Regional Employment and Economic Impact Study

Contract 2006-061

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EXECUTIVE SUMMARY

The goal of this study is to draw conclusions regarding the economic impacts of providing different levels of benefits to direct service industry (DSI) aluminum smelters located in Washington and Montana. These conclusions are based on information found in source materials provided to the authors by the Bonneville Power Administration and the Northwest Power and Conservation Council.

The Bonneville Power Administration has developed four Alternatives, one offering no incentives, one offering financial benefits up to $59 million dollars annually, and two offering 560 aMW of power benefits. In the case of Alternatives that provide some benefits to DSIs, up to 320 aMW were proposed for sale to Alcoa, up to 140 aMW to the smelter in Columbia Falls MT., and up to 100 aMW to the smelter in Goldendale. Alcoa operates two smelters in the region, one near Wenatchee, and the other in Ferndale. Alcoa has access to power from the Chelan County PUD that would allow it to operate two potlines at the Wenatchee plant, and in this analysis we have assumed that these two potlines would not use energy from Bonneville. Therefore this portion of the Wenatchee plant has been excluded from estimates of economic impact. Currently one potline is operating at Columbia Falls, but the Bonneville offer would allow two potlines to operate. Currently the Goldendale plant is not operating, and Alcoa is operating one potline at the Ferndale plant. The Bonneville offers would allow one potline to possibly operate at Goldendale, and two potlines to possibly operate at Ferndale.

We conclude that there is some uncertainty as to the likelihood of operation of these smelters, given BPA's offers, their pricing structure and future market prices for power.

> Alternative 2, which offers a dollar-capped financial benefit similar to the current policy, presents considerable uncertainty as to energy price to the smelters, such that if all of them asked for their maximum allocation, we conclude that none would be economically viable. If they requested less than the 560 aMW of energy, then some of them could operate.
>
> Alternatives 3b and 4 have a higher level of certainty because they offer a specific price similar or equal to the priority firm rate, and we conclude that there would requests for Bonneville power under these Alternatives.
>
> No energy would be demanded by the smelters under Alternative 3a in which the offered rate was estimated to be $45 per megawatt-hour; it would have the same economic impacts as Alternative 1 that offers no benefits to the smelters.

The rate impacts on Non-DSI could cost up to 1,666 jobs in the region. However, we conclude that the magnitude of these job losses is likely to be less than the job gains associated with sales of energy under Alternatives 3b and 4. Job gains from smelter operations would be more concentrated in counties with smelters that operate. The losses that result from higher electricity prices, however, would be spread widely across the Bonneville service area. Alternatives 1 and 3a would entail job losses relative to the current (2006) situation.

Table E-1 Short-Term Regional Impacts (Change from base case, Alternative 1)

	Alternative 1-No benefits Provided	Alternative 2 Up to 560 MW capped at $59 million	Alternative 3b- Up to 560 aMW at IP rate	Alternative 4- Up to 560 aMW at PF rate
Total Number of smelter jobs impacted (+ or-)	0	0 to 1276	600 to 1276	600 to 1276
Total Number of jobs created or lost in other industries due to smelters	0	0 to 3545	1659 to 3545	1659 to 3545
Loss of jobs in non-DSI related sectors	0	Up to -1,110	Up to -1,666	Up to -1,666
Total net impact on income ($ millions)	0	0 to $289	$141.9 to $289	$141.9 to $289

Summary of the Results under uncertainty

As we will show in the sections below, there is not a definitive outcome that we can summarize for this study. Under alternative 2, if market prices remain less than or equal to $50, the long-term net gain in employment can be between 95 to 1232 jobs, and net gain in income can be between $6 and $55 million dollars. If market prices increase above $50 dollars per MWh, risk to DSI increases and closure of plants is a possibility. However, based on theoretical analysis, and experience of past plant closures, year 2000, loss of smelting jobs and income would not be permanent as other jobs and income are created (discussion on page 28 of this report expands on this point).

Under alternatives 3b and 4, the risk of higher power market prices is on BPA's customers. The net employment and income impact decreases as market prices increase. As market prices increase, negative impact on non-DSI sectors increase. At the range of market prices we evaluated, we conclude that net employment impact can be between 3182 to 512 jobs. Additionally, the smelter jobs gained are likely to be higher income jobs than those jobs lost so that long-term net income can be between $8 and $159 million dollars.

Note that for alternatives 3b and 4 we assumed that the price offered to DSI remains at around $31 dollars/MWH for the 20-year duration of the contract. However, if DSI power rates increase to $45 /MWH level then closure of the plants is a possibility. But as we discussed above, loss of smelter jobs and income would not be a permanent loss. Table E-2 shows the possible range of employment and income impacts for different alternatives and market price scenarios. Note that in our analysis, we did not vary the price of aluminum, nor did we evaluate market prices of energy over $70 dollars.

Table E-2 Long-term Net Regional Impacts under Various Alternatives

Market Price $/MWH	40	45	50	55	60	70
Alternative 2						
Employment	**1232**	1232	**95**	0	0	0
Income M$	**55**	55	**6**	0	0	0
Alternative 3b & 4						
Employment	**3,182**	2,737	**2,292**	1,874	1,402	512
Income M$	159	134	**109**	83	58	8

I. Statement of Objectives

The goal of this study is to draw conclusions regarding the economic impacts of providing different levels of benefits to DSI Smelters located in Washington and Montana. These conclusions are to be based on information found in Source Materials provided to the authors by the Bonneville Power Administration and the Northwest Power and Conservation Council. The Source Material includes documents developed in 2000 and 2001 as a part of planning the sale of energy to DSI smelters in the region up to the year 2011, as well as source material developed by May 31, 2006 by interested parties responding to a letter issued March 30, 2006 by the Bonneville Power Administration requesting "empirically based papers and studies that will help us understand the positive and negative impacts to the PNW economy that may result from the agency providing benefits to the DSI's (Norman 2006)." This Source Material has been used to evaluate the economic impacts of alternative scenarios on DSI and Non-DSI customers for the 2011-2027 time period. The report is organized as follows. First, we provide some background on the development of the aluminum industry in the Pacific Northwest. Then, we discuss scenarios developed by the Bonneville Power Administration for possible energy sales to the aluminum industry beginning in the year 2011. Next, we focus on smelter economics and the Source Material that we were asked to use in this study. Then we present findings regarding the likely operations of the four smelters given likely energy prices available to them.

II. Background

The Bonneville Power Act of 1937 made provisions for the sale of energy at less than retail utility rates to industrial customers in the Pacific Northwest. This legislation created three classes of customers: (1) public utilities, (2) private utilities, and (3) "direct service industries (DSI's)." DSI's are sold electrical power directly by Bonneville, instead of the normal sale to a customer by a "retail" electrical power utility. The logic of sales to DSI's was to create jobs in communities in the Pacific Northwest, and as a component of the forecasting process for the development of the Columbia and Snake River electrical power system, a share of the power from this system was allocated to DSI's. Historically, the preponderance of this power has been sold to the aluminum reduction industry.

Beginning in 1937/1938, Reynolds located an aluminum smelter in Longview Washington to take energy from Bonneville Dam, and during World War II, aluminum smelters were built in Oregon and Washington to produce aluminum ingot. After World War II there were expansions of the aluminum reduction industry in the Pacific Northwest, to support strategic national materials requirements, and many of these plants were granted highly favorable marketing and financing arrangements to assure that their investments were amortized. Long-run low-cost power contracts were consummated with many of these smelters, and purchase arrangements were made for all of their output in the 1960's and 1970's. There were forecasts of huge expansions in loads for these DSI customers and other customers made by BPA and their consultants in the late 1960's, but these forecasts failed to materialize. In the mid-1970's there was a revolution in methods of electrical power forecasting, in which trend extrapolations of electrical power demands were replaced by much more sophisticated econometric models, that included variables such as the energy cost of competing sources, and the competitiveness of the region, among others. The huge forecasting errors related to earlier institutions led to Congressional action to establish the Northwest Power Planning Council. The NWPPC used modern demand forecasting methods in the early 1980's to forecast much lower growth rates in energy demand in the Pacific Northwest, in large measure due to rising energy prices. The aluminum industry stopped expanding in this region in the early 1970's.

Historically, there were 10 smelters operating in the Pacific Northwest, including one in Montana (Columbia Falls), two in Oregon (Troutdale and The Dalles) and seven in Washington State (Vancouver, Longview, Tacoma, Mead, Wenatchee, Goldendale and Bellingham). Table 1 summarizes characteristics of these plants and their economic impacts. When these plants were operating, they had a combined annual production capacity of 1.66 million tons and energy consumption of 3,147 aMW. They directly employed 13,160 persons and had a total job impact of 37,650 (multiplier effect of 2.86), and had a payroll of $791 million dollars and a total income effect of $1.37 billion (multiplier effect of 1.73).

During the past few years six of these plants have ceased operations and are unlikely to be restarted as a result of high production costs (due to increased energy prices and other causes) and low product prices, among other reasons. The six that are not included in the BPA offers include:

- Alcoa - Troutdale, Multnomah County, OR
- Golden Northwest - The Dalles, Wasco County, OR
- Glencore - Vancouver, Clark County, WA
- Longview Aluminum - Longview, Cowlitz County, WA
- Kaiser - Tacoma, Pierce County, WA
- Kaiser - Mead, Spokane County, WA

Table 1 – Aluminum Industry Plants and Economic Impacts (Data are related to full production)

						Employment		Income ($mils)	
Owner	**Plants**	**State**	**County**	**Capacity (M tons/yr.)**	**Electricity Demand (MW)**	**Direct**	**Direct and Indirect**	**Direct**	**Direct and Indirect**
Plants that are closed									
Alcoa	Troutdale	OR	Multnomah	130	279	520	1,200	$28.3	$31.7
Golden Northwest	The Dalles	OR	Wasco	84	167	530	1,320	$28.8	$51.0
Glencore	Vancouver	WA	Clark	119	228	610	1,230	$35.9	$48.2
Longview Aluminum	Longview	WA	Cowlitz	210	417	880	2,040	$46.6	$71.1
Kaiser	Tacoma	WA	Pierce	71	140	350	850	$19.1	$31.8
Kaiser	Mead	WA	Spokane	209	390	2,180	7,820	$152.1	$304.2
			Sub-total	823	1,621	5,070	14,460	$310.8	$538.0
Plants that could operate									
Glencore	Columbia Falls	MT	Flathead	163	324	610	1,980	$28.7	$65.5
Alcoa	Wenatchee	WA	Chelan	229	428	580	1,590	$37.0	$45.8
Golden Northwest	Goldendale	WA	Klickitat	166	317	700	1,290	$37.8	$40.4
Alcoa Ferndale (INTALCO)	Bellingham	WA	Whatcom	282	457	1,130	3,870	$66.2	$145.4
			Sub-total	**840**	**1,526**	**3,020**	**8,730**	**$169.7**	**$297.1**
			% Total	51%	48%	37%	38%	35%	36%
			Total all	1,663	3,147	8,090	23,190	$480.5	$835.1

Sources:
Production capacity and energy consumption data from Metal Strategies, LLC, The Survivability of the Pacific Northwest Aluminum Smelters, Redacted Version, February, 2001.
Employment and Income impacts from studies by Dick Conway & Associates for the Pacific Northwest Aluminum Association (separate studies for Washington, Oregon and Montana).(Conway Jr. 2000a), (Conway Jr. 2000b), (Conway Jr. 2000c)

III. Discussion of Scenarios and Bonneville's Proposed Allocation of Energy

Bonneville has proposed the possible sale of 560 MW of power to the aluminum industry beginning in FY 2012, as well as 17MW to Port Townsend Paper, as listed in Table 2. This energy represents requirements at Goldendale to operate one potline, and to operate two potlines at Columbia Falls. The allocation to Alcoa could operate one potline at Ferndale and two potlines at Wenatchee, or could be used to operate two potlines at Ferndale. As discussed below, Alcoa has an alternative power source in Wenatchee, and could operate two potlines or about 40% of its plant there without taking Bonneville energy.

Table 2 Allocation of Energy

Alcoa (Whatcom and Chelan counties in Washington State)	320 aMW
Columbia Falls (Flathead County in Montana)	140 aMW
Goldendale (Klickitat County in Washington State)	100 aMW
Port Townsend Paper (Jefferson County in Washington State)	17 aMW
Total	577 aMW

Bonneville provided four alternatives, whose properties are described in Table 3. Bonneville has assumed for the purpose of this analysis that the priority firm power rate in FY 2012 costs would be $30 per MWh in Alternative one, which is considered the base case for this analysis, while the market rate in FY 2012 would be $50 per MWh. It further assumes that power sales to DSI's would be for a flat block of power, delivered evenly across all hours of the day.

Alternative #1 presumes that no Bonneville power would be sold to these DSI customers.

Alternative #2 would provide up to $59 million in benefits to the four aluminum plants. Table 2 provides data on the allocation of energy to the three aluminum companies, plus energy that would be sold to Port Townsend Paper. In this alternative, if the three aluminum plants purchased all 560MW of energy, this would be 4,905,600 megawatt-hours of energy (365 days x 24 hours/day x 560MW). Dividing this level of megawatt hours into the $59 million in total benefits yields $12.03 per MW hour benefit in the price paid by the DSI's to Bonneville for energy. If the market price is assumed to be $50, then $50 minus $12.03 equals $37.97MWh would be the price paid to Bonneville by the DSI's. In this alternative, if less than 560MW of energy were used continuously, the same level of benefit would theoretically be available, which would increase the MWh price reduction from market rates. However, this rate cannot fall below the priority firm power rate (defined by Bonneville to be $31MWh for this scenario). Under this alternative many possible levels of purchase are likely. Columbia Falls and/or Alcoa could operate only one potline, and Goldendale might not restart. We have modeled many responses to this alternative in Section V of this report,

Alternative #3 would make available the 560MW to smelters as described in Table 2 priced at industrial firm power (IP) rates, with two possible pricing outcomes. Section 7(b)(2) of the Northwest Power Act says that if the Act causes rate increases for publicly-owned utilities over what they would have been without the Act, then the increased costs would be allocated to the DSI's and investor-owned exchanging utilities. If clause 7(b)(2) is not triggered, then the industrial power rate would be $31.50 per MWh, while if it is triggered then the industrial power rate would rise to $45 from Bonneville.

Alternative #4 would sell up to 560MW at the lowest priority firm power rate to the DSI's, which would be $31.50 per MWh.

Table 3: BPA's Projected Power Rates in FY 2012 (Rates in MWh)

Alternative	Description	Change in Priority Firm Power Rate	Change in Industrial Power Rate
Alt. #1	Base Case - $0 DSI Benefits	$0.00	NA
Alt. #2	Current Proposed Financial Benefits of $59 million	$1.00	NA
Alt. #3a	560MW Sale at IP Rate (7(b)(2) triggered)	$0.40	$15.00 *
Alt. #3b	560 MW Sale at IP Rate (7(b)(2) not triggered)	$1.50	$1.50
Alt. #4	560MW Federal Power System Sale at equivalent to lowest cost priority firm power rate	$1.50	NA

***- Assumes all of increase in cost is recovered from DSI.**

IV. Aluminum Smelter Economics and Available Source Material

Data Needs for This Analysis. In an analysis of this type, we would ideally have at our disposal an accurate forecast of market and cost of production conditions over the time period being analyzed (2011-2027). This would include data on alumina costs, transportation costs for alumina to each smelter (ocean freight costs as well as barging or overland transportation costs), electrical power costs, labor costs, non-electrical power operating costs (except labor), transportation costs on the shipment of ingot to markets, and the price of aluminum metal (which is quoted on the London Metals Exchange). In order to evaluate the economic impact of various levels of production on the regional economy, data of the type just described should be available on expenditures made for goods and services that could be used with a model of a regional economy, such as an input-output model. Data should also be available on the economic impacts on other industries and customers related to a decision to allocate energy to DSI's. Ideally, these data would be structured so that local economic impacts could be evaluated separately from regional economic impacts.

Given the nature of smelter operations, and the data needs for undertaking a judgment regarding the economic impacts of the alternatives identified in Table 2, the reviwers were asked to consider the Source Material that is referred to in Table 4. This table indicates the date when the Source Material was written. The studies included here fall into three broad categories. They are (1) economic impact studies using input-output models assessing indirect and induced impacts of aluminum industry operations on regional economies (2, 3, 4, 5, 6, and 8), (2) studies of the plants themselves and their economic viability (items 1 and 9), and (3) a study of impacts of higher electricity rates, which would result from providing benefits to aluminum companies, on other businesses and households (item 7).

Table 4 Guide to Source Material

Author and Study #	Title
(1) Metal Strategies LLC (2000) (Moison 2000)	The Survivability of the Pacific Northwest Aluminum Smelters
(2) Policy Assessment Corporation (Backus and Kleeman 2000)	Impacts of Aluminum Industry Closings on the Pacific Northwest
(3) Dick Conway & Associates (2000) (Conway Jr. 2000)	The Washington State Aluminum Industry Economic impact Study
(4) Dick Conway & Associates (2000) (Conway Jr. 2000)	The Oregon State Aluminum Industry Economic Impact Study
(5) Dick Conway & Associates (2000) (Conway Jr. 2000)	The Montana State Aluminum Industry Economic Impact Study
(6) Mid-Columbia Economic Development District (2000) (District 2000)	An Assessment of the Employment and Income Impacts of the Primary Metals Industry in Wasco and Klickitat Counties
(7) Hamilton Water Economics and Economic Modeling Specialists Inc. (2006) (Hamilton and Robison 2006)	Economic Impacts from Rate Increases to Non-DSI Federal Power Customers Resulting from Concessional Rates to the DSI's.
(8) Dick Conway & Associates (2006) (Conway Jr. 2006)	The Economic Impact of the Washington State Aluminum Industry
(9) CRU Strategies Ltd. (2006) (CRU Strategies 2006)	Northwest Smelter Operating Outlook

IV. Gap Analysis – Comments on Source Material Relative to our Assignment.

The previous section of this report has outlined the nature of the Source Material. We now turn to the adequacy of data in the Source Material with regard to our charge to present to the Bonneville Power Administration an estimate of the economic impact of the four alternatives described above. The economic impacts of the Alternatives depend directly on whether they are effective in allowing the plants to operate. None of the source material addresses this issue directly, although items #1 and #9 approach the question of vulnerability.

Table 5 provides a guide to the committee's evaluation of the relevance of the Source Material. This table makes it clear that most of the Source Material is not directly relevant to the charge to this committee. Most of it does not address the time period when Bonneville must make decisions about whether to allocated this 560MW of power to DSI's.

Table 5 Relevance of Source Material to This Analysis

Author	Does the Report Address Conditions in 2011-2027	Are the data useful for addressing conditions in 2011-2027
(1) Metal Strategies LLC (2000)	NO	Somewhat
(2) Policy Assessment Corporation (2000)	YES, partially	Somewhat
(3) Dick Conway & Associates (2000)	NO	Somewhat
(4) Dick Conway & Associates (2000)	NO	Somewhat
(5) Dick Conway & Associates (2000)	NO	Somewhat
(6) Mid-Columbia Economic Development District (2000)	NO	Somewhat
(7) Hamilton Water Economics and Economic Modeling Specialists Inc. (2006)	YES, partially	Somewhat
(8) Dick Conway & Associates (2006)	NO	Somewhat
(9) CRU Strategies Ltd. (2006)	Yes, partially	Yes, partially

Economic Impact Studies

Existing economic impact studies of smelters (Source Material items 2, 3, 4, 5, 6, and 8) provide useful data on the economic impacts of the four smelters that could possibly receive Bonneville power beginning in 2011. Item (2) contains estimates of the economic impact of closedown of each smelter in the region over the 2001 to 2020 time period. Items (3), (4), (5), (6), and (8) provide estimates of cross-sectional economic impacts benchmarked against the year 2000 or 2001, and in the case of item (8) for Washington State smelters in the year 2006. Item (7) provides useful information on economic impacts on non-federal power customers. In each of these studies, input-output models are used to estimate indirect and induced impacts on specific regions as a result of either power supplied to specific smelters, or the cessations of power supplies to these smelters. These studies estimate output, employment, and labor income economic impacts. None of these studies are linked to BPA's scenarios for possible power sales after 2011 to these smelters.

Caveats on the Economic Impact Studies

Almost all of the economic impact studies (items #2, 3, 4, 5, 6, 7, and 8) are benchmarked against historic conditions in the regional aluminum industry. This is not the case for studies #7 and #8. Those studies that are benchmarked against the historical industry

(#2, 3, 4, 5, and 6) provide useful information on output (sales or GSP) impacts, employment impacts, and labor income impacts of the industry. Study # 8 refers to the current situation in the Washington aluminum industry. None of these studies anticipate conditions that the industry will face in 2011, and none of them are based on a cost estimate of the profitability of these aluminum smelters in the year 2011. Hence, a key question for the consultants emerges from the existing studies. We have many historic economic impact studies, and they have been conducted by highly respected organizations.

The main point that we would make is that these studies have relied on data that is not relevant to the current question at hand, or is only marginally relevant.

Plant Studies

Source Materials 1 and 9 provide information on particular plants being considered for benefits by BPA for the 2011-2027 time period. The Metal Strategies study (Item #1) provides useful operations data for each smelter. The CRU study (Item #9) provides useful information on the two Alcoa smelters operating in the region

Smelter Economics

Aluminum smelters operate on a continuous basis. There are high startup and shutdown costs (CRU Strategies 2006, Moison 2000). Given the high electrochemical requirement of energy to separate oxygen and aluminum from alumina in the reduction process, historically aluminum smelters have been located in regions with relatively low energy costs, and long-run guaranteed supplies of energy that allow amortization of the capital intensive facilities in this industry. As the federal power system was developed in the Pacific Northwest, a specific provision was made for a class of customers in the Bonneville Power Act who would use electrical power in energy-intensive types of manufacturing, the direct service industrial customers (DSI's). Ongoing technological improvements in rectification and distribution equipment, and in the scale of smelting facilities, have gradually lowered the energy requirements in highly efficient plants. The CRU report notes that Northwest smelters are relatively old, and are less energy efficient than new state-of-the-art facilities (CRU Strategies 2006). Between rising energy prices, technological obsolescence, changing world market conditions, and shifting locations of global aluminum reduction capacity, the aluminum reduction industry in the Pacific Northwest has had a sharp downturn in output in recent years. Northwest smelters have moved over the span of the last several decades from being highly competitive to marginal operations. A number of these plants have closed permanently, and others are operating intermittently or on a partial capacity basis.

Comments on the CRU Study

In its report, CRU advocated a power pricing structure different than the current BPA offer. CRU suggests a two-tier pricing structure with a low, cost-based price for a portion of the load, supplemented by market-priced power for the balance of the load. The CRU proposal is quite different from the BPA's current offer of an "economic benefit" (otherwise called a subsidy) to producers based on how much the producer obtains market power. The industry has been seeking power at a low fixed rate.

The desire for cost-based power by the industry arises from its key operating characteristics. The Hall-Heroult smelting technology is an electro-chemical process that reduces alumina into aluminum metal. The reduction takes place in a steel pot with a carbon lining (serving as the cathode) and a carbon anode in the presence of a catalyst (cryolite). In normal operations, the anode is consumed and replaced every 40 days while the lining lasts seven to eight years. Pot lining is a very expensive and labor-intensive process. The smelting process has been optimized over time as continuous, 24 hour a day- and 7 day process. The only interruption in normal operations is replacing anodes (which can be done in hours) and relining those pots as required (which takes weeks).

Potlines can obviously be both started and shut down. This is the operating response to cyclical changes in market conditions. However, both are very expensive processes. Starting a line can take four to six months. CRU estimates this expense at the Ferndale smelter at $7MM per potline or $74/mt. Shut-down expenses are roughly 50% of start-up expenses. CRU estimates that standby costs to perform ongoing maintenance on an idle smelter at $30MM per year[1]. Additionally, starting and shutting a potline substantially shortens the average life of the pot lining. Thus, actual operating costs tend to be higher than a theoretical calculation of cost. Additionally, pot linings deteriorate over time if a potline is not operated. Consequently, the cost of lines not run for a substantial period will likely have both higher start-up and operating costs than a theoretical calculation. These costs can be reduced if maintenance personnel are present at the smelter.

Thus, there does appear to be logic supporting a view emphasizing a base level of continuous production, which might be relatively small, with the balance of capacity used on a swing basis.

The most important issue for the viability of an aluminum smelter is electric power -- both availability and rate. While this can be modified somewhat by the technology employed (power efficiency), normally a function of the smelter age, the cost of power is the dominant determinant of the competitiveness of a smelter. This is why the issue of a competitive power rate is critical to the viability of the smelters in this region.

A related issue is the structure of the power rate. The structure of the current BPA offer for the 2006-2010 period is as an explicit economic benefit in the form of payment in lieu of physical power. The expectation is that this economic benefit combined with acquisition of power from the market would lead to an effective power rate that would make the smelters viable. This structure likely has advantages for the BPA and non-DSI's including a known cost. However, this structure imposes extra costs and uncertainties on the smelters that affect their viability. The current market for power in the form of forward market quotes for Mid-Columbia and California-Oregon border (annual average for quotes for the next 3 years) does not appear to combine with the BPA offer to achieve a power price close to the preference rate. The market power rate is determined by regional supply-demand conditions for power that is influenced by a number of factors including gas and other energy

[1] If employment of a core group of around 400 staff per smelter is to be maintained, this will cost $24 mn/yr per smelter and raises the standby costs to nearer $30 mn/yr in total.

prices. Fluctuating market prices for power has historically not been a successful recipe for the smelter industry. In order to create the synthetic equivalent of the traditional pricing formula (preference rate), the smelter needs to obtain forward pricing either by obtaining a guaranteed price or using derivative instruments for hedging. Using hedging requires significant costs that could prove prohibitive for a smaller, less sophisticated operator as well as adding to costs for all. One issue is whether in fact the market in power derivatives in the region have sufficient liquidity to enable effective hedging at all. In any event, there are material added costs as well as uncertainties added by the structure of the offer.

Plant Studies

Items #1 and #9 are studies of given plants, and we have carefully considered them in our analysis. Item #1 does not address the future of federal power to them after 2011 to any detail, but does develop scenarios regarding shutdown of each plant by county that can be used in this current assignment of estimating economic impacts. Some of the Dick Conway studies can be regarded as plant studies, as they reported results related to particular plants. This is the case with study #8 (the remaining Washington plants).

Alcoa Plants Alcoa submitted a report written by CRU Strategies, Inc on the operating outlook for Ferndale and Wenatchee, the two smelters owned by Alcoa in the Pacific Northwest. The Ferndale smelter, located near Bellingham (WA), has three potlines that use 144KA[2] technology. The Wenatchee smelter, located in Wenatchee (WA), has five potlines, three of which use 103KA technology and one that uses 132KA technology. These smelters are no longer state-of-the-art, which for the industry is now 300-350KA.

The top two U.S. smelters in terms of technical efficiency are Ferndale and Mt. Holly. Alcoa owns 50% of Mt. Holly, which is located in South Carolina. When it was built in 1980, the smelter had 180KA pot technology. It is noteworthy that Alcoa has upgraded Mt. Holly to 225KA in recent years, while Ferndale's technology has never been improved and the smelter has been partially idled for the past five years. Alcoa's decision to upgrade one over the other likely stems partially from the company's perception of power rates and stability of power rates between the two regions.

The pot technology employed at a smelter is critical to its technical performance. In general, higher amperage results in more production and less power used. In addition, smelters with higher amperage have higher labor productivity. The specific amount of power used is critical in determining what electricity rate a smelter can pay and operate profitability over the long term.

In technical terms, Ferndale is the most advanced smelter in the region, and it is above average by world standards. Wenatchee is below average by world standards because it's older. This smelter has two important issues beyond technology. First, it is at a disadvantage because its inland location significantly adds to freight costs for both incoming alumina (which is shipped from Australia) and outbound ingot shipments. Second, Wenatchee has the advantage of access to 200MW of power from Rocky Reach at good

[2] KA is defined as thousands of amperes.

power rates, which enables Wenatchee to run part of the smelter in spite of other cost disadvantages.

Table 6 entitled Alcoa Operating Economics shows our estimates of power prices that are needed for Ferndale and Wenatchee to achieve breakeven profitability under full and partial restart scenarios. (Full and partial production of the smelter were examined to differences in costs that result from different scales of operations.) Our estimates start with various cost and technical parameters from the CRU study, supplemented by a few of our assumptions where necessary (CRU Strategies 2006). The data uses the five-year average projection from 2011-2015 in constant 2005 dollars for both pricing and cost elements. The key items from CRU are:

- LME 3-month contract price,
- U.S. market premium,
- Outbound freight,
- Alumina pricing, and
- Operating costs excluding alumina and power (including alumina freight).

CRU assumes an LME 3-month price of $1,557/mt. From this, we subtract $30/mt, which is what we assume as the normal contango (the 3-month price less the cash price). We then add CRU's estimate of $100/mt for the U.S. market premium and subtract CRU's estimate of $40/mt for freight. This gets us to net realized ingot price of $1,587/mt for Ferndale and $1,537/mt for Wenatchee. (Wenatchee's price is lower because of its higher freight costs.) Note, these prices are in '05 dollars for 2011-2015 period.

We now estimate costs for each smelter. We calculate the alumina cost at $388/mt, which is CRU's estimate of the price of alumina at $199/mt multiplied by 1.95, which is the number of tonnes of alumina needed to make one tonne of aluminum. We then take CRU's estimates for all the other costs excluding alumina and power, which varies depending on the smelter and depending on whether there is a full or partial restart. For example, CRU estimates that Ferndale under full production would have operating costs excluding alumina and power at $552/mt. When added to alumina costs, this results in operating costs excluding power at $940/mt. This cost figure is subtracted from the realized price, resulting in a break-even power cost. This is the per-ton dollar amount that the smelter can expend on power and still break even on a cash basis (no profit and no depreciation). Dividing the power cost by power efficiency (MWh/mt) yields the power rate that the smelter can pay and breakeven on a cash basis. CRU gives the power usage of Ferndale at 16.0MWh/mt. This appears consistent with data from similar technology smelters including 15% rectifier losses. This is power lost to convert alternating current from the grid to direct current needed to power the pots. (In the CRU and the Metal Strategy studies, all power usage data are direct current at pots.) Based on CRU's estimate for Ferndale, we estimate a power usage of 17.7MWh/mt for Wenatchee, recognizing that there are differences in technology at the two smelters. The result is that the cash breakeven power rate for Ferndale at full operation is $40.4/MWh—Ferndale could afford to pay $40.4/MWh and break even with any rate lower generating a profit. At partial operation, the breakeven rate falls to $33.3/MWh. The breakeven rate for Wenatchee is $29.4/MWh for full operation and $22.0/MWh for partial operation.

Table 6 Alcoa Operating Economics

	Average of 2011-2015 in 2005$			
	Alcoa Ferndale (INTALCO)		**Wenatchee**	
	Full	Partial	Full	Partial
Revenues ($/mt)				
LME 3-month contract aluminum price	$1,557	$1,557	$1,557	$1,557
Contango (3-month contract less cash price)	30	30	30	30
LME Cash contract	1,527	1,527	1,527	1,527
U.S. Market premium	100	100	100	100
Outbound freight	40	40	90	90
Net realized price	**$1,587**	**$1,587**	**$1,537**	**$1,537**
Costs ($/mt)				
Alumina (1)	$388	$388	$388	$388
Operating costs ex. alumina & power	552	666	629	759
Total operating costs ex. power	**$940**	**$1,054**	**$1,017**	**$1,147**
Profit Analysis ($/mt)				
Net realized price	$1,587	$1,587	$1,537	$1,537
Total operating costs	940	1,054	1,017	1,147
Cash breakeven power cost	**$647**	**$533**	**$520**	**$390**
Power Efficiency (MWh/mt) (2)	16.0	16.0	17.7	17.7
Cash breakeven power price ($/MWh)	**$40.4**	**$33.3**	**$29.4**	**$22.0**
Cash breakeven power cost	$647	$533	$520	$390
Return on Capital ($/mt)	175	175	100	100
Power cost to earn cost of capital ($/mt)	**$472**	**$358**	**$420**	**$290**
Power Efficiency (MWh/mt) (2)	16.0	16.0	17.7	17.7
Power rate needed to earn cost of capital ($/MWh)	**$29.5**	**$22.4**	**$23.7**	**$16.4**

Source: CRU Strategies, Inc

(1) alumina costs at $199/mt fob Australia x 1.95 mt of alumina per mt of aluminum
(2) includes 15% rectifier losses

However, smelters will not operate long term without earning their cost of capital. In recent years, smelting capacity in the middle of the global cost curve has been acquired at a price close to $2,000/mt. This would require profits of $190/mt to earn cost of capital at a rate of 9.5% (CRU's assumption) for our benchmark smelter at the middle of the cost curve. We have no knowledge of the asset value on Alcoa's books, but we estimate that given their technologies and power costs, the economic value of Ferndale is slightly below this benchmark and Wenatchee is significantly below this benchmark. (With likely power rates, Ferndale is somewhat above the middle of the cost curve while Wenatchee is further up the cost curve.) We estimate that Ferndale and Wenatchee need $175/mt and $100/mt, respectively, to earn its cost of capital. This lowers the power rate that Ferndale and Wenatchee can pay to $29.5/MWh and $23.7/MWh, respectively, at full production and $23.7/MWh and $16.4/MWh, respectively, for partial production.

Alcoa Conclusions: A power rate close to the projected preference rate of $31/MWh appears to make Ferndale a viable smelter long term, providing there is sufficient power at that rate for full operations. The future of Ferndale without those conditions is uncertain. A power rate below the projected preference rate appears to be needed for Wenatchee. Hence, Wenatchee will likely survive in some form based on access to Rocky Reach but is questionable without that access. These conclusions are similar to those expressed in the CRU study.

Extension to Other Smelters: The CRU study only addressed the two Alcoa smelters. Therefore, we cannot calculate similar parameters for other smelters in the region. We must also be quite careful in comparing cost estimates from Metal Strategies because the study was done in 2000 and some of the costs have changed meaningfully since then. Moreover, there is a loss of technical performance when a smelter has not been running for an extended period of time. Pot lining deteriorates materially, plus there is usually a significant worsening in equipment and even technical parameters unless a maintenance staff has been on site. This would cause start-up costs to be much higher than the $7MM cited by CRU in its study for smelters that have been idled for more than a few years. Additionally, operating costs are also likely to be higher because pots have to be relined more often. These key changes also severely limit the usefulness of the 2000 smelter cost data.

However, we can examine the efficiency comparison based on the study by Metal Strategies. These data show that the power usage per metric ton for all the smelters in the region is significantly higher than Ferndale. This implies that costs are higher at the other smelters, which lowers the breakeven power rate. While more data are needed to make a definitive statement, these data suggest that the other smelters may not survive at the preference power rate of $31/MWh without some additional advantage. (Columbia Falls may have some advantage from the commodity trading skills of its parent company, access to power outside the Northwest including Canada, and lower outbound freight rates.) However, additional data needs to be gathered before any smelter is "written off" from a regional public policy perspective.

<u>Relationship between Alcoa & Chelan PUD</u>

Alcoa and the Chelan PUD have an agreement to supply energy to the Wenatchee Alcoa Plant through 2011. The Chelan PUD has traditionally provided an incentive to Alcoa in the form of low energy rates if the firm maintained certain levels of employment. For example, during the shutdown from mid-2001 to late-2004, Alcoa's agreement with Chelan PUD allowed it to have access to a quantity of power equal to 23% of Rocky Reach production on the market and returned market price less cost of generation and administrative expenses to Alcoa/Colockum during shutdown mode. In return, Alcoa agreed to employ a minimum of 390 employees during the shutdown period.

During operations, the Chelan PUD remarkets power not used by the Wenatchee plant and holds the net proceeds (sales less administrative costs), which may be used by Alcoa as a credit against future purchases from the District. In 2005, the average price for Alcoa's resales was 11.04/MWh., as reported in Table 7.

Table 7 – Chelan County PUD Major Customers - 2005

Customer	Business	Energy Sales (000 MWh)	Revenues from Energy Sales ($1,000s)	% of Total Revenues From Energy Sales	$/MWh
Alcoa Power (2)	Aluminum Mfg.	1,465	16,171	11.40%	11.04
Douglas County PUD	Electric Utility	172	1,920	1.40%	11.16
Stemilt Growers Inc.	Agriculture	64	1,298	0.90%	20.28
City of Cashmere	Electric Utility	60	800	0.60%	13.33
Keyes Fibre Inc.	Paper Products	40	650	0.50%	16.25
		1,801	$20,839	14.80%	11.57

Source: (Chelan County 2005) , page 76

(1) Excludes nonfirm sales for resale.

(2) In 1992, the Distribution Division and Alcoa entered into a long-term contract extending through 2011 which assigned Alcoa Power's 23% share of the output of the Rocky Reach System to the Distribution Division. In return, the Distribution Division will provide 23% of the Rocky Reach System output to Alcoa at cost and procure any additional power needed or sell any surplus power to Alcoa Power at contractual rates, which approximate market rates. In July 2001, Alcoa curtailed production at its Wenatchee plant. Alcoa received the net proceeds of sales from their share of power marketed by the District.

In December 2004, Alcoa restarted production at its Wenatchee plant. If Alcoa needs additional power, the Chelan PUD has an obligation under the current contract to make 42 MW of firm energy available at average industrial rates. Over the past five years, Chelan PUD's industrial users have been charged around $19/MWh, as reported in Table 8.

The ability of Alcoa to blend the rates from BPA and Chelan PUD improve the viability of the Wenatchee plant. However, the terms of the current contract only extend until 2011 and are unknown beyond this point.

Table 8 - Average Chelan PUD Industrial Rates

Item	2001	2002	2003	2004	2005
Energy Sales (000 MWh)	267	254	263	268	285
Revenue ($000)	5,126	4,877	5,017	5,077	5,326
$/MWh	19.20	19.20	19.08	18.94	18.69

Source: (Chelan County 2005), pages 74 and 75

Review of Short-Term Multipliers

Table 9 pulls data from the Source Material that summarizes multipliers and estimated current employment at the four smelters if they operated at the number of potlines indicated in this table. The Conway and Policy Assessment (PA) studies contained employment multipliers, or they can be calculated from the data provided in these studies. The Conway studies also allow income and output multipliers to be calculated for most smelters (no output multiplier reported for the Columbia Falls smelter). The multipliers reported in Table 5 are state level multipliers. The employment multiplier for the Conway studies in Washington State are considerably above the PA employment multiplier. In contrast, the Policy Assessment employment multiplier for the Columbia Falls plant is well above the Conway employment multiplier. While the PA study reported income and gross regional product impacts, it does not report direct income or sales, making it not possible to estimate multipliers comparable to those derived from the Conway studies. The Conway and Mid-Columbia Economic Development District studies are typical regional economic impact studies using input-output models. These are cross-sectional studies that do not take into account long-run economic impacts.

Table 9 Short-Term Multiplier Comparisons

	Estimated Direct Employment	**Conway Jobs Multiplier State**	Conway Jobs Multiplier County	Conway Income Multiplier State	Conway Income Multiplier County	Conway Output Multiplier State	**PA Jobs Multiplier State***
Alcoa Wenatchee – 2 Potlines	380	**3.94**	2.74	3.13	1.24	1.71	**2.46**
Alcoa Ferndale (INTALCO) – 1 Potline	460	**3.94**	3.42	3.13	2.20	1.71	**2.46**
Columbia Falls – 2 Potlines	277	**Not Reported**	3.25	2.68	2.28	Not reported	**4.05****
Goldendale – 1 potline	249	**3.94**	1.84	3.13	1.07	1.71	**2.46**

*- Employment impact multiplier in 2001 (Short-term multiplier)
** - Reflects impact of losing a relatively large employer is a small county

V. Operational Conclusions and Recommendations

After considering the Source Material provided by BPA, and selected other materials referenced in this report, the consultants arrive at the following conclusions, summarized in Table 11.

Assuming that the Chelan County PUD continues to provide the Alcoa Wenatchee smelter with energy at low costs, we visualize this smelter able to operate two potlines under all the scenarios posed by Bonneville. If this were the case, this smelter would need no Bonneville energy, and we have not considered it in the economic impact estimates presented below, that are based only on the supply of Bonneville power to these smelters.

Under alternative 1, in which no federal energy would be provided to any smelters, we conclude that the smelter in Goldendale will remain closed, and the Ferndale and Columbia Falls smelters will close.

Under alternative 2, in which up to $59 million per year in benefits will be granted to the smelters as described in Table 2, we conclude that Alcoa could operate either one or two potlines in Ferndale, the Goldendale smelter has an equal probability of remaining shut down or operating one potline, and the Columbia Falls smelter would operate two potlines. The result for alternative 2 depends upon the actual demands for power from Bonneville. If all 560MW of power are demanded, and the price is $38/MWh, we conclude that the Ferndale, Goldendale, and Columbia Falls plants would probably not be competitive. However, if the Goldendale plant did not demand federal power, then the price to others (assuming they wanted federal power) would drop to about $35MWh, and if Alcoa took its energy from Chelan County and shifted its federal energy demands to Ferndale. If Alcoa sought to operate only one potline at Ferndale, then under the subsidy formula the energy cost to the smelters would be about $33MWh, a level that would probably keep these smelters operating at the levels assumed here. We have also modeled the impacts of the possibility of Alcoa operating two potlines at Ferndale.

Alternatives 3b and 4 would have the same result as under alternative 2. Under Alternative 3a, the result would be the same as under alternative 1.

Table 10 -Likely Operating Scenarios FY 2012 - (number of potlines operating)

	Current Situation	Alt 1	Alt 2	Alt 3a	Alt 3b	Alt 4
Wenatchee	2	2	2	2	2	2
Alcoa Ferndale (INTALCO)	1	Shut down	1 or 2	Shut down	1 or 2	1 or 2
Goldendale	Shut down	shut down	0 or 1	Shut down	0 or 1	0 or 1
Columbia Falls	1	Shut down	Possibly 2	Shut down	1 or 2	1 or 2

Economic Impact of Alternatives

Given the short-term multipliers reported above from the various studies, we can estimate short-term employment and income impacts, as reported in Table 11, assuming that the plants are operating, using the Source Material. To access the employment impact, we start with using <u>the state multiplier of 3.94 as reported in the Conway study, but in the sensitivity section of the report we relax this assumption</u>.

The income impacts have been computed using the data from the 2000 studies, and the 2006 update by Conway (Conway Jr. 2006). In particular, estimated labor income levels have been adjusted upwards for direct effects from the levels of the 2000 studies, using the consumer price index from the BLS for the period 2000-2006 (this value is 1.176). It is recognized that this may not be the best indicator of labor income changes since 2000, but we will use it for purposes of this impact study.

Table 11 Short-term Economic Impacts of Aluminum Reduction Plants Operating Under Benchmark Scenarios (Including Goldendale operating one potline) Income impacts millions $2006

	Direct Jobs	State Job Impacts	Local Job Impacts	Income Impact State	Income Impact Local
Alcoa Wenatchee	380	1497	1042	$102.6	$40.7
Alcoa Ferndale 1 potline	460	**1812**	1575	114.0	80.2
Alcoa Ferndale 2 potlines	750	**2955**	2569	185.9	130.7
Columbia Falls 1 potline	140	Not reported	**447**	27.9	20.3
Columbia Falls 2 potlines	277	Not reported	**885**	47.3	40.2
Goldendale	249	**981**	459	55.8	19.1

The bolded values used in the subsequent analysis.

We can now move to estimate short-term economic impacts under the various scenarios reported in Table 11. These impacts are reported in Table 12. Table 12 presents short-term estimates of employment and income impacts at the regional levels. We find that economic impacts are the lowest under alternatives 1 and 3a, as none of the plants would operate. The impacts of Alternatives 2, 3b and 4 are estimated to be the same, and are either equal to the current level of impacts, or if the Goldendale plant operates and if Alcoa operates two potlines at Ferndale, are raised by the magnitudes of the economic impacts reported in Table 11 for this plant. Impacts of two potlines being operated at Ferndale are benchmarked against an estimated 750 employees.

Table 12 - Short-term State Economic Impacts of Alternative Scenarios

	Alt 1	Alt 2	Alt 3a	Alt 3b	Alt 4
Employment Impact State					
Alcoa Ferndale (INTALCO)	0	0 or 1812 or 2955	0	1812 or 2955	1812 or 2955
Goldendale	0	0 or 981	0	0 or 981	0 or 981
Columbia Falls	0	0 or 447 or 885	0	447 or 885	447 or 885
Region Total	0	0 to 4821	0	2259 to 4821	2259 to 4821
Income Impact State ($ Millions)					
Alcoa Ferndale (INTALCO)	0	0 or 114 or 185.9	0	114 or 185.9	114 or 185.9
Goldendale	0	0 or 55.8	0	0 or 55.8	0 or 55.8
Columbia Falls	0	0 or 27.9 or 47.3	0	27.9 or 47.3	27.9 or 47.3
Region Total	0	0 to 289	0	141.9 to 289	141.9 to 289

Offsetting these short-term economic impacts are the possible effects raised by the non-DSI study.

Non-DSI Impact Study

The non-DSI impact study (Item #7) was produced by Economic Modeling Specialists Inc. for the Public Power Council (Hamilton and Robison 2006). This study modeled assumed economic impacts on the 4-state region within which BPA distributes power due to assumed increases in energy rates to utilities given a sale of 560MW to DSI customers. The study assumes that there is a rate subsidy of $150 million in its base case analysis, and then models the economic impact of this assumed subsidy by estimating reduced income to industry sectors, and assuming that this translates into reduced spending by regional consumers (due to reduced income). This study concludes that there would be a short-run economic impact of 2,235 job losses, and a long-run economic impact of 2,823 job losses. The study also predicts value-added impacts. The study indicates that the economic impacts are calculated in a linear model, hence if the subsidy were lower so are the impacts.

The short run results by Hamilton/Robison are similar to a regional analysis prepared as a part of the Lower Snake River Juvenile Salmon Migration Feasibility Study in 2002[3]. In this analysis, the authors assumed that rate payers would pay to replace the energy provided by the four Lower Snake River dams, estimated to cost approximately $168 million per year for residential, agricultural, commercial and industrial users. Using the Implan model, the authors estimated that this would cause a loss of 2,382 jobs and income of $232 million. Applying a similar linear calculation to these results, a $150 million loss in income (or subsidy to DSIs) would result in a loss of 2,129 jobs, which is relatively close to Hamilton/Robison's short-term impacts (2,235 jobs).

As indicated above, the results of the non-DSI study are linear and can be modified to take into account the varying levels of subsidy being considered for the DSIs. BPA has determined that a change in priority firm power rates would equate to the following levels of subsidies, if the DSIs accepted the agreement. (See Table 10)
Under Alternative 2, a $59 million annual subsidy to the DSIs increases Bonneville PF rates by $1.00, a figure provided to the consultants by Bonneville (See Table 3). According to Hamilton & Robison, this would lead to a loss of 879 jobs in the short-run and a loss of 1,110 jobs in the long run. Under Alternative 3a, a $0.40 increase in PFP rate equals a $24 million annual subsidy to the DSIs. Extrapolating Hamilton & Robison's findings, this would lead to a loss of 352 jobs in the short-run and a loss of 444 jobs in the long-run, but as noted in the conclusions below, we find that no DSI's would take power from Bonneville under this alternative. Under Alternatives 3b and 4, a $1.50 increase in the PFP rate would provide an $89 million annual subsidy to the DSIs. Using Hamilton & Robison's findings, we estimate that this could lead to a loss of 1,319 jobs in the short-run and a loss of 1,666 jobs in the long-run.

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[3] Source: U.S. Army Corps of Engineers, W. W. D. (2002). Lower Snake River Juvenile Salmon Migration Feasibility Study. Walla Walla, U.S. Army Corps of Engineers**:** 489.

Final Feasibility Report and Environmental Impact Statement, Regional Economic Analysis, Section 1.5.1 Electric Power Effects.

Table 13 – Estimated Impacts to non-DSIs from DSI Subsidies using $50 market prices

	Hamilton	BPA Alternative		
	Robison	**Alt 2**	**Alt 3a**	**Alt 3b/Alt 4**
Subsidy to DSIs				
Change in priority firm power rate ($/MWh)		**$1.00**	**$0.40**	**$1.50**
Annual subsidy ($millions)	**$150**	**$59**	**$24**	**$89**
Impacts				
Short-run				
Value added ($millions)	($182.80)	($71.90)	($28.80)	($107.90)
Employment (# of jobs)	-2,235	-879	-352	-1,319
Long-run				
Value added ($millions)	($160.00)	($62.90)	($25.20)	($94.40)
Employment (# of jobs)	-2,823	-1,110	-444	-1,666

As noted above, short-term job losses to non-DSIs could range from 444 under Alternative 3a to 1,666 under Alternatives 3b or 4. The loss of jobs to non-DSIs is substantially lower than the gain in jobs for the DSIs. The estimates of job losses to non-DSI's cannot be added to the estimates of jobs and income related to DSI power sales alternatives, because the models used to arrive at these impact estimates are not commensurable. The non-DSI study used a four-state version of the U.S. input-output model, while the regional models that we have relied upon for impacts of DSI's were benchmarked against states or individual counties. The multiplier structure of the non-DSI study model would likely be higher than in the state level DSI aluminum studies, but the authors of the current study did not have access to the actual input-output models used in these various studies to be able to compare their multiplier structure.

Sensitivity Analysis for Short-term Impact

Range of Short-term Impacts on non-DSIs

There is considerable uncertainty on economic impacts expressed in Table 12. Uncertainties stem from at least two sources, DSI demand placed on BPA and the future cost that BPA would face when acquiring power to meet this demand. The four alternatives do not present the same level of risk to DSI and BPA and non-DSIs.

In alternative 2, BPA and non-DSI exposure is capped at $59 million dollars. Whereas under alternatives 3 and 4, BPA and its customers are exposed to risk of market price increases. The cost to BPA and revenue requirements from non-DSI customers would increase significant as market price for power increases. In this analysis, we assumed that PF rate remains at $31.5 and DSI demand at 560MW.

Comparison of the Short-term Employment impacts at Various Market Prices and Employment Multipliers

To measure the sensitivity of short-term impacts, we modified two input variables, employment multiplier and market prices.

Estimated state employment multipliers drives the indirect employment levels generated by continued operation of DSI. Review of the Source Material, provides us with a range for this employment multiplier. PA analysis calculated a short-term employment multiplier of 2.43 while Conway calculated a higher multiplier at 3.94. We would note that these multipliers do not reflect changes that have occurred in the counties with a smelter since 2000.

We also varied the market price for power. In the previous section of this report we used a static market price of $50 dollars per mWh. For sensitivity analysis we varied market prices from $40 to $70 dollars per mWh. These prices are used as average sustained price for a 24 by 7 block of power. Actual market prices can be higher at any period. By no means is the $70 per MWh to be considered as the maximum possible price for electricity prices.

Sensitivity Analysis for Scenario 2 - Capped Annual Payments

In this Alternative the risk of market price exposure is on the DSI. We developed a simple model to estimate the operational decision of DSI for this fixed level of annual payment and the market purchases they would have to make.

We assumed that the breakeven market price for each smelter is as follows.

Table 14	**Assumed # of potlines to be operated**	**AMW**	MWH/Ton	Power prices to breakeven $/MWH
Alcoa Ferndale (INTALCO)	1	152	13	29.5
Columbia Falls	1	65	16	25.1
Goldendale	1	106	16	25.1

We assume each smelter will want to operate one potline. We calculate the effective power cost to each smelter at different market prices.

Table 15 - Effective Power rate to DSI						
Price of electricity $/MWH	**40**	**45**	**50**	**55**	**60**	**70**
Effective Power rate $/MWh						
Alcoa Ferndale (INTALCO)	19	24	29	34	39	49
Columbia Falls	19	24	29	34	39	49
Goldendale	19	24	29	34	39	49

The decision whether or not to operate a potline is dependent on whether the power costs are above or below the breakeven point. If the cost of power was below the breakeven point, the potline is not operated. The following table shows the result of comparison of breakeven point and effective power rate. At lower market prices all three smelters can operate but as market prices increase only the more efficient plant can operate. Using the above simplified model we estimate the short-term impact on employment and income at different market prices. As market prices go up fewer smelters can operate profitably.

Table 16- Operational Decision (1=operate)

Price of electricity $/MWH	**40**	**45**	**50**	**55**	**60**	**70**
Alcoa Ferndale (INTALCO)	1	1	1	0	0	0
Columbia Falls	1	1	0	0	0	0
Goldendale	1	1	0	0	0	0

As market prices go higher than 50 dollars, our simple model shows that, only one smelter would be able to operate one potline. We assumed that if a smelter does not operate, it would forgo its share of $59 million dollars incentive. Table 17 shows the direct, indirect or induced employment impact from continued operations of DSI. At lower market prices 732 employees would be working at smelting operations, and between 1610 to 829 employees are indirectly impacted as a result of continued operations. Impacts on non-DSI are about 879 job losses in other industries. The net impact is that in short-term there would be net job gains are between 2200 to 700 jobs. As market prices increases the net impact is reduced to zero for DSI's, and non-DSI impacts are do not exist in relation to the purpose of this analysis.

Table 17 Short-Term Employment Impact at different Market Prices

Market Price $/MWH	**40**	**45**	**50**	**55**	**60**	**70**
Direct Employment impact						
Alcoa Ferndale (INTALCO)	377	377	377	-	-	-
Columbia Falls	122	122	-	-	-	-
Goldendale	233	233	-	-	-	-
Total	**732**	**732**	**377**	**-**	**-**	**-**
Indirect employment impact						
With a 2.5 Multiplier	1,098	1,098	565	-	-	-
With a 3.9 Multiplier	2,123	2,123	1,092	-	-	-
Average	1,610	1,610	829	-	-	-
Non-DSI employment Impact	(879)	(879)	(879)	-	-	-
Net Employment Impact	**1,463**	**1,463**	**326**	-	-	-

To calculate the indirect income impact we used 3.13 multiplier for state of Washington and 2.68 state of Montana. Table 18 shows the short-term impact on income. Consistent with the employment impact there is a positive short-term impact on state income. The net impact on income is between -3 to $46 million dollars.

Table 18 Short-Term State Income Impact (millions of $)

Market Price $/MWH	**40**	**45**	**50**	**55**	**60**	**70**
Direct Income Impact M$						
Alcoa Ferndale (INTALCO)	22	22	22	-	-	-
Columbia Falls	6	6	-	-	-	-
Goldendale	12	12	-	-	-	-
Total Direct income	**40**	**40**	**22**	**-**	**-**	**-**
Indirect Income impact						
Alcoa Ferndale (INTALCO)	47	47	47	47	47	47
Columbia Falls	10	10	-	10	10	-
Goldendale	21	21	-	21	21	-
Total Indirect Income	**77**	**77**	**47**	**77**	**77**	**47**
Non-DSI Income impact $M	**(72)**	**(72)**	**(72)**	-	-	-
Net Impact on Income $M	**46**	**46**	**-3**	**0**	**0**	**0**

Sensitivity analysis for Alternative 3 and 4

Under these two Alternatives, BPA offers 560 MW of power at fixed rates. For simplicity we assumed the effective rate to the DSI would be $31.50 per mWh. To measure short-term regional impacts under various market prices we constructed a simple model that tried to evaluate impact of DSI operations on BPA. In this model we start with assuming that Alcoa Ferndale, and Columbia Falls would operate 2 and Goldendale would operate one potline. We first estimated demand for power from each smelter. Then calculated BPA's cost for providing the power to DSI, at different market prices. We netted out DSI payments to BPA. In this scenario, not all of 560 MW would be used. Table 18-A shows BPA exposure at different market prices.

Table 18 – A Market Prices and BPA Exposure

Market Price /MWH	40	45	50	55	60	70
BPA Exposure $Millions	40	64	88	111	135	182

We then calculate short-term impact of offering 560 MW. As Tables 19 and 20 indicate, the positive economic impact of DSI is significantly reduced as market prices go up. Last row in table 19 measures cost to BPA per net employee. As market prices and BPA's exposure increase, the cost per job goes up. Table 20 shows the impact on state income. As market prices go up net employment and net income decreases significantly.

Table 19- Short-term Impact on Employment

Market price	40	45	50	55	60	70
DSI Direct Impact						
Alcoa Ferndale (INTALCO)	753	753	753	753	753	753
Columbia Falls	244	244	244	244	244	244
Goldendale	233	233	233	233	233	233
Total	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**	**1,231**
Indirect Impact						
With a 2.5 Multiplier	1,846	1,846	1,846	1,846	1,846	1,846
With a 3.9 Multiplier	3,569	3,569	3,569	3,569	3,569	3,569
Average	**2,707**	**2,707**	**2,707**	**2,707**	**2,707**	**2,707**
Non-DSI Impact	**(599)**	**(951)**	**(1,304)**	**(1,656)**	**(2,008)**	**(2,713)**
Net Employment Impact	**3,339**	**2,987**	**2,635**	**2,282**	**1,930**	**1,225**
BPA cost per net employment impact $	**12,040**	**21,378**	**33,214**	**48,704**	**69,850**	**148,629**

Table 20- Short-term Impact on State Income

Market price	40	45	50	55	60	70
Direct Impact M$						
Alcoa Ferndale (INTALCO)	44	44	44	44	44	44
Columbia Falls	11	11	11	11	11	11
Goldendale	12	12	12	12	12	12
Total Direct income	**68**	**68**	**68**	**68**	**68**	**68**
Indirect impact						
Alcoa Ferndale (INTALCO)	94	94	94	94	94	94
Columbia Falls	19	19	19	19	19	19
Goldendale	21	21	21	21	21	21
Total Indirect Income	**134**	**134**	**134**	**134**	**134**	**134**
Non-DSI impact	(49)	(78)	(107)	(136)	(165)	(222)
Net Income Impact M$	**85**	**56**	**27**	**(2)**	**(30)**	**(88)**

Long-Term Impacts

Up to this point in this report, we have only considered short-term economic impact of offering financial benefits or physical power to DSI. In this section we explore the longer-term impact of different alternatives. We will focus on two groups of alternatives, those that could result in closure of the remaining plants (alternatives 1 and 3a) and those alternatives that could result in continued operations (alternatives, 2, 3b and 4). As we showed earlier, under the Alternative 2, where financial exposure of BPA is limited, and the market price risk is placed on DSI, at higher market prices DSI may also be forced to close down their operations.

We first evaluate the long-term economic impact for the scenarios where smelters continue operating. Tables 21 and 22 show the long-term impact for Alternative 2, under different market prices.

Table 21 - Long Term Employment and Income Impact Alternative 2

Price of electricity $/MWH	**40**	**45**	**50**	**55**	**60**	**70**
Employment						
Direct DSI	732	732	377	-	-	-
Indirect DSI	1610	1610	829	0	0	0
Indirect non-DSI	(1,110)	(1,110)	(1,110)	-	-	-
Total	**1232**	**1232**	**95**	**0**	**0**	**0**
Income (M$)						
Direct DSI	40	40	22	-	-	-
Indirect DSI	77	77	47	-	-	-
Indirect non-DSI	(63)	(63)	(63)	-	-	-
Total	**55**	**55**	**6**	**0**	**0**	**0**

Table 22- Long Term Employment and Income Impact Alternative 3

Price of electricity $/MWH	**40**	**45**	**50**	**55**	**60**	**70**
Employment Impact						
Direct DSI	1231	1231	1231	1231	1231	1231
Indirect DSI (average)	2707	2707	2707	2707	2707	2707
Non-DSI	(756)	(1,201)	(1,646)	(2,091)	(2,536)	(3,426)
Total	**3,182**	**2,737**	**2,292**	**1,847**	**1,402**	**512**
Income impact $M						
Direct DSI	68	68	68	68	68	68
Indirect DSI	134	134	134	134	134	134
Non-DSI	(43)	(68)	(93)	(119)	(144)	(194)
Total	**159**	**134**	**109**	**83**	**58**	**8**

Long-term impact of Plant Closure

Study number 2, PA study conducted in 2000, evaluated immediate and long-term economic impact of closure various smelters. PA study took a broader look at economic impacts, using a model developed by Regional Economic Models Inc (REMI). This model attempts to estimate impact differences from Bureau of Economic Analysis (BEA) forecasts of activity, and those that are estimated to actually occur given forward linkages of aluminum ingot producers with their markets. It was difficult for the consultants to determine the exact specifications of the PA model, given documentation provided to us. Its differences with other economic impact estimates may be real, or may be the product of differences driven by competitive factors, given certain defensive statements made in Appendix I of the PA report.

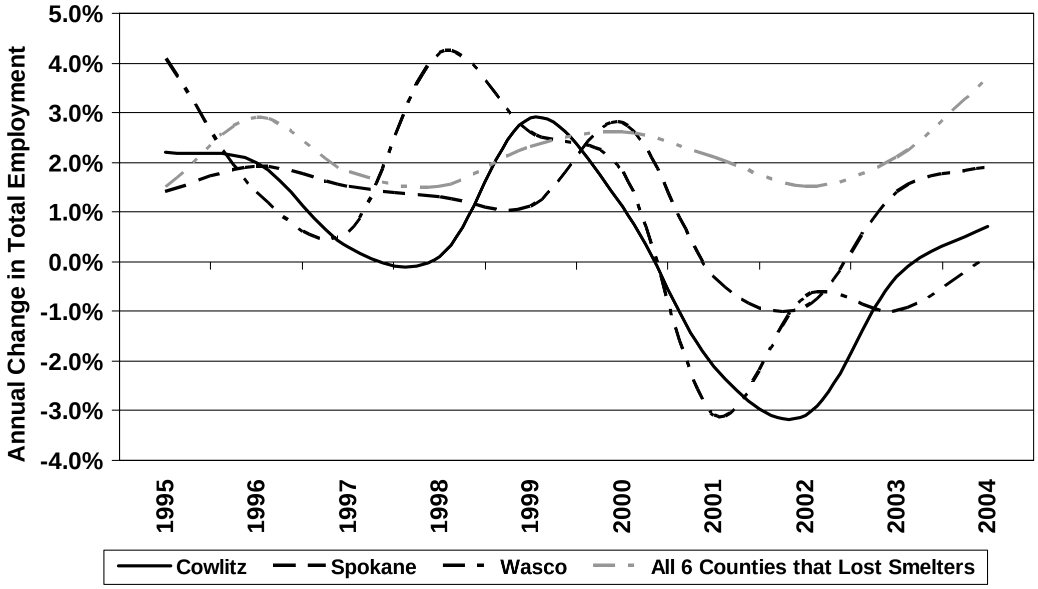
PA analysis indicated that "the region does have a statistically insignificant permanent offset due to the loss of the aluminum smelter industry, but the underlying regional economy is unaffected by the loss. This offset is on the order of 0.4% of the regional economy or the equivalent of 0.02% /year over the 20 year analysis period. A 0.02% change is almost within the noise limits of the economic behavior." The estimated long-term impact from PA study seems to be consistent with the observed 2000-2004 employment and personal income figures presented earlier in this report (see figures 1 and 2 presented earlier).

Reaction to post 2000 Plant Closures

Another venue for evaluating the longer-term impact of the plant closures is to look at the counties that lost smelter jobs after 2000. Based on actual employment and income data, we can see that the economic impacts of the closure of the six plants, as well as the economic impact of closure of the Goldendale plant have already been felt in local economies. However, other economic activities are also influencing the development trends in counties with historic aluminum smelters. Figure 1 shows the percentage annual change in employment in counties in which the aluminum smelters have been closed permanently. Declining trends in employment growth were mainly confined to the period 2001 through 2003 and were particularly strong in Cowlitz and Wasco counties. A large portion of this decline was caused by the loss of the smelters although in some cases other sectors were also impacted (e.g., loss of high tech jobs in Multnomah County et al).

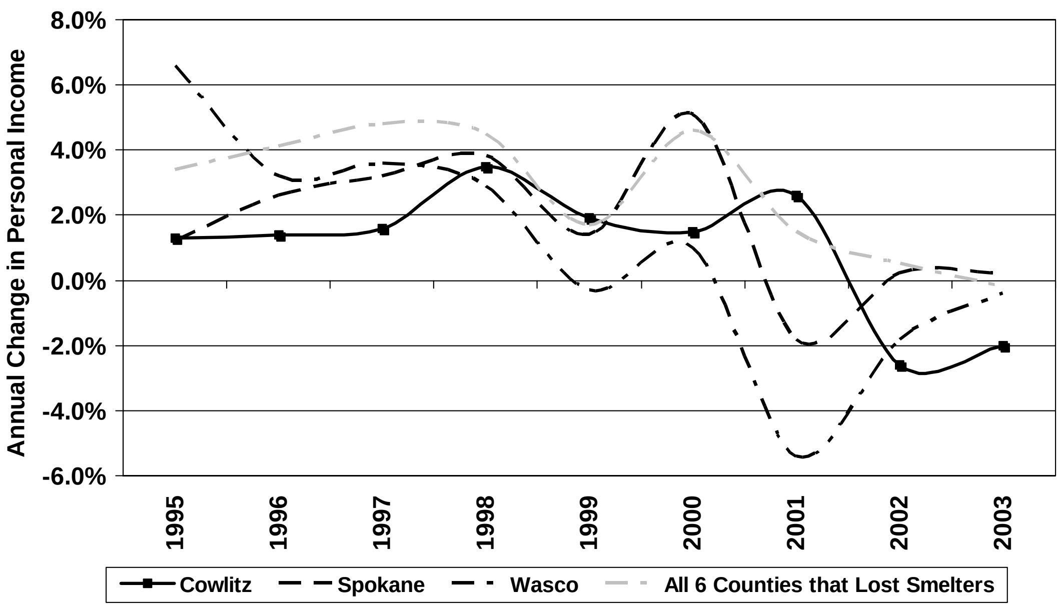
However, employment in all of the counties began to rebound in 2004. These economies are dynamic and are expected to adjust over time. The larger counties (particularly Pierce and Clark counties) have more diverse economies and other sectors created enough jobs to offset the loss of employment at the smelters.

Figure 1 Employment Trends in Counties without Smelter Operation Capability



The effects on personal income, which includes employee compensation as well as income from investments, pensions and other forms of income, indicate a similar trend as that for employment. As shown in Figure 2, real personal income declined or grew at a slower rate of growth in the period 2001 through 2003 for all counties that lost smelter production. However, the initial fall in personal income centered in the year of closure and then moderated in the next year. For example, in Wasco County, real personal income fell 5.4% in 2001 and dropped another 1.8% in 2002 but there was no further loss in 2003. Similar experiences were recorded in other counties (particularly Cowlitz and Spokane counties).

Figure 2 – Trends in Real Personal Income



From above figures we can conclude that, the economies of the counties that lost smelter jobs are resilient to singular changes (such as the loss of a smelter) because other sectors compensate for the loss within a few years. We would expect the long-term economic impacts to be less than the short-term impacts for the remaining smelters.

Conclusions and Recommendations

In the short-term, there can be positive gains in employment and income from continued operation of the remaining smelters. However, long-term net employment gains and losses are dependent on the market prices. Should the plants close, in the long-term, given the resiliency of the regional economy there is no significant drop in regional employment and income.

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