to full plant operation levels in 1999.

TABLE 8

LOCAL ANNUAL INCOME IMPACTS

	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>	<u>1998</u>	<u>1999</u>	<u>2000</u>	<u>2001</u>
TOTAL PAYROLL	\$1,700,000	\$3,400,000	\$3,400,000	\$3,720,000	\$3,960,000	\$4,200,000	\$800,000	\$800,000
LOCAL PAYROLL (75%)	\$1,275,000	\$2,550,000	\$2,550,000	\$2,790,000	\$2,970,000	\$3,150,000	\$600,000	\$600,000
HOUSEHOLD EXP. (75%)	\$956,250	\$1,912,500	\$1,912,500	\$2,092,500	\$2,227,500	\$2,362,500	\$450,000	\$450,000
HOUSEHOLD INCOME MULTIPLIER	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
HOUSEHOLD EXP. IMPACTS	<u>\$312,694</u>	<u>\$625,388</u>	<u>\$625,388</u>	<u>\$684,248</u>	<u>\$728,393</u>	<u>\$772,538</u>	<u>\$147,150</u>	<u>\$147,150</u>
TOTAL PAYROLL IMPACTS	\$1,587,694	\$3,175,388	\$3,175,388	\$3,474,248	\$3,698,393	\$3,922,538	\$747,150	\$747,150
CONSTRUCTION PAYROLL	\$1,700,000	\$3,400,000	\$3,400,000	\$3,400,000	\$3,400,000	\$3,400,000	\$0	\$0
CONSTRUCTION MATERIALS	\$6,375,000	\$12,750,000	\$12,750,000	\$12,750,000	\$12,750,000	\$12,750,000	\$0	\$0
LOCAL CONST. MAT. (5%)	\$318,750	\$637,500	\$637,500	\$637,500	\$637,500	\$637,500	\$0	\$0
LOCAL CONST. MULTIPLIER	1.69	1.69	1.69	1.69	1.69	1.69	1.69	1.69
CONSTRUCTION IMPACTS	\$1,098,285	\$2,196,570	\$3,075,198	\$3,075,198	\$3,075,198	\$2,196,570	\$0	\$0
PROPERTY TAXES	\$0	\$0	\$0	\$1,225,000	\$2,100,000	\$3,150,000	\$4,200,000	\$4,200,000
FEDERAL ROYALTY SHARE (50%)	\$0	\$0	\$0	\$200,057	\$400,113	\$600,170	\$800,226	\$800,226
TOTAL TAX & ROYALTIES	\$0	\$0	\$0	\$1,425,057	\$2,500,113	\$3,750,170	\$5,000,226	\$5,000,226
EDUCATION SHARE T&R (60%)	\$0	\$0	\$0	\$855,034	\$1,500,068	\$2,250,102	\$3,000,136	\$3,000,136
EDUCATION MULTIPLIER	<u>1.70</u>	<u>1.70</u>	<u>1.70</u>	<u>1.70</u>	<u>1.70</u>	<u>1.70</u>	<u>1.70</u>	<u>1.70</u>
EDUCATION IMPACTS	\$0	\$0	\$0	\$1,450,137	\$2,544,115	\$3,816,172	\$5,088,230	\$5,088,230
OTHER SERVICES SHARE T&R (40%)	\$0	\$0	\$0	\$570,023	\$1,000,045	\$1,500,068	\$2,000,090	\$2,000,090
OTHER SERVICES MULTIPLIER	<u>1.48</u>	<u>1.48</u>	<u>1.48</u>	<u>1.48</u>	<u>1.48</u>	<u>1.48</u>	<u>1.48</u>	<u>1.48</u>
OTHER SERVICES IMPACTS	\$0	\$0	\$0	\$843,633	\$1,480,067	\$2,220,100	\$2,960,134	\$2,960,134
TOTAL LOCAL IMPACTS	\$1,587,694	\$3,175,388	\$3,175,388	\$7,193,075	\$10,222,687	\$13,708,980	\$13,795,740	\$13,795,740

TABLE 9

LOCAL ANNUAL EMPLOYMENT IMPACTS

	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>	<u>1998</u>	<u>1999</u>	<u>2000</u>	<u>2001</u>
GEOHERMAL EMPLOYMENT	50	100	100	108	114	120	20	20
HOUSEHOLD EXPENDITURES	\$956,250	\$1,912,500	\$1,912,500	\$2,092,500	\$2,227,500	\$2,362,500	\$450,000	\$450,000
JOBS MULTIPLIER (JOBS/\$1,000,000)	<u>15</u>	<u>15</u>	<u>15</u>	<u>15</u>	<u>15</u>	<u>15</u>	<u>15</u>	<u>15</u>
HOUSEHOLD EXP. JOB IMPACTS	14	29	29	31	33	35	7	7
LOCAL CONSTRUCTION MATERIALS	\$318,750	\$637,500	\$637,500	\$637,500	\$637,500	\$637,500	\$0	\$0
JOBS MULTIPLIER (JOBS/\$1,000,000)	<u>21</u>	<u>21</u>	<u>21</u>	<u>21</u>	<u>21</u>	<u>21</u>	<u>21</u>	<u>21</u>
CONSTRUCTION JOB IMPACTS	7	13	13	13	13	13	0	0
EDUCATION SHARE T&R	\$0	\$0	\$0	\$855,034	\$1,500,068	\$2,250,102	\$3,000,136	\$3,000,136
JOBS MULTIPLIER (JOBS/\$1,000,000)	<u>24</u>	<u>24</u>	<u>24</u>	<u>24</u>	<u>24</u>	<u>24</u>	<u>24</u>	<u>24</u>
EDUCATION JOB IMPACTS	0	0	0	21	37	55	73	73
OTHER SERVICES SHARE T&R	\$0	\$0	\$0	\$570,023	\$1,000,045	\$1,500,068	\$2,000,090	\$2,000,090
JOBS MULTIPLIER (JOBS/\$1,000,000)	<u>17</u>	<u>17</u>	<u>17</u>	<u>17</u>	<u>17</u>	<u>17</u>	<u>17</u>	<u>17</u>
OTHER SERVICES JOB IMPACTS	0	0	0	10	17	26	34	34
TOTAL EMPLOYMENT IMPACTS	64	129	129	170	201	236	134	134

Employment impacts are calculated in Table 9. For each category, the expenditure change is multiplied by the jobs multiplier to yield estimated direct, indirect, and induced employment changes. The total employment impacts include the employment directly associated with geothermal development, plus the employment impacts for each category except construction materials.

CONCLUSIONS

It is useful to first clarify limitations of the study. This study presents economic impact estimates of geothermal development in Malheur County. It is not a cost/benefit analysis. No comprehensive comparison of quantifiable project costs and benefits is provided. The public service discussion addressed some environmental impacts, but a comprehensive analysis is beyond the scope of this study. No attempt was made to assess the value of geothermal development compared to other types of electric resources, whether efficiency or new generation.

The primary effects of geothermal development - or any large construction project - on the local economy are income associated with wage payments, and income from local purchases of construction material. The next big direct impact is revenue for the County government from property taxes and royalties. State level revenue impacts occur through income taxes. The multipliers for household and local government expenditures estimated for this analysis are equally applicable to any source of payroll or county government revenues.

It is instructive to compare estimated geothermal economic impacts with existing industry in Malheur County. The top ten Malheur County property tax payers' total 1991 assessment was about \$150 million (Malheur Assessor, 1992). Table 10 compares projected geothermal property values with the top three current (private) property owners in Malheur County.

TABLE 10

MALHEUR COUNTY PROPERTY COMPARISON

<u>OWNER</u>	<u>1991 ASSESSED VALUE</u>
Ore-Ida	\$53,849,720
Idaho Power	\$23,360,611
Amalgamated Sugar	\$16,678,100
Geothermal Plant - 25 MW	\$70,000,000
Geothermal Plant - 100 MW	\$280,000,000

Source: Malheur County Assessor's Office

Simple multiplication is used between 25 MW plant costs and those for a 100 MW plant. A 25 MW geothermal development would represent a little over 2 percent of the total current base and the full 100 MW about nine percent. To put it in perspective, the combined value of Pacific Northwest Bell and Pacificorp property is roughly equal to one 25 MW plant in value. A 100 MW project would be four times the combined value of Pacific Northwest Bell and Pacificorp property in Malheur county. Any investment of this size - regardless of what the project produces - would become the largest development in Malheur County.

Table 11 compares projected geothermal revenues with recent payments to Malheur County. Malheur County's major industries are agriculture and livestock. Principal products are row crops, processed potatoes and sugar. The largest county landowner is the federal government. As shown, only payments in lieu of taxes from the federal Bureau of Land Management represent a comparable revenue source for Malheur County. That payment includes land use, recreation, power, minerals, user fee and grazing fee payments.

On an employment basis, the long-term impacts of geothermal power development are small compared to existing industries. The trend toward modular design and shop fabrication results in a smaller construction workforce compared to both early geothermal projects and other (recent) thermal plants. Geothermal development would lead to only marginal increases in total employment once the construction phase concludes. It should be noted that plant operation and maintenance jobs would pay relatively well. This results in greater economic impacts per job.

One reason impacts are not greater is the lack of a geothermal industry infrastructure in Malheur County. If major geothermal resource development were to occur over time, more of the materials and labor for development would come from local sources. Findings presented here are also sensitive to plant capital costs, steam efficiency, tax rates and the health of the economy in Malheur County. Other similar developments in the region may also affect these projections.

TABLE 11**MALHEUR COUNTY REVENUE COMPARISON**

<u>TAXPAYER</u>	<u>1991 PAYMENT</u>
Ore-Ida	\$1,208,855
BLM (Payments in lieu of taxes)	\$598,000
Idaho Power	\$433,925
Geothermal Plant - 25 MW	
Property Taxes	\$1,225,000
Royalties	<u>\$200,057</u>
Total	\$1,425,057
Geothermal Plant - 100 MW	
Property Taxes	\$4,200,000
Royalties	<u>\$800,226</u>
Total	\$5,000,226

Sources: Malheur County Assessor's Office; Administration

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APPENDIX A

IMPLAN MODEL SUMMARY

IMPLAN is a secondary-data input/output model that translates national level information about the goods and services purchased and products sold by each industry in the economy into state- or county-level input output models using local economic information. The model is based on industry production functions estimated in 1977 by the U.S. Bureau of Economic Analysis. The 1977 model has been price-updated to 1982. In other words, trade between industries and purchases of labor and other services reflects patterns that occurred in 1977, translated into 1982 dollars. In using the model the assumption is made that interindustry trade is reasonably comparable to 1977 trade patterns. The IMPLAN software allows for adjustments to most of the data and industry structures where more current information is available. However, large scale revisions of the basic model were beyond the scope of this study. For this analysis, IMPLAN's national data and Oregon and Malheur County data previously reviewed by Alan Fox, an IMPLAN consultant, formed the basis for the Malheur model. The data was provided as part of an IMPLAN training workshop.

APPENDIX B

MALHEUR COUNTY PERSONAL CONSUMPTION EXPENDITURE PATTERNS FRACTION OF TOTAL CONSUMER SPENDING WITHIN REGION

PERSONAL CONSUMPTION EXPENDITURE PATTERNS
 FRACTION OF TOTAL CONSUMER SPENDING WITHIN REGION
 NOTE: INDUSTRY BASED
 MODEL:: malheu.I

INDUSTRY		PCE - LOW	PCE - MED	PCE - HI
DAIRY FARM PRODUCTS	1	.00630	.00508	.00358
POULTRY AND EGGS	2	.00001	.00001	.00000
RANCH FED CATTLE	3	.00000	.00000	.00000
RANGE FED CATTLE	4	.00011	.00018	.00019
CATTLE FEEDLOTS	5	.00671	.00639	.00475
SHEEP, LAMBS AND GOATS	6	.00000	.00000	.00000
HOGS, PIGS AND SWINE	7	.00000	.00000	.00000
OTHER MEAT ANIMAL PRODUCTS	8	.00000	.00000	.00000
MISCELLANEOUS LIVESTOCK	9	.00022	.00021	.00016
FOOD GRAINS	11	.00002	.00002	.00002
FEED GRAINS	12	.00004	.00004	.00004
HAY AND PASTURE	13	.00027	.00045	.00049
GRASS SEEDS	14	.00002	.00003	.00003
FRUITS	16	.00003	.00002	.00002
TREE NUTS	17	.00004	.00004	.00004
VEGETABLES	18	.00318	.00271	.00208
SUGAR CROPS	19	.00001	.00002	.00002
MISCELLANEOUS CROPS	20	.00003	.00005	.00006
FOREST PRODUCTS	22	.00006	.00007	.00008
GREENHOUSE AND NURSERY PRODUCTS	23	.00109	.00129	.00175
AGRICULTURAL, FORESTRY, FISHERY	26	.00009	.00008	.00008
LANDSCAPE AND HORTICULTURAL SERV	27	.00001	.00001	.00001
GOLD ORES	32	.00000	.00000	.00000
SILVER ORES	33	.00000	.00000	.00000
CONSTRUCTION SAND AND GRAVEL	48	.00000	.00000	.00000
BENTONITE	50	.00000	.00000	.00000
NONMETALLIC MINERALS (EXCEPT FUE	55	.00000	.00000	.00000
NEW RESIDENTIAL STRUCTURES	66	.00000	.00000	.00000
NEW INDUSTRIAL AND COMMERCIAL BU	67	.00000	.00000	.00000
NEW UTILITY STRUCTURES	68	.00000	.00000	.00000
NEW FARM STRUCTURES	70	.00000	.00000	.00000
NEW GOVERNMENT FACILITIES	72	.00000	.00000	.00000
MAINTENANCE AND REPAIR, RESIDENT	73	.00000	.00000	.00000
MAINTENANCE AND REPAIR OTHER FAC	74	.00000	.00000	.00000
CANNED FRUITS AND VEGETABLES	93	.00012	.00010	.00007
DEHYDRATED FOOD PRODUCTS	94	.00022	.00019	.00013
FROZEN FRUITS, JUICES AND VEGETA	97	.00520	.00443	.00340
PREPARED FEEDS, N.E.C	103	.00003	.00003	.00003
SUGAR	108	.00055	.00049	.00036
FOOD PREPARATIONS, N.E.C	126	.00299	.00278	.00202
LOGGING CAMPS AND LOGGING CONTRA	160	.00000	.00000	.00000
SAWMILLS AND PLANING MILLS, GENE	161	.00000	.00000	.00000
MILLWORK	164	.00000	.00000	.00001
STRUCTURAL WOOD MEMBERS, N.E.C	167	.00000	.00000	.00000
PREFABRICATED WOOD BUILDINGS	168	.00000	.00000	.00000
WOOD PRODUCTS, N.E.C	172	.00018	.00021	.00029
WOOD HOUSEHOLD FURNITURE	174	.00156	.00206	.00248
UPHOLSTERED HOUSEHOLD FURNITURE	177	.00071	.00094	.00113
NEWSPAPERS	200	.00113	.00111	.00110
COMMERCIAL PRINTING	205	.00001	.00001	.00001
CONCRETE BLOCK AND BRICK	267	.00000	.00000	.00000
CONCRETE PRODUCTS, N.E.C	268	.00000	.00000	.00000
READY-MIXED CONCRETE	269	.00000	.00000	.00001
FABRICATED STRUCTURAL METAL	308	.00000	.00000	.00000
FABRICATED PLATE WORK (BOILER SH	310	.00001	.00001	.00001
FABRICATED METAL PRODUCTS, N.E.C	329	.00001	.00001	.00001
FARM MACHINERY AND EQUIPMENT	332	.00002	.00002	.00002

MACHINERY, EXCEPT ELECTRICAL, N.	361	.00001	.00001	.00001
RAILROADS AND RELATED SERVICES	446	.00165	.00116	.00159
LOCAL, INTERURBAN PASSENGER TRAN	447	.00082	.00058	.00079
MOTOR FREIGHT TRANSPORT AND WARE	448	.00443	.00313	.00311
AIR TRANSPORTATION	450	.00074	.00052	.00071
TRANSPORTATION SERVICES	452	.00011	.00008	.00010
ARRANGEMENT OF PASSENGER TRANSPO	453	.00010	.00010	.00010
COMMUNICATIONS, EXCEPT RADIO AND	454	.00859	.00673	.00502
RADIO AND TV BROADCASTING	455	.00017	.00016	.00016
GAS PRODUCTION AND DISTRIBUTION	457	.00561	.00432	.00366
WATER SUPPLY AND SEWERAGE SYSTEM	458	.00023	.00021	.00018
SANITARY SERVICES AND STEAM SUPP	459	.00040	.00037	.00032
RECREATIONAL RELATED WHOLESALE T	460	.00103	.00155	.00188
OTHER WHOLESALE TRADE	461	.00025	.00024	.00024
RECREATIONAL RELATED RETAIL TRAD	462	.00642	.00967	.01171
OTHER RETAIL TRADE	463	.06647	.06419	.06268
BANKING	464	.01274	.01355	.01541
CREDIT AGENCIES	465	.00310	.00330	.00375
SECURITY AND COMMODITY BROKERS	466	.00057	.00060	.00068
INSURANCE CARRIERS	467	.00552	.00816	.01048
INSURANCE AGENTS AND BROKERS	468	.00000	.00000	.00000
OWNER-OCCUPIED DWELLINGS	469	.06505	.09006	.12183
REAL ESTATE	470	.01734	.00936	.00323
HOTELS AND LODGING PLACES	471	.00323	.00298	.00532
LAUNDRY, CLEANING AND SHOE REPAI	472	.00073	.00183	.00104
FUNERAL SERVICE AND CREMATORIES	473	.00115	.00122	.00139
PORTRAIT AND PHOTOGRAPHIC STUDIO	474	.00124	.00212	.00229
ELECTRICAL REPAIR SERVICES	475	.00239	.00167	.00167
WATCH, CLOCK, JEWELRY AND FURNIT	476	.00048	.00034	.00034
BEAUTY AND BARBER SHOPS	477	.00410	.00378	.00376
MISCELLANEOUS REPAIR SHOPS	478	.00000	.00000	.00000
SERVICES TO BUILDINGS	479	.00000	.00000	.00000
PERSONNEL SUPPLY SERVICES	480	.00000	.00000	.00000
COMPUTER AND DATA PROCESSING SER	481	.00000	.00000	.00000
MANAGEMENT AND CONSULTING SERVIC	482	.00000	.00000	.00000
EQUIPMENT REPAIR AND LEASING	484	.00000	.00000	.00000
PHOTOFINISHING, COMMERCIAL PHOTO	485	.00000	.00000	.00000
OTHER BUSINESS SERVICES	486	.00000	.00000	.00000
ADVERTISING	487	.00000	.00000	.00000
LEGAL SERVICES	488	.00000	.00000	.00000
ENGINEERING, ARCHITECTURAL SERVI	489	.00000	.00000	.00000
ACCOUNTING, AUDITING AND BOOKKEE	490	.00015	.00008	.00003
EATING AND DRINKING PLACES	491	.04359	.05282	.05020
AUTOMOBILE RENTAL AND LEASING	492	.00008	.00008	.00010
AUTOMOBILE REPAIR AND SERVICES	493	.01641	.02011	.01788
AUTOMOBILE PARKING AND CAR WASH	494	.00149	.00149	.00177
MOTION PICTURES	495	.00023	.00028	.00040
DANCE HALLS, STUDIOS AND SCHOOLS	496	.00005	.00006	.00008
BOWLING ALLEYS AND POOL HALLS	498	.00053	.00063	.00090
MEMBERSHIP SPORTS AND RECREATION	501	.00057	.00068	.00098
AMUSEMENT AND RECREATION SERVICE	502	.00164	.00280	.00304
DOCTORS AND DENTISTS	503	.05713	.04170	.03428
HOSPITALS	504	.05435	.03967	.03261
NURSING AND PROTECTIVE CARE	505	.00695	.00507	.00417
OTHER MEDICAL AND HEALTH SERVICE	506	.00206	.00150	.00124
ELEMENTARY AND SECONDARY SCHOOLS	507	.00012	.00013	.00014
COLLEGES, UNIVERSITIES, SCHOOLS	508	.00277	.00297	.00336
OTHER EDUCATIONAL SERVICES	509	.00088	.00095	.00107
BUSINESS ASSOCIATIONS	510	.00003	.00004	.00004
LABOR AND CIVIC ORGANIZATIONS	511	.00198	.00210	.00239
RELIGIOUS ORGANIZATIONS	512	.00519	.00295	.00532
OTHER NONPROFIT ORGANIZATIONS	513	.00104	.00059	.00106
RESIDENTIAL CARE	514	.00206	.00256	.00388
SOCIAL SERVICES, N.E.C.	515	.00775	.00618	.00987

U.S. POSTAL SERVICE	516	.00162	.00156	.00152
OTHER FEDERAL GOVERNMENT ENTERPR	518	.00058	.00064	.00061
LOCAL GOVERNMENT PASSENGER TRANS	519	.00063	.00044	.00060
OTHER STATE AND LOCAL GOVT ENTER	521	.00547	.00497	.00459
GOVERNMENT INDUSTRY	525	.00000	.00000	.00000
REST OF THE WORLD INDUSTRY	526	.00000	.00000	.00000
HOUSEHOLD INDUSTRY	527	.00150	.00187	.00283
INVENTORY VALUATION ADJUSTMENT	528	.00000	.00000	.00000
TOTAL FRACTION IN REGION:		.46249	.45604	.47286
REGIONAL FRACTION CHECK		1.00002	1.00001	.99999

APPENDIX C

MALHEUR COUNTY STATE AND LOCAL GOVERNMENT EXPENDITURE PATTERNS FRACTION OF TOTAL STATE & LOCAL GOVERNMENT SPENDING WITHIN REGION

STATE AND LOCAL GOVERNMENT EXPENDITURE PATTERNS
 FRACTION OF TOTAL SLG SPENDING WITHIN REGION
 NOTE: INDUSTRY BASED
 MODEL:: malheu.S

INDUSTRY		SLG - EDU	SLG-NONED	SLG-TOTAL
DAIRY FARM PRODUCTS	1	.00000	.00000	.00000
POULTRY AND EGGS	2	.00000	.00000	.00000
RANCH FED CATTLE	3	.00000	.00000	.00000
RANGE FED CATTLE	4	.00000	.00000	.00000
CATTLE FEEDLOTS	5	.00112	.00348	.00241
SHEEP, LAMBS AND GOATS	6	.00000	.00000	.00000
HOGS, PIGS AND SWINE	7	.00000	.00000	.00000
OTHER MEAT ANIMAL PRODUCTS	8	.00000	.00000	.00000
MISCELLANEOUS LIVESTOCK	9	.00002	.00000	.00001
FOOD GRAINS	11	.00000	.00000	.00000
FEED GRAINS	12	.00000	.00000	.00000
HAY AND PASTURE	13	.00000	.00000	.00000
GRASS SEEDS	14	.00000	.00000	.00000
FRUITS	16	.00000	.00000	.00000
TREE NUTS	17	.00000	.00000	.00000
VEGETABLES	18	.00000	.00000	.00000
SUGAR CROPS	19	.00000	.00000	.00000
MISCELLANEOUS CROPS	20	.00000	.00000	.00000
FOREST PRODUCTS	22	.00000	.00000	.00000
GREENHOUSE AND NURSERY PRODUCTS	23	.00000	.00000	.00000
AGRICULTURAL, FORESTRY, FISHERY	26	.00000	.00000	.00000
LANDSCAPE AND HORTICULTURAL SERV	27	.00000	.00000	.00000
GOLD ORES	32	.00000	.00000	.00000
SILVER ORES	33	.00000	.00000	.00000
CONSTRUCTION SAND AND GRAVEL	48	.00000	.00000	.00000
BENTONITE	50	.00000	.00000	.00000
NONMETALLIC MINERALS (EXCEPT FUE	55	.00000	.00000	.00000
NEW RESIDENTIAL STRUCTURES	66	.00190	.00069	.00124
NEW INDUSTRIAL AND COMMERCIAL BU	67	.01129	.01412	.01284
NEW UTILITY STRUCTURES	68	.03264	.00000	.01479
NEW FARM STRUCTURES	70	.00000	.00000	.00000
NEW GOVERNMENT FACILITIES	72	.00453	.00000	.00205
MAINTENANCE AND REPAIR, RESIDENT	73	.00000	.00000	.00000
MAINTENANCE AND REPAIR OTHER FAC	74	.00424	.00428	.00426
CANNED FRUITS AND VEGETABLES	93	.00000	.00000	.00000
DEHYDRATED FOOD PRODUCTS	94	.00000	.00000	.00000
FROZEN FRUITS, JUICES AND VEGETA	97	.00000	.00000	.00000
PREPARED FEEDS, N.E.C	103	.00000	.00000	.00000
SUGAR	108	.00000	.00000	.00000
FOOD PREPARATIONS, N.E.C	126	.00000	.00001	.00000
LOGGING CAMPS AND LOGGING CONTRA	160	.00000	.00000	.00000
SAWMILLS AND PLANING MILLS, GENE	161	.00000	.00000	.00000
MILLWORK	164	.00000	.00000	.00000
STRUCTURAL WOOD MEMBERS, N.E.C	167	.00000	.00000	.00000
PREFABRICATED WOOD BUILDINGS	168	.00000	.00000	.00000
WOOD PRODUCTS, N.E.C	172	.00000	.00000	.00000
WOOD HOUSEHOLD FURNITURE	174	.00000	.00000	.00000
UPHOLSTERED HOUSEHOLD FURNITURE	177	.00000	.00000	.00000
NEWSPAPERS	200	.00000	.00000	.00000
COMMERCIAL PRINTING	205	.00000	.00000	.00000
CONCRETE BLOCK AND BRICK	267	.00000	.00000	.00000
CONCRETE PRODUCTS, N.E.C	268	.00000	.00000	.00000
READY-MIXED CONCRETE	269	.00000	.00000	.00000
FABRICATED STRUCTURAL METAL	308	.00000	.00000	.00000
FABRICATED PLATE WORK (BOILER SH	310	.00000	.00000	.00000
FABRICATED METAL PRODUCTS, N.E.C	329	.00000	.00000	.00000
FARM MACHINERY AND EQUIPMENT	332	.00000	.00000	.00000

MACHINERY, EXCEPT ELECTRICAL, N.	361	.00000	.00000	.00000
RAILROADS AND RELATED SERVICES	446	.00000	.00000	.00000
LOCAL, INTERURBAN PASSENGER TRAN	447	.00000	.00000	.00000
MOTOR FREIGHT TRANSPORT AND WARE	448	.00000	.00000	.00000
AIR TRANSPORTATION	450	.00105	.00173	.00142
TRANSPORTATION SERVICES	452	.00011	.00019	.00016
ARRANGEMENT OF PASSENGER TRANSPO	453	.00000	.00000	.00000
COMMUNICATIONS, EXCEPT RADIO AND	454	.00328	.00670	.00515
RADIO AND TV BROADCASTING	455	.00000	.00000	.00000
GAS PRODUCTION AND DISTRIBUTION	457	.00000	.00000	.00000
WATER SUPPLY AND SEWERAGE SYSTEM	458	.00000	.00000	.00000
SANITARY SERVICES AND STEAM SUPP	459	.00000	.00000	.00000
RECREATIONAL RELATED WHOLESALE T	460	.00000	.00000	.00000
OTHER WHOLESALE TRADE	461	.00000	.00000	.00000
RECREATIONAL RELATED RETAIL TRAD	462	.00000	.00007	.00004
OTHER RETAIL TRADE	463	.00000	.00000	.00000
BANKING	464	.01768	.00000	.00801
CREDIT AGENCIES	465	.00000	.00000	.00000
SECURITY AND COMMODITY BROKERS	466	.00153	.00000	.00069
INSURANCE CARRIERS	467	.00000	.00000	.00000
INSURANCE AGENTS AND BROKERS	468	.00000	.00000	.00000
OWNER-OCCUPIED DWELLINGS	469	.00000	.00000	.00000
REAL ESTATE	470	.00000	.00000	.00000
HOTELS AND LODGING PLACES	471	.00000	.00000	.00000
LAUNDRY, CLEANING AND SHOE REPAI	472	.00000	.00000	.00000
FUNERAL SERVICE AND CREMATORIES	473	.00000	.00000	.00000
PORTRAIT AND PHOTOGRAPHIC STUDIO	474	.00000	.00000	.00000
ELECTRICAL REPAIR SERVICES	475	.00000	.00000	.00000
WATCH, CLOCK, JEWELRY AND FURNIT	476	.00000	.00000	.00000
BEAUTY AND BARBER SHOPS	477	.00000	.00000	.00000
MISCELLANEOUS REPAIR SHOPS	478	.00000	.00000	.00000
SERVICES TO BUILDINGS	479	.00000	.00000	.00000
PERSONNEL SUPPLY SERVICES	480	.00000	.00000	.00000
COMPUTER AND DATA PROCESSING SER	481	.00000	.00000	.00000
MANAGEMENT AND CONSULTING SERVIC	482	.00000	.00000	.00000
EQUIPMENT REPAIR AND LEASING	484	.00000	.00000	.00000
PHOTOFINISHING, COMMERCIAL PHOTO	485	.00000	.00000	.00000
OTHER BUSINESS SERVICES	486	.00000	.00000	.00000
ADVERTISING	487	.00000	.00000	.00000
LEGAL SERVICES	488	.00000	.00000	.00000
ENGINEERING, ARCHITECTURAL SERVI	489	.00000	.00000	.00000
ACCOUNTING, AUDITING AND BOOKKEE	490	.00000	.00000	.00000
EATING AND DRINKING PLACES	491	.00000	.00000	.00000
AUTOMOBILE RENTAL AND LEASING	492	.00000	.00000	.00000
AUTOMOBILE REPAIR AND SERVICES	493	.00000	.00000	.00000
AUTOMOBILE PARKING AND CAR WASH	494	.00000	.00000	.00000
MOTION PICTURES	495	.00000	.00000	.00000
DANCE HALLS, STUDIOS AND SCHOOLS	496	.00000	.00000	.00000
BOWLING ALLEYS AND POOL HALLS	498	.00000	.00000	.00000
MEMBERSHIP SPORTS AND RECREATION	501	.00000	.00000	.00000
AMUSEMENT AND RECREATION SERVICE	502	.00000	.00000	.00000
DOCTORS AND DENTISTS	503	.00000	.00000	.00000
HOSPITALS	504	.00000	.00000	.00000
NURSING AND PROTECTIVE CARE	505	.00000	.00000	.00000
OTHER MEDICAL AND HEALTH SERVICE	506	.00000	.00000	.00000
ELEMENTARY AND SECONDARY SCHOOLS	507	.00000	.00000	.00000
COLLEGES, UNIVERSITIES, SCHOOLS	508	.00000	.00031	.00017
OTHER EDUCATIONAL SERVICES	509	.00000	.00000	.00000
BUSINESS ASSOCIATIONS	510	.00000	.00000	.00000
LABOR AND CIVIC ORGANIZATIONS	511	.00000	.00000	.00000
RELIGIOUS ORGANIZATIONS	512	.00000	.00000	.00000
OTHER NONPROFIT ORGANIZATIONS	513	.00000	.00000	.00000
RESIDENTIAL CARE	514	.00000	.00000	.00000
SOCIAL SERVICES, N.E.C.	515	.00000	.00000	.00000

U.S. POSTAL SERVICE	516	.00319	.00081	.00189
OTHER FEDERAL GOVERNMENT ENTERPR	518	.00000	.00001	.00000
LOCAL GOVERNMENT PASSENGER TRANS	519	.00000	.00000	.00000
OTHER STATE AND LOCAL GOVT ENTER	521	.00015	.00021	.00018
GOVERNMENT INDUSTRY	525	.49357	.35011	.41512
REST OF THE WORLD INDUSTRY	526	.00000	.00000	.00000
HOUSEHOLD INDUSTRY	527	.00000	.00000	.00000
INVENTORY VALUATION ADJUSTMENT	528	.00000	.00000	.00000
TOTAL FRACTION IN REGION:		.57632	.38272	.47046
REGIONAL FRACTION CHECK		.99999	1.00000	