PUGET SOUND ENERGY PLANS FOR ANOTHER 20 YEARS OF BURNING COAL

The Sierra Club's analysis of Puget Sound Energy's 2013 integrated resource plan

COAL-FREE PSE

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"As a PSE customer... Every time you turn on a light bulb, every time you watch TV, and every time you charge your cell phone, you will be paying to keep open one of the dirtiest coal-burning power plants in the country."

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INTRODUCTION

In Washington, if you are a Puget Sound Energy (PSE) customer, you may be surprised at the amount of your energy that comes from coal. While PSE supports many clean energy programs, 20 percent of the energy supplied by Puget Sound Energy comes from one of the biggest, most polluting coal-fired power plants in the West—the Colstrip Generating Facility in Eastern Montana. This reliance on an old and dirty coal plant to provide electricity is unnecessary. Every two years, PSE prepares an Integrated Resource Plan (IRP) to look at its energy needs and to evaluate its generation options. PSE's most recent IRP analysis, which concluded May 30, 2013, showed that PSE customers may have to pay ***more*** for dirty coal-fired power compared to other, cleaner alternatives in the coming months and years. So why is PSE planning to continue spending money on an old, dirty, and ***more expensive*** source of energy instead of investing in cleaner alternatives? Good question.

From cradle to grave, mining and burning coal wreaks havoc on the health and vibrancy of our communities. Coal mining rips up landscapes, contaminates waterways, and causes harmful air pollution. It also poses serious health threats to local communities and coal-related employees. Burning coal produces smog, soot, mercury and other toxic air pollutants, including huge amounts of climate change inducing greenhouse gases like carbon dioxide. Air and water pollution from PSE's coal plant threatens local ranchers' water supply and exposes people to life-threatening pollutants near the plant.

Rosebud County, where Colstrip is located, has the 3rd highest asthma rate in Montana. Ranchers and Native American tribes are caught in an endless struggle with this irresponsible and polluting plant. The amount of carbon pollution that spews from Colstrip's smokestacks is almost equal to two eruptions at Mt. St. Helen's every year. Here in Washington, we are already experiencing the impact of extreme weather events: drought; flooding; storm-water pollution; and earlier river runoff.

Regulators are finally cracking down on coal plants like Colstrip, and PSE is facing hundreds of millions of dollars in costs to meet more protective health and environmental rules at the plant. PSE wants you to pay for these huge costs. As a PSE customer, that means that every time you turn on a light bulb, every time you watch TV, and every time you charge your cell phone, you will be paying to keep open one of the dirtiest coal-burning power plants in the country.

It does not have to be this way. Washington State law requires PSE to conduct the IRP process every two years to plan for the future energy needs of its customers and to solicit feedback from those customers. At the direction of the Washington Utilities and Transportation Commission (UTC), PSE specifically examined the costs of continuing to operate Colstrip over the next 20 years. The results of the IRP analysis show that continuing to spend money on Colstrip is an economic gamble for PSE's customers. After evaluating several likely scenarios—including the finalization of rules to control harmful coal ash disposal at Colstrip, the implementation of a carbon tax or other CO_2 regulation, or the continued depression in natural gas fuel prices—PSE's own IRP analysis showed that Colstrip is in many cases a more expensive resource than other, cleaner generation alternatives.

It is time for PSE to plan for a future without coal. PSE does not need Colstrip, and PSE's customers cannot afford the economic, health and environmental impacts of Colstrip.

OVERVIEW OF THE IRP

In Washington State, the IRP process serves as a general plan for meeting load and reserves with the least cost alternative while accounting for contingencies such as environmental impacts. The utility must look at all of its options, including energy efficiency, and

pick the best mix of electricity resources and capital spending that meets its customers' needs. As part of the process, PSE met statutory public participation requirements by holding several public meetings over the course of a year and a half (the IRP Advisory Group or "IRPAG").

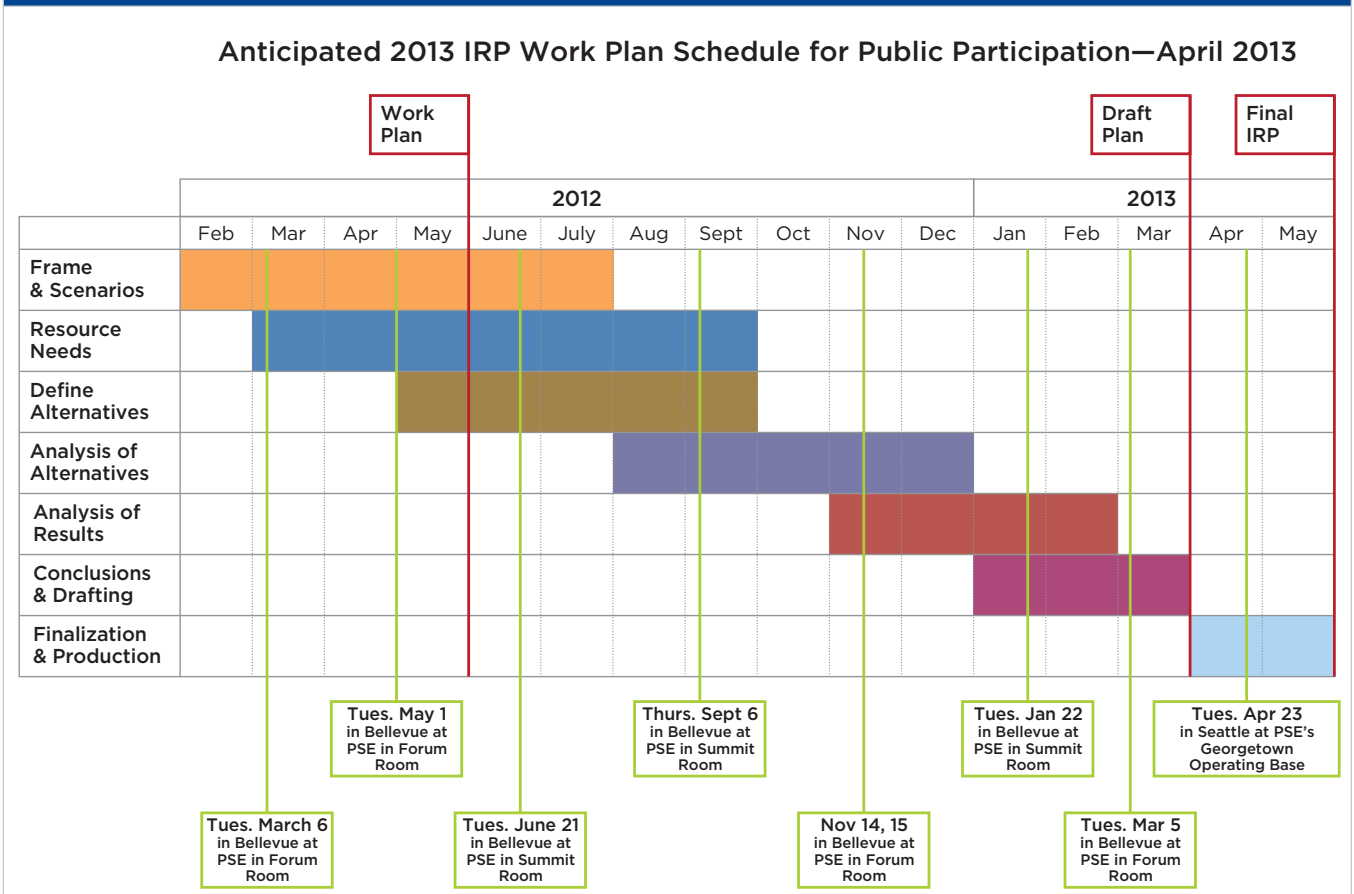
In contrast to an application to increase rates, there is no contested proceeding around the IRP, and in fact the UTC does not issue a ruling on the plan. Currently, PSE is only required to develop a plan, subject to stakeholder input and public comment, and this plan then serves as a guide to future electricity resource decisions that will be subject to UTC approval.

The IRP process is an important planning tool that allows the public an opportunity to engage with PSE in the development of its long term resource strategy. Sierra Club participated extensively in past IRP proceedings with PSE and in the most recent 2013 IRP stakeholder process. Based on Sierra Club's prior recommendations, the UTC directed PSE to take a hard look at Colstrip and the costs of continuing to operate Colstrip in the 2013 IRP. The UTC provided two directives for PSE to complete in the 2013 IRP process:

1. PSE should model a scenario without Colstrip that includes results showing how PSE would choose to meet its load obligations without Colstrip in its portfolio and estimates of the impact on Net Present Value (cost) of its portfolio and rates.
2. PSE should conduct a broad examination of the cost of continuing the operation of Colstrip over the 20-year planning horizon, including a range of anticipated costs associated with federal EPA regulations on coal-fired generation.

PSE held a series of meetings with the IRPAG (see Figure 1) at which assumptions, methodology, and results were presented, and at which stakeholders and members of the public could ask questions and offer comments. Sierra Club and other stakeholders also provided written comments between meetings, and PSE responded to some of those comments either by providing written responses or by addressing them at the meetings. Many of PSE's assumptions, scenarios, and sensitivity cases derived from stakeholder input, including that of Sierra Club.

Figure 1: IRP Modeling Process



Source: http://pse.com/aboutpse/EnergySupply/Documents/IRPAG_2012-11-14.pdf

Specifically with respect to Colstrip, PSE ultimately analyzed four different environmental compliance cases (see Attachment 1), along with a range of scenarios and sensitivities affecting electricity prices, CO_2 emissions costs, and other factors. These data provided some quantitative detail about the huge economic cost liabilities facing Colstrip over the coming years. The information was a step forward; however, PSE's analysis did not provide a level of review of upcoming capital costs at Colstrip that will allow the public or the UTC to make any type of prudence determination one way or the other about the future economic benefits of Colstrip. The analysis was more academic and exploratory in nature.

While the IRPAG process was extensive and PSE staff provided a detailed review of the process, there were a number of important limitations in terms of the information provided to stakeholders and the ultimate reporting of the results. It is clear that PSE selectively withheld, obfuscated, or failed to produce underlying data and final conclusions in ways that undermine the integrity of the public participation process.

The 2013 IRP process created solid progress on the overall analysis for planning the future of Colstrip. PSE provided the public with a more detailed look at the costs of operating Colstrip than it has ever previously provided. However, PSE still fell short on many aspects of the IRP process. PSE either ignored or rejected several public comments regarding the environmental harms and associated costs of operating Colstrip. In many cases, PSE did not provide any factual or evidentiary support for its capital cost assumptions, even when those assumptions conflicted with other, higher costs documented by Colstrip's other owners. PSE also refused to provide underlying data and assumptions to support its modeling. Instead, PSE presented the results as a "black-box" analysis without providing an opportunity for the public to verify or refute the methodology or results. PSE similarly refused to break-out and quantify its conclusions on Colstrip Units 1&2 separately from Units 3&4, despite the obvious evidence showing that Colstrip Units 1&2 are much more costly for customers.

IRP RESULTS

The IRP process involved a complicated review PSE's generating portfolio options with many moving parts. It is difficult, if not impossible, to be certain about the impacts of any single resource choice because many of the most influential factors impacting electricity supply are variable and uncertain. Nevertheless, Sierra Club, with the assistance of technical experts at Synapse Energy Economics, drew the following conclusions from PSE draft IRP:

- PSE's own analysis shows **substantial economic and regulatory risks** of continuing to operate Colstrip, **particularly at Units 1&2**.
- PSE is likely to face **hundreds of millions** in new capital and operating costs at Colstrip in the coming years (beginning in 2015) to comply with environmental regulations.
- Replacement of Colstrip Units 1&2 would have **less than a 1%–2% rate impact** in PSE's conservative "Base scenario." In more plausible scenarios (such as moderate CO_2 prices) **replacing Colstrip Units 1&2 would result in a relative decrease in customer electricity rates**.
- Natural gas prices and future CO_2 regulations have significant impacts on the relative economics of continuing to operate Colstrip.
- Accelerated investment in Demand Side Resources (DSR) such as energy efficiency dramatically reduced the relative economic value of Colstrip.

With respect to process, it is important to note that the IRP analysis and all of the IRP results remained within the exclusive control of PSE throughout the process. PSE was generally responsive to questions and input from stakeholders, but PSE did not provide any of its modeling data or analyses to stakeholders. As a result, the public must accept, without the ability to verify, that PSE's assumptions are valid and that PSE executed its analysis properly. PSE's IRP results must therefore be viewed cautiously. Without public transparency, PSE's results and conclusions run the risk of being self-serving justifications for the preexisting internal business plans of the company.

Despite the limited transparency of PSE's analysis, the 2013 Draft IRP results do allow the public to draw several important conclusions about PSE's energy portfolio.

COLSTRIP ANALYSIS

Colstrip provides approximately 20% of PSE's energy. The four-unit plant is best considered as two pairs of units: Units 1&2 are older (1975/76), and PSE owns 50% of those units along with PPL Montana; Units 3&4 are not quite as old (1984/86), and PSE owns 25%, with the balance split among five other owners.

The UTC directed PSE to model a scenario in its 2013 IRP without Colstrip. The UTC also directed PSE to

examine the costs of continuing to operate Colstrip in the face of upcoming environmental regulations and other costs. Colstrip is a large part of PSE's resource mix, and the utility would require a different plan and resource mix to meet its customers' needs in the absence of Colstrip. In order to understand the cost impacts between spending money on Colstrip or replacing it with alternative resources, PSE compared the total costs between the different scenarios (i.e. with Colstrip under several different assumptions and without Colstrip). This method provides an estimate for the value of the plant to PSE's customers. It also allows PSE and the public to see how the relative cost of Colstrip changes depending on different external variables such as fuel prices or CO_2 costs.

During the IRPAG meetings, Sierra Club and other stakeholders (including UTC staff) expressed particular interest in extensive analysis of the future of Colstrip. PSE ultimately provided a detailed list of possible future environmental requirements and upgrades at the four Colstrip units, along with PSE's projected compliance costs. (the "Colstrip Matrix"—provided here as Attachment 1). PSE then defined four scenarios from "low-cost" (Case 1) to "very high cost" (Case 4) to characterize the forward-going cost trajectories at the plant. These Colstrip cost cases helped define the range of potential costs that Colstrip may face depending on developing environmental regulations and the technical costs to comply with those regulations. There were several instances where PSE underestimated or omitted certain costs that could impact Colstrip in the future; nevertheless, the Colstrip cases generally provide a reasonable range of potential environmental compliance costs facing Colstrip.

Of the four Colstrip units, Units 1&2 are subject to higher compliance costs and are closer to the margin economically. According to PSE's own estimates, Units 1&2 may be required to spend up to $130 million in 2015 to install baghouses to comply with the Mercury and Air Toxics (MATS) rule, and up to an additional $65 million in 2017 to remove sulfur dioxide and nitrogen oxides to comply with regional haze requirements (followed by another $78 – $190 million by 2022 – 2027). Even under PSE's lower regulatory scenario (Case 2), capital costs would exceed $24 million in 2015 and $38 million in 2017 at Units 1&2. Units 3&4 do not face all of the same environmental regulations as Units 1&2 and therefore do not face the same level of capital expenses as quickly. However, PSE still estimates that Units 3&4 face costs of up to $190 million by 2022 – 2027 to control nitrogen oxides.

In addition to the capital costs at all four units, PSE faces additional expenditures that will be required under the coal combustion residuals (CCR) rules. This rule, which is still under development, would regulate the handling and disposal of the harmful fly ash waste produced by Colstrip. Several major fly ash spills have occurred in recent years including the 2008 spill at the Tennessee Valley Authority's (TVA) Kingston coal plant and the 2011 spill at the Oak Creek Power Plant into Lake Michigan. Colstrip is a huge producer of harmful coal ash, and if CCR rules classify coal ash as "hazardous waste," PSE has estimated that disposal costs could range from $8 – $24 per megawatt-hour (MWh), which is between $42 – $125 million1 annually, beginning in 2018.

In addition, multiple environmental lawsuits in Montana state and federal courts could require additional expenditures at Colstrip to clean up harmful pollution from coal ash. Specifically, a recently filed lawsuit asserts that the Montana Department of Environmental Quality must provide better enforcement of Montana water quality laws with respect to groundwater contamination from Colstrip's leaking coal ash ponds. Another suit challenges the sufficiency of the Montana Department of Environmental Quality's administrative order on consent governing remediation of the contaminated coal ash ponds. A federal suit asserts that Colstrip's owners violated the Clean Air Act by making changes to Colstrip without obtaining proper permits and making necessary environmental improvements. If successful, these lawsuits could create significant compliance costs for PSE and the other Colstrip owners. Even though PSE did not fully account for these potential liabilities, and therefore understated the economic risks of Colstrip, the results of PSE's analysis nevertheless show that Colstrip is a risk for customers.

The results of PSE's analysis strongly suggest that Units 1&2 are economically close to the margin, and a large number of scenarios render those units uneconomic. However, despite obvious liabilities facing Units 1&2, which do not affect Units 3&4 the same way, the IRP generally treats all four units together as a single generation source, obscuring any conclusions that could otherwise be drawn about the viability of Units 1&2 relative to Units 3&4. Incredibly, PSE has insisted that while it would not be difficult for a knowledgeable third party to disaggregate the results, the company

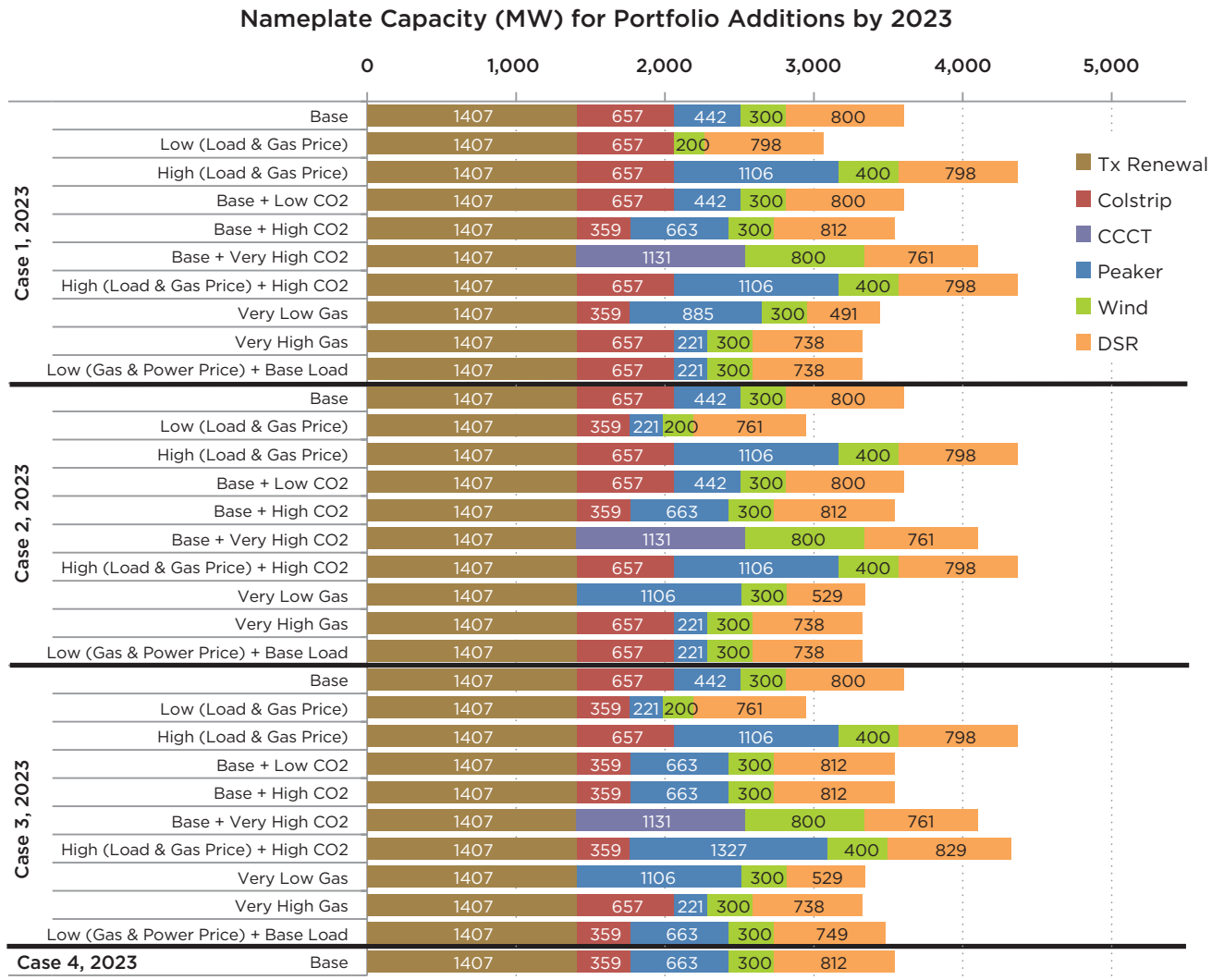
itself will not do so in the IRP because it would compromise its competitive position if it ever wanted to sell the units. This logic is paradoxical because the effect is denying the information to the public and the commission, while acknowledging that the information is not effectively hidden from actual competitors or potential buyers. The refusal to disaggregate results for Units 1&2 from Units 3&4 is a serious and inexcusable shortcoming in the IRP.

PSE'S CONCLUSIONS AND REMAINING COLSTRIP ISSUES

PSE generally concludes that continued reliance on Colstrip to provide electricity reduces cost and market risks for customers. This conclusion is overly simplistic and misleading because it fails to account for the significant risks, particularly at Units 1&2, that customers face under many of the scenarios. As noted above, to the extent that PSE's results for Units 1&2 can be disaggregated from the results for Units 3&4, it is clear that the results for these two pairs of units are very different. This is evident in Figure 2, below, which shows a snapshot of PSE's expected resource mix under various scenarios in 2023. In scenarios where some or all of Colstrip retires, PSE assumed that the retirement occurred in 2017.[2]

The red bars in Figure 2 represent PSE's share of Colstrip's capacity, up to a maximum of 657 MW. If the entire 657 MW bar remains, this means that the model found it economical to continue to operate all four Colstrip units. If only a 359 MW red bar is shown, then the model replaced Colstrip Units 1&2 in 2017. If there is no red bar for Colstrip, then the model replaced all four Colstrip units in 2017. Figure 2 shows that it is more economical to replace Units 1&2 in a large proportion of the scenarios (15 out of 31). Units 3&4 are also replaced under very low gas prices or very high

Figure 2: Resource Builds by Scenario



Source: PSE, April 23, 2013 IRPAG Presentation.
Scenarios with 359 MW in the red bars indicate retirement of Units 1&2 only.

CO_2 prices.[3] Figure 2 shows that the relative economic costs and benefits of Colstrip are very different between Units 1&2 and Units 3&4.

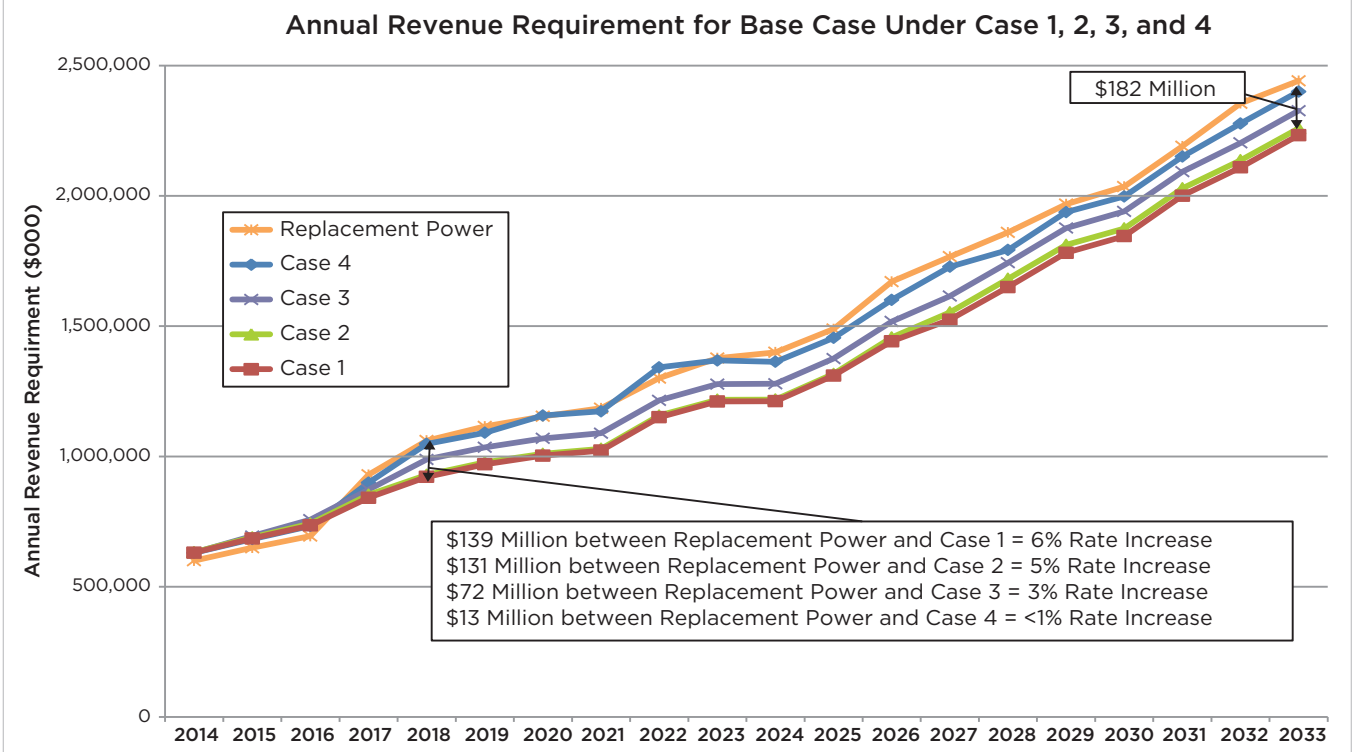
Despite this clear divergence between the pairs of units, for most of Chapter 5 in the IRP PSE treats Colstrip as a single resource, and the analysis compares costs with and without the entire plant. This raises the question of how each of these results and graphs would look if PSE treated Units 1&2 separately; indeed, the only justification for treating all four units *en mass* is that they are all coal units located near the town of Colstrip, Montana—the operating characteristics, costs, and ownership structures would otherwise suggest treating each pair of units independently.

PSE's refusal to provide the results of Units 1&2 separately from Units 3&4 prevents the public from drawing clear conclusions about the economic prudence of continuing to spend customer money to keep Colstrip Units 1&2 in PSE's resource mix. However, there are some rough conclusions that are apparent. For example, Figure 3 shows an estimate of the relative difference in cost of each of the four Colstrip cases in PSE's "Base" scenario. The Base scenario contains numerous flaws, including a $0 estimate for carbon price indefinitely. Yet even in this overly conservative scenario, replacement of Colstrip 1&2 would have less than a 1% – 2% rate impact in terms of total revenue requirements.[4] In more plausible scenarios (such as moderate CO_2 prices) replacing Colstrip units 1&2 would result in lower rates for customers.

The results presented by PSE in Figure 3 show only the overly-conservative "Base" scenario. Figure 3, and PSE's conclusions based on this figure, are therefore biased in favor of retaining Colstrip. In reality, it is very unlikely that PSE will face a $0 cost for CO_2. The rate impacts shown in Figure 3 are therefore higher than what would plausibly be expected, and a more realistic analysis would reduce or even eliminate the cost of replacing all four Colstrip units. In scenarios other than the Base scenario, PSE's analysis shows that natural gas prices, CO_2 prices, and investment in Demand-Side Resources (DSR) have significant impacts on the relative economics of Colstrip:

- **NATURAL GAS PRICES:** if prices remain low ($4.20, 20-yr levelized, nominal), Colstrip Units 1&2 are uneconomical in several scenarios. If price estimates drop to $3.17, all four Colstrip units are uneconomical.
- **CO_2 PRICES:** A CO_2 price somewhere between $6 – $25/ton starting in 2014 makes Colstrip Units 1&2 uneconomical in the base gas scenario ($6.06 gas, 20-yr. levelized).[5] A CO_2 price between $25 – $75/ton makes all four Colstrip units uneconomical in all scenarios.

Figure 3: Annual Revenue Requirement in Base Scenario



Source: PSE, April 23, 2013 IRPAG Presentation.

- **DSR:** The relative value of Colstrip is very sensitive to investment in Demand-Side Resources (energy efficiency or demand response). During the IRP process, PSE showed that accelerating the same level of DSR investment from a 20-yr period to a 10-yr period (i.e. same investment, but made sooner) resulted in a 14% – 64% drop in the relatively economic value of all four Colstrip units, depending on the Colstrip environmental capital expense assumptions.[6] It is likely that further investments in DSR would similarly reduce or eliminate the relative economic value of Colstrip under all scenarios.

PSE's analysis also failed to account for additional costs that may increase the plant's capital needs and operating expenses. For example, increasing coal fuel costs at the plant and the cost impacts from a likely nonattainment designation under the 1-hour sulfur dioxide national ambient air quality standards (NAAQS) would increase electricity costs at the plant. Similarly, PSE's analysis ignores the environmental harm and potential litigation liability that the Colstrip owners will likely face by continuing to pollute groundwater sources in Eastern Montana and failing to meet Clean Air Act requirements. These additional potential costs that are not accounted for in PSE's analysis further degrade the relative economics of continuing to operate Colstrip compared to other cleaner electric generation sources.

In summary, the IRP shows that continuing to operate Colstrip creates a substantial economic risk for Washington ratepayers. PSE's analysis indicates that Colstrip Units 1&2 are economically marginal at best, and a net cost in many instances, compared to alternative sources of generation.

CONCLUSIONS

PSE's conclusion in the IRP that Colstrip is "economic" is overly simplistic and misleading. All of PSE's Base results unreasonably presume a $0 CO_2 price for the next 20 years. PSE also underestimates several capital expenses that will be required to comply with environmental laws. Most importantly, PSE's conclusions do not address the relative difference between the economics of Colstrip Units 1&2 separately from Units 3&4. Several scenarios show that spending additional money on Colstrip Units 1&2 to comply with modern pollution control laws would cost PSE customers more than the cost of other available alternatives for generating electricity. At this point, it is not justified for PSE to make any additional capital expenditure at these units. PSE and Washington have better, cheaper, and cleaner alternatives for meeting customers' electricity needs.

ENDNOTES

1 Assuming operation of 5.2 million MWh per year.

2 The fixed retirement date of 2017 reflects a limitation of the company's approach. PSE's models could not shift the retirement date forward or backward to account for potential differences in costs depending on when the units were replaced. In future IRP's, PSE should work to model scenarios with variable replacement dates that account for potentially avoidable capital costs near the end of the units expected replacement date.

3 Case 4, representing the Case 3 assumptions plus higher estimated compliance costs for selective catalytic reduction (SCR) installations and CCR regulations based on past representations made by PSE, was only tested against the base scenario. Given these high compliance costs, the model shows that Colstrip Units 1&2 are uneconomical in the base scenario, and presumably would have been uneconomical in all other scenarios as well. It is reasonable to expect that Units 3&4 would also have been found uneconomical in many of the sensitivity scenarios with Case 4 compliance costs, but PSE did not perform (or at least report) any analysis of Compliance Case 4 beyond the base scenario.

4 A more precise estimate is not available because PSE did not provide data specific to units 1&2. The 1–2% estimate assumes that less than half of any rate impact form closing all four Colstrip units (i.e. 5% in case 2) would be attributable to Units 1&2 (i.e. less than 2.5%).

5 Estimates assume increase to $20 and $80, respectively, by 2033. A precise tipping point is not available because PSE did not analyze this question or provide access to data.

6 Case 1=14%, Case 2=14%, Case 3=23%, Case 4=64%. PSE refused to provide this data for units 1&2 alone.

“We know the end point for coal is soon. We know coal is a dead end.”

-Andy Wappler, VP for Corporate Affairs, Puget Sound Energy

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High Cost Case

Colstrip 1 & 2	Assumed Technology Employed and Estimated Costs to PSE (Costs in $ millions unless otherwise noted)														
	National Ambient Air Quality Standards (Compliance Dates Vary)				Mercury & Air Toxics (April 2015)			CSAPR *Note 14*	Montana Regional Haze FIP (Sept 2017) *Note 4*			Coal Combustion Residuals (expect 2018 compliance)		Clean Water Act	
	Ozone	SO_2	$PM_{2.5}$	NO_2	Mercury	Acid Gases	Other Metals		SO_2	NOx	PM	Non-Hazardous	Hazardous	Part 316(b)	Effluent Guidelines
	Expect that NOx, SO_2 and PM reductions required to meet other rules will maintain plant compliance				Complies *Note 2*	Complies *Note 2*	Additional Particulate Control	Not Applicable	Reduce emissions to 0.08 LB/MMBtu	Reduce emissions to 0.15 LB/MMBtu	0.10 LB/MMBtu		Hazardous Waste Landfill	Complies *Note 2*	No liquid waste discharges
Technology *Note 3*	none				Existing Mercury Control System	Existing Wet Scrubber System	Upgrade to existing Scrubbers and New Fabric Filters (Baghouses) *Note 15*	none	Additional Scrubber and Lime Injection *Notes 6 & 13*	Upgrade Low NOx Burners & SOFA, add SNCR. Assume SCR by 2027 *Notes 7, 11 & 12*	Complies *Note 2*		Hazardous Waste Landfill *Note 16*	none	none
Variable Operating, $/MWH	$0				$0	$0	$0.0	$0	$0.5	$0.8	$0		8.0	$0	$0
Annual Fixed Operating Cost	$0				$0	$0	$0.1	$0	$0.6	$0.4	$0		0.2	$0	$0
Total Capital Cost (2014-2018) ost (SCR added by 2027)	$0				$0	$0	$130.0	$0	$54.0	$11.1 $78.0	$0		6.0	$0	$0

Colstrip 3 & 4	Assumed Technology Employed and Estimated Costs to PSE (Costs in $ millions unless otherwise noted)														
	National Ambient Air Quality Standards (Compliance Dates Vary)				Mercury & Air Toxics (April 2015)			CSAPR	Montana Regional Haze FIP (Sept 2017) *Note 4*			Coal Combustion Residuals (expect 2018 compliance)		Clean Water Act	
	Ozone	SO_2	$PM_{2.5}$	NO_2	Mercury	Acid Gases	Other Metals		SO_2	NOx	PM	Non-Hazardous	Hazardous	Part 316(b)	Effluent Guidelines
	Expect that NOx, SO_2 and PM reductions required to meet other rules will maintain plant compliance				Complies *Note 2*	Complies *Note 2*	Complies *Note 2*	Not Applicable	none	none in 2017 Assume SCR in 2027	none		Hazardous Waste Landfill	Complies *Note 2*	No liquid waste discharges
Technology *Note 3*	none				Existing Mercury Control System	Existing Wet Scrubber System	Existing Wet Scrubber System	none	Existing Wet Scrubber System	Assume Selective Catalytic Reduction by 2027 *Note 12*	none		Hazardous Waste Landfill *Note 16*	none	none
Variable Operating, $/MWH	$0				$0	$0	$0	$0	$0	$1.0	$0		$8.0	$0	$0
Annual Fixed Operating Cost	$0				$0	$0	$0	$0	$0	$0.1	$0		$0.2	$0	$0
Total Capital Cost (SCR added by 2027)	$0				$0	$0	$0	$0	$0	$190.0	$0		$9.8	$0	$0

Low Cost Case

Colstrip 1 & 2

	Assumed Technology Employed and Estimated Costs to PSE (Costs in $ millions unless otherwise noted)														
	National Ambient Air Quality Standards (Compliance Dates Vary)				Mercury & Air Toxics (April 2015)			CSAPR *Note 14*	Montana Regional Haze FIP (Sept 2017) *Note 4*			Coal Combustion Residuals (expect 2018 compliance)		Clean Water Act	
	Ozone	SO_2	$PM_{2.5}$	NO_2	Mercury	Acid Gases	Other Metals		SO_2	NOx	PM	Non-Hazardous	Hazardous	Part 316(b)	Effluent Guidelines
	Expect that NOx, SO_2 and PM reductions required to meet other rules will maintain plant compliance				Complies *Note 2*	Complies *Note 2*	Additional Particulate Control	Not Applicable	Reduce emissions to 0.08 LB/MMBtu	Reduce emissions to 0.15 LB/MMBtu	0.10 LB/MMBtu	Onsite Dry Ash *Note 8*		Complies *Note 2*	No liquid waste discharges
Technology *Note 3*	None				Existing Mercury Control System	Existing Wet Scrubber System	Upgrade to Existing Scrubber System *Note 5*	none	Upgrade to Scrubber and Lime Injection *Notes 5 & 6*	Upgrade Low NOx Burners & SOFA *Note 7*	Complies *Note 2*			none	none
Variable Operating, $/MWH	$0				$0	$0	$0.0	$0	$0.5	$0.5	$0	$0.2		$0	$0
Annual Fixed Operating Cost	$0				$0	$0	$0.1	$0	$0.5	$0.4	$0	$0.5		$0	$0
Total Capital Cost	$0				$0	$0	$9.1	$0	$1.5	$6.3	$0	$7.0		$0	$0

Colstrip 3 & 4

	Assumed Technology Employed and Estimated Costs to PSE (Costs in $ millions unless otherwise noted)														
	National Ambient Air Quality Standards (Compliance Dates Vary)				Mercury & Air Toxics (April 2015)			CSAPR	Montana Regional Haze FIP (Sept 2017) *Note 4*			Coal Combustion Residuals (expect 2018 compliance)		Clean Water Act	
	Ozone	SO_2	$PM_{2.5}$	NO_2	Mercury	Acid Gases	Other Metals		SO_2	NOx	PM	Non-Hazardous	Hazardous	Part 316(b)	Effluent Guidelines
	Expect that NOx, SO_2 and PM reductions required to meet other rules will maintain plant compliance				Complies *Note 2*	Complies *Note 2*	Complies *Note 2*	Not Applicable	none	none	none	Onsite Dry Ash *Note 8*		Complies *Note 2*	No liquid waste discharges
Technology *Note 3*	None				Existing Mercury Control System	Existing Wet Scrubber System	Existing Wet Scrubber System	none	Existing Wet Scrubber System	Existing Low NOx Burners & SOFA	none			none	none
Variable Operating, $/MWH	$0				$0	$0	$0	$0	$0	$0.0	$0	$0.2		$0	$0
Annual Fixed Operating Cost	$0				$0	$0	$0	$0	$0	$0.0	$0	$0.5		$0	$0
Total Capital Cost	$0				$0	$0	$0	$0	$0	$0.0	$0	$7.0		$0	$0

Mid Cost Case

Colstrip 1 & 2

	Assumed Technology Employed and Estimated Costs to PSE (Costs in $ millions unless otherwise noted)																
	National Ambient Air Quality Standards (Compliance Dates Vary)				Mercury & Air Toxics (April 2015)			CSAPR *Note 14*	Montana Regional Haze FIP (Sept 2017) *Note 4*			Coal Combustion Residuals (expect 2018 compliance)		Clean Water Act	
	Ozone	SO_2	$PM_{2.5}$	NO_2	Mercury	Acid Gases	Other Metals		SO_2	NOx	PM	Non-Hazardous	Hazardous	Part 316(b)	Effluent Guidelines
	Expect that NOx, SO_2 and PM reductions required to meet other rules will maintain plant compliance				Complies *Note 2*	Complies *Note 2*	Additional Particulate Control	Not Applicable	Reduce emissions to 0.08 LB/MMBtu	Reduce emissions to 0.15 LB/MMBtu	0.10 LB/MMBtu	Onsite Dry Ash *Note 8*		Complies *Note 2*	No liquid waste discharges
Technology *Note 3*	none				Existing Mercury Control System	Existing Wet Scrubber System	Upgrade to Existing Scrubbers and Wet ESP *Notes 5 & 9*	none	Additional Scrubber and Lime Injection *Notes 6 & 10*	Upgrade Low NOx Burners, add SOFA and SNCR *Notes 7 & 11*	Complies *Note 2*			none	none
Variable Operating, $/MWH	$0				$0	$0	$0.1	$0	$0.5	$0.8	$0	$0.2		$0	$0
Annual Fixed Operating Cost	$0				$0	$0	$0.1	$0	$0.6	$0.4	$0	$0.5		$0	$0
Total Capital Cost	$0				$0	$0	$24.1	$0	$27.5	$11.1	$0	$7.0		$0	$0

Colstrip 3 & 4

	National Ambient Air Quality Standards (Compliance Dates Vary)				Mercury & Air Toxics (April 2015)			CSAPR	Montana Regional Haze FIP (Sept 2017) *Note 4*			Coal Combustion Residuals (expect 2018 compliance)		Clean Water Act	
	Ozone	SO_2	$PM_{2.5}$	NO_2	Mercury	Acid Gases	Other Metals		SO_2	NOx	PM	Non-Hazardous	Hazardous	Part 316(b)	Effluent Guidelines
	Expect that NOx, SO_2 and PM reductions required to meet other rules will maintain plant compliance				Complies *Note 2*	Complies *Note 2*	Complies *Note 2*	Not Applicable	none	none in 2017 Assume SCR in 2027	none	Onsite Dry Ash *Note 8*		Complies *Note 2*	No liquid waste discharges
Technology *Note 3*	none				Existing Mercury Control System	Existing Wet Scrubber System	Existing Wet Scrubber System	none	Existing Wet Scrubber System	Add Selective Catalytic Reduction in 2027 *Note 12*	none			none	none
Variable Operating, $/MWH	$0				$0	$0	$0	$0	$0	$1.0	$0	$0.2		$0	$0
Annual Fixed Operating Cost	$0				$0	$0	$0	$0	$0	$0.1	$0	$0.5		$0	$0
Total Capital Cost (SCR added by 2027)	$0				$0	$0	$0	$0	$0	$190.0	$0	$7.0		$0	$0

Notes

1. The cost estimates shown have been developed by PSE based on budget forecasts, EPA studies, industry information and engineering judgment. Mid Cost Case costs for Regional Haze compliance are based on costs in EPA's draft Federal Implementation Plan for Montana (draft FIP).
   Costs shown are for PSE's 50% interest in Units 1 & 2 and 25% interest in Units 3 & 4. The costs of each case are not additive.
2. "Complies" means that existing unit equipment has been shown, by testing or other means, to meet the requirements of the rule or proposed rule.
3. "Technology" means the type of equipment modifications or additions expected to meet to meet the requirements of the rule for that emission. Levels of Technology and their cost are varied among the four cases.
4. Limits for sulfur dioxide (SO_2), nitrogen oxides (NOx) and particulate matter (PM) are from EPA's State of Montana, Regional Haze Federal Implementation Plan (September2012).
5. "Scrubber upgrade" means internal modifications to the existing scrubbers to improve PM and SO_2 capture. Cost estimate is from confidential vendor information.
6. "Lime Injection" means the addition of a system for injection of lime into the slurry mixture of each scrubber. Cost based on draft FIP and vendor information.
7. "Low NOx burners and add SOFA" means replacement of the existing coal burner systems and addition of separated overfire air (SOFA) system from the boiler windbox. Cost based on draft FIP and vendor information.
8. "On-site Dry Ash" means the addition of a system to dry the ash/slurry paste to the limits needed to meet the Sub-Title D (non-hazardous) requirements of EPA's proposed Coal Combustion Residuals Rule. Costs were developed by PSE using the Regulatory Impact Analysis for EPA's Proposed Regulation of Coal Combustion Residuals (April 2010).
9. "Upgrade to Existing Scrubber System & Wet ESP" means scrubber modifications in Note 5 plus the addition of wet electro-static precipitators (Wet ESP). Cost is from vendor information.
10. "Additional Scrubber and Lime Injection" means addition of equipment in Notes 5 and 6 plus an additional scrubber vessel installed on each unit. The installation cost of the new scrubber vessels in estimated to be $25 million per unit based on the draft FIP.
11. "Low NOx Burners & SOFA and SNCR" means the addition of equipment in note 7 plus the addition of selective non-catalytic reduction (SNCR) equipment to each boiler. Cost based on draft FIP and vendor information.
12. "Assume SCR in 2027" means an assumption that subsequent Regional Haze Reasonable Progress Requirements calls for the addition of Selective Catalytic Reduction (SCR) equipment by the year 2027. Cost based on draft FIP.
13. "Additional Scrubber and Lime Injection" means addition of equipment in Notes 5 and 6 plus an additional scrubber vessel installed on each unit. The installation cost of each additional scrubber vessel in estimated to be $50 million per unit (2 x draft FIP cost).
14. CSAPR is Cross State Air Pollution Rule which applied only to plants in eastern US and has been vacated by the Court of Appeals for the DC Circuit.
15. "New Fabric Filters (Baghouses) means the addition of fabric filters to meet particulate emission limit. Cost based on PPL-M estimate submitted to EPA.
16. "Hazardous Waste Landfill" means the shipment of the ash/slurry paste to a landfill meeting the Sub-Title C (hazardous) requirements of EPA's proposed Coal Combustion Residuals Rule. Alternatively, a Hazardous Waste Landfill could be permitted, constructed and operated adjacent to the plant site by plant owners. Costs based on Regulatory Impact Analysis for EPA's Proposed RCRA Regulation of Coal Combustion Residuals (April 2010)
17. "Assume SCR in 2022" means an assumption that subsequent Regional Haze Reasonable Progress Requirements calls for the addition of Selective Catalytic Reduction (SCR) equipment by the year 2022. Added at request of Sierra Club.
18. "Hazardous Waste Landfill" means the shipment of the ash/slurry paste to a landfill meeting the Sub-Title C (hazardous) requirements of EPA's proposed Coal Combustion Residuals Rule. Alternatively, a Hazardous Waste Landfill could be permitted, constructed and operated adjacent to the plant site by plant owners. Cost based on disposal cost of $300/ton of ash. Added at request of Sierra Club.

Very High Cost Case (added at request of the Sierra Club)

Colstrip 1 & 2	Assumed Technology Employed and Estimated Costs to PSE (Costs in $ millions unless otherwise noted)														
	National Ambient Air Quality Standards (Compliance Dates Vary)				Mercury & Air Toxics (April 2015)			CSAPR *Note 14*	Montana Regional Haze FIP (Sept 2017) *Note 4*			Coal Combustion Residuals (expect 2018 compliance)		Clean Water Act	
	Ozone	SO_2	$PM_{2.5}$	NO_2	Mercury	Acid Gases	Other Metals		SO_2	NOx	PM	Non-Hazardous	Hazardous	Part 316(b)	Effluent Guidelines
	Expect that NOx, SO_2 and PM reductions required to meet other rules will maintain plant compliance				Complies *Note 2*	Complies *Note 2*	Additional Particulate Control	Not Applicable	Reduce emissions to 0.08 LB/MMBtu	Reduce emissions to 0.15 LB/MMBtu	0.10 LB/MMBtu		Hazardous Waste Landfill	Complies *Note 2*	No liquid waste discharges
Technology *Note 3*	none				Existing Mercury Control System	Existing Wet Scrubber System	New Fabric Filters (Baghouses) *Note 15*	none	Additional Scrubber and Lime Injection *Notes 6 & 13*	Low NOx Burners, add SOFA and SNCR. Assume SCR added by 2022 *Notes 7, 11 & 17*	Complies *Note 2*		Hazardous Waste Landfill *Note 18*	none	none
Variable Operating, $/MWH	$0				$0	$0	$0.0	$0	$0.5	$0.8	$0		24.0	$0	$0
Annual Fixed Operating Cost	$0				$0	$0	$0.1	$0	$0.6	$0.4	$0		0.2	$0	$0
Total Capital Cost (2014-2018)	$0				$0	$0	$130.0	$0	$54.0	$11.1	$0		6.0	$0	$0
Total Capital Cost (SCR added by 2022)										$190.0					

Colstrip 3 & 4	Assumed Technology Employed and Estimated Costs to PSE (Costs in $ millions unless otherwise noted)														
	National Ambient Air Quality Standards (Compliance Dates Vary)				Mercury & Air Toxics (April 2015)			CSAPR	Montana Regional Haze FIP (Sept 2017) *Note 4*			Coal Combustion Residuals (expect 2018 compliance)		Clean Water Act	
	Ozone	SO_2	$PM_{2.5}$	NO_2	Mercury	Acid Gases	Other Metals		SO_2	NOx	PM	Non-Hazardous	Hazardous	Part 316(b)	Effluent Guidelines
	Expect that NOx, SO_2 and PM reductions required to meet other rules will maintain plant compliance				Complies *Note 2*	Complies *Note 2*	Complies *Note 2*	Not Applicable	none	none in 2017 Assume SCR in 2022	none		Hazardous Waste Landfill	Complies *Note 2*	No liquid waste discharges
Technology *Note 3*	none				Existing Mercury Control System	Existing Wet Scrubber System	Existing Wet Scrubber System	none	Existing Wet Scrubber System	Assume Selective Catalytic Reduction by 2022 *Note 17*	none		Hazardous Waste Landfill *Note 18*	none	none
Variable Operating, $/MWH	$0				$0	$0	$0	$0	$0	$1.0	$0		$24.0	$0	$0
Annual Fixed Operating Cost	$0				$0	$0	$0	$0	$0	$0.1	$0		$0.2	$0	$0
Total Capital Cost (SCR added by 2022)	$0				$0	$0	$0	$0	$0	$190.0	$0		$9.8	$0	$0