THE WASHINGTON STATE ALUMINUM INDUSTRY ECONOMIC IMPACT STUDY

Prepared for

The Pacific Northwest Aluminum Industry

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EXECUTIVE SUMMARY

The aluminum industry has been a permanent fixture in the Pacific Northwest economy, especially in Washington State, for the past sixty years. The purpose of this study is to estimate the economic importance of the aluminum industry to the state and the nine counties where major aluminum plants are located: The year of analysis is 1998:

- The Washington aluminum companies constituted a $2.6 billion industry, as measured by total sales in 1998.

- The aluminum industry employed 7,510 workers. The five largest producers accounted for nine-tenths of the industry's employment: Alcoa, Inc., Goldendale Aluminum Company, Kaiser Aluminum & Chemical Corporation, Reynolds Metals Company, and Vanalco, Inc. (Note that Alcoa and Reynolds completed a merger in May 2000.)

- Aluminum industry employees earned $370.5 million in wages and salaries (excluding non-wage benefits) in 1998. The average wage and salary was $49,330 per year, approximately 1.7 times the state average. Labor income (including non-wage benefits) totaled $440.9 million for an average of $58,710 per employee.

- In addition to labor compensation, aluminum producers spent $1,830.1 million for goods and services, including $990.0 million for goods and services supplied in Washington. The major in-state expenditures included $384.1 million for primary metals (principally aluminum ingot) and $411.3 million for electricity.

In 1998, the aluminum industry's employment impact on the Washington economy extended beyond the 7,510 people working for the industry, since the industry's payroll and other operating expenditures created job opportunities in other state businesses through the so-called multiplier (respending) process:

- The aluminum industry accounted for $1,662.6 million of Washington Gross State Product, according to an estimate made with the Washington Projection and Simulation Model, an interindustry econometric model designed for forecasting and impact analysis.

- The total economic impact of the industry amounted to 29,600 jobs and $1,379.0 million in personal income, representing 0.9 percent of Washington total employment and personal income, a significant statewide impact.

- The aluminum industry employment multiplier was 3.9, implying that every industry job supported 2.9 jobs elsewhere in the economy. The multiplier is relatively large, comparable in size to the aerospace multiplier, because of the aluminum industry's high wages and high level of in-state spending.

- The equivalent of 46,030 people living in Washington depended upon the aluminum industry. The implied population multiplier was 6.1, meaning that each aluminum industry employee directly and indirectly supported 6.1 residents in the state.

- The total impact of the aluminum industry on state and local taxes amounted to $129.1 million or 0.9 percent of Washington state and local taxes in 1998. More than two-thirds of the taxes came from sales and use taxes and property taxes. The aluminum companies directly paid $29.0 million in state and local taxes, while the aluminum workers contributed another $25.5 million.

In 1998, the impact of the aluminum industry on the state was significant, amounting to nearly one percent of total employment, but its relative impact on the counties where the aluminum plants are located was even greater:

- The five major aluminum companies operated ten establishments in nine counties around Washington State.

- Measured in absolute terms, the biggest impact on a county economy came from the two Kaiser plants in Spokane County. With 2,180 employees earning $152.1 million in labor income (including non-wage benefits), Kaiser supported a total of 7,820 jobs in the county, according to the Spokane County economic base model. The company accounted for 3.2 percent of the employment and 3.2 percent of the personal income in the county. Aluminum operations raised county per capita income by $94.

- In relative terms, the Alcoa plant in Whatcom County had an even larger impact, supporting 3,870 jobs or 4.2 percent of total county employment. Thus, one out of every 24 jobs in Whatcom County was tied directly or indirectly to the Ferndale aluminum plant.

- The aluminum industry's impact on the other three metropolitan counties was smaller but still significant. Vanalco supported 1,230 jobs (0.8 percent of total employment) in Clark County, while Kaiser supported 850 jobs (0.3 percent of total employment) in Pierce County.

- In the four rural counties that have aluminum plants, the industry constituted a big part of their economic base. In Chelan County, where Alcoa employed 580 workers, the industry supported a total of 1,590 jobs, representing 3.4 percent of county employment. The impact of the Reynolds aluminum plant in Cowlitz County was even greater, amounting 2,040 jobs or 4.3 percent of county employment. In Stevens County, although the Alcoa plant supported only 770 county jobs, it accounted for 4.9 percent of total county employment.

- No county was more dependent upon the aluminum industry than Klickitat County. The Goldendale plant employed 700 workers, who earned $37.8 million in labor income (including non-wage benefits). Including the indirect impact, Goldendale supported 1,290 jobs in the county, accounting for 14.8 percent of total employment or one out of every seven jobs. Because of its high wages, the aluminum plant raised county per capita income by $354 (1.9 percent).

- The aluminum industry generated $26.7 million in local taxes in the nine counties, most of which came from property taxes. The aluminum industry itself paid $7.9

million, while employees of the aluminum companies paid another $6.8 million. In most counties, the aluminum industry constituted a significant share of the tax base: Chelan County (3.8 percent), Cowlitz County (3.6 percent), Spokane County (3.5 percent), Stevens County (5.7 percent), and Whatcom County (4.6 percent). In Klickitat County, the Goldendale plant accounted for 18.5 percent of the total taxes collected in the county.

In an economic sense, the term "two Washingtons," referring to the urban-rural split in the state economy, is an oversimplification, since the state is in fact composed of several economically diverse areas. Nevertheless, there is a group of counties, many of them highly dependent upon agriculture and forest products, that have not shared in the state's recent economic prosperity. Despite the presence of the aluminum industry, Chelan, Cowlitz, Klickitat, and Stevens are among these distressed counties:

- Typical of Washington's struggling rural economies is Stevens County, which has grown little since the end of the timber boom twenty years ago. Between 1980 and 1998, while Washington added more than one million wage and salary jobs, Stevens County added less than 3,000. As a result, in 1998, its unemployment rate stood at 9.0 percent, nearly twice the Washington unemployment rate. With a small fraction of its population gainfully employed, Stevens County ranked next to last among Washington's 39 counties in per capita income. At $16,716, it was 40.4 percent below the state average ($28,066).

- Chelan, Cowlitz, and Klickitat Counties have similar economic characteristics. In 1998, Chelan County's unemployment rate was 8.8 percent, almost double the state rate, while its per capita income was $23,322, nearly $5,000 below the state average. Cowlitz County, one of the slowest growing counties in the state, also had a high unemployment rate (7.9 percent) and a low per capita income ($21,290). In 1998, Klickitat County was among the most distressed counties in Washington. It had the fifth lowest employment growth rate (0.6 percent since 1980), the fourth highest unemployment rate (10.8 percent), and the fifth lowest per capita income ($18,240).

- The loss of a high-wage aluminum plant in an economically distressed rural county would be disastrous. Based on the economic impact estimates, the long-run losses in Klickitat County, for example, would amount to nearly 1,300 jobs, $40 million in personal income, and $2 million in local taxes. Recognizing that there would be no replacement for the aluminum industry, Klickitat County would stand to lose one-tenth of its economy.

The aluminum industry plays several roles in our economy. Foremost, it is a producer of a strong and light-weight material that is used in thousands of products. In Washington State, the industry is also a major provider of high-paying jobs. Many of these jobs are found in rural counties, which have not only struggled with the ups and downs of their resource industries, but have also not benefited from the rapid growth of the state's high-technology sector. This has left many of them with stagnating economies, high unemployment rates, and low per capita incomes. In such circumstances, the loss of the aluminum industry (its employees and payroll as well as its impact on other businesses and households) would be economically disastrous.

THE WASHINGTON STATE ALUMINUM INDUSTRY ECONOMIC IMPACT STUDY

1. INTRODUCTION

The aluminum industry has been a permanent fixture in the Pacific Northwest economy, especially in Washington State, for the past sixty years. The purpose of this study is to estimate the economic importance of the aluminum industry to the state and the nine counties where the major aluminum plants are located.

The study draws upon the analytical capabilities of the Washington Projection and Simulation Model (WPSM), an interindustry econometric model of the state, and economic base models of each of the nine aluminum-producing counties. Originally developed at the University of Washington in 1976, WPSM is designed for forecasting and impact analysis. Through its depiction of the interrelationships (i.e., purchases and sales) among sectors of the state economy (businesses, households, and government), the model has the ability of measuring the impact of changes in one industry (such as primary aluminum) on the rest of the economy. Given the state impact, the economic base models, which have been built specifically for this study, in effect estimate the portion of the state impact that falls on each of the nine counties.

The rest of the report is divided into four parts. Section 2 describes the aluminum industry, highlighting its history and current operations. Sections 3 and 4, which are the centerpiece of the study, present estimates of the aluminum industry's economic impact on the state and the nine counties. The impacts are measured primarily in terms of employment, income, and taxes. The analysis makes use of estimates of the aluminum industry's sales, employment, labor income, and in-state expenditures, which are derived from company records. The fourth section discusses the particular importance of the aluminum industry to four economically distressed counties. The report closes in Section 5 with a few concluding remarks.

2. THE ALUMINUM INDUSTRY

History

The hydroelectric potential of the Columbia River remained untapped until the 1930s, when the federal government financed dam building as one way to alleviate the economic suffering caused by the Great Depression. The immediate aim of the projects was to provide badly needed jobs. In the resource-dependent Pacific Northwest, the unemployment rate had risen to 25 percent, the average income had fallen by 50 percent, and many timber companies and farmers had been forced into bankruptcy. In the long term, the Columbia River dams were built to provide flood control, allow navigation of the river, generate electricity for homes and factories in the region, and supply water to irrigate the Columbia Basin.

On July 17, 1933, ground was broken in northeastern Washington for Grand Coulee Dam, the greatest construction project undertaken to that time. In 1941, when the dam was completed, it stood 550 feet high and measured 5,232 feet across. At the peak of construction, the project engaged 8,800 workers. Hundreds of other jobs sprung up in the half dozen small settlements near the dam, where the construction workers lived and spent their earnings.

The federal government encouraged aluminum companies to construct aluminum production facilities, which are very power intensive, in the Pacific Northwest to provide a use for the electricity produced at federal hydroelectric dams. The federal government's role in the building of aluminum plants continued into the 1940s and 1950s.

In 1940, the United States was on the brink of entering World War II and needing all the power it could muster to support military-related industries. In the Pacific Northwest, manufacturers were called upon to produce food, clothing, lumber, metals, machinery, ships, and aircraft for the war. As the home to several large shipyards and The Boeing Company, Seattle alone garnered $5.6 billion in war contracts. In 1944, at the height of the war, Boeing employed 50,000 people and rolled out sixteen B-17s and six B-29s each day.

Aluminum, which was light-weight, strong, and dissipated heat quickly, was a critical war material, especially for aircraft. At the outset of World War II, the Pacific Northwest had two aluminum reduction plants, both in Washington: the Aluminum Company of America plant in Vancouver and the Reynolds Metals Company plant in Longview.[1] As the war effort built up, the federal government constructed additional smelters in Spokane, Tacoma, and Troutdale, Oregon, all of which were operated by Alcoa. To meet the electricity requirements of these plants Congress appropriated $2 billion for a six-fold increase in the generating capacity of the Columbia River dams between 1941 and 1945. At the end of the war, the federal government sold the Troutdale smelter to Reynolds and the Spokane and Tacoma smelters to Kaiser Aluminum & Chemical Corporation.

Boosted by the post-war economic boom, the domestic demand for aluminum rose rapidly. New products were developed for construction (e.g., aluminum siding), household uses (e.g., aluminum foil), and food and beverage packaging (e.g., TV dinners).

In the 1950s, the Korean War prompted a 70 percent increase in U.S. aluminum production capacity, resulting in construction of new facilities at Columbia Falls, Montana, Wenatchee, Washington, and The Dalles, Oregon. Additional smelters were built in the mid-1960s at Ferndale and Goldendale, Washington. At that point, the Pacific Northwest produced 40 percent of the nation's primary aluminum and the regional aluminum industry, as we know it today, was more or less in place.

The road for the aluminum industry since that time has not been smooth (Figure 1). Cyclical downturns in the industry, a slowdown in long-term demand because of competing materials (e.g., vinyl for siding and plastics for packaging), and the construction of dozens of aluminum smelters around the world at locations with low power costs have threatened the survival of more than one Pacific Northwest plant. Perhaps most problematic for the local aluminum industry has been the rising cost of electricity. In fact, at the time of this report, Kaiser and Vanalco have temporarily curtailed production in response to high market prices for power.

Current Operations

Essentially two facts explain the presence of the aluminum industry in Washington State. First, the Columbia River, which winds its way through the state, embodies 40 percent of the nation's

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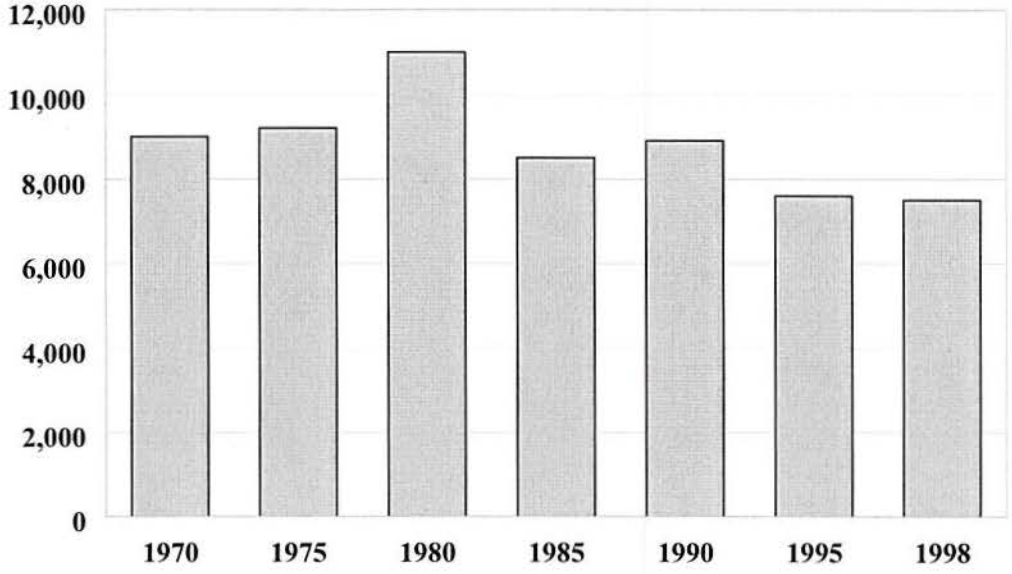
[1] Alcoa and Reynolds completed a merger in May 2000. Alcoa now owns Reynolds' Longview and Troutdale, Oregon plants, but under the merger agreement it must sell a minority portion of the Longview facility.

Figure 1

WASHINGTON STATE
ALUMINUM INDUSTRY EMPLOYMENT, 1970-1998



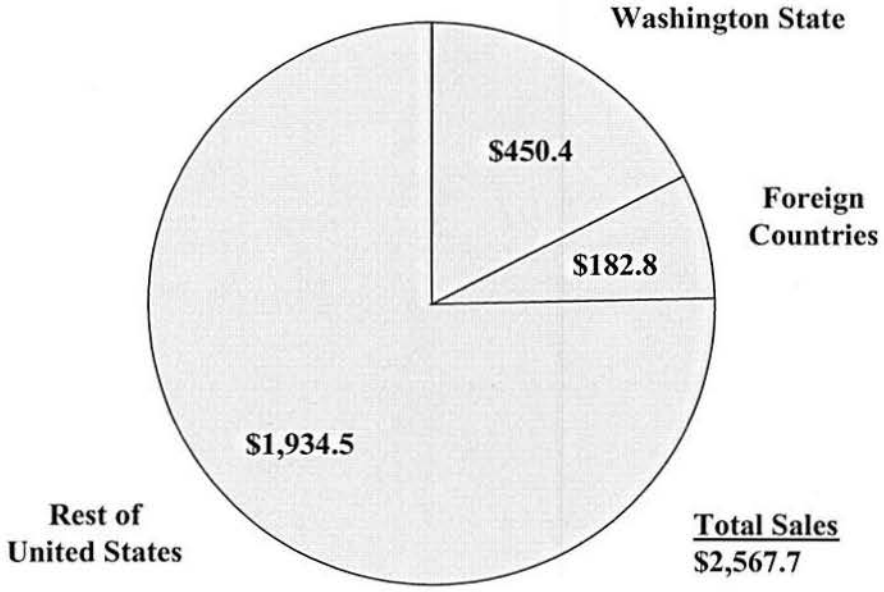
capacity for hydroelectric energy, the country's cheapest source of power. Second, 6-8 kilowatt-hours of electricity are required to produce one pound of aluminum ingot, the basic material for aluminum products. Thus, the supply of low-cost federal hydroelectric power in the state and the encouragement of the federal government have been a draw to aluminum companies for the past sixty years.

The aluminum industry is a highly integrated operation. The products of one plant are often used as inputs to production in another plant. Of the primary aluminum produced in Washington, one-fifth is sold to aluminum fabricating plants in the state, where it is manufactured into sheet and plate. These semi-finished products, which are ultimately used in airplanes, automobiles, packaging, and construction materials, are then sold throughout the world.

In 1998, the Washington aluminum industry sold $2,567.7 million worth of products, according to a survey of aluminum companies (Figure 2). In-state sales of aluminum ingot, shot, sheet, and plate amounted to $450.4 million. The largest market for primary and fabricated aluminum, accounting for three-fourths of total sales, was the rest of the United States. Aluminum shipments to other states were estimated to be $1,934.5 million. Foreign countries comprised the aluminum industry's smallest market, though the volume of international exports was far from insignificant. Despite the substantial impact of the Asian economic crisis in 1998, foreign sales summed to $182.8 million.

Figure 2

WASHINGTON STATE
ALUMINUM INDUSTRY SALES, 1998
Millions of Dollars



Constituting a $2.6-billion direct sales industry, the Washington aluminum companies employed 7,510 workers in 1998 (Table 1). The five largest producers accounted for nine-tenths of the industry's employment: Alcoa, Goldendale Aluminum Company, Kaiser, Reynolds, and Vanalco, Inc. Kaiser, which employed 2,610 people in four plants, had the largest combined operation in the state. With three plants, Alcoa employed 2,020 workers. Rounding out the large employers were Reynolds with 880 employees, Goldendale with 700, and Vanalco with 610. There were also 690 employees working in a number of smaller establishments. These operations included aluminum foundries and fabricating shops.

In 1998, aluminum industry employees earned $370.5 million in wages and salaries (excluding non-wage benefits). The average wage and salary was $49,330 per year, approximately 1.7 times the state average. Including non-wage benefits, labor income totaled $440.9 million. With an average labor income of $58,710 per year, aluminum industry employees were among the best paid workers in the state.

Washington aluminum plants are distributed widely around the state. They are located in metropolitan and rural counties on both sides of the Cascade Mountains (Table 2). The ten facilities owned by the five major companies are found in nine counties: Benton (Kaiser), Chelan (Alcoa), Clark (Vanalco), Cowlitz (Reynolds), Klickitat (Goldendale), Pierce (Kaiser), Spokane (Kaiser), Stevens (Alcoa), and Whatcom (Alcoa).

Table 1

WASHINGTON STATE ALUMINUM INDUSTRY OUTPUT, EMPLOYMENT, AND WAGES AND SALARIES, 1998

Output (mils. $)	2,567.7
Employment	7,510
Alcoa, Inc.	2,020
Goldendale Aluminum Company	700
Kaiser Aluminum & Chemical Corporation	2,610
Reynolds Metals Company	880
Vanalco	610
Other	690
Wages and salaries* (mils. $)	370.5
Average wage and salary* ($)	49,330
Average Washington State wage and salary* ($)	29,480

*Excludes non-wage benefits.

Table 2

WASHINGTON STATE ALUMINUM INUDSTRY EMPLOYMENT AND LABOR EARNINGS BY COUNTY, 1998

County	Employment	Labor Income* (mils. $)
Benton County (Kaiser)	40	1.9
Chelan County (Alcoa)	580	37.0
Clark County (Vanalco)	610	35.9
Cowlitz County (Reynolds)	880	46.6
Klickitat County (Goldendale)	700	37.8
Pierce County (Kaiser)	350	19.1
Spokane County (Kaiser)	2,180	152.1
Stevens County (Alcoa)	350	18.1
Whatcom County (Alcoa)	1,130	66.2
Other counties	690	26.2
Washington State	7,510	440.9

*Includes non-wage benefits.

Spokane County, home of two large Kaiser plants, had 2,180 aluminum employees in 1998, the greatest number for a single county. With a total labor income (including non-wage benefits) of $152.1 million, aluminum workers accounted for one-sixth of Spokane County's total manufacturing payroll. In Whatcom County, the Ferndale plant operated by Alcoa employed 1,130 workers, who earned $66.2 million in labor income. This also represented one-sixth of the total manufacturing income in the county. In relative terms, the Goldendale aluminum smelter in Klickitat County had the greatest impact on county manufacturing. Its 700 workers earned $37.8 million in labor income, accounting for three-fifths of Klickitat County's manufacturing income. Aluminum plants in Cowlitz County (880 employees with $46.6 million in labor income), Chelan County (580 with $37.0 million), and Stevens County (350 with $18.1 million) also made substantial contributions to the economic base of their counties.

3. WASHINGTON STATE IMPACT

Note on Methodology

The ability of a region to export is a key determinant of its economic health. In the context of the Washington State economy, exports are broadly defined to include sales of locally produced goods and services to foreign markets and customers in the rest of the United States (including the federal government). Without export activity, the regional economy would be small, inefficient, and poor. Since the lack of export income would preclude the purchase of imports, consumers would have access only to goods and services that could be produced within the region. For those products that were provided locally, markets would be of limited size and producers would be unable to take advantage of the efficiencies that accompany specialization and large-scale production. As a consequence, regional per capita income would be low and few people would choose to live and work in the region.

Of course, Washington is far from a self-contained economy. Exports of aluminum, agricultural commodities and processed food, logs and lumber, pulp and paper, machinery, aircraft, software, and professional services provide income that has led to a sizable, broad-based, and complex economy. Even the jobs of the grocery clerk, the carpenter, and school teacher depend upon export activity, although the links are not always apparent. Without the income from exports, there would be a smaller demand for groceries; without export-producing employees and their families, there would be less need for housing; and without the children of these families, there would be fewer schools.

As a major exporting industry, the aluminum industry not only manufactures aluminum for hundreds of products, ranging from airplanes to cans, but it also plays a significant role in the Washington economy. The industry's employment impact extends well beyond the 7,510 people working in it, since its payroll and other operating expenditures create job opportunities in other state businesses through the so-called multiplier (respending) process.

The Washington Projection and Simulation Model (WPSM) provides a means of measuring the total (direct and indirect) impact of the aluminum industry on the state economy.[2] The impact-estimating procedure is a straightforward exercise. Using WPSM, the behavior of the economy is first simulated with the aluminum industry's output (and thus the industry's employment, labor income, and in-state purchases) to produce a baseline projection over a period of time. The

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[2]Refer to Appendix A for technical notes describing the impact estimating procedure.

simulation is then repeated but without the aluminum industry's output to yield a conditional projection. The difference between the two projections is a measure of the total impact (the so-called multiplier effect) of the aluminum industry. Since WPSM is a comprehensive model of the Washington economy, the impact can be expressed in terms of output (production), employment, and income by industry, labor force, the unemployment rate, resident population, personal income, consumption expenditures, state and local government spending, and fixed investment, among other economic and demographic variables.

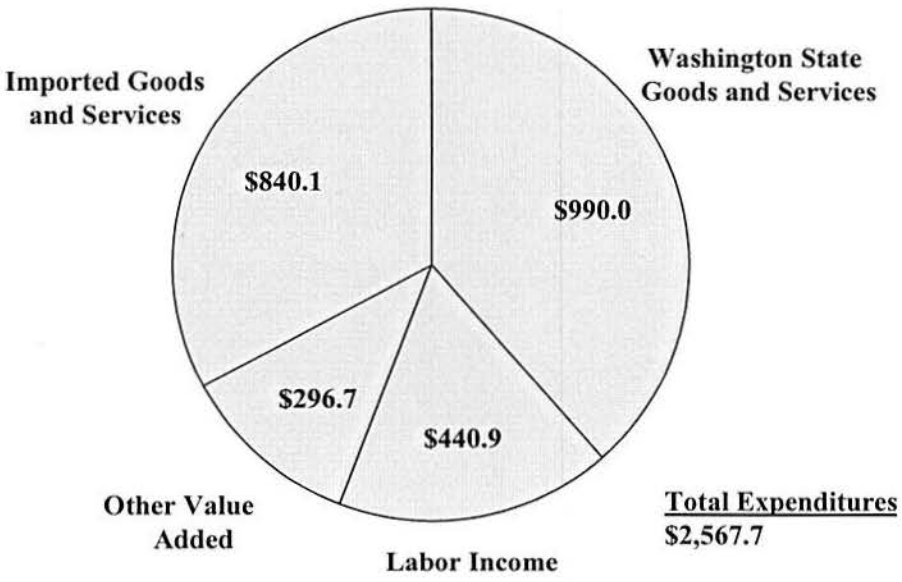
In a similar manner, the county impact analyses are conducted with economic base models constructed specifically for this study. These models have been built for each of the nine counties that are home to major aluminum plants. Due to data limitations, these county models are simpler than the state model and contain a smaller number of variables (principally, employment, income, and population). Nevertheless, the models provide reasonable estimates of the local economic impact of the aluminum industry.

Direct Economic Impact

The impact of the aluminum industry on the Washington economy stems from its employment and labor income as well as its expenditures for goods and services that are produced in the state. Together, these constitute the industry's direct economic impact.

Figure 3

WASHINGTON STATE
ALUMINUM INDUSTRY OPERATING EXPENDITURES, 1998
Millions of Dollars



According to industry data, the aluminum industry's operating expenditures (which equal its value of production) totaled $2,567.7 million in 1998 (Figure 3).[3] The industry employed 7,510 workers, who earned $440.9 million in labor income (wages, salaries, and non-wage benefits). In addition, the aluminum industry paid out $1,830.1 million for goods and services (Table 3). Of this amount, an estimated $990.0 million were spent on goods and services produced in Washington. Another $296.7 million of the industry's operating expenditures covered non-wage categories of value added, such as employers' contributions to social insurance, depreciation, rent, net interest payments, indirect business taxes, and profit.

Table 3

WASHINGTON STATE ALUMINUM INDUSTRY OPERATING EXPENDITURES, 1998

Millions of Dollars

	Total	Supplied in Washington State	Imported
Goods and services	1,830.1	990.0	840.1
Chemical products	52.3	12.0	40.3
Petroleum products	49.9	28.5	21.4
Primary metals (including alumina)	905.6	384.1	521.5
Transportation services	97.2	41.0	56.2
Utilities*	428.7	428.7	0.0
Wholesale and retail trade	62.5	25.0	37.5
Finance, insurance, and real estate	18.5	13.1	5.4
Services	40.0	31.2	8.8
Scrap	92.1	0.7	91.4
Other goods and services	83.3	25.7	57.6
Value added	737.6	737.6	0.0
Labor income	440.9	440.9	0.0
Other value added**	296.7	296.7	0.0
Total expenditures	2,567.7	1,727.6	840.1

*All utility services, including electricity, are assumed to be provided in state. This is consistent with the fact that Washington electricity generation exceeds Washington loads. Moreover, it would be difficult to match electricity consumption with specific generators.

**Includes employers' contributions to social insurance, depreciation, rent, net interest payments, indirect business taxes, and profits.

[3]When profit is included, total operating expenditures equal the total value of production.

Reflecting the integrated structure of the aluminum industry, its largest input to production, amounting to $905.6 million in 1998, was primary metals, principally alumina and aluminum ingot. Whereas alumina was imported, much of the aluminum ingot was produced in Washington. Purchases of primary metals from Washington manufactures totaled $384.1 million. The largest in-state expenditure was for electricity (part of utilities). Accounting for one-sixth of the industry's total operating expenditures, electricity purchases totaled $411.3 million. For the energy-intensive aluminum reduction plants, the outlays for electricity ran as high as 30 percent of total operating costs. Other major in-state expenditures included $41.0 million for transportation services, $31.2 million for various services, and $28.5 million for petroleum products. The $25.0 million purchase from wholesale and retail trade is the mark-up on goods procured from in-state vendors. The cost of the goods themselves are shown as in-state purchases or imported purchases from the industries that produce them, depending upon the location of the manufacturers.

Washington State Economic Impact

Table 4 shows the aluminum industry's total impact on the Washington economy. The first column portrays the Washington economy in 1998 with the aluminum industry. The second column is a projection of the economy (i.e., a picture of what the economy would look like) without the industry. The difference between the two projections is an estimate of the aluminum industry's total impact on the state economy. As evident in the numbers, especially jobs and income, the total economic impact is considerably greater than the direct impact:

1. Gross State Product. Gross State Product, like its national counterpart (Gross Domestic Product), is the broadest measure of economic activity in the state. In 1998, the aluminum industry accounted for $1,662.6 million of Washington Gross State Product.

2. Output. The impact of the aluminum industry on total output (production) in the private sector amounted to $4,403.4 million. This figure includes the output of the aluminum industry. Thus, its impact on the output of other Washington industries amounted to $1,835.7 (=$4,403.4-$2,567.7) million. Most of the indirect impact fell on nonmanufacturing industries, principally wholesale and retail trade and services.

3. Employment. Including the indirect impact, 29,600 jobs (wage and salary employees and proprietors) in the state depended upon the aluminum industry. This represented 0.9 percent of total state employment in 1998. Virtually all of the indirect jobs were in nonmanufacturing industries and government. The implied employment multiplier was 3.9 (=29,600/7,510), indicating that for every job in the aluminum industry there were 2.9 supporting jobs in the rest of the economy. The wage and salary employment multiplier, which does not count proprietors, was 3.4 (=25,480/7,510).

4. Personal income. Directly and indirectly, the aluminum industry accounted for $1,379.0 million in personal income or 0.9 percent of total Washington personal income. The aluminum industry raised Washington per capita income by 16 dollars in 1998, according to the WPSM simulation.

Table 4

ALUMINUM INDUSTRY IMPACT ON THE WASHINGTON STATE ECONOMY, 1998

	1998 Actual	Without Aluminum Industry	Impact (Difference)	Percent of Washington State
DIRECT IMPACT				
Output (mils. $)	2,567.7	0.0	2,567.7	
In-state expenditures (mils. $)	990.0	0.0	990.0	
Employment	7,510	0.0	7,510	
Labor income (mils. $)	440.9	0.0	440.9	
TOTAL IMPACT				
Gross State Product (mils. $)	186,629.0	184,966.4	1,662.6	0.9
Output (mils. $)	249,859.9	245,456.5	4,403.4	1.8
Resources	6,704.5	6,676.3	28.2	0.4
Manufacturing	85,175.1	82,293.7	2,881.4	3.4
Nonmanufacturing	157,980.3	156,486.5	1,493.8	0.9
Employment	3,475,690	3,446,090	29,600	0.9
Proprietors	646,000	641,880	4,120	0.6
Wage and salary employment	2,829,690	2,804,210	25,480	0.9
Resources	56,620	56,410	210	0.4
Manufacturing	383,390	374,650	8,740	2.3
Primary metals	11,600	3,760	7,840	67.6
Other manufacturing	371,790	370,890	900	0.2
Nonmanufacturing	1,853,500	1,840,510	12,990	0.7
Construction	149,670	149,190	480	0.3
Transportation services	92,290	91,840	450	0.5
Communications	29,700	29,430	270	0.9
Utilities	15,390	14,880	510	3.3
Wholesale and retail trade	640,810	636,300	4,510	0.7
Finance, insurance, and real estate	140,830	139,830	1,000	0.7
Services	784,810	779,040	5,770	0.7
Government	536,180	532,640	3,540	0.7
Personal income (mils. $)	159,674.1	158,295.1	1,379.0	0.9
Labor income	116,102.1	115,037.0	1,065.1	0.9
Other income	43,572.0	43,258.1	313.9	0.7
Per capita income ($)	28,066	28,050	16	0.1
Population	5,689,300	5,643,270	46,030	0.8

5. Population. The equivalent of 46,030 people living Washington depended upon the aluminum industry in 1998. The implied population multiplier is 6.1 (=46,030/7,510), meaning that each aluminum industry employee directly and indirectly supported 6.1 residents in the state.

The implied employment multiplier for the aluminum industry is higher than that found for most industries. Wage and salary employment multipliers, for example, typically range between two and three. In a 1989 study, the aerospace wage and salary employment multiplier was estimated to be 3.2.[4] The corresponding multiplier for the aluminum industry (3.4) is larger than the aerospace multiplier, despite the fact that The Boeing Company, which constitutes 90 percent of the state aerospace industry, pays somewhat higher wages. Boeing employees earned $53,980 per year in wages and salaries in 1998, compared to $49,330 for the aluminum industry. But, with regard to the overall impact on the state economy, the aluminum industry's lower average wage is more than compensated by its high level of spending for locally produced goods and services. Excluding intra-industry purchases of aluminum ingot and other primary metals, the aluminum industry spent an estimated $605.9 million for Washington produced goods and services in 1998 or $80,700 per employee. In contrast, the aerospace industry, which imports most of the components that make up its commercial aircraft, spent approximately $30,000 per worker. In other words, the aluminum industry has a higher multiplier, because each employee in effect pumps more money into the local economy.

State and Local Tax Impact

The total impact of the aluminum industry on state and local taxes amounted to $129.1 million or 0.9 percent of Washington state and local taxes in 1998 (Table 5). This figure includes taxes collected by state government as well as by all local governments (counties, cities, and special

Table 5

ALUMINUM INDUSTRY IMPACT ON WASHINGTON STATE AND LOCAL TAXES, 1998

	Aluminum Industry Taxes (mils. $)	Total Tax Impact (mils. $)	Percent of Washington State
Sales and use tax	6.4	48.0	0.8
Business and occupations tax	11.2	23.2	1.0
Property tax	10.2	44.8	0.9
Other taxes	1.2	13.1	0.8
Total state and local taxes	29.0	129.1	0.9

[4]Note that there is no single multiplier for an economy. Multipliers vary across industries and over time. There are also different types of multipliers. In addition to employment and population multipliers, there are output, income, and tax multipliers. For a given multiplier, such as the aluminum industry employment multiplier, there is even a short-run multiplier (measuring the short-run impact of a specific change in economic activity) and a long-run multiplier (measuring the long-run impact). The multipliers presented in this study are long-run multipliers.

tax districts) in Washington. Most of the tax revenue came from sales and use taxes ($48.0 million) and property taxes ($44.8 million), the better part of which went into state coffers ($39.3 million from sales and use taxes and $11.1 million from property taxes). Directly and indirectly, the aluminum industry generated another $36.3 million in business and occupation taxes and miscellaneous taxes.

Of the $129.1 million in taxes, the aluminum industry directly paid $29.0 million. Business and occupation taxes and property taxes accounted for nearly three-fourths of the taxes paid by industry. Aluminum workers contributed another $25.5 million in taxes. This amount included $12.6 million in sales and use taxes and $9.9 million in property taxes, as a result of household spending and home ownership. More than one-half of the total tax impact, totaling to $74.6 million, came from the businesses and workers that were indirectly impacted by the aluminum industry in 1998.

4. COUNTY IMPACT

County Economic Impact

The economic impact of the aluminum industry on Washington State was significant, amounting to nearly one percent of total employment. But its relative impact on the counties where aluminum plants were located was even greater. The county impacts in 1998 are shown in Table 6. Note that the nine county impacts do not sum to the state impact. There are two reasons for this. First, the county impacts pertain only to the five major aluminum companies, which account for nine-tenths of industry employment. Second, the impact of an aluminum plant located in one county tends to spill over into other counties. For example, some of the people who work at the Alcoa facility in Chelan County reside in neighboring Douglas County, where they spend much of their income. Spillover effects also occur in places like Yakima County (Washington's bread basket), Thurston County (the state capital), and King County (the state's commercial center), which provide goods and services to counties throughout Washington State. The nine county employment impacts in Table 6 sum to 19,570 jobs and comprise two-thirds of the total state employment impact (29,600 jobs).

Five of the nine counties (Benton, Clark, Pierce, Spokane, and Whatcom) are defined by the U.S. Bureau of the Census as metropolitan counties.[5] Measured in absolute terms, the biggest impact on a single county emanated from the two Kaiser plants in Spokane County. With 2,180 employees earning $152.1 million in labor income, Kaiser supported a total of 7,820 jobs in the county in 1998, according to the Spokane County economic base model. The implicit employment multiplier was 3.6 (=7,820/2,180), which was the highest of the nine county employment multipliers. The large size of the multiplier is attributable to Kaiser's high wages and to the fact that Spokane, as the regional center for the Inland Empire, has a relatively self-sufficient economy. As in the case of the state economic impact, the greatest number of jobs supporting the aluminum company and its employees were found in wholesale and retail trade (1,400), services (1,630), and government (770). The two Kaiser aluminum plants accounted for 3.2 percent of total county employment. The personal income impact was an estimated $304.2 million or 3.2 percent of county income. Aluminum operations raised county per capita income by $94 (0.4 percent).

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[5]Economic data describing each of the counties in 1998 can be found in Appendix B.

Table 6

ALUMINUM INDUSTRY IMPACT ON COUNTY ECONOMIES, 1998

	Benton County	Chelan County	Clark County
DIRECT IMPACT			
Employment	40	580	610
Labor income (mils. $)	1.9	37.0	35.9
TOTAL IMPACT			
Employment	110	1,590	1,230
Proprietors	10	210	140
Wage and salary employment	100	1,380	1,090
Resources	0	20	0
Manufacturing	40	590	610
Primary metals	40	580	610
Other manufacturing	0	10	0
Nonmanufacturing	50	600	390
Construction	0	20	20
Transportation and public utilities	10	30	30
Wholesale and retail trade	20	190	150
Finance, insurance, and real estate	0	40	30
Services	20	320	160
Government	10	170	90
Personal income (mils. $)	4.0	45.8	48.2
Per capita income ($)	0	146	19
Population	170	1,600	1,580
PERCENT OF COUNTY			
Employment	0.1	3.4	0.8
Proprietors	0.1	2.3	0.4
Wage and salary employment	0.2	3.7	0.9
Resources	0.0	0.4	0.0
Manufacturing	0.9	22.3	3.0
Nonmanufacturing	0.1	2.5	0.5
Government	0.1	2.8	0.4
Personal income	0.1	3.3	0.6
Per capita income	0.0	0.6	0.1
Population	0.1	2.7	0.5

Table 6 (continued)

ALUMINUM INDUSTRY IMPACT ON COUNTY ECONOMIES, 1998

	Cowlitz County	Klickitat County	Pierce County
DIRECT IMPACT			
Employment	880	700	350
Labor income (mils. $)	46.6	37.8	19.1
TOTAL IMPACT			
Employment	2,040	1,290	850
Proprietors	190	140	100
Wage and salary employment	1,850	1,150	750
Resources	0	0	0
Manufacturing	900	700	360
Primary metals	880	700	350
Other manufacturing	20	0	10
Nonmanufacturing	750	280	320
Construction	40	20	10
Transportation and public utilities	60	40	20
Wholesale and retail trade	300	90	120
Finance, insurance, and real estate	50	20	30
Services	300	110	140
Government	200	170	70
Personal income (mils. $)	71.1	40.4	31.8
Per capita income ($)	12	354	3
Population	3,290	1,880	1,280
PERCENT OF COUNTY			
Employment	4.3	14.8	0.3
Proprietors	2.4	5.7	0.2
Wage and salary employment	4.7	18.4	0.3
Resources	0.0	0.0	0.0
Manufacturing	9.2	50.1	1.4
Nonmanufacturing	3.3	10.2	0.2
Government	3.3	10.3	0.1
Personal income	3.6	11.5	0.2
Per capita income	0.1	1.9	0.0
Population	3.6	9.7	0.2

Table 6 (continued)

ALUMINUM INDUSTRY IMPACT ON COUNTY ECONOMIES, 1998

	Spokane County	Stevens County	Whatcom County
DIRECT IMPACT			
Employment	2,180	350	1,130
Labor income (mils. $)	152.1	18.1	66.2
TOTAL IMPACT			
Employment	7,820	770	3,870
Proprietors	1,060	120	650
Wage and salary employment	6,760	650	3,220
Resources	0	0	10
Manufacturing	2,240	350	1,160
Primary metals	2,180	350	1,130
Other manufacturing	60	0	30
Nonmanufacturing	3,750	220	1,730
Construction	140	10	100
Transportation and public utilities	250	20	120
Wholesale and retail trade	1,400	70	670
Finance, insurance, and real estate	330	10	110
Services	1,630	110	730
Government	770	80	320
Personal income (mils. $)	304.2	26.7	145.4
Per capita income ($)	94	98	99
Population	11,510	1,370	5,890
PERCENT OF COUNTY			
Employment	3.2	4.9	4.2
Proprietors	2.4	2.3	3.1
Wage and salary employment	3.4	6.1	4.5
Resources	0.0	0.0	0.3
Manufacturing	9.9	16.5	12.2
Nonmanufacturing	2.6	3.8	3.6
Government	2.1	3.2	2.8
Personal income	3.2	4.0	4.2
Per capita income	0.4	0.6	0.4
Population	2.8	3.5	3.8

In relative terms, the Alcoa plant in Whatcom County, the smallest of Washington's metropolitan areas, had an even greater economic impact. Counting the multiplier effect, Alcoa supported 3,870 jobs or 4.2 percent of total county employment. In other words, one out of every 24 jobs in Whatcom County was tied directly or indirectly to the aluminum plant in Ferndale. Alcoa's impact on personal income amounted to $145.4 million, which represented 4.2 percent of county income. Similar to the Spokane County impact, Alcoa lifted Whatcom County per capita income by $99 (0.4 percent).

The aluminum industry's impact on the other three metropolitan counties was smaller. Vanalco supported 1,230 jobs (0.8 percent of total employment) in Clark County, while Kaiser supported 850 jobs (0.3 percent of total employment) in Pierce County. Two factors explain these smaller numbers. First, the two aluminum plants are comparatively small, employing 610 and 350 workers, respectively. Second, both counties were also subject to sizeable spillover effects, because of their respective proximity to the large Portland and Seattle economies, which tended to capture substantial portions of the aluminum industry impacts. The impact of the aluminum industry in Benton County was very small, since the Alcoa plant employed only 40 people.

In absolute numbers of jobs, the impacts in the four rural counties (Chelan, Cowlitz, Klickitat, and Stevens) were smaller than the impacts in Spokane and Whatcom. However, considering the small size of these rural counties, the aluminum industry nevertheless made up a big part of their economic base. In Chelan County, the Alcoa plant employed 580 workers and supported a total of 1,590 county jobs. This represented 3.4 percent of county employment, making the impact, in this sense, comparable in importance to the Kaiser impact in Spokane County. The impact of the Reynolds aluminum plant in Cowlitz County was even greater, amounting to 2,040 jobs or 4.3 percent of total employment. In Stevens County, although the Alcoa plant supported only 770 county jobs, it accounted for 4.9 percent of county employment.

No county, however, was more dependent upon the aluminum industry than Klickitat County. In 1998, the Goldendale Aluminum Company employed 700 workers, who earned $37.8 million in labor income. Including the indirect impact, Goldendale supported 1,290 jobs in the county, accounting for 14.8 percent of total employment or one out of every seven county jobs. The aluminum plant added $40.4 million to Klickitat County personal income, representing 11.5 percent of county income. The income impact would have been even greater were it not for the fact that some people working in Klickitat County lived and spent their money in other counties. The Goldendale facility raised per capita income in the county by an estimated $354 (1.9 percent). Directly and indirectly, Goldendale supported 1,880 people living in Klickitat County. This meant the one out of every ten residents was economically dependent upon the aluminum industry.

Local Tax Impact

Across all nine counties, the aluminum industry generated $26.7 million in local taxes (Table 7). These included taxes paid to county and city governments as well as to special tax districts (e.g., school districts and ports). More than two-thirds of the tax revenue came from property taxes. The aluminum industry itself paid $7.9 million in local taxes, while employees of the aluminum companies contributed another $6.8 million. The remaining taxes resulted from the indirect impact of the aluminum companies and their employees on other businesses and households in the counties.

Table 7

ALUMINUM INDUSTRY IMPACT ON COUNTY LOCAL TAXES, 1998

Millions of Dollars

	Aluminum Industry Taxes	Total Tax Impact	Percent of County
Benton County	0.0*	0.1	0.1
Chelan County	0.5	1.7	3.8
Clark County	0.5	1.5	0.6
Cowlitz County	0.6	2.5	3.6
Klickitat County	0.9	1.7	18.5
Pierce County	0.7	2.0	0.3
Spokane County	2.6	10.1	3.5
Stevens County	0.4	0.9	5.7
Whatcom County	1.7	6.2	4.6

*Less than $50,000.

Within the individual counties, the size of the relative tax impact tended to vary with the size of the relative personal income impact. As an illustration, the aluminum industry in Spokane County generated 3.2 percent of county personal income and 3.5 percent of county local taxes. The relative impacts in Whatcom County were 4.2 percent and 4.6 percent, respectively. The two exceptions to this rule were Stevens County and Klickitat County, where the relative tax impacts (5.7 percent and 18.5 percent, respectively) were much larger than the relative income impacts (4.0 percent and 11.5 percent, respectively). In both counties, the higher than expected contributions to local taxes by the aluminum industry was due to the fact that, apart from the aluminum companies and their employees, the economies of these counties were dominated by low-income businesses and households with a low tax-generating capacity.

For every county the relative tax impact of the aluminum industry was greater than or equal to the relative population impact, according to model estimates. This implied that the aluminum industry was, in effect, contributing more to local government coffers than it was taking out. In Spokane County, for example, the relative tax impact (3.5 percent of total local taxes) exceeded the relative population impact (2.8 percent of total population) by 0.7 percentage points. If the demand for local government services were proportional to population (a reasonable assumption), then the demand placed on local government by the aluminum industry (including its supporting businesses and households) would amount to 2.7 percent of the total demands. If the aluminum industry were, at the same time, generating 3.5 percent of the total taxes collected by local government, it would be contributing a marginal surplus to local government budgets equal to 0.7 percent of the total local taxes collected in the county.

Distressed Counties

The term "two Washingtons," referring to the urban-rural split in the state economy, is an oversimplification, since Washington is in fact composed of several economically diverse

regions. Even the metropolitan areas are far from a homogenous lot. Seattle, though still affected by swings in aircraft production, has a broad industrial base, while the fortunes of the Tri-Cities rise and fall with activity on the Hanford nuclear reservation.

This qualification notwithstanding, Washington can be described as having two economies: a healthy urban economy found in most metropolitan areas and a struggling rural economy spread around the rest of the state. This dichotomy is in large part explained by the fact that employment growth in recent decades has occurred outside resource-based industries, such as farming and forest products, which have provided the economic foundations for many rural communities. In fact, virtually all of the new employment opportunities in Washington since 1978 (the last major forest products employment peak) have been created in non-resource manufacturing, trade, services, and government. The geographical focus of these jobs has not been the state's rural counties but its larger metropolitan areas.

Table 8

WASHINGTON STATE DISTRESSED COUNTIES, 1998

	Unemployment Rate (%)	Resource Employment (% of total)	Per Capita Income ($)	1980-98 Employment Growth Rate (%/year)
Pend Oreille County	12.1	15.1	16,742	1.9
Columbia County	11.4	29.0	18,874	0.1
Ferry County	11.3	23.2	15,103	1.1
Klickitat County	10.8	22.6	18,240	0.6
Okanogan County	10.8	29.6	19,306	1.6
Adams County	10.7	35.3	18,949	0.8
Yakima County	10.5	24.1	19,948	2.0
Grays Harbor County	10.2	16.7	19,869	-0.8
Franklin County	10.0	27.9	17,830	1.9
Skamania County	10.0	12.4	19,349	-2.8
Pacific County	9.9	24.1	19,143	0.5
Grant County	9.2	31.6	18,983	3.0
Stevens County	9.0	19.1	16,716	1.7
Chelan County	8.8	16.9	23,322	2.5
Lewis County	8.3	16.2	19,833	1.5
Cowlitz County	7.9	17.7	21,290	1.1
Puget Sound Region*	3.5	3.5	33,042	2.8
Washington State	4.8	7.1	28,066	2.6

*King, Pierce, Snohomish, and Kitsap Counties.

Of particular concern is a group of rural counties that has not shared in the state's recent economic prosperity (Table 8). With high unemployment rates, depressed per capita incomes, and low rates of employment growth, these counties have clearly been left behind. Their poor economic performance is due largely to the fact that they have a high fraction of employment engaged in resource industries (agriculture, forestry, fishing, mining, food products, wood products, and paper products).

Despite the presence of the aluminum industry, Chelan, Cowlitz, Klickitat, and Stevens Counties are among the distressed counties in the state (Table 9). Typical of Washington's struggling rural economies is Stevens County, the home of the Alcoa Addy plant. From one perspective, Stevens County fared well in the 1990s, growing faster than Washington (Table 10). In terms of wage and salary employment, the county grew at a 3.1 percent annual rate between 1990 and 1998, compared to a 2.3 percent rate for the state. In absolute terms, however, Stevens County has grown little since the end of the timber boom two decades ago. Between 1980 and 1998, while Washington added more than one million wage and salary jobs, Stevens County added less than 3,000. In fact, employment growth has barely kept up with population growth. As a result, Stevens County has remained underemployed, as indicated by its high unemployment rate and its extremely low labor force participation rate (the ratio of labor force to population). In 1998, its unemployment rate stood at 9.0 percent, nearly twice the Washington unemployment rate of 4.8 percent, while its labor force participation rate was only 44.3 percent, compared to 53.4 percent for the state. With a small fraction of its population gainfully employed, Stevens County ranked next to last among Washington's 39 counties in per capita income. At $16,716, it was 40.4 percent below the state average of $28,066. Per capita income in Stevens County was barely one-half the per capita income in the Puget Sound region (King, Pierce, Snohomish, and Kitsap Counties).

Chelan, Cowlitz, and Klickitat Counties have similar economic characteristics. In 1998, Chelan County's unemployment rate was 8.8 percent, almost double the state rate, while its per capita income was $23,322, nearly $5,000 below the state average. Cowlitz County, one of the slowest growing counties in the state, also had a high unemployment rate (7.9 percent) and a low per capita income ($21,290). In 1998, Klickitat County, with more than one-fifth of its employment in agriculture and forest products, was among the most distressed counties in Washington. It had the fifth lowest employment growth rate (0.6 percent since 1980), the fourth highest unemployment rate (10.8 percent), and the fifth lowest per capita income ($18,240).

The loss of a high-wage aluminum plant in an economically distressed rural county would be nothing short of disastrous. In Klickitat County, for example, the immediate impact of a plant closure would be to drive up its already high unemployment rate to 20 percent. The shutdown would cause near-term jobs losses in trade, services, and government, but the full repercussions would not be felt for two or three years. Unemployment compensation, welfare payments, and spending out of savings would cushion the economy's fall, at least for a while. But, when the unemployment checks ran out and savings dried up, the economy would sink further. Based on the economic impact estimates in Tables 6 and 7, the long-run losses in Klickitat County would amount to about 1,300 jobs, $40 million in personal income, and $2 million in local taxes. Recognizing that there would be no replacement for the aluminum industry, Klickitat County would stand to lose one-tenth of its economy. The only positive development in the long run would be an eventual decline in the unemployment rate. But that would come about only because many people would have moved out.

Table 9

SELECTED WASHINGTON STATE DISTRESSED COUNTY ECONOMIES, 1970-1998

	1970	1980	1990	1998
CHELAN COUNTY				
Wage and salary employment	18,570	23,880	30,990	37,310
Unemployment rate (%)	10.9	12.4	8.5	8.8
Personal income (mils. $98)	610.6	914.0	1,097.4	1,400.5
Per capita income ($98)	14,868	20,169	20,954	23,322
Population	41,060	45,320	52,370	60,050
COWLITZ COUNTY				
Wage and salary employment	26,090	32,610	36,660	39,690
Unemployment rate (%)	8.1	10.7	6.7	7.9
Personal income (mils. $98)	1,032.0	1,535.6	1,677.3	1,949.5
Per capita income ($98)	15,002	19,290	20,342	21,290
Population	68,800	79,600	82,460	91,570
KLICKITAT COUNTY				
Wage and salary employment	4,330	5,600	5,710	6,250
Unemployment rate (%)	9.3	14.5	11.7	10.8
Personal income (mils. $98)	163.9	273.4	298.2	352.0
Per capita income ($98)	13,454	17,144	17,882	18,240
Population (thous.)	12,180	15,950	16,680	19,300
STEVENS COUNTY				
Wage and salary employment	4,240	7,860	8,340	10,680
Unemployment rate (%)	11.5	12.7	8.3	9.0
Personal income (mils. $98)	205.2	440.1	487.3	659.7
Per capita income ($98)	11,768	15,103	15,662	16,716
Population	17,440	29,140	31,110	39,460
WASHINGTON STATE				
Wage and salary employment	1,282,120	1,791,260	2,361,870	2,829,690
Unemployment rate (%)	9.2	7.9	4.9	4.8
Personal income (mils. $98)	54,744.6	86,360.6	116,543.2	159,674.1
Per capita income ($98)	16,019	20,786	23,781	28,066
Population	3,417,400	4,154,700	4,900,700	5,689,300

Table 10

DISTRESSED COUNTY GROWTH RATES

Average Annual Percent Change

	1970-80	1980-90	1990-98
CHELAN COUNTY			
Wage and salary employment	2.5	2.6	2.3
Personal income ($98)	4.1	1.8	3.1
Population	1.0	1.5	1.7
COWLITZ COUNTY			
Wage and salary employment	2.3	1.2	1.0
Personal income ($98)	4.1	0.9	1.9
Population	1.5	0.4	1.3
KLICKITAT COUNTY			
Wage and salary employment	2.6	0.2	1.1
Personal income ($98)	5.2	0.9	2.1
Population	2.7	0.4	1.8
STEVENS COUNTY			
Wage and salary employment	6.4	0.6	3.1
Personal income ($98)	7.9	1.0	3.9
Population	5.3	0.7	3.0
WASHINGTON STATE			
Wage and salary employment	3.4	2.8	2.3
Personal income ($98)	4.7	3.0	4.0
Population	2.0	1.7	1.9

5. CONCLUSION

The aluminum industry plays many roles our economy. Foremost, it is a producer of a strong and light-weight material that is used in thousands of products, including airplanes, automobiles, and packaging.

In Washington State, the industry is also a provider of thousands of high-wage jobs. When the first aluminum plant opened sixty years ago, it helped pull Washington out of the Great Depression. Since then it has been a fixture in the state economy, despite rising energy costs and growing competition overseas.

Perhaps the aluminum industry's most important role in the state economy takes place in the "other Washington." Historically, the industry tended to put its plants close to the dams that provided the hydroelectric power needed to produce aluminum. As a consequence, several aluminum facilities in Washington were built in small rural counties. In recent decades, not only have these counties struggled with the ups and downs of their resource industries, but they also have not benefited from the rapid growth of the state's high-technology sector. This has left many of them with stagnating economies, high unemployment rates, and low per capita incomes. In such circumstances, the loss of the aluminum industry (its employees and payroll as well as its impact on other businesses and households) would be economically disastrous.

Appendix A

TECHNICAL NOTES

TECHNICAL NOTES

A-1. DEFINITIONS AND CONVENTIONS

Gross State Product

Gross State Product is the Washington counterpart to U.S. Gross Domestic Product (GDP). It is the value of the state's total production of goods and services for final use. Gross State Product can be measured in two ways. First, it is the sum of goods and services purchased by households (personal consumption expenditures), the capital sector (gross private domestic investment), government (federal, state, and local government expenditures), and the foreign sector (exports less imports). Second, it is the sum of value added (gross product originating) in industry, households, and government. Gross State Product, which in this study is valued in 1998 dollars, is the most comprehensive indicator of economic activity in the state.

Output

Except for wholesale and retail trade and transportation services, industry output is the value of production or sales. Output is valued at producers' prices in 1998 dollars. For trade and transportation, output is the value of trade and transportation margins (mark-ups). Output measured in purchasers' prices equals output measured in producers' prices plus trade and transportation margins.

Employment

Adopting the concept used by the U.S. Bureau of Economic Analysis, employment is the annual average number of full and part-time wage and salary employees and self-employed workers (proprietors). In a given year, total employment is greater than the total number of persons employed, as measured by the U.S. Bureau of Labor Statistics, because of workers holding more than one job.

Personal Income

The components of personal income are labor income, property income (dividends, interest, and rent), transfer payments, contributions to social insurance, and the residence adjustment. Labor income includes wages, salaries, proprietors' income, and other labor income earned by job-holders working in the state or county. Note that labor income is measured by place of work, whereas personal income is measured by place of residence. The adjustment for residence, which may be positive or negative, takes into account the income of people who work in one state or county but live in another. Personal income is valued in 1998 dollars. Following standard conventions, the U.S. implicit price deflator for personal consumption expenditures (1998=1.000) is used to convert current-dollar personal income estimates into 1998 dollars.

A-2. IMPACT ANALYSIS METHODOLOGY

Input-Output Models

The input-output model, as represented by the table of output, employment, and income multipliers, is the analytical method most commonly used to measure economic impacts. Five

survey-based input-output models for Washington State have been constructed, the most recent one being for 1987 (Chase, Bourque, and Conway, 1993).

An input-output model shows how industries and households in the economy are interrelated. When one industry expands or declines, the model estimates the production, employment, and income changes in other industries affected directly or indirectly by the demands of the original industry. For example, a drop in aluminum production reduces the demand for transportation services. The decline in transportation services in turn leads to lower levels of employment and income in that industry and a reduction in consumer spending.

Although the Washington input-output model attempts to capture the interactions among industries and households in the state, it still represents a somewhat simplified depiction of economic behavior. In particular, the model is subject to four restrictions that affect the precision of the impact estimates: (1) a static depiction of impacts; (2) constant input-output coefficients; (3) a simple specification of the interactions among production, income, and personal consumption; and (4) a neglect of the indirect impacts of induced private investment, state and local government spending, and population change. In estimating impacts, the fourth restriction is the most significant. Since the input-output model does not take into account induced investment, public expenditures, or migration, it tends to significantly understate the magnitude of economic impacts. For a more complete account of the properties of the Washington input-output model in the context of an impact study, refer to Conway (1991).

Washington Projection and Simulation Model

The Washington Projection and Simulation Model (Bourque, Conway, and Howard, 1977, and Conway, 1990) is a regional interindustry econometric model designed for forecasting and impact analysis. With a comprehensive specification of the structure of the state economy, WPSM is formulated to overcome many of the shortcomings of the input-output model. WPSM IV, whose structure is described here, is the fourth generation of a model originally developed at the University of Washington.

The features of WPSM IV are shown in Table A-1. The model generates economic forecasts on an annual basis, the projection horizon extending up to 25 years. The system of equations is formulated to predict the behavior of 151 endogenous variables. The model consists of 123 behavioral equations, 28 accounting identities, and 68 exogenous variables, the last of which primarily express economic conditions in the United States. WPSM identifies 26 Washington industries (Table A-2) and three public sectors. For each industry, there are projections of output, employment, and labor income. Among the other economic and demographic variables predicted by the model are Gross State Product, personal consumption expenditures, investment, state and local government expenditures, labor force, the unemployment rate, personal income, population by age and sex, and the Seattle consumer price index.

Impact Estimation Procedure

This study draws upon the simulation capabilities of the Washington Projection and Simulation Model to measure the direct and indirect economic impact of the aluminum industry. The impact estimation procedure is, in general, a straightforward exercise. Employing WPSM, the behavior of the state economy is first simulated with the aluminum industry output (and thus the industry's employment, labor income, and in-state purchases) to produce a baseline projection over a period of time. The simulation is then repeated but without the aluminum industry

Table A-1

FEATURES OF THE WASHINGTON PROJECTION AND SIMULATION MODEL

Projection Horizon

1-25 years

Model Size

151 endogenous variables
68 exogenous variables
123 behavioral equations
28 identities

Industry Detail

26 industries, each having projections of
output
employment (wage and salary employees and proprietors)
labor income (wages, salaries, proprietors' income, and other labor income)

Other Selected Endogenous Variables

Gross State Product
personal consumption expenditures
housing construction
nonresidential investment
state and local government expenditures
exports (including federal government expenditures)
imports
labor force
unemployment rate
personal income
per capita income
net migration
population by age and sex
Seattle consumer price index
price of single-family home

Table A-2

CLASSIFICATION OF INDUSTRIES IDENTIFIED IN THE WASHINGTON PROJECTION AND SIMULATION MODEL

Industry	SIC Code
Agriculture	01-02
Forestry and fishing	08-09
Mining	10-14
Food products	20
Apparel	23
Lumber and wood products	24
Paper products	26
Printing and publishing	27
Chemical products	28
Petroleum products	29
Stone, clay, and glass products	32
Primary metals	33
Fabricated metals	34
Nonelectrical machinery	35
Electrical machinery	36
Aerospace	372,376
Shipbuilding	373
Other transportation equipment	371,374,375,379
Other manufacturing	22,25,30,31,38,39
Construction	15-17
Transportation services	40-42,44-47
Communications	48
Utilities	49
Wholesale and retail trade	50-59
Finance, insurance, and real estate	60-67
Services	07,70-86,88-89

output to yield a conditional projection. The difference between the two sets of projections is a measure of the aluminum industry's total (direct and indirect) impact on the state economy. Since WPSM is a comprehensive model, the impact can be expressed in terms of employment and income by industry, population, personal income, household expenditures, state and local government spending, and fixed investment, among other economic and demographic variables.

Since WPSM defines the primary metals industry (SIC 33) but not specifically the aluminum industry (SIC 3334, 3353, 3354, 3355, 3363, and 3365), it is necessary to take into account the differences between the two industries (in terms of their interindustry purchases, employment, and wages) in simulating the economic impact of the aluminum industry. Although the aluminum industry is part of primary metals, simulating changes in primary metals as a whole would not give the desired impact results. Taking note of the aluminum industry employment-output ratio, for example, one can alter the primary metals employment-output ratio in a primary metals simulation through the use of an ADD-FACTOR to give an employment-output ratio equal to that for the aluminum industry (as determined by company records). Similar adjustments to the primary metals simulation can be made to take into account differences in wage rates (income-employment ratios) and in-state expenditures for goods and services (in-state expenditures-output ratios). In effect, the ADD-FACTOR adjustments are tantamount to introducing a new industry, in this case the aluminum industry, into the simulation model.

Employment Multiplier

Employment multipliers are one means of standardizing the measurements of economic impacts for purposes of comparison. The employment multiplier for an industry is defined as the ratio of its total employment impact to its direct employment impact. In 1998, for example, the aluminum industry's sales of $2,567.7 million supported 7,510 jobs (rounded to the nearest ten) in the industry and indirectly supported 22,090 jobs in other Washington industries, according to simulations with WPSM. In this case, the aluminum industry's employment multiplier is 3.9 (=[7,510+22,090]/7,510=29,600/7,510). The multiplier can be interpreted to mean that, on average, each aluminum industry job indirectly supports 2.9 other jobs in the state economy. The aluminum industry's wage and salary employment multiplier, which excludes proprietors, is 3.4 (=25,480/7,510). The aluminum industry has a relatively large multiplier because of its high labor income ($58,710) and in-state expenditures ($131,820) per employee.

County Impacts

There are nine Washington counties that have aluminum plants. Estimating the economic impact of the aluminum industry on each county is basically a three-step procedure:

1. Estimate the direct employment and income impacts on the county.

2. Using an economic base model of the county, estimate the aluminum industry's indirect employment and income impacts.

3. Given the estimate of the total employment impact, estimate the population impact.

Each county economic base model identifies fourteen employment categories, including nine major sectors: resources (agriculture, forestry, fishing, and mining); primary metals; other manufacturing; construction; transportation and public utilities; wholesale and retail trade; finance, insurance, and real estate; services; and government.

The economic base model is specified in terms of income. Thus, following standard procedures for building economic base models, a single income multiplier is estimated for the county. This multiplier, combined with the estimate of the aluminum industry's labor income (after deducting the income of aluminum workers who live outside the county), leads to an estimate of the county's total personal income impact. Employment-income ratios (i.e., the number of jobs in wholesale and retail trade, for example, supported per dollar of personal income in the county) are then used to estimate the indirect employment impact.

The size of the aluminum industry's impact on a county essentially depends upon three things: (1) the size of the aluminum facility (the number of workers and the amount of payroll); (2) the percent of county jobs held by people who live in the county; and (3) the degree to which the county economy is self-sufficient. The first factor determines the size of the direct impact of the aluminum industry on the county, while the next two factors determine the size of the aluminum industry's multiplier.

Note that the sum of the nine county impacts does not equal the state impact. The aluminum impact is not limited to the nine counties, because it spills over into other counties. Two examples of counties that receive these spillover impacts are Yakima and Thurston, both of produce goods and services (in this case, fruits and vegetables and government services, respectively) for the entire state.

Since the economic base model is a simple model, at least compared to WPSM, it is subject to appreciable measurement error. Nevertheless, the results obtained from the economic base models constructed for this study constitute reasonable estimates of the aluminum industry's impact on the nine Washington counties.

Tax Impact

Two tax impacts are estimated. The first, corresponding to the state economic impact, is the impact of the aluminum industry on Washington state and local taxes. These include all taxes collected by the state, counties, cities, and special tax districts in Washington. The second is the tax impact on local governments (the county, cities, and special tax districts) of the nine counties that have aluminum plants.

There are three steps to the analysis:

1. Estimate the taxes paid by the aluminum industry.

2. Estimate the taxes paid by the aluminum industry employees.

3. Estimate the taxes paid by all businesses and employees indirectly supported by the aluminum industry.

Four types of taxes are estimated: sales and use taxes, business and occupation taxes, property taxes, and other taxes. The taxes paid by the aluminum industry are estimated from surveys of the five largest aluminum companies. The survey responses are cross-checked by calculating the aluminum industry's reported tax bases (e.g., gross income) by the appropriate tax rate (e.g., the business and occupation tax rate for manufacturing). Taxes paid by aluminum industry employees and other businesses and employees indirectly supported by the aluminum industry are estimated by multiplying various tax coefficients (e.g., the sales and use tax-personal income

ratio) by the relevant economic impact (e.g., the personal income of aluminum industry employees).

A-3. ALUMINUM INDUSTRY DATA

The direct economic impact of the aluminum industry on Washington State is the industry's output, employment, labor income, taxes, and expenditures for goods and services produced by state county businesses. Information on these variables for 1998, the year of the impact analysis, were provided by the five largest aluminum companies in the state. Together, these companies represent approximately 90 percent of the Washington aluminum industry. The information obtained from the aluminum companies was cross-checked and supplemented with data on the national aluminum industry from the U.S. input-output table (U.S. Bureau of Economic Analysis, 1997).

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Appendix B

ECONOMIC CHARACTERISTICS OF WASHINGTON STATE AND SELECTED COUNTIES, 1998

Table B-1

ECONOMIC CHARACTERISTICS OF WASHINGTON STATE AND SELECTED COUNTIES, 1998

	Washington State	Benton County	Chelan County	Clark County	Cowlitz County
Civilian labor force	3,039,200	70,800	35,030	176,300	41,650
Persons employed	2,894,600	66,100	31,960	169,200	38,380
Persons unemployed	144,600	4,700	3,070	7,100	3,270
Unemployment rate (%)	4.8	6.6	8.8	4.0	7.9
Employment	3,475,690	75,260	46,720	152,570	47,800
Proprietors	646,000	12,700	9,410	33,730	8,110
Wage and salary employees	2,829,690	62,560	37,310	118,840	39,690
Resources	56,620	3,560	4,230	860	650
Manufacturing	383,390	4,380	2,620	20,400	9,750
Primary metals	11,600	380	760	730	910
Other manufacturing	371,790	4,000	1,860	19,670	8,840
Nonmanufacturing	1,853,500	44,330	24,200	78,000	23,170
Construction	149,670	2,930	1,800	10,280	2,770
Transportation and public utilities	137,380	7,800	1,040	5,580	1,620
Wholesale and retail trade	640,810	12,280	8,760	27,750	8,500
Finance, insurance, and real estate	140,830	1,970	1,260	5,540	1,400
Services	784,810	19,350	11,340	28,850	8,880
Government	536,180	10,290	6,260	19,580	6,120
State and local government	392,370	8,950	5,330	15,920	5,500
Federal government, civilian	66,000	810	710	2,450	270
Federal government, military	77,810	530	220	1,210	350
Personal income (mils. $)	159,674.1	3,197.1	1,400.5	8,731.4	1,949.5
Labor income	116,102.1	2,389.7	1,096.4	4,623.1	1,386.1
Property income	26,533.0	475.9	283.1	1,341.5	303.6
Transfer payments	23,475.8	488.4	259.0	1,150.8	408.4
Contributions to social insurance (-)	8,291.9	170.3	73.3	335.4	103.7
Residence adjustment	1,855.1	13.4	-164.7	1,951.4	-44.9
Per capita income ($)	28,066	23,465	23,322	26,706	21,290
Population	5,689,300	136,250	60,050	326,940	91,570

Table B-1 (continued)

ECONOMIC CHARACTERISTICS OF WASHINGTON STATE AND SELECTED COUNTIES, 1998 (continued)

	Klickitat County	Pierce County	Spokane County	Stevens County	Whatcom County
Civilian labor force	8,710	332,500	208,600	17,480	79,200
Persons employed	7,770	317,400	198,600	15,910	74,600
Persons unemployed	940	15,100	10,000	1,570	4,600
Unemployment rate (%)	10.8	4.5	4.8	9.0	5.8
Employment	8,730	326,150	244,810	15,830	91,410
Proprietors	2,480	58,720	43,990	5,150	20,730
Wage and salary employees	6,250	267,430	200,820	10,680	70,680
Resources	460	1,310	540	160	1,930
Manufacturing	1,400	25,710	22,550	2,130	9,520
Primary metals	700	870	3,940	350	1,150
Other manufacturing	700	24,840	18,610	1,780	8,370
Nonmanufacturing	2,720	169,900	141,930	5,810	47,850
Construction	350	14,130	10,610	380	5,660
Transportation and public utilities	370	8,920	7,880	390	2,860
Wholesale and retail trade	850	59,910	49,960	1,910	18,270
Finance, insurance, and real estate	160	13,220	11,510	240	2,580
Services	990	73,720	61,970	2,890	18,480
Government	1,670	70,510	35,800	2,580	11,380
State and local government	1,490	37,870	26,090	2,030	9,990
Federal government, civilian	110	9,390	4,290	400	840
Federal government, military	70	23,250	5,420	150	550
Personal income (mils. $)	352.0	15,779.6	9,468.6	659.7	3,473.3
Labor income	206.4	9,152.3	6,765.6	341.5	2,309.1
Property income	78.4	2,224.4	1,635.9	108.5	720.3
Transfer payments	89.1	2,959.7	1,859.4	169.9	583.3
Contributions to social insurance (-)	14.8	650.8	496.7	25.2	164.6
Residence adjustment	-7.1	2,094.0	-295.6	65.0	25.2
Per capita income ($)	18,240	23,325	23,169	16,716	22,147
Population	19,300	676,510	408,670	39,460	156,830