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| **From:** | Ghoshal, Orijit |
| **To:** | UTC DL Records Center |
| **Cc:** | C B |
| **Subject:** | UE-160918 and UG-160919 |
| **Date:** | Thursday, February 22, 2018 3:31:56 PM |
| **Attachments:** | Invenergy Comment Letter on PSE 2017 IRP.pdf |

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To Whom It May Concern,

Please find the comments of Invenergy LLC in UE-160918. The comments are dated 2/22/2018 and are titled “Invenergy Comment Letter on PSE 2017 IRP”. Thank you,

**Orijit Ghoshal** | Manager, Regulatory Affairs
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February 22, 2018

Steven V. King, Executive Director and Secretary
Washington Utilities and Transportation Commission
P.O. Box 47250
1300 S. Evergreen Park Drive S.W.
Olympia, Washington 98504-7250

Re: Puget Sound Energy's 2017 Integrated Resource Plan for Electricity Docket No. UE-160918

Dear Mr. King:

## 1. Background on Invenergy

Invenergy appreciates this opportunity to submit comments on the 2017 Integrated Resource Plan (IRP) for electricity that Puget Sound Energy (PSE) filed with the Commission on November 14, 2017.

Invenergy is North America's largest independent, privately held renewable energy provider. The Company develops, owns and operates large-scale renewable and other clean energy generation and storage facilities in North America, Latin America, Japan and Europe.

To date, Invenergy has contracted, started construction, or is operating 10,850 MW of wind projects, 491 MW of solar projects, 6,092 MW of natural gas capacity, and 94 MW of energy storage projects.

Invenergy has developed or operates wind, solar and thermal generating assets in Washington, Oregon, Idaho, Montana, and California. These include the Vantage (WA), Willow Creek (OR), Wolverine Creek (ID), and Judith Gap (MT) wind farms; the Desert Green (CA) solar installation; and the Grays Harbor Energy Center (WA) natural gas-fired combined-cycle combustion turbine project.

## 2. Invenergy's Interest and Participation in the PSE 2017 IRP Process

As a proven, highly capable and financially strong independent power producer with significant energy assets in the Pacific Northwest, Invenergy is well-positioned to provide

reliable, cost-effective and environmentally responsible electric resources to meet PSE's needs. Invenergy can supply these electric resources to PSE with superior flexibility, diversity and risk mitigation.

Invenergy has committed time and expertise to gain an in-depth understanding of PSE's 2017 IRP, including the approach, assumptions and analyses the utility used to develop its resource strategy.

Invenergy actively and constructively participated as a member of the Advisory Group for PSE's 2017 IRP. This included regularly attending Advisory Group meetings where we shared expert advice on IRP practices and provided detailed feedback on PSE's assumptions and analyses. Throughout the process Invenergy provided numerous verbal and written comments and suggestions, backed up with data and other documentation from respected, objective sources.

**3. Multiple Inputs to PSE's 2017 Are Questionable**

Invenergy has identified tenuous assumptions and innacurate claims that PSE has used to narrow the scope of its 2017 IRP, and bias its analyses. These include:

- An unsupported assumption that purchasing capacity in the short-term wholesale market represents a firm resource to serve over 1,700 megawatts of PSE's peak retail loads (this represents over one-fourth of PSE's peak capacity needs in 2018)
- An unsupported claim that relying heavily on purchasing energy in the short-term wholesale power market does not entail physical supply availability risks
- Wholesale power price forecasts that under-represent the potential magnitude of price volatility in the short-term market
- Over-representation of the actual usability of PSE's existing natural gas-fired generation, including aging single-cycle combustion turbines, to serve its energy loads in the event of supply shortages or high prices in the short-term wholesale power market
- An assumption that natural gas-fired combined-cycle combustion turbine generation will be subject to carbon dioxide emissions pricing, but that single-cycle combustion turbine generation will not
- Over-statement of the difference between capital costs for new combined-cycle combustion turbine power plants and single-cycle combustion turbine power plants
- PSE's belief that its customers, rather than the utility, would bear the consequences if its assumptions about the availability of purchases from short-term wholesale power market and use of its existing gas-fired generation to fill deficits turn out to be incorrect

Invenergy's detailed comments about PSE's assumptions and claims, and discussion of the implications, are attached.

**4. PSE's 2017 IRP Inputs Should be Revised**

Before acknowledging Puget Sound Energy's ("PSE") Integrated Resource Plan ("IRP"), the Washington Utilities and Transportation Commission ("UTC" or "Commission") should:

a) require PSE to analyze – rather than assume – large and increasing reliance on purchases from the short-term wholesale power market to supply an inordinately large share of its capacity and energy needs

b) use forecasts of future wholesale power prices that more fully reflect potential volatility in the short-term market

c) more accurately represent the actual capability of PSE's existing natural gas-fired power plants to backstop its planned reliance on short-term purchases

d) apply costs for carbon dioxide emissions on a consistent basis across all carbon-emitting generating resources, rather than assuming that single-cycle combustion turbines will be exempt

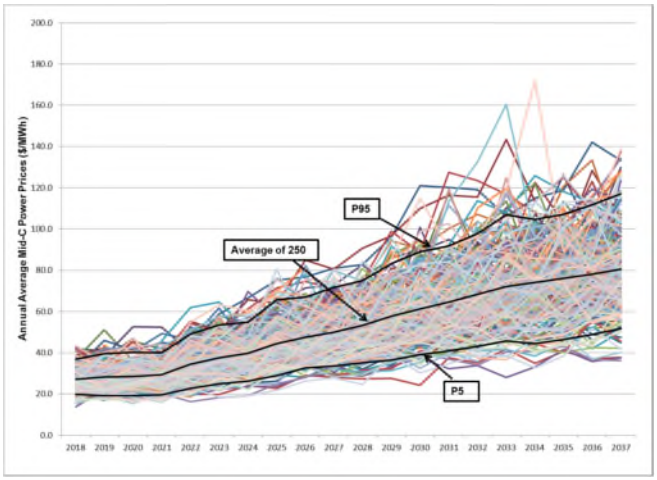
e) require PSE to align its assumptions with industry standards regarding the costs and dispatchability of natural gas generation facilities

**5. PSE's Choice of Inputs Prematurely Narrowed the Scope of its IRP Analyses**

PSE used these and other assumptions to sidestep its responsibilities to plan for sufficient firm electric resources – including peaking capacity and energy. It did not evaluate resource strategies, including addition of long-term resources, that would reduce its reliance on the short-term market.

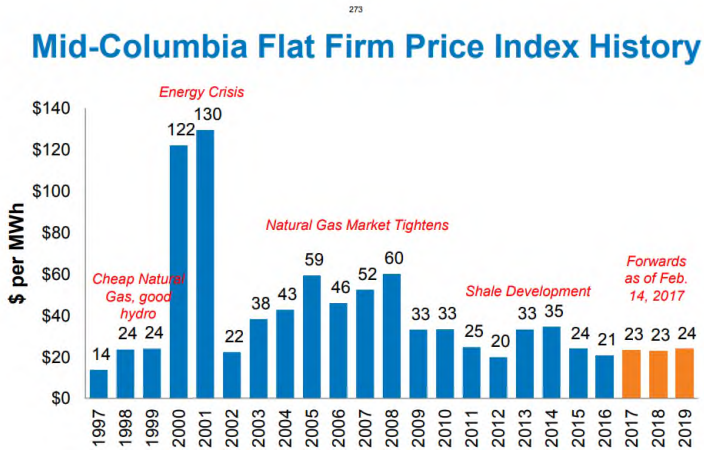
**6. The Short-Term Market Price Forecasts Used for PSE's 2017 IRP Analysis Under-Represent Market Volatility**

PSE's IRP analysis uses forecasts of short-term wholesale power prices that under-represent market volatility. First, forecasted annual prices remain within a relatively narrow band. Second, because prices in each scenario fluctuate from year to year, the impacts are averaged out across time.




PSE 2017 IRP, Figure N-10, Page N-23

In contrast, Avista Utilities' 2017 IRP showed that price spikes that can result from a tight market can be dramatic and expensive for ratepayers:




Avista 2017 Electric IRP, Appendix A at 273.

**7. PSE Recognizes New Resources are Needed, But Assumes Others Will Build to Enable its Short-Term Market Purchases**

PSE has the largest firm resource deficit of any load-serving entity in the Pacific Northwest region, including the Commission's other jurisdictional electric utilities. Avista Utilities' 2017 IRP shows sufficient firm resources to meet its needs without reliance on the short-term market. The preferred portfolio for PacifiCorp's 2017 IRP shows short-term market reliance during the winter season of up to 332 megawatts in 2018, and up to 297 megawatts in 2027.

Thus, if and when a regional resource deficit occurs, PSE implicitly plans to be the largest contributor to the deficits. It is questionable to count on others to build resources to relieve a regional deficit for PSE's benefit.

The underlined portions of the following discussion on page 1-9 of the 2017 IRP report are quite concerning:

*"PSE relies heavily on the short-term market to meet the energy and peak capacity needs of our customers. Risk associated with this exposure to market is managed in the short term; long term, however, regional resource adequacy cannot be addressed without adding new resources. If regional resource adequacy assessments are off or unexpected demand-side or supply-side shocks happen that render the region short of resources, the burden of the resulting deficits would fall on PSE's customers. Therefore, PSE will develop strategies mitigate this risk. These strategies may include:*

- *maintaining options to build capacity resources quickly;*
- *re-examining PSE policies with regard to how much of its market reliance should be managed via short-term purchases versus long-term contracts; and*
- *working with others in the region on options for PSE to join or to help develop functioning wholesale markets that incorporate, energy, capacity and flexibility services."*

"Maintaining options to build capacity resources quickly" would apparently involve PSE quickly adding single-cycle combustion turbine generation. The IRP analysis has not addressed the cost and environmental consequences of such a stratergy.

Additionally, if PSE deliberately chooses not to maintain adequate capacity and energy resources to reliably and cost-effectively meet its retail electric customers' needs, the burden of consquences should belong with PSE, not with PSE customers.

**8. PSE's Analysis of Market Risk**

Appendix G to PSE's 2017 IRP presents an analysis of wholesale power market risk. This analysis does not fully address or resolve the risks of PSE's heavy reliance on using power purchases in the short-term market to serve large portions of its requirements for firm capacity and energy. Shortcomings include:

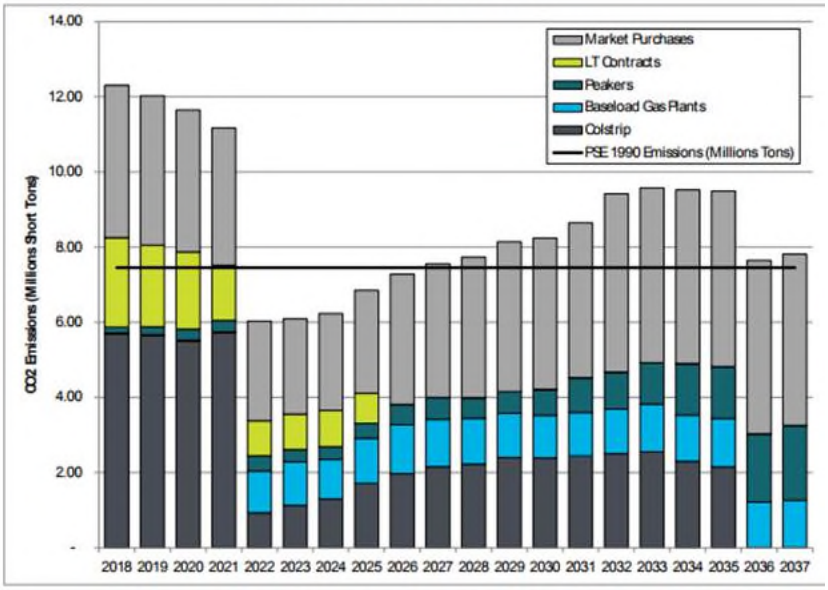
a) The analysis assumes that 3,400 megawatts of short-term imports will be available from California during the winter to serve firm requirements in the Pacific Northwest

b) The analysis continued operation of Colstrip Units 3 & 4

c) Does not address volatility in short-term market prices and resulting exposure to potentially large spikes in costs for PSE's power purchases in the short-term market for its capacity and energy requirements

## 9. PSE's Over-Reliance on the Short-Term Market Does Not Prevent Increasing Carbon Emissions

*Figure 1-6: Projected Annual Total PSE Portfolio $CO_2$ Emissions and Savings from Conservation*




**10. The Commission Should Clarify Allowable Use of PSE's Power Cost Recovery Mechanism**

The WUTC should make clear that if PSE bets on relying on the short-term market to serve a large share of its firm resource needs in a tightening market, and if that bet fails --- then PSE will not be allowed to recover costs of high-priced power purchases, and PSE will also be liable for impacts of physical supply shortages. Ratepayers should not bear the costs of PSE's risky strategy.

**11. The Commission should convene a process to examine the risks of heavily relying on spot market purchases to serve firm retail load in a tightening market**

In response to previous criticism and inquiry regarding PSE's strategy to rely heavily on spot market purchases, in this IRP, PSE provided an appendix explaining their approach to measuring the mitigating the risks associated with the risky strategy. That appendix fails to reduce the risk that ratepayers face if PSE's strategy fails to work as planned. Even under PSE's planned scenario, the appendix fails to reassure ratepayers that the risks PSE is taking with their money have been properly accounted for and managed. Thus, given the continuing need for the Commission to ensure that ratepayers are not unnecessarily exposed to PSE's risky bets, the Commission should convene and conduct an open, Commission-Staff guided process to examine the risks of relying on spot market purchases to serve firm retail load in the Pacific Northwest market. Such a process should include, at a minimum, discussion of planned and potential generator retirements, reliability needs on the grid as a result of retirements, and the potential costs of replacement power or blackouts as a result of resource deficits.

**Attachment**
**Detailed Comments on Inputs to PSE's 2017 IRP**

A number of assumptions, claims and forecasts that PSE used for its 2017 IRP are particularly questionable.

## i. PSE's 2017 IRP Treats Long-Term Reliance on Short-Term Market Purchases as if They Were a Firm Resource

First, PSE has assumed that purchasing wholesale power in the short-term market and delivering it over firm transmission capacity somehow constitutes a firm, long-term power resource. This assumption is highly risky, especially in light of its scope.

### Large and Growing Winter Peak Capacity Resource Deficits

- The IRP assumes 1,722 megawatts of short-term market purchases will be available to help supply PSE's peak capacity resource requirements in 2018. To put the magnitude of this assumption into perspective, 1,722 megawatts represents **28** percent of PSE's projected total peak capacity requirement in 2018.
- Then, if PSE does not add new firm capacity resources, its projections show a firm capacity resource deficit of 2,470 megawatts in 2027. This represents **40** percent of PSE's total peak capacity resource requirement just nine years from now!

(PSE 2017, IRP Figure 6-7, Page 6-12.)

### Large and Growing Annual and Winter Season Energy Resource Deficits

- PSE's 2017 IRP also assumes that 872 average megawatts of short-term power purchases will be available to help supply its firm energy resource requirements in 2018. 872 average megawatts represents **26** percent of PSE's total annual energy resource requirements in 2018.
- Then, if PSE does not add new firm energy resources, its projections show an annual firm annual energy energy resource deficit of roughly 1,250 average megawatts in 2027. This represents roughly **48** percent of PSE's total annual energy requirements nine years from now!
- While PSE's firm energy resource deficits are extremely large on an annual basis, the deficits are likely to be significantly higher during the winter months. This is due to the fact its firm energy requirements are higher during the winter months than on an annual average basis.

(PSE 2017, IRP Figure 6-8, Page 6-14.)

### ii. PSE's Existing Resources Would Not Be Able to Overcome its Firm Energy Resource Deficit

**PSE Over-Represents the Ability of Its Existing Natural Gas-Fired Generation to Fill Energy Deficits**

Page 1-14 of the IRP report states the following:

*"Unlike utilities in the region that are heavily dependent on hydro, PSE has thermal resources that can be used to generate electricity if needed. This resource diversity is an important difference. In* fact, on an average monthly or annual basis, *PSE could generate significantly more energy than needed to meet our load, but it is often more cost effective to purchase wholesale market energy than to run our high-variable cost thermal resources."*

Invenergy believes this statement is based on unrealistic assumptions about use of PSE's natural gas-fired generation, and is therefore misleading, especially on a forward-looking basis.

Figure 6-8 of the IRP report shows full deployment of PSE's owned and contracted generating resources to meet annual energy resource requirements, with the exception of its natural gas-fired power plants. Annual energy production for gas-fired power plants is shown as a quantity of annual energy generation resulting from economic dispatch under the market conditions assumed for PSE's Base Scenario. The projected quantity of natural gas-fired generation is about 100 average megawatts in 2018, growing to nearly 500 megawatts in 2027.

However, it is important to recognize that while PSE owns a total of nearly 2,100 megawatts of natural gas-fired generation, one-third (720 megawatts) of the total is single-cycle combustion turbines, including several units that have been in service for 34 to 37 years. All consume roughly 50 percent more fuel and emit 50 percent more carbon dioxide than more efficient combined-cycle combustion turbine power plants. Thus, operating PSE's single-cycle combustion turbines to generate a material amount of power to help supply its annual or winter season firm energy requirements would be inefficient both in terms of costs and environmental impacts.

Recognizing that it would be impractical to use PSE's single-cycle combustion turbines to help supply a significant quantity of firm energy requirements, PSE is left with its 1,360 megawatts of combined-cycle combustion turbine generation. This amount includes nearly 600 megawatts of units that have been in service for 24-25 years. That would only leave about 760 megawatts of modern, fuel- and emissions-efficient combined-cycle combustion turbine generation.

In other words, PSE actually only controls somewhere between 760 and 1,360 megawatts of natural gas-fired generation that can realistically and responsibly be used to help supply its annual and winter season energy requirements. Subtracting the 500 average megawatts of annual gas-fired generation already shown in Figure 6-8 would leave a net amount of 260 to 860 megawatts of incremental PSE-owned combined-cycle generation available. Those amounts would not be adequate to backstop PSE's projected 1,250 average megawatt quantity of annual short-term market purchases in 2027. Further, the shortfall in PSE's ability to self-supply its energy needs during the winter season would likely be significantly larger.

**PSE's Assumptions About Short-Term Market Purchases and Use of Its Existing Generation Would Create Huge Physical and Financial Risk Exposures**

Page 1-14 of the IRP report also states the following:

*Compared to the physical planning constraints that define peak resource need, meeting customers' "energy need" for PSE is more of a financial concept that involves minimizing costs. Portfolios are required to cover the amount of energy needed to meet physical loads, but our models also examine how to do this most economically, and this includes the ability to purchase energy from the wholesale market.*

As demonstrated above, the reality is that in the coming years, PSE's owned generating resources will not be sufficient to actually supply its annual or winter season physical capacity or energy needs. Consequently, PSE faces:

- reliability risks resulting from PSE counting on other entities to supply physical power via the short-term wholesale power market to meet a large portion of its firm resource needs (such entities have no obligation to plan, develop and maintain generating resources for sale in the short-term power market)
- cost risks resulting from PSE voluntarily accepting large exposure to price volatility in the short-term wholesale power market

In developing its 2017 IRP, PSE did not address these and other risks associated with its deliberate, long-term exposure to an uncertain and potentially volatile short-term wholesale power market. Instead, PSE merely assumed that it can do so, and that if the market is disrupted it can meet any deficits with increased use of its existing generating resources. These assumptions do not stand up to examination.

Invenergy is not aware of another utility in the Pacific Northwest that is as dependent on the short-term power market as PSE, or that plans to maintain such large firm resource deficits over the long term.

### iii. PSE's Capital Cost Assumptions for Natural Gas-Fired Generating Projects are Biased and Inconsistent with Multiple Reputable Sources

A second major flaw in PSE assumptions for its 2017 IRP is its choice of estimated capital costs for new natural gas-fired combustion turbine generation. In brief, PSE has chosen to use an artificially high differential between estimated capital costs for single-cycle combustion turbine (SCCT) projects and combined-cycle combustion turbine (CCCT) projects. This indicates that PSE has a clear bias in favor of SCCT resources, and against CCCT resources.

For its 2017 IRP, PSE has assumed the following capital costs for SCCT and CCCT projects:

- SCCT Projects (Frame Technology): $571-$634 per kilowatt
- CCCT Projects (Frame Technology): $1,267-$1,299 per kilowatt
- Difference Between CCCT and SCCT Projects: $665-696 per kilowatt

(PSE 2017 IRP, Figure D-15, Page D-30)

Despite extensive comments and concerns expressed by Invenergy and various other participants on the Advisory Group about these assumptions, PSE elected to use them for its 2017 IRP. They are highly questionable and are clearly inconsistent with numerous other estimates provided by other sources.

Virtually all other recent estimates of capital costs for new natural gas-fired combustion turbine projects show smaller differentials between capital costs for SCCTs and CCCTs. Examples that contradict PSE's estimates include the following:

*U.S. DOE Energy Energy Information Administration 2018 Annual Energy Outlook: Total Overnight Capital Costs (2018$)*

- SCCT Projects - Advanced (Frame) Technology, 237 megawatts: $727 per kilowatt
- CCCT Projects Advanced (Frame) Technology, 429 megawatts: $1,205 per kilowatt
- Capital Cost Difference Between CCCT and SCCT Projects: $478 per kilowatt

https://www.eia.gov/outlooks/aeo/assumptions/pdf/table_8.2.pdf
(Table 8.3, Page 3 –Northwest Power Pool (NWPP) Region 21)

*U.S. DOE Energy Information Administration Actual Average Construction Costs for Projects Installed in 2015*

- Combustion Turbine SCCT Projects: $779 per kilowatt
- Combustion Turbines as Part of CCCT Projects: $635 per kilowatt

- Steam Turbines as Part of CCCT Projects: $583 per kilowatt
- CCCT Projects: $618 per kilowatt
  (Based on project capacity shares of 2/3 combustion turbine and 1/3 steam turbine)
- Capital Cost Difference Between CCCT and SCCT Projects: $-161 per kilowatt

https://www.eia.gov/electricity/generatorcosts/
(Lines 18-20)

*Northwest Power and Conservation Council 7th Northwest Power Plan (2016$)*

- SCCT Projects (Frame Technology, 2020): $814 per kilowatt
- CCCT Projects (Frame Technology, Dry Cooling, 2020): $1,379 per kilowatt
- Capital Cost Difference Between CCCT and SCCT Projects: $565 per kilowatt

https://www.nwcouncil.org/media/7149910/7thplanfinal_appdixh_gresources.pdf
(Appendix H, Pages H-12 and H-21, All-In Capital Costs)

*Avista Utilities 2017 Integrated Resource Plan (2016$)*

- SCCT Projects (Advance Large Frame): $654 per kilowatt
- CCCT Projects (Modern CCCT): $1,148 per kilowatt
- Capital Cost Difference Between CCCT and SCCT Projects: $494 per kilowatt

https://www.myavista.com%2F-%2Fmedia%2Fmyavista%2Fcontent-documents%2Fabout-us%2Four-company%2Firp-documents%2F2017-electric-irp-final.pdf%3Fla%3Den&usg=AOvVaw3wf8SqfAwGply3F9bCaMgB
(Page 9-5)

**iv. PSE's 2017 IRP Assumes Carbon Emissions Costs Will Apply to Combined-Cycle Combustion Turbine Generation But Not to Single-Cycle Combustion Turbine Generation**

For its 2017 IRP, PSE assumed that the Washington State Clean Air Rule (CAR) and the federal Clean Power Plan (CPP) would be implemented. The CPP, which was put on hold by judicial action in October 2017 and which President Trump signed an Executive Order to replace, considered natural gas-fired combined-cycle combustion turbine generation to be "baseload", and would have made it subject to the rule's CO2 emissions reduction requirements. However, the CPP did not consider natural gas-fired single-cycle combustion turbine generation to be baseload generation and thus would have exempted it from compliance. The basic rationale for this was that SCCTs are "peakers" and typically operate on a very limited basis.

Based on the assumption that the CPP and CAR would be implemented, PSE used CO2 price forecasts for its IRP resource analysis, including the following mid-case forecasts:

- CAR CO2 price of $30 per ton in 2018, ending in 2022
- CPP CO2 price of $19 per ton in 2022, rising to $52 per ton in 2037

(PSE 2017 IRP Appendix N, Page N-33)

PSE's 2017 IRP resource analysis assigned CPP CO2 prices to CCCT generation, but not to SCCT generation. As a result, this introduced a significant bias against CCCT generation (which is more fuel efficient, has lower operating costs and produces lower CO2 emissions per megawatt-hour), in favor of SCCT generation (which is less fuel efficient, has lower operating costs and produces lower CO2 emissions per megawatt-hour). PSE relied on the assumption that because the CAR does not apply to certain peaking facilitites, PSE's future peaking plants would have no associated "carbon price." The CAR has been ruled at least partially invalid by a Thurston County Superior Court Judge, and the Department of Ecology tasked with enforcing the rule has suspended all compliance activities.[1] PSE's reliance on this rule for its planning is thus unrealistic and biases their portfolio away from CCCT generation and towards SCCT generation.

On March 6, 2016, EPIS Inc. (vendor for AURORA, one of the models PSE used for its IRP analysis) published an article demonstrating that exempting SCCTs from the carbon prices can result in increased use of them, including for baseload generation purposes, at CO2 prices at $30 per ton and above. (http://epis.com/powermarketinsights/index.php/2016/03/04/simple-cycle-combustion-turbines-in-the-cpp/)

As noted, the CPP is likely to be replaced, and other efforts are being taken to address CO2 emissions. Invenergy believes that it is becoming increasingly evident that exempting SCCT generation from CO2 emissions pricing would pose significant risks of increased use of SCCTs beyond occasional peaking purposes. This would be a perverse outcome that runs counter to the policy goal of reducing overall CO2 emissions. The most recent version of legislation in Washington designed to reduce CO2 emissions does not exempt or treat any differently the emissions created by peaking versus baseload gas plants. *See* Senate Bill 6203.

Taken together, tables on pages N-89 (Base+ No CO2 scenario), N-102 (Base Scenario) and N-103 (Base+No CO2) appear to indicate that if SCCTs and CCCTs are both subject to CO2 prices:

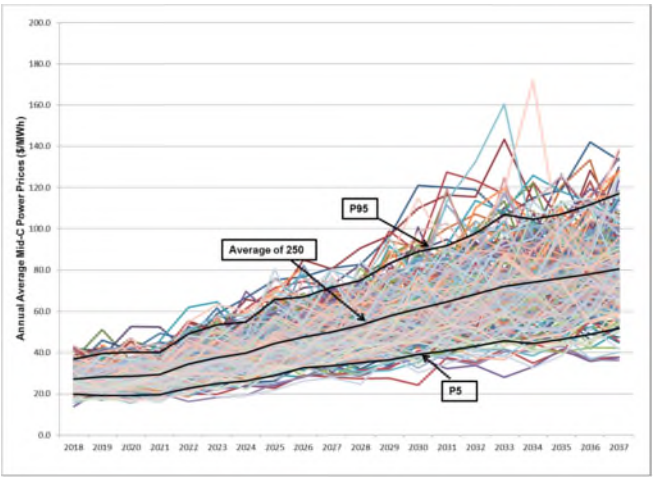
[1] https://ecology.wa.gov/Air-Climate/Climate-change/Reducing-carbon-pollution/Clean-Air-Rule

1. CCCTs are superior to SCCTs
2. Small impact on CO2 emissions even at zero CO2 price

Therefore, Invenergy considers PSE's assumption that CO2 emissions costs would apply to CCCT generation but not to SCCT generation in the future is neither accurate or appropriate. It is one of several factors that combine to create a large bias against CCCT generating resources, in favor of SCCT generating resources.

### v. Wholesale Power Price Forecasts Under-Represent Cost Risks of Relying on Short-Term Purchases

PSE's IRP analysis uses forecasts of short-term wholesale power prices that under-represent market volatility. First, forecasted annual prices remain within a relatively narrow band. Second, because prices in each scenario fluctuate from year to year, the impacts are averaged out across time.

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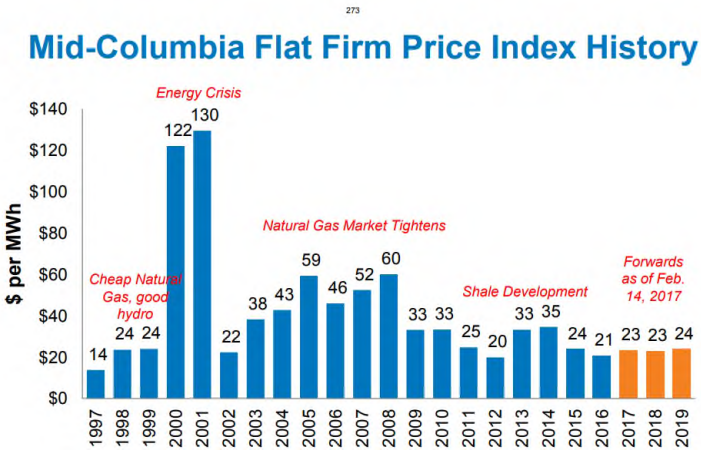

Avista 2017 Electric IRP, Appendix A at 273.

Actual price volatility in the short-term wholesale power market can be much higher. By under-represeting the potential for market price volatility, PSE's analysis obscures the actual magnitude of reliability and power cost risks that are associated with its large reliance on short-term market purchases.

PSE's Resource Adequacy analysis does not capture risks of exposure to short-term market purchases – e.g., Figure N-26, Page N-53 shows that PSE would only have 4,103 MW of reources to meet a peak need of 5,850 MW of in 2020; the figure indicates that 1,714 MW of short-term purchases would be used to fill the gap