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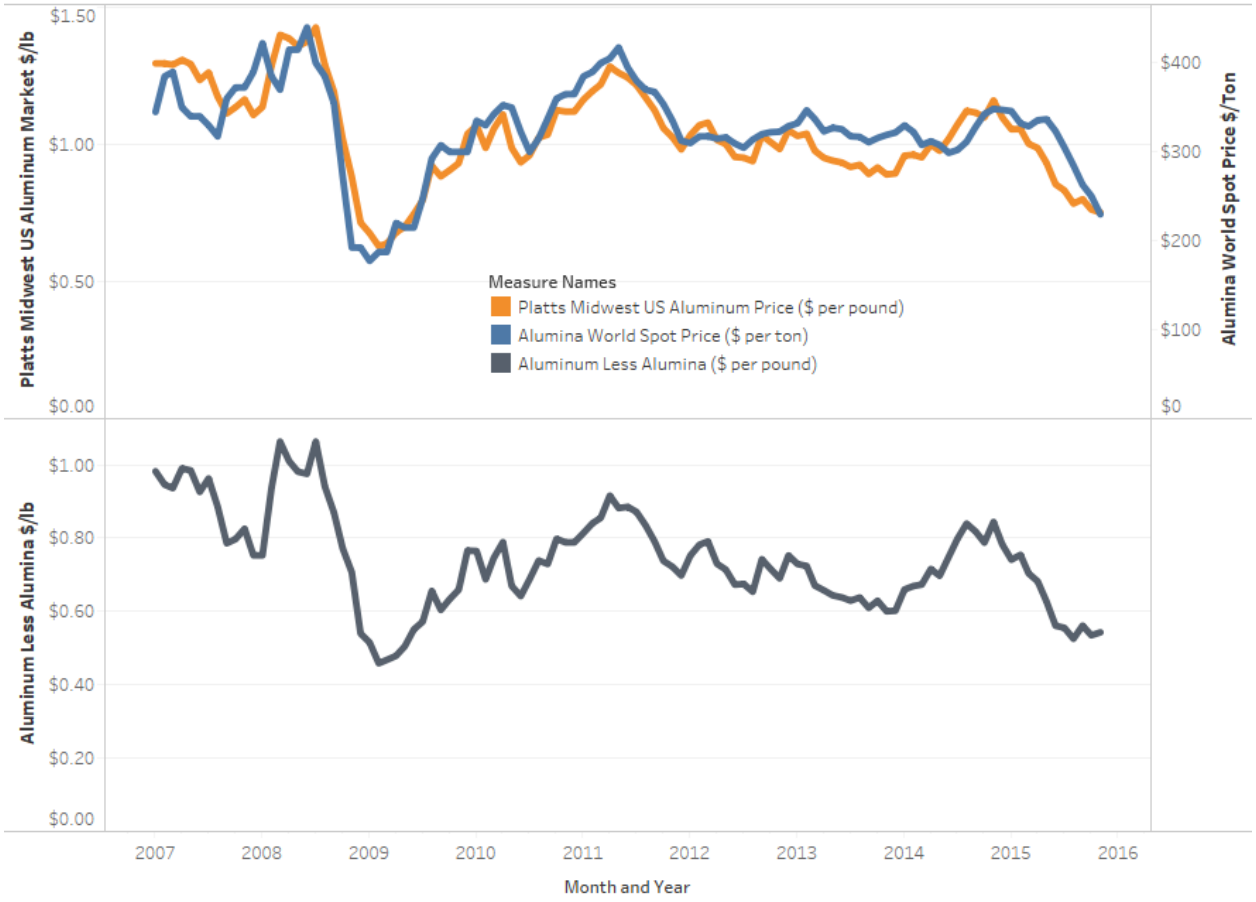
Regarding:
Request for Comment: Section 232 National Security Investigation of Imports of Aluminum, 82 Fed. Reg. 21509 (May 9, 2017) & 82 Fed. Reg. 25597 (June 2, 2017)

Energy GPS LLC welcomes the opportunity to submit the following paper summarizing the historic rise and dramatic decline of the Pacific Northwest aluminum industry.

Electricity is a Volatile Commodity and a Major Component of Aluminum Costs

The production of primary aluminum is energy intensive – more specifically, electricity intensive. Aluminum smelting is the process of extracting aluminum from its oxide, alumina, generally by the Hall-Héroult process. This is an electrolytic process requiring large amounts of electricity. The largest input cost for primary aluminum is the feedstock alumina. Alumina can be easily stored and transported; it trades on a global market where regional price differences are a function of transportation costs. Figure 1 shows the extremely high correlation between spot Midwest US aluminum prices (orange line) and spot alumina prices (blue line). The bottom pane of Figure 1 shows the aluminum price net of the cost of the alumina feedstock (net aluminum price). This net aluminum price represents the amount of money that is left to cover all other costs plus profit.

Figure 1 - Aluminum Prices Closely Track Alumina Costs



Electricity costs stand in stark contrast to alumina – it can only be purchased from a regional, interconnected grid. Electricity prices can be highly volatile. The localized

nature of electricity markets, coupled with volatile pricing, means that electricity is often the most important cost item that determines the profitability of an aluminum smelter. Figure 2 shows the relationship between spot net aluminum prices (bottom pane from Figure 1) and spot electricity prices in the Pacific Northwest (Mid Columbia delivery point). The top pane compares net aluminum prices and electricity prices. The bottom pane shows the electricity price (expressed in $ per ton of Aluminum) as a proportion of the net aluminum price.

Figure 2 - Electricity Prices Do Not Track Net Aluminum Prices (Aluminum Less Alumina)

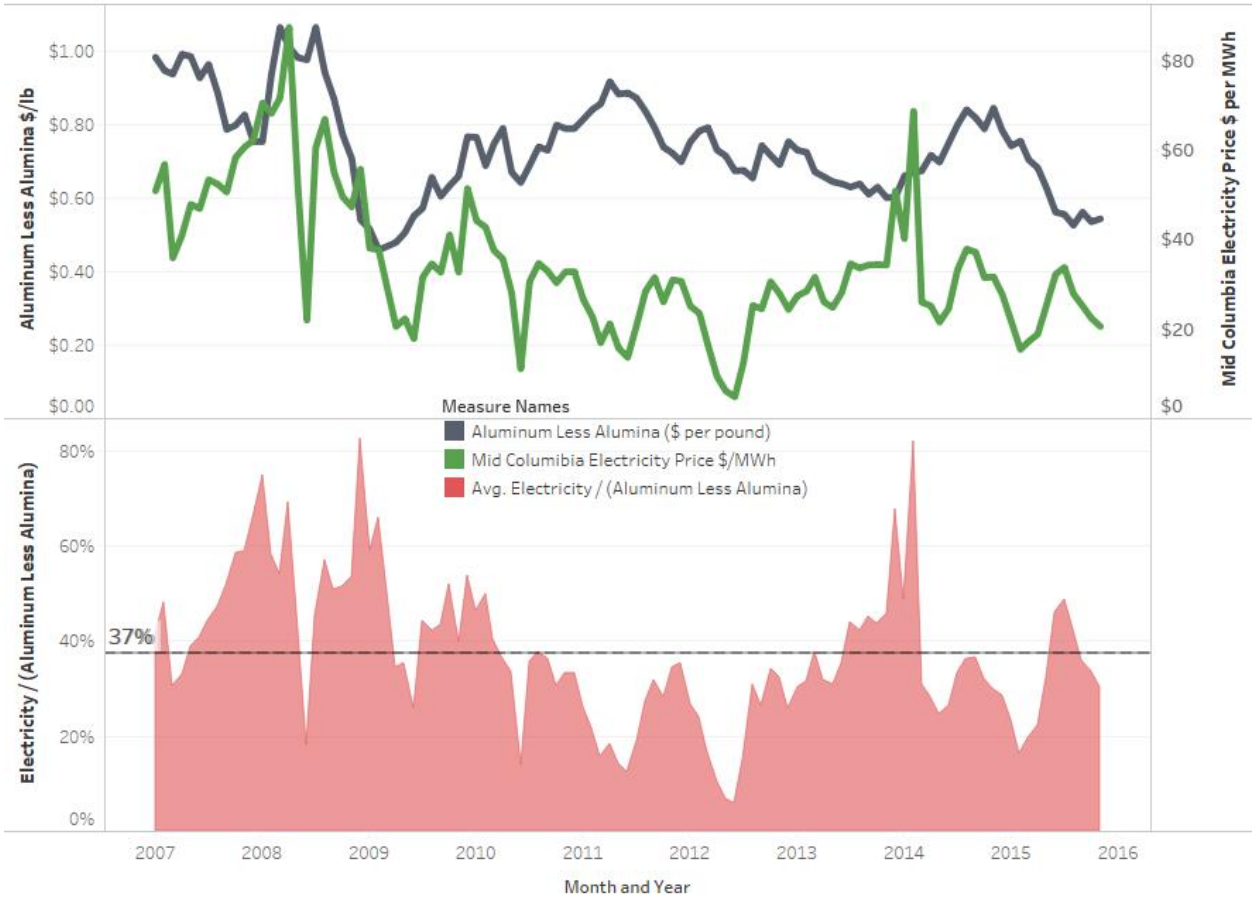


Figure 2 illustrates that electricity prices, on average, account for 37% of net aluminum prices. Further, electricity prices are highly volatile and uncorrelated to the price of aluminum. As a result, electricity's proportion of the net aluminum value varied wildly from 2007 to 2015 from as low as 8% to as high as 80%.

The Pacific Northwest Aluminum Industry Highlights the Perils of Electricity Costs to Aluminum Smelters

The rise and fall of the aluminum industry in the Pacific Northwest highlights the critical role played by electricity prices in the competitive position of aluminum smelters. For the sixty years from 1940 until 2000 the aluminum industry grew and thrived in the Pacific Northwest. In 1998 the Pacific Northwest had ten operating smelters out of a total of twenty-three in the United States. Starting in June of 2000 the Northwest smelters began to curtail operations due to the Western US electricity crisis. By May of 2001 all ten smelters were curtailed. Five out of the ten smelters never resumed operation after the energy crisis subsided in 2001. By 2003 two more smelters permanently closed due to an inability to secure affordable electricity contracts. One more smelter permanently closed as a result of the fallout from the financial crisis and resulting plunge in commodity prices in 2009, leaving only two aluminum smelters in the region. The remainder of this paper describes how events played out that resulted in the decline of the Northwest's aluminum industry. The story of the Northwest aluminum industry is a story of access to cheap power and the consequences of losing such access.

The Evolution of the Pacific Northwest Aluminum Industry Is Tied to Inexpensive Power from the Columbia River

The history of the aluminum industry in the Pacific Northwest is tied to the development of hydroelectric dams on the Columbia River in Oregon and Washington. Inexpensive hydroelectricity spawned the development of 10 smelters scattered throughout the region. At a time when demand for electricity in the region was limited and there was no ability to move power out of the region, the federal government, which was responsible for generating and distributing the electricity, and the aluminum smelters enjoyed a symbiotic relationship that brought tremendous benefits to both parties. The arrangement provided the aluminum smelters access to abundant, inexpensive power. For the federal government, working under the auspices of the Bonneville Power Administration (BPA), the arrangement brought steady demand for power plus a number of operating benefits such as flexible demand that enabled BPA to manage variations in water supply.

The connection between BPA and the majority of the aluminum smelters endured from the time the dams and smelters were built until 2001. While the contractual and pricing relationships evolved over the years, the aluminum industry continued to operate because it had access to low-cost power from BPA. During the 1980's and 1990's, BPA's power rates rose due to an increase in spending on environmental regulations (primarily fish) and the need for BPA to absorb cost over-runs on a failed nuclear power program. During the 1990's, wholesale electricity markets opened up and smelters had the opportunity to purchase from power marketers instead of, or in addition to, BPA. By the mid 1990's market prices for electricity fell

below BPA's rates. The seeds of the end of most of the Northwest smelters were sown in 1996 when the aluminum companies signed 5-year contracts with BPA. Under these contracts the aluminum smelters secured about 75% of their electricity supply from BPA at a rate of $22 per MWh while the remaining 25% of electricity supply came from the market, which at the time was below $15 per MWh. For the first few years the electricity purchasing strategy worked for the aluminum smelters. "In 1998, the Pacific Northwest aluminum industry sold more than $3 billion worth of products and employed approximately 10,000 people in Oregon, Washington, and Montana."[1] Although margins were thin at this time, the smelters continued to operate.

The Western Electricity Crisis Curtailed 100% of Northwest Production; 50% of Production Never Returned

Between June of 2000 and May of 2001 the Western United States experienced dramatic increases in market electricity prices of a magnitude and duration that had never been seen before or since in any North American power market. The price of power at the Northwest's electricity hub, known as the Mid Columbia, averaged $13.93 from June of 1996 to May of 1997. From June of 2000 to May of 2001 the Mid Columbia price averaged $214.52 per MWh – a 15x increase! During the electricity crisis the power used to make aluminum was much more valuable than the aluminum being produced.

The high electricity prices directly impacted the smelters in two ways. First, the approximately 25% of electricity for smelting that was being sourced from the market was no longer economically viable resulting in some initial curtailments in the middle of 2000. With 75% of the electricity supply still coming from BPA at a price of $22 per MWh the smelters could keep operating. In the winter of 2000/2001 BPA experienced an acute supply shortage. Lack of precipitation in the Columbia River basin resulted in lower stream flows and less hydro production for BPA. During December 2000 and January 2001, BPA approached the aluminum companies and offered to buy them out of the remainder of their $22 per MWh supply contracts which expired in October of 2001. One by one the aluminum companies agreed to curtail production in order to cut deals to re-sell power to BPA. The result was complete curtailment of the Northwest's aluminum smelters and windfall gains totaling into the hundreds of million dollars for the aluminum companies who were fortunate enough to sell power that they purchased for $22 per MWh back to BPA at prices well north of $100 per MWh.

Figure 3 illustrates the interplay between aluminum prices and electricity costs from 1996 through 2002. The blue line shows electricity costs. This line, expressed

[1] "The Oregon State Aluminum Industry Economic Impact Study", Richard Conway, November 2000, p. v.

in $ per pound of aluminum, is calculated using daily Mid Columbia prices and a conversion efficiency of 8 kWh per pound of aluminum. The orange line is the price of aluminum in the United States expressed in dollars per pound of production.

Figure 3 | Comparison of Electricity Costs and Aluminum Prices 1996 to 2002

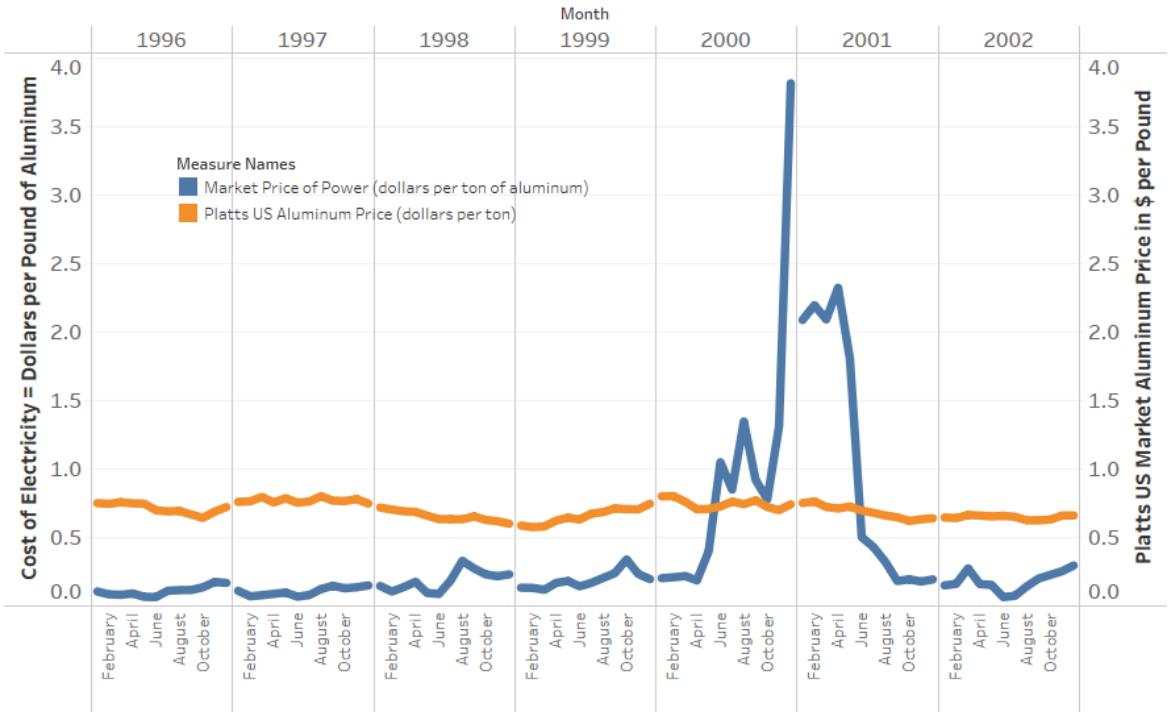


Figure 3 clearly shows the extraordinary increase in electricity prices that precipitated the curtailment of aluminum smelting starting in June of 2000. Between June of 2000 and the first quarter of 2001 all of the Northwest aluminum smelters had curtailed all, or the vast majority of, their Northwest operations. News articles from that time tell the highlights of the story quite well:

"Officials at the Kaiser Mead plant announced today that they will temporarily close the plant. At midnight, the final shift of workers will leave the building, and will not return for at least 10 months. Four-hundred workers will be left without jobs. Steelworkers spent the day emptying aluminum pots and preparing the plant for its only shut down in history. It's a shutdown that Susan Ashe of the Kaiser Corporation says is intended to save vital power. ***"We're in a curious situation now, where power rates have sky-rocketed through the roof and there's a real need in the region. There's not enough energy to go around, particularly with a cold snap coming on, to meet everybody's needs".***[2] December 10th, 2000

[2] http://www.sandpoint.com/NewsArticles/2000/Kaiser%20Mead%20Shuts%20Down.htm

Five of the ten smelters never resumed operations including four facilities in Washington (Longview, Vancouver, Spokane, Tacoma) and The Dalles in Oregon.

Two More Aluminum Smelters Cease Operations by 2003

By 2002 power prices had declined from the exceptionally high levels. The aluminum smelters found themselves in new, uncharted territory. They had signed 20-year contracts in 1981 that expired in October of 2001. It wasn't clear what rights they might have to BPA power. BPA's rates were still experiencing upward pressure with more fish obligations. In addition, environmental regulations such as the requirement to divert water around electricity turbines in order to facilitate fish passage effectively reduced the amount of capacity and energy that BPA could extract from the dams which put additional upward pressure on prices (lower volume increases average rates). It is expensive to restart an aluminum smelter; aluminum companies wanted multi-year, stable, power rates in order to invest the time and money into restarting. The five remaining smelters were looking for a viable path forward with some of them operating at reduced output levels. By 2003, two additional facilities permanently closed, citing lack of access to affordable power prices as the primary reason. These include Alcoa's Troutdale Oregon facility and Northwest Aluminum's Goldendale facility (Golden Northwest).

"In a statement released yesterday, Golden Northwest CEO Brett Wilcox said 'We remain committed to restart smelter operations as soon as possible, and to put our employees back to work. ***The key to restarting our smelters is to obtain an economical power supply. We are trying to work with the Bonneville Power Administration to make that possible and are continuing efforts to develop generating resources to provide a long-term power supply.'"***[3] April 9th, 2003

By the end of 2003 seven of the ten smelters were permanently closed. The seven smelters were the least efficient of the Northwest aluminum operators.

Power Costs Remain Critical Factor for Remaining Smelters

Three aluminum facilities managed to resume some level of operations after 2002: Alcoa's Wenatchee and Ferndale facilities in Washington and Glencore's Columbia Falls facility in Montana. The Columbia Falls facility closed in 2009. As is evidenced in Figure 2, aluminum prices fell precipitously in 2008 and 2009 to a much greater degree than Northwest electricity prices. Using spot electricity prices, the electricity proportion of the net aluminum price (aluminum less alumina feedstock) averaged 55% in 2008 and 46% in 2009 compared to a long-term average of 37% from 2007 to 2015. The Columbia Falls facility was unable to secure a satisfactory long term

[3] http://www.whitesalmonenterprise.com/news/2003/apr/09/goldendale-aluminum-plant-closing/

supply contract with BPA and closed down in the face of high electricity prices compared to aluminum prices. The Ferndale facility has continued to operate with a long term power supply contract with BPA. The Wenatchee facility secured a long term contract with Chelan County which owns two dams on the Columbia River.

Data Centers Replace the Aluminum Smelters

The Pacific Northwest has seen a proliferation of new data centers. Government policy in the form of tax breaks, a mild climate, and low electricity prices are driving the data center siting decisions. Amazon Web Services has three data centers in eastern Oregon. Apple and Facebook have data centers in central Oregon. Grant County in central Washington, which owns two dams on the Columbia River, boasts that it is "The World's Premier Data Center Location."[4] Grant County's average industrial electricity rates of 2.88 cents per kWh have enticed many data centers including Dell, Intuit, Microsoft, Sabey, Server Farm Realty, Vantage, and Yahoo.

Like many areas, the Northwest is transitioning from an industrial economy to the internet economy. The smelting operation in The Dalles closed in 2001. Five years later Google opened a data center in the same area. The Northwest Power Planning and Conservation Council summarized it well – data center "power demand could increase significantly - to nearly 2,500 average megawatts by 2030. That would rival the electricity consumption of the region's aluminum industry at its peak in the 1980s."[5]

Bottom Line – A Strong Primary Aluminum Industry Requires Access to Low Cost Electricity

The development of the Pacific Northwest primary aluminum industry was dependent on the development of hydropower on the Columbia River. The symbiotic relationship between smelters and dams held together for more than fifty years until power prices spiked in the early 2000s. Policy makers that are examining the decline of the US primary aluminum industry and considering government policies to add new domestic smelting capacity should study the relationship between the availability of low cost electricity and the Pacific Northwest aluminum smelting industry. The long history of the Northwest aluminum industry highlights the importance of abundant and affordable electricity. When the Northwest aluminum industry developed there were no other buyers for the prodigious output of the Columbia River dams. In today's market there are other large electricity consumers, who just like the smelters 50 years ago, are sprouting up along the Columbia River with the goal of securing low cost electricity supplies.

[4] http://www.grantedc.com/grant-county-key-industries/data-centers
[5] https://www.nwcouncil.org/energy/data-center-power-demand/