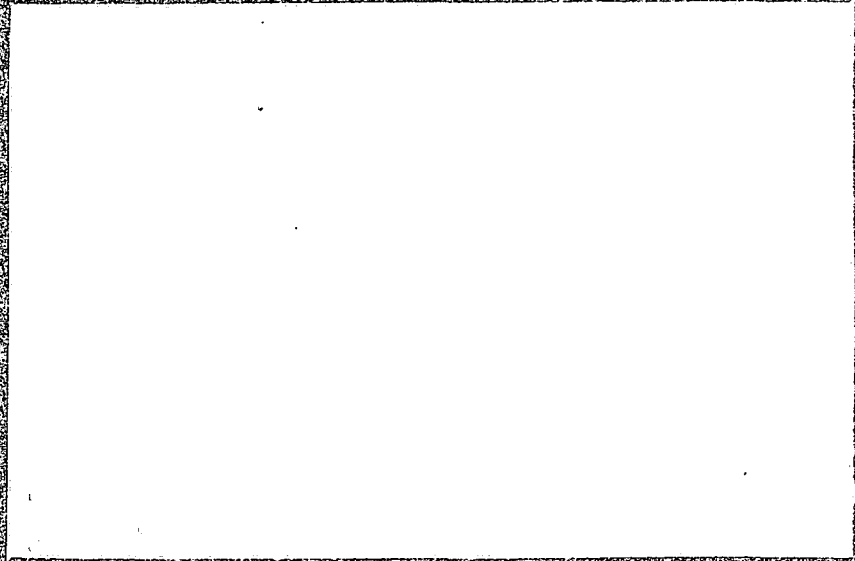


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*Potential of
Wood Energy
Resources*

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REGIONAL EMPLOYMENT AND INCOME EFFECTS
OF A 50-MW WOOD-FIRED POWER PLANT

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OF A 50-MW WOOD-FIRED POWER PLANT

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*The two appendices, together comprising 42 pages, are available for \$2.00 from the Publications Office, Research Program on Technology and Public Policy, Thayer School, Hanover, NH, 03755.

ABSTRACT

The construction and operation of a 50-Mw wood-fired power plant could have a profound influence on the rural region in which it is located. Using Department of Commerce regional data, we employed input-output computer analysis techniques to estimate the effects on local income and employment of constructing and operating such a plant in a three-county region in northern Vermont.

For each of these two phases -- construction and operation -- we estimated the expenditures the plant will make in the region. The input-output model then showed the effect this additional revenue will have as it percolates through the regional economy. In general, the result was a total new annual income for local industries of about double the plant's yearly outlay. The increase in local income also created new jobs; regional unemployment rates could theoretically drop about one-half of one percent because of the plant's presence.

Because most of the plant's expenditures in the three-county region will be for labor, the industries which profit most from its spending will be the retail, wholesale, food, and apparel businesses, which depend on individual consumer sales. These businesses are likely to suffer a mild recession after the relatively intense two-year construction phase, as operation phase annual expenditures are substantially lower than construction phase levels and require fewer workers. However, with proper planning, regional businesses and individual workers should be able to benefit substantially from both phases of the plant's activities.

PROBLEM STATEMENT

The introduction of an industrial facility has social and economic consequences for the surrounding region, some beneficial and some detrimental. It stimulates the local economy; it thus increases corporate and personal income and creates jobs. On the other hand, the process of adjustment to these new levels of business activity may cause disruption, waste, and personal loss within the region. Also, various activities associated with the introduction of an industrial plant can arouse social dissatisfaction even though they may be legal and economically justifiable. This report evaluates the consequences of the construction and operation of a proposed 50-Mw wood-fired power plant (WFPP) in northern Vermont.

New industrial facilities affect regional business activity through both purchases and sales. In buying the productive inputs they need, the operators of a facility invariably pass some money on to other regional firms and laborers, who then respond a part of their new income by transferring it to other regional parties, and so on until the original expenditure passes entirely out of the region to secure imported goods and services. All corporate recipients in this chain of spending may hire extra workers to increase their output until it satisfies the increased demand for their goods. The net effect is an increase in regional income, both business and personal, greater than the amount of the original expenditures alone, and an increase in regional employment greater than the employment

provided directly by the industrial facility originating the growth. The sales of a new facility affect regional business activity through the same process, but with a different beginning: by selling a product formerly unavailable in the region or by selling at a lower price a product already available, a new facility makes it attractive for regional firms that use that product to expand operations. In expanding, these firms will spend money and hire new workers, beginning the type of spending chain described above.

Of the two channels through which a small plant could affect the surrounding economy, the impact of the sales side is negligible. Electricity is sold through an area-wide power grid, not directly to regional consumers.* A plant in a region with an established grid could not affect the local economy through its sales by increasing the availability of electricity; it could only lower the price. But a 50-Mw power plant is not likely to do even that to a significant degree; its electricity is quite expensive and its output is too small to affect the average price of electricity in the region.

The problem of evaluating the impact on regional business level of a wood-fired generating facility reduces, then, to estimating the changes in regional income and employment that the expenditures associated with the plant will induce by initiating a chain of regional spending. However, merely estimating future changes in regional income and employment will not tell how the regional economy will be affected by the process of change. Therefore, we also consider directly the

*This assumes the WFPP is not a private cogenerating (i.e., producing both steam and electricity) facility.

nature of the adjustment process in order to identify the problems it may cause and to suggest measures to minimize them.

METHODS OF ANALYSIS

There are several established methods for estimating the impact on regional income and employment, also called the "multiplier effect," of new expenditures. One of the most commonly used is the economic base study, which is inexpensive and requires modest amounts of data. However, it yields only one number: a single multiplier that tells how much extra income (or employment, depending on the method of calculation) an initial expenditure should create directly and indirectly in the region under study. Regional econometric studies give much more information, but they are expensive, necessitate long development periods involving highly trained specialists, and require large amounts of data.

I chose finally to base my study of multiplier effects on an input-output (I-O) analysis. Forecasting the changes in income resulting from new expenditures in the area is the express purpose of I-O, and it is probably the most sophisticated technique in general use for doing this. The necessary input-output data, normally difficult to obtain, were supplied by the Regional Economic Analysis Division (R.E.A.D.) of the Bureau of Economic Analysis, U.S. Department of Commerce. My assessment of the qualitative effects of new expenditures -- regional economic adjustments and noneconomic problems -- was based on subjective data and personal communications.

Estimating Multiplier Effects with Input-Output Analysis

I-O is a method of data organization and manipulation designed to estimate the multiplier effect of any new expenditure within an economy. The data are first collected and organized for a specific economic region, such as a country, a state, a county, or a metropolitan area. Once this is done, the analyst specifies a set of hypothetical expenditures to be made within the region. It is necessary to specify both the dollar amount of each expenditure and the industry in which it will be made. The result is a set of estimates that tell how much extra income should ultimately accrue to each industry, including households, within the study region as a result of the expenditures.

For example, according to the I-O data used in the analysis for this report, if \$100 were spent by sawmills in northern Vermont (say, for lumber), regional lumber and wood products firms should receive about \$46 of extra income through direct and indirect channels as a result. Households in the area should get about \$49 of extra income, and northern Vermont farmers should get an extra \$3 after the multiplier effect had fully worked itself out. This is all in addition to the original \$100 expenditure to the sawmills. For the purposes of an I-O analysis, such income figures can also be interpreted as changes in sales and output. The firms of the lumber and wood products industry received the extra \$146 because they sold, and therefore produced, an extra \$146 worth of lumber, veneer, wooden crates, and so forth. To get the extra \$49, members of

the households did work of that value, and the farmers had to produce the extra \$3 worth of food they sold.

To estimate the combined multiplier effect of the expenditures arising from the introduction of a new industrial facility, the changes in regional income brought about by each individual purchase are added together. Data on the average employment per dollar of sales in different industries then permit one to convert I-O estimates of income changes into estimates of employment changes.

R.E.A.D. supplied all of the I-O and industrial employment data necessary for my study. This reduced my task in the analysis to identifying and estimating all plant-related expenditures made to regional parties, performing the calculations, and interpreting the results. To facilitate the analysis, I developed a computer program, written in BASIC, to perform the many multiplications involved. Appendix A documents the program.

Estimating Regional Expenditures of the Plant

I divided the list of plant expenditures into two main categories: construction phase expenditures and operation phase expenditures (the latter were subdivided into operation activities, wood harvesting, and wood transportation expenditures). This permitted me to calculate separate multiplier effect estimates for each aspect of the plant's activities and thus to make generalizations about the impact of the multiplier effect over time and across the study region.

Estimates of the expenditures associated with constructing and operating a typical 50-Mw wood-fired facility have been made by Wheelabrator Cleanfuel Corporation in Washington, DC, and Rust Engineering Company in Birmingham, Alabama, for a U.S. Department of Energy project. I adapted many of their estimates for use in this analysis. The technologies that will be used in the wood harvesting and wood transportation parts of the operation phase have not been selected, so I considered several reasonable alternatives before establishing a final list of expenditures for both of them. In general, however, I adopted a single estimate for each expenditure; I did not carry through my analysis for a range of numbers. If an expenditure could plausibly have been anywhere within a range, I chose an estimate in the middle. Whenever there was doubt about the proportion of an expenditure that would be spent regionally (a common problem with expenditures for labor), I consistently assumed that a large, though still plausible, fraction would go to regional parties. The purpose of this latter decision was to obtain I-O estimates that reflect the maximum reasonable impact of plant-related operations.

Sources of Error in the Input-Output Calculation

Partly because of the difficulties involved in separating out multiplier effects from general business activity, there are no reliable empirical studies of the predictive accuracy of I-O analysis. But it is possible to consider the sources of inaccuracy. The information presented here is not essential

to understanding the rest of this report, but it may be helpful to readers who wish to understand the limitations of the methods used in my analysis.

Inaccuracy can enter I-O analysis from two sources. First, the analysis itself is based on several unrealistic assumptions about the way economic processes work. These assumptions must be made if the technique is to work, but they may allow its results to be inaccurate or misleading. Second, the I-O data I used had their own unique limitations because of the methods used by the R.E.A.D. to prepare them.

I-O analysis is based on two major assumptions involving instantaneous adjustment and linearity. The assumption of instantaneous adjustment means that I-O calculations assume all industries can increase their output by any amount, and that they do so immediately as sales increase. In reality, there will be delays between the time a firm receives extra income and the time it spends that income to increase its output. These delays are not shown anywhere in the results of an I-O analysis, so those results are somewhat misleading. What I-O calculations present as the immediate multiplier effect of an expenditure is actually a flow of dollars that will take some time to materialize fully. Further, the production adjustments of the firms involved may be incomplete. Especially in the case of a large expenditure, the buyer is likely to purchase some of the goods or services he needs from firms outside the immediate region rather than wait for local companies to develop the capacity to supply him with as much as he wants.

In this way, dollars can leave a regional economy sooner than I-O analysis would predict, and so I-O estimates of regional multiplier effects can be too high.

The assumption of linearity in I-O implies that firms and people always spend their income in the same pattern, irrespective of scale. In fact, this is not true. A business that receives an increase in income might not need any more machinery, but could decide to hire more workers. Or it might begin to use new production techniques that require the purchase of a new mix of materials. When a household's income increases, the family is likely to buy less soup and more steak. So I-O techniques are likely to trace some dollars from an initial expenditure through the wrong channels, making some industry income forecasts too high and others too low. These problems are especially severe when a large facility is placed in a rural area; the facility expenditures push local businesses far beyond their normal range of operation.

The particular I-O data supplied by the R.E.A.D. suffer some inaccuracy because they are adapted from national data, and so do not in all ways reflect the peculiar characteristics of the study region to which they are adapted.* To construct its regional I-O data, the R.E.A.D. begins with the United States national I-O data compiled by the Bureau of Economic Analysis. R.E.A.D. then adjusts these data to account for the fact that businesses and households in a smaller region spend more of their income outside of that region than they do if the

*For a more complete and technical description of the methods the R.E.A.D. uses to construct its I-O data, refer to Appendix B.

region is much larger (i.e., the United States). It is impossible to determine the accuracy of the adjustment. The I-O data correction could either over- or underestimate the fraction of new expenditures that remain in the region. The R.E.A.D. adjustments of national data also ignore local differences in buying patterns; the R.E.A.D. I-O data assume that in any region the firms of any given industry spend their income in the same way as the average United States firm of that industry.

All things considered, I judge that the income and employment changes forecasted by my I-O analysis are:

- best considered as "ballpark" estimates, good as indicators of the general pattern of distribution of multiplier effects, but certainly inaccurate in their absolute amounts;
- more likely to be a little high than too low;
- more detailed and accurate than the estimates an analyst could produce if he were relying merely on his own judgement.

Delineating the Study Region

The R.E.A.D. data are available for any single county or group of counties. I chose three counties in north central Vermont -- Caledonia, Lamoille, and Washington -- as my study region for several reasons. First, the three-county region is roughly the size of the area that will be affected by the introduction of the plant. If the WFPP is built there, almost all of the expenditures for plant-related operations made within Vermont can be made in those three counties. Local firms can probably transport the wood fuel to the plant;

wood chips can be shipped by any conventional trucking operation, and available data show that there exists within the region a large trucking industry (USDC 1972). Those inputs required for construction and operation that would have to be purchased outside the region -- such as heavy power generating machinery and wood harvesting equipment -- are not manufactured anywhere else in Vermont either.

Second, the area is a likely location for a WFPP because it is the heart of the probable wood supply region in the Green Mountains. Third, I did not include counties on the Canadian border because it is likely that WFPPs in these locations would harvest part of their wood in Canada, taking the impact of the plant outside the study region (High 1978). I also excluded Chittenden County, because much of it is agricultural land.

CONSTRUCTION PHASE FORECASTS

Construction of a 50-Mw WFPP requires almost two years (WCC 1977, pp. V-4,5). During that time, the construction project would employ as many as five hundred workers on site and contribute millions of dollars to the regional economy. Particularly in a rural area, the economic impact of the project would be major; it would certainly be greater than the impact of the plant and related activities once operation begins.

To use the Department of Commerce I-O data in calculating income and employment effects of the plant's construction, it is possible either to express construction expenditures as a total sum or to indicate the total purchases within several major categories. The first approach implicitly assumes that the expenditures will be allocated among the same bundle of goods and services and in the same proportions as the average national construction project. This is quite inaccurate since the power plant construction will use more specialized heavy equipment and less conventional construction materials than typical construction efforts. Therefore, I estimated total expenditures for each category of construction inputs identified in the I-O industrial data and available within the study region.

Estimates of Construction Phase Expenditures.

Most of the construction cost figures I used were given to me directly by Project Manager Brown Milligan of Rust Engineering

Company in Birmingham, Alabama, the design engineers for the proposed Wheelabrator Cleanfuel Corporation plant in Maine. These figures correspond closely to the cost estimates made for a 50-Mw plant by the MITRE Corporation (MITRE 1977, p. 126). Rust did not separately estimate the cost of some items, primarily construction materials. I made my own estimates from the Wheelabrator Cleanfuel plant description and building cost estimation materials (M-B-M 1974; Walker 1973).

From the Wheelabrator Cleanfuel project description, I identified six major sources of income for the three-county region during plant construction: wages for labor, the sale to the plant of three construction materials, and the wholesale and shipping markups on diesel fuel used by construction equipment. The final estimates showed labor to be by far the most significant expense for the plant, but all categories were included to ensure a complete analysis.

Labor. Estimates for labor costs of the project are shown in Table 1. All contracted labor is unionized. The construction worker wage of \$8.84 includes foremen and other secondary supervisors who earn more than rank-and-file workers. Rust Engineering estimated that of the \$21 million expected to go to subcontractors, one-half, or \$10.5 million, would go to labor. In the absence of precise information about how these labor payments would be distributed over time, I assumed that half, \$5.25 million, would be paid out during each of the two years of construction.

For a site on the border of the study region, such as St. Johnsbury, the estimate of total annual payments to labor

TABLE 1: ANNUAL LABOR COSTS TO CONSTRUCT
A 50-MW WOOD-FIRED POWER PLANT

	<u>Cost</u>
<u>Contracted Labor</u>	
Supervisors (8 @ \$29,000/year)	\$232,000
Construction workers (240 x 52 weeks/year x 40 hours/week x \$8.84/hour)	4,413,000
<u>Subcontracted Labor</u>	
All workers	5,250,000
	<hr/>
TOTAL	\$9,895,000

Source: Milligan 1977.

(\$9,895,000) is certainly too high; many of the construction workers will commute to work while living, and therefore spending much of their incomes, outside of the study region. But to obtain a set of I-O forecasts that reflect the "maximum reasonable impact" of the project on the study region, I retained the original figure.

Construction materials. Only three major construction materials of the project are produced in the study region: construction lumber, concrete slab for roofing, and ready-mix concrete. I made estimates of the total project requirements of these materials from the plant description (WCC 1977). To get annual expenditure estimates, I divided the current cost of the materials by two, assuming that their purchases would be evenly divided between the two years of construction. My final estimates were about \$5,000 per year for construction lumber, about \$7,500 for concrete slab for roofing, and about \$55,000 for ready-mix concrete, totaling \$67,500 annually. According to the I-O classification scheme used in the data supplied by the R.E.A.D., these expenditures are made to the sawmill, concrete products, and ready-mix concrete industries, respectively.

Fuel. The diesel fuel consumed by the construction project is relevant to the analysis even though it is not produced in the region, because regional wholesalers and truckers would each gain a markup on the fuel that is sold to the contractor. Thus, the construction project would give money to the regional wholesale trade and motor freight

industries. Rust Engineering estimates that the project will consume about \$135,000 worth of diesel fuel per year. According to one Vermont wholesaler, about 5 percent of the wholesale price of diesel fuel is the wholesaler's markup, and another 5 percent goes to the trucking company that ships it (Bradford 1977). Thus, the project will expend about \$6,750 in the region annually for wholesale trade services related to fuel and another \$6,750 for transportation of fuel.

Other expenditures that might be made to local industry were deemed too small to merit consideration. The complete set of regional construction phase expenditures is shown in Table 2.

Forecasts of New Income and Employment

Indirect employment and income estimates provided by the I-O calculations for the set of expenditures given in Table 2 are tabulated in Table 3.

Income. "New Income" in Table 3 includes all income that accrues within the study region to each industry as a direct or indirect result of the original expenditures. For example, the regional "Lumber and Wood Products" industry receives \$5,000 in income directly from the construction expenditures because this amount is paid to the regional firms in one of its component industries, sawmills. It receives an indirect income of \$18,500 from the sale of products to other industries and households that have themselves experienced a rise in income directly or indirectly from the original expenditures. Likewise, the \$11,600,000 of new income listed as received by households includes the \$9,895,000 of original construction

TABLE 2: TOTAL ANNUAL REGIONAL CONSTRUCTION EXPENDITURES
BY A WOOD-FIRED POWER PLANT

(1977 dollars)

	<u>Receiving Industry</u>	<u>Product</u>	<u>Annual Expenditure</u>
LABOR	Households	Labor	\$ 9,895,000
	Sawmills	Lumber	5,000
CONSTRUCTION MATERIALS	Concrete Products	Concrete slab	7,500
	Ready-mix Concrete	Ready-mix concrete	55,000
FUEL	Wholesale Trade	Fuel markup	6,750
	Motor Freight	Fuel shipping	6,750
		TOTAL	\$9,976,000

TABLE 3: MODEL FORECASTS OF REGIONAL INCOME AND EMPLOYMENT INCREASES
FROM CONSTRUCTION OF WOOD-FIRED POWER PLANT

CONSTRUCTION IMPACT

(1977 DOLLARS)

ANNUAL EXPENDITURES:	LABOR	9,895,000
	LUMBER	5,000
	CONCRETE SLAB	7,500
	READY-MIX CONCRETE	55,000
	WHOLESALE TRADE	6,750
	SHIPPING	6,750

		9,976,000

INDUSTRY	NEW INCOME ¹	NEW EMPLOYMENT ¹
-----	-----	-----
FARMS	242,000	9.8
AGRICULTURAL SERVICES	14,600	0.6
NONMETALLIC MINERAL MINING + QUARRYING	8,290	0.2
CONTRACT CONSTRUCTION	43,600	1.1
FOOD + KINDRED PRODUCTS	475,000	9.2
TEXTILE MILL PRODUCTS	111,000	3.1
APPAREL + FABRICATED TEXTILE PRODUCTS	280,000	5.1
LUMBER + WOOD PRODUCTS, EXC FURNITURE	23,500	0.5
FURNITURE + FIXTURES	24,300	0.8
PRINTING, PUBLISHING, + ALLIED PRODUCTS	37,600	1.5
CHEMICALS AND ALLIED PRODUCTS	67,500	1.3
RUBBER AND MISC PLASTIC PRODUCTS	14,600	0.1
STONE, CLAY + GLASS PRODUCTS	69,000	2.0
FABRICATED METALS PRODUCTS	4,230	0.1
MACHINERY EXC ELECTRICAL	2,170	0.0
ELECTRICAL MACHINERY	3,490	0.1
MISC MANUFACTURING	30,200	0.8
MOTOR FREIGHT TRANS + WAREHOUSING	96,500	2.9
AIR TRANSPORTATION	4,170	0.1
TRANS SERVICES, INCL CARRIER AFFILIATES	2	0.0
COMMUNICATIONS	161,000	3.6
PUBLIC UTILITIES	279,000	3.8
WHOLESALE TRADE	438,000	23.4
RETAIL TRADE	1,470,000	92.7
BANKING	97,700	4.1
CREDIT AGENCIES + HOLDING + INVEST. CO.	9,050	0.8
SECURITY + COMMODITY BROKERS	5,580	0.3
INSURANCE CARRIERS, INCL SOLICITORS	217,000	8.2
INSURANCE CARRIERS, BROKERS AND SERVICES	50,300	2.6
REAL ESTATE AND COMBINATIONS	261,000	0.5
LODGING PLACES	36,200	2.3
PERSONAL + MISC REPAIR SERVICES	163,000	8.3
MISC BUSINESS SERVICES	19,400	1.5
AUTO REPAIR + SERVICES	155,000	4.6
MOTION PICTURES	8,350	0.4
AMUSEMENT + RECREATION SERVICES	20,200	1.4
MEDICAL + OTHER HEALTH SERVICES	353,000	24.9
LEGAL AND MISC PROFESSIONAL SERVICES	56,200	3.9
PRIVATE EDUCATIONAL SERVICES	175,000	11.9
HOUSEHOLDS	11,600,000	5.5
TOTAL	17,100,000	244.0

1. Income estimates are rounded to three significant figures; employment estimates are rounded to the nearest tenth. Estimates should be considered upper bounds to actual increases.

wages, plus \$1,705,000 - all wages paid to the workers hired as an indirect result of the original expenditures. These are workers hired by regional industries because the industries themselves are receiving some new income, either directly or indirectly, from the construction project. In the case of an industry like farming, which does not receive direct expenditures from the construction project, all new income is received indirectly.

The income figures in Table 3 show income beyond that normally received. For example, if the plant is built, the lumber and wood products industry gains about \$23,500 over its income from normal business.

The income figures can be interpreted as output and sales. To get its extra \$242,000 of income, the farming industry must produce and sell that dollar amount worth of extra crops; the lumber and wood products industry must produce and sell an extra \$23,500 worth of output to earn its bonus, and so on. The total of the new incomes can therefore be interpreted as the total increase in gross regional product brought about by the construction project in the study region.

Employment. The estimates under "New Employment" in Table 3 can be misleading. Consider the banking industry. Its new income is listed as \$97,700. The 4.1 after that in the "New Employment" column means simply that surveys of bank financial statements and employment records show the average bank to have a little over four employees for each \$97,700 of gross income. Therefore, the best guess is that when the region's banking industry experiences an increase in income of this amount, it

will hire four new employees. The lumber and wood products industry, in contrast, will receive only about half the new income that it typically must receive before a new employee is hired. This is evidenced by the 0.5 entered as its new employment. Such fractional new employment estimates are best interpreted as effectively zero new employment in the industry. In the case of households, "New Employment" means workers hired by households (gardeners, servants). The work done by the members of households to get their new income is considered the product, not the employment, of the households industry. The employment of individuals is counted under the industry that hires them, not under households.

The total of the new employment in all industries, about 244, includes only the employment created indirectly by the construction project. Because their income was treated as an original expenditure (to households), the 500 or so construction workers are not counted as new employment in Table 3.

The impact of the plant's construction in northern Vermont is primarily the result of new consumer spending, according to the forecasts in Table 3. Because the construction expenditures made in the region go predominantly to labor, the households sector experiences the greatest increase in income. The next greatest beneficiaries are the industries in which households make their major purchases. In order of decreasing importance after households, the industries registering the greatest new incomes are retail trade, food and kindred

products, wholesale trade, medical services, apparel and textile products, public utilities, real estate, farms, and insurance carriers.

In absolute numbers, the retail trade industry experiences the greatest expansion, hiring about 93 new workers. But it is already a large sector. Department of Commerce data for 1973 put the number of retail sales employees in the three counties of the study region at 5,313 (USDC 1974). Setting it at, by subjective extrapolation, 6,000 for the starting year of plant construction, the additional 93 jobs mean an increase in retail employment of only 1.6 percent.

Estimates of new income and employment for the "Lodging Places" industry are probably much too low in the I-O results. Because it assumes that all households spend new income in the same "average" way, the I-O analysis neglects the differences in lifestyle of different people. Many of the construction workers for the plant project are likely to relocate temporarily nearer the site in apartments, boarding houses, and hotels. This should lead to significant increases in the income and employment of the lodging industry that are not shown in the results. Considerations of dynamic economic adjustment that might affect the forecasts presented in Table 3 are discussed in the next section.

The new employment estimates yield some idea of the effect of plant construction on regional employment. Indirectly, the construction expenditures would create about 244 regional jobs. On the construction project will be another.

248 workers earning \$4.65 million a year, plus \$5.25 million annually in subcontracted labor. There are no independent estimates of the number of workers employed by subcontractors. By assuming that the wage/worker ratio is the same for both subcontracted and contracted labor, I estimated that subcontracts will provide 280 jobs. This brings total new employment in the area to 280 (subcontracted) plus 248 (contracted) plus 244 (indirect), or 772 workers.

The question of where the new employees come from is critical. If workers migrate into the study region to fill these new jobs, the number of unemployed there will not fall, though the number of employed will rise. At the very least, the project supervisors are bound to be brought in from outside. To estimate the maximum reasonable effect of the construction project on regional unemployment, assume that 772 new jobs go to regional residents. Statistics of the Vermont Department of Employment Security set the average number of unemployed people in the Lamoille, St. Johnsbury, and Barre-Montpelier labor areas in 1976 at 4,702, and the total civilian labor force at 50,683 (VDES 1977).^{*} Thus, the regional unemployment rate for 1976 averaged 9.3 percent. Hiring 772 people in the region in new jobs would bring the unemployment rate down to 7.8 percent.

It must be remembered that these are maximum impact figures. Especially if the plant is built on the edge of the study region, many of the newly created jobs are likely to

^{*}Together these three labor areas comprise all of the study region, part of Essex County, and most of Orange County. Department of Employment Security statistics are not collected by county, so they could not be tabulated for the precise study region.

go to people outside the region who commute or move into the region, not to the currently unemployed within the region. Also, for reasons more thoroughly discussed in the following section, it may be that not all of the 244 indirect jobs estimated by the I-O analysis will actually be created.

Considerations of Economic Adjustment

Three important dynamic considerations neglected in the I-O estimates are the migration of people into the study region, the delays involved in the process of regional economic expansion, and the policies firms use to expand their output. Immigration could cause both the regional employment to change and the distribution of new income to differ from the I-O forecasts. A result of the delays in expansion is that the construction project will not achieve its peak impact until well after the start of construction. Also, the methods firms use to expand could cause the peak to be lower than estimated.

The new jobs created by the plant construction project should attract some workers into the region. This would reduce the project's impact on unemployment below levels forecast in the study. Further, new residents would need housing and thus would increase sales in the regional construction and supporting industries. To the extent that the construction project causes immigration, the forecasted unemployment level of 7.8 percent is probably low as are the forecasts of new income and employment in construction-related industries shown in Table 3.

The construction project impact outlined in Table 3 is supposed to apply to the study region for the entire two-year period of construction. But the changes it involves would not be made instantaneously in the real economy. Construction laborers would receive their first pay checks and gradually spend them. Regional businesses would then experience a rise in sales, becoming greater as the multiplier effect worked itself out and businesses began buying more from one another. For a highly flexible industry like insurance sales, adjustments could be made quickly. When insurance carriers begin selling more policies, they can hire more clerks and even open new offices in a short time. In contrast, a farmer might not be able to increase his output for more than a year after he realized his sales prospects had gone up. Furthermore, new farms take years to establish. Especially in industries like farming and other capital- and land-intensive businesses, the short-run effects of increased demand are likely to be shortages, higher prices, and increased imports. Only after a delay can most businesses expand their output. As a result, the actual peak of the business expansion may not come until over a year after the beginning of construction.

For these reasons, regional businesses may not expand to the full extent predicted by the I-O forecasts. The first reaction of most businesses to an increase in sales is to utilize existing equipment and labor more intensively. Especially if the increase in sales is thought to be temporary, businesspeople will avoid major permanent expansions such as

constructing new buildings and entering long-term contracts with new employees. Businesses selling directly to the construction project or its workers are especially liable to realize that their good fortune is temporary, and thus take easily reversible measures to increase output. The effect of such actions would be to reduce somewhat the multiplier effect of the construction expenditures, cutting down the indirectly-derived new income and new employment.

Noneconomic Problems Arising from the Construction Project

The construction contractors I interviewed identified three characteristics of a large construction project that can stimulate community dissatisfaction: temporary facilities, construction noise, and the uneven distribution of wealth.

For large projects in rural areas, temporary living quarters sometimes have to be erected near the site for workers who need to relocate in the area but who cannot find other housing. The temporary housing may be an eyesore, and the concentration of residences may cause traffic and sewage problems. My sources agreed, however, that for the particular project proposed this is not likely to be a great problem (Morrisey 1977). The primary plant sites considered in the High (1978) report are all populated densely enough to allow construction workers to live within commuting distance. Those who do not can generally find spots in existing apartments, hotels, or boarding houses.

Noise is sometimes a nuisance to neighbors of a construction project. However, according to a study sponsored by the

U.S. Environmental Protection Agency, the volume of noise from construction equipment drops fairly rapidly over distance and through barriers (EPA 1971). The plant would be built on a large plot of cleared land, according to most plans. It would not likely be placed very near a large urban area, so it should be quite distant from any high concentration of residences or working places. Noise should not be a significant problem.

The expenditures of a construction project often boost the incomes of some local businesspeople greatly, but scarcely reach others. This can cause jealousy among citizens. This is a difficult problem to assess, and there is no good solution for it. For a project of the magnitude considered here, it could be a real problem, but probably not great enough to merit special concern.

In general, the construction project studied here is too small to cause much public dissatisfaction.

OPERATION PHASE FORECASTS

The operation of a WFPP, in comparison to its construction, will have a smaller, more diffuse, and longer lasting effect on the surrounding region. Primary plant expenditures will still be for labor, but the amount spent annually will drop significantly from spending levels during construction. Of special interest, therefore, is the impact of the transition between the two periods, as well as the impact of the WFPP's operation itself.

Estimates of Operation Phase Expenditures

I estimated expenditures and made I-O forecasts for three categories of activity in the plant's operation: operation activities, wood harvesting, and wood transportation. However, expenditures for wood harvesting and transportation will vary with the wood procurement technology used. There are two reasonable procedures for chipping and transporting wood for a WFPP. For each of these two procedures, various capital-labor mixes could be used.

The scheme employed by many large paper mills uses concentration yards. With this approach, harvesters deliver roundwood to two or three receiving sites. At these receiving sites, or concentration yards, the roundwood is stockpiled; then it is chipped and shipped to the plant by rail as required. The alternative scheme is on-site chipping. According to this plan, the trees harvested are chipped in the field and the chips are loaded immediately into semitrailers. The trucks convey the chips to the plant for storage and eventual burning.

With either of these two chipping and transporting schemes, the wood can be harvested in a variety of ways. The most capital-intensive procedure uses a feller-buncher (a machine that scissors through trees at the base and stacks them together on the ground) and skidders or forwarders to bring the trees to the loading site. Another technique, involving less capital and more labor, employs a harvesting crew with a pair of chain saws in place of the feller-buncher. There are also operations that use tractors or horses instead of skidders.

For the expenditure figures of the I-O calculations I used data for an on-site chipping operation that harvests with chain saws. I chose on-site chipping primarily because I have better data from such operations. However, an on-site chipping operation and a concentration yard operation can both be expected to have about the same costs. Both perform the same functions with similar machinery and labor, but differ in the sequence of their operations. It also happens that the industrial classification scheme into which the R.E.A.D. I-O data are arranged includes both truck and rail shipping in the same industry -- motor freight transportation and warehousing. Thus, for the purposes of this I-O analysis, it is unnecessary to differentiate between expenditures made for truck and for rail services. Consequently, my expenditure estimates for wood harvesting and transportation derived from an on-site chipping system can be considered roughly representative of a concentration yard procedure.

Operation activities. The two expenditures of plant operation that would provide income to regional interests are labor and office supplies, the latter because the retail markup would be received by local stores. The plans of Rust Engineering Corporation call for seven plant supervisors earning \$17,500 per year and 25 to 30 other plant workers paid \$12,500 per year each (Milligan 1977). This means a total annual labor expenditure of about \$472,500: $(7 \times \$17,500) + (28 \times \$12,500)$.

In addition, Rust estimates the plant would require about \$50,000 in supplies annually. Much or all of this would probably be purchased from local retail outlets, which can be expected to retain as much as 40 percent of that amount in the form of their retail markup (Cartwright 1977). I therefore included \$20,000 in retail trade in the set of regional operation activities expenditures.

Wood harvesting. For information on wood harvesting expenditures, I referred to the Vermont Governor's Task Force Report (Task Force 1975) and spoke with foresters and harvesters. Especially helpful was Chester McLain, who runs in Vermont and New Hampshire an on-site chipping crew of approximately the same configuration considered here.

To calculate the labor costs of wood harvesting, average salary and number of workers must be estimated. Salaries vary, but harvesters earn about \$300 per work week in New England (McLain 1977; Laferriere 1977). The number of workers needed depends in part on certain limitations on harvesting time:

crews can harvest only about 48 to 50 weeks per year because of bad weather, and during the week they can harvest only a little over four days because it is necessary to devote some time to equipment maintenance (McLain 1977; Kroplin 1977). My calculations for the number of crews required to supply a 50-Mw WFPP (16.7), the total number of harvesters (116.9), and the total annual harvester payroll (\$1,753,500) are shown in Table 4.

Harvesting crews typically must pay a stumpage fee to the owner of the land from which they take wood. In Vermont, the stumpage fee is generally about \$1 per ton of green wood removed (Task Force 1975, p.30). Therefore, the wood harvesters for the WFPP should pay about \$800,000 to regional landowners (based on figures from Sherwood & Meadows 1978). In northern Vermont, the landowners are predominantly private individuals, so this \$800,000 can be treated as an expenditure to households. The stumpage fees paid to landowners living outside my study region should not be included in this figure. But the total of these fees is highly uncertain. Thus, to obtain estimates giving the greatest impact, I assumed that all fee recipients were local residents.

The final relevant expenditure of the wood harvesting operation is the purchase of diesel fuel, for which the wholesale and transportation markups are retained by local merchants. The only report of fuel consumption for a complete harvesting crew was provided by Mr. McLain. His seven-man crew with chain saws, skidders, a whole-tree chipper, and a tractor

TABLE 4: CALCULATIONS FOR NUMBER OF WOOD HARVESTERS AND TOTAL ANNUAL PAYROLL REQUIRED FOR THE OPERATION OF A WOOD-FIRED POWER PLANT

Number of Crews Required

$$\frac{(F/R) \times H}{(D \times K)} = \frac{(800,000/225) \times 8}{(34 \times 50)} = 16.7 \text{ crews}$$

F = Total wood fuel required by the plant annually - 800,000 green tons of chips¹

R = Harvesting rate of a seven-man crew - 225 green tons of chips per day²

F/R = Crew-days of harvesting required per year

H = Hours in crew's work day - 8

(F/R) x H - Crew-hours of harvesting required per year

D = Hours per week a crew devotes to harvesting - 34³

K = Harvesting work weeks per year - 50

(D x K) = Hours per year a crew devotes to harvesting

Number of Wood Harvesters

$$\text{No. of crews} \times \text{workers/crew} = 16.7 \times 7 = 116.9 \text{ harvesters}$$

Total Annual Harvester Payroll

$$\begin{aligned} \text{No. of harvesters} \times \text{average weekly pay} \times \text{harvesting work weeks/year} \\ = 116.9 \times \$300 \times 50 = \$1,753,500 \end{aligned}$$

1. Source: Sherwood & Meadows 1978.

2. Source: McLain 1977.

3. Source: McLain 1977 and Kroplin 1977.

uses 1,000 gallons of diesel per work-week. Therefore, the 16.7 crews working 50 weeks per year use 835,000 gallons of diesel each year. With the wholesale and transportation mark-ups for a gallon of diesel fuel at \$.02 each, this sets the payments of the wood harvesters to regional wholesalers for providing fuel at about \$16,700 per year. Payments to truckers for transporting the fuel would be the same.

Wood transportation. A WFPP could use one of two systems to haul wood from the harvest areas to the plant: hire a private trucking firm or purchase its own trucks and run its own operation. To obtain the maximum impact on the area, I assumed the plant would choose the latter. There are no firms in the three-county region that sell tractor-trailer rigs, so these expenditures will be made outside the area in any case. However, there are new construction and labor expenses in the second system that are not reflected if a private trucker is contracted. For example, the plant, in starting up a trucking operation, will have to build a maintenance shed and hire people to run it. Also, we assume that the WFPP will hire truckers who are not currently employed, rather than diverting already employed workers.

On the basis of Adler et al. (1978), we estimate that the 32 truck drivers necessary to run the fleet will receive \$640,000 in wages each year. Currier (1978) and Berwick (1978) estimate that the maintenance operation will require four mechanics and one secretary-bookkeeper. The salary requirements of these workers will be about \$200 and \$150 per week

respectively, totaling \$49,400 [(\$10,400 x 4) + \$7,800]. Annual labor expenditures will therefore be \$689,400.

In computing the cost of building the maintenance shed, I inputted into the model only those products manufactured in the region (as in the calculations for the construction phase of the plant). The products are lumber, concrete slab, and ready-mix concrete. Currier (1978) and Berwick (1978) estimated that 5 percent of the construction materials cost (totaling about \$30,000) will go to lumber and about 20 percent each to concrete slab and ready-mix concrete. These amounts are therefore estimated at \$1,500, \$6,000, and \$6,000, respectively.

Adler et al. (1978) estimated the total annual fuel cost of the 32-truck fleet at \$160,000. According to our previous assumptions, 5 percent of the wholesale price of diesel fuel is the wholesaler's markup and 5 percent goes to the company that ships it. Fuel expenditures are therefore set at \$8,000 and \$8,000.

A summary of the estimates of the annual regional expenditures for the operation of the WFPP is provided in Table 5. The total annual expense is \$3,798,300.

Forecasts of New Income and Employment

The I-O forecasts for the economic impact of operation activities, wood harvesting, and wood transportation in the WFPP's operation phase are listed in Tables 6 through 8. Separate forecasts for each subactivity are provided because the magnitude of their impacts will be different and will

TABLE 5: ANNUAL REGIONAL EXPENDITURES FOR THE OPERATION OF A 50-MW WOOD-FIRED POWER PLANT

	<u>RECEIVING INDUSTRY</u>	<u>PRODUCT</u>	<u>ANNUAL EXPENDITURE</u>
Operation Activities	Households	Labor	\$ 472,500
	Retail Trade	Markup on office supplies	20,000
Wood Harvesting	Households	Labor	1,753,500
	Households	Stumpage fees	800,000
	Wholesale Trade	Markup on fuel	16,700
	Motor Freight and Warehousing	Transportation of fuel	16,700
Wood Transportation	Households	Labor	689,400
	Sawmills	Lumber	1,500
	Concrete Products	Concrete slab	6,000
	Ready-mix Concrete	Ready-mix concrete	6,000
	Wholesale Trade	Markup on fuel	8,000
	Motor Freight and Warehousing	Transportation of fuel	8,000
TOTAL			\$ 3,798,300

TABLE 6: MODEL FORECASTS OF REGIONAL INCOME AND EMPLOYMENT INCREASES
FROM OPERATION ACTIVITIES OF WOOD-FIRED POWER PLANT

OPERATION ACTIVITIES IMPACT

(1977 DOLLARS)

ANNUAL EXPENDITURES:	LABOR	472,500
	RETAIL TRADE	20,000

		492,500

INDUSTRY	NEW INCOME ¹	NEW EMPLOYMENT ¹
-----	-----	-----
FARMS	12,000	0.5
AGRICULTURAL SERVICES	729	0.0
NONMETALLIC MINERAL MINING + QUARRYING	72	0.0
CONTRACT CONSTRUCTION	2,270	0.1
FOOD + KINDRED PRODUCTS	23,300	0.5
TEXTILE MILL PRODUCTS	5,480	0.2
APPAREL + FABRICATED TEXTILE PRODUCTS	13,700	0.3
LUMBER + WOOD PRODUCTS, EXC FURNITURE	803	0.0
FURNITURE + FIXTURES	1,190	0.0
PRINTING, PUBLISHING, + ALLIED PRODUCTS	1,880	0.1
CHEMICALS AND ALLIED PRODUCTS	3,320	0.1
RUBBER AND MISC PLASTIC PRODUCTS	753	0.0
STONE, CLAY + GLASS PRODUCTS	212	0.0
FABRICATED METALS PRODUCTS	206	0.0
MACHINERY EXC ELECTRICAL	105	0.0
ELECTRICAL MACHINERY	173	0.0
MISC MANUFACTURING	1,470	0.0
MOTOR FREIGHT TRANS + WAREHOUSING	4,140	0.1
AIR TRANSPORTATION	204	0.0
TRANS SERVICES, INCL CARRIER AFFILIATES	0	0.0
COMMUNICATIONS	8,020	0.2
PUBLIC UTILITIES	14,000	0.2
WHOLESALE TRADE	21,200	1.1
RETAIL TRADE	92,000	5.8
BANKING	4,970	0.2
CREDIT AGENCIES + HOLDING + INVEST. CO.	446	0.0
SECURITY + COMMODITY BROKERS	275	0.0
INSURANCE CARRIERS, INCL SOLICITORS	10,700	0.4
INSURANCE CARRIERS, BROKERS AND SERVICES	2,510	0.1
REAL ESTATE AND COMBINATIONS	13,400	0.0
LODGING PLACES	1,770	0.1
PERSONAL + MISC REPAIR SERVICES	8,080	0.4
MISC BUSINESS SERVICES	981	0.1
AUTO REPAIR + SERVICES	7,680	0.2
MOTION PICTURES	409	0.0
AMUSEMENT + RECREATION SERVICES	999	0.1
MEDICAL + OTHER HEALTH SERVICES	17,300	1.2
LEGAL AND MISC PROFESSIONAL SERVICES	2,880	0.2
PRIVATE EDUCATIONAL SERVICES	8,580	0.6
HOUSEHOLDS	567,000	0.3
TOTAL	855,000	13.1

1. Income estimates are rounded to three significant figures; employment estimates are rounded to the nearest tenth.

TABLE 7: MODEL FORECASTS OF REGIONAL INCOME AND EMPLOYMENT INCREASES
FROM HARVESTING FOR WOOD-FIRED POWER PLANT

WOOD HARVESTING IMPACT

(1977 DOLLARS)

ANNUAL EXPENDITURES:	LABOR	1,753,500
	STUMPAGE FEES	800,000
	WHOLESALE TRADE	16,700
	SHIPPING	16,700

		2,586,900

INDUSTRY	NEW INCOME ¹	NEW EMPLOYMENT ¹
-----	-----	-----
FARMS	63,000	2.6
AGRICULTURAL SERVICES	3,840	0.2
NONMETALLIC MINERAL MINING + QUARRYING	369	0.0
CONTRACT CONSTRUCTION	11,300	0.3
FOOD + KINDRED PRODUCTS	123,000	2.4
TEXTILE MILL PRODUCTS	28,900	0.8
APPAREL + FABRICATED TEXTILE PRODUCTS	72,700	1.3
LUMBER + WOOD PRODUCTS, EXC FURNITURE	4,220	0.1
FURNITURE + FIXTURES	6,310	0.2
PRINTING, PUBLISHING, + ALLIED PRODUCTS	9,800	0.4
CHEMICALS AND ALLIED PRODUCTS	17,500	0.3
RUBBER AND MISC PLASTIC PRODUCTS	3,820	0.0
STONE, CLAY + GLASS PRODUCTS	1,110	0.0
FABRICATED METALS PRODUCTS	1,100	0.0
MACHINERY EXC ELECTRICAL	568	0.0
ELECTRICAL MACHINERY	930	0.0
MISC MANUFACTURING	7,770	0.2
MOTOR FREIGHT TRANS + WAREHOUSING	40,900	1.2
AIR TRANSPORTATION	1,080	0.0
TRANS SERVICES, INCL CARRIER AFFILIATES	5	0.0
COMMUNICATIONS	42,000	0.9
PUBLIC UTILITIES	72,300	1.0
WHOLESALE TRADE	129,000	6.9
RETAIL TRADE	381,000	24.1
BANKING	25,400	1.1
CREDIT AGENCIES + HOLDING + INVEST. CO.	2,350	0.2
SECURITY + COMMODITY BROKERS	1,450	0.1
INSURANCE CARRIERS, INCL SOLICITORS	56,600	2.2
INSURANCE CARRIERS, BROKERS AND SERVICES	13,100	0.7
REAL ESTATE AND COMBINATIONS	67,900	0.1
LODGING PLACES	9,370	0.6
PERSONAL + MISC REPAIR SERVICES	42,400	2.2
MISC BUSINESS SERVICES	5,010	0.4
AUTO REPAIR + SERVICES	40,900	1.2
MOTION PICTURES	2,160	0.1
AMUSEMENT + RECREATION SERVICES	5,230	0.4
MEDICAL + OTHER HEALTH SERVICES	91,400	6.4
LEGAL AND MISC PROFESSIONAL SERVICES	14,900	1.0
PRIVATE EDUCATIONAL SERVICES	45,400	3.1
HOUSEHOLDS	3,010,000	1.4
TOTAL	4,450,000	64.0

1. Income estimates are rounded to three significant figures; employment estimates are rounded to the nearest tenth.

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TABLE 8: MODEL FORECASTS OF REGIONAL INCOME AND EMPLOYMENT INCREASES
FROM TRANSPORTATION FOR WOOD-FIRED POWER PLANT

TRANSPORTATION IMPACT (1977 DOLLARS)

ANNUAL EXPENDITURES:	LABOR	689,400
	LUMBER	1,500
	CONCRETE SLAB	6,000
	READY-MIX CONCRETE	6,000
	WHOLESALE TRADE	8,000
	SHIPPING	8,000
		718,900

INDUSTRY	NEW INCOME ¹	NEW EMPLOYMENT ¹
FARMS	17,400	0.7
AGRICULTURAL SERVICES	1,070	0.0
NONMETALLIC MINERAL MINING + QUARRYING	1,060	0.0
CONTRACT CONSTRUCTION	3,230	0.1
FOOD + KINDRED PRODUCTS	33,900	0.7
TEXTILE MILL PRODUCTS	7,970	0.2
APPAREL + FABRICATED TEXTILE PRODUCTS	20,000	0.4
LUMBER + WOOD PRODUCTS, EXC FURNITURE	3,400	0.1
FURNITURE + FIXTURES	1,730	0.1
PRINTING, PUBLISHING, + ALLIED PRODUCTS	2,710	0.1
CHEMICALS AND ALLIED PRODUCTS	4,830	0.1
RUBBER AND MISC PLASTIC PRODUCTS	1,060	0.0
STONE, CLAY + GLASS PRODUCTS	13,000	0.4
FABRICATED METALS PRODUCTS	324	0.0
MACHINERY EXC ELECTRICAL	180	0.0
ELECTRICAL MACHINERY	262	0.0
MISC MANUFACTURING	2,180	0.1
MOTOR FREIGHT TRANS + WAREHOUSING	16,000	0.5
AIR TRANSPORTATION	297	0.0
TRANS SERVICES, INCL CARRIER AFFILIATES	2	0.0
COMMUNICATIONS	11,700	0.3
PUBLIC UTILITIES	20,000	0.3
WHOLESALE TRADE	39,200	2.1
RETAIL TRADE	105,000	6.6
BANKING	7,070	0.3
CREDIT AGENCIES + HOLDING + INVEST. CO.	646	0.1
SECURITY + COMMODITY BROKERS	400	0.0
INSURANCE CARRIERS, INCL SOLICITORS	15,700	0.6
INSURANCE CARRIERS, BROKERS AND SERVICES	3,670	0.2
REAL ESTATE AND COMBINATIONS	19,000	0.0
LODGING PLACES	2,570	0.2
PERSONAL + MISC REPAIR SERVICES	11,600	0.6
MISC BUSINESS SERVICES	1,500	0.1
AUTO REPAIR + SERVICES	11,500	0.3
MOTION PICTURES	593	0.0
AMUSEMENT + RECREATION SERVICES	1,430	0.1
MEDICAL + OTHER HEALTH SERVICES	25,100	1.8
LEGAL AND MISC PROFESSIONAL SERVICES	4,230	0.3
PRIVATE EDUCATIONAL SERVICES	12,400	0.8
HOUSEHOLDS	823,000	0.4
TOTAL	1,250,000	18.4

1. Income estimates are rounded to three significant figures; employment estimates are rounded to the nearest tenth.

be spread out through the region. The business expansion resulting from plant operation expenditures should be concentrated near the plant site, while the effects of the harvesting should be diffused throughout the woodland communities. The effects of the trucking should be divided among the towns in which the trucking operations are based.

As in the construction phase, the major impact of the operations phase on the study region comes from the wage payments to local workers. As a result, the economic profile presented by the I-O estimates in Tables 6 through 8 suggests an impact similar in pattern to, but smaller in scale than, the impact of the construction expenditures. The strongest effects are on households and retail trade, but they are only about one-third to one-half as great as in the construction phase forecasts.

To estimate the impact of the operation of the plant on regional unemployment, I assumed the same base employment figures for the study region used for the construction phase estimates, or about 4,702 unemployed of a labor force of 50,683 in the Lamoyille, St. Johnsbury, and Barre-Montpelier areas. This estimate deliberately omits the employment gained by the construction phase.

Table 9 shows the total number of new jobs created by the WFPF's operation. The 96 indirectly created jobs are the sum of new employment from Tables 6 through 8. The bottom total shows the distribution of the jobs across industries, for comparison with Table 3. Counting the number of jobs created

TABLE 9: TOTAL INCREASE IN REGIONAL EMPLOYMENT FROM
OPERATION OF A WOOD-FIRED POWER PLANT

<u>Direct Employment</u>	<u>Number of Jobs</u>
Operation activities	35
Wood harvesting	117
Truckers	32
Maintenance shed	<u>5</u>
	189
<u>Indirect Employment*</u>	
Operation	13.1
Harvesting	64.0
Transportation	<u>18.4</u>
	95.5 (96)
TOTAL EMPLOYMENT	285
<i>*Indirect employment¹ in:</i>	
<i>Retail trade</i>	36.5
<i>Wholesale trade</i>	10.1
<i>Medical & other health services</i>	9.4
<i>Other</i>	<u>39.5</u>
	95.5

1. From Tables 6 through 8.

directly (189), the total number of unemployed should come down to 4,417 and the regional unemployment rate should drop from 9.3 to 8.7 percent.

Economic Adjustment During the Transition Phase

The primary economic adjustment problem in the region is a shift from the inflated level of business activity during the intensive construction effort to the lower level during the plant's operation. In general, the problem is greatest in those industries that experience the largest increases in income and employment as a result of the construction project. However, not all industries and communities will experience a uniform decline in income and employment during the transition period. Theoretically, some industries unfavored by construction spending could experience a small boom, while those favored previously will decline either precipitously or slowly.

In absolute numbers, the most strongly affected industry (after households) is retail trade, with a drop in income of \$892,000 and a drop in employment of about 56 workers, according to the I-O forecasts. As pointed out earlier, however, the retail trade industry is the largest in the region (not counting households). It is, therefore, one most capable of accommodating a pulse in its sales. In fact, if local businessmen realize that the increased business they experience during plant construction is temporary, they can minimize the ill effects of the subsequent loss of business by avoiding the temptation to make large, permanent expansions that might later leave them with excess capacity. During the construction period, this would mean a slightly reduced expansion for the

regional economy. However, at the end of the period, it would result in a smoother, less wasteful adjustment to the lower level of business.

The shift in the distribution of the multiplier effect during the transition should not be great, because in both phases most of the original expenditure money goes to households, which always spend their income in the same patterns (according to I-O assumptions). The operation phase expenditures are lower so that business falls off generally (the level of new income drops roughly 50 to 60 percent), but no particular industry should experience severely sharp or mild business reductions.

The probable exceptions to this are the lodging and the construction industries. As mentioned earlier, many construction workers are likely to live temporarily near the construction site in apartments, boarding houses, and hotels. In fact, the increased income and employment of the lodging industry is likely to be much higher than the I-O forecasts for the construction phase indicate, because the forecasts do not take into consideration the special circumstances of the construction workers. When the project is over, the construction workers will leave their temporary lodgings. The recipients of the wages paid for the plant and harvesting operations will probably already have homes or apartments, and so be much less inclined to rent rooms. Thus the drop in business should be sharper for the lodging industry than for regional industry generally.

The disproportionately rapid decline in the business of the construction industry could produce a serious unemployment problem. With completion of the plant's construction, about 520 workers employed directly and through subcontracts will be laid off. Construction companies interviewed generally agreed that unemployment is not usually a serious problem at the end of a construction project because the workers know when their jobs will end and prepare for it (Morrisey 1977). However, it is still likely that at the beginning of the operation phase there will be many temporarily unemployed construction workers, raising the regional unemployment rate above the base 9.3 percent level assumed at the beginning of the operation phase.

The probable shift in the location of economic impact will be as important as the change in the sectors benefiting from the expenditures. During construction, the impact of the expenditures should be concentrated in the communities near the plant site. During operation, the expenditures should be spread throughout the harvesting region. Thus the economy of the community immediately around the plant should be especially hard hit by the halt of construction, while outlying areas might even experience a small business increase.

The problem presented by the slowdown of construction and the beginning of operation is one of preparation. If local merchants and producers foresee the inevitable shift in business, they can avoid steps that will commit them to high levels of production and ultimately prove wasteful. Some business decline, leading eventually to a partial loss of newly gained employment, seems inevitable, however.

CONCLUSIONS

The economic impact of constructing and operating a 50-Mw WFPP in three northern Vermont counties will be primarily the result of the money paid in wages to individuals. These expenditures, along with those for construction materials, fuel, office supplies, harvesting fees, and transportation of fuel, will circulate through the regional economy to produce new annual income almost twice the amount of the original plant expenditures. For the construction phase (about two years), the plant's \$9,976,000 annual expenditure will produce about \$17,100,000 in new income annually; during operation (about 20 to 30 years), a \$3,795,300 yearly expenditure creates \$6,555,000 in income regionally.

This income will result in the creation of new jobs in the area -- about 244 during construction and 96 during operation. Counting those workers hired directly by the WFPP, the total jobs created will be about 772 during construction and 285 during operation. With little immigration of workers, these levels should be sufficient to lower regional unemployment by about one-half of one percentage point.

The adverse socioeconomic effects of the plant on the surrounding region should be minor. The most serious problem is the drop in business and employment for merchants and workers in communities near the site when plant construction ends. However, if institutions and individuals are well informed of the construction schedule of the WFPP, they should be able to protect themselves.

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